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VOL. III
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PROGRAM MANAGER RMA CONTAMINATION CLEANUP

U.S. ARMY
MATERIEL COMMAND

— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

COMPREHENSIVE MONITORING PROGRAM

Contract Number DAAA15-87-0095

FINAL SURFACE WATER DATA ASSESSMENT REPORT FOR 1989

JUNE 1990

Version 2.0

Volume III

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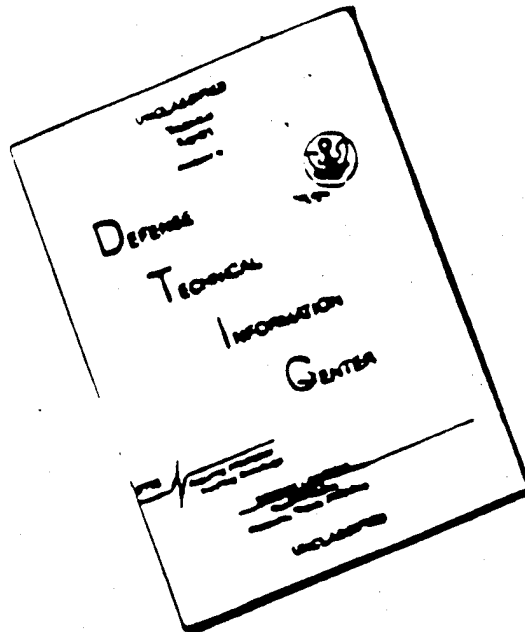
REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 06/00/90	3. REPORT TYPE AND DATES COVERED	
4. TITLE AND SUBTITLE COMPREHENSIVE MONITORING PROGRAM, FINAL SURFACE WATER DATA ASSESSMENT REPORT FOR 1989, VERSION 2.0			5. FUNDING NUMBERS	
6. AUTHOR(S)			DAAA15 87 0095	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ROBERT L. STOLLAR AND ASSOCIATES DENVER, CO			8. PERFORMING ORGANIZATION REPORT NUMBER 91343R01	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) HARDING LAWSON ASSOCIATES DENVER, CO			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) THE 1989 SURFACE WATER REPORT IS DIVIDED INTO SIX SECTIONS AND TWO APPENDICES. SECTION 1 PROVIDES A GENERAL HISTORICAL REVIEW OF THE DEVELOPMENT OF THE RMA. THE HISTORICAL ROLE OF SURFACE WATER FEATURES AT RMA, THE EFFECTS OF RMA INDUSTRIAL ACTIVITIES ON SURFACE SYSTEM MORPHOLOGY, AND THE MAJOR DRAINAGE BASINS THAT EXIST ON RMA ARE PRESENTED IN SECTION 2. SECTION 3 PROVIDE A DETAILED DISCUSSION OF THE PRESENT CMP PROGRAMS STRATEGIES AND METHODOLOGIES. SECTION 4 PRESENTS THE WATER QUALITY AND QUANTITY DATA COLLECTED DURING FISCAL YEAR 1989. SECTION 5 INTERPRETS THE COLLECTED SURFACE WATER DATA. SECTION 6 PROVIDES CONCLUSIONS AND A DETAILED SUMMARY OF FY89 RESULTS. APPENDIX A INCLUDES INFORMATION RELATED TO SURFACE WATER QUANTITY AND APPENDIX B INCLUDES INFORMATION RELATED TO SURFACE WATER QUALITY. DTIC QUALITY INSPECTED 3				
14. SUBJECT TERMS CONTAMINANTS, SAMPLING, DRAINAGE BASINS			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

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**FINAL SURFACE WATER DATA ASSESSMENT
REPORT FOR 1989**

JUNE 1990

Version 2.0

Volume III

APPENDIX A

(Appendices A-1 to A-6)

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APPENDIX A

Surface-Water Quantity Data for Water Year 1989

APPENDIX A-1

Surface-Water Station Survey Information

APPENDIX A-1.1

Monitoring Station Survey Information

Station #	Location	Northing	Easting	Elevation/GH
SW01001	N. Uvalda Interceptor	175,588.02	2,187,896.41	5,260.55 = TBM 5,258.92 = 3.33 on SG
SW01003	South Plants Ditch	177,784.84	2,185,793.81	5,255.61 = TBM 5,248.78 = 0.00 on SG 5,253.13 = PZF on SW Weir 5,252.21 = PZF on S Weir
SW01004	Upper Derby Lake	176,932.23	2,187,034.25	5,247.77 = 0.00 on SG
SW01005	Lower Derby Lake	176,414.44	2,183,945.48	5,230.17 = 0.00 on SG
SW02001	Ladora Weir	176,311.48	2,183,662.77	5,235.49 = TBM 5,228.84 = 0.00 on SG
SW02003	Ladora Lake	177,726.61	2,179,691.86	5,222.11 = 15.00 on SG
SW02004	Lake Mary	177,378.84	2,178,434.27	5,202.39 = 0.00 on SG
SW05001	South First Creek (old)	175,590.08	2,197,131.85	5,281.87 = TBM 5,278.58 = 0.00 on SG 5,278.91 = PZF
SW08003	South First Creek (new)	173,686.65	2,198,520.22	5,293.84 = TBM A 5,293.94 = TBM B 5,290.83 = PZF 5,290.82 = 0.00 on SG
SW11001	Peoria Interceptor	170,287.71	2,179,583.49	5,252.48 = TBM 5,250.28 = 3.33 on SG
SW11002	Havana Interceptor	170,992.86	2,178,854.75	5,261.49 = TBM 5,252.09 = 0.00 on SG
SW11003	Havana Pond	172,696.42	2,180,121.78	5,253.97 = TBM 5,244.08 = 0.00 on SG
SW12005	South Uvalda Interceptor	170,445.36	2,186,746.06	5,272.37 = TBM 5,274.40 = 3.33 on SG
SW12007	Highline Lateral	175,292.77	2,188,725.83	5,275.15 = TBM 5,275.10 = 3.33 on SG 5,272.63 = PZF
SW24001	Sewage Treatment Effluent	194,147.34	2,186,376.17	5,154.56 = PVC

Appendix A-1.1 Table A-1.1-1 (cont'd.)

Station #	Location	Northing	Easting	Elevation/GH
SW24002	N. First Creek (new)	195,311.93	2,187,575.26	5,146.52 = TBM A 5,146.01 = TBM B 5,141.75 = PZF 5,144.51 = 3.33 on SG
SW36001	Basin A	180,985.85	2,184,525.97	5,253.51 = TBM A 5,253.50 = TBM B 5,252.11 = 0.00 on SG 5,252.19 = PZF
SW37001	First Creek Off-post	199,013.30	2,180,816.71	5,108.99 = TBM 5,110.24 = 3.33 on SG 5107.43 = PZF Weir

SG = Staff Gage
TBM = Temporary Bench Mark
PZF = Point of Zero Flow

APPENDIX A-1.2

Station Survey Information

APPENDIX A-1.2

Cross-Section Survey Plots

Cross Sections were surveyed at the following stations:

- North Uvalda (SW01001)
- Peoria Interceptor (SW11001)
- Havana Interceptor (SW11002)
- South Uvalda (SW12005)
- North First Creek (SW24002)

Two channel cross sections were surveyed below the structure, one cross section through the center of the structure, one cross section upstream of the structure through the existing staff gage and two additional cross sections were surveyed upstream of the staff gage. The maximum distance between adjacent cross sections was five channel widths.

One cross section was surveyed at Havana Interceptor along with upstream and downstream thalweg elevations for bed slope calculations. Four cross sections were surveyed at North Uvalda. Six cross sections were surveyed at Peoria Interceptor and South Uvalda. A total of five cross sections were surveyed at North First Creek.

Each cross section elevation is in feet mean sea level (MSL) and is tied to a vertical control (temporary bench mark - TBM) near each gage. All cross sections were surveyed from left bank to right bank looking in a downstream direction. Horizontal and vertical scales for plotting were selected independently for each station reach based on best visual representation of plots to actual site conditions. Cross-section plot number three and four for each station includes the staff gage elevations on the cross-section plot. .

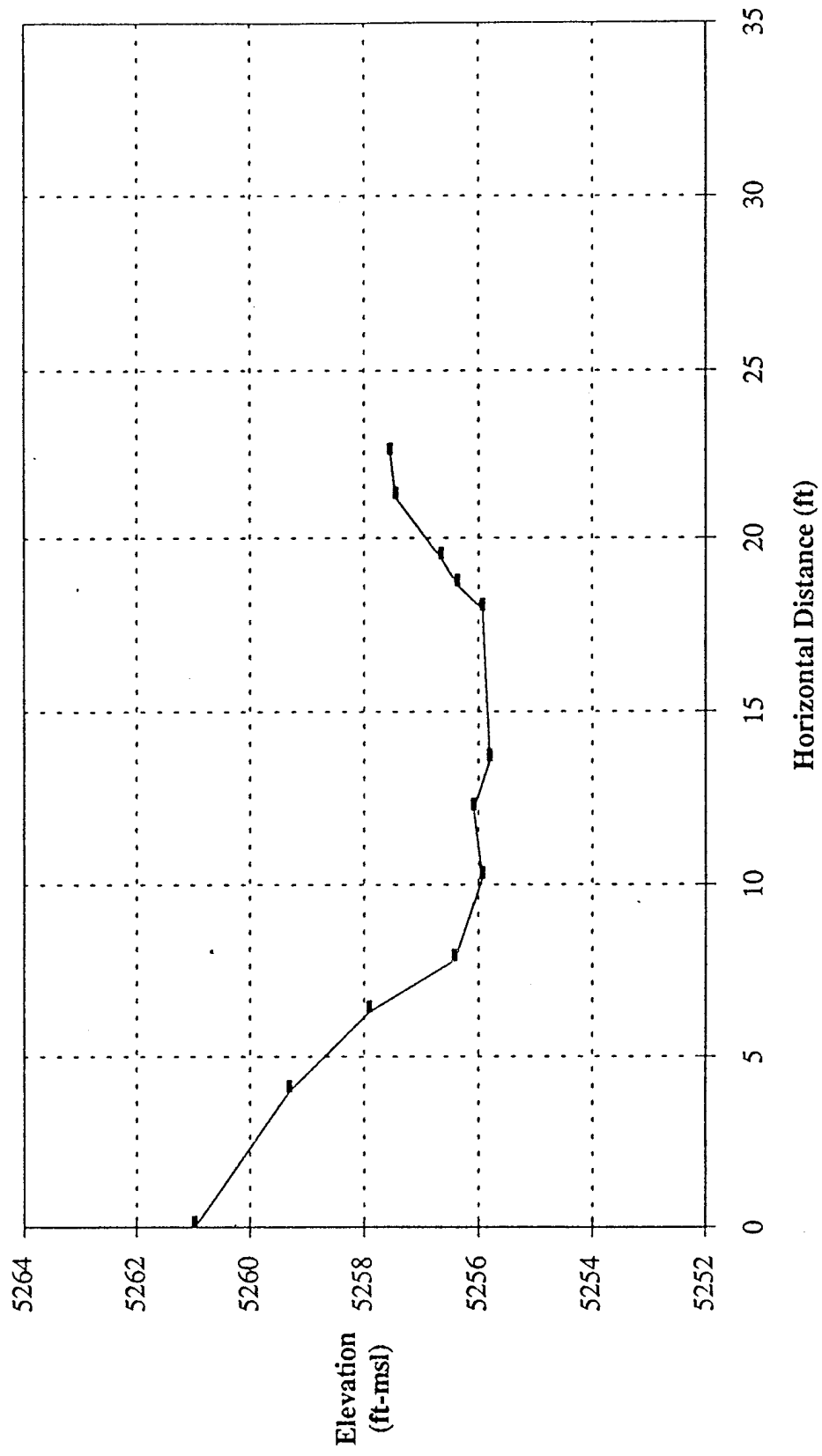
Plan view drawings were produced for each surveyed station. The plan views contain the following information:

- Distance between cross sections.
- Location of the control structure.
- Location of the stilling well.
- Location of the staff gage.
- Location of the TBM.
- Direction of flow.
- Average width of the channel.

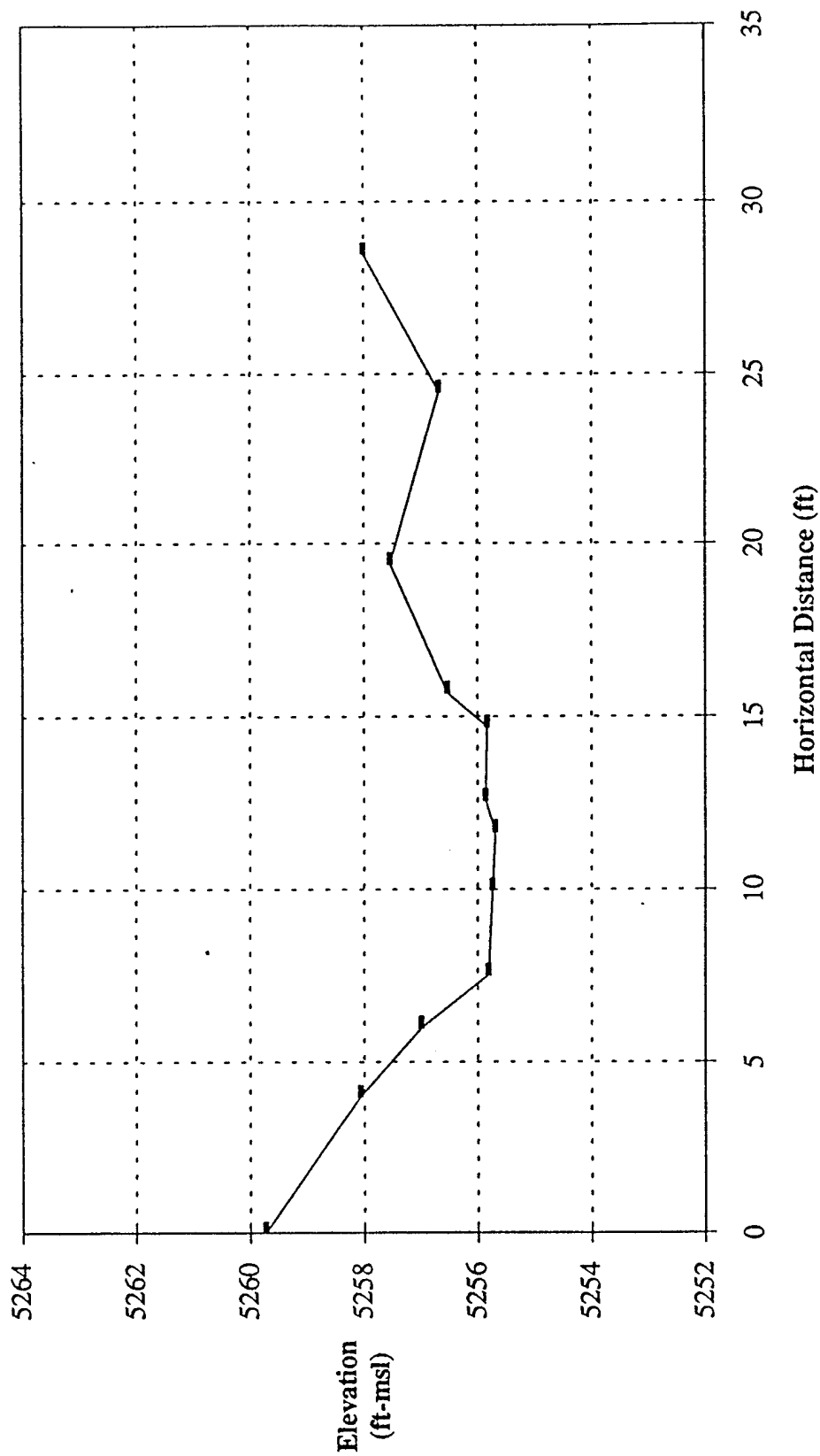
APPENDIX A-1.2.1

Cross Section Survey Plots

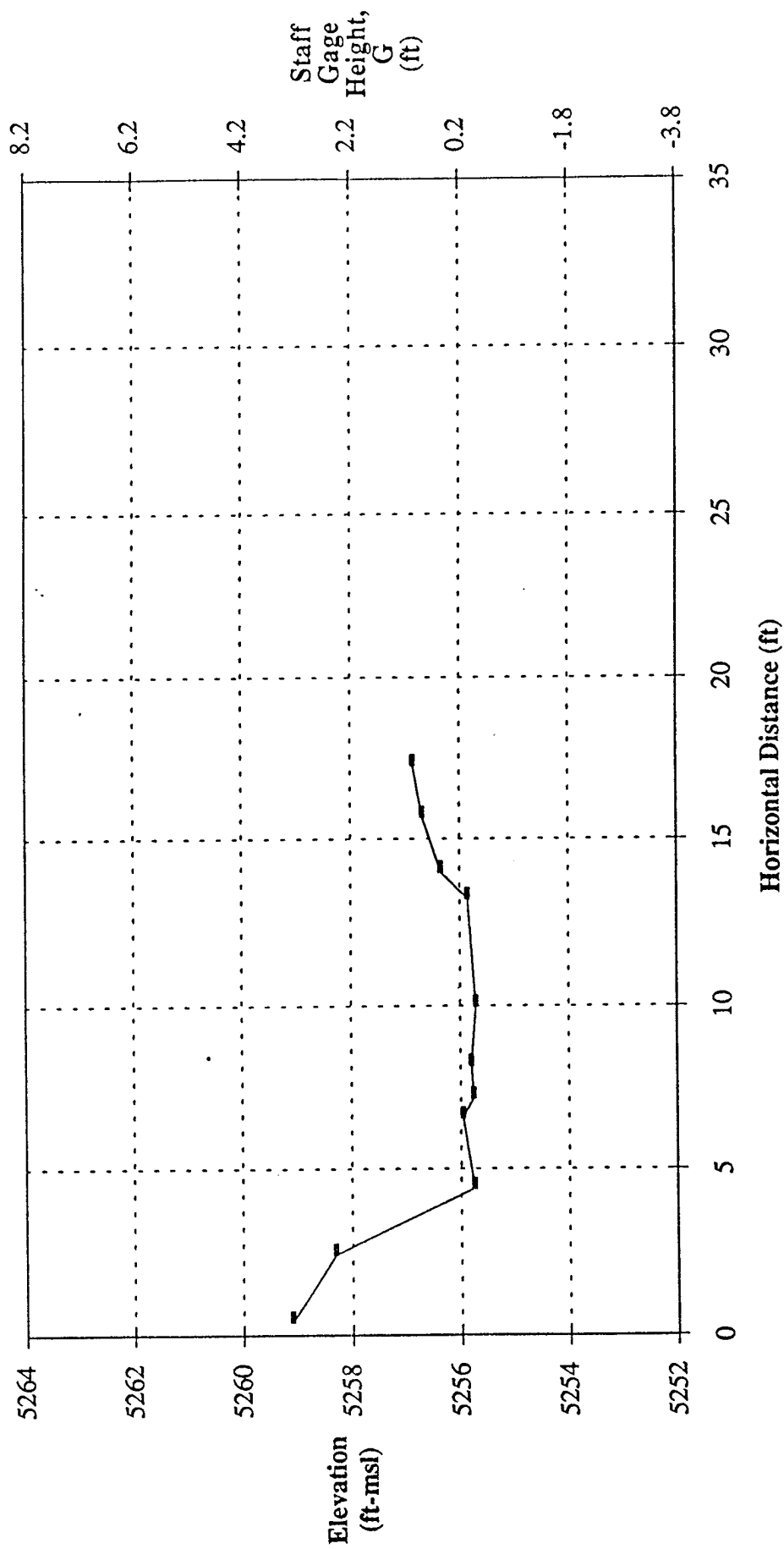
NORTH UVALDA (STATION SW01001)
CROSS SECTION 1



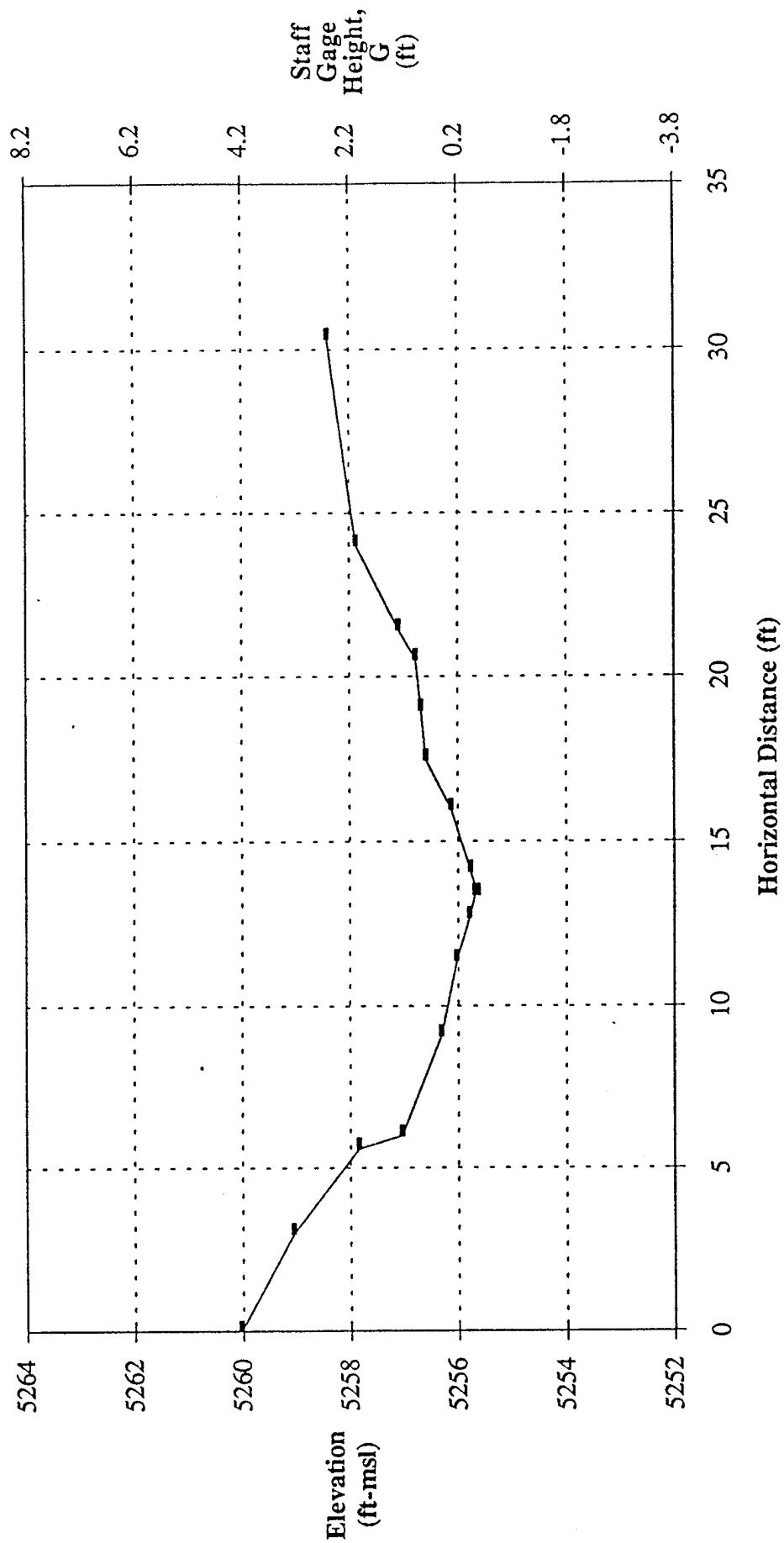
NORTH UVALDA (STATION SW01001)
CROSS SECTION 2



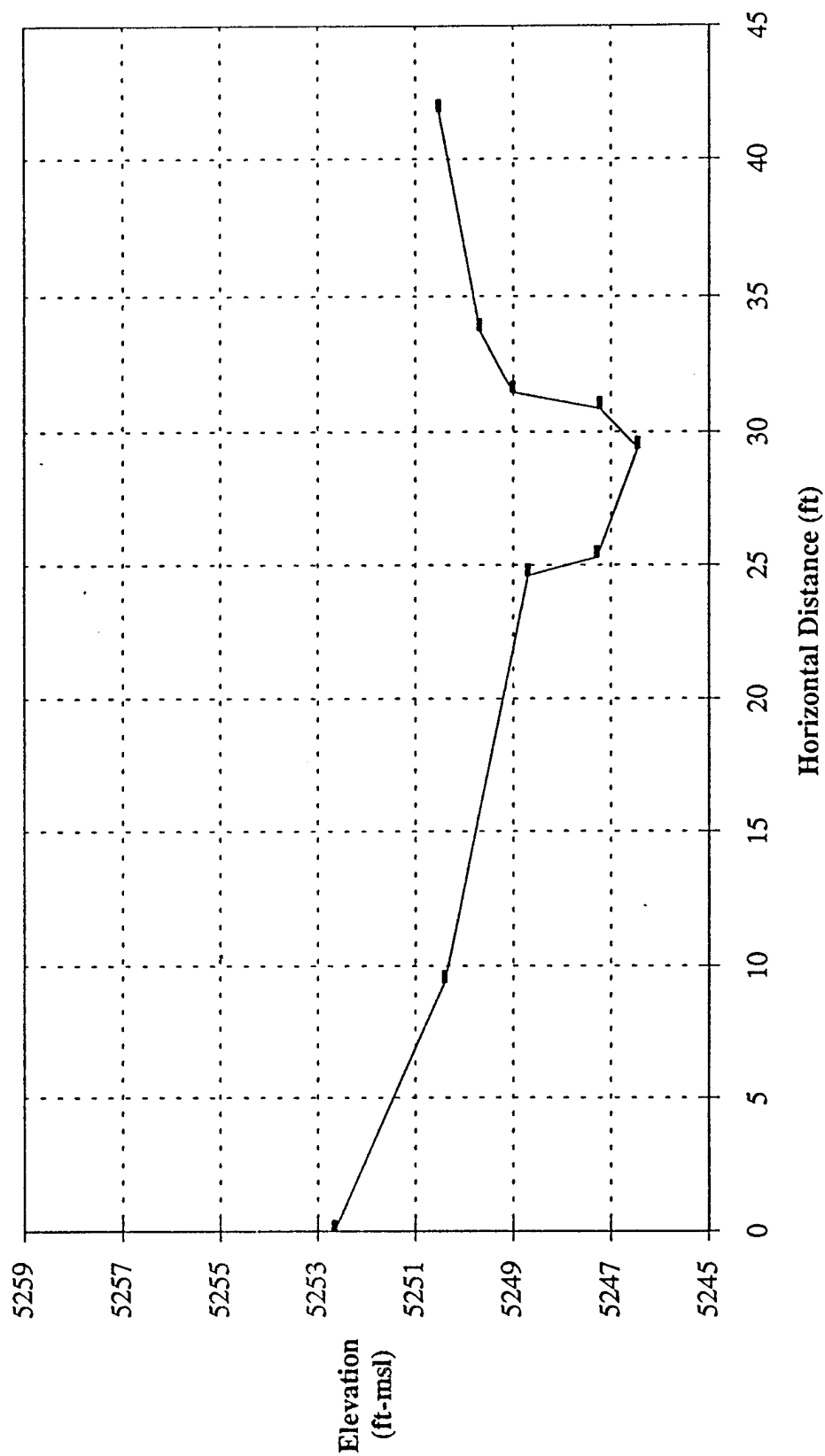
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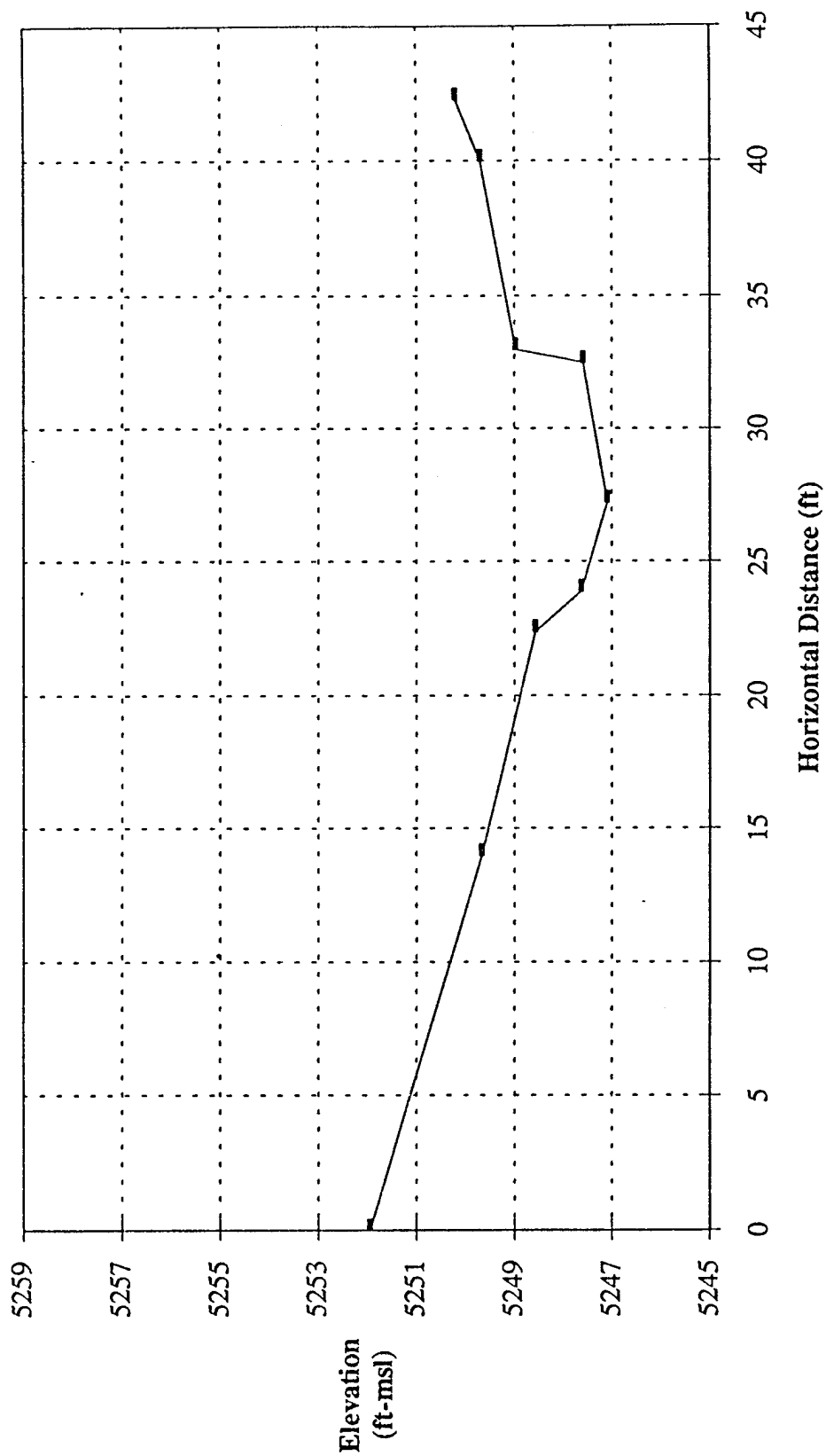
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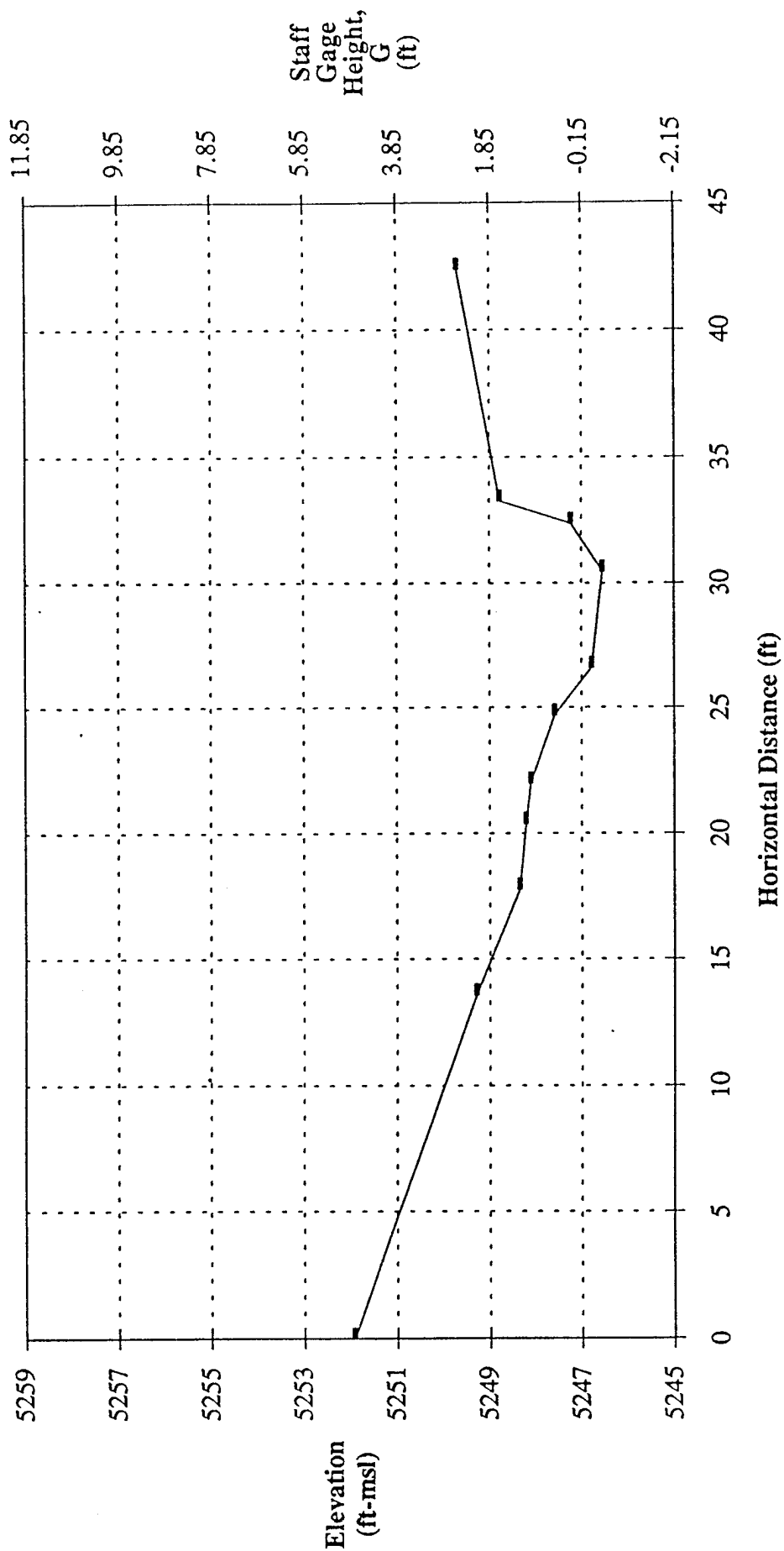
PEORIA INTERCEPTOR (STATION SW11001)
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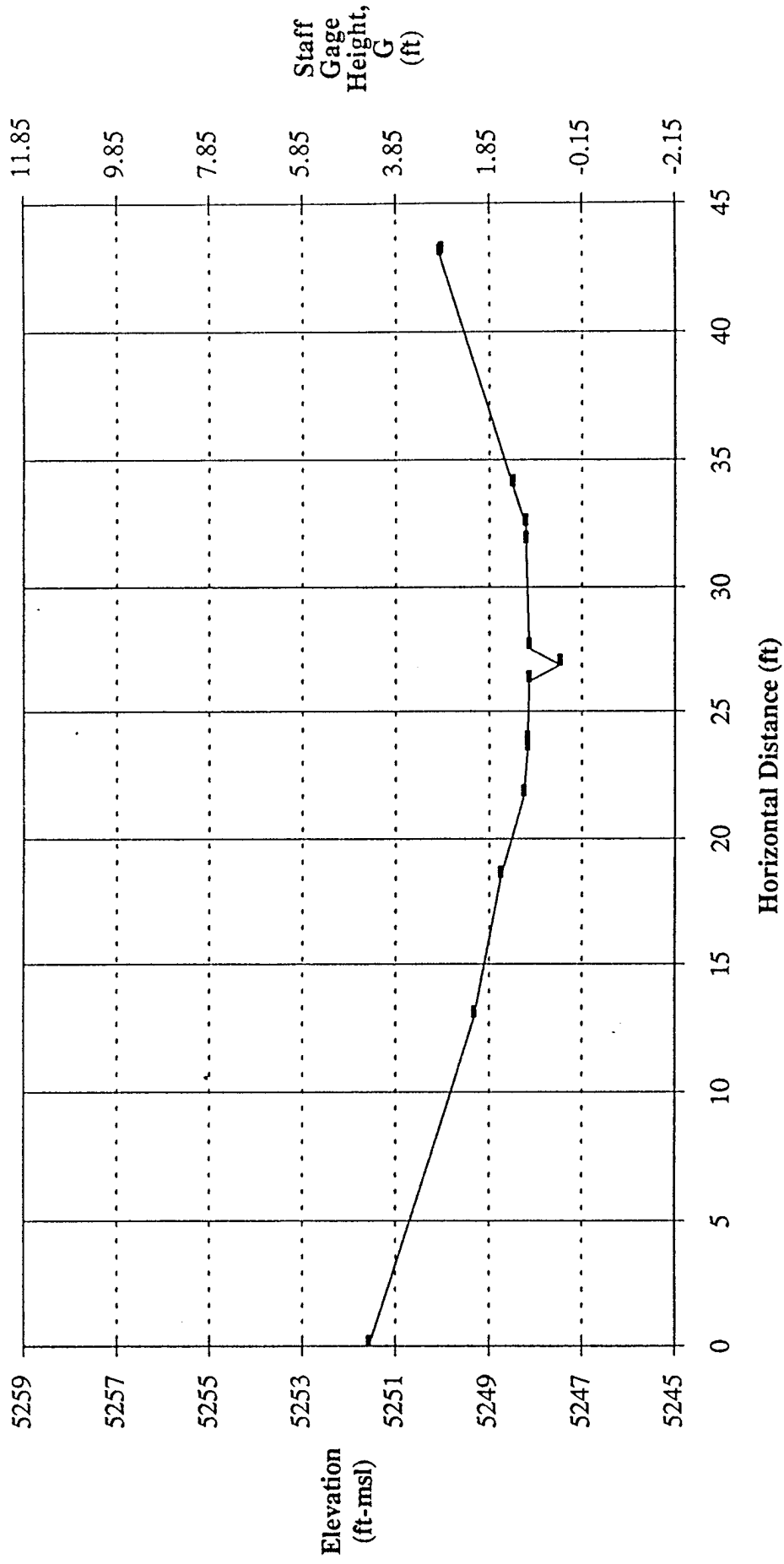
PEORIA INTERCEPTOR (STATION SW11001)
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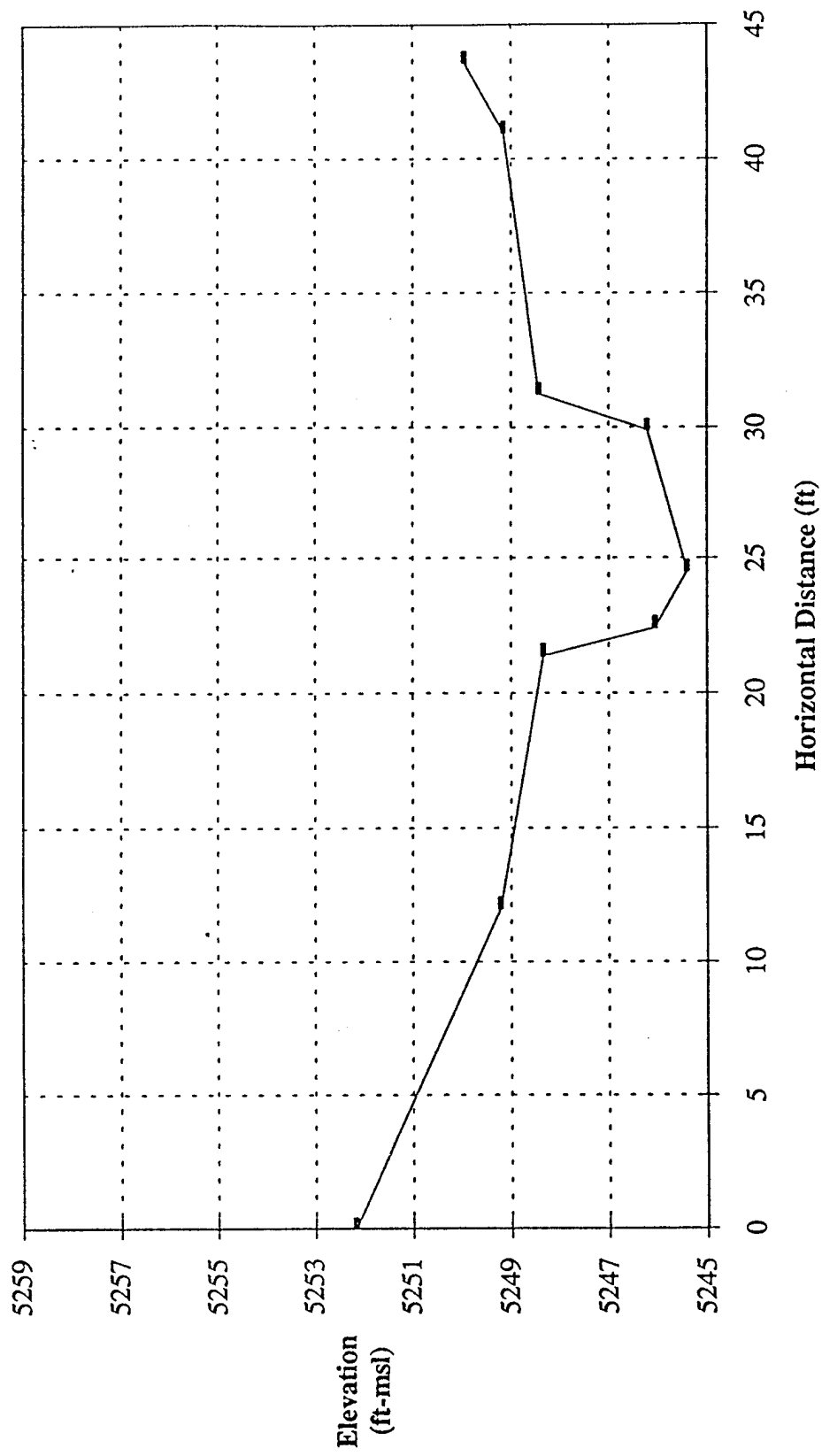
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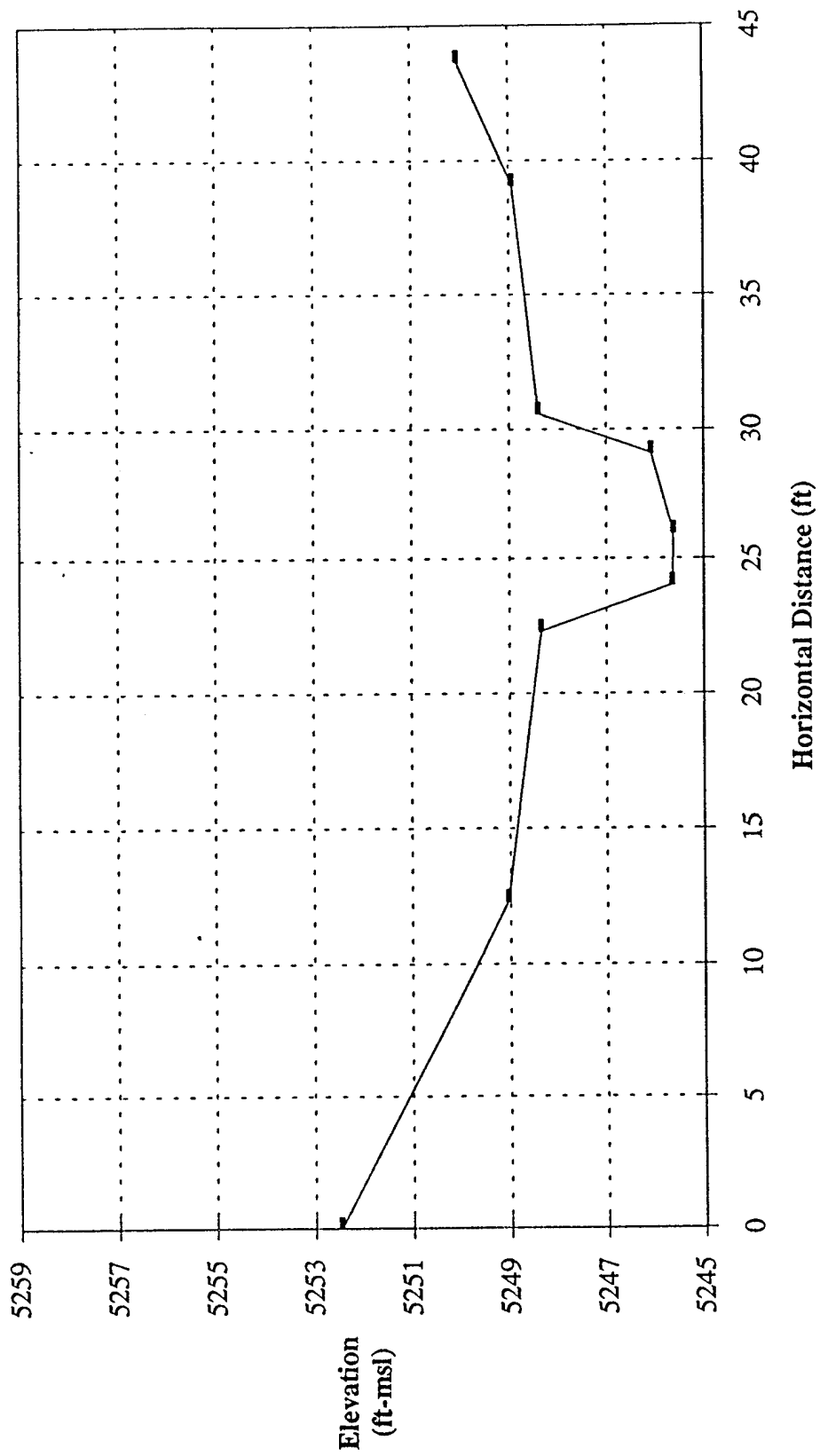
PEORIA INTERCEPTOR (STATION SW11001) CROSS SECTION 4



