MONITORING YEAR 4 ANNUAL REPORT

Final

HOGAN CREEK STREAM MITIGATION PROJECT

Surry County, NC
DEQ Contract 6496
DMS Project Number 94708

DWR # 20120182
USACE Action ID SAW-2011-02268

Data Collection Period: April-October 2018
Submission Date: December 5, 2018

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
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PREPARED BY:

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December 5, 2018

Mr. Matthew Reid
Western Project Manager
Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Hogan Creek Stream Mitigation Project
Yadkin River Basin – CU# 03040101
Surry County, North Carolina
NCEEP Project # 94708
Contract No. 6496

Dear Mr. Reid:

Wildlands Engineering, Inc. (Wildlands) has reviewed the Division of Mitigation Services (DMS) comments from the Draft Monitoring Year 4 report for the Hogan Creek Stream Mitigation Project. The following Wildlands responses to DMS's report comments are noted in italics lettering.

DMS comment; Please update last sentence in Executive Summary. The adaptive management measures scheduled to repair Hogan Creek Reach 1 and Reach 2 will occur in January 2019.

Wildlands response; Text in the Executive Summary has been updated to indicate that site repairs are scheduled to occur in January 2019.

DMS comment; 1.2.2 Vegetation Areas of Concern: DMS has contracted with a provider for invasive species treatment beginning in Spring 2018. Treatments occurred in June 2018 and again in August 2018. Additional treatments will continue until closeout.

Wildlands response; Text in Section 1.2.2 has been added to indicate that invasive species treatment occurred in June and August 2018 and that additional treatments will continue until closeout.

DMS comment; 1.2.4 Stream Areas of Concern: The repair construction to Hogan Creek Reach 1 and Reach 2 will begin in January 2019.

Wildlands response; Text in Section 1.2.4 has been updated to indicate that site repairs are scheduled to occur in January 2019.

DMS comment; 1.3 Monitoring Year 3 Summary: Please update section to indicate that adaptive management measures will occur in January 2019 and invasive plant control will continue in 2019.

Wildlands response; Text in Section 1.3 has been updated to indicate that adaptive management measures will occur in January 2019 and invasive plant control will continue in 2019.

DMS comment; Table 2: Please update Invasive Species Treatment dates to Jun/Aug – 2018

Wildlands response; In Table 2, Invasive Species Treatment dates have been updated to Jun/Aug -2018.

DMS comment; Please include the attached invasive species treatment log in the appendix.

Wildlands response; Invasive species treatment logs have been included in Appendix A.

DMS comment; XS and Profiles: For ease of reading and comparing data, please turn off markers for all data except the current monitoring year.

Wildlands response; For XS and Profiles, all markers for data except the current monitoring year have been turned off.

Enclosed please find three (3) hard copies and one (1) electronic copy on CD of the Final Monitoring Report. Please contact me at 704-332-7754 x110 if you have any questions.

Sincerely,

Kirsten Y. Gimbert

Kirsten Y. Gimbert
Project Manager
kgimbert@wildlandseng.com

EXECUTIVE SUMMARY

The North Carolina Department of Environmental Quality (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 8-digit Hydrologic Unit Code (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 (MY) 4 activities were completed in October of 2018.

The Hogan Creek Stream Mitigation Project is on track to meet monitoring success criteria for vegetation, geomorphology, and hydrology performance standards. The MY4 vegetation survey resulted in an average stem density of 452 planted stems per acre. The Site is meeting the final requirement of 260 stems per acre, with all plots (100%) individually meeting this requirement. The MY4 vegetation monitoring and visual assessment revealed significant reductions in invasive plant population along the left riparian area of UT2 and UT2B in response to treatment that took place Summer of 2018. Areas of invasive species persist along the riparian areas along Hogan Creek especially at the roadside of Miller Gap Road. 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. The adaptive management measures scheduled to repair Hogan Creek Reach 1 and Reach 2 will occur in January 2019.

HOGAN CREEK STREAM MITIGATION PROJECT

Year 4 Monitoring Report

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APPENDICES

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 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 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. The monitoring year 4 activities were completed in October of 2018. 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 MY4 efforts.

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 4 Data Assessment

Annual monitoring was conducted from April to October of 2018 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

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 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 MY4 vegetation survey was completed in August 2018. The data indicate an average stem density of 452 planted stems per acre which increased from MY3 because two stems were found that were missing in previous monitoring years. The Site is meeting the final requirement of 260 stems per acre, with all plots (100%) individually meeting this requirement. The planted stem mortality was approximately 1% of the MY3 stem count which was 438 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*), tulip poplar (*Liriodendron tulipifera*), and sycamore (*Platanus occidentalis*) were observed. A majority of the planted stems (88.2%) scored a vigor of 3 or 4, indicating that they are likely to survive. Approximately 5.9% of the planted stems scored a vigor of 2, indicating fair plant health but with some damage present. Stems that scored a vigor of 1 are not likely to survive account for approximately 4.4% of planted stems. This lower vigor rating is due to damage from vine strangulation, suffocation from dense herbaceous cover, 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 and Management Activity

Observations indicate that invasive plant populations continue to present areas of concern in MY4 with species including: kudzu (*Pueraria montana*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), multiflora rose (*Rosa multiflora*), and Lespedeza (*Sericea Lespedeza)*. Invasive species treatment occurred in the summer of 2018 and significantly reduced areas of kudzu along the left floodplain of UT2 and UT2B preservation reaches. Additionally, the kudzu that was present along the right floodplain of lower Hogan Creek Reach 1 has been decreased. However other areas of invasive

species continue to persist throughout the site. Areas of encroaching kudzu are spreading into the easement along both sides of Miller Gap Road. 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. Approximately 5% of the easement acreage continues to be affected by invasive species. DMS has contracted with a provider for invasive species treatment beginning in Spring 2018. Treatments occurred in June 2018 and again in August 2018. Additional treatments will continue until closeout. These vegetation areas of concern are shown in Figure 3 of Appendix B.

1.2.3 Stream Assessment

Morphological surveys for MY4 were conducted in June and July 2018. The MY4 riffle pebble counts in Hogan Creek for cross-sections 1, 5, and 6 indicate similar or coarser sediment size distribution as compared to MY0. For the riffle pebble count at cross-section 3, the sediment size distribution has remained consistent with MY2-MY3 which shows a fining of riffle bed materials. This increase in fine sediment size percentage is indicative of the downcutting present around this cross-section that has caused 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 MY3 and MY4. 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 MY3 and MY4, 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 an increase in bank height ratio 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 MY4 due to the expansion of the point bar inside the meander bend. Cross-section data from UT2 indicate some change in bankfull dimensions compared to the baseline. UT2 cross-section data indicate moderate increase in width-depth ratio at the two riffles and a modest decrease in cross-sectional area at the pool cross-section. Visual observations of UT2 indicate overall stability with some sediment deposition observed downstream of the bridge. 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 MY3 and MY4. Consistent with the trend displayed in previous monitoring years, max pool depths increased in all reaches compared to baseline, particularly in Hogan Creek. Around station 17+00 on Hogan Creek Reach 1 downstream of the confluence with UT1, the pool has maintained depth 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 maintained pool depth as well. The profiles of Hogan Creek and UT2 show modest change in pool spacing and riffle slope. Please refer to Appendix D for longitudinal profiles with annual overlays and Table 13a-c for stream reach data summaries.

1.2.4 Stream Areas of Concern and Management Activity

Stream areas of concern included instances of bank erosion and sediment deposition on portions of Hogan Creek and UT2. Nine areas of bank erosion were observed in Hogan Creek Reach 1 and five were observed in Hogan Creek Reach 2. Twelve of these areas of bank erosion were noted in MY3 with two new areas noted in MY4. In Hogan Creek Reach 1, approximately 7% of both banks are unstable due to

erosion with no stabilizing woody vegetation. Downstream, similarly about 10% 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 construction to Hogan Creek Reach 1 and Reach 2 will begin in January 2019. 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 April 19, 2018 based on the visual observation of wrack lines and crest gage measurements. Monthly rainfall data indicate higher than the 70th percentile rainfall amounts occurred during the months of April through May and July through August of 2018. 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 MY4 with at least four documented bankfull events for each reach. Refer to Appendix E for hydrologic data and graphs.

1.3 Monitoring Year 4 Summary

The Hogan Creek Stream Mitigation Project is on track to meet monitoring success criteria for vegetation, geomorphology, and hydrology performance standards. The MY4 vegetation survey resulted in an average stem density of 452 planted stems per acre. The Site is meeting the final requirement of 260 stems per acre, with all plots (100%) individually meeting this requirement. The MY4 vegetation monitoring and visual assessment revealed significant reductions in invasive plant population along the left riparian area of UT2 and UT2B in response to treatment. Areas of invasive species persist along the riparian areas along Hogan Creek especially at the roadside of Miller Gap Road. 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. However, the adaptive management measures to repair Hogan Creek Reach 1 and 2 will occur in January 2019 and invasive plant control will continue in 2019. 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 2018 are based on standard guidance and procedures documents (Rosgen 1996 and USACE 2003). Geomorphic data were collected following the standards outlined in The Stream Channel Reference Site: An Illustrated Guide to Field Techniques (Harrelson et al., 1994) and in the Stream Restoration: A Natural Channel Design Handbook (Doll et al., 2003). All Integrated Current Condition Mapping was recorded using a Trimble handheld GPS with sub-meter accuracy and processed using Pathfinder and ArcGIS. Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed by the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008). Crest gages were installed in surveyed riffle cross-sections and monitored quarter

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.

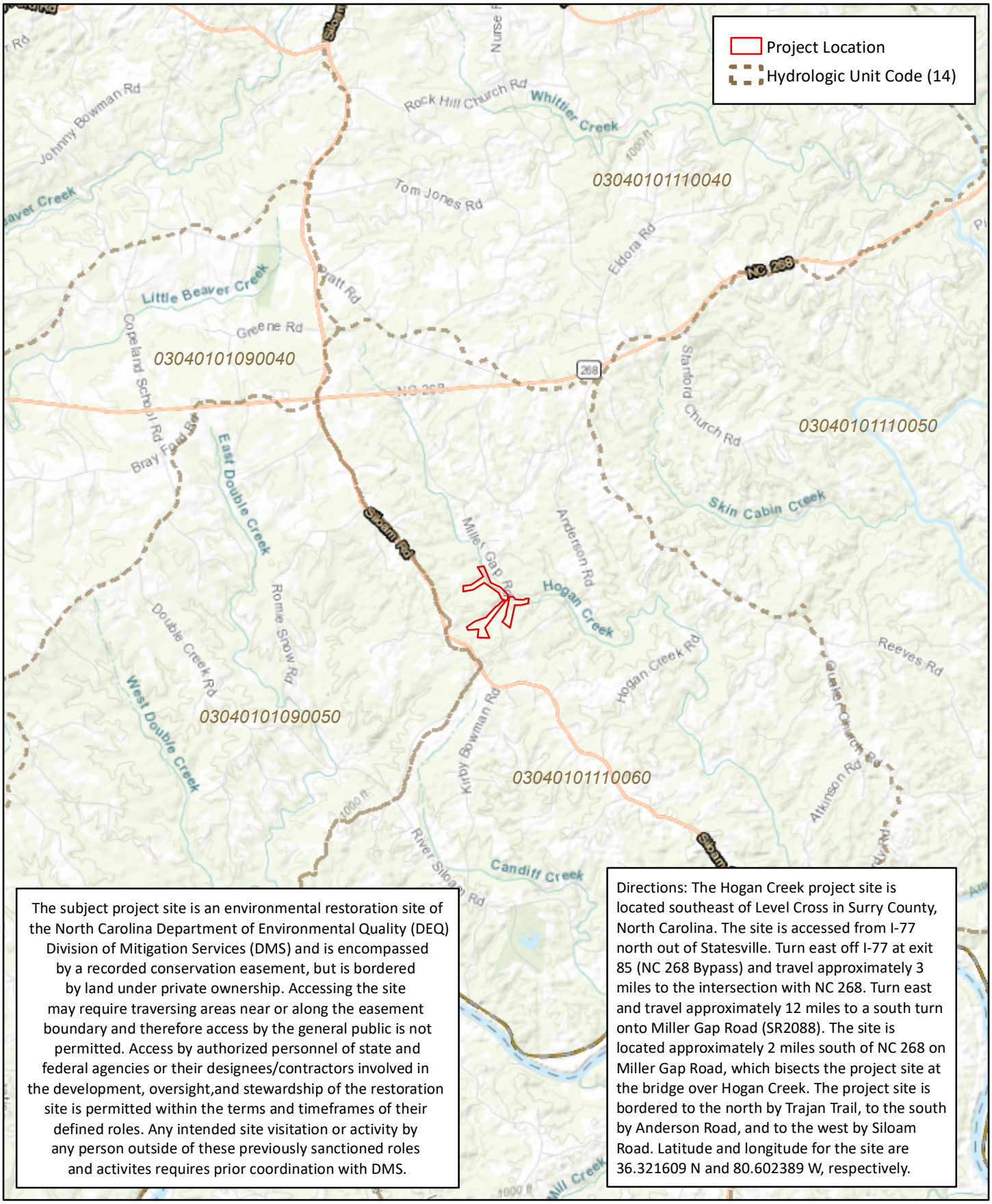
NCDENR. 2009. Upper Yadkin River Basin Restoration Priorities. Retrieved from https://deq.nc.gov/about/divisions/mitigation-services/dms-planning/watershed-planning-documents/yadkin-river-basin

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.

