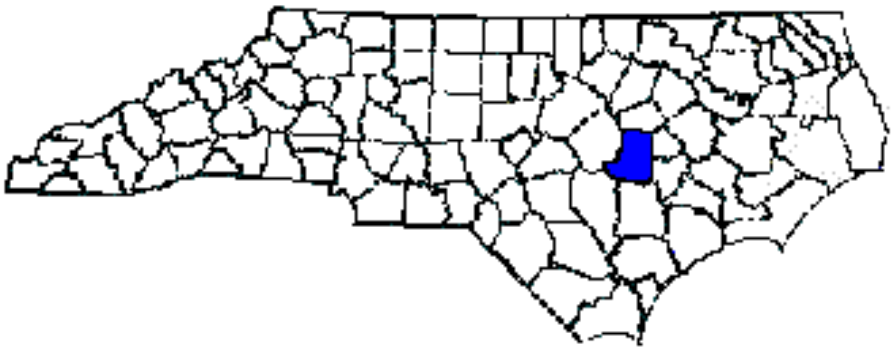
ANNUAL REPORT FOR 2011



Jeffreys Warehouse Stream Mitigation Site
Wayne County
TIP No. R-1030AA

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North Carolina Department of Transportation
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SUMMARY

The following report summarizes the stream monitoring activities conducted during the Year 2011 along an unnamed tributary emptying into the Little River, hereinafter referred to as the Jeffreys Warehouse Mitigation Site. The site, situated on I-795/US 117 in Goldsboro, was designed and constructed during 2006 by the North Carolina Department of Transportation (NCDOT) in order to provide mitigation for stream impacts associated with the construction of Transportation Improvement Program (TIP) number R-1030AA. This report provides the monitoring results for the fifth formal year of monitoring (Year 2011).

Based on the overall monitoring assessment, the Jeffreys Warehouse Mitigation Site has met the required monitoring protocols for the fifth formal year of monitoring and is stable at this time. There is extensive growth of vegetation throughout the stream corridor, both within and outside of the bankfull limits associated with the channel. All fourteen of the cross sections along the unnamed tributary are stable. A surface gauge was installed in December 2007 in order to assist in determining the number of bankfull events that the site has experienced. A review of peak stream flows was conducted for the period between January 2010 and November 2010. According to the graph, there were approximately three bankfull events documented during this monitoring period.

The longitudinal profile survey was not conducted along the stream at the Jeffreys Warehouse Mitigation Site in 2010 or 2011 due to extensive vegetation growth along the channel. The heavy vegetation growth made it difficult to survey the channel without cutting down many of the desired species along the channel. An onsite agency review meeting was held on January 11, 2010. It was determined during this meeting that in lieu of doing the longitudinal profile, visual inspection of the channel stability throughout the reach and photo documentation at the permanent photo point locations would be completed. All other monitoring activities will continue to be completed throughout the five year monitoring period.

NCDOT proposes to discontinue stream monitoring at the Jeffreys Warehouse Mitigation Site.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2011 at the Jeffreys Warehouse Mitigation Site. The site is located adjacent to US 117 in Goldsboro (Figure 1). The Jeffreys Warehouse Mitigation Site was constructed to provide mitigation for stream impacts associated with TIP number R-1030AA in Wayne County.

The mitigation project includes approximately 3,380 linear feet of stream restoration. Construction was completed during 2006 by the NCDOT. Stream restoration involved the installation of cross vanes, j-hooks, and rootwads, sloping the adjacent streambanks to promote stability, and widening of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

1.2 Purpose

In order for a mitigation site to be considered successful, the site must meet the success criteria. This report details the monitoring in 2011 at the Jeffreys Warehouse Mitigation Site.

1.3 Project History

March 2006	Construction Completed.
October 2007	Stream Channel Monitoring (Year 1)
November 2008	Stream Channel Monitoring (Year 2)
October 2009	Stream Channel Monitoring (Year 3)
January 2010	On-site Stream Stability Review with Resource Agencies
October 2010	Stream Channel Monitoring (Year 4)
August 2011	Stream Channel Monitoring (Year 5)

1.4 Debit Ledger

Table 1. Jeffreys Warehouse Mitigation Site Debit Ledger

Jeffreys Warehouse	Wetland and Stream Debit Types				
TIP DEBITS	**Riverine Wetland Restoration**	**Non-Riverine Wetland Restoration**	**Riverine Wetland Preservation**	**Stream Restoration**	**Neuse Buffer Restoration**
B-3528				452	75,581
B-4300					40,028
B-4304		0.92			3,653
B-4592					16,398
B-4600					7,113
EB-4993				279	
R-2719A		2.76			172,387
R-2719A MOD					450
R-2814A&B	2.62	1.77	3.75		
R-3825A				174	
U-3344A				25	45,558
U-4011				61	
U-4703					24,458
SR 1340 2C.054015					11,393
As-Built Quantity	**3.66**	**23.02**	**12.36**	**3,731**	**689,607**
Debit Summary	**2.62**	**5.45**	**3.75**	**991**	**397,019**
Acres Remaining	**1.04**	**17.57**	**8.61**	**2,740**	**292,588**

Note: Debit ledger information up to date as of December 7th, 2011.

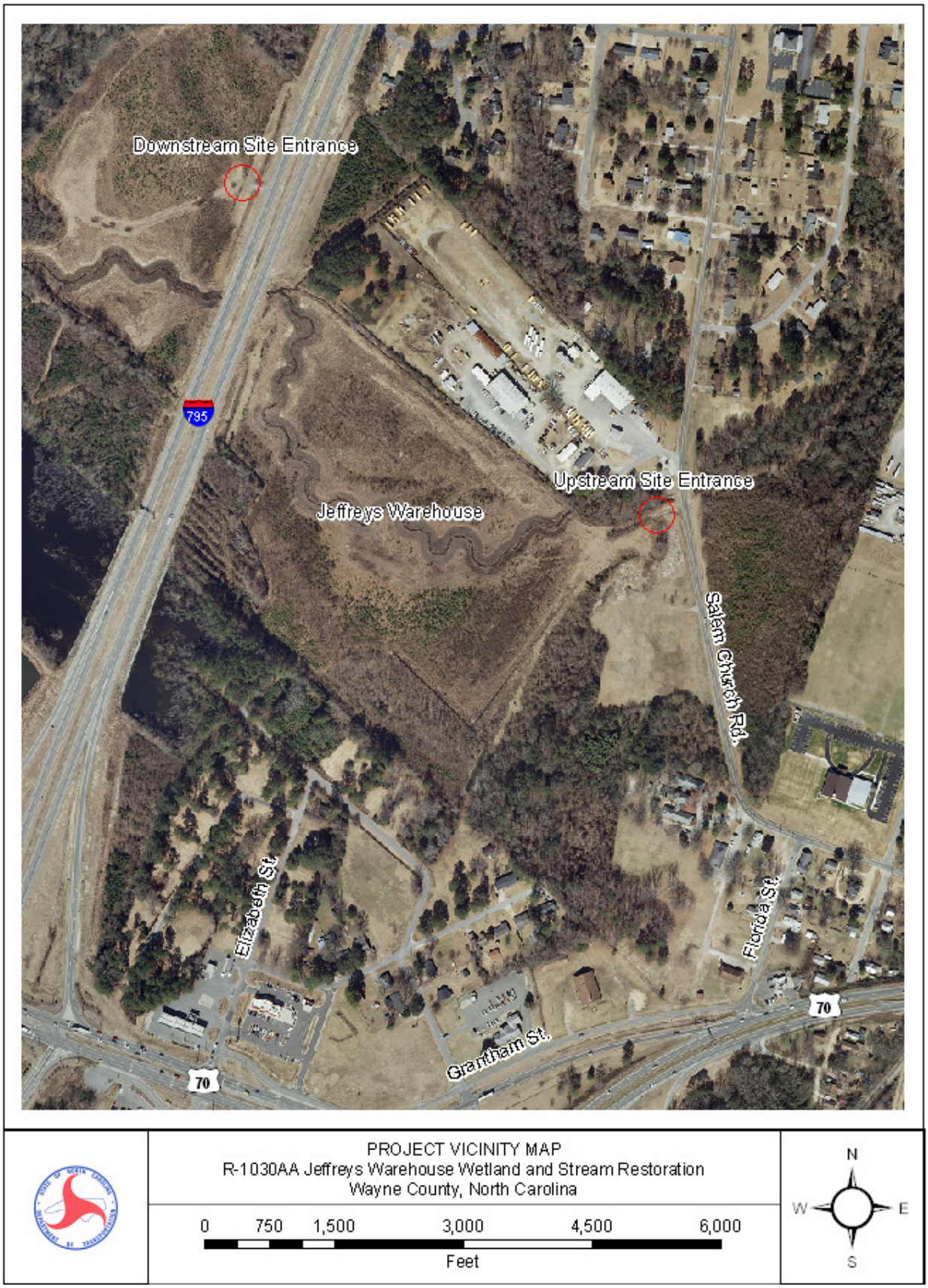


Figure 1. Vicinity Map

2.0 STREAM ASSESSMENT

2.1 Stream Monitoring Requirements

US Army Corps of Engineers (USACE):

Per the Jeffreys Warehouse Conceptual Mitigation Plan dated September 17, 2004: The stream will be monitored using the criteria set forth in the Stream Mitigation Guidelines document issued by an interagency team of the USACE, Environmental Protection Agency, N.C. Wildlife Resource Commission and N.C. Division of Water Quality in April 2003. Monitoring Level I procedures, as set forth in the document, will be followed.