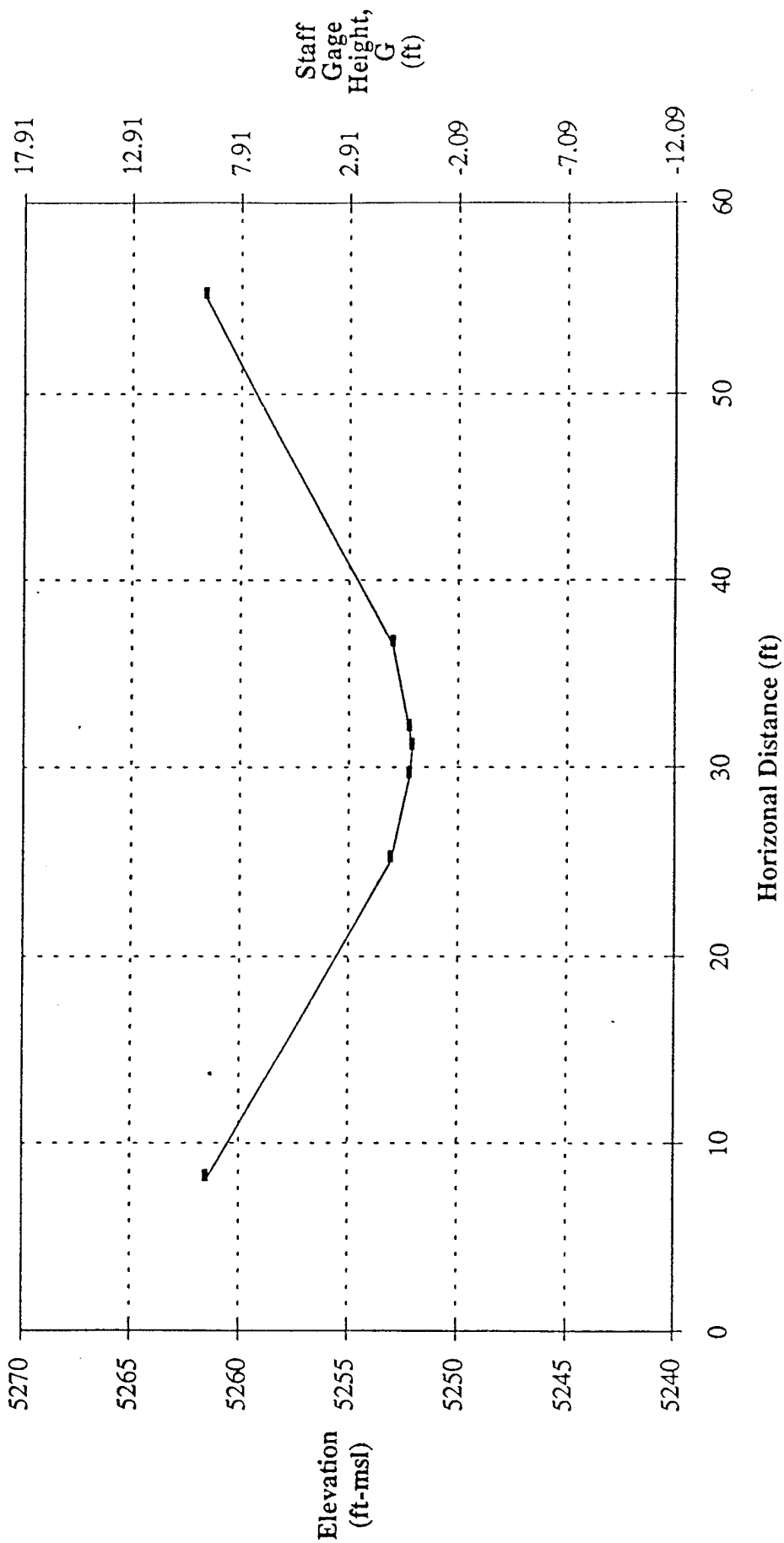
PEORIA INTERCEPTOR (STATION SW111001)
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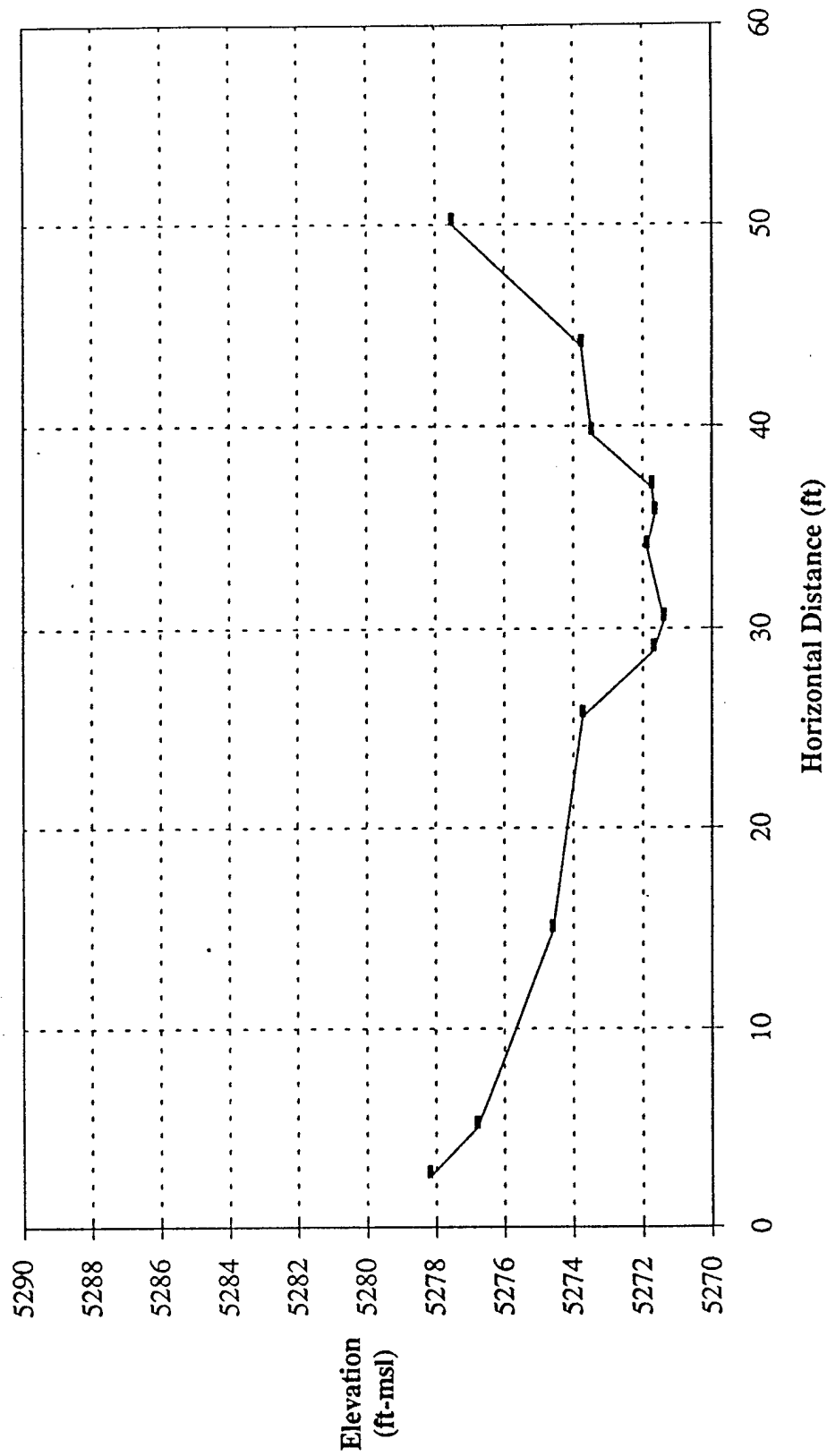
PEORIA INTERCEPTOR (STATION SW11001)
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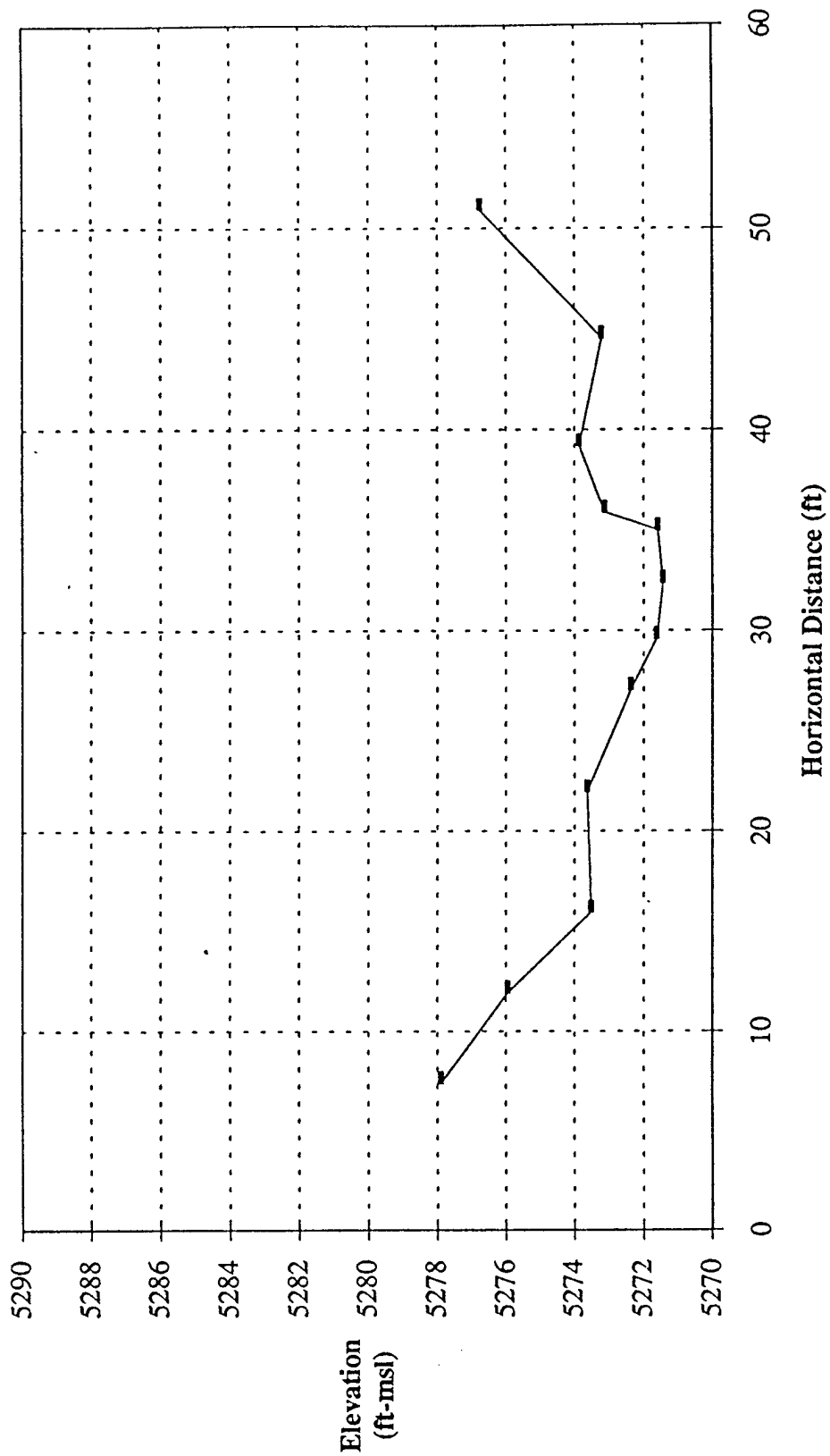
HAVANA INTERCEPTOR (STATION SW11002) CROSS SECTION 1



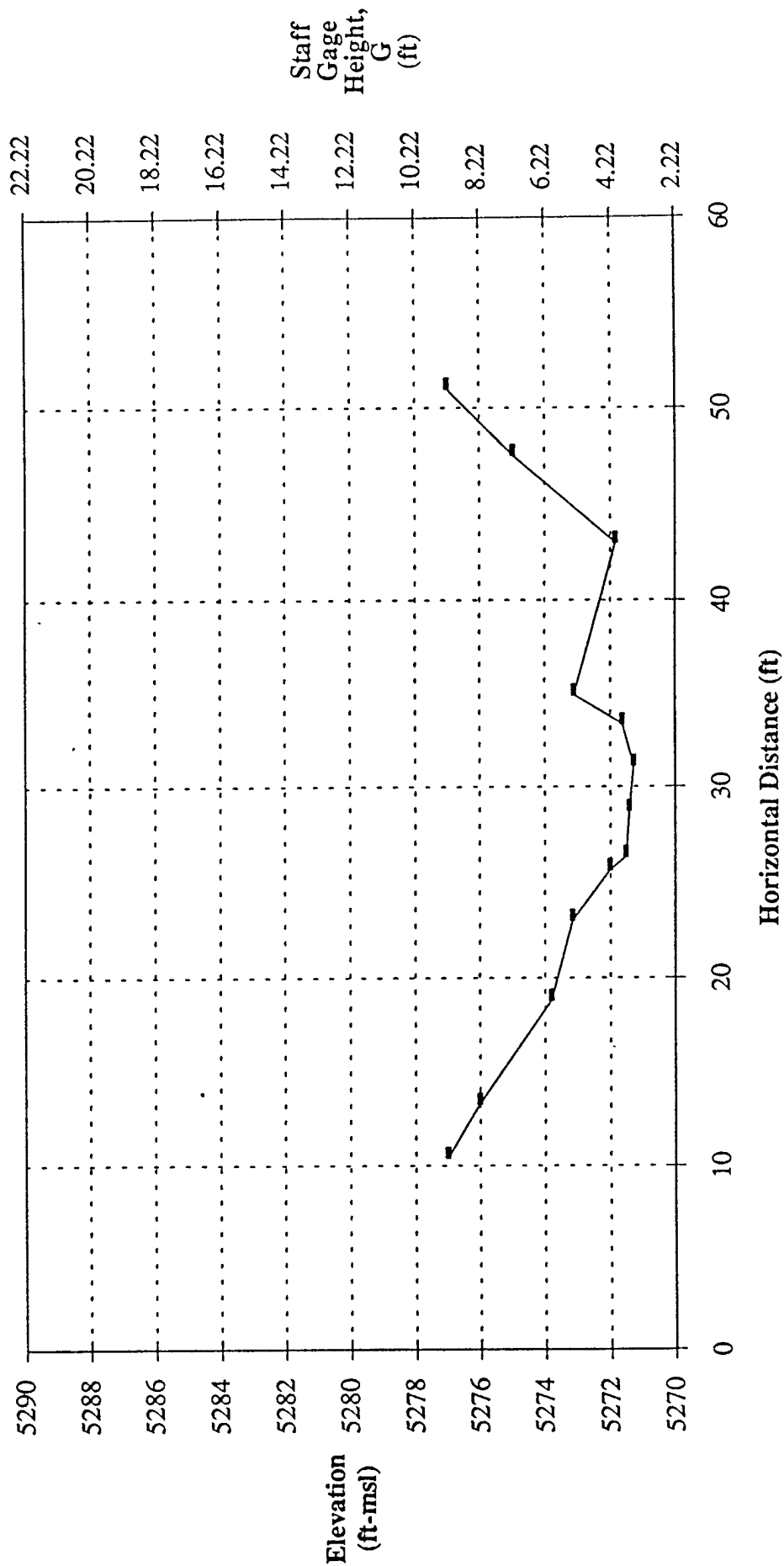
SOUTH UVALDA (STATION 12005)
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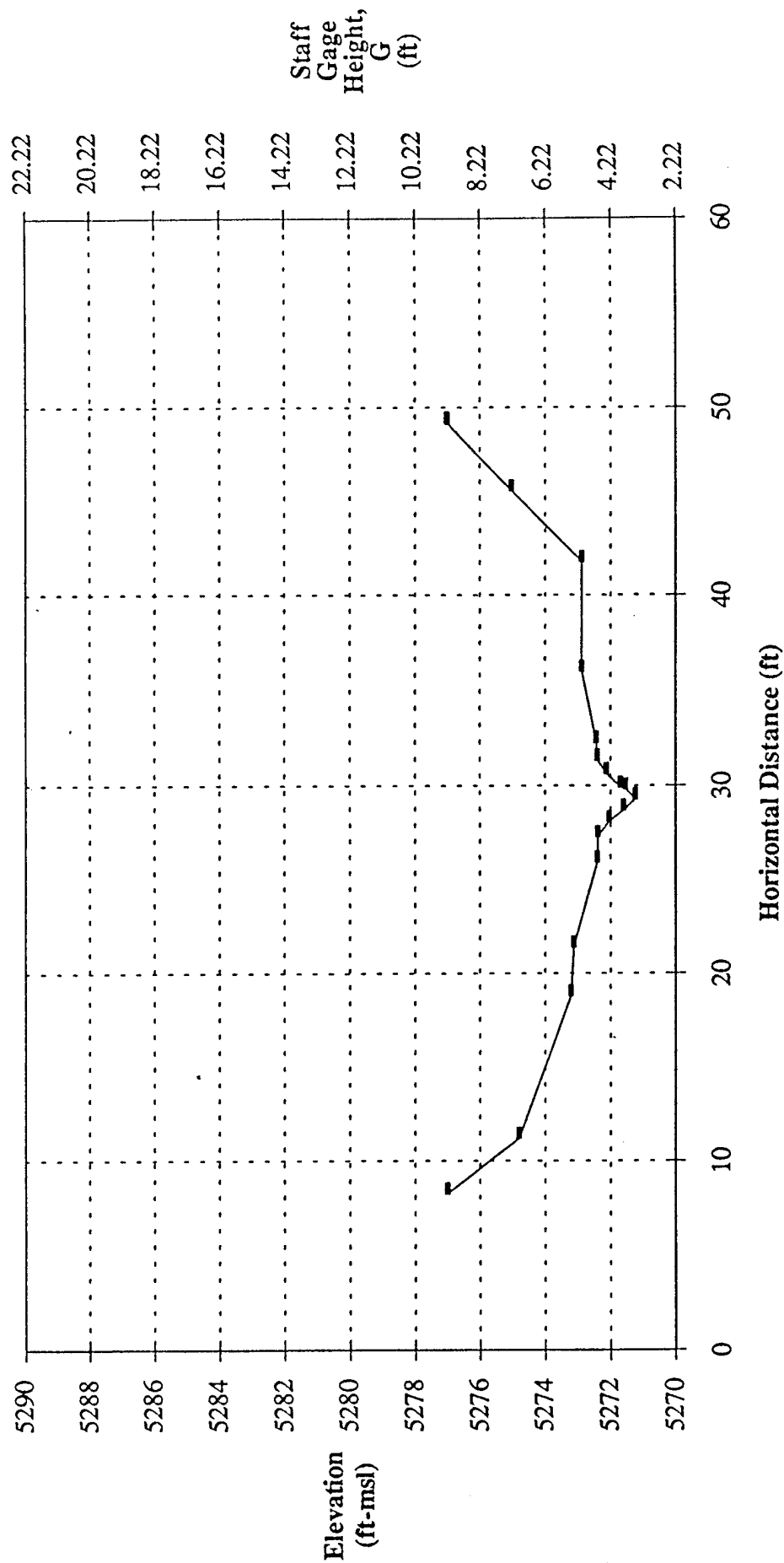
SOUTH UVALDA (STATION 12005)
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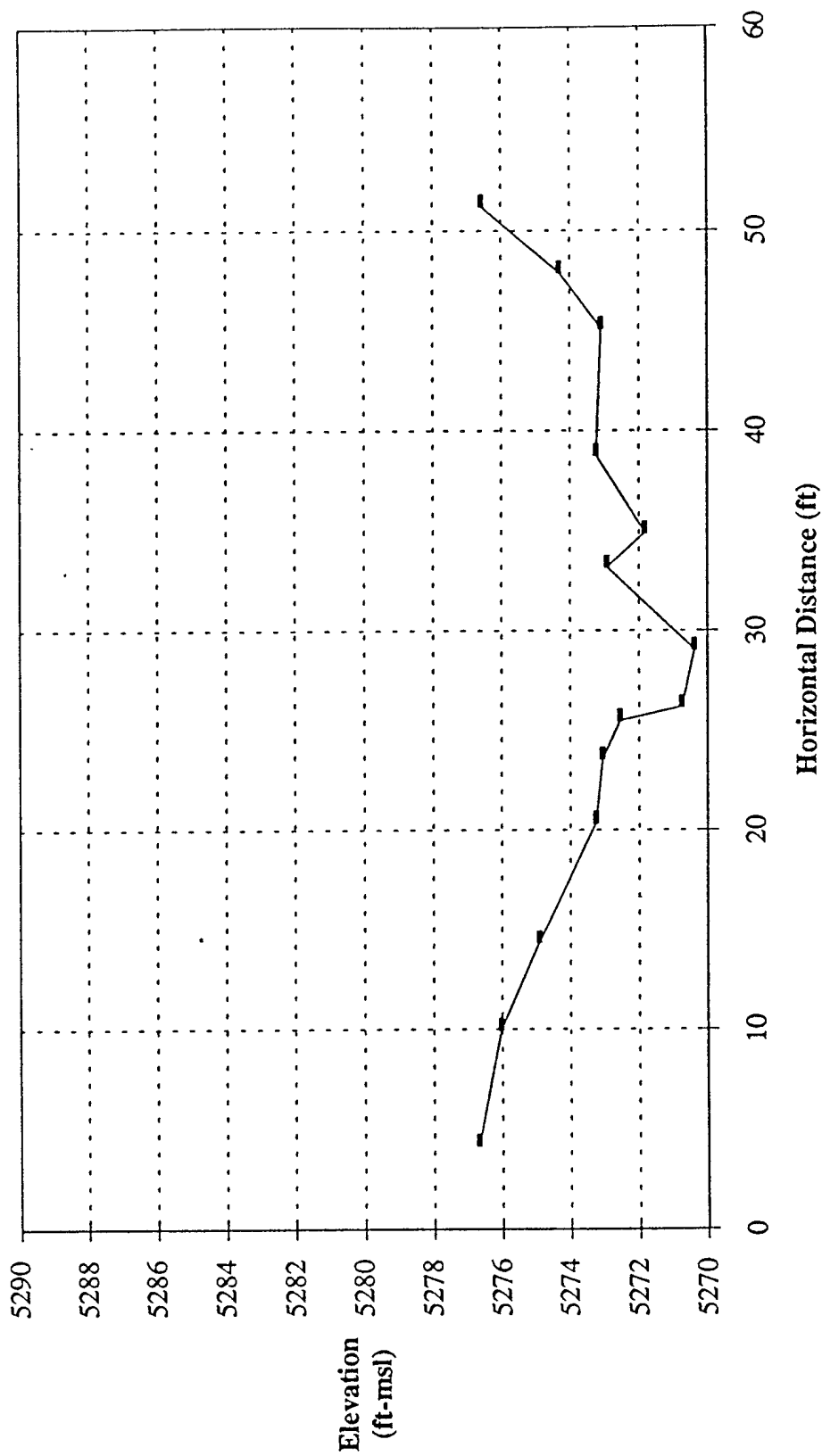
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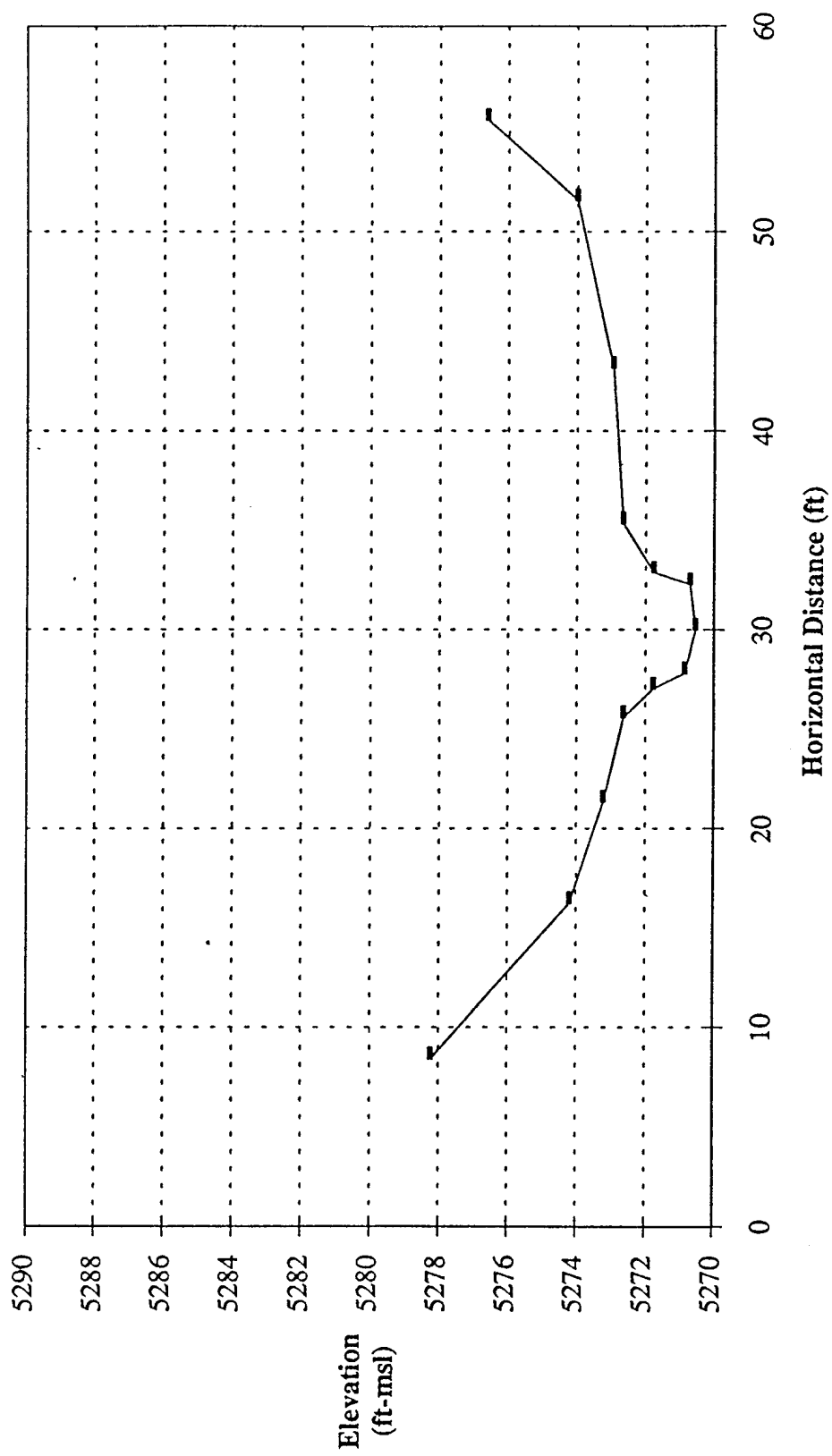
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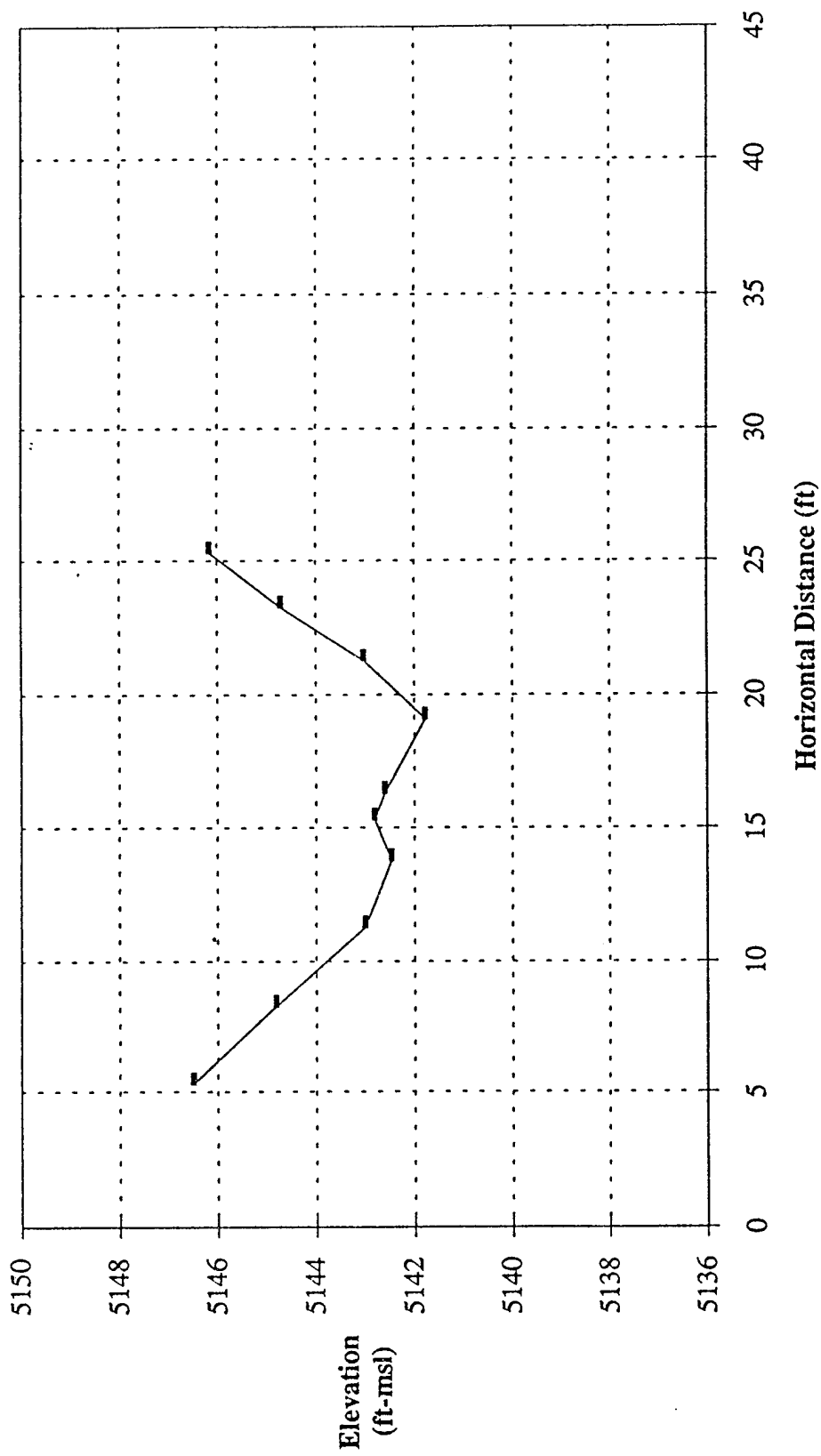
SOUTH UVALDA (STATION SW12005)
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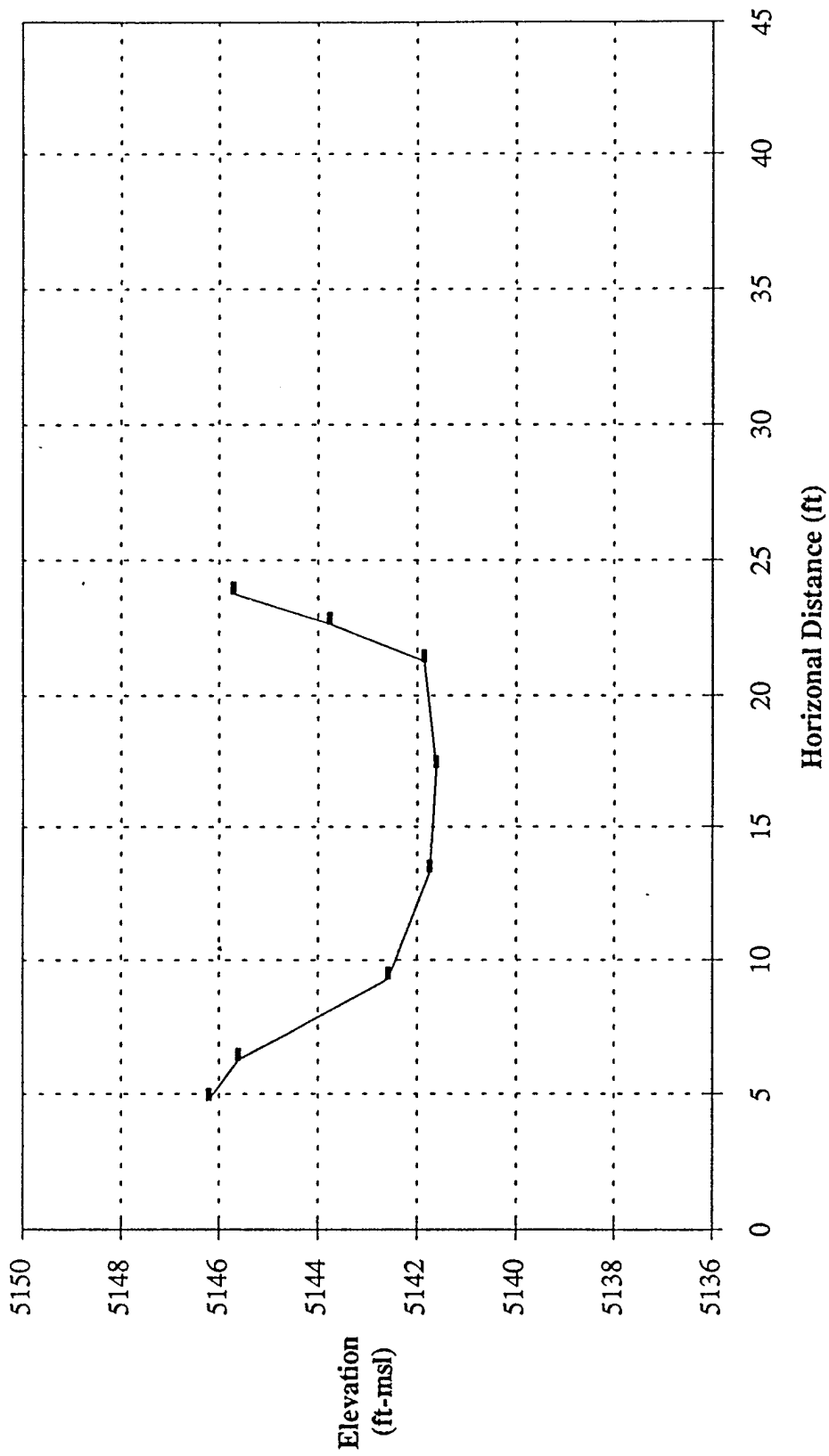
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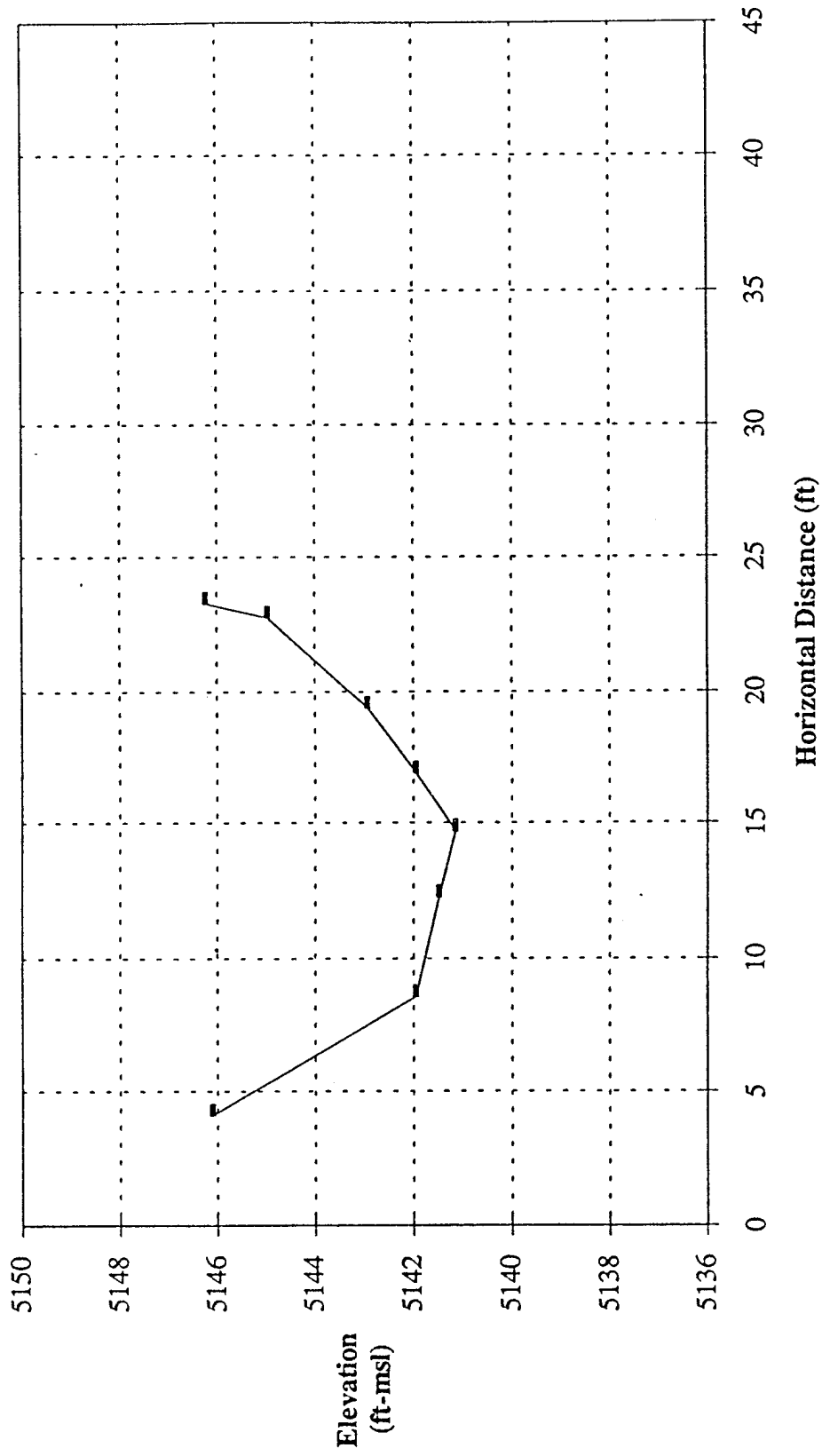
NORTH FIRST CREEK (STATION SW24002)
CROSS SECTION 1



