

McKee Creek Stream Restoration

Monitoring Report – Year 4 of 5

FINAL

Contract #004391

DMS Project #92573

Cabarrus County, North Carolina



Construction 2010
Collected October/November 2015
Report January 2016

Submitted to:

NCDEQ – Division of Mitigation Services
1601 Mail Service Center,
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Prepared By:



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EXECUTIVE SUMMARY / PROJECT ABSTRACT

The project goals and objectives stated in the McKee Creek Restoration Plan (NCDMS 2008) are as follows:

Project Goals:

- ▶ Restore through stream enhancement (Level I and Level II) McKee Creek;
- ▶ Restore Clear Creek (Priority I restoration);
- ▶ Restore the physical and biological processes of McKee and Clear Creeks;
- ▶ Restore riparian vegetation to the maximum extent feasible.

Project Objectives:

Improve water quality by reducing bank erosion, restricting livestock access to the creeks, and re-establishing the riparian buffer;

- ▶ Stabilize McKee Creek through the use of in-stream structures and pattern re-alignment in selected areas;
- ▶ Restore the dimension, pattern, and profile of Clear Creek;
- ▶ Improve the floodplain functionality of Clear Creek by matching floodplain elevation with bank full stage;
- ▶ Improve water quality by reducing bank erosion, restricting livestock access to the creeks, and re-establishing the riparian buffer;
- ▶ Improve the wildlife habitat functions of the site through riparian buffer establishment, improved stream bed form diversity, and improved floodplain functionality to reduce stream incision;
- ▶ Protect the site through a permanent conservation easement along the project reaches.

The subject site is located approximately 10 miles northeast of Charlotte, NC in the Lower Yadkin River Basin. Land use in the area consists of agricultural use and suburban residential development.

VEGETATION RESULTS

Success Criteria

Success of the riparian buffer plantings is based on vegetation success criteria established in the USACE Stream Mitigation Guidelines (2003). Four (4) permanent monitoring plots were established in the Spring of 2012. Successful restoration must contain a minimum of 288 live stems per acre at Year 4 and 260 live stems per acre at Year 5.

Year 4 shows an average of 415 live stems per acre, with a minimum count of 243. These estimates are based on Level 2 of the CVS-DMS monitoring protocol and include only planted woody stems. The stem count is based on the average of the stem counts within the four vegetation plots. Reference pictures of each monitoring plot were taken and attached to this report.

Vegetation Plot 1 (McKee Creek Reach 1)

Total stem count was 6 planted live stems (243/acre) and 11 volunteer stems, yielding a total count of 17 stems (688/acre). The planted live stem count is below the success criteria, possibly due to mowing activity in 2012. The 6 live stem count is consistent with the live stem count in Year 3 monitoring (6 live stems), and the volunteer stem count of 11 is an increase from Year 3 monitoring (5 volunteer stems).

Vegetation Plot 2 (McKee Creek Reach 1)

Total stem count was 11 planted live stems (445/acre) and 36 volunteer stems, yielding a total count of 47 stems (1,903/acre). The total planted live stem count is well above the success criteria. The 11 live stem count

is reduced from the live stem count in Year 3 monitoring (12 live stems), and the volunteer stem count of 36 is reduced from Year 3 monitoring (38 volunteer stems).

Vegetation Plot 3 (McKee Creek Reach 2)

Total stem count was 7 planted live stems (283/acre) and 3 volunteer stems, yielding a total count of 10 stems (405/acre). The total planted live stem count is below the success criteria. The 7 live stem count is reduced from the live stem count in Year 3 monitoring (9 live stems), and the volunteer stem count of 3 is reduced from Year 3 monitoring (4 volunteer stems).

Vegetation Plot 4 (Clear Creek Reach)

Total stem count was 17 planted live stems (688/acre) and 44 volunteer stems, yielding a total count of 61 stems (2,470/acre). The total planted live stem count is well above the success criteria. The 17 live stem count is reduced from the live stem count in Year 3 monitoring (22 live stems), and the volunteer stem count of 44 is increased from Year 3 monitoring (17 volunteer stems).

Invasive Vegetation

Non-native invasive vegetation was noted within Vegetation Plots 1, 2 and 3. Observed species include multiflora rose (*Rosa multiflora*), autumn olive (*Eleagnus umbellata*), and Japanese honeysuckle (*Lonicera japonica*). Vegetation plot 2 contained the highest percentage invasive species with an approximate vegetative cover of 50%. Most notable was the honeysuckle, which has intertwined with a majority most of the woody species along the eastern edge of the plot.

Overall Performance

Overall vegetation within the project easement appears to meet or exceed the defined success criteria. Although planted species are below the criteria in Plots 1 and 3, the total stem counts for these plots are above criteria when combined with volunteer stems (688/acre and 405/acre, respectively). Areas of invasive species remain present within the McKee Creek reaches; however, eradication efforts appear to have controlled this presence to existing areas.

STREAM RESULTS

NOTE: Qualitative and quantitative stream assessment data was limited during the Fall 2015 monitoring event due to excessive rainfall totals in the months leading up to and during the field monitoring. This area experienced approximately 8.15 inches of rain in October 2015, and 8.37 inches of rain in November 2015.

As part of the monitoring, each reach was visually inspected, and survey data was collected where possible. During the survey and assessment events (Oct 28 and November 11, 2015) both streams were at or exceeding bankfull conditions, obscuring a majority of the in-channel structures, both natural and constructed.

McKee Creek Reach 1

The constructed J-hook within McKee Creek Reach 1 near Station 27+00 was not observed due to high flow conditions during both the October survey event and the November assessment event. Survey data was collected within the realigned section of McKee Creek Reach 1 between Stations 25+00 and 27+00. Based on the qualitative and quantitative data, the following is noted:

- ▶ This section of stream was at bankfull, with a surface water depth exceeding 3.5 feet; however, flow was confined within the constructed channel and the banks appeared stable.
- ▶ Elevation data shows the channel to be approximately in the same profile as prior surveys, with possible evidence of aggradation in the upper reach near Station 25+50. This noted aggradation is likely the result of sediment transport occurring during high flow events prior to and during the surveying event.
- ▶ A fallen tree located near Station 45+00 has resulted in minor bank wasting.

McKee Creek Reach 2

None of the constructed features within McKee Creek Reach 2 were observed due to high flow conditions during both the October survey event and the November assessment event. Survey data was collected within McKee Creek Reach 2 between Stations 10+00 and 14+00 (the survey was halted in the area of Station 14+00 due to high water). Based on the qualitative and quantitative data, the following is noted:

- ▶ This section of stream was at bankfull, with a surface water depths varying from 2.5 feet to >4 feet; however, flow was confined within the channel, and the banks appeared stable.
- ▶ Heavy siltation was noted throughout the reach, particularly in the upstream area near Peach Orchard Road, where a flow-deflecting silt bar has formed in the left portion of the channel near Station 11+00.
- ▶ A fallen tree was noted on the right bank near the cross-vane at Station 12+00, forming a strainer which has trapped a significant amount of woody debris and formed a log dam. This debris blockage has caused flow diversion to the right side of the channel (near the fallen tree), resulting in wasting of the right bank.
- ▶ Elevation data shows the profile to be approximately matched to prior surveys; however, the data also indicates aggradation throughout the surveyed portion of the reach, likely the result of high flow events prior to and during the survey event.
- ▶ Bare bank areas were noted on the right bank between Stations 14+00 and 17+00, likely the result of heavy sedimentation and sparse, dormant vegetation. All other areas appeared to be well-stabilized with vegetation.

Clear Creek

A majority of the constructed features within the Clear Creek reach were visible during the assessment event (November 11, 2015), and appeared to be functional, providing stabilization and/or flow direction during high flow conditions. Survey data was collected throughout the entire reach. Based on the qualitative and quantitative data, the following is noted:

- ▶ The CCPV for Clear Creek has been updated to show the surveyed location of the channel, which varies slightly from the prior survey.
- ▶ Elevation data shows the general stream profile to be approximately matched to prior surveys. The survey indicates siltation in a majority of the glide/pools, likely the effect of high flow and sediment transport prior to and during the survey.
- ▶ Elevation data from the two cross-sections within the Clear Creek reach (Cross-sections RXS-3 and PXS-3) show variations from previous surveys. A review of raw survey data confirmed the elevations collected during the survey. The variations noted may be the result of stabilization and changes within the channel; however, it should be noted the survey was conducted during high flow, and the data may reflect abnormalities in the in-stream positioning of the equipment. It is anticipated that the variations in data will either be confirmed as changes in the channel or possible data collection abnormalities during the MY5 survey.
- ▶ Heavy sediment deposition was noted outside the channel in several locations, burying streamside vegetative cover and resulting in loose embankments. This condition will likely improve as vegetation emerges in the Spring.
- ▶ A small beaver dam has been constructed near the Station 11+00, near the upstream origin.
- ▶ Loose fabric was noted on two of the three log vanes downstream from the ford; however, these structures were intact and functioning under high flow conditions.

- ▶ Short-circuiting was noted on both the downstream cross-vanes, possibly due to high flow. In the upper vane, siltation on the right arm has caused erosion of the left bank. In the lower vane, flow is being directed towards the left bank resulting in minor erosion. Both structures appear to be well stabilized.
- ▶ Riparian vegetation is well established, and providing excellent stabilization for the channel.

HYDROLOGY RESULTS

During both monitoring events, obvious signs of floodplain interaction were noted within all three reaches of the project.

- ▶ Flattened vegetation, wrack/debris lines, heavy sediment deposits, and standing water were noted throughout the easement in all three reaches.
- ▶ On Clear Creek, drainage patterns were noted both towards the channel and away from the channel. On both reaches of McKee Creek, water was observed flowing into the channel from the riparian area.
- ▶ Three crest gages at the site could not be accessed or were not properly working. Crest gage 1, located upstream of Peach Orchard Rd, is situated at the base of a very steep portion of the channel bank. During the monitoring events, this bank was too wet to safely descend, and the water level in the channel was overtopping chest waders. When the crest gage was accessed, under difficult conditions, the cap could not be removed. Crest gage 2, located upstream of the Clear Creek ford, also had a top cap which could not be removed. Crest gage 3, located at the end of the Clear Creek reach, had been dislodged and was not vertical.
- ▶ Rainfall data for Cabarrus County during the period between Nov 2014 and Nov 2015 totaled 48.06 inches of rain, including 8.15 inches in Oct 2015 and 8.37 inches in Nov 2015.

Summary information/data related to the occurrence of items, such as beaver or encroachment, and statistics related to performance of various project and monitoring elements, can be found in the tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly the Restoration Plan) documents available on the DMS website. All raw data supporting the tables and figures in the appendices is available from DMS upon request.

METHODOLOGY

All survey was preformed utilizing either total station tradition survey methods or a survey grade GPS unit to capture points with high horizontal and vertical accuracy. The longitudinal stationing was formatted as close as possible to the original restoration plan stationing. The methodology used in this monitoring assessment followed the prescribed recommendation of the CVS-DMS Vegetation Monitoring Protocol Level-2.

REFERENCES

Town of Harrisburg North Carolina, Visitors Page, Geography and Climate
<http://www.harrisburgnc.org/Visitors/GeographyClimate.aspx>

Lower Yadkin LWP- PFR, 2003 and WMP&R - Lower Yadkin LWP, 2004
http://www.ncdms.net/services/lwps/Clarke_Creek/F_R_Rocky_Yadkin.pdf

Wolman Pebble Count,
<http://limnology.wisc.edu/courses/zoo548/Wolman%20Pebble%20Count.pdf>

Rainfall Data for Cabarrus County,

McKee Creek
DMS Project No. 92573
Monitoring Year 4 of 5

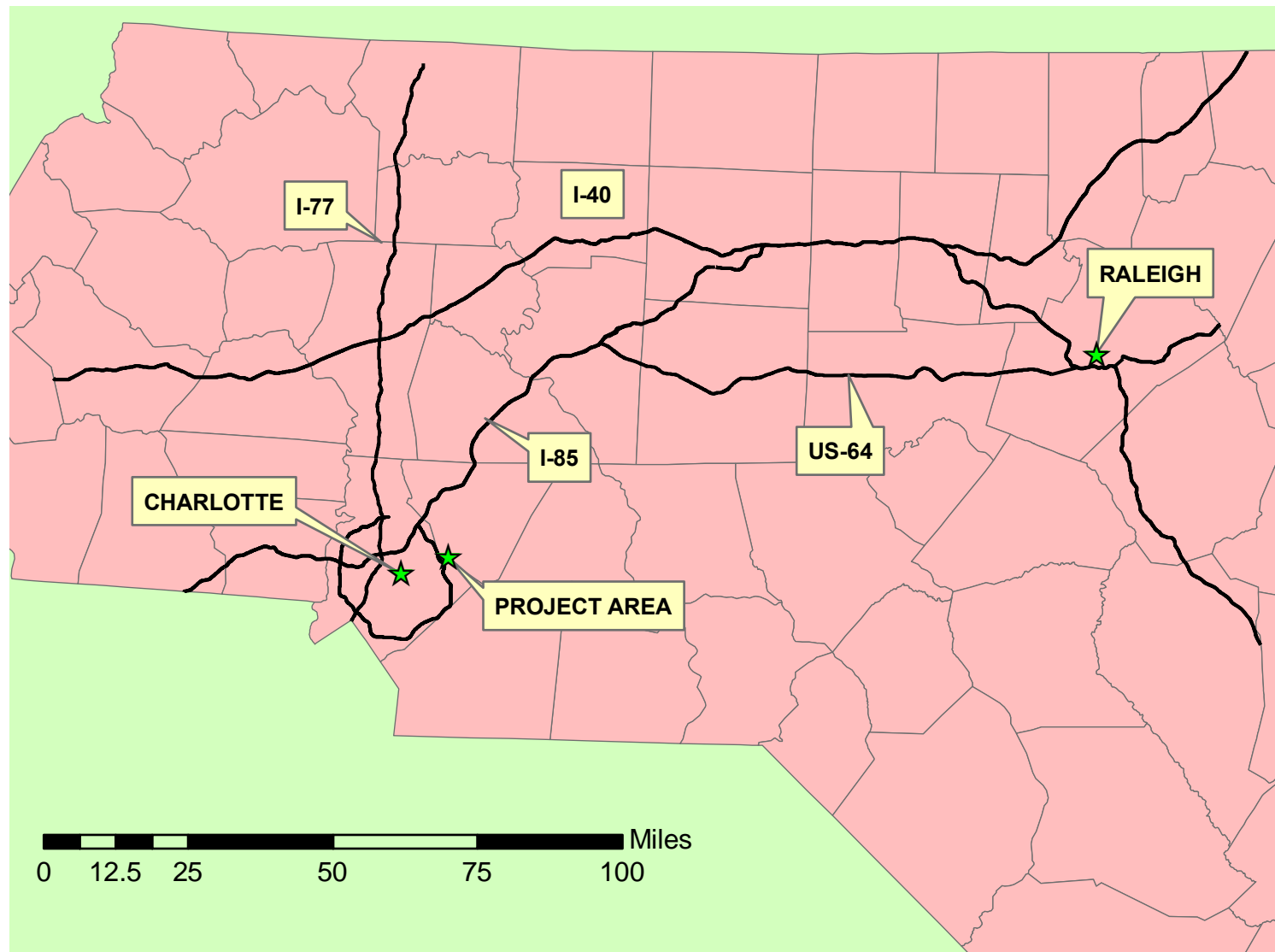
WithersRavenel

January 2016

<http://www.nc-climate.ncsu.edu/cronos>

Appendix A

Project Vicinity Map and Background Tables



The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership.

