County Line Creek (High Vista)
Monitoring Report
Year 7 (2010)

Buncombe and Henderson Counties, North Carolina

USGS HUC: 06010105
Project ID No. 175

Prepared for:

NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

Submitted November 2010
Revised March 2011

Executive Summary

The County Line Stream Restoration project falls within the USGS hydrologic unit **06010105**. The project stream (County Line Creek) lies within a golf course and the watershed includes low to medium density residential areas and forested areas. Prior to restoration work, landowners efforts to modify the channel through channelization and clearing riparian areas impaired the ecological functions of the creek.

Kimley-Horn and Associates, Inc. (KHA) developed the plans for restoration using natural channel design methods. The original contractor implemented the plans and completed construction of the restored channel in 2002. During the winter of 2007, maintenance work was performed on sections of the lower 2,000 feet of the stream between stations 15+00 and 35+00. KHA performed Years 1-7 monitoring, assessing the stream and riparian condition of the project. 2010 was the third year of monitoring since the repair and the site is planned to be offered for closure at the end of 2011.

Vegetation monitoring was carried out in the fall of 2010 and included the assessment of 8 vegetation plots. The mean stem counts exceeded 1,000 stems per acre, well above the requisite 260 stems per acre, and exhibited a native species count ranging from 3 to 10. The planting associated with the stream repair in 2007 and the supplemental planting in late 2008 (as a result of easement encroachment) created some discontinuity in densities for certain plots. For this reason, the relevant data histories for those plots may not begin until 2008 or 2009. These planting efforts involved the installation of larger, 3 year-old trees that possessed a larger stem caliper and root mass. Some invasive species were observed in vegetation quads 1, 4, 6 and 7. Quads 1, 6 and 7 had multi-flora rose while quad 4 contained privet, but did not appear to be a significant problem. Over the history of the project, landowners adjacent to the riparian buffer have disturbed or destroyed sections of the vegetation. KHA did not observe encroachment in 2010. KHA was informed that EEP staff engaged the new management of the golf course and certain land owners to restate the easement requirements. Bollards with signage marking the boundary were installed and supplemental containerized plantings were added in winter 2008 to previously impacted areas.

The survey included three primary longitudinal profiles and six cross-sections, which have demonstrated stability within their morphologic parameters. The geomorphic topographic survey encompassed areas between stations 03+00 and 35+00. The survey included three primary longitudinal profiles and six cross-sections, which have indicated vertical and lateral stability. The stream assessment, which included a visual survey, indicated 99% of the projects banks are stable and approximately 95% of the riffle/pool features exhibited expected habitat characteristics.

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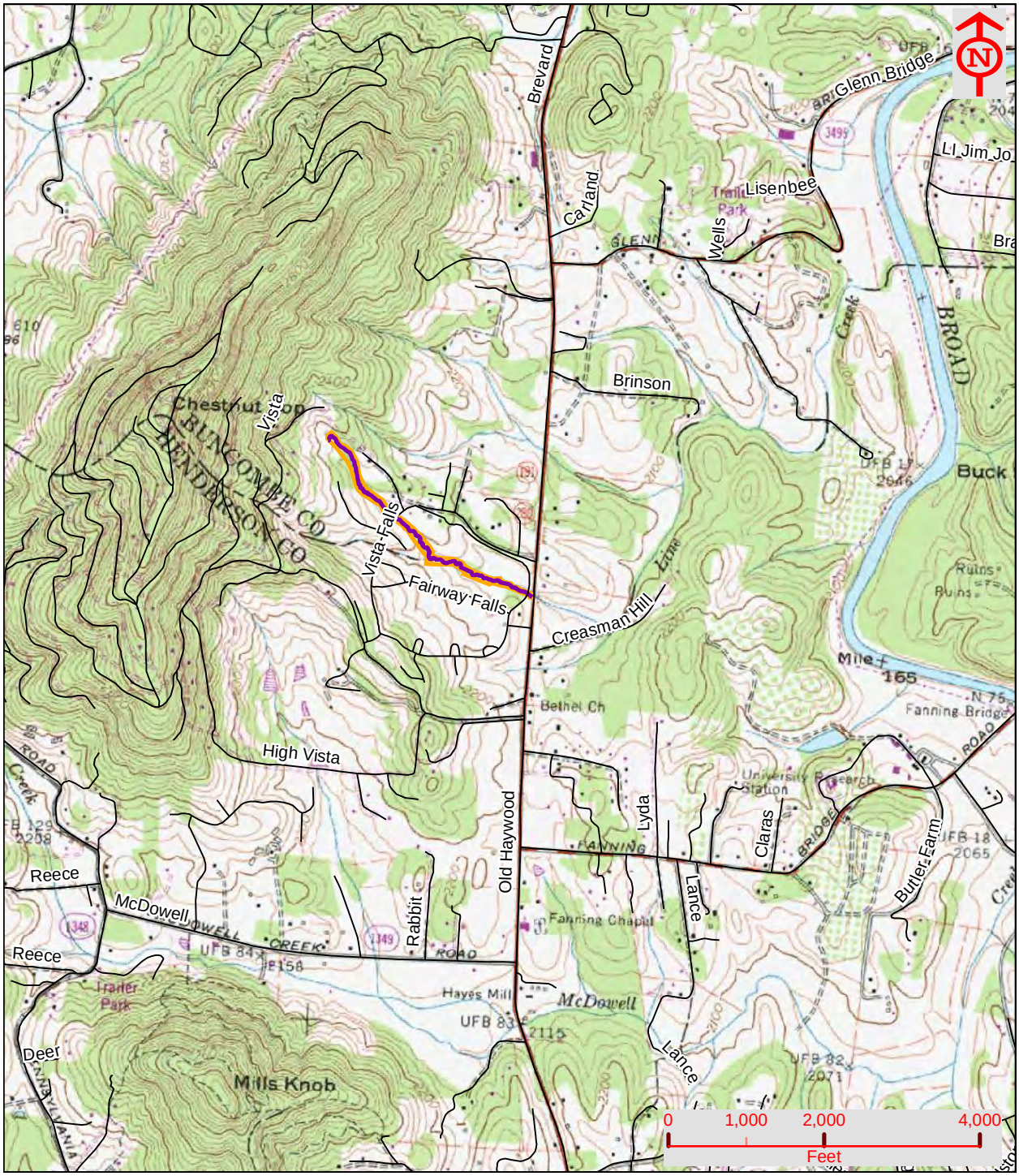

Title	Project Setting		
Prepared For:	**Project**	County Line Creek (High Vista) Stream Restoration Monitoring Year 7 – 2010 Buncombe and Henderson Counties, North Carolina	
	Date	**Project Number**	**Figure**
	3/1/11	175	1

Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Upper (2006 Aerial courtesy of NC One Map)
Prepared For: Ecosystem Enhancement Program	**Project** County Line Creek (High Vista) Stream Restoration Monitoring Year 7 – 2010 Buncombe and Henderson Counties, North Carolina

Date	Project Number	Figure
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Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Middle (2006 Aerial courtesy of NC One Map)
Prepared For: Ecosystem Enhancement Program	**Project** County Line Creek (High Vista) Stream Restoration Monitoring Year 7 – 2010 Buncombe and Henderson Counties, North Carolina

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Kimley-Horn and Associates, Inc.

Title	Current Conditions Plan View Lower (2006 Aerial courtesy of NC One Map)
Prepared For: Ecosystem Enhancement Program	**Project** County Line Creek (High Vista) Stream Restoration Monitoring Year 7 – 2010 Buncombe and Henderson Counties, North Carolina

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Kimley-Horn and Associates, Inc.

PROJECT TABLES

Table I. Project Restoration Components County Line Creek (High Vista) Stream Restoration (EEP No. 00175)											
Project Segment or Reach ID	**Existing Feet / Acres**	**Type**	**Approach**	**Footage or Acreage**		**Creditable Footage**		**Stationing**			**Comment**
Main	3,541	R	P2	3,541	lf	3,442	lf	0+00.0	-	35+00.0	The creditable footage number is the total footage minus 99 feet to account for crossings
Main	287	P	-	287	lf	259	lf	-	-	-	The creditable footage number is the total footage minus 28 feet to account for crossings
Trib	119	R	P2	119	lf	109	lf	-	-	-	The creditable footage number is the total footage minus 10 feet to account for crossings
Trib	52	P	-	52	lf	52	lf	-	-	-	
Mitigation Unit Summaries											
Stream Creditable Footage	**Riparian Wetland (Ac.)**		**Non-Riparian Wetland (Ac.)**					**Total Wetland (Ac.)**		**Buffer (Ac.)**	**Comment**
3,862	- -		- -					- -		- -	

Table II. Project Activity and Reporting History County Line Creek (High Vista) Stream Restoration (EEP No. 00175)				
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**	**Comments**
Restoration Plan	2002		11/2001	
Final Design – 90%			2002	
Construction	2002		8/2002	
Maintenance / Repairs			2007	
Supplemental Plantings			Winter 2008	
Temporary S&E mix applied to entire project area				
Permanent seed mix applied				
Containerized and B&B plantings for reach/segments 1&2	2002			
Mitigation Plan / As-built (Year 0 Monitoring –	2002		10/2002	Performed by Kimley-Horn and Associates
Year 1 monitoring	2003	Oct-05	12/2003	Performed by Kimley-Horn and Associates
Year 2 Monitoring	2004	Oct-06	12/2004	Performed by N.C. State University
Year 3 Monitoring	2005		12/2005	Performed by Soil and Environmental Consultants
Year 4 Monitoring	2007	Nov-07	12/2007	Performed by Kimley-Horn and Associates
Year 5 Monitoring	2008	Dec-08	02/2009	Performed by Kimley-Horn and Associates
Year 6 Monitoring	2009	Nov-09	11/2009	Performed by Kimley-Horn and Associates
Year 7 Monitoring	2010	Nov-10	11/2010	Performed by Kimley-Horn and Associates

Table III. Project Contact Table County Line Creek (High Vista) Stream Restoration (EEP No. 00175)		
Designer	3001 Weston Parkway	
Kimley-Horn and Associates, Inc.	Cary, NC 27513	
Primary Designer POC	Will Wilhelm, P.E.	
Construction Contractor	6106 Corporate Park Drive	
Shamrock Environmental Corp.	Brown Summit, NC 27214	
Primary Contractor POC	Greg Kiser	
Construction Contractor Maintenance	126 Circle G Lane	
Land Mechanic Designs, Inc.	Willow Springs, NC 27592	
Primary Contractor POC		
Planting Contractor		
Planting contractor POC		
Seeding Contractor		
Planting contractor POC		
Seed Mix Sources		
Nursery Stock Suppliers		
Monitoring Performers	3001 Weston Parkway	
Kimley-Horn and Associates, Inc.	Cary, NC 27513	
Stream Monitoring POC	Daren Pait, P.E.	(919) 677-2000
Vegetation Monitoring POC	Daren Pait, P.E.	(919) 677-2000