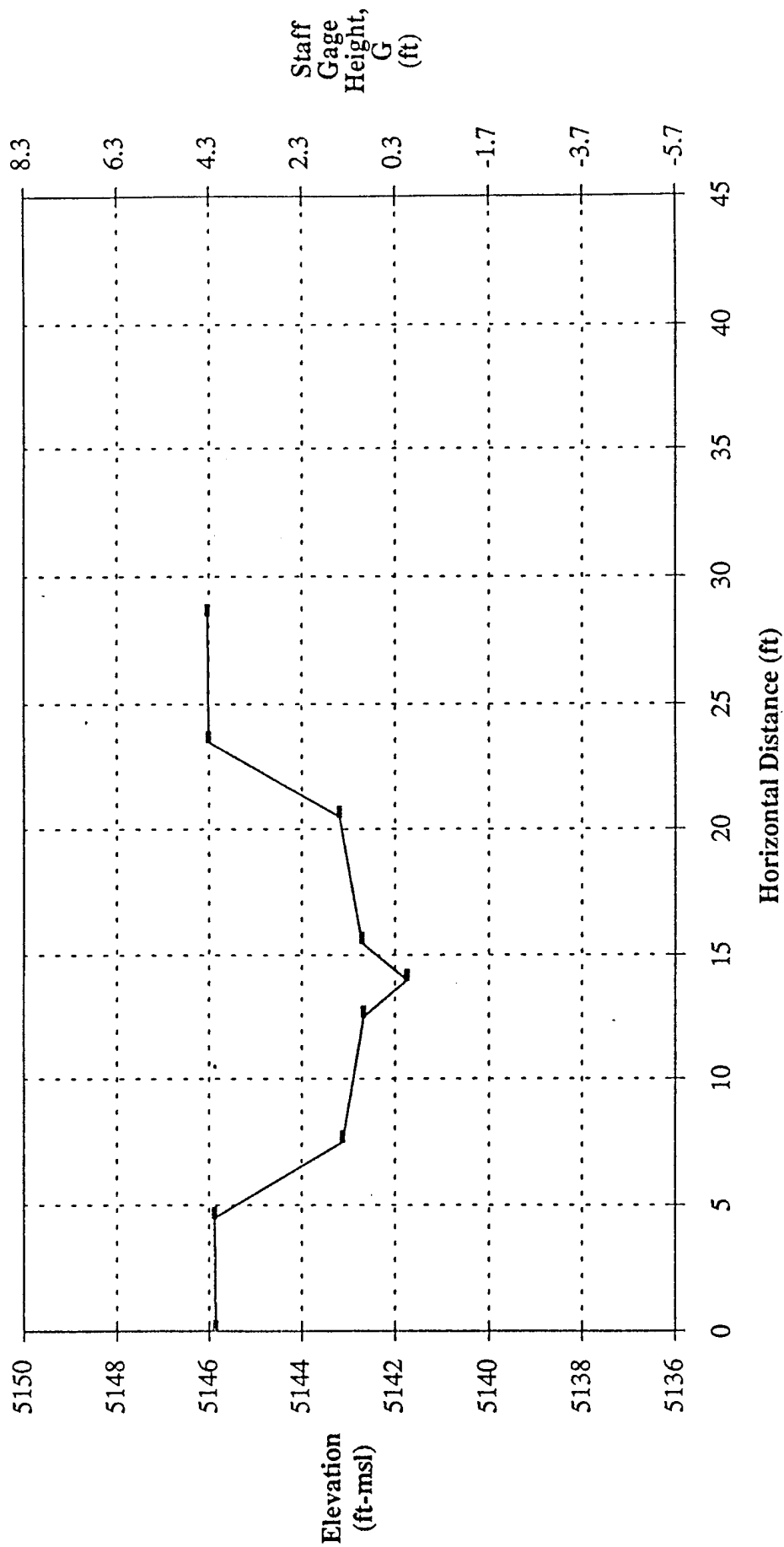
NORTH FIRST CREEK (STATION SW24002)
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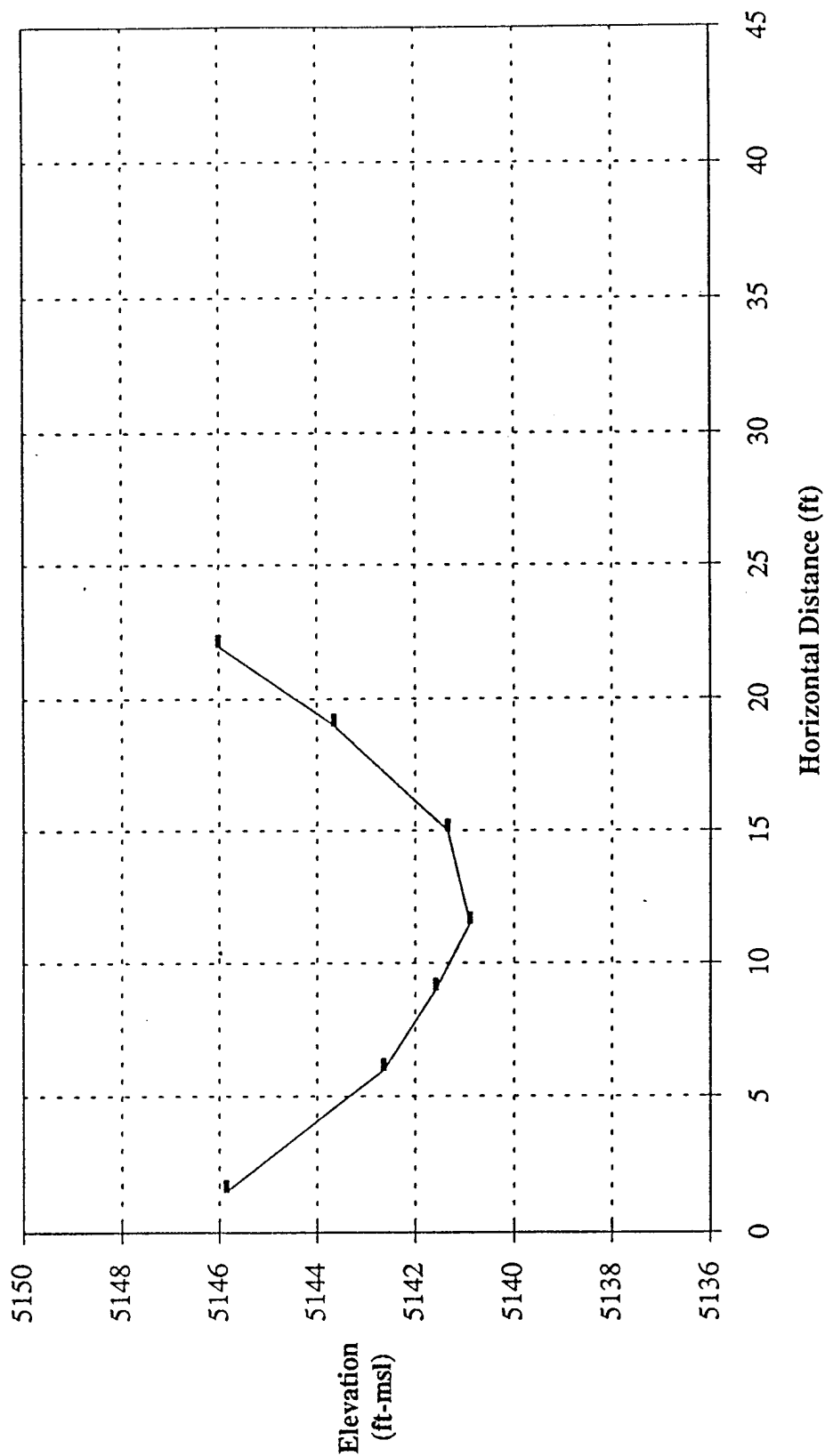
NORTH FIRST CREEK (STATION SW24002)
CROSS SECTION 3



NORTH FIRST CREEK (STATION SW24002)
CROSS SECTION 4

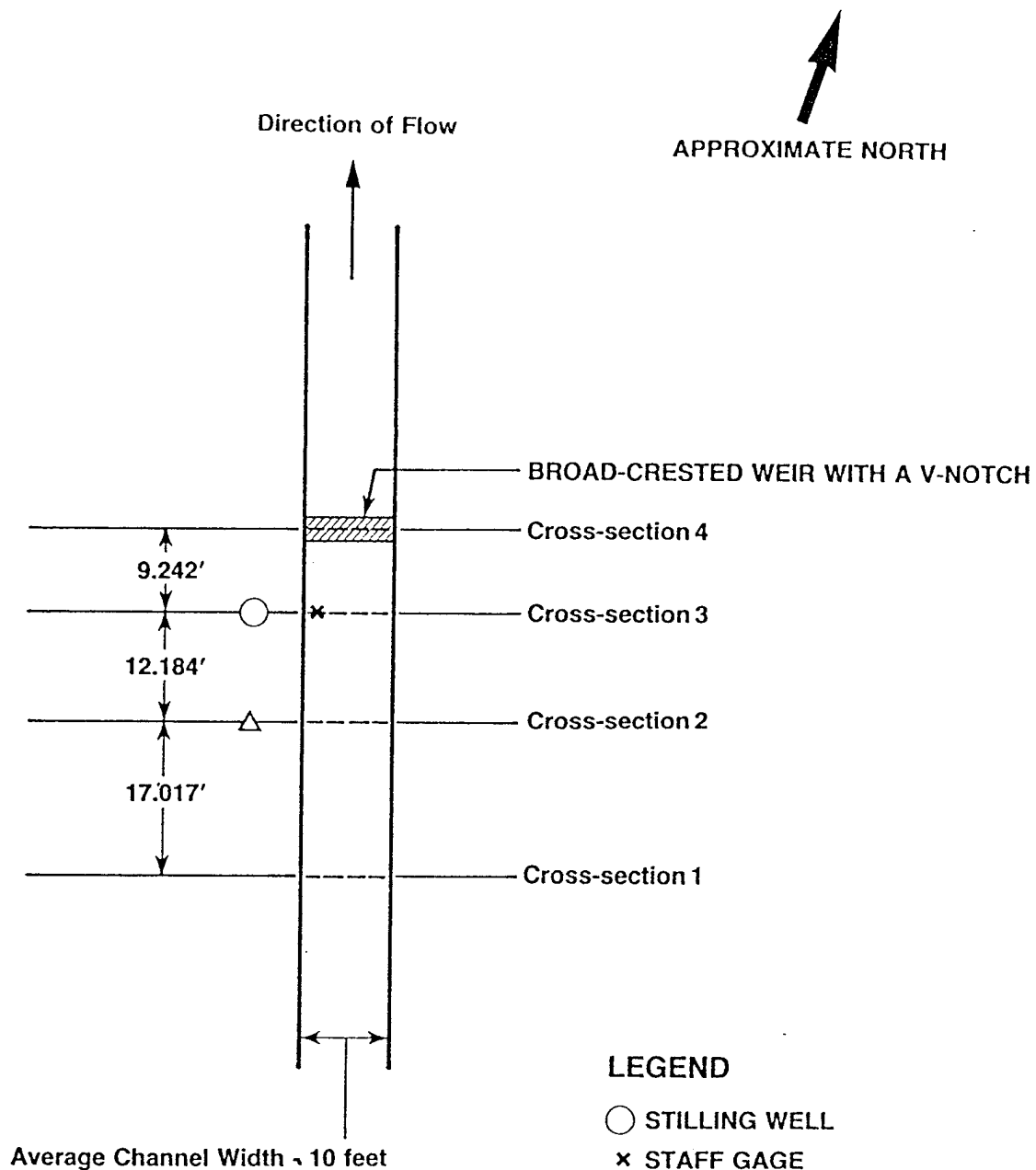


NORTH FIRST CREEK (STATION SW24002)
CROSS SECTION 5



APPENDIX A-1.2.2

Monitoring Station Plan Views



Prepared for :

U.S. Army Program Manager for
Rocky Mountain Arsenal
Commerce City, Colorado

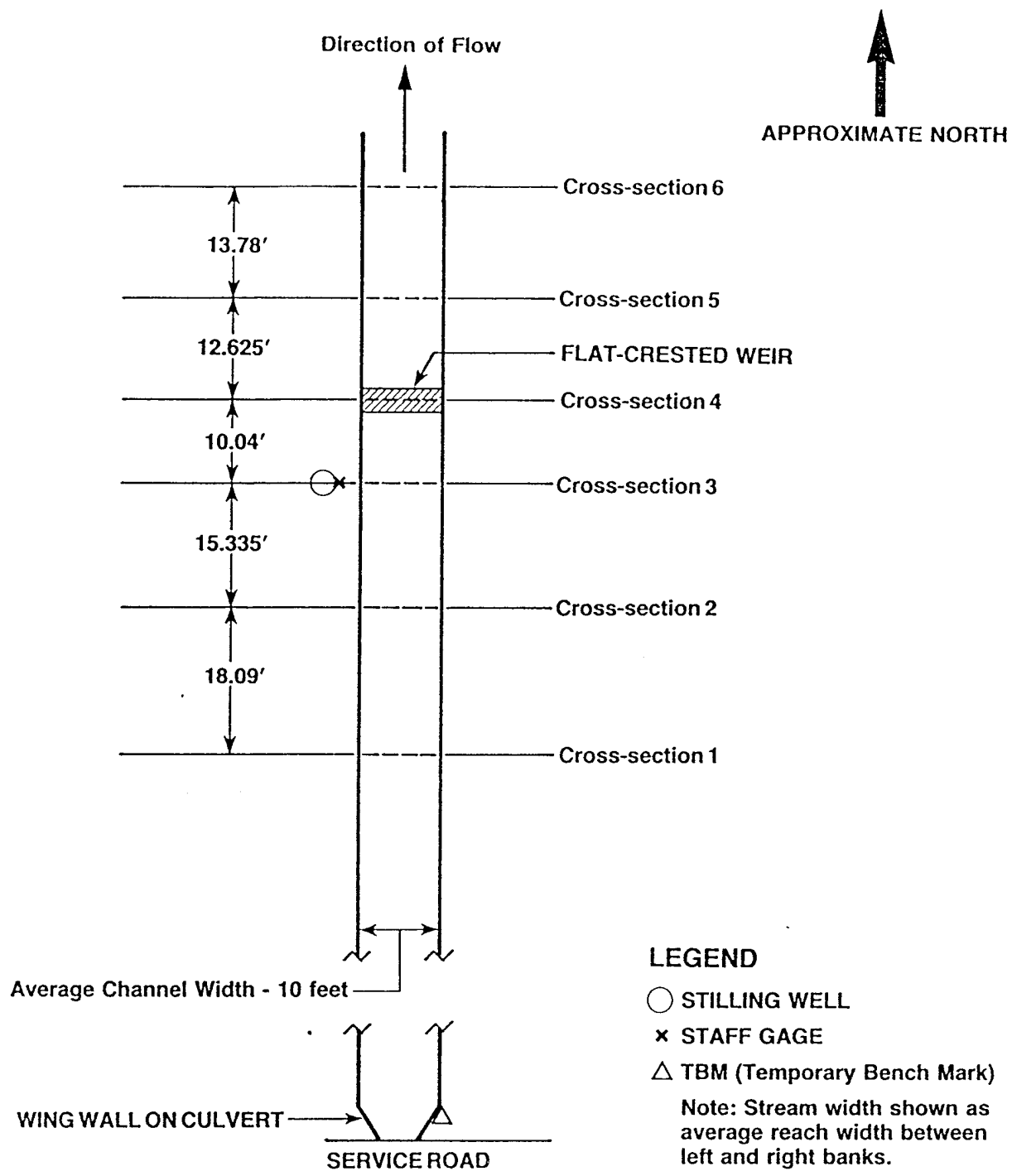
Prepared by :

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Riverside Technology, Inc.

Figure A-1.2.2-1

North Uvalda (SW01001)
Cross-Section Locations

CMP SW FY89



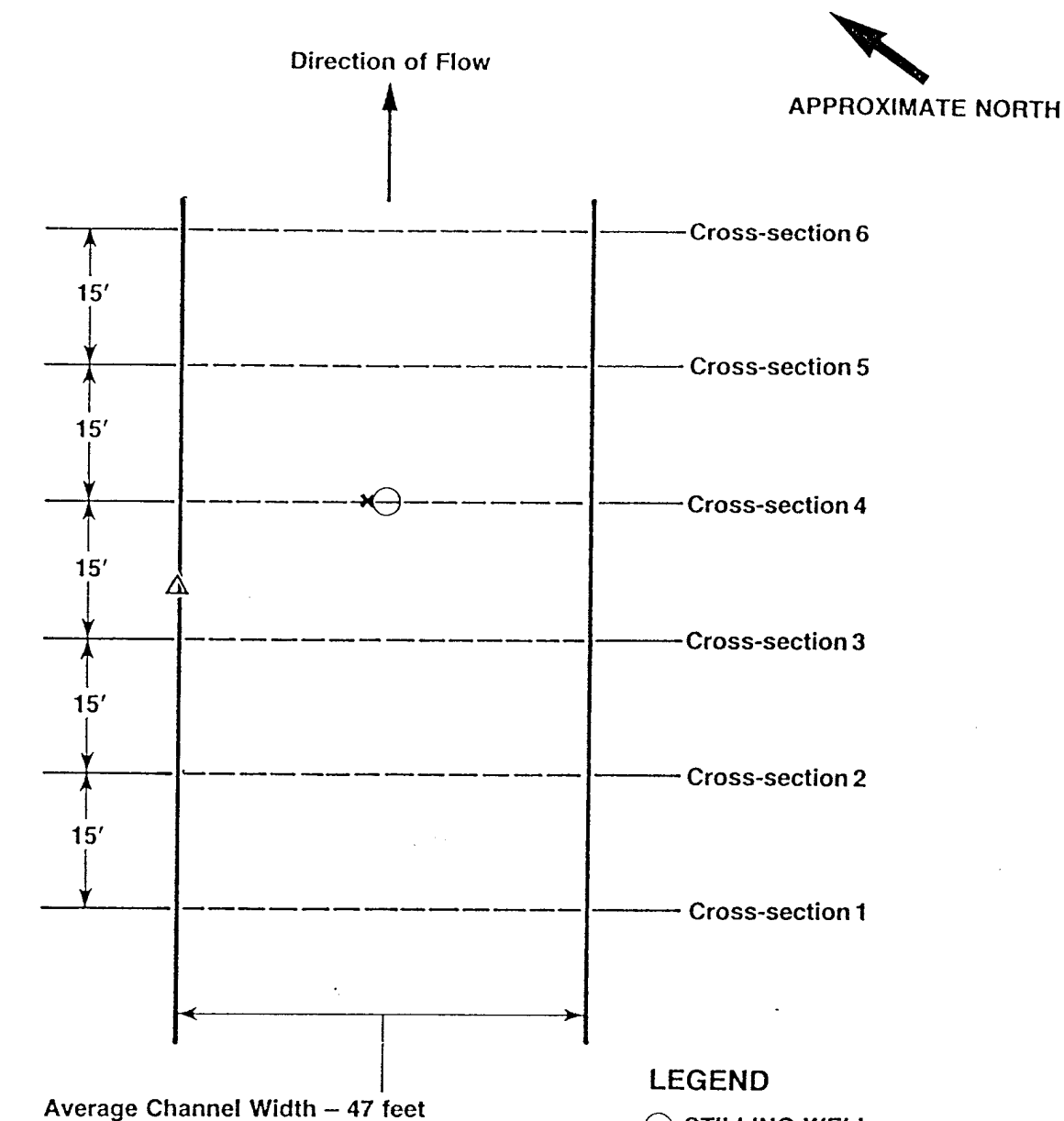
Prepared for :
U.S. Army Program Manager for
Rocky Mountain Arsenal
Commerce City, Colorado

Prepared by :
R.L. Stollar & Associates, Inc.
Riverside Technology, Inc.

Figure A-1.2.2-2

Peoria Interceptor
(SW11001)

Cross-Section Locations
CMP SW FY89



LEGEND

- STILLING WELL
- × STAFF GAGE
- △ TBM (Temporary Bench Mark)

Note: Stream width shown as average reach width between left and right banks.

Prepared for :

U.S. Army Program Manager for
Rocky Mountain Arsenal
Commerce City, Colorado

Prepared by :

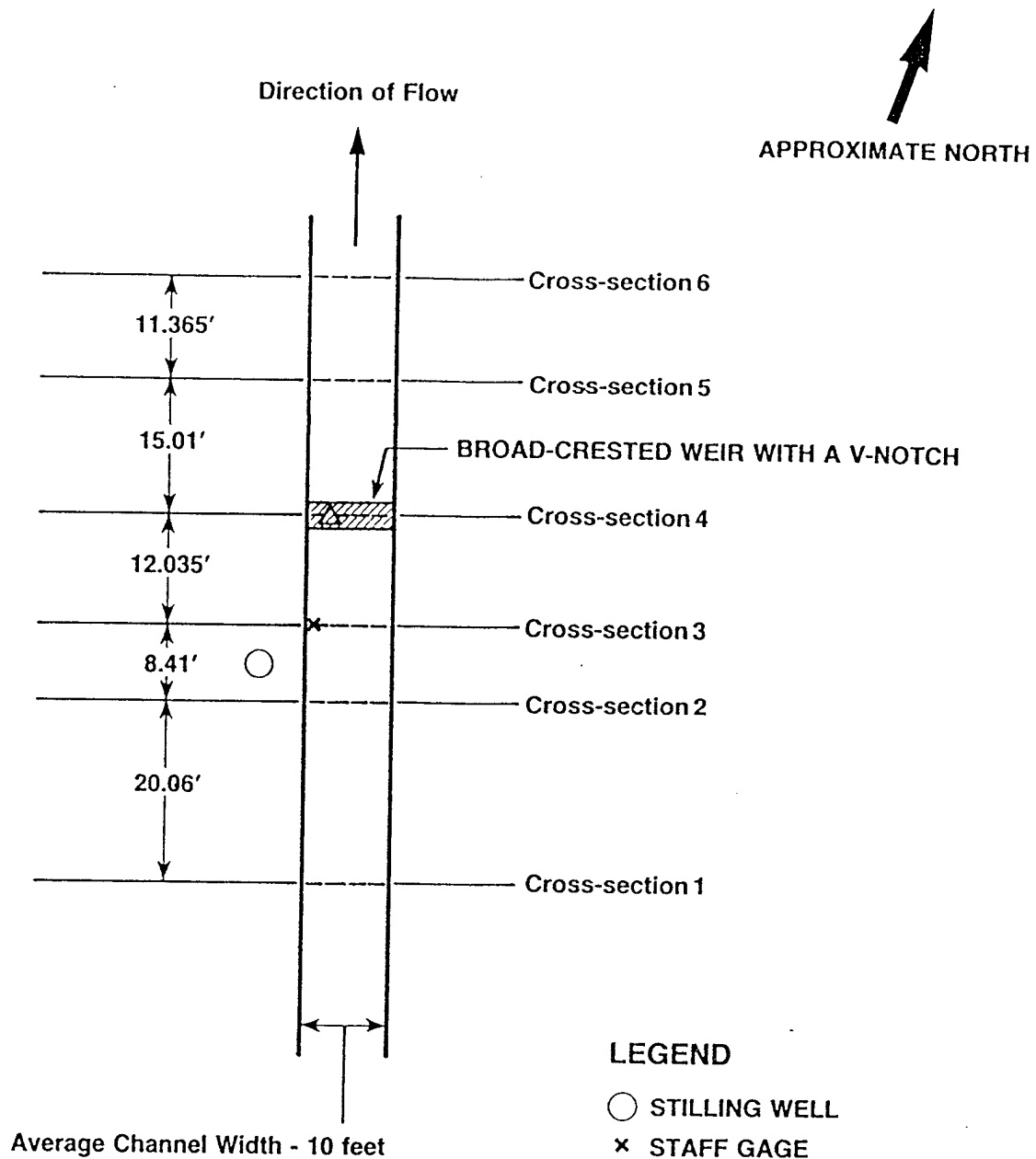
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Figure A-1.2.2-3

Havana Interceptor
(SW11002)

Cross-Section Locations

CMP SW FY89



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 U.S. Army Program Manager for
 Rocky Mountain Arsenal
 Commerce City, Colorado

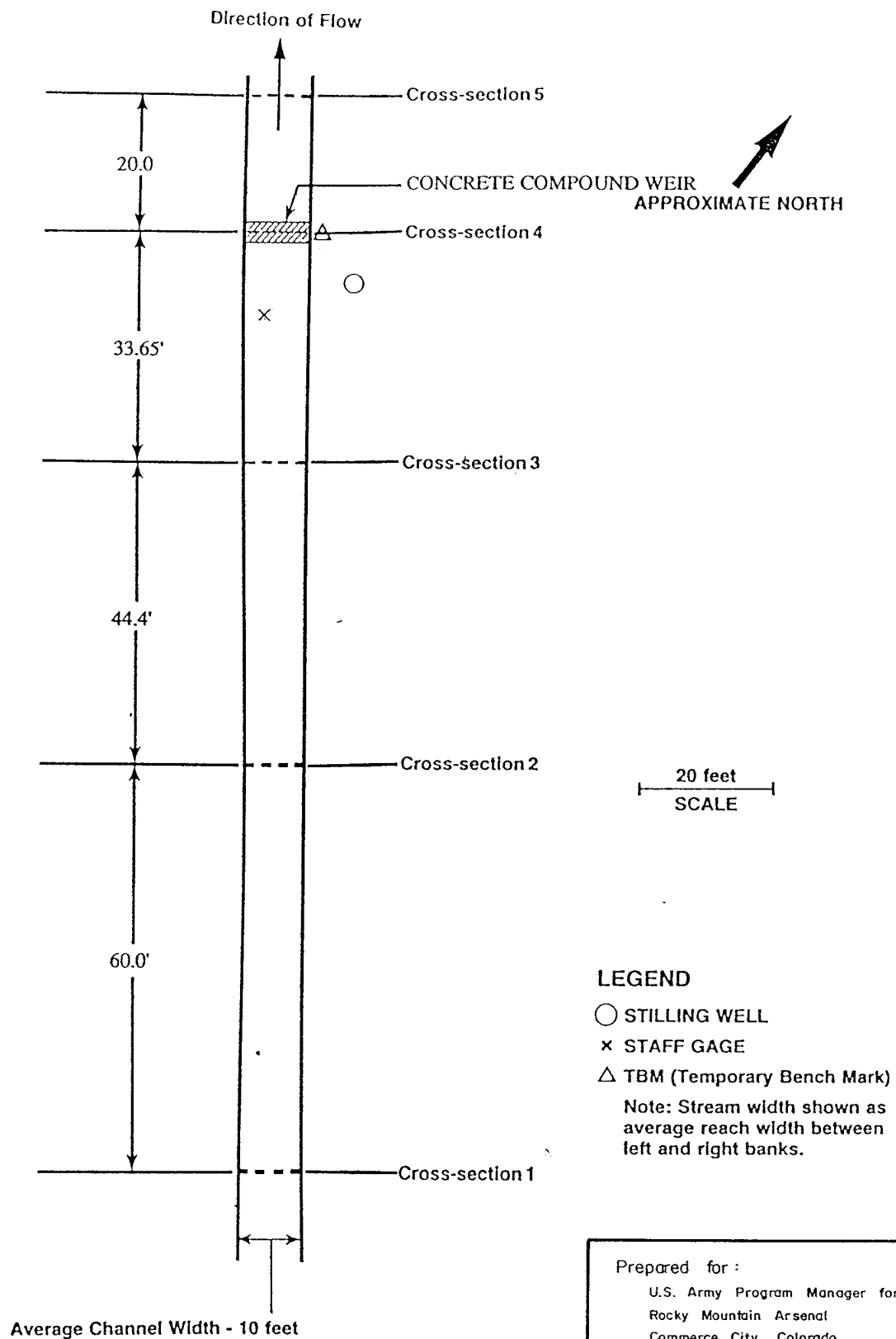
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 R.L. Stollar & Associates, Inc.
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Figure A-1.2.2-4

South Uvalda (SW 12005)

Cross-Section Locations

CMP SW FY89



LEGEND

- STILLING WELL
- × STAFF GAGE
- △ TBM (Temporary Bench Mark)

Note: Stream width shown as average reach width between left and right banks.

Prepared for :

U.S. Army Program Manager for
Rocky Mountain Arsenal
Commerce City, Colorado

Prepared by :

R.L. Stollar & Associates, Inc.
Riverside Technology, Inc.

