McKee Creek Stream Restoration
Monitoring Report – Year 5 of 5
FINAL
Contract # 004391
DMS Project # 92573
Cabarrus County, North Carolina

Construction 2010
Collected October/November 2016
Report November 2016

Submitted to:
NCDEQ – Division of Mitigation Services
1601 Mail Service Center,
Raleigh, NC 27699-1601

Prepared By:

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Executive Summary/ Project Abstract

The project goals and objectives stated in the McKee Creek Restoration Plan (NCEEP 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 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 Spring 2012. Successful restoration must contain a minimum of 260 live stems per acre at Year 5.

Year 5 shows an average of 426 planted live stems per acre, with a minimum count of 243. These estimates are based on Level 2 of the CVS-EEP 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. Year 5 shows a total average of 1,447 stems per acre

including volunteers, with a minimum count of 445. 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 7 volunteer stems, yielding a total count of 13 stems (526/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 and Year 4 monitoring (6 live stems each year), and the volunteer stem count of 7 is a decrease from Year 4 monitoring (11 volunteer stems).

Vegetation Plot 2 (McKee Creek Reach 1)

Total stem count was 11 planted live stems (445/acre) and 44 volunteer stems, yielding a total count of 55 stems (2,227/acre). The total planted live stem count is well above the success criteria. The 11 planted live stem count is consistent with the live stem count in Year 4 monitoring (11 live stems), and the volunteer stem count of 44 is an increase from Year 4 monitoring (36 volunteer stems).

Vegetation Plot 3 (McKee Creek Reach 2)

Total stem count was 7 planted live stems (283/acre) and 4 volunteer stems, yielding a total count of 11 stems (445/acre). The total planted live stem count exceeds the success criteria of 260 stems/acre at Year 5. The 7 planted live stem count is consistent with the live stem count in Year 4 monitoring (7 live stems), and the volunteer stem count of 4 is an increase from Year 4 monitoring (3 volunteer stems).

Vegetation Plot 4 (Clear Creek Reach)

Total stem count was 17 planted live stems (688/acre) and 47 volunteer stems, yielding a total count of 64 stems (2,591/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 4 monitoring (18 live stems), and the volunteer stem count of 47 is increased from Year 4 monitoring (44 volunteer stems).

Invasive Vegetation

Minor non-native invasive vegetation was noted within Vegetation Plots 1, 2 and 3, primarily comprised of Japanese honeysuckle (Lonicera japonica). Vegetation plot 2 continues to have Lonicera intertwined with the hardwood species along the eastern edge of the plot; however, this presence is diminished greatly, and is not considered to be problematic in Year 5.

Invasive species have been treated in the past along and within the conservation easement. Visual inspection indicates treatment has been successful, but has not fully eradicated invasives to the maximum extent possible. For persistent existing invasive, DMS will implement two invasive treatments on site in the 2017 growing season. Invasive treatments will include the entire conservation easement.

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 Plot 1, the total stem count for this plot is above criteria when combined with volunteer stems (526/acre). This plot was impacted by mechanized mowing of the adjacent sewer easement in 2012. Plot data after this time showed only six of the planted stems remaining (243/acre). Based on this, the remaining live stems could not reach the success criteria of 280 stems per acre, regardless of survival rate. The six stems have survived during the last three annual monitoring events, and should be considered successful under the circumstances.

Stream Results

NOTE: Qualitative and quantitative stream assessment data was collected in October and November of 2016. As part of the monitoring, each reach was visually inspected, and survey data was collected for the restored sections of McKee Creek and all of Clear Creek.

McKee Creek Reach 1

McKee Creek Reach 1 was visually inspected throughout the easement, and survey data was collected within the Enhancement (Level I) portion of McKee Creek Reach 1 between Stations 25+00 and 27+00. No disturbance or alteration of the Enhancement (Level I) area was noted during the visual assessment.

The majority of McKee Creek Reach 1 is Enhancement (Level II). No disturbance or alteration of the Enhancement (Level II) area was noted during the visual assessment.

Surveyed elevation data for the enhancement section shows the channel to be approximately in the same profile as prior surveys, with possible evidence of minor aggradation over time, likely the result of natural stabilization. Sediment bars and pools were noted in this area, with consistent pattern and profile, differentiated substrate, and groundwater discharge throughout the reach. The constructed J-hook near Station 27+00 has naturalized and appears to have met intended function.

This reach appears to meet the stated objective of the stabilization of McKee Creek through the use of in-stream structures and pattern re-alignment in selected areas.

McKee Creek Reach 2

McKee Creek Reach 2 was visually inspected throughout the easement, and survey data was collected between Stations 10+00 and 16+50. Surveyed elevation data for this reach shows profile variations over past surveys; however, the stream pattern remains stable throughout the reach, and visual inspection indicates the stream has naturalized within the realignment. The five J-Hooks constructed within the realignment have naturalized, and riparian vegetation is established throughout the easement.

In 2012, the lower section of McKee Creek Reach 2 was heavily impacted by a tornado, starting near Station 17+00, which has resulted in downed and broken mature trees in and along the channel. Much of the woody debris remains, and has caused partial blockage of the channel, resulting in the accumulation of natural and man-made debris. This blockage causes backwater buildup, reducing flow velocity as the stream approaches this area. Over time, the reduced flow velocity may have led to increased sedimentation upstream, possibly increasing aggradation within the channel, as reflected in the surveyed profile; however, the run/riffle/pool profile of the entire reach appears to have stabilized.

This reach appears to meet the stated objective of the stabilization of McKee Creek through the use of in-stream structures and pattern re-alignment in selected areas.

Clear Creek

Clear Creek was visually inspected throughout the easement, and survey data was collected throughout the reach, between Stations 10+00 and 28+00. Surveyed elevation data for this reach shows minor profile variations over past surveys; however, the stream pattern remains stable throughout the reach, and visual inspection indicates the stream has naturalized. Strong riparian vegetation is well-established throughout a majority the easement.

The majority of constructed features within the restored stream channel have provided the intended structural function for the stream to naturalize throughout the easement. Numerous run/riffle/pools - both constructed and natural - are present, along with alluvial deposits, depositional bars, macrobenthos, habitat structures, groundwater, and other common stream features.

Between Stations 25+00 and 27+00, there is evidence of channel degradation in the lower reach of the stream, primarily in the form of channel incising and reduced substrate sorting. This area was also impacted during the 2012 tornado, and a majority of the mature hardwood vegetation was lost in the riparian area of this reach.

Structures located approximately between Stations: 23+00 – 27+25 are failing and have significant downcutting. DMS will be implementing project repair on the failing reach of Clear Creek. The repair will include the installation of six (6) constructed ruffles and the removal or repair of existing structures to stabilize and re-establish the channel profile to approximately the original design configuration. The repair will also include minimal supplemental planting and planting of the disturbed areas. The repair work will be completed in February 2017.

The Clear Creek reach appears to meet the stated objectives of restoration of the dimension, pattern, and profile, and improving the floodplain functionality by matching floodplain elevation with bank full stage.

Hydrology Results

Vegetative assessment data and visual stream/buffer assessment data was collected Sept 27, 2016. Field surveying was conducted Oct 25 and 26, 2016. Additional survey data was collected Nov 22, 2016. During these field monitoring events, obvious signs of floodplain interaction were noted within all three reaches of the project.

- Flattened vegetation, wrack/debris lines, and standing water were noted in all three reaches, and throughout the easement.

- 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 gauges were no longer in working order (two had been dislodged) and were removed, as this was the final monitoring event.

- Rainfall data for Cabarrus County during the period between Nov 2015 and Nov 2016 totaled 51.95 inches of rain.

- A new crest gauge will be installed on the downstream end of Clear Creek during the February 2017 repair in an effort to capture any 2017 growing season bankfull events.

It should be noted that the hydrology monitoring requirements of the restoration were met prior to the Fall 2016 monitoring.

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 total station tradition survey methods 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-EEP Vegetation Monitoring Protocol Level-2.

