MONITORING YEAR 3 ANNUAL REPORT

Final

HOGAN CREEK STREAM MITIGATION PROJECT

Surry County, NC
NCDEQ Contract 6496
NCDMS Project Number 94708

DWR # 20120182
USACE Action ID SAW-2011-02268

Data Collection Period: June-October 2017
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PREPARED FOR:

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EXECUTIVE SUMMARY

The NCDEQ Division of Mitigation Services (DMS) restored, enhanced, and preserved approximately 9,782 linear feet (LF) of stream channel at the Hogan Creek Stream Mitigation Site (Site) in Surry County, North Carolina. The restoration project was developed to fulfill stream mitigation requirements accepted by the DMS for the Upper Yadkin River Basin (HUC 03040101). The Hogan Creek Stream Mitigation Project will net 4,994 stream mitigation credits through a combination of restoration, enhancement I and II, and preservation.

The Site is within a Targeted Local Watershed (TLW) identified in the Upper Yadkin River Basin Restoration Priority (RBRP) plan (NCDENR, 2009). The RBRP identified the Candiff Creek/Hogan Creek 14-digit HUC as a TLW due to water quality and habitat impacts from past and present agricultural practices. Agriculture is the primary land use in the watershed (41% agriculture land cover) and the RBRP identified non-forested buffers and livestock operations as major stressors to water quality. There are 26 permitted animal operations and 25% of the watershed has non-forested riparian buffers. The site assessment phase of the project identified other stressors as well, including bank erosion, sediment deposition, disconnection of the streams and floodplains, and exotic plant species. The project was identified as an opportunity to improve water quality and aquatic and terrestrial habitats within the TLW. In addition to being within an TLW, the upper Hogan Creek subwatershed has been identified as a priority area for stream restoration and agricultural BMPs as part of DMS's initial Ararat River Local Watershed Planning (LWP) effort (EcoEngineering, 2008).

The final design was completed in November of 2012. Construction activities and as-built surveys were completed in December of 2014. Planting of the Site took place in March of 2015. The baseline monitoring efforts began in May of 2015 and monitoring year 1 efforts began in October of 2015. The region experienced an unusually high amount of precipitation during fall/winter 2015. The storm event damaged several areas on Hogan Creek Reach 1 and Reach 2 that were repaired in December of 2015. The Monitoring Year 3 (MY3) activities were completed in October of 2017.

The Hogan Creek Stream Mitigation Project is on track to meet monitoring success criteria for vegetation, geomorphology, and hydrology performance standards. However, adaptive management measures are scheduled to occur in 2018 to address a growing invasive plant problem and several areas of bank instability on Hogan Creek. The MY3 vegetation survey resulted in an average stem density of 438 planted stems per acre. The Site has met the interim requirement of 320 planted stems per acre, with 5 of the 6 plots (83%) individually meeting this requirement. The MY3 vegetation monitoring and visual assessment revealed growing invasive plant populations in the riparian areas, especially in a large area near the confluence of UT2 and Hogan Creek, at the upstream end of Hogan Creek Reach 2, and the left riparian area of UT2 and UT2B preservation reaches. Areas of stream bank erosion with no stabilizing woody vegetation appear to be trending toward less stable conditions in Hogan Creek Reaches 1 and 2. The performance standard of two recorded bankfull events in separate monitoring years has been met for Hogan Creek and UT2.

HOGAN CREEK STREAM MITIGATION PROJECT

Year 3 Monitoring Report

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Section 1: PROJECT OVERVIEW

The Site was implemented under a design-bid-build contract with DMS in Surry County, NC. The Site is located in the Yadkin River Basin; eight-digit Cataloging Unit (CU) 03040101 and the 14-digit Hydrologic Unit Code (HUC) 03040101110060 (Figure 1). Located in the Piedmont physiographic province (NCGS 2004), the project watershed primarily includes agricultural land cover. The drainage area for the lower end of Hogan Creek is 1,514 acres. Hogan Creek is a main tributary to the Yadkin River in the Upper Yadkin River Basin (HUC 03040101). The site is located approximately 2 miles south of NC 268 on Miller Gap Road, which bisects the project site at the triple box culvert over Hogan Creek. A vicinity map is included in Appendix A as Figure 1.

The NCDEQ Division of Mitigation Services (DMS) restored, enhanced, and preserved approximately 9,782 LF of Hogan Creek and three previously unnamed tributaries (UTs), provide livestock fencing and alternative water sources to keep livestock out of the streams, remove invasive plant species across the project, establish native riparian buffer, and preserve relatively un-impacted forested streams. The restoration project was developed to fulfill stream mitigation requirements accepted by the DMS for the Upper Yadkin River Basin (HUC 03040101). Mitigation work within the Site included restoring and enhancing 4,109 LF and preserving 5,673 LF of stream. The Hogan Creek Mitigation Project will net 4,994 stream mitigation credits through a combination of restoration, enhancement I and II, and preservation. The final design was completed in November of 2012. Construction activities and as-built surveys were completed in December of 2014. Planting of the Site took place in March of 2015. The baseline monitoring efforts began in May of 2015 and monitoring year 1 efforts began in October of 2015. The region experienced an unusually high amount of precipitation during fall/winter 2015. The storm event damaged several areas on Hogan Creek Reach 1 and Reach 2 that were repaired in December of 2015. Monitoring year 2 efforts began in April of 2016. The Monitoring year 3 activities were completed in October of 2017. More detailed information related to the project activity, history, and contacts can be found in Appendix A, Tables 1 and 2. Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figure 2. Please refer to the Project Component Map (Figure 2) for the stream features and to Table 1 for the project component and mitigation credit information for the Site. This report documents the results of the monitoring year three efforts (MY3).

1.1 Project Goals and Objectives

Prior to construction activities, non-forested buffers and livestock operations were identified as major stressors to water quality within the watershed. The site assessment phase of the project identified other stressors as well, including bank erosion, sediment deposition, disconnection of the streams and floodplains, and exotic plant species. The majority of the project area was utilized as a cattle operation for over fifty years. Cattle accessed Hogan Creek and the downstream reach of UT2 exacerbating bank erosion and allowing direct nutrient and fecal inputs to the streams. Deforested riparian buffers and levee construction along Hogan Creek and UTs also contributed to channel degradation. Table 11 in Appendix D present the pre-restoration conditions in detail.

This mitigation site is intended to provide numerous ecological benefits within the Yadkin River Basin. The project goals identified in the Mitigation Plan (Confluence, 2012) include:

- Improve water quality in Hogan Creek and the UTs through reductions in sediment and nutrient inputs from local sources;
- Create conditions for dynamic equilibrium of water and sediment movement between the supply reaches and project reaches;

- Promote floodwater attenuation and secondary functions associated with more frequent and extensive floodwater contact times;
- Improve in-stream habitat by increasing the diversity of bedform features;
- Enhance and protect native riparian vegetation communities; and
- Reduce fecal, nutrient, and sediment loads to project streams by promoting and implementing livestock best management practices.

The project objectives have been defined as follows:

- Restoration of the dimension, pattern, profile of 684 LF of Hogan Creek Reach 1, 962 LF of Hogan Creek Reach 2, 555 LF of UT2, and 292 LF of UT3;
- Restoration of the dimension and profile (Enhancement I) of 1,200 LF of Hogan Creek Reach 1.
- Limited channel work coupled with livestock exclusion and/or invasive species control (Enhancement II) on 66 LF of UT1 and 350 LF of UT2;
- Livestock exclusion fencing and alternative water source installations;
- Invasive plant species control measures across the entire project wherever necessary; and
- Preservation of approximately 5,673 LF relatively un-impacted forested streams in a permanent conservation easement.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring was conducted from June to October of 2017 to assess the condition of the project. The stream restoration success criteria for the Site follows the approved performance standards presented in the Hogan Creek Stream Mitigation Project Final Mitigation Plan (Confluence, 2012).

1.2.1 Vegetation Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-NCEEP Level 2 Protocol (Lee et al., 2008). A total of 6 vegetation monitoring plots were established during the baseline monitoring within the project easement areas using a standard 10 by 10 meter plot. Please refer to Figure 3 in Appendix B for the vegetation monitoring locations. The interim measure of vegetation success for the Site is the survival of at least 320 planted stems per acre at the end of year three of the monitoring period. The final vegetation success criterion is the survival of 260 planted stems per acre in the riparian corridor along restored and enhanced reached at the end of year five of the monitoring period.

The MY3 vegetation survey was completed in August 2017. The data indicate an average stem density of 438 planted stems per acre. The Site has met the interim requirement of 320 stems per acre, with 5 of the 6 plots (83%) individually meeting this requirement. Vegetation plot 3, with a density of 283 stems per acre, did not meet the interim success criteria. However, vegetation plot 3 still meets density requirements of 260 planted stems per acre at the end of monitoring year 5. The planted stem mortality was approximately 6% of the MY2 stem count which was 467 stems per acre. There is an average of about 11 planted stems per plot. In vegetation plots 1, 2 and 4, a high density of volunteers, predominantly river birch (*Betula nigra*) and tulip poplar (*Liriodendron tulipifera*), were observed. A majority of the planted stems (84.3%) scored a vigor of 3 or 4, indicating that they are likely to survive. Approximately 8.6% of the planted stems scored a vigor of 2, indicating fair plant health but with some damage present. This lower vigor rating is due to damage from vine strangulation, suffocation from dense herbaceous cover, insects, or other unknown factors. Please refer to Appendix B for vegetation plot photographs and Appendix C for vegetation data tables.

1.2.2 Vegetation Areas of Concern

Observations indicate that invasive plant populations continue to present areas of concern in MY3 with species including: kudzu (*Pueraria montana*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and Lespedeza (*Sericea Lespedeza)*. At the lower end of Hogan Creek Reach 1, kudzu is spreading from the edge of the mature forest along both stream banks. Areas of encroaching kudzu are spreading into the easement along both sides of Miller Gap Road. A significant area of kudzu has remained an issue along the left flood plain of UT2 and UT2B preservation reaches. Other invasive plant populations include smaller areas of Chinese privet and multiflora rose at the upper portion of Hogan Creek Reach 1 and past the wood line along the downstream portion of Hogan Creek Reach 2. DMS has contracted with a provider for invasive species treatment beginning in Spring 2018 through 2019/Closeout. These vegetation areas of concern are shown in Figure 3 of Appendix B.

1.2.3 Stream Assessment

Morphological surveys for MY3 were conducted in June and July 2017. The MY3 riffle pebble counts in Hogan Creek for cross-sections 1, 5, and 6 indicate similar or coarser sediment size distribution as compared to MY0. The D_{50} values for these cross-sections have all increased as compared to MY2. For the riffle pebble count at cross-section 3, the sediment size distribution has remained consistent with MY2 which shows a fining of riffle bed materials. This increase in fine sediment size percentage may be indicative of excess fine sediment inputs from the watershed and movement of coarse sediment during large bankfull events. Refer to Appendix D for pebble count plots with annual overlays.

Cross-section data indicate modest changes between MY2 and MY3. Hogan Creek riffle cross-section 3 displayed a trend between MY0 and MY2 with a reduction in width-depth ratio and an increase in bankfull maximum depth. Between MY2 and MY3, cross-section 3 dimensions exhibited only modest changes indicating that the downcutting displayed in previous years has stabilized. Hogan Creek riffle cross-section 5 data shows a decrease in width-depth ratio and an increase in cross-sectional area. This is due to the right bank erosion that has migrated downstream. Hogan Creek pool cross-sections indicate maintenance of pool maximum depths and stable function. Hogan Creek pool cross-section 4 data displays a reduction in cross-sectional area between MY0 and MY3 due to the expansion of the point bar. Cross-section data from UT2 indicate some change in bankfull dimensions compared to the baseline. UT2 cross-section data indicate moderate change in width-depth ratio at the two riffles and a modest increase in maximum depth at the pool cross-section. Visual observations of UT2 indicate overall stability. Similarly, UT1 and UT3 appear stable and functioning as intended. Please refer to Appendix D for cross-section plots with annual overlays and Table 12 for morphology and hydraulic summary.

The surveyed longitudinal profile data for the project streams illustrates that bedform features are maintaining lateral and vertical stability for the majority of the surveyed reaches between MY2 and MY3. Max pool depths increased in all reaches, particularly in Hogan Creek. Around station 17+00 on Hogan Creek Reach 1 downstream of the confluence with UT1, the pool depth has increased due to scour from a log structure and is enhancing aquatic habitat. On Hogan Creek Reach 2 at station 31+50 downstream of the confluence with UT3, scour along the outer bend of the channel has increased pool depth as well. The profiles of Hogan Creek Reach 2 and UT2 show modest change in pool spacing and riffle slope. Hogan Creek Reach 1 facet lengths and slopes have shifted as the coarse sediment that was deposited following the flood event that occurred shortly after construction moves downstream during flood events.

1.2.4 Stream Areas of Concern

Stream areas of concern included instances of bank erosion and sediment deposition on portions of Hogan Creek. Nine areas of bank erosion were observed in Hogan Creek Reach 1 and three were observed in Hogan Creek Reach 2. Ten of these areas of bank erosion were note in MY2 with two new areas noted in MY3. In Hogan Creek Reach 1, approximately 7% of both banks are unstable due to erosion with no stabilizing woody vegetation. Downstream, about 6% of both banks are unstable due to erosion on Hogan Creek Reach 2. Areas with no woody vegetation nearby appear to be trending toward less stable conditions. DMS has contracted with a provider to perform site evaluation, design and construction oversight for a repair on Hogan Creek. The repair is scheduled to be constructed in November 2018. These stream areas of concern are indicated on the current condition plan view Figure 3 and Table 6 in Appendix B.

1.2.5 Hydrology Assessment

Bankfull events were documented for Hogan Creek and UT2 on July 5, 2017 based on the visual observation of wrack lines on Hogan Creek Reach 2 and crest gage measurement for UT2. A nearby rain gage station recorded approximately 28 inches of rain between April and August 2017. Monthly rainfall data indicate significantly higher than normal rainfall occurred during April and May of 2017. Two bankfull flow events must be documented on restoration reaches within the five-year monitoring period and must occur in separate years. Therefore, the performance standard has been met in MY3 with at least three bankfull events documented for each reach. Refer to Appendix E for hydrologic data and graphs.

1.3 Monitoring Year 3 Summary

The Hogan Creek Stream Mitigation Project is on track to meet monitoring success criteria for vegetation, geomorphology, and hydrology performance standards. However, adaptive management measures are scheduled to occur in 2018 to address a growing invasive plant problem and several areas of bank instability on Hogan Creek. The MY3 vegetation survey resulted in an average stem density of 438 planted stems per acre. The Site has met the interim requirement of 320 planted stems per acre, with 5 of the 6 plots (83%) individually meeting this requirement. The MY3 vegetation monitoring and visual assessment revealed growing invasive plant populations in the riparian areas especially at the roadside of Miller Gap Road along Hogan Creek and the left riparian area of UT2 and UT2B preservation reaches. Areas of stream bank erosion with no stabilizing woody vegetation appear to be trending toward less stable conditions in Hogan Creek Reach 1 and 2. The performance standard of two recorded bankfull events in separate monitoring years has been met for Hogan Creek and UT2.

Summary information and data related to the 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 annual monitoring reports can be found in the Mitigation Plan documents available on DMS's website. All raw data supporting the tables and figures in the appendices are available from DMS upon request.

Section 2: METHODOLOGY

The stream monitoring methodologies utilized in 2017 are based on standard guidance and procedures documents (Rosgen 1996 and USACE 2003).

- Stream longitudinal profile and cross-section data were collected throughout three reaches using a total station survey. Approximately 3,175 linear feet of stream and 9 cross-sections were surveyed. Cross-sections and longitudinal profile start and stop locations were permanently marked with capped rebar and PVC conduit.
- Forty-one permanent photo points were established throughout the project to visually monitor stream stability and vegetation.
- Wolman pebble counts were conducted at four representative riffle cross-sections to evaluate particle size distribution over time. A minimum of 100 particles were selected at random and measured (Harrelson 1994).
- Vegetation monitoring included documenting species composition and survival of planted stems within six randomly located vegetation plots. Each 0.0247 acre vegetation plot was permanently marked with rebar and PVC conduit at all four corners.
- Two crest gauges were installed and were checked during semi-annual visits to determine if a bankfull event has occurred. The crest gauges were installed and surveyed at riffles on Hogan Creek Reach 2 and UT2.
- Visual assessments were performed on all stream and buffer restoration areas on a semi-annual basis. Problem areas were noted, including channel instability (lateral and/or vertical instability, structure failure/instability and/or piping, headcuts), vegetation health (low stem density, vegetation mortality, invasive species or encroachment), beaver activity, and livestock access. Areas of concern were mapped, photographed, and described in this monitoring report.

Section 3: REFERENCES

Confluence Engineering, PC. 2012. Hogan Creek Stream Mitigation Plan. NCEEP, Raleigh, NC.

Doll, B.A., Grabow, G.L., Hall, K.A., Halley, J., Harman, W.A., Jennings, G.D., and Wise, D.E. 2003. Stream Restoration A Natural Channel Design Handbook.

EcoEngineering. 2008. Technical Memorandum Task 2, Upper Yadkin Basin Local Watershed Plan.

Harrelson, Cheryl C; Rawlins, C.L.; Potyondy, John P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* Gen. Tech. Rep. RM-245. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Lee, Michael T., Peet, Robert K., Steven D., Wentworth, Thomas R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from: http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-2.pdf

North Carolina Climate Retrieval and Observations Network of the Southeast Database (NCCRONOS). 2017. State Climate Office of North Carolina. Version 2.7.2. NC-SR-2-Dobson 2.3 SE. Station ID Dobson 2.3 SE. Accessed November 2017.