NC Division of Water Quality (NCDWQ):

DWQ No. 060332: The permitee shall monitor the relocated stream channel annually. Physical monitoring should include an evaluation of streambank stability as well as stream morphology. The geomorphology of the stream should be assessed using Rosgen or similar classification system. The report should include permanent cross sections of riffles and pools, longitudinal profiles, and pebble counts.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation project covers approximately 3,380 linear feet of stream restoration. Construction was completed during 2006 by the NCDOT. Stream restoration involved the installation of cross vanes, j-hooks, and rootwads, sloping the adjacent streambanks to promote stability, and widening of the floodplain to allow for overbank flooding. It also included the installation of coir fiber matting and live stakes along the streambank and bareroot seedlings in the buffer area.

2.2.2 Monitoring Conditions

The objective of the Jeffreys Warehouse Mitigation Site restoration was to construct an E stream type as identified in the Rosgen's Applied River Morphology. A total of fourteen cross sections (seven in a riffle, six in a pool, and one in a glide) were surveyed. For this report, only cross sections containing riffles were used in the comparison of channel morphology presented below in Table 1. Data shown in Table 1 includes the riffle cross sections that were surveyed.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of fourteen cross sections and pebble count for the entire reach at the Jeffreys Warehouse Mitigation Site. The length of the channel assessment was approximately 3,410 linear feet. Cross section locations are presented below. Benchmark stakes were installed on both the left and right streambanks for each cross section location. The layout comparisons of the cross sections are shown in Appendix B.

- Cross Section #1. Jeffreys Warehouse, Upper Reach, Station 256, midpoint of pool
- Cross Section #2. Jeffreys Warehouse, Upper Reach, Station 314, head of riffle
- Cross Section #3. Jeffreys Warehouse, Upper Reach, Station 487.2, midpoint of riffle
- Cross Section #4. Jeffreys Warehouse, Upper Reach, Station 546, midpoint of pool
- Cross Section #5. Jeffreys Warehouse, Upper Reach, Station 1030, midpoint of glide
- Cross Section #6. Jeffreys Warehouse, Upper Reach, Station 1122, midpoint of riffle
- Cross Section #7. Jeffreys Warehouse, Upper Reach, Station 1612.2, midpoint of pool
- Cross Section #8. Jeffreys Warehouse, Upper Reach, Station 1654.2, midpoint of riffle
- Cross Section #9. Jeffreys Warehouse, Upper Reach, Station 1953.3, midpoint of pool
- Cross Section #10. Jeffreys Warehouse, Upper Reach, Station 1982.8, head of riffle
- Cross Section #11. Jeffreys Warehouse, Lower Reach, Station 2773.6, midpoint of pool
- Cross Section #12. Jeffreys Warehouse, Lower Reach, Station 2862.7, midpoint of riffle
- Cross Section #13. Jeffreys Warehouse, Lower Reach, Station 3006, midpoint of pool
- Cross Section #14. Jeffreys Warehouse, Lower Reach, Station 3063.3, midpoint of riffle

The fourteen cross sections that were established during 2008 are being monitored on a yearly basis to determine the actual extent of aggradation or degradation. All of the cross section locations appeared stable. Morphological comparisons are presented in the charts depicted below. Appendix B depicts each cross section comparison as well as a summarized table of morphological variables. Future survey data will vary depending on actual location of rod placement and alignment; however this information should remain similar in appearance.

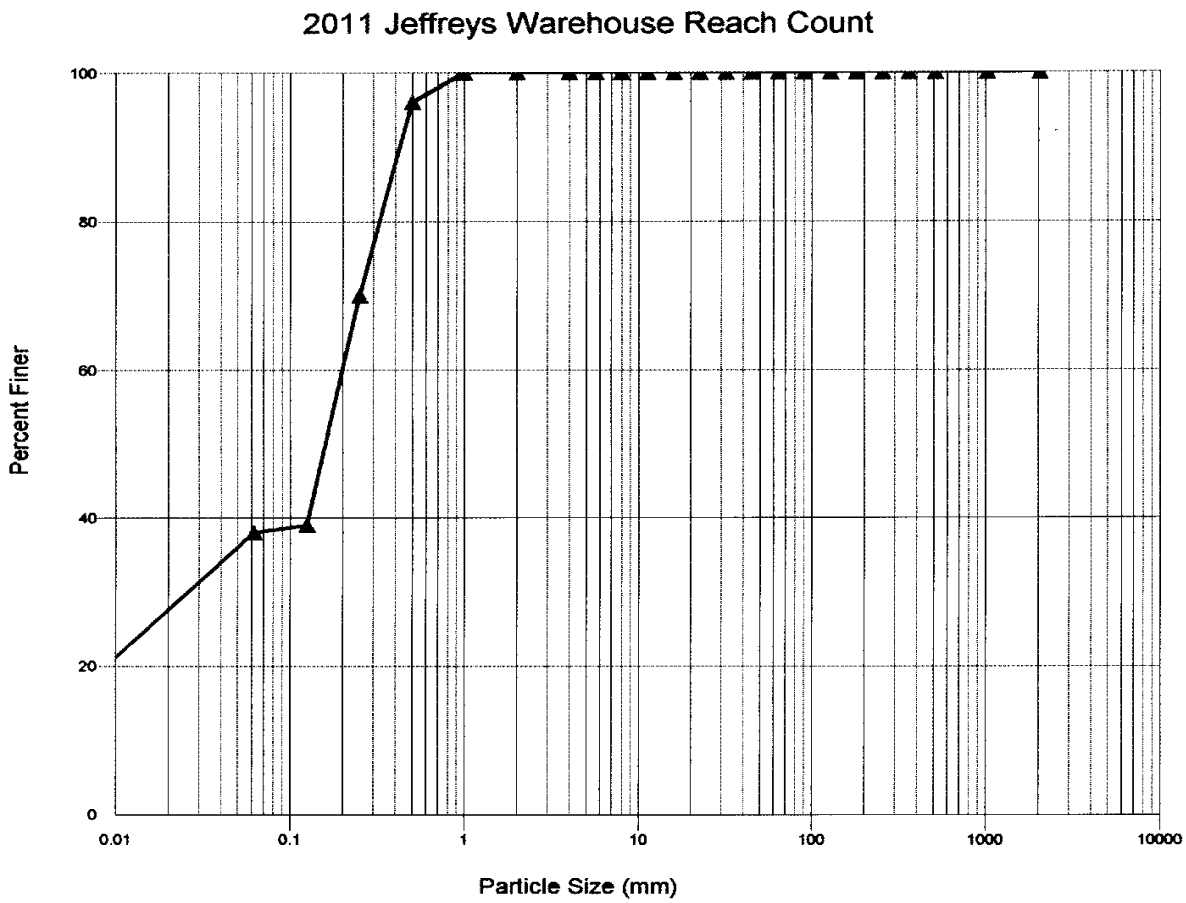
Table 2. Cross Section Comparisons - Upper Reach										
Variable	Proposed	Cross Section #2 (Riffle)	Cross Section #3 (Riffle)	Cross Section #6 (Riffle)	Cross Section #8 (Riffle)	Cross Section #10 (Riffle)	Cross Section #12 (Riffle)	Cross Section #14 (Riffle)	Min. - Max Values (Riffle Sections Only)	
		2011	2011	2011	2011	2011	2011	2011	2010	2011
Drainage Area (sq. mi)	0.68-0.76	0.68-0.76	0.68-0.76	0.68-0.76	0.68-0.76	0.68-0.76	0.68-0.76	0.68-0.76	0.68 - 0.76	0.68 - 0.76
Bankfull Cross Sectional Area (ft^2)	12	**8.73**	**12.19**	**11.07**	**5.83**	**11.17**	**7.86**	**9.1**	5.87 - 12.02	5.83 – 12.19
Maximum Bankfull Depth (ft)	1.1	**1.71**	**1.57**	**1.84**	**1.03**	**1.47**	**1.19**	**1.3**	1.04 - 2	1.03 – 1.84
Width of Floodprone Area (ft)	59	**65**	**60**	**68.2**	**69**	**61**	**58**	**50**	50 - 69	50 – 69
Bankfull Mean Depth (ft)	1.0	**0.97**	**0.94**	**0.61**	**0.37**	**0.78**	**0.65**	**0.59**	0.4 - 0.95	0.37 – 0.94
Width/Depth Ratio	12	**9.28**	**13.83**	**29.51**	**42.97**	**18.33**	**18.46**	**26.07**	10.59 – 42.5	9.28 – 42.97
Entrenchment Ratio	4.9	**7.22**	**4.62**	**3.79**	**4.34**	**4.27**	**4.83**	**3.25**	3.2 - 6.82	3.25 – 7.22
Bankfull Width (ft)	12	**9**	**13**	**18**	**15.9**	**14.3**	**12**	**15.38**	9.53 – 17.13	9 – 18