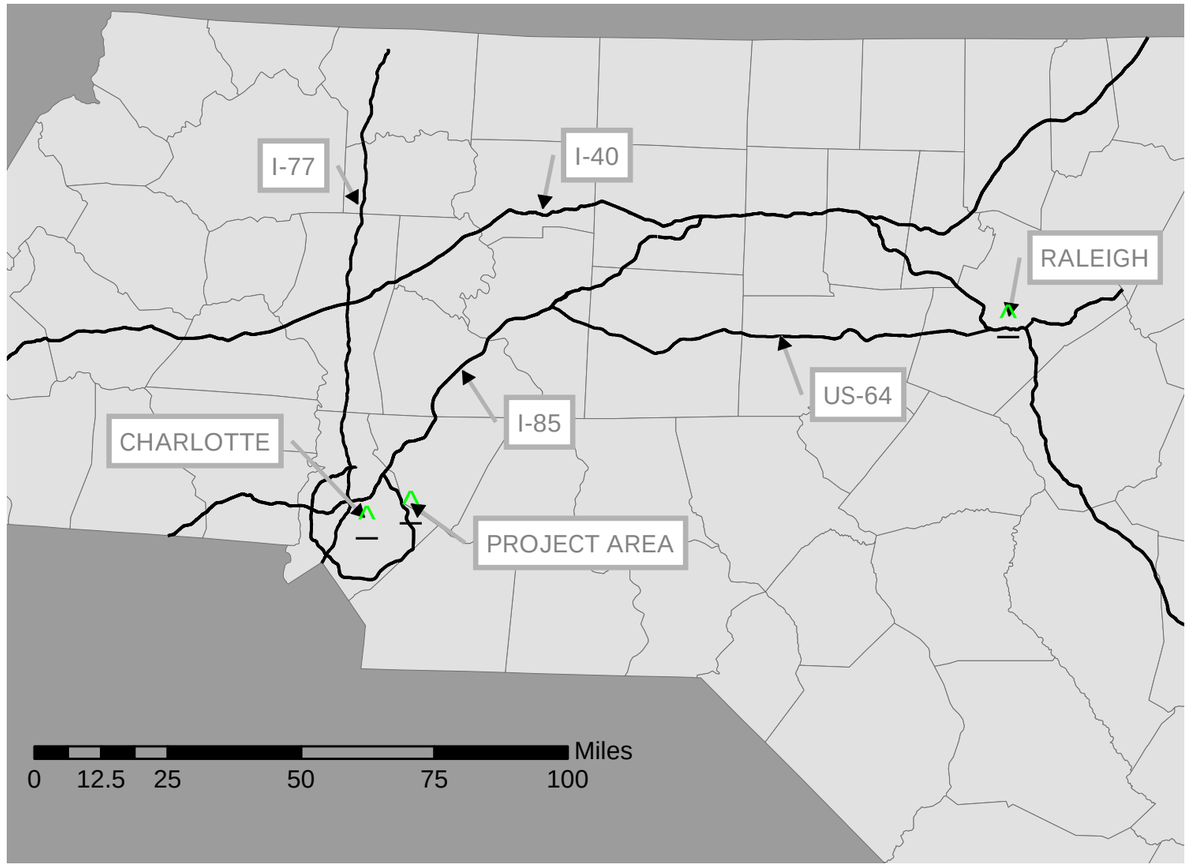
References

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

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

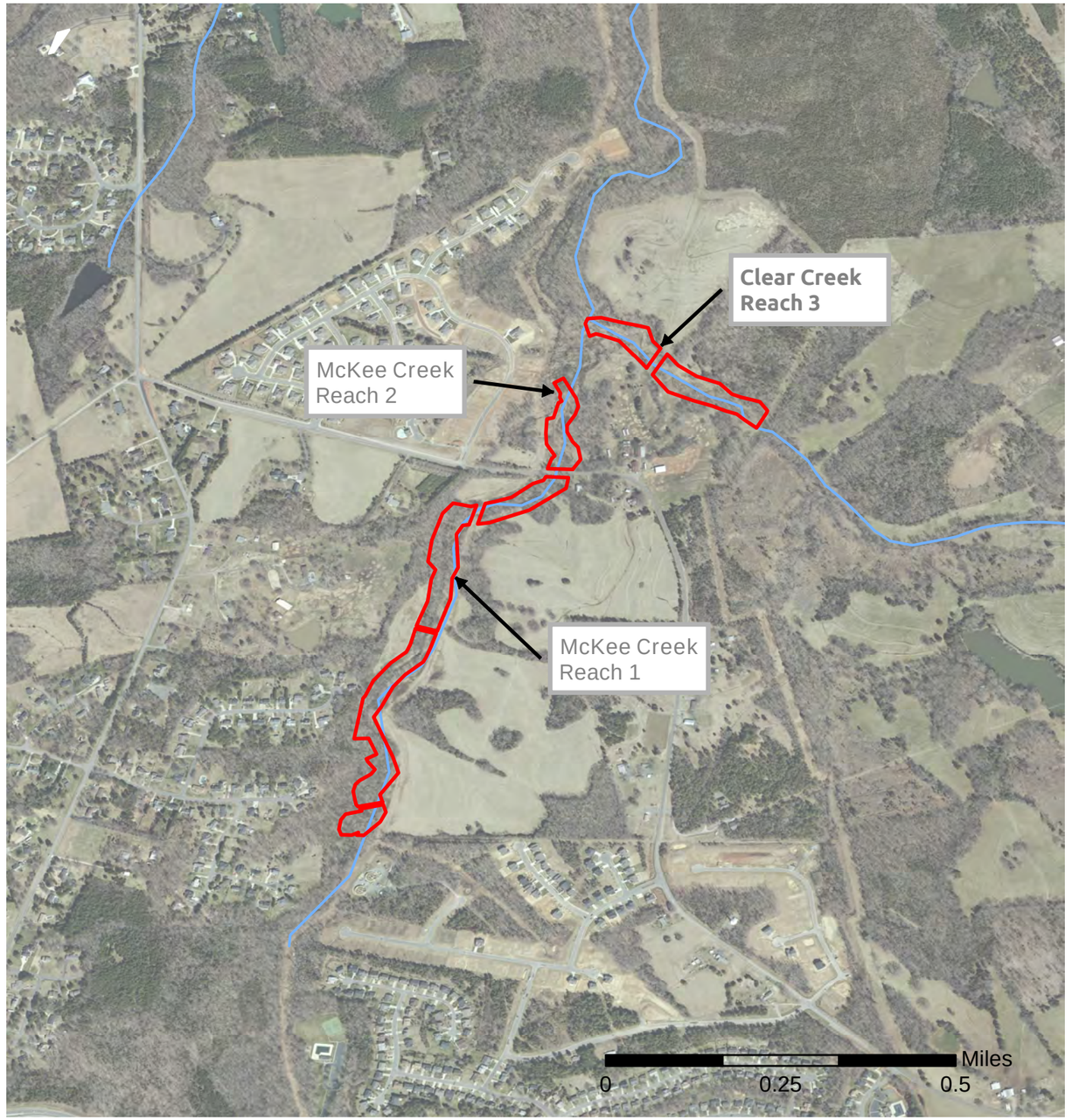
Rainfall Data for Cabarrus County,
http://www.nc-climate.ncsu.edu/cronos

Appendix A
Project Vicinity Map and Background Tables



The subject project site is an environmental restoration site of the NCDENR Division of Mitigation Services (DMS) 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 DMS.

Take US-64 West from the Raleigh area to I-85 (approximatley 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.



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McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Vicinity Map Restoration
DMS # 92573
Cabarrus County, NC
November 2016

Figure 1

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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

ASSET STATUS
RESTORATION -OR- EQUIVALENT

STATIONING
CONSERVATION EASEMENT
E1
E2
NO CREDIT
R

McKee Reach 1 - E2 - 2988 LF
McKee Reach 1 - E1 - 400 LF
McKee Reach 2 - E1 - 678 LF
Clear Clear Creek - R - 1505 LF
No Credit - 490 LF

Asset Map

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\AssetMap.mxd

Aerial Date: 2015 Printed Date: 2/17/2017 Created By: GLP

Table 1. Project Components and Mitigation Credits - 2016 (MY5)
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 Equivelent	Restoration Footage or Acreage	Mitigation Ratio
McKee Reach 1	10+00 - 25+00, 29+00 - 46+40		2988	P4	E2	2,988	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	1,505	1.0:1

Component Summation

Restoration Level	Stream (linear feet)	Riparian Wetland (acres)		Non-riparian Wetlands (acres)		Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine				
Restoration	1,505						
Enhancement							
Enhancement I	1078						
Enhancement II	2,988						
Creation							
Preservation							
High Quality Preservation							

BMP Elements

Element	Location	Purpose/Function	Notes

BMP Elements
BR = BioretentionCell; 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 - 2016 (MY5)
McKee Creek Project # 92573

Elapsed Time Since Grading Complete: 6 yrs 7 months
Elapsed Time Since Planting Complete: 6 yrs 7 months
Number of Reporting Years: 5

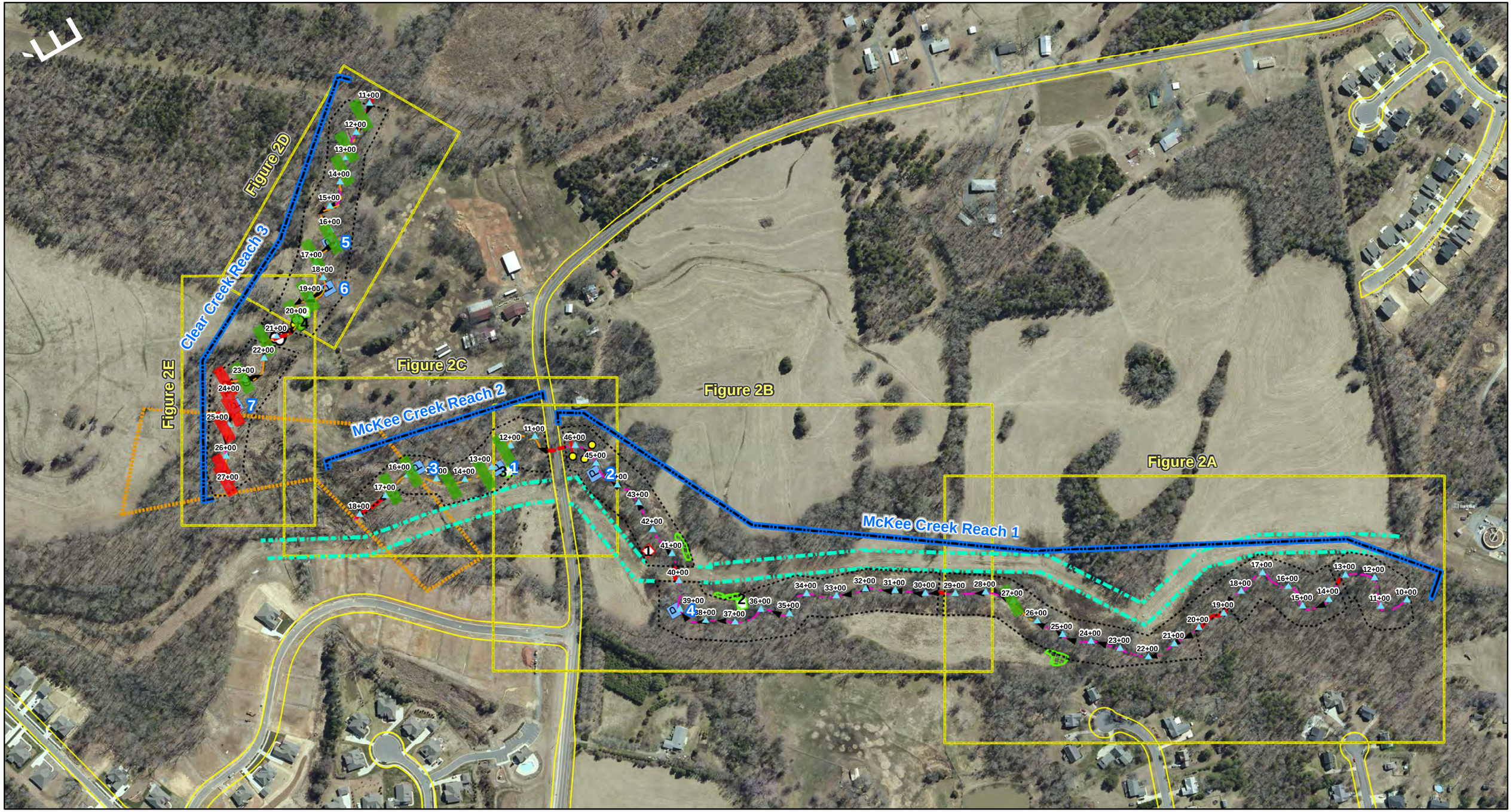
Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan		August-08
Final Design – Construction Plans		April-09
Construction		May-10
Containerized, bare root and B&B plantings for reach/segments 1&2		May-10
Mitigation Plan / As-built (Year 0 Monitoring – baseline)		
Spring Year 1 Monitoring	April-12	May-12
Fall Year 1 Monitoring	October-12	November-12
Spring Year 2 Monitoring	April-13	May-13
Beaver Removal		Summer-13
Invasives Treatment		Fall-13
Fall Year 2 Monitoring	October-13	November-13
Spring Year 3 Monitoring	April-14	April-14
Invasives Treatment		Summer-14
Fall Year 3 Monitoring	October-14	December-14
Spring Year 4 Monitoring	April-15	May-15
Fall Year 4 Monitoring	Oct/Nov-15	January-16
Spring Year 5	May-16	June-16
Fall Year 5 Monitoring	Oct/Nov-16	December-16

Table 3. Project Contacts Table - 2016 (MY5) McKee Creek Project # 92573	
Designer Primary project design POC	WithersRavenel, Inc. 115 MacKenan Drive Cary, NC 27511 Martin Richmond (919) 469-3340
Construction Contractor Construction contractor POC	River Works Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Edward Haynes
Survey Contractor Survey contractor POC	Turner Land Surveying Elisabeth Turner
Planting Contractor Planting contractor POC	River Works Inc. 6105 Chapel Hill Road Raleigh, NC 27607 Edward Haynes
Seeding Contractor Contractor point of contact	Green Resources 5204 Highgreen Ct Colfax, NC 27235 Rodney Montgomery
Seed Mix Sources	
Nursery Stock Suppliers	Not Known
Monitoring Performers	WithersRavenel, 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 - 2016 (MY5)

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	3640	696	1641
Valley Classification	VIII	VIII	VIII
Drainage Area(acres)	4131	4214	635
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 vegitation	<1 %	< 1%	< 1%
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		
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
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

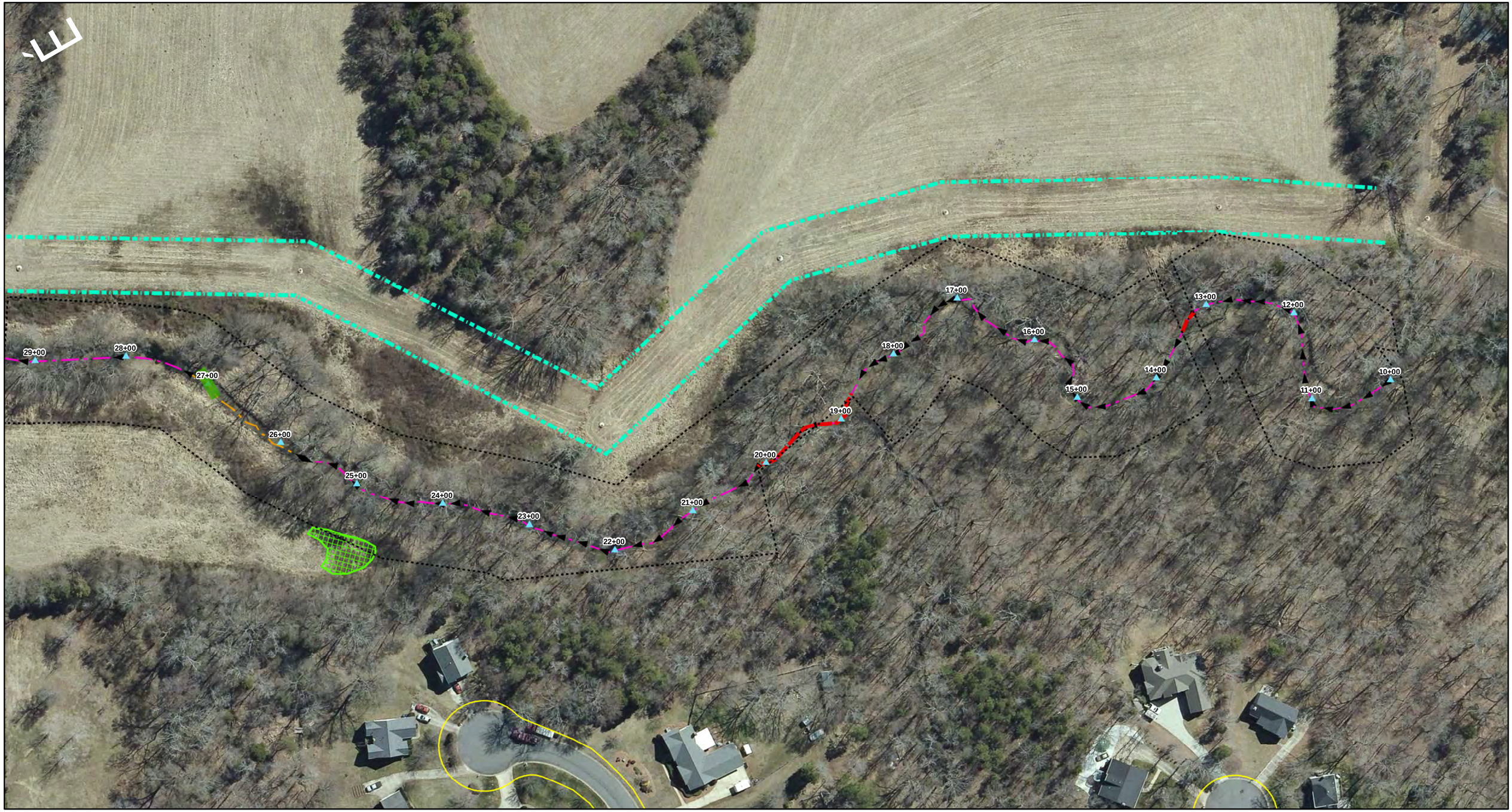
Structures
- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot
- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