Therefore access by the general public is not permitted.

Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, monitoring and stewardship of the restoration site is permitted within the terms and timeframes of their defined, pre-approved roles. Any intended site visitation or activity by any person outside of these previously sanctioned activities/roles requires prior coordination with EEP.

Take US-64 West from the Raleigh area to I-85 (approximately 85 miles). Take I-85 south toward Charlotte (approximately 48 miles). Take exit 48 onto I-485 toward Rock Hill (approximately 8 miles) Take exit 39 onto Harrisburg Road north stay on Robinson Church for approximately 1 mile and then turn right onto NCSR 1169 Peach Orchard Road. Peach Orchard Road intersects the project site.

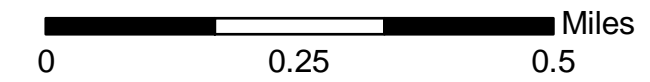
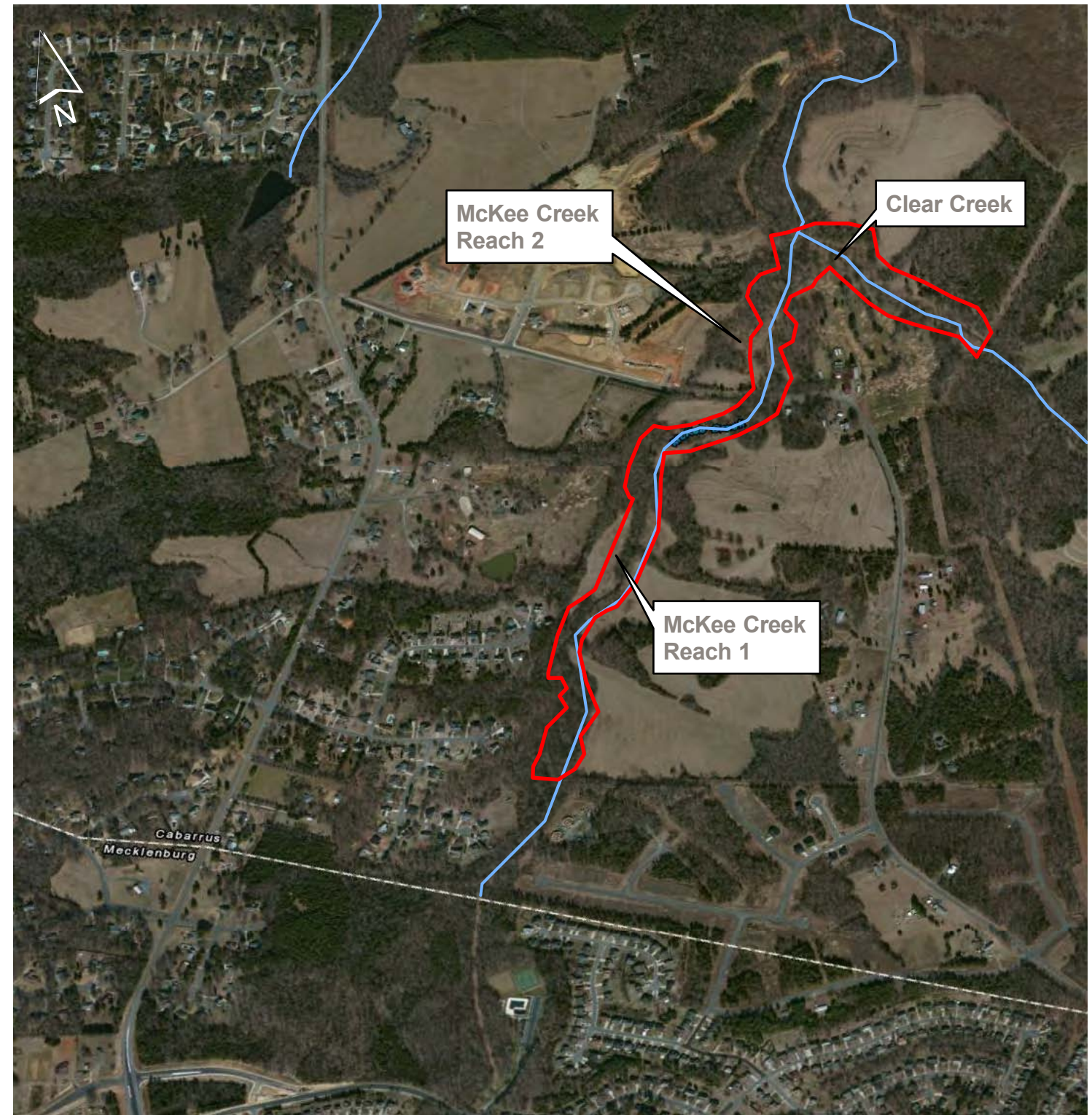


Table 1. Project Components and Mitigation Credits - 2015 (MY4)
McKee Creek Project #: 92573

Mitigation Credits									
	Stream		Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	3419								

Project Components							
Project Component -or- Reach ID	Stationing/Location		Existing Footage/Acreage	Approach (PI, PII, etc.)	Restoration -or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
McKee Reach 1	10+00 - 25+00, 29+00 - 46+40		2988	P4	E2	2988	2.5:1
McKee Reach 1	25+00 - 29+00		400	P2	E1	400	1.5:1
McKee Reach 2	10+00 - 17+23.67		678	P2	E1	678	1.5:1
Clear Creek	11+03.05 - 27+59.18		1505	P1	R	1505	1 to 1

Note: Italicized values have been revised for MY4, and are subject to verification in MY5

Component Summation						
Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetlands (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	1505					
Enhancement						
Enhancement I	1078					
Enhancement II	2988					
Creation						
Preservation						
High Quality Preservation						

BMP Elements			
Element	Location	Purpose/Function	Notes

BMP Elements
 BR = Bioretention Cell; SF = Sand Filter; SW = Stormwater Wetland; WDP = Wet Detention Pond; DDP = Dry Detention Pond; FS = Filter Strip; S = Grassed Swale; LS = Level Spreader; NI = Natural Infiltration Area; FB = Forested Buffer

**Table 2. Project Activity and Reporting History - 2015 (MY4)
McKee Creek Project # 92573**

**Elapsed Time Since Grading Complete: 5 yrs 7 months
Elapsed Time Since Planting Complete: 5 yrs 7 months
Number of Reporting Years: 4**

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan		Aug-08
Final Design – Construction Plans		Apr-09
Construction		May-10
Containerized, bare root and B&B plantings for reach/segments 1&2		May-10
Mitigation Plan / As-built (Year 0 Monitoring – baseline)		
Spring Year 1 Monitoring	Apr-12	May-12
Fall Year 1 Monitoring	Oct-12	Nov-12
Spring Year 2 Monitoring	Apr-13	May-13
Beaver Removal		Summer-13
Invasives Treatment		Fall-13
Fall Year 2 Monitoring	Oct-13	Nov-13
Spring Year 3 Monitoring	Apr-14	Apr-14
Invasives Treatment		Summer-14
Fall Year 3 Monitoring	Oct-14	Dec-14
Spring Year 4 Monitoring	Apr-15	May-15
Fall Year 4 Monitoring	Oct/Nov-15	Jan-16

**Table 3. Project Contacts Table - 2015 (MY4)
McKee Creek Project # 92573**

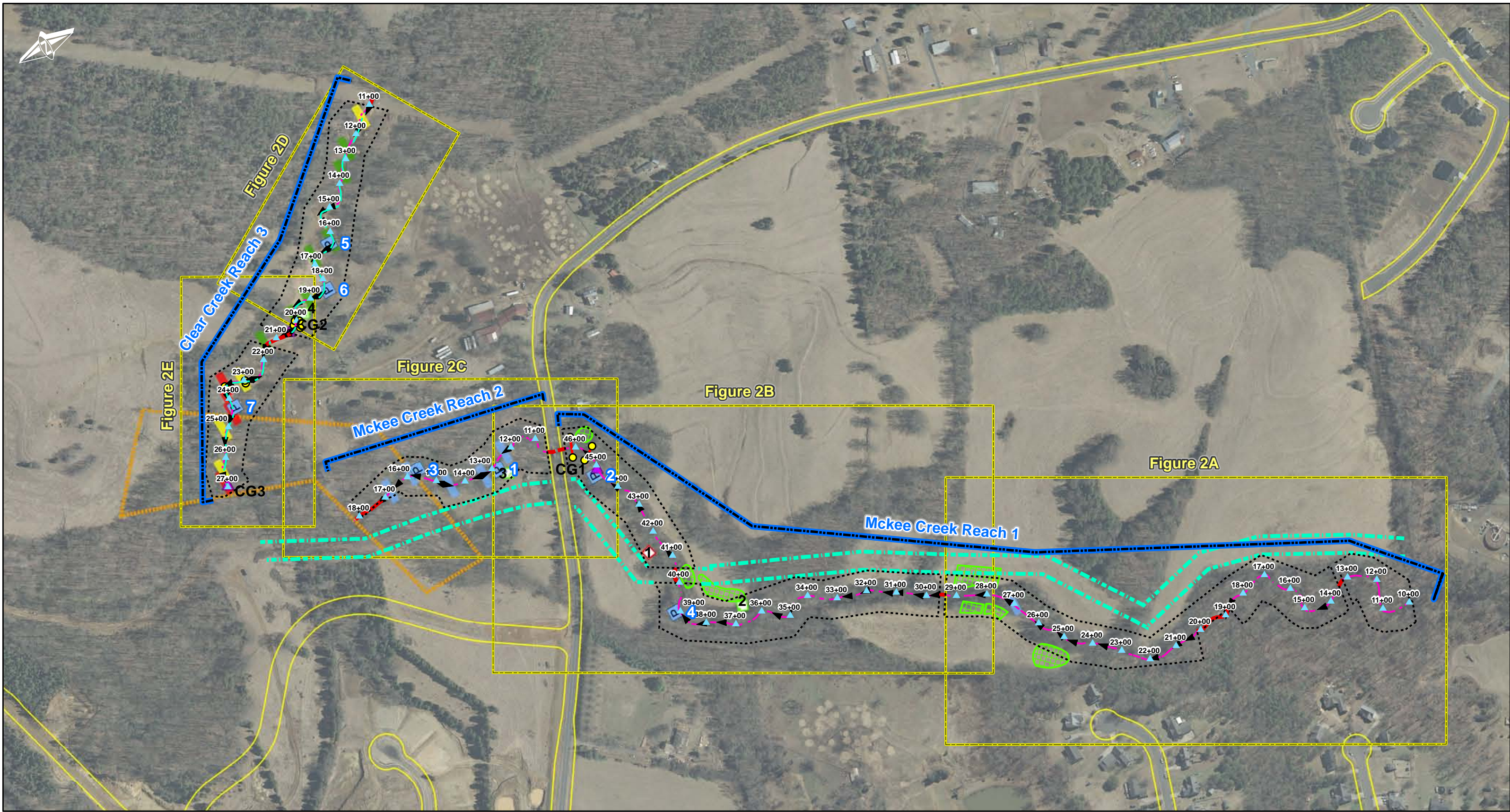
Designer	Withers & Ravenel, Inc. 115 MacKenan Drive Cary, NC 27511 Martin Richmond (919) 469-3340
Primary project design POC	
Construction Contractor	River Works Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Edward Haynes
Construction contractor POC	
Survey Contractor	Turner Land Surveying
Survey contractor POC	Elisabeth Turner
Planting Contractor	River Works Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Edward Haynes
Planting contractor POC	
Seeding Contractor	Green Resources 5204 Highgreen Ct Colfax, NC 27235 Rodney Montgomery
Contractor point of contact	
Seed Mix Sources	
Nursery Stock Suppliers	Not Known
Monitoring Performers	Withers & Ravenel, Inc. 115 MacKenan Drive Cary, NC 27511
Stream Monitoring POC	Martin Richmond (919) 469-3340
Vegetation Monitoring POC	Martin Richmond (919) 469-3340
Wetland Monitoring POC	Martin Richmond (919) 469-3340

Table 4. Project Baseline Information and Attributes - 2015 (MY4)

Project Name		McKee Creek, Project #92573	
County		Cabarrus	
Project Area (acres)		17.41	
Project Coordinates(latitude and longitude)		35.265562°N; -80.639582°W	
Project Watershed Summary Information			
Physiographic Province:		Piedmont	
River Basin:		Yadkin Pee Dee	
USGS Hydrologic Unit 8-digit	3040105	USGS Hydrologic Unit 14-digit	3040105010050
DWQ Sub-basin		Clear- 03-07-11/03-08-34	
Thermal Regime		Warm Thermal Regime	
Project Drainage Area (acres)		8980	
Project Drainage Area Percentage of Impervious Area		36	
CGIA Land Use Classification		Single Family and Wooded	
Reach Summary Information			
Parameters	McKee Reach 1	McKee Reach 2	Clear Creek
Length of Reach	2988	678	1505
Valley Classification	VIII	VIII	VIII
Drainage Area(acres)	3640	696	1641
NCDWQ stream identification score	Perennial	Perennial	Perennial
NCDWQ Water Quality Classification	C	C	C/C
Morphological Description (stream type)	E4	E4	E/C5
Evolutionary trend	C4	C4	C5
Underlying mapped soils	CHEWACLA	CHEWACLA	CHEWACLA
Drainage class			
Soil Hydric status	Yes	Yes	Yes
Slope	0.005	0.005	0.014
FEMA classification	AE	AE	Mckee (Backwater)
Native vegetation community]	Piedmont Alluvial Forest	Piedmont Alluvial Forest	Piedmont Alluvial Forest
Percent composition of exotic invasive vegetation			
Wetland Summary Information			
Parameters	Wetland 1	Wetland 2	Wetland 3
Size of Wetland (acres)			
Wetland Type(non-riparian, riparian riverine or riparian non-riverine)			
Mapped Soil Series			
Drainage class			
Soil Hydric Status			
Source of Hydrology			
Hydrologic Impairment			
Native vegetation community			
Percent composition of exotic invasive vegetation			
Regulatory Considerations			
Regulation	Applicable?	Resolved?	Supporting Dcumentation
Waters of the United States - Section 404	Yes		SAW-2008-2808
Waters of the United States - Section 401	Yes		DWQ#2008-1441
Land Quality	Yes		CABAR-2009-0024
Endangered Species Act	No		
Historic Preservation Act	No		
Coastal Zone Management Act(CZMA)/Costal Area Management Act(CAMA)	No		
FEMA Floodplain Compliance	Yes		
Essential Fisheries Habitat	No		

Appendix B

Visual Assessment Data



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0 150 300 600 Feet
 1 inch = 300 feet

McKee Creek & Clear Creek Restoration Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- ▲ Stationing
- Conservation Easement
- P Photo Points
- ▲ Crest Gauge
- ROW
- ▲ Centerline
- ▲ Centerline Fall 2015
- Excluded
- Sewer Easement
- Cross Section
- Invasives