Table 3. Pebble Count – Entire Reach						
Particle Sizes	Proposed	2007	2008	2009	2010	2011
D16(mm)		0.07	0.06	0.05	0.08	0.03
D35 (mm)		0.11	0.39	0.09	0.33	0.06
D50 (mm)	< 1	0.22	0.67	0.13	0.47	0.17
D84 (mm)		0.85	1.61	0.33	1.41	0.38
D95 (mm)		2	1.97	11.3	2.67	0.49

A representative pebble count was taken throughout the surveyed reach. This information is used to determine the stream type. Jeffreys Warehouse Mitigation Site was designed as a sand bed system with the D_{50} being less than one. The pebble counts taken during the Year 2011 monitoring period noted that the D_{50} (50 percent of the sampled population is equal to or finer than the representative particle diameter) for the entire reach of Jeffreys Warehouse Mitigation Site was approximately 0.17 mm, which is indicative of a sand-bed stream.

The graph depicting the 2011 particle size distributions for the entire reach of the Jeffreys Warehouse Mitigation Site is presented below.

Chart 1. Particle Size Distribution for Entire Reach



The longitudinal profile survey was not conducted along the stream at the Jeffreys Warehouse Mitigation Site in 2011 due to extensive vegetation growth along the channel. The heavy vegetation growth made it difficult to survey the channel without cutting down many of the desired species along the channel. An onsite agency review meeting was held on January 11, 2010. It was determined during this meeting that in lieu of doing the longitudinal profile, visual inspection of the channel stability throughout the reach and photo documentation at the permanent photo point locations would be completed.

Photo points 1 through 7 showed an extensive growth of herbaceous and woody vegetation. The channel bed is stable throughout the stream restoration project. An old beaver dam was located just upstream of cross section #8. Water surface shots were not taken at cross section #8 due to no water flow within this section of the stream. Cross sections 11 through 14 were shot on day two of our field work and water was out onto the floodplain at these cross section locations due to heavy rainfall from the previous night. NCDOT has contracted USDA to trap the beavers and breach the beaver dams throughout the monitoring period.

A surface gauge was installed in December 2007 in order to assist in determining the number of bankfull events that the site has experienced. A review of peak stream flows was conducted for the period between January 2010 and November 2010. According to the graph, there were approximately three bankfull events documented during this monitoring period. Herbaceous and woody vegetation is thriving throughout the stream restoration project. Some of the vegetation noted included cattail, black willow, silky dogwood, fennel, sedge, smartweed, *Juncus* sp., alder, woolgrass, and various grasses.

2.4 Conclusions

Overall the Jeffreys Warehouse Stream Mitigation Site remains very stable. There is extensive growth of vegetation throughout the stream corridor, both within and outside of the bankfull limits associated with the channel. All fourteen of the cross sections along the unnamed tributary are stable. There is evidence along the floodplain that the Jeffreys Warehouse Mitigation Site has experienced several bankfull events since construction was completed in March 2006.

NCDOT proposes to discontinue stream monitoring at the Jeffreys Warehouse Mitigation Site.

3.0 REFERENCES

North Carolina Department of Transportation. Jeffreys Warehouse Conceptual Mitigation Plan, September 17, 2004. Wayne County, North Carolina.

North Carolina Department of Transportation. Division of Water Quality No. 060332. TIP R-1030AA, March 21, 2006. Wayne County, North Carolina.

Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

APPENDIX A

SITE PHOTOGRAPHS AND SITE MAP

Jeffreys Warehouse

Photo Point #1 (upstream)

Photo Point #1 (downstream)

Photo Point # 2 (upstream)

Photo Point # 2 (downstream)

Photo Point # 3 (upstream)

Photo Point # 3 (downstream)

August 2011

Jeffreys Warehouse

Photo Point # 4 (upstream)

Photo Point # 4 (downstream)

Photo Point #5 (upstream)

Photo Point #5 (downstream)

Photo Point #6 (upstream)

Photo Point #6 (downstream)

August 2011

Jeffreys Warehouse

Photo Point #7 (upstream)

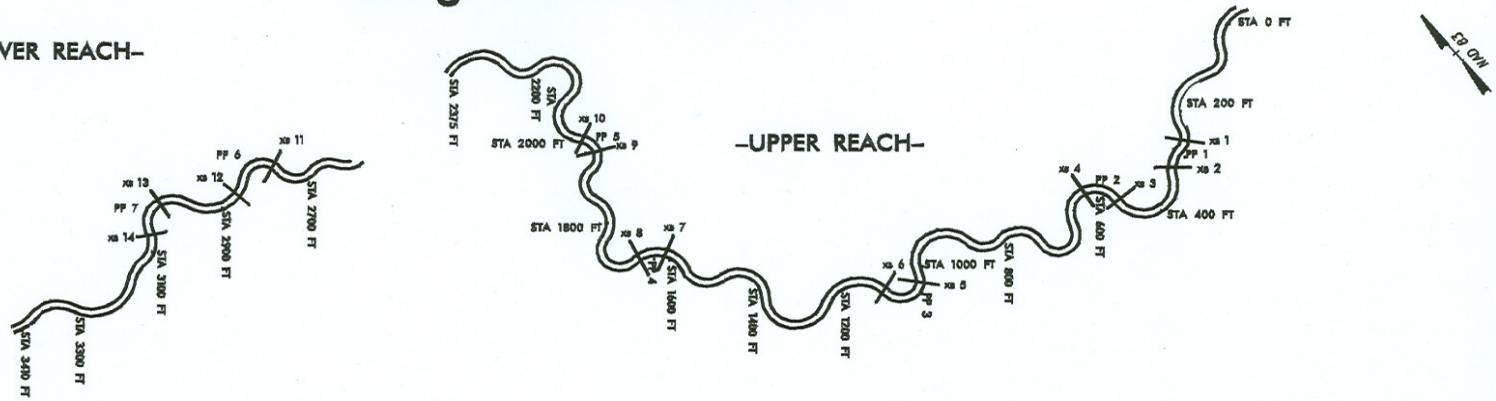
Photo Point #7 (downstream)

August 2011

PROJECT REFERENCE NO.	SHEET NO.
R-1030AA	

Jeffreys Warehouse Mitigation Site

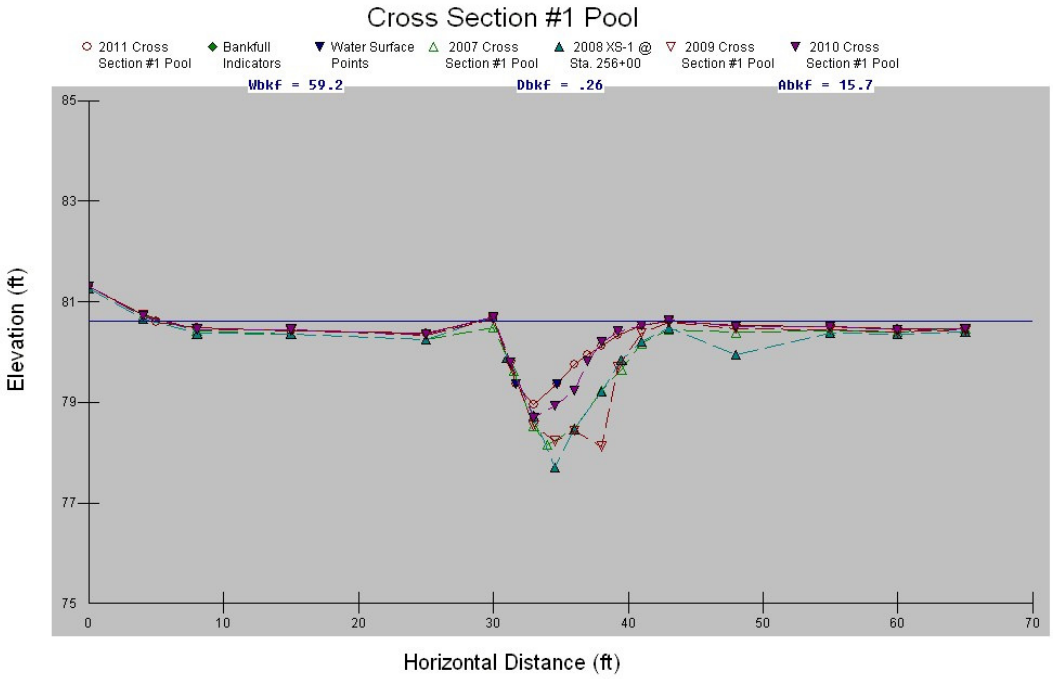
Photo Point and Cross Section Locations and Long. Profile Stations