Aerial Date: 2015 Printed Date: 3/29/2017 Created By: GLP



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0 50 100 200 Feet

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McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- Stationing
- Conservation Easement
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2A

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

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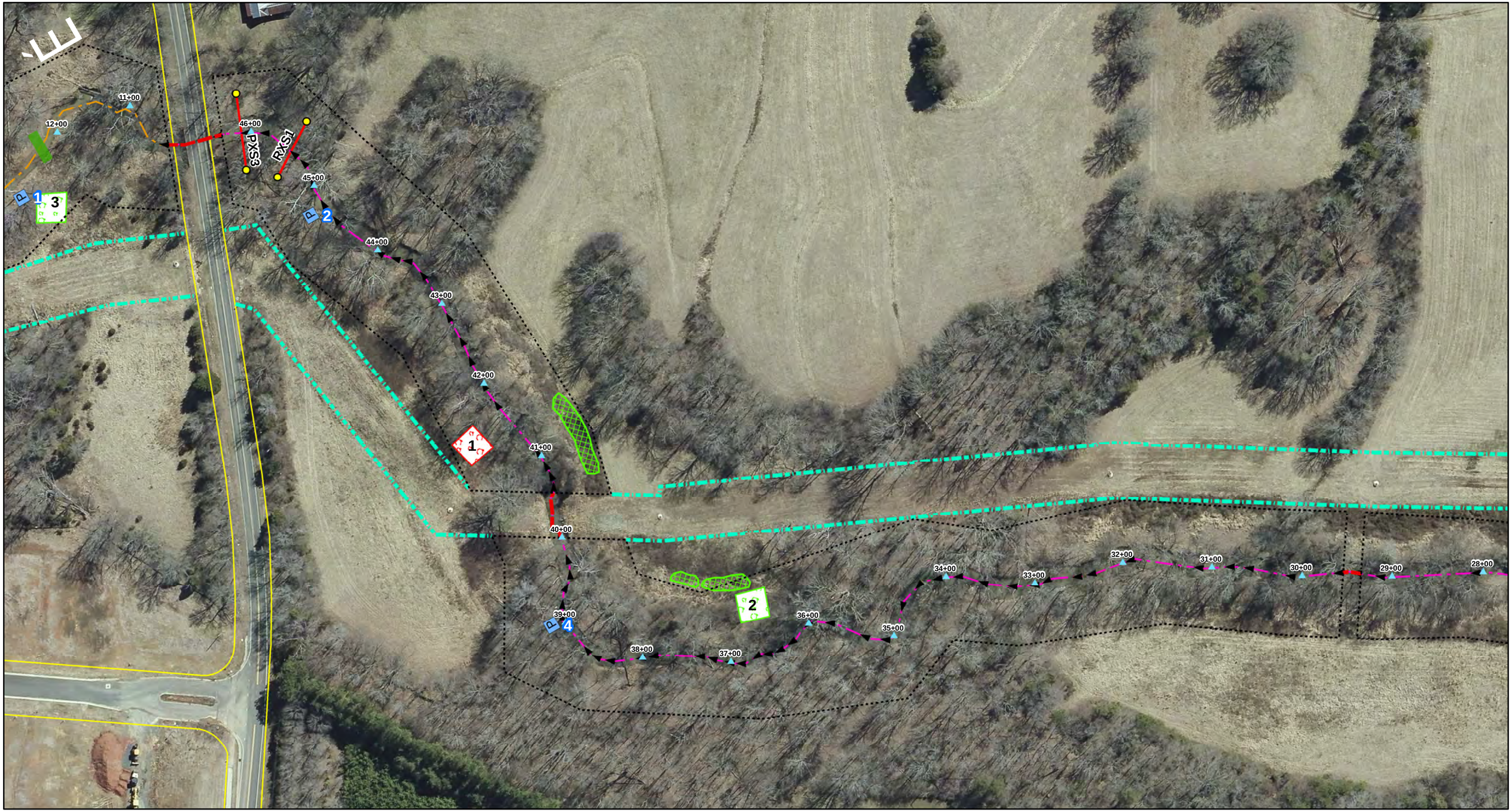

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1 inch = 100 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- Stationing
- Conservation Easement
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2B

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

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0 35 70 140 Feet

1 inch = 70 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- # Stationing
- Conservation Easement
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2C

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

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0 25 50 100 Feet

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McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- # Stationing
- Conservation Easement
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

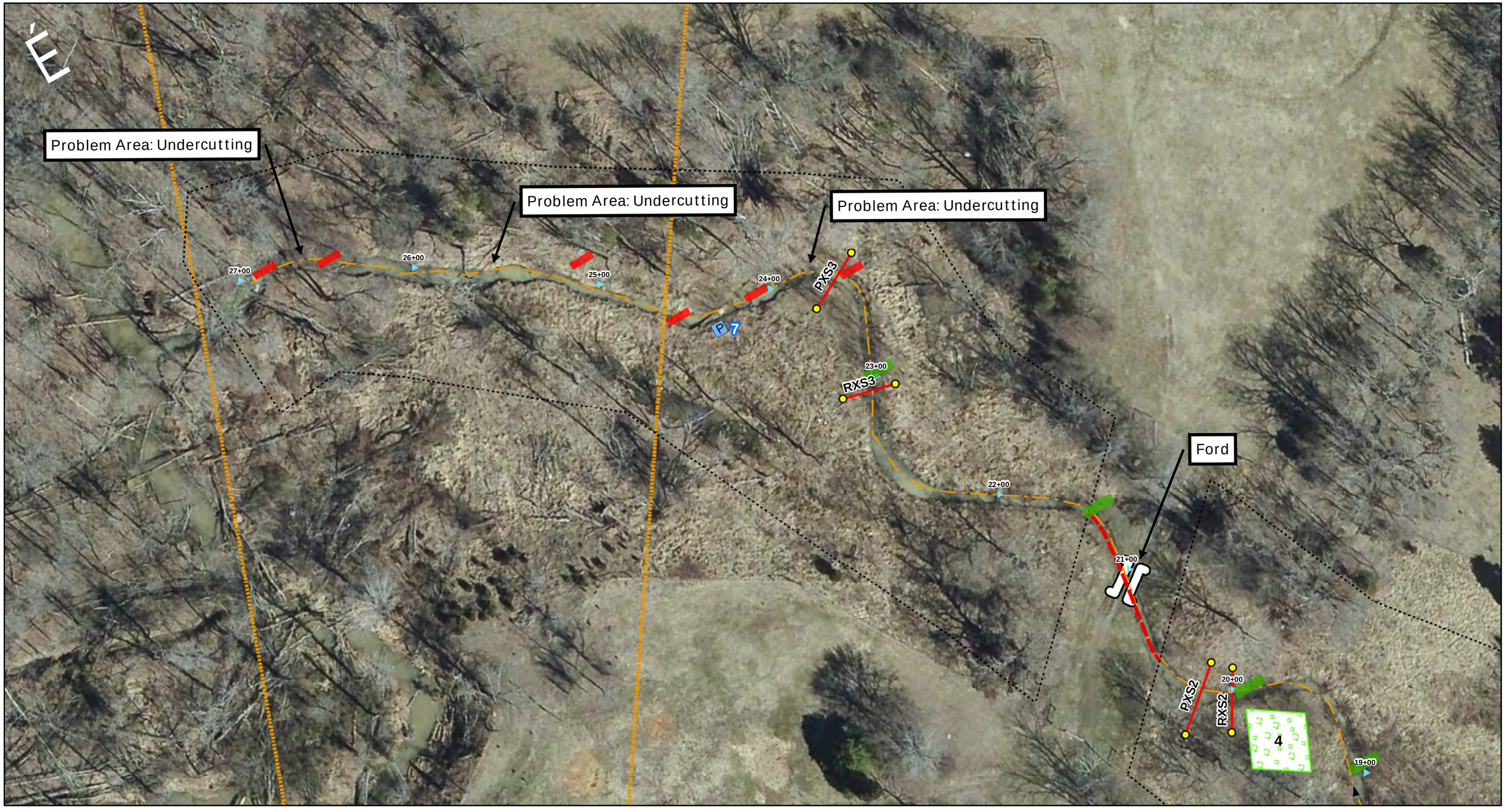
Vegetation Plot

- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2D

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

Aerial Date: 2015 Printed Date: 3/29/2017 Created By: GLP



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1 inch = 50 feet

McKee Creek & Clear Creek Restoration

Stream Current Condition Plan View

Cabarrus County, North Carolina

Legend

- Stationing
- Conservation Easement
- Photo Points
- ROW
- Centerline
- Centerline Fall 2016
- No Credit
- Sewer Easement
- Cross Section
- Invasives

Structures

- Failing
- NA - High Water
- Stable
- Stressed

Vegetation Plot

- Critereia Unmet
- Criteria Met
- Tornado Damage April 2012

Figure 2E

Path: K:\07\07-0560\070568.01-EEP-McKee Creek Monitoring\GIS\2016_Fall\ReportMap_Overall.mxd

Aerial Date: 2015 Printed Date: 3/29/2017 Created By: GLP

Table 5 **Visual Stream Morphology Stability Assessment - 2016 (MY5)**
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 slumping, caving, or collapse		Totals	0	0	100%	0	0	100.00%
					0	0	100%	0	0	100.00%
Engineered Structures	Overall Integrity	Structures physically intact with no dislodged boulders or logs	1	1			100%			
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill	1	1			100%			
	Piping	Structures lacking any substantial flow underneath sills or arms	1	1			100%			
	Bank Protection	Bank erosion within the stuctures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	1	1			100%			
	Habitat	Pool forming structures maintaining ~ Max Pool Depth: Mean Bankfull Depth >= 1.6 Rootwads/logs providing some cover at base-flow	1	1			100%			

Table 5 **Visual Stream Morphology Stability Assessment - 2016 (MY5)**
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)			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)	4	4			100%			
		Length Appropriate(>30% of centerline distance between tail of upstream riffle and head of downstream riffle)	4	4			100%			
	Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at dowsntream of meander bend (glide)	4	4			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 slumping, caving, or collapse			0	0	100%	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	5	5			100%			
	Grade Control	Grade control structures exhibiting maintenance of grade across the sill	5	5			100%			
	Piping	Structures lacking any substantial flow underneath sills or arms	5	5			100%			
	Bank Protection	Bank erosion within the stuctures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	5	5			100%			
	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 5 **Visual Stream Morphology Stability Assessment - 2016 (MY5)**
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)			0	0	100%			
		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			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			4	60	99.96%	0	0	99.96%
	Mass Wasting	Bank slumping, caving, or collapse			0	0	100%	0	0	100.00%
				Totals	4	60	100%	0	0	99.96%
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	5	7			100%			
	Piping	Structures lacking any substantial flow underneath sills or arms	16	20			100%			
	Bank Protection	Bank erosion within the stuctures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	14	20			100%			
	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 - 2016 (MY5)

McKee Creek Project # 92573

Planted Acreage **4.44**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	Acreage in Easement	% of Planted Acreage
Bare Area	Very limited cover of both woody and herbaceous material	.1 acres	Pattern and Color	0	0		0%
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%

Easment Acreage **17.41**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	Acreage in Easement	% of Easement
Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale)	300 SF	Pattern and Color	4	0.1104	0.053	0.30%
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 – McKee Creek Reach 2