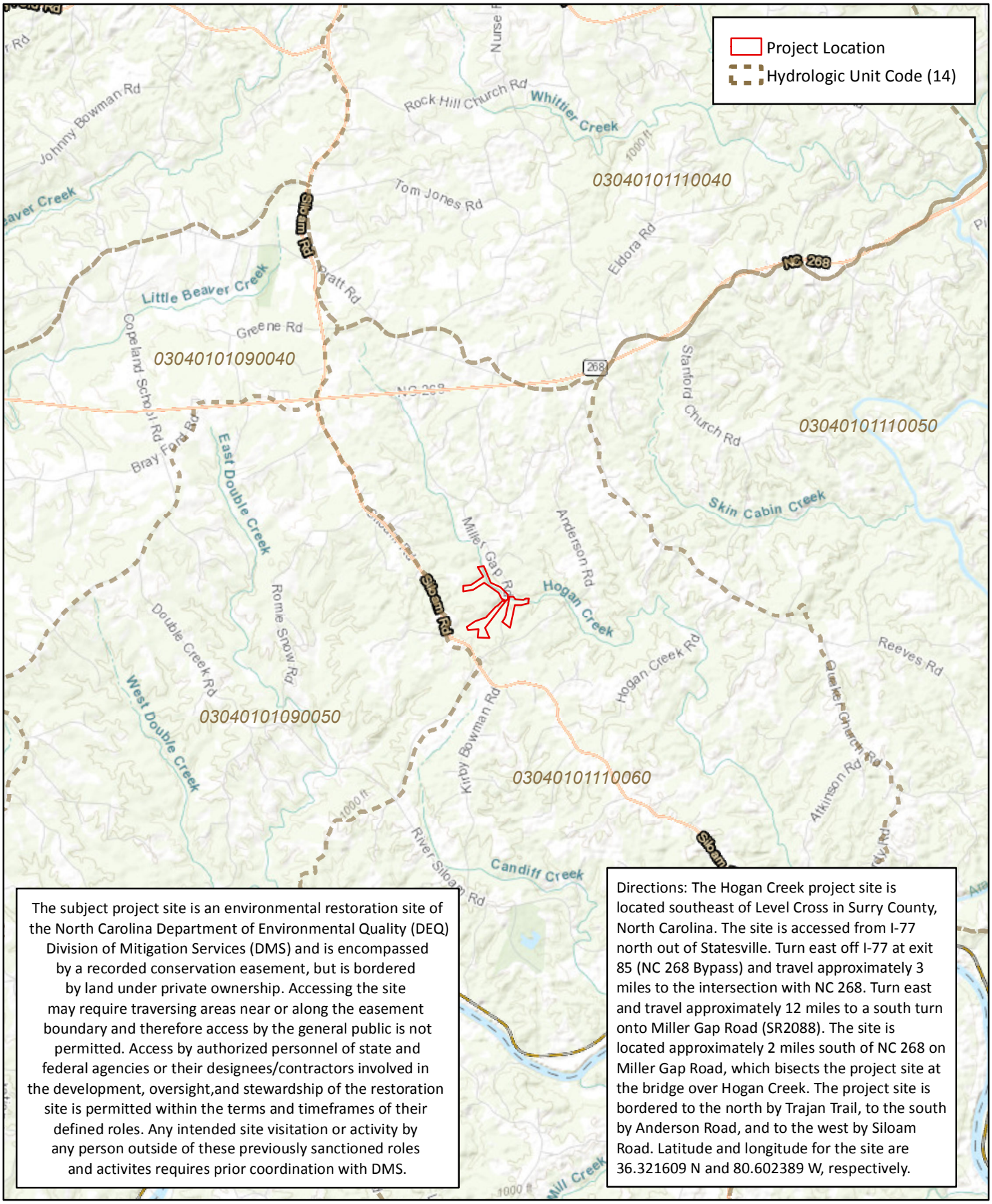
NCDENR. 2009. Upper Yadkin River Basin Restoration Priorities. Retrieved from https://deq.nc.gov/about/divisions/mitigation-services/dms-planning/watershed-planning-documents/yadkin-river-basin

North Carolina Geological Survey (NCGS). 2004. Physiography of North Carolina. Map compiled by the Division of Land Resources. Raleigh.

Rosgen, D.L. 1996. Applied River Morphology. Pagosa Springs, CO: Wildland Hydrology Books.

United States Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

APPENDIX A. General Tables and Figures



The subject project site is an environmental restoration site of the North Carolina Department of Environmental Quality (DEQ) Division of Mitigation Services (DMS) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and 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, oversight,and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activites requires prior coordination with DMS.

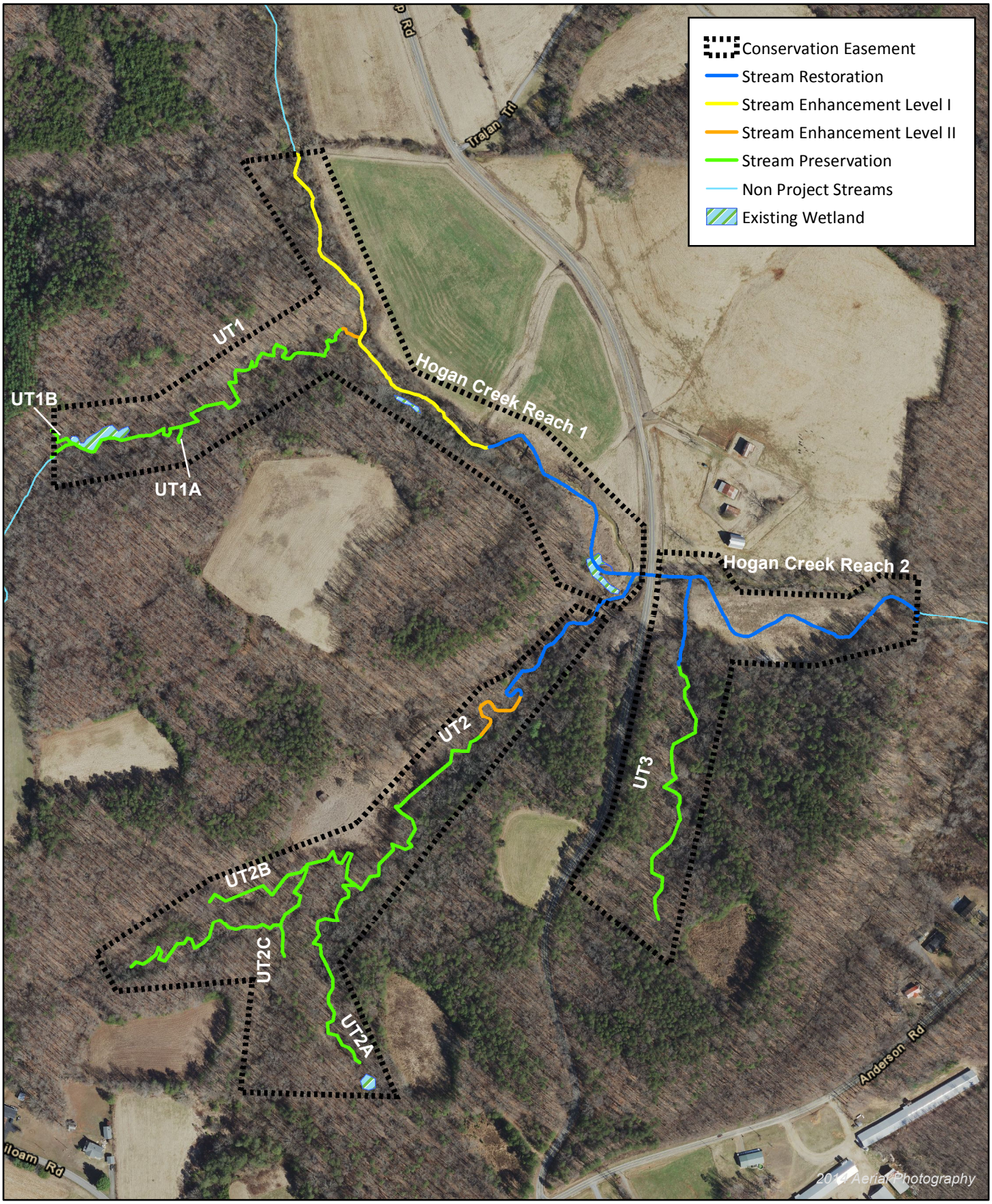
Directions: The Hogan Creek project site is located southeast of Level Cross in Surry County, North Carolina. The site is accessed from I-77 north out of Statesville. Turn east off I-77 at exit 85 (NC 268 Bypass) and travel approximately 3 miles to the intersection with NC 268. Turn east and travel approximately 12 miles to a south turn onto Miller Gap Road (SR2088). The site is located approximately 2 miles south of NC 268 on Miller Gap Road, which bisects the project site at the bridge over Hogan Creek. The project site is bordered to the north by Trajan Trail, to the south by Anderson Road, and to the west by Siloam Road. Latitude and longitude for the site are 36.321609 N and 80.602389 W, respectively.

WILDLANDS ENGINEERING

0 0.5 1 Mile

Figure 1 Project Vicinity Map
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Surry County, NC



WILDLANDS ENGINEERING

0 400 Feet

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Figure 2 Project Component/Asset Map
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Surry County, NC

Table 1. Project Components and Mitigation Credits
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Mitigation Credit Summaries [1]

	Stream	Riparian Wetland	Non-Riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Overall Credit	4,994	N/A	N/A	N/A	N/A	N/A

Project Components [1]

Project Component or Reach ID	Stationing	Pre-project Footage or Acreage	Restoration Footage or Acreage	Restoration Level	Restoration or Rest Equiv.	Mitigation Ratio	Mitigation Credits	Notes
Hogan Reach 1	10+00 - 22+00	1,331	1,200	P2	EI	1:1	1,200	-
Hogan Reach 1	22+00 - 28+84	797	684	P2	R	1:1	684	Crossing was removed from total
Hogan Reach 2	29+35 - 38+97	876	962	P2	R	1:1	962	-
UT1,1A, 1B	Upstream of 10+00	1,485	1,485	Preservation	P	5:1	297	-
UT1	10+00 - 10+66	66	66	P3	EII	2.5:1	26	-
UT2, 2A, 2B,2C	Upstream of 6+50	3,225	3,225	Preservation	P	5:1	645	-
UT2	6+50 - 10+00	370	350	P3	EII	2.5:1	140	-
UT2	10+00 - 15+55	633	555	P2	R	1:1	555	Crossing was removed from total
UT3	Upstream of 9+40	963	963	Preservation	P	5:1	193	-
UT3	9+40 - 12+32	260	292	P2	R	1:1	292	-

Length and Area Summations [1]

Restoration Level	Stream (Linear Feet)	Riparian Wetland (acres)		Non-riparian Wetland (acres)	Buffer (Square feet)		Upland (acres)	
		Riverine	Non-Riverine					
		-						
Restoration	2,493	-	-	-	-	-	-	-
Enhancement		-	-	-	-	-	-	-
Enhancement I	1,200							
Enhancement II	416							
Creation		-	-	-			-	-
Preservation	5,673	-	-	-			-	-
High Quality Preservation	-	-	-	-			-	-
	-	-	-	-			-	-

N/A - Not Applicable

[1] Project components and mitigation credits reverted back to Mitigation Plan asset totals as requested by IRT.

Table 2. Project Activity and Reporting History

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Activity or Deliverable		Data Collection Complete	Completion or Delivery
Mitigation Plan		October-2011	February-2012
Final Design – Construction Plans		October-2011	November-2012
Construction		N/A	December-2014
Temporary S&E Mix Applied		N/A	December-2014
Permanent Seed Mix Applied		N/A	December-2014
Containerized, bare root and B&B plantings for reach/segments		N/A	March-2015
Baseline Monitoring Document (Year 0)	Vegetation Survey	May-2015	August-2015
	Stream Survey	June-2015	
Stream Repair/Maintenance		N/A	December-2015
Year 1 Monitoring	Vegetation Survey	October-2015	January-2016
	Stream Survey	December-2015	
Invasive Species Treatment		May-2016	May-2016
Supplemental Planting		N/A	January-2016
Invasive Species Treatment		September-2016	September-2016
Year 2 Monitoring	Vegetation Survey	October-2016	November-2016
	Stream Survey	June-2016	
Year 3 Monitoring	Vegetation Survey	August-2017	December-2017
	Stream Survey	July-2017	
Year 4 Monitoring	Vegetation Survey	2018	December-2018
	Stream Survey	2018	
Year 5 Monitoring	Vegetation Survey	2019	December-2019
	Stream Survey	2019	

N/A - Not Applicable

Table 3. Project Contacts Table

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Designer	Wildlands Engineering, Inc. 167-B Haywood Road Asheville, NC 28806
Primary Project Design POC	Andrew Bick 828-606-0306
Construction Contractor	Carolina Environmental Contracting, Inc. 150 Pine Ridge Road Mount Airy, NC 27030
Construction Contractor POC	Wayne Taylor 336-341-6489
Survey Contractor	Turner Land Surveying, PLLC PO Box 41023 Raleigh, NC 27629
Survey Contractor POC	David Turner 919-623-5095
Planting Contractor	Keller Environmental, LLC 7921 Haymarket Lane Raleigh, NC 27615
Planting Contractor POC	Jay Keller 919-749-8259
Seeding Contractor	Carolina Environmental Contracting, Inc. 150 Pine Ridge Road Mount Airy, NC 27030
Seeding Contractor POC	Wayne Taylor 336-341-6489
Seed Mix Sources	Green Resources 336-855-6363
Nursery Stock Suppliers	Foggy Mountain Nursery 336-384-5323
Monitoring Performers	Wildlands Engineering, Inc. 1430 South Mint Street, Ste 104 Charlotte, NC 28205 704.332.7754
Stream Monitoring POC	Kirsten Gimbert 704-332-7754, ext 110
Vegetation Monitoring POC	Kirsten Gimbert 704-332-7754, ext 110

Table 4. Project Baseline Information and Attributes
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Project Information	
Project Name	Hogan Creek Stream Mitigation Project
County	Surry
Project Area (acres)	36
Project Coordinates (latitude and longitude)	36.321609 N, 80.602389 W
Project Watershed Summary Information	
Physiographic Province	Piedmont
River Basin	Yadkin
USGS Hydrologic Unit 8-digit	03040101
USGS Hydrologic Unit 14-digit	03040101110060
DWR Sub-basin	Pee Dee River Subbasin 03-07-02
Project Drainage Area (acres)	1,514 ac (2.37 mi^2)
Project Drainage Area Percentage of Impervious Area	0.40%
CGIA Land Use Classification	Managed Herbaceous Cover, Broadleaf Deciduous Forest Land

Reach Summary Information

Parameters	Hogan Creek Reach 1	Hogan Creek Reach 2	Main Stem UT1	Main Stem UT2	UT3
Length of Reach Post Construction (LF)	1,961	992	1,442	2,869	1,227
Valley classification (Rosgen)	VIII	VIII	VI	VI	VI
Drainage area (acres)	1,479	1,514	60	81	18
NCDWQ stream identification score	40	37	31	31.5	32.5
NCDWQ Water Quality Classification	C	C	C	C	C
Morphological Description (Rosgen stream type)	C4	C4	E4b	E4b	G4
Evolutionary trend	C-F	C-F	Eb-G	Eb-G	Eb-G
Underlying mapped soils	CsA	CsA	CsA, FsE	FsE	FsE
Drainage class	well drained	well drained	well drained	well drained	well drained
Soil Hydric status	not hydric	not hydric	not hydric	not hydric	not hydric
Slope	0.007	0.005	0.031	0.021	0.030
FEMA classification	AE	AE	Not in SFHA	Not in SFHA	Not in SFHA
Native vegetation community	Felsic Mesic Forest	Felsic Mesic Forest	Felsic Mesic Forest	Felsic Mesic Forest	Felsic Mesic Forest
Percent composition of exotic invasive vegetation	0	0	0	0	0

Wetland Summary Information

Parameters	Wetland 1	Wetland 2	Wetland 3	Wetland 4
Size of Wetland (acres)	0.09	0.02	0.13	0.10
Wetland Type	riparian non-riverine	riparian non-riverine	riparian non-riverine	riparian non-riverine
Mapped Soil Series	CsA	CsA and FsE	CsA and FsE	CsA and FsE
Drainage class	well drained	well drained	well drained	well drained
Soil Hydric Status	not hydric	not hydric	not hydric	not hydric
Source of Hydrology	Creek (oxbow)	Toe seep	Toe seep	Impoundment
Hydrologic Impairment	none	none	none	none
Native vegetation community	Dist. Small Stream/ Narrow FP Forest	Dist. Small Stream/ Narrow FP Forest	Dist. Small Stream/ Narrow FP Forest	Herbaceous
Percent composition of exotic invasive vegetation	0	0	0	0

Regulatory Considerations

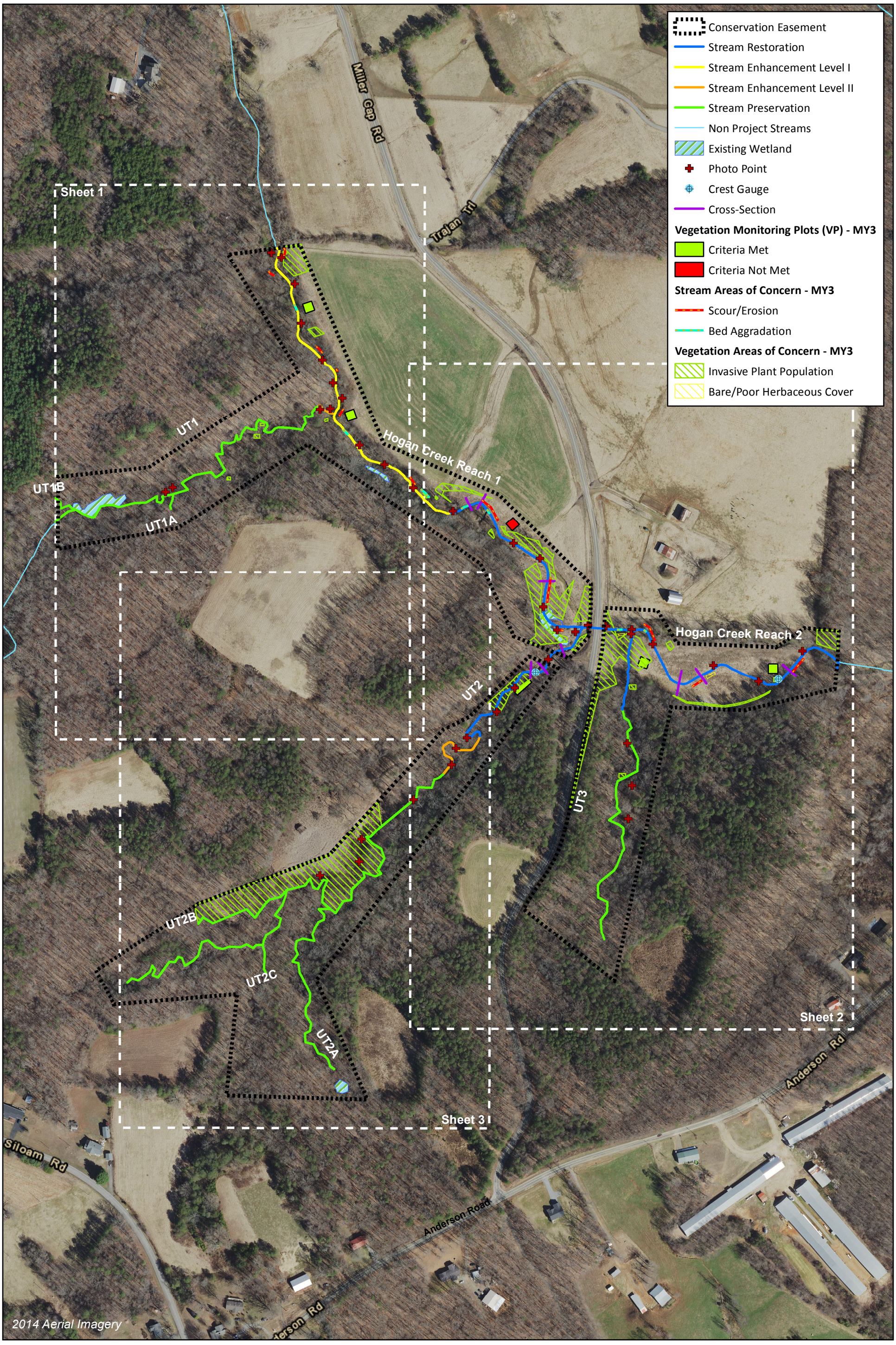
Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States – Section 404	Y	Y	USACE Action ID # SAW-2011-02268
Waters of the United States – Section 401	Y	Y	NCDWR # 20120182
Endangered Species Act	Y	Y	CE Approved 9/30/11
Historic Preservation Act	N	N/A	-
Coastal Zone Management Act (CZMA)/ Coastal Area Management Act (CAMA)	N	N/A	-
FEMA Floodplain Compliance	Y	Y	LOMR Submitted 5/2015
Essential Fisheries Habitat	N	N/A	-