PP – Photo Points
XS – Cross Sections

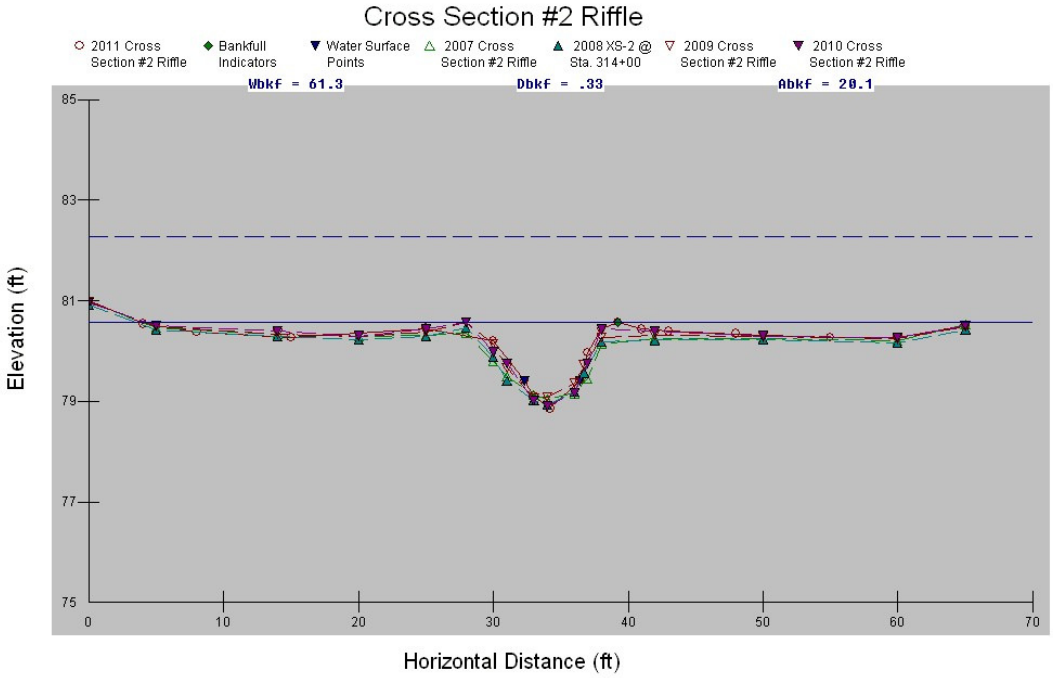
APPENDIX B

CROSS SECTIONS
AND SURFACE GAUGE DATA

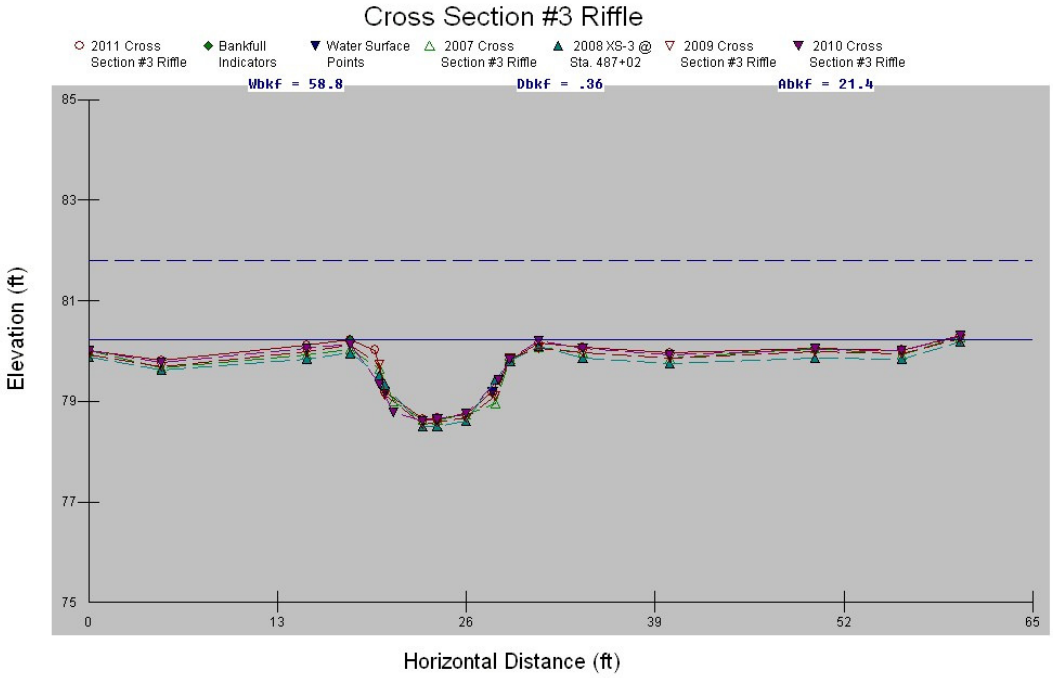


Cross-Section #1 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	14.82	15.22	17.64	10.47	9.08
Maximum Bankfull Depth (ft)	2.29	2.78	2.48	1.94	1.67
Bankfull Mean Depth (ft)	1.15	1.20	1.37	0.81	0.70
Bankfull Width (ft)	12.93	12.73	12.92	12.91	12.94

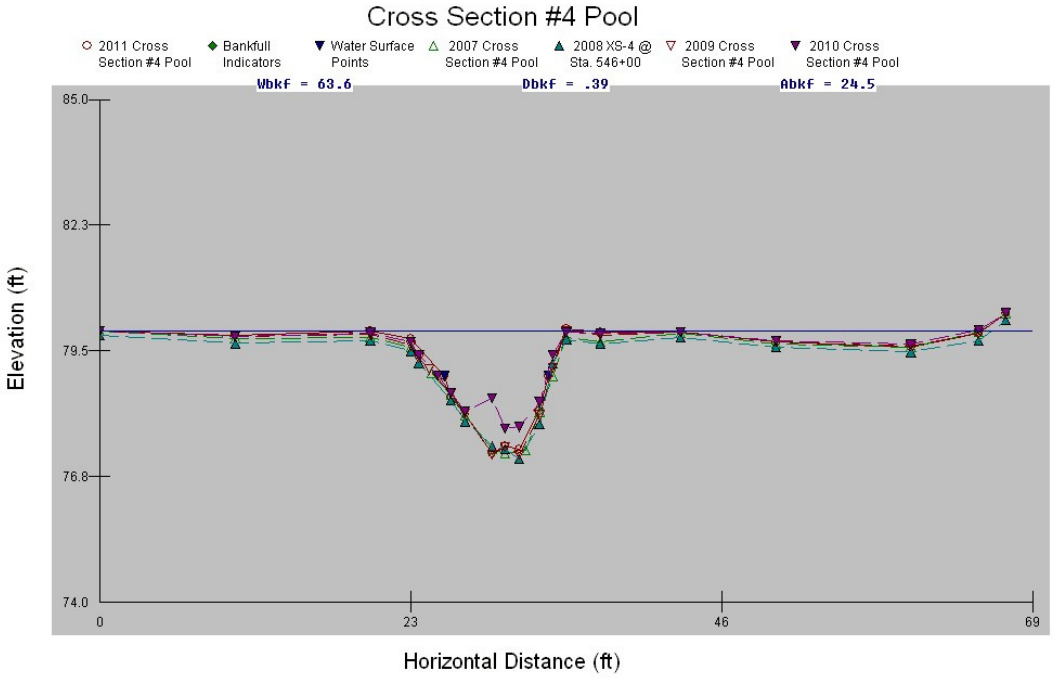
*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.