Table IV. Project Background Table County Line Creek (High Vista) Stream Restoration (EEP No. 00175)	
Project County	Henderson/Buncombe
Drainage Area	0.35 sq. miles
Drainage impervious cover estimate (%)	0.1
Stream Order	1st /2nd
Physiographic Region	Mountain
Ecoregion	Blue Ridge Belt
Rosgen Classification of As-built	B4/C4
Cowardin Classification	N/A
Dominant soil types	Codorus, Hayesville, Delanco
Reference site ID	N/A
USGS HUC for Project and Reference	6010105
NCDWQ Sub-basin for Project and Reference	04-3-2002
NCDWQ classification for Project and Reference	N/A
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	0%

Table V. Verification of Bankfull Events County Line Creek (High Vista) Stream Restoration (EEP No. 00175)			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo #**
10/20/2009	N/A	Bankfull wracklines were not observed and the crest gauge did not indicate bkf event occurrence.	N/A
11/12/2009	Oct-Nov 2009	Bankfull wracklines were observed, indications that there had been a bankfull event.	N/A
7/7/2010	N/A	Crest Gage indicated a 1.75' bankfull event	SP1

Table VI. Categorical Stream Feature Visual Stability Assessment County Line Creek (High Vista) Stream Restoration (EEP No. 00175) Reach 1								
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**	**MY-06**	**MY-07**
A. Riffles	--	--	--	87%	94%	94%	95%	95%
B. Pools	--	--	--	95%	93%	93%	93%	93%
C. Thalweg	--	--	--	100%	100%	100%	100%	100%
D. Meanders	--	--	--	78%	96%	96%	96%	96%
E. Bed General	--	--	--	82%	100%	99%	99%	99%
F. Bank Condition	--	--	--	92%	100%	100%	99%	99%
G. Vanes / J Hooks etc.	--	--	--	88%	93%	93%	95%	95%
H. Wads and Boulders	--	--	--	52%	78%	78%	90%	90%

Table VII. Baseline Morphology and Hydraulic Summary

County Line Creek (High Vista) Stream Restoration (EEP No. 00175)

Reach 1

Parameter		USGS Gage Data			Regional Curve			Pre-Existing Condition			Project Reference Stream (Onsite)			Project Reference Stream (Raccoon Creek)			Design			As-built		
	Units	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																						
BF Width	ft	*	*	*	*	*	12.9	3	8	6	6.1	8.6	*	15.4	15.9	15.7	6	9	*	*	*	8.9
Floodprone Width	ft	*	*	*	*	*	*	19	73	40	9	18	*	*	*	100	*	*	>20.0	*	*	19.0
BF Cross Sectional Area	ft^2	*	*	*	*	*	10.6	8	11	10	3.3	5.1	*	23.8	23.8	23.8	3.3	5.1	*	*	*	4.3
BF Mean Depth	ft	*	*	*	*	*	0.8	1	3.3	2	0.5	0.6	*	1.5	1.5	1.5	0.5	0.6	*	*	*	0.5
BF Max Depth	ft	*	*	*	*	*	*	*	*	*	0.8	1.2	*	2.4	2.7	2.6	0.8	1.2	*	*	*	1.1
Width/Depth Ratio		*	*	*	*	*	*	1	8	2.7	11.3	14.4	*	10	10.7	10.3	12	15	*	*	*	18.5
Entrenchment Ratio		*	*	*	*	*	*	3	12	6.7	1.5	2.1	*	*	*	6.4	*	*	>2.2	*	*	2.1
Bank Height Ratio											1	1				1.3						
Wetted Perimeter	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Hydraulic radius	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Pattern																						
Channel Beltwidth	ft	*	*	*	*	*	*	15	60	30	*	*	*	*	*	52	*	*	18+			
Radius of Curvature	ft	*	*	*	*	*	*	*	*	*	*	*	*	8.5	15.8	12.2	*	*	18			
Meander Wavelength	ft	*	*	*	*	*	*	60	135	90	32	48	41	30	84	49.4	18	98	*			
Meander Width ratio		*	*	*	*	*	*	3	10	5	*	*	*	3.3	3.4	3.3	*	*	2+			
Profile																						
Riffle length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Riffle slope	ft/ft	*	*	*	*	*	*	0.01	0.1	0.04	0.01	0.023	0.02	0.063	0.115	0.085	0.04	0.1	*	*	*	0.045
Pool length	ft	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*			
Pool spacing	ft	*	*	*	*	*	*	*	*	*	8.5	36	*	42	163	102	9	48	30			50.3
Substrate[1]																						
d50	mm	*	*	*	*	*	*	*	*	11.6	31.4	34.8	*	*	*	0.8	*	*	*			
d84	mm	*	*	*	*	*	*	*	*	63	62	86	*	*	*	64	*	*	*			
Additional Reach Parameters																						
Valley Length	ft		*			*			*			*			*			*			*	
Channel Length	ft		*			*			*			*			*			*			*	
Sinuosity			*			*			1.1			*	1		*	1.3		1.1 - 1.2			*	
Water Surface Slope	ft/ft		*			*			*			*			*			*				
BF slope	ft/ft		*			*			0.039		0.007	0.07				0.01		0.039			*	
Rosgen Classification			*			*			Incised E,F,G			B4			E5c			B4			B4/C4	
*Habitat Index			*			*			*			*			*			*			*	
*Macrobenthos			*			*			*			*			*			*			*	

[1]Substrate collected at each cross section

Table VIII. Morphology and Hydraulic Monitoring Summary
County Line Creek (High Vista) Stream Restoration (EEP No. 00175)

Parameter		Cross Section 1								Cross Section 2								Cross Section 3							
		Riffle								Pool								Riffle							
Dimension	**Units**	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7
BF Width	ft	8.8	6.9	3.7	16.3	9.1	9.3	8.7	10.0	13.4	11.0	6.0	14.4	*	6.0	7.9	8.1	9.0	9.3	18.0	9.9	5.0	5.7	5.6	5.7
Floodprone Width	ft	16.0	14.0	*	32.3	38.2	15.4	21.0	21.8			*	25.5	*	11.1	12.0	19.2	22.0	25.0	*	23.7	20.8	26.9	23.0	22.0
BF Cross Sectional Area	ft	3.2	2.9	2.1	9.6	3.1	1.6	1.9	2.7	15.3	16.0	2.0	11.8	*	3.3	5.5	6.7	5.4	8.3	18.4	9.6	3.0	2.0	2.5	3.7
BF Mean Depth	ft	0.4	0.4	0.6	0.6	0.3	0.2	0.2	0.3	1.1	1.4	0.3	0.8	*	0.6	0.7	0.8	0.6	0.9	1.0	1.0	0.6	0.5	0.4	0.6
BF Max Depth	ft	0.9	1.2	1.0	1.5	0.9	0.5	0.7	0.9	2.7	2.9	1.4	1.6	*	1.0	1.4	1.5	1.2	1.5	3.0	1.8	1.0	1.3	1.1	1.3
Width/Depth Ratio		24.2	16.6	6.4	27.7	26.8	16.0	40.2	36.9	*	7.6	18.2	17.4	*	11.0	11.3	9.9	14.9	10.4	17.7	10.3	8.3	8.3	12.8	8.9
Entrenchment Ratio		1.8	2.0	*	2.0	4.2	1.5	2.4	2.2	*	*	*	1.8	*	1.9	1.5	2.4	2.4	2.7	*	2.4	4.2	3.0	4.1	3.4
Bank Height Ratio		1.0	1.0	*	*	1.0	1.0	1.1	1.0	*	*	*	*	*	1.0	1.4	1.0	1.0	1.0	*	*	1.0	1.0	1.3	1.0
Wetted Perimeter	ft	9.4	8.1	*	17.4	9.4	9.5	9.0	10.6	14.9	14.0	*	15.0	*	6.5	7.8	9.2	9.7	10.7	*	11.9	5.5	5.9	6.2	6.6
Hydraulic radius	ft	0.3	0.4	*	0.6	0.3	0.2	0.2	0.3	1.0	1.1	*	0.8	*	0.5	0.7	0.7	0.6	0.8	*	0.8	0.5	0.5	0.4	0.6
Substrate																									
d50	mm	1.0	22.0	1.6	*	2.3	0.1	22.6	0.1	*	*	2.0	*	*	8.0	16.0	5.7	4.9	8.2	0.3	*	3.3	0.3	11.3	0.5
d84	mm	30.1	47.9	16.0	*	25.6	19.3	64.0	16.0	*	*	22.6	*	*	72.6	32.0	64.0	25.3	36.6	7.2	*	36.1	11.7	45.0	11.3

Parameter		Cross Section 4								Cross Section 5								Cross Section 6							
		Pool								Riffle								Riffle							
Dimension	**Units**	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7	AB	MY1	MY2	MY3	MY4	MY5	MY6	MY7
BF Width	ft	14.6	9.7	11.4	11.6	11.1	11.9	14.3	11.3	*	*	*	*	7.1	4.7	7.7	7.8	10.1	*	*	*	*	*	8.6	8.6
Floodprone Width	ft				17.9	13.8	19.1	25.0	17.0	*	*	*	*	16.8	13.5	37.0	17.1	34.0	*	*	*	*	*	34.0	29.2
BF Cross Sectional Area	ft	17.7	15.4	25.1	11.3	4.9	7.6	23.0	10.3	*	*	*	*	2.8	0.8	4.0	2.4	2.7	*	*	*	*	*	2.8	3.8
BF Mean Depth	ft	1.2	1.6	2.2	1.0	0.4	0.6	1.6	0.9	*	*	*	*	0.4	0.4	0.5	0.3	0.3	*	*	*	*	*	0.3	0.4
BF Max Depth	ft	2.3	1.8	3.3	1.6	0.8	1.5	2.8	1.6	*	*	*	*	0.9	1.0	1.2	0.9	0.8	*	*	*	*	*	0.8	1.0
Width/Depth Ratio		12.1	6.1	5.2	12.0	27.8	8.5	8.9	12.4	*	*	*	*	17.8	9.3	14.8	25.8	37.6	*	*	*	*	*	26.6	19.6
Entrenchment Ratio		*	*	*	1.5	1.2	1.7	1.7	1.5	*	*	*	*	2.4	1.4	4.8	2.2	3.4	*	*	*	*	*	4.0	3.4
Bank Height Ratio		*	*	*	*	1.0	1.7	1.1	1.0	*	*	*	*	1.0	2.0	1.3	1.0	1.3	*	*	*	*	*	1.0	1.0
Wetted Perimeter	ft	15.7	12.0	*	13.0	11.3	12.7	15.9	11.9	*	*	*	*	7.5	4.9	8.2	8.1	9.0	*	*	*	*	*	8.2	9.1
Hydraulic radius	ft	1.1	1.3	*	0.9	0.4	0.6	1.5	0.9	*	*	*	*	0.4	0.4	0.5	0.3	0.3	*	*	*	*	*	0.3	0.4
Substrate																									
d50	mm	*	*	3.5	*	2.8	16.0	0.5	16.0	*	*	*	*	*	N/A	<0.062	<0.062	*	*	*	*	*	*	*	*
d84	mm	*	*	29.8	*	21.3	39.3	16.0	32.0	*	*	*	*	*	0.1	0.1	0.1	*	*	*	*	*	*	*	*