N/A Not-applicable

Table 5. Monitoring Component Summary
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Parameter	Monitoring Feature	Quantity Length By Reach (ft)					Frequency
		Hogan Creek Reach 1	Hogan Creek Reach 2	UT1	UT2	UT3	
Dimension	Riffle XS	2	2		2		Annual
	Pool XS	1	1		1		Annual
Pattern/Profile	Longitudinal Profile	1500	1000		675		Annual
Substrate	100 Pebble Count	2	2				Annual
Hydrology	Crest Gage		1		1		Semi-Annual
Vegetation	Vegetation Plots	3	2		1		Annual
Visual Assessment	Project Site	Y	Y	Y	Y	Y	Semi-Annual
Reference Photos	Permanent Photo Points	18	6	3	10	4	Annual

APPENDIX B. Visual Assessment Data

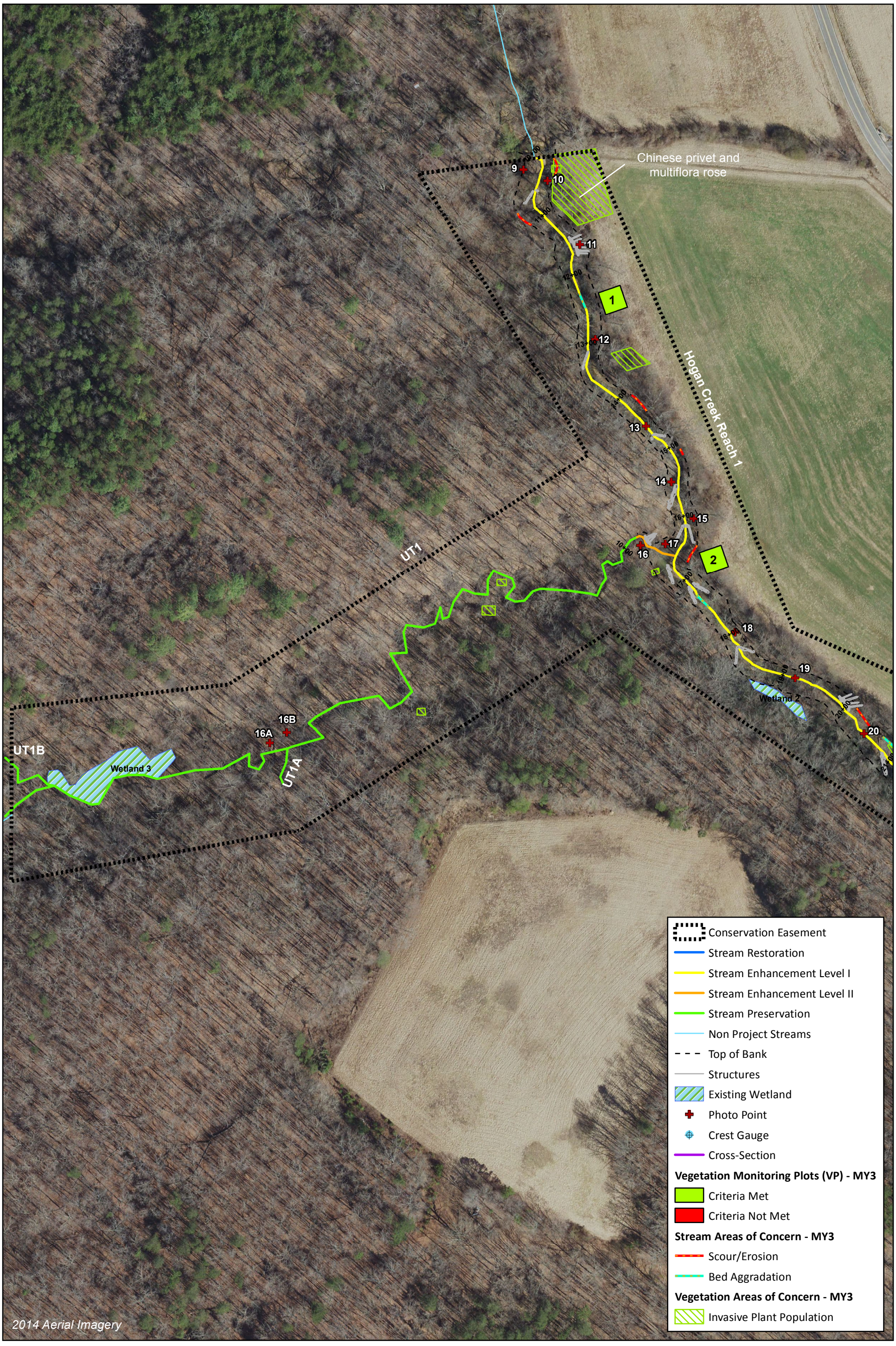


WILDLANDS ENGINEERING

0 250 500 Feet

Figure 3.0 Integrated Current Condition Plan View Map (Key)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Surry County, NC

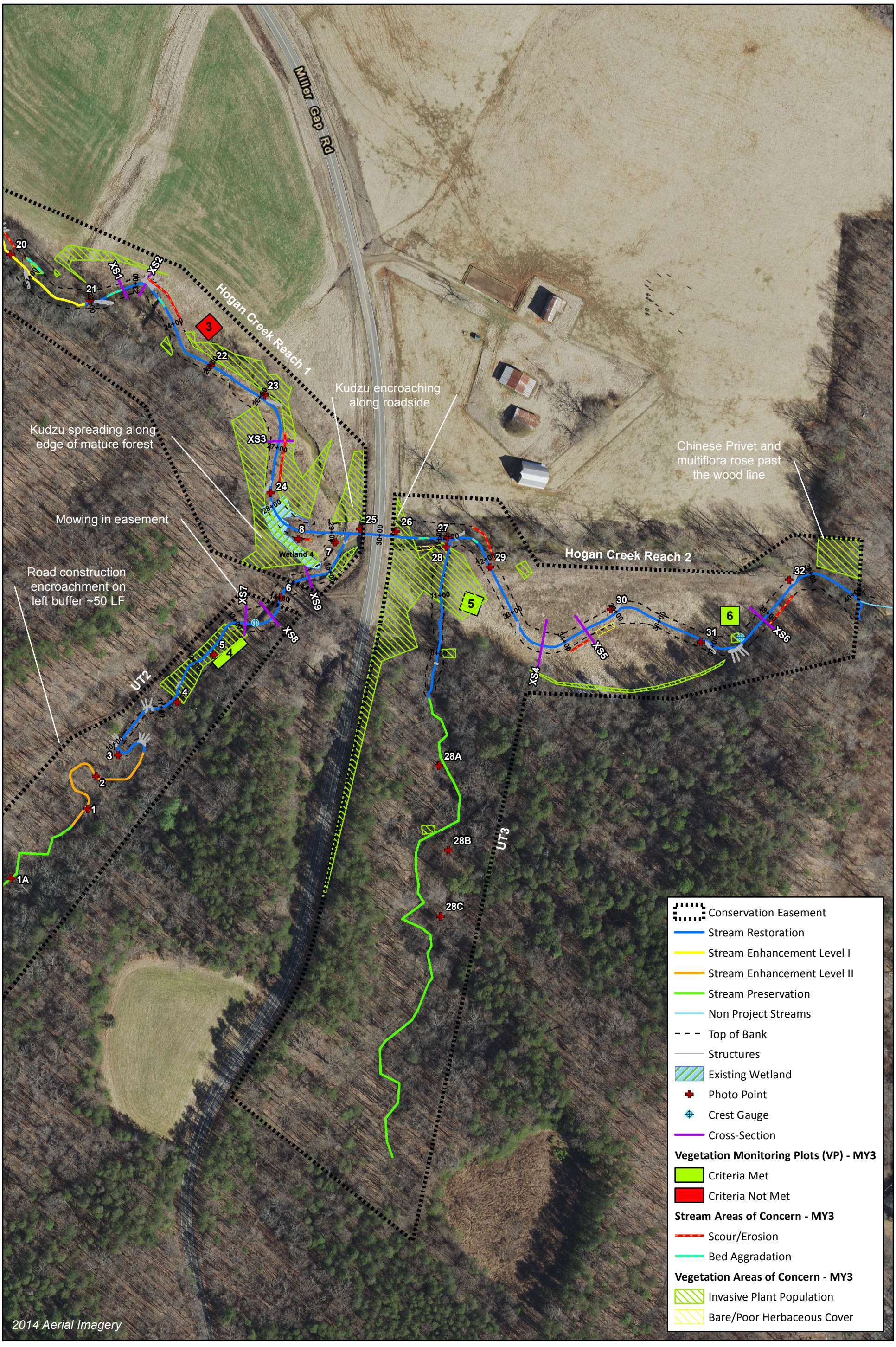


WILDLANDS ENGINEERING

0 125 250 Feet

Figure 3.1 Integrated Current Condition Plan View Map (Sheet 1 of 3)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

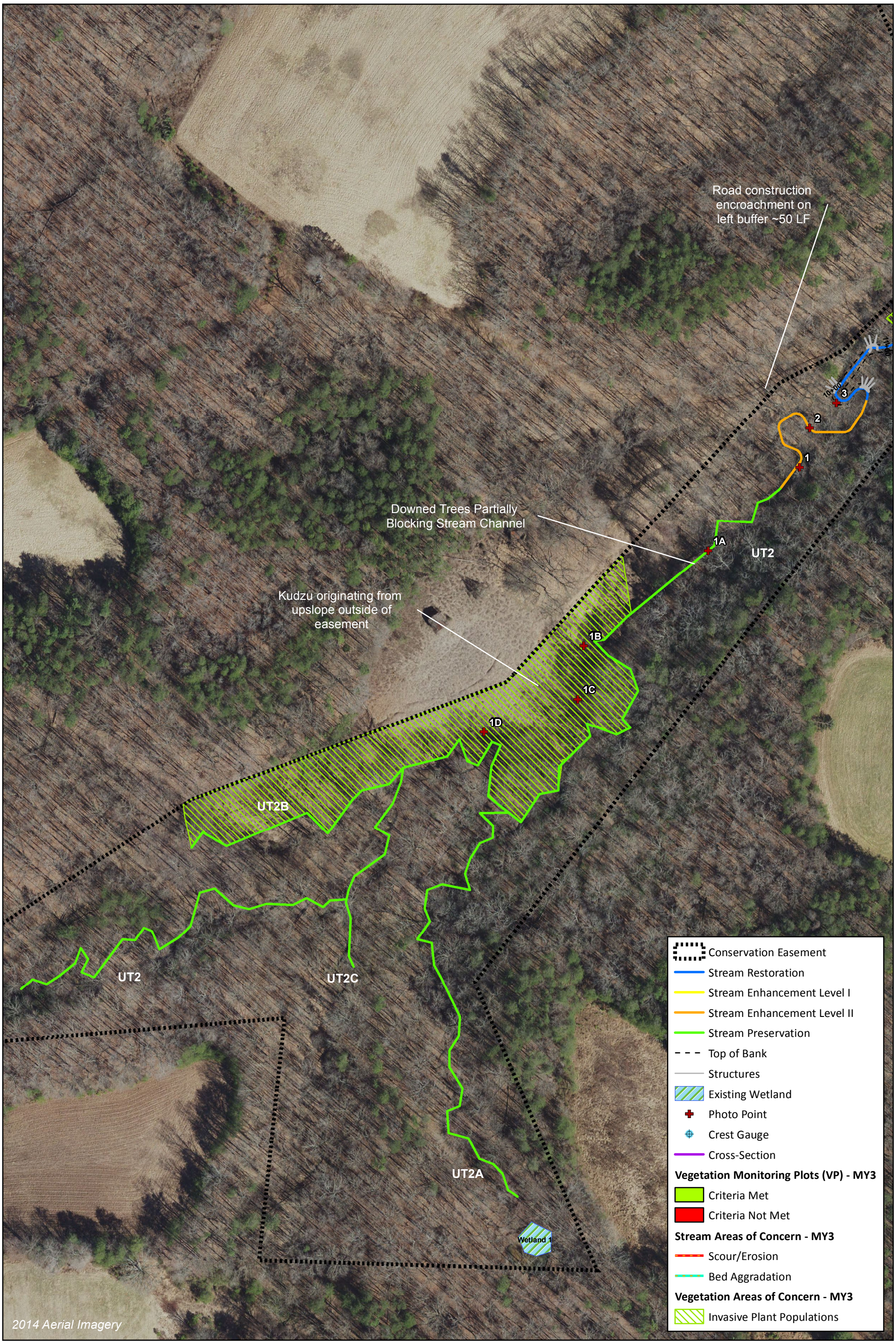
Surry County, NC



WILDLANDS ENGINEERING

Figure 3.2 Integrated Current Condition Plan View Map (Sheet 2 of 3)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Surry County, NC



WILDLANDS ENGINEERING

0 125 250 Feet

N

Figure 3.3 Integrated Current Condition Plan View Map (Sheet 3 of 3)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Surry County, NC

Table 6a. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Creek Reach 1 (Assessed Length : 1,961 feet)

Major Channel Category	Channel Sub-Category	Metric	Number 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
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			5	130	93%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	14	14			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	13	13			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	13	13			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		2. Thalweg centering at downstream of meander (Glide)	13	13			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			9	340	91%	4	80	93%
	2. 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	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	N/A
				Totals	9	340	91%	4	80	93%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	15	15			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	5	5			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	12	12			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	14	15			93%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	14	15			93%			

Table 6b. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Creek Reach 2 (Assessed Length : 992 feet)

Major Channel Category	Channel Sub-Category	Metric	Number 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
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			2	30	97%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	4	6			67%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	4	5			80%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	4	5			80%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	4	5			80%			
		2. Thalweg centering at downstream of meander (Glide)	4	5			80%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			3	120	94%	0	0	N/A
	2. 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	N/A
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	N/A
				Totals	3	120	94%	0	0	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	1	1			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	5	5			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	6	6			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	6	6			100%			

Table 6c. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

UT2 (Assessed Length : 930 feet)

Major Channel Category	Channel Sub-Category	Metric	Number 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
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	14	14			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	13	13			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	13	13			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	13	13			100%			
		2. Thalweg centering at downstream of meander (Glide)	13	13			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. 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%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	6	6			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	2	2			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	4	4			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	6	6			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	6	6			100%			

Table 6d. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

UT3 (Assessed Length : 275 feet)

Major Channel Category	Channel Sub-Category	Metric	Number 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
1. Bed	1. **Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	4	4			100%			
	3. Meander Pool Condition	1. Depth Sufficient (Max Pool Depth : Mean Bankfull Depth ≥ 1.6)	4	4			100%			
		2. Length appropriate (>30% of centerline distance between tail of upstream riffle and head of downstrem riffle)	4	4			100%			
	4.**Thalweg Position**	1. Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		2. Thalweg centering at downstream of meander (Glide)	4	4			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			0	0	100%	0	0	100%
	2. 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%
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	0	0	100%
				Totals	0	0	100%	0	0	100%
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	1	1			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	1	1			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	1	1			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	1	1			100%			

Table 7. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

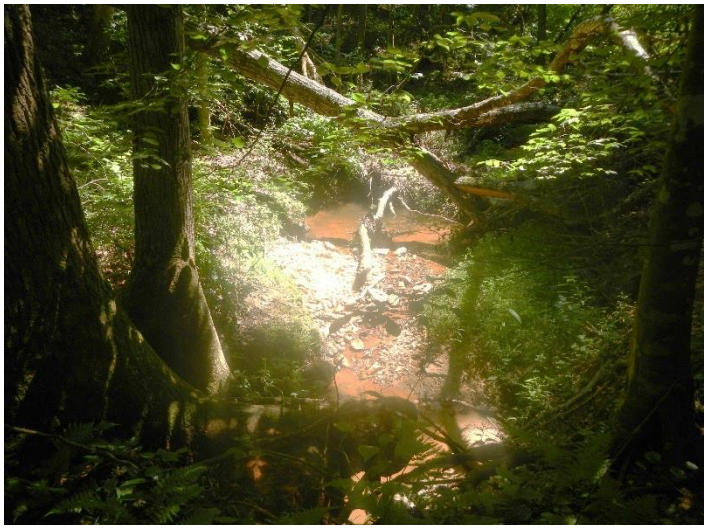
Planted Acreage **6.7**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Planted Acreage
1. Bare Areas	Very limited cover of both woody and herbaceous material.	0.1 acres	Cross Hatch Yellow	2	0.01	0.1%
2. Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1 acres	Pattern and Color	2	0.05	0.7%
			Total	4	0.06	0.9%
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 acres	Pattern and Color	0	0.00	0.0%
			Cumulative Total	0	0.06	0.9%