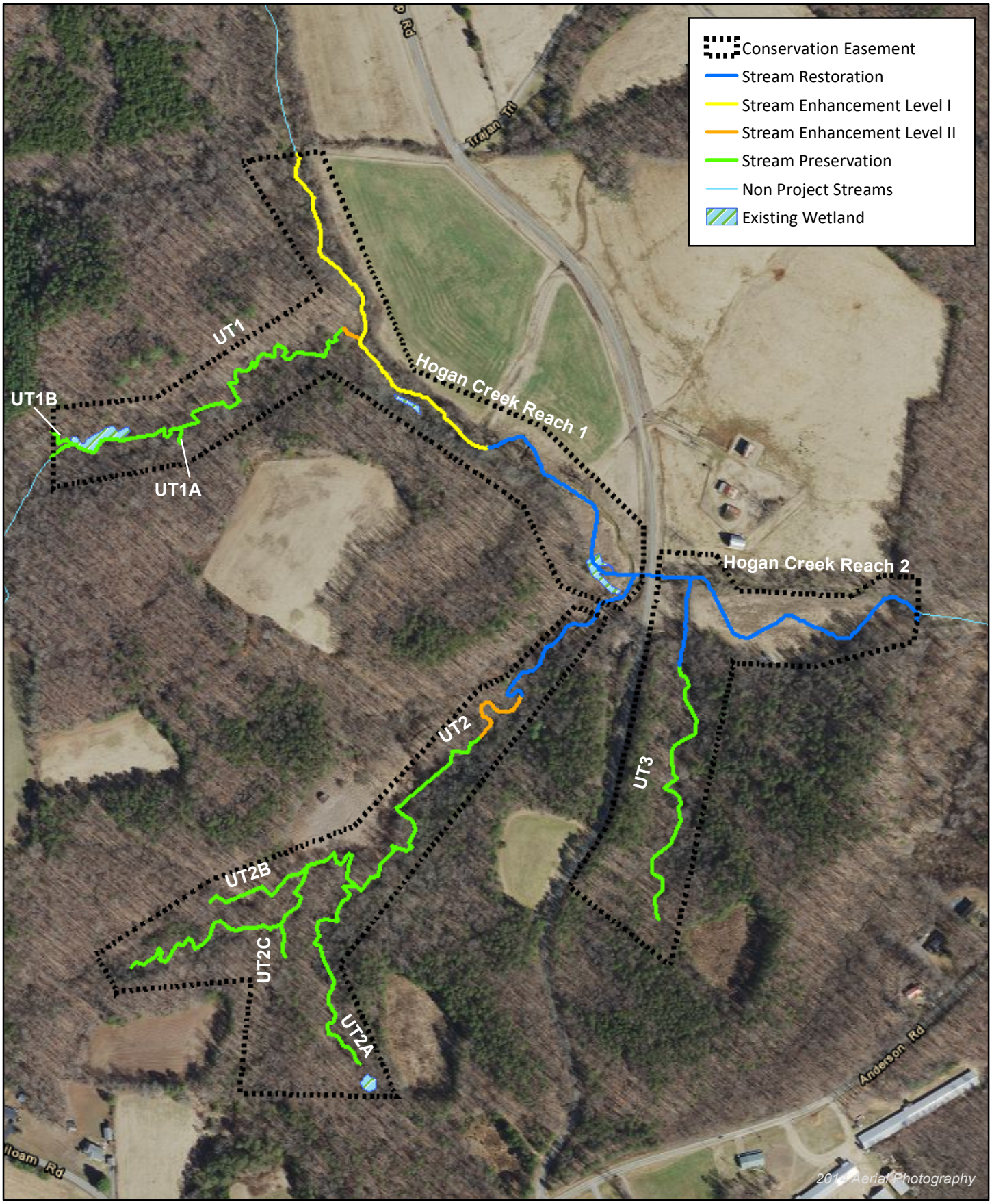
Directions: The Hogan Creek project site is located southeast of Level Cross in Surry County, North Carolina. The site is accessed from I-77 north out of Statesville. Turn east off I-77 at exit 85 (NC 268 Bypass) and travel approximately 3 miles to the intersection with NC 268. Turn east and travel approximately 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 4 - 2018

Surry County, NC



WILDLANDS ENGINEERING

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Figure 2 Project Component/Asset Map
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Surry County, NC

Table 1. Project Components and Mitigation Credits
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Mitigation Credit Summaries [1]

	Stream	Riparian Wetland	Non-Riparian Wetland	Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Overall Credit	4,994.000	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	1,200.000	-
Hogan Reach 1	22+00 - 28+84	797	684	P2	R	1:1	684.000	Crossing was removed from total
Hogan Reach 2	29+35 - 38+97	876	962	P2	R	1:1	962.000	-
UT1,1A, 1B	Upstream of 10+00	1,485	1,485	Preservation	P	5:1	297.000	-
UT1	10+00 - 10+66	66	66	P3	EII	2.5:1	26.400	-
UT2, 2A, 2B,2C	Upstream of 6+50	3,225	3,225	Preservation	P	5:1	645.000	-
UT2	6+50 - 10+00	370	350	P3	EII	2.5:1	140.000	-
UT2	10+00 - 15+55	633	555	P2	R	1:1	555.000	Crossing was removed from total
UT3	Upstream of 9+40	963	963	Preservation	P	5:1	192.600	-
UT3	9+40 - 12+32	260	292	P2	R	1:1	292.000	-

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 4 - 2018

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	
Invasive Species Treatment		N/A	June/August -2018
Year 4 Monitoring	Vegetation Survey	August-2018	November-2018
	Stream Survey	June-2018	
Year 5 Monitoring	Vegetation Survey	2019	November-2019
	Stream Survey	2019	

N/A - Not Applicable

Table 3. Project Contacts Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Designer	Confluence Engineering, PC 16 Broad Street Asheville, NC 28801
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 4 - 2018

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 4 - 2018

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

Invasive Treatment Logs

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 6-12-18

Habitat Assessment and Restoration Professionals
Invasive Species Management Division

Client	Site	Start Time	End Time
NC	Hogan	8	4

Crew Leader	Hours
Peoples	8
Crew Members	**Hours**
Bernal	8
Cooper	8

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	~~27~~ 24
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS					
	Clear	P/C	Cloudy	Foggy	Rain
Start	✓				
End			✓		

WIND CONDITIONS					
	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	✓				
End	✓				

AMBIENT TEMPERATURE	
START	75
END	65

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	(2)	3	4	5	DENSE
FLAT	1	2	(3)	4	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS
Late afternoon/evening rain

	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	Glyphosate	25%	48 oz	96 oz
SURFACTANT	—			
DYE	✓			
HERBICIDE				
SURFACTANT				
DYE				
HERBICIDE				
SURFACTANT				
DYE				

SPECIES TREATED (X species)		
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

SPECIES TREATED (X species)		
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
✓	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussonetia papyrifera*
	Periwinkle	*Vinca spp.*

SPECIES TREATED (X species)		
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortunei*
	Wisteria	*Wisteria spp.*
	Privet	*Ligustrum*

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 6-13-18

Habitat Assessment and Restoration Professionals

Invasive Species Management Division

Client	Site	Start Time	End Time
NC	Hogan	7	4

Crew Leader	Hours
Peoples	9
Crew Members	**Hours**
Bernal	9
Cooper	9

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	27
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS					
	Clear	P/C	Cloudy	Foggy	Rain
Start		✓			
End			✓		

WIND CONDITIONS					
	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	✓				
End		✓			

AMBIENT TEMPERATURE	
START	80
END	65

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	2	(3)	4	5	DENSE
FLAT	1	2	(3)	4	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS
evening rain

	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	Glyphosate	25%	48 oz	96 oz
SURFACTANT				
DYE	✓			
HERBICIDE				
SURFACTANT				
DYE				
HERBICIDE				
SURFACTANT				
DYE				

SPECIES TREATED (X species)		
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

SPECIES TREATED (X species)		
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
✓	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussonetia papyrifera*
	Periwinkle	*Vinca spp.*

SPECIES TREATED (X species)		
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortunei*
	Wisteria	*Wisteria spp.*
	Privet	*Ligustrum spp*

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 6-14-18

Habitat Assessment and Restoration Professionals

Invasive Species Management Division

Client	Site	Start Time	End Time
NC	Hogan	7	4

Crew Leader	Hours
Peoples	9
Crew Members	**Hours**
Bernal	9
Cooper	9

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	27
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS	Clear	P/C	Cloudy	Foggy	Rain
Start	/				
End		/			

WIND CONDITIONS	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	/				
End		/			

AMBIENT TEMPERATURE	
START	70
END	90

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	2	(3)	4	5	DENSE
FLAT	1	2	(3)	4	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS

	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	Triclopyr	1%	45 oz	36 gallon
SURFACTANT	Liberate ✓	~~1%~~ .02	9 oz	↓
DYE				
HERBICIDE				
SURFACTANT				
DYE				
HERBICIDE				
SURFACTANT				
DYE				

	SPECIES TREATED (X species)	
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

	SPECIES TREATED (X species)	
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
✓	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussonetia papyrifera*
	Periwinkle	*Vinca spp.*

	SPECIES TREATED (X species)	
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortunei*
	Wisteria	*Wisteria spp.*
✓	Privet	

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 6-15-18

Habitat Assessment and Restoration Professionals

Invasive Species Management Division

Client	Site	Start Time	End Time
NC	Hogan	7	3

Crew Leader	Hours
Peoples	8
Crew Members	**Hours**
Bernal	8
Cooper	8

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	24
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS					
	Clear	P/C	Cloudy	Foggy	Rain
Start	✓				
End	✓				

WIND CONDITIONS					
	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	✓				
End		✓			

AMBIENT TEMPERATURE	
START	65
END	85

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	2	(3)	4	5	DENSE
FLAT	1	2	3	(4)	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS

	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	Triclopyr	1%	30	24 gallon
SURFACTANT	Liberate	.02	6	↓
DYE	✓			↓
HERBICIDE				
SURFACTANT				
DYE				
HERBICIDE				
SURFACTANT				
DYE				

SPECIES TREATED (X species)		
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

SPECIES TREATED (X species)		
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
✓	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussanetia papyrifera*
	Periwinkle	*Vinca spp.*

SPECIES TREATED (X species)		
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortnunei*
	Wisteria	*Wisteria spp.*
✓	Privet	

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 6-16-18

Habitat Assessment and Restoration Professionals

Invasive Species Management Division

Client	Site	Start Time	End Time
NC	Hogan	7	3

Crew Leader	Hours
Peoples	8
Crew Members	**Hours**
Cooper	8
Bernal	8

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	24
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS					
	Clear	P/C	Cloudy	Foggy	Rain
Start	✓				
End	✓				

WIND CONDITIONS					
	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	✓				
End		✓			

AMBIENT TEMPERATURE	
START	65
END	86

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	2	(3)	4	5	DENSE
FLAT	1	2	3	(4)	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS

	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	triclopyr	1%	35oz	28 gallon
SURFACTANT	Liberate	2%	7oz	↓
DYE	✓			↓
HERBICIDE	Streamline	.2%	3oz	14 gallon
SURFACTANT	Tactic	.2%	3oz	↓
DYE	✓			↓
HERBICIDE				
SURFACTANT				
DYE				

SPECIES TREATED (X species)		
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

SPECIES TREATED (X species)		
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
✓	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussonetia papyrifera*
	Periwinkle	*Vinca spp.*

SPECIES TREATED (X species)		
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortunei*
	Wisteria	*Wisteria spp.*
✓	Privet	*Ligustrum spp*

HARP
HABITAT ASSESSMENT & RESTORATION PROFESSIONALS

Date: 8-13-18

Habitat Assessment and Restoration Professionals

Invasive Species Management Division

Client	Site	Start Time	End Time
	Hogan	8	4

Crew Leader	Hours
Peoples	8
Crew Members	**Hours**
Bernal	8

PRIMARY REMOVAL METHOD (Separate hours per application method)	
METHOD	**# OF HOURS**
CUT and PAINT	
FOLIAR SPRAY APPLICATION BP/TRACTOR w/tank/ATV w/tank	16
HACK and SQUIRT	
HAND PULL	
CUT and CHIP	
Other	

WEATHER CONDITIONS					
	Clear	P/C	Cloudy	Foggy	Rain
Start	✓				
End	✓				

WIND CONDITIONS					
	CALM	1-5MPH	6-10MPH	11-15MPH	GUSTING
Start	✓				
End	✓				

AMBIENT TEMPERATURE	
START	70
END	89

SITE CONDITIONS INFESTATION AND TOPOGRAPHY						
LIGHT	1	(2)	3	4	5	DENSE
FLAT	1	2	(3)	4	5	STEEP

AREA COMPLETED/COMMENTS/RECOMMENDATIONS FOR FOLLOWUP TREATMENT/SPECIAL NOTES OF CONDITIONS

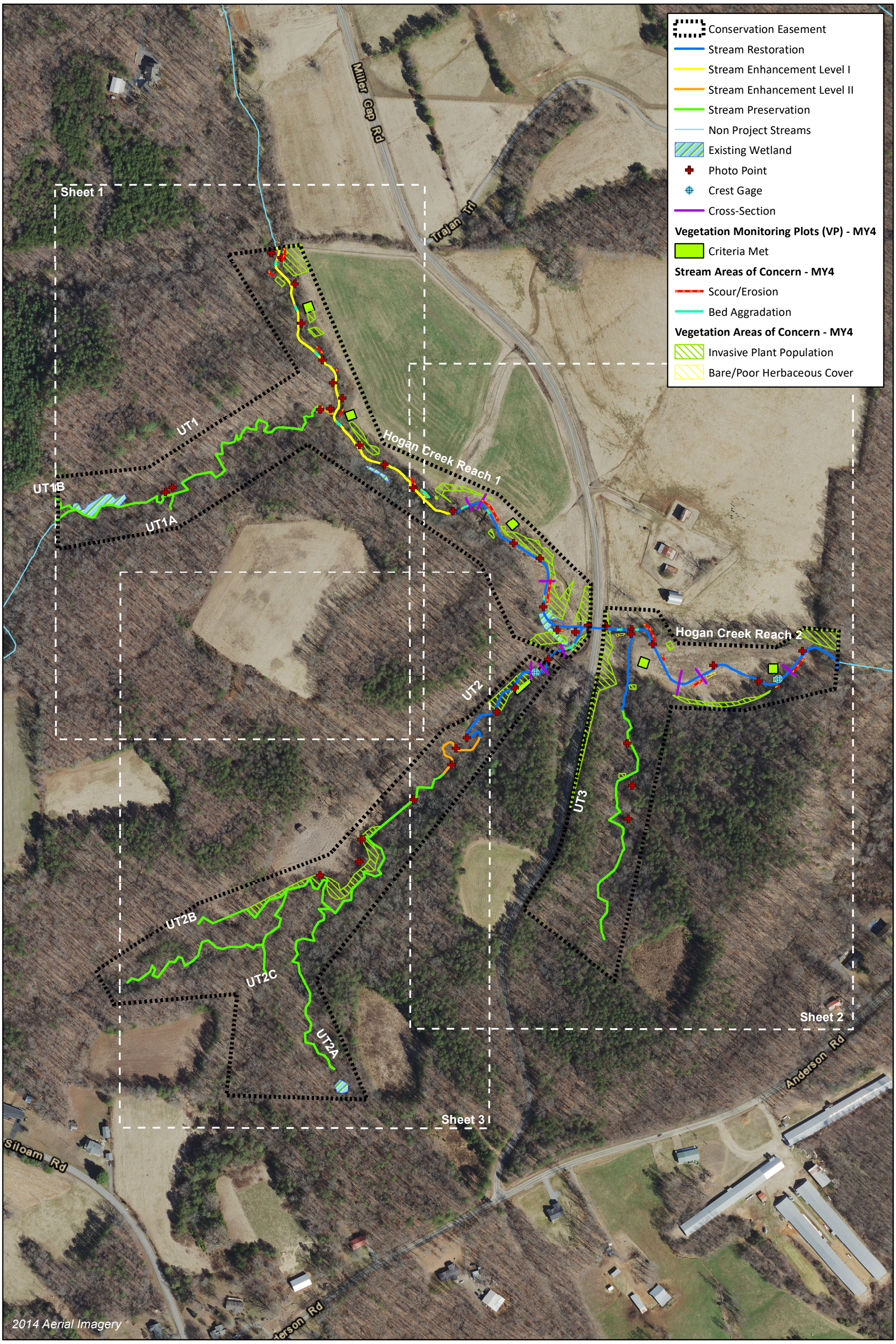
	CHEMICAL	RATE OF APPLICATION	TOTAL CONCENTRATION	TOTAL SOLUTION
HERBICIDE	glyphosate imazapyr	2%/.5%	40oz/8oz	16 gallon
SURFACTANT	Liberate	.0%	4oz	↓
DYE	blue			↓
HERBICIDE				
SURFACTANT				
DYE				
HERBICIDE				
SURFACTANT				
DYE				