Parameter		AB (2002)			MY-01 (2003)			MY-02 (2004)			MY-03 (2005)			MY-04 (2007)			MY-05 (2008)			MY-06 (2009)			MY-07 (2010)		
Pattern		**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth	ft	*	*	*	*	*	*	15	79	26	38	110	68	9.4	38.5	21.8	9.4	38.5	21.8	9.4	38.5	21.8	9.4	38.5	21.8
Radius of Curvature	ft	*	*	*	*	*	*	13	96	41	23	57	33	7.3	70.7	21.1	7.3	70.7	21.1	7.3	70.7	21.1	7.3	70.7	21.1
Meander Wavelength	ft	*	*	*	*	*	*	50	378	124	83	464	173	72	193	108	72	193	108	72	193	108	72	193	108
Meander Width ratio		*	*	*	*	*	*				2.9	8.3	5.2	1.2	4.8	2.7	1.2	4.8	2.7	1.2	4.8	2.7	1.2	4.8	2.7
Profile																									
Riffle length	ft	*	*	*	*	*	*	14.3	71.4	28.6	*	*	*	4.2	52.3	19.7	9.9	49.3	32.4	4.3	33.8	13.2	8.8	41.3	16.4
Riffle slope	ft/ft	*	*	0.0450	*	*	0.0500	0.0120	0.0433	0.0181	0.0187	0.0274	0.0243	0.007	0.082	0.042	0.0036	0.0538	0.02935	0.0179	0.0966	0.0367	0.0150	0.0590	0.0350
Pool length	ft	*	*	*	*	*	*	5.7	40.0	14.3	8.8	31.7	18.3	6.8	44.6	25.1	7.5	68.6	35.6	7.0	39.0	17.5	5.5	43.6	16.4
Pool spacing	ft	*	*	30	*	*	55	28.6	245.7	100.0	12.2	76.6	49.3	25.0	117.0	56.0	24.8	98.5	43.7	15.3	92.1	32.9	9.0	124.5	42.4
Additional Parameters																									
Valley Length	ft												2977			3426									
Channel Length	ft												3513			3623									
Sinuosity													1.18			1.06									
Water Surface Slope	ft/ft												*												
BF slope	ft/ft	0.02	0.05		0.0212	0.0415		0.025	0.061	0.04			0.02431	0.008	0.03	0.02	0.0241	0.0506	0.0249	0.0241	0.0506	0.0249	0.0239	0.05	0.0243
Rosgen Classification													B4			B4									
Habitat Index*																									
Macrobenthos*																									

AB and MY1 Materials for sections - XS1 Riffle values represent the upper section and XS 3 Riffle values represent the lower sections.

APPENDIX A
VEGETATION MONITORING DATA

Table AI. Vegetative Problem Areas County Line Creek (High Vista) Stream Restoration (EEP No. 00175)						
Feature/Issue	**Station # / Range**			**Side**	**Probable Cause**	**Photo #**
Bare Bank						
Bare Bench						
Varying Degrees of Encroachment						
Invasive/Exotic Populations	225	-	275	Left	Small population of Multiflora Rose	VP1
	700	-	800	Left	Small population of Chinese Privet	
	1,510	-	1,600	Left	Small population of Chinese Privet	VP2
	2,100	-	2,200	Right	Small population of Multiflora Rose	
	2,500	-	2,550	Left	Small population of Chinese Privet	
	2,800	-	2,850	Left	Small population of Multiflora Rose	

Table AII: Stem counts for each species arranged by plot.
County Line Creek (High Vista) Stream Restoration (EEP No. 00175)

Plots	1						2						3						4					
Year	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010
Acer rubrum					1	2					1													
Alnus serrulata			10	1	1	3			3		1	3												
Betula nigra										2	1	1			2	1		2						
Cornus amomum	19	19		2	3	3			1			2	9	8		5	6	5			13	6	6	6
Diospyros virginiinia																								
Fraxinus pennsylvanica			2						1	2	1	1			1				3	3	2			
Hamamelis virginiana																2	2	2			1	1	2	1
Liriodendron tulipera			11	7	5	6				2	6	5				1	3	3			4	2	2	1
Lindera benzoin												1												
Pinus taeda					1	1																		
Platanus occidentalis			12	3	7	5	1	1	11	6	9	6												
Populus deltoides	1	1										3	5	5	1						8			3
Prunus serotina						3												3			2	1	1	1
Quercus rubra																								
Robinia pseudoacacia			3	4	1	4			1	1	2					2	1	2						
Salix nigra	15	13	2	3	3	3					1	2	9	6				1			7	5	6	6
Sambucus canadensis	1	1	2						1	1	1	1	0	0										
Viburnum dentatum	5	3											4	4										
Total Stems	41	37	42	20	22	30	1	1	18	14	23	25	27	23	4	11	12	18	3	3	37	15	17	18
Plot Size (acres)	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0210	0.0210	0.0210	0.0210	0.0210	0.0210	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0210	0.0210	0.0210	0.0210	0.0210	0.0210
Stems Per Acre	5942	5362	6087	2899	3188	4348	48	48	857	667	1095	1190	3913	3333	580	1594	1739	2609	143	143	1762	714	810	857
Stems Per acre Requirements	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260

Plots	5						6						7						8					
Year	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010	2003	2005	2007	2008	2009	2010
Acer rubrum																								
Alnus serrulata																	2	1					1	1
Betula nigra					3	5					3	3						1						
Cornus amomum	16	15	6	11	12	12						2	12	12			3	4	20	17	11	14	15	15
Diospyros virginiinia						1					3	3												
Fraxinus pennsylvanica			2	1	1																			
Hamamelis virginiana																								
Liriodendron tulipera					1																		1	1
Lindera benzoin																								
Pinus taeda																								
Platanus occidentalis																								
Populus deltoides	0	0												0						0				
Prunus serotina						1					10	7												
Quercus rubra						1					1	2												
Robinia pseudoacacia																								
Salix nigra	7	7	2	1	1	1								0						0	1	1	1	1
Sambucus canadensis	6	0	1										5	4						0				
Viburnum dentatum	0	0												0						0				
Total Stems	29	22	11	13	18	21	0	0	0	0	17	17	17	16	0	0	5	6	20	17	12	15	18	18
Plot Size (acres)	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0210	0.0210	0.0210	0.0210	0.0210	0.0210	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069	0.0069
Stems Per Acre	4203	3188	1594	1884	2609	3043	0	0	0	0	810	810	2464	2319	0	0	725	870	2899	2464	1739	2174	2609	2609
Stems Per acre	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260

Note: The planting associated with the stream repair plus the supplemental planting in late 2008 associated with recent encroachment areas created some discontinuity in densities for certain plots and for this reason the relevant data histories for those plots may not begin until 2008 or 2009. These planting efforts involved the installation of larger, 3 year-old trees that possessed a larger stem caliper and root mass.

VQ 1 (2010)

VQ 2 (2010)

VQ 3 (2010)

VQ 4 (2010)

VQ 5 (2010)

VQ 6 (2010)

VQ 7 (2010)

VQ 8 (2010)

APPENDIX B
STREAM MONITORING DATA

Table BI. Stream Problem Areas

County Line Creek (High Vista) Stream Restoration (EEP No. 00175)

Feature Issue	Station # / Range			Side	Description	Suspected Cause	Photo number
2010 Assessment							
Degradation	0+80	-	0+90	Center	Headcut - Localized	Excessive shear stress	
	8+65	-	8+78	Center	Headcut - Localized	Excessive shear stress	
Bank scour	9+25	-	9+40	Left	Outer bend scour	Excessive shear stress	
	10+05	-	10+15	Left	Outer bend scour	Excessive shear stress	
	10+50	-	10+55	Center	Bank Scour	Excessive shear stress	
	36+92	-	37+16	Left	Outer bend scour	Excessive shear stress	
2009 Assessment							
Degradation	0+80	-	0+90	Center	Headcut - Localized	Excessive shear stress	
	8+65	-	8+78	Center	Headcut - Localized	Excessive shear stress	
Bank scour	9+25	-	9+40	Left	Outer bend scour	Excessive shear stress	
	10+05	-	10+15	Left	Outer bend scour	Excessive shear stress	
	10+50	-	10+55	Center	Bank Scour	Excessive shear stress	
	36+92	-	37+16	Left	Outer bend scour	Excessive shear stress	
2008 Assessment							
Degradation	10+25	-	10+50	Center	Bed Degradation		
	12+50	-	13+10	Center	Bed Degradation		
Bank scour	10+00	-	10+15	Left	Bank Scour		
2007 Assessment							
Degradation	8+75			Center	Headcut - Localized	Excessive shear stress	SP1
	12+50			Center	Headcut - Localized	Excessive shear stress	SP2
Bank scour	10+50	-	10+55	Left	Outer bend scour	Excessive shear stress	SP3
	11+50	-	11+70	Right	Bank scour	Excessive shear stress	SP4
Engineered structures – back or arm scour Etc.	22+91			Center	Arm scour and missing header rock - Located on adjacent tributary	Excessive shear stress	SP5
2005 Assessment							
Bank scour	31+59	-	31+72			High velocity/excess shear	
	29+68					Structure scour	
	27+50	-	26+92			High velocity/excess shear	
	27+28					Scour at rootwad	
	15' up UT		23+78			High velocity/excess shear	
	13+12					Scour at structure	
Engineered structures – back or arm scour Etc.	34+75					Rock shift at apex of vane	
	34+00					Large drop over structure	
	29+68					Rootwad scour (span channel)	
	28+94					Large drop over structure	
	27+28					Scour at rootwad	
	13+12					Scour at structure	
	4+27					Large drop over structure -scour at structure	
	1+80					Water flowing under vane	
2004 Assessment							
Structure Failure	360						
	1,310						
	2,040						
	2,790						
	2,810						
	2,860						
	3,360						
	3,470						
Bank Erosion	1,145						
	3,300						