Cross-Section #2 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	7.72	7.09	6.27	8.58	8.73
Maximum Bankfull Depth (ft)	1.21	1.25	1.2	1.53	1.71
Width of the Floodprone Area (ft)	65	65	65	65	65
Bankfull Mean Depth (ft)	0.8	0.78	0.73	0.9	0.97
Width/Depth Ratio	12.01	11.62	11.73	10.59	9.28
Entrenchment Ratio	6.76	7.17	7.6	6.82	7.22
Bankfull Width (ft)	9.61	9.06	8.56	9.53	9

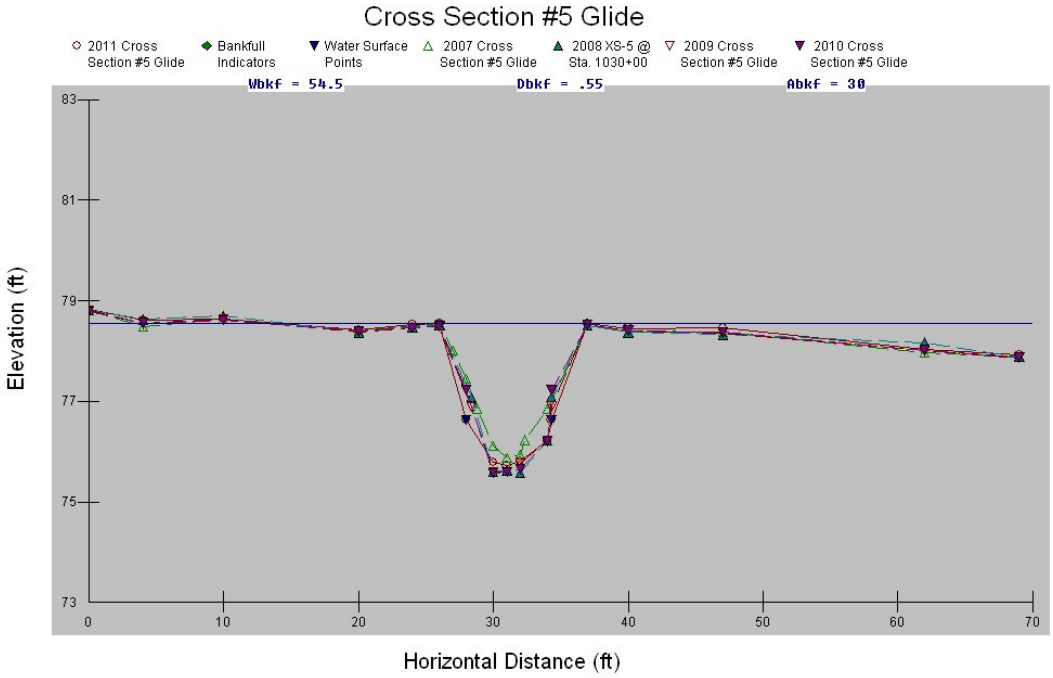


Cross-Section #3 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	11.17	10	11.2	12.02	12.19
Maximum Bankfull Depth (ft)	1.44	1.46	1.52	1.52	1.57
Width of the Floodprone Area (ft)	60	60	60	60	60
Bankfull Mean Depth (ft)	0.87	0.82	0.88	0.95	0.94
Width/Depth Ratio	14.75	14.82	14.42	13.28	13.83
Entrenchment Ratio	4.68	4.94	4.73	4.75	4.62
Bankfull Width (ft)	12.83	13	12.69	12.62	13



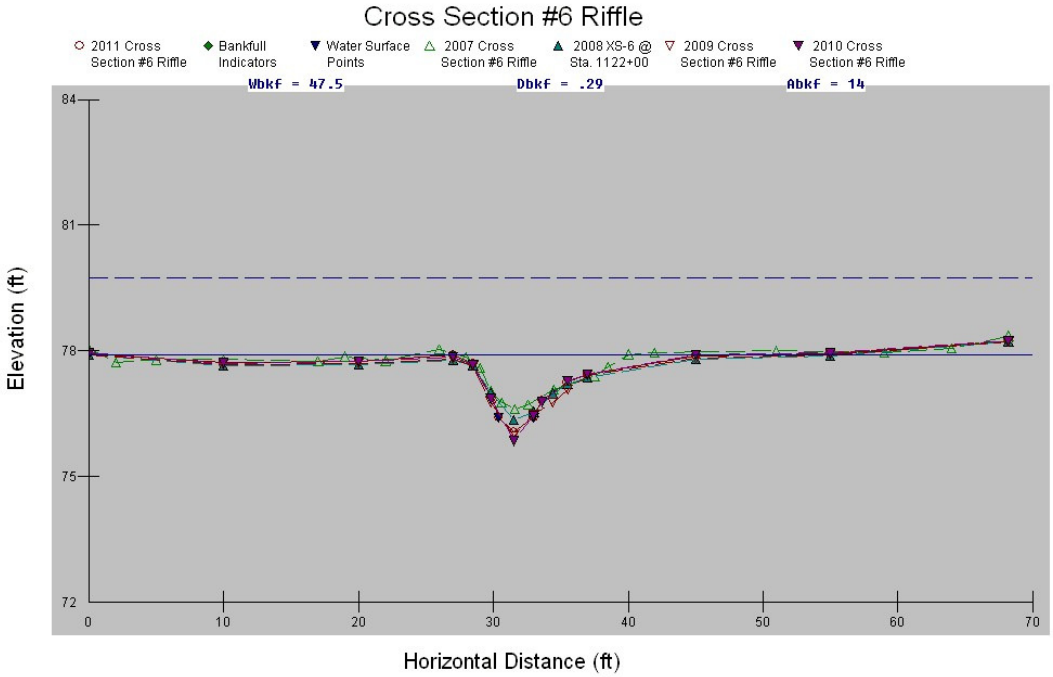
Cross-Section #4 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	18.23	18.3	18.55	15.04	18.41
Maximum Bankfull Depth (ft)	2.54	2.62	2.63	2.09	2.68
Bankfull Mean Depth (ft)	1.26	1.26	1.24	1.04	1.28
Bankfull Width (ft)	14.5	14.5	14.97	14.46	14.44

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.

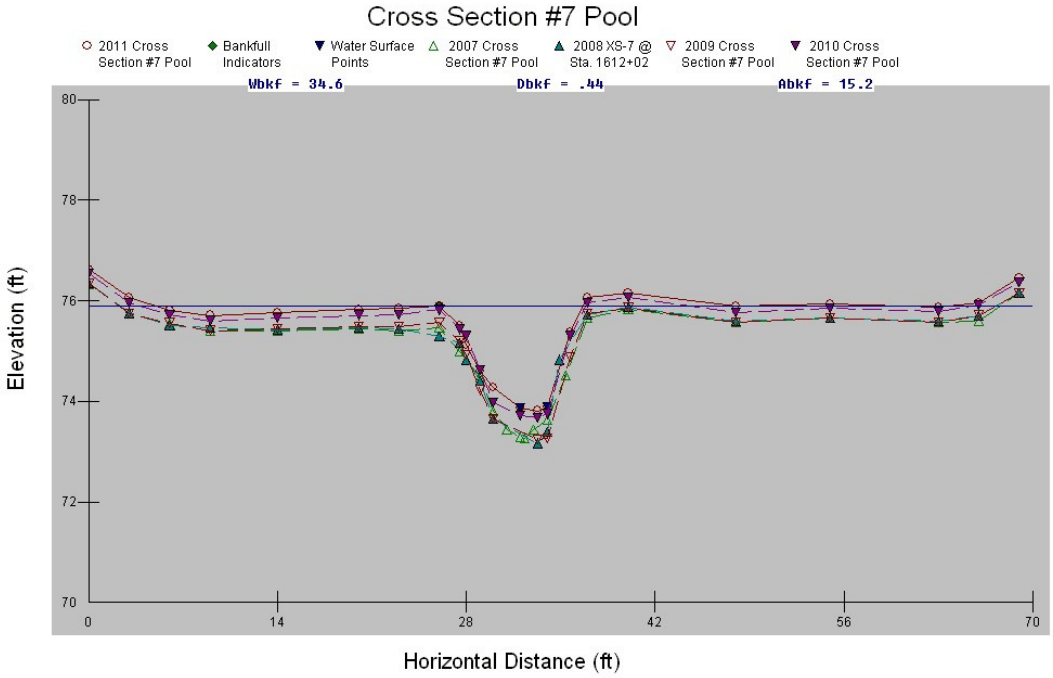


Cross-Section #5 (Glide) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	16.46	18.74	19.03	18.77	20.43
Maximum Bankfull Depth (ft)	2.66	2.94	2.91	2.94	2.81
Bankfull Mean Depth (ft)	1.5	1.70	1.74	1.71	1.86
Bankfull Width (ft)	10.98	11	10.97	10.98	11

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.