Easement Acreage **36**

Vegetation Category	Definitions	Mapping Threshold	CCPV Depiction	Number of Polygons	Combined Acreage	% of Easement Acreage
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	1000 SF	Cross Hatch Green	25	3.46	9.6%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	Pattern and Color	0	0.00	0.0%

Stream Photographs

	
PP1 – Main Stem UT2, looking upstream *(07/05/2017)*	**PP1A** – Main Stem UT2, looking upstream *(07/05/2017)*
	
PP1B – Main Stem UT2, looking downstream *(07/05/2017)*	**PP1C –** Main Stem UT2, looking upstream *(07/05/2017)*
	
PP1D – Main Stem UT2, looking upstream *(07/05/2017)*	**PP2** – Main Stem UT2, looking downstream *(07/05/2017)*

	
PP3 – Main Stem UT2, looking upstream *(07/05/2017)*	**PP4** – Main Stem UT2, looking upstream *(07/05/2017)*
	
PP5 – Main Stem UT2, looking downstream *(07/05/2017)*	**PP6** – Main Stem UT2, looking downstream *(07/05/2017)*
	
PP7 – Main Stem UT2, looking downstream *(07/05/2017)*	**PP8 –** Reach 1 Hogan Creek, looking upstream *(07/05/2017)*

	
PP9 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP10 –** Reach 1 Hogan Creek, looking downstream *(07/06/2017)*
	
PP11 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP12 –** Reach 1 Hogan Creek, looking downstream *(07/05/2017)*
	
PP13 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP14 –** Reach 1 Hogan Creek, looking downstream *(07/05/2017)*

PP15 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*

PP16 – Main Stem UT1, looking downstream *(07/05/2017)*

PP16A – Main Stem UT1, looking upstream *(07/05/2017)*

PP16B – Main Stem UT1, looking downstream *(07/05/2017)*

PP17 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*

PP18 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*

	
PP19 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP20 –** Reach 1 Hogan Creek, looking downstream *(07/05/2017)*
	
PP21 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP22 –** Reach 1 Hogan Creek, looking downstream *(07/05/2017)*
	
PP23 – Reach 1 Hogan Creek, looking downstream *(07/05/2017)*	**PP24 –** Reach 1 Hogan Creek, looking downstream *(07/05/2017)*

PP25 – Reach 1 Hogan Creek, looking upstream *(07/05/2017)*

PP26 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

PP27 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

PP28 – UT3, looking upstream *(07/05/2017)*

PP28A – UT3, looking upstream *(07/05/2017)*

PP28B – UT3, looking downstream *(07/05/2017)*

PP28C – UT3, looking upstream *(07/05/2017)*

PP29 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

PP30 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

PP31 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

PP32 – Reach 2 Hogan Creek, looking downstream *(07/05/2017)*

Vegetation Photographs

	
Vegetation Plot 1 – *(08/29/2017)*	**Vegetation Plot 2** – *(08/29/2017)*
	
Vegetation Plot 3 – *(08/29/2017)*	**Vegetation Plot 4 –** *(08/29/2017)*
	
Vegetation Plot 5 – *(08/29/2017)*	**Vegetation Plot 6** – *(08/29/2017)*

APPENDIX C. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Plot	MY4 Success Criteria	Tract Mean
1	Y	83%
2	Y	
3	N	
4	Y	
5	Y	
6	Y	

Table 9. CVS Vegetation Plot Metadata

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Database Name	cvs-eep-entrytool-v2.3.1 Hogan MY3.mdb
Database Location	Q:\ActiveProjects\005-02152 Hogan Monitoring\Monitoring\MY3 (2017)\Vegetation Assessment
Computer Name	BULLPEN
File Size	61603840
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	94708
Project Name	Hogan Creek
Description	
River Basin	
Length(ft)	
Stream-to-edge Width (ft)	
Area (sq m)	
Required Plots (calculated)	
Sampled Plots	6
Required Plots (calculated)	6
Sampled Plots	6

Table 10. Planted and Total Stem Counts
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)																	
			94708-01-0001			94708-01-0002			94708-01-0003			94708-01-0004			94708-01-0005			94708-01-0006		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree			5															
Betula nigra	river birch	Tree	3	3	58			32	1	1	9	6	6	6			5			
Diospyros virginiana	common persimmon	Tree													4	4	4	5	5	5
Fraxinus pennsylvanica	green ash	Tree	3	3	3	3	3	3	2	2	2	4	4	4	1	1	1			
Juglans nigra	black walnut	Tree															2			
Liriodendron tulipifera	tuliptree	Tree			15									19						
Nyssa sylvatica	blackgum	Tree																2	2	2
Pinus taeda	loblolly pine	Tree															2			
Platanus occidentalis	American sycamore	Tree	2	2	2	3	3	3	1	1	1	8	8	8						1
Prunus serotina	black cherry	Tree																		
Quercus alba	white oak	Tree																		
Quercus lyrata	overcup oak	Tree	1	1	1	2	2	2	3	3	3	1	1	1	4	4	4	5	5	5
Quercus phellos	willow oak	Tree													1	1	1			
		Stem count	9	9	84	8	8	40	7	7	15	19	19	38	10	10	19	12	12	13
		size (ares)	1			1			1			1			1			1		
		size (ACRES)	0.0247			0.0247			0.0247			0.0247			0.0247			0.0247		
		Species count	4	4	6	3	3	4	4	4	4	4	4	5	4	4	7	3	3	4
		Stems per ACRE	364	364	3399	324	324	1619	283	283	607	769	769	1538	405	405	769	486	486	526

			Annual Means											
			MY0 (2015)			MY1 (2015)			MY2 (2016)			MY3 (2017)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	red maple	Tree			1			7			1			5
Betula nigra	river birch	Tree	10	10	10	10	10	149	10	10	169	10	10	165
Diospyros virginiana	common persimmon	Tree							11	11	11	9	9	9
Fraxinus pennsylvanica	green ash	Tree	17	17	17	14	14	14	15	15	15	13	13	13
Juglans nigra	black walnut	Tree			1									2
Liriodendron tulipifera	tuliptree	Tree						70			62			64
Nyssa sylvatica	blackgum	Tree	12	12	12	12	12	12	2	2	2	2	2	2
Pinus taeda	loblolly pine	Tree									3			2
Platanus occidentalis	American sycamore	Tree	13	13	13	14	14	17	14	14	20	14	14	15
Prunus serotina	black cherry	Tree			27			41			33			
Quercus alba	white oak	Tree			2			1			1			
Quercus lyrata	overcup oak	Tree	13	13	13	15	15	15	17	17	17	16	16	16
Quercus phellos	willow oak	Tree	6	6	6	4	4	4	1	1	1	1	1	1
		Stem count	71	71	102	69	69	330	70	70	335	65	65	294
		size (ares)	6			6			6			6		
		size (ACRES)	0.148			0.148			0.148			0.148		
		Species count	6	6	10	6	6	10	7	7	12	7	7	11
		Stems per ACRE	479	479	688	465	465	2226	472	472	2259	438	438	1983

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%
Volunteer species included in total

PnoLS: Number of planted stems excluding live stakes
P-all: Number of planted stems including live stakes
T: Total stems

APPENDIX D. Morphological Summary Data and Plots

Table 11a. Baseline Stream Data Summary

Hogan Creek Stream Restoration Project

DMS Project No.94708

Monitoring Year 3 - 2017

Hogan Creek - Reach 1 (1,532 feet)

Parameter	Gage	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)	N/A	-	-	-	21.5	-	25.7	29.7	-	-	27.2	-	30.4	33.6	-	-	22.5	23.3	24.0	22.8	24.2	24.2	25.6	N/A	2
Floodprone Width (ft)					178.0	-	220.0	246.0	-	-	72.1	-	72.3	72.5	-	-	100.0	150.0	200.0	>100	>100	>100	>100	N/A	2
Bankfull Mean Depth (ft)		-	-	-	2.0	-	1.9	2.1	-	-	1.9	-	2.0	2.2	-	-	1.8	1.9	2.2	1.7	1.8	1.8	1.8	N/A	2
Bankfull Max Depth (ft)					2.5	-	2.7	3.2	-	-	2.4	-	2.5	2.7	-	-	2.5	2.6	2.8	2.7	2.8	2.8	2.9	N/A	2
Bankfull Cross Sectional Area (ft^2)		-	-	-	45.1	-	48.6	59.3	-	-	50.8	-	61.6	72.4	-	-	40.6	44.1	47.6	41.4	42.7	42.7	43.9	N/A	2
Width/Depth Ratio					10.3	-	13.6	14.9	-	-	14.5	-	15.0	15.6	-	-	12.1	12.3	12.5	12.6	13.8	13.8	14.9	N/A	2
Entrenchment Ratio					8.3	-	8.6	8.3	-	-	2.7	-	2.7	2.7	-	-	4.4	6.5	8.3	>3.9	>4.2	>4.2	>4.4	N/A	2
Bank Height Ratio					1.3	-	1.3	1.4	-	-	1.0	-	1.0	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	2
Profile																									
Riffle Length (ft)	N/A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37.17	58.9	-	98.4	-	8
Riffle Slope (ft/ft)					0.010	-	0.024	0.055	-	-	0.019	-	0.020	0.021	-	-	0.007	0.010	0.013	0.002	0.010	-	0.018	-	8
Pool Length (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25.0	62.6	-	88.0	-	13
Pool Max depth (ft)					4.0	-	4.3	4.7	-	-	3.4	-	3.5	3.5	-	-	4.0	4.0	4.0	2.5	3.2	-	4.1	-	13
Pool Spacing (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73.3	120.9	-	200.08	-	12
Pattern																									
Channel Beltwidth (ft)	N/A				44.0	-	65.0	117.0	-	-	86.0	-	86.0	86.0	-	-	48.0	88.0	126.0	63.0	96.5	101.0	121.0	24.9	4
Radius of Curvature (ft)					20.0	-	29.0	52.0	-	-	19.6	-	22.7	25.8	-	-	67.0	73.0	101.0	70.0	76.5	75.0	86.0	6.8	4
Rc:Bankfull width (ft/ft)					0.9	-	1.1	1.8	-	-	0.7	-	0.8	0.9	-	-	3.0	3.1	4.2	2.9	3.2	3.1	3.6	N/A	N/A
Meander Wavelength (ft)					133.0	-	297.0	479.0	-	-	81.0	-	81.0	81.0	-	-	133.0	311.0	325.0	165.0	263.7	306.0	320.0	85.7	3
Meander Width Ratio					2.0	-	2.5	3.9	-	-	3.2	-	3.2	3.2	-	-	2.1	3.8	5.3	2.6	4.0	4.2	5.0	N/A	N/A
Substrate, Bed, and Transport parameters																									
Ri% / Ru% / P% / G% / S%	N/A				-												-			-					
SC% / Sa% / G% / C% / B% / Be%					-												-			0%,3.5%,96%,0.5%,0%,0%					
d16 / d35 / d50 / d84 / d95 (mm)					-												-			14, 19, 23, 41, 56					
Reach Shear Stress (competency) lb/ft^2					-												-			-					
Max part size (mm) mobilized at bankfull					-												-			-					
Stream Power (transport capacity) W/m^2					-												-			-					
Additional Reach Parameters																									
Rosgen Classification	N/A				C4						C4						C4			C4					
Bankfull Velocity (fps)		-	-	-	-												-			-					
Bankfull Discharge (cfs)		-	-	-	-																				
Valley length (ft)					2,525						4,730									1,294					
Channel Thalweg length (ft)					2,762						327						2,897			1,532					
Sinuosity (ft)					1.12						1.26						1.15			1.18					
Water Surface Slope (Channel) (ft/ft)					0.0064						0.0127						0.0071			0.0063					
BF slope (ft/ft)					0.0071						0.0101						0.0062			0.0067					
Bankfull Floodplain Area (acres)					-						-						-			-					
% of Reach with Eroding Banks					-						-														
Channel Stability or Habitat Metric					-						-														
Biological or Other					-						-														

N/A - Not Applicable

- Information Unavailable

Table 11b. Baseline Stream Data Summary

Hogan Creek Stream Restoration Project

DMS Project No.94708

Monitoring Year 3 - 2017

Hogan Creek - Reach 2 (1,085 feet)

Parameter	Gage	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)	N/A	-	-	-	21.5	-	25.7	29.7	-	-	27.2	-	30.4	33.6	-	-	22.5	23.3	24.0	24.2	24.5	24.5	24.7	N/A	2
Floodprone Width (ft)					178.0	-	220.0	246.0	-	-	72.1	-	72.3	72.5	-	-	100.0	150.0	200.0	>100	>100	>100	>100	N/A	2
Bankfull Mean Depth (ft)		-	-	-	2.0	-	1.9	2.1	-	-	1.9	-	2.0	2.2	-	-	1.8	1.9	2.2	1.9	2.1	2.1	2.3	N/A	2
Bankfull Max Depth (ft)					2.5	-	2.7	3.2	-	-	2.4	-	2.5	2.7	-	-	2.5	2.6	2.8	3.2	3.4	3.4	3.6	N/A	2
Bankfull Cross Sectional Area (ft^2)		-	-	-	45.1	-	48.6	59.3	-	-	50.8	-	61.6	72.4	-	-	40.6	44.1	47.6	45.2	50.9	50.9	56.6	N/A	2
Width/Depth Ratio					10.3	-	13.6	14.9	-	-	14.5	-	15.0	15.6	-	-	12.1	12.3	12.5	10.8	11.9	11.9	13.0	N/A	2
Entrenchment Ratio					8.3	-	8.6	8.3	-	-	2.7	-	2.7	2.7	-	-	4.4	6.5	8.3	>4.0	>4.1	>4.1	>4.1	N/A	2
Bank Height Ratio					1.3	-	1.3	1.4	-	-	1.0	-	1.0	1.1	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	2
Profile																									
Riffle Length (ft)	N/A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	95.63	111.62	-	130.25	-	5
Riffle Slope (ft/ft)					0.010	-	0.024	0.055	-	-	0.019	-	0.020	0.021	-	-	0.007	0.010	0.013	0.004	0.005	-	0.007	-	5
Pool Length (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43.7	68.8	-	117.1	-	5
Pool Max depth (ft)					4.0	-	4.3	4.7	-	-	3.4	-	3.5	3.5	-	-	4.0	4.0	4.0	3.80	4.73	-	5.8	-	5
Pool Spacing (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	164.1	208.4	-	253.1	-	4
Pattern																									
Channel Beltwidth (ft)	N/A				44.0	-	65.0	117.0	-	-	86.0	-	86.0	86.0	-	-	48.0	88.0	126.0	84.0	114.0	117.0	141.0	28.6	3
Radius of Curvature (ft)					20.0	-	29.0	52.0	-	-	19.6	-	22.7	25.8	-	-	67.0	73.0	101.0	69.0	73.3	74.0	75.0	2.8	5
Rc:Bankfull width (ft/ft)					0.9	-	1.1	1.8	-	-	0.7	-	0.8	0.9	-	-	3.0	3.1	4.2	2.8	3.0	3.0	3.1	N/A	N/A
Meander Wavelength (ft)					133.0	-	297.0	479.0	-	-	81.0	-	81.0	81.0	-	-	133.0	311.0	325.0	292.0	307.0	301.0	328.0	18.7	3
Meander Width Ratio					2.0	-	2.5	3.9	-	-	3.2	-	3.2	3.2	-	-	2.1	3.8	5.3	3.4	4.7	4.8	5.8	N/A	N/A
Substrate, Bed, and Transport parameters																									
Ri% / Ru% / P% / G% / S%	N/A						-											-				-			
SC% / Sa% / G% / C% / B% / Be%							-											-				0%,3%,9%,89%, 0%, 0%			
d16 / d35 / d50 / d84 / d95 (mm)							-											-				13, 24, 22, 35, 49			
Reach Shear Stress (competency) lb/ft^2							-											-				-			
Max part size (mm) mobilized at bankfull							-											-				-			
Stream Power (transport capacity) W/m^2							-											-				-			
Additional Reach Parameters																									
Rosgen Classification	N/A						C4						C4					C4				C4			
Bankfull Velocity (fps)		-	-	-			-											-				-			
Bankfull Discharge (cfs)		-	-	-			-																		
Valley length (ft)							2,525						4,730					2,897				794			
Channel Thalweg length (ft)							2,762						327									1,085			
Sinuosity (ft)							1.12						1.26					1.15				1.37			
Water Surface Slope (Channel) (ft/ft)							0.0064						0.0127					0.0071				0.0050			
BF slope (ft/ft)							0.0071						0.0101					0.0062				0.0053			
Bankfull Floodplain Area (acres)							-						-					-				-			
% of Reach with Eroding Banks							-						-												
Channel Stability or Habitat Metric							-						-												
Biological or Other							-						-												

N/A - Not Applicable

- Information Unavailable

Table 11c. Baseline Stream Data Summary

Hogan Creek Stream Restoration Project

DMS Project No.94708

Monitoring Year 3 - 2017

UT2 (675 feet)