Table BII. Visual Morphological Stability Assessment

County Line Creek (High Vista) Stream Restoration (EEP No. 00175)

Feature Category		Metric (per As-built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-built	Total Number / feet in unstable state			% Perform in Stable Condition	Feature Perform. Mean or Total
A. Riffles	1	Present?	36	36		NA		100%	94%
	2	Armor stable (e.g. no displacement)?	36	36		NA		100%	
	3	Facet grade appears stable?	32	36		NA		89%	
	4	Minimal evidence of embedding/fining?	36	36		NA		100%	
	5	Length appropriate?	30	36		NA		83%	
B. Pools	1	Present? (e.g not subject to severe aggrad. or migrat.?)	35	35		NA		100%	93%
	2	Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	32	35		NA		91%	
	3	Length appropriate?	31	35		NA		89%	
C. Thalweg	1	Upstream of meander bend (run/inflection) centering?	30	30		NA		100%	100%
	2	Downstream of meander (glide/inflection) centering?	30	30		NA		100%	
D. Meanders	1	Outer bend in state of limited/controlled erosion?	29	30		NA		97%	96%
	2	Of those eroding, # w/concomitant point bar formation?	1	1		NA		100%	
	3	Apparent Rc within spec?	26	30		NA		87%	
	4	Sufficient floodplain access and relief?	30	30		NA		100%	
E. Bed General	1	General channel bed aggradation areas (bar formation)			0	/	0	100%	99%
	2	Channel bed degradation – areas of increasing down-cutting or head cutting?			3	/	85	98%	
F. Bank	2	Actively eroding, wasting, or slumping bank			2	/	25	100%	100%
G. Vanes	1	Free of back or arm scour?	44	45		NA		98%	94%
	2	Height appropriate?	41	45		NA		91%	
	3	Angle and geometry appear appropriate?	42	45		NA		93%	
	4	Free of piping or other structural failures?	43	45		NA		96%	
H. Wads/ Boulders	1	Free of scour?	7	9		NA		78%	89%
	2	Footing stable?	9	9		NA		100%	

Total Assessment length was 3,500 linear feet

H: As-Built number = number assessed, some structures not readily visible. Banks in these areas were stable

PS 1 (2010)

PS 2 (2010)

PS 3 (2010)

PS 4 (2010)

PS 5 (2010)

PS 6 (2010)

PS 7 (2010)

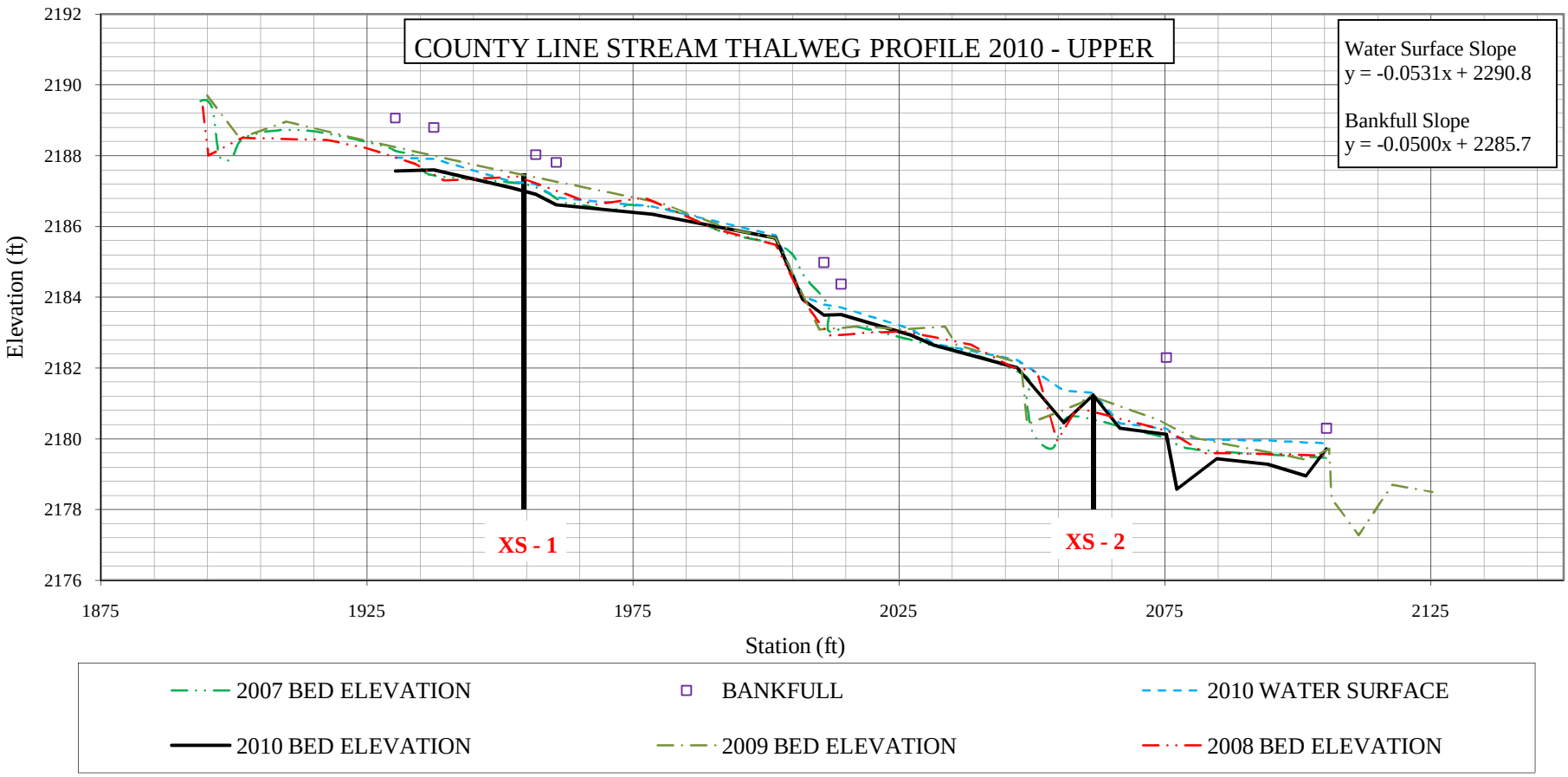
PS 8 (2010)

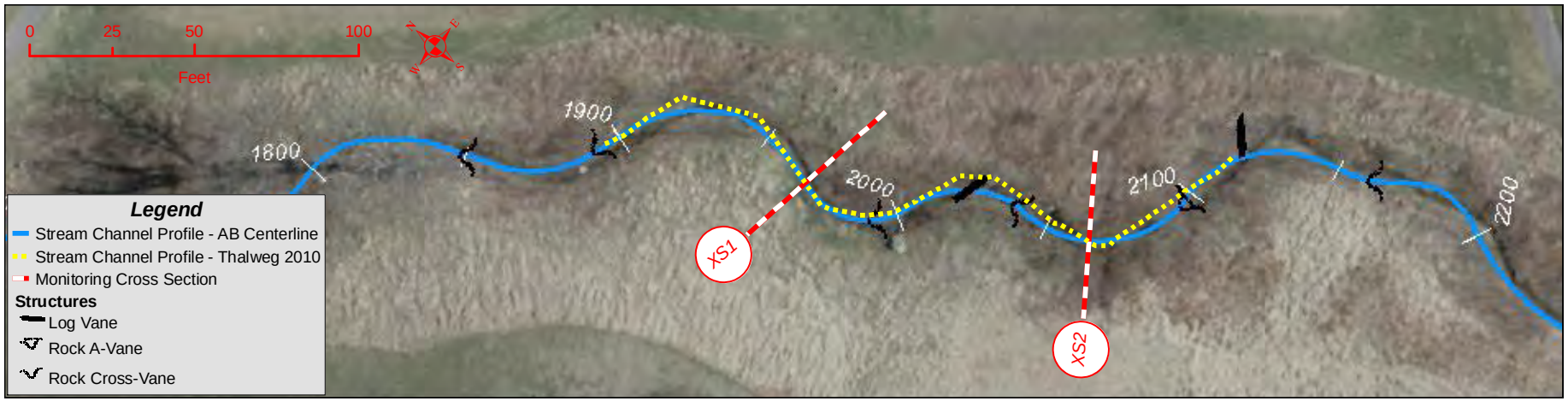
PS 9 (2010)

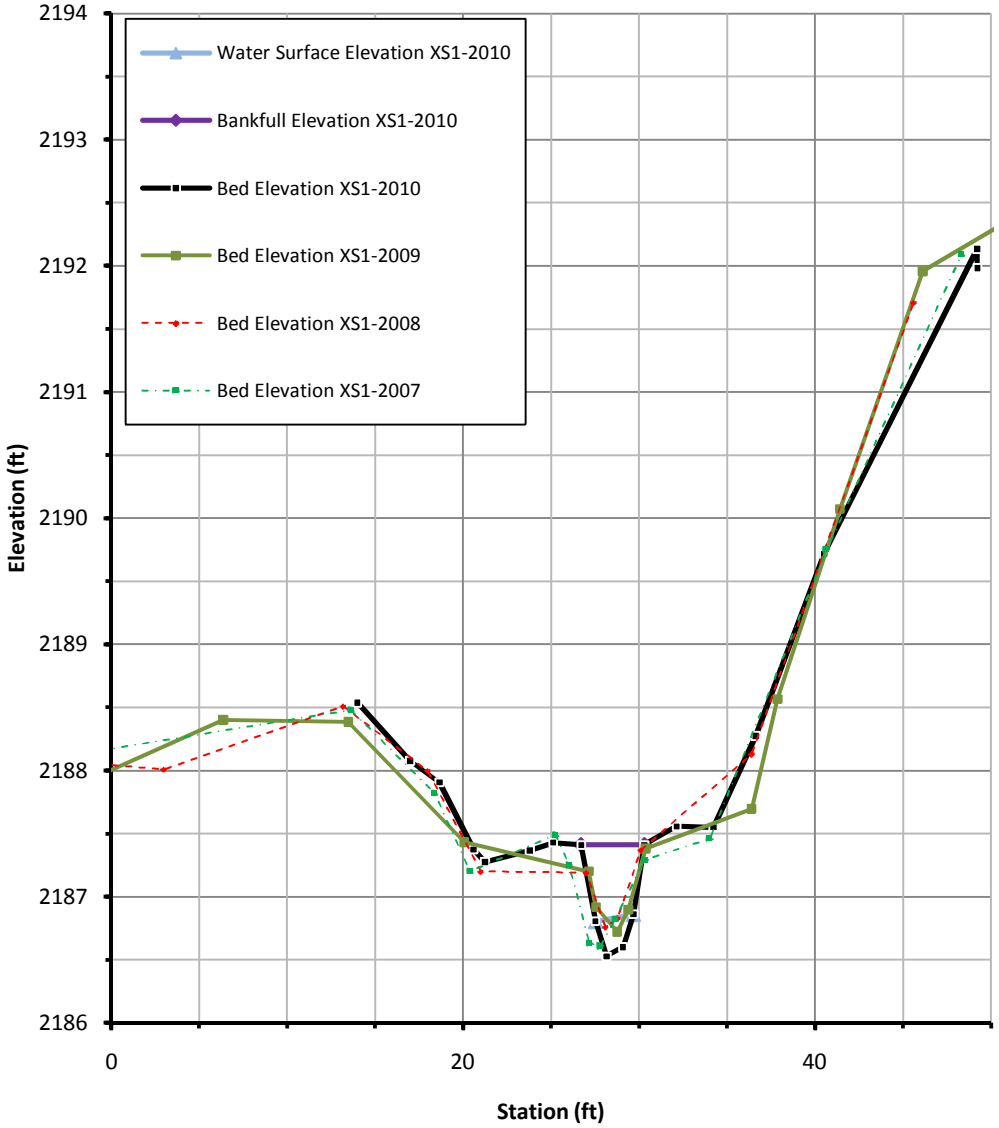
PS 10 (2010)