Frame No. 2

Description: Photo Station #2 – McKee Creek Reach 1

Frame No. 3

Description: Photo Station #3 – McKee Creek Reach 2

Frame No. 4

Description: Photo Station #4 – McKee Creek Reach 1

Frame No. 5

Description: Photo Station #5 – Clear Creek Reach 3

Frame No. 6

Description: Photo Station #6 - Clear Creek Reach 3

Frame No. 7

Description: Photo Station #7 - Clear Creek Reach 3

Frame No. 1

Description: Vegetation Plot #1 – McKee Creek Reach 1

Frame No. 2

Description: Vegetation Plot #2 – McKee Creek Reach 1

Frame No. 3

Description: Vegetation Plot #3 – McKee Creek Reach 2

Frame No. 4

Description: Vegetation Plot #4 – Clear Creek Reach 3

Appendix C
Vegetation Plot Data

Table 7. Veg Plot Criteria Attainment - 2016 (MY5)
McKee Creek Project # 92573

Vegetation Plot ID	Vegetation Survival Threshold Met?	Tract Mean
1	No	
2	Yes	
3	Yes	66%
4	Yes	100%

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

Report Prepared By	Martin Richmond
Date Prepared	03/29/2017 10:47
database name	Withers&Ravenel-McKee Yr5.mdb
database location	C:\Users\lwelch\Downloads
computer name	WR1398
file size	10056752
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) - 2016 (MY5)
McKee Creek Project # 92573

Species	Common Name	Type	Current Data - 2016 (MY5)								Annual Means											
			Plot 1		Plot 2		Plot 3		Plot 4		Current Mean		MY 1 (2012)		MY 2 (2013)		MY 3 (2014)		MY 4 (2015)		MY 5 (2016)	
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T
Acer negundo	**Box Elder**	Tree	0	3	0	1	0	0	0	15	0	4.75	0	1.25	0	1.75	0	2.25	0	5	0	4.75
Betula nigra	**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	1	2
Carya aquatica	**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	0.75	0.75
Diospyrus virginiana	**Persimmon**	Tree	0	0	0	0	0	0	0	1	0	0.25	0	1	0	1.25	0	1	0	0.5	0	0.25
Eleagnus umbellata	**Autumn Olive**	Shrub	0	0	0	0	0	0	0	0	0	0	0	0.75	0	0.5	0	0	0	0	0	0
Fraxinus pennsylvanica	**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	0.5	0.5
Juglans nigra	**Black Walnut**	Tree	3	6	0	3	0	0	0	2	0.75	2.75	1.75	1.75	1.25	1.75	1.5	3	0.75	2.5	0.75	2.75
Liquidambar styraciflua	**Sweetgum**	Tree	0	1	0	36	0	2	0	5	0	11	0	9.5	0.25	9.5	0	9.75	0	9.5	0	11
Liriodenron tulipifera	**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	1	1.25
Platanus occidentalis	**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	4	8.25
Quercus michauxii	**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	0.5	0.5
Quercus nigra	**Water Oak**	Tree	0	0	0	0	1	1	0	0	0.25	0.25	0	1	0	0	0	0	0	0	0.25	0.25
Quercus laurifolia	**Laurel Oak**	Tree	0	0	0	2	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0.5	0	0.5
Quercus falcata	**Oak**	Tree	0	0	0	0	0	0	0	0	0	0	0.5	0.5	0	0.5	0.25	0.25	0.25	0.25	0	0
Rhus copallinum	**Winged Sumac**	Shrub	0	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0	0	0	0	0	0
Salix nigra	**Black Willow**	Tree	0	0	0	0	0	0	6	12	1.5	3	2.25	2.25	2.25	3	2	2.5	1.5	2.25	1.5	3
Ulmus alata	**Winged Elm**	Tree	0	0	0	0	0	0	0	0	0	0	0	2.25	0	0	0	0	0	0	0	0
Unknown	**Unknown**	Unknown	0	0	0	0	0	0	0	0	0	0	1	1	0	0	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	0.0247
	Species Count		3	5	4	8	5	6	4	8	4	6.75										
	Stem Count		6	13	11	55	7	11	17	64	10.25	35.75	14	30	12	29	12	29	10	34	10	36
	Stems Per Acre		**243**	**526**	**445**	**2227**	**283**	**445**	**688**	**2591**	**415**	**1447**	**567**	**1204**	**486**	**1164**	**486**	**1164**	**415**	**1366**	**415**	**1447**

Appendix D
Stream Survey Data

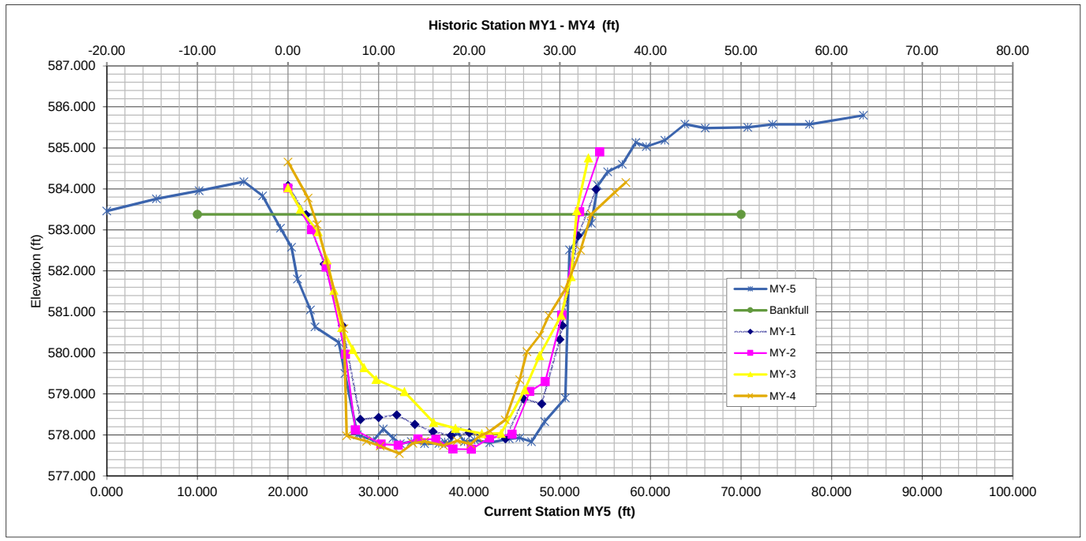
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5 - 2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	McKee MY-05
XS-ID	RXS-1
Drainage Area	6.42 sq. mi
Date	10/25/2016
Field Crew	Phillips/McLauren

Summary Data	
Bankfull Elevation	583.378
Bankfull Cross-Sectional Area	149.18
Bankfull Width	34.320271
Flood Prone Area Elevation	589.009
Flood Prone Width	30.5
Max Depth at Bankfull	5.592
Mean Depth at Bankfull:	4.24
W/D Ratio:	8.09
Entrenchment Ratio:	0.89
Bank Height Ratio:	1.43

MY1-2012		MY2-2013		MY3-2014		MY4-2015		MY5-2016		MY5-2015	
Station	Elevation	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	0.00	583.46	42.26594	577.812
2.00	583.37	2.60	583.01	1.36	583.50	2.22	583.78	5.47	583.76	44.41177	577.908
4.00	582.17	4.22	582.09	3.32	582.95	3.20	583.13	10.19	583.96	45.57667	577.929
6.00	580.67	6.35	579.97	4.29	582.27	6.17	580.59	15.13	584.17	46.87189	577.835
8.00	578.38	7.42	578.13	5.05	581.53	6.47	577.98	17.19	583.83	48.32585	578.323
10.00	578.43	10.27	577.78	5.92	580.62	8.67	577.84	19.16	583.04	50.60553	578.9
12.00	578.49	12.16	577.75	7.15	580.08	10.17	577.73	20.38	582.58	51.06902	582.512
14.00	578.26	14.35	577.90	8.38	579.64	12.27	577.55	21.03	581.80	53.48351	583.161
16.00	578.08	16.32	577.89	9.71	579.35	13.77	577.80	22.46	581.05	54.18797	584.085
18.00	577.99	18.21	577.66	12.84	579.05	15.07	577.85	22.97	580.64	55.28448	584.416
20.00	578.06	20.23	577.65	16.05	578.31	17.17	577.75	25.59	580.26	56.88621	584.598
22.00	577.97	22.24	577.93	18.47	578.16	18.67	577.86	26.28	579.50	58.38179	585.133
24.00	577.91	24.74	578.02	21.38	578.03	20.17	577.78	27.64	578.00	59.53558	585.03
26.00	578.88	26.70	579.06	23.51	578.04	20.97	577.94	29.42	577.87	61.58937	585.185
28.00	578.76	28.39	579.30	26.12	579.10	22.27	578.09	30.51	578.15	63.80636	585.578
30.00	580.33	30.23	580.93	27.76	579.93	23.97	578.37	31.57	577.92	66.03413	585.483
30.27	580.67	32.20	583.44	30.14	580.92	25.57	579.35	32.40	577.79	70.74629	585.5
32.00	582.86	34.42	584.90	31.23	581.86	26.37	580.03	33.60	577.84	73.47931	585.573
34.00	583.99			31.86	583.47	27.77	580.43	35.07	577.79	77.53915	585.574
				33.14	584.75	28.77	580.91	36.65	577.79	83.50004	585.793
						30.57	581.54	37.31	577.83		
						32.27	582.51	37.73	577.79		
						33.47	583.39	38.66	578.08		
						36.07	583.92	39.47	577.84		
						37.27	584.16	40.57	577.88		

Left Bank to Right Bank



Note: Historical station data has been offset by 20 ft to provide comparative analysis to current station data

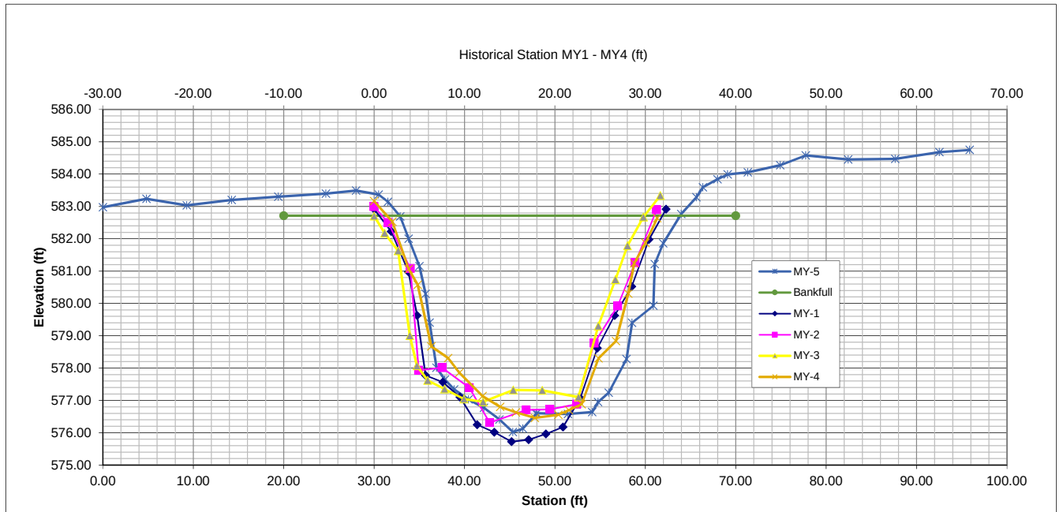
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5 - 2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	McKee MY-5
XS-ID	PXS-1
Drainage Area	6.42 sq. mi
Date	10/26/2016
Field Crew	Phillips/McLauren

Summary Data	
Bankfull Elevation	582.715
Bankfull Cross-Sectional Area	126.8268
Bankfull Width	29.29
Flood Prone Area Elevation	588.327
Flood Prone Width	50
Max Depth at Bankfull	6.258
Mean Depth at Bankfull:	3.80
W/D Ratio:	7.70
Entrenchment Ratio:	1.71
Bank Height Ratio:	1.21