Parameter	Gage	Regional Curve			Pre-Existing Condition						Reference Reach Data						Design			Monitoring Baseline					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Med	Max	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle Only																									
Bankfull Width (ft)	N/A	-	-	-	-	-	8.2	-	-	-	-	-	7.1	-	-	-	-	9.0	-	6.5	7.1	7.1	7.6	N/A	2
Floodprone Width (ft)					-	-	66.0	-	-	-	-	-	15.0	-	-	-	-	30.0	-	21	24.9	24.9	28.8	N/A	2
Bankfull Mean Depth (ft)		-	-	-	-	-	1.5	-	-	-	-	-	0.9	-	-	-	-	0.7	-	0.5	0.6	0.6	0.7	N/A	2
Bankfull Max Depth (ft)					-	-	2.1	-	-	-	-	-	1.2	-	-	-	-	1.0	-	0.9	1.1	1.1	1.2	N/A	2
Bankfull Cross Sectional Area (ft^2)		-	-	-	-	-	12.1	-	-	-	-	-	6.6	-	-	-	-	6.5	-	4.0	4.4	4.4	4.7	N/A	2
Width/Depth Ratio					-	-	5.6	-	-	-	-	-	7.6	-	-	-	-	12.5	-	8.9	11.6	11.6	14.2	N/A	2
Entrenchment Ratio					-	-	8.0	-	-	-	-	-	2.1	-	-	-	-	3.3	-	3.2	3.5	3.5	3.8	N/A	2
Bank Height Ratio					-	-	1.6	-	-	-	-	-	1.0	-	-	-	-	1.0	-	1.0	1.0	1.0	1.0	N/A	2
Profile																									
Riffle Length (ft)	N/A				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14.3	34.4	-	67.3	-	11
Riffle Slope (ft/ft)					0.030	-	0.033	0.056	-	-	0.023	-	0.033	0.036	-	-	0.027	0.032	0.038	0.014	0.028	-	0.052	-	11
Pool Length (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2	11.0	-	27.1	-	12
Pool Max depth (ft)					-	-	2.7	-	-	-	-	-	1.5	-	-	-	-	1.6	-	1.2	2.0	-	3.2	-	12
Pool Spacing (ft)					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13.1	54.8	-	151.0	-	11
Pattern																									
Channel Beltwidth (ft)	N/A				28.0	-	42.0	56.0	-	-	62.0	-	67.5	73.0	-	-	17.0	26.0	49.0	26.0	38.0	39.0	54.0	2.7	5
Radius of Curvature (ft)					16.0	-	18.5	21.0	-	-	7.0	-	16.0	25.0	-	-	22.0	27.0	30.0	19.0	21.6	22.0	26.0	2.4	6
Rc:Bankfull width (ft/ft)					2.0	-	2.3	2.6	-	-	1.0	-	2.3	3.5	-	-	2.4	3.0	3.3	2.7	3.0	3.1	3.7	N/A	N/A
Meander Wavelength (ft)					128.0	-	159.0	190.0	-	-	53.0	-	58.5	64.0	-	-	73.0	103.0	130.0	101.0	112.3	109.5	132.0	2.7	6
Meander Width Ratio					3.4	-	5.1	6.8	-	-	8.7	-	9.5	10.3	-	-	1.9	2.9	5.5	3.7	5.4	5.5	7.6	N/A	N/A
Substrate, Bed, and Transport parameters																									
Ri% / Ru% / P% / G% / S%	N/A				-												-			-					
SC% / Sa% / G% / C% / B% / Be%					-												-			N/A					
d16 / d35 / d50 / d84 / d95 (mm)					-												-			N/A					
Reach Shear Stress (competency) lb/f^2					-												-			-					
Max part size (mm) mobilized at bankfull					-												-			-					
Stream Power (transport capacity) W/m^2					-												-			-					
Additional Reach Parameters																									
Rosgen Classification	N/A				E4b						E4b						B4			B4					
Bankfull Velocity (fps)		-	-	-	-												-			-					
Bankfull Discharge (cfs)		-	-	-	-																				
Valley length (ft)					641						1,350									544					
Channel Thalweg length (ft)					568						1,980						555			675					
Sinuosity (ft)					1.33						1.47						1.4			1.24					
Water Surface Slope (Channel) (ft/ft)					0.0235						0.0263						0.0223			0.0218					
BF slope (ft/ft)					0.0312						0.0356						0.0312			0.0229					
Bankfull Floodplain Area (acres)					-						-						-			-					
% of Reach with Eroding Banks					-						-														
Channel Stability or Habitat Metric					-						-														
Biological or Other					-						-														

N/A - Not Applicable

- Information Unavailable

Table 12. Morphology and Hydraulic Summary (Dimensional Parameters - Cross-Section)
Hogan Creek Stream Restoration Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Reach 1 (1,532 feet)

	Cross-Section 1 (Riffle)						Cross-Section 2 (Pool)						Cross-Section 3 (Riffle)					
Based on fixed baseline bankfull elevation	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	990.8	990.8	990.8	990.8			990.7	990.7	990.7	990.7			987.6	987.6	987.6	987.6		
Bankfull Width (ft)	25.6	25.4	25.6	22.7			29.1	30.6	26.2	25.8			22.8	22.9	22.9	22.4		
Floodprone Width (ft)	>100	>100	>100	>100			N/A	N/A	N/A	N/A			>100	>100	>100	>100		
Bankfull Mean Depth (ft)	1.7	1.6	1.7	1.8			2.0	2.2	2.0	2.1			1.8	2.0	2.4	2.5		
Bankfull Max Depth (ft)	2.9	2.9	3.2	3.3			4.5	4.9	4.9	4.4			2.7	3.6	4.0	4.0		
Bankfull Cross Sectional Area (ft^2)	43.9	41.8	44.2	39.9			57.6	66.7	64.2	54.9			41.4	45.9	54.6	55.3		
Bankfull Width/Depth Ratio	14.9	15.4	14.8	12.9			14.7	14.1	10.7	12.1			12.6	11.4	9.6	9.1		
Bankfull Entrenchment Ratio	>3.9	>3.9	>3.8	>4.4			N/A	N/A	N/A	N/A			>4.4	>4.4	>4.4	>4.5		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.1		
d50 (mm)	19	23	17	41			N/A	N/A	N/A	N/A			26	29	6.9	1.0		

Hogan Reach 2 (1,085 feet)

	Cross-Section 4 (Pool)						Cross-Section 5 (Riffle)						Cross-Section 6 (Riffle)					
Based on fixed baseline bankfull elevation	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2[1]**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	984.0	984.0	984.0	984.0			983.6	983.6	983.6	983.6			982.1	982.1	982.1	982.1		
Bankfull Width (ft)	44.6	45.5	44	43.2			24.2	24.8	23.6	24.7			24.7	28.1	28.2	28.7		
Floodprone Width (ft)	N/A	N/A	N/A	N/A			>100	>100	>100	>100			>100	>100	>100	>100		
Bankfull Mean Depth (ft)	2.2	2.1	1.6	1.7			1.9	2.0	2.4	2.5			2.3	2.0	2.2	2.1		
Bankfull Max Depth (ft)	4.2	4.3	4.2	4.6			3.2	3.6	3.9	3.6			3.6	3.8	3.9	3.8		
Bankfull Cross Sectional Area (ft^2)	98.9	95.4	69.1	72.5			45.2	49.2	56.6	61			56.6	56.5	61.1	61.4		
Bankfull Width/Depth Ratio	20.1	21.7	28.1	25.7			13.0	12.5	9.8	10			10.8	14.0	13	13.4		
Bankfull Entrenchment Ratio	N/A	N/A	N/A	N/A			>4.1	>4.0	>4.2	>4.0			>4.0	>3.6	>3.5	>3.5		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	0.9		
d50 (mm)	N/A	N/A	N/A	N/A			27	32	6.4	41			31	30	0.18	64		

UT2 (675 feet)

	Cross-Section 7 (Riffle)						Cross-Section 8 (Pool)						Cross-Section 9 (Riffle)					
Based on fixed baseline bankfull elevation	**Base**	**MY1**	**MY2[1]**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**
based on fixed bankfull elevation	989.4	989.4	989.4	989.4			988.2	988.2	988.2	988.2			986.4	986.4	986.4	986.4		
Bankfull Width (ft)	7.6	6.9	7.9	6.2			6.9	7.1	7.1	5.7			6.5	6.8	6.8	5.5		
Floodprone Width (ft)	28.8	29.0	30	29.3			N/A	N/A	N/A	N/A			21.0	20.6	19.2	18.8		
Bankfull Mean Depth (ft)	0.5	0.5	0.6	0.6			0.6	0.7	0.7	0.7			0.7	0.7	0.6	0.5		
Bankfull Max Depth (ft)	0.9	1.0	1.1	1.0			1.0	1.3	1.0	1.3			1.2	1.1	0.9	0.8		
Bankfull Cross Sectional Area (ft^2)	4.0	3.5	4.9	3.5			4.4	5.1	4.7	4.3			4.7	4.6	4.1	2.7		
Bankfull Width/Depth Ratio	14.2	13.6	12.8	10.8			10.7	9.8	10.8	7.7			8.9	10.3	11.3	11.2		
Bankfull Entrenchment Ratio	3.8	4.2	3.8	4.7			N/A	N/A	N/A	N/A			3.2	3.0	2.8	3.4		
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.0			1.0	1.0	1.0	1.1		
d50 (mm)	N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A			N/A	N/A	N/A	N/A		

N/A - Not Applicable

[1]Adjustment in survey points included in bankfull calculations resulting in change to previous monitoring year bankfull dimensions.

Table 13a. Monitoring Data - Stream Reach Data Summary
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Creek-Reach 1 (1,532 feet)

Parameter	Baseline						MY1						MY2						MY3						MY4						MY5					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	22.8	24.2	24.2	25.6	N/A	2	22.9	24.2	24.2	25.4	N/A	2	22.9	24.25	24.25	25.6	N/A	2	22.4	22.6	22.6	22.7	N/A	2												
Floodprone Width (ft)	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2												
Bankfull Mean Depth (ft)	1.7	1.8	1.8	1.8	N/A	2	1.6	1.8	1.8	2.0	N/A	2	1.7	2.1	2.1	2.4	N/A	2	1.8	2.2	2.2	2.5	N/A	2												
Bankfull Max Depth (ft)	2.7	2.8	2.8	2.9	N/A	2	2.9	3.3	3.3	3.6	N/A	2	3.2	3.6	3.6	4	N/A	2	3.3	3.7	3.7	4.0	N/A	2												
Bankfull Cross Sectional Area (ft^2)	41.4	42.7	42.7	43.9	N/A	2	41.8	43.9	43.9	45.9	N/A	2	44.2	49.4	49.4	54.6	N/A	2	39.9	47.6	47.6	55.3	N/A	2												
Width/Depth Ratio	12.6	13.8	13.8	14.9	N/A	2	11.4	13.4	13.4	15.4	N/A	2	9.6	12.2	12.2	14.8	N/A	2	9.1	11.0	11.0	12.9	N/A	2												
Entrenchment Ratio	>3.9	>4.2	>4.2	>4.4	N/A	2	>3.9	>4.2	>4.2	>4.4	N/A	2	>3.8	>4.1	>4.1	>4.4	N/A	2	>4.4	>4.45	>4.45	>4.5	N/A	2												
Bank Height Ratio	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1.0	1.1	1.1	1.1	N/A	2												
Profile																																				
Riffle Length (ft)	37.17	58.9	-	98.4	-	8	15.0	62.1	73.5	98.0	-	8	11.7	23.2	23.6	38	-	10	10.1	29.0	26.1	53.3	-	10												
Riffle Slope (ft/ft)	0.002	0.010	-	0.018	-	8	0.006	0.013	0.011	0.020	-	8	0.011	0.05	0.022	0.057	-	10	0.011	0.029	0.022	0.072	-	10												
Pool Length (ft)	25.0	62.6	-	88.0	-	13	20.0	67.1	76.0	105.0	-	13	30.87	85.3	89.5	140.8	-	13	32.4	100.7	115.4	170.7	-	12												
Pool Max depth (ft)	2.5	3.2	-	4.1	-	13	2.8	3.7	3.4	4.8	-	13	2.3	3.7	3.6	5.1	-	13	2.4	3.8	3.8	5.8	-	12												
Pool Spacing (ft)	73.3	120.9	-	200.1	-	12	52.0	112.8	111.0	148.0	-	12	57	110.1	103	204.0	-	12	46.9	122.5	120.9	180.5	-	11												
Pattern																																				
Channel Beltwidth (ft)	63.0	96.5	101.0	121.0	24.9	4																														
Radius of Curvature (ft)	70.0	76.5	75.0	86.0	6.8	4																														
Rc:Bankfull width (ft/ft)	2.9	3.2	3.1	3.6	N/A	N/A																														
Meander Wavelength (ft)	165.0	263.7	306.0	320.0	85.7	3																														
Meander Width Ratio	2.6	4.0	4.2	5.0	N/A	N/A																														
Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4																	
Channel Thalweg length (ft)	1,532						1,530						1,532						1,532																	
Sinuosity (ft)	1.18						1.18						1.18						1.18																	
Water Surface Slope (Channel) (ft/ft)	0.0063						0.0064						0.007						0.0064																	
BF slope (ft/ft)	0.0067						0.0069						0.0069						0.0068																	
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
SC% / Sa% / G% / C% / B% / Be%	0%	3.5%	96%	0.5%	0%	0%	0%	0.5%	98%	1.5%	0%	0%	13%	21.0%	64%	3.0%	0%	0%	12%	20%	53%	14.5%	0.5%	0%												
d16 / d35 / d50 / d84 / d95 /	14	19	23	41	56		13	21	27	44	62		0.19	6.1	10	33	50		0.20	5.6	21	63	139													
% of Reach with Eroding Banks	0%						7%						9%						9%																	
Channel Stability or Habitat Metric																																				
Biological or Other																																				

N/A - Not Applicable
- Information Unavailable

Table 13b. Monitoring Data - Stream Reach Data Summary
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Creek-Reach 2 (1,085 feet)

Parameter	Baseline						MY1						MY2						MY3						MY4						MY5					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	24.2	24.5	24.5	24.7	N/A	2	24.8	26.5	26.5	28.1	N/A	2	23.6	25.9	25.9	28.2	N/A	2	24.7	26.7	26.7	28.7	N/A	2												
Floodprone Width (ft)	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2	>100	>100	>100	>100	N/A	2												
Bankfull Mean Depth (ft)	1.9	2.1	2.1	2.3	N/A	2	2.0	2.0	2.0	2.0	N/A	2	2.2	2.3	2.3	2.4	N/A	2	2.1	2.3	2.3	2.5	N/A	2												
Bankfull Max Depth (ft)	3.2	3.4	3.4	3.6	N/A	2	3.6	3.7	3.7	3.8	N/A	2	3.9	3.9	3.9	3.9	N/A	2	3.6	3.7	3.7	3.8	N/A	2												
Bankfull Cross Sectional Area (ft^2)	45.2	50.9	50.9	56.6	N/A	2	49.2	52.9	52.9	56.5	N/A	2	56.6	58.9	58.9	61.1	N/A	2	61.0	61.2	61.2	61.4	N/A	2												
Width/Depth Ratio	10.8	11.9	11.9	13.0	N/A	2	12.5	13.3	13.3	14.0	N/A	2	9.8	11.4	11.4	13.0	N/A	2	10.0	11.7	11.7	13.4	N/A	2												
Entrenchment Ratio	>4.0	>4.1	>4.1	>4.1	N/A	2	>3.6	>3.8	>3.8	>4.0	N/A	2	>3.5	>3.75	>3.75	>4.0	N/A	2	>3.5	>3.75	>3.75	>4.0	N/A	2												
Bank Height Ratio	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	0.9	1.0	1.0	1.0	N/A	2												
Profile																																				
Riffle Length (ft)	95.6	111.6	-	130.3	-	5	56.0	91.0	101.0	125.0	-	5	24.7	51.8	46.9	97.6	-	5	19.6	46.3	43.2	68.2	-	5												
Riffle Slope (ft/ft)	0.004	0.005	-	0.007	-	5	0.004	0.009	0.007	0.018	-	5	0.008	0.012	0.01	0.017	-	5	0.006	0.009	0.007	0.014	-	5												
Pool Length (ft)	43.7	68.8	-	117.1	-	5	60.0	87.3	64.0	135.0	-	5	29.91	74.4	75.4	107.0	-	5	54.0	71.1	58.1	117.1	-	5												
Pool Max depth (ft)	3.8	4.7	-	5.8	-	5	4.0	4.8	4.6	5.7	-	5	3.77	4.4	4.4	5.4	-	5	3.5	4.5	4.4	6.0	-	5												
Pool Spacing (ft)	164.1	208.4	-	253.1	-	4	169.0	196.5	189.5	238.0	-	4	93.7	134.2	129.4	201.0	-	4	76.8	140.8	142.6	201.3	-	4												
Pattern																																				
Channel Beltwidth (ft)	84.0	114.0	117.0	141.0	28.6	3																														
Radius of Curvature (ft)	69.0	73.3	74.0	75.0	2.8	5																														
Rc:Bankfull width (ft/ft)	2.8	3.0	3.0	3.1	N/A	N/A																														
Meander Wavelength (ft)	292.0	307.0	301.0	328.0	18.7	3																														
Meander Width Ratio	3.4	4.7	4.8	5.8	N/A	N/A																														
Additional Reach Parameters																																				
Rosgen Classification	C4						C4						C4						C4																	
Channel Thalweg length (ft)	1,085						1,085						1,085						1,085																	
Sinuosity (ft)	1.37						1.37						1.37						1.37																	
Water Surface Slope (Channel) (ft/ft)	0.0050						0.0045						0.005						0.0054																	
BF slope (ft/ft)	0.0053						0.0053						0.0053						0.0057																	
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
SC% / Sa% / G% / C% / B% / Be%	0%	3%	9%	89%	0%	0%	0%	0%	99%	1%	0%	0%	17%	50.0%	31%	2.0%	0%	0%	0%	13.0%	51%	32%	4%	0%												
d16 / d35 / d50 / d84 / d95 /	13	24	22	35	49		18	25	31	52	70		0.062	0.16	0.3	17	40		7.1	31	46	138	243												
% of Reach with Eroding Banks	0%						2%						13%						6%																	
Channel Stability or Habitat Metric																																				
Biological or Other																																				

N/A - Not Applicable
- Information Unavailable

Table 13c. Monitoring Data - Stream Reach Data Summary
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

UT2 (675 feet)

