MONITORING YEAR 3 ANNUAL REPORT

Final

HOPEWELL STREAM MITIGATION SITE

Randolph County, NC
NCDEQ Contract 004642
NCDMS Project Number 95352

Data Collection Period: February 2017 - September 2017
Final Submission Date: December 20, 2017

PREPARED FOR:

NC Department of Environmental Quality
Division of Mitigation Services
1652 Mail Service Center
Raleigh, NC 27699-1652

PREPARED BY:

WILDLANDS
ENGINEERING

1430 South Mint Street, Suite 104
Charlotte, NC 28203

Phone: 704.332.7754
Fax: 704.332.3306

EXECUTIVE SUMMARY

Wildlands Engineering, Inc. (Wildlands) completed a full delivery project at the Hopewell Mitigation Site (Site) for the North Carolina Division of Mitigation Services (DMS) to restore, enhance, and preserve a total of 12,308 linear feet (LF) of perennial and intermittent streams in Randolph County, NC. The Site is expected to generate 7,412 stream mitigation units (SMUs) by closeout. The Site is located near the town of Asheboro in Randolph County, NC in the Yadkin-Pee Dee River Basin. The eight digit Cataloging Unit (CU) is 03040104 and the 14-digit Hydrologic Unit Code (HUC) is 03040104030010 (Figure 1). The Little River eventually flows into the Pee Dee River near the town of Ingram in Richmond County. The other five streams are small headwater tributaries to the Little River. The project streams consist of the Little River, and five unnamed tributaries (UTs) to the Little River (Figure 2). The adjacent land to the streams and wetlands is primarily pasture land and forest.

The Site is located in the Little River watershed which was designated as a Targeted Local Watershed (TLW) in the 2009 Lower Yadkin Pee-Dee River Basin Restoration Priorities (RBRP) plan. The RBRP plan does not specifically identify stressors or project goals in this TLW, but states that continuing watershed improvements will increase ecological uplift. The intent of this project is to help meet the goals for the watershed outlined in the RBRP and provide numerous ecological benefits within the Yadkin-Pee Dee River Basin.

The project goals established in the mitigation plan (Wildlands, 2013) were completed with careful consideration of goals and objectives that were described in the RBRP and to meet DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed. The following project goals established include:

- Restoring a degraded stream impacted by cattle to create and improve aquatic habitat, reduce sediment inputs from streambank erosion, and reduce agricultural runoff pollution; and
- Restoring a riparian buffer along stream corridors for additional terrestrial and aquatic habitat, nutrient input reduction, and water quality benefits.

The Site construction, planting, and as-built surveys were completed between July 2014 and January 2015. A conservation easement is in place on 35.4 acres of the riparian corridors to protect them in perpetuity.

Monitoring Year 3 (MY3) assessments and site visits were completed between February and September 2017 to assess the conditions of the project. Overall, the Site has met the required stream and vegetation success criteria for MY3. The overall average stem density for the Site is 461 stems per acre and is therefore meeting the MY3 requirement of 320 stems per acre. All restored and enhanced streams are stable and functioning as designed. Five hydrology monitoring stations with crest gages and pressure transducers were installed on the Site to document bankfull events. Multiple bankfull events have been recorded since project construction and therefore the Site has met the Monitoring Year 7 hydrology success criteria in which two or more bankfull events must have occurred in separate years within the restoration reaches.

HOPEWELL STREAM MITIGATION SITE
Monitoring Year 3 Annual Report

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APPENDICES

Section 1: PROJECT OVERVIEW

The Hopewell Stream Mitigation Site (Site) is located in central Randolph County within the Yadkin-Pee Dee River Basin (USGS Hydrologic Unit 03040104) near the town of Asheboro, North Carolina. The Site is located along Hopewell Friends Road, Mack Road, and Pisgah Covered Bridge Road, just east of Interstate 74/73. The Site is located in in the Carolina Slate Belt of the Piedmont Physiographic Province (USGS, 1998). The project watershed consists primarily of agricultural and wooded land. The only significant development in the watershed is within the northern extent which includes portions of the City of Asheboro. The drainage area for the western portion of the project site is 429 acres (0.67 square miles). The drainage area for the eastern portion of the project site; which includes a reach on the Little River, is 4,517 acres (7.06 square miles).

The project streams consist of the Little River and five UTs to the Little River. Mitigation work within the Site included restoration, enhancement, and preservation of 12,308 linear feet (LF) of perennial and intermittent stream channel. Stream restoration reaches included UT2 (Reach 1 and 2), UT2A (Reach 2), UT2B (Reach 2), and UT2C (Reach 2 and 3). Stream enhancement I (EI) included UT1B Reach 1 and UT2A Reach 1. Stream enhancement II (EII) reaches included Little River Reach 2, UT1A Reach 1, UT1B Reach 2 and 3, UT2B Reach 1, and UT2C Reach 1. Preservation reaches at the Site included Little River Reach 1 and UT1A Reach 2. The riparian areas were planted with native vegetation to improve habitat and protect water quality. Construction activities were completed by Terry's Plumbing and Land Mechanics Designs, Inc. in November 2014. Planting and seeding activities were completed by Bruton Natural Systems, Inc. and Terry's Plumbing in January 2015. A conservation easement has been recorded and is in place along the stream riparian corridors to protect them in perpetuity. The conservation easement includes 35.954 acres (Deed Book 2371, Page 108-122) within a tract owned by Double T Farms of Randolph, LLC. The project provides 7,412 stream mitigation units (SMU's).

Directions and a map of the Site are provided in Figure 1 and project components are illustrated for the Site in Figure 2.

1.1 Project Goals and Objectives

Prior to construction activities, many of the streams on the Site, especially those that were accessed less by cattle, exhibited relative stability. However, other project reaches appeared incised and had been severely trampled by cattle resulting in unstable banks and the bed morphologies were often destroyed. Table 4 in Appendix 1 and Tables 10a through 10d in Appendix 4 present the pre-restoration conditions in detail.

This Site is intended to provide numerous ecological benefits within the Yadkin-Pee Dee River Basin. The Site will help meet the goals for the watershed outlined in the RBRP and provide numerous ecological benefits within the Yadkin-Pee Dee River Basin. While many of these benefits are limited to the Hopewell project area, others, such as pollutant removal, reduced sediment loading, and improved aquatic and terrestrial habitat, have farther-reaching effects. Expected improvements to water quality and ecological processes are outlined below as project goals and objectives. These project goals were established with careful consideration of goals and objectives that were described in the RBRP and to meet DMS mitigation needs while maximizing the ecological and water quality uplift within the watershed.

The RBRP describes the goals for the 8-digit HUC as the following:

- Continuation of watershed improvement efforts already on-going;
- Protection of valuable natural resources; and

- Development of local partnerships that will work together to implement management strategies for stormwater impacts.

The following project specific goals were established in the mitigation plan (Wildlands, 2013) to contribute to meeting management goals as described above for the Yadkin-Pee Dee Catalog Unit 03040104 and the Little River TLW include:

- Restoring a degraded stream impacted by cattle to create and improve aquatic habitat, reduce sediment inputs from streambank erosion, and reduce agricultural runoff pollution; and
- Restoring a riparian buffer along stream corridors for additional terrestrial and aquatic habitat, nutrient input reduction, and water quality benefits.

The project goals were addressed through the following project objectives as stated in the mitigation plan:

- On-site nutrient inputs will be decreased by removing cattle from streams and filtering on-site runoff through buffer zones. Off-site nutrient inputs will be absorbed on–site by filtering flood flows through restored floodplain areas, where flood flow will spread through native vegetation;
- Restored buffers and exclusion of livestock to streams will significantly reduce inputs of livestock wastes to streams. This will eliminate a major source of fecal coliform pollution;
- Streambank erosion which contributes sediment load to the creek will be greatly reduced, if not eliminated, in the project area. Eroding stream banks will be stabilized using bioengineering, natural channel design techniques, and grading to reduce bank angles and bank height. Storm flow containing fine sediment will be filtered through restored floodplain areas, where flow will spread through native vegetation. Spreading flood flows will also reduce velocity and allow sediment to settle out. Sediment transport capacity of restored reaches will be improved so that capacity balances more closely to load;
- Restored riffle/pool sequences will promote aeration of water and create deep water zones, helping to lower water temperature. Establishment and maintenance of riparian buffers will create long-term shading of the channel flow to minimize thermal heating. Lower water temperatures will help maintain dissolved oxygen concentrations;
- In-stream structures will be constructed to improve habitat diversity and trap detritus. Wood habitat structures will be included in the stream as part of the restoration design. Such structures may include log drops and riffle structures that incorporate woody debris;
- Adjacent buffer and riparian habitats will be restored with native vegetation as part of the project. Native vegetation will provide cover and food for terrestrial wildlife. Native plant species will be planted and invasive species will be treated. Eroding and unstable areas will also be stabilized with vegetation as part of this project; and
- The restored land will be protected in perpetuity through a conservation easement.

The design streams were restored to the appropriate type based on the surrounding landscape, climate, and natural vegetation communities but also with strong consideration to existing watershed conditions and trajectory. The final mitigation plan was submitted and accepted by the DMS in October of 2013. Construction activities were completed by Terry's Plumbing and Land Mechanic Designs, Inc. in November 2014. Planting and seeding activities were completed by Bruton Natural Systems, Inc. in January 2015. Baseline monitoring (MY0) was conducted between December 2014 and January 2015. Annual monitoring will be conducted for seven years with the close-out anticipated to commence in 2021 given the success criteria are met. Appendix 1 provides more detailed project activity, history, contact information, and watershed/site background information for this project.

1.2 Monitoring Year 3 Data Assessment

Annual monitoring and quarterly site visits were conducted during MY3 to assess the condition of the project. The stream and vegetation success criteria for the Site follows the approved success criteria presented in the Hopewell Stream Mitigation Plan (Wildlands, 2013). The MY3 vegetation and stream surveys were completed in July 2017.

1.2.1 Vegetative Assessment

Planted woody vegetation is being monitored in accordance with the guidelines and procedures developed for the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008). A total of 31 vegetation plots were established during the baseline monitoring within the project easement areas. All of the plots were installed using a standard 10 meter by 10 meter plot. The final vegetative success criteria will be the survival of 210 planted stems per acre in the riparian corridor along restored and enhanced reaches at the end of the seven year monitoring period (MY7). The interim measure of vegetative success for the Site will be the survival of at least 320 planted stems per acre at the end of year three of the monitoring period (MY3) and at least 260 stems per acre at the end of the fifth year of monitoring (MY5). Planted vegetation must average 10 feet in height in each plot at the end of the seventh year of monitoring. If this performance standard is met by MY5 and stem density is trending towards success (i.e., no less than 260 five year old stems/acre), monitoring of vegetation on the Site may be terminated provided written approval is provided by the United States Army Corps of Engineers in consultation with the NC Interagency Review Team.

The 2017 vegetation monitoring resulted in an average stem density of 461 stems per acre, which is well above the interim requirement of 320 stems/acre required at MY3 and approximately 29% less than the baseline density recorded (649 stems/acre). There is an average of 11 stems per plot as compared to 16 stems per plot in MY0. While the majority of the plots are on track to meet the success criteria required for MY7; one plot (24) is not currently meeting the MY3 success criteria and two additional plots (25 and 26) exceed the MY3 requirements by only 10%. While these plots are currently indicating low survival rates as compared to others at the Site, they are still on track to meet the final success criteria of 210 stems per acre. With inclusion of volunteer stems, plot 24 meets the MY3 success criteria. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

1.2.2 Vegetation Areas of Concern

While significant efforts were implemented during construction to control the invasive species within the Site, additional follow up treatments have been and may continue to be necessary throughout the seven year monitoring period. Invasive species treatments were implemented during MY2 and MY3. In November 2017, the non-native invasive shrub, Chinese privet (*Ligustrum sinense*), was treated on the west side as well as previously treated areas on the east side where re-sprouting was occurring. In addition to the above, the non-native tree of heaven (*Ailanthus altissima*) noted in isolated areas was treated in MY2 and MY3. These areas will continue to be monitored and controlled as necessary during subsequent years. Other non-native species of concern noted at the Site include multiflora rose (*Rosa multiflora*) and Japanese honeysuckle (*Lonicera japonica*) but are not negatively impacting planted stem densities. Non-native, invasive species will continue to be monitored and controlled as necessary.

Along the upper section of UT1B Reach 1 there were several, small bare areas (<1% of the planted acreage) noted in MY1. These bare areas were re-seeded, limed, and fertilized in MY2 resulting in herbaceous layer establishment within the majority of these areas in MY3. Additionally; as a result of a mature sweetgum (*Liquidambar styraciflua*) within this reach, natural recruitment of this native, early

successional species has resulted in a small monoculture (~0.2 acres) along the right bank which does not appear to be negatively impacting the planted stems.

Based on the results from the vegetation monitoring plots, an area of low planted stem survivability was noted along a portion of Little River Reach 2. Additional, sub-samples within these areas indicated that the overall planted stem numbers are adequate but not as dense as the remaining planted area at the Site.

Refer to Appendix 2 for the vegetation condition assessment table and the Integrated Current Condition Plan View (CCPV).

1.2.3 Stream Assessment

In general, cross sections for UT2, UT2A, UT2B, UT2C, and UT1B show little to no change in the bankfull area, maximum depth ratio, or width-to-depth ratio. Changes observed at cross section 7 (UT2 - Reach 2) between MY1 and MY2 were the result of pool scouring at this one location. No additional scouring was observed during MY3. Some minor riffle scour was observed at cross section 9 (UT2B – Reach 2) which will continue to be monitored during subsequent years. Vegetation root mat growth within the channel at cross section 14 (UT1B – Reach 1) has resulted in a decreased bankfull area and depth in MY3. The decreased bankfull area and depth observed in MY2 at cross section 17 (UT2C - Reach 2) associated with willow root mats within the channel appears to have stabilized.

In general, substrate materials in the restoration and enhancement reaches indicated coarser materials in the riffle reaches and finer particles in the pools.

Refer to Appendix 2 for the visual stability assessment table, CCPV map, and reference photographs. Refer to Appendix 4 for the morphological data and plots.

1.2.4 Stream Areas of Concern

The changes in cross sectional area and depth noted for cross sections 14 and 17 will continue to be monitored during subsequent years for signs of instability and a maintenance plan will be established if deemed necessary. The increased pool depth at one location on UT2 does not constitute a problem as long as the stream is otherwise stable.

1.2.5 Hydrology Assessment

At the end of the seven year monitoring period, two or more bankfull events must have occurred in separate years within the restoration reaches. At least two bankfull events have been recorded on all restoration reaches during annual monitoring resulting in attainment of the stream hydrology assessment criteria. Refer to Appendix 5 for hydrologic data.

1.2.6 Adaptive Management Plan

Wildlands will continue to monitor and implement invasive treatments to reduce and control the extent of invasive species at the Site. Follow up treatments will be conducted annually as necessary.

Wildlands will continue monitoring those areas along UT1B Reach 1 that were noted with poor herbaceous growth and additional lime and fertilizer applications will be incorporated if deemed necessary to promote herbaceous plant establishment.

1.3 Monitoring Year 3 Summary

All streams within the Site are stable and functioning as designed. The overall, average stem density for the Site is on track to meet the MY5 success criteria; however, one vegetation plot is currently not meeting and two additional plots are indicating low survival rates of planted stems. All restored and

enhanced streams are stable and functioning as designed. Multiple bankfull events have been documented within the restored stream reaches at the Site and therefore the Site has met the Monitoring Year 7 hydrology success criteria.

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 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

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. Crest gages and pressure transducers were installed in surveyed riffle cross sections and monitored quarterly to document bankfull events and consecutive days of flow. Hydrologic monitoring instrument installation and monitoring methods are in accordance with the United States Army Corps of Engineers (USACE, 2003) standards. Vegetation monitoring protocols followed the Carolina Vegetation Survey-EEP Level 2 Protocol (Lee et al., 2008).

Section 3: REFERENCES

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.

Harrelson, C.C., Rawlins, C.L., Potyondy, J.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, M.T., Peet, R.K., S.D., Wentworth, T.R. 2008. CVS-EEP Protocol for Recording Vegetation Version 4.2. Retrieved from http://cvs.bio.unc.edu/protocol/cvs-eep-protocol-v4.2-lev1-5.pdf.

Rosgen, D. L. 1994. A classification of natural rivers. *Catena* 22:169-199.

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Rosgen, D.L. 1997. A Geomorphological Approach to Restoration of Incised Rivers. Proceedings of the Conference on Management of Landscapes Disturbed by Channel Incision. Center For Computational Hydroscience and Bioengineering, Oxford Campus, University of Mississippi, Pages 12-22.