Left Bank to Right Bank

MY1-2012		MY2-2013		MY3-2014		MY4-2015		MY5-2016		MY5-2016	
Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation	Station	Elevation
0.00	582.92	0.00	582.99	0.00	582.70	0.00	583.16	0.00	582.98	54.12511	576.637
1.90	582.23	1.55	582.50	1.17	582.18	2.02	582.53	4.83	583.24	54.7685	576.95
3.80	580.98	4.01	581.08	2.65	581.63	3.83	581.06	9.28	583.03	55.93684	577.24
4.75	579.63	4.92	577.93	3.95	579.00	4.83	580.58	14.26	583.20	57.91341	578.281
5.70	577.78	7.52	578.01	4.73	578.07	6.33	578.67	19.41	583.30	58.54454	579.402
7.60	577.57	10.52	577.39	5.93	577.62	8.19	578.31	24.67	583.40	60.8895	579.931
9.50	577.11	12.78	576.31	7.80	577.35	9.42	577.85	28.02	583.49	61.03625	581.215
11.40	576.25	16.82	576.71	9.93	577.05	12.00	577.13	30.50	583.37	61.96585	581.859
13.30	576.02	19.44	576.72	12.06	576.96	13.95	576.80	31.52	583.14	63.97351	582.765
15.20	575.73	22.42	576.88	15.39	577.32	15.70	576.63	32.88	582.69	65.64229	583.284
17.10	575.79	24.34	578.77	18.59	577.31	17.79	576.46	33.82	582.00	66.36113	583.592
19.00	575.97	26.94	579.92	22.61	577.10	20.38	576.56	35.01	581.15	67.9829	583.845
20.90	576.18	28.88	581.26	24.80	579.30	21.55	576.70	35.69	580.30	69.10723	583.99
22.80	577.07	31.25	582.90	26.69	580.74	22.96	576.88	36.13	579.41	71.32732	584.059
24.70	578.62			28.02	581.78	24.81	578.30	36.90	578.01	74.91986	584.273
26.60	579.63			29.78	582.67	26.75	578.83	37.84	577.64	77.74708	584.578
28.50	580.53			31.66	583.34	28.12	580.30	38.85	577.34	82.43154	584.455
30.40	581.98					28.76	581.24	40.45	577.03	87.62854	584.473
32.30	582.92					30.03	581.87	42.14	576.77	92.53217	584.682
						31.31	582.64	43.87	576.41	95.87134	584.749
								45.35	576.02		
								46.46	576.13		
								47.92	576.59		
								47.99	576.61		
								51.45	576.58		



Note: Historical station data has been offset by 30 ft to provide comparative analysis to current station data

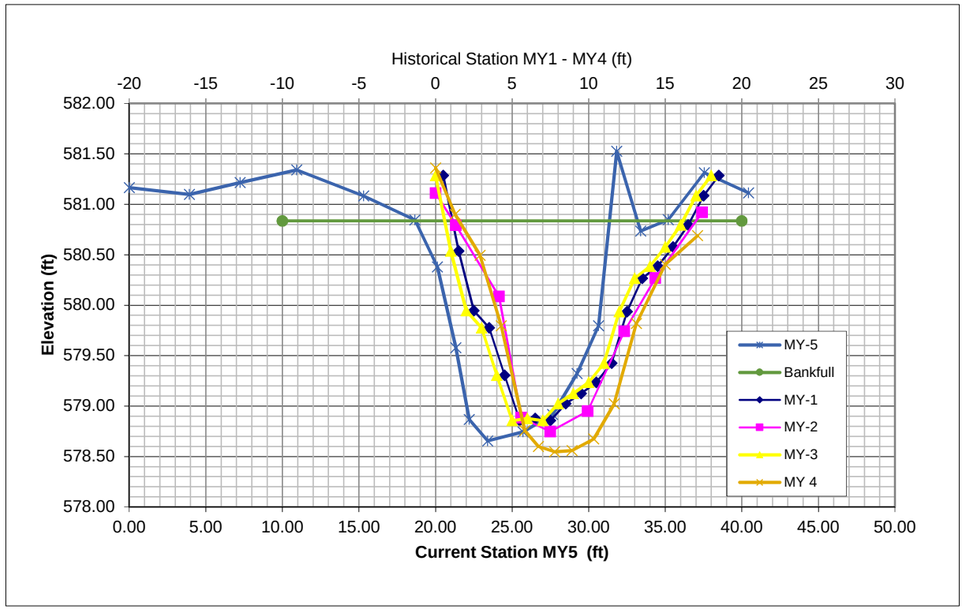
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5- 2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-5
XS-ID	RXS-2
Drainage Area	0.95
Date	10/27/2016
Field Crew	Phillips/McLauren

Summary Data	
Bankfull Elevation	580.836
Bankfull Cross-Sectional Area	19.39526
Bankfull Width	10.51099
Flood Prone Area Elevation	582.666
Flood Prone Width	120
Max Depth at Bankfull	2.181
Mean Depth at Bankfull:	1.55
W/D Ratio:	6.77
Entrenchment Ratio:	11.42
Bank Height Ratio:	1.32

Left Bank to Right Bank

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	0.00	581.17
1.50	580.54	1.32	580.79	1.00	580.54	1.27	580.90	3.93	581.10
2.50	579.95	4.14	580.09	2.00	579.95	2.91	580.50	7.25	581.22
3.50	579.78	5.59	578.89	3.00	579.78	4.29	579.80	10.94	581.34
4.50	579.31	7.49	578.75	4.00	579.31	5.82	578.76	15.31	581.08
5.50	578.86	9.94	578.95	5.00	578.86	6.72	578.60	18.65	580.85
6.50	578.88	12.33	579.74	6.00	578.88	7.77	578.55	20.13	580.38
7.50	578.86	14.35	580.27	7.00	578.86	8.91	578.56	21.32	579.58
8.50	579.03	17.40	580.92	8.00	579.03	10.33	578.67	22.21	578.87
9.50	579.13			9.00	579.13	11.66	579.02	23.40	578.66
10.50	579.24			10.00	579.24	13.11	579.82	25.72	578.75
11.50	579.43			11.00	579.43	15.00	580.41	27.65	578.92
12.50	579.94			12.00	579.94	17.11	580.69	29.25	579.32
13.50	580.27			13.00	580.27			30.64	579.80
14.50	580.39			14.00	580.39			31.84	581.53
15.50	580.58			15.00	580.58			33.39	580.74
16.50	580.80			16.00	580.80			35.19	580.85
17.50	581.09			17.00	581.09			37.56	581.31
18.50	581.29			18.00	581.29			40.44	581.11



Note: Historical station data has been offset by 20 ft to provide comparative analysis to current station data

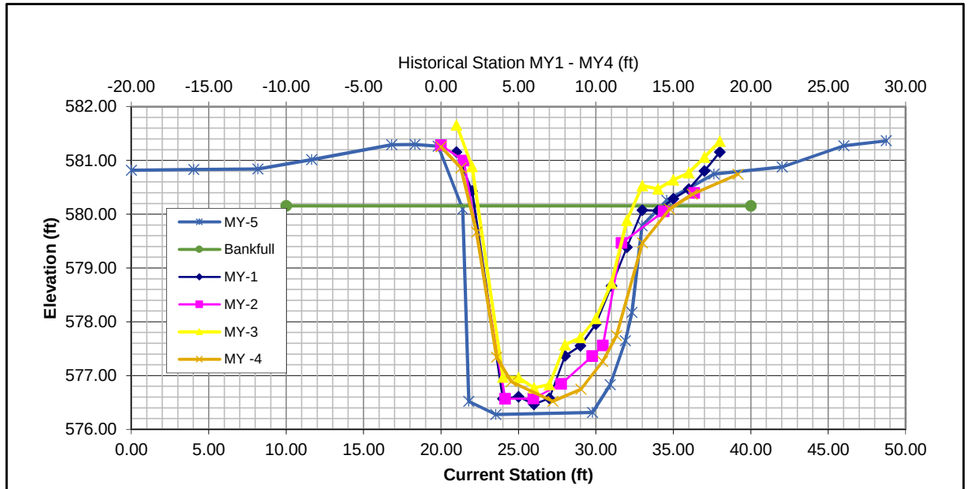
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5 -2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-05
XS-ID	PXS-2
Drainage Area	0.95
Date	10/26/16
Field Crew	Phillips/McLauren

Summary Data	
Bankfull Elevation	580.155
Bankfull Cross-Sectional Area	40.42198
Bankfull Width	11.59
Flood Prone Area Elevation	583.545
Flood Prone Width	150
Max Depth at Bankfull	3.88
Mean Depth at Bankfull:	2.45
W/D Ratio:	4.73
Entrenchment Ratio:	12.94602
Bank Height Ratio:	1.31

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	0.00	580.82
2.00	580.44	1.46	581.00	2.00	580.89	1.28	580.86	4.03	580.83
4.00	576.57	4.13	576.57	4.00	576.97	2.30	579.67	8.17	580.84
5.00	576.61	5.97	576.57	5.00	576.96	3.58	577.34	11.65	581.01
6.00	576.47	7.76	576.85	6.00	576.77	4.53	576.89	16.82	581.29
7.00	576.58	9.76	577.36	7.00	576.83	7.22	576.52	18.32	581.30
8.00	577.37	10.45	577.56	8.00	577.57	9.04	576.75	19.81	581.26
9.00	577.56	11.66	579.47	9.00	577.71	10.44	577.26	21.39	580.09
10.00	577.96	14.39	580.05	10.00	578.06	11.33	577.74	21.79	576.52
11.00	578.67	16.35	580.39	11.00	578.72	13.01	579.47	23.54	576.28
12.00	579.39			12.00	579.89	14.76	580.09	29.78	576.31
13.00	580.08			13.00	580.53	16.23	580.37	30.92	576.83
14.00	580.07			14.00	580.47	19.17	580.74	31.91	577.65
15.00	580.29			15.00	580.64			32.32	578.17
16.00	580.47			16.00	580.77			32.98	579.79
17.00	580.81			17.00	581.06			34.58	580.26
18.00	581.16			18.00	581.36			37.62	580.75
								42.04	580.88
								46.01	581.27
								48.75	581.37

Left Bank to Right Bank



Note: Historical Station data has been offset by 20 ft to provide comparative analysis to current data

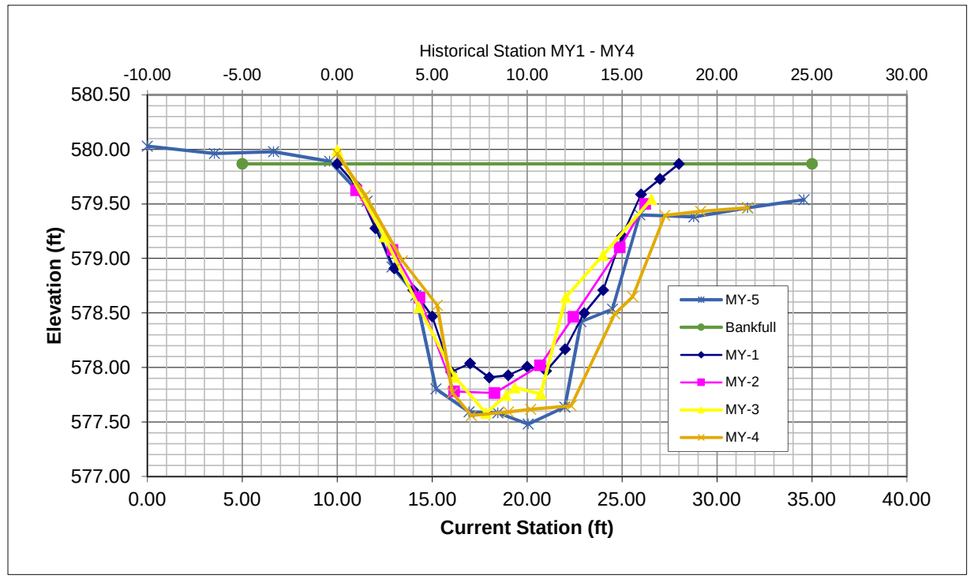
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5 - 2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-05
XS-ID	RXS-3
Drainage Area	0.95
Date	10/26/2016
Field Crew	Phillips/McLauren

Summary Data	
Bankfull Elevation	579.868
Bankfull Cross-Sectional Area	28.58
Bankfull Width	12.93157
Flood Prone Area Elevation	582.156
Flood Prone Width	250
Max Depth at Bankfull	2.388
Mean Depth at Bankfull:	1.65
W/D Ratio:	7.83
Entrenchment Ratio:	19.33
Bank Height Ratio:	1.07

Left Bank to Right Bank

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	0.00	580.03
1.00	579.67	2.91	579.08	2.47	579.20	1.48	579.58	3.53	579.96
2.00	579.28	4.33	578.64	4.31	578.55	3.43	578.98	6.65	579.98
3.00	578.91	6.15	577.78	6.20	577.91	5.26	578.57	9.60	579.89
4.00	578.71	8.29	577.76	7.83	577.58	6.06	577.77	11.56	579.53
5.00	578.47	10.68	578.02	8.89	577.74	7.06	577.56	12.88	578.92
6.00	577.96	12.44	578.46	9.35	577.82	9.01	577.59	14.14	578.66
7.00	578.04	14.88	579.10	10.72	577.76	10.18	577.62	15.20	577.80
8.00	577.91	16.22	579.50	12.04	578.65	12.32	577.65	16.94	577.59
9.00	577.93			13.99	579.03	14.61	578.49	18.46	577.58
10.00	578.01			16.54	579.54	15.56	578.65	20.05	577.48
11.00	577.97					17.25	579.39	21.98	577.64
12.00	578.17					19.14	579.43	22.83	578.42
13.00	578.50					21.63	579.47	24.50	578.54
14.00	578.71							25.93	579.40
15.00	579.21							28.77	579.38
16.00	579.59							31.62	579.46
17.00	579.73							34.58	579.54
18.00	579.87								