SPECIES TREATED (X species)		
	Autum Olive	*Eleagnus umbellata*
	Burdock	*Arctium minus*
	Burning Bush	*Euonymus alata*
	Bush Honeysuckle	*Lonicera spp.*
	Butterfly Bush	*Buddleja davidii*
	Callery Pear	*Pyrus calleryana*
	China berry tree	*Melia azedarach*
	Chinese tallow tree	*Triadica sebifera*
	Chinese yam	*Dioscorea oppositifolia*
	Clematis	*Clematris termifolia*
	Climbing ferns	*Lygodium spp.*
	Cogon grass	*Imperata cylindrica*
	Clown vetch	Securigera *varia*
	English Ivy	*Hedera helix*
	Five leaf akebia	*Akebia quinata*
	Garlic mustard	*Alliaria petiolata*
	Golden bamboo	*Phyllostachys aurea*

SPECIES TREATED (X species)		
	Ground Ivy	*Glechoma hederacea*
	Japanese Barberry	*Berberis thunbergii*
	Jap. Honeysuckle	*Lonicera japonica*
	Jap. Hop	*Humulus japonicus*
	Jap.Knot weed	*Polygonum cuspidatum*
	Jap. Spiraea	*Spiraea japonica*
	Jap.Stilt Grass	*Microstegium vimnieum*
	Johnson Grass	*Sorghum haleperse*
✓	Kudzu	*Pueraria montana*
	Lespedeza	*Lespodeza cureata*
	Mile-A-Minute Vine	*Poly. perfoliatum*
	Mimosa	*Albizia julibrissin*
	Multiflora Rose	*Rosa multiflora*
	Nandina	*Nandia domestica*
	Orient.bittersweet	*Celastrus orbieculatus*
	PaperMulberry	*Broussonetia papyrifera*
	Periwinkle	*Vinca spp.*

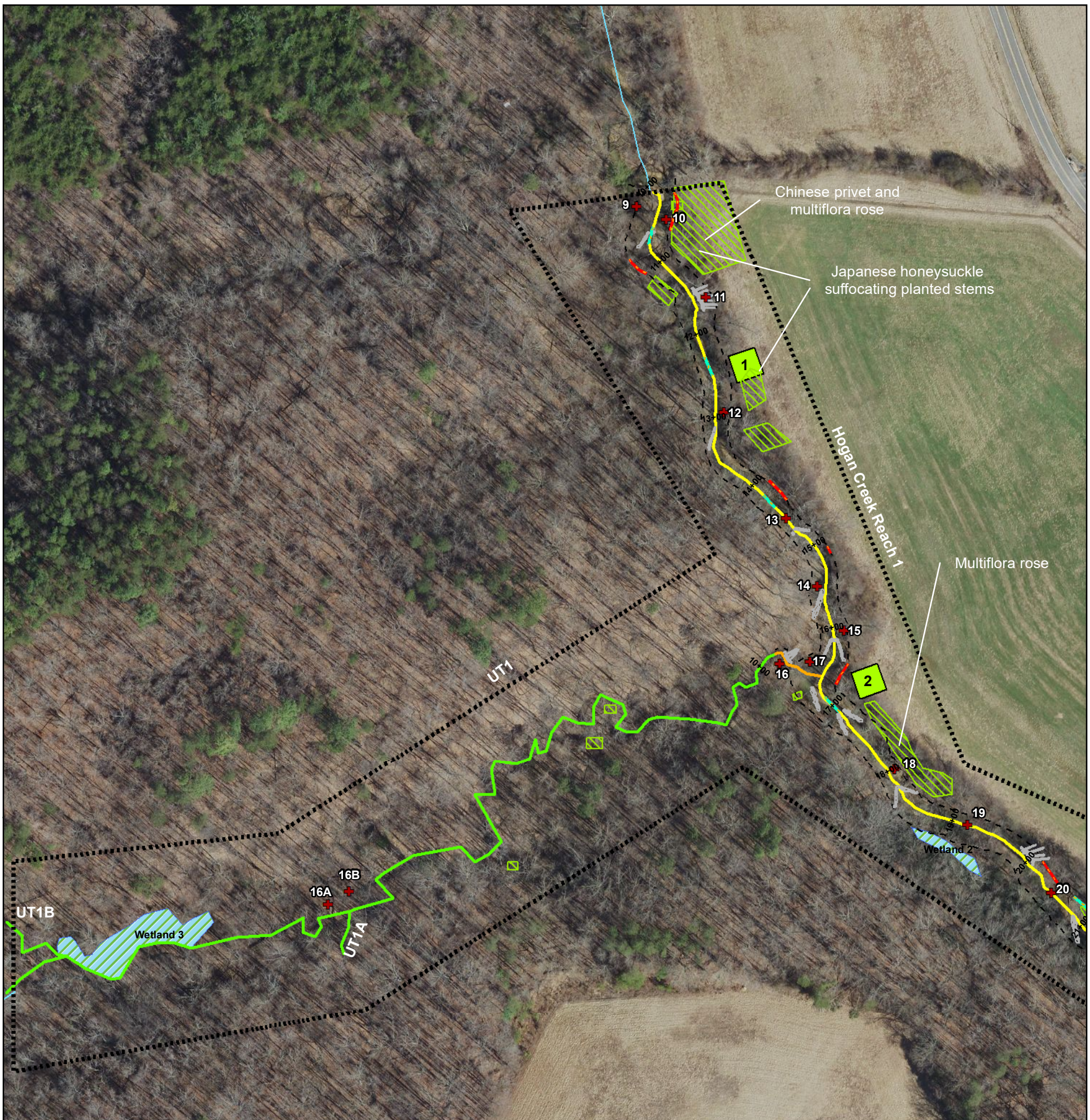
SPECIES TREATED (X species)		
	Phragmites	*Phragmites oustrolis*
	Porcelian Berry	*Ampelopsis brev*
	Purple loosestrife	*Lythrum salicaria*
	Russian Olive	*Eleagnus angustifolia*
	Smart weed	*Polygonum spp.*
	Tamarisk	*Tamarix spp.*
	Tree of Heaven	*Ailanthus altissima*
	Tropical Soda App.	*Solanum viarum*
	Viburnum	*Virburnum spp.*
	White Mulberry	*Morus alba*
	White Poplar	*Populus alba*
	Willows	Salix spp.
	Wineberry	*Rubus phoenicolasius*
	Winter Creeper	*Euonymus fortunei*
	Wisteria	*Wisteria spp.*

APPENDIX B. Visual Assessment Data



WILDLANDS ENGINEERING

Figure 3.0 Integrated Current Condition Plan View Map (Key)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018
Surry County, NC



WILDLANDS ENGINEERING

Figure 3.1 Integrated Current Condition Plan View Map (Sheet 1 of 3)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018
Surry County, NC

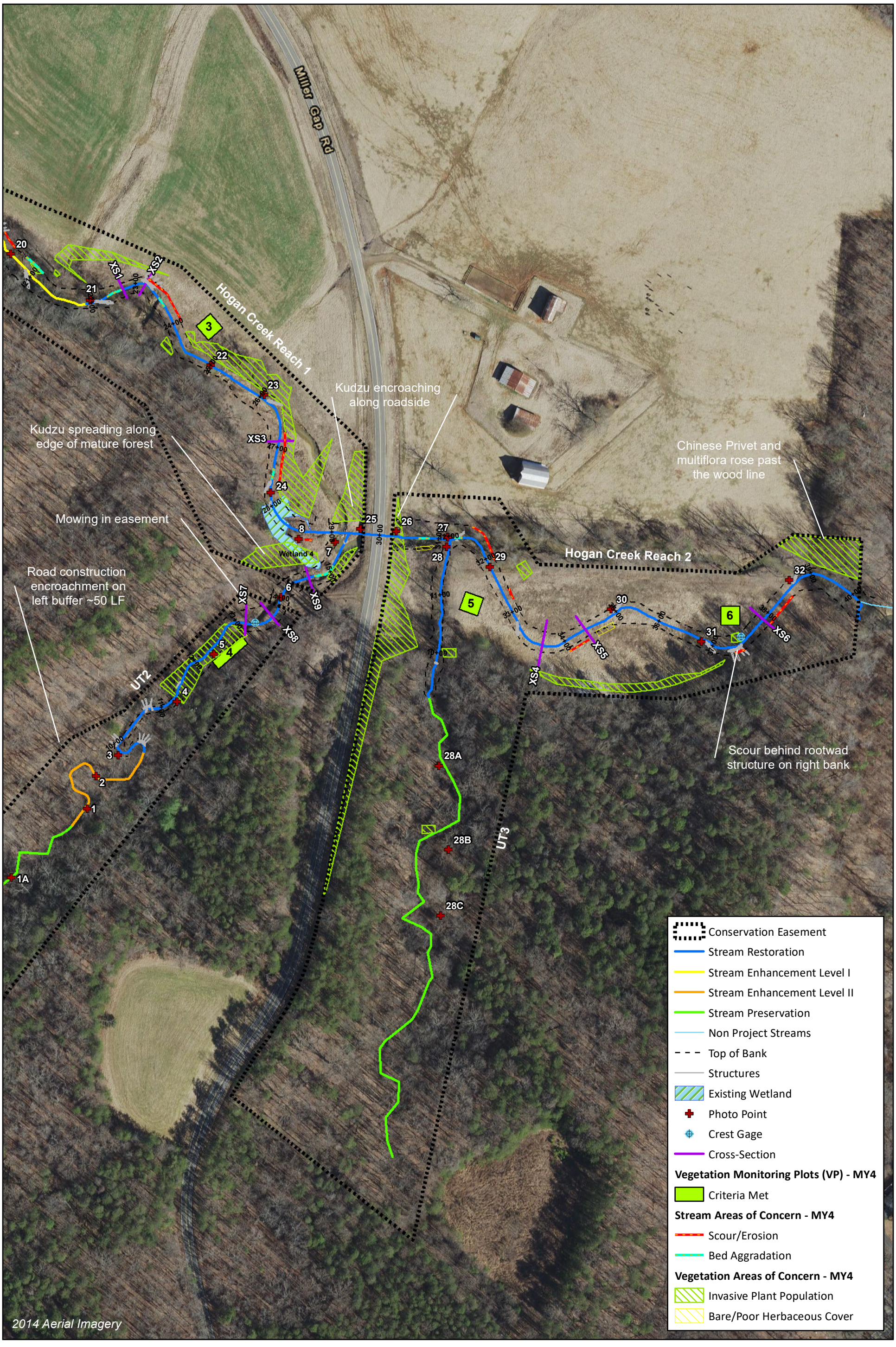


Figure 3.2 Integrated Current Condition Plan View Map (Sheet 2 of 3)
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Surry County, NC

Road construction encroachment on left buffer ~50 LF

Downed Trees Partially Blocking Stream Channel

Kudzu persists around taller canopy trees along stream banks

UT2

UT2B

UT2C

UT2A

1

2

3

1A

1B

1C

1D

Wetland 1

2014 Aerial Imagery

Conservation Easement
Stream Restoration
Stream Enhancement Level I
Stream Enhancement Level II
Stream Preservation
Top of Bank
Structures
Existing Wetland
Photo Point
Crest Gage
Cross-Section
Vegetation Monitoring Plots (VP) - MY4
Criteria Met
Stream Areas of Concern - MY4
Scour/Erosion
Bed Aggradation
Vegetation Areas of Concern - MY4
Invasive Plant Populations

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 4 - 2018
Surry County, NC

Table 6a. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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)			8	190	90%			
		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	365	91%	4	95	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	365	91%	4	95	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)	13	15			87%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	13	15			87%			

Table 6b. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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			5	200	90%	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	5	200	90%	0	0	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs.	5	6			83%			
	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.	4	5			80%			
	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)	5	6			83%			
	4. Habitat	Pool forming structures maintaining ~ Max Pool Depth : Mean Bankfull Depth ratio ≥ 1.6 Rootwads/logs providing some cover at base-flow.	5	6			83%			

Table 6c. Visual Stream Morphology Stability Assessment Table
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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)			1	40	96%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	12	14			86%			
	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 4 - 2018

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 4 - 2018

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	N/A	0	0.00	0.0%
			Total	2	0.01	0.1%
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	N/A	0	0.00	0.0%
			Cumulative Total	0	0.01	0.1%

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	24	1.84	5.1%
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	none	N/A	0	0.00	0.0%

Stream Photographs

PP1 – Main Stem UT2, looking downstream *(6/06/2018)*

PP1A – Main Stem UT2, looking upstream *(6/06/2018)*

PP1B – Main Stem UT2, looking downstream *(6/06/2018)*

PP1C – Main Stem UT2, looking upstream *(6/06/2018)*

PP1D – Main Stem UT2, looking upstream *(6/06/2018)*

PP2 – Main Stem UT2, looking downstream *(6/06/2018)*

PP3 – Main Stem UT2, looking upstream *(6/06/2018)*

PP4 – Main Stem UT2, looking upstream *(6/06/2018)*

PP5 – Main Stem UT2, looking downstream *(6/06/2018)*

PP6 – Main Stem UT2, looking downstream *(6/06/2018)*

PP7 – Main Stem UT2, looking downstream *(6/06/2018)*

PP8 – Reach 1 Hogan Creek, looking upstream *(6/06/2018)*

PP9 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP10 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP11 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP12 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP13 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP14 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP15 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP16 – Main Stem UT1, looking downstream *(6/06/2018)*