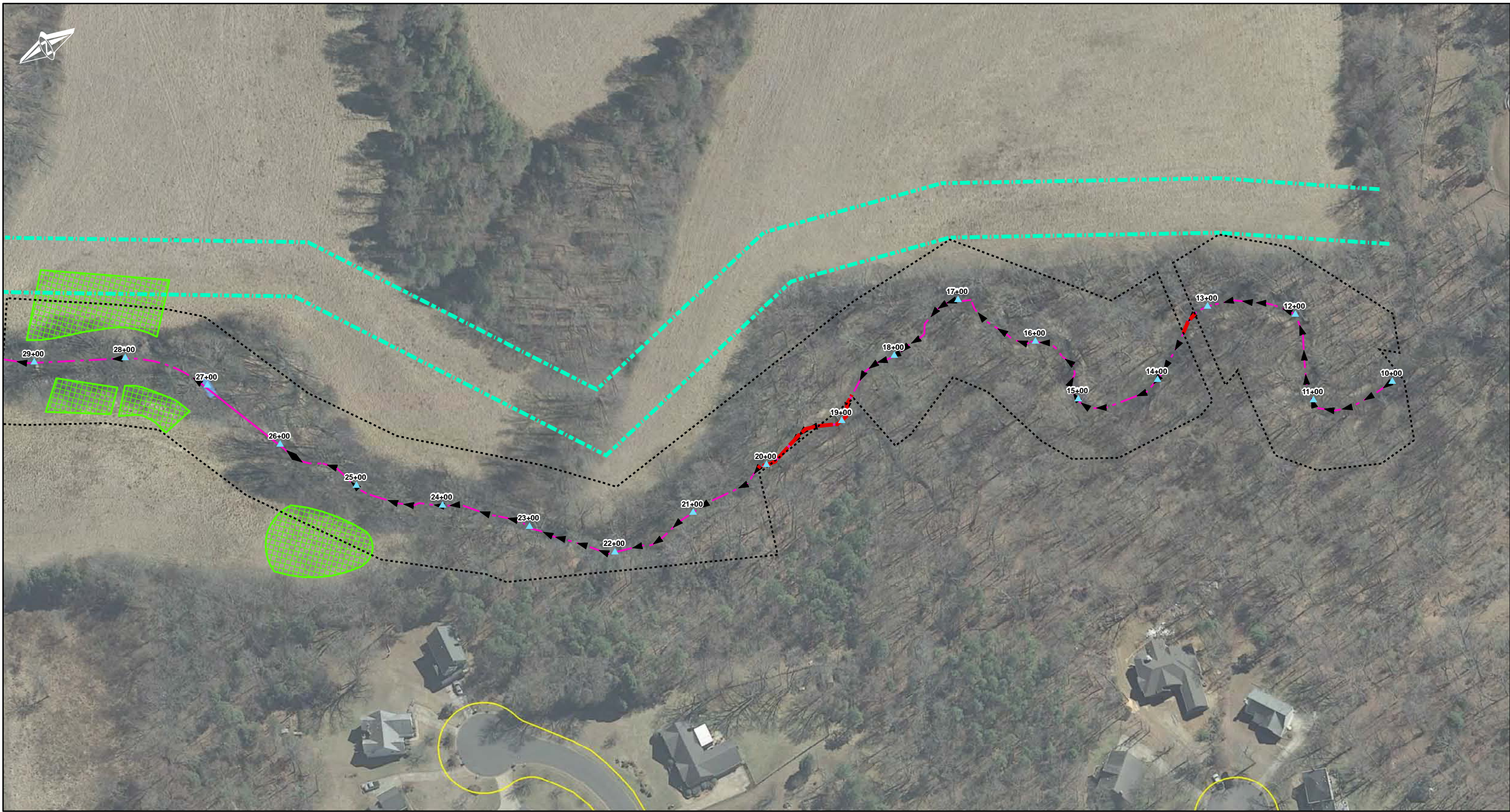
Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Criteria Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2



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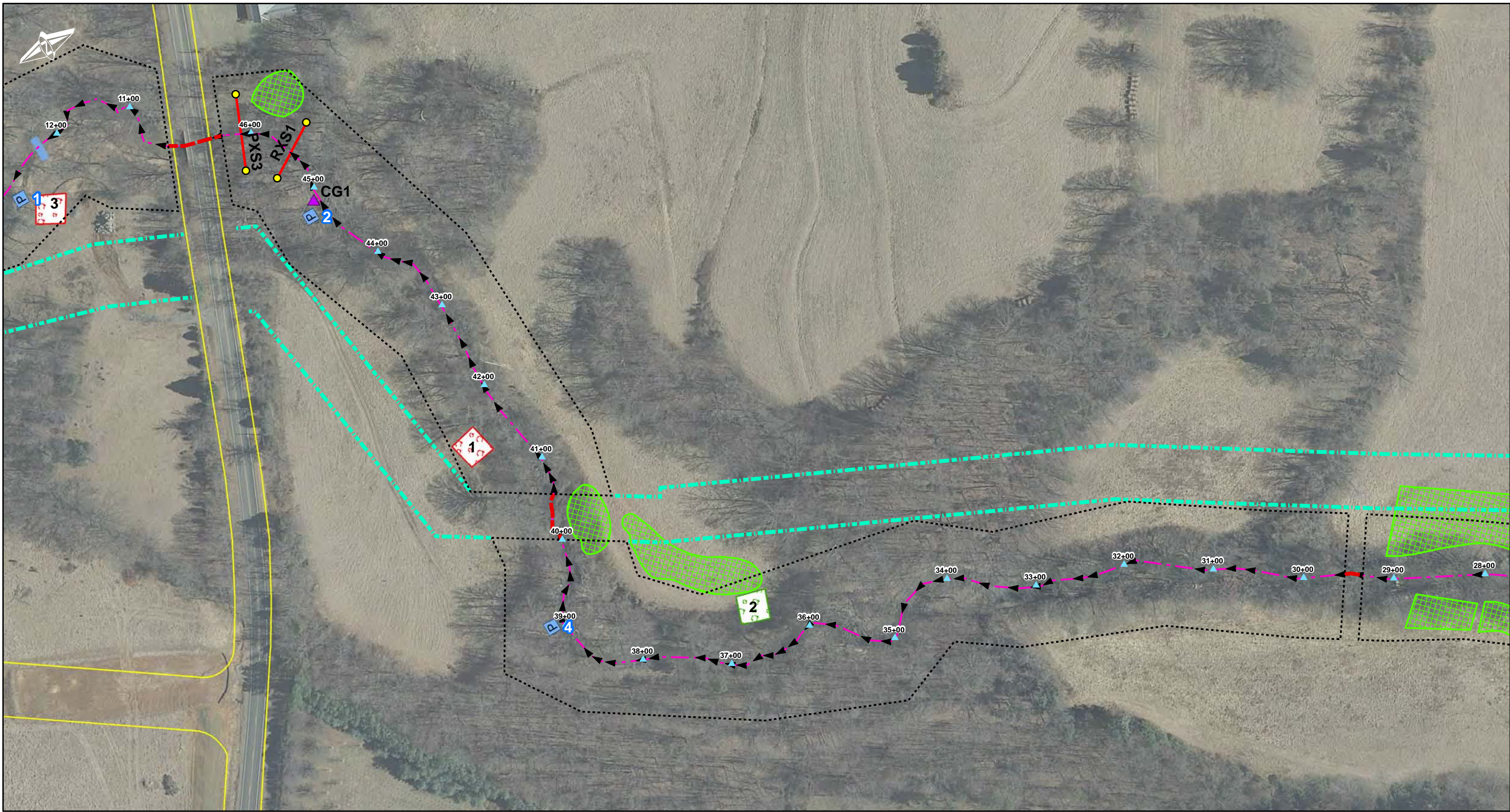
0 50 100 200 Feet
 1 inch = 100 feet

McKee Creek & Clear Creek Restoration Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend		Structures	Vegetation Plot
▲ Stationing	▲ Centerline	■ Failing	■ Criteria Unmet
--- Conservation Easement	▲ Centerline Fall 2015	■ NA - High Water	■ Criteria Met
P Photo Points	■ Excluded	■ Stable	■ Tornado Damage April 2012
▲ Crest Gauge	■ Sewer Easement	■ Stressed	
— ROW	● Cross Section		
	■ Invasives		

Figure
2A



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0 50 100 200 Feet
 1 inch = 100 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- ▲ Stationing
- P Photo Points
- ▲ Crest Gauge
- ROW
- ▲— Centerline
- ▲— Centerline Fall 2015
- Excluded
- - - Sewer Easement
- Cross Section
- X Invasives

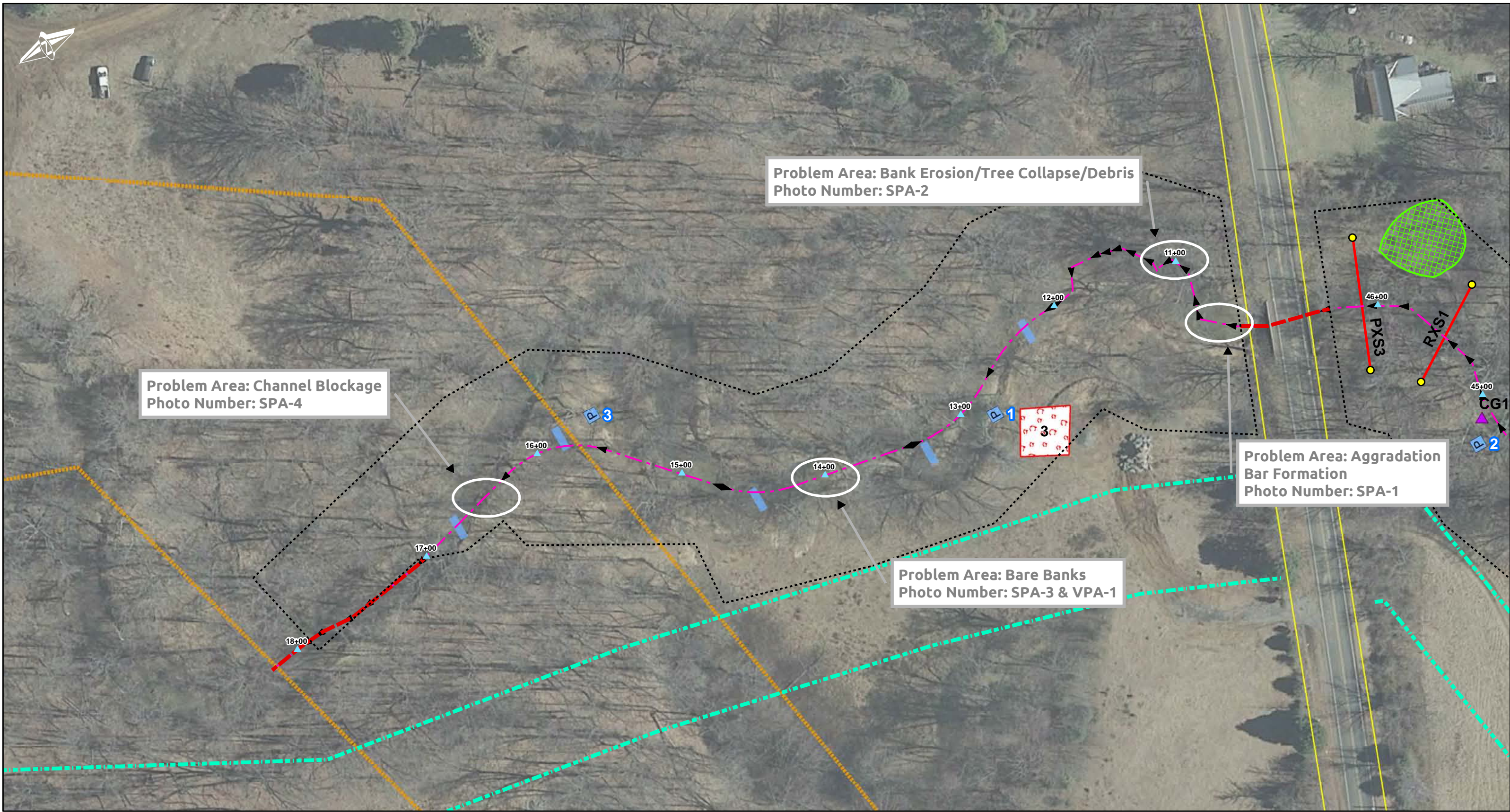
Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- X Criteria Unmet
- X Criteria Met
- X Tornado Damage April 2012

Figure 2B



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0 30 60 120 Feet
 1 inch = 60 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- ▲ Stationing
- Conservation Easement
- P Photo Points
- ▲ Crest Gauge
- ROW
- Centerline
- Centerline Fall 2015
- Excluded
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Criteria Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2C



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0 25 50 100 Feet
 1 inch = 50 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- Stationing
- Conservation Easement
- Photo Points
- Crest Gauge
- ROW
- Centerline
- Centerline Fall 2015
- Excluded
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Criteria Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2D



**Problem Area: Engineered Structure
Sediment/Flow Deflection
Photo Number: SPA-6**



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0 25 50 100 Feet
1 inch = 50 feet

McKee Creek & Clear Creek Restoration Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- Centerline
- Centerline Fall 2015
- Stationing
- Conservation Easement
- Photo Points
- Crest Gauge
- ROW
- Excluded
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Criteria Unmet
- Criteria Met
- Tornado Damage April 2012

**Figure
2E**

Table 5 Visual Stream Morphology Stability Assessment - 2015 (MY4)
 Reach ID McKee Creek Reach 1
 Assessed Length 3301

Major Channel Category	Channel Sub-Category	Metric	Number of Stable Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
Bed	Vertical Stability	Aggradation- Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		Degradation-Evidence of downcutting			0	0	100%			
	Riffle Condition	Texture/Substrate - Riffle maintains coarser substrate	0	0			100%			
	Meander Pool Condition	Depth Sufficient (Max Pool Depth: Mean Bankfull Depth >= 1.6)	0	0			100%			
		Length Appropriate(>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	0	0			100%			
	Thalweg Position	Thalweg centering at upstream of meander bend (Run)	0	0			100%			
Thalweg centering at downstream of meander bend (glide)		0	0	100%						
Bank	Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and or scour and erosion			0	0	100%	0	0	100.00%
	Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100.00%
	Mass Wasting	Bank stumping, caving, or collapse		Totals	0	0	100%	0	0	100.00%
Engineered Structures	Overall Integrity	Structures physically intact with no dislodged boulders or logs	N/E	N/E						
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill	0	0			100%			
	Piping	Structures lacking any substantial flow underneath sills or arms	0	0			100%			
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	0	0			100%			
	Habitat	Pool forming structures maintaining - Max Pool Depth: Mean Bankfull Depth >= 1.6 Rootwads/logs providing some cover at base-flow	N/E	N/E						

Table 5 **Visual Stream Morphology Stability Assessment - 2015 (MY4)**
 Reach ID McKee Creek Reach 2
 Assessed Length 723