Note: Historical Station data has been offset by 10 ft to provide comparative analysis to current data

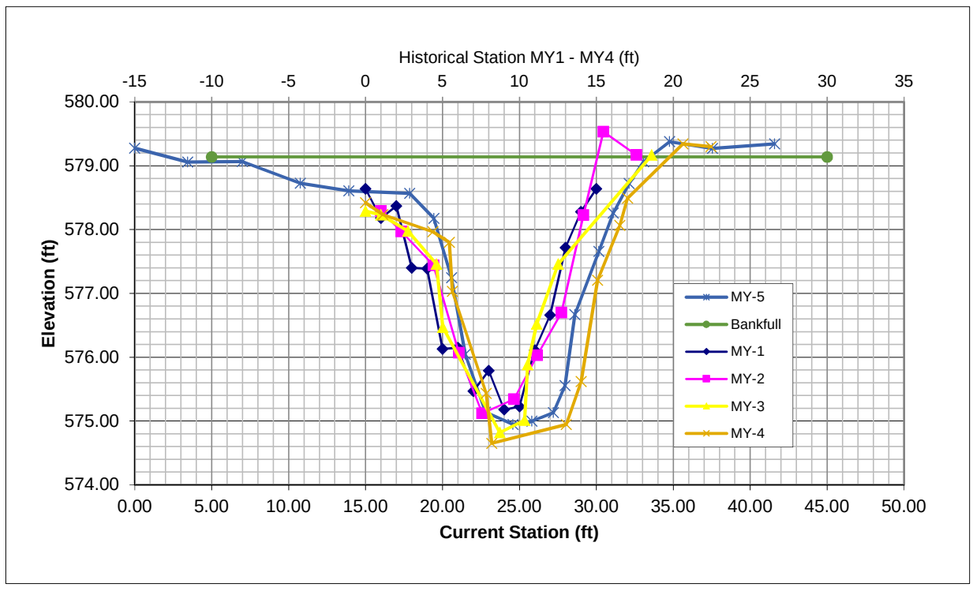
McKee Creek Stream Restoration
Cabarrus County, NC
DMS Project# 92573
MY 5 -2016

Cross-section Plot Exhibit	
River Basin	Yadkin Pee-Dee
Watershed	Clear MY-05
XS-ID	PXS-3
Drainage Area	0.95
Date	10/26/2016
Field Crew	Phillips/Mclauren

Summary Data	
Bankfull Elevation	579.138
Bankfull Cross-Sectional Area	42.80913
Bankfull Width	29.63
Flood Prone Area Elevation	583.458
Flood Prone Width	200
Max Depth at Bankfull	4.191
Mean Depth at Bankfull:	1.83
W/D Ratio:	16.23033
Entrenchment Ratio:	6.750471
Bank Height Ratio:	1.057027

Left Bank to Right Bank

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	0.00	579.27
1.00	578.18	2.32	577.97	1.00	578.23	1.12	578.23	3.43	579.06
2.00	578.37	4.43	577.44	2.75	577.98	4.37	577.97	6.99	579.07
3.00	577.40	6.06	576.07	4.60	577.46	5.45	577.80	10.76	578.73
4.00	577.39	7.57	575.12	5.01	576.47	5.64	577.03	13.91	578.61
5.00	576.13	9.64	575.34	8.73	574.82	7.84	575.43	17.87	578.57
6.00	576.15	11.16	576.03	10.34	575.01	8.20	574.65	19.44	578.18
7.00	575.47	12.74	576.70	10.54	575.89	13.04	574.95	20.58	577.24
8.00	575.79	14.16	578.23	11.12	576.52	14.01	575.62	21.47	576.05
9.00	575.18	15.45	579.53	12.52	577.46	15.08	577.21	22.80	575.14
10.00	575.23	17.60	579.17	18.60	579.17	16.52	578.06	24.58	574.95
11.00	576.11					17.03	578.49	25.81	575.00
12.00	576.66					20.63	579.34	27.20	575.13
13.00	577.72					22.45	579.30	27.97	575.56
14.00	578.28							28.60	576.67
15.00	578.64							30.17	577.66
								31.10	578.26
								32.13	578.72
								33.06	579.06
								34.76	579.38
								37.54	579.27
								41.58	579.34

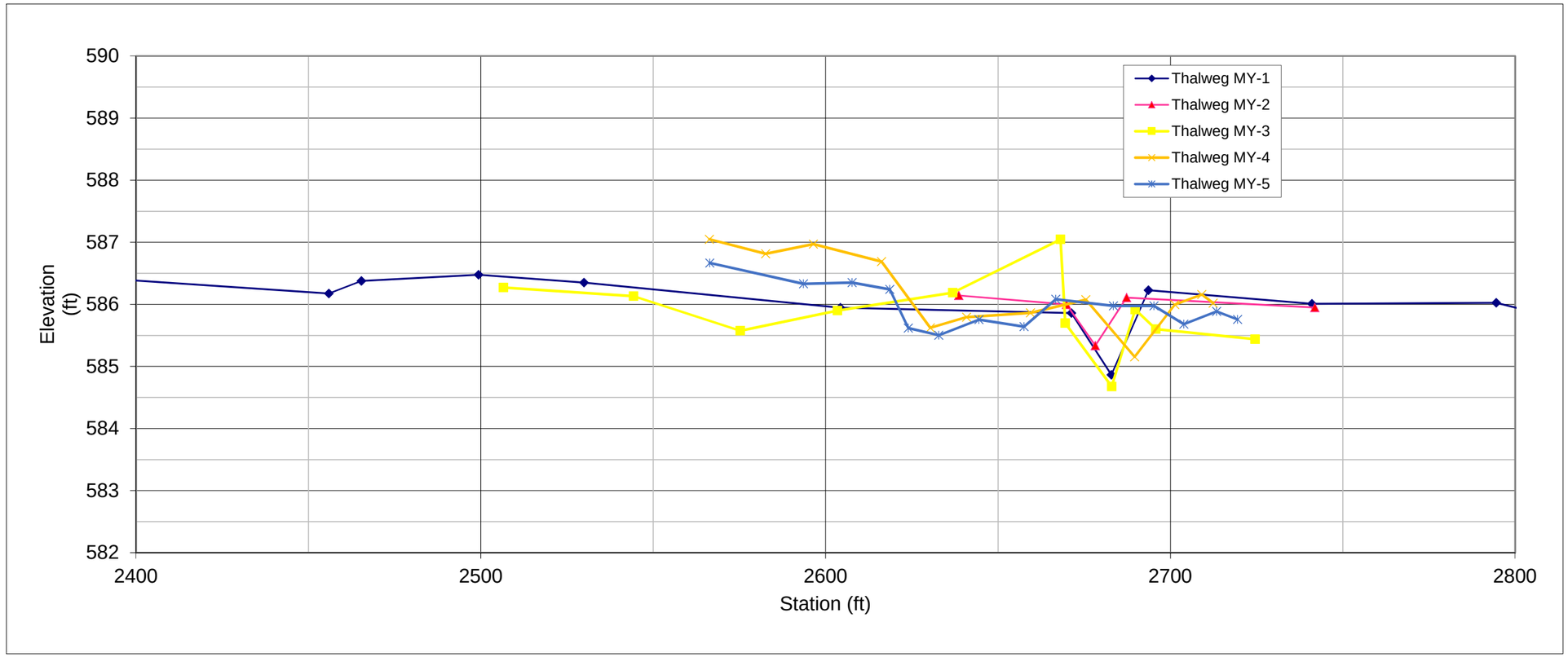


Note: Historical Station data has been offset by 15 ft to provide comparative analysis to current data

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	10/26/2016
Field Crew	Richmond/McLaurin

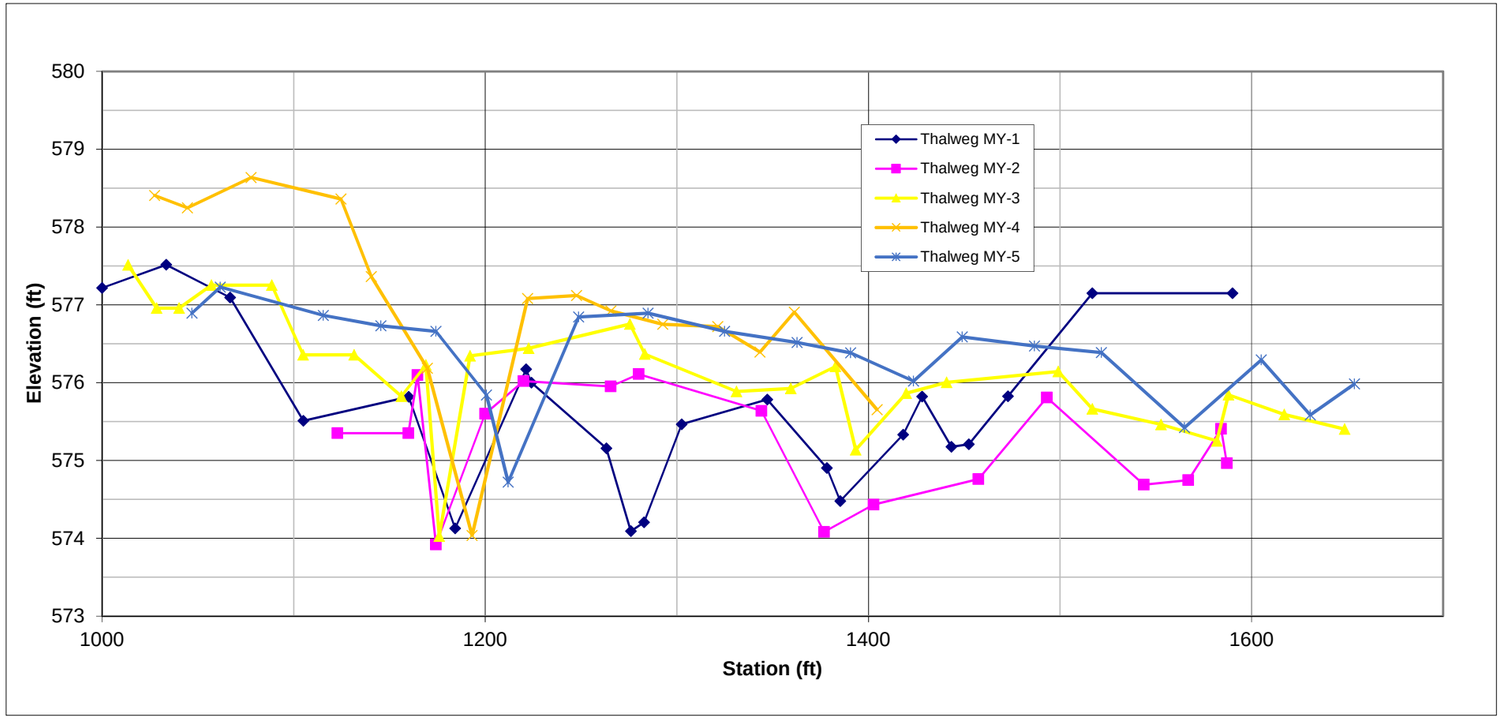
MY5-2016	
Station	Elevation
2566.40	586.67
2593.60	586.33
2607.70	586.35
2618.59	586.24
2623.97	585.62
2632.85	585.50
2644.50	585.75
2657.54	585.64
2666.75	586.08
2683.47	585.98
2695.26	585.98
2703.92	585.68
2713.38	585.89
2719.48	585.76



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	10/26/2016
Field Crew	Richmond/McLaurin