PP16A – Main Stem UT1, looking upstream *(6/06/2018)*

PP16B – Main Stem UT1, looking downstream *(6/06/2018)*

PP17 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP18 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP19 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP20 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP21 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP22 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP23 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP24 – Reach 1 Hogan Creek, looking downstream *(6/06/2018)*

PP25 – Reach 1 Hogan Creek, looking upstream *(6/06/2018)*

PP26 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

PP27 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

PP28 – UT3, looking upstream *(6/06/2018)*

PP28A – UT3, looking upstream *(6/06/2018)*

PP28B – UT3, looking downstream *(6/06/2018)*

PP28C – UT3, looking upstream *(6/06/2018)*

PP29 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

PP30 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

PP31 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

PP32 – Reach 2 Hogan Creek, looking downstream *(6/06/2018)*

Vegetation Photographs

Vegetation Plot 1 – *(8/08/2018)*

Vegetation Plot 2 – *(8/08/2018)*

Vegetation Plot 3 – *(8/08/2018)*

Vegetation Plot 4 – *(8/08/2018)*

Vegetation Plot 5 – *(8/08/2018)*

Vegetation Plot 6 – *(8/08/2018)*

APPENDIX C. Vegetation Plot Data

Table 8. Vegetation Plot Criteria Attainment

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Plot	MY4 Success Criteria	Tract Mean
1	Y	100%
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	

Table 9. CVS Vegetation Plot Metadata

Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

Database Name	cvs-eep-entrytool-v2.3.1 Hogan MY4.mdb
Database Location	Q:\ActiveProjects\005-02152 Hogan Monitoring\Monitoring\MY4\Vegetation Assessment
Computer Name	MIMI-PC
File Size	61771776
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 4 - 2018

			Current Plot Data (MY4 2018)																	
			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																		
Betula nigra	river birch	Tree	3	3	128			45	1	1	9	6	6	6			4			1
Diospyros virginiana	common persimmon	Tree													4	4	4	6	6	6
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															3			
Liriodendron tulipifera	tuliptree	Tree			2									15						2
Nyssa sylvatica	blackgum	Tree																2	2	2
Pinus taeda	loblolly pine	Tree			6						2			2			3			2
Platanus occidentalis	American sycamore	Tree	2	2	2	3	3	19	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	4	4	4	1	1	1	3	3	3	5	5	5
Quercus phellos	willow oak	Tree													2	2	2			
		Stem count	9	9	142	8	8	69	8	8	18	19	19	36	10	10	20	13	13	19
		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	5	4	4	6	4	4	7	3	3	7
		Stems per ACRE	364	364	5747	324	324	2792	324	324	728	769	769	1457	405	405	809	526	526	769

			Annual Means														
			MY0 (2015)			MY1 (2015)			MY2 (2016)			MY3 (2017)			MY4 (2018)		
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**
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	10	10	193
Diospyros virginiana	common persimmon	Tree							11	11	11	9	9	9	10	10	10
Fraxinus pennsylvanica	green ash	Tree	17	17	17	14	14	14	15	15	15	13	13	13	13	13	13
Juglans nigra	black walnut	Tree			1									2			3
Liriodendron tulipifera	tuliptree	Tree						70			62			64			19
Nyssa sylvatica	blackgum	Tree	12	12	12	12	12	12	2	2	2	2	2	2	2	2	2
Pinus taeda	loblolly pine	Tree									3			2			15
Platanus occidentalis	American sycamore	Tree	13	13	13	14	14	17	14	14	20	14	14	15	14	14	31
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	16	16	16
Quercus phellos	willow oak	Tree	6	6	6	4	4	4	1	1	1	1	1	1	2	2	2
		Stem count	71	71	102	69	69	330	70	70	335	65	65	294	67	67	304
		size (ares)	6			6			6			6			6		
		size (ACRES)	0.148			0.148			0.148			0.148			0.148		
		Species count	6	6	10	6	6	10	7	7	12	7	7	11	7	7	10
		Stems per ACRE	479	479	688	465	465	2226	472	472	2259	438	438	1983	452	452	2050

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 Mitigation Project

DMS Project No.94708

Monitoring Year 4 - 2018

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 Mitigation Project

DMS Project No.94708

Monitoring Year 4 - 2018

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/f^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 Mitigation Project

DMS Project No.94708

Monitoring Year 4 - 2018

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 Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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[2]**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4[2]**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4[2]**	**MY5**
bankfull elevation (ft)	990.8	990.8	990.8	990.8	991.0		990.7	990.7	990.7	990.7	990.8		987.6	987.6	987.6	987.6	987.4	
low bank elevation (ft)	990.8	990.8	990.9	990.9	990.8		990.7	990.7	990.7	990.6	990.6		987.6	987.6	987.7	987.9	987.9	
Bankfull Width (ft)	25.6	25.4	25.6	22.7	29.4		29.1	30.6	26.2	25.8	29.1		22.8	22.9	22.9	22.4	19.1	
Floodprone Width (ft)	>100	>100	>100	>100	>100		N/A	N/A	N/A	N/A	N/A		>100	>100	>100	>100	>100	
Bankfull Mean Depth (ft)	1.7	1.6	1.7	1.8	1.5		2.0	2.2	2.0	2.1	2.0		1.8	2.0	2.4	2.5	2.2	
Bankfull Max Depth (ft)	2.9	2.9	3.2	3.3	3.4		4.5	4.9	4.9	4.4	4.8		2.7	3.6	4.0	4.0	3.4	
Bankfull Cross Sectional Area (ft^2)	43.9	41.8	44.2	39.9	43.9		57.6	66.7	64.2	54.9	57.6		41.4	45.9	54.6	55.3	41.4	
Bankfull Width/Depth Ratio	14.9	15.4	14.8	12.9	19.7		14.7	14.1	10.7	12.1	14.7		12.6	11.4	9.6	9.1	8.8	
Bankfull Entrenchment Ratio	>3.9	>3.9	>3.8	>4.4	>3.4		N/A	N/A	N/A	N/A	N/A		>4.4	>4.4	>4.4	>4.5	>5.2	
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	<1.0		N/A	N/A	N/A	N/A	N/A		1.0	1.0	1.0	1.1	1.1	
d50 (mm)	19	23	17	41	42		N/A	N/A	N/A	N/A	N/A		26	29	6.9	1.0	7.1	

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[2]**	**MY5**	**Base**	**MY1**	**MY2[1]**	**MY3**	**MY4[2]**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4[2]**	**MY5**
bankfull elevation (ft)	984.0	984.0	984.0	984.0	984.7		983.6	983.6	983.6	983.6	983.3		982.1	982.1	982.1	982.1	981.9	
low bank elevation (ft)	984.0	984.0	984.0	984.0	984.0		983.6	983.6	983.7	983.8	983.8		982.1	982.1	982.0	981.9	981.9	
Bankfull Width (ft)	44.6	45.5	44	43.2	60.4		24.2	24.8	23.6	24.7	23.7		24.7	28.1	28.2	28.7	26.1	
Floodprone Width (ft)	N/A	N/A	N/A	N/A	N/A		>100	>100	>100	>100	>100		>100	>100	>100	>100	>100	
Bankfull Mean Depth (ft)	2.2	2.1	1.6	1.7	1.6		1.9	2.0	2.4	2.5	1.9		2.3	2.0	2.2	2.1	2.2	
Bankfull Max Depth (ft)	4.2	4.3	4.2	4.6	4.7		3.2	3.6	3.9	3.6	2.9		3.6	3.8	3.9	3.8	4.1	
Bankfull Cross Sectional Area (ft^2)	98.9	95.4	69.1	72.5	98.9		45.2	49.2	56.6	61	45.2		56.6	56.5	61.1	61.4	56.6	
Bankfull Width/Depth Ratio	20.1	21.7	28.1	25.7	36.9		13.0	12.5	9.8	10	12.4		10.8	14.0	13	13.4	12.0	
Bankfull Entrenchment Ratio	N/A	N/A	N/A	N/A	N/A		>4.1	>4.0	>4.2	>4.0	>4.2		>4.0	>3.6	>3.5	>3.5	>3.8	
Bankfull Bank Height Ratio	N/A	N/A	N/A	N/A	N/A		1.0	1.0	1.0	1.0	1.2		1.0	1.0	1.0	<1.0	1.0	
d50 (mm)	N/A	N/A	N/A	N/A	N/A		27	32	6.4	41	29		31	30	0.18	64	56.1	

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[2]**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4[2]**	**MY5**	**Base**	**MY1**	**MY2**	**MY3**	**MY4[2]**	**MY5**
bankfull elevation (ft)	989.4	989.4	989.4	989.4	989.7		988.2	988.2	988.2	988.2	988.5		986.4	986.4	986.4	986.4	986.9	
low bank elevation (ft)	989.4	989.4	989.3	989.4	989.7		988.2	988.3	988.3	988.3	993.4		986.4	986.5	986.4	986.5	986.8	
Bankfull Width (ft)	7.6	6.9	7.9	6.2	8.2		6.9	7.1	7.1	5.7	6.7		6.5	6.8	6.8	5.5	8.1	
Floodprone Width (ft)	28.8	29.0	30	29.3	25.9		N/A	N/A	N/A	N/A	N/A		21.0	20.6	19.2	18.8	17.8	
Bankfull Mean Depth (ft)	0.5	0.5	0.6	0.6	0.5		0.6	0.7	0.7	0.7	0.7		0.7	0.7	0.6	0.5	0.6	
Bankfull Max Depth (ft)	0.9	1.0	1.1	1.0	1.0		1.0	1.3	1.0	1.3	1.2		1.2	1.1	0.9	0.8	1.1	
Bankfull Cross Sectional Area (ft^2)	4.0	3.5	4.9	3.5	4.0		4.4	5.1	4.7	4.3	4.4		4.7	4.6	4.1	2.7	4.7	
Bankfull Width/Depth Ratio	14.2	13.6	12.8	10.8	17.1		10.7	9.8	10.8	7.7	10.3		8.9	10.3	11.3	11.2	14.1	
Bankfull Entrenchment Ratio	3.8	4.2	3.8	4.7	3.1		N/A	N/A	N/A	N/A	N/A		3.2	3.0	2.8	3.4	2.2	
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0		N/A	N/A	N/A	N/A	N/A		1.0	1.0	1.0	1.1	<1.0	
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	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.

[2]Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY5 bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter provided by NCIRT and NCDMS (9/2018).

Table 13a. Monitoring Data - Stream Reach Data Summary
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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	19.1	24.3	24.3	29.4	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	>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	1.5	1.9	1.9	2.2	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	3.4	3.4	3.4	3.4	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	41.4	42.7	42.7	43.9	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	8.8	14.3	14.3	19.7	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	>3.4	>4.3	>4.3	>5.2	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	0.9	1.0	1.0	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	16.6	43.0	37.4	97.6	-	11						
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	0.007	0.023	0.021	0.051	-	11						
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	13.8	98.1	99.7	172.0	-	11						
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	3.2	4.0	3.9	5.6	-	11						
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	61.5	132.0	129.1	230.6	-	10						
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						C4											
Channel Thalweg length (ft)	1,532						1,530						1,532						1,532						1,532											
Sinuosity (ft)	1.18						1.18						1.18						1.18						1.18											
Water Surface Slope (Channel) (ft/ft)	0.0063						0.0064						0.007						0.0064						0.0060											
BF slope (ft/ft)	0.0067						0.0069						0.0069						0.0068						0.0067											
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%	5%	23%	58%	14.0%	0%	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		0.40	7.5	17	61	105							
% of Reach with Eroding Banks	0%						7%						9%						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 4 - 2018

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	23.7	24.9	24.9	26.1	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	>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	1.9	2.1	2.1	2.2	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	2.9	3.5	3.5	4.1	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	45.2	50.9	50.9	56.6	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	12	12.2	12.2	12.4	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	>3.8	>4.0	>4.0	>4.2	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	1.0	1.1	1.1	1.2	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	51.5	94.0	69.9	151.2	-	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	0.004	0.0089	0.009	0.012	-	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	42.3	98.1	87.5	184.1	-	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	4.2	4.9	4.5	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	188.1	202.1	203.0	214.4	-	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						C4											
Channel Thalweg length (ft)	1,085						1,085						1,085						1,085						1,085											
Sinuosity (ft)	1.37						1.37						1.37						1.37						1.37											
Water Surface Slope (Channel) (ft/ft)	0.0050						0.0045						0.005						0.0054						0.0053											
BF slope (ft/ft)	0.0053						0.0053						0.0053						0.0057						0.0062											
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%	0%	5.0%	69%	23%	3%	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		13	24	37	95	224							
% of Reach with Eroding Banks	0%						2%						13%						6%						10%											
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 4 - 2018

UT2 (675 feet)