Major Channel Category	Channel Sub-Category	Metric	Number of Stable Performing as Intended	Total Number in As-Built	Number of Unstable Segments	Amount of Unstable Footage	% Stable Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
Bed	Vertical Stability	Aggradation- Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	20	97%			
		Degradation-Evidence of downcutting			0	0	100%			
	Riffle Condition	Texture/Substrate - Riffle maintains coarser substrate	0	0			100%			
	Meander Pool Condition	Depth Sufficient (Max Pool Depth: Mean Bankfull Depth >= 1.6)	N/E	N/E						
		Length Appropriate(>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	N/E	N/E						
	Thalweg Position	Thalweg centering at upstream of meander bend (Run)	N/E	N/E						
Thalweg centering at downstream of meander bend (glide)		N/E	N/E							
Bank	Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and or scour and erosion			0	0	100%	0	0	100.00%
	Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			0	0	100%	0	0	100.00%
	Mass Wasting	Bank stumping, caving, or collapse			1	20	97%	0	0	100.00%
				Totals	0	0	100%	0	0	100.00%
Engineered Structures	Overall Integrity	Structures physically intact with no dislodged boulders or logs	N/E	N/E						
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill	N/E	N/E						
	Piping	Structures lacking any substantial flow underneath sills or arms	N/E	N/E						
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	N/E	N/E						
	Habitat	Pool forming structures maintaining - Max Pool Depth: Mean Bankfull Depth >= 1.6 Rootwads/logs providing some cover at base-flow	N/E	N/E						

Table 5 Visual Stream Morphology Stability Assessment - 2015 (MY4)
 Reach ID Clear Creek
 Assessed Length 1566

Major Channel Category	Channel Sub-Category	Metric	Number of Stable Performing as Intended	Total Number in As-Built	Number of Unstable Sections	Amount of Unstable Footage	% Stable Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
Bed	Vertical Stability	Aggradation- Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			1	25	98%			
		Degradation-Evidence of downcutting			0	0	100%			
	Riffle Condition	Texture/Substrate - Riffle maintains coarser substrate	2	2			100%			
	Meander Pool Condition	Depth Sufficient (Max Pool Depth: Mean Bankfull Depth>= 1.6)	16	16			100%			
		Length Appropriate (>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	16	16			100%			
	Thalweg Position	Thalweg centering at upstream of meander bend (Run)	16	16			100%			
Thalweg centering at downstream of meander bend (glide)		16	16			100%				
Bank	Scoured/Eroding	Bank lacking vegetative cover resulting simply from poor growth and or scour and erosion			1	20	98%	0	0	100.00%
	Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT include undercuts that are modest, appear sustainable and are providing habitat			1	15	99%	0	0	99.00%
	Mass Wasting	Bank stumping, caving, or collapse			1	20	98%	0	0	100.00%
Totals					0	0	100%	0	0	100.00%
Engineered Structures	Overall Integrity	Structures physically intact with no dislodged boulders or logs	13	13			100%			
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill	7	7			100%			
	Piping	Structures lacking any substantial flow underneath sills or arms	19	20			95%			
	Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	19	20			95%			
	Habitat	Pool forming structures maintaining - Max Pool Depth: Mean Bankfull Depth >= 1.6 Rootwads/logs providing some cover at base-flow	5	5			100%			

Table 6 Vegetation Condition Assessment - 2015 (MY4)

McKee Creek Project # 92573

Planted Acreage 4.44

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Area	Very limited cover of both woody and herbaceous material	.1 acres	Pattern and Color	1	0.1	98%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria	.1 acres	Pattern and Color	0	0	0
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year	.25 Acres	Pattern and Color	0	0	0

Easement Acreage 17.41

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement
Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	500 SF	Pattern and Color	7	0.624	3.58%
Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale)	None	Pattern and Color	0	0	0

Frame No. 1



Description: Photo Station 1.

Frame No. 2



Description: Photo Station 4.

Frame No. 3



Description: Photo Station 5.

Frame No. 4



Description: Photo Station 6.

Frame No. 5



Description: Photo Station 7.

Frame No. 1



Description: Vegetation Plot 1.

Frame No. 2



Description: Vegetation Plot 2.

Frame No. 3



Description: Vegetation Plot 3.

Frame No. 4



Description: Vegetation Plot 4.

Appendix C

Vegetation Plot Data

**Table 7. Veg Plot Criteria Attainment - 2015 (MY4)
McKee Creek Project # 92573**

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	No	33%
2	Yes	
3	No	
4	Yes	

**Table 8. CVS Vegetation Plot Metadata
McKee Creek Project # 92573**

Report Prepared By	Martin Richmond
Date Prepared	12/4/2015 10:38
database name	Withers&Ravenel-McKee Yr4.mdb
database location	C:\Users\lwelch\Downloads
computer name	WR1398
file size	79175680

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----

Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

PROJECT SUMMARY-----

Project Code	92573
project Name	McKee Creek
Description	McKee Creek Upstream and Downstream of Peach Orchard and Clear Creek
River Basin	Yadkin-Pee Dee
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	8

Table 9. Planted Stem Counts (Species by Plot with Annual Means) - 2015 (MY4)
McKee Creek Project # 92573

Species	Common Name	Type	Current Data - 2015 (MY4)								Annual Means											
			Plot 1		Plot 2		Plot 3		Plot 4		Current Mean		MY 1 (2012)		MY 2 (2013)		MY 3 (2014)		MY 4 (2015)			
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T		
<i>Acer negundo</i>	Box Elder	Tree	0	4	0	1	0	0	0	15	0	5	0	1.25	0	1.75	0	2.25	0	5		
<i>Betula nigra</i>	River Birch	Tree	1	1	2	4	1	3	0	0	1	2	0.75	1.25	0.75	1.25	0.75	2	1	2		
<i>Carya aquatica</i>	Water Hickory	Tree	0	0	2	2	0	0	1	1	0.75	0.75	0.5	0.5	0.5	1.5	0.5	0.5	0.75	0.75		
<i>Diospyrus virginiana</i>	Persimmon	Tree	0	1	0	0	0	0	0	1	0	0.5	0	1	0	1.25	0	1	0	0.5		
<i>Eleagnus umbellata</i>	Autumn Olive	Shrub	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.5	0	0	0	0		
<i>Fraxinus pennsylvanica</i>	Green Ash	Tree	0	0	2	2	0	0	0	0	0.5	0.5	1	1	1	1	0.75	0.75	0.5	0.5		
<i>Juglans nigra</i>	Black Walnut	Tree	3	7	0	1	0	0	0	2	0.75	2.5	1.75	1.75	1.25	1.75	1.5	3	0.75	2.5		
<i>Liquidambar styraciflua</i>	Sweetgum	Tree	0	2	0	30	0	1	0	5	0	9.5	0	9.5	0.25	9.5	0	9.75	0	9.5		
<i>Liriodendron tulipifera</i>	Tulip Poplar	Tree	0	0	0	0	1	1	3	4	1	1.25	0.75	0.75	0.5	0.5	1	1.25	1	1.25		
<i>Platanus occidentalis</i>	American Sycamore	Tree	2	2	5	5	2	2	7	24	4	8.25	4.5	4.25	4.75	5.5	4.5	4.75	4	8.25		
<i>Quercus michauxii</i>	Swamp Chestnut Oak	Tree	0	0	0	0	2	2	0	0	0.5	0.5	1	0.5	0.75	0.75	0.75	0.75	0.5	0.5		
<i>Quercus nigra</i>	Water Oak	Tree	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0		
<i>Quercus laurifolia</i>	Laurel Oak	Tree	0	0	0	2	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0.5		
<i>Quercus falcata</i>	Oak	Tree	0	0	0	0	1	1	0	0	0.25	0.25	0.5	0.5	0	0.5	0.25	0.25	0.25	0.25		
<i>Rhus copallinum</i>	Winged Sumac	Shrub	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0		
<i>Salix nigra</i>	Black Willow	Tree	0	0	0	0	0	0	6	9	1.5	2.25	2.25	2.25	2.25	3	2	2.5	1.5	2.25		
<i>Ulmus alata</i>	Winged Elm	Tree	0	0	0	0	0	0	0	0	0	0	0	2.25	0	0	0	0	0	0		
<i>Unknown</i>	Unknown	Unknown	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0		
	Plot Area (acres)		0.0247		0.0247		0.0247		0.0247			0.0247	0.0247	0.0247	0.0247	0.0247	0.0247	0.0247	0.0247	0.0247		
	Species Count		3	6	4	8	5	6	4	8	4	7										
	Stem Count		6	17	11	47	7	10	17	61	10.25	33.75	14	30	12	29	12	29	10	34		
	Stems Per Acre		243	688	445	1903	283	405	688	2470	415	1366	567	1204	486	1164	486	1164	415	1366		

Appendix D

Stream Survey Data

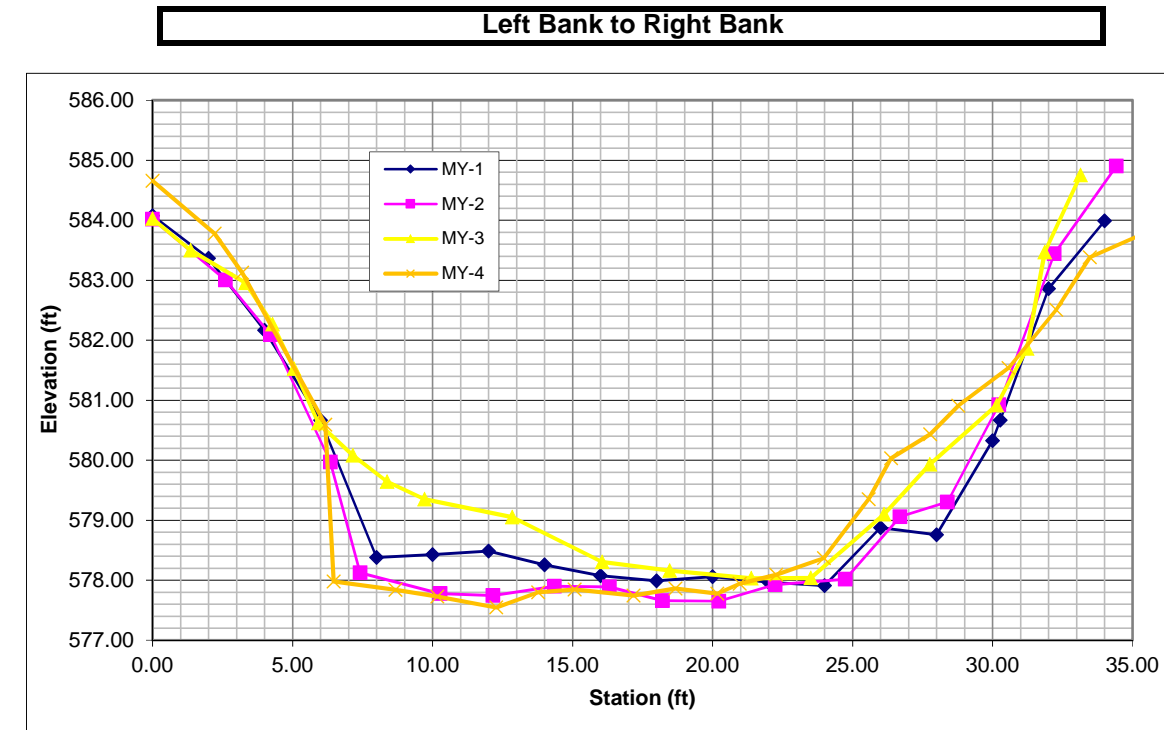
**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	McKee MY-04
XS-ID	RXS-1
Drainage Area	6.42 sq. mi
Date	10/25/2015
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	583.378
Bankfull Cross-Sectional Area	91.05
Bankfull Width	21
Flood Prone Area Elevation	589.009
Flood Prone Width	30.5
Max Depth at Bankfull	5.832
Mean Depth at Bankfull:	4.93
W/D Ratio:	4.26
Entrenchment Ratio:	1.45
Bank Height Ratio:	1.22



MY1-2012		MY2-2013		MY3-2014		MY4-2015		MY5-2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.00	584.08	0.00	584.02	0.00	584.03	0.00	584.66		
2.00	583.37	2.60	583.01	1.36	583.50	2.22	583.78		
4.00	582.17	4.22	582.09	3.32	582.95	3.20	583.13		
6.00	580.67	6.35	579.97	4.29	582.27	6.17	580.59		
8.00	578.38	7.42	578.13	5.05	581.53	6.47	577.98		
10.00	578.43	10.27	577.78	5.92	580.62	8.67	577.84		
12.00	578.49	12.16	577.75	7.15	580.08	10.17	577.73		
14.00	578.26	14.35	577.90	8.38	579.64	12.27	577.55		
16.00	578.08	16.32	577.89	9.71	579.35	13.77	577.80		
18.00	577.99	18.21	577.66	12.84	579.05	15.07	577.85		
20.00	578.06	20.23	577.65	16.05	578.31	17.17	577.75		
22.00	577.97	22.24	577.93	18.47	578.16	18.67	577.86		
24.00	577.91	24.74	578.02	21.38	578.03	20.17	577.78		
26.00	578.88	26.70	579.06	23.51	578.04	20.97	577.94		
28.00	578.76	28.39	579.30	26.12	579.10	22.27	578.09		
30.00	580.33	30.23	580.93	27.76	579.93	23.97	578.37		
30.27	580.67	32.20	583.44	30.14	580.92	25.57	579.35		
32.00	582.86	34.42	584.90	31.23	581.86	26.37	580.03		
34.00	583.99			31.86	583.47	27.77	580.43		
				33.14	584.75	28.77	580.91		
						30.57	581.54		
						32.27	582.51		
						33.47	583.39		
						36.07	583.92		
						37.27	584.16		



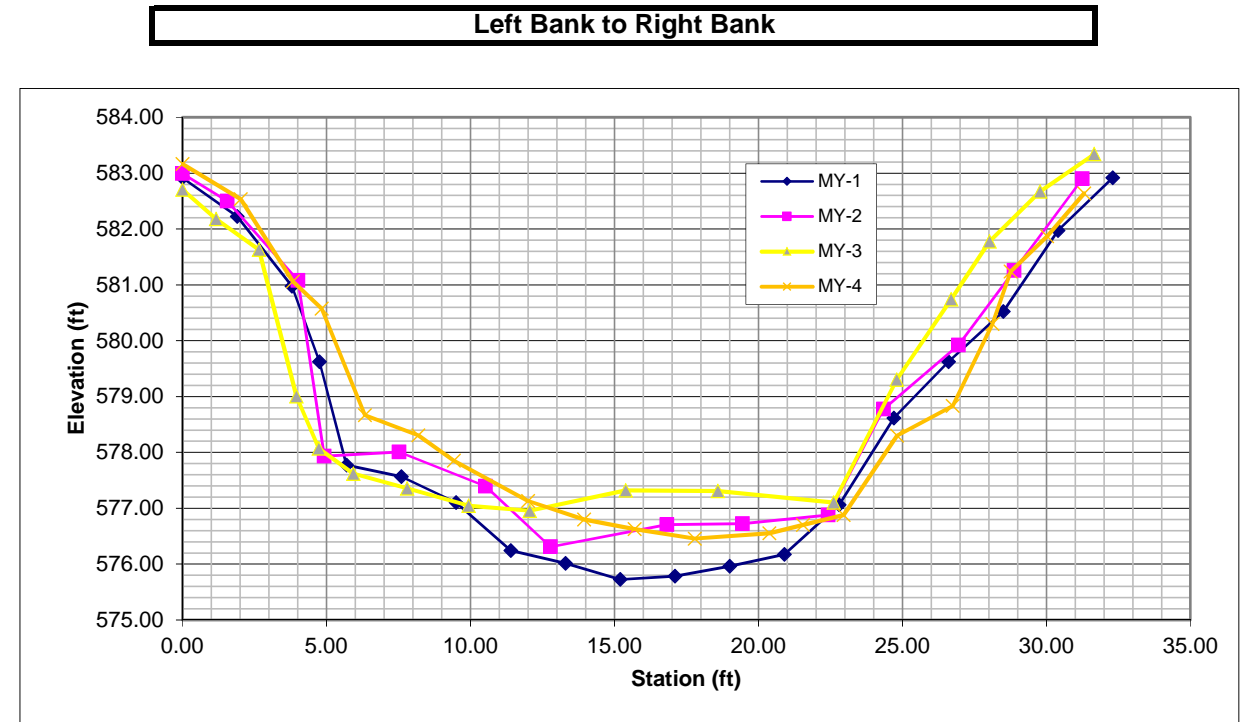
**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	McKee MY-04
XS-ID	PXS-1
Drainage Area	6.42 sq. mi
Date	10/25/2015
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	582.715
Bankfull Cross-Sectional Area	69.69584
Bankfull Width	15.61
Flood Prone Area Elevation	588.327
Flood Prone Width	50
Max Depth at Bankfull	6.258
Mean Depth at Bankfull:	3.95
W/D Ratio:	3.95
Entrenchment Ratio:	3.20
Bank Height Ratio:	1.21