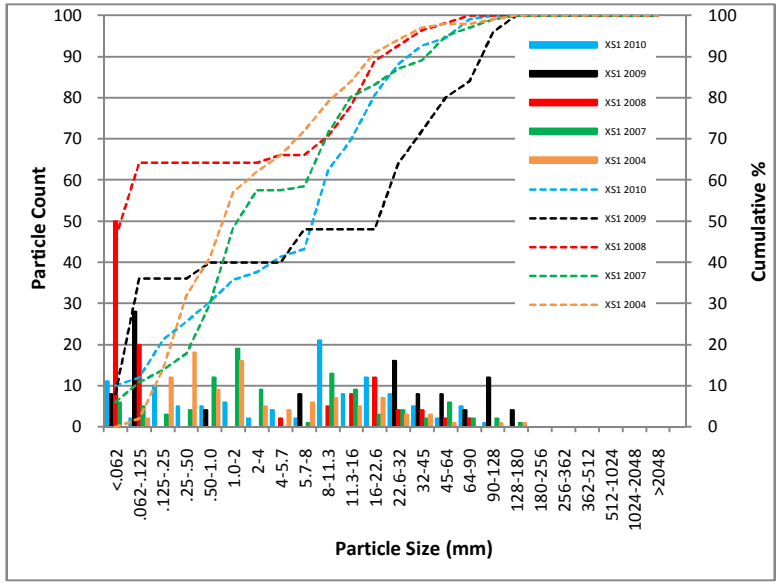
PS 11 (2010)

SP 1: Crest Gage


COUNTY LINE STREAM THALWEG PROFILE 2010 - UPPER
Water Surface Slope
y = -0.0531x + 2290.8
Bankfull Slope
y = -0.0500x + 2285.7
Elevation (ft)
2192
2190
2188
2186
2184
2182
2180
2178
2176
1875
1925
1975
2025
2075
2125
Station (ft)
XS - 1
XS - 2
2007 BED ELEVATION
BANKFULL
2010 WATER SURFACE
2010 BED ELEVATION
2009 BED ELEVATION
2008 BED ELEVATION

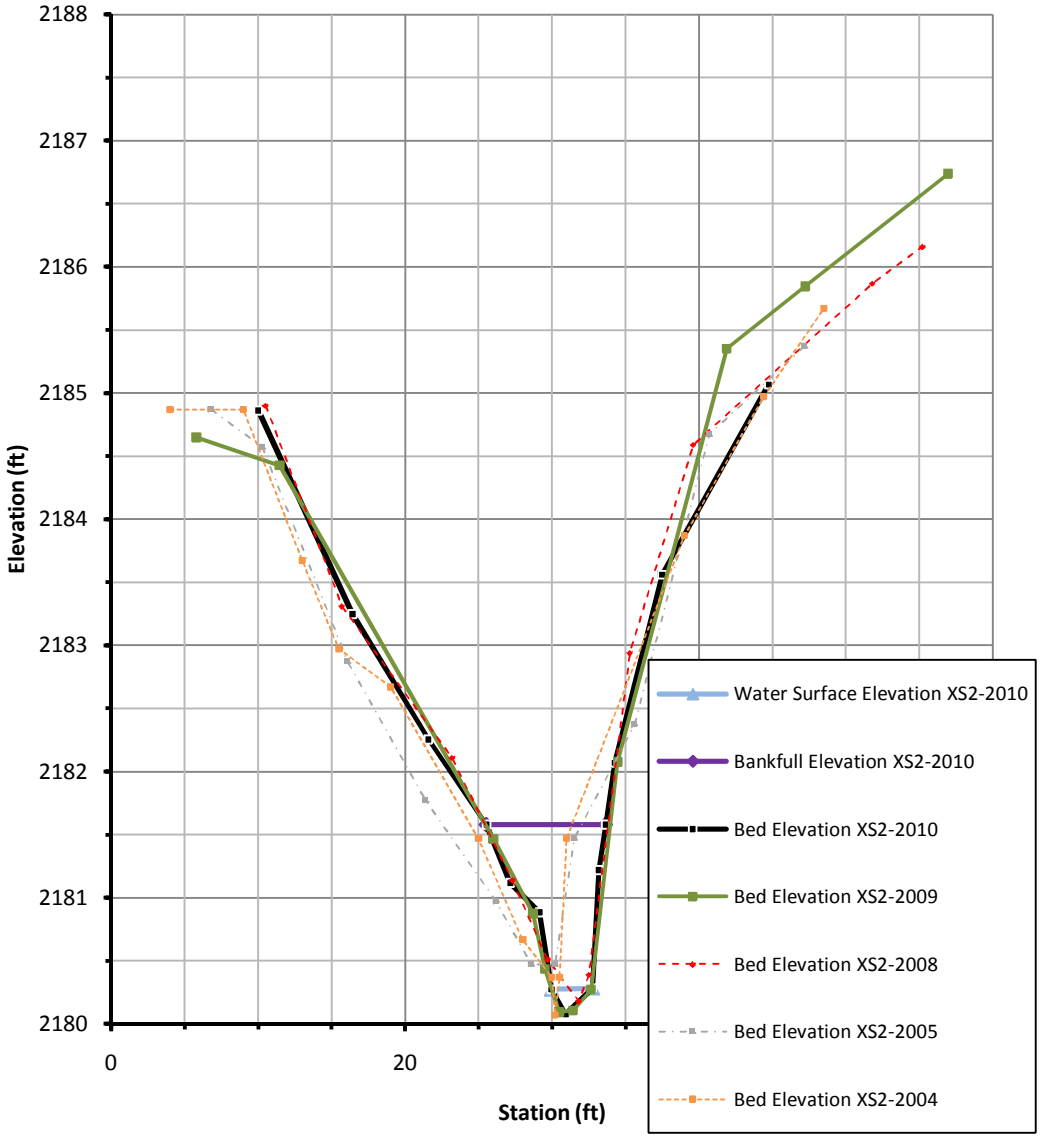

0
25
50
100
Feet
1800
1900
2000
2100
2200
XS1
XS2
Legend
Stream Channel Profile - AB Centerline
Stream Channel Profile - Thalweg 2010
Monitoring Cross Section
Structures
Log Vane
Rock A-Vane
Rock Cross-Vane

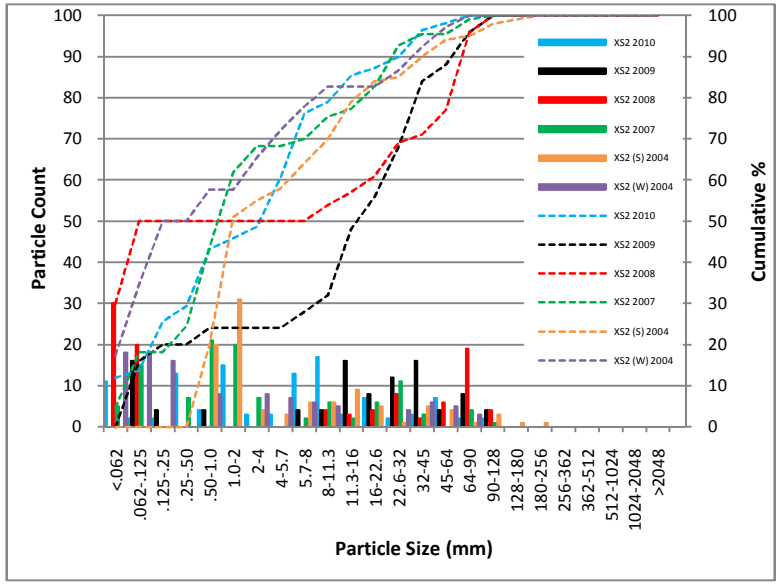




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS1	2003	MY1	RIFFLE	7.94	2.90	0.37
XS1	2004	MY2	RIFFLE	11.92	3.43	0.29
XS1	2005	MY3	RIFFLE	6.77	2.80	0.41
XS1	2007	MY4	RIFFLE	9.83	2.43	0.25
XS1	2008	MY5	RIFFLE	9.74	2.28	0.23
XS1	2009	MY6	RIFFLE	8.73	1.90	0.22
XS1	2010	MY7	RIFFLE	3.59	2.08	0.58