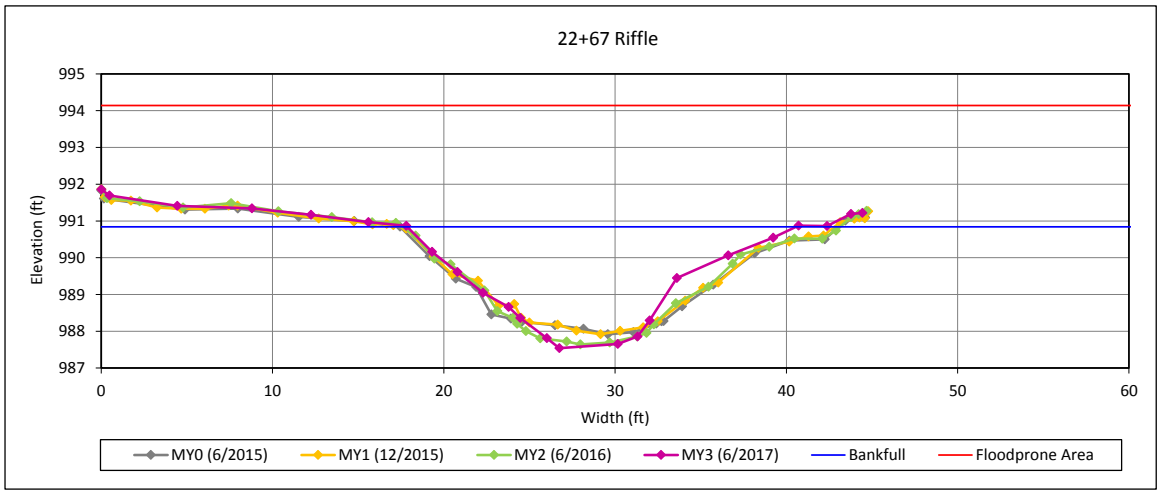
Parameter	Baseline						MY1						MY2						MY3						MY4						MY5					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	6.5	7.1	7.1	7.6	N/A	2	6.8	6.9	6.9	6.9	N/A	2	6.8	7.4	7.4	7.9	N/A	2	5.5	5.85	5.85	6.2	N/A	2												
Floodprone Width (ft)	21	24.9	24.9	28.8	N/A	2	20.6	24.8	24.8	29.0	N/A	2	19.2	24.6	24.6	30	N/A	2	18.8	24.05	24.05	29.3	N/A	2												
Bankfull Mean Depth (ft)	0.5	0.6	0.6	0.7	N/A	2	0.5	0.6	0.6	0.7	N/A	2	0.6	0.6	0.6	0.6	N/A	2	0.5	0.55	0.55	0.6	N/A	2												
Bankfull Max Depth (ft)	0.9	1.1	1.1	1.2	N/A	2	1.0	1.1	1.1	1.1	N/A	2	0.9	1.0	1.0	1.1	N/A	2	0.8	0.9	0.9	1	N/A	2												
Bankfull Cross Sectional Area (ft^2)	4.0	4.4	4.4	4.7	N/A	2	3.5	4.1	4.1	4.6	N/A	2	4.1	4.5	4.5	4.9	N/A	2	2.7	3.1	3.1	3.5	N/A	2												
Width/Depth Ratio	8.9	11.6	11.6	14.2	N/A	2	10.3	12.0	12.0	13.6	N/A	2	11.3	12.1	12.1	12.8	N/A	2	10.8	11	11	11.2	N/A	2												
Entrenchment Ratio	3.2	3.5	3.5	3.8	N/A	2	3.0	3.6	3.6	4.2	N/A	2	2.8	3.3	3.3	3.8	N/A	2	3.4	4.05	4.05	4.7	N/A	2												
Bank Height Ratio	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1.0	1.0	1.0	1.0	N/A	2	1	1.05	1.05	1.1	N/A	2												
Profile																																				
Riffle Length (ft)	14.3	34.4	-	67.3	-	11	12.0	28.9	29.0	62.0	-	11	7.88	29.3	25.6	69.8	-	11	12.4	26.8	24.4	45.9	-	11												
Riffle Slope (ft/ft)	0.014	0.028	-	0.052	-	11	0.014	0.026	0.024	0.050	-	11	0.012	0.041	0.030	0.099	-	11	0.011	0.036	0.032	0.071	-	11												
Pool Length (ft)	4.2	11.0	-	27.1	-	12	7.0	13.3	12.0	28.0	-	13	7.07	17.2	13.7	50.4	-	13	7.9	19.5	19.4	35.6	-	10												
Pool Max depth (ft)	1.2	2.0	-	3.2	-	12	1.1	1.7	1.7	2.4	-	13	1.14	1.7	1.7	2.3	-	13	1.0	1.8	1.9	2.8	-	10												
Pool Spacing (ft)	13.1	54.8	-	151.0	-	11	8.0	50.4	43.5	145.0	-	12	11.9	47.8	35.9	137.8	-	12	22.1	57.6	48.6	134.3	-	9												
Pattern																																				
Channel Beltwidth (ft)	26.0	38.0	39.0	54.0	2.7	5																														
Radius of Curvature (ft)	19.0	21.6	22.0	26.0	2.4	6																														
Rc:Bankfull width (ft/ft)	2.7	3.0	3.1	3.7	N/A	N/A																														
Meander Wavelength (ft)	101.0	112.3	109.5	132.0	2.7	6																														
Meander Width Ratio	3.7	5.4	5.5	7.6	N/A	N/A																														
Additional Reach Parameters																																				
Rosgen Classification	B4						B4						B4						B4																	
Channel Thalweg length (ft)	675						670						675						675																	
Sinuosity (ft)	1.24						1.24						1.24						1.24																	
Water Surface Slope (Channel) (ft/ft)	0.0218						0.0208						0.0215						0.0205																	
BF slope (ft/ft)	0.0229						0.0226						0.0224						0.0222																	
Ri% / Ru% / P% / G% / S%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-												
SC% / Sa% / G% / C% / B% / Be%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-													
d16 / d35 / d50 / d84 / d95 /		-	-	-	-			-	-	-	-		-	-	-	-	-		-	-	-	-	-													
% of Reach with Eroding Banks	0%						0%						0%						0%																	
Channel Stability or Habitat Metric																																				
Biological or Other																																				

N/A - Not Applicable
- Information Unavailable

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 1-Hogan Creek Reach 1



Bankfull Dimensions	
39.9	x-section area (ft.sq.)
22.7	width (ft)
1.8	mean depth (ft)
3.3	max depth (ft)
24.0	wetted perimeter (ft)
1.7	hydraulic radius (ft)
12.9	width-depth ratio
100.0	W flood prone area (ft)
4.4	entrenchment ratio
1.0	low bank height ratio

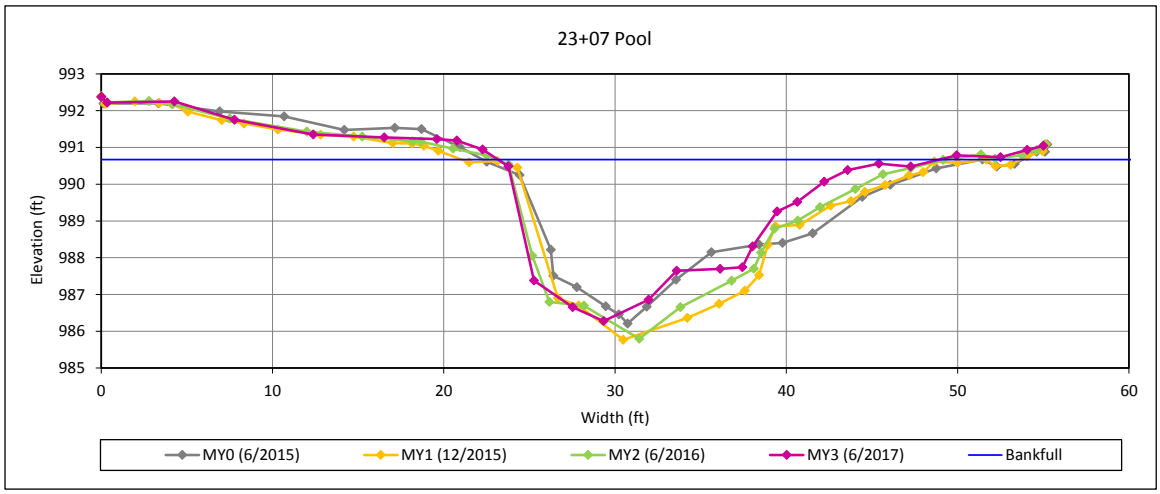
Survey Date: 06/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 2-Hogan Creek Reach 1



Bankfull Dimensions	
54.9	x-section area (ft.sq.)
25.8	width (ft)
2.1	mean depth (ft)
4.4	max depth (ft)
28.8	wetted perimeter (ft)
1.9	hydraulic radius (ft)
12.1	width-depth ratio

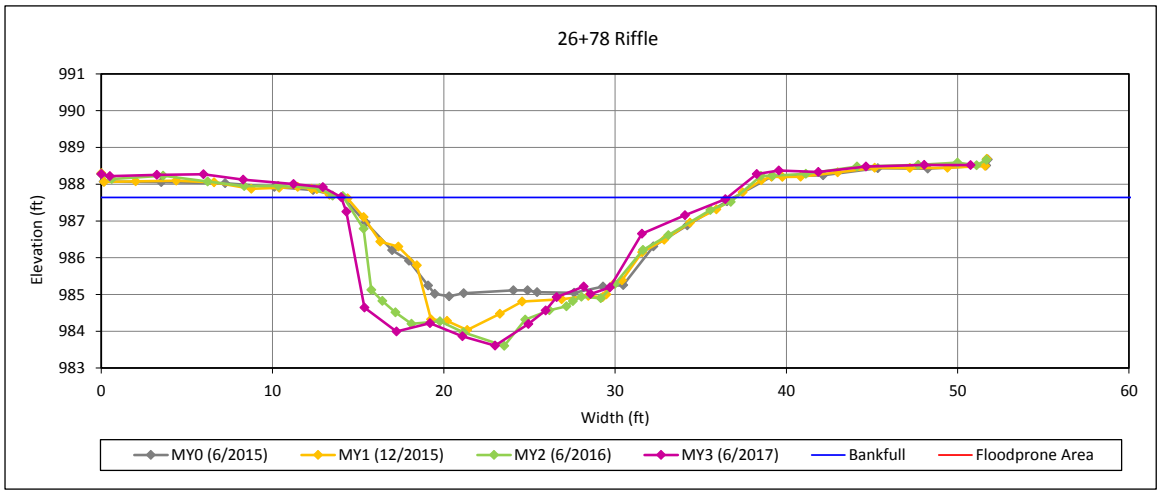
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 3-Hogan Creek Reach 1



Bankfull Dimensions	
55.3	x-section area (ft.sq.)
22.4	width (ft)
2.5	mean depth (ft)
4.0	max depth (ft)
25.5	wetted perimeter (ft)
2.2	hydraulic radius (ft)
9.1	width-depth ratio
100.0	W flood prone area (ft)
4.5	entrenchment ratio
1.1	low bank height ratio

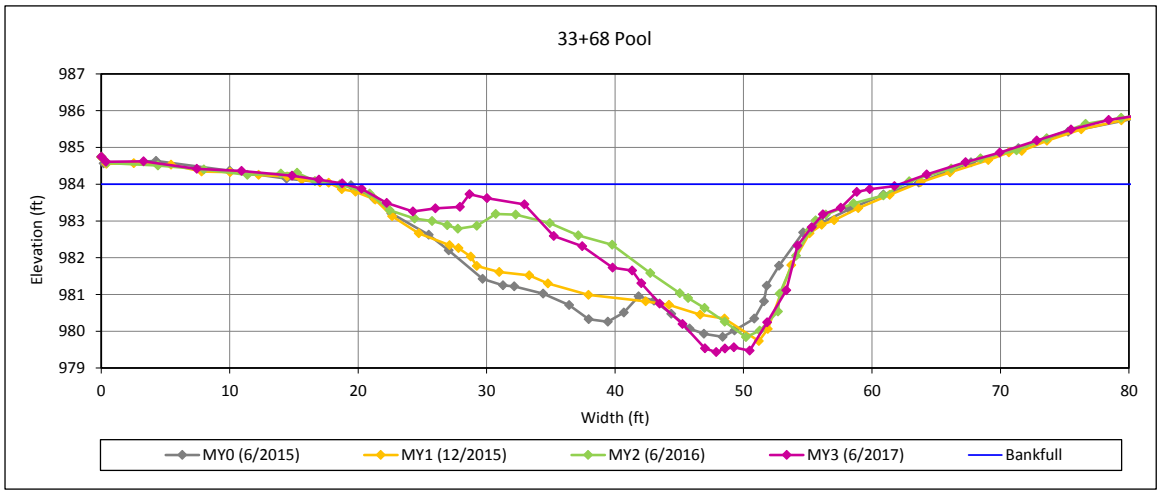
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 4-Hogan Creek Reach 2



Bankfull Dimensions	
72.5	x-section area (ft.sq.)
43.2	width (ft)
1.7	mean depth (ft)
4.6	max depth (ft)
45.3	wetted perimeter (ft)
1.6	hydraulic radius (ft)
25.7	width-depth ratio

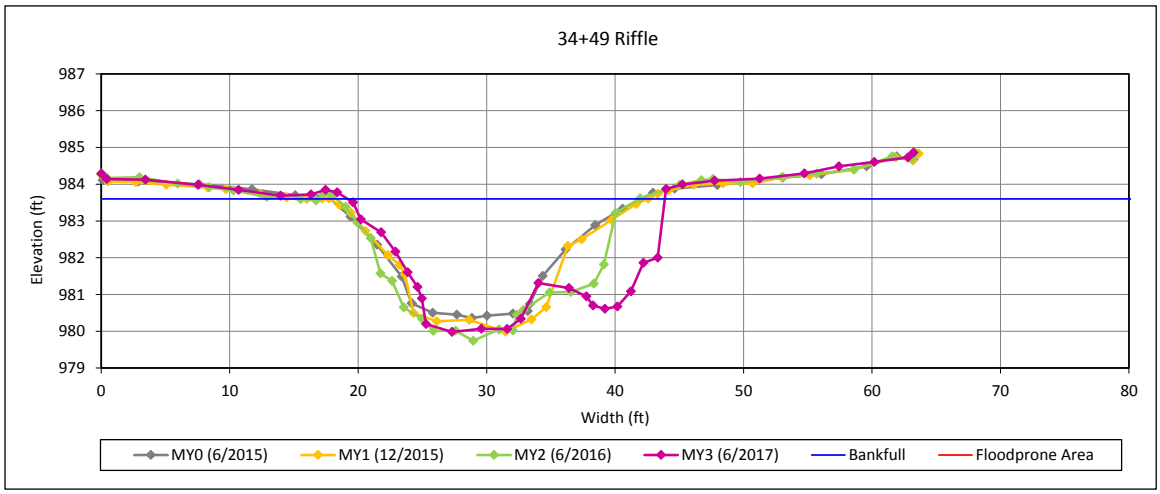
Survey Date: 06/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 5-Hogan Creek Reach 2



Bankfull Dimensions	
61.0	x-section area (ft.sq.)
24.7	width (ft)
2.5	mean depth (ft)
3.6	max depth (ft)
27.8	wetted perimeter (ft)
2.2	hydraulic radius (ft)
10.0	width-depth ratio
100.0	W flood prone area (ft)
4.0	entrenchment ratio
1.0	low bank height ratio

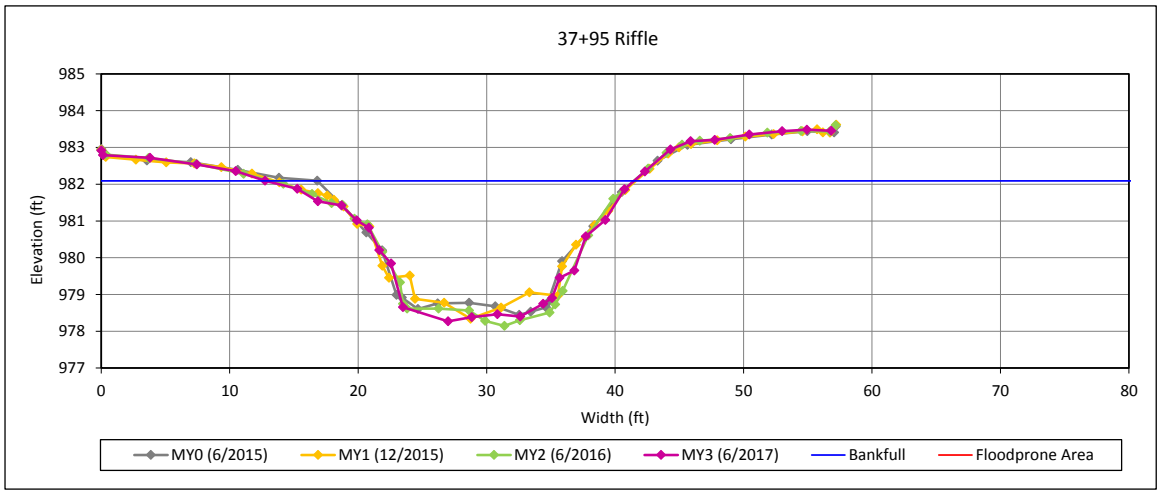
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 6-Hogan Creek Reach 2



Bankfull Dimensions	
61.4	x-section area (ft.sq.)
28.7	width (ft)
2.1	mean depth (ft)
3.8	max depth (ft)
30.7	wetted perimeter (ft)
2.0	hydraulic radius (ft)
13.4	width-depth ratio
100.0	W flood prone area (ft)
3.5	entrenchment ratio
0.9	low bank height ratio

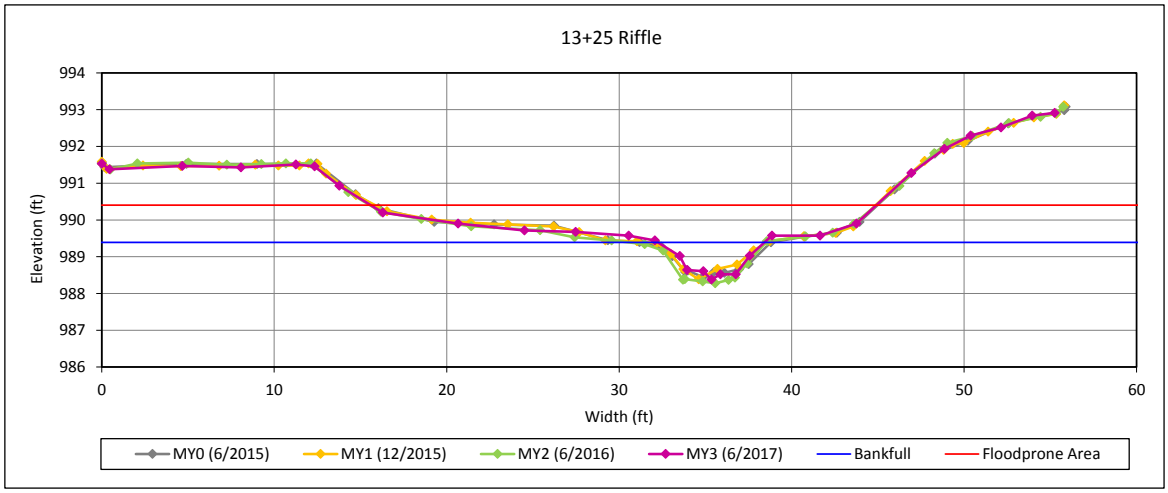
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 7-UT2