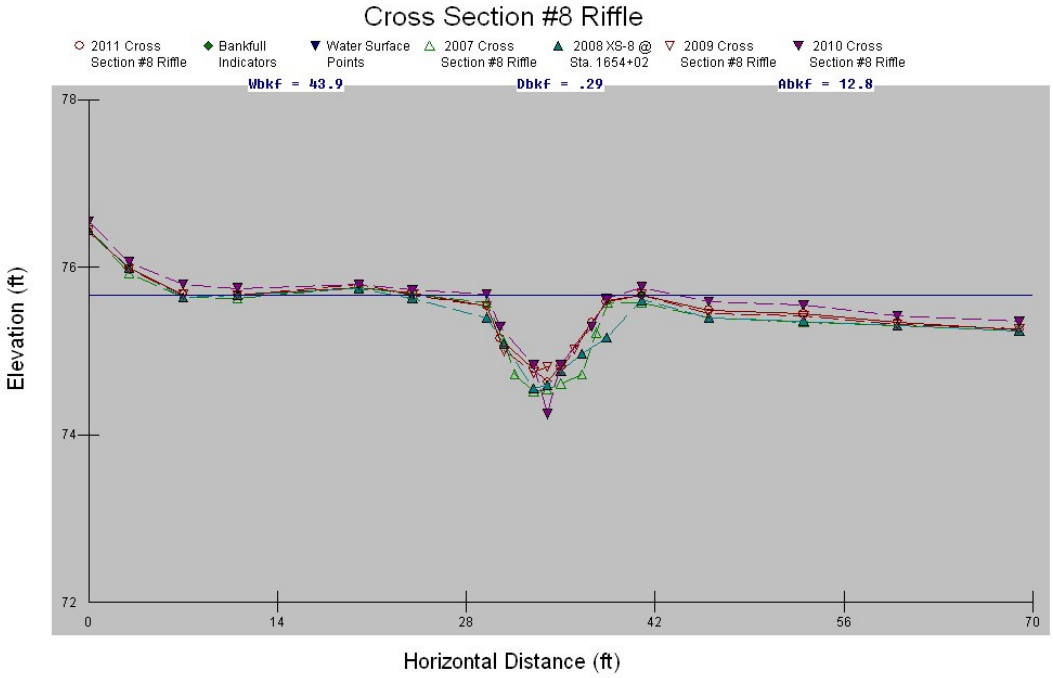


Cross-Section #6 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	9.22	9.17	10.53	10.48	11.07
Maximum Bankfull Depth (ft)	1.38	1.43	1.83	2	1.84
Width of the Floodprone Area (ft)	68.2	68.2	68.2	68.2	68.2
Bankfull Mean Depth (ft)	0.61	0.52	0.6	0.61	0.61
Width/Depth Ratio	24.85	34.02	29.33	28.08	29.51
Entrenchment Ratio	4.5	3.86	3.88	3.98	3.79
Bankfull Width (ft)	15.16	17.69	17.6	17.13	18

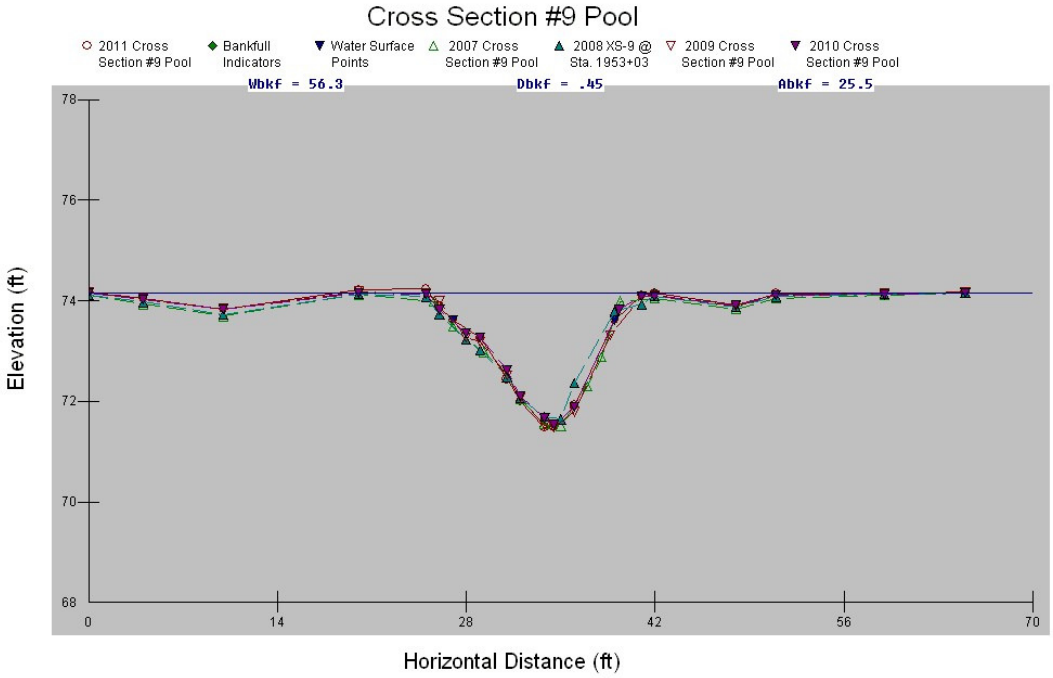


Cross-Section #7 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	13.37	12.97	14.7	13.56	13.21
Maximum Bankfull Depth (ft)	2.2	2.28	2.32	2.14	2.08
Bankfull Mean Depth (ft)	1.25	0.97	1.37	1.26	1.24
Bankfull Width (ft)	10.73	13.33	10.74	10.74	10.68

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.

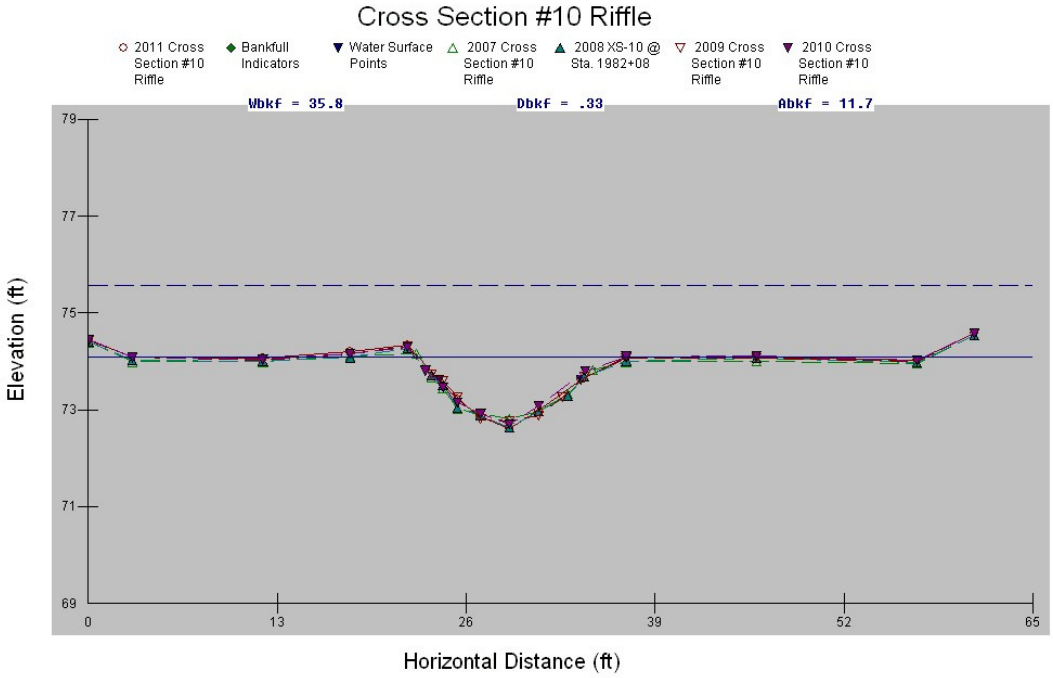


Cross-Section #8 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	6.51	7.54	6.17	6.84	5.83
Maximum Bankfull Depth (ft)	1.07	1.06	0.93	1.51	1.03
Width of the Floodprone Area (ft)	69	69	69	69	69
Bankfull Mean Depth (ft)	0.57	0.44	0.36	0.4	0.37
Width/Depth Ratio	20.18	38.64	47.22	42.5	42.97
Entrenchment Ratio	6	4.06	4.06	4.06	4.34
Bankfull Width (ft)	11.5	17	17	17	15.9