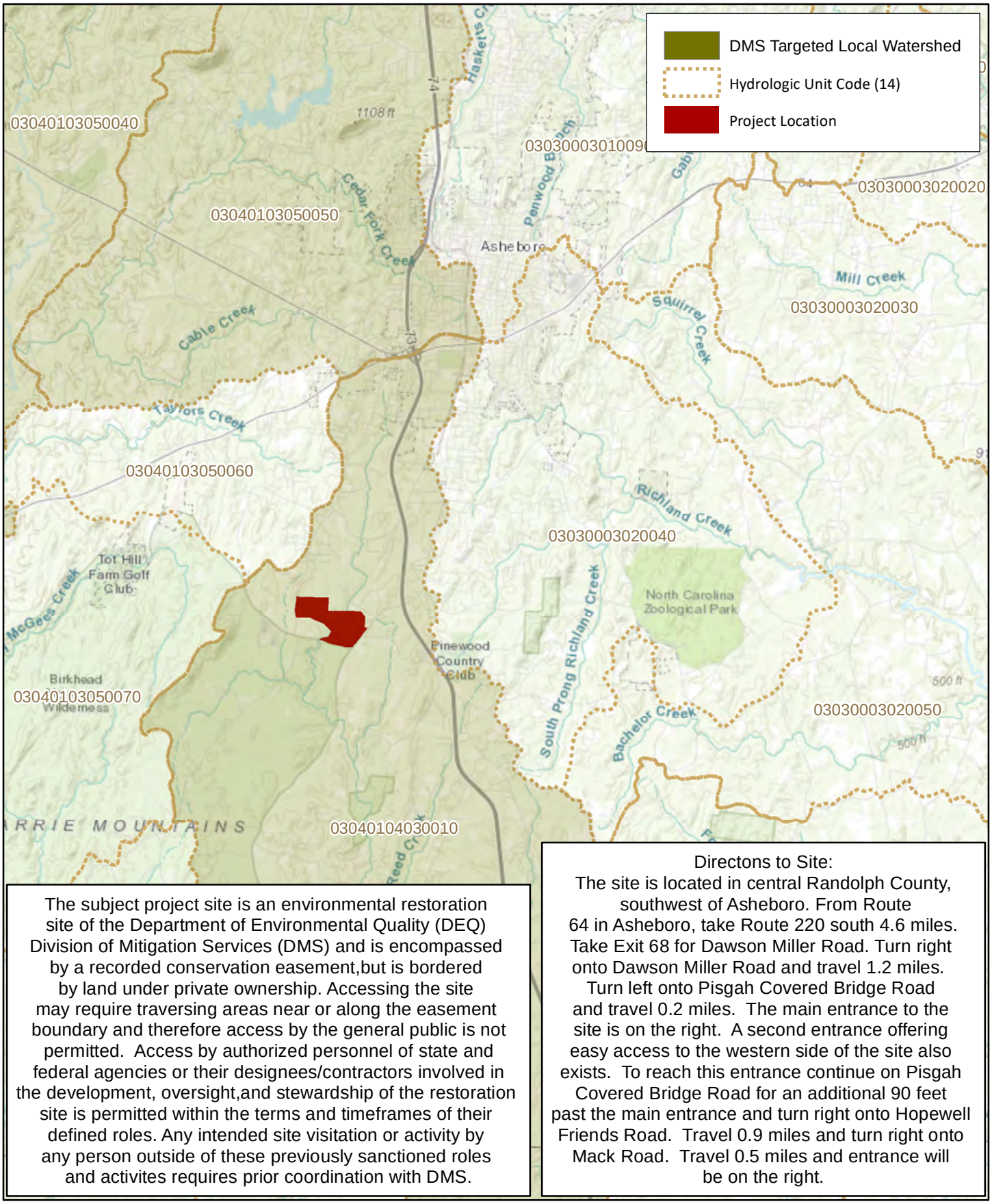
United States Army Corps of Engineers. 2003. Stream Mitigation Guidelines. USACE, NCDENR-DWQ, USEPA, NCWRC.

United States Geological Survey. 1998. North Carolina Geology. http://www.geology.enr.state.nc.us/usgs/carolina.htm

Wildlands Engineering, Inc. 2015. Hopewell Stream Mitigation Site Baseline Monitoring Document and As-Built Baseline Report. NCEEP, Raleigh, NC.

Wildlands Engineering, Inc. 2013. Hopewell Stream Mitigation Site Mitigation Plan. NCEEP, Raleigh, NC.

APPENDIX 1. General Figures and Tables



The subject project site is an environmental restoration site of the 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.

Directons to Site:
The site is located in central Randolph County, southwest of Asheboro. From Route 64 in Asheboro, take Route 220 south 4.6 miles. Take Exit 68 for Dawson Miller Road. Turn right onto Dawson Miller Road and travel 1.2 miles. Turn left onto Pisgah Covered Bridge Road and travel 0.2 miles. The main entrance to the site is on the right. A second entrance offering easy access to the western side of the site also exists. To reach this entrance continue on Pisgah Covered Bridge Road for an additional 90 feet past the main entrance and turn right onto Hopewell Friends Road. Travel 0.9 miles and turn right onto Mack Road. Travel 0.5 miles and entrance will be on the right.

WILDLANDS ENGINEERING

0 0.5 1 2 Miles

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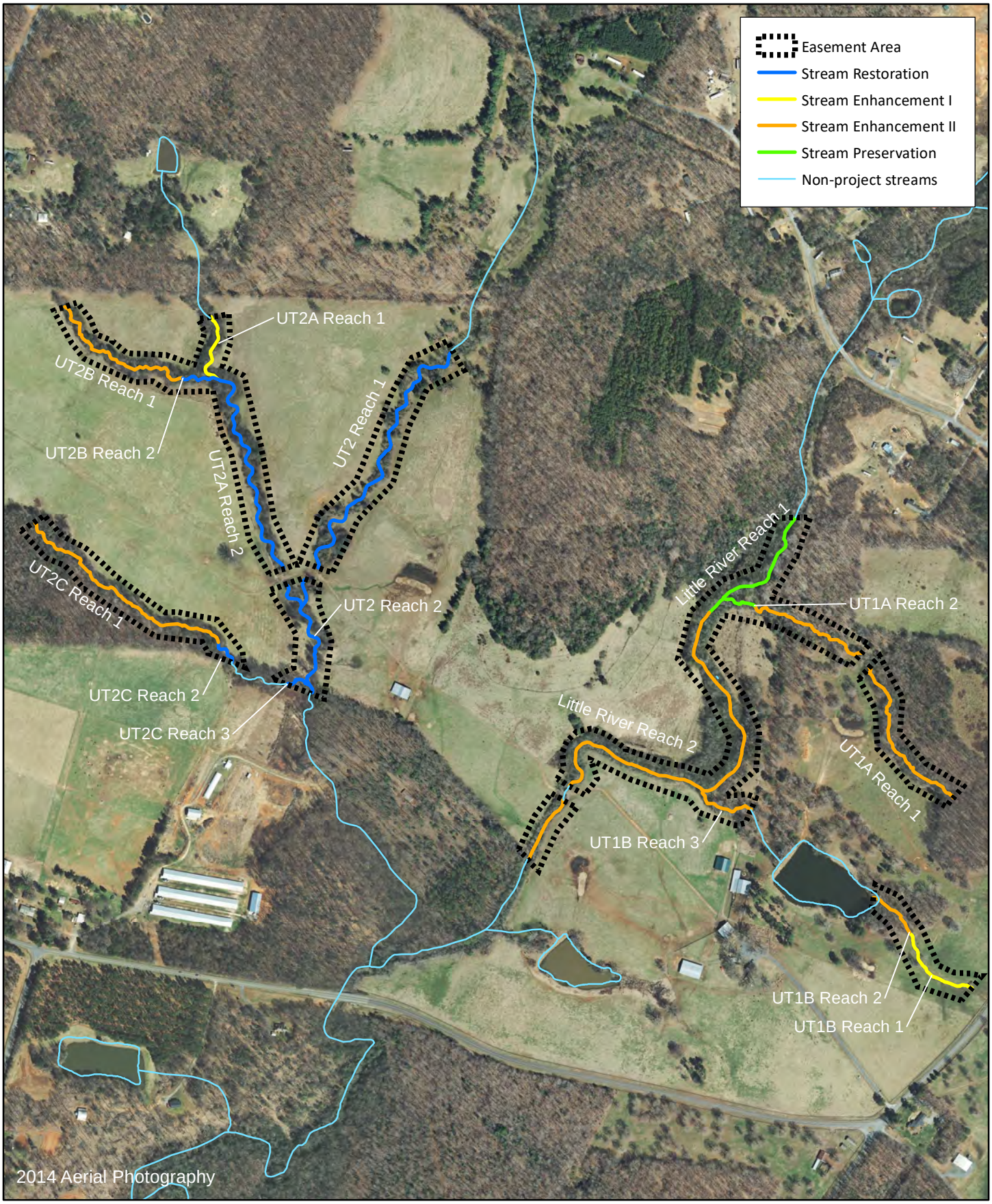
Figure 1 Vicinity Map
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County, NC



WILDLANDS ENGINEERING

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Figure 2 Project Component Map
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County, NC

Table 1. Project Components and Mitigation Credits
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	7,248	164	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Project Components							
Reach ID	As-Built Stationing / Location	Existing Footage / Acreage	Approach	Restoration or Restoration Equivalent	Restoration Footage / Acreage	Mitigation Ratio	Credits (SMU / WMU)
STREAMS							
Little River Reach 1	100+00 - 107+04	704	Preservation	P	704	5:1	141
Little River Reach 2	107+04 - 126+53 128+06 - 131+57	2,374	Fencing / Invasives Control	EII	2,300	2.5:1	920
UT1A Reach 1	200+00 - 208+95 209+84 - 217+00	1,611	Fencing / Invasives Control	EII	1,611	2.5:1	644
UT1A Reach 2	217+00 - 218+17	117	Preservation	P	117	5:1	23
UT1B Reach 1	300+87 - 305+67	475	Fencing / Invasives Control	EI	480	1.5:1	320
UT1B Reach 2 & 3	305+67 - 308+25 350+00 - 353+17	580	Fencing / Invasives Control	EII	575	2.5:1	230
UT2 Reach 1 & 2	400+00 - 415+47 416+35 - 423+16	2,419	Priority 1	Restoration	2,228	1:1	2,228
UT2A Reach 1	500+39 - 504+25	386	Fencing / Invasives Control	EI	386	1.5:1	257
UT2A Reach 2	504+25 - 516+21 517+00 - 518+68	1,368	Priority 1	Restoration	1,364	1:1	1,364
UT2B Reach 1	600+00 - 608+48	848	Fencing / Invasives Control	EII	848	2.5:1	339
UT2B Reach 2	608+48 - 610+46	114	Priority 1	Restoration	198	1:1	198
UT2C Reach 1	700+00 - 712+50	1,215	Fencing / Invasives Control	EII	1,250	2.5:1	500
UT2C Reach 2	712+50 - 713+60	326	Priority 1	Restoration	110	1:1	110
UT2C Reach 3	800+00 - 801+37		Priority 1	Restoration	137	1:1	137

Component Summation						
Restoration Level	Stream (LF)	Riparian Wetland (acres)		Non-Riparian Wetland (acres)	Buffer (square feet)	Upland (acres)
		Riverine	Non-Riverine			
Restoration	4,037	-	-	-	-	-
Enhancement		-	-	-	-	-
Enhancement I	866					
Enhancement II	6,584					
Preservation	821	-	-	-		
High Quality Preservation	-	-	-	-		-

Table 2. Project Activity and Reporting History

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Activity or Report	Data Collection Complete	Completion or Scheduled Delivery
Mitigation Plan	January 2013	November 2013
Final Design - Construction Plans	January 2013	March 2014
Construction	July 2014-November 2014	November 2014
Temporary S&E mix applied to entire project area[1]	November 2014	November 2014
Permanent seed mix applied to reach/segments	November 2014	November 2014
Bare root and live stake plantings for reach/segments	January 2015	January 2015
Baseline Monitoring Document (Year 0)	December 2014-January 2015	February 2015
Year 1 Monitoring	September 2015	December 2015
Invasive Plant Control	April 2016	
Bare Areas (UT2A) Limed/Fertilized/Seeded	April 2016	
Year 2 Monitoring	August 2016	December 2016
Invasive Plant Control	February 2017	
Invasive Plant Control	October 2017	
Year 3 Monitoring	July 2017	December 2017
Year 4 Monitoring	2018	December 2018
Year 5 Monitoring	2019	December 2019
Year 6 Monitoring	2020	December 2020
Year 7 Monitoring	2021	December 2021

[1]Seed and mulch is added as each section of construction is completed.

Table 3. Project Contact Table

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Designer Jeff Keaton, PE	**Wildlands Engineering, Inc.** 1430 South Mint Street, Suite 104 Charlotte, NC 28203 704.332.7754
Construction Contractor	**Terry's Plumbing** 465 Lewallen Road Asheboro, NC 27205
	Land Mechanics Designs, Inc. 126 Circle G Lane Willow Spring, NC 27592
Planting Contractor	**Bruton Natural Systems, Inc** P.O. Box 1197 Fremont, NC 27830
Seeding Contractor	**Terry's Plumbing** 465 Lewallen Road Asheboro, NC 27205
Seed Mix Sources	**Green Resource, LLC**
Nursery Stock Suppliers	
Bare Roots	**Dykes and Son Nursery**
Live Stakes	**Bruton Natural Systems, Inc**
Monitoring Performers	**Wildlands Engineering, Inc.**
Monitoring, POC	Kirsten Gimbert 704.332.7754, ext. 110

Table 4. Project Information and Attributes

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Project Information	
Project Name	Hopewell Stream Mitigation Site
County	Randolph county
Project Area (acres)	35.4
Project Coordinates (latitude and longitude)	35°37'37.32" N, 79° 51'13.27" W
Project Watershed Summary Information	
Physiographic Province	Carolina Slate Belt of the Piedmont Physiographic Province
River Basin	Yadkin-Pee Dee
USGS Hydrologic Unit 8-digit	03040104
USGS Hydrologic Unit 14-digit	03040104030010
DWR Sub-basin	03-07-15
Project Drainiage Area (acres)	4,083
Project Drainage Area Percentage of Impervious Area	2%
CGIA Land Use Classification	2.01.03 – Hay and Pasture Land; 2.99.05 - Farm Ponds; 4 – Forest Land; 1 - Urban and Developed Land

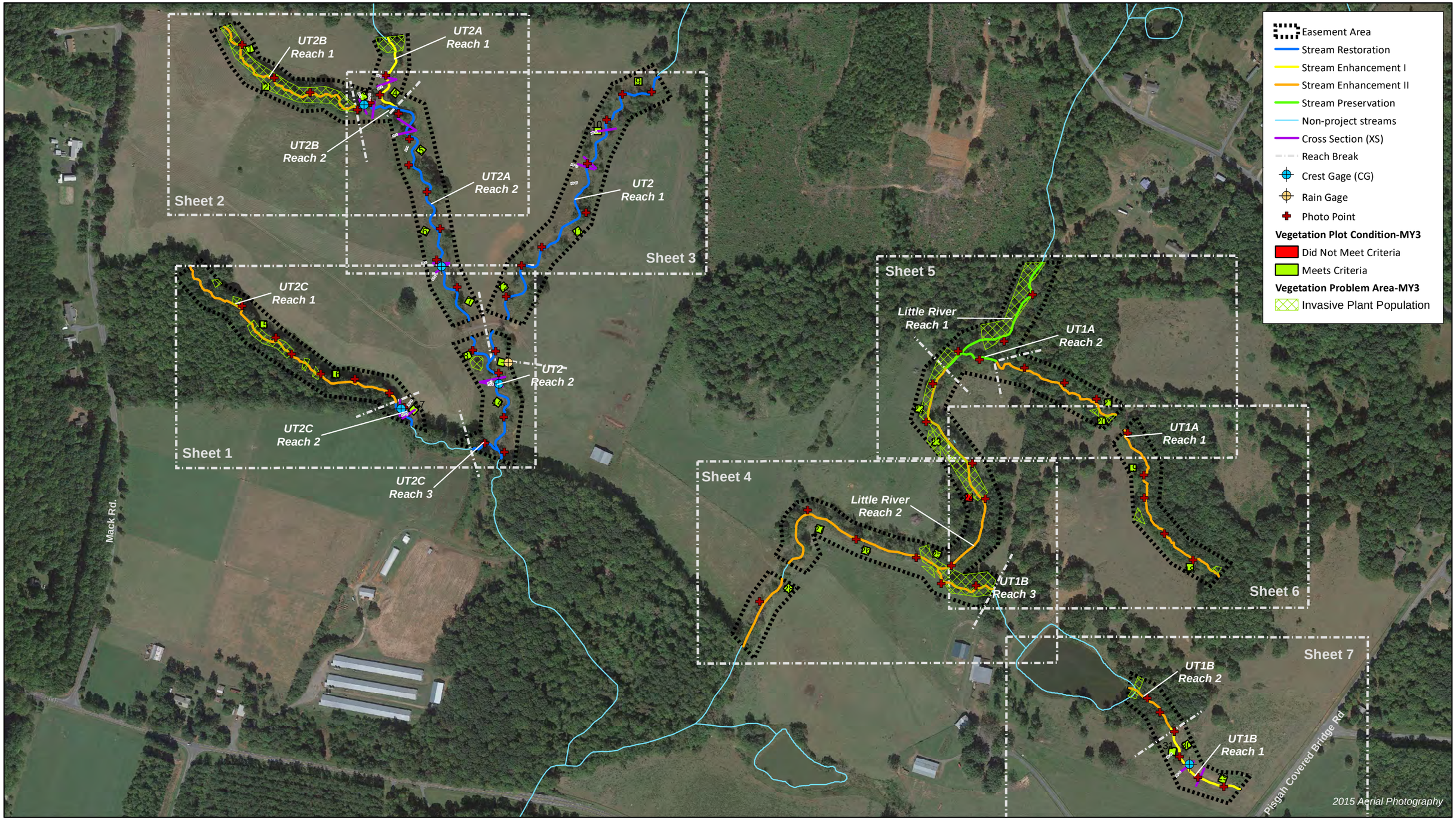
Reach Summary Information

Parameters	Little River	UT1A	UT1B Reach 1	UT1B Reach 2 & 3	UT2 Reach 1	UT2 Reach 2	UT2A Reach 1	UT2A Reach 2	UT2B	UT2C
Length of reach (linear feet) - Post-Restoration	3,911	597	480	575	1,547	681	386	1,364	1,046	247
Drainage area (acres)	4,083	38	19	45	246	378	64	102	22	51
NCDWR stream identification score	43.5	22.5	24.5	30	35.5	35.5	27	35	23.7	31
NCDWR Water Quality Classification	C									
Morphological Desription (stream type)	P	I	I	P	P	P	I	P	I	P
Evolutionary trend (Simon's Model) - Pre- Restoration	I/II	I	III	I	III/IV	IV	III	III/IV	III	III
Underlying mapped soils	Badin-Tarrus Complex, Chewacla Loam, Georgeville silt loam, Georgeville silty clay loam, Mecklenburg clay loam, Riverview sandy loam									
Drainage class	---	---	---	---	---	---	---	---	---	---
Soil hydric status	---	---	---	---	---	---	---	---	---	---
Slope	0.0051	0.0389	0.03	0.0583	0.0093	0.0075	0.0102	0.011	0.0259	0.0154
FEMA classification	AE*									
Native vegetation community	Piedmont Bottomland Forest / Mixed Mesic Hardwood Forest									
Percent composition exotic invasive vegetation-Post-Restoration	0%									