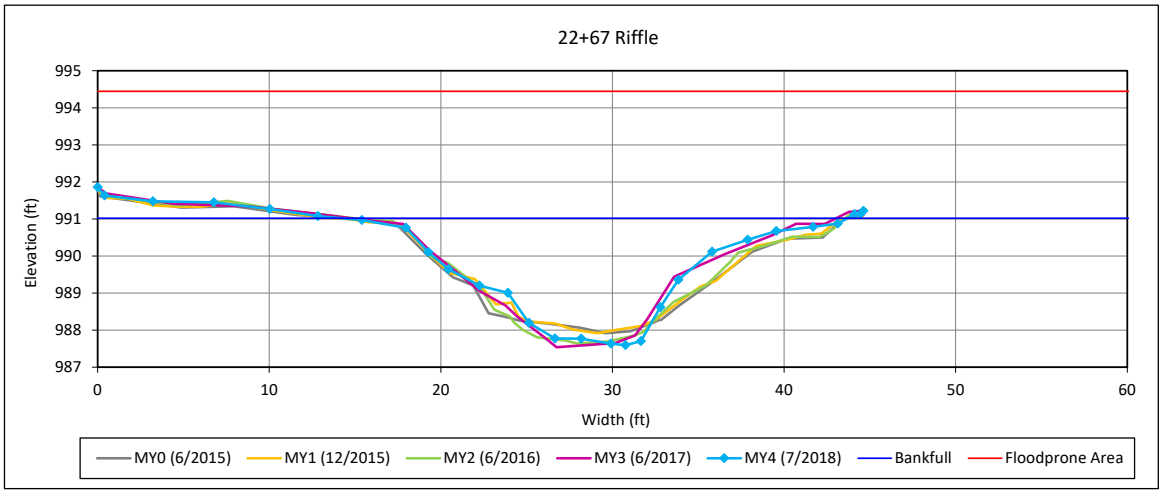
Parameter	Baseline						MY1						MY2						MY3						MY4						MY5					
	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle only																																				
Bankfull Width (ft)	6.5	7.1	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	8.1	8.2	8.2	8.2	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	17.8	21.9	21.9	25.9	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	0.5	0.6	0.6	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	1.0	1.1	1.1	1.1	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	4.0	4.4	4.4	4.7	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	14.1	15.6	15.6	17.1	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	2.2	2.7	2.7	3.1	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	0.9	1.0	1.0	1.0	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	5.2	19.7	16.6	55.4	-	16						
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	0.023	0.050	0.044	0.130	-	16						
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	10.0	18.8	18.0	39.8	-	16						
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	0.8	1.6	1.6	2.6	-	15						
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	14.6	42.0	36.8	142.0	-	14						
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						B4											
Channel Thalweg length (ft)	675						670						675						675						675											
Sinuosity (ft)	1.24						1.24						1.24						1.24						1.24											
Water Surface Slope (Channel) (ft/ft)	0.0218						0.0208						0.0215						0.0205						0.0199											
BF slope (ft/ft)	0.0229						0.0226						0.0224						0.0222						0.0224											
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%						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 4 - 2018

Cross-Section 1-Hogan Creek Reach 1



Bankfull Dimensions	
43.9	x-section area (ft.sq.)
29.4	width (ft)
1.5	mean depth (ft)
3.4	max depth (ft)
30.8	wetted perimeter (ft)
1.4	hydraulic radius (ft)
19.7	width-depth ratio
100.0	W flood prone area (ft)
3.4	entrenchment ratio
0.9	low bank height ratio

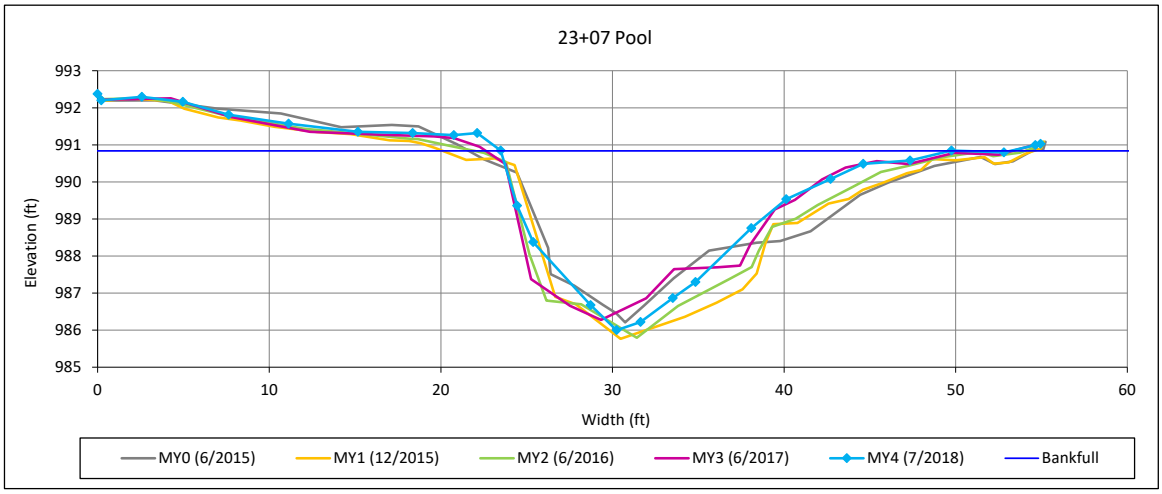
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 2-Hogan Creek Reach 1



Bankfull Dimensions	
57.6	x-section area (ft.sq.)
29.1	width (ft)
2.0	mean depth (ft)
4.8	max depth (ft)
31.7	wetted perimeter (ft)
1.8	hydraulic radius (ft)
14.7	width-depth ratio

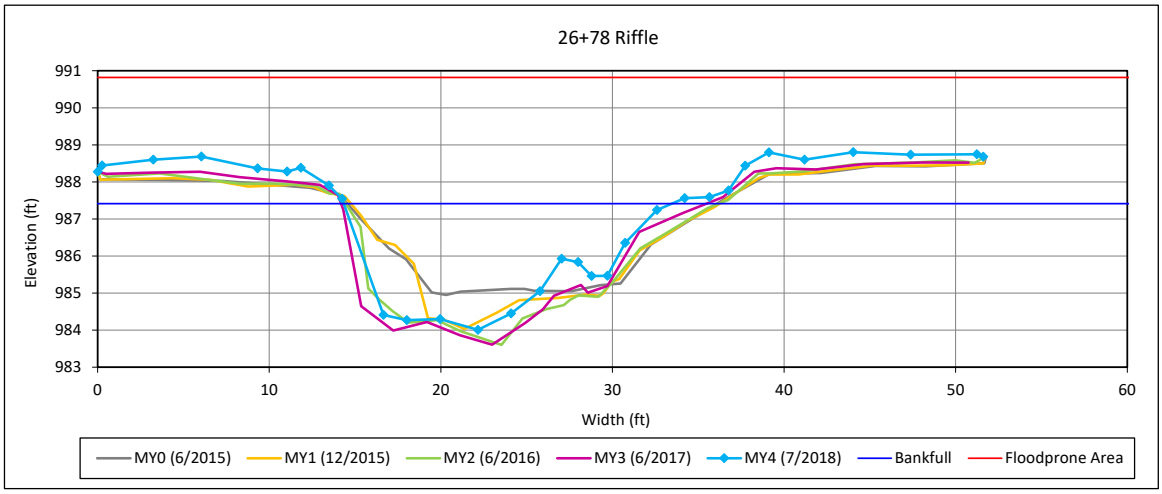
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 3-Hogan Creek Reach 1



Bankfull Dimensions	
41.4	x-section area (ft.sq.)
19.1	width (ft)
2.2	mean depth (ft)
3.4	max depth (ft)
21.7	wetted perimeter (ft)
1.9	hydraulic radius (ft)
8.8	width-depth ratio
100.0	W flood prone area (ft)
5.2	entrenchment ratio
1.1	low bank height ratio

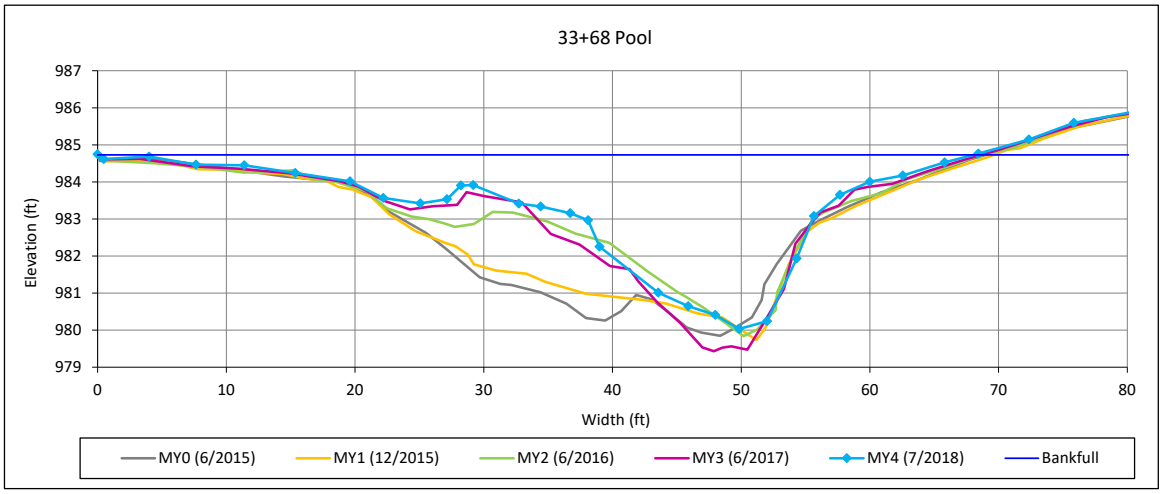
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 4-Hogan Creek Reach 2



Bankfull Dimensions	
98.9	x-section area (ft.sq.)
60.4	width (ft)
1.6	mean depth (ft)
4.7	max depth (ft)
62.2	wetted perimeter (ft)
1.6	hydraulic radius (ft)
36.9	width-depth ratio

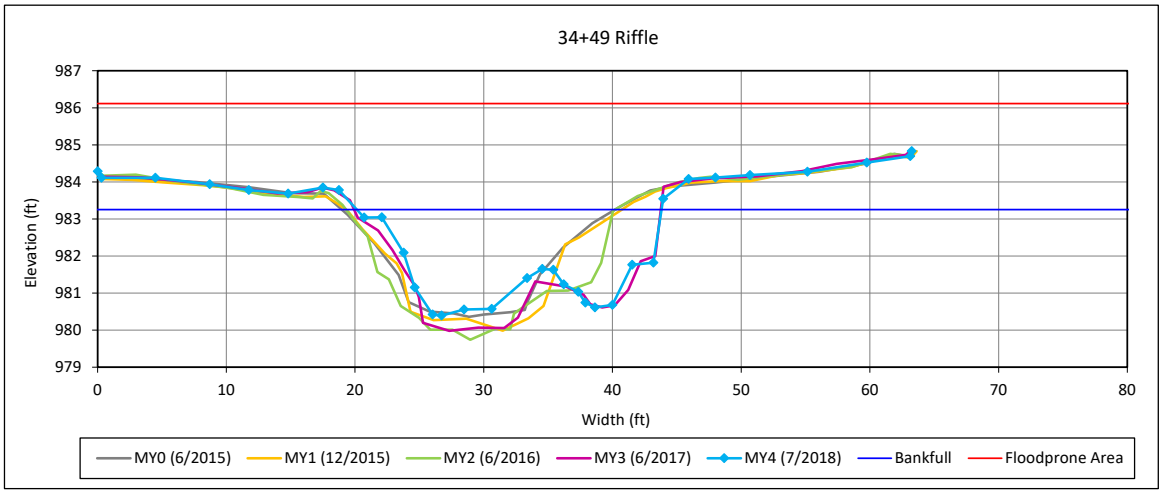
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 5-Hogan Creek Reach 2



Bankfull Dimensions	
45.2	x-section area (ft.sq.)
23.7	width (ft)
1.9	mean depth (ft)
2.9	max depth (ft)
26.2	wetted perimeter (ft)
1.7	hydraulic radius (ft)
12.4	width-depth ratio
100.0	W flood prone area (ft)
4.2	entrenchment ratio
1.2	low bank height ratio

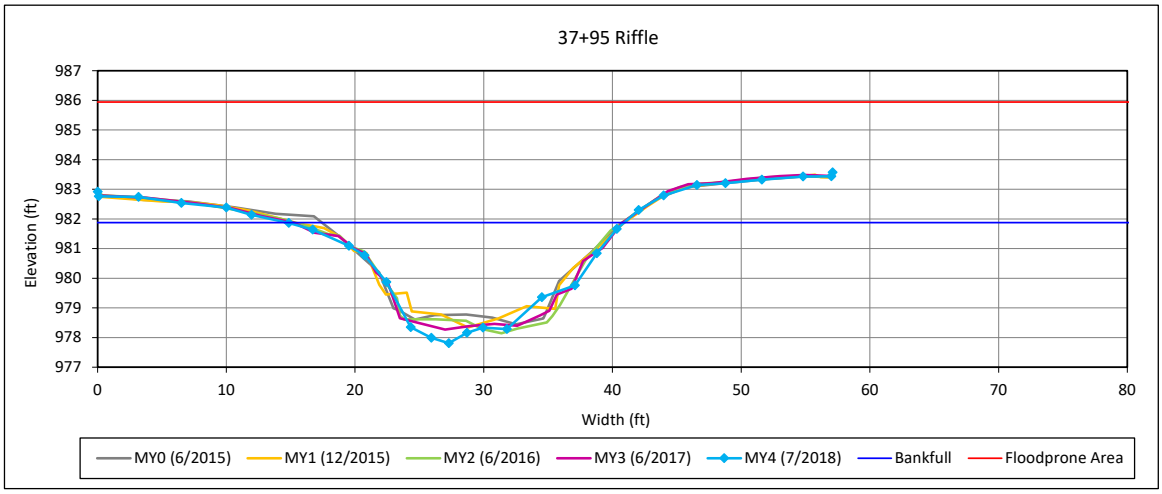
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 6-Hogan Creek Reach 2



Bankfull Dimensions	
56.6	x-section area (ft.sq.)
26.1	width (ft)
2.2	mean depth (ft)
4.1	max depth (ft)
27.8	wetted perimeter (ft)
2.0	hydraulic radius (ft)
12.0	width-depth ratio
100.0	W flood prone area (ft)
3.8	entrenchment ratio
1.0	low bank height ratio

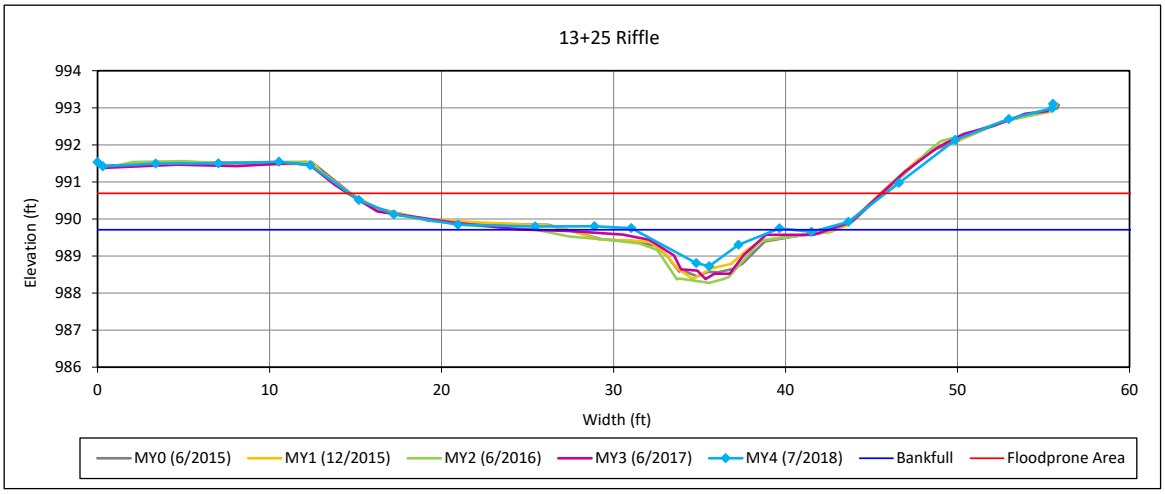
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 7-UT2