Figure A-1.2.2-5

North First Creek
(SW24002)

Cross-Section Locations

CMP SW FY89

APPENDIX A-1.2.3

Cross Section Survey Data

Appendix A-1.2.3

Table A-1.2.3-1 North Uvalda (SW01001) Cross Section Survey Data

Horizontal Distance (ft)	Elevation (ft-msl)	Horizontal Distance (ft)	Elevation (ft-msl)
<u>Cross Section 1</u>		<u>Cross Section 3</u>	
0.00	5260.980	0.40	5259.105
4.00	5259.310	2.40	5258.305
6.30	5257.915	4.40	5255.750
7.90	5256.425	6.60	5255.955
10.20	5255.925	7.20	5255.760
12.20	5256.090	8.20	5255.800
13.60	5255.805	10.00	5255.715
17.90	5255.925	13.20	5255.855
18.60	5256.370	14.00	5256.350
19.40	5256.655	15.70	5256.690
21.20	5257.445	17.30	5256.855
22.50	5257.550		
<u>Cross Section 2</u>		<u>Cross Section 4</u>	
0.00	5259.740	0.00	5260.040
4.00	5258.070	3.00	5259.055
6.00	5256.995	5.60	5257.840
7.50	5255.810	6.00	5257.040
10.00	5255.745	9.10	5256.315
11.70	5255.695	11.40	5256.025
12.60	5255.865	12.70	5255.790
14.70	5255.930	13.40	5255.695
15.70	5256.525	14.10	5255.775
19.40	5257.535	16.00	5256.125
24.50	5256.675	17.50	5256.585
28.50	5258.010	19.00	5256.675
		20.50	5256.775
		21.40	5257.095
		24.00	5257.880
		30.30	5258.400

Appendix A-1.2.3

Table A-1.2.3-2 Peoria Interceptor (SW11001) Cross Section Survey Data

Horizontal Distance (ft)	Elevation (ft-msl)	Horizontal Distance (ft)	Elevation (ft-msl)
<u>Cross Section 1</u>		<u>Cross Section 4</u>	
0.00	5252.665	0.00	5251.580
9.40	5250.400	12.90	5249.315
24.60	5248.695	18.50	5248.760
25.30	5247.295	21.70	5248.260
29.40	5246.470	23.50	5248.180
30.90	5247.235	23.80	5248.480
31.50	5249.005	26.20	5248.150
33.80	5249.690	26.87	5247.480
41.80	5250.525	27.54	5248.150
		31.80	5248.210
		32.50	5248.220
		34.00	5248.500
		43.00	5250.070
		43.10	5250.030
<u>Cross Section 2</u>		<u>Cross Section 5</u>	
0.00	5251.955	0.00	5252.185
14.00	5249.655	12.00	5249.215
22.40	5248.570	21.40	5248.345
23.90	5247.630	22.40	5246.060
27.20	5247.095	24.50	5245.410
32.50	5247.590	29.90	5246.225
33.00	5248.970	31.30	5248.435
40.00	5249.700	41.00	5249.155
42.30	5250.205	43.60	5249.950
<u>Cross Section 3</u>		<u>Cross Section 6</u>	
0.00	5251.935	0.00	5252.480
13.60	5249.290	12.30	5249.045
17.80	5248.355	22.30	5248.350
20.40	5248.215	24.00	5245.625
22.00	5248.115	26.00	5245.625
24.70	5247.590	29.10	5246.085
26.60	5246.790	29.10	5246.085
30.50	5246.555	39.10	5248.935
32.40	5247.235	43.70	5250.055
33.30	5248.780		
42.40	5249.695		

Appendix A-1.2.3

Table A-1.2.3-3 Havana Interceptor (SW11002) Cross Section Survey Data

Horizontal Distance (ft)	Elevation (ft-msl)
8.00	5261.540
25.00	5253.075
29.50	5252.215
31.00	5252.090
32.00	5252.220
36.50	5252.975
55.00	5261.645

Appendix A-1.2.3

Table A-1.2.3-4 South Uvalda (SW12005) Cross Section Survey Data

Horizontal Distance (ft)	Elevation (ft-msl)	Horizontal Distance (ft)	Elevation (ft-msl)
<u>Cross Section 1</u>		<u>Cross Section 3</u>	
2.50	5278.170	10.42	5277.000
5.00	5276.790	13.33	5276.020
14.80	5274.610	18.83	5273.810
25.60	5273.740	23.03	5273.170
28.90	5271.680	25.63	5272.005
30.40	5271.380	26.33	5271.515
33.90	5271.885	28.73	5271.425
35.60	5271.730	31.13	5271.285
36.90	5271.730	33.33	5271.635
39.60	5273.470	34.93	5273.105
44.00	5273.770	43.03	5271.845
50.00	5277.520	47.53	5274.990
		51.23	5277.130
<u>Cross Section 2</u>		<u>Cross Section 4</u>	
7.42	5277.890	6.02	5277.615
11.92	5275.955	11.22	5274.810
15.92	5273.515	18.82	5273.210
22.02	5273.635	21.42	5273.135
27.12	5272.370	25.92	5272.400
29.62	5271.615	27.32	5272.400
32.42	5271.440	28.12	5272.040
35.02	5271.580	28.72	5271.600
35.92	5273.120	29.32	5271.240
39.22	5273.870	29.82	5271.535
44.52	5273.220	29.92	5271.695
50.92	5276.760	30.62	5272.130
		31.32	5272.405
		32.22	5272.435
		35.92	5272.885
		41.82	5272.880
		45.62	5275.040
		49.22	5277.030

Table A-1.2.3-4

South Uvalda (SW12005) Cross Section Survey Data (continued)

Horizontal Distance (ft)	Elevation (ft-msl)	Horizontal Distance (ft)	Elevation (ft-msl)
<u>Cross Section 5</u>		<u>Cross Section 6</u>	
4.17	5276.700	8.42	5278.230
9.97	5276.040	16.22	5274.190
14.37	5274.915	21.42	5273.205
20.37	5273.265	25.62	5272.640
23.57	5273.070	27.02	5271.770
25.47	5272.560	27.82	5270.840
26.17	5270.740	30.02	5270.525
29.07	5270.385	32.32	5270.690
33.17	5272.930	32.92	5271.770
34.87	5271.835	35.42	5272.660
38.77	5273.245	43.22	5272.950
45.17	5273.100	51.52	5273.995
47.97	5274.305	55.42	5276.615
51.17	5276.580		

Appendix A-1.2.3

Table A-1.2.3-5 North First Creek (SW24002) Cross Section Survey Data

Horizontal Distance (ft)	Elevation (ft-msl)	Horizontal Distance (ft)	Elevation (ft-msl)
<u>Cross Section 1</u>		<u>Cross Section 4</u>	
5.30	5146.500	0.00	5145.860
8.30	5144.820	4.50	5145.885
11.30	5143.010	7.50	5143.130
13.80	5142.820	12.50	5142.680
15.30	5142.470	14.00	5141.750
16.30	5142.610	15.50	5142.710
19.10	5141.780	20.50	5143.200
21.30	5143.040	23.50	5146.010
23.30	5144.720	28.50	5146.040
25.30	5146.160		
<u>Cross Section 2</u>		<u>Cross Section 5</u>	
4.80	5146.210	1.50	5145.870
6.30	5146.610	6.00	5142.640
9.30	5142.590	9.00	5141.590
13.30	5141.750	11.50	5140.900
17.30	5141.620	15.00	5141.340
21.30	5141.860	19.00	5143.660
22.70	5143.770	22.00	5146.020
23.80	5145.710		
<u>Cross Section 3</u>			
4.10	5146.110		
8.60	5141.950		
12.30	5141.480		
12.30	5141.150		
16.90	5141.950		
19.40	5142.935		
22.80	5144.970		
23.30	5146.230		

APPENDIX A-1.2.4

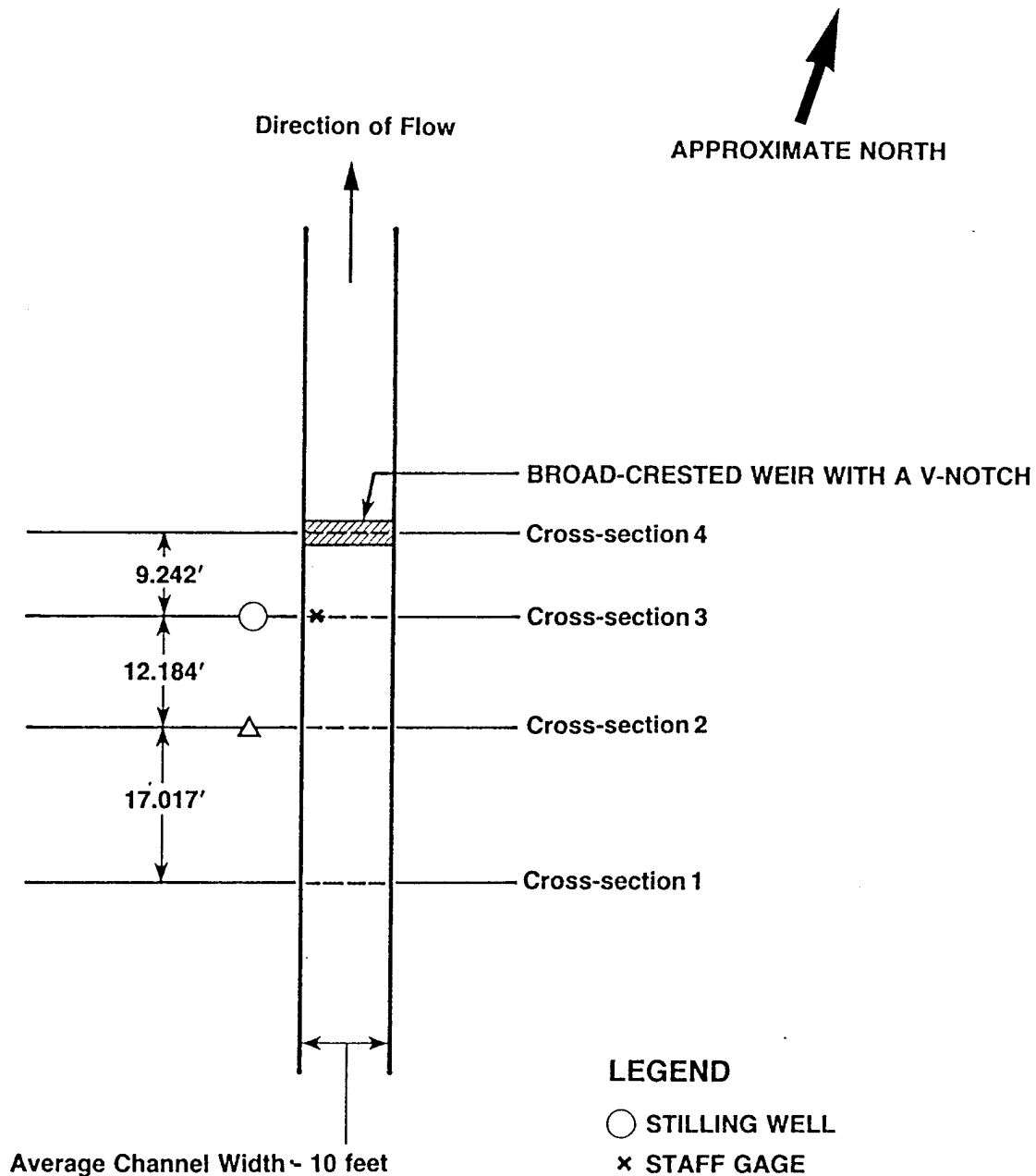
Channel Reach Survey Procedure

Vertical control was established by referencing to an existing temporary bench mark (TBM) located at or near each structure. Each TBM is permanently secured such that additional or future surveys can be referenced to the same elevation. The need to do additional surveying may arise as a result of flooding which could cause changes in channel geometry, from aggradation or degradation of the stream channel bottom as a result of increased or decrease sediment transport, and from modifications or changes in the control structure, staff location or staff elevation.

Each stream cross section was referenced either to the TBM or an established pin at the nearest upstream or downstream cross section to maintain vertical control. All rod readings were recorded to the nearest 0.005 feet. For each surveying instrument location, a backsight and foresight to established pins was recorded. All level loops were closed on the original TBM at each location, with an allowable vertical closure error not-to-exceed 0.01 feet. An end-to-end test or "peg test" was conducted on the surveying instrument each day prior to use to ensure instrument accuracy.

Horizontal control was established by driving 5/8-inch rebar stakes (pins) at the endpoints of each cross section. The pins serve as reference locations for each cross section and may be used for future surveys, if required. Each pin was tagged with aluminum tags etched with the station identification, pin identification and date. Pins were positioned on both sides of the stream channel perpendicular to flow lines in the stream. The location of the pins is high enough such that a wide range of high flows will be contained within the surveyed cross sections. Each pin was hammered into the ground approximately 1.5 feet. The remaining 0.5 feet was painted orange and tagged with orange surveyor's flagging for ease of locating in the future. For step-backwater modeling purposes, baseline and azimuth measurements were not required. Since all cross sections were staked and identified, horizontal control with reference to magnetic north can easily be obtained by additional surveys.

All cross sections were surveyed from left to right looking in a downstream direction. Horizontal stations were determined to the nearest 0.1 feet using a cloth tape stretched between the pins. Horizontal stationing was determined for all slope breaks along each cross section, for the left and right overbank reaches, left and right channel banks, left and right edge of water and for the thalweg of each cross section. Additionally, the water surface elevation at each cross section were determined to compute the energy grade of a particular reach.

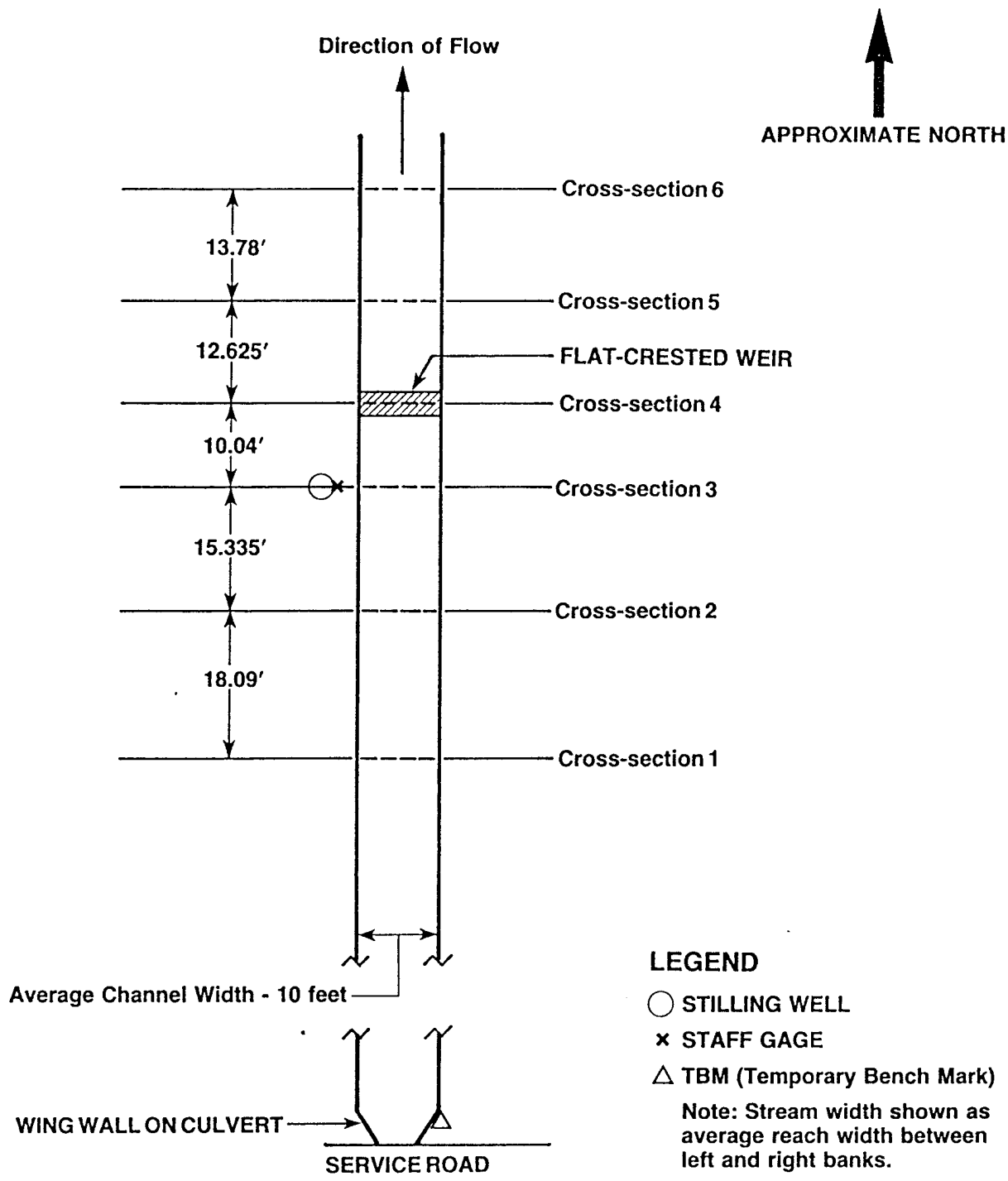


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Figure A-1.2.2-1
 North Uvalda (SW01001)
 Cross-Section Locations

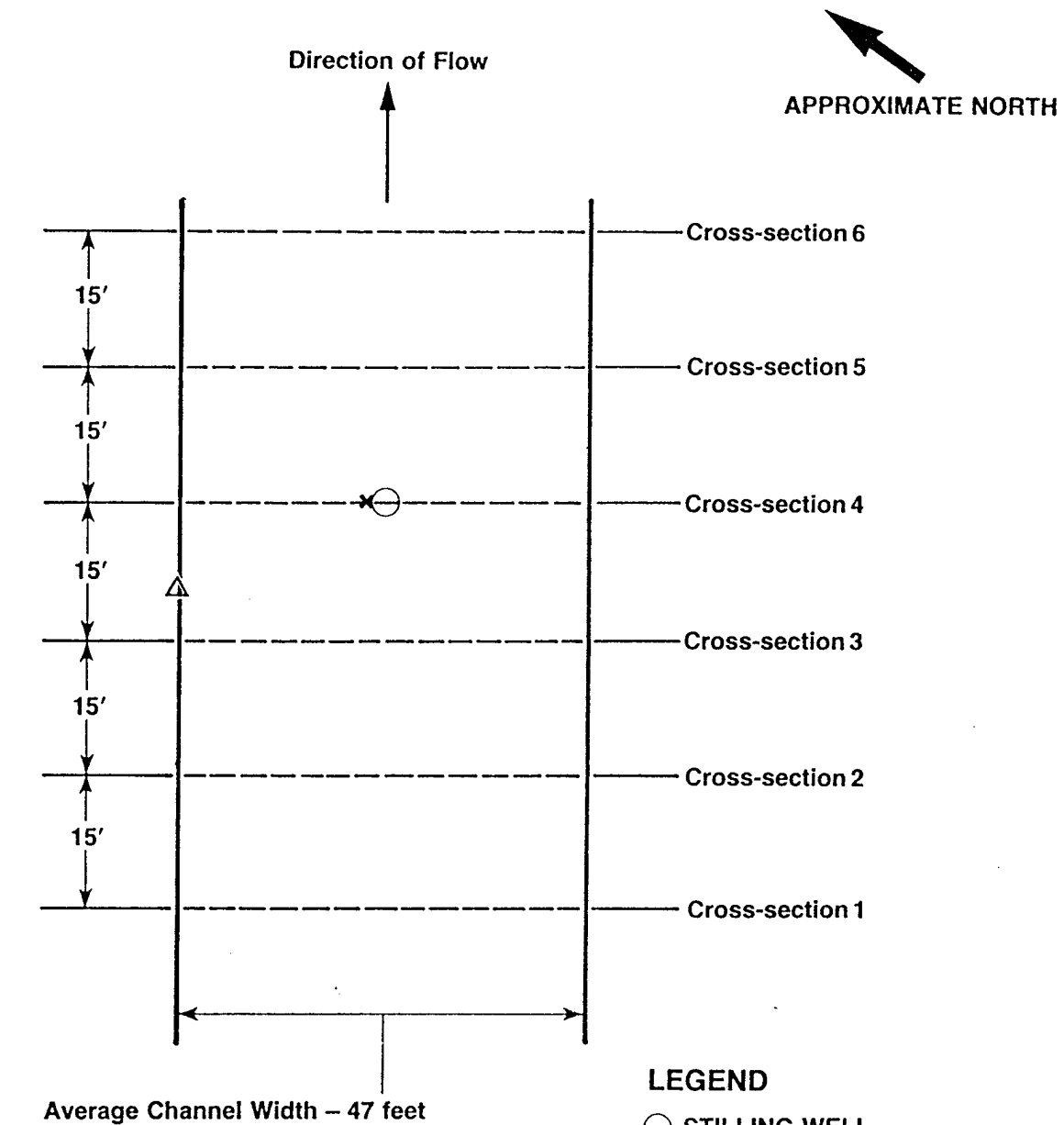
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Figure A-1.2.2-2
Peoria Interceptor
(SW11001)
Cross-Section Locations
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LEGEND

- STILLING WELL
- x STAFF GAGE
- △ TBM (Temporary Bench Mark)

Note: Stream width shown as average reach width between left and right banks.

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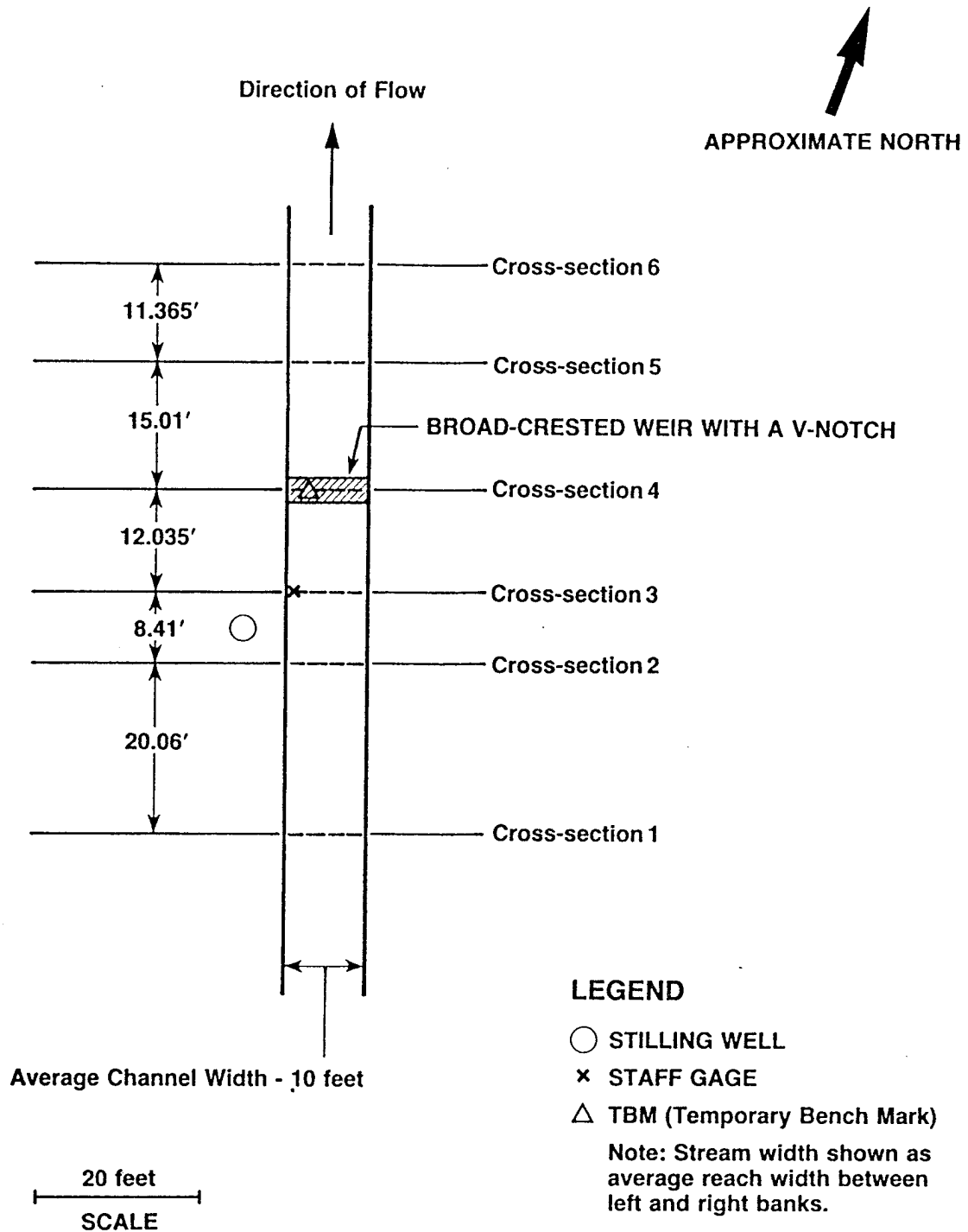
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Figure A-1.2.2-3

Havana Interceptor
(SW11002)

Cross-Section Locations

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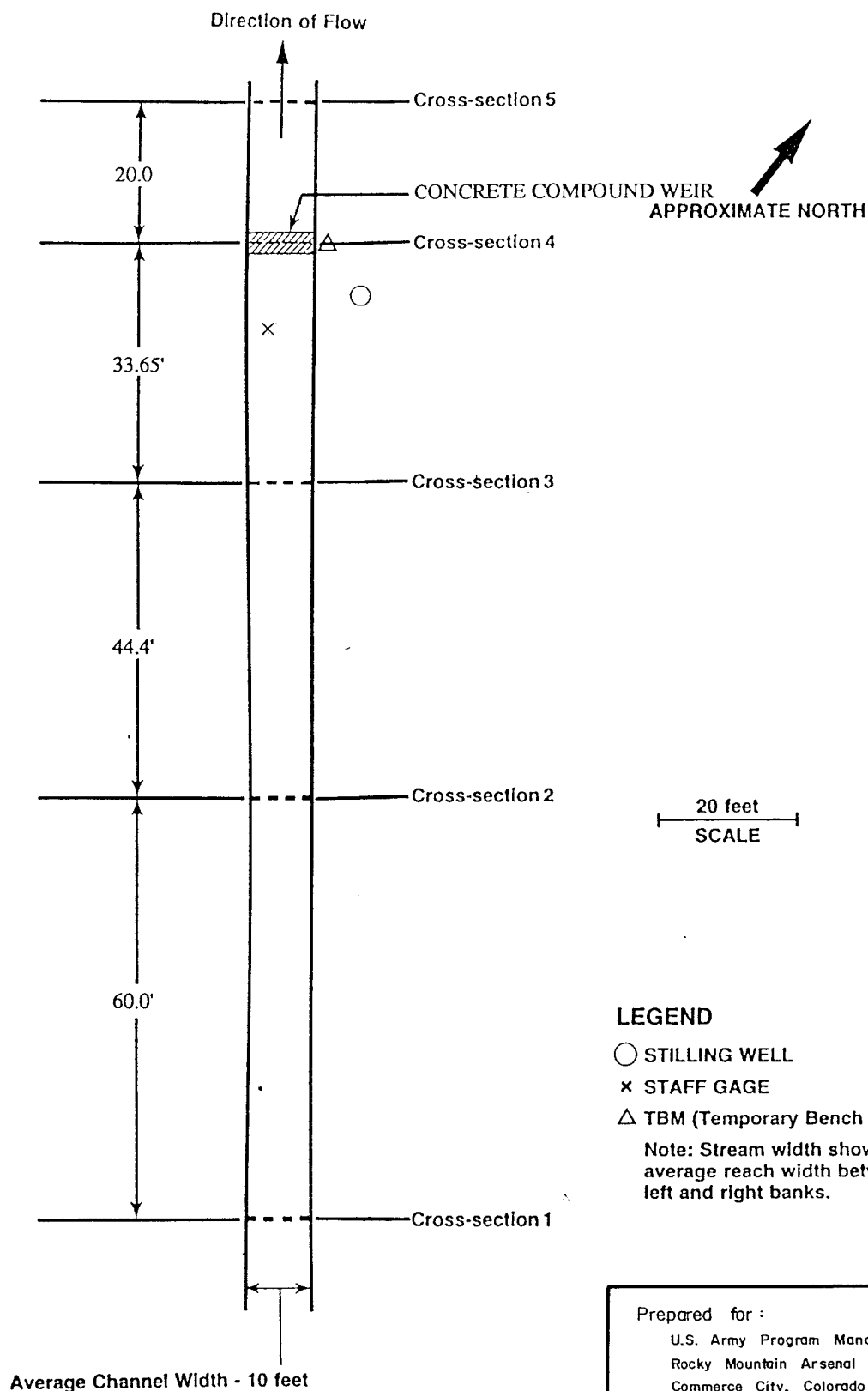
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Figure A-1.2.2-4

South Uvalda (SW12005)
 Cross-Section Locations

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LEGEND

- STILLING WELL
- × STAFF GAGE
- △ TBM (Temporary Bench Mark)

Note: Stream width shown as average reach width between left and right banks.

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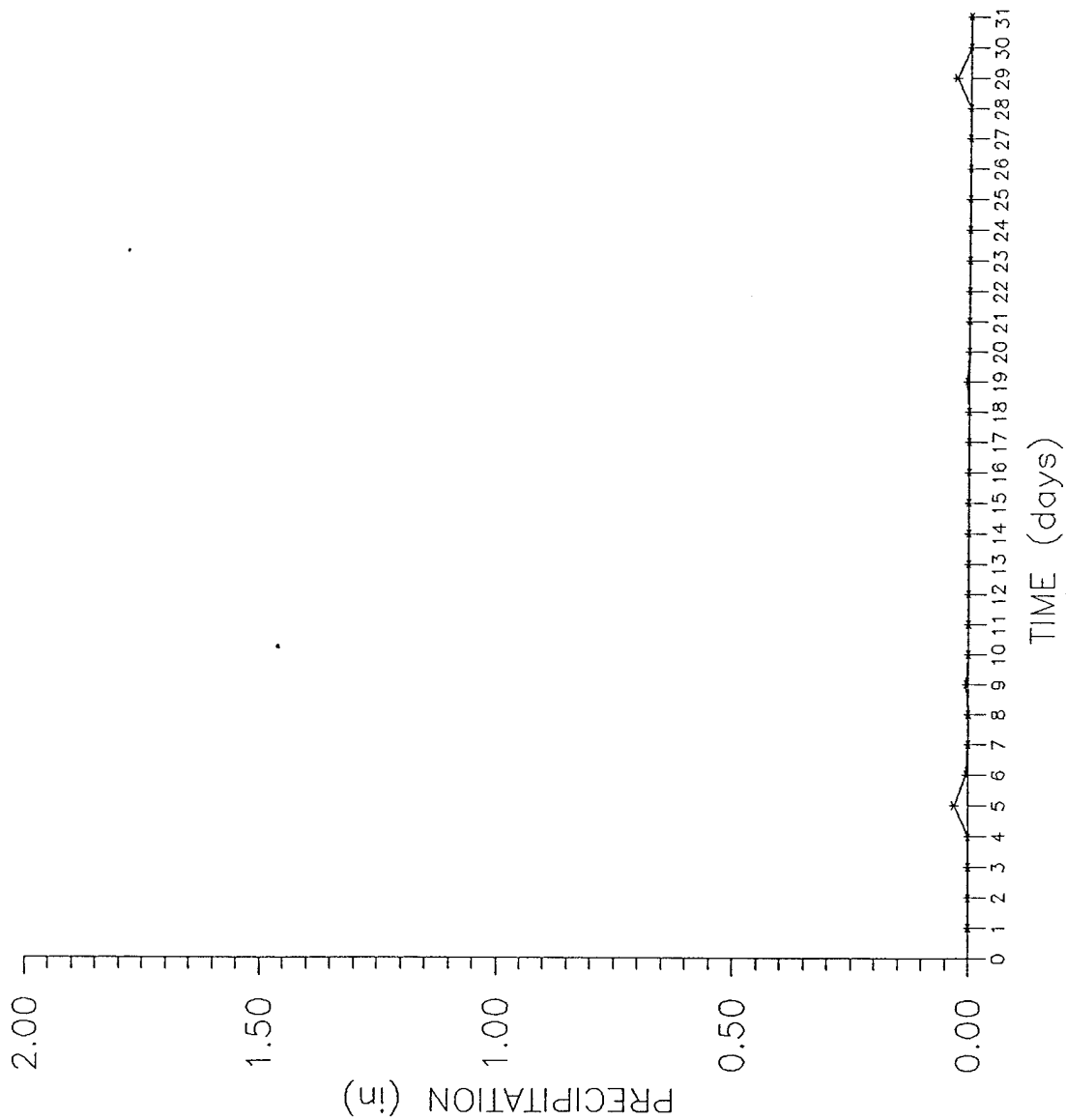
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Figure A-1.2.2-5

North First Creek
(SW24002)

Cross-Section Locations

CMP SW FY89



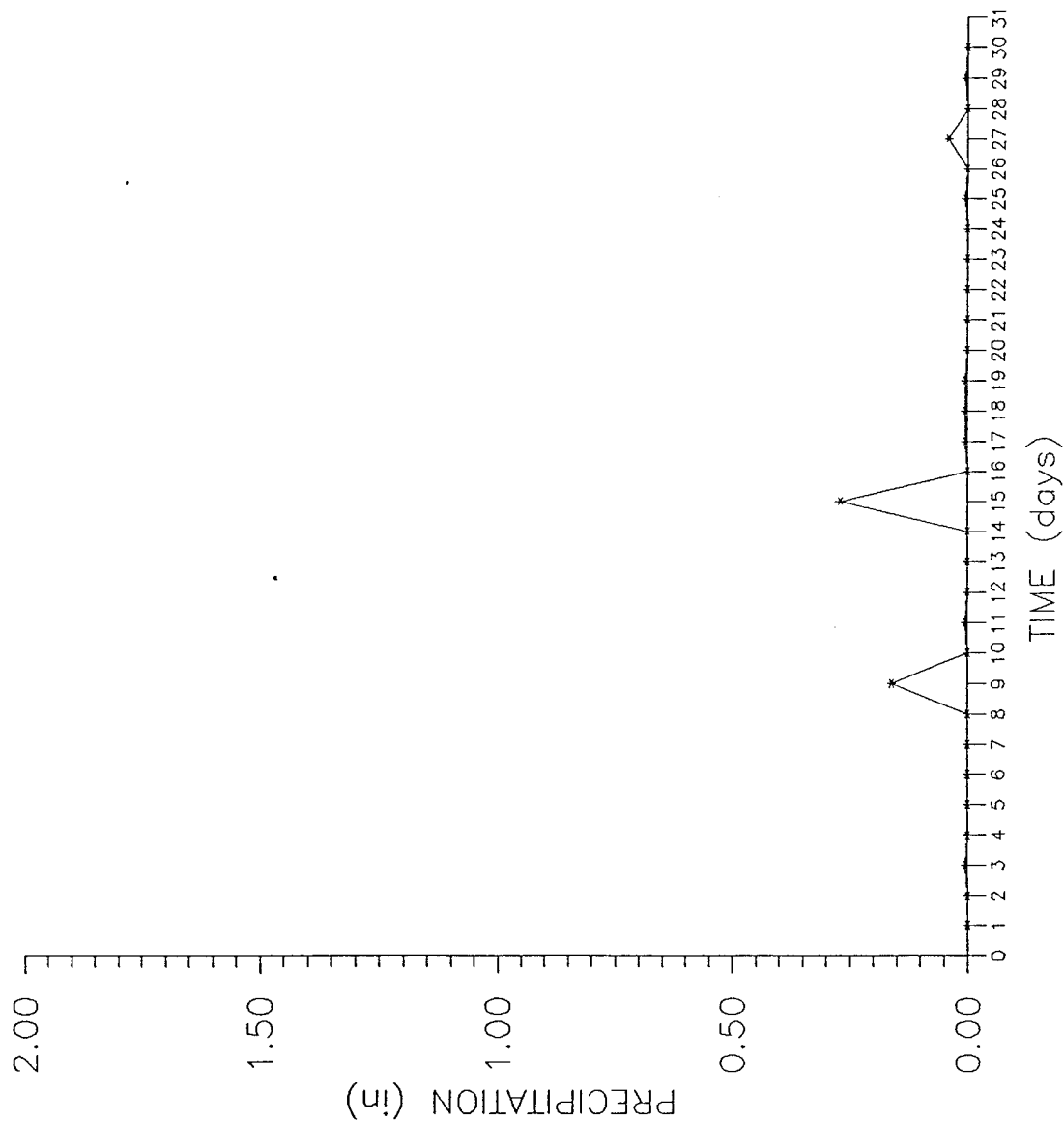
----- PRECIPITATION

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Figure A-11.1-1

October 1988 Precipitation

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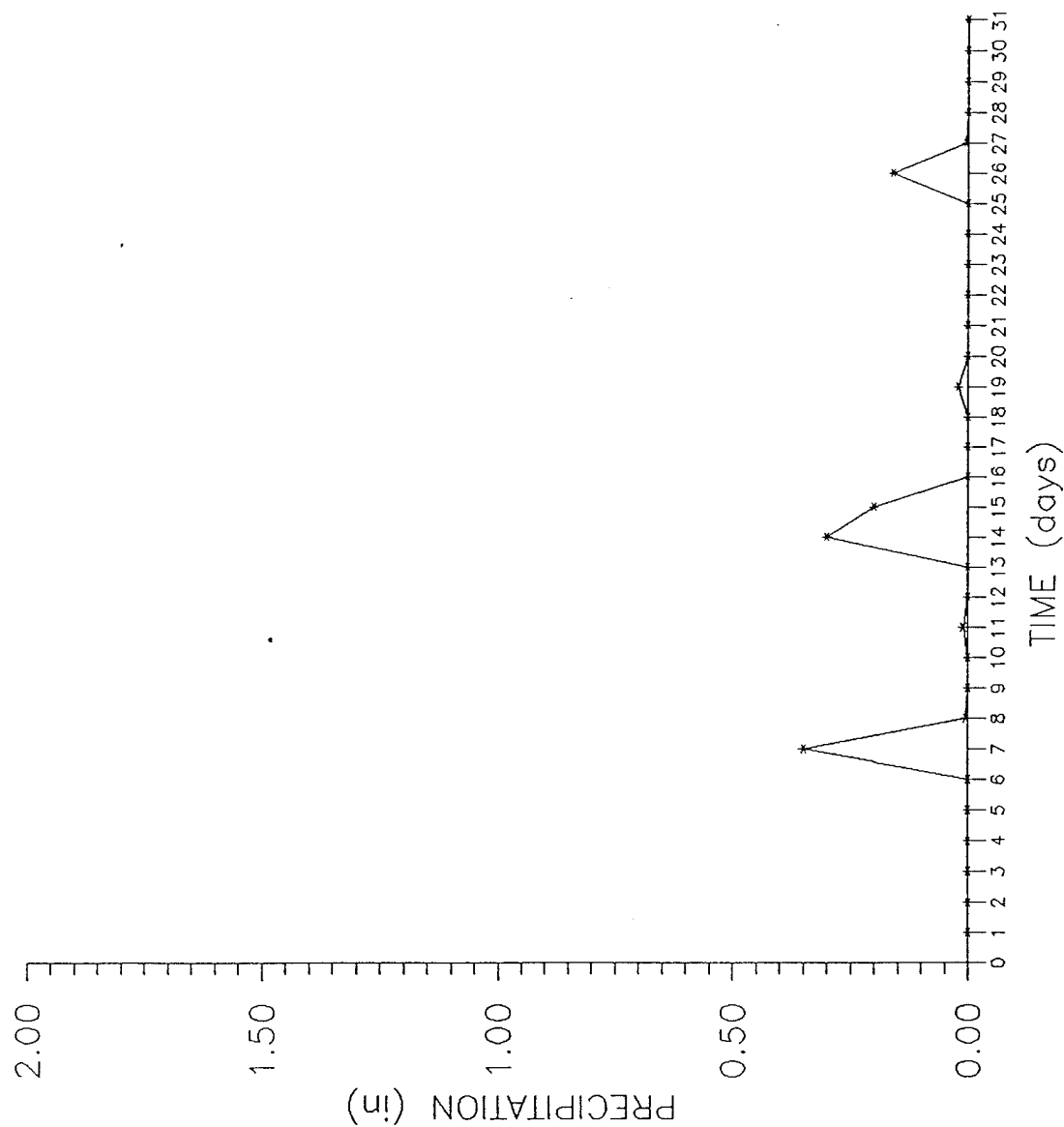
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Figure A-11.1-2