Regulatory Considerations

Regulation	Applicable?	Resolved?	Supporting Documentation
Waters of the United States - Section 404	X	X	USACE Nationwide Permit No.27 and DWQ 401 Water Quality Certification No. 3885.
Waters of the United States - Section 401	X	X	
Division of Land Quality (Dam Safety)	N/A	N/A	N/A
Endangered Species Act	X	X	Hopewell Mitigation Plan; Wildlands determined "no effect" on Randolph County listed endangered species. (Letter from USFWS dated July 27, 2012)
Historic Preservation Act	X	X	No historic resources were found to be impacted (letter from SHPO dated 7/13/2012).
Coastal Zone Management Act (CZMA)/Coastal Area Management Act (CAMA)	N/A	N/A	N/A
FEMA Floodplain Compliance	X	X	Little River is a mapped Zone AE floodplain with defined base flood elevations. A floodway has not been delineated but non-encroachment widths have been defined; (FEMA Zone AE, FIRM panel 7648).
Essential Fisheries Habitat	N/A	N/A	N/A

APPENDIX 2. Visual Assessment Data



WILDLANDS ENGINEERING

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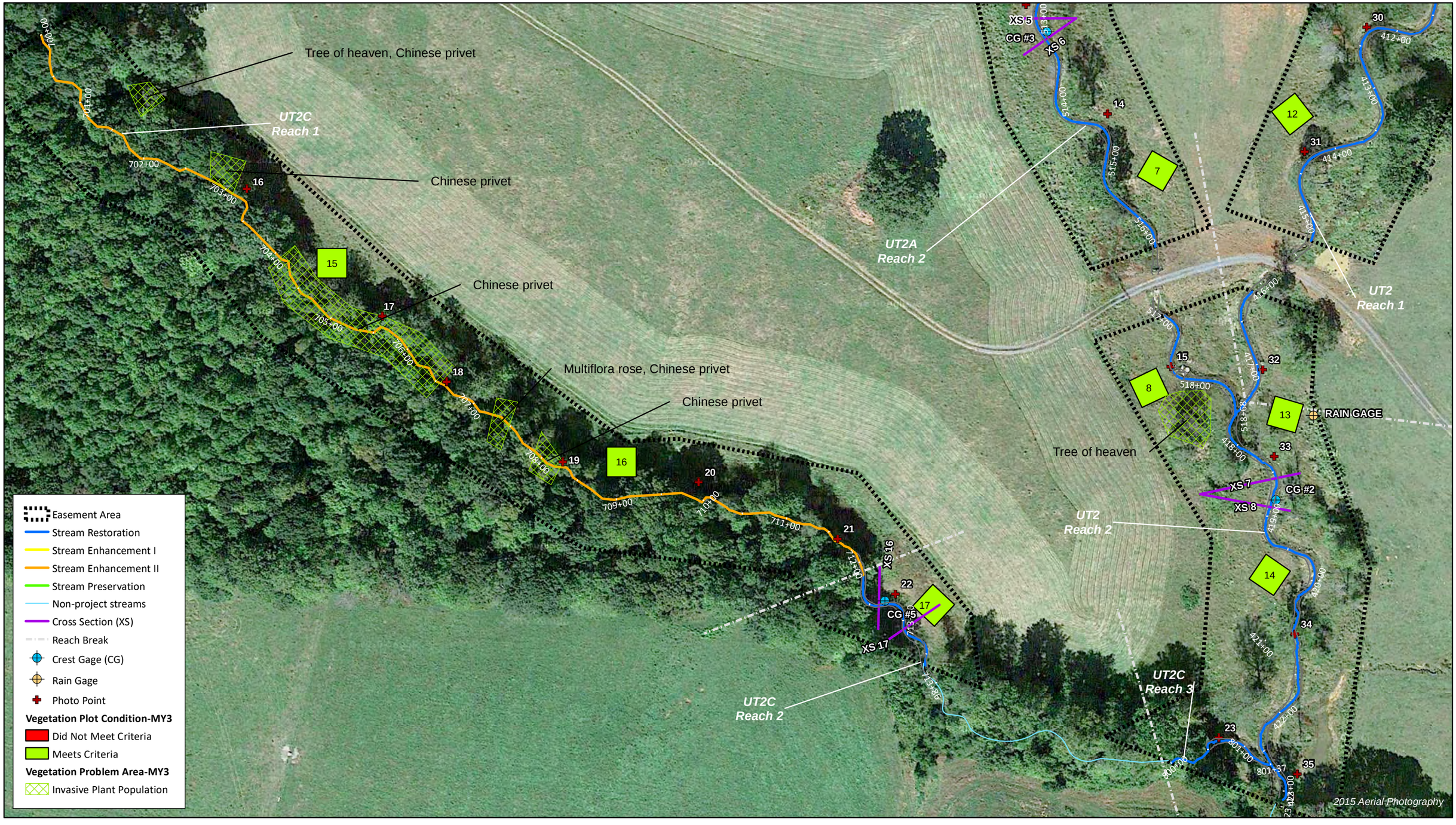
Figure 3.0 Integrated Current Condition Plan View (Key)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

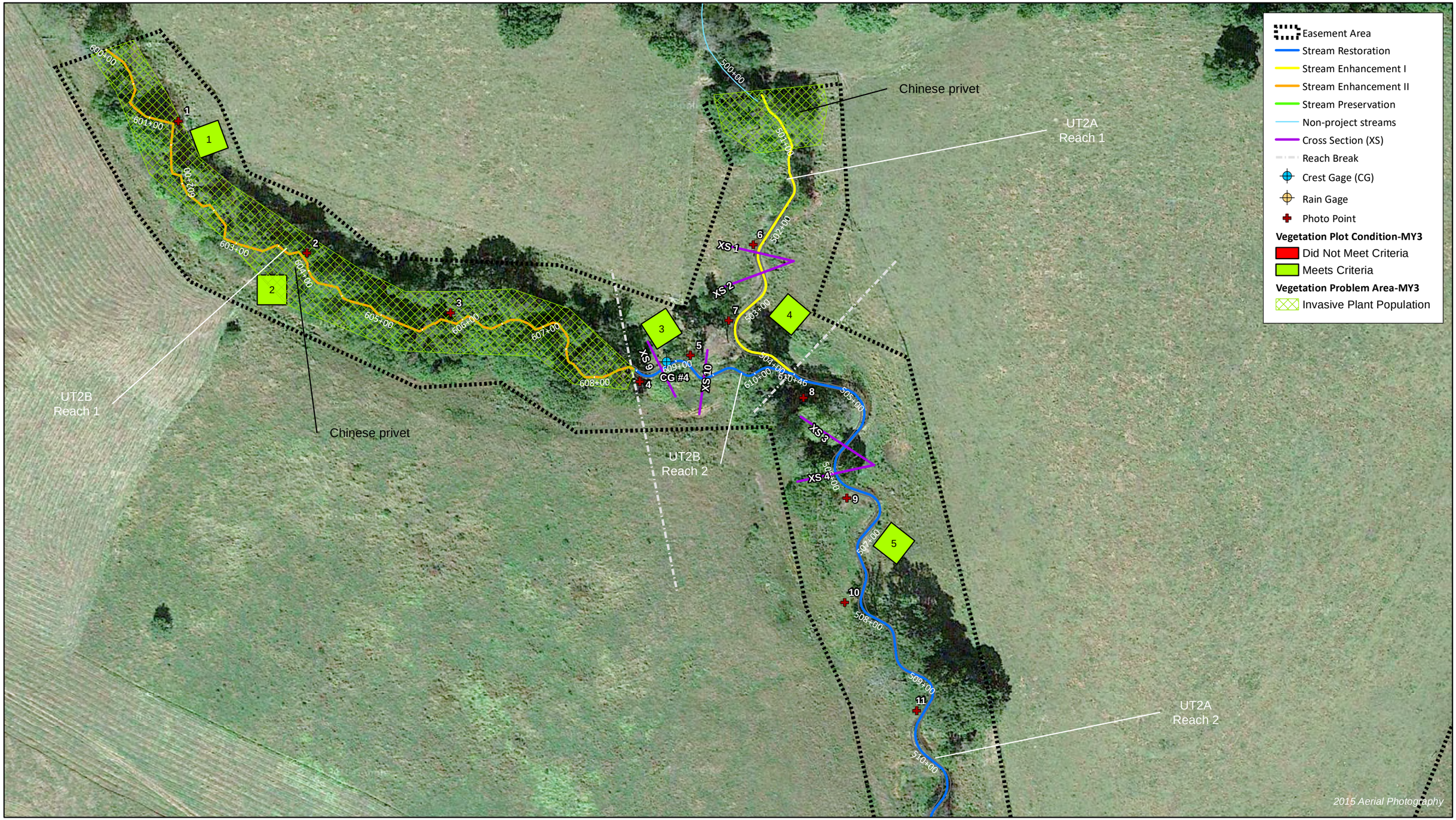


WILDLANDS ENGINEERING

0 50 100 200 Feet

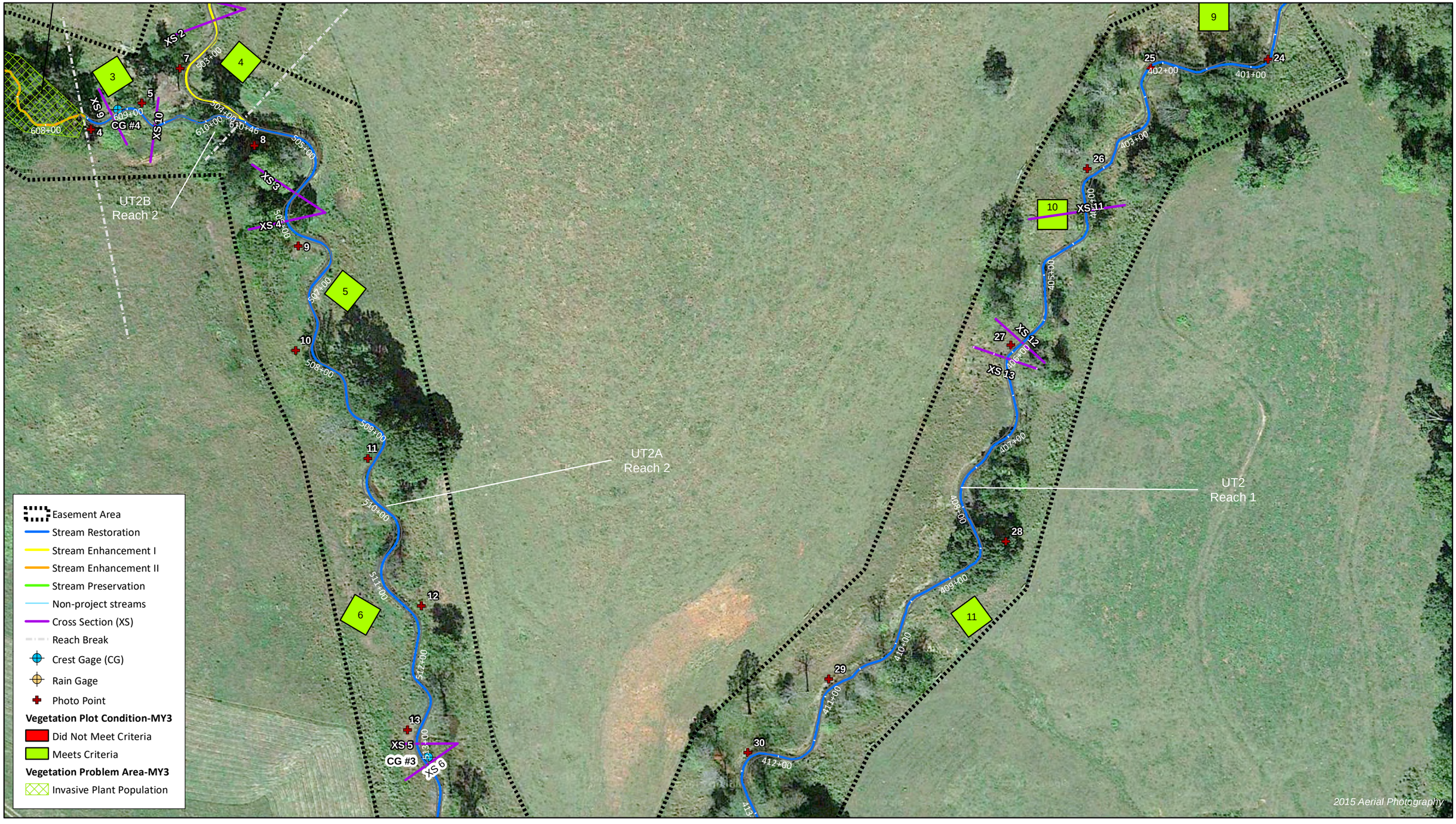
N

Figure 3.1 Integrated Current Condition Plan View (Sheet 1 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County



0 50 100 200 Feet

Figure 3.2 Integrated Current Condition Plan View (Sheet 2 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

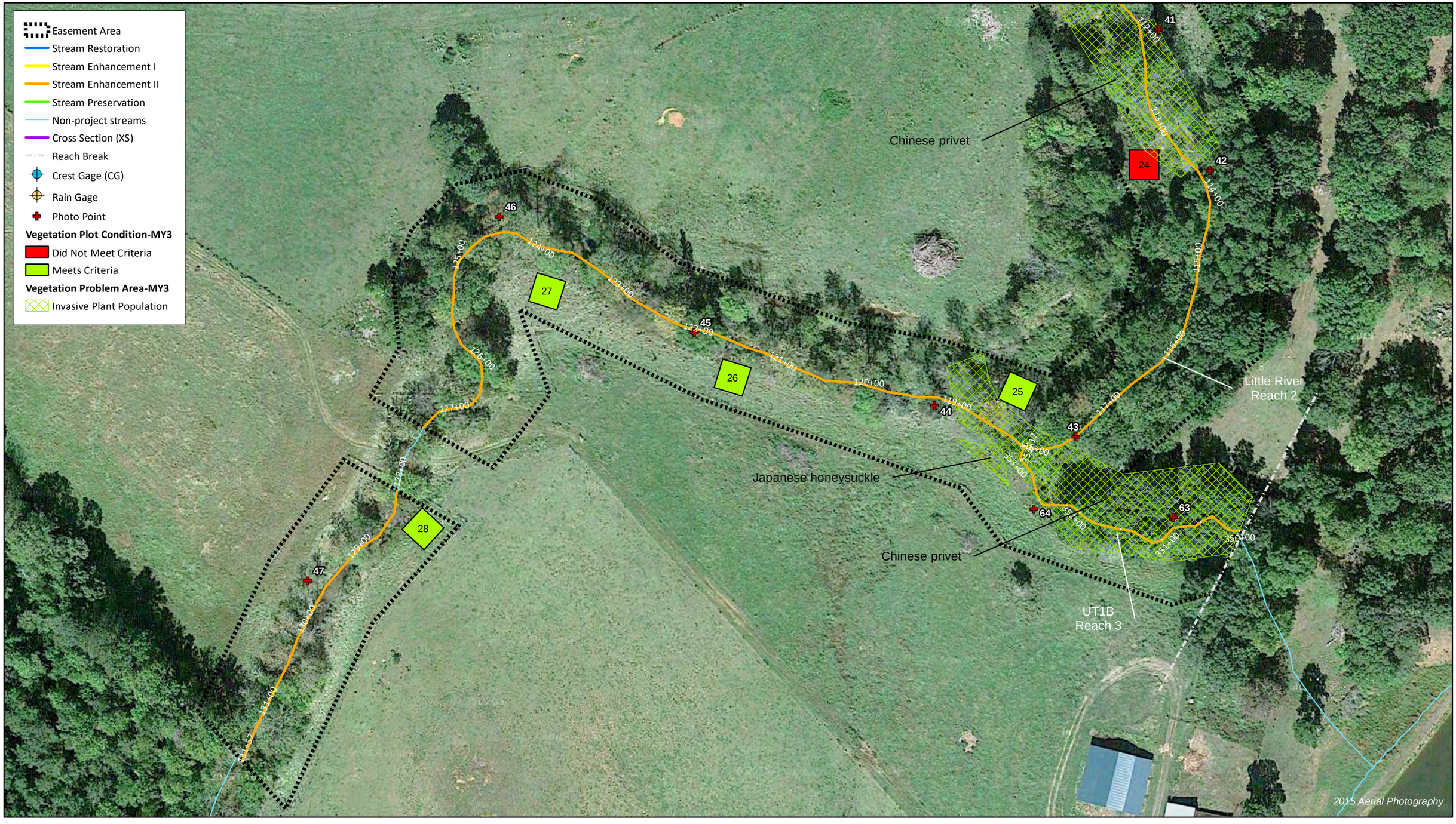


WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.3 Integrated Current Condition Plan View (Sheet 3 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County



WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.4 Integrated Current Condition Plan View (Sheet 4 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

Easement Area
Stream Restoration
Stream Enhancement I
Stream Enhancement II
Stream Preservation
Non-project streams
Cross Section (XS)
Reach Break
Crest Gage (CG)
Rain Gage
Photo Point

Vegetation Plot Condition- MY3

Did Not Meet Criteria
Meets Criteria

Vegetation Problem Area-MY3

Invasive Plant Population

Little River Reach 1
Little River Reach 2
UT1A Reach 1
UT1A Reach 2
Chinese privet
Multiflora rose
Japanese honeysuckle
36
37
38
39
40
52
53
54
55
56
20
21
22
23
100+00
101+00
102+00
103+00
104+00
105+00
106+00
107+00
108+00
109+00
110+00
111+00
208+00
210+00
211+00
212+00
213+00
214+00
215+00
216+00
217+00
218+00
2015 Aerial Photography

WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.5 Integrated Current Condition Plan View (Sheet 5 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.6 Integrated Current Condition Plan View (Sheet 6 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

WILDLANDS ENGINEERING

0 50 100 200 Feet

N

Figure 3.7 Integrated Current Condition Plan View (Sheet 7 of 7)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017
Randolph County