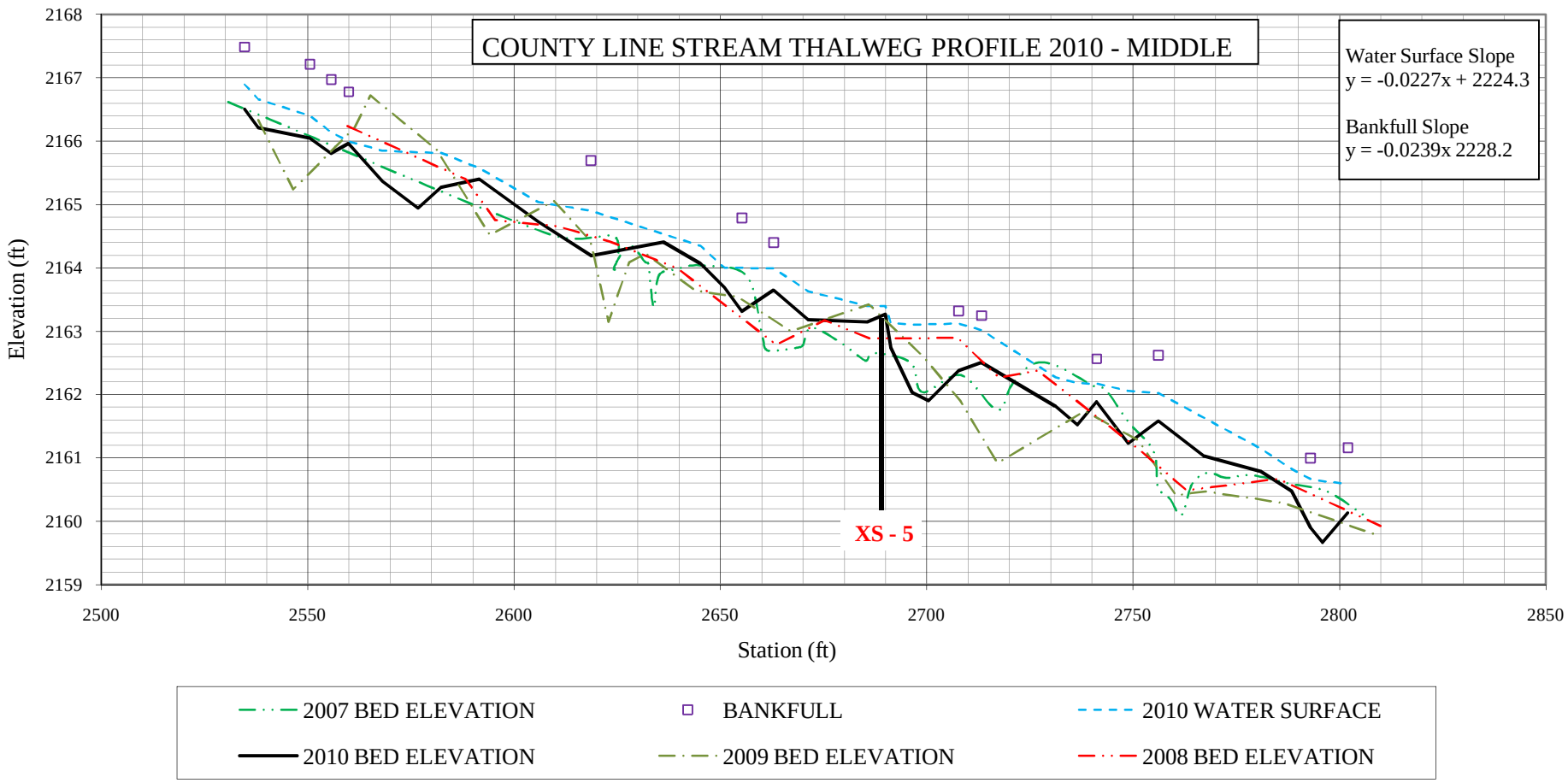
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS1	2004	MY2	1.48	16
XS1	2007	MY4	2.16	22.6
XS1	2008	MY5	0.07	19.32
XS1	2009	MY6	22.6	64
XS1	2010	MY7	0.06	16

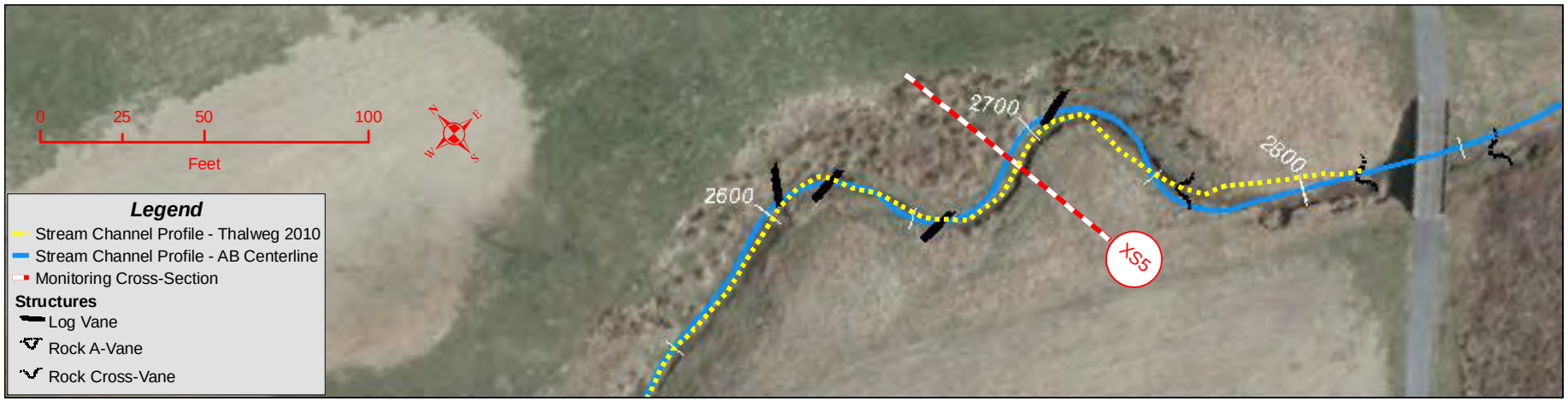


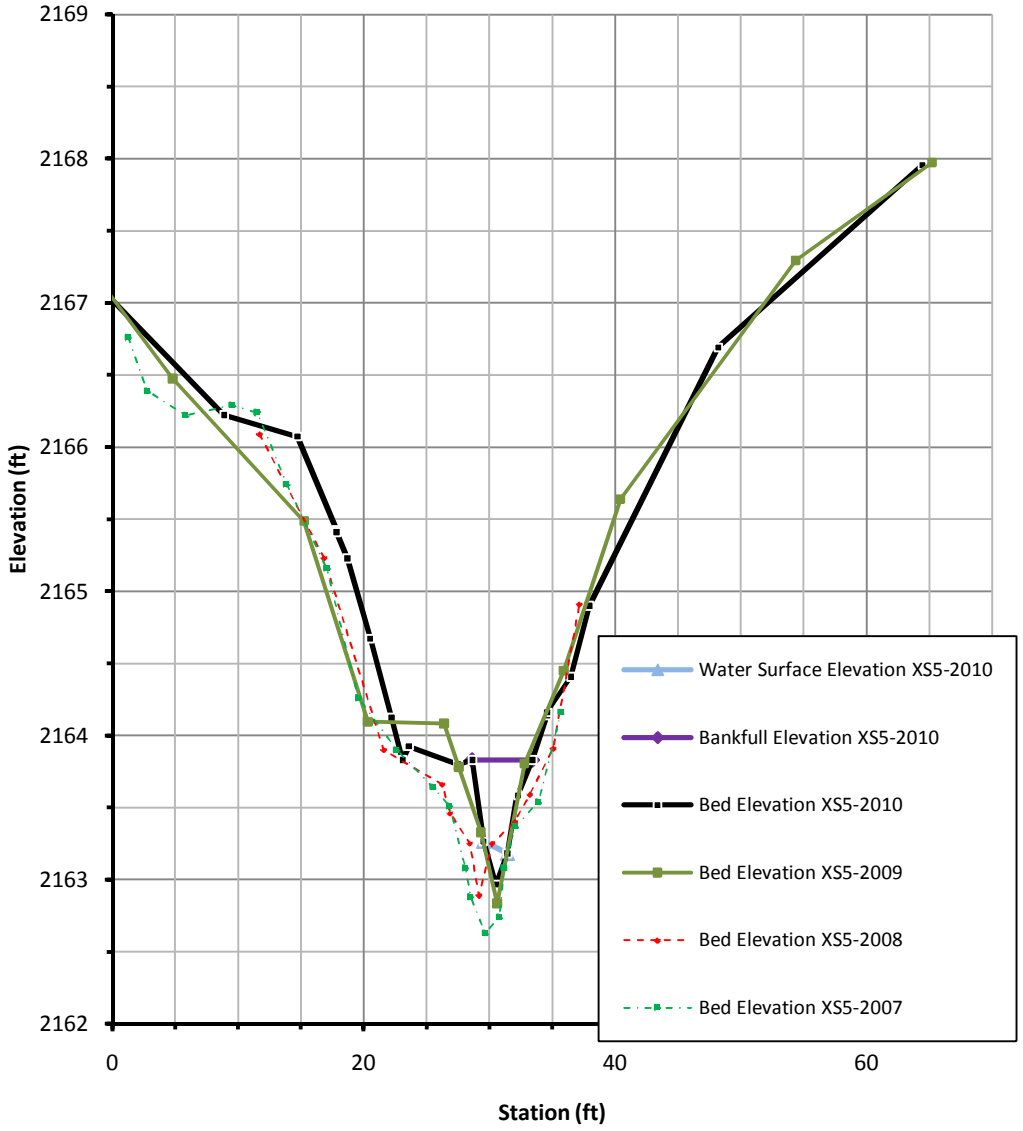


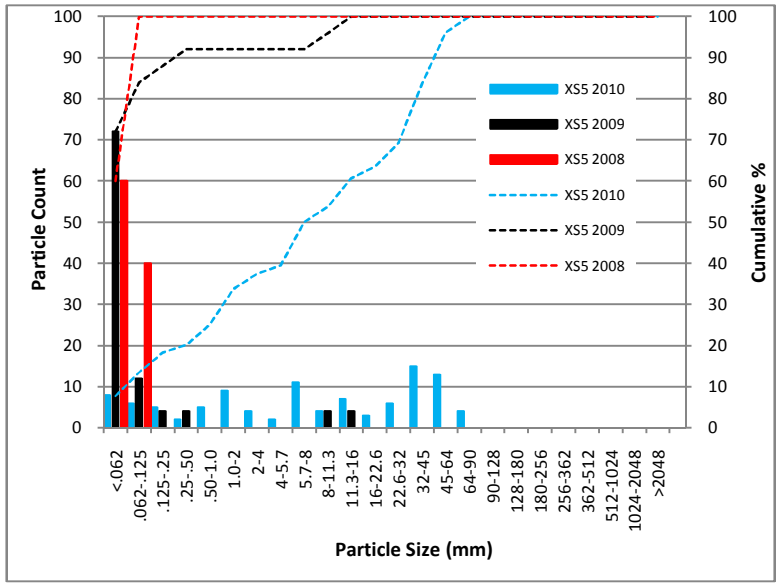
ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS2	2003	MY1	POOL	6.62	11.98	1.81
XS2	2004	MY2	POOL	5.28	3.04	0.58
XS2	2005	MY3	POOL	7.06	3.50	0.50
XS2	2007	MY4	POOL	5.11	8.51	1.67
XS2	2008	MY5	POOL	6.88	4.37	0.64
XS2	2009	MY6	POOL	7.85	5.48	0.70
XS2	2010	MY7	POOL	8.11	6.68	0.82