MY1-2012		MY2-2013		MY3-2014		MY4-2015		MY5-2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation		
0.00	582.92	0.00	582.99	0.00	582.70	0.00	583.16		
1.90	582.23	1.55	582.50	1.17	582.18	2.02	582.53		
3.80	580.98	4.01	581.08	2.65	581.63	3.83	581.06		
4.75	579.63	4.92	577.93	3.95	579.00	4.83	580.58		
5.70	577.78	7.52	578.01	4.73	578.07	6.33	578.67		
7.60	577.57	10.52	577.39	5.93	577.62	8.19	578.31		
9.50	577.11	12.78	576.31	7.80	577.35	9.42	577.85		
11.40	576.25	16.82	576.71	9.93	577.05	12.00	577.13		
13.30	576.02	19.44	576.72	12.06	576.96	13.95	576.80		
15.20	575.73	22.42	576.88	15.39	577.32	15.70	576.63		
17.10	575.79	24.34	578.77	18.59	577.31	17.79	576.46		
19.00	575.97	26.94	579.92	22.61	577.10	20.38	576.56		
20.90	576.18	28.88	581.26	24.80	579.30	21.55	576.70		
22.80	577.07	31.25	582.90	26.69	580.74	22.96	576.88		
24.70	578.62			28.02	581.78	24.81	578.30		
26.60	579.63			29.78	582.67	26.75	578.83		
28.50	580.53			31.66	583.34	28.12	580.30		
30.40	581.98					28.76	581.24		
32.30	582.92					30.03	581.87		
						31.31	582.64		



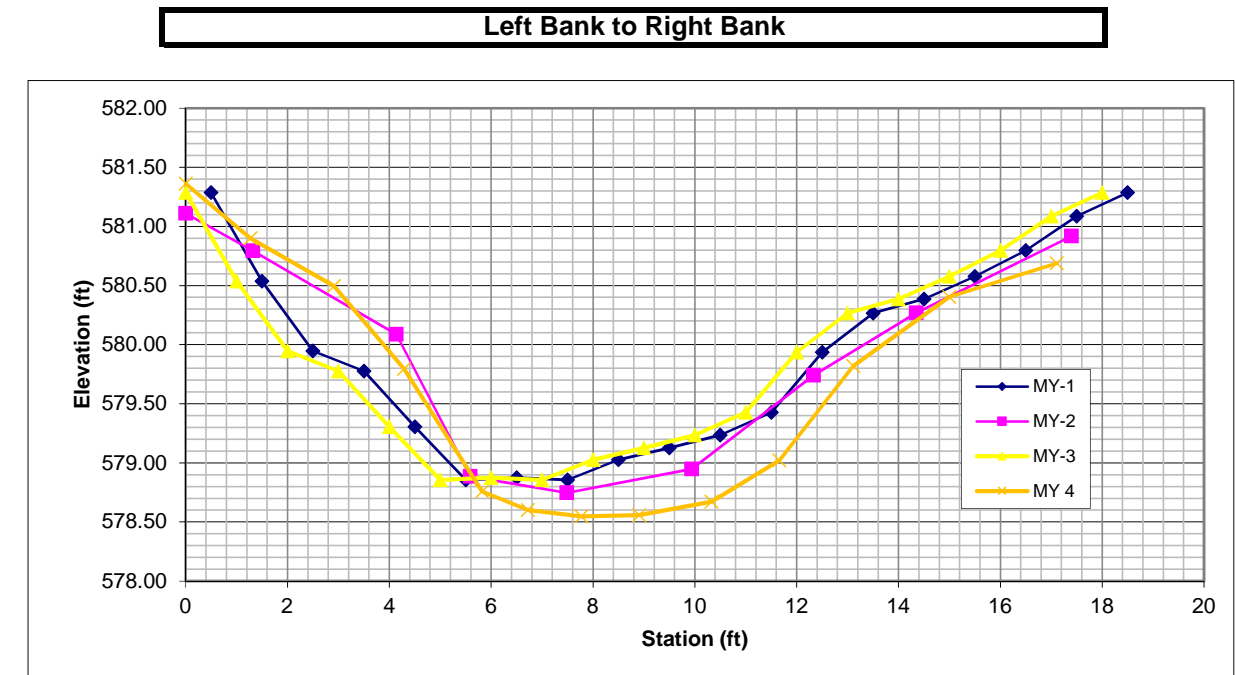
**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-04
XS-ID	RXS-2
Drainage Area	0.95
Date	10/25/2015
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	580.836
Bankfull Cross-Sectional Area	20.36755
Bankfull Width	13.11
Flood Prone Area Elevation	582.666
Flood Prone Width	120
Max Depth at Bankfull	2.289
Mean Depth at Bankfull:	1.39
W/D Ratio:	9.45
Entrenchment Ratio:	9.15
Bank Height Ratio:	1.25



MY1-2013		MY2-2013		MY3-2014		MY4-2015		MY5-2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.50	581.29	0.00	581.11	0.00	581.29	0.00	581.36		
1.50	580.54	1.32	580.79	1.00	580.54	1.27	580.90		
2.50	579.95	4.14	580.09	2.00	579.95	2.91	580.50		
3.50	579.78	5.59	578.89	3.00	579.78	4.29	579.80		
4.50	579.31	7.49	578.75	4.00	579.31	5.82	578.76		
5.50	578.86	9.94	578.95	5.00	578.86	6.72	578.60		
6.50	578.88	12.33	579.74	6.00	578.88	7.77	578.55		
7.50	578.86	14.35	580.27	7.00	578.86	8.91	578.56		
8.50	579.03	17.40	580.92	8.00	579.03	10.33	578.67		
9.50	579.13			9.00	579.13	11.66	579.02		
10.50	579.24			10.00	579.24	13.11	579.82		
11.50	579.43			11.00	579.43	15.00	580.41		
12.50	579.94			12.00	579.94	17.11	580.69		
13.50	580.27			13.00	580.27				
14.50	580.39			14.00	580.39				
15.50	580.58			15.00	580.58				
16.50	580.80			16.00	580.80				
17.50	581.09			17.00	581.09				
18.50	581.29			18.00	581.29				



**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

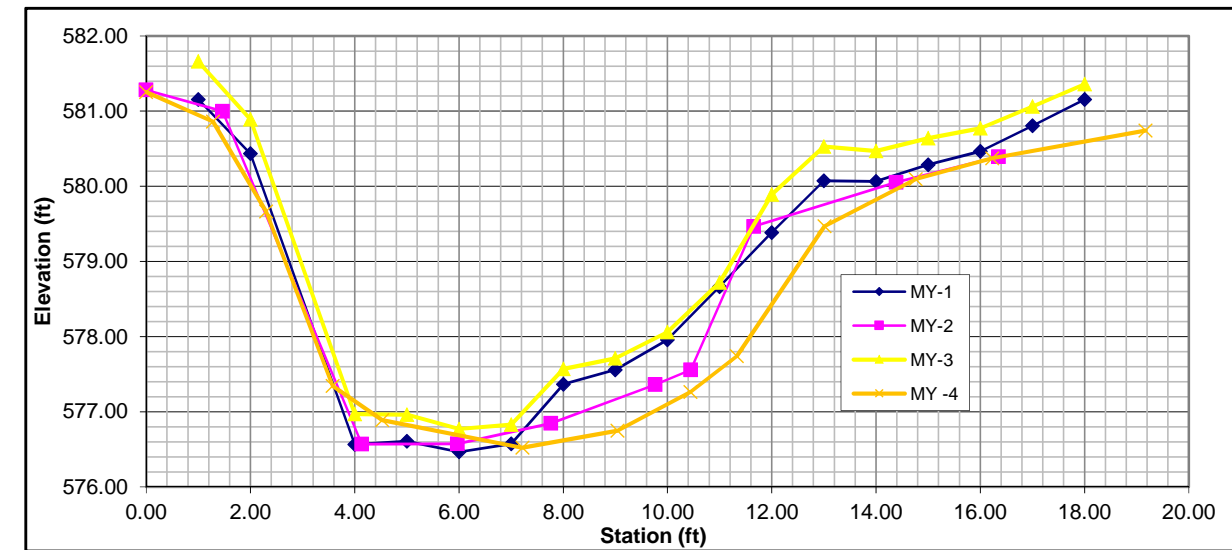
Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-04
XS-ID	PXS-2
Drainage Area	0.95
Date	10/25/15
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	580.155
Bankfull Cross-Sectional Area	25.35077
Bankfull Width	11.33
Flood Prone Area Elevation	583.545
Flood Prone Width	150
Max Depth at Bankfull	3.634
Mean Depth at Bankfull:	2.102111
W/D Ratio:	5.38982
Entrenchment Ratio:	13.23919
Bank Height Ratio:	1.321959



MY1		MY2		MY3		MY4		MY5	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
1.00	581.16	0.00	581.28	1.00	581.66	0.00	581.26		
2.00	580.44	1.46	581.00	2.00	580.89	1.28	580.86		
4.00	576.57	4.13	576.57	4.00	576.97	2.30	579.67		
5.00	576.61	5.97	576.57	5.00	576.96	3.58	577.34		
6.00	576.47	7.76	576.85	6.00	576.77	4.53	576.89		
7.00	576.58	9.76	577.36	7.00	576.83	7.22	576.52		
8.00	577.37	10.45	577.56	8.00	577.57	9.04	576.75		
9.00	577.56	11.66	579.47	9.00	577.71	10.44	577.26		
10.00	577.96	14.39	580.05	10.00	578.06	11.33	577.74		
11.00	578.67	16.35	580.39	11.00	578.72	13.01	579.47		
12.00	579.39			12.00	579.89	14.76	580.09		
13.00	580.08			13.00	580.53	16.23	580.37		
14.00	580.07			14.00	580.47	19.17	580.74		
15.00	580.29			15.00	580.64				
16.00	580.47			16.00	580.77				
17.00	580.81			17.00	581.06				
18.00	581.16			18.00	581.36				

Left Bank to Right Bank



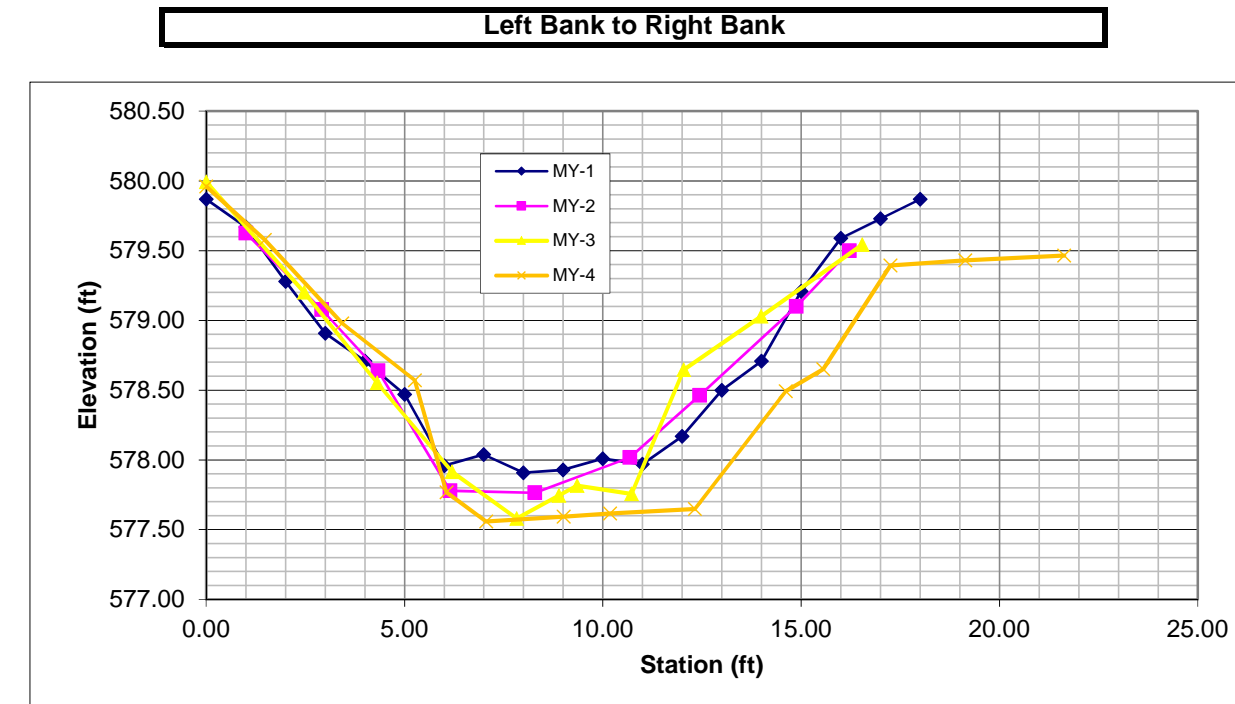
**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-04
XS-ID	RXS-3
Drainage Area	0.95
Date	10/25/2015
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	579.868
Bankfull Cross-Sectional Area	27.52
Bankfull Width	14.08
Flood Prone Area Elevation	582.156
Flood Prone Width	250
Max Depth at Bankfull	2.31
Mean Depth at Bankfull:	1.67
W/D Ratio:	8.44
Entrenchment Ratio:	17.76
Bank Height Ratio:	1.04