Table 5a. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT1B Reach 1 (480 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	8	8			100%			
	3. Meander Pool Condition	Depth Sufficient	8	8			100%			
		Length Appropriate	8	8			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	8	8			100%			
		Thalweg centering at downstream of meander bend (Glide)	8	8			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	n/a	n/a			n/a			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	n/a	n/a			n/a			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	n/a	n/a			n/a			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 5b. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2 Reach 1 & 2 (2,228 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	30	30			100%			
	3. Meander Pool Condition	Depth Sufficient	29	29			100%			
		Length Appropriate	29	29			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	29	29			100%			
		Thalweg centering at downstream of meander bend (Glide)	29	29			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	32	32			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	13	13			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	13	13			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	20	20			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	20	20			100%			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 5c. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2A Reach 1 & 2 (1,750 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	31	31			100%			
	3. Meander Pool Condition	Depth Sufficient	31	31			100%			
		Length Appropriate	31	31			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	31	31			100%			
		Thalweg centering at downstream of meander bend (Glide)	31	31			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	32	32			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.	2	2			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	21	21			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	20	20			100%			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 5d. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2B Reach 2 (198 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	7	7			100%			
	3. Meander Pool Condition	Depth Sufficient	6	6			100%			
		Length Appropriate	6	6			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	6	6			100%			
		Thalweg centering at downstream of meander bend (Glide)	6	6			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	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.	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	6	6			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	6	6			100%			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 5e. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2C Reach 2 (110 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	5	5			100%			
	3. Meander Pool Condition	Depth Sufficient	4	4			100%			
		Length Appropriate	4	4			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	4	4			100%			
		Thalweg centering at downstream of meander bend (Glide)	4	4			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	1. Overall Integrity	Structures physically intact with no dislodged boulders or logs.	4	4			100%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	4	4			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	4	4			100%			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 5f. Visual Stream Morphology Stability Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2C Reach 3 (137 LF)

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	Adjust % for Stabilizing Woody Vegetation
1. Bed	1. Vertical Stability (Shallow and Run units)	Aggradation			0	0	100%			
		Degradation			0	0	100%			
	2. Riffle Condition	Texture/Substrate	3	3			100%			
	3. Meander Pool Condition	Depth Sufficient	2	2			100%			
		Length Appropriate	2	2			100%			
	4. Thalweg Position	Thalweg centering at upstream of meander bend (Run)	2	2			100%			
		Thalweg centering at downstream of meander bend (Glide)	2	2			100%			
2. Bank	1. Scoured/Eroded	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion.			0	0	100%	n/a	n/a	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%	n/a	n/a	n/a
	3. Mass Wasting	Bank slumping, calving, or collapse			0	0	100%	n/a	n/a	n/a
				Totals	0	0	100%	n/a	n/a	n/a
3. Engineered Structures[1]	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.	n/a	n/a			n/a			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	n/a	n/a			n/a			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%.	1	1			100%			
	4. Habitat	Pool forming structures maintaining ~Max Pool Depth : Bankfull Depth ≥ 1.6 Rootwads/logs providing some cover at baseflow.	1	1			100%			

[1]Excludes constructed shallows since they are evaluated in section 1.

Table 6. Vegetation Condition Assessment Table
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Planted Acreage **24**

Vegetation Category	Definitions	Mapping Threshold (Ac)	Number of Polygons	Combined Acreage	% of Planted Acreage
Bare Areas	Very limited cover of both woody and herbaceous material	0.1	1	0.1	0.4%
Low Stem Density Areas	Woody stem densities clearly below target levels based on MY3, 4, or 5 stem count criteria.	0.1	0	0.0	0.0%
		Total	**1**	**0.1**	**0.4%**
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 Ac	0	0	0%
		Cumulative Total	**1**	**0.1**	**0.4%**

Easement Acreage **35**

Vegetation Category	Definitions	Mapping Threshold (SF)	Number of Polygons	Combined Acreage	% of Easement Acreage
Invasive Areas of Concern	Areas of points (if too small to render as polygons at map scale).	1,000	18	3.96	11.3%
Easement Encroachment Areas	Areas of points (if too small to render as polygons at map scale).	none	0	0	0%

Stream Photographs

	
UT2B R1 – Photo Point 1 looking upstream *(07/17/2017)*	**UT2B R1** – Photo Point 1 looking downstream *(07/17/2017)*
	
UT2B R1 – Photo Point 2 looking upstream *(07/17/2017)*	**UT2B R1** – Photo Point 2 looking downstream *(07/17/2017)*
	
UT2B R1 – Photo Point 3 looking upstream *(07/17/2017)*	**UT2B R1** – Photo Point 3 looking downstream *(07/17/2017)*

	
UT2B R1 – Photo Point 4 looking upstream *(07/17/2017)*	**UT2B R1** – Photo Point 4 looking downstream *(07/17/2017)*
	
UT2B R1 – Photo Point 5 looking upstream *(07/17/2017)*	**UT2B R1** – Photo Point 5 looking downstream *(07/17/2017)*
	
UT2A R1 – Photo Point 6 looking upstream *(07/17/2017)*	**UT2A R1** – Photo Point 6 looking downstream *(07/17/2017)*

	
UT2A R1 – Photo Point 7 looking upstream *(07/17/2017)*	**UT2A R1** – Photo Point 7 looking downstream *(07/17/2017)*
	
UT2A R2 – Photo Point 8 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 8 looking downstream *(07/17/2017)*
	
UT2A R2 – Photo Point 9 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 9 looking downstream *(07/17/2017)*

	
UT2A R2 – Photo Point 10 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 10 looking downstream (*07/17/2017)*
	
UT2A R2 – Photo Point 11 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 11 looking downstream *(07/17/2017)*
	
UT2A R2 – Photo Point 12 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 12 looking downstream *(07/17/2017)*

	
UT2A R2 – Photo Point 13 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 13 looking downstream *(07/17/2017)*
	
UT2A R2 – Photo Point 14 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 14 looking downstream *(07/17/2017)*
	
UT2A R2 – Photo Point 15 looking upstream *(07/17/2017)*	**UT2A R2** – Photo Point 15 looking downstream *(07/17/2017)*

	
UT2C R1 – Photo Point 16 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 16 looking downstream *(07/17/2017)*
	
UT2C R1 – Photo Point 17 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 17 looking downstream *(07/17/2017)*
	
UT2C R1 – Photo Point 18 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 18 looking downstream *(07/17/2017)*

	
UT2C R1 – Photo Point 19 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 19 looking downstream *(07/17/2017)*
	
UT2C R1 – Photo Point 20 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 20 looking downstream *(07/17/2017)*
	
UT2C R1 – Photo Point 21 looking upstream *(07/17/2017)*	**UT2C R1** – Photo Point 21 looking downstream *(07/17/2017)*

UT2C R2 – Photo Point 22 looking upstream *(07/17/2017)*

UT2C R2 – Photo Point 22 looking downstream *(07/17/2017)*

UT2C R3 – Photo Point 23 looking upstream *(07/17/2017)*

UT2C R3 – Photo Point 23 looking downstream *(07/17/2017)*

UT2 R1 – Photo Point 24 looking upstream *(07/17/2017)*

UT2 R1 – Photo Point 24 looking downstream *(07/17/2017)*

	
UT2 R1 – Photo Point 25 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 25 looking downstream *(07/17/2017)*
	
UT2 R1 – Photo Point 26 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 26 looking downstream *(07/17/2017)*
	
UT2 R1 – Photo Point 27 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 27 looking downstream *(07/17/2017)*

	
UT2 R1 – Photo Point 28 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 28 looking downstream *(07/17/2017)*
	
UT2 R1 – Photo Point 29 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 29 looking downstream *(07/17/2017)*
	
UT2 R1 – Photo Point 30 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 30 looking downstream *(07/17/2017)*

	
UT2 R1 – Photo Point 31 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 31 looking downstream *(07/17/2017)*
	
UT2 R1 – Photo Point 32 looking upstream *(07/17/2017)*	**UT2 R1** – Photo Point 32 looking downstream *(07/17/2017)*
	
UT2 R2 – Photo Point 33 looking upstream *(07/17/2017)*	**UT2 R2** – Photo Point 33 looking downstream *(07/17/2017)*

	
UT2 R2 – Photo Point 34 looking upstream *(07/17/2017)*	**UT2 R2** – Photo Point 34 looking downstream *(07/17/2017)*
	
UT2 R2 – Photo Point 35 looking upstream *(07/17/2017)*	**UT2 R2** – Photo Point 35 looking downstream *(07/17/2017)*
	
Little River R1 – Photo Point 36 looking upstream *(07/18/2017)*	**Little River R1**–Photo Point 36 looking downstream *(07/18/2017)*

	
Little River R1 – Photo Point 37 looking upstream *(07/18/2017)*	**Little River R1**–Photo Point 37 looking downstream *(07/18/2017)*
	
Little River R1 – Photo Point 38 looking upstream *(07/18/2017)*	**Little River R1**–Photo Point 38 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 39 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 39 looking downstream *(07/18/2017)*

	
Little River R2 – Photo Point 40 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 40 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 41 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 41 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 42 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 42 looking downstream *(07/18/2017)*

	
Little River R2 – Photo Point 43 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 43 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 44 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 44 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 45 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 45 looking downstream *(07/18/2017)*

	
Little River R2 – Photo Point 46 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 46 looking downstream *(07/18/2017)*
	
Little River R2 – Photo Point 47 looking upstream *(07/18/2017)*	**Little River R2**–Photo Point 47 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 48 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 48 looking downstream *(07/18/2017)*

	
UT1A R1 – Photo Point 49 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 49 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 50 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 50 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 51 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 51 looking downstream *(07/18/2017)*

	
UT1A R1 – Photo Point 52 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 52 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 53 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 53 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 54 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 54 looking downstream *(07/18/2017)*

	
UT1A R1 – Photo Point 55 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 55 looking downstream *(07/18/2017)*
	
UT1A R1 – Photo Point 56 looking upstream *(07/18/2017)*	**UT1A R1** – Photo Point 56 looking downstream *(07/18/2017)*
	
UT1B R1 – Photo Point 57 looking upstream *(07/18/2017)*	**UT1B R1** – Photo Point 57 looking downstream *(07/18/2017)*

	
UT1B R1 – Photo Point 58 looking upstream *(07/18/2017)*	**UT1B R1** – Photo Point 58 looking downstream *(07/18/2017)*
	
UT1B R1 – Photo Point 59 looking upstream *(07/18/2017)*	**UT1B R1** – Photo Point 59 looking downstream *(07/18/2017)*
	
UT1B R1 – Photo Point 60 looking upstream *(07/18/2017)*	**UT1B R1** – Photo Point 60 looking downstream *(07/18/2017)*

	
UT1B R2 – Photo Point 61 looking upstream *(07/18/2017)*	**UT1B R2** – Photo Point 61 looking downstream *(07/18/2017)*
	
UT1B R2 – Photo Point 62 looking upstream *(07/18/2017)*	**UT1B R2** – Photo Point 62 looking downstream *(07/18/2017)*
	
UT1B R3 – Photo Point 63 looking upstream *(07/18/2017)*	**UT1B R3** – Photo Point 63 looking downstream *(07/18/2017)*

	
UT1B R3 – Photo Point 64 looking upstream *(07/18/2017)*	**UT1B R3** – Photo Point 64 looking downstream *(07/18/2017)*

VEGETATION PHOTOGRAPHS

VEGETATION PLOT 1 – (*07/17/2017*)

VEGETATION PLOT 2 – (*07/17/2017*)

VEGETATION PLOT 3 – (*07/17/2017*)

VEGETATION PLOT 4 – (*07/17/2017*)

VEGETATION PLOT 5 – (*07/17/2017*)

VEGETATION PLOT 6 – (*07/17/2017*)

	
VEGETATION PLOT 7 – (*07/17/2017*)	**VEGETATION PLOT 8 – (*07/17/2017*)**
	
VEGETATION PLOT 9 – (*07/17/2017*)	**VEGETATION PLOT 10 – (*07/17/2017*)**
	
VEGETATION PLOT 11 – (*07/17/2017*)	**VEGETATION PLOT 12 – (*07/17/2017*)**

	
VEGETATION PLOT 13 – (*07/17/2017*)	**VEGETATION PLOT 14 – (*07/17/2017*)**
	
VEGETATION PLOT 15 – (*07/17/2017*)	**VEGETATION PLOT 16 – (*07/17/2017*)**
	
VEGETATION PLOT 17 – (*07/17/2017*)	**VEGETATION PLOT 18 – (*07/17/2017*)**

VEGETATION PLOT 19 – (*07/17/2017*)

VEGETATION PLOT 20 – (*07/18/2017*)

VEGETATION PLOT 21 – (*07/18/2017*)

VEGETATION PLOT 22 – (*07/18/2017*)

VEGETATION PLOT 23 – (*07/18/2017*)

VEGETATION PLOT 24 – (*07/18/2017*)

VEGETATION PLOT 25 – (*07/18/2017*)

VEGETATION PLOT 26 – (*07/18/2017*)

VEGETATION PLOT 27 – (*07/18/2017*)

VEGETATION PLOT 28 – (*07/18/2017*)

VEGETATION PLOT 29 – (*07/17/2017*)

VEGETATION PLOT 30 – (*07/17/2017*)

VEGETATION PLOT 31 – (*07/17/2017*)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Plot	MY3 Success Criteria Met (Y/N)	Tract Mean
1	Y	
2	Y	
3	Y	
4	Y	
5	Y	
6	Y	
7	Y	
8	Y	
9	Y	
10	Y	
11	Y	
12	Y	
13	Y	
14	Y	
15	Y	
16	Y	97%
17	Y	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	N	
25	Y	
26	Y	
27	Y	
28	Y	
29	Y	
30	Y	
31	Y	

Table 8. CVS Vegetation Tables - Metadata
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Report Prepared By	Ruby Davis
Date Prepared	7/21/2017 10:47
Database Name	cvs-eep-entrytool-v2.5.0 Hopewell MY3.mdb
Database Location	Q:\ActiveProjects\005-02133 Hopewell Mitigation FDP\Monitoring\Monitoring Year 3\Vegetation Assessment
Computer Name	RUBY
File Size	54394880
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Project Planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Project 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	95352
Project Name	Hopewell Stream Mitigation Site
Area (sq m)	128285.35
Required Plots (calculated)	22
Sampled Plots	31

Table 9a. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)														
			Vegetation Plot 1			Vegetation Plot 2			Vegetation Plot 3			Vegetation Plot 4			Vegetation Plot 5		
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						4			25			13			3
Alnus serrulata	Hazel alder	Shrub															
Betula nigra	River birch	Tree				1	1	1				1	1	1			
Carya	Hickory	Tree															
Celtis laevigata	Sugarberry	Tree															
Chamaecyparis thyoides	Atlantic white cedar	Tree															
Crataegus	Hawthorn	Tree															
Diospyros virginiana	Common persimmon	Tree			1						1						
Fraxinus pennsylvanica	Green ash	Tree				1	1	1	6	6	6	5	5	5			
Juglans nigra	Black walnut	Tree						1									
Juniperus virginiana	Eastern redcedar	Tree															
Liquidambar styraciflua	Sweetgum	Tree			2						125			45			3
Liriodendron tulipifera	Tuliptree	Tree												1	1	1	14
Nyssa sylvatica	Blackgum	Tree															
Pinus	Pine	Tree												14			4
Pinus rigida	Pitch pine	Tree									20						
Pinus serotina	Pond pine	Tree															
Platanus occidentalis	American sycamore	Tree	2	2	2	2	2	2	2	2	2	7	7	7	2	2	2
Prunus serotina	Black cherry	Tree															
Quercus	Oak	Tree															
Quercus michauxii	Swamp chestnut oak	Tree	4	4	4	3	3	3	2	2	2				3	3	3
Quercus phellos	Willow oak	Tree	2	2	2	1	1	1	3	3	3				3	3	3
Quercus rubra	Northern red oak	Tree	2	2	2	3	3	3							2	2	2
Rhus glabra	Smooth sumac	Shrub															
Robinia pseudoacacia	Black locust	Tree															
Salix sericea	Silky willow	Shrub															
Sambucus canadensis	Common Elderberry	Shrub															
Ulmus alata	Winged elm	Tree															
		Stem count	10	10	13	11	11	16	13	13	184	13	13	86	11	11	34
		Size (ares)		1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	6	6	6	8	4	4	8	3	3	7	5	5	8
		Stems per ACRE	405	405	526	445	445	647	526	526	7,446	526	526	3,480	445	445	1,376

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%

Volunteers included

PnoLS: Number of planted stems excluding live stakes

P-All: Number of planted stems including live stakes

T: Total stems

Table 9b. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)														
			Vegetation Plot 6			Vegetation Plot 7			Vegetation Plot 8			Vegetation Plot 9			Vegetation Plot 10		
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															
Alnus serrulata	Hazel alder	Shrub															
Betula nigra	River birch	Tree				1	1	1	3	3	3	2	2	2	1	1	2
Carya	Hickory	Tree															
Celtis laevigata	Sugarberry	Tree															
Chamaecyparis thyoides	Atlantic white cedar	Tree															
Crataegus	Hawthorn	Tree															
Diospyros virginiana	Common persimmon	Tree			43												2
Fraxinus pennsylvanica	Green ash	Tree	3	3	3	1	1	2				1	1	1	2	2	2
Juglans nigra	Black walnut	Tree									1						
Juniperus virginiana	Eastern redcedar	Tree															
Liquidambar styraciflua	Sweetgum	Tree			3			2									
Liriodendron tulipifera	Tuliptree	Tree	1	1	6	1	1	1							4	4	4
Nyssa sylvatica	Blackgum	Tree															
Pinus	Pine	Tree															
Pinus rigida	Pitch pine	Tree															
Pinus serotina	Pond pine	Tree															
Platanus occidentalis	American sycamore	Tree	1	1	2	8	8	8	5	5	5	7	7	7	2	2	2
Prunus serotina	Black cherry	Tree															
Quercus	Oak	Tree															
Quercus michauxii	Swamp chestnut oak	Tree	4	4	4	3	3	3	2	2	2	1	1	1			
Quercus phellos	Willow oak	Tree	1	1	1							1	1	1	1	1	1
Quercus rubra	Northern red oak	Tree	1	1	1				1	1	1	2	2	2	5	5	5
Rhus glabra	Smooth sumac	Shrub															
Robinia pseudoacacia	Black locust	Tree															
Salix sericea	Silky willow	Shrub									1						
Sambucus canadensis	Common Elderberry	Shrub															
Ulmus alata	Winged elm	Tree															
		Stem count	11	11	63	14	14	17	11	11	13	14	14	14	15	15	18
		Size (ares)		1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	6	6	8	5	5	6	4	4	6	6	6	6	6	6	7
		Stems per ACRE	445	445	2550	567	567	688	445	445	526	567	567	567	607	607	728