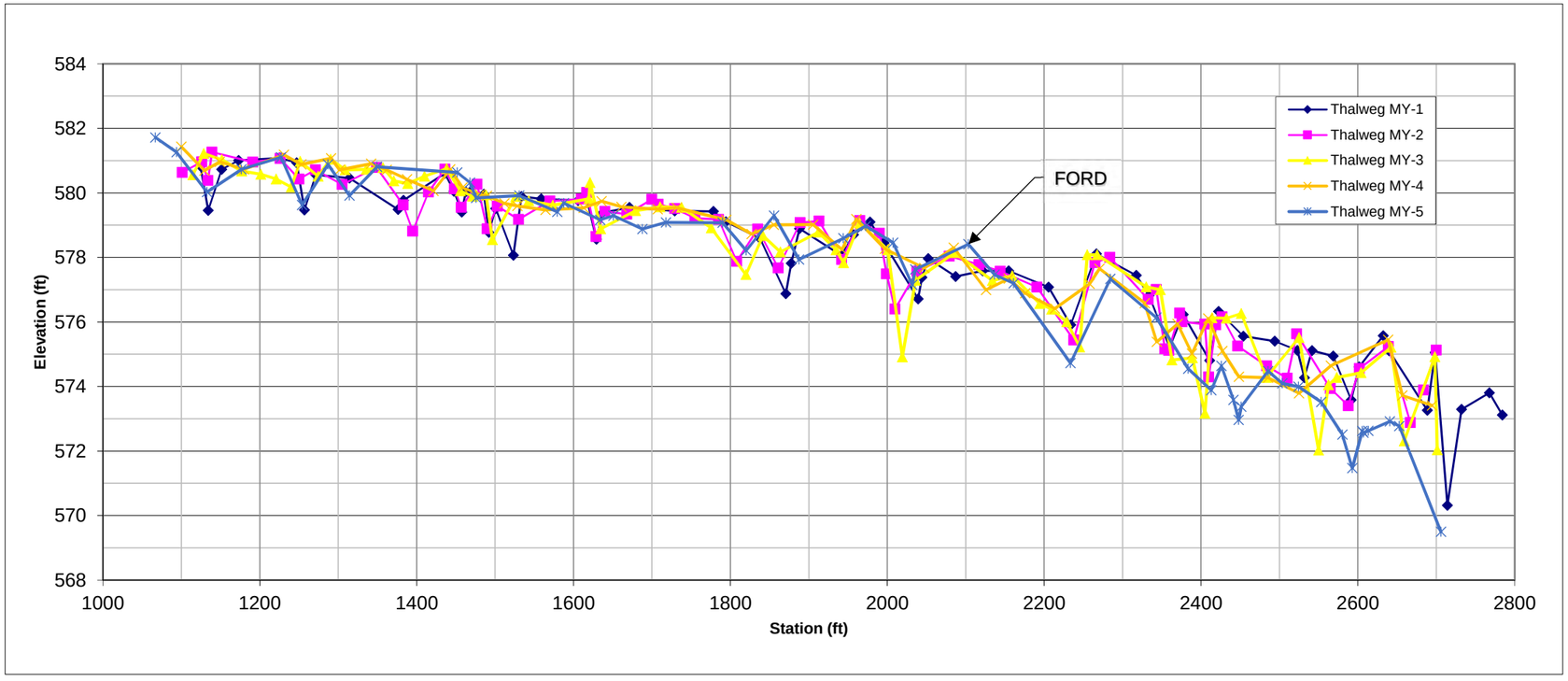
MY5-2016	
Station	Elevation
1046.84	576.89
1061.65	577.23
1115.38	576.86
1145.46	576.73
1174.17	576.66
1200.56	575.84
1212.00	574.72
1248.72	576.85
1285.02	576.89
1324.87	576.66
1362.78	576.52
1390.69	576.38
1423.57	576.02
1448.92	576.59
1486.73	576.47
1521.55	576.39
1564.93	575.42
1605.05	576.29
1630.63	575.59
1653.70	575.98



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

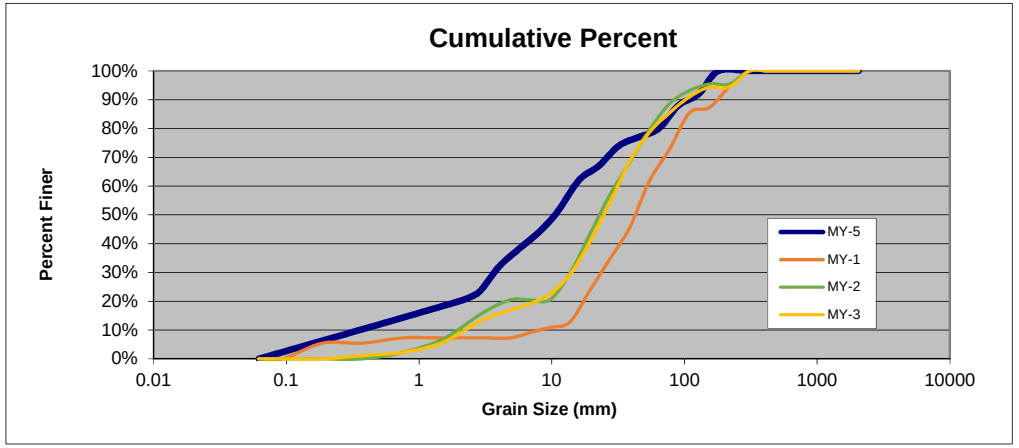
Longitudinal Profile Plot	
River Basin	Yadkin Pee-Dee
Watershed	Clear Creek
Station	11+00 - 28+00
Date	11/22/2016
Field Crew	Phillips/McLaurin

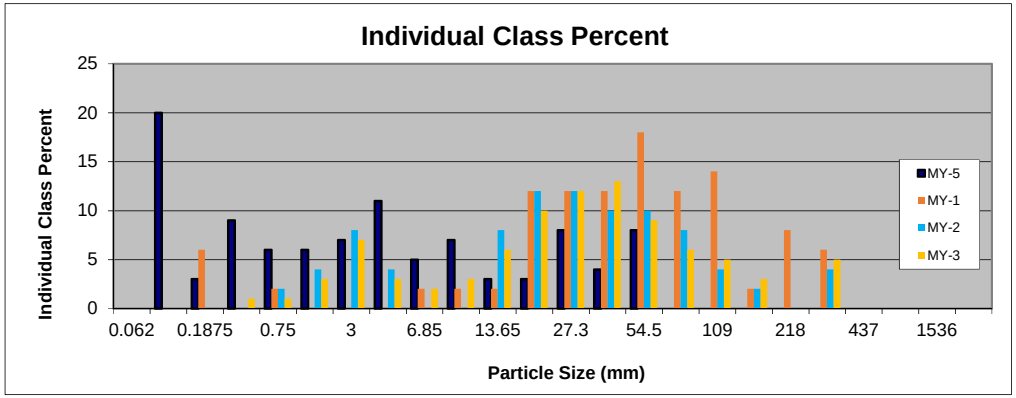
MY5-2016		MY5-2016	
Station	Elevation	Station	Elevation
1066.83	581.72	2031.78	577.15
1093.89	581.26	2035.86	577.63
1132.58	580.03	2103.49	578.41
1176.47	580.73	2136.85	577.47
1227.05	581.10	2161.29	577.20
1253.94	579.62	2233.64	574.72
1287.03	580.88	2284.45	577.33
1314.41	579.91	2343.27	576.14
1349.49	580.81	2383.85	574.55
1451.64	580.63	2413.27	573.88
1468.09	580.32	2426.24	574.63
1475.74	579.84	2441.58	573.58
1530.74	579.92	2447.99	572.96
1579.26	579.41	2451.32	573.37
1587.77	579.68	2485.67	574.48
1633.97	579.16	2503.76	574.10
1650.92	579.30	2524.34	574.00
1687.80	578.88	2553.25	573.52
1717.83	579.08	2580.52	572.51
1790.00	579.08	2592.92	571.47
1820.19	578.22	2595.22	572.62
1855.77	579.29	2607.15	572.57
1887.53	577.93	2613.43	572.63
1943.93	578.59	2640.86	572.92
1972.62	578.97	2652.98	572.77
2007.36	578.46	2705.99	569.50



Pebble Count Exhibit - 2016 (MY5)				
Mckee Creek Stream Resotration				
Mckee Creek				
Riffle				
Particle	**Size**	**Count**	**Percent**	**Cumulative Percent**
Silt Clay	0.062	0	0%	0%
Sand	2	20	20%	20%
	2.8	3	3%	23%
Gravel	4	9	9%	32%
	5.6	6	6%	38%
	8	6	6%	44%
	11	7	7%	51%
	16	11	11%	62%
	22.6	5	5%	67%
	32	7	7%	74%
	45	3	3%	77%
	64	3	3%	80%
Cobble	90	8	8%	88%
	128	4	4%	92%
	180	8	8%	100%
Boulder	309	0	0%	100%
	437	0	0%	100%
Bedrock	2048	0	0%	100%
Total		100	100%	100%

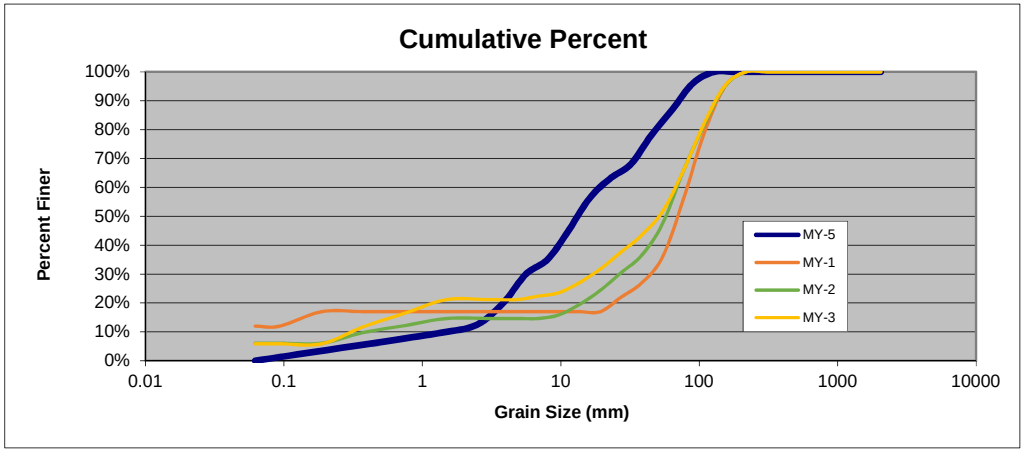
Summary Data	
D50	10.57
D84	77
D95	147.5

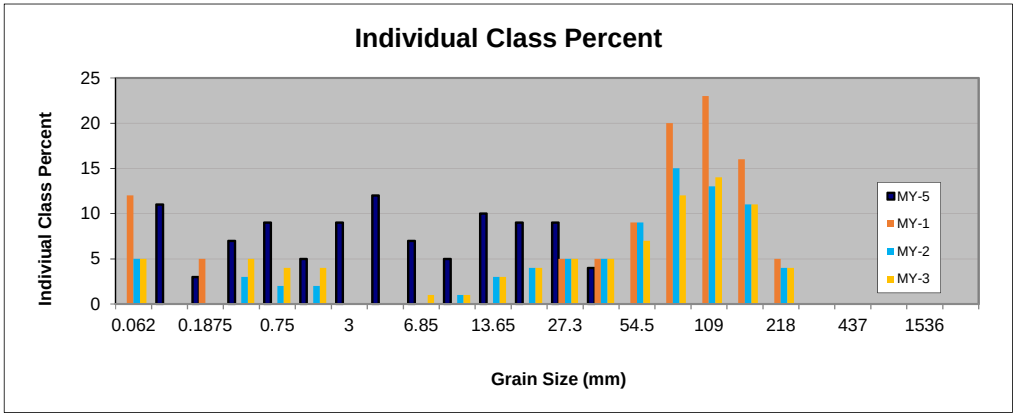




Pebble Count Exhibit - 2016 (MY5)				
Mckee Creek Stream Resotration				
Clear Creek Upstream				
Riffle				
Particle	**Size**	**Count**	**Percent**	**Cumulative Percent**
Silt Clay	0.062	0	0%	0%
Sand	2	11	11%	11%
	2.8	3	3%	14%
Gravel	4	7	7%	21%
	5.6	9	9%	30%
	8	5	5%	35%
	11	9	9%	44%
	16	12	12%	56%
	22.6	7	7%	63%
	32	5	5%	68%
	45	10	10%	78%
	64	9	9%	87%
Cobble	90	9	9%	96%
	128	4	4%	100%
	180	0	0%	100%
Boulder	309	0	0%	100%
	437	0	0%	100%
Bedrock	2048	0	0%	100%
Total		100	100%	100%