Bankfull Dimensions	
4.0	x-section area (ft.sq.)
8.2	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
8.5	wetted perimeter (ft)
0.5	hydraulic radius (ft)
17.1	width-depth ratio
25.9	W flood prone area (ft)
3.1	entrenchment ratio
1.0	low bank height ratio

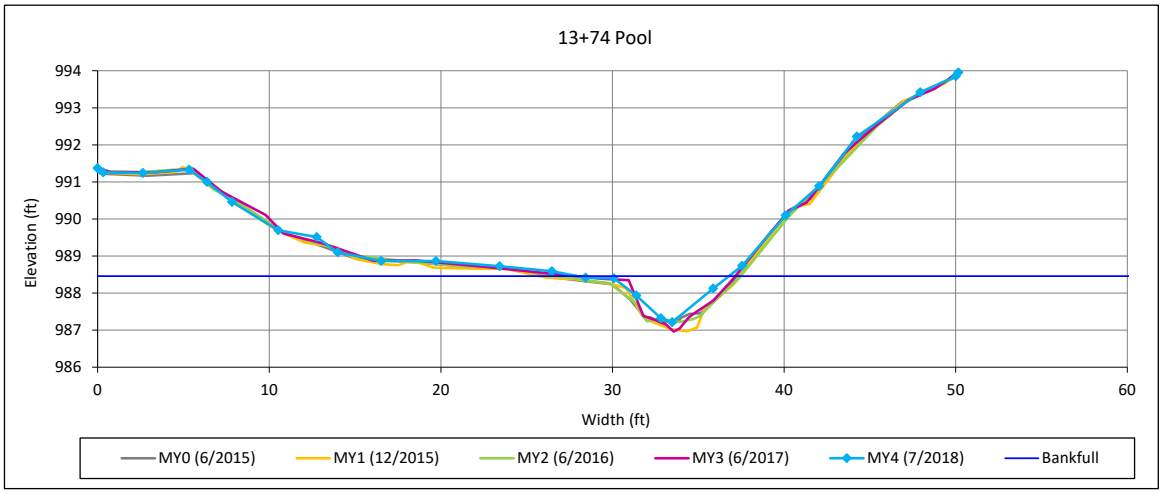
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 8-UT2



Bankfull Dimensions	
4.4	x-section area (ft.sq.)
6.7	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
7.2	wetted perimeter (ft)
0.6	hydraulic radius (ft)
10.3	width-depth ratio

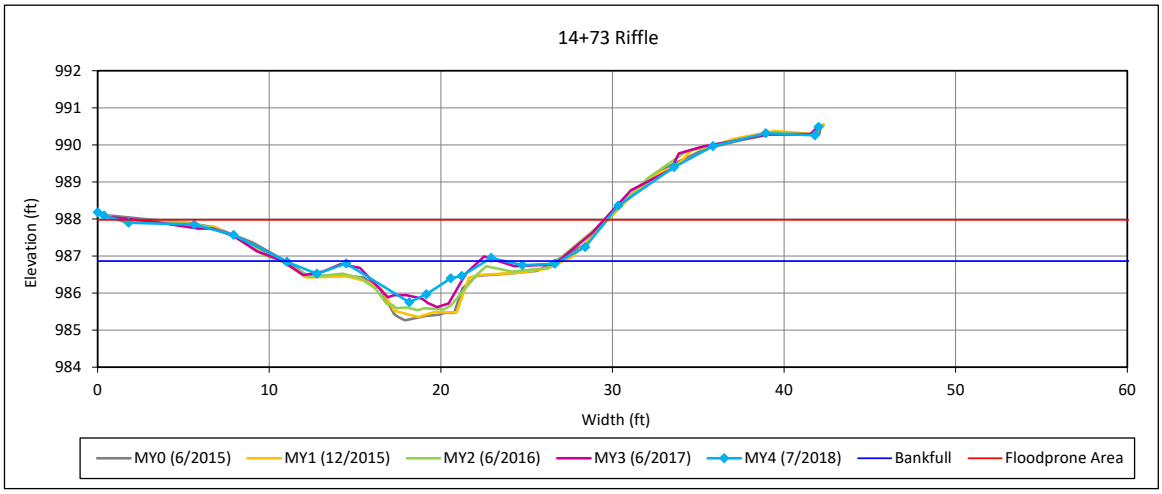
Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

Cross-Section Plots

Hogan Creek Stream Mitigation Project
NCDMS Project No. 94708
Monitoring Year 4 - 2018

Cross-Section 9-UT2



Bankfull Dimensions	
4.7	x-section area (ft.sq.)
8.1	width (ft)
0.6	mean depth (ft)
1.1	max depth (ft)
8.4	wetted perimeter (ft)
0.6	hydraulic radius (ft)
14.1	width-depth ratio
17.8	W flood prone area (ft)
2.2	entrenchment ratio
0.9	low bank height ratio

Survey Date: 7/2018
Field Crew: Kee Mapping & Surveying

View Downstream

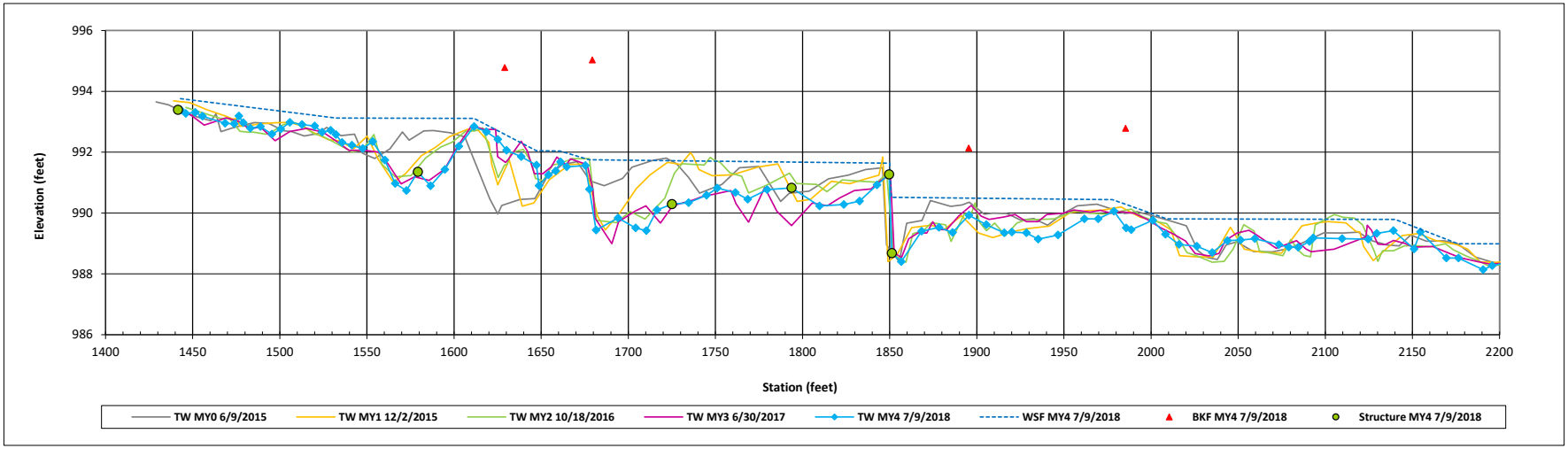
Longitudinal Profile Plots

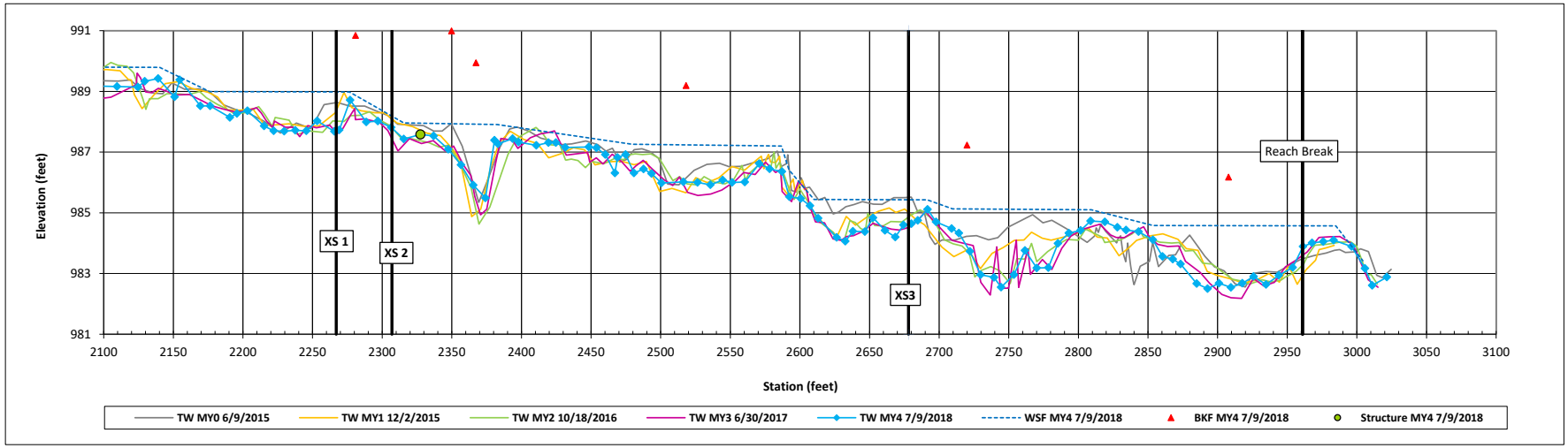
Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 4 - 2018