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%

Volunteers included

PnoLS: Number of planted stems excluding live stakes

P-All: Number of planted stems including live stakes

T: Total stems

Table 9c. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)														
			Vegetation Plot 11			Vegetation Plot 12			Vegetation Plot 13			Vegetation Plot 14			Vegetation Plot 15		
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															
Alnus serrulata	Hazel alder	Shrub									1						
Betula nigra	River birch	Tree	3	3	3	2	2	2				1	1	1	1	1	1
Carya	Hickory	Tree															
Celtis laevigata	Sugarberry	Tree															
Chamaecyparis thyoides	Atlantic white cedar	Tree															
Crataegus	Hawthorn	Tree															
Diospyros virginiana	Common persimmon	Tree						2			20			3			10
Fraxinus pennsylvanica	Green ash	Tree	4	4	4	3	3	3	2	2	2	1	1	1	2	2	2
Juglans nigra	Black walnut	Tree			1			1			1						
Juniperus virginiana	Eastern redcedar	Tree															
Liquidambar styraciflua	Sweetgum	Tree															4
Liriodendron tulipifera	Tuliptree	Tree				2	2	2			2	3	3	13			1
Nyssa sylvatica	Blackgum	Tree									2						
Pinus	Pine	Tree															
Pinus rigida	Pitch pine	Tree			2									1			
Pinus serotina	Pond pine	Tree															
Platanus occidentalis	American sycamore	Tree	1	1	1	4	4	4	9	9	15			1	9	9	9
Prunus serotina	Black cherry	Tree															
Quercus	Oak	Tree															
Quercus michauxii	Swamp chestnut oak	Tree	2	2	2	1	1	1				5	5	5	1	1	1
Quercus phellos	Willow oak	Tree										2	2	2			
Quercus rubra	Northern red oak	Tree				2	2	2	1	1	1	1	1	2	2	2	2
Rhus glabra	Smooth sumac	Shrub															
Robinia pseudoacacia	Black locust	Tree															
Salix sericea	Silky willow	Shrub															
Sambucus canadensis	Common Elderberry	Shrub															
Ulmus alata	Winged elm	Tree						3									
		Stem count	10	10	13	14	14	20	12	12	44	13	13	29	15	15	30
		Size (ares)		1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	6	6	6	9	3	3	8	6	6	9	5	5	8
		Stems per ACRE	405	405	526	567	567	809	486	486	1,781	526	526	1,174	607	607	1,214

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%

Volunteers included

PnoLS: Number of planted stems excluding live stakes

P-All: Number of planted stems including live stakes

T: Total stems

Table 9d. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)														
			Vegetation Plot 16			Vegetation Plot 17			Vegetation Plot 18			Vegetation Plot 19			Vegetation Plot 20		
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															
Alnus serrulata	Hazel alder	Shrub															
Betula nigra	River birch	Tree	1	1	1	3	3	3	2	2	2	1	1	1	4	4	6
Carya	Hickory	Tree															
Celtis laevigata	Sugarberry	Tree												1			
Chamaecyparis thyoides	Atlantic white cedar	Tree															
Crataegus	Hawthorn	Tree															
Diospyros virginiana	Common persimmon	Tree															
Fraxinus pennsylvanica	Green ash	Tree	4	4	4	4	4	4	2	2	2	5	5	5	5	5	5
Juglans nigra	Black walnut	Tree			1						2						
Juniperus virginiana	Eastern redcedar	Tree															3
Liquidambar styraciflua	Sweetgum	Tree						40			50			6			5
Liriodendron tulipifera	Tuliptree	Tree				1	1	41						1			
Nyssa sylvatica	Blackgum	Tree															
Pinus	Pine	Tree															2
Pinus rigida	Pitch pine	Tree															
Pinus serotina	Pond pine	Tree															
Platanus occidentalis	American sycamore	Tree	6	6	6	4	4	4	2	2	2	4	4	5	1	1	1
Prunus serotina	Black cherry	Tree															
Quercus	Oak	Tree															5
Quercus michauxii	Swamp chestnut oak	Tree	2	2	2	1	1	1	1	1	1	1	1	1			
Quercus phellos	Willow oak	Tree				1	1	1									
Quercus rubra	Northern red oak	Tree				1	1	1	2	2	2				4	4	4
Rhus glabra	Smooth sumac	Shrub															
Robinia pseudoacacia	Black locust	Tree									1						
Salix sericea	Silky willow	Shrub															
Sambucus canadensis	Common Elderberry	Shrub															
Ulmus alata	Winged elm	Tree									1						
		Stem count	13	13	14	15	15	95	9	9	63	11	11	20	14	14	31
		Size (ares)		1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	4	4	5	7	7	8	5	5	9	4	4	7	4	4	8
		Stems per ACRE	526	526	567	607	607	3,845	364	364	2,550	445	445	809	567	567	1,255

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%

Volunteers included

PnoLS: Number of planted stems excluding live stakes

P-All: Number of planted stems including live stakes

T: Total stems

Table 9e. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)														
			Vegetation Plot 21			Vegetation Plot 22			Vegetation Plot 23			Vegetation Plot 24			Vegetation Plot 25		
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															
Alnus serrulata	Hazel alder	Shrub															
Betula nigra	River birch	Tree	2	2	6	2	2	5	2	2	2				1	1	1
Carya	Hickory	Tree															
Celtis laevigata	Sugarberry	Tree															
Chamaecyparis thyoides	Atlantic white cedar	Tree															
Crataegus	Hawthorn	Tree															
Diospyros virginiana	Common persimmon	Tree						10									1
Fraxinus pennsylvanica	Green ash	Tree	1	1	1	3	3	3	2	2	32	1	1	1	1	1	1
Juglans nigra	Black walnut	Tree															
Juniperus virginiana	Eastern redcedar	Tree						1									
Liquidambar styraciflua	Sweetgum	Tree			10			2			10			2			
Liriodendron tulipifera	Tuliptree	Tree	1	1	2			5									
Nyssa sylvatica	Blackgum	Tree															
Pinus	Pine	Tree															
Pinus rigida	Pitch pine	Tree															
Pinus serotina	Pond pine	Tree															
Platanus occidentalis	American sycamore	Tree	2	2	2	1	1	1	6	6	7	4	4	6	4	4	5
Prunus serotina	Black cherry	Tree															
Quercus	Oak	Tree															
Quercus michauxii	Swamp chestnut oak	Tree				3	3	3									
Quercus phellos	Willow oak	Tree	2	2	2												
Quercus rubra	Northern red oak	Tree	4	4	4			1			1	1	1	1	2	2	2
Rhus glabra	Smooth sumac	Shrub															
Robinia pseudoacacia	Black locust	Tree															
Salix sericea	Silky willow	Shrub															
Sambucus canadensis	Common Elderberry	Shrub															
Ulmus alata	Winged elm	Tree															
		Stem count	12	12	27	9	9	31	10	10	52	6	6	10	8	8	10
		Size (ares)		1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02	
		Species count	6	6	7	4	4	9	3	3	5	3	3	4	4	4	5
		Stems per ACRE	486	486	1,093	364	364	1,255	405	405	2,104	243	243	405	324	324	405

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%

Volunteers included

PnoLS: Number of planted stems excluding live stakes

P-All: Number of planted stems including live stakes

T: Total stems

Table 9f. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

			Current Plot Data (MY3 2017)																	
			Vegetation Plot 26			Vegetation Plot 27			Vegetation Plot 28			Vegetation Plot 29			Vegetation Plot 30			Vegetation Plot 31		
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																		
Alnus serrulata	Hazel alder	Shrub																		
Betula nigra	River birch	Tree	1	1	1							1	1	1	1	1	1			
Carya	Hickory	Tree																		
Celtis laevigata	Sugarberry	Tree																1	1	1
Chamaecyparis thyoides	Atlantic white cedar	Tree																		
Crataegus	Hawthorn	Tree																		
Diospyros virginiana	Common persimmon	Tree																		
Fraxinus pennsylvanica	Green ash	Tree	2	2	2	4	4	7	5	5	5	2	2	2	4	4	4	3	3	3
Juglans nigra	Black walnut	Tree															4			1
Juniperus virginiana	Eastern redcedar	Tree																		
Liquidambar styraciflua	Sweetgum	Tree						1						50			150			55
Liriodendron tulipifera	Tuliptree	Tree				1	1	1				1	1	1			1	1	1	2
Nyssa sylvatica	Blackgum	Tree																		
Pinus	Pine	Tree																		5
Pinus rigida	Pitch pine	Tree												1			1			
Pinus serotina	Pond pine	Tree																		
Platanus occidentalis	American sycamore	Tree	1	1	1	4	4	4	4	4	4	1	1	16						
Prunus serotina	Black cherry	Tree																		
Quercus	Oak	Tree																		
Quercus michauxii	Swamp chestnut oak	Tree				3	3	3												
Quercus phellos	Willow oak	Tree	1	1	1	1	1	1	1	1	1									
Quercus rubra	Northern red oak	Tree	3	3	3							5	5	5	4	4	4	4	4	4
Rhus glabra	Smooth sumac	Shrub												6			1			
Robinia pseudoacacia	Black locust	Tree																		
Salix sericea	Silky willow	Shrub																		
Sambucus canadensis	Common Elderberry	Shrub																		
Ulmus alata	Winged elm	Tree																		
		Stem count	8	8	8	13	13	17	10	10	10	10	10	82	9	9	166	9	9	71
		Size (ares)		1			1			1			1			1			1	
		Size (ACRES)		0.02			0.02			0.02			0.02			0.02			0.02	
		Species count	5	5	5	5	5	6	3	3	3	5	5	8	3	3	8	4	4	7
		Stems per ACRE	324	324	324	526	526	688	405	405	405	405	405	3,318	364	364	6,718	364	364	2,873

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%
Volunteers included

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

Table 9g. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

			Annual Means											
			MY3 (2017)			MY2 (2016)			MY1 (9/2015)			MY0 (1/2015)		
Scientific Name	**Common Name**	**Species Type**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**	**PnoLS**	**P-all**	**T**
Acer rubrum	Red maple	Tree			45						2			
Alnus serrulata	Hazel alder	Shrub			1			1						
Betula nigra	River birch	Tree	37	37	47	37	37	42	44	44	51	53	53	53
Carya	Hickory	Tree									1			
Celtis laevigata	Sugarberry	Tree	1	1	2	1	1	1						
Chamaecyparis thyoides	Atlantic white cedar	Tree									1			
Crataegus	Hawthorn	Tree						1						
Diospyros virginiana	Common persimmon	Tree			93			82			51			
Fraxinus pennsylvanica	Green ash	Tree	79	79	113	86	86	133	85	85	116	92	92	92
Juglans nigra	Black walnut	Tree			13			14						
Juniperus virginiana	Eastern redcedar	Tree			4						1			
Liquidambar styraciflua	Sweetgum	Tree			565			261			102			
Liriodendron tulipifera	Tuliptree	Tree	17	17	98	24	24	64	24	24	28	52	52	52
Nyssa sylvatica	Blackgum	Tree			2			1						
Pinus	Pine	Tree			25									
Pinus rigida	Pitch pine	Tree			25									
Pinus serotina	Pond pine	Tree						1						
Platanus occidentalis	American sycamore	Tree	105	105	133	110	110	146	108	108	115	114	114	114
Prunus serotina	Black cherry	Tree						4						
Quercus	Oak	Tree			5			2						
Quercus michauxii	Swamp chestnut oak	Tree	42	42	42	45	45	45	45	45	45	46	46	46
Quercus phellos	Willow oak	Tree	20	20	20	34	34	34	36	36	36	71	71	71
Quercus rubra	Northern red oak	Tree	52	52	55	58	58	61	60	60	62	69	69	69
Rhus glabra	Smooth sumac	Shrub			7									
Robinia pseudoacacia	Black locust	Tree			1									
Salix sericea	Silky willow	Shrub			1									
Sambucus canadensis	Common Elderberry	Shrub						3						
Ulmus alata	Winged elm	Tree			4						1			
		Stem count	353	353	1,301	395	395	896	402	402	612	497	497	497
		Size (ares)		31			31			31			31	
		Size (ACRES)		0.77			0.77			0.77			0.77	
		Species count	8	8	22	8	8	18	7	7	14	7	7	7
		Stems per ACRE	461	461	1,698	516	516	1,170	525	525	799	649	649	649

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%
Volunteers included

APPENDIX 4. Morphological Summary Data and Plots

Table 10a. Baseline Stream Data Summary
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT2 Reaches 1 and 2

		Pre-Restoration Condition				Reference Reach Data										Design				As-Built/Baseline			
Parameter	Gage	UT2 Reach 1		UT2 Reach 2		Dutchman's Creek		UT to Rocky Creek		Spencer Creek Reach 1		Spencer Creek Reach 2		Spencer Creek Reach 3		UT2 Reach 1		UT2 Reach 2		UT2 Reach 1		UT2 Reach 2	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																							
Bankfull Width (ft)		7.9	10.9	10.7		23.0	32.0	12.2		8.7		2.1	2.6	1.0	1.2	12.5		14.0		10.6	14.2	15.3	
Floodprone Width (ft)		12	18	14		61	69	72		229		60	>114	14	125	50	125	50	125	>68	101	>55	
Bankfull Mean Depth		1.0	1.4	1.4		1.1	1.4	1.3		1.2		1.6	1.8	0.8	1.0	1.0		1.0		0.8	0.9	1.0	
Bankfull Max Depth		1.4	1.8	2.0		1.9	2.1	1.8		1.9		2.1	2.6	1.0	1.2	1.5		1.5		1.3	1.7	1.5	
Bankfull Cross-sectional Area (ft^2)	N/A	11.1	11.4	14.9		32.9	36.1	16.3		10.6		17.8	19.7	6.6	8.7	12.0		14.3		8.4	12.7	14.8	
Width/Depth Ratio		5.7	10.4	7.7		16.4	28.9	9.1		7.3		5.8	7.1	7.9	9.3	13.0		14.0		13.2	15.8	15.8	
Entrenchment Ratio		1.5	1.7	1.3		2.2	2.6	6.0		26.3		5.5	10.2	1.7	4.3	4.0	10.0	3.6	8.9	>7	7.1	>4	
Bank Height Ratio		1.4	1.9	2.1		---		1.0		1.0		1.0		1.0		1.0		1.0		1.0		1.0	
D50 (mm)		0.100		12.5																24.2	28.0	45.8	
Riffle Length (ft)						---		---		---				---		---		---		11	120	24	36
Riffle Slope (ft/ft)		---		---		---		0.0606	0.0892	0.01	0.067	0.013		0.0184	0.0343	0.0105	0.0225	0.0154	0.033	0.0033	0.0227	0.0104	0.0386
Pool Length (ft)	N/A					---		---		---		---		---		---		---		17	66	41	105
Pool Max Depth (ft)		2.0	2.2	2.2		---		2.2	6.7	2.5		3.3		1.2	1.8	1.8	2.4	1.9	2.5	1.7	3.6	3.2	5.0
Pool Spacing (ft)		---		---		---		26	81	13	47	71		9	46	19	81	21	91	20	108	65	132
Pool Volume (ft^3)																							
Pattern																							
Channel Beltwidth (ft)		45	79	67	69	84		---		24	52	38	41	10	50	20	75	22	84	5	11	32	79
Radius of Curvature (ft)		12	28	22	25	---		---		5	22	11	15	12	85	23	38	25	42	13	35	21	24
Rc:Bankfull Width (ft/ft)	N/A	1.5	2.6	2.1	2.3	---		---		0.6	2.5	1.3	1.4	1.9	9.1	1.8	3.0	1.8	3	1.2	2.5	1.4	1.6
Meander Length (ft)		102	245	125	132	---		---		---		---		53	178	50	188	56	120	60	171	113	120
Meander Width Ratio		5.7	7.2	6.3	6.4	---		---		6.0	6.0	#DIV/0!	3.6	1.6	5.4	1.6	6.0	1.6	6.0	0.5	0.8	2.1	5.2
Substrate, Bed and Transport Parameters																							
Ri%/Ru%/P%/G%/S%																							
SC%/Sa%/G%/C%/B%/Be%																							
d16/d35/d50/d84/d95/d100	N/A	SC/SC/0.1/45/180		SC/4.6/12.5/70/128		---		SC/2.4/22.6/120/256		0.1/3/8.6/77/180		SC/3/8.8/42/90		1.9/8.85/11/64/128						15/31/46/97/228/>2048		15/31/46/97/228/>2048	
Reach Shear Stress (Competency) lb/ft^2		---		---												0.39		0.61		0.37	0.43	0.67	
Max part size (mm) mobilized at bankfull																							
Stream Power (Capacity) W/m^2																							
Additional Reach Parameters																							
Drainage Area (SM)		0.38		0.59		2.90		1.10		0.50		0.96		0.37		0.38		0.59		0.38		0.59	
Watershed Impervious Cover Estimate (%)		1%		1%		---		---		---		---		---		1%		1%		1%		1%	
Rosgen Classification		G5/4		G4		B/C		E4b		E4/C4		E4		E4		C4		C4		C4		C4	
Bankfull Velocity (fps)		3.7	4.0	3.9		---		5.5		---		4.9	5.4		5.6	3.1		3.9		2.7	3.0	3.8	
Bankfull Discharge (cfs)		45		58		203		85		---		97		35		40		54		23	38	56	
Q-NFF regression (2-yr)		85		112																			
Q-USGS extrapolation (1.2-yr)	N/A	46		62																			
Q-Mannings		---		---																			
Valley Length (ft)		1,465		428		---		---		---		---		---		1,465		428		1,465		428	
Channel Thalweg Length (ft)		1,527		704		---		---		---		---		---		1,715		732		1,787		529	
Sinuosity		1.3		1.1		---		1.1		1.1		1.3		1.0	1.3	1.0	1.2	1.0	1.2	1.2		1.2	
Water Surface Slope ($ft/ft)^2$		---		---		---		---		---		---		---		---		---		0.0087		0.0126	
Bankfull Slope (ft/ft)		0.0083		0.0082		0.019		0.0235		0.132		0.0047		0.019	0.022	0.0083		0.0108		0.0085	0.0086	0.0103	0.0107