MY1-2012		MY2-2013		MY3-2014		MY4-2015		MY5-2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.00	579.87	1.00	579.63	0.00	579.99	0.00	579.96		
1.00	579.67	2.91	579.08	2.47	579.20	1.48	579.58		
2.00	579.28	4.33	578.64	4.31	578.55	3.43	578.98		
3.00	578.91	6.15	577.78	6.20	577.91	5.26	578.57		
4.00	578.71	8.29	577.76	7.83	577.58	6.06	577.77		
5.00	578.47	10.68	578.02	8.89	577.74	7.06	577.56		
6.00	577.96	12.44	578.46	9.35	577.82	9.01	577.59		
7.00	578.04	14.88	579.10	10.72	577.76	10.18	577.62		
8.00	577.91	16.22	579.50	12.04	578.65	12.32	577.65		
9.00	577.93			13.99	579.03	14.61	578.49		
10.00	578.01			16.54	579.54	15.56	578.65		
11.00	577.97					17.25	579.39		
12.00	578.17					19.14	579.43		
13.00	578.50					21.63	579.47		
14.00	578.71								
15.00	579.21								
16.00	579.59								
17.00	579.73								
18.00	579.87								



**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

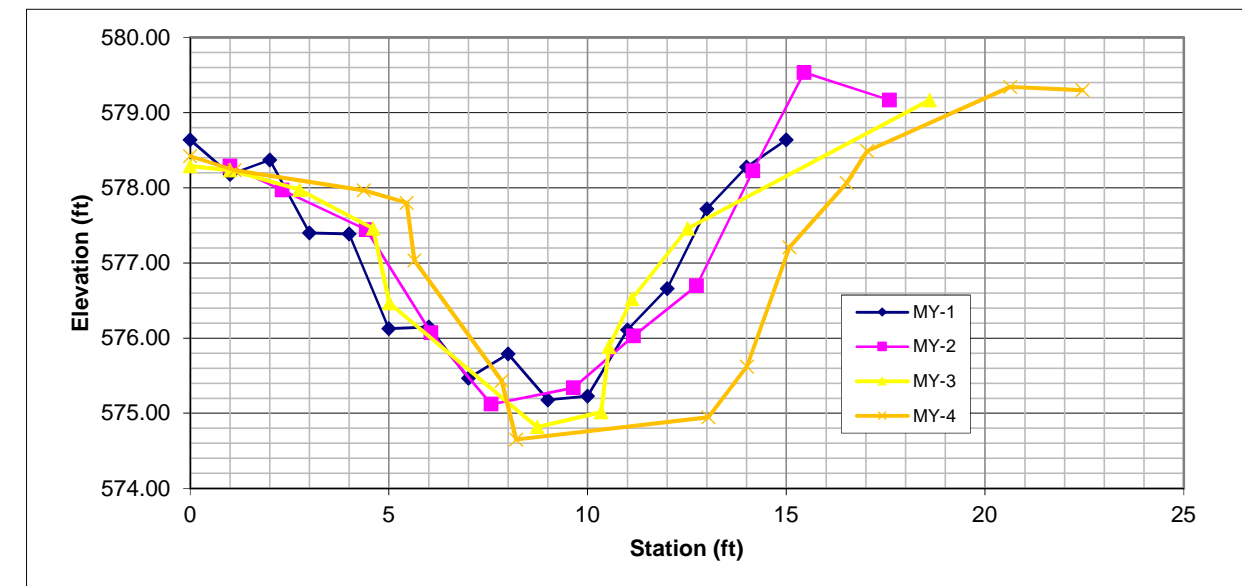
Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-04
XS-ID	PXS-3
Drainage Area	0.95
Date	10/25/2015
Field Crew	Richmond/Burley

Summary Data	
Bankfull Elevation	579.138
Bankfull Cross-Sectional Area	45.25133
Bankfull Width	14.99
Flood Prone Area Elevation	583.458
Flood Prone Width	200
Max Depth at Bankfull	4.488
Mean Depth at Bankfull:	2.406556
W/D Ratio:	6.228819
Entrenchment Ratio:	16.67779
Bank Height Ratio:	1.045455



MY1 - 2012		MY2 - 2013		MY3 - 2014		MY4 - 2015		MY5 - 2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.00	578.64	1.00	578.29	0.00	578.29	0.00	578.42		
1.00	578.18	2.32	577.97	1.00	578.23	1.12	578.23		
2.00	578.37	4.43	577.44	2.75	577.98	4.37	577.97		
3.00	577.40	6.06	576.07	4.60	577.46	5.45	577.80		
4.00	577.39	7.57	575.12	5.01	576.47	5.64	577.03		
5.00	576.13	9.64	575.34	8.73	574.82	7.84	575.43		
6.00	576.15	11.16	576.03	10.34	575.01	8.20	574.65		
7.00	575.47	12.74	576.70	10.54	575.89	13.04	574.95		
8.00	575.79	14.16	578.23	11.12	576.52	14.01	575.62		
9.00	575.18	15.45	579.53	12.52	577.46	15.08	577.21		
10.00	575.23	17.60	579.17	18.60	579.17	16.52	578.06		
11.00	576.11					17.03	578.49		
12.00	576.66					20.63	579.34		
13.00	577.72					22.45	579.30		
14.00	578.28								
15.00	578.64								

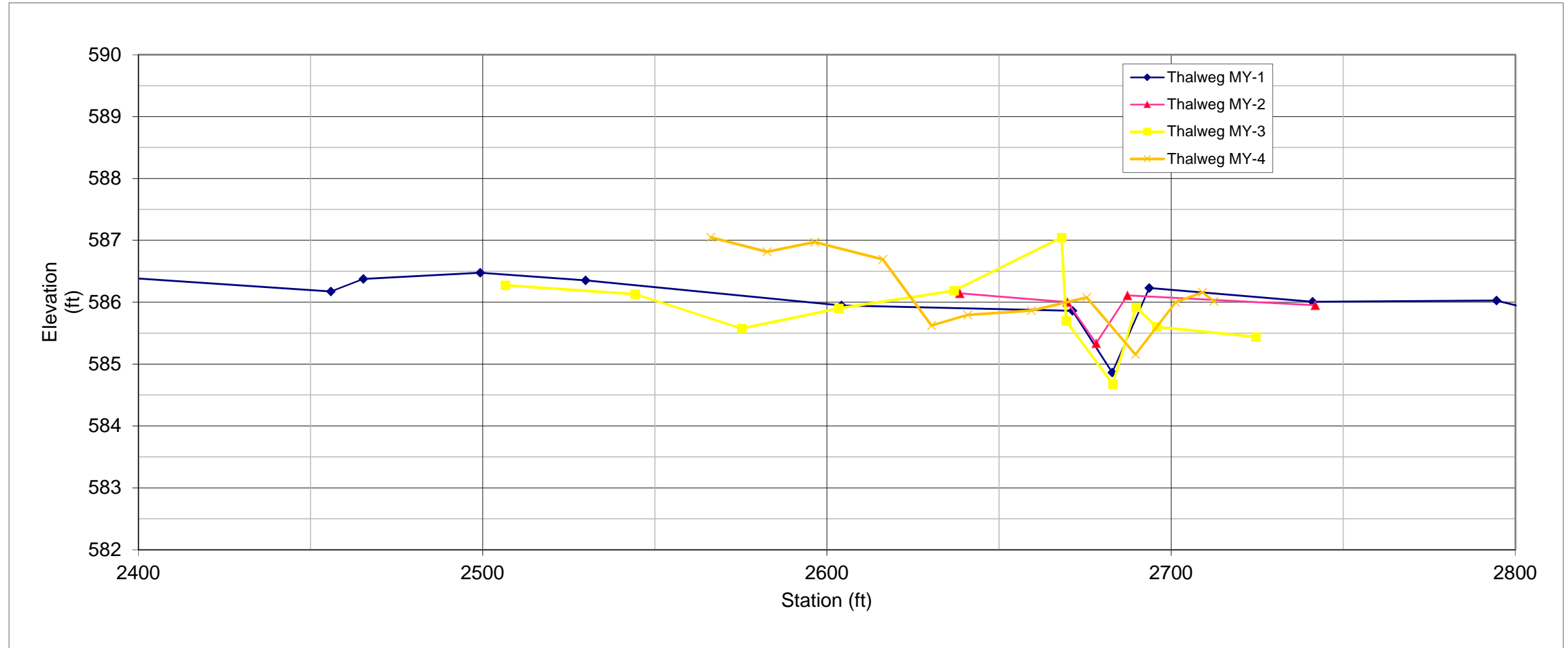
Left Bank to Right Bank



**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Longitudinal Profile Plot	
River Basin	Yadkin Pee-Dee
Watershed	McKee Reach 1
Station	24+00 - 28+00
Date	10/25/2015
Field Crew	Richmond/Burley

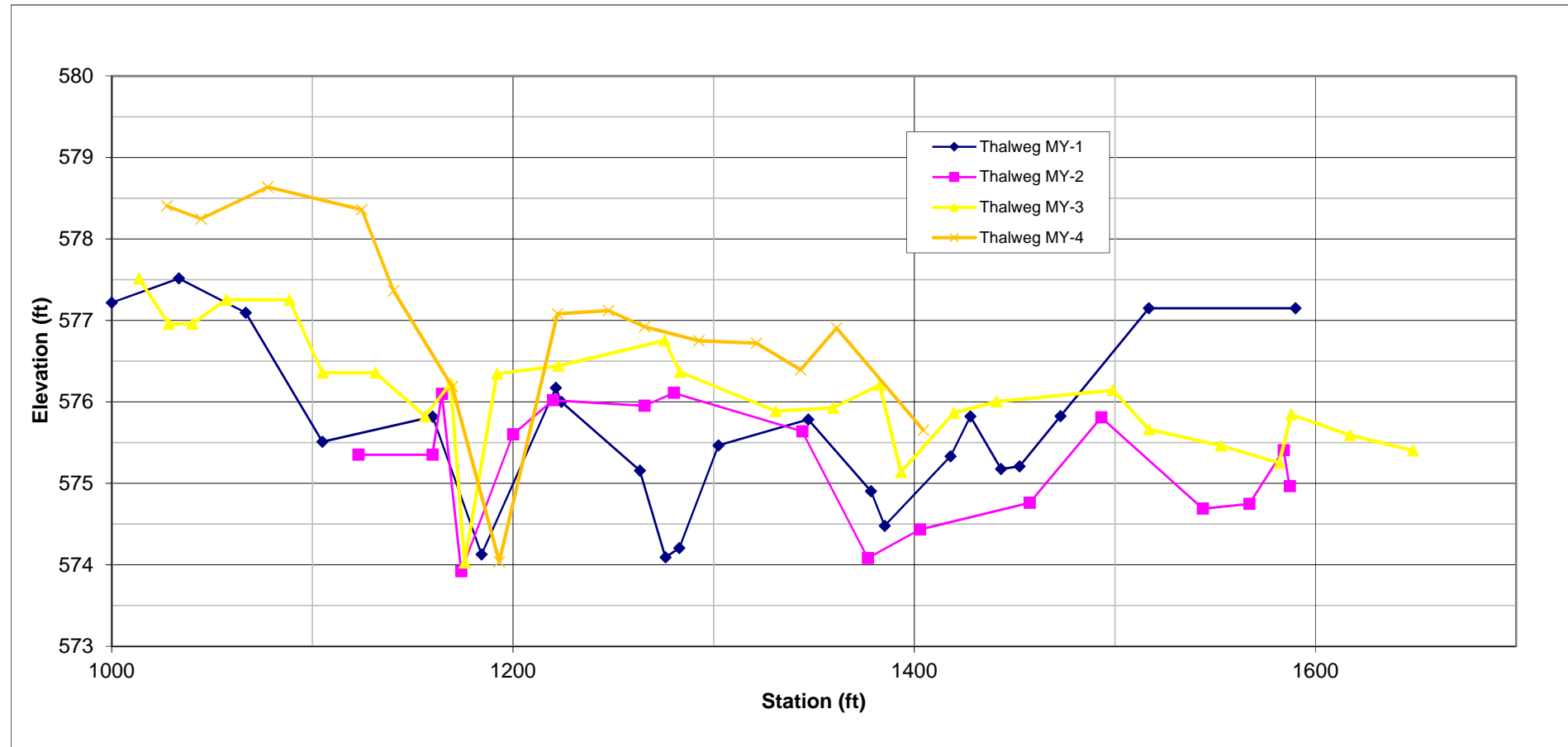
MY4-2015	
Station	Elevation
2566.29	587.05
2582.59	586.82
2596.45	586.97
2616.21	586.69
2630.38	585.62
2640.90	585.80
2659.41	585.87
2675.47	586.08
2689.65	585.16
2701.28	586.00
2709.10	586.16
2712.40	586.02



**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Longitudinal Profile Plot	
River Basin	Yadkin Pee-Dee
Watershed	McKee Reach 2
Station	10+00 - 17+00
Date	10/25/2015
Field Crew	Richmond/Burley

MY4-2015	
Station	Elevation
1027.41	578.41
1044.54	578.25
1077.68	578.64
1124.63	578.36
1140.46	577.37
1169.77	576.19
1193.13	574.04
1222.09	577.08
1247.61	577.12
1265.57	576.92
1292.59	576.75
1321.32	576.72
1343.43	576.40
1361.25	576.91
1404.50	575.65



**McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573**

Longitudinal Profile Plot	
River Basin	Yadkin Pee-Dee
Watershed	Clear Creek
Station	11+00 - 28+00
Date	10/25/2015
Field Crew	Richmond/Burley

MY4-2015		MY4-2015	
Station	Elevation	Station	Elevation
1100.00	581.43	1855.47	579.01
1129.25	580.69	1905.70	579.02
1148.79	580.96	1942.11	578.24
1180.00	580.73	1960.53	579.18
1230.63	581.18	1996.91	578.26
1252.82	580.88	2047.14	577.67
1290.92	581.07	2084.71	578.30
1301.72	580.71	2126.12	576.99
1342.01	580.90	2154.86	577.34
1361.75	580.71	2176.06	576.89
1387.56	580.42	2213.90	576.41
1421.43	580.06	2257.88	577.18
1442.83	580.73	2270.57	577.65
1458.43	580.16	2328.40	576.58
1480.65	579.95	2343.75	575.38
1489.79	579.91	2370.20	575.94
1511.79	579.67	2388.49	575.02
1528.47	579.59	2409.31	576.10
1564.17	579.47	2427.22	575.10
1612.79	579.54	2448.37	574.30
1635.75	579.74	2485.64	574.27
1661.02	579.56	2524.95	573.79
1707.47	579.49	2565.81	574.65
1731.65	579.54	2638.61	575.45
1794.90	579.17	2656.92	573.73
1826.92	578.72	2694.75	573.41