November 1988 Precipitation

CMP SW FY89

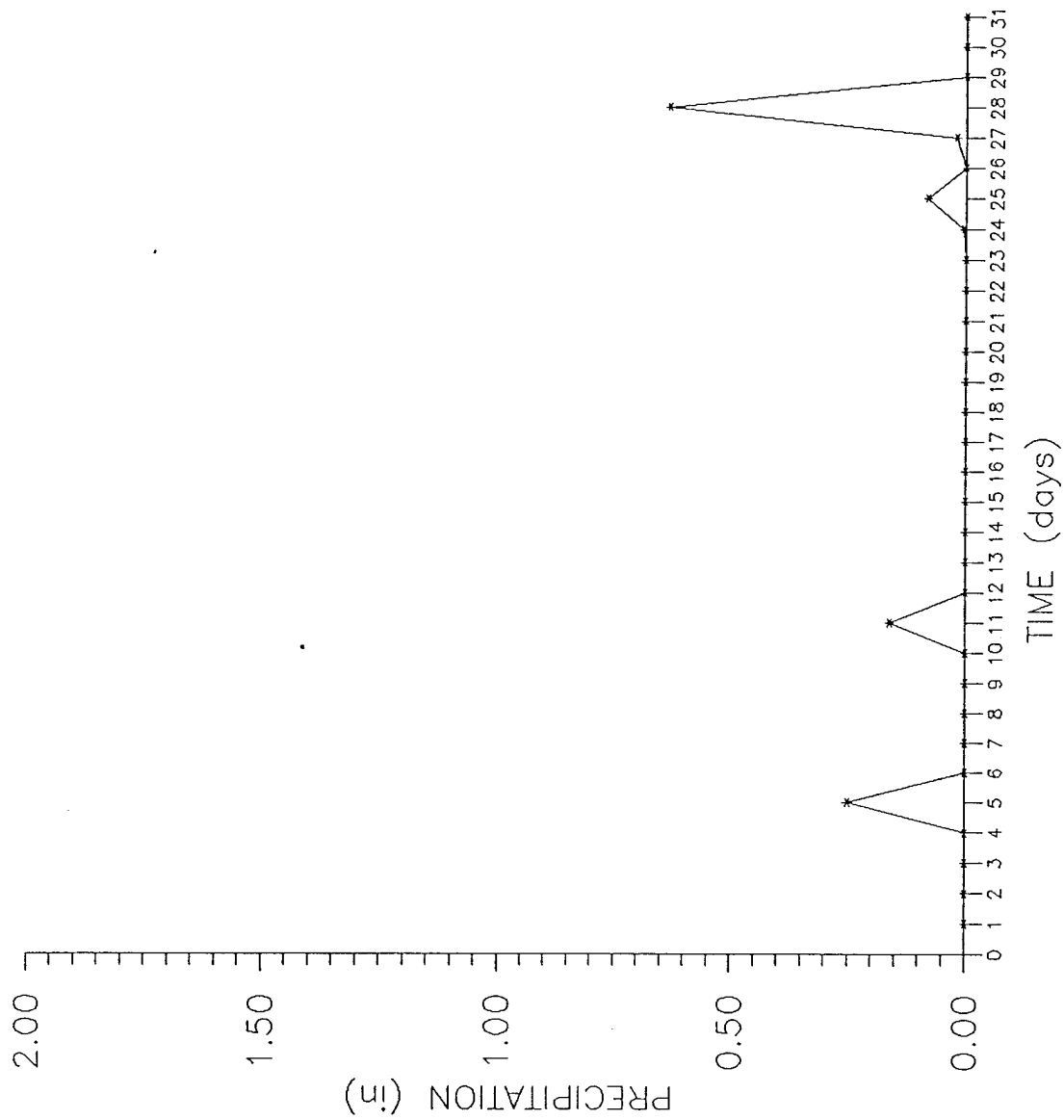


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Figure A-11.1-3

December 1988 Precipitation

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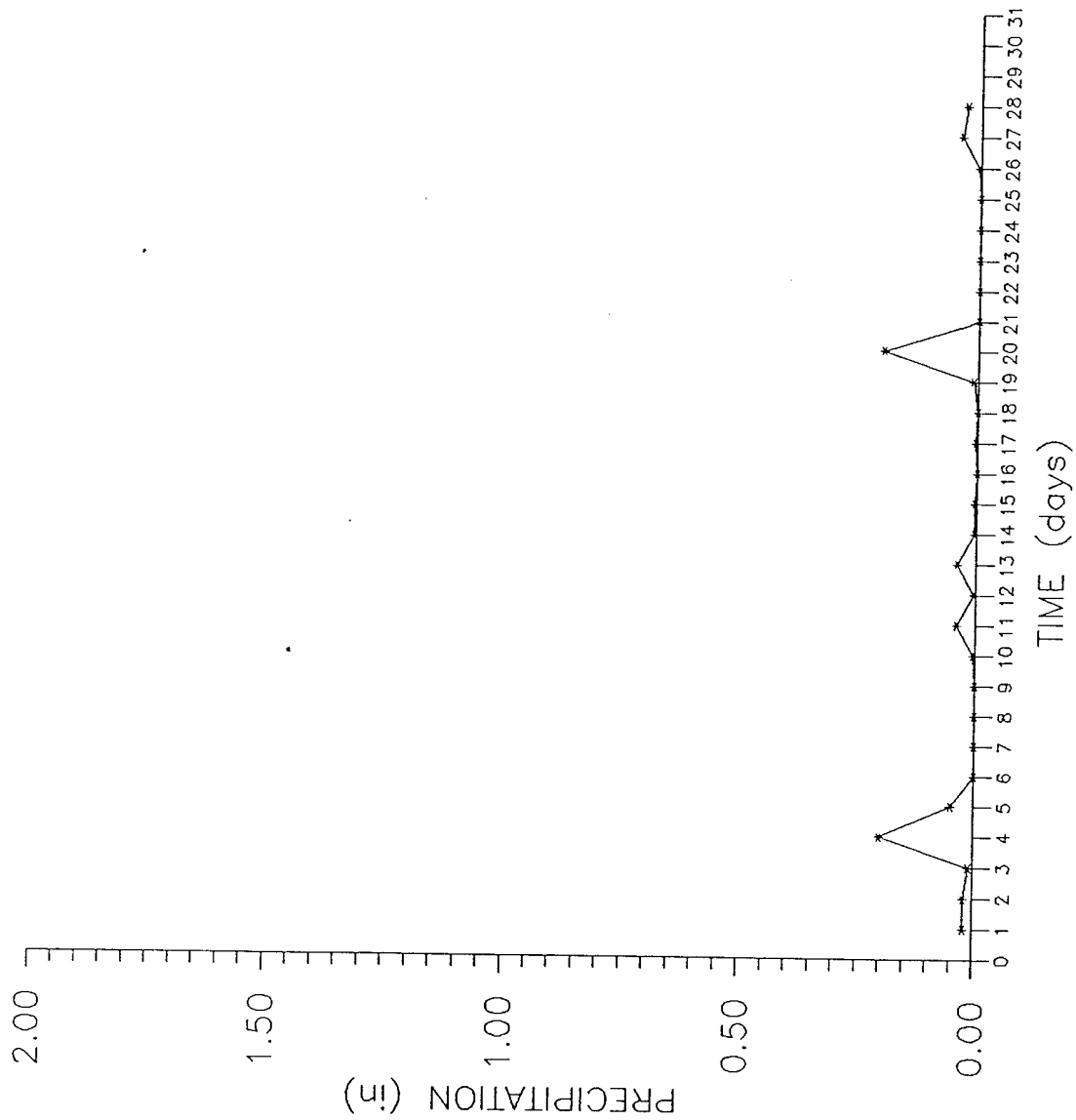


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Figure A-11.1-4

January 1989 Precipitation

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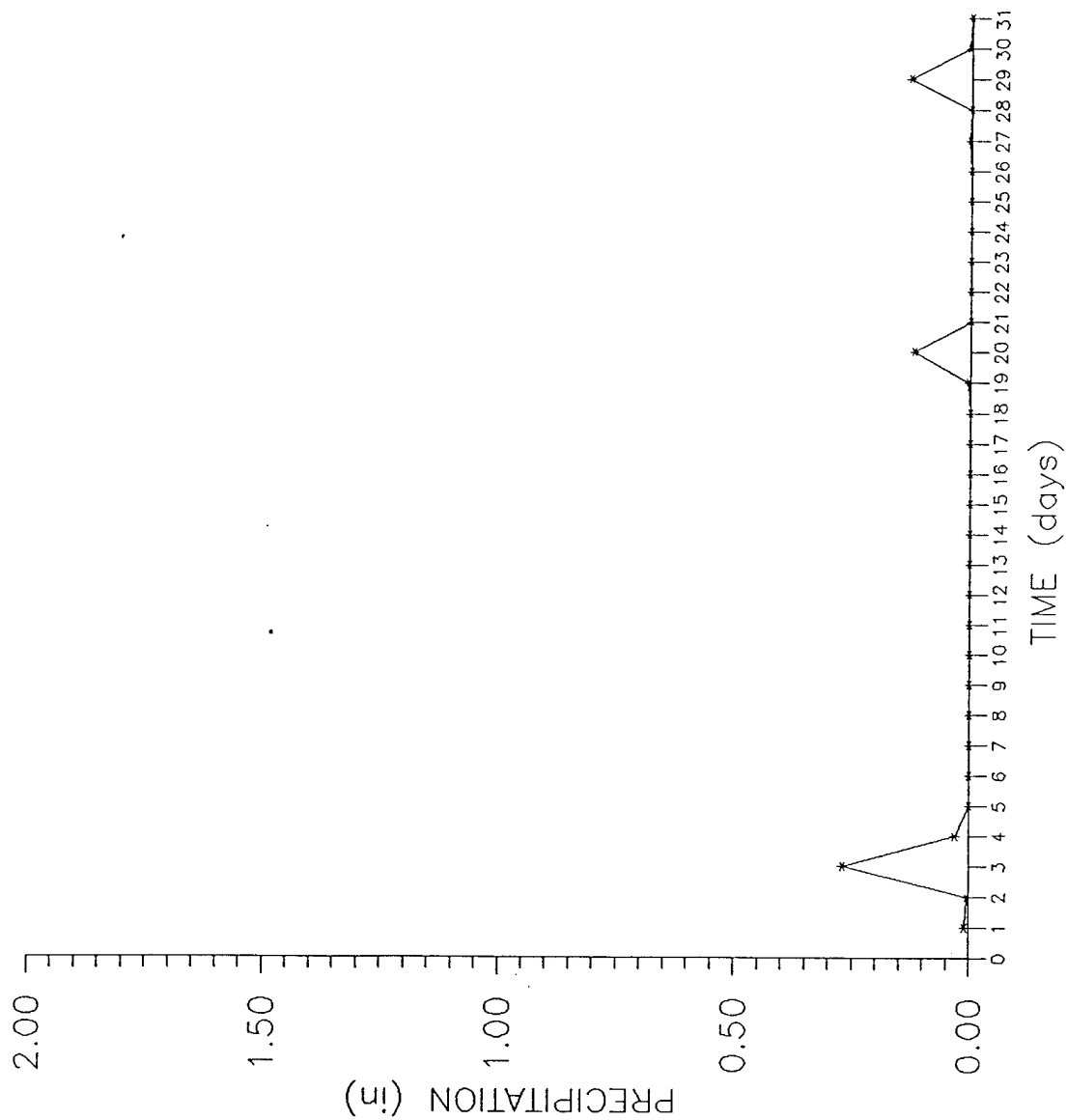


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Figure A-11.1-5

February 1989 Precipitation

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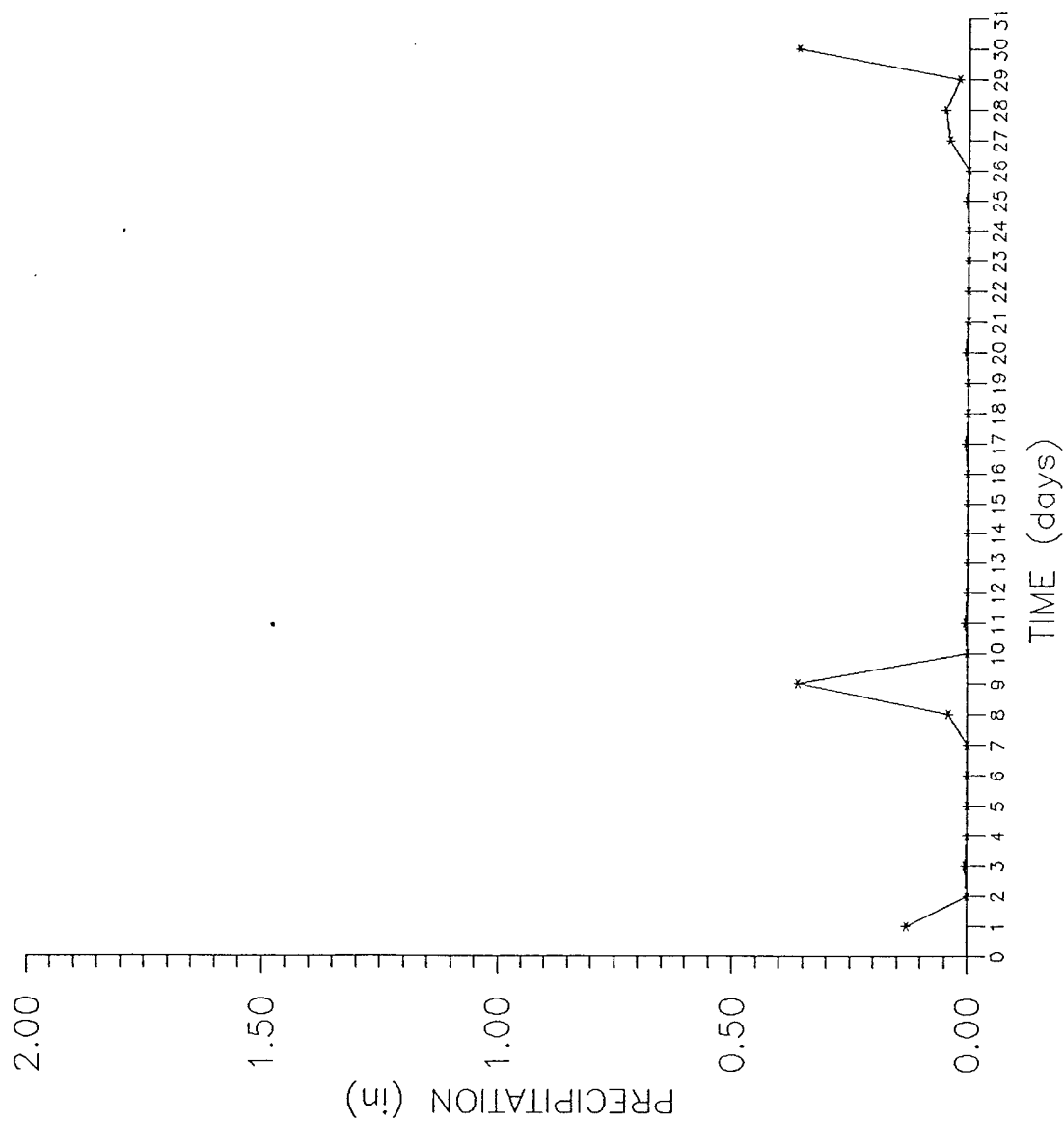


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Figure A-11.1-6

March 1989 Precipitation

CMP SW FY89

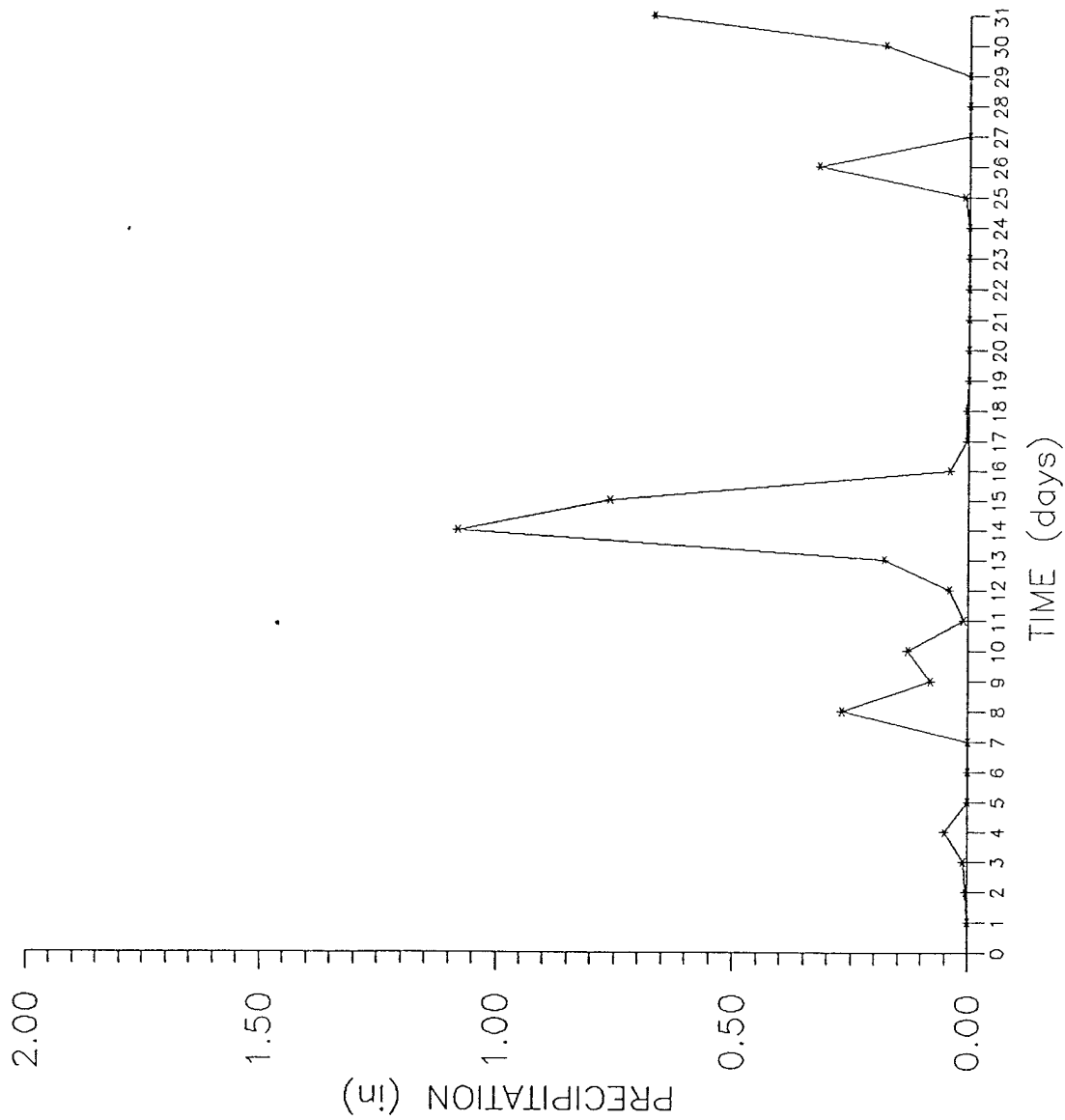


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Figure A-11.1-7

April 1989 Precipitation

CMP SW FY89

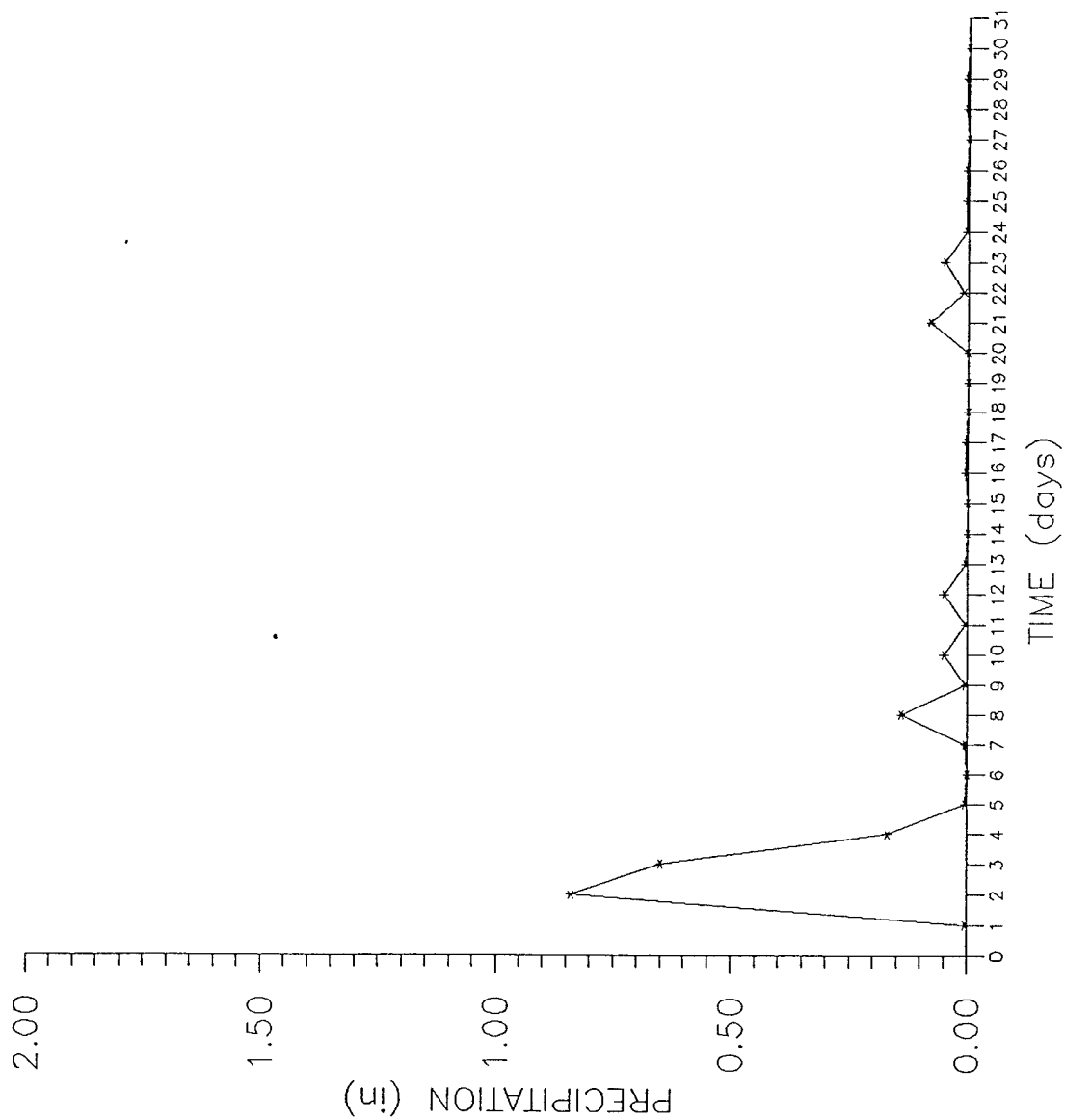


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Figure A-1.1.1-8

May 1989 Precipitation

CMP SW FY89



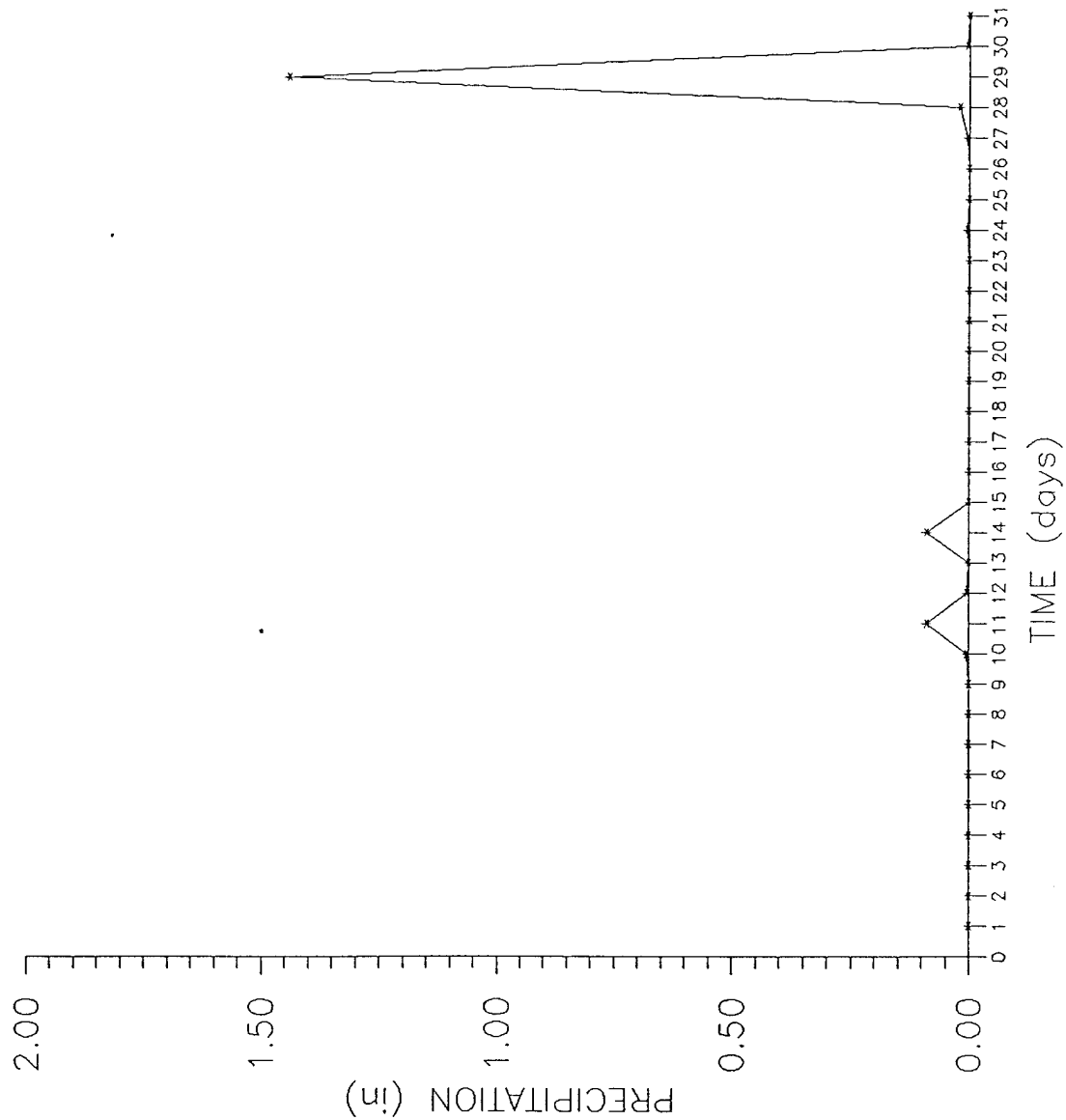
PRECIPITATION

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Figure A-11.1 -9

June 1989 Precipitation

CMP SW FY89

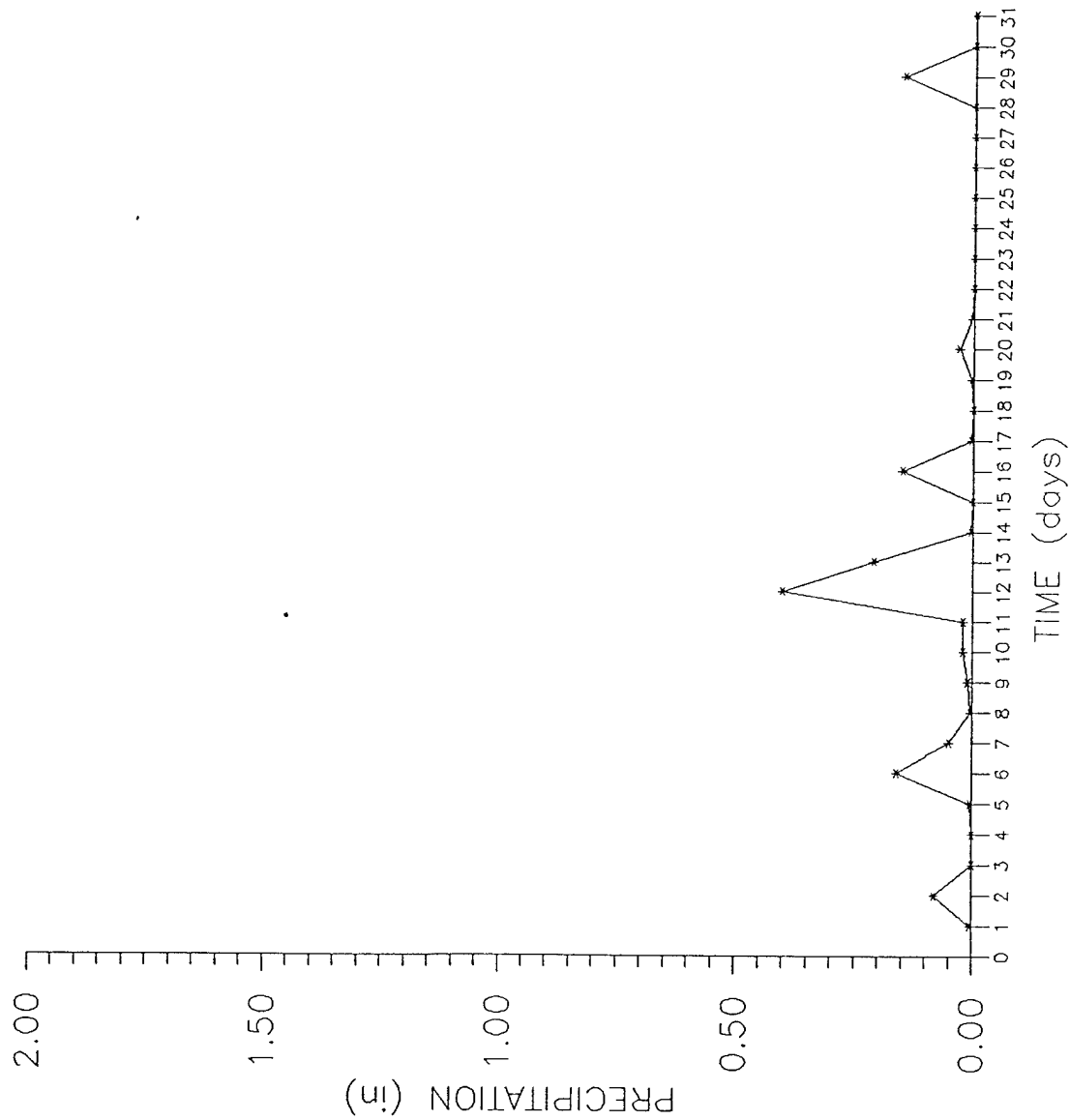


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Figure A-11.1-10

July 1989 Precipitation

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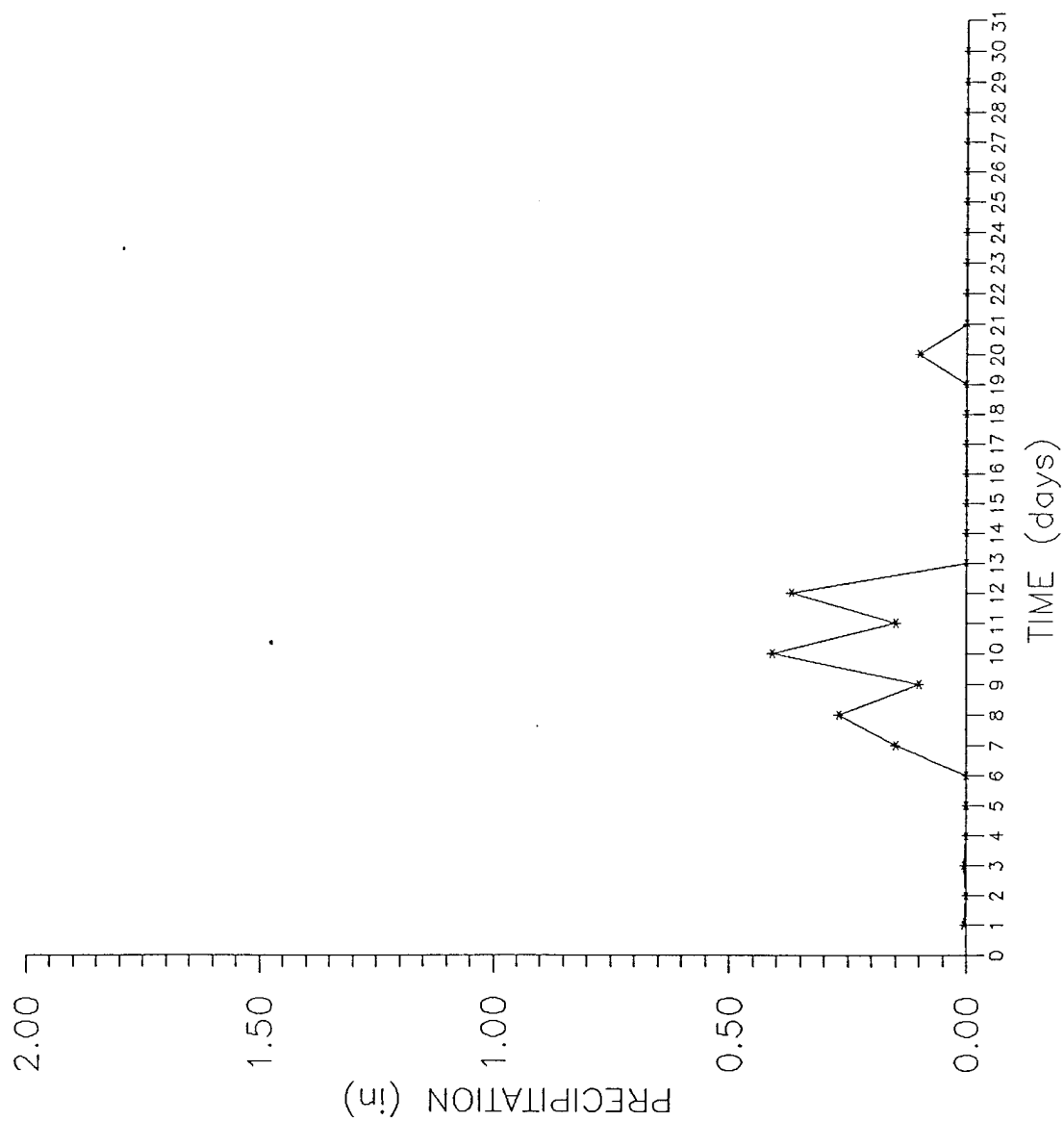
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Figure A-11.1-11

August 1989 Precipitation

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Figure A-11.1-12

September 1989 Precipitation

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APPENDIX A-2

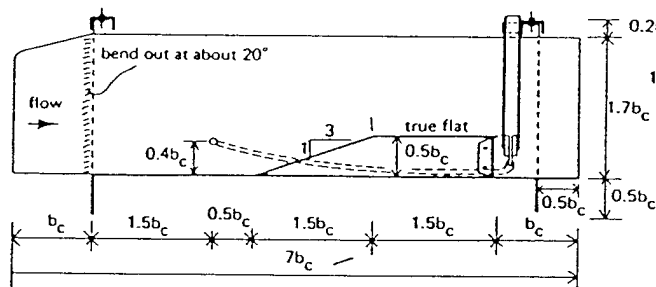
Instantaneous Discharge Measurements

APPENDIX A-2.1

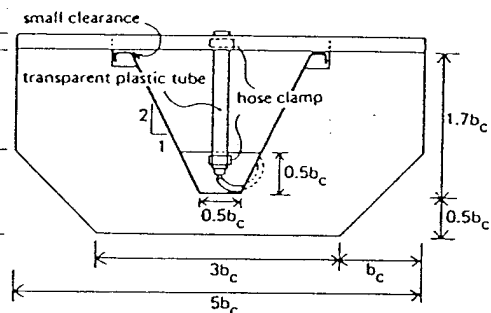
Flume Specifications

VIEWS

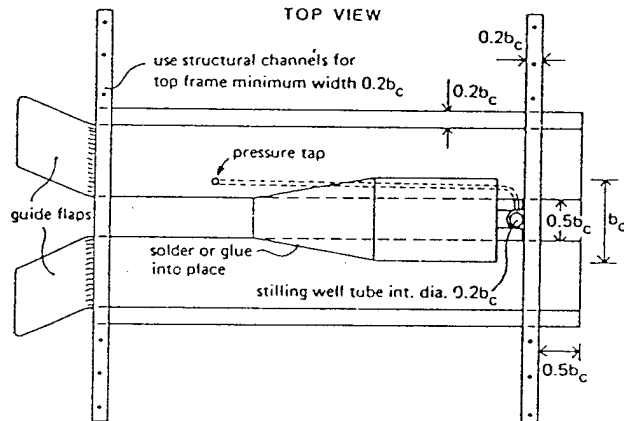
LONGITUDINAL SECTION



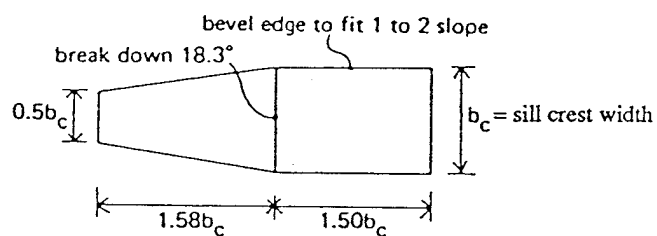
END VIEW



TOP VIEW



TOP VIEW SILL DETAIL



100 mm Flume	200 mm Flume
$b_c = 100 \text{ mm}$ $= 3.94 \text{ in}$	$b_c = 200 \text{ mm}$ $= 7.87 \text{ in}$

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Prepared by :

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Riverside Technology, Inc.

Figure A-2.1-1

100mm and 200mm Long-Throated Flume Specifications

CMP SW FY89

Appendix A-2.1

Table 2.1-1 Stage Discharge Relationship for 100 mm Portable Long-throated

h (ft)	Q (cfs)
0.04	0.0078
0.05	0.0113
0.06	0.0153
0.07	0.0198
0.08	0.0247
0.09	0.0301
0.10	0.0360
0.11	0.0424
0.12	0.0492
0.13	0.0565
0.14	0.0643
0.15	0.0726
0.16	0.0814
0.17	0.0907
0.18	0.1004
0.19	0.1107
0.20	0.1214
0.21	0.1327
0.22	0.1445
0.23	0.1568
0.24	0.1697
0.25	0.1831
0.26	0.1970
0.27	0.2114
0.28	0.2264
0.30	0.2420
0.31	0.2582
0.32	0.2748
0.33	0.2921
	0.3099

- (1) Design and ratings taken from "Flow Measuring Flumes for Open Channel Systems"; Marinus G. Bos, John A. Repogle, Albert J. Clemmens, 1984 by John Wiley & Sons, Inc.
- (2) "h" is upstream sill - referenced head.