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 10b. Baseline Stream Data Summary
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT2A Reaches 1 and 2

		Pre-Restoration Condition				Reference Reach Data	Design				As-Built/Baseline			
Parameter	**Gage**	**UT2A Reach 1**		**UT2A Reach 2**		**See Table 10a.**	**UT2A Reach 1**		**UT2A Reach 2**		**UT2A Reach 1**		**UT2A Reach 2**	
		Min	**Max**	**Min**	**Max**		**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle														
Bankfull Width (ft)		6.2		6.0	7.9		9.0		10.0		10.3		9.8	10.9
Floodprone Width (ft)		40		6	10		50	125	50	125	>87		63	>88
Bankfull Mean Depth		1.0		0.8	1.0		0.6		0.7		0.8		0.7	
Bankfull Max Depth		2.0		1.1	1.5		0.9		0.8	1.1	1.6		1.1	1.2
Bankfull Cross-sectional Area (ft^2)	N/A	6.2		6.1	6.2	See Table 10a.	5.7		7.0		8.0		6.8	8.0
Width/Depth Ratio		6.2		5.9	10.0		14.0		14.0		13.3		14.0	14.9
Entrenchment Ratio		6.5		0.8	1.7		5.6	13.9	5	12.5	>8		5.7	>9
Bank Height Ratio		1.4		2.3	2.9		1.0		1.0		1.0		1.0	
D50 (mm)		0.1		0.1							30.9		34.3	39.8
Profile														
Riffle Length (ft)							---		---		18	54	10	67
Riffle Slope (ft/ft)		---		---			0.119	0.0255	0.013	0.028	0.0032	0.0210	0.0034	0.0330
Pool Length (ft)	N/A					See Table 10a.	---		---		18	54	14	55
Pool Max Depth (ft)		2.3		1.9	2.7		1.2	1.5	1.4	1.7	1.4	2.9	1.5	4.1
Pool Spacing (ft)		---		---			14	59	15	65	40	67	27	88
Pool Volume (ft^3)														
Pattern														
Channel Beltwidth (ft)		18	22	26	72		14	54	16	60	20	38	15	42
Radius of Curvature (ft)		8	31	6	28		16	27	18	30	16	25	18	30
Rc:Bankfull Width (ft/ft)	N/A	1.3	5.0	1.0	3.5	See Table 10a.	1.8	3.0	1.8	3.0	0.5	2.4	1.8	2.8
Meander Length (ft)		54	61	102	173		36	135	40	150	76	116	64	147
Meander Width Ratio		2.9	3.6	4.3	9.1		1.6	6.0	1.6	6.0	1.9	3.7	1.5	3.9
Substrate, Bed and Transport Parameters														
Ri%/Ru%/P%/G%/S%														
SC%/Sa%/G%/C%/B%/Be%														
d16/d35/d50/d84/d95/d100	N/A	SC/SC/0.1/3/7		SC/SC/0.1/3/7		See Table 10a.					SC/2/18/57/87/180		SC/2/18/57/87/180	
Reach Shear Stress (Competency) lb/ft^2		---		---			0.3		0.36		0.25		0.44	0.45
Max part size (mm) mobilized at bankfull														
Stream Power (Capacity) W/m^2														
Additional Reach Parameters														
Drainage Area (SM)		0.10		0.16			0.10		0.16		0.10		0.16	
Watershed Impervious Cover Estimate (%)		<1%		<1%			<1%		<1%		<1%		<1%	
Rosgen Classification		E/G5/4		E/G5/4			C4		C4		C4		C4	
Bankfull Velocity (fps)		3.0		2.7	3.1		2.6		3.0		2.2		2.8	
Bankfull Discharge (cfs)		19		19			15		21		18		19	25
Q-NFF regression (2-yr)		35		48										
Q-USGS extrapolation (1.2-yr)	N/A	18		25		See Table 10a.								
Q-Mannings		---		---										
Valley Length (ft)		283		1,198			283		1,198		283		1,198	
Channel Thalweg Length (ft)		368		1,368			386		1,311		386		1,443	
Sinuosity		1.3		1.2			1.0	1.2	1.0	1.2	1.3		1.2	
Water Surface Slope $(ft/ft)^2$		---		---			---		---		0.006		0.0108	
Bankfull Slope (ft/ft)		0.0082		0.0086			0.0102		0.0110		0.0084	0.0092	0.0107	0.0109

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 10c. Baseline Stream Data Summary
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT2B Reach 2 and UT2C Reaches 2 and 3

		Pre-Restoration Condition				Reference Reach Data	Design				As-Built/Baseline			
Parameter	**Gage**	**UT2B**		**UT2C**		**See Table 10a.**	**UT2B Reach 2**		**UT2C Reach 2 & 3**		**UT2B Reach 2**		**UT2C Reach 2 & 3**	
		Min	**Max**	**Min**	**Max**		**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle														
Bankfull Width (ft)		3.4	5.1	4.2	6.4		5.0		7.8		5.2		9.9	
Floodprone Width (ft)		4	8	7	53		50	125	50	125	>41		>48	
Bankfull Mean Depth		0.4	0.6	0.6	0.9		0.4		0.6		0.4		0.5	
Bankfull Max Depth		0.7	1.0	0.9	1.4		0.5	0.6	0.7	0.8	0.6		1.1	
Bankfull Cross-sectional Area (ft^2)	N/A	2.2	2.3	3.8	4.2	See Table 10a.	2.1		4.3		2.1		5.3	
Width/Depth Ratio		5.5	11.3	4.6	9.6		12.0		14.0		13.0		18.4	
Entrenchment Ratio		1.2	1.6	1.2	2.6		10.0	25.0	6.4	16.0	>8		>5	
Bank Height Ratio		1.7	4.0	1.0	3.4		1.0		1.0		1.0		1.0	
D50 (mm)		2.1		6.0							25.4		18.4	
Profile														
Riffle Length (ft)							---		---		7	25	6	20
Riffle Slope (ft/ft)		---		---			0.03	0.065	0.0180	0.0380	0.0146	0.0441	0.0051	0.0584
Pool Length (ft)	N/A					See Table 10a.	---		---		10	21	3	25
Pool Max Depth (ft)		---		1.1	1.2		0.6	1.0	1.1	1.5	1.3	2.8	2.2	3.7
Pool Spacing (ft)		---		---			8	33	12	51	19	36	23	36
Pool Volume (ft^3)														
Pattern														
Channel Beltwidth (ft)		25	32	33	46		8	30	12	47	8	19	10	25
Radius of Curvature (ft)		20		6	20		9	15	14	23	9	15	14	15
Rc:Bankfull Width (ft/ft)	N/A	2.9	3.9	1.4	3.1	See Table 10a.	1.8	3.0	1.9	3.0	1.7	2.9	1.4	1.5
Meander Length (ft)		23	21	160	165		20	75	31	117	40	62	45	82
Meander Width Ratio		7.4	6.3	7.9	7.2		1.6	6.0	1.6	6.0	1.6	3.6	1.0	2.5
Substrate, Bed and Transport Parameters														
Ri%/Ru%/P%/G%/S%														
SC%/Sa%/G%/C%/B%/Be%														
d16/d35/d50/d84/d95/d100	N/A	SC/SC/2.1/18/107		SC/0.8/6/45/78		See Table 10a.					SC/6/21/55/128/256		SC/SC/9/45/78/128	
Reach Shear Stress (Competency) lb/ft^2		---		---			0.49		0.46	0.72	0.46		0.25	1.11
Max part size (mm) mobilized at bankfull														
Stream Power (Capacity) W/m^2														
Additional Reach Parameters														
Drainage Area (SM)		0.03		0.08			0.03		0.08		0.03		0.08	
Watershed Impervious Cover Estimate (%)		<1%		<1%			<1%		<1%		<1%		<1%	
Rosgen Classification		G4		E/G4			C4		C4		C4b		C4/C4b	
Bankfull Velocity (fps)		3.0	3.2	3.3	3.7		3		2.7		2.7		2.1	
Bankfull Discharge (cfs)		7		14			7		13		6		11	
Q-NFF regression (2-yr)		18		31										
Q-USGS extrapolation (1.2-yr)	N/A	9		15		See Table 10a.								
Q-Mannings		---		---										
Valley Length (ft)		183		296			183		229		183		229	
Channel Thalweg Length (ft)		114		326			198		247		198		247	
Sinuosity		1.2		1.1			1.0	1.2	1.0	1.2	1.1		1.1	
Water Surface Slope $(ft/ft)^2$		---		---			---		---		0.0211		0.0083	0.0365
Bankfull Slope (ft/ft)		0.0250		0.0120			0.0259		0.0154	0.024	0.0207	0.0215	0.0102	0.0459

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 10d. Baseline Stream Data Summary

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT1B Reach 1

		Pre-Restoration		Reference Reach Data	Design		As-Built/Baseline	
Parameter	**Gage**	**UT1B**		**See Table 10a.**	**UT1B Reach 1**		**UT1B Reach 1**	
		Min	**Max**		**Min**	**Max**	**Min**	**Max**
Dimension and Substrate - Riffle								
Bankfull Width (ft)	N/A	7.1	13.2	See Table 10a.	5.0		4.8	
Floodprone Width (ft)		8	28		10	25	12.4	
Bankfull Mean Depth		0.7	1.1		0.4		0.4	
Bankfull Max Depth		1.2	1.9		0.5		0.6	
Bankfull Cross-sectional Area (ft^2)		8.0	12.0		1.9		1.8	
Width/Depth Ratio		10.1	12.0		13.0		13.3	
Entrenchment Ratio		2.2			10.0	25.0	2.6	
Bank Height Ratio		2.5			1.0		1.0	
D50 (mm)		52.3					56.3	
Profile								
Riffle Length (ft)	N/A			See Table 10a.	---		11	47
Riffle Slope (ft/ft)		---			0.0154	0.033	0.0185	0.0646
Pool Length (ft)					---		20	105
Pool Max Depth (ft)		1.4	2.6		1.9	2.5	1.1	1.6
Pool Spacing (ft)		---			21	91	56	103
Pool Volume (ft^3)								
Pattern								
Channel Beltwidth (ft)	N/A	20	47	See Table 10a.	22	84	---	
Radius of Curvature (ft)		10	84		25	42	---	
Rc:Bankfull Width (ft/ft)		0.9	7.5		1.8	3.0	---	
Meander Length (ft)		68	294		56	210	---	
Meander Width Ratio		1.8	4.2		1.6	6.0	---	
Substrate, Bed and Transport Parameters								
Ri%/Ru%/P%/G%/S%	N/A			See Table 10a.				
SC%/Sa%/G%/C%/B%/Be%								
d16/d35/d50/d84/d95/d100		SC/15.41/52.3/136/172					SC/1/6/128/256/512	
Reach Shear Stress (Competency) lb/ft^2		---			0.61		0.54	
Max part size (mm) mobilized at bankfull								
Stream Power (Capacity) W/m^2								
Additional Reach Parameters								
Drainage Area (SM)	N/A	0.03		See Table 10a.	0.03		0.03	
Watershed Impervious Cover Estimate (%)		<1%			<1%		<1%	
Rosgen Classification		Eb/B4			C4b		C4b	
Bankfull Velocity (fps)		1.7			3.3		2.8	
Bankfull Discharge (cfs)		12			6		5	
Q-NFF regression (2-yr)		15						
Q-USGS extrapolation (1.2-yr)		7						
Q-Mannings		---						
Valley Length (ft)		431			431		431	
Channel Thalweg Length (ft)		475			475		480	
Sinuosity		1.1			1.0	1.2	1.1	
Water Surface Slope ($ft/ft)^2$		---			---		0.0270	
Bankfull Slope (ft/ft)		0.0369			0.0360		0.0246	0.0260

SC: Silt/Clay <0.062 mm diameter particles
(---): Data was not provided
N/A: Not Applicable

Table 11a. Morphology and Hydraulic Summary (Dimensional Parameters - Cross Section)

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

	Cross-Section 1, UT2A Reach 1 (Pool)								Cross-Section 2, UT2A Reach 1 (Riffle)								Cross-Section 3, UT2A Reach 2 (Riffle)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	722.6	722.6	722.6	722.6					722.4	722.4	722.4	722.4					719.7	719.7	719.7	719.7				
Bankfull Width (ft)	12.1	12.7	12.7	13.1					10.3	9.7	10.1	10.7					9.8	10.3	10.2	10.2				
Floodprone Width (ft)	---	---	---	---					>87	>88	>88	>88					>88	>87	>92	>75				
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.2					0.8	0.8	0.8	0.7					0.7	0.7	0.8	0.5				
Bankfull Max Depth (ft)	2.7	2.5	2.5	2.7					1.6	1.3	1.4	1.3					1.1	1.1	1.3	1.0				
Bankfull Cross-Sectional Area (ft^2)	16.8	16.5	16.5	15.1					8.0	7.6	7.6	7.0					6.8	6.7	7.7	5.6				
Bankfull Width/Depth Ratio	8.7	9.8	9.8	11.4					13.3	12.4	13.3	16.3					14.0	15.8	13.6	18.6				
Bankfull Entrenchment Ratio	---	---	---	---					>8	>9	>9	>8					>9	>8	>9	>7				
Bankfull Bank Height Ratio	---	---	---	---					1.0	1.0	1.0	1.0					1.0	1.0	1.0	1.0				
d50 (mm)	---	---	---	---					30.9	40.3	27.7	0.3					39.8	26.3	26.9	43.3				
	Cross-Section 4, UT2A Reach 2 (Pool)								**Cross-Section 5, UT2A Reach 2 (Pool)**								**Cross-Section 6, UT2A Reach 2 (Riffle)**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	719.6	719.6	719.6	719.6					713.5	713.5	713.5	713.5					713.4	713.4	713.4	713.4				
Bankfull Width (ft)	12.1	12.1	12.7	11.8					12.7	12.8	12.6	12.6					10.9	14.0	13.8	10.9				
Floodprone Width (ft)	---	---	---	---					---	---	---	---					63	66	69	67				
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.3					1.0	0.9	1.1	1.0					0.7	0.6	0.7	0.7				
Bankfull Max Depth (ft)	3.0	2.7	2.8	3.1					1.6	1.7	1.8	1.9					1.2	1.2	1.4	1.3				
Bankfull Cross-Sectional Area (ft^2)	16.7	15.6	16.7	16.0					12.3	12.1	11.1	13.0					8.0	9.0	9.2	8.0				
Bankfull Width/Depth Ratio	8.8	9.4	9.7	8.8					13.2	13.5	12.4	12.2					14.9	21.8	20.6	14.8				
Bankfull Entrenchment Ratio	---	---	---	---					---	---	---	---					5.7	4.7	5.0	6.1				
Bankfull Bank Height Ratio	---	---	---	---					---	---	---	---					1.0	1.0	1.0	1.0				
d50 (mm)	---	---	---	---					---	---	---	---					34.3	41.6	29.1	18.6				
	Cross-Section 7, UT2 Reach 2 (Pool)								**Cross-Section 8, UT2 Reach 2 (Riffle)**								**Cross-Section 9, UT2B Reach 2 (Riffle)**							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	705.9	705.9	705.9	705.9					705.0	705.0	705.0	705.0					724.4	724.4	724.4	724.4				
Bankfull Width (ft)	32.2	32.4	32.8	32.7					13.1	13.1	13.5	13.9					5.2	6.0	5.7	6.0				
Floodprone Width (ft)	---	---	---	---					>55	>60	>60	>59					>41	>29	>42	>66				
Bankfull Mean Depth (ft)	1.2	1.3	1.6	1.5					1.1	1.2	1.2	1.1					0.4	0.3	0.4	0.5				
Bankfull Max Depth (ft)	3.8	3.6	5.1	5.1					1.5	1.8	1.9	1.7					0.6	0.5	0.6	1.2				
Bankfull Cross-Sectional Area (ft^2)	38.6	41.8	52.1	50.1					14.6	16.2	16.5	14.4					2.1	1.8	2.3	3.1				
Bankfull Width/Depth Ratio	26.9	25.1	20.7	21.4					11.8	10.6	11.1	13.6					13.0	19.9	14.2	11.8				
Bankfull Entrenchment Ratio	---	---	---	---					>4	>5	>5	>4					>8	>5	>8	>11				
Bankfull Bank Height Ratio	---	---	---	---					1.0	1.0	1.0	1.0					1.0	1.0	1.0	1.1				
d50 (mm)	---	---	---	---					45.8	25.7	23.4	38.7					25.4	33.7	11.0	22.6				

	Cross-Section 10, UT2B Reach 2 (Pool)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	723.4	723.4	723.4	723.4				
Bankfull Width (ft)	10.8	11.3	10.5	10.7				
Floodprone Width (ft)	---	---	---	---				
Bankfull Mean Depth (ft)	0.8	0.8	0.7	0.8				
Bankfull Max Depth (ft)	1.5	1.5	1.8	1.8				
Bankfull Cross-Sectional Area (ft^2)	8.3	8.6	7.8	9.0				
Bankfull Width/Depth Ratio	14.1	14.8	14.0	12.8				
Bankfull Entrenchment Ratio	---	---	---	---				
Bankfull Bank Height Ratio	---	---	---	---				
d50 (mm)	---	---	---	---				

Table 11b. Morphology and Hydraulic Summary (Dimensional Parameters - Cross Section)
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