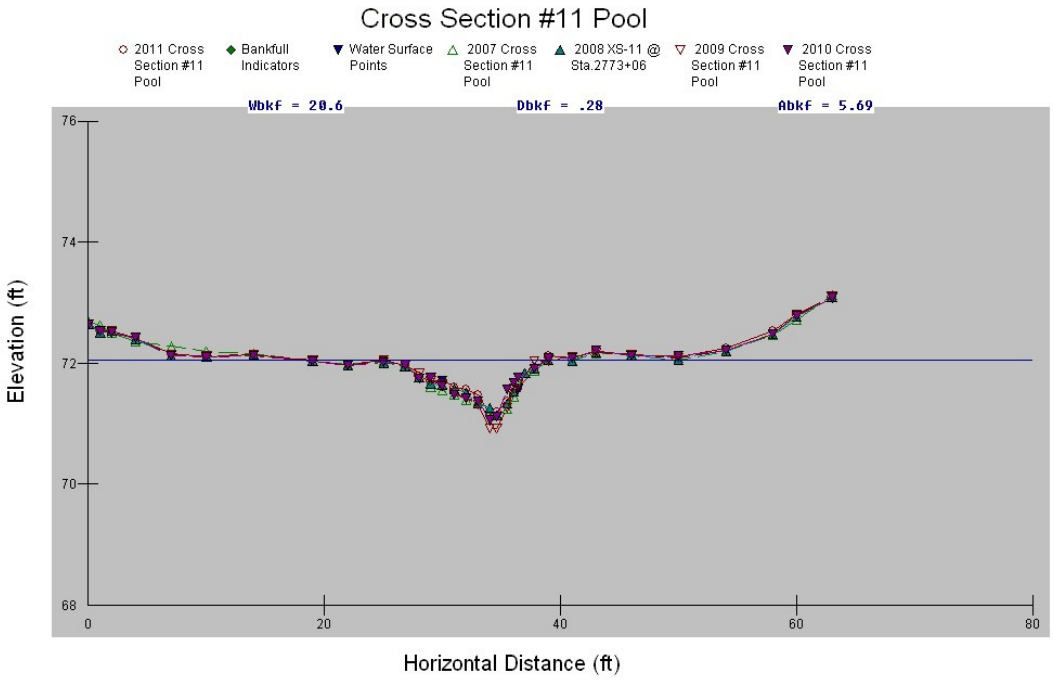


Cross-Section #9 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	19.26	19.26	21.12	19.49	21.24
Maximum Bankfull Depth (ft)	2.48	2.44	2.63	2.56	2.68
Bankfull Mean Depth (ft)	1.4	1.13	1.26	1.23	1.26
Bankfull Width (ft)	13.8	17	16.8	15.87	16.8

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.

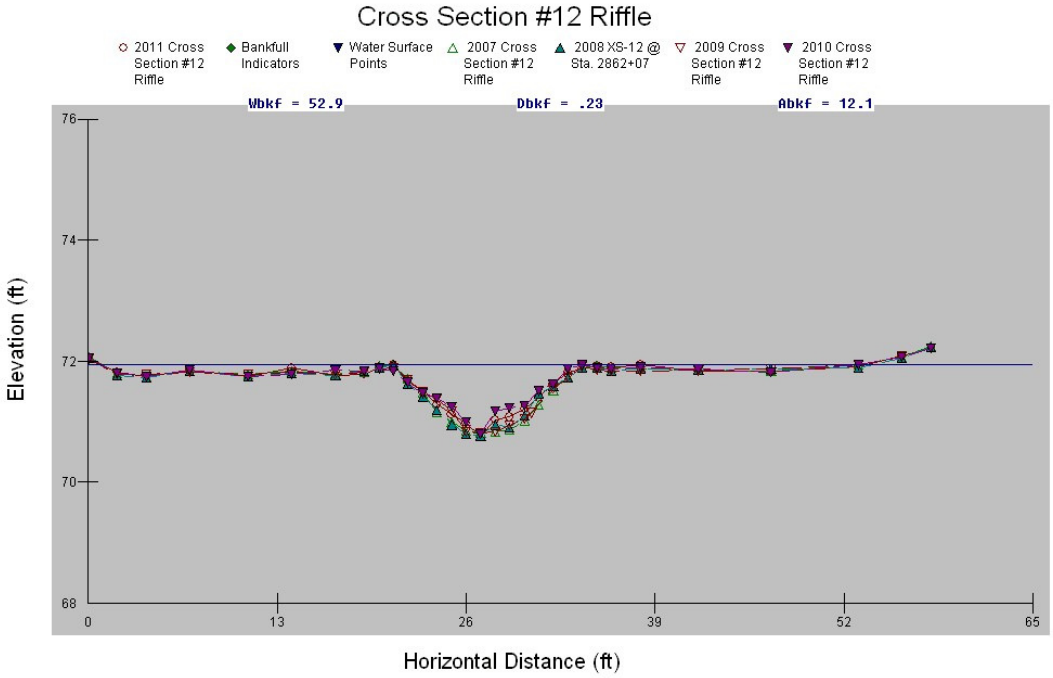


Cross-Section #10 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	9.84	10.65	10.98	10.71	11.17
Maximum Bankfull Depth (ft)	1.17	1.37	1.31	1.4	1.47
Width of the Floodprone Area (ft)	61	61	61	61	61
Bankfull Mean Depth (ft)	0.7	0.75	0.77	0.74	0.78
Width/Depth Ratio	20.1	19.03	18.61	19.62	18.33
Entrenchment Ratio	4.33	4.27	4.26	4.2	4.27
Bankfull Width (ft)	14.07	14.27	14.33	14.52	14.3

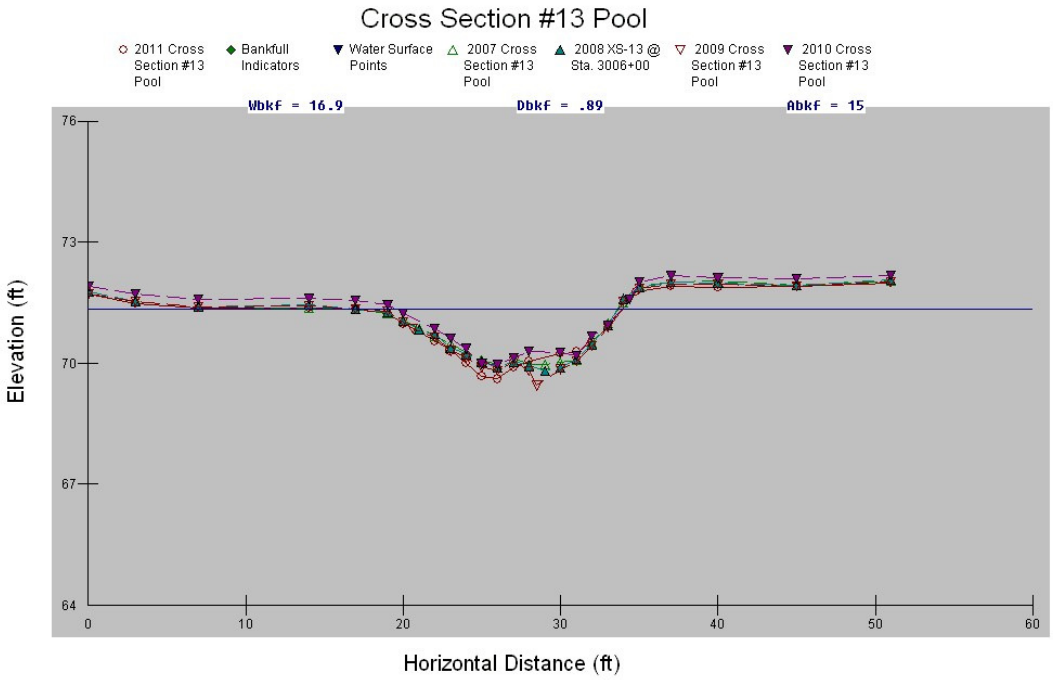


Cross-Section #11 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	5.71	4.22	5.9	5.07	5.41
Maximum Bankfull Depth (ft)	0.89	0.81	1.13	0.96	0.9
Bankfull Mean Depth (ft)	0.41	0.38	0.42	0.37	0.4
Bankfull Width (ft)	13.86	11.26	14	13.58	13.63

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.