Appendix A-2.1

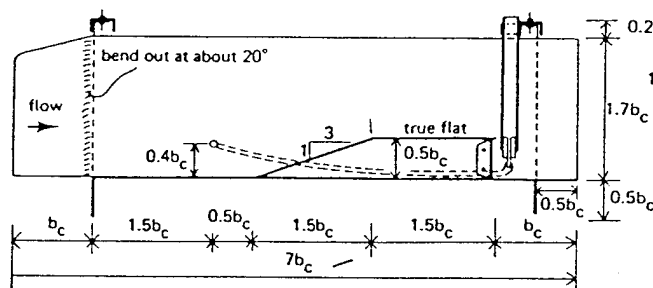
Table 2.1-2 Depth Discharge Relationship for Long-throated Portable Flume with 0.66 ft (200 mm) wide sill (1)

h (ft)	Q (cfs)	h (ft)	Q (cfs)
0.07	0.0367	0.37	0.6008
0.08	0.0456	0.38	0.6303
0.09	0.0552	0.39	0.6606
0.10	0.0655	0.40	0.6915
0.11	0.0765	0.41	0.7232
0.12	0.0883	0.42	0.7557
0.13	0.1007	0.43	0.7887
0.14	0.1137	0.44	0.8226
0.15	0.1275	0.45	0.8572
0.16	0.1419	0.46	0.8927
0.17	0.1570	0.47	0.9288
0.18	0.1727	0.48	0.9656
0.19	0.1891	0.49	0.9656
0.20	0.2062	0.50	1.042
0.21	0.2240	0.51	1.081
0.22	0.2424	0.52	1.121
0.23	0.2615	0.53	1.161
0.24	0.2813	0.54	1.203
0.25	0.3017	0.55	1.245
0.26	0.3229	0.56	1.288
0.27	0.3447	0.57	1.332
0.28	0.3672	0.58	1.376
0.29	0.3903	0.59	1.422
0.30	0.4142	0.60	1.468
0.31	0.4387	0.61	1.515
0.32	0.4640	0.62	1.563
0.33	0.4900	0.63	1.611
0.34	0.5167	0.64	1.661
0.35	0.5440	0.65	1.711
0.36	0.5721	0.66	1.762

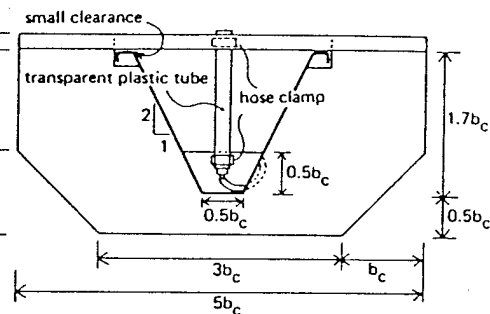
- (1) Design and ratings taken from "Flow Measuring Flumes for Open Channel Systems"; Marinus G. Bos, John A. Repogle, Albert J. Clemmens, 1984 by John Wiley & Sons, Inc.
- (2) "h" is upstream sill - referenced head.

VIEWS

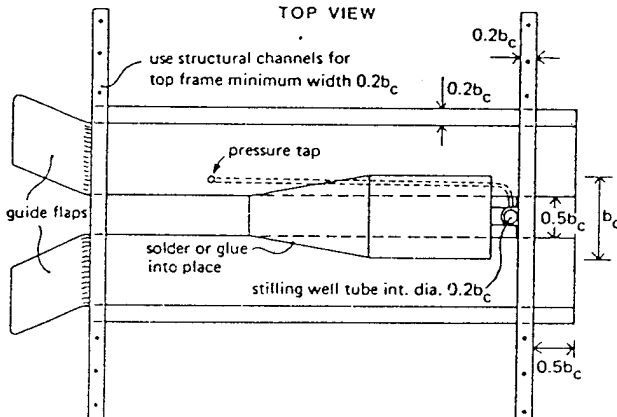
LONGITUDINAL SECTION



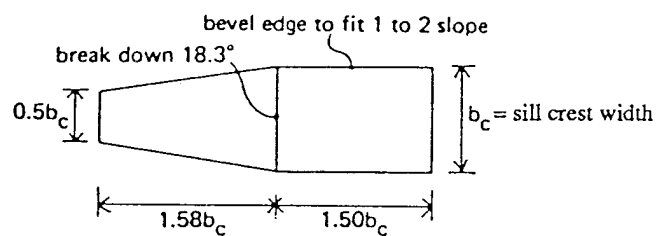
END VIEW



TOP VIEW



TOP VIEW SILL DETAIL



100 mm Flume	200 mm Flume
$b_c = 100 \text{ mm}$ $= 3.94 \text{ in}$	$b_c = 200 \text{ mm}$ $= 7.87 \text{ in}$

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U.S. Army Program Manager for
Rocky Mountain Arsenal
Commerce City, Colorado

Prepared by :

R.L. Stollar & Associates, Inc.
Riverside Technology, Inc.

Figure A-2.1-1

100mm and 200mm
Long-Throated Flume
Specifications

CMP SW FY89

APPENDIX A-2.2

Discharge Measurement Procedures

A-2.2 Pygmy and Type-AA Current Meter Discharge Measurement Procedure

The following details procedure methods used in performing an instantaneous discharge measurement using pygmy or Type-AA current meters.

The calibration check for the Pygmy and Type-AA current meters are as follows:

- the rotor and shaft alignment was checked by spinning the bucket wheel;
- the cups were checked for damage and bending;
- the Type-AA tailpiece condition was checked; and
- a spin test was performed to check the condition of the bearing and record. A normal Type-AA meter spin test should never have been less than 1 1/2 minutes. The normal spin for a Pygmy meter should never have been less than 1/2 minute.

The Marsh-McBirney current meter is a factory calibrated electromagnetic-type meter and cannot be adjusted in the field. However, the battery, the electromagnetic sensor and internal electrical circuitry was checked. In addition the above field inspection procedures, each meters' manufacturer suggested instructions for routine care and maintenance was followed.

The following procedures were implemented to measure and calculate current meter instantaneous discharge rates:

- A measuring tape was stretched across the stream at right angles to the direction of flow to determine the width of the stream and to be used in the measurement of each flow cell.
- The spacing of the subsections (flow cells) was generally made by dividing the total width of the stream into 20 subsections. Sections were usually chosen so that no section contained more than 10 percent of the total flow. Equal widths (subsections) across a cross section were used unless the discharge was well distributed. For RMA where 20 sections were not usually possible a minimum distance of 0.3 feet between subsections was generally used.
- Recording stream stage from the staff gage and the recorder (if present). Identifying the starting point by either LEW or REW (left edge of water or right edge of water, respectively, when facing downstream). Recording the starting time on the

measurement sheet and on the recorder (if present). Recording the staff gage periodically during measurement and time in order to determine the mean gage height for the measurement.

- Recording the distance from the initial measuring point to the edge of water and the depth at the edge of water.
- For stream depths encountered during WY88, measurements were made at 0.6 depth using a top setting wading rod. This rod is masked so as to automatically suspend the current meter at 0.6 depth by "setting" the total depth on the wading rod.
- After the meter was set at the proper depth, it was allowed to stabilize to the stream current. The wading rod was kept in a vertical position and the current meter was held parallel to the direction of flow. The hydrologist stood in a position that least affected the velocity of the water passing the current meter by standing downstream and off to one side of the rod.
- The measuring and recording of flow velocity using the Pygmy or Type-AA meters was performed in accordance with the manufacturer's instructions. The minimum time for measuring velocity in each subsection was 40 seconds. A headphone set was wired into the meters and a click was heard in the headphones that corresponded to each meter revolution. The number of revolutions was recorded for each 40 second time interval. The velocity for each subsection was either calculated or obtained from the meter manufacturer's table for the numbered revolutions per 40 seconds. Marsh-McBirney meter measurements were obtained from the direct digital display on the instrument.
- The remaining stream flow measurement was obtained by moving to each of the verticals and repeating the process. Upon completion of the measurement the time and bank where the section ended and the stream staff gage and recorder water level was recorded on the discharge measurement sheet.
- The description of the stream bed, flow conditions, location of the measurement, weather and any other pertinent information which may have affected the accuracy of the measurement or the stage discharge relationship was recorded on the discharge measurement sheet.
- A field calculation that added the section widths, totalled the section widths and computed the discharge was performed.

Long-Throated Flume Discharge Measurement Procedure

Instantaneous discharge measurements are taken using either the 100mm or 200mm long-throated flumes depending on stream stage and flow conditions. The 100mm flume is capable of measuring flows ranging from 0.0078 cfs to 0.3099 cfs, and the 200mm flume is capable of measuring flows ranging from 0.0367 cfs to 1.762 cfs.

Both flumes are custom built, galvanized sheetmetal rated structures. A water intake port in the flume channel is hydraulically connected to a clear plastic stilling well that is attached to the structure. The water level in the flume channel is measured as hydraulic head in the stilling well. The structures are mathematically rated, which enables a conversion of the measured hydraulic head to a corresponding discharge.

Procedures for obtaining instantaneous discharge measurements with either the 100mm or 200mm long-throated flumes are as follows:

- Select a site in the channel for the flume. This site should be in a reach of the channel that is straight both upstream and downstream of the flume site. The channel should be free of obstructions and have uniform flow.
- Record gage height (if available) and time in the log book and on the data sheet.
- Prepare the channel at the flume site by removing any rocks or debris which will interfere with leveling and sealing of the flume during installation.
- Install the flume in the channel making sure the flume is stable and level. Leveling of the cross-slope and longitudinal slope may be done with a carpenter's level.
- Seal the bottoms and sides of both the upstream and downstream faces of the wingwalls of the flume with soil. The flume must be completely sealed so that all flow is diverted through the flume for an accurate measurement.
- Allow the flow to stabilize over the sill of the flume. Check for leaks around the edges and bottom of the flume and seal if necessary.
- Obtain the sill-referenced head by measuring the distance from the top of the sill to the water level in the stilling well with a metal tape measure.
- For each size of flume, a rating table was prepared (see stage discharge relationship

tables). Using the proper rating table, find the h value, in feet, and record the corresponding discharge value, in cfs. The head, discharge, time and gage height (if available) are recorded in the log book and on the data sheet. Generally, there are three discharge measurements taken at five minute intervals at each site.

APPENDIX A-2.3

1989 Water Year Instantaneous
Discharge Measurement Records

WY89 Discharge Measurements Summary

APPENDIX A-2.3 TABLE A-2.3-1

SUMMARY OF DISCHARGE MEASUREMENTS FOR MONITORING STATIONS

SITE ID#	SITE NAME	DATE	INSTRUMENT TYPE	DISCH (CFS)	STAGE (FT) START/STOP	COMMENTS LOCATION
SW01001	N. UVALDA	89269	FLUME-100MM	0.03	0.19	STAGE CONVERTED TO DISCHARGE
SW02006	STEAM PLANT EFFLUENT	89117	FLUME-200MM	0.34	NA	EVEN WITH SURVEY STK
		89167	FLUME-100MM	0.09	NA	EVEN WITH SURVEY STK
		89201	FLUME-100MM	0.06	NA	EVEN WITH SURVEY STK
		89270	FLUME-100MM	0.11	NA	10FT UP STAKE
SW07001	UVALDA DITCH A	89268	FLUME-100MM	0.06	NA	
SW07002	UVALDA DITCH B	89268	FLUME-100MM	0.17	NA	
SW08001		89272	FLUME-100MM	0.14	NA	1100' ABOVE SW08003
SW08003	S FIRST CREEK	89097	PYG CURRENT METER	0.59	0.49	25FT BELOW GAGE
		89102	PYG CURRENT METER	1.06	0.58/0.57	43FT BELOW GAGE
		89115	FLUME-200MM	0.72	0.47	40FT BELOW GAGE
		89123	FLUME-200MM	0.86	0.50	40FT BELOW GAGE
		89125	PYG CURRENT METER	9.23	1.23/1.22	40FT BELOW GAGE
		89134	NA	6.40	1.10	CALCULATED FROM STAGE
		89171	FLUME-200MM	0.69	0.48	30FT BELOW GAGE
		89201	FLUME-100MM	0.01	0.13	30FT BELOW GAGE
		89269	FLUME-100MM	0.10	0.22	30FT BELOW GAGE
		89272	FLUME-100MM	0.06	0.20	30FT BELOW WEIR
SW08004		89272	FLUME-100MM	0.04	NA	1400'BELOW SW08003
SW11001	PEORIA INT	89116	FLUME-200MM	0.13	0.72	30FT BELOW WEIR
		89134	NA	14.01	1.56	CALCULATED FROM STAGE
		89201	FLUME-200MM	0.16	0.69	30FT BELOW WEIR
		89270	FLUME-100MM	0.05	0.70	100FT BELOW GAGE
SW11002	HAVANA INT	89101	PYG CURRENT METER	1.46	0.52/0.51	8FT DWNSTR BUBBLER
		89116	PYG CURRENT METER	0.37	0.25	UNDER OLD BRIDGE
		89130	NA	20.87	1.00	CALCULATED FROM STAGE
		89201	FLUME-200MM	0.37	0.23	END OF CONC CHANNEL
		89270	FLUME-200MM	0.49	0.25	END OF CONC CHANNEL

APPENDIX A-2.3 TABLE A-2.3-1

SUMMARY OF DISCHARGE MEASUREMENTS FOR MONITORING STATIONS

SITE ID#	SITE NAME	DATE	INSTRUMENT TYPE	DISCH (CFS)	STAGE (FT) START/STOP	COMMENTS LOCATION
SW12001	UVALDA DITCH C	89110	PYG CURRENT METER	0.33	NA	
		89268	FLUME-200MM	0.27	NA	
SW12005	S. UVALDA	89080	PYG CURRENT METER	0.26	3.85	30FT BELOW WEIR
		89080	PYG CURRENT METER	0.30	3.85	30FT BELOW WEIR
		89107	PYG CURRENT METER	0.35	3.80	30FT BELOW WEIR
		89111	FLUME-200MM	0.26	3.84	30FT BELOW GAGE
		89130	NA	4.53	4.58	CALCULATED FROM STAGE
		89171	FLUME-200MM	0.54	3.88	40FT BELOW GAGE
		89269	FLUME-200MM	0.30	0.51	30FT BELOW GAGE
		89272	FLUME-200MM	0.17	0.50	50FT BELOW GAGE
SW12008		89272	FLUME-200MM	0.11	NA	.41MILES BELOW 12005
SW12009		89272	FLUME-200MM	0.10	NA	.90MILES BELOW 12005
SW24001	SEWAGE PLANT	89138	NA/VOLUMETRIC	0.01	NA	END OF PIPE
		89270	NA/VOLUMETRIC	NA	NA	VARIABLE FLOW
SW24002	N FIRST CREEK	89096	PYG CURRENT METER	0.32	0.47	35FT BELOW WEIR
		89111	PYG CURRENT METER	0.31	0.46/0.47	55FT BELOW GAGE
		89123	FLUME-200MM	0.79	0.52	30FT BELOW GAGE
		89135	PYG CURRENT METER	3.35	0.93/0.92	
SW24004	FIRST CREEK NORTH BOUNDARY	89114	FLUME-200MM	0.14	NA	
SW30002	FIRST CREEK AT NORTH PLANTS	89114	FLUME-200MM	0.46	NA	
SW36001	BASIN A	89271	NA-VOLUMETRIC	0.02	0.11	END OF DISC PIPE

APPENDIX A-2.3 TABLE A-2.3-1

SUMMARY OF DISCHARGE MEASUREMENTS FOR MONITORING STATIONS

SITE ID#	SITE NAME	DATE	INSTRUMENT TYPE	DISCH (CFS)	STAGE (FT) START/STOP	COMMENTS LOCATION
SW37001	FIRST CREEK	89097	PYG CURRENT METER	0.29	0.51	40FT ABOVE FLUME
	OFF-POST	89110	PYG CURRENT METER	0.31	0.52	30FT ABOVE GAGE
		89123	FLUME-200MM	0.54	0.58	40FT ABOVE FLUME
		89194	FLUME-100MM	0.02	0.58	10FT BELOW FLUME

NA - NOT APPLICABLE

PYG - GURLEY 625 PYGMY CURRENT METER

WY89 Discharge Measurement Field Records

R. L. STOLLAR & ASSOCIATES

COMPILED BY

566

10510715

69249

DISCH.

IN HRS.

OW GAGE AND

(c) BASED ON

NO 27065 1/6

756

①

0711

1571

270

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Journal of Interpersonal Violence 26(1) 1-17
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FT

1000

OUTSIDE

19

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1400

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--	--

1997-1998

--	--

[illegible]

START @ 1600
FINISH @ 1620

2

2

DATE		PARTY		
89/17	4/27	19 89	JZ	L3 KH

DATE		PARTY		
89/17	4/27	19 89	JZ	L3 KH

WIDITH

AREA

VEL.

G.H.

DISCH.

METHOD	LONG TARGETED FILLING NO SECS	CUT CHANGE	ALL
1			
2			
3			
4			
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92			
93			
94			
95			
96			
97			
98			
99			
100			

NAME WILLIAM NO. 3533 G.H. CHANGE NA IN HRS

METER TYPE	BEFORE	AFTER
SPIN RECODE	NA	NA

MEAS. PLOTS _____ % DIFF. FROM _____ AFTER _____ RATING _____

WADING, UPSTR., DOWNSTR., SIDE BRIDGE _____ F _____

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW	WEATHER
LOW - UNIFORM	COOL, CLOUDY, LT WIND

OTHER	AID	TO	1500
	55		

[illegible]

GAGE 100% IN SIA LLEN WATER 05 OF @ 1500

RECORD REMOVED	NA	INTAKE ELIMISHED	NA
----------------	----	------------------	----

Observed

OBSERVER

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CONTROL	NO	CONTROL INSTALLED
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	10	10
11	11	11
12	12	12
13	13	13
14	14	14
15	15	15
16	16	16
17	17	17
18	18	18
19	19	19
20	20	20
21	21	21
22	22	22
23	23	23
24	24	24
25	25	25
26	26	26
27	27	27
28	28	28
29	29	29
30	30	30
31	31	31
32	32	32
33	33	33
34	34	34
35	35	35
36	36	36
37	37	37
38	38	38
39	39	39
40	40	40
41	41	41
42	42	42
43	43	43
44	44	44
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70	70	70
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72	72	72
73	73	73
74	74	74
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88	88	88
89	89	89
90	90	90
91	91	91
92	92	92
93	93	93
94	94	94
95	95	95
96	96	96
97	97	97
98	98	98
99	99	99
100	100	100

[illegible]

REMARKS

1. *Journal of the American Medical Association*, 1997; 278: 1039-1044.

GH OF ZERO FLOW

[illegible][illegible]

R. L. STOLLAR & ASSOCIATES

COMPILED BY
CHECKED BY

STATION NAME SOUTH PLANTS STEAM EFF SW 02006

DATE	WIDTH	AREA	VEI	PARTY	CHK
89/07	1.5'			99	JK

WIDTH ~1.5' AREA 1700 m² VEL. _____ G.H. _____ DISCH. 0.0907

METHOD 100 MM PLATE NO. SECS N/A G.H. CHANGE N/A IN HRS.

METER TYPE N.A

SPIN BEFORE MEAS. NA AFTER NA

MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____

WADING, UPSTH., DOWNSTH., SIDE BRIDGE _____ FEET, MILE, ABOVE, BELOW GAGE, AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW LOW-UNIFORM WEATHER WARM, SUNNY, NO WIND

OTHER _____ AIR 80° F@ 1125

GAGE NONE INSTALLED WATER 265' OF @ 1125

RECORD REMOVED	NA	U	U
INTAKE FLUSHED	NA	U	U

OBSERVER

CONTROL NO CONTROL INSTALLED

REMARKS

G.H. OF ZERO FLOW

G.H. OF ZERO FLOW

[illegible][illegible]

R. L. STOLLAR & ASSOCIATES

727

306

DISCH. 1107

IN HRS.

below GAGE, AND

(18%), BASED ON

()

1330

U.S. -

100

13

[illegible]

R. L. STOLLAR & ASSOCIATES

COMPILED BY

COMPILED BY

COMPILED BY

STATION NAME SC07001

DATE 89268 9/25 1989 PARTY S.G. G.P. J.G. DISCH. C.G.
WIDTH AREA VEL. G.H.

METHOD 1-1617c NO. SECS _____ G.H. CHANGE _____ IN _____ HRS.

METER TYPE _____

SPIN BEFORE MEAS. AFTER

MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____

WADING, UPSTR., DOWNSTR., SIDE BRIDGE _____ FEET _____

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

FLOW Low, ch, form WEATHER c/clear, warm

OTHER _____ AIR 75 ♀@ 10/64

GAGE None WATER 12,9 °F @ 2823

RECORD REMOVED
INTAKE CUISINES
U

Observed

CONTROL None installed

REMARKS Tell Samojing - Fluene is the

Plant was destroyed - was skinned prior to
incense & offered

STABILITY OF ZERO FLOW

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
Location	Flood	B(Pr)	CBS			Time	
#1	.14'	.14'	.0643			.0945	
#2	.14'	.14'	.0643			.0950	
#3	.14'	.14'	.0643			.0950	
Total length of reference tube = .5'							
Ten at surface top of sill = .18'							
Total depth of H ₂ O in tube = .16'							
.5' - .16' = .34'							
.18' + .34' = .52' (.5')							
b = .14 = .0643 cfs							

FOPM31 / DEC 87

R. L. STOLLAR & ASSOCIATES

MEASURED BY
COMPILED BY
CHECKED BY

STATION NAME Sw08001 S. 1st Creek

DATE 89272 9/27 19 89 PARTY GPB TG

WIDTH 76 m AREA _____ VEL. _____ G.H. None DISCH. 14

METHOD Flowm NO. SECS _____ G.H. CHANGE _____ IN _____ HRS. _____

METER TYPE _____
SPIN BEFORE MEAS. _____ AFTER _____
MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
WADING UPSTR., DOWNSTR., SIDE BRIDGE _____ FEET, MILE ABOVE BELOW GAGE, AND
6.5 MILE _____
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%). BASED ON
FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW low uniform WEATHER clear warm

OTHER _____ AIR 85 4@ 1155

GAGE _____
WATER 15.2' @ 1155
=

RECORD REMOVED _____ INTAKE FLUSHED L _____

OBSERVER

CONTROL	None
REMARKS	Crinoid mass measurement - Fall Sample Suspended sock sample taken

G.H. OF ZERO FLOW **FT**

[illegible][illegible]

DISCHARGE MEASUREMENT NOTES

CHECKED BY

METHOD METER NO. SECS 20 G.H. CHANGE 0 IN. 0 HRS. 0

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

GAGE STAFF - 600P COND WATER 52 OF@ 1130

OBSERVER _____

REMARKS	BANKS BUILT IN TOWARDS CREEK ~ 4'
---------	-----------------------------------

GAGE READINGS



FOPM31 / DEC 87

R. L. STOLLAR & ASSOCIATES

DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO.

COMPILED BY

CHECKED BY

STATION NAME

DATE

WIDTH

METHOD

METER TYPE

SPIN BEFORE MEAS.

MEAS. PLOTS

WADING, UPSTR.

MEASUREMENT RATED

FOLLOWING CONDITIONS:

CROSS SECTION

FLOW

OTHER

GAGE

OBSERVER

CONTROL

REMARKS

G.H. OF ZERO FLOW

FT

WEATHER

AIR

WATER

RECORD REMOVED

INTAKE FLUSHED

U

N.O.

WEIGHTED M.G.H.

G.H. CORRECTION

CORRECT M.G.H.

RECORDER

INSIDE

OUTSIDE

BEFORE

Q TAKEN

AFTER

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

South First Creek (SW08003)

4/25

19

89

PARTY JK, PB

DISCH. 71003

AREA

VEL.

G.H.

G.H. CHANGE

IN 15 HRS.

200mm Leno

NO SECS

DOWNSTR. SIDE BRIDGE

40

FEET MILE, ABOVE (BELOW GAGE) AND

GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON

CROSS SECTION

UNIFORM

SUNNY, BREEZY

70.5 ft @ 1015

64

1015

Year

INTAKE FLUSHED

U

N.O.

same

sampled Spring at same

same

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

0.47

1035 - Measurement taken

MEASUREMENT NO.
COMPILED BY
CHECKED BY

MEASUREMENT NO. PA
COMPILED BY _____
CHECKED BY _____

STATION NAME SOUTH FIRST CREEK (SW08003)

DATE MAY 3 '19 89 PARTY JK+BS

WIDTH _____ AREA _____ VEL. _____ G.H. 0.50 DISCH. 0.86

METHOD 200mm FLOW SECS _____ G.H. CHANGE 0 INCS 5 HRS.

METER TYPE NA
 SPIN BEFORE MEAS. NA AFTER NA
 MEAS. PLOTS NA % DIFF. FROM NA RATING NA
 WADING, UPSTR., DOWNSTR., SIDE BRIDGE 40 FEET, MILE, ABOVE, BELOW GAGE, AND
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION

FLOW UNIFORM WEATHER SUNNY
OTHER AIR 60's F@
GAGE 6000 SHAPE WATER 50's OF @ U
RECORD REMOVED NO INTAKE FLUSHED LAD
OBSERVER

CONTROL	CLEAR
REMARKS	CHECKING FOR VARIATION w/ FUME
Q	MEASUREMENT

G.H. OF ZERO FLOW _____ ET

GAGE READINGS				
TIME		RECORDER	INSIDE	OUTSIDE
0915	BEFORE	0.50	—	0.50
0920	DURING	0.50		0.50
0925	"	0.50		0.50
0930	"	0.50		0.50
0935	AFTER	0.50		0.50
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

[illegible]

R. L. STOLLAR & ASSOCIATES
DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. _____
COMPILED BY _____
CHECKED BY _____

STATION NAME SOUTA FIRST CREEK (608003)
DATE 8/12/89 PART BS, JK, DG
WIDTH 5/5 AREA _____ VEL. _____ G.H. _____ DISCH. _____
METHOD 6 NO. SECS _____ G.H. CHANGE _____ IN _____ HRS. _____

METER TYPE BURLEY #625 PYGMY SER # ANUG349
SPIN BEFORE MEAS. 40 AFTER 42
MEAS. PLOTS _____
WADING, UPSTR. DOWNSTR. SIDE BRIDGE 400 FEET MILE, ABOVE, BELOW GAGE, AND
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW HIGH - NON UNIFORM WEATHER WARM SUNNY, BREEZY
OTHER SOMEEDGE BACKWATER AIR 65 F@ 102.0

GAGE STAFF - GOOD SHAPE WATER 55 OF@ 102.0
RECORD REMOVED _____ INTAKE FLUSHED L NO

OBSERVER DOUG GRUB - RTV

CONTROL V - NOTCH CEMENT WEIR
REMARKS HIGH FLOW FOR UNKNOWN REASONS
CLEARED SAGE OUT DRAIN OF CONTROL

G.H. OF ZERO FLOW _____ FT

GAGE READINGS			
TIME	RECORDED	INSIDE	OUTSIDE
1020 NOT	BEFORE		1.23
1031	START		1.23
1052	MID		1.22
1108	END		1.22
1110	AFTER		1.22
WEIGHTED M.G.H.			
G.H. CORRECTION			
CORRECT M.G.H.			

BW = BACK WATER

MEASUREMENT NO.
COMPILED BY
CHECKED BY

COMPILED BY _____
CHECKED BY _____

STATION NAME: SOUTH FIRST CREEK (5009003)

DATE: 8/7/1 6/20 19 89 PARTY JK KA, LH

WIDTH: 31A AREA _____ VEL. _____ G.H. _____ DISCH. _____

METHOD 200MM NO. SECS _____ NA G.H. CHANGE 1 IN 1.5 HRS.

METER TYPE NA
 SPIN BEFORE MEAS. NA AFTER NA
 MEAS. PLOTS NA % DIFF. FROM _____
 WADING, UPSTR., DOWNSTR., SIDE BRIDGE 70 FEET MILE, ABOVE (BELOW) GAGE, AND _____
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW Low - Mod WEATHER WARM, SUNNY, 4 WIND
OTHER _____ AIR 90° @ 1245
GAGE STAFF - GOOD COND WATER 60° @ 1245
RECORD REMOVED YES INTAKE FLUSHED U NO

OBSERVER _____

CONTROL	V-NOTCH	WELL
REMARKS		

G.H. OF ZERO FLOW _____

GAGE READINGS				
TIME		RECORDER	INSIDE	OUTSIDE
1228		0.46		0.48
1245		0.48		0.48
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

FOPM31 / DEC 87

R. L. STOLLAR & ASSOCIATES

75

STATION NAME South 1st Creek SW 08003

METER TYPE

FLOW	WEATHER
Flowing, Unif. fens	Clear, Partly cloudy

GAGE WATER 65 of @ 1445

OBSERVER

CONTROL Cement Watch (120") well

G.H. OF ZERO FLOW

GAGE READINGS				
TIME		RECORDER	INSIDE	OUTSIDE
1425				0.22
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

[illegible]

DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. _____
COMPILED BY 76
CHECKED BY _____

STATION NAME	5608008 S. 1st Creek			
DATE	89272	7/29	19 89	PARTY T.G. GWP
WIDTH	100m	AREA	VEL.	G.H. 0.20 DISCH. 0.5
METHOD	F-100m	NO. SECS	G.H. CHANGE 0	IN HRS.

METER TYPE _____
SPIN BEFORE MEAS. _____ AFTER _____
MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
WADING: UPSTR. DOWNSTR., SIDE BRIDGE 30 FEET, MILE, ABOVE, BELOW GAGE, AND BELOW
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION

FLOW low, uniform WEATHER clear, warm
OTHER _____ AIR 85 °F @ 12:40
GAGE 120 WATER 18.3 % @ 12:30
RECORD REMOVED _____ INTAKE FLUSHED 1

OBSERVER

CONTROL	REMARKS	G.H. OF ZERO FLOW	FT
Cement v-notch over	Basinless measurement - Fall sampling - suspended Sed. sample taken		

G.H. OF ZERO FLOW

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
100	21.17	F/Lane					
#1		1.13	1 CFT	.0565	70	12.35	12.42
#2		1.15	1.14 TO	.0565	70	12.35	12.42
#3		1.13	1.14	.0565	70	12.35	12.42
Total length of tube = .5'							
Top of tube to top of sill = .48'							
Total depth of H ₂ O in tube = .16'							
	.5' - .16' = .34'						
	.48' - .34' = .14' (.4)						
	b = .14' = .0693 cfs						
C.R. 10 #6							
	1	1.34427					
	2	1.83294					
	3	18.1616					
	4	1.000					
	5	12.065					
	6	0.000					

R. L. STOLLAR & ASSOCIATES

MEASUREMENT NO.
COMPILED BY
CHECKED BY

STATION NAME 5608004 S. 1st Creek
DATE 8/22/22 9/22/19 89 PARTY TC, GPP
WIDTH 100 m AREA _____ VEL. _____ G.H. None DISCH. 0.24
METHOD F/400C NO. SECS _____ G.H. CHANGE _____ IN _____ HRS. _____

METER TYPE _____
 SPIN BEFORE MEAS. _____ AFTER _____
 MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
 WADING: UPSTR., DOWNSTR., SIDE BRIDGE _____ FEET, MILE ABOVE, BELOW GAGE, AND _____
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW, LOW, Uniform WEATHER c/c, c/c, c/c, c/c

OTHER _____ AIR 85 F@ 1322

GAGE _____ WATER _____ °F @ _____

RECORD REMOVED _____ INTAKE FLUSHED L

OBSERVER _____

CONTROL

REMARKS Grain loss measurement
Fall sampling, ^{submerged} sediment sample taken

G.H. OF ZERO FLOW _____ FT

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
100 mm Flume							
#1		.10	hCF	cfs		Time	
#2		.10		.0360		1400	
#3		.10		.0360		1405	
Total length of reference tube = .5'							
Top of tube to top of still = .18'							
Total depth of H ₂ O in tube = .12'							
.5' - .12' = .38'							
.48 - .38 = .10 (h)							
h = .10' = .0360 cfs							

R. L. STOLLAR & ASSOCIATES

MEASUREMENT NO.

COMPILED BY
CHECKED BY

STATION NAME PEORIA INTERCEPT (SW11001)
 DATE 89116 4/26 '89 PARTY TK, LB, KH
 WIDTH _____ AREA _____ VEL. _____ G.H. _____ DISCH. _____
 METHOD LONG THROATED
FLUME NO. SECS. N/A G.H. CHANGE _____ IN _____ HRS. _____

METER TYPE NA
SPIN BEFORE MEAS. NA AFTER NA RATING
MEAS. PLOTS % DIFF. FROM
WADING, UPSTR DOWNSTR SIDE BRIDGE 30 FEET MILE, ABOVE (BELOW GAGE) AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW Low - Uniform WEATHER COOL, CLOUDY

OTHER

GAGE STAFF WATER 50° OF @ 1010

RECORD REMOVED

INTAKE FLUSHED L

0

OBSERVER

CONTROL

REMARKS

G.H. OF ZERO FLOW _____ FT

GAGE READINGS				
TIME		RECORDER	INSIDE	OUTSIDE
1116		.76		.72
1125	85 89116	.72		.72
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

MEASUREMENT NO.
COMPILED BY
CHECKED BY

STATION NAME	S211001 Peoria Interceptor				
DATE	8/27	19 87	PARTY	GPP	553
WIDTH	100mm	AREA	VEL	GH	70 DISCH. 0.92
METHOD	Flow	NO. SECS	G.H. CHANGE		-0.02 IN 1/2 HRS.

METER TYPE _____
SPIN BEFORE MEAS. _____ AFTER _____
MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
WADING, UPSTR. DOWNSTR. SIDE BRIDGE 4 2 FEET, MILE, ABOVE, BELOW GAGE, AND _____
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW 6000 WEATHER Partly Cloudy Wind 15-25
OTHER _____ AIR 68 °@ 0830
GAGE 0.72 WATER 60 °@ 0924 U
RECORD REMOVED _____ INTAKE FLUSHED L _____

OBSERVER _____

CONTROL	Metal V-notch Weir
REMARKS	Fall sampling

G.H. OF ZERO FLOW ET

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
100 mm long + bracketed					Fume		
#1		b (ft)		cf s		Time	
	.11			.0492		0845	
#2	.12			.0492		0855	
#3	.12			.0492		0900	
Total length at reference base = 15'							
Top of tube to top of S.U.I. = .48'							
Total depth of H ₂ O = .14' (in tube)							
.5' - .14' = .36'							
.48' - .36' = .12'							
b = .12' = .0492 cfs							
Data read Short sharp							
DLY Read							
CHRT 5845							
KRR 0000							
Time 0209							
ISS used 0030							
ISS/wk 0.70 @ 0950							

REW 11.1 10.95]

44

STATION NAME HAVANA INTERCEPTOR _____

DATE 8901 APR 24 " 11 19 89 PARTY KH JK LL

WIDTH 8.4 AREA _____ VEL. 0.592 G.H. NA DISCH. 1.458

METER TYPE GURLEY #625 PYGMY CURRENT NO: NN6343

WADING, UPSTR. DOWNSTR. SIDE BRIDGE 18 FEET, MILE, ABOVE, BELOW GAGE, AND
0.1925

FLOW LOW TO MODERATE WEATHER PARTLY SUNNY ^{3 12ND} LT 45 mph

GAGE NONE INSTALLED WATER 45

515
OF@ 775

OBSERVER _____

8' DOWNSTREAM FROM BUBBLER

GAGE READINGS

FOPM31 / DEC 87

LEW	2.2'
REW	7.0'

MEASUREMENT NO.
COMPILED BY
CHECKED BY

CHÉDÉRG

STATION NAME HAVANA INTERCEPTOR SW 11003

DATE	89116	APR	26	19	89	PARTY	KH	JK	LB
WIDTH	49	AREA		VEL.	5.80	G.H.		NA	DISCH. 3.65

METHOD 0.6 NO. SECS 88.40 G.H. CHANGE NA IN NA HRS.

METER TYPE Py6mly
SPIN BEFORE MEAS: 49 AFTER NA

MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
WADING, UPSTR., DOWNSTR., SIDE BRIDGE / ☒ FEET MILE, ABOVE ☒ BELOW ☒ GAGE AN

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

FLOW LOW, UNIFORM WEATHER SUNNY, -LT WIND 0-5MPH

OTHER _____ AIR 75 4@ 1324

GAGE WATER 53 °F 1324

RECORD REMOVED _____ INTAKE FLUSHED L _____

OBSERVER NONE

CONTROL NONE

REMARKS
LOW FLOW / NO STAFF OR RECORDER

G.H. OF ZERO FLOW

GAGE READINGS				
TIME		RECORDER	INSIDE	OUTSIDE
1330	MEASURED WITH TAPE	NA		0.25
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

[illegible]

DISCHARGE MEASUREMENT NOTES

26

11002

3 DISCH. 23670

IN 5 HRS.

RECEIVED

BELOW GAGE, AND
R 8%). BASED ON

1640

1070
1640

10/07/20

USHED L 170

PAST

E

GAGE READINGS				
TIME	DEPTH OVER BUBBLE LINE	RECORDER	INSIDE	OUTSIDE
16.59				0.233
17.01	CL 10	0.2305		
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

[illegible]

R. L. STOLLAR & ASSOCIATES

DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO.