	Cross-Section 11, UT2 Reach 1 (Riffle)								Cross-Section 12, UT2 Reach 1 (Riffle)								Cross-Section 13, UT2 Reach 1 (Pool)								Cross-Section 14, UT1B Reach 1 (Pool)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	719.3	719.3	719.3	719.3					717.3	717.3	717.3	717.3					717.4	717.4	717.4	717.4					764.2	764.2	764.2	764.2				
Bankfull Width (ft)	14.2	13.7	13.9	13.8					10.6	10.6	11.2	10.9					19.6	17.4	17.1	18.2					5.2	4.9	5.3	5.0				
Floodprone Width (ft)	101	105	104	103					>68	>57	>68	>66					---	---	---	---					---	---	---	---				
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.8					0.8	0.7	0.7	0.6					1.2	1.1	1.3	1.1					0.5	0.2	0.2	0.1				
Bankfull Max Depth (ft)	1.7	1.8	1.9	1.8					1.3	1.1	1.3	1.2					2.4	2.0	2.3	2.3					0.7	0.3	0.4	0.3				
Bankfull Cross-Sectional Area (ft^2)	12.7	14.1	14.0	11.7					8.4	7.3	7.7	7.1					23.1	18.5	21.5	19.8					2.5	1.0	1.2	0.6				
Bankfull Width/Depth Ratio	15.8	13.3	13.8	16.4					13.2	15.6	16.2	16.9					16.7	16.4	13.6	16.7					10.4	23.3	22.5	40.5				
Bankfull Entrenchment Ratio	7.1	7.6	7.4	7.4					>7	>5	>6	>6					---	---	---	---					---	---	---	---				
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0					1.0	1.0	1.0	1.0					---	---	---	---					---	---	---	---				
d50 (mm)	28.0	17.4	14.6	74.5					24.2	22.1	12.8	25.4					---	---	---	---					---	---	---	---				

	Cross-Section 15, UT1B Reach 1 (Riffle)								Cross-Section 16, UT2C Reach 2 (Riffle)								Cross-Section 17, UT2C Reach 2 (Pool)							
Dimension and Substrate	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**	**Base**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY6**	**MY7**
based on fixed bankfull elevation	761.9	761.9	761.9	761.9					709.2	709.2	709.2	709.2					708.3	708.3	708.3	708.3				
Bankfull Width (ft)	4.8	4.6	5.2	3.6					9.9	9.0	9.3	8.9					13.0	12.8	11.8	10.8				
Floodprone Width (ft)	12	8	10	9					>48	>45	>47	>47					---	---	---	---				
Bankfull Mean Depth (ft)	0.4	0.2	0.3	0.2					0.5	0.5	0.5	0.4					0.9	0.8	0.5	0.5				
Bankfull Max Depth (ft)	0.6	0.3	0.5	0.4					1.1	1.0	1.1	1.1					2.0	2.0	1.2	1.3				
Bankfull Cross-Sectional Area (ft^2)	1.8	1.0	1.5	0.7					5.3	4.6	4.9	3.9					11.2	10.7	5.9	5.7				
Bankfull Width/Depth Ratio	13.3	22.1	18.8	19.0					18.4	17.5	17.6	20.3					15.1	15.3	23.8	20.4				
Bankfull Entrenchment Ratio	2.6	1.6	1.9	2.4					>5	>5	>5	>5					---	---	---	---				
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.3					1.0	1.0	1.0	1.1					---	---	---	---				
d50 (mm)	56.3	69.7	13.3	23.9					18.4	10.8	8.0	11.5					---	---	---	---				

Table 12a. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Hopewell-UT1B Reach 1

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	4.8		4.6		5.2		3.6									
Floodprone Width (ft)	12		8		10		9									
Bankfull Mean Depth	0.4		0.2		0.3		0.2									
Bankfull Max Depth	0.6		0.3		0.5		0.4									
Bankfull Cross Sectional Area (ft^2)	1.8		1.0		1.5		0.7									
Width/Depth Ratio	13.3		22.1		18.8		19.0									
Entrenchment Ratio	2.6		1.6		1.9		2.4									
Bank Height Ratio	1.0		1.0		1.0		1.3									
D50 (mm)	56.3		69.7		13.3		23.9									
Profile																
Riffle Length (ft)	11	47														
Riffle Slope (ft/ft)	0.0185	0.0646														
Pool Length (ft)	20	105														
Pool Max Depth (ft)	1.1	1.6														
Pool Spacing (ft)	56	103														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	---															
Radius of Curvature (ft)	---															
Rc:Bankfull Width (ft/ft)	---															
Meander Wave Length (ft)	---															
Meander Width Ratio	---															
Additional Reach Parameters																
Rosgen Classification	C4b															
Channel Thalweg Length (ft)	480															
Sinuosity (ft)	1.1															
Water Surface Slope (ft/ft)	0.0270															
Bankfull Slope (ft/ft)	0.0246	0.0260														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	SC/1/6/128/256/512		SC/0.7/7/139/241/>2048		SC/6/9/23/57/180											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12b. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Hopewell-UT2 Reach 1

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	10.6	14.2	10.6	13.7	11.2	13.9	10.9	13.8								
Floodprone Width (ft)	>68	101	>57	105	>68	104	>66	103								
Bankfull Mean Depth	0.8	0.9	0.7	1.0	0.7	1.0	0.6	0.8								
Bankfull Max Depth	1.3	1.7	1.1	1.8	1.3	1.9	1.2	1.8								
Bankfull Cross Sectional Area (ft^2)	8.4	12.7	7.3	14.1	7.7	14.0	7.1	11.7								
Width/Depth Ratio	13.2	15.8	13.3	15.6	13.8	16.2	13.6	16.4								
Entrenchment Ratio	>7	7.1	>5	7.6	>6	7.4	>6	7.4								
Bank Height Ratio	1.0		1.0		1.0		1.0									
D50 (mm)	24.2	28.0	17.4	22.1	12.8	14.6	25.4	74.5								
Profile																
Riffle Length (ft)	11	120														
Riffle Slope (ft/ft)	0.0033	0.0227														
Pool Length (ft)	17	66														
Pool Max Depth (ft)	1.7	3.6														
Pool Spacing (ft)	20	108														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	5	11														
Radius of Curvature (ft)	13	36														
Rc:Bankfull Width (ft/ft)	1.2	2.5														
Meander Wave Length (ft)	60	171														
Meander Width Ratio	0.5	0.8														
Additional Reach Parameters																
Rosgen Classification	C4															
Channel Thalweg Length (ft)	1,787															
Sinuosity (ft)	1.20															
Water Surface Slope (ft/ft)	0.0087															
Bankfull Slope (ft/ft)	0.0085	0.0086														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	15/31/46/97/228/>2048		SC/5.6/20/112/237/2048		SC/10/17/51/174/2048											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12c. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Hopewell-UT2 Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	15.3		13.1		13.5		13.9									
Floodprone Width (ft)	>55		>60		>60		>59									
Bankfull Mean Depth	1.0		1.2		1.2		1.0									
Bankfull Max Depth	1.5		1.8		1.9		1.7									
Bankfull Cross Sectional Area (ft^2)	14.8		16.2		16.5		14.4									
Width/Depth Ratio	15.8		10.6		11.1		13.6									
Entrenchment Ratio	>4		>5		>5		4.3									
Bank Height Ratio	1.0		1.0		1.0		1.0									
D50 (mm)	45.8		25.7		23.4		38.7									
Profile																
Riffle Length (ft)	24	36														
Riffle Slope (ft/ft)	0.01039	0.03859														
Pool Length (ft)	41	105														
Pool Max Depth (ft)	3.2	5.0														
Pool Spacing (ft)	65	132														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	32	79														
Radius of Curvature (ft)	21	24														
Rc:Bankfull Width (ft/ft)	1.4	1.6														
Meander Wave Length (ft)	113	120														
Meander Width Ratio	2.1	5.2														
Additional Reach Parameters																
Rosgen Classification	C4															
Channel Thalweg Length (ft)	529															
Sinuosity (ft)	1.2															
Water Surface Slope (ft/ft)	0.0126															
Bankfull Slope (ft/ft)	0.0103	0.0107														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	15/31/46/97/228/>2048		SC/5.6/20/112/237/2048		SC/10/17/51/174/2048											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12d. Monitoring Data - Stream Reach Data Summary
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT2A Reach 1

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	10.3		9.7		10.1		10.7									
Floodprone Width (ft)	>87		>88		>88		>87									
Bankfull Mean Depth	0.8		0.8		0.8		0.7									
Bankfull Max Depth	1.6		1.3		1.4		1.3									
Bankfull Cross Sectional Area (ft^2)	8.0		7.6		7.6		7.0									
Width/Depth Ratio	13.3		12.4		13.3		16.3									
Entrenchment Ratio	>8		>9		>9		>8									
Bank Height Ratio	1.0		1.0		1.0		1.1									
D50 (mm)	30.9		40.3		27.7		0.3									
Profile																
Riffle Length (ft)	18	54														
Riffle Slope (ft/ft)	0.0032	0.0210														
Pool Length (ft)	18	54														
Pool Max Depth (ft)	1.4	2.9														
Pool Spacing (ft)	40	67														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	20	38														
Radius of Curvature (ft)	16	25														
Rc:Bankfull Width (ft/ft)	0.5	2.4														
Meander Wave Length (ft)	76	116														
Meander Width Ratio	1.9	3.7														
Additional Reach Parameters																
Rosgen Classification	C4															
Channel Thalweg Length (ft)	1,443															
Sinuosity (ft)	1.2															
Water Surface Slope (ft/ft)	0.0108															
Bankfull Slope (ft/ft)	0.0107	0.0109														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	SC/2/18/57/87/180		---		---											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12e. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Hopewell-UT2A Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	9.8	10.9	10.3	14.0	10.2	13.8	10.9	12.6								
Floodprone Width (ft)	63	>88	66	>87	69	>92	67	>75								
Bankfull Mean Depth	0.7		0.6	0.7	0.7	0.8	0.5	0.7								
Bankfull Max Depth	1.1	1.2	1.1	1.2	1.3	1.4	1.0	1.3								
Bankfull Cross Sectional Area (ft^2)	6.8	8.0	6.7	9.0	7.7	9.2	5.6	8.0								
Width/Depth Ratio	14.0	14.9	15.8	21.8	13.6	20.6	14.8	18.6								
Entrenchment Ratio	5.7	>9	4.7	>8	5.0	>9	6.1	>7								
Bank Height Ratio	1.0		1.0		1.0		1.0									
D50 (mm)	34.3	39.8	26.3	41.6	26.9	29.1	18.6	43.3								
Profile																
Riffle Length (ft)	10	67														
Riffle Slope (ft/ft)	0.0034	0.0330														
Pool Length (ft)	14	55														
Pool Max Depth (ft)	1.5	4.1														
Pool Spacing (ft)	27	88														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	15	42														
Radius of Curvature (ft)	18	30														
Rc:Bankfull Width (ft/ft)	1.8	2.8														
Meander Wave Length (ft)	64	147														
Meander Width Ratio	1.5	3.9														
Additional Reach Parameters																
Rosgen Classification	C4															
Channel Thalweg Length (ft)	1,443															
Sinuosity (ft)	1.2															
Water Surface Slope (ft/ft)	0.0108															
Bankfull Slope (ft/ft)	0.0107	0.0109														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	SC/2/18/57/87/180		SC/13/28/128/220/362		SC/4/12/78/152/256											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12f. Monitoring Data - Stream Reach Data Summary
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Hopewell-UT2B Reach 2

Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	5.2		6.0		5.7		6.0									
Floodprone Width (ft)	>41		>29		>42		>66									
Bankfull Mean Depth	0.4		0.3		0.4		0.5									
Bankfull Max Depth	0.6		0.5		0.6		1.2									
Bankfull Cross Sectional Area (ft^2)	2.1		1.8		2.3		3.1									
Width/Depth Ratio	13.0		19.9		14.2		11.8									
Entrenchment Ratio	>8		>5		>8		>11									
Bank Height Ratio	1.0		1.0		1.0		1.1									
D50 (mm)	25.4		33.7		11.0		22.6									
Profile																
Riffle Length (ft)	7	25														
Riffle Slope (ft/ft)	0.0146	0.0441														
Pool Length (ft)	10	21														
Pool Max Depth (ft)	1.3	2.8														
Pool Spacing (ft)	19	36														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	8	19														
Radius of Curvature (ft)	9	15														
Rc:Bankfull Width (ft/ft)	1.7	2.9														
Meander Wave Length (ft)	40	62														
Meander Width Ratio	1.6	3.6														
Additional Reach Parameters																
Rosgen Classification	C4b															
Channel Thalweg Length (ft)	198															
Sinuosity (ft)	1.1															
Water Surface Slope (ft/ft)	0.0211															
Bankfull Slope (ft/ft)	0.0207	0.0215														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	SC/6/21/55/128/256		SC/4/9/38/83/180		2.2/7/19/54/82/180											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Table 12g. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 3 - 2017

Hopewell-UT2C Reach 2 & 3

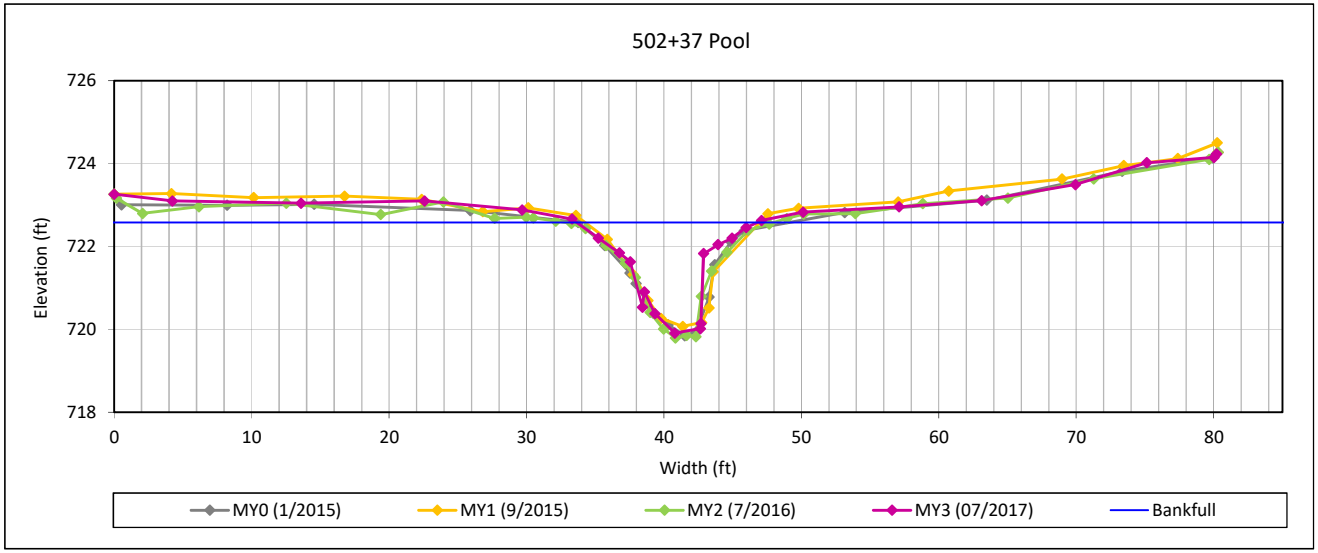
Parameter	As-Built/Baseline		MY1		MY2		MY3		MY4		MY5		MY6		MY7	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Dimension and Substrate - Riffle																
Bankfull Width (ft)	9.9		9.0		9.3		8.9									
Floodprone Width (ft)	>48		>45		>47		>47									
Bankfull Mean Depth	0.5		0.5		0.5		0.4									
Bankfull Max Depth	1.1		1.0		1.1		1.1									
Bankfull Cross Sectional Area (ft^2)	5.3		4.6		4.9		3.9									
Width/Depth Ratio	18.4		17.5		17.6		20.3									
Entrenchment Ratio	>5		>5		>5		>5									
Bank Height Ratio	1.0		1.0		1.0		1.1									
D50 (mm)	18.4		10.8		8.0		11.5									
Profile																
Riffle Length (ft)	6	20														
Riffle Slope (ft/ft)	0.0051	0.0584														
Pool Length (ft)	3	25														
Pool Max Depth (ft)	2.2	3.7														
Pool Spacing (ft)	23	36														
Pool Volume (ft^3)	---															
Pattern																
Channel Beltwidth (ft)	10	25														
Radius of Curvature (ft)	14	15														
Rc:Bankfull Width (ft/ft)	1.4	1.5														
Meander Wave Length (ft)	45	82														
Meander Width Ratio	1.0	2.6														
Additional Reach Parameters																
Rosgen Classification	C4/C4b															
Channel Thalweg Length (ft)	247															
Sinuosity (ft)	1.1															
Water Surface Slope (ft/ft)	0.0083	0.0365														
Bankfull Slope (ft/ft)	0.0102	0.0459														
Ri%/Ru%/P%/G%/S%	---															
SC%/Sa%/G%/C%/B%/Be%	---															
d16/d35/d50/d84/d95/d100	SC/SC/9/45/78/128		SC/0.2/6/73/124/256		0.2/0.5/1.3/9/45/128											
% of Reach with Eroding Banks	0%		0%		0%											

(---): Data was not provided

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 1, UT2A Reach 1



Bankfull Dimensions	
15.1	x-section area (ft.sq.)
13.1	width (ft)
1.2	mean depth (ft)
2.7	max depth (ft)
15.9	wetted parimeter (ft)
0.9	hyd radi (ft)
11.4	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