Bankfull Dimensions	
3.5	x-section area (ft.sq.)
6.2	width (ft)
0.6	mean depth (ft)
1.0	max depth (ft)
6.7	wetted perimeter (ft)
0.5	hydraulic radius (ft)
10.8	width-depth ratio
29.3	W flood prone area (ft)
4.7	entrenchment ratio
1.0	low bank height ratio

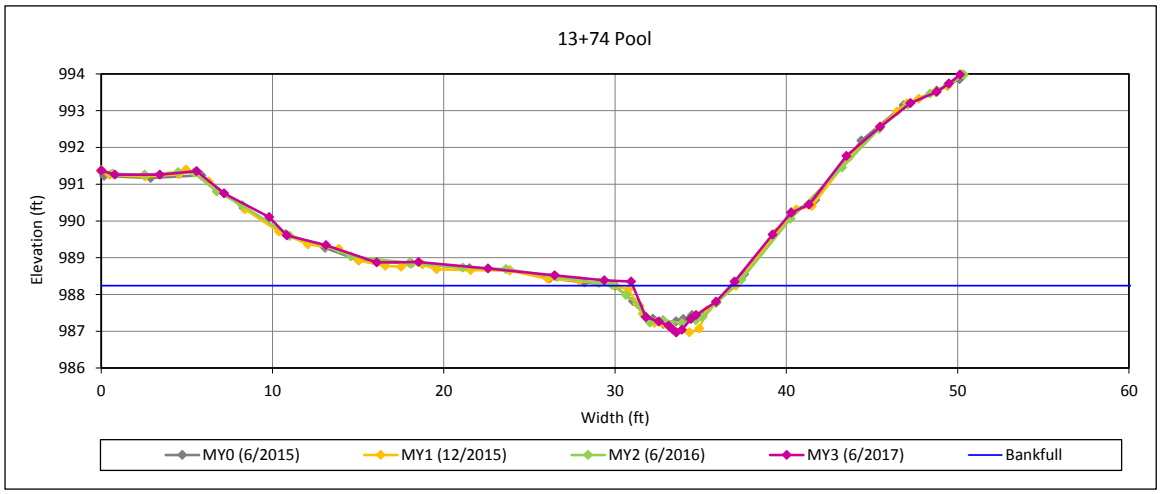
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 8-UT2



Bankfull Dimensions	
4.3	x-section area (ft.sq.)
5.7	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
6.4	wetted perimeter (ft)
0.7	hydraulic radius (ft)
7.7	width-depth ratio

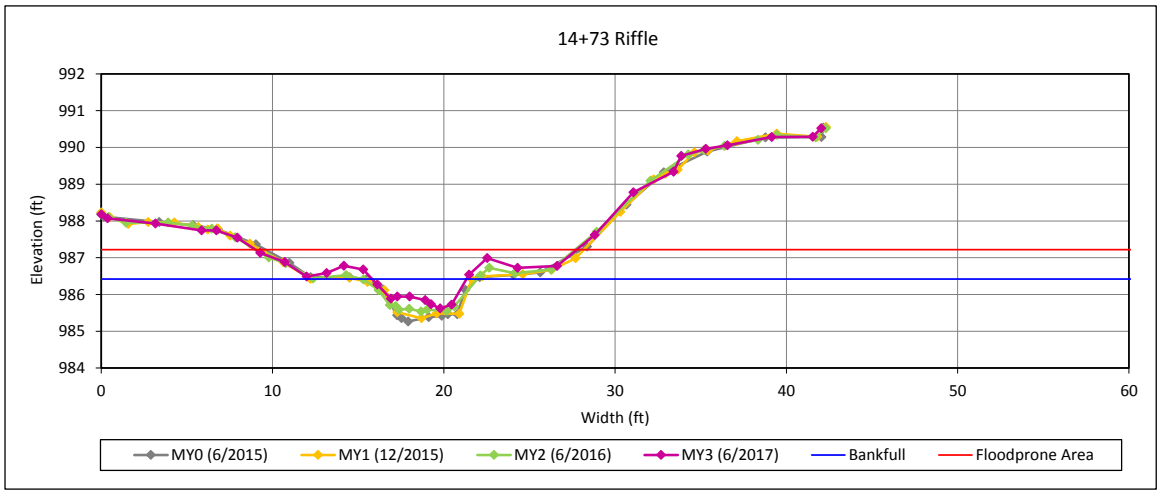
Survey Date: 6/2017
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 3 - 2017

Cross-Section 9-UT2



Bankfull Dimensions	
2.7	x-section area (ft.sq.)
5.5	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
5.9	wetted perimeter (ft)
0.5	hydraulic radius (ft)
11.2	width-depth ratio
18.8	W flood prone area (ft)
3.4	entrenchment ratio
1.1	low bank height ratio

Survey Date: 06/2017
Field Crew: Kee Mapping & Surveying

View Downstream

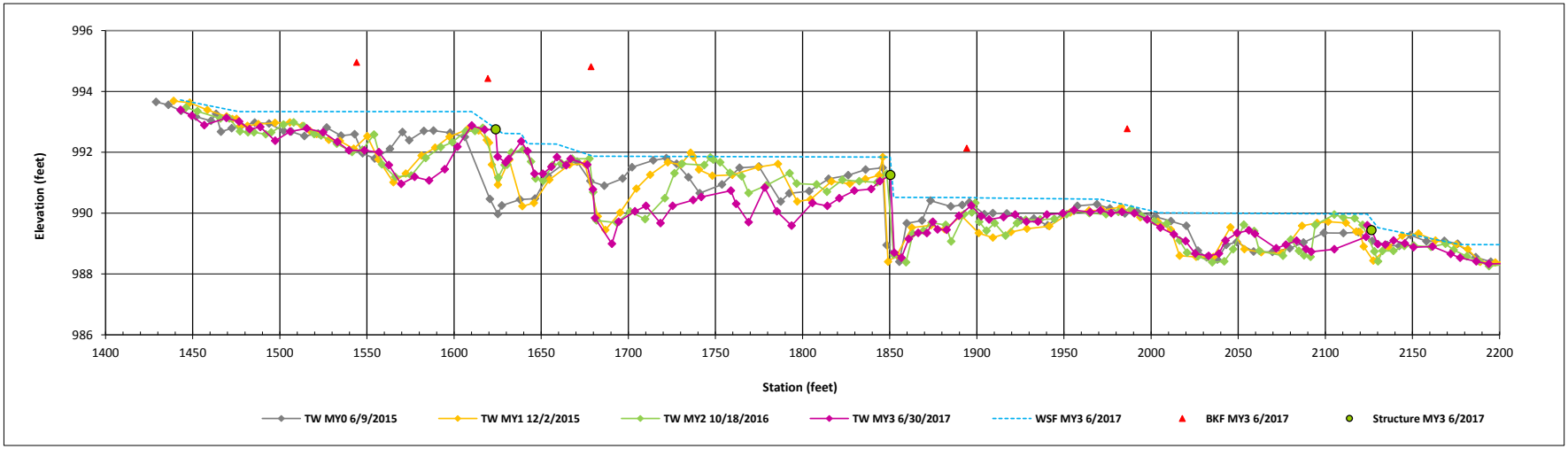
Longitudinal Profile Plots

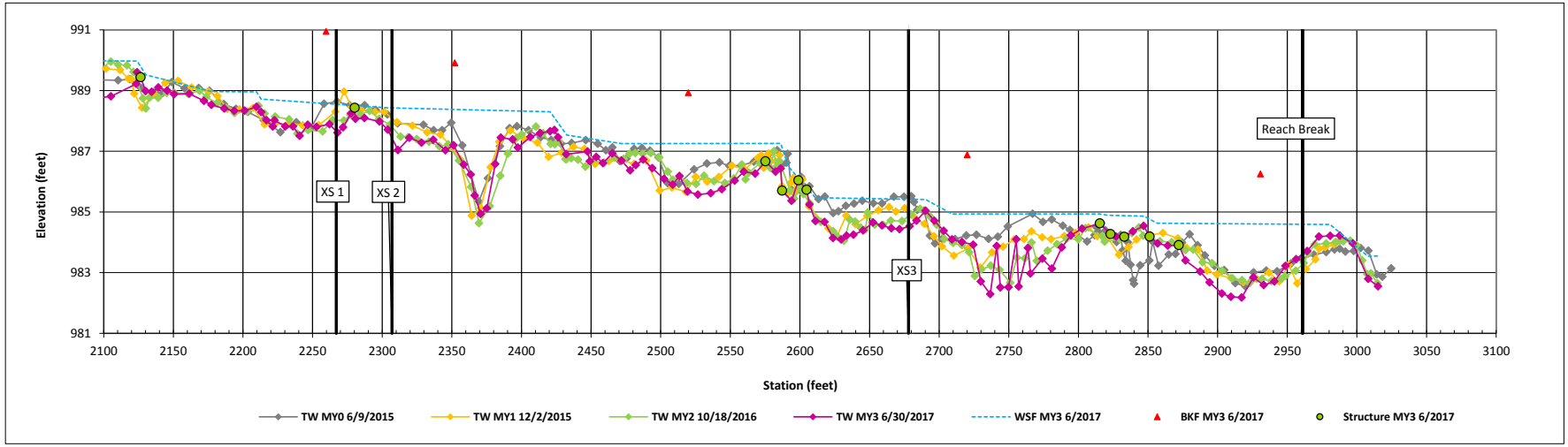
Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 3 - 2017

Hogan Creek Reach 1 (STA 14+29 - STA 29+61)





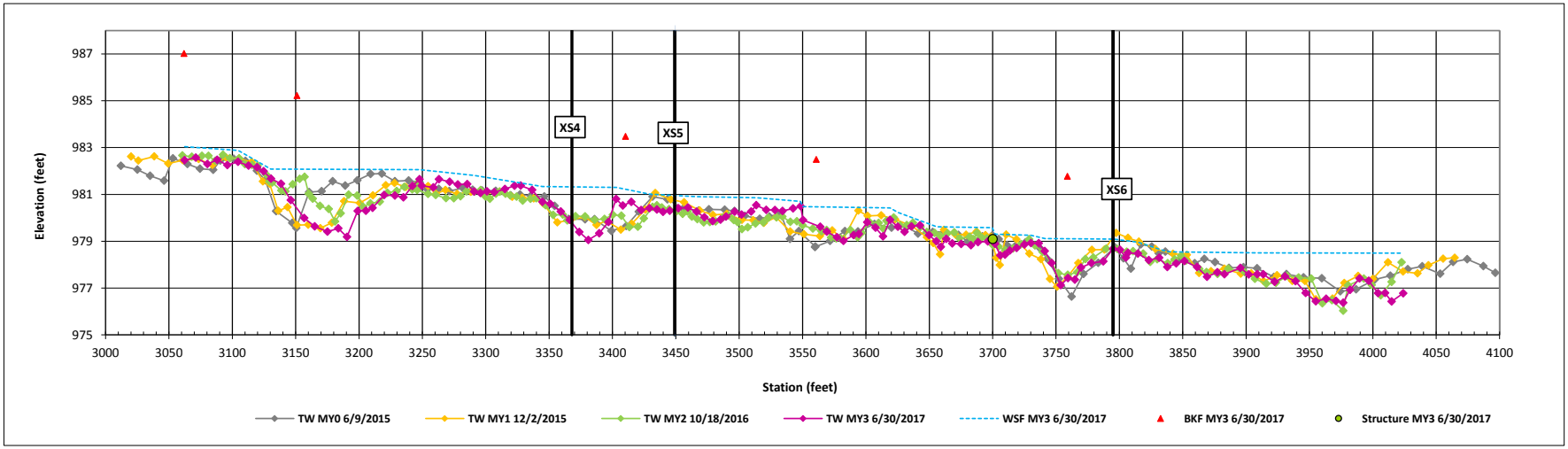
Longitudinal Profile Plots

Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 3 - 2017

Hogan Creek Reach 2 (STA 30+11 - STA 40+96)



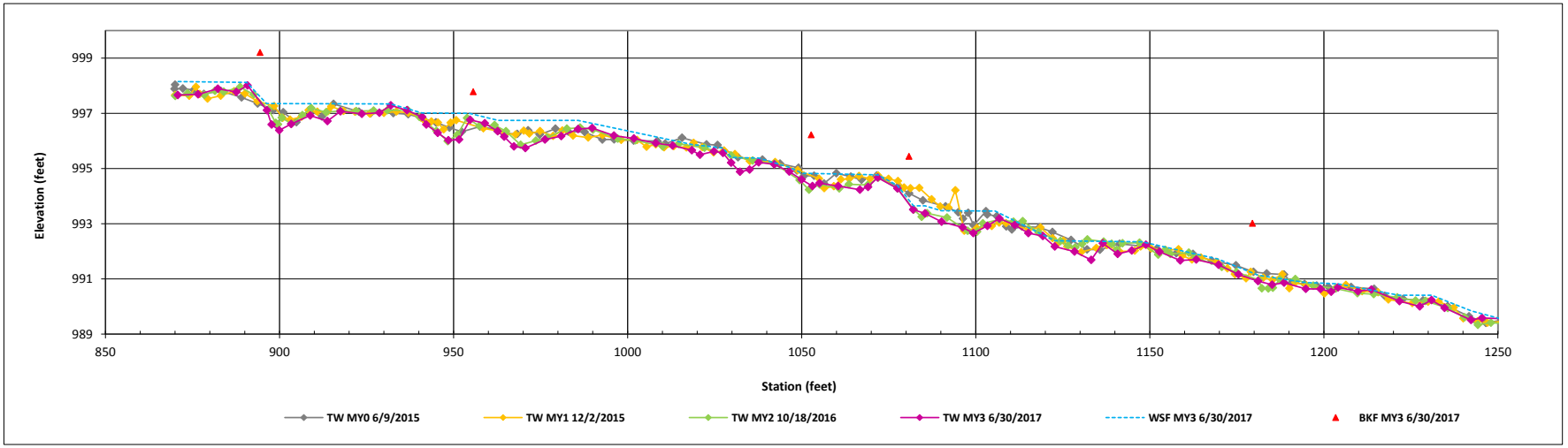
Longitudinal Profile Plots

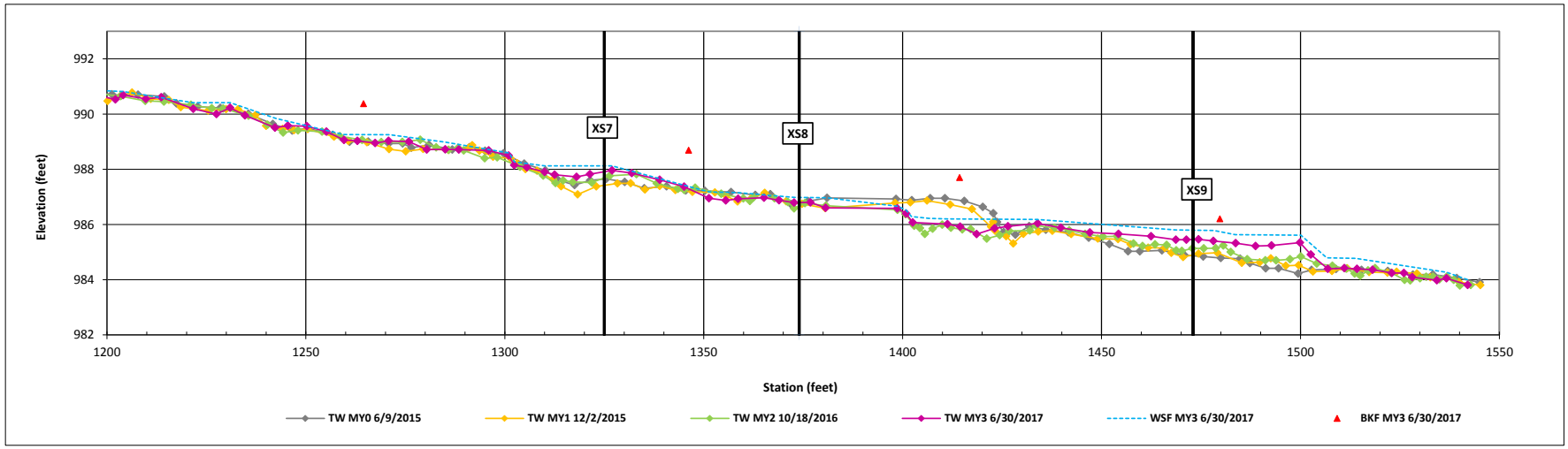
Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 3 - 2017

UT2 (STA 8+70 - STA 15+45)