COMPILED BY

CHECKED BY

STATION NAME Sew 11002 House on Interest Sten

DATE 89270 9/27 1989 PARTY GNP TG SF6

WIDTH / AREA / VEL. DISCH. 49

METHOD	$F/\eta_{sp}, c$	NO. SECS	GH CHANGE	IN LIDS
1	1.0	10	1.0	1.0
2	1.0	10	1.0	1.0
3	1.0	10	1.0	1.0
4	1.0	10	1.0	1.0
5	1.0	10	1.0	1.0
6	1.0	10	1.0	1.0
7	1.0	10	1.0	1.0
8	1.0	10	1.0	1.0
9	1.0	10	1.0	1.0
10	1.0	10	1.0	1.0
11	1.0	10	1.0	1.0
12	1.0	10	1.0	1.0
13	1.0	10	1.0	1.0
14	1.0	10	1.0	1.0
15	1.0	10	1.0	1.0
16	1.0	10	1.0	1.0
17	1.0	10	1.0	1.0
18	1.0	10	1.0	1.0
19	1.0	10	1.0	1.0
20	1.0	10	1.0	1.0
21	1.0	10	1.0	1.0
22	1.0	10	1.0	1.0
23	1.0	10	1.0	1.0
24	1.0	10	1.0	1.0
25	1.0	10	1.0	1.0
26	1.0	10	1.0	1.0
27	1.0	10	1.0	1.0
28	1.0	10	1.0	1.0
29	1.0	10	1.0	1.0
30	1.0	10	1.0	1.0
31	1.0	10	1.0	1.0
32	1.0	10	1.0	1.0
33	1.0	10	1.0	1.0
34	1.0	10	1.0	1.0
35	1.0	10	1.0	1.0
36	1.0	10	1.0	1.0
37	1.0	10	1.0	1.0
38	1.0	10	1.0	1.0
39	1.0	10	1.0	1.0
40	1.0	10	1.0	1.0
41	1.0	10	1.0	1.0
42	1.0	10	1.0	1.0
43	1.0	10	1.0	1.0
44	1.0	10	1.0	1.0
45	1.0	10	1.0	1.0
46	1.0	10	1.0	1.0
47	1.0	10	1.0	1.0
48	1.0	10	1.0	1.0
49	1.0	10	1.0	1.0
50	1.0	10	1.0	1.0
51	1.0	10	1.0	1.0
52	1.0	10	1.0	1.0
53	1.0	10	1.0	1.0
54	1.0	10	1.0	1.0
55	1.0	10	1.0	1.0
56	1.0	10	1.0	1.0
57	1.0	10	1.0	1.0
58	1.0	10	1.0	1.0
59	1.0	10	1.0	1.0
60	1.0	10	1.0	1.0
61	1.0	10	1.0	1.0
62	1.0	10	1.0	1.0
63	1.0	10	1.0	1.0
64	1.0	10	1.0	1.0
65	1.0	10	1.0	1.0
66	1.0	10	1.0	1.0
67	1.0	10	1.0	1.0
68	1.0	10	1.0	1.0
69	1.0	10	1.0	1.0
70	1.0	10	1.0	1.0
71	1.0	10	1.0	1.0
72	1.0	10	1.0	1.0
73	1.0	10	1.0	1.0
74	1.0	10	1.0	1.0
75	1.0	10	1.0	1.0
76	1.0	10	1.0	1.0
77	1.0	10	1.0	1.0
78	1.0	10	1.0	1.0
79	1.0	10	1.0	1.0
80	1.0	10	1.0	1.0
81	1.0	10	1.	

METER TYPE

SPIN BEFORE MEAS.
MEAS. PILOTS
AFTER
% DIFF. FROM
RATING

WADING, UPSTR, DOWNSTR, SIDE BRIDGE, FEET, MILE, ABOVE, BELOW, GAGE, AN

MEASUREMENT DATA EXCELLENT

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

[Handwritten signature]

FLOW	WEATHER
... ..	Party cloudy

OTHER _____ AIR 78 1034 1034

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WAGE 10.37H Q26F A4325C 11.0K WATER OF@

RECORD REMOVED N/A INTAKE FLUSHED 11/10

OBSERVER

COPIES

CONTROL LINEAR CONTROL

REMARKS Fall Samplings Measurement made

100' below the 2nd floor - 12' 1

[illegible]

G.H. OF ZERO FLOW

[illegible]

FOPM31 / DEC 87

START = 1520	REW	2.20
END = 1547	LEW	6.20

wy 89 H 1
OK

12005

DATE 89080 3/21 '19 89 PARTY JK LB
WIDTH 4.00' AREA 1.28 VEL. 580 G.H. 3.85 DISCH. 260
METHOD .6 NO. SECS 3040 ²⁰⁰⁰14 G.H. CHANGE 0 IN 5 HRS.

METER TYPE PYGMY No. 625
 SPIN BEFORE MEAS. 55 AFTER 15
 MEAS. PLOTS % DIFF. FROM RATING
 WADING, UPSTR. DOWNSTR. SIDE BRIDGE 50
 FEET, MILE ABOVE (BELOW) GAGE, AND

WADING, UPSTR. DOWNSTR. SIDE BRIDGE 50 FEET, MILE, ABOVE BELOW GAGE AND
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION

FLOW LOW - MOD / UNIFORM WEATHER GOOD - WARM / SUNNY
OTHER AIR 45 °@ 1600

GAGE STAFF - 6000 CONO WATER 45 OF @ 1600
RECORD REMOVED NO INTAKE FLUSHED 1 YES

OBSERVER

CONTROL CEMENT WEIR - 30' UPSTREAM OF NEARS PT.

REMARKS Q LOCATION HAS METAL SHEETING
ON EAST BANK

G.H. OF ZERO FLOW _____ FT

GAGE READINGS				
TIME	RECORDER	INSIDE	OUTSIDE	
1520	3.85'		3.85'	
1538	3.85'		3.85'	
1547	3.85'		3.85'	
WEIGHTED M.G.H.				
G.H. CORRECTION				
	3.85			3.85
CORRECT M.G.H.				

[illegible]

DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. W487#2
COMPILED BY 113
CHECKED BY _____

STATION NAME SOUTH VALDA 12005

DATE	89080	3/21	19	89	A	PARTY	LB	JK			
WIDTH	7.0	AREA	0.940	VEL.	0.310	G.H.	3.85	DISCH.	0.299		
	FLOW		0.963	JK	0.980						
METHOD	METER	6	NO. SECS	115	G.H. CHANGE				IN	1.0	HRS.

METER TYPE PY6MY #625
 SPIN BEFORE MEAS. 55 AFTER 45
 MEAS. PLOTS % DIFF. FROM RATING
 WADING, UPSTR. (DOWNSTR.) SIDE BRIDGE 50 FEET MILE, ABOVE, BELOW GAGE, AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

LOW-MOD WARM, SUNNY LT BRZEE

OTHER	AID	45	11.00
-------	-----	----	-------

CAGE	STAFF - GOOD - CASH	AIR	4@ 70
	STAFF - GOOD - CASH	45	1000

WAGE 2.11 5000 - COMP WAIVER 12 0% 10 10

RECORD REMOVED 700 INTAKE FLUSHED 1

OBSERVER

1000

CONTROL CEMENT WEIR - 30' UPSTREAM

REMARKS (1) LOCATION HAS METAL SHEETING ON

EAST BANK

GH OF ZERO FLOW

GAGE READINGS				
TIME	RECORDER	INSIDE	OUTSIDE	
1554	3.85'		3.85'	
1606	3.85'		3.85'	
1613	3.85'		3.85'	
WEIGHTED M.G.H.				
G.H. CORRECTION				
	3.85			3.85
CORRECT M.G.H.				

1

[illegible]

R. L. STOLLAR & ASSOCIATES DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. 20471/187 KH
COMPILED BY
CHECKED BY

STATION NAME SOUTH UVALDA SW/2005
DATE 8/10/79 4/17 89 PARTY SG KH JK
WIDTH 4.1 AREA 16.47 VEL. 5.43 G.H. 2.8 DISCH. 0.352
METHOD Flow (0.6) NO. SECS _____ IN _____ HRS.

METER TYPE PYGMY CURRENT METER (GURLEY) #625 NO. NN6349
SPIN BEFORE MEAS. 60 SEC AFTER 52 SEC
MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
WADING, UPSTR., DOWNSTR., SIDE BRIDGE _____ FEET, MILE, ABOVE, BELOW GAGE, AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW LOW-MODERATE WEATHER SUNNY; WIND 45 mph

OTHER _____ AIR 60 °F @ 1248

GAGE _____ WATER 55 °F @ 1248
U

RECORD REMOVED _____ INTAKE FLUSHED _____

OBSERVER PAUL WHITE, BRAD STEPHENSON

CONTROL _____

REMARKS _____

G.H. OF ZERO FLOW _____ FT

GAGE READINGS			
TIME	RECORDER	INSIDE	OUTSIDE
<u>1203</u>	<u>RECORDED 3.82</u>		<u>3.82</u>
<u>1254</u>	<u>3.81</u>		<u>3.81</u>
<u>1321</u>	<u>* 3.81</u>		<u>3.81</u>
<u>1331</u>	<u>3.81</u>		<u>3.81</u>
WEIGHTED M.G.H.			
G.H. CORRECTION			
CORRECT M.G.H.			

Distance from Initial Point	Wt. Wt. 1/100	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
<u>1.8</u>	<u>3.75</u>	<u>0.17</u>	<u>20</u>	<u>40</u>	<u>.000</u>	<u>.000</u>	<u>0.00</u>
<u>2.2</u>	<u>0.2</u>	<u>.18</u>	<u>19</u>	<u>40</u>	<u>.475</u>	<u>.036</u>	<u>.0171</u>
<u>2.4</u>	<u>0.2</u>	<u>.18</u>	<u>21</u>	<u>40</u>	<u>.525</u>	<u>.036</u>	<u>.0189</u>
<u>2.6</u>	<u>0.2</u>	<u>0.20</u>	<u>25</u>	<u>40</u>	<u>.625</u>	<u>.040</u>	<u>.025</u>
<u>2.8</u>	<u>0.2</u>	<u>0.22</u>	<u>27</u>	<u>40</u>	<u>.675</u>	<u>.044</u>	<u>.0297</u>
<u>3.0</u>	<u>0.2</u>	<u>0.18</u>	<u>20</u>	<u>40</u>	<u>.50</u>	<u>.036</u>	<u>.018</u>
<u>3.2</u>	<u>0.25</u>	<u>0.17</u>	<u>22</u>	<u>40</u>	<u>.55</u>	<u>.0425</u>	<u>.023375</u>
<u>3.5</u>	<u>0.3</u>	<u>0.17</u>	<u>16</u>	<u>40</u>	<u>.40</u>	<u>.051</u>	<u>.0204</u>
<u>3.8</u>	<u>0.3</u>	<u>0.18</u>	<u>23</u>	<u>40</u>	<u>.575</u>	<u>.054</u>	<u>.03105</u>
<u>* 4.1</u>	<u>0.3</u>	<u>0.16</u>	<u>24</u>	<u>40</u>	<u>.60</u>	<u>.048</u>	<u>.0288</u>
<u>4.4</u>	<u>0.3</u>	<u>0.18</u>	<u>23</u>	<u>40</u>	<u>.515</u>	<u>.054</u>	<u>.03105</u>
<u>4.7</u>	<u>0.3</u>	<u>0.18</u>	<u>22</u>	<u>40</u>	<u>.55</u>	<u>.054</u>	<u>.0297</u>
<u>5.0</u>	<u>0.3</u>	<u>0.18</u>	<u>24</u>	<u>40</u>	<u>.60</u>	<u>.054</u>	<u>.0324</u>
<u>5.3</u>	<u>0.3</u>	<u>0.14</u>	<u>23</u>	<u>40</u>	<u>.575</u>	<u>.042</u>	<u>.02415</u>
<u>5.6</u>	<u>0.3</u>	<u>0.19</u>	<u>16</u>	<u>40</u>	<u>.40</u>	<u>.057</u>	<u>.0228</u>
<u>5.9</u>	<u>0.15</u>	<u>0.00</u>	<u>0</u>	<u>40</u>	<u>.000</u>	<u>.000</u>	<u>.000</u>
					<u>0.543</u>	<u>0.049</u>	<u>0.352</u>

DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. _____
COMPILED BY _____
CHECKED BY pad

DATE 11/11 4/21 AREA Long & Thayer DISCH. 0.2615
WIDTH _____ VEL. 89 PARTY JK, BS IN _____ HRS. _____
METHOD _____ G.H. CHANGE 0

METER TYPE N/A
 SPIN BEFORE MEAS. N/A AFTER _____
 MEAS. PLOTS _____
 WADING. UPSTR. (DOWNSTR.) SIDE BRIDGE 30 FEET (MILE, ABOVE, BELOW GAGE) AND _____
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: ~~CROSS~~ SECTION

FLOW SEMI-UNIFORM WEATHER p. cloudy
OTHER _____ AIR 75 @ 1530

GAGE OK WATER 55 OF @ 1530

RECORD REMOVED ND INTAKE FLUSHED L

RTI
OBSERVLR

CONTROL 0/2

REMARKS
1ST TIME W/ 0.66' LONG THROATED

FLUME

G.H. OF ZERO FLOW 3.43 FT

GAGE READINGS				
TIME	RECORDER	INSIDE	OUTSIDE	
1525	3.84		3.84	
1530	3.84		3.84	
1535	3.84		3.84	
WEIGHTED M.G.H.				
G.H. CORRECTION				
	3.84			
CORRECT M.G.H.				
				3.84

[illegible]

DISCHARGE MEASUREMENT NOTES

JK

METHOD 200 MM FLUME NO. SECS _____ G.H. CHANGE 0 IN 5 HRS. DISCH. 3.77

MEAS. PLOTS _____
WADING, UPSTR. DOWNSTR. SIDE BRIDGE _____
% DIFF. FROM _____
RATING _____
FEET, MILE, ABOVE, BELOW GAGE, AND _____
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW LOW-UNIFORM WEATHER COOL, SUNNY

GAGE Staff - Good cond WATER 60 of @ 1340

RECORD REMOVED NO INTAKE FLUSHED L NO

OBSERVER

CONTROL	REMARKS
V-NOTCH WEIR APPROX 30' UPSTREAM	

REMARKS _____

G.H. OF ZERO FLOW _____

[illegible][illegible]

R. L. STOLLAR & ASSOCIATES

COMPILED BY

COMPILED BY

COMPILED BY

STATION NAME South Elm/Sec SW/2005

DATE 8/24/9 9/26 19 87 PARTY TO, GGP, SFG

WIDTH 200m AREA _____ VEL. _____ GH. .51 DISCH. 30

METHOD Fluor NO. SECS _____ G.H. CHANGE 0 IN _____ HRS _____

METER TYPE _____
 SPIN BEFORE MEAS. _____ AFTER _____
 MEAS. PLOTS _____ % DIFF. FROM _____ RATING _____
 WADING, UPSTR., DOWNSTR., SIDE BRIDGE _____ FEET, MILE, ABOVE, BELOW GAGE, AND
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION _____

FLOW <i>low, thin</i>	WEATHER <i>clear</i>
OTHER	AIR <i>70</i>

GAGE _____ WATER 52 of @ 0920
RECORD REMOVED _____ INTAKE FLUSHED L

OBSERVER

CONTROL	Cement Un-match water
REMARKS	Fall Sampling

G.H. OF ZERO FLOW

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
R.C.	mm	Fume					
#1		.24		.2813		C910	
#2		.25		.3017		C920	
#3		.25					
Total length of reference tube = 1.05'							
Top of tube to top of sill = .901							
Total depth of H ₂ O in tube = .40'							
1.05 - .40 = .65'							
.901 - .65 = .25(h)							
h = .25' = .3017 cfs							
C.R.O #1	1		131779				
	2		154376				
	3		14080				
	4		1000				
	5		12098				
	6		0000				
Depth over saddle line = .31'							

R. L. STOLLAR & ASSOCIATES

77

STATION NAME SW/2005 S. Guala/Ga

DATE 89272 9/29 19 89 PARTY TC GPO

METHOD	NO. SECS	G.H. CHANGE
<i>F/47m</i>		

METER TYPE _____

SPIN BEFORE MEAS. _____ AFTER _____
MEAS. PLOTS _____ % DIFF FROM _____

FLOW modified 11/25/00 WEATHER 1/10

OTHER

[illegible]

RECORD REMOVED

OBSERVER

CONTROL Cement 11-20-76 1-20-76

REMARKS

G.H. OF ZERO FLOW

[illegible]

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
200 mm Flowm.							
#1		.18'		.1727		1515	
#2.		.18'		.1727		1515	
#3		.18'		.1727		1515	
Total length of reference tube = 105'							
Top of tube to top of sill = .961'							
Total depth of H ₂ O in tube = .133'							
1.05' - .133' = .72'							
T.C. → .961' - .72' = .18' (h)							
h = .18' ≈ .1727 cfs							
C.A. 10-							

MEASUREMENT NO.
COMPILED BY
CHECKED BY

STATION NAME SEWAGE TREATMENT PLANT SW24001

DATE 8/13/8 PARTY LB, KH

WIDTH NA AREA NA VEL. NA G.H. NA DISCH. 0.005

METHOD BUCKET NO. SECS NA G.H. CHANGE NA IN HRS.

METER TYPE NA
 SPIN BEFORE MEAS. NA AFTER NA
 MEAS. PLOTS NA % DIFF. FROM NA RATING
 WADING, UPSTR., DOWNSTR., SIDE BRIDGE NA FEET, MILE, ABOVE, BELOW GAGE, AND
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION

FLOW LOW-VNIFORM WEATHER COOL, PT CLOUDY
OTHER _____ AIR 70° 1100
GAGE NONE WATER _____ OF @ 1100
RECORD REMOVED N0 INTAKE FLUSHED L N0
OBSERVER _____

CONTROL	REMARKS
	USED TUCKET METHOD TO FIGURE

G.H. OF ZERO FLOW	NA	ET
-------------------	----	----

[illegible][illegible]

R. L. STOLLAR & ASSOCIATES DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO.
COMPILED BY
CHECKED BY

KEH

STATION NAME 24002 NORTH FIRST CREEK
DATE 8/11/89 4/21/89 PARTY C. BRADY
WIDTH 6.3 AREA 2.705 VEL. 1.35 G.H. 0.47 DISCH. 3.13
METHOD 16 NO. SECS 40 each G.H. CHANGE +0.01 IN 1/2 HRS.

METER TYPE Surveyor's current Meter #625 No.
SPIN BEFORE MEAS. 31 AFTER 46
MEAS. PLOTS % DIFF. FROM RATING
WADING, UPSTR. DOWNSTR. SIDE BRIDGE NO. 44 FEED MILE, ABOVE, BELOW GAGE AND
MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
FOLLOWING CONDITIONS: CROSS SECTION

FLOW NON UNIFORM, low WEATHER SUNNY 75°F SLIGHT BREEZE
OTHER AIR 75 °F@ 1045
GAGE STEVENS TYPE F, GAGE WATER HO OF@ 1045
NO RECORD REMOVED NO INTAKE FLUSHED L

OBSERVER PAUL WHITE, JULIE STEPHENS

CONTROL WEIR (CEMENT CONTROL STRUCTURE)
REMARKS Higher flow on right edge; measurement suspect as low flow will not turn meter consistently

G.H. OF ZERO FLOW FT

GAGE READINGS				
TIME	RECORDED	INSIDE	OUTSIDE	
1037		0.46	0.47	
1050	START	0.46	0.46	
1119		0.47	0.47	
1120	FINISH	0.47	0.47	
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

1050
START
1128
FINISH
REW 7-6-89
224 4/21/89

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
7.8	0.5	0.05	0	40	0	0.025	0
6.8	1.0	0.20	0	40	0	0.200	0
5.8	0.8	0.42	0	40	0	0.336	0
5.4	0.4	0.62	0	40	0	0.248	0
5.0	0.4	0.60	0	40	0	0.240	0
4.8	0.5	0.60	7	40	1.75	0.300	0.525
4.4	0.4	0.61	7	40	1.75	0.244	0.427
4.0	0.4	0.62	7	40	1.75	0.248	0.434
3.6	0.4	0.65	7	40	1.75	0.260	0.455
3.2	0.4	0.63	7	40	1.75	0.252	0.441
2.8	0.4	0.55	8	40	2.00	0.220	0.440
2.4	0.35	0.42	11	40	2.75	0.147	0.40425
2.1	0.3	0.41	0	40	0	0.123	0
1.8	0.3	0.28	0	40	0	0.074	0
1.5	0.15	0.05	0	40	0	0.0075	0
						2.705	
					1.35 m/s		3.13 cfs

R. L. STOLLAR & ASSOCIATES DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO. 98
 COMPILED BY RLS
 CHECKED BY RLS
 STATION NAME NORTH 1ST CROSS (SW 24002)
 DATE 23 MAY 89 AREA 1.89 VEL. 0.52 DISCH. 0.79
 WIDTH 3 PARTIAL NA G.H. 0 IN. 5 HRS.
 METHOD 200MM FLOWING SECS 0 G.H. CHANGE 0
 METER TYPE NA
 SPIN BEFORE MEAS. NA AFTER NA
 MEAS. PLOTS NA % DIFF. FROM NA RATING 30
 WADING, UPSTR. DOWNSTR. SIDE BRIDGE 30 FEET, MILE, ABOVE (BELOW) GAGE, AND
 MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON
 FOLLOWING CONDITIONS: CROSS SECTION

FLOW UNIFORM WEATHER SUNNY
 OTHER CLEAR AIR 60°F
 GAGE CLEAR WATER 50°F
 OBSERVER NO RECORD REMOVED NO INTAKE FLUSHED NO

GAGE READINGS			
TIME	REORDER	INSIDE	OUTSIDE
1005	BEFORE	0.52	0.52
1020	DURING	0.52	0.52
1025	"	0.52	0.52
1030	"	0.52	0.52
WEIGHTED M.G.H.			
G.H. CORRECTION			
CORRECT M.G.H.			
		0.52	0.52

G.H. OF ZERO FLOW FT

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
1020	h(2) = 0.49		Q = 0.76				
1025	h(2) = 0.43		Q = 0.79				
1030	h(2) = 0.43		Q = 0.79				
FINAL Q = 0.79							

R.L. STOLLAR & ASSOCIATES DISCHARGE MEASUREMENT NOTES

MEASUREMENT NO.

COMPILED BY
CHECKED BY

STATION NAME NORTH FIRST CREEK

DATE 8/13/89 5/15 89 PARTY B.S.

WIDTH 3.9 AREA 1.986 VEL. 1.375 G.H. 0.92 DISCH. 3.3545

METHOD .6 NO. SECS 11 G.H. CHANGE IN HRS 34

METER TYPE GURLEY #625 PV6MV

SPIN BEFORE MEAS. 4 AFTER 43

MEAS. PLOTS 4 % DIFF. FROM 43 RATING

WADING, UPSTR. DOWNSTR. SIDE BRIDGE FEET, MILE, ABOVE BELOW GAGE AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%) BASED ON

FOLLOWING CONDITIONS: POOR CROSS SECTION

FLOW 1400 - UNIFORM WEATHER COOL, CLOUDY

OTHER AIR 45° WATER 45° U 45° 0950 00

GAGE STAFF - GOOD COND. RECORD REMOVED NO INTAKE FLUSHED L NO

OBSERVER

CONTROL CLEAR

REMARKS 20425 AFTER STORM

G.H. OF ZERO FLOW

FT

GAGE READINGS				
TIME	RECORDER	INSIDE	OUTSIDE	
0930	BEFORE	0.93	0.93	
1015	"	0.93	0.93	
1021	START	0.92	0.92	
1032	MID	0.92	0.92	
1041	END	0.92	0.92	
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.				

Distance from Initial Point	Width	Depth	Revolutions	Time in Seconds	Velocity	Area	Discharge
3.0	.15	0	0	0	0	0	0
3.3	.30	.33	70	40	1.75	.099	.173
3.6	.30	.52	66	40	1.65	.156	.257
3.9	.30	.63	67	40	1.675	.189	.317
4.2	.30	.63	50	40	1.25	.189	.236
4.5	.30	.63	52	40	1.30	.189	.246
4.8	.30	.61	49	40	1.225	.183	.224
5.1	.30	.60	83	40	2.075	.180	.374
5.4	.30	.67	154	40	3.35	.201	.673
5.7	.30	.73	99	40	2.475	.219	.542
6.0	.30	.60	50	40	1.25	.180	.225
6.3	.30	.42	14	40	0.35	.126	.044
6.6	.30	.25	19	40	0.475	.1075	.036
6.9	.15	0	0	0	0	0	0
					1.345	1.986	3.397

R. L. STOLLAR & ASSOCIATES

COMPILED BY

CHECKED BY

STATION NAME 7⁵¹ CREEK @ NORTH PLANTS (SW30002)

DATE	8/14	19 89	PARTY	DK, LB
WIDTH	~ 13 ft			
AREA	7/54			

METER TYPE NA
CONNECTION NA
MEAS NA
SERIAL NA

MEAS. PLOTS _____
WADING 1ST DIST DOWNSTREAM SIDE BRIDGE
SPIN BEFORE MEAS. _____ AFTER _____
% DIFF. FROM _____ RATING _____

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS:

FLOW LOW - UNIFORM WEATHER COOL, CLEAR, LT W

OTHER _____ AIR . 00 ₣@ 1/12/

RECORD REMOVED NA INTAKE FLUSHED NA

OBSERVER

CONTROL

REMARKS REEDS AND VEGETATION 10-15' VPSTN

SECRET

[illegible]

DISCHARGE MEASUREMENT WITH BUCKET & TAILER. MEASURED JUST BEFORE WEIR.

COMPILED BY _____
CHECKED BY DEG

STATION NAME ALBANY 36001

DATE SEPTEMBER 29 19 89 PARTY IC, SEG, GPP DISCH.
WIDTH N/A AREA N/A VEL. N/A G.H. 11

METHOD BUCKET / 1412 NO. SECS 7 G.H. CHANGE

METER TYPE	NA
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

SPIN BEFORE MEAS. ΔA AFTER N/A

MEAS. PLOTS 41A % DIFF. FROM NA RATING
WADING, UPSTR., DOWNSTR., SIDE BRIDGE FEED

WADING, UPSTR., DOWNSTR., SIDE BRIDGE _____ FEE _____

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR

FOLLOWING CONDITIONS: CROSS SECTION

FLOW LOW, UNIFORM WEATHER

OTHER _____

GAGE STAFF 17/2 C (001612) WATER

RECORD REMOVED _____ N/O

OBSERVER:

CONTROL DIGITAL Y NOTCHA DE 12 R

REMARKS DISCHARGE TAKEN AT NOZZA OF W-12

3.2. H. OF ZERO FLOW

[illegible]

STAF- 1435
FINISH- 1453

DISCHARGE MEASUREMENT NOTES

CHECKED BY

Present Invention Meter

MEASUREMENT RATED EXCELLENT (80%)

OBSERVER NONE

REMARKS

G.H. OF ZERO FLOW

CONFIDENTIAL

FORM 31 / DEC 87

MEASUREMENT NO.
COMPILED BY
CHECKED BY

STATION NAME FIRST PEEK OFF-POST (37001)

DATE 8/23 AREA 5.2 PARTY JK, BS

WIDTH 2.9 VEL. _____ G.H. _____ DISCH. _____

METHOD 200M ^{72UM} NO. SECS NA G.H. CHANGE NA IN HRS _____

METER TYPE NA
SPIN BEFORE MEAS. NA AFTER NA
MEAS. PLOTS NA % DIFF. FROM NA RATING
WADING UPST. DOWNSTR., SIDE BRIDGE 40 FEET MILE ABOVE, BELOW GAGE, AND

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

FLOW LOW-UNIFORM WEATHER COOL SL CLOUDY, LT WIND

OTHER

GAGE SHAFF - 6000 SHAPE WATER 55° of @ 1055

RECORD REMOVED
INTAKE FLUSHED L

OBSERVER

CONTROL NONE - FLOW UNDER STATIONARY FLUIDS

REMARKS

G.H. OF ZERO FLOW

GAGE READINGS				
TIME	RECORDER	INSIDE	OUTSIDE	
1045	005		0.61	
1054	005		0.51	
1059	005		0.55	
1104	005		0.56	
1109	005		0.57	
1114	055		0.58	
WEIGHTED M.G.H.				
G.H. CORRECTION				
CORRECT M.G.H.		055		

OSS = OUT OF SERVICE

MEASUREMENT NO.
COMPILED BY
CHECKED BY

STATION NAME FIRST CREEK OFF-POST

DATE 89/94 7/13 AREA 19 PARTY JK DISCH. 1053
WIDTH _____ VEL. _____ G.H. 0.58 IN 1/2 HRS.
METHOD 100 MM L NO. SECS 2 G.H. CHANGE 0

METER TYPE NA
SPIN BEFORE MEAS. NA AFTER NA
MEAS. PLOTS % DIFF. FROM RATING
WADING UPSTR. (DOWNSTR., SIDE BRIDGE) 10 KEEP MILE, ABOVE, BELOW GAGE, AND
3.14 C

MEASUREMENT RATED EXCELLENT (2%), GOOD (5%), FAIR (8%), POOR (OVER 8%), BASED ON FOLLOWING CONDITIONS: CROSS SECTION

FLOW VERY LOW-UNIFORM WEATHER WARM, MOSTLY SUNNY
OTHER AIR 85 °@ 1545

GAGE INSIDE STAFF - GOOD COND WATER 65 OF @ 1545
RECORD REMOVED EARLIER INTAKE FLUSHED L: NO
IN DAY
OBSERVED

OBSERVER

CONTROL CEMENT FLUME

REMARKS	STRUCTURE IN GOOD COND
---------	------------------------

G.H. OF ZERO FLOW 0.50 FT

[illegible]

APPENDIX A-3

Rating Curves

APPENDIX A-3.1

Rating Curve Development Procedures

Appendix A-3.1 Rating Curve Development Procedures

Channel Control Rating Development. - The development of the rating curve for a channel control station would normally use a graphical analysis of discharge measurements plotted on logarithmic graph paper. Upon review of the discharge measurements, made prior to the 1989 water year, for the only channel control station, Havana Interceptor, all were rejected as unreliable for rating curve development. Therefore, the following analysis was performed to derive a rating curve for Havana Interceptor:

- A normal depth hydraulic analysis was performed using HEC-2 to predict gage height and corresponding discharges from channel geometry.
- The predicted discharges and gage heights were plotted on logarithmic paper. The discharge was on the ordinate and the gage height was on the abscissa.
- A curve of connected straight-line segments was visually fitted through the plotted points.
- Endpoint coordinates of each straight-line segment were determined from the rating curve plot. A rating equation was derived in the form of a power curve (Rantz 1982).

The rating equation was of the form

$$Q = pG^N$$

where

Q = discharge in cubic feet per second (cfs);

G = the gage height of the water surface in feet;

p = regression coefficient (dimensionless); and

N = regression coefficient (dimensionless), generally not equal to p.

Two different criteria were used to confirm the permanence and/or follow shifts in the rating curve for Havana Interceptor. These criteria are as follows:

- Instantaneous discharge measurements made during the 1989 water year must be within ± 5 percent of the rating curve discharge corresponding to the same gage height in order to confirm the permanence of the rating curve.
- For low-flow measurements, the ± 5 percent criteria may be too stringent because of station control insensitivity; therefore, departures greater than ± 5 percent are

acceptable and confirm the permanence of the rating curve if the indicated shift in stage does not exceed 0.02 feet.

A detailed analysis of each instantaneous discharge measurement made during the 1989 water year at this station is presented in Appendix A-5.

Section Control Rating Development. - Laboratory-rated discharge-measurement structures have been installed at seven RMA stations (Highline Lateral, Ladora Weir, Basin A, South First Creek, North First Creek, First Creek Off-post, and South Plants Ditch). These structures provide section control for the complete range of stages falling within the capacity of each structure. Each artificial control stabilizes and constricts the channel at a section, and thereby simplifies the procedure for obtaining accurate records of discharge. Although these structures have been built in conformance with the dimensions of laboratory-rated weirs or flumes (the relationship of stage to discharge has been carefully measured under controlled conditions) differences between the model and prototype invariably exist, if only in approach-channel conditions (Rantz 1982). Therefore, instantaneous discharge measurements were made at artificial section control stations to verify the rating curves prepared for the respective model structures.

It should be emphasized that the primary purpose of the weir structures, and the triangular-throated flume at the First Creek Off-post station, was to measure flows within the capacity of the structures. Therefore, no attempt was made to determine the relationship of stage to discharge for stages and flows exceeding the capacity of the artificial section controls.

The laboratory rating for each structure was plotted along with the discharge measurements to discharge if a correlation existed. These laboratory ratings are based on depth of water above the zero-reference of the structure. Since the field-measured staff gage heights do not generally equal the water depths above the zero-reference of the structures, an offset was subtracted from each staff gage height to obtain the plotted depth value. This offset (e) is the gage height (in feet) corresponding to zero flow for the existing control. If the discharge measurements consistently plotted on the empirical rating curve, the empirical curve was used. For stations at RMA requiring modification of the empirical ratings, the verified stage-discharge measurements were plotted, and connected straight-line segments were fit to the plotted points. Regression analysis to fit a power curve was performed as previously described (Channel Control Rating Development) to obtain a calibrated rating curve and rating equations for the existing condition of each structure. For the stations where zero on the staff gage does not correspond to zero flow, the rating equation will be of the form

$$Q = p(G-e)^N$$

where

$$Q = \text{discharge in cubic feet per second (cfs);}$$

- (G-e) = head or depth of water on the control in feet;
G = the gage height of the water surface in feet;
e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
p = regression coefficient (dimensionless); and
N = regression coefficient (dimensionless), generally not equal to p.

Confirmation of the permanence of these rating curves followed the same criteria as previously described in Section 3.1.2.6, Rating Curve Development Procedures; and in this Appendix, Channel Control Rating Development.

The development of the rating curve for South First Creek followed the normal graphical analysis of instantaneous discharge measurements. The reliable instantaneous discharge measurements were plotted on logarithmic graph paper with the discharge on the ordinate and the corresponding gage height on the abscissa. A curve of connected straight-line segments was visually fitted through the plotted points. Endpoint coordinates of each straight-line segment were determined from the rating curve plot. Regression analysis to fit a power curve was performed, as previously described (channel control rating development), to obtain a calibrated rating curve and equations for the existing condition of the structures. The rating curve required extrapolation beyond the range defined by discharge measurements for low flows. A table of gage height and discharge was generated by using the rating equation in the defined region for the lowest flows. These points were plotted on rectangular-coordinate graph paper along with the gage height of zero flow, and a smooth curve was drawn to merge the point of zero flow with the defined range of points (Rantz 1982). Several points from this extrapolated curve below the defined segment were transferred onto the logarithmic paper. Straight-line segments were connected between selected extrapolated points and equations were derived for the segments as previously described.

Upon review of the four instantaneous discharge measurements made at the North First Creek gaging station, only one was accepted as reliable for rating curve development. Therefore, the following analysis was performed to derive a rating curve for this station:

- A normal depth hydraulic analysis was performed using HEC-2 to predict gage height and corresponding discharges from channel geometry.
- The predicted discharges and gage heights were plotted on logarithmic graph paper, along with the one reliable discharge measurement.

- A curve of connected straight-line segments was visually fit through the plotted points.
- Endpoint coordinates of each straight-line segment were determined from the rating curve plot and regression analysis to fit a power curve, as previously described (channel control rating development).

A detailed analysis of each instantaneous discharge measurement made during the 1989 water year at each of these stations is presented in Appendix A-5.

Compound Control Rating Development. - The development of rating curves for the compound control stations (South Uvalda, North Uvalda, and Peoria Interceptor) utilized a procedure that was a combination of the procedures delineated in the previous two station control sections (section control and channel control). Additional considerations included the following:

- Discharge measurements were evaluated to determine if the measured discharges and corresponding staff readings could occur theoretically. This evaluation was conducted using HEC-2 to simulate the channel hydraulics. Discharge measurements that appeared invalid based upon the HEC-2 analysis were not used in the rating curve development.
- The rating curves required extrapolation beyond the range defined by discharge measurements for high flows. An analysis was performed using HEC-2 to determine if the transition from section control to channel control had occurred at the highest recorded stage. In all cases, this transition had not occurred. Further analysis demonstrated that it was inappropriate to use HEC-2 for the high flow extrapolation.

A hydraulic analysis using HEC-2 was attempted to predict the higher flows. (Note however, that these higher flows are section controlled.) This was done by assuming critical depth at the control section and that normal depth would then occur at the gage section. The present stations were constructed such that there is insufficient distance between the gage section and the control section. The result is that normal depth occurs upstream of the gage section, therefore, yielding an unrealistic result.

- The high flow extrapolation was done using the Manning equation:

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

where

Q = discharge (cfs);
n = Manning's channel roughness coefficient (dimensionless);
A = cross-sectional area (ft²);
R = hydraulic radius = $\frac{A}{P}$;
P = wetted perimeter (ft); and
S = slope (ft/ft).

The cross-section geometry corresponding to the maximum recorded gage height was plotted from reach survey data to determine the cross-sectional area and wetted perimeter at the location of the staff gage. The slope of the corresponding stream surface energy gradient was not available. Since average streambed slope typically approaches the energy gradient at the higher stages (Rantz 1982), the average streambed slope was computed from contour maps or reach survey data for input to Manning's equation. The channel roughness coefficient, n, was determined from stage-discharge measurements and field observations of streambed and bank cover conditions. The calculated discharge was plotted on logarithmic paper and regression analysis was performed on this line segment as previously described.

Confirmation of the permanence of these rating curves followed the same criteria as previously described. A detailed analysis of each instantaneous discharge measurement made during the 1989 water year at each of these stations is presented in Appendix A-5.

APPENDIX A-3.2

Gage Height vs. Discharge

APPENDIX A-3.3

Head vs. Discharge

APPENDIX A-4

Rating Equations

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW01001, NORTH UVALDA

DESCRIPTION: BROAD CRESTED CONCRETE WEIR

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
-0.104 to -0.060	0.882177764	1.444590283	-0.105	10-01-88	09-30-89
-0.059 to 0.000	1.597817538	1.636135791	-0.105	10-01-88	09-30-89
0.001 - 0.015	0.118589583	0.205644337	0.00	10-01-88	09-30-89
0.016 - 0.03	0.184078048	0.310340083	0.00	10-01-88	09-30-89
0.04 - 0.05	0.356680281	0.498980945	0.00	10-01-88	09-30-89
0.06 - 0.09	0.631774902	0.689816811	0.00	10-01-88	09-30-89
0.10 - 0.15	2.323074133	1.230573848	0.00	10-01-88	09-30-89
0.16 - 0.20	5.667685192	1.700702010	0.00	10-01-88	09-30-89
0.21 - 0.515	12.65759878	2.199930256	0.00	10-01-88	09-30-89
0.516 - 0.975	14.63974813	2.419166422	0.00	10-01-88	09-30-89
0.976 - 2.00	14.95376940	3.257434047	0.00	10-01-88	09-30-89
2.01 - 2.54	45.64969387	1.647337806	0.00	10-01-88	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW01003, SOUTH PLANTS DITCH

DESCRIPTION: 90 DEGREE V-NOTCH WEIR PLATE

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
3.43 - 3.62	(1)	(1)	3.43	10-01-88	09-30-89
3.63 - 3.80	2.488803337	2.481549685	3.43	10-01-88	09-30-89
3.80 - 5.43 (2)	33.30000000	1.500000000	3.80	10-01-88	09-30-89

- (1) For gage heights between 3.43 ft and 3.62 ft which corresponds to heads of 0.00 ft and 0.19 ft, use the given coefficients for the gage height range of 3.63 ft - 3.80 ft. Note that the flow can only be estimated in the low-flow range due to the fact that the nappe may not spring free of the crest when the head is less than 0.2 ft.
- (2) For gage heights above 3.80 ft use the coefficients given to compute a flow. To this add 0.21 cfs, the maximum flow through the V-notch. Note that the flow can only be estimated in this range above 3.80 ft.