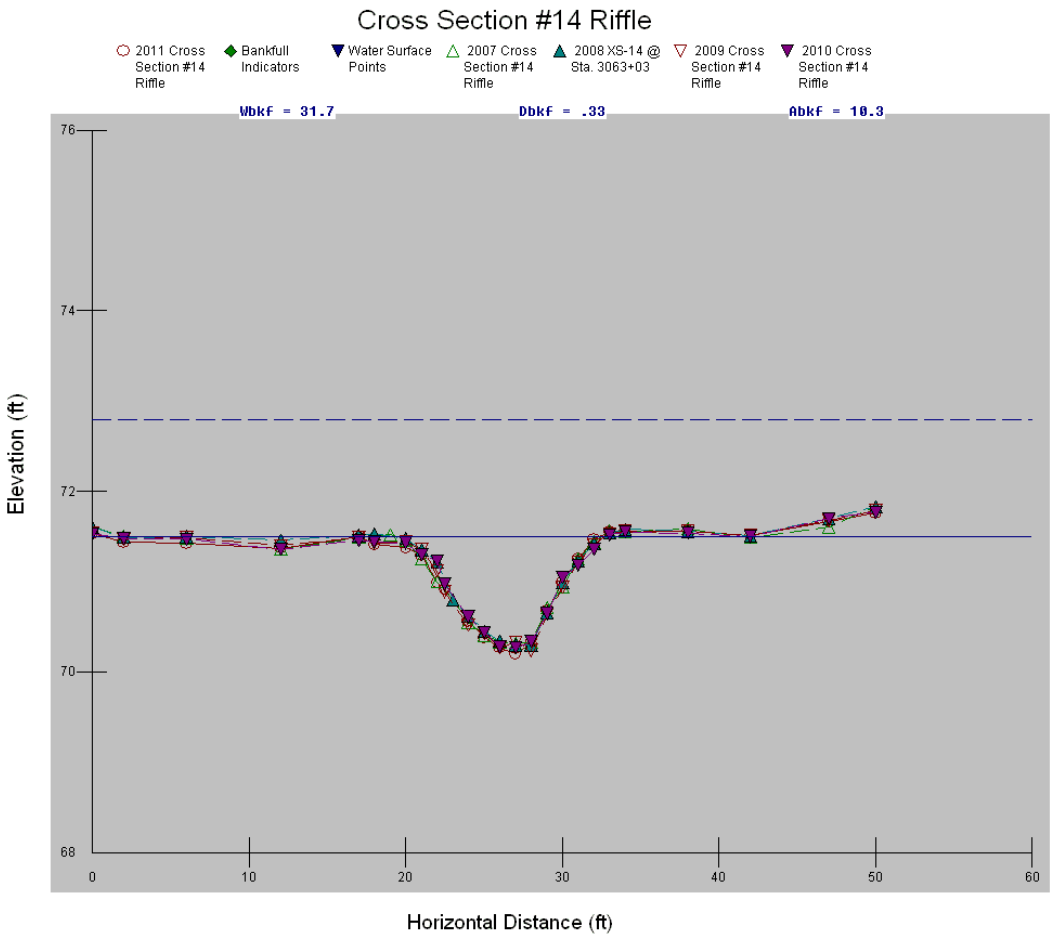


Cross-Section #12 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	8.89	8.28	7.91	5.87	7.86
Maximum Bankfull Depth (ft)	1.11	1.14	1.07	1.04	1.19
Width of the Floodprone Area (ft)	58	58	58	58	58
Bankfull Mean Depth (ft)	0.64	0.64	0.61	0.49	0.65
Width/Depth Ratio	21.73	20.11	21.13	24.24	18.46
Entrenchment Ratio	4.17	4.51	4.5	4.88	4.83
Bankfull Width (ft)	13.91	12.87	12.89	11.88	12

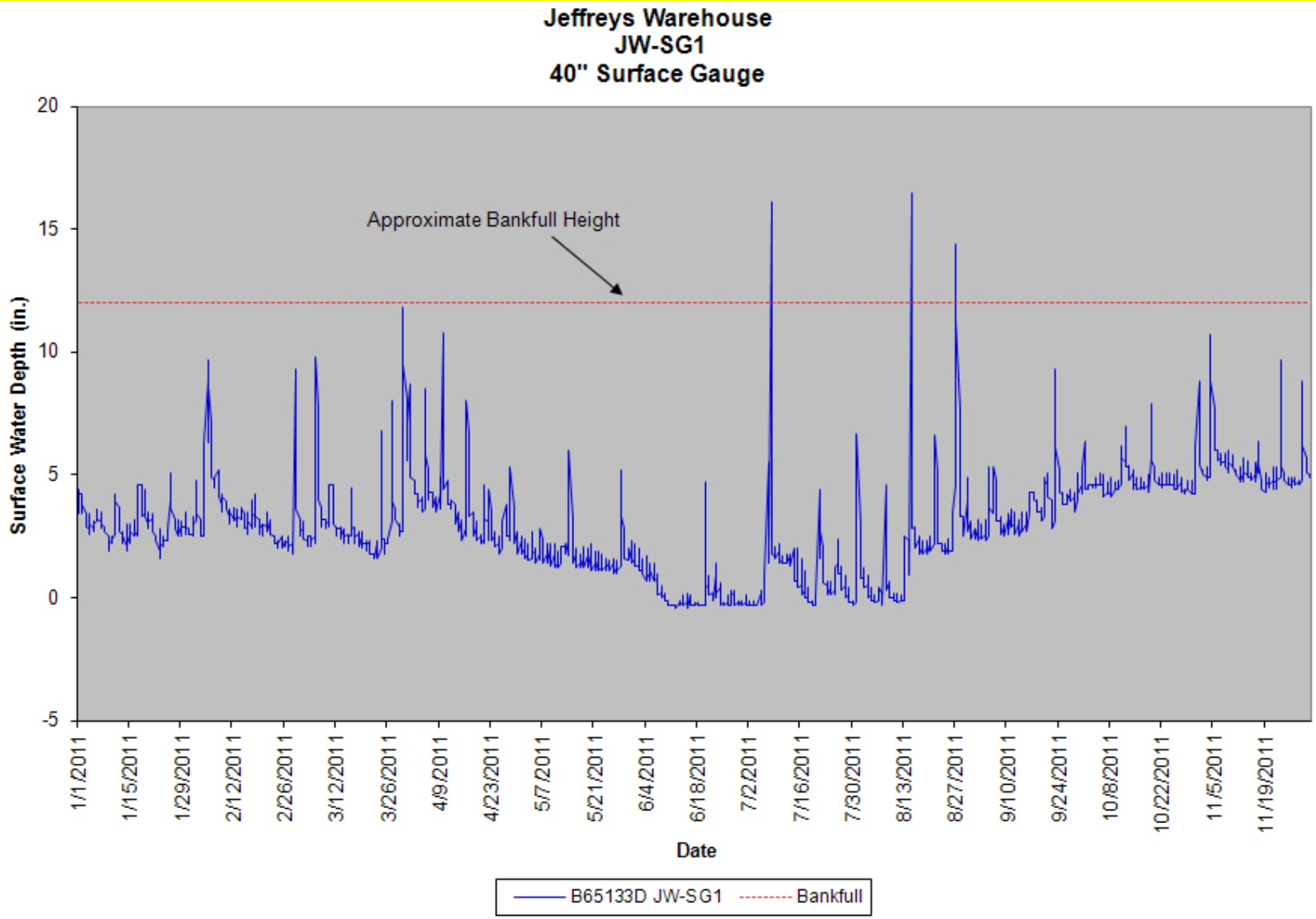


Cross-Section #13 (Pool) Abbreviated Morphological Summary*					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	13.92	13.35	14.85	15.27	14.98
Maximum Bankfull Depth (ft)	1.39	1.46	1.84	1.6	1.73
Bankfull Mean Depth (ft)	0.83	0.92	1.01	0.88	0.89
Bankfull Width (ft)	16.69	14.49	14.63	17.36	16.92

*According to the Rosgen Classification of Natural Rivers floodprone width, entrenchment ratio, and width/depth ratio are not measured in pool, glide or run features.



Cross-Section #14 (Riffle) Abbreviated Morphological Summary					
	2007	2008	2009	2010	2011
Bankfull Cross Sectional Area (ft^2)	8.97	8.76	8.82	8.05	9.10
Maximum Bankfull Depth (ft)	1.21	1.23	1.25	1.19	1.30
Width of the Floodprone Area (ft)	50	50	50	50	50
Bankfull Mean Depth (ft)	0.66	0.58	0.56	0.52	0.59
Width/Depth Ratio	20.71	25.86	27.98	30.04	26.07
Entrenchment Ratio	3.66	3.33	3.19	3.2	3.25
Bankfull Width (ft)	13.67	15	15.67	15.62	15.38


Jeffreys Warehouse
JW-SG1
40" Surface Gauge
Approximate Bankfull Height
Surface Water Depth (in.)
20
15
10
5
0
-5
1/1/2011
1/15/2011
1/29/2011
2/12/2011
2/26/2011
3/12/2011
3/26/2011
4/9/2011
4/23/2011
5/7/2011
5/21/2011
6/4/2011
6/18/2011
7/2/2011
7/16/2011
7/30/2011
8/13/2011
8/27/2011
9/10/2011
9/24/2011
10/8/2011
10/22/2011
11/5/2011
11/19/2011
Date
B65133D JW-SG1
Bankfull