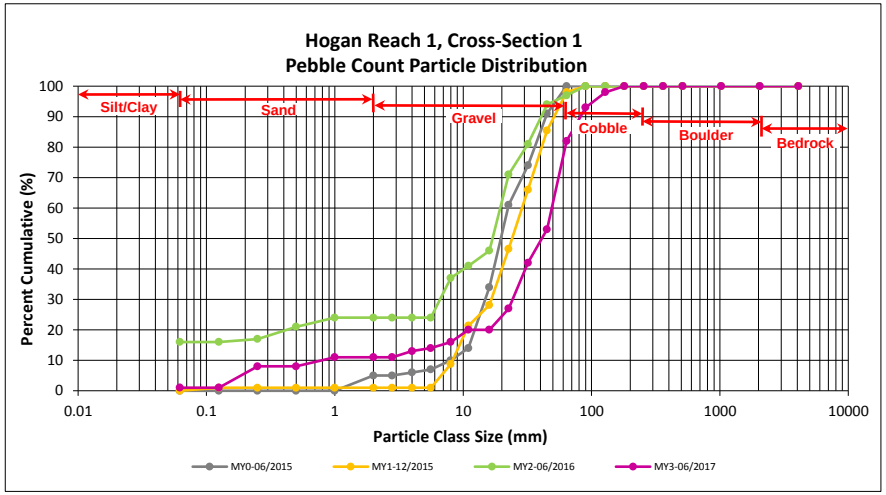
Cross-Section Pebble Count Plots

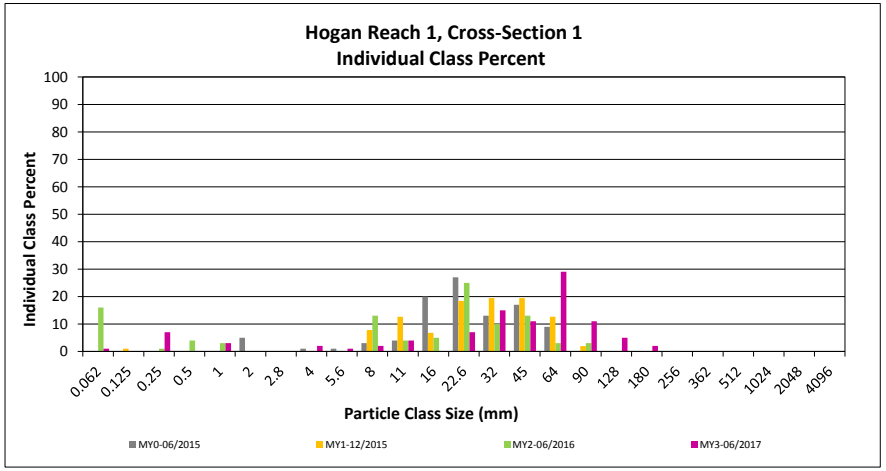
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Reach 1, Cross-Section 1

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250	7	7	8
	Medium	0.25	0.50			8
	Coarse	0.5	1.0	3	3	11
	Very Coarse	1.0	2.0			11
GRAVEL	Very Fine	2.0	2.8			11
	Very Fine	2.8	4.0	2	2	13
	Fine	4.0	5.6	1	1	14
	Fine	5.6	8.0	2	2	16
	Medium	8.0	11.0	4	4	20
	Medium	11.0	16.0			20
	Coarse	16.0	22.6	7	7	27
	Coarse	22.6	32	15	15	42
	Very Coarse	32	45	11	11	53
	Very Coarse	45	64	29	29	82
COBBLE	Small	64	90	11	11	93
	Small	90	128	5	5	98
	Large	128	180	2	2	100
	Large	180	256			100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 1	
Channel materials (mm)	
D_{16} =	8.00
D_{35} =	27.21
D_{50} =	41.0
D_{84} =	68.1
D_{95} =	103.6
D_{100} =	180.0





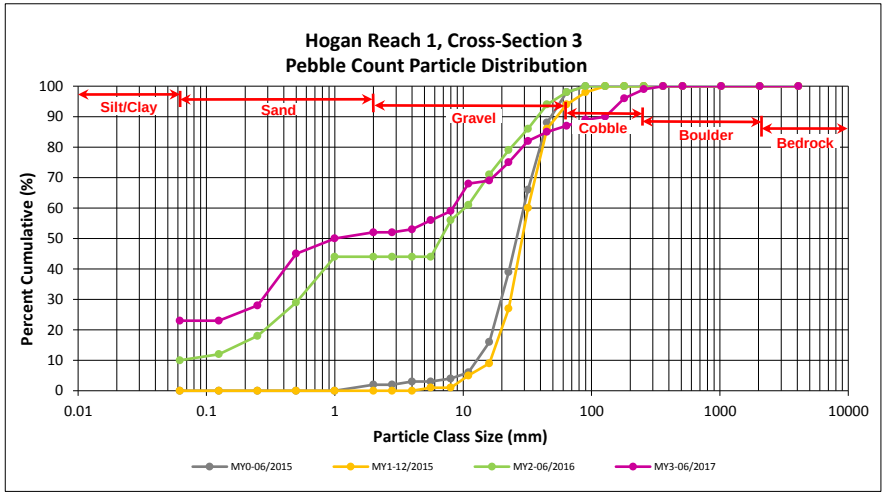
Cross-Section Pebble Count Plots

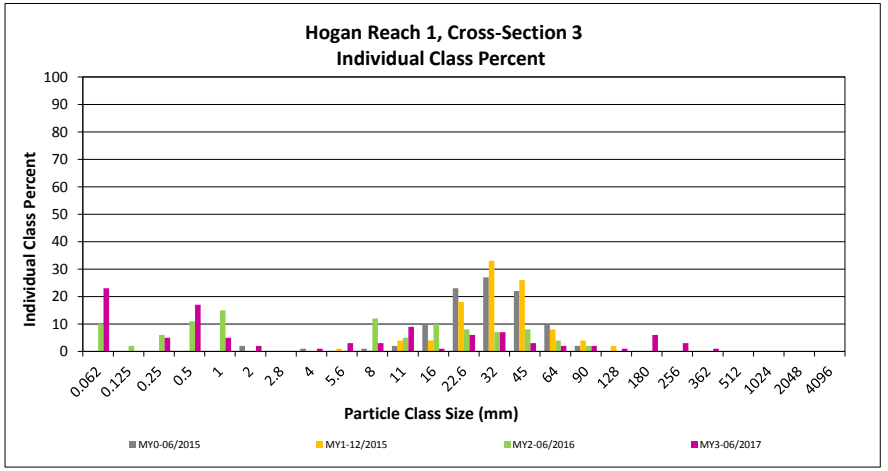
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Reach 1, Cross-Section 3

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	23	23	23
SAND	Very fine	0.062	0.125			23
	Fine	0.125	0.250	5	5	28
	Medium	0.25	0.50	17	17	45
	Coarse	0.5	1.0	5	5	50
	Very Coarse	1.0	2.0	2	2	52
GRAVEL	Very Fine	2.0	2.8			52
	Very Fine	2.8	4.0	1	1	53
	Fine	4.0	5.6	3	3	56
	Fine	5.6	8.0	3	3	59
	Medium	8.0	11.0	9	9	68
	Medium	11.0	16.0	1	1	69
	Coarse	16.0	22.6	6	6	75
	Coarse	22.6	32	7	7	82
	Very Coarse	32	45	3	3	85
	Very Coarse	45	64	2	2	87
COBBLE	Small	64	90	2	2	89
	Small	90	128	1	1	90
	Large	128	180	6	6	96
	Large	180	256	3	3	99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 3	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	0.33
D_{50} =	1.0
D_{84} =	40.2
D_{95} =	170.1
D_{100} =	362.0





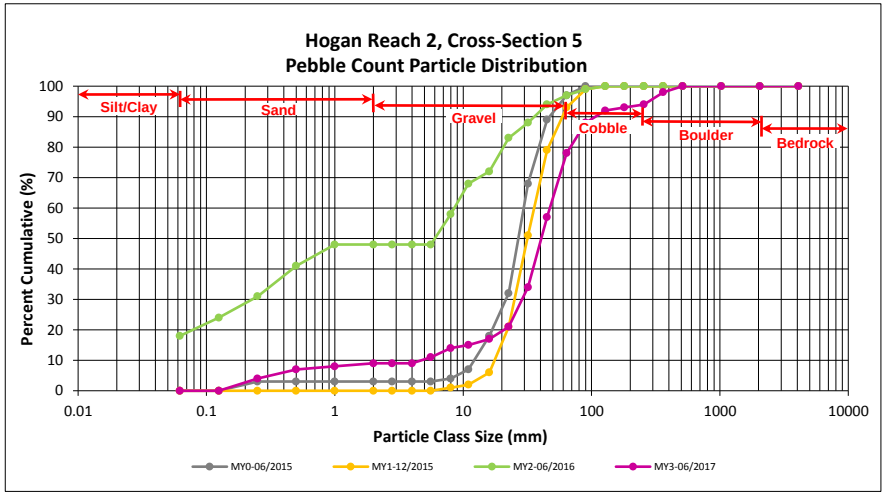
Cross-Section Pebble Count Plots

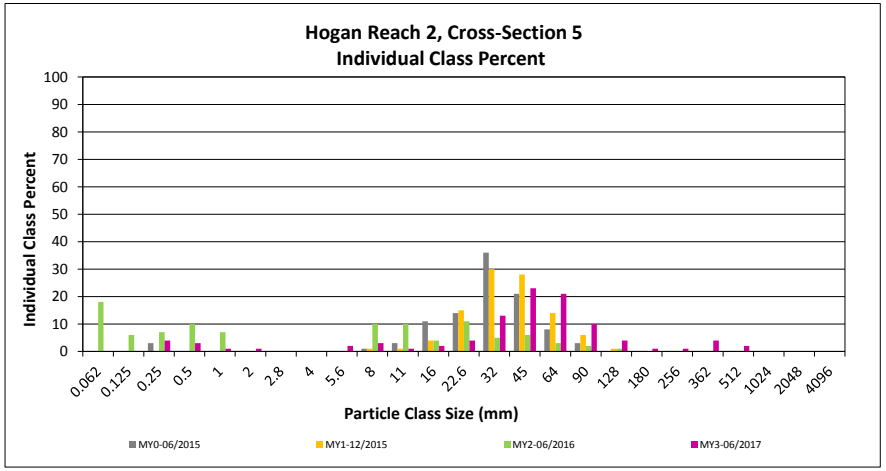
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Reach 2, Cross-Section 5

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	4	4	4
	Medium	0.25	0.50	3	3	7
	Coarse	0.5	1.0	1	1	8
	Very Coarse	1.0	2.0	1	1	9
GRAVEL	Very Fine	2.0	2.8			9
	Very Fine	2.8	4.0			9
	Fine	4.0	5.6	2	2	11
	Fine	5.6	8.0	3	3	14
	Medium	8.0	11.0	1	1	15
	Medium	11.0	16.0	2	2	17
	Coarse	16.0	22.6	4	4	21
	Coarse	22.6	32	13	13	34
	Very Coarse	32	45	23	23	57
	Very Coarse	45	64	21	21	78
COBBLE	Small	64	90	10	10	88
	Small	90	128	4	4	92
	Large	128	180	1	1	93
	Large	180	256	1	1	94
BOULDER	Small	256	362	4	4	98
	Small	362	512	2	2	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 5	
Channel materials (mm)	
D_{16} =	13.27
D_{35} =	32.48
D_{50} =	40.6
D_{84} =	78.5
D_{95} =	279.2
D_{100} =	512.0





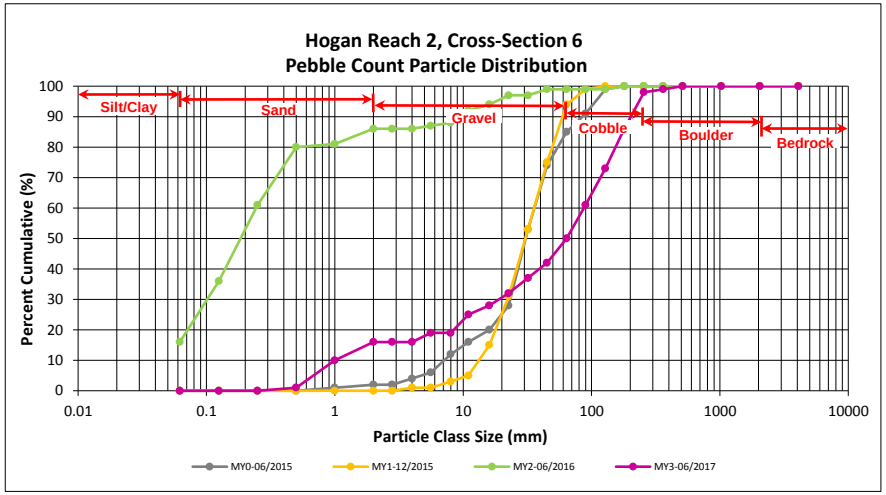
Cross-Section Pebble Count Plots

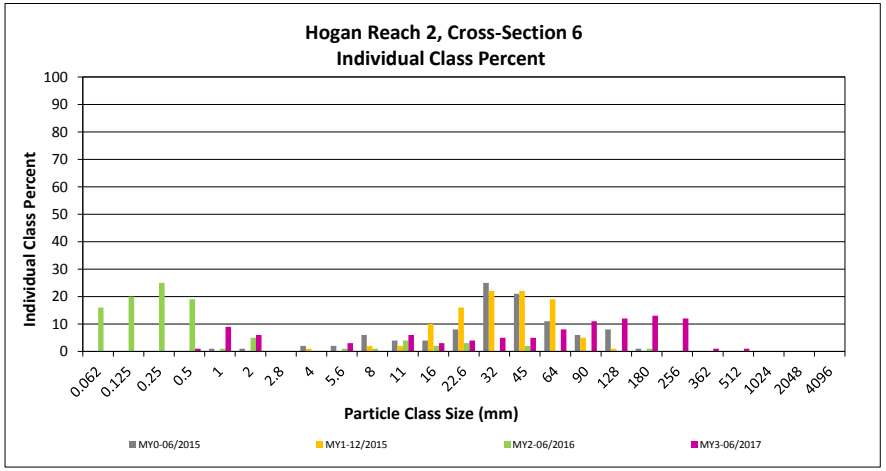
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 3 - 2017

Hogan Reach 2, Cross-Section 6

Particle Class		Diameter (mm) min	Diameter (mm) max	Riffle 100-Count	Summary: Class Percentage	Summary: Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250			0
	Medium	0.25	0.50	1	1	1
	Coarse	0.5	1.0	9	9	10
	Very Coarse	1.0	2.0	6	6	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6	3	3	19
	Fine	5.6	8.0			19
	Medium	8.0	11.0	6	6	25
	Medium	11.0	16.0	3	3	28
	Coarse	16.0	22.6	4	4	32
	Coarse	22.6	32	5	5	37
	Very Coarse	32	45	5	5	42
	Very Coarse	45	64	8	8	50
COBBLE	Small	64	90	11	11	61
	Small	90	128	12	12	73
	Large	128	180	13	13	86
	Large	180	256	12	12	98
BOULDER	Small	256	362	1	1	99
	Small	362	512	1	1	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 6	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	27.84
D_{50} =	64.0
D_{84} =	170.8
D_{95} =	234.4
D_{100} =	512.0





APPENDIX E. Hydrology Summary Data and Plots

Table 14. Verification of Bankfull Events

Hogan Creek Stream Mitigation Project

DMS Project No.94708

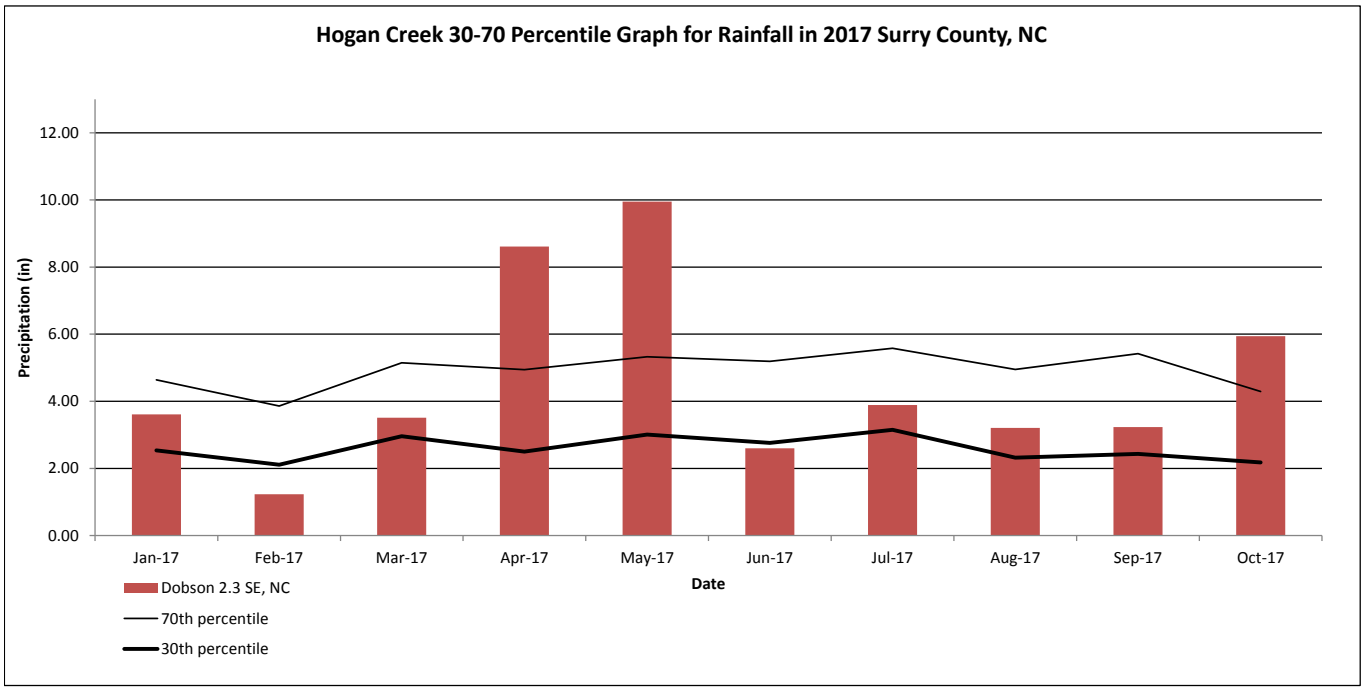
Monitoring Year 3 - 2017

Reach	Monitoring Year	Date of Data Collection	Date of Occurrence	Method
Hogan Creek Reach 2*	MY1	10/26/2015	10/2/2015-10/3/2015	Crest Gage
UT2	MY1	10/26/2015	10/2/2015-10/3/2015	Crest Gage
UT2 & Hogan Creek Reach 2	MY2	4/12/2016	4/1/2016-4/12/2016	Wrack Lines/Sediment Deposition
UT2	MY2	8/2/2016	~ 6/16/2016	Crest Gage
Hogan Creek Reach 2	MY3	7/5/2017	~5/22/2017-5/23/2017	Wrack Lines
UT2	MY3	7/5/2017	~5/22/2017-5/23/2017	Crest Gage/Wrack Lines

*Crest Gage was damaged from bankfull event

Monthly Rainfall Data

Hogan Creek Stream Mitigation Project
DMS Project No.94708
Monitoring Year 3 - 2017



[1] 2017 rainfall collected from NC CRONOS Station Name: Dobson 2.3 SE, NC (NCSU, 2017)

[2] 30th and 70th percentile rainfall data collected from weather station ELKIN, NC (USDA, 2017)