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





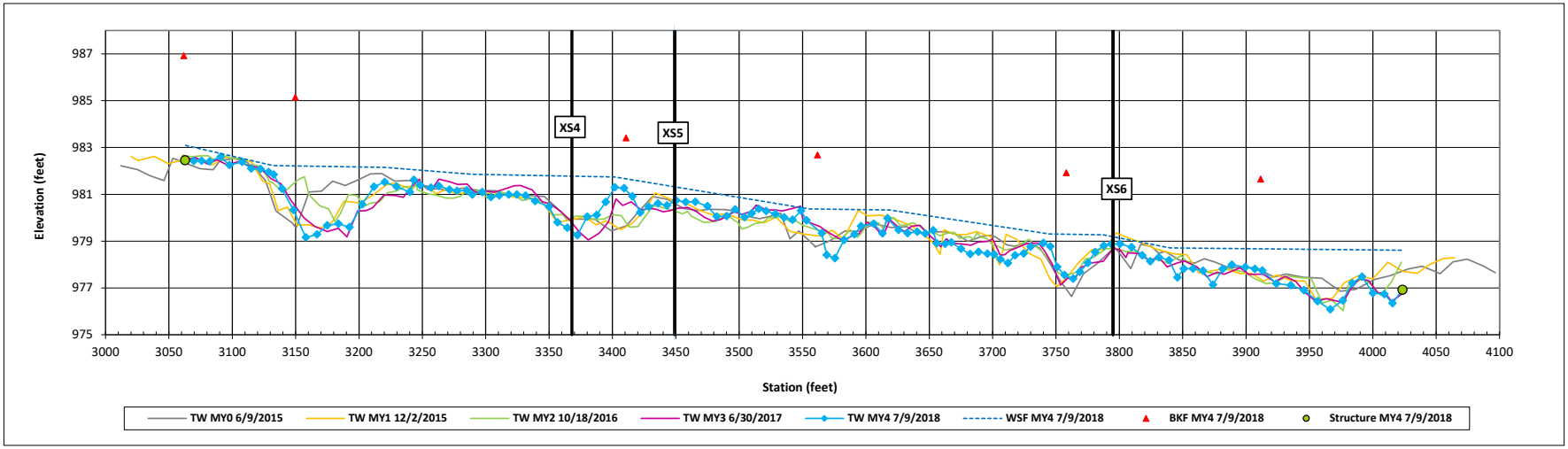
Longitudinal Profile Plots

Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 4 - 2018

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



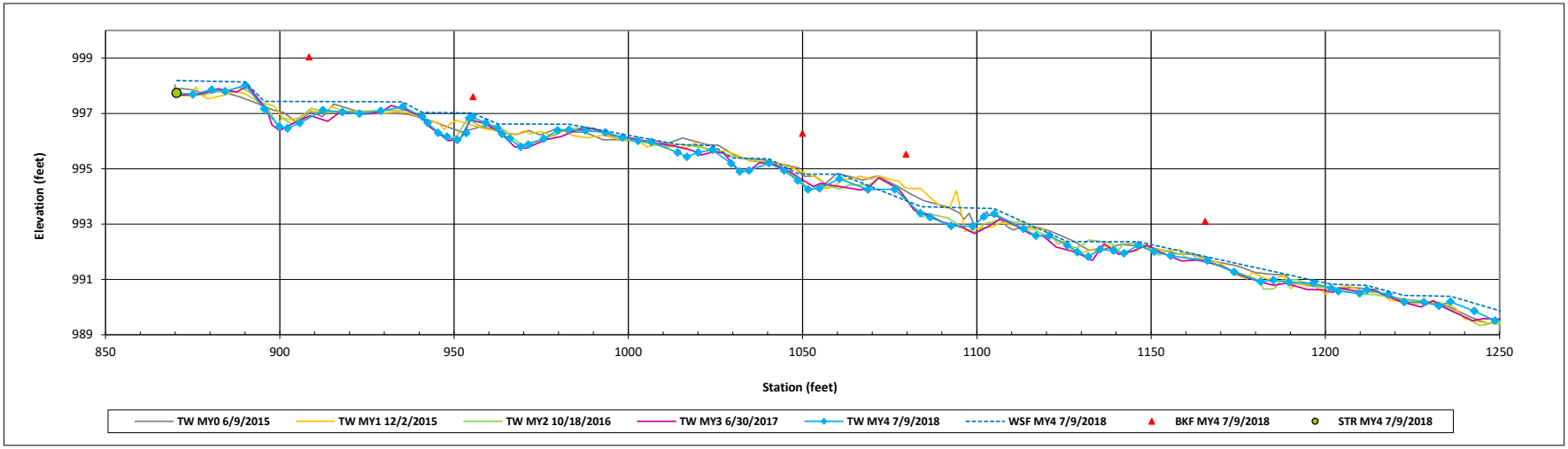
Longitudinal Profile Plots

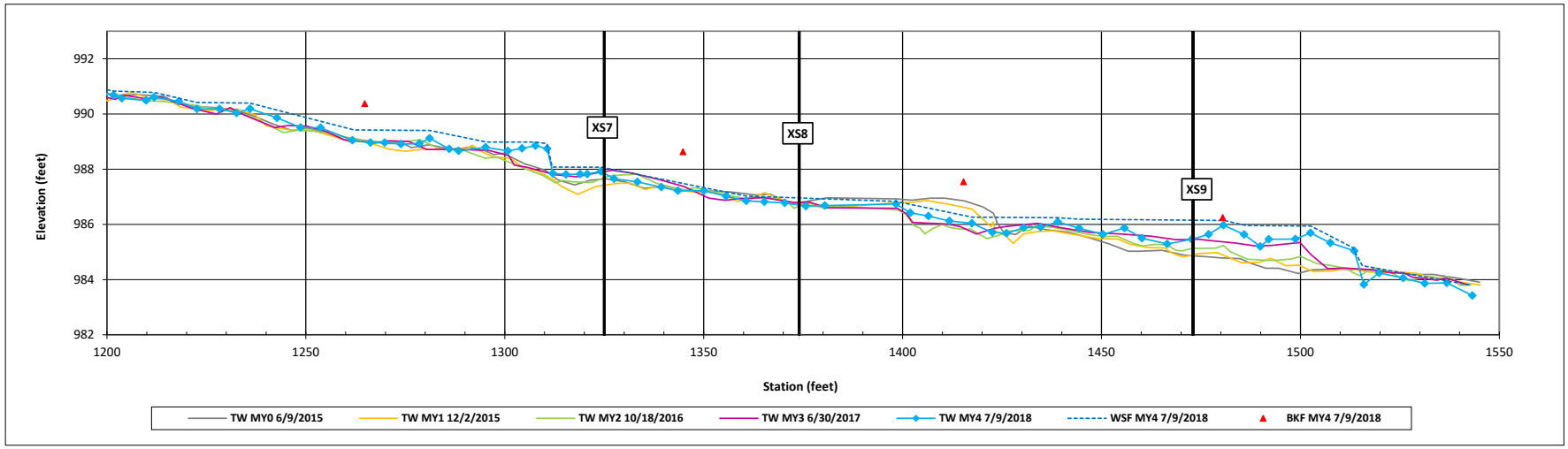
Hogan Creek Mitigation Project

DMS Project No. 92343

Monitoring Year 4 - 2018

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





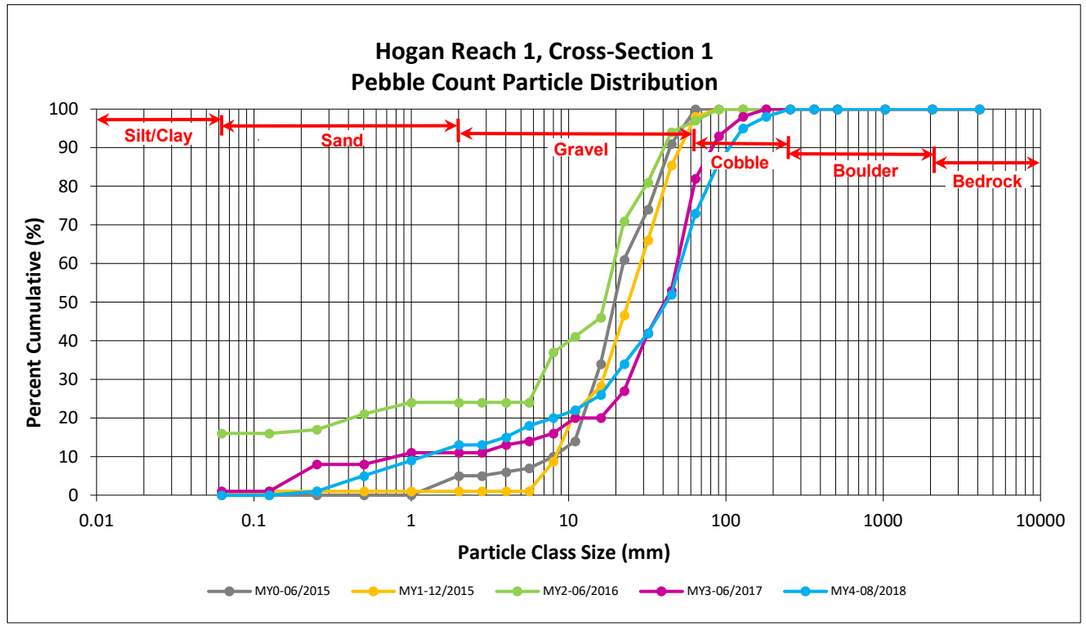
Cross-Section Pebble Count Plots

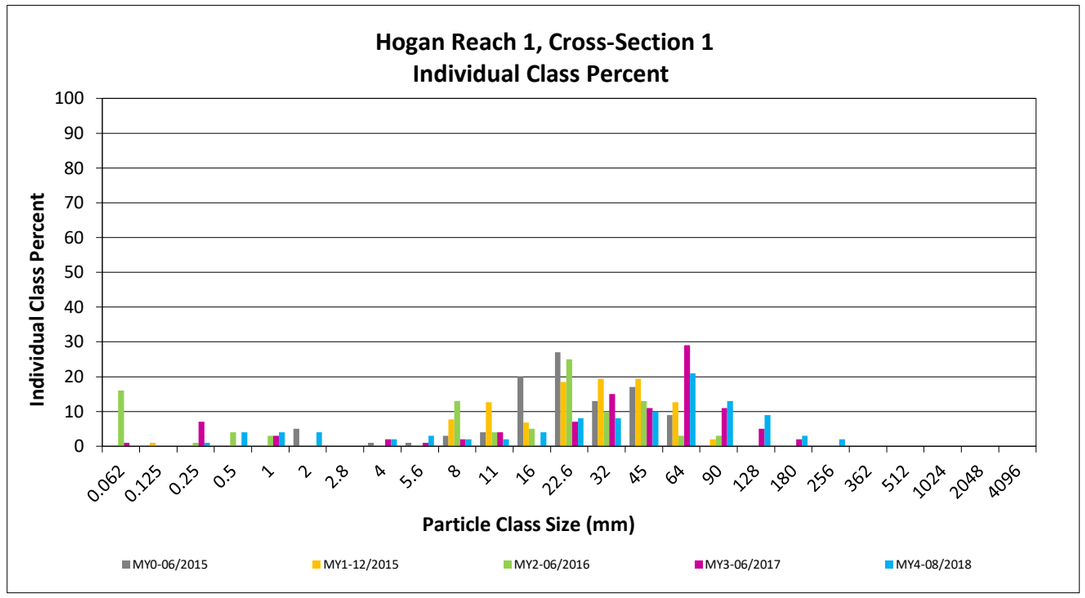
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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			0
SAND	Very fine	0.062	0.125			0
	Fine	0.125	0.250	1	1	1
	Medium	0.25	0.50	4	4	5
	Coarse	0.5	1.0	4	4	9
	Very Coarse	1.0	2.0	4	4	13
GRAVEL	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0	2	2	15
	Fine	4.0	5.6	3	3	18
	Fine	5.6	8.0	2	2	20
	Medium	8.0	11.0	2	2	22
	Medium	11.0	16.0	4	4	26
	Coarse	16.0	22.6	8	8	34
	Coarse	22.6	32	8	8	42
	Very Coarse	32	45	10	10	52
	Very Coarse	45	64	21	21	73
COBBLE	Small	64	90	13	13	86
	Small	90	128	9	9	95
	Large	128	180	3	3	98
	Large	180	256	2	2	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} =	4.47
D_{35} =	23.60
D_{50} =	42.0
D_{84} =	85.4
D_{95} =	128.0
D_{100} =	256.0





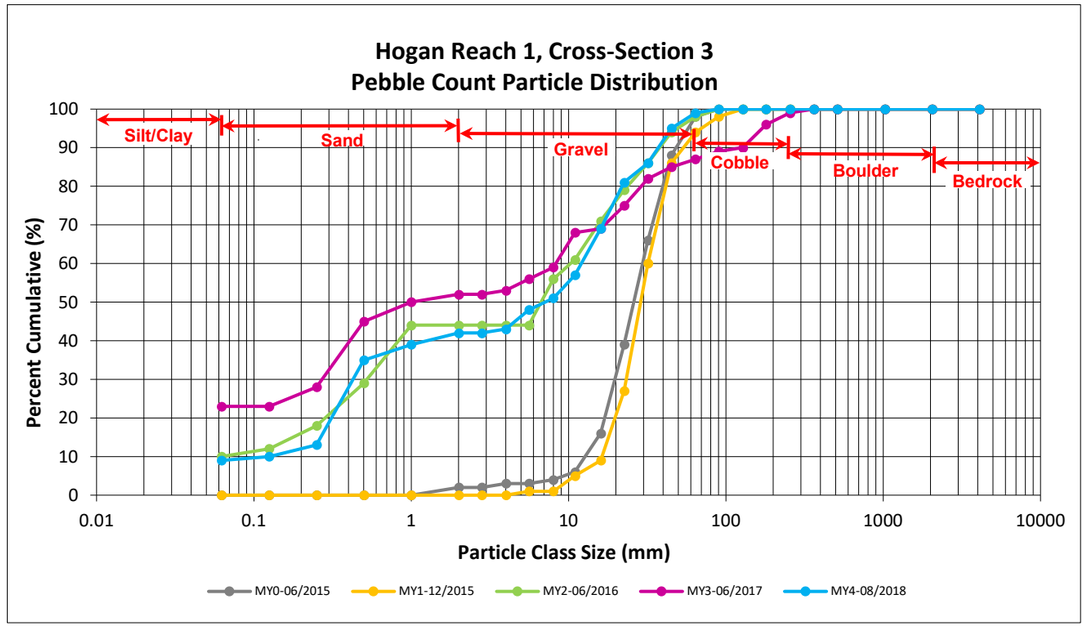
Cross-Section Pebble Count Plots

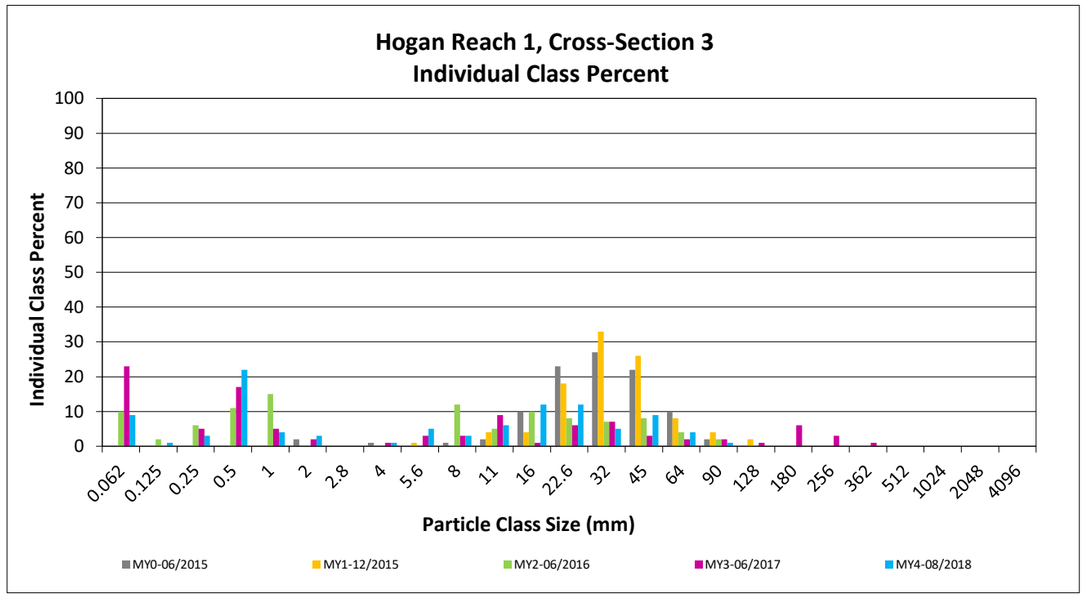
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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	9	9	9
SAND	Very fine	0.062	0.125	1	1	10
	Fine	0.125	0.250	3	3	13
	Medium	0.25	0.50	22	22	35
	Coarse	0.5	1.0	4	4	39
	Very Coarse	1.0	2.0	3	3	42
GRAVEL	Very Fine	2.0	2.8			42
	Very Fine	2.8	4.0	1	1	43
	Fine	4.0	5.6	5	5	48
	Fine	5.6	8.0	3	3	51
	Medium	8.0	11.0	6	6	57
	Medium	11.0	16.0	12	12	69
	Coarse	16.0	22.6	12	12	81
	Coarse	22.6	32	5	5	86
	Very Coarse	32	45	9	9	95
	Very Coarse	45	64	4	4	99
COBBLE	Small	64	90	1	1	100
	Small	90	128			100
	Large	128	180			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 3	
Channel materials (mm)	
D_{16} =	0.27
D_{35} =	0.50
D_{50} =	7.1
D_{84} =	27.8
D_{95} =	45.0
D_{100} =	90.0