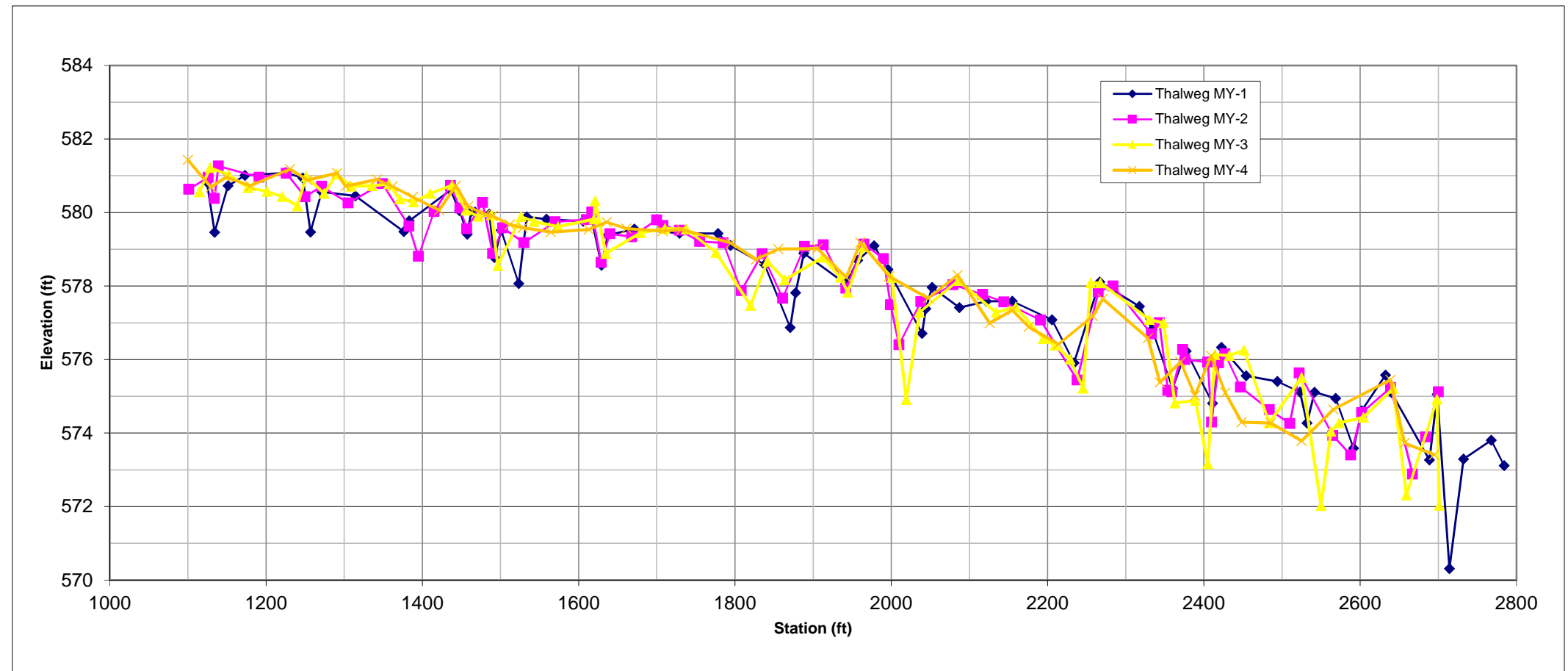


Table 10a. Baseline Stream Data Summary -R2
McKee Creek Project # 92573 - Clear Creek

Parameter	Gauge2	Regional Curve			Pre-Existing Condition				Design			Dixon Branch			
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Med	Max	SD5	n	Min	Med	Max	Min	Med	Max
Bankfull Width (ft)					11.5		16.7				17.3		7.9		13.9
Floodprone Width (ft)					50		150			90		190	35		100
Bankfull Mean Depth (ft)					1.3		2				1.4		0.8		1.4
¹ Bankfull Max Depth (ft)					3.7		6.1			2.2		2.5	2		2.9
Bankfull Cross Sectional Area (ft ²)					21.8		24.8				25		11.3		13.2
Width/Depth Ratio					5.8		12.8				12		5.4		10.8
Entrenchment Ratio					3.8		11.3			5.2		11	3.1		8.9
¹ Bank Height Ratio					1.4		2.3				1		1.1		1.5
Profile															
Riffle Length (ft)															
Riffle Slope (ft/ft)					0.0059		0.0084			0.0061		0.0106	0.012		0.018
Pool Length (ft)															
Pool Max depth (ft)					2.8		3.3			5.3		8	2.1		2.5
Pool Spacing (ft)					57.5		116.9			127.7		223.6	10		45
Pattern															
Channel Beltwidth (ft)					35		47			52		78	29		50
Radius of Curvature (ft)					15		25			35		52	6		22
Rc:Bankfull width (ft/ft)					11.5		16.7				17.3		7.9		13.9
Meander Wavelength (ft)					45		75			132		196	48		85
Meander Width Ratio					3.4		5.6			3		4.5	4.3		7.6
Transport parameters															
Reach Shear Stress (competency) lb/ft ²															
Max part size (mm) mobilized at bankfull															
Stream Power (transport capacity) W/m ²															
Additional Reach Parameters															
Rosgen Classification							E/C5				C4				E4
Bankfull Velocity (fps)							3.3-3.9				3.6				3.6
Bankfull Discharge (cfs)							89								
Valley length (ft)															
Channel Thalweg length (ft)															
Sinuosity (ft)							1.12				1.21				1.3
Water Surface Slope (Channel) (ft/ft)							0.0042				0.0071				0.0055
BF slope (ft/ft)							0.0042				0.0032				0.0055
³ Bankfull Floodplain Area (acres)															
⁴ % of Reach with Eroding Banks															
Channel Stability or Habitat Metric															
Biological or Other															

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

**Table 10a. Baseline Stream Data Summary
McKee Creek Project # 92573 - McKee-Reach 1**

Parameter	Gauge2	Regional Curve			Pre-Existing Condition					Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Med	Max	SD5	n	Min	Med	Max	Min	Mean	Med	Max	SD5	n
Dimension and Substrate - Riffle Only																		
Bankfull Width (ft)					27.5		31.8				31							
Floodprone Width (ft)					75		160			75		160						
Bankfull Mean Depth (ft)					2.1		2.8			2.6								
¹ Bankfull Max Depth (ft)					3.5		4.4			3.4		4.4						
Bankfull Cross Sectional Area (ft2)					68.2		77.6			80								
Width/Depth Ratio					10.2		14.9			12								
Entrenchment Ratio					2.6		5.5			2.4		5.2						
¹ Bank Height Ratio					1		2.1			1								
Profile																		
Riffle Length (ft)																		
Riffle Slope (ft/ft)					1.9		4.5			1.9		3.3						
Pool Length (ft)																		
Pool Max depth (ft)					3.1		6.4			5.2		7.7						
Pool Spacing (ft)					50		205			123.9		216.9						
Pattern																		
Channel Beltwidth (ft)					65		145			93		139						
Radius of Curvature (ft)					48		195			62		108						
Rc:Bankfull width (ft/ft)					27.5		31.8			31								
Meander Wavelength (ft)					101		305			235		350						
Meander Width Ratio					2.2		5			2		4.5						
Transport parameters																		
Reach Shear Stress (competency) lb/ft2							0.49			0.52								
Max part size (mm) mobilized at bankfull							45			45								
Stream Power (transport capacity) W/m2																		
Additional Reach Parameters																		
Rosgen Classification							E4			C4								
Bankfull Velocity (fps)							4.4-5.0			4.1								
Bankfull Discharge (cfs)							350											
Valley length (ft)																		
Channel Thalweg length (ft)																		
Sinuosity (ft)							1.28			1.16								
Water Surface Slope (Channel) (ft/ft)							0.0029			0.0032								
BF slope (ft/ft)							0.0029			0.0032								
³ Bankfull Floodplain Area (acres)																		
⁴ % of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data. 5. Of value/needed only if the n exceeds 3

**Table 10a. Baseline Stream Data Summary -R2
McKee Creek Project # 92573 - McKee-Reach 2**

Parameter	Gauge2	Regional Curve			Pre-Existing Condition					Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Med	Max	SD5	n	Min	Med	Max	Min	Mean	Med	Max	SD5	n
Dimension and Substrate - Riffle Only																		
Bankfull Width (ft)					25.5		26.8				31.9							
Floodprone Width (ft)					75		160			75		160						
Bankfull Mean Depth (ft)					2.1		2.8				2.6							
¹ Bankfull Max Depth (ft)					3.5		4.4			3.4		4.4						
Bankfull Cross Sectional Area (ft ²)					68.2		77.6				80							
Width/Depth Ratio					10.2		14.9				12							
Entrenchment Ratio					2.6		5.5			2.4		5.2						
¹ Bank Height Ratio					1		2.1			1								
Profile																		
Riffle Length (ft)					101		305											
Riffle Slope (ft/ft)					0.0055		0.0131			0.0061		0.0106						
Pool Length (ft)																		
Pool Max depth (ft)					6.5		6.5			5.3		8						
Pool Spacing (ft)					45		180			127.7		223.6						
Pattern																		
Channel Beltwidth (ft)					135		240			96		287						
Radius of Curvature (ft)					95		240			64		144						
Rc:Bankfull width (ft/ft)					25.5		26.8				31.9							
Meander Wavelength (ft)					208		377			243		477						
Meander Width Ratio					5		9.2			3		9						
Transport parameters																		
Reach Shear Stress (competency) lb/ft ²							0.33				0.38							
Max part size (mm) mobilized at bankfull							45				45							
Stream Power (transport capacity) W/m ²																		
Additional Reach Parameters																		
Rosgen Classification							E4				C4							
Bankfull Velocity (fps)							4.0-4.5				4.1							
Bankfull Discharge (cfs)							350											
Valley length (ft)																		
Channel Thalweg length (ft)																		
Sinuosity (ft)							1.5				1.17							
Water Surface Slope (Channel) (ft/ft)							0.0027				0.0027							
BF slope (ft/ft)							0.0018				0.0018							
³ Bankfull Floodplain Area (acres)																		
⁴ % of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data. 5. Of value/needed only if the n exceeds 3

**Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
McKee Creek Project #92573- Clear Creek**

Parameter	Pre-Existing Condition						Reference Reach(es) Data						Design						As-built/Baseline					
1R1% / Ru% / P% / G% / S%																								
1SC% / Sa% / G% / C% / B% / Be%																								
1d16 / d35 / d50 / d84 / d95 / dip / disp (mm)	0.35	0.7	1.2	3.2	6		0.4	1.3	3	14	18													
2Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																								
3Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																								

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosley built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of e

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design survey), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construction distribution of the

the reach. This means that the distributions for these parameters should include data from both the cross-section surveys and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling

a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

**Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
McKee Creek Project # 92573- Reach 1**

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					As-built/Baseline				
1R% / Ru% / P% / G% / S%																				
1SC% / Sa% / G% / C% / B% / Be%																				
1d16 / d35 / d50 / d84 / d95 / dip / disp (mm)	0.7	27.8	49.4	83.2	109.5	0.7	27.8	49.4	83.2	109.5										
2Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																				
3Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																				

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loosely built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of every segment for ER would not be necessary.

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions.

ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design survey), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construction distribution of these parameters, leaving the reader/consumer with a sample that is weighted heavily on the stable sections of the reach. This means that the distributions for these parameters should include data from both the cross-section surveys and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling of the BHR at riffles beyond those subject to cross-sections and therefore can be readily integrated and provide a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

**Table 10b. Baseline Stream Data Summary (Substrate, Bed, Bank, and Hydrologic Containment Parameter Distributions)
McKee Creek Project # 92573- Reach 2**

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design					As-built/Baseline				
1Ri% / Ru% / P% / G% / S%																				
1SC% / Sa% / G% / C% / B% / Be%																				
1d16 / d35 / d50 / d84 / d95 / dip / disp (mm)	0.7	27.8	49.4	83.2	109.5	0.7	27.8	49.4	83.2	109.5										
2Entrenchment Class <1.5 / 1.5-1.99 / 2.0-4.9 / 5.0-9.9 / >10																				
3Incision Class <1.2 / 1.2-1.49 / 1.5-1.99 / >2.0																				

Shaded cells indicate that these will typically not be filled in.

1 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

2 = Entrenchment Class - Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as visual estimates

3 = Assign/bin the reach footage into the classes indicated and provide the percentage of the total reach footage in each class in the table. This will result from the measured cross-sections as well as the longitudinal profile

Footnotes 2,3 - These classes are loostey built around the Rosgen classification and hazard ranking breaks, but were adjusted slightly to make for easier assignment to somewhat coarser bins based on visual estimates in the field such that measurement of e

The intent here is to provide the reader/consumer of design and monitoring information with a good general sense of the extent of hydrologic containment in the pre-existing and the rehabilitated states as well as comparisons to the reference distributions. ER and BHR have been addressed in prior submissions as a subsample (cross-sections as part of the design survey), however, these subsamples have often focused entirely on facilitating design without providing a thorough pre-construction distribution of the reach. This means that the distributions for these parameters should include data from both the cross-section surveys and the longitudinal profile and in the case of ER, visual estimates. For example, the typical longitudinal profile permits sampling a more complete sample distribution for these parameters, thereby providing the distribution/coverage necessary to provide meaningful comparisons.

Table 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections) - 2015 (MY4)

McKee Creek Project # 92573

	Cross Section 1 (Riffle-1)							Cross Section 2 (Pool-1)							Cross Section 3 (Riffle-2)						
Based on fixed baseline bankfull elevation1	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	583.4	581.0	583.40	583.38				582.7	580.0	580.74	582.72				580.8	580.5	580.70	580.84			
Bankfull Width (ft)	24.27	22.00	24.44	21.00				22.5	23.00	22.74	15.60				18.00	13.00	10.00	13.11			
Floodprone Width (ft)	160.0	33.00	30.50	30.50				160.0	36.0	50.00	50.00				150.0	150.0	120.00	120.00			
Bankfull Mean Depth (ft)	1.89	1.98	1.18	4.93				2.45	2.37	2.75	3.95				1.36	1.05	1.02	1.39			
Bankfull Max Depth (ft)	2.76	2.85	2.59	5.83				3.90	3.69	3.78	6.26				2.43	1.75	1.61	2.29			
Bankfull Cross Sectional Area (ft2)	53.00	51.40	32.06	91.05				63.68	58.50	71.95	69.69				30.61	13.40	11.26	20.36			
Bankfull Width/Depth Ratio	12.82	11.11	20.72	4.26				9.20	9.70	8.26	3.95				13.23	12.33	16.87	9.45			
Bankfull Entrenchment Ratio	6.59	1.50	1.25	1.45				7.10	1.57	2.20	3.20				8.82	11.54	12.00	9.15			
Bankfull Bank Height Ratio	2.53	2.23	2.32	1.22				1.84	1.81	1.69	1.21				1.00	1.20	1.73	1.25			
Based on current/developing bankfull feature2																					
Record elevation (datum) used																					
Bankfull Width (ft)																					
Floodprone Width (ft)																					
Bankfull Mean Depth (ft)																					
Bankfull Max Depth (ft)																					
Bankfull Cross Sectional Area (ft2)																					
Bankfull Width/Depth Ratio																					
Bankfull Entrenchment Ratio																					
Bankfull Bank Height Ratio																					
Cross Sectional Area between end pins (ft2)																					
d50 (mm)																					
	Cross Section 4 (Pool-2)							Cross Section 5 (Riffle-3)							Cross Section 6 (Pool-3)						
Based on fixed baseline bankfull elevation1	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used	580.2	580.4	580.53	580.16				579.87	579.60	579.54	579.87				579.14	578.29	578.29	579.14			
Bankfull Width (ft)	17.00	14.30	8.00	11.33				17.00	13.88	14.07	14.08				15.00	13.20	11.52	14.99			
Floodprone Width (ft)	150.0	150.0	150.00	150.00				250.00	200.00	250.00	250.00				250.00	200.00	200.00	200.00			
Bankfull Mean Depth (ft)	2.55	2.62	2.81	2.10				1.11	0.96	1.29	1.67				1.70	1.68	1.64	2.41			
Bankfull Max Depth (ft)	3.97	3.82	3.76	3.63				1.96	1.84	1.96	2.31				3.46	3.17	3.47	4.49			
Bankfull Cross Sectional Area (ft2)	30.61	31.60	25.53	25.35				21.02	14.73	12.27	27.52				27.27	21.35	17.81	45.25			
Bankfull Width/Depth Ratio	6.66	5.46	2.85	5.39				15.37	14.51	10.87	8.44				8.80	7.87	7.01	6.23			
Bankfull Entrenchment Ratio	8.82	10.49	18.75	13.24				14.71	14.41	17.77	17.76				16.67	15.15	21.70	16.68			
Bankfull Bank Height Ratio	1.18	1.00	1.30	1.32				1.00	1.01	1.23	1.04				1.00	1.00	1.25	1.05			
Based on current/developing bankfull feature2																					
Record elevation (datum) used																					
Bankfull Width (ft)																					
Floodprone Width (ft)																					
Bankfull Mean Depth (ft)																					
Bankfull Max Depth (ft)																					
Bankfull Cross Sectional Area (ft2)																					
Bankfull Width/Depth Ratio																					
Bankfull Entrenchment Ratio																					
Bankfull Bank Height Ratio																					
Cross Sectional Area between end pins (ft2)																					
d50 (mm)																					

1 = Widths and depths for monitoring resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: "It is uncertain if the monitoring datum has been consistent over the performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary."