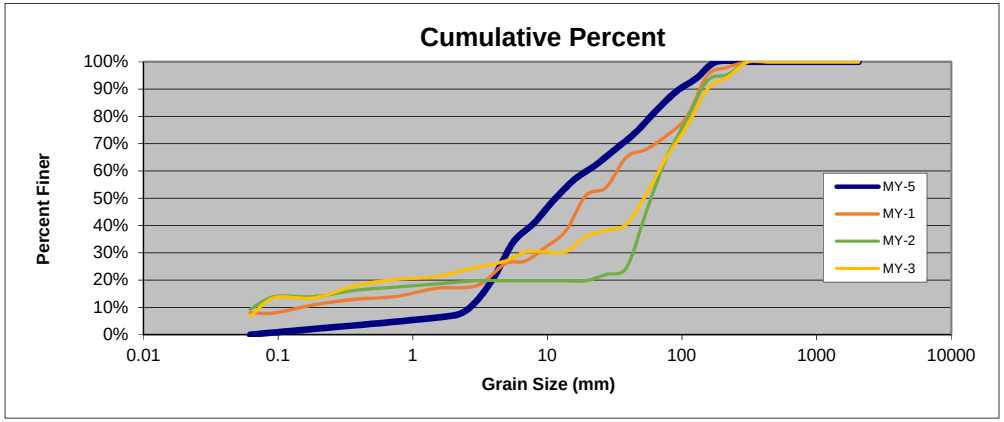
Summary Data	
D50	13.5
D84	154
D95	154





Pebble Count Exhibit - 2016 (MY5)				
Mckee Creek Stream Restoration				
Clear Creek Downstream				
Riffle				
Particle	**Size**	**Count**	**Percent**	**Cumulative Percent**
Silt Clay	0.062	0	0%	0%
Sand	2	7	7%	7%
	2.8	4	4%	11%
Gravel	4	10	10%	21%
	5.6	13	13%	34%
	8	7	7%	41%
	11	8	8%	49%
	16	8	8%	57%
	22.6	5	5%	62%
	32	6	6%	68%
	45	6	6%	74%
	64	8	8%	82%
Cobble	90	7	7%	89%
	128	5	5%	94%
	180	6	6%	100%
Boulder	309	0	0%	100%
	437	0	0%	100%
Bedrock	2048	0	0%	100%
Total		100	100%	100%

Summary Data	
D50	11.63
D84	71.43
D95	136.67



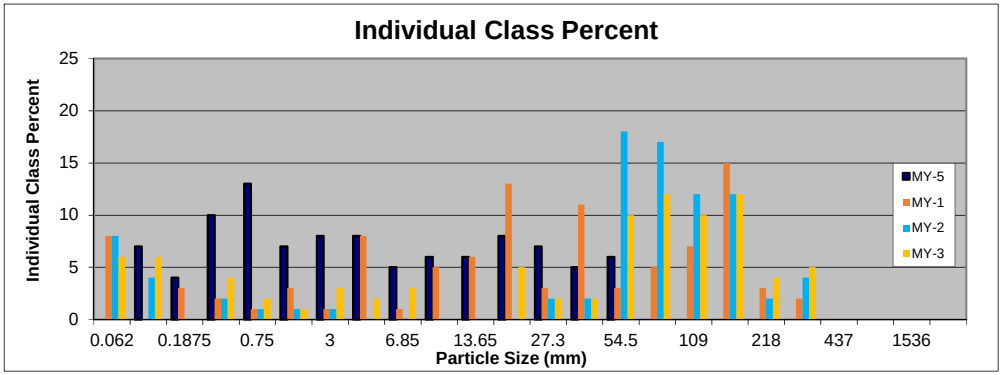


Table 10a. Baseline Stream Data Summary
McKee Creek Project # 92573 - Mckee-Reach 1

Parameter	Gauge2	Regional Curve			Pre-Existing Condition					Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Med	Max	SD5	n	Min	Med	Max	Min	Mean	Med	Max	SD5	n
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							
1Bankfull 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						
1Bank 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/f2					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								
3Bankfull 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					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Med	Max	SD5	n	Min	Med	Max	Min	Mean	Med	Max	SD5	n
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							
1Bankfull 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						
1Bank 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/f2					0.33					0.38								
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)					4.0-4.5					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**								
3Bankfull 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 - 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
1Bankfull Max Depth (ft)					**3.7**		**6.1**			**2.2**		**2.5**	2		2.9
Bankfull Cross Sectional Area (ft2)					**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
1Bank 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/f2															
Max part size (mm) mobilized at bankfull															
Stream Power (transport capacity) W/m2															
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		
3Bankfull 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- Reach 1

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 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 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-constrution 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 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-constrution 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- Clear Creek

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)	0.35	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-constrution 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 11a. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections) - 2016 (MY5)

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	583.38			582.7	580.0	580.74	582.72	582.72			580.8	580.5	580.70	580.84	580.84	
Bankfull Width (ft)		24.27	22.00	24.44	21.00	34.32			22.5	23.00	22.74	15.60	29.29			18.00	13.00	10.00	13.11	10.51	
Floodprone Width (ft)		160.0	33.00	30.50	30.50	30.50			160.0	36.0	50.00	50.00	50.00			150.0	150.0	120.00	120.00	120.00	
Bankfull Mean Depth (ft)		1.89	1.98	1.18	4.93	4.24			2.45	2.37	2.75	3.95	3.80			1.36	1.05	1.02	1.39	1.55	
Bankfull Max Depth (ft)		2.76	2.85	2.59	5.83	5.59			3.90	3.69	3.78	6.26	6.26			2.43	1.75	1.61	2.29	2.18	
Bankfull Cross Sectional Area (ft2)		53.00	51.40	32.06	91.05	149.18			63.68	58.50	71.95	69.69	126.83			30.61	13.40	11.26	20.36	19.40	
Bankfull Width/Depth Ratio		12.82	11.11	20.72	4.26	8.09			9.20	9.70	8.26	3.95	7.70			13.23	12.33	16.87	9.45	6.77	
Bankfull Entrenchment Ratio		6.59	1.50	1.25	1.45	0.89			7.10	1.57	2.20	3.20	1.71			8.82	11.54	12.00	9.15	11.42	
Bankfull Bank Height Ratio		2.53	2.23	2.32	1.22	1.43			1.84	1.81	1.69	1.21	1.21			1.00	1.20	1.73	1.25	1.32	
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	580.16			579.87	579.60	579.54	579.87	579.87			579.14	578.29	578.29	579.14	579.14	
Bankfull Width (ft)		17.00	14.30	8.00	11.33	11.59			17.00	13.88	14.07	14.08	12.93			15.00	13.20	11.52	14.99	29.63	
Floodprone Width (ft)		150.0	150.0	150.00	150.00	150.00			250.00	200.00	250.00	250.00	250.00			250.00	200.00	200.00	200.00	200.00	
Bankfull Mean Depth (ft)		2.55	2.62	2.81	2.10	2.45			1.11	0.96	1.29	1.67	1.65			1.70	1.68	1.64	2.41	1.83	
Bankfull Max Depth (ft)		3.97	3.82	3.76	3.63	3.88			1.96	1.84	1.96	2.31	2.39			3.46	3.17	3.47	4.49	4.19	
Bankfull Cross Sectional Area (ft2)		30.61	31.60	25.53	25.35	40.42			21.02	14.73	12.27	27.52	28.58			27.27	21.35	17.81	45.25	42.81	
Bankfull Width/Depth Ratio		6.66	5.46	2.85	5.39	4.73			15.37	14.51	10.87	8.44	7.83			8.80	7.87	7.01	6.23	16.23	
Bankfull Entrenchment Ratio		8.82	10.49	18.75	13.24	12.95			14.71	14.41	17.77	17.76	19.33			16.67	15.15	21.70	16.68	6.75	
Bankfull Bank Height Ratio		1.18	1.00	1.30	1.32	1.31			1.00	1.01	1.23	1.04	1.07			1.00	1.00	1.25	1.05	1.06	
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 m
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 - 2016 (MY5)

McKee Creek Project # 92573 McKee Creek- Reach 1

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	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
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			48.15			1
Pool Max depth (ft)							2	3	3	4	1	6			0.7			1			1.24			1			1.893			1			0.58			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						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						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						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						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						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						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 - 2016 (MY5)
McKee Creek Project # 92573 McKee Creek- Reach 2

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	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
Bankfull Width (ft)								24.7				1		22.00				1		24.44				1	N/A (survey limitations)							34.32				1
Floodprone Width (ft)								160				1		33.00				1		30.5				1	N/A (survey limitations)							30.50				1
Bankfull Mean Depth (ft)								1.89				1		1.98				1		1.179				1	N/A (survey limitations)							4.24				1
1Bankfull Max Depth (ft)								2.76				1		2.85				1		2.587				1	N/A (survey limitations)							5.59				1
Bankfull Cross Sectional Area (ft2)								53				1		51.40				1		32.058				1	N/A (survey limitations)							149.18				1
Width/Depth Ratio								12.82				1		11.11				1		20.723				1	N/A (survey limitations)							8.09				1
Entrenchment Ratio								6.59				1		1.50				1		1.2479				1	N/A (survey limitations)							0.89				1
1Bank Height Ratio								2.53				**1**		2.23				1		2.316				1	N/A (survey limitations)							1.43				1
Profile																																				
Riffle Length (ft)							10	32.2	34	44	13.54	5	45	53.5	53.5	62		2	40					2	N/A (survey limitations)											
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	N/A (survey limitations)											
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	N/A (survey limitations)						48.64	73.21	79.03	86.14	14.82	4
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	N/A (survey limitations)						0.57	1.0925	0.84	2.12	0.61	4
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	N/A (survey limitations)						0	62.23	72.63	114.1	47.14	3
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						C4					
Channel Thalweg length (ft)							1422						464 (survey reduction)						464 (survey reduction)						377 (survey reduction)						661					
Sinuosity (ft)							1.39						1.15						1.2						1.19						1.18					
Water Surface Slope (Channel) (ft/ft)							0.0026						0.0026						0.003						N/A						0.0014					
BF slope (ft/ft)							0.0026						0.0026						0.003						N/A						0.0015					
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							0	23	57	20	0	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							10%						2%						4%						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 - 2016 (MY5)
McKee Creek Project # 92573 Clear Creek

Parameter	Baseline						MY-1						MY-2						MY- 3						MY- 4						MY- 5					
Dimension and Substrate - Riffle only	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
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	10.51	11.72		12.93		2
Floodprone Width (ft)							150	200		250		2	200.0	200.0		200.0		2	120	185		250		2	120	185		250		2	120.00	185.00		250.00		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	1.55	1.60		1.65		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	2.18	2.28		2.39		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	19.40	23.99		28.58		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	6.77	7.30		7.83		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	11.42	15.38		19.33		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	1.07	1.20		1.32		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	11.93	27.85	22.58	58.82	15.74	6
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	0.0044	0.0161	0.0178	0.0210	0.006	6
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	26.63	63.25	59.98	123.16	30.56	7
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	0.96	1.45	1.30	2.47	0.474	7
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	0.00	178.42	110.14	657.88	219.5	6
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						C4					
Channel Thalweg length (ft)							1660						1658						1587						1638						1603					
Sinuosity (ft)							1.19						1.17						1.17						1.18						1.195					
Water Surface Slope (Channel) (ft/ft)							0.0033						0.0033						0.004						0.00496						0.008					
BF slope (ft/ft)							0.0033						0.0034						0.004						0.004						0.009					
Ri% / Ru% / P% / G% / S%[3]																																				
SC% / Sa% / G% / C% / B% / Be%[3]							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							0	12.5	72	15.5	0	0
d16 / d35 / d50 / d84 / d95 /[3]							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[2]							1%						5%						5%						5%						5%					
Channel Stability or Habitat Metric																																				
Biological or Other																																				

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

Appendix E
Hydrology Data

Table 12. Verification of Bankfull Events - 2016 (MY5)			
Date of Data Collection	**Date of Occurance**	**Method**	**Photo # (if available)**
Crest Gauge 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	
10/16 - 11/16	Unknown	Visual observation; Debris lines; Flattened vegetation; Floodplain interaction	
10/26/16		Crest Gauge Removed	
Crest Gauge 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	
10/16 - 11/16	Unknown	Visual observation; Debris lines; Flattened vegetation; Floodplain interaction	
11/22/16		Crest Gauge Removed	
Crest Gauge 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	
10/16 - 11/16	Unknown	Visual observation; Debris lines; Flattened vegetation; Floodplain interaction	
11/22/16		Crest Gauge Removed	

Month	Monthly Total (in)
Nov-15	9.12
Dec-15	9.08
Jan-16	2.21
Feb-16	3.36
Mar-16	1.35
Apr-16	1.80
May-16	7.16
Jun-16	4.00
Jul-16	5.54
Aug-16	3.06
Sep-16	4.36
Oct-16	3.10
Nov-16	0.42
Total	**54.56**