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS2	2004 (S)	MY2	1.96	22.6
XS2	2004 (W)	MY2	0.23	9.84
XS2	2007	MY4	1.07	13.45
XS2	2008	MY5	8	72.57
XS2	2009	MY6	16	32
XS2	2010	MY7	5.7	64


COUNTY LINE STREAM THALWEG PROFILE 2010 - MIDDLE
Water Surface Slope
y = -0.0227x + 2224.3
Bankfull Slope
y = -0.0239x 2228.2
Elevation (ft)
2168
2167
2166
2165
2164
2163
2162
2161
2160
2159
2500
2550
2600
2650
2700
2750
2800
2850
Station (ft)
XS - 5
2007 BED ELEVATION
BANKFULL
2010 WATER SURFACE
2010 BED ELEVATION
2009 BED ELEVATION
2008 BED ELEVATION

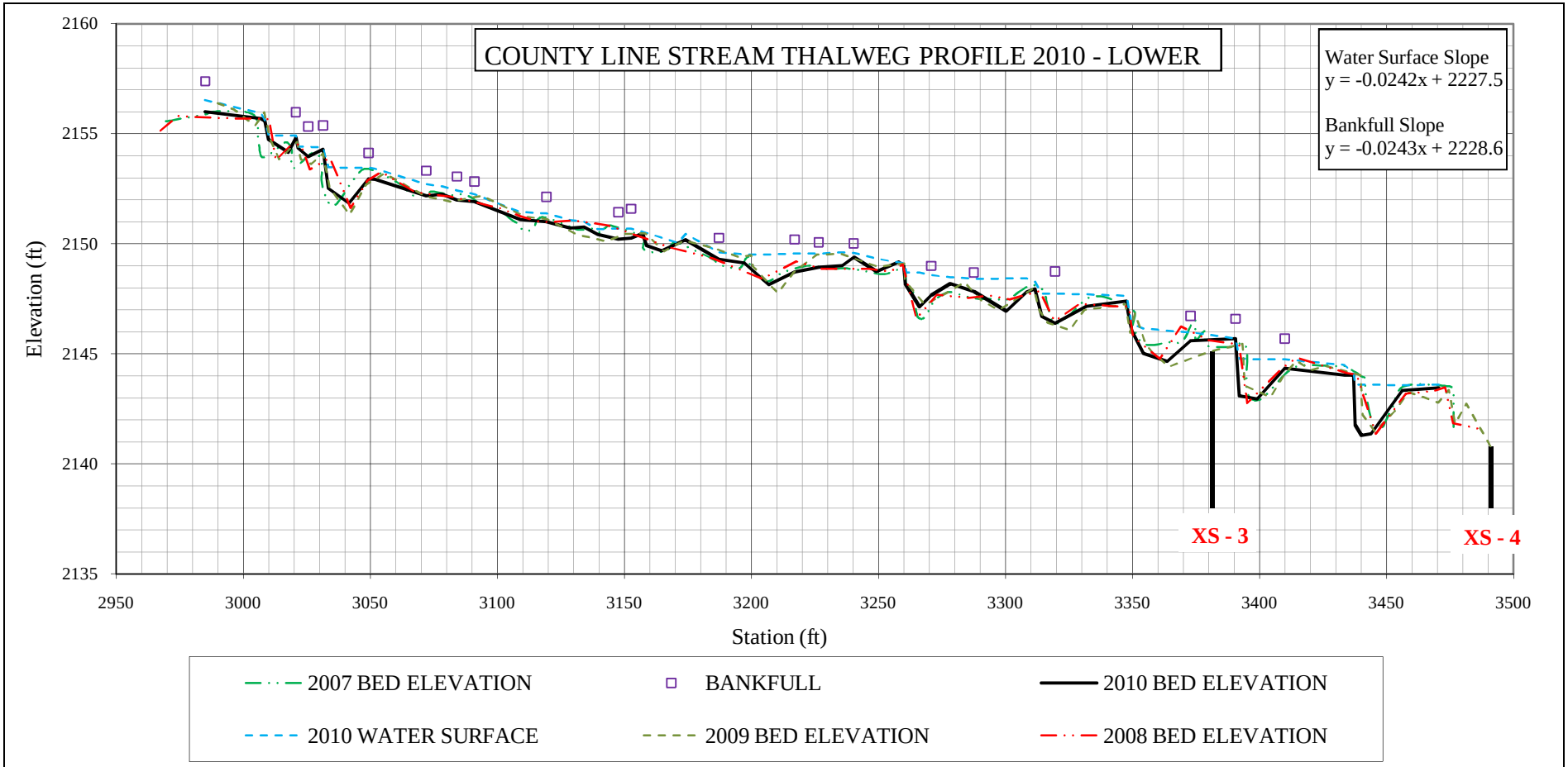

0
25
50
100
Feet
Legend
Stream Channel Profile - Thalweg 2010
Stream Channel Profile - AB Centerline
Monitoring Cross-Section
Structures
Log Vane
Rock A-Vane
Rock Cross-Vane
2700
2800
2600
XS5



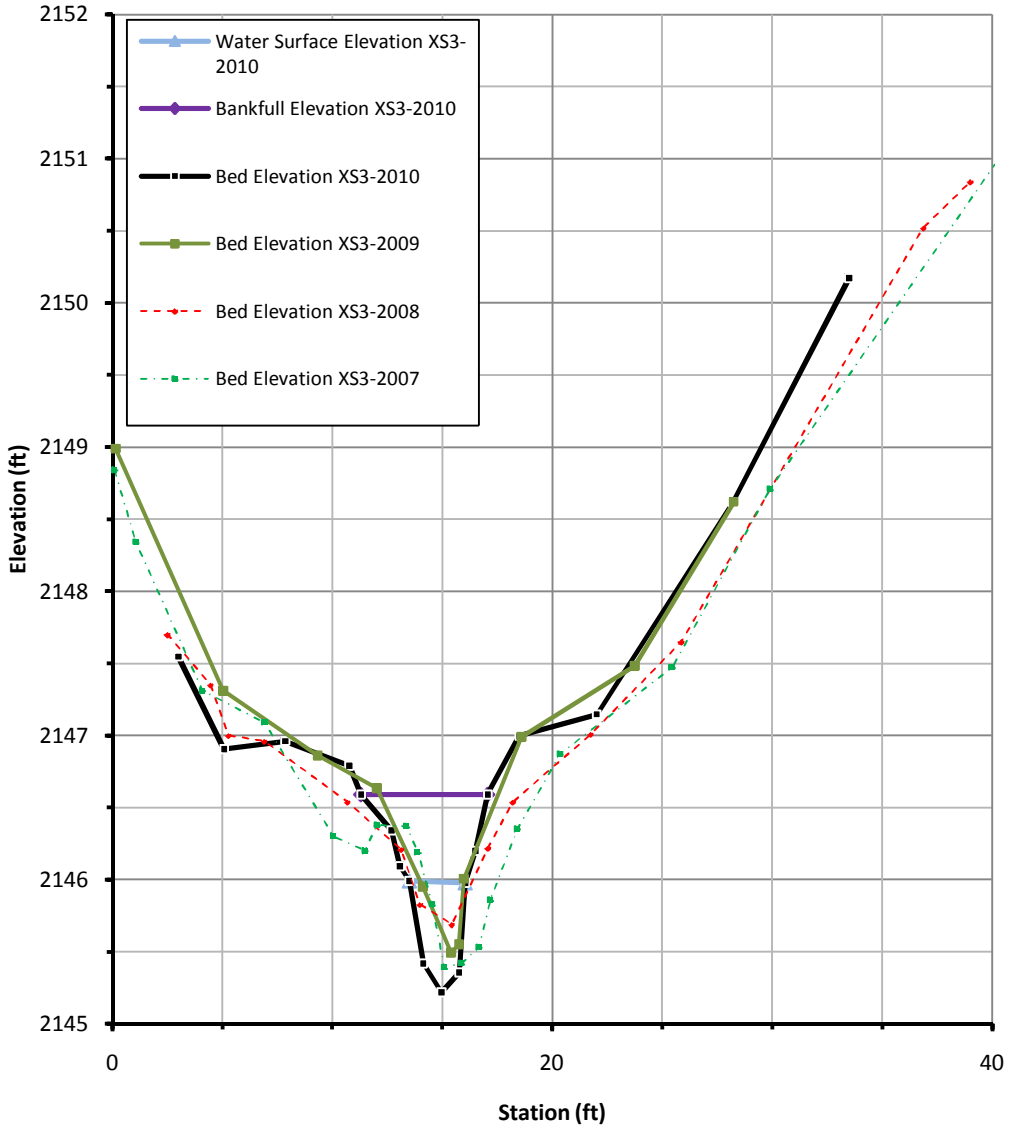


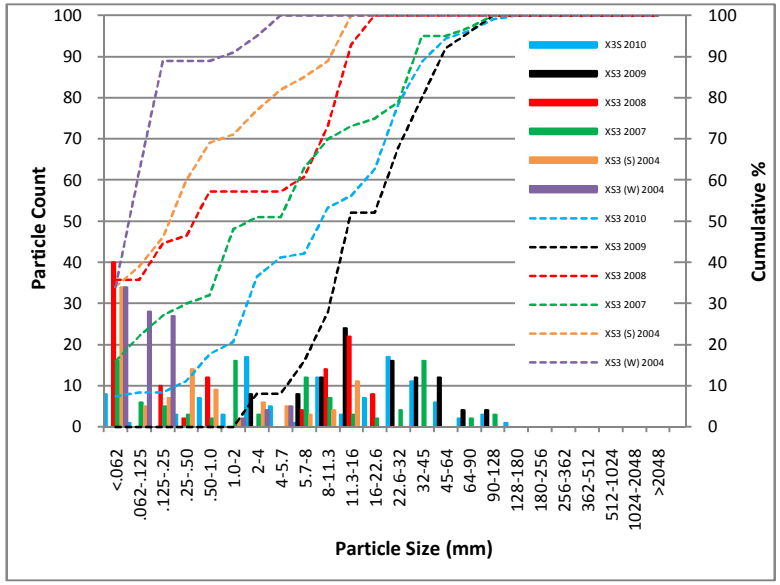
ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS5	2007	MY4	RIFFLE	5.24	2.21	0.42
XS5	2008	MY5	RIFFLE	4.73	0.81	0.17
XS5	2009	MY6	RIFFLE	7.75	4.05	0.52
XS5	2010	MY7	RIFFLE	4.77	2.14	0.45

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS5	2008	MY5	<0.062	0.09
XS5	2009	MY6	<0.062	0.125
XS5	2010	MY7	<0.062	0.062