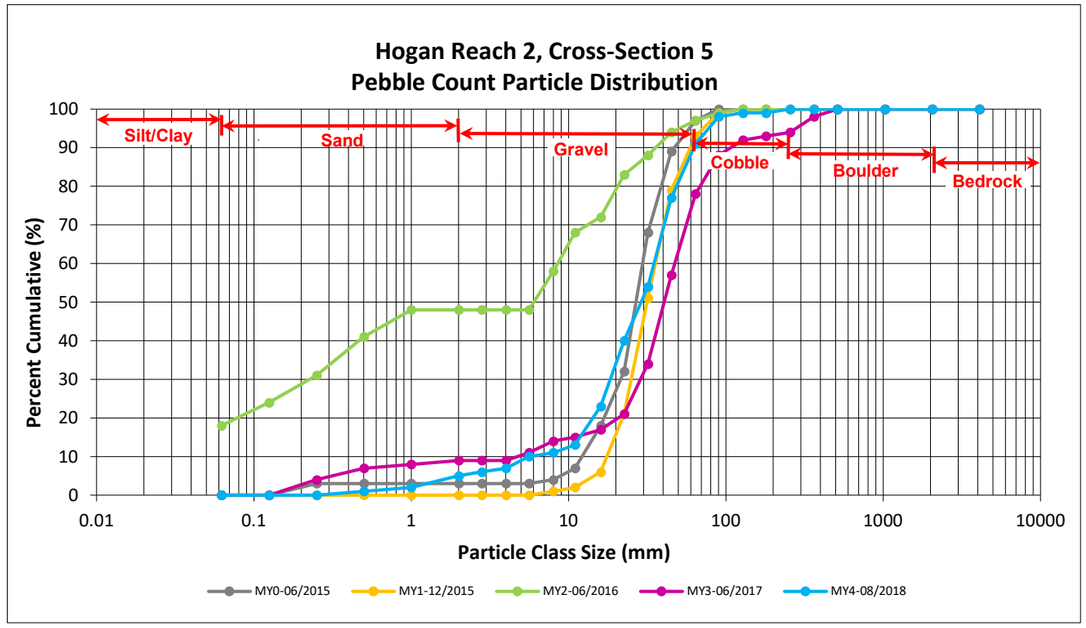
Cross-Section Pebble Count Plots

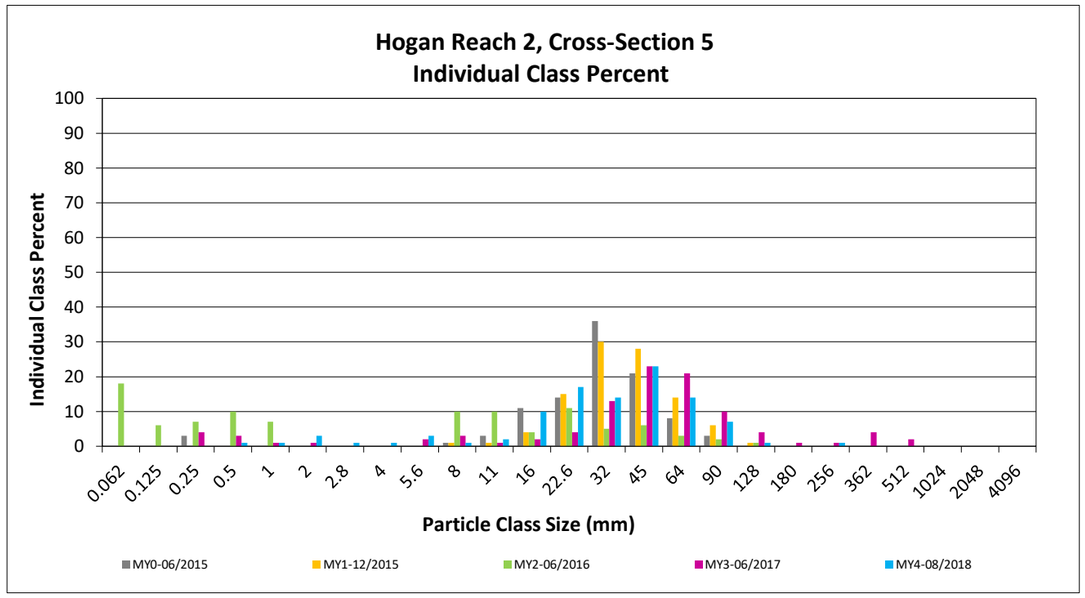
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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			0
	Medium	0.25	0.50	1	1	1
	Coarse	0.5	1.0	1	1	2
	Very Coarse	1.0	2.0	3	3	5
GRAVEL	Very Fine	2.0	2.8	1	1	6
	Very Fine	2.8	4.0	1	1	7
	Fine	4.0	5.6	3	3	10
	Fine	5.6	8.0	1	1	11
	Medium	8.0	11.0	2	2	13
	Medium	11.0	16.0	10	10	23
	Coarse	16.0	22.6	17	17	40
	Coarse	22.6	32	14	14	54
	Very Coarse	32	45	23	23	77
	Very Coarse	45	64	14	14	91
COBBLE	Small	64	90	7	7	98
	Small	90	128	1	1	99
	Large	128	180			99
	Large	180	256	1	1	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 5	
Channel materials (mm)	
D_{16} =	12.31
D_{35} =	20.42
D_{50} =	29.0
D_{84} =	53.7
D_{95} =	77.8
D_{100} =	256.0





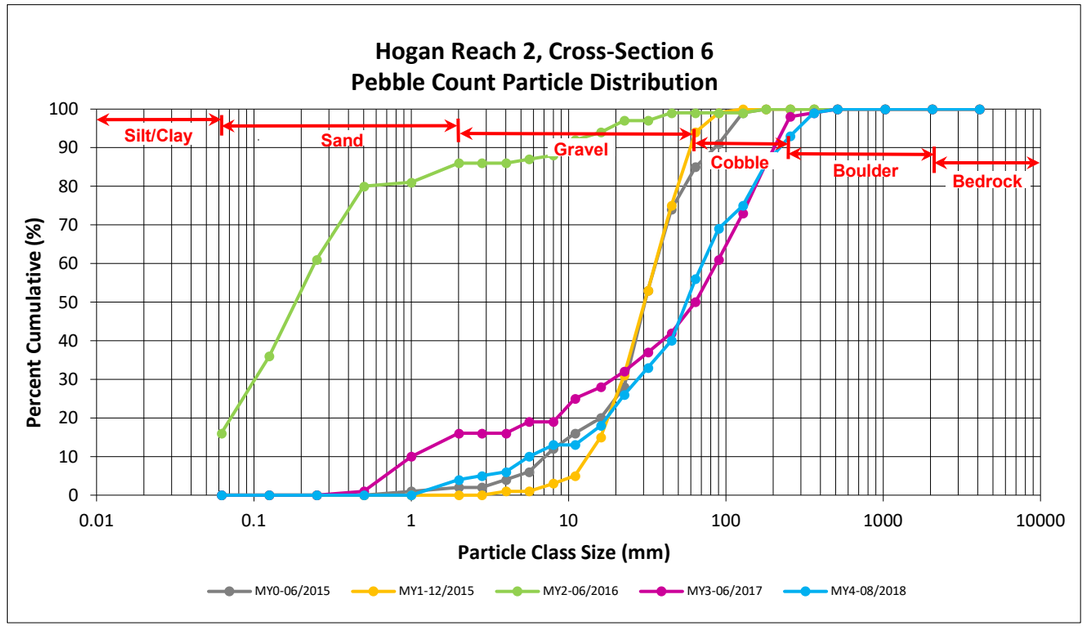
Cross-Section Pebble Count Plots

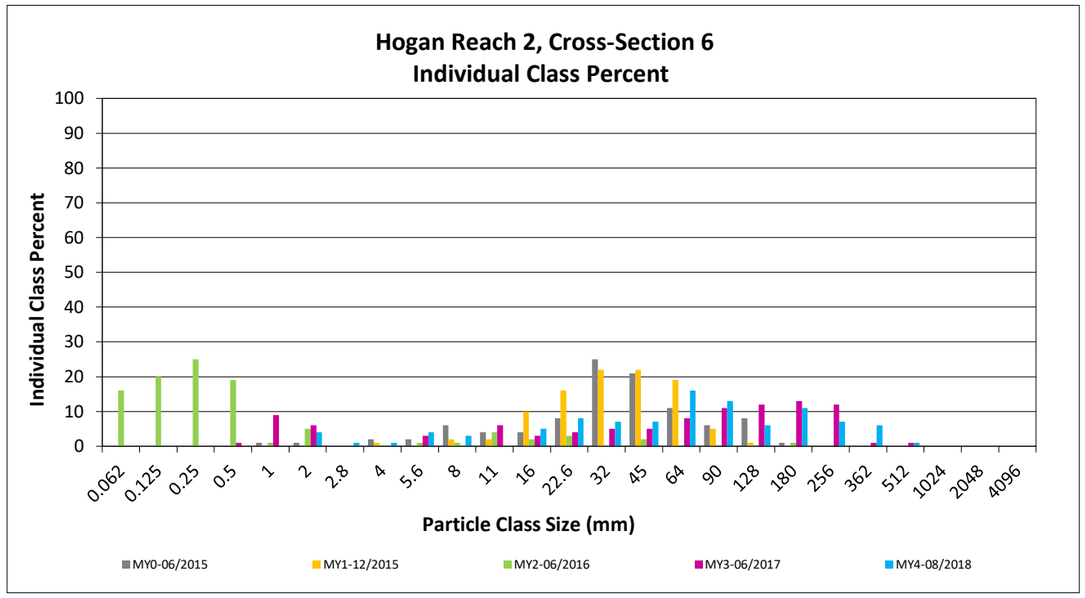
Hogan Creek Stream Mitigation Project
DMS Project No. 94708
Monitoring Year 4 - 2018

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			0
	Coarse	0.5	1.0			0
	Very Coarse	1.0	2.0	4	4	4
GRAVEL	Very Fine	2.0	2.8	1	1	5
	Very Fine	2.8	4.0	1	1	6
	Fine	4.0	5.6	4	4	10
	Fine	5.6	8.0	3	3	13
	Medium	8.0	11.0			13
	Medium	11.0	16.0	5	5	18
	Coarse	16.0	22.6	8	8	26
	Coarse	22.6	32	7	7	33
	Very Coarse	32	45	7	7	40
	Very Coarse	45	64	16	16	56
COBBLE	Small	64	90	13	13	69
	Small	90	128	6	6	75
	Large	128	180	11	11	86
	Large	180	256	7	7	93
BOULDER	Small	256	362	6	6	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} =	13.77
D_{35} =	35.27
D_{50} =	56.1
D_{84} =	169.2
D_{95} =	287.3
D_{100} =	512.0





APPENDIX E. Hydrology Summary Data and Plots

Table 14. Verification of Bankfull Events

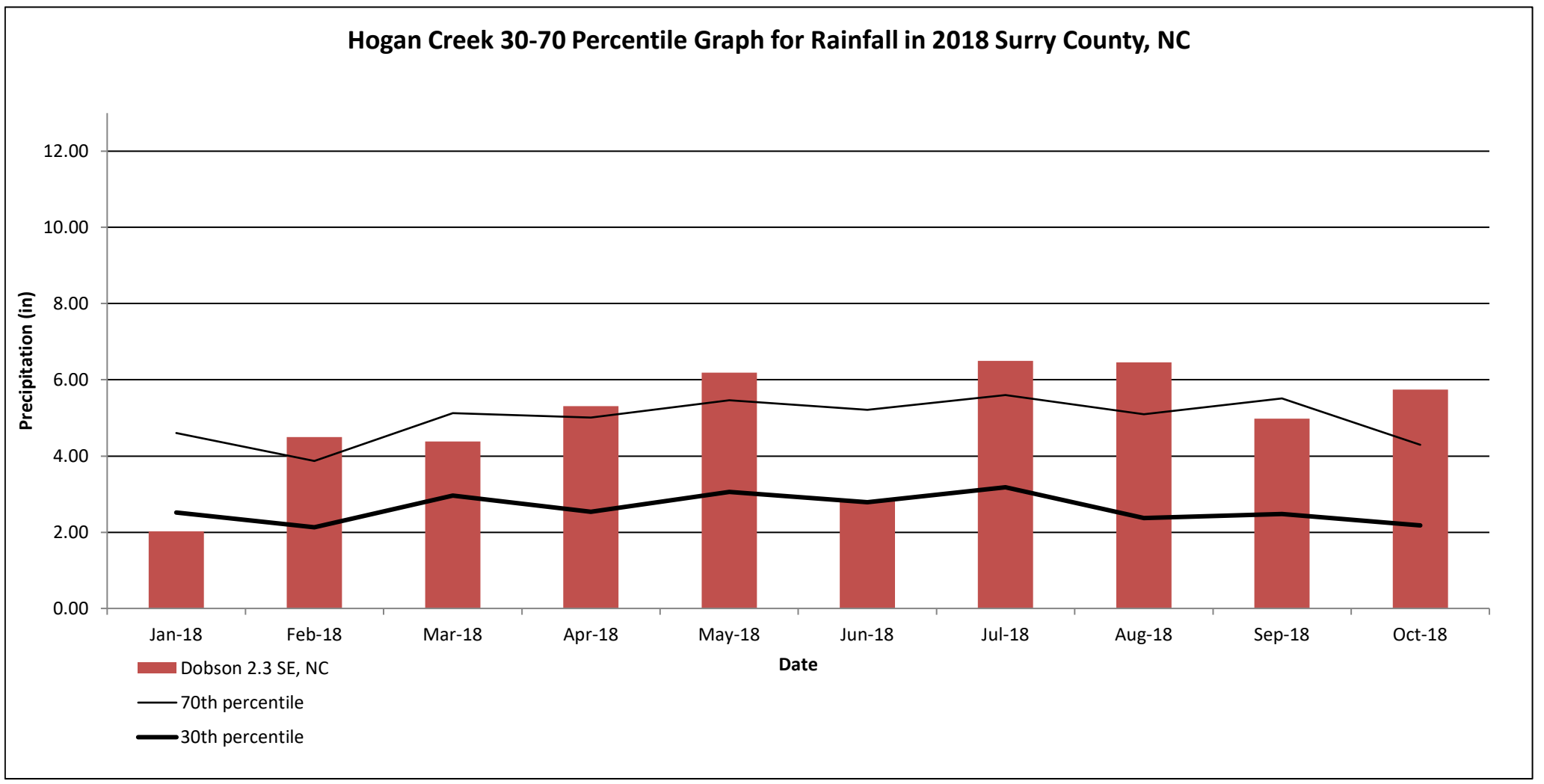
Hogan Creek Stream Mitigation Project
DMS Project No.94708
Monitoring Year 4 - 2018

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
	MY2	4/12/2016	4/1/2016-4/12/2016	Wrack Lines/Sediment Deposition
	MY3	7/5/2017	~5/22/2017-5/23/2017	Wrack Lines
	MY4	4/19/2018	~4/16/2018	Crest Gage/Wrack Lines
UT2	MY1	10/26/2015	10/2/2015-10/3/2015	Crest Gage
	MY2	8/2/2016	~ 6/16/2016	Crest Gage
	MY2	4/12/2016	4/1/2016-4/12/2016	Wrack Lines/Sediment Deposition
	MY3	7/5/2017	~5/22/2017-5/23/2017	Crest Gage/Wrack Lines
	MY4	4/19/2018	~4/16/2018	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 4 - 2018



[1] 2018 rainfall collected from NC CRONOS Station Name: Dobson 2.3 SE, NC (NCSU, 2018)

[2] 30th and 70th percentile rainfall data collected from weather station ELKIN, NC (USDA, 2018)