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW02001, LADORA WEIR

DESCRIPTION: 2-INCH-WIDE PLANKS FITTED ON TOP OF A CONCRETE WALL

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 $(G-e)$ = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p .

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
4.13 - 4.32	(1)	(1)	4.13	10-01-88	09-30-89
4.13 - 6.13	19.98000000	1.500000000	4.13	10-01-88	09-30-89

(1) For gage heights between 4.13 ft and 4.32 ft, which corresponds to heads of 0.0 ft and 0.19 ft, use the given coefficients for the gage height range of 4.33 ft - 6.13 ft. Note that the flow can only be estimated in the low-flow range due to the fact that the nappe may not spring free of the crest when the head is less than 0.2 ft.

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW08003, SOUTH FIRST CREEK

DESCRIPTION: CONCRETE COMPOUND WEIR

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.03 - 0.12	0.274865251	1.562869813	0.00	10-01-88	09-30-89
0.13 - 0.20	30.32336677	3.781175623	0.00	10-01-88	09-30-89
0.21 - 1.38	4.970971764	2.657613623	0.00	10-01-88	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW11001, PEORIA INTERCEPTOR

DESCRIPTION: FLAT CRESTED WEIR WHICH CONSISTS OF A NARROW PLANK POSITIONED PERPENDICULAR TO FLOW. CHANGED TO A 90 DEGREE V-NOTCH WEIR ON APRIL 14, 1989.

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
1.04 - 1.06	3.640718E-12	436.7207643	0.00	10-01-88	04-07-89
1.07 - 1.12	0.051158789	35.71755364	0.00	10-01-88	04-07-89
1.13 - 1.29	1.202206920	7.860705838	0.00	10-01-88	04-07-89
1.30 - 4.32	5.407527455	1.955820912	0.00	10-01-88	04-07-89
0.404 - 0.50	0.236237085	1.280211429	0.39	04-14-89	09-30-89
0.51 - 0.59	1.131299766	1.989813381	0.39	04-14-89	09-30-89
0.60 - 1.05	2.488803337	2.481549685	0.39	04-14-89	09-30-89
1.051 - 1.06	0.123984198	40.32966282	0.00	04-14-89	09-30-89
1.07 - 1.12	0.415469558	19.57665310	0.00	04-14-89	09-30-89
1.13 - 1.29	1.795908698	6.659737538	0.00	04-14-89	09-30-89
1.30 - 4.32	6.058487140	1.884610242	0.00	04-14-89	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW11002, HAVANA INTERCEPTOR

DESCRIPTION: CONCRETE LINED TRAPEZOIDAL CHANNEL

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.01 - 0.025	2.000000126	1.000000012	0.00	10-01-88	09-30-89
0.026 - 0.10	2.364864829	1.045426716	0.00	10-01-88	09-30-89
0.11 - 0.175	2.305695547	1.034422377	0.00	10-01-88	09-30-89
0.176 - 0.24	4.725356666	1.446111016	0.00	04-25-89	09-30-89
0.25 - 0.32	23.80114393	2.579018353	0.00	04-25-89	09-30-89
0.33 - 1.39	20.86833977	2.463609783	0.00	04-25-89	09-30-89
1.40 - 1.91	21.46649374	2.377791962	0.00	04-25-89	09-30-89
1.92 - 4.14	8.454697601	3.817702957	0.00	04-25-89	09-30-89
0.176 - 4.14	3.276612758	1.236048284	0.00	10-01-88	04-25-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW12005, SOUTH UVALDA

DESCRIPTION: V-NOTCH IN A 12 INCH WIDE CONCRETE WEIR

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
3.428 - 3.57	4.315263E-29	48.79427888	0.00	10-01-88	09-30-89
3.58 - 3.84	1.627457E-16	26.03831775	0.00	10-01-88	05-08-89
3.85 - 4.31	7.204057E-14	21.50994769	0.00	10-01-88	05-08-89
4.32 - 4.82	0.000700004	5.768606020	0.00	10-01-88	05-08-89
4.83 - 4.92	1.199150E-29	43.49109493	0.00	10-01-88	09-30-89
4.93 - 5.10	6.693750E-10	14.95383007	0.00	10-01-88	09-30-89
5.11 - 8.00	0.014836562	4.572277074	0.00	10-01-88	09-30-89
3.58 - 4.06	1.931987E-19	31.33173826	0.00	05-09-89	09-30-89
4.07 - 4.82	0.000653393	5.812418902	0.00	05-09-89	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW12007, HIGHLINE LATERAL

DESCRIPTION: CIPPOLETTI WEIR

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.01 - 0.04	5.999999825	0.999999995	0.00	10-01-88	09-30-89
0.05 - 0.09	11.77702045	1.209511252	0.00	10-01-88	09-30-89
0.10 - 0.20	15.97301939	1.336071751	0.00	10-01-88	09-30-89
0.21 - 0.33	26.14011331	1.642122716	0.00	10-01-88	09-30-89
0.34 - 1.00	54.66181761	2.307513945	0.00	10-01-88	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW24002, NORTH FIRST CREEK

DESCRIPTION: CONCRETE COMPOUND WEIR

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.084 - 0.25	4.547328047	2.470675002	0.00	10-01-88	09-30-89
0.26 - 1.24	3.522261553	2.286416481	0.00	10-01-88	09-30-89
1.25 - 1.70	3.174816454	2.769205688	0.00	10-01-88	09-30-89

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW36001, BASIN A

DESCRIPTION: 90 DEGREE V-NOTCH WEIR PLATE

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.07 - 0.26	(1)	(1)	0.07	10-01-88	09-30-89
0.27 - 1.32	2.488803337	2.481549685	0.07	10-01-88	09-30-89

(1) For gage heights between 0.07 ft and 0.26 ft which corresponds to heads of 0.0 ft and 0.19 ft use the given coefficients for the gage height range of 0.27 ft - 1.32 ft. Note that the flow can only be estimated in the low-flow range due to the fact that the nappe may not spring free of the crest when the head is less than 0.2 ft.

STAGE-DISCHARGE RATING EQUATIONS

STATION: SW37001, FIRST CREEK OFF POST

DESCRIPTION: CONCRETE TRIANGULAR-THROATED FLUME

EQUATION FORM: $Q = p(G-e)^N$

where: Q = Discharge in cubic feet per second;
 (G-e) = head or depth of water on the control in feet;
 G = the gage height of the water surface in feet;
 e = gage height in feet of zero flow for a section control of regular shape, or the gage height of effective zero flow for a channel control or a section control of irregular shape;
 p = regression coefficient (dimensionless); and
 N = regression coefficient (dimensionless), generally not equal to p.

Gage Height, G, Range (ft)	p	N	e (ft)	Valid Period	
				Begin Date	End Date
0.50 - 0.54	0.124999989	0.999999979	0.50	06-15-89	09-30-89
0.55 - 0.59	1.226773025	1.709511275	0.50	06-15-89	09-30-89
0.60 - 0.75	4.306533142	2.231012279	0.50	06-15-89	09-30-89
0.76 - 2.50	6.853180828	2.566146561	0.50	06-15-89	09-30-89

APPENDIX A-5

Comparison of Instantaneous Discharge
Versus Computed Discharge

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COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
SOUTH FIRST CREEK (SW08003)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Start, Stop Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100* [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10) = (4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	04/07/89	1130,1205	0.49	---	0.59	0.75	-21.3	0.45	0.04		RLSA, Pygmy #625, downstream 25'
2	04/12/89	1536,1647	0.58	---	1.1	1.1	0.0	0.57	0.01	X	RLSA, Pygmy #625, downstream 45' below gage
3	04/25/89	1000,1042	0.47	---	0.72	0.67	7.5	0.48	-0.01	X	RLSA, 200mm flume, downstream 40' below gage
4	05/03/89	0915,0935	0.50	---	0.86	0.79	8.9	0.52	-0.02	X	RLSA, 200mm flume, downstream 40' below gage
5	05/05/89	1020,1110	1.23	---	9.2	8.6	7.0	1.26	-0.03	X	RLSA, Pygmy #625, downstream 40' below gage
6	06/20/89	1228,1245	0.48	---	0.69	0.71	-2.8	0.48	0.00	X	RLSA, 200mm flume, downstream 30' below gage
7	07/20/89	1335,1343	0.13	---	0.01	0.01	0.0	0.12	0.01	X	RLSA, 100mm flume, downstream 30' below gage
8	09/26/89	1440,1450	0.22	---	0.10	0.09	11.1	0.23	-0.01	X	RLSA, 100mm flume, downstream 30' below weir
9	09/29/89	1235,1246	0.20	---	0.06	0.07	-14.3	0.19	0.01	X	RLSA, 100mm flume, downstream 30' below weir

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
PEORIA INTERCEPTOR (SW11001)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100* [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10) = (4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	04/26/89	1116,1125	0.72	---	0.13	0.16	-18.8	0.30	0.03		RLSA, Long throated flume, downstream 30' below gage
2	07/20/89	1710,1727	0.69	---	0.16	0.13	23.1	0.33	-0.03		RLSA, 200mm flume, downstream 30' below gage
3	09/27/89	0845,0900	0.70	---	0.05	0.14	-64.3	0.21	0.10		RLSA, 100mm flume, downstream 100' below gage

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
HAVANA INTERCEPTOR (SW11002)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Start, Stop Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100* [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10) = (4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	04/11/89	1515,1545	0.52	N/A	1.5	N/A	N/A	N/A	N/A		RLSA, Pygmy #625, downstream 8' below bubble line
2	04/26/89	1330	0.24**	0.29	0.37	0.60	-38.3	0.17	0.07		RLSA, Pygmy #625, 10' above gage
3	07/20/89	1630,1655	0.18**	0.23	0.37	0.40	-7.5	0.17	0.01	X	RLSA, 200mm flume, downstream 350' below gage
4	09/27/89	1020,1030	0.19**	0.24	0.49	0.43	14.0	0.21	-0.02	X	RLSA, 200mm flume, downstream 500' below gage

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

** Computed by (New Gage - 0.05 offset)

COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
SOUTH UVALDA (SW12005)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Start, Stop Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100 * [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10) = (4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	03/21/89	1520,1547	3.85,3.85	---	0.26	0.28	-7.1	3.84	0.01	X	RLSA, Pygmy #625, downstream 50' below gage
2	03/21/89	1544,1613	3.85,3.85	---	0.30	0.28	7.1	3.85	0.00	X	RLSA, Pygmy #625, downstream 50' below gage
3	04/17/89	1203,1331	3.82,3.81	---	0.35	0.22	59.1	3.88	-0.06		RLSA, Pygmy #625, downstream 50' below gage
4	04/21/89	1525,1535	3.84,3.84	---	0.26	0.27	-3.7	3.84	0.00	X	RLSA, Long throated flume, downstream 30' below gage
5	06/20/89	1330,1349	3.88,3.88	---	0.54	0.54	0.0	3.88	0.00	X	RLSA, 200mm flume, downstream 40' below gage
6	09/26/89	0910,0920	3.83**	0.51	0.30	0.36	-16.7	3.81	0.02	X	RLSA, 200mm flume, downstream 30' below gage
7	09/29/89	1515,1515	3.82**	0.50	0.17	0.33	-48.5	3.74	0.08		RLSA, 200mm flume, downstream 50' below gage

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

** Computed by (New Gage + 3.32 offset)

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COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
NORTH FIRST CREEK (SW24002)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Start, Stop Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100* [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10)=(4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	04/06/89	1510,1530	0.47,0.47	---	0.32	0.63	-49.2	0.35	0.12		RLSA, Pygmy #625, downstream 40' below gage
2	04/21/89	1056,1128	0.46,0.47	---	0.31	0.60	-48.3	0.35	0.11		RLSA, Pygmy #625, downstream 35' below gage
3	05/03/89	1005,1030	0.52,0.52	---	0.79	0.79	0.00	0.52	0.00	X	RLSA, 200mm flume, downstream 30' below gage
4	05/15/89	0930,1041	0.93,0.92	---	3.4	3.0	13.3	0.98	-0.05		RLSA, Pygmy #625, downstream 30' below gage

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

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COMPARISON OF INSTANTANEOUS DISCHARGE VERSUS COMPUTED DISCHARGE *
FIRST CREEK OFF-POST (SW37001)

(1) Meas- urement Number	(2) Date	(3) Start, Stop Time (hrs)	(4) Old Start, Stop Gage Height (feet)	(5) New Start, Stop Gage Height (feet)	(6) Instan- taneous Discharge (cfs)	(7) Computed Discharge (cfs)	(8) = 100* [(6)-(7)]/(7) Difference in Discharge (%)	(9) Computed Gage ht. (ft.)	(10)=(4)-(9) Difference in Gage ht. (ft.)	(11) Measurements used for Rating Curve Development	(12) Comments
1	04/07/89	1435,1453	0.51	--	0.29	N/A	N/A	N/A	N/A		RSLA, Pygmy #625, upstream 40' above gage
2	04/20/89	1648,1714	0.52	--	0.31	N/A	N/A	N/A	N/A		RSLA, Pygmy #625, upstream 30' above gage
3	05/03/89	1045,1114	0.61,0.58	--	0.54	N/A	N/A	N/A	N/A		RLSA, 200mm flume, upstream 40' above gage
4 **	07/13/89	1546,1550	--	0.58	0.02	0.02	0.0	0.09	--	X	RLSA, 100mm flume, downstream 10' below gage

* Computed discharge and computed gage height were obtained from rating curves and do not necessarily represent gage height output produced from strip charts.

** New control structure installed June 1989.

APPENDIX A-6

Continuous Gage Height Recorders
Equipment and Procedures

APPENDIX A-6.1

Stevens Type F Equipment Specifications
and Procedures

A-6.1 Stevens Type F Recorder Procedures

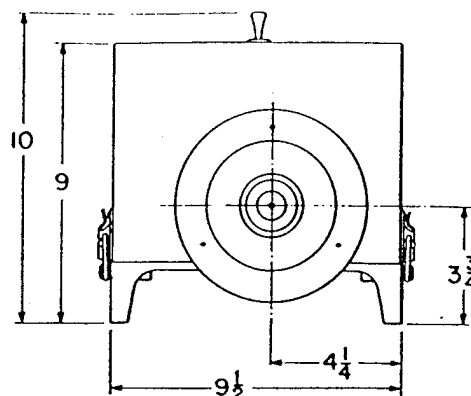
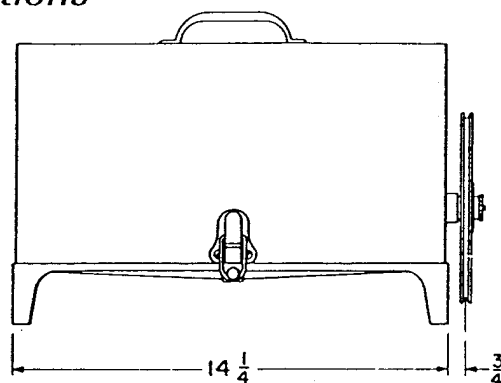
During Water Year 1989 there were eleven surface water stations equipped with Stevens Type F water level recorders. The Stevens Type F recorders currently in use are Model 68's equipped with quartz multispeed timers and either multiple D-cell batteries or a single mercury battery power source. The Stevens Type F recorder is attached to a float, beaded wire, and pulley. Changing water levels in the stilling well cause the float to rise and fall which turns the recorder's drum proportionally. The quartz multispeed timer moves a pen across the strip chart at a uniform speed. The resulting record produced is a graph of water level versus time.

Weekly activities at the continuous monitoring stations included collecting and replacing strip charts, checking recorder operation, calibrating strip charts to the outside observed stage and initial time, and removing obstructions from stilling wells, channel sections and control structures. Freezing conditions prohibited the use of the recorders from late November 1988 through February 1989. Stage data is invalid during periods of freezing because the frozen water in the stilling well incapacitates the recorder's float and pulley system.

The strip chart analog stage data were reduced to a digitized format using the computer program CPSPC (Radian Corp., October 1987, Version 3.1) in conjunction with a digitizer. After a strip chart has been digitized, the software program transforms the digital file into units used by the analog record. In this case, the scale was correlated to Julian date and scientific hours for time and to 0.01 ft for gage height. The minimal digitized strip chart points chosen were 0.00, 12.00, and 24.00 for each record day. Other significant stage points selected for digitization were high flow events, when gage heights were digitized at a minimum of 15 minute intervals, and any stage points that exhibited 0.1+ ft of deflection within any 2 hour period. Finally, the digitized stage output was compared to the strip chart analog record and corrected to the observed staff gage settings.

STEVENS TYPE F Water-level Recorder

Specifications



GAGE SCALES ADAPT RECORDER TO WATER-LEVEL RANGE

The relationship between the rotation of the float pulley and the chart drum is set by gearing. Changes in the gearing, or the pulley circumference, thus affect the ratio between the chart record and water-level changes. This ratio is known as *gage scale*.

To make a field change from any scale listed in the Table, below, (except 1:20 and 1:24) to another, requires only the substitution of a pair of gears. The 1:20 and 1:24 scales are obtained by installing the 750 mm. or 36 in. circumference ring on the float pulley of a Recorder geared for the 1:10 or 1:12 scales, respectively.

Table 3
GAGE SCALES FOR STEVENS TYPE F RECORDER
(obtained by gearing)

Gage Scale	Water Level Change for 1 Rev. of Drum	Value of Smallest Chart Division	Float Pulley Required
English Decimal System—		F1/F2 F3 Chart	
1:1	1.0 ft.	.01 ft. .1 in.	18 in. circ.
1:2	2.0 ft.	.02 ft. .2 in.	18 in. circ.
1:5	5.0 ft.	.05 ft. .5 in.	18 in. circ.
1:10	10.0 ft.	.10 ft. 1.0 in.	18 in. circ.
1:20	20.0 ft.	.20 ft. 2.0 in.	36 in. circ.
English Duo-Decimal System—		F3 Chart	
10:12	1.2 ft.	.01 ft.	18 in. circ.
5:12	2.4 ft.	.02 ft.	18 in. circ.
1:6	6.0 ft.	.05 ft.	18 in. circ.
1:12	12.0 ft.	.10 ft.	18 in. circ.
1:24	24.0 ft.	.20 ft.	36 in. circ.
Metric System—		F4 Chart	
1:1	0.3 m.	2 mm.	375 mm. circ.
1:2	0.6 m.	4 mm.	375 mm. circ.
1:5	1.5 m.	10 mm.	375 mm. circ.
1:10	3.0 m.	20 mm.	375 mm. circ.
1:20	6.0 m.	40 mm.	750 mm. circ.

NOTE: Range is unlimited since the chart drum may make any number of revolutions.

Leupold & Stevens, Inc.

P.O. Box 688

Tel. 503 646-9171

Beaverton, Oregon 97005 U.S.A. • Cable LEUSTEV, Beaverton.

Basic Type F Recorder Specifications

Float operated water level recorder with horizontal ball bearing chart drum; rectangular chart 12 inches (or 30 cm) x 9.6 inches; capillary pen with Lucite reservoir; 1 oz. black ink; 4 legged cast aluminum base for shelf or table mounting; metal cover without port.

APPLICATION OPTIONS:

Type of pen drive:

- ☐ 8 day spring driven clock
- ☐ 30 day weight driven clock
- ☐ synchronous motor for ___V, ___Hz
- ☐ battery driven clock, 1.5 VDC

Time scale:

_____ (refer to Table 1 for availability)

Gage scale:

_____ (refer to Table 3 for availability)

Chart:

- ☐ F1 ☐ F3 ☐ F7
- ☐ F2 ☐ F4 ☐ F8

Float Pulley:

- ☐ 18 in. or 375 mm circumference for
- ☐ beaded float line ☐ perforated tape
- ☐ 36 in. or 750 mm pulley ring for 1:20 and 1:24 gage scales

Float line/ tape:

- ☐ _____ feet stainless steel float line with set end hooks
- ☐ _____ feet stainless steel perforated and graduated float tape with set end hooks and index bracket

Float with counterweight:

- ☐ 2 1/2 in. ☐ 5 in.
- ☐ 3 in. ☐ 6 in.
- ☐ 3 1/2 in. ☐ 7 in.
- ☐ 4 in. ☐ 8 in.

Accessories:

- ☐ Scow float with adjustable anchor rod and counterweight
- ☐ Automatic clock starter (for 8 day clock only)
- ☐ Cover with viewing port
- ☐ Pencil stylus (in place of pen)

Note: See Price List for options available. Manufacturer reserves the right to make changes in design or materials for product improvement, without notice.

APPENDIX A-6.2

Datapod Equipment Specifications and Procedures

The Omnidata International, Inc. model DP115 datapod, equipped with a 10-turn potentiometer, operates in conjunction with the Stevens Type F recorder. Data collected by the DP115 is used to obtain digital stage measurements in conjunction with the Stevens recorder.

Proper setup of the DP115 datapod requires that two recording functions are set:

- Resolution (stage change required to record a data point); and
- Sampling time interval.

The recording functions are set on the datapod using the control switches located on the inside panel. Switches 1 and 2 control resolution, and switches 3 and 4 control sampling interval. A resolution of 0.01 ft and a sampling interval of 30 minutes is set on the data pod. The datapod will record a change in stage of 0.01 ft or greater at 30 minute intervals; however, if the stage change is less than 0.01 ft the datapod does not record a data point. This function allows the datapod to conserve space on the data storage module (DSM). A stage data point is also recorded when the unit is powered up and will record a data point at 24 hour intervals regardless of any change in stage.

The datapod's DSM is changed monthly along with the units batteries. Data "short dumps" are acquired weekly and recorded in the log book. The following procedures are used to acquire the "short dump" and to change the DSM and batteries on the datapod.

Procedure:

Note: ** indicates that a display has to be recorded in the log book.

[] indicates a display that will appear on the DP115.

1. **RECORD station number in the log book.
2. **RECORD the DP115 serial number on the log book.
3. **RECORD the display message [RUN] in the log book: Display.
4. Loosen the four screws on the face plate and separate the face plate from the case. (do not remove screws if only a short dump is being acquired.)

SHORT DUMP

Note: The DP115 will advance through the following sequence fairly quickly. If a display is missed, the sequence can be reinitiated by pressing the button on the outer case after the last display [RUN] is shown.

5. Push the button on the outer case -
 - [DLY] will be displayed, then -
 - [CHN1] will be displayed, then -
 - a number will be displayed indicating the current stream stage.
 - **RECORD** the number with the label: CHN1
 - [ERR] will be displayed, then -
 - a number indicating the number of errors will be displayed.
 - **RECORD** this number with the label: ERR
 - [TIME] will be displayed, then -
 - a number indicating the time (relative to startup) will be displayed.
 - **RECORD** this number with the label: TIME
 - [DSM USED] will be displayed, then -
 - a number will be displayed indicating the amount of data storage modules space so far.
 - **RECORD** this number with the label: DSM USED
 - [RUN] will be displayed indicating the DP115 is finished with the short dump.

Note: continue procedures only if DSM and batteries are to removed.

Caution: There is a 24- hour clock in the DP115 that displays time to the nearest tenth hour.

Example: When the [TIME] display reads XXX.1, the DP115 has advanced 6 minutes into the hour.

The DP115 clock begins as soon as the last battery is inserted.

The DP115 is set to make a stream gage recording every 30 minutes. A 30 minute interval will be denoted on the [TIME] display as XXX.0 or XXX.5. If it is getting close to a recording interval such as XXX.4 or XXX.9, wait until after the reading has been made and then continue. (The LED will flash when a reading is being taken.)

6. Remove a battery from the battery pack to power down the DP115.
7. ****RECORD** the time of day with the label: Stop Time.
8. ****RECORD** the staff gage reading with the label: Staff Gage (ft).

Caution: Be sure your fingers are clean and dry before touching the DSM. Care should be taken not to touch any of the pins on the DSM.

9. Remove the DSM from the back of the face plate by gently pulling it straight up and place it in the protective container with the pins on the DSM inserted into the anti-static foam in the plastic storage container.

POWER UP

10. Replace the battery removed (or replace all batteries) to power up the DP115.
11. [DATA POD 115] will appear in the display window, then -
12. [SAM] will appear in the display window, then -
a number indicating the sample interval.
**RECORD this number with the label: SAM.
13. [RES] will appear in the display window, then -
a number indicating the deviation from straight-line resolution.
**RECORD this number with the label: RES
14. [DLY] will appear in the display window, then -
15. [CHN1] will appear in the display window, then -
a number indicating the sensor test for Channel 1.
**RECORD this number with the label: CHN1.
16. Push in and hold the external button until [PLUG IN DSM PUSH] appears in the display window, then -
17. Insert a new DSM in the DP115.
**RECORD the DSM number with the label: DSM#IN
Note: If either test fails, remove a battery, replace the DSM with another one and start the procedure again from "Power Up".
23. If both tests pass:
**RECORD the time of day with the label: Start Time.
**RECORD the staff gage height with the label: Staff Gage (ft).
24. [RUN] should then be displayed in the display window.
**RECORD RUN with the label: DISPLAY
25. Replace the face plate on the case and tighten the 4 screws.

The DSM containing data is read with an Omnidata Model 217 Reader. The DSM Reader transmits the data from the DSM to a computer file where it can be further reduced to a stream stage record.

DPI15 DATAPOD SPECIFICATIONS

FUNCTION:

Single channel stream stage recorder.

TYPE OF SENSORS:

10-turn potentiometer. 5,000 to 100,000 Ohm resistance.

RESOLUTION:

0.01 foot in 10 feet of water.

RECORDING FUNCTIONS:

Records time of change and amount of change in water level.

SAMPLING INTERVALS:

User sets the time of day.

INPUT CONNECTOR:

3-pin environmentally sealed.

DATA STORAGE:

Medium: Non-volatile, interchangeable memory module.

Retrieval: Via built-in display or Model 217 Reader.

OPERATING CONTROLS AND DISPLAY:

Display: 4 1/2 digit LCD with low battery indicator.

Push Button: control data display and retrieval.

CLOCK ACCURACY:

+/- 3 minutes per month (-10C to + 60C).

SELF TEST:

Performs self test functions on power-up.

OPERATING ENVIRONMENT:

-35 deg C to + 60 deg C, 0 to 100% RH, dust and water tight.

POWER:

8 alkaline AA penlight cells.

SIZE AND WEIGHT:

6.3" x 3.3" x 2.3", 1.2 lb.

APPENDIX A-6.3

Data Logger Equipment
Specifications and Procedures

Data Logger/Bubbler System Procedures

Four Campbell Scientific CR-10 data logger/bubbler systems were put into operation at RMA during WY89. The CR-10 data logger/bubbler system provides stream stage data throughout the year including periods of freezing conditions.

Customized software was developed to operate the data logger and associated bubbler system. The data logger/bubbler system software controls several functions:

- operating the system on a specified uniform time interval;
- performing the calibration calculations; and
- storing the data in the RAM pack storage module.

This software can be loaded either by the use of the hand-held display or by transferring the program from a PC compatible computer to the unit's RAM pack storage module, then down loading the program from the RAM pack into the data logger. The time interval between the start of each measurement cycle is user-selectable and may range from 20 seconds to 6554 seconds. The measurement cycle interval used during WY89 was 900 seconds (15 minutes). Calibration of the data logger/bubbler system is based on two different pressure measurements made at a known distance apart in a reference cylinder located in each station's gage house. The software residing in the data logger performs the calibration calculation prior to each measurement cycle. During the routine monthly maintenance, the calibration is checked using the station's staff gage reading as a reference point, so that the accuracy of each measurement can be verified.

Data are retrieved from the from the RAM pack storage module using either SMCOM or PC208 software. Both SMCOM and PC208 are available from Campbell Scientific, Inc. These communication software programs run on PC compatible computers, additionally, the PC208 software also serves as a simple data formatting and programming tool for the data logger.

Various field operating procedures were used during WY89 for proper and continual operation of CR-10 data logger/bubbler system stations. They are as follows:

1. Reading and Recording the Current Datalogger Output

This procedure is performed during each weekly station visit. Each CR-10 is equipped with a hand help keypad and display. The following key entries denote specific display readouts. Output from the keypad's display is recorded in the field log book and a data sheet that is kept in the gage house. Additionally, nitrogen tank pressure, staff gage reading, and flow condition are recorded in the log book and data sheet.

- *5 - (Real Time)
 - A - The Current Year
 - A - The Julian Day
 - A - The Time - Mountain Standard
- *6 - (Field Data)
 - A
 - #1 - Head above tube in stream.
 - A
 - #2 - Depth in reference tube above top line.
 - A
 - #3 - Ambient Temp. - °C
 - A
 - #4 - Reference differential - distance between lines in reference tube - (approx. 1 ft - 1.0).
 - A
 - #5 - Battery voltage - should be above 12 v.
 - A
 - #6 (with Isco sampler), 0.01 = sample taken, 0.00 = no sample.
 - #20 and #21 - Time sample(s) taken.
 - #20 - XXXX divide by 24 and add 1 = (day sample taken).
 - #21 - minutes + #20 = (actual time sample taken).

2. Changing Batteries

The CR-10 data logger/bubbler system is powered by an industrial 12-volt, 15 amp-hour, sealed lead-acid battery. When the voltage falls below 12 volts, the battery is changed. The battery could be damaged if it is left in the field when the voltage drops below 12 volts. This is especially critical in the cold winter months.

The CR-10 has an internal battery pack consisting of eight alkaline D-cell batteries, that can be used as a back-up for the primary power supply. The following procedure is used to keep power applied to the unit while the external battery is being changed:

1. Insert the one D-cell battery back into the internal battery pack.
2. Disconnect the leads from the discharged external battery.
3. Connect a charged external battery.
4. Remove the D-cell battery from the internal battery pack.

3. Changing Nitrogen Tanks

Industrial nitrogen is supplied to the bubbler from a standard 2,200 psi nitrogen tank. The tank is equipped with a low pressure regulator to maintain a constant flow of 9 psi to the bubbler. The pressure to the bubbler can be changed by using the T-handle on the regulator. The regulator also has a gauge that indicates the pressure of nitrogen in the tank. When the tank pressure drops to approximately 500 psi, it is replaced with a full one. The following procedure is used to change the nitrogen tank:

1. With hand-held display, check *5 mode time to be sure that the instrument is not about to sample.
2. Close the valve on the top of the nitrogen tank.
3. With a 7/8" wrench, unscrew the flare nut on the regulator from the nitrogen tank orifice.
4. Unhook the safety chain and remove the empty tank from the shelter.
5. Place a full tank in the shelter and fasten the safety chain around it.
6. Place the regulator on the full tank and tighten the flare nut.
Note: Slightly wiggling the regulator while tightening the flare nut will help ensure a tight fit to the mating fitting on tank.
7. Open the valve at the top of the bottle. The pressure to the bubbler should read 9 psi.
8. Check for leaks around the regulator flare nut and tank orifice. After the regulator is attached to the new tank, open the T-handle until 0 psi is read on low pressure gage. Observe the tank pressure gauge to determine if any pressure is lost (15 minutes should be adequate). If the pressure drops, there is a leak in the connection. If a leak is detected, close the valve on top of the tank and remove the regulator. Place the regulator in a different position on the orifice and retighten the flare nut. Repeat the procedure to check for leaks.

SPECIFICATIONS

The following electrical specifications are valid for an ambient temperature range of -25°C to $+50^{\circ}\text{C}$ unless otherwise specified.

ANALOG INPUTS

NUMBER OF CHANNELS: 12 single ended or 6 differential with any combination, software selectable.

CHANNEL EXPANSION: Increments of 32 channels multiplexed through a single CR10 channel with the Model AM32 Relay Scanner. Maximum of 6 AM32's possible.

ACCURACY OF VOLTAGE MEASUREMENTS AND ANALOG OUTPUT VOLTAGES:
0.2% of FSR, 0.1% of FSR (0 to 40°C).

RANGE AND RESOLUTION: Ranges are software selectable for any channel. Resolution for single ended measurements is twice the value shown.

Full Scale Range	Resolution
± 2.50 volts	333. microvolts
± 0.25 volts	33.3 microvolts
± 25.0 millivolts	3.33 microvolts
± 7.5 millivolts	1.00 microvolts
± 2.5 millivolts	0.33 microvolts

INPUT SAMPLE RATES: The fast or slow A/D conversion on the four lowest input ranges uses a 250 μs or 2.72 ms signal integration time, respectively. Two integrations, separated in time by $\frac{1}{2}$ of an AC line cycle, are used with the 60 Hz or 50 Hz noise rejection option. Differential measurements include a second sampling with reversed input polarity to reduce thermal offset and common mode errors. Input sample rates are the time required to measure and convert the result to engineering units.

Fast single ended voltage:	2.6 ms
Fast differential voltage:	4.2 ms
Slow single ended voltage:	5.1 ms
Slow differential voltage:	9.2 ms
Diff. w/60 Hz rejection:	25.9 ms
Fast diff. thermocouple:	8.6 ms

INPUT NOISE VOLTAGE:

Fast differential	— 0.82 microvolts RMS
Slow differential	— 0.25 microvolts RMS
Diff. w/60 Hz rejection	— 0.18 microvolts RMS

COMMON MODE RANGE: ± 2.5 volts.

DC COMMON MODE REJECTION: >140 dB.

NORMAL MODE REJECTION: 70 dB (60 Hz with slow differential measurement).

INPUT CURRENT: 3 nanoamps max.

INPUT RESISTANCE: 200 gigohms.

EXCITATION OUTPUTS

DESCRIPTION: The CR10 has 3 switched excitations, active only during measurement, with only one output active at any time. The off state is high impedance.

RANGE: ± 2.5 volts.

RESOLUTION: 0.67 millivolts.

ACCURACY: Same as voltage input.

OUTPUT CURRENT: 20 mA @ ± 2.5 V, 35 mA @ ± 2.0 V, 50 mA @ ± 1.5 V.

FREQUENCY SWEEP FUNCTION: A swept frequency square wave output between 0 and 2.5 volts is provided for vibrating wire transducers. Timing and frequency range are specified by the instruction.

PERIOD AVERAGING MEASUREMENTS

DEFINITION: The time period for a specified number of cycles of an input frequency is measured, then divided by the number of cycles to obtain the average period of a single cycle.

INPUTS: Any single ended analog channel; signal dividing or AC coupling is normally required.

INPUT FREQUENCY RANGE:

Range Code	Preamplifier Gain	Input Hysteresis	Maximum Frequency
4	1	10 mV	200 kHz
3	10	1 mV	50 kHz
2	33	300 μV	20 kHz
1	100	100 μV	8 kHz

REFERENCE ACCURACY: ± 40 ppm.

RESOLUTION: ± 100 nanoseconds divided by the number of cycles measured. Resolution is reduced by signal noise and for signals with a slow transition through the zero voltage threshold.

TIME REQUIRED FOR MEASUREMENT: Signal period times the number of cycles measured plus 1.5 cycles; minimum measurement time is 2 ms.

RESISTANCE AND CONDUCTIVITY MEASUREMENTS

ACCURACY: 0.015% of full scale bridge output, limited by the matching bridge resistors. The excitation voltage should be programmed so the bridge output matches the full scale input voltage range.

MEASUREMENT TYPES: 6 wire and 4 wire full bridge; 4 wire, 3 wire, and 2 wire half bridge. Bridge measurements are ratio-metric and dual polarity to eliminate thermal emf's. AC resistance measurements use a dual polarity 750 μs excitation pulse for ionic depolarization, with the signal integration occurring over the last 250 μs .

PULSE COUNTERS

NUMBER OF PULSE COUNTER CHANNELS: 2 eight bit or 1 sixteen bit selectable.

MAXIMUM COUNT RATE: 2000 Hz, eight bit counters; 250 kHz, sixteen bit counters. Pulse counter channels scanned at 8 Hz.

MODES: Switch closure, high frequency pulse, and low level AC.

SWITCH CLOSURE MODE

Minimum Switch Closed Time: 5 ms.
Minimum Switch Open Time: 6 ms.
Maximum Bounce Time: 1 ms open without count.

HIGH FREQUENCY PULSE MODE

Minimum Pulse Width: 2 μs .
Maximum Input Frequency: 250 kHz.
Voltage Thresholds: Count upon transition from below 1.5 V to above 3.5 V.
Maximum Input Voltage: ± 20 V.

LOW LEVEL AC MODE

(Typical of magnetic pulse flow sensors, selected anemometers, etc.)

Min AC Input Voltage: 6 mV RMS
Input Hysteresis: 11 mV
Max. AC Input Voltage: 20 V RMS

Frequency Range:

AC Input (RMS)	Range
20 millivolts	1 Hz to 100 Hz
50 millivolts	0.5 Hz to 400 Hz
150 millivolts to 20 V	0.3 Hz to 1000 Hz

(Consult factory if higher frequencies are desired.)

DIGITAL I/O PORTS

8 ports, software selectable as binary inputs or control outputs.

OUTPUT VOLTAGES (no load):

high — 5 V ± 0.1 V; low — < 0.1 V.

OUTPUT RESISTANCE: 500 ohms.

INPUT STATE: high — > 3 V; low — < 0.8 V.

INPUT RESISTANCE: 100 kohms.

TRANSIENT PROTECTION

All input and output connections to the CR10 module are protected using RC filters or transzorbors connected to a heavy copper bar between the circuit card and the case. The CR10WP Wiring Panel includes additional spark gap and transzorb protection.

CPU AND INTERFACE

PROCESSOR: Hitachi 6303.

MEMORY: 32k ROM, 16k RAM expandable to 64k.

DISPLAY: 8 digit LCD (0.5" digits).

PERIPHERAL INTERFACE: 9 pin D-type connector for keyboard/display, storage module, cassette, modem, printer, and RS232 adapter. Baud rates selectable at 300, 1200, 9600, and 76,800.

CLOCK ACCURACY: ± 1 minute per month.

MAXIMUM PROGRAM EXECUTION RATE: System tasks initiated in sync with real-time up to 64 Hz. One measurement with tape transfer is possible at this rate without interruption.

SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 volts.

TYPICAL CURRENT DRAIN: 0.5 mA quiescent, 13 mA during processing, and 35 mA during analog measurement.

BATTERIES: 7.5 Ahr alkaline D-cells or 5 Ahr rechargeable lead acid batteries; standard.

PHYSICAL SPECIFICATIONS

SIZE: 7.8" x 3.5" x 1.5"; 9" x 3.5" x 2.9" with CR10WP Wiring Panel. Input connectors extend length 0.15".

WEIGHT: 2 lbs.

WARRANTY

Two years against defects in materials and workmanship.



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