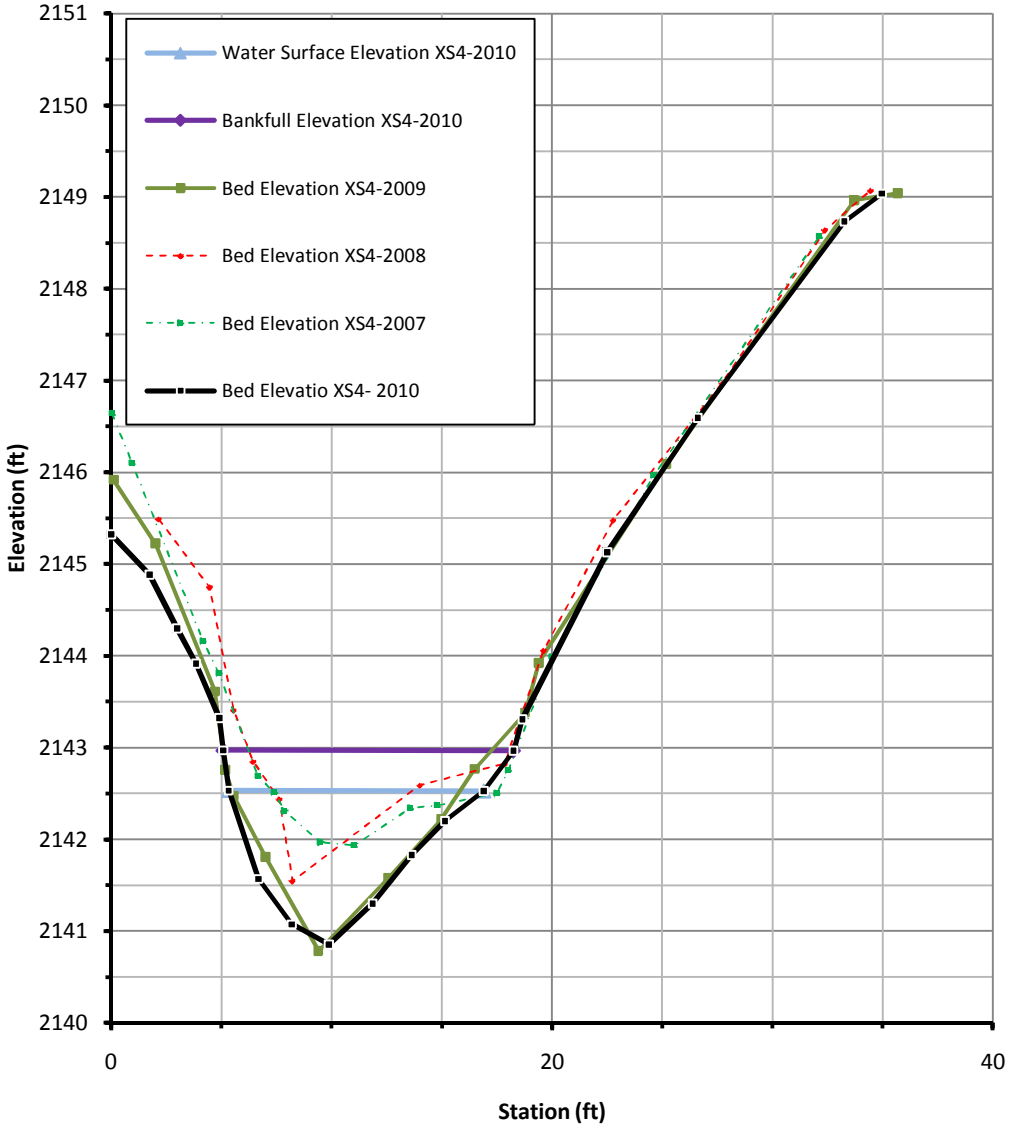
Kimley-Horn and Associates, Inc.

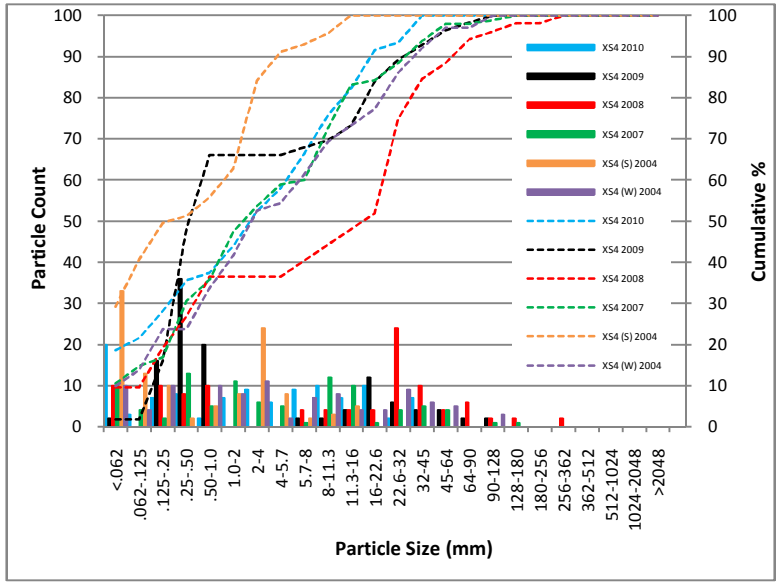




ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS3	2003	MY1	POOL	16.50	10.33	0.63
XS3	2004	MY2	POOL	11.75	13.43	1.14
XS3	2005	MY3	POOL	13.79	13.81	1.00
XS3	2007	MY4	POOL	7.34	3.06	0.42
XS3	2008	MY5	POOL	5.66	1.99	0.35
XS3	2009	MY6	POOL	8.18	4.21	0.51
XS3	2010	MY7	POOL	5.76	3.81	0.66

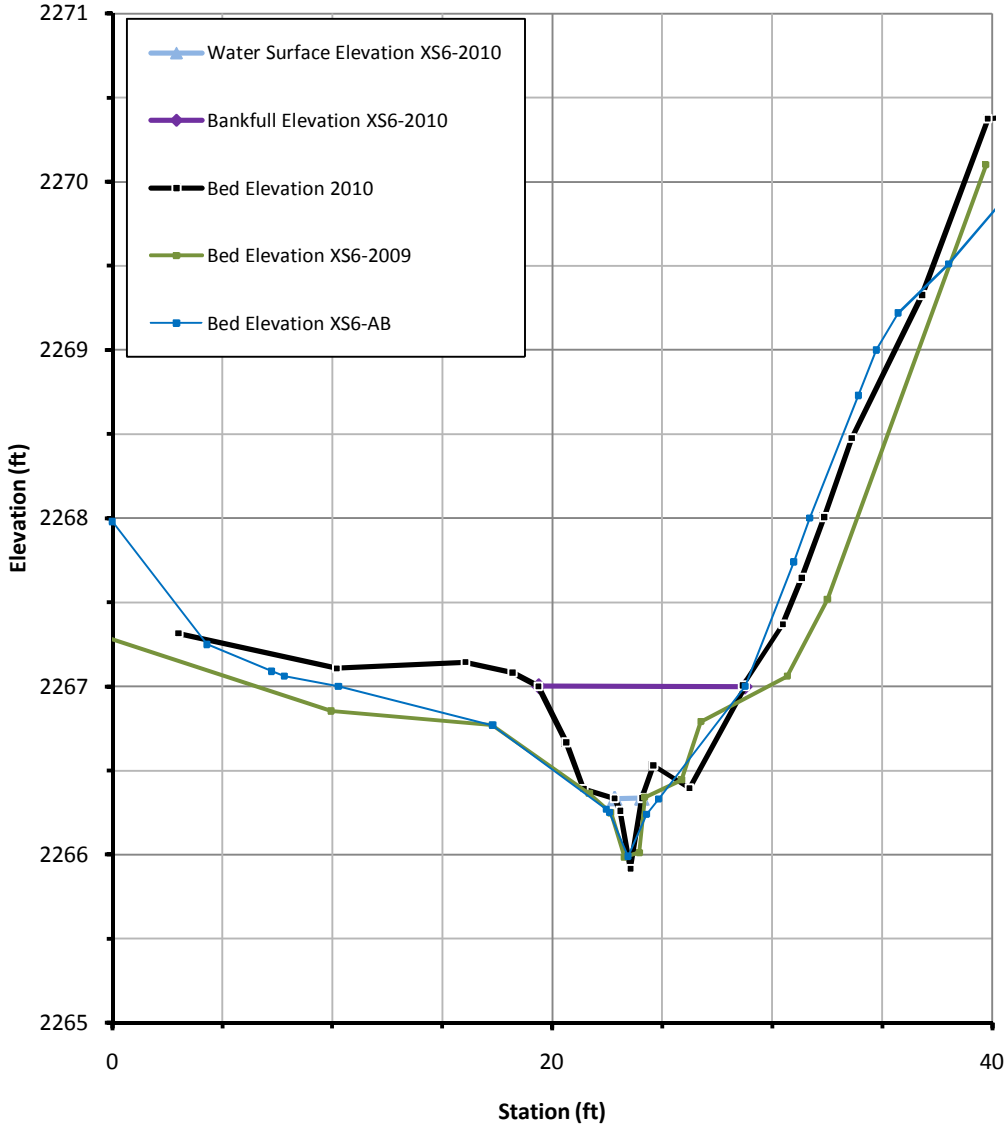
ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS3	2004 (S)	MY2	0.30	7.15
XS3	2004 (W)	MY2	0.09	0.22
XS3	2007	MY4	3.17	35.6
XS3	2008	MY5	0.25	11.66
XS3	2009	MY6	11.3	45
XS3	2010	MY7	0.5	11.3





ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS4	2003	MY1	POOL	9.57	13.90	1.45
XS4	2004	MY2	POOL	10.85	20.11	1.85
XS4	2005	MY3	POOL	11.85	13.61	1.15
XS4	2007	MY4	POOL	12.25	8.44	0.69
XS4	2008	MY5	POOL	11.91	7.56	0.63
XS4	2009	MY6	POOL	14.78	25.35	1.71
XS4	2010	MY7	POOL	11.31	10.32	0.91

ID	YEAR	PHASE	d50 (mm)	d84 (mm)
XS4	2004 (S)	MY2	0.16	2.91
XS4	2004 (W)	MY2	3.31	28.50
XS4	2007	MY4	3.56	32.00
XS4	2008	MY5	16.00	39.26
XS4	2009	MY6	0.5	16
XS4	2010	MY7	16	32



ID	YEAR	PHASE	FACET TYPE	Wbkf	Abkf	Dbkf
XS6	2003	AB	RIFFLE	10.1	2.73	0.27
XS6	2009	MY6	RIFFLE	8.6	2.78	0.32
XS6	2010	MY7	RIFFLE	9.4	4.48	0.48