2 = Based on the elevation of any dominant depositional feature that develops and is observed at the time of survey. If the baseline datum remains the only significant depositional feature then these two sets of dimensional parameters will be equal, however, if another depositional feature of significance develops above or below the baseline bankfull datum then this should be tracked and quantified in these cells.

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary - 2015 (MY4)
McKee Creek Project # 92573 Clear Creek

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)						21.02	17.5		25.85		2	13.2	13.5		13.9		2	10	12.04		14.07		2	13.11	13.59		14.08		2							
Floodprone Width (ft)						150	200		250		2	200.0	200.0		200.0		2	120	185		250		2	120	185		250		2							
Bankfull Mean Depth (ft)						1.11	1.23		1.36		2	1.0	1.3		1.7		2	1.02	1.16		1.29		2	1.39	1.53		1.67		2							
Bankfull Max Depth (ft) ¹						1.96	2.19		2.43		2	1.8	2.5		3.2		2	1.61	1.79		1.96		2	2.289	2.3		2.31		2							
Bankfull Cross Sectional Area (ft ²)						21.02	23.44		25.85		2	14.7	18.0		21.4		2	11.26	11.77		12.27		2	20.37	23.95		27.52		2							
Width/Depth Ratio						13.23	14.29		15.37		2	7.9	11.2		14.5		2	9.77	10.32		10.87		2	8.44	8.95		9.45		2							
Entrenchment Ratio						8.333	11.52		14.71		2	14.4	14.8		15.2		2	12.00	14.89		17.77		2	9.15	13.46		17.76		2							
Bank Height Ratio ¹						1	1		1		2	1.0	1.0		1.0		2	1.23	1.48		1.73		2	1.04	1.15		1.25		2							
Profile																																				
Riffle Length (ft)						12	16.5	18	22	4	6	10	29.36	30	45	10.7	11	11	27.14	35	50	10.6	6	9.13	28.53	23.59	57.83	23	4							
Riffle Slope (ft/ft)						0	0.021	0	0	0	6	0.019	0.034	0.034	0.049	0.02	6	0.012	0.032	0.034	0.045	0.018	6	0.004	0.020	0.021	0.033	0.012	4							
Pool Length (ft)						15	35.09	33	66	17	13	10	29.36	30	45	10.7	11	15	29.14	32	45	10.4	11	15.35	27.78	22.01	50.23	11.28	11							
Pool Max depth (ft)						1.502	2.297	2	6	1	16	0.78	1.33	1.219	1.408	0.492	11	1.2	2.1	2.1	5	1.2	11	0.191	0.859	0.8	1.722	0.504	11							
Pool Spacing (ft)						26	105	98	189	55	8	20	94.18	86	158	51.12	11	25	98	100	200	57	11	26.45	132.2	147.8	219.9	73.36	7							
Pattern																																				
Channel Beltwidth (ft)						42	64.17	65	85	16	6																									
Radius of Curvature (ft)						20	44.82	40	84	23	11																									
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)						153	171.5	168	195	16	6																									
Meander Width Ratio						2.333	3.565	3.611	4.722	0.867	6																									
Additional Reach Parameters																																				
Rosgen Classification									C4						C4					C4								C4								
Channel Thalweg length (ft)									1660						1658					1587							1638									
Sinuosity (ft)									1.19						1.17					1.17							1.18									
Water Surface Slope (Channel) (ft/ft)									0.0033						0.0033					0.004							0.00496									
BF slope (ft/ft)									0.0033						0.0034					0.004							0.004									
Ri% / Ru% / P% / G% / S%																																				
SC% / Sa% / G% / C% / B% / Be%						10	7	35	47	1	0	7.5	9	30	51	2.5	0	6.32	14.94	30.46	45.41	2.87	0													
d16 / d35 / d50 / d84 / d95 ²						1.5	27.3	38.5	109	154		0.75	54.5	77	154	218		0.75	27.3	54.5	154	218														
% of Reach with Eroding Banks ³									1%						5%					5%							5%									
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave
 4 = Of value/needed only if the n exceeds 3

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary - 2015 (MY4)
McKee Creek Project # 92573 McKee Creek- Reach 1

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5							
	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n		
Dimension and Substrate - Riffle only																																						
Bankfull Width (ft)																																						
Floodprone Width (ft)																																						
Bankfull Mean Depth (ft)																																						
1Bankfull Max Depth (ft)																																						
Bankfull Cross Sectional Area (ft2)																																						
Width/Depth Ratio																																						
Entrenchment Ratio																																						
1Bank Height Ratio																																						
Profile																																						
Riffle Length (ft)							15	24	20	38	8	18																										
Riffle Slope (ft/ft)							0	0	0	0	0	18																										
Pool Length (ft)							10	43	32	132	33	15		17.47				1		20				1		14.18				1								
Pool Max depth (ft)							2	3	3	4	1	6		0.7				1		1.24				1		1.893				1								
Pool Spacing (ft)							59	84	86	103	19	4																										
Pattern																																						
Channel Beltwidth (ft)							42	91	64	170	56	5																										
Radius of Curvature (ft)							22	49	46	80	19	7																										
Rc:Bankfull width (ft/ft)																																						
Meander Wavelength (ft)							138	437	290	1070	387	5																										
Meander Width Ratio							1.615	3.515	2.462	6.538	2.149	5																										
Additional Reach Parameters																																						
Rosgen Classification							E4/C4						Not enough stream data to calculate						Not enough stream data to calculate						Not enough stream data to calculate													
Channel Thalweg length (ft)							3274						Not enough stream data to calculate						Not enough stream data to calculate						Not enough stream data to calculate													
Sinuosity (ft)							1.12						Not enough stream data to calculate						Not enough stream data to calculate						Not enough stream data to calculate													
Water Surface Slope (Channel) (ft/ft)							0.0019						Not enough stream data to calculate						Not enough stream data to calculate						Not enough stream data to calculate													
BF slope (ft/ft)							0.0019						Not enough stream data to calculate						Not enough stream data to calculate						Not enough stream data to calculate													
3Ri% / Ru% / P% / G% / S%																																						
3SC% / Sa% / G% / C% / B% / Be%																																						
3d16 / d35 / d50 / d84 / d95 /																																						
2% of Reach with Eroding Banks							0%						Not enough stream data to calculate						Not enough stream data to calculate																			
Channel Stability or Habitat Metric																																						
Biological or Other																																						

Shaded cells indicate that these will typically not be filled in.
 1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.
 2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table
 3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

Exhibit Table 11b. Monitoring Data - Stream Reach Data Summary - 2015 (MY4)
McKee Creek Project # 92573 McKee Creek- Reach 2

Parameter	Baseline						MY-1						MY-2						MY-3						MY-4						MY-5					
	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n	Min	Mean	Med	Max	SD4	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)							24.7					1	22.00					1	24.44					1												
Floodprone Width (ft)							160					1	33.00					1	30.5					1												
Bankfull Mean Depth (ft)							1.89					1	1.98					1	1.179					1												
1Bankfull Max Depth (ft)							2.76					1	2.85					1	2.587					1												
Bankfull Cross Sectional Area (ft2)							53					1	51.40					1	32.06					1												
Width/Depth Ratio							12.82					1	11.11					1	20.72					1												
Entrenchment Ratio							6.59					1	1.50					1	1.248					1												
1Bank Height Ratio							2.53					1	2.23					1	2.316					1												
Profile																																				
Riffle Length (ft)							10	32.2	34	44	13.54	5	45	53.5	53.5	62		2	40					2												
Riffle Slope (ft/ft)							-0.049	-0.003	0.012	0.028	0.035	5	0.002	0.005	0.005	0.008		2	0.002	0.005	0.005	0.007		2												
Pool Length (ft)							24	36.6	39	55	12.74	5	15	27.8	30	40	12.32	5	20	32.8	29	39	12.1	5												
Pool Max depth (ft)							1.242	2.386	2.187	3.287	0.423	5	0.442	1.498	1.683	2.46	0.88	5	0.5	1.5	1.6	2.2	0.78	5												
Pool Spacing (ft)							45	178.8	206	267	87.81	5	0	141	162.5	239	101.2	4	50	185	200	260	80.23	4												
Pattern																																				
Channel Beltwidth (ft)							97	101	101	105	5.657	2																								
Radius of Curvature (ft)							65	128.3	120	200	67.88	3																								
Rc:Bankfull width (ft/ft)																																				
Meander Wavelength (ft)							282	322	322	362	56.57	2																								
Meander Width Ratio							4.042	4.208	4.208	4.375	0.236	2																								
Additional Reach Parameters																																				
Rosgen Classification													E4/C4					C4						C4						C4						
Channel Thalweg length (ft)													1422					464 (survey reduction)						464 (survey reduction)						377 (survey reduction)						
Sinuosity (ft)													1.39					1.15						1.2						1.19						
Water Surface Slope (Channel) (ft/ft)													0.0026					0.0026						0.003						N/A						
BF slope (ft/ft)													0.0026					0.0026						0.003						N/A						
3Ri% / Ru% / P% / G% / S%																																				
3SC% / Sa% / G% / C% / B% / Be%							0	7.27	54.55	21.82	5.45	0	0	6	73	16	5	0	0	5.62	73.03	15.73	5.62	0												
3d16 / d35 / d50 / d84 / d95 /							19.3	38.5	54.5	109	309		3	19.3	27.3	77	154		4.85	19.3	27.3	77	309													
2% of Reach with Eroding Banks																																				
Channel Stability or Habitat Metric																																				
Biological or Other																																				

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

4. = Of value/needed only if the n exceeds 3

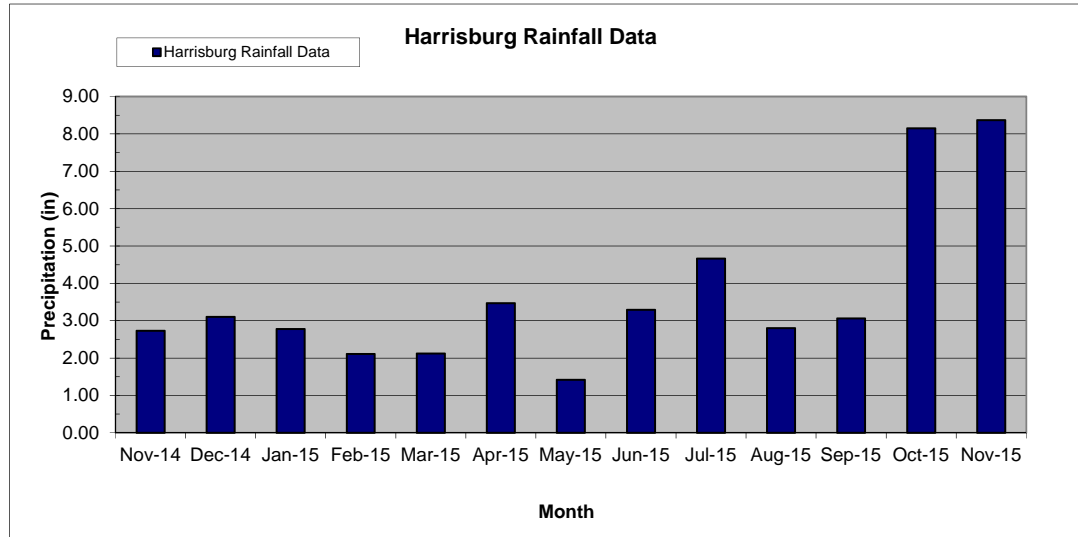
Appendix E

Hydrology Data

Table 12. Verification of Bankfull Events - 2015 (MY4)

Date of Data Collection	Date of Occurance	Method	Photo # (if available)
Crest Gage 1			
10/01/12	Unknown	Crest Gauge, Wrack of Flow Stage	
10/01/13	Unknown	Crest Gauge, Wrack of Flow Stage	
10/28/14	Unknown	Crest Gauge, Wrack of Flow Stage	
10/25/15	10/25/2015	Visual observation; Debris lines; Flattened vegetation	
11/11/15	11/11/2015	Visual observation; Debris lines; Flattened vegetation	
Crest Gage 2			
10/01/13	Unknown	Crest Gauge, Wrack of Flow Stage	
Fall 2014	Unknown	Crest Gauge, Wrack of Flow Stage	
10/25/15	10/25/2015	Visual observation; Debris lines; Flattened vegetation; Floodplain interaction	
11/11/15	11/11/2015	Visual observation; Debris lines; Flattened vegetation; Floodplain interaction	
Crest Gage 3			
10/01/12	Unknown	Crest Gauge, Wrack of Flow Stage	
10/01/13	Unknown	Crest Gauge, Wrack of Flow Stage	
10/28/14	Unknown	Crest Gauge, Wrack of Flow Stage	
10/25/15	10/25/2015	Visual observation; Debris lines; Flattened vegetation	
11/11/15	11/11/2015	Visual observation; Debris lines; Flattened vegetation	

Month	Days Recorded	Monthly Total
Nov-14	8	2.73
Dec-14	31	3.10
Jan-15	31	2.78
Feb-15	24	2.11
Mar-15	31	2.12
Apr-15	30	3.47
May-15	31	1.42
Jun-15	30	3.29
Jul-15	31	4.66
Aug-15	31	2.80
Sep-15	30	3.06
Oct-15	31	8.15
Nov-15	23	8.37



Crest Gauge Readings

Gauge	Year	WSE	Year	WSE	Year	WSE	Year	WSE
CG1	MY1-2012	581.2	MY2-2013	581.5	MY3-2014	582.0	MY4-2015	N/A
CG2	MY1-2012	580.8	MY2-2013	580.4	MY3-2014	580.2	MY4-2015	N/A
CG3	MY1-2012	577.1	MY2-2013	578.2	MY3-2014	577.3	MY4-2015	N/A