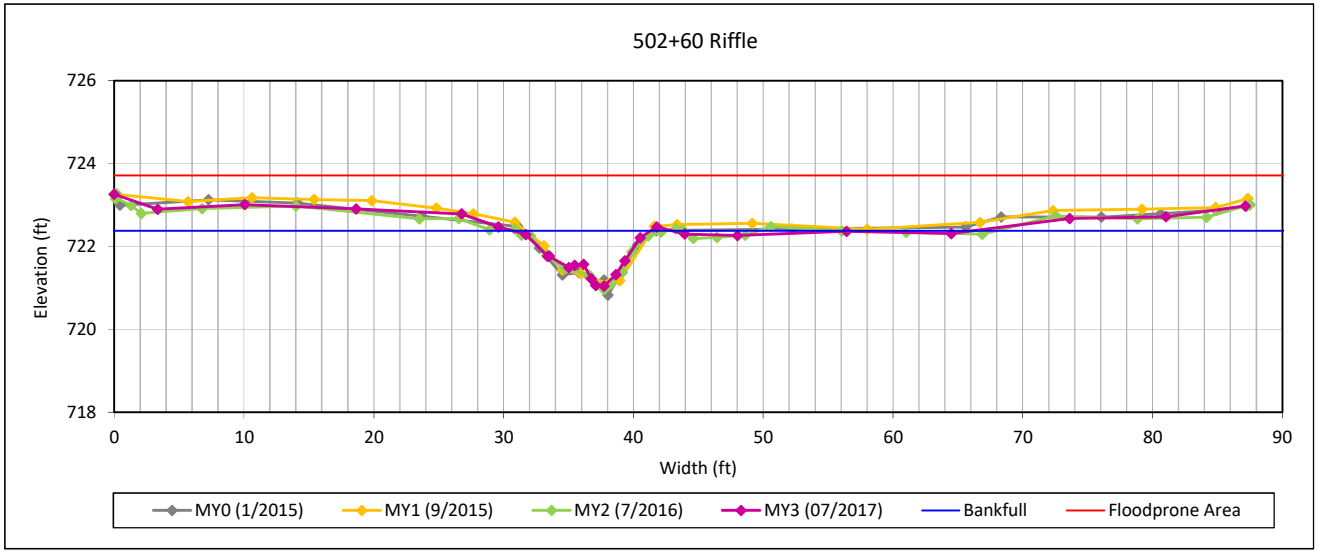
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 2, UT2A Reach 1



Bankfull Dimensions	
7.0	x-section area (ft.sq.)
10.7	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
11.2	wetted parimeter (ft)
0.6	hyd radi (ft)
16.3	width-depth ratio
87.1	W flood prone area (ft)
8.2	entrenchment ratio
1.0	low bank height ratio

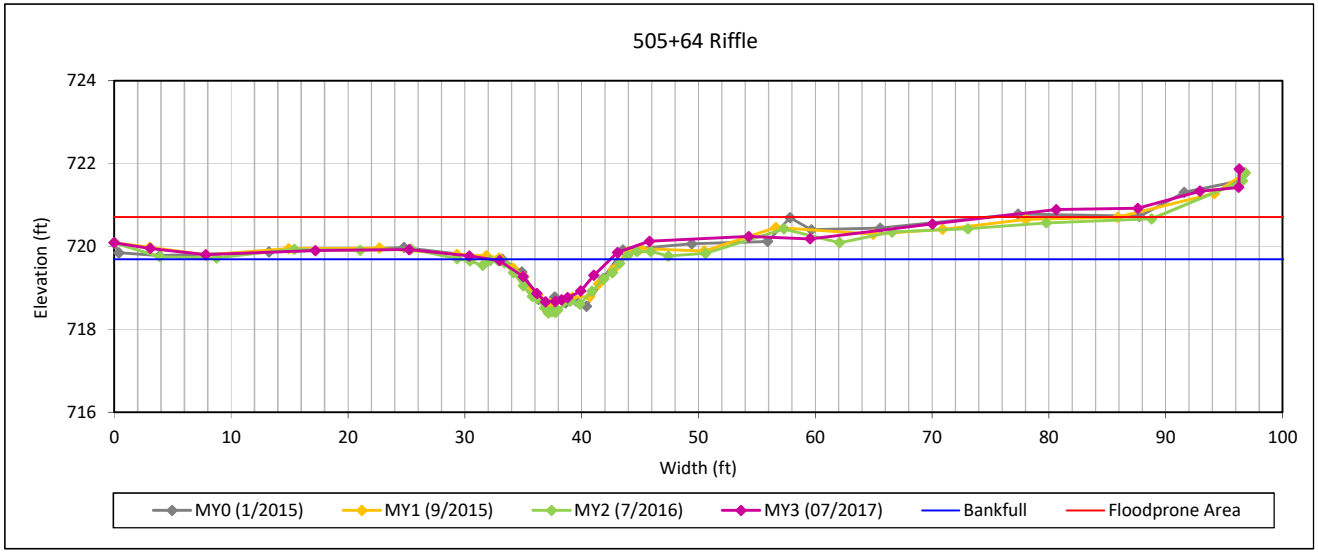
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 3, UT2A Reach 2



Bankfull Dimensions	
5.6	x-section area (ft.sq.)
10.2	width (ft)
0.5	mean depth (ft)
1.0	max depth (ft)
10.5	wetted parimeter (ft)
0.5	hyd radi (ft)
18.6	width-depth ratio
75.2	W flood prone area (ft)
7.4	entrenchment ratio
1.0	low bank height ratio

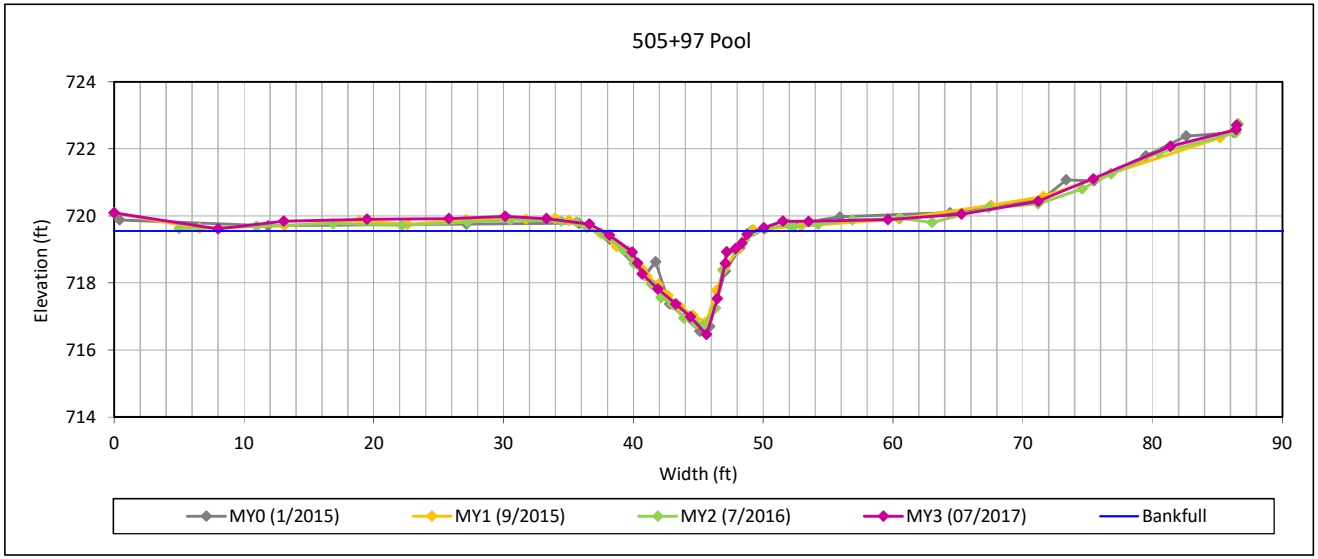
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 4, UT2A Reach 2



Bankfull Dimensions	
16.0	x-section area (ft.sq.)
11.8	width (ft)
1.3	mean depth (ft)
3.1	max depth (ft)
14.0	wetted parimeter (ft)
1.1	hyd radi (ft)
8.8	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

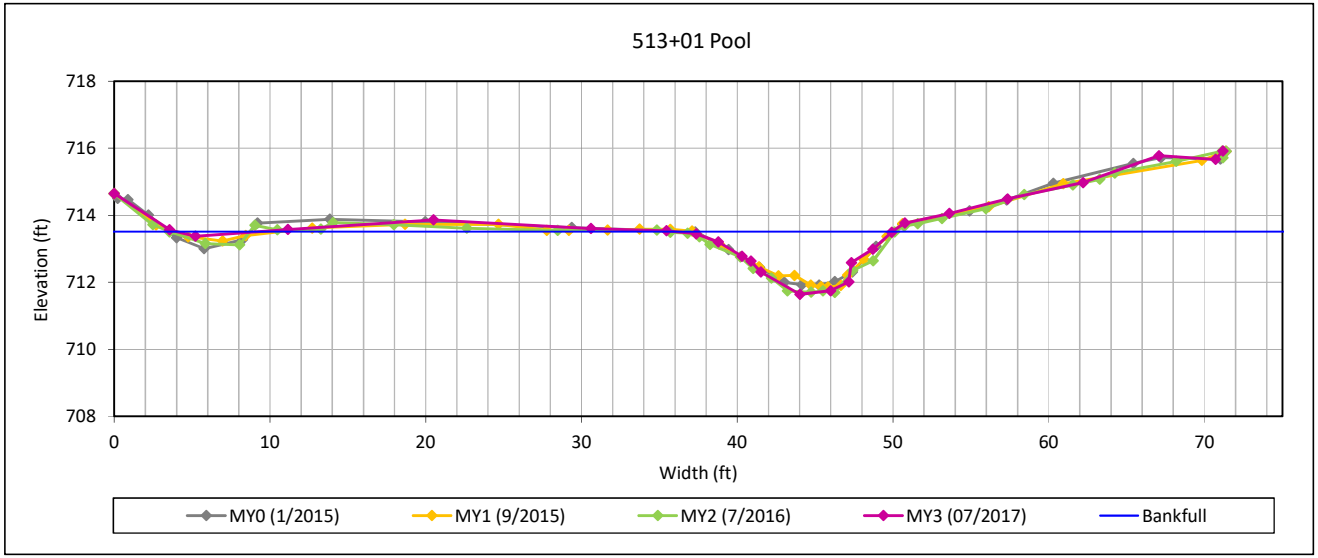
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 5, UT2A Reach 2



Bankfull Dimensions	
13.0	x-section area (ft.sq.)
12.6	width (ft)
1.0	mean depth (ft)
1.9	max depth (ft)
13.5	wetted parimeter (ft)
1.0	hyd radi (ft)
12.2	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

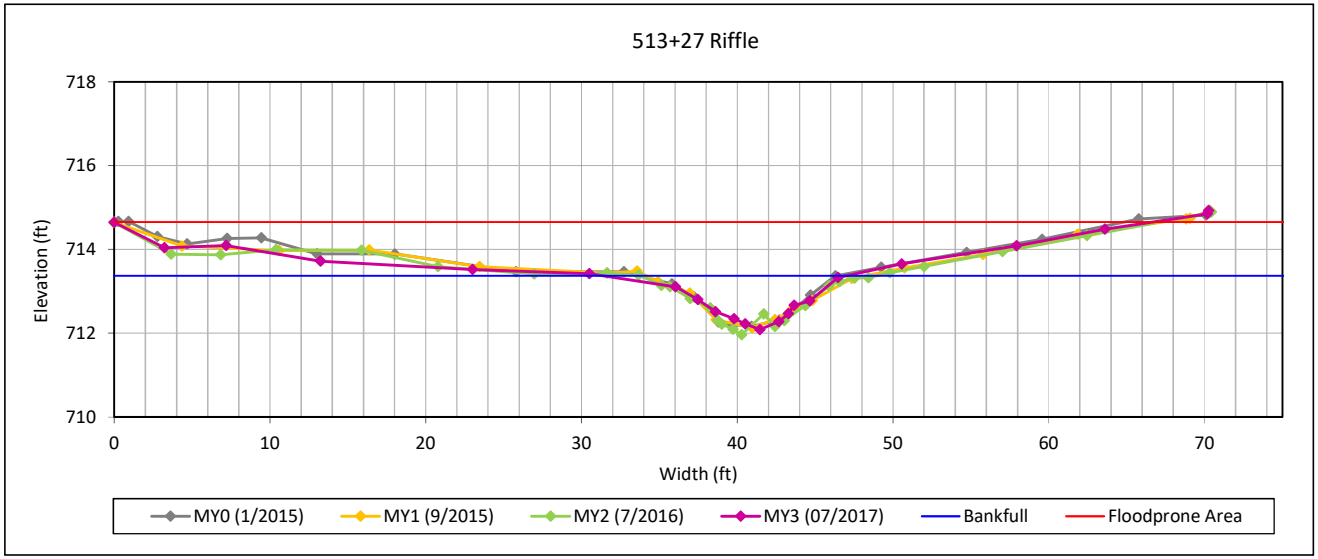
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 6, UT2A R2



Bankfull Dimensions	
8.0	x-section area (ft.sq.)
10.9	width (ft)
0.7	mean depth (ft)
1.3	max depth (ft)
11.2	wetted parimeter (ft)
0.7	hyd radi (ft)
14.8	width-depth ratio
66.6	W flood prone area (ft)
6.1	entrenchment ratio
1.0	low bank height ratio

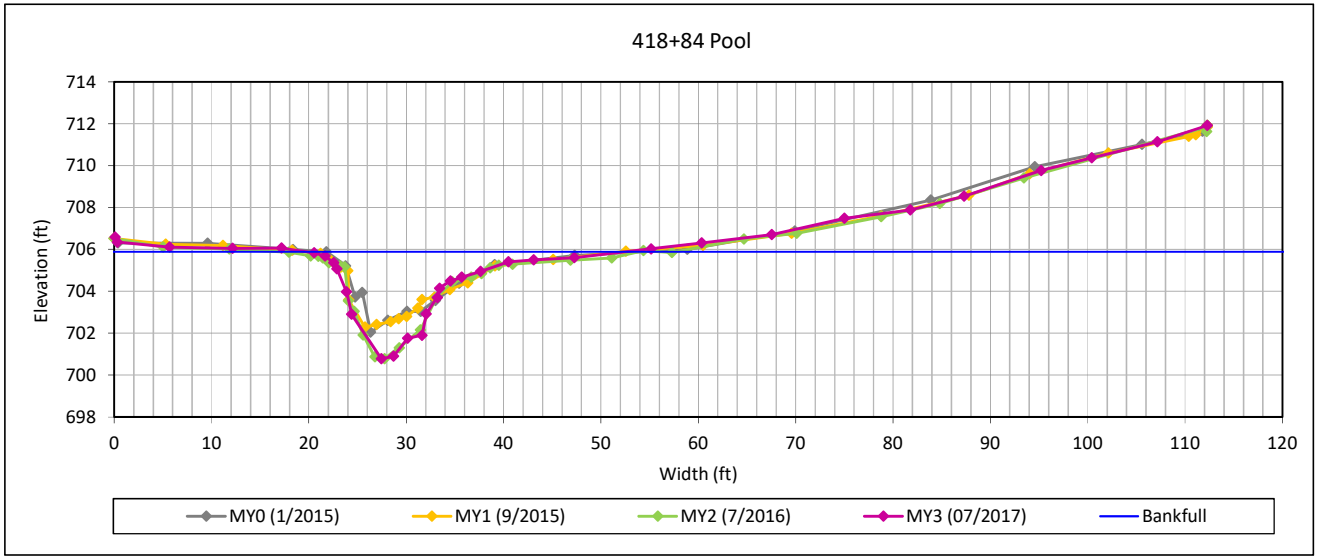
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 7, UT2 R2



Bankfull Dimensions	
50.1	x-section area (ft.sq.)
32.7	width (ft)
1.5	mean depth (ft)
5.1	max depth (ft)
36.3	wetted parimeter (ft)
1.4	hyd radi (ft)
21.4	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

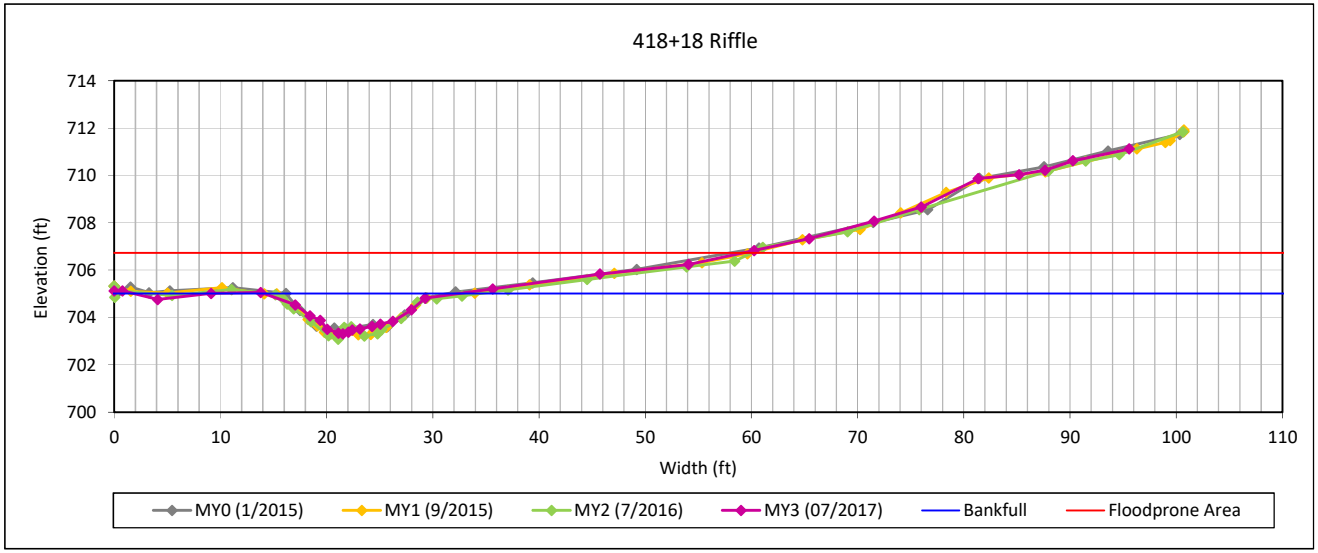
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 8, UT2 R2



Bankfull Dimensions	
14.4	x-section area (ft.sq.)
13.9	width (ft)
1.0	mean depth (ft)
1.7	max depth (ft)
14.3	wetted parimeter (ft)
1.0	hyd radi (ft)
13.6	width-depth ratio
59.3	W flood prone area (ft)
4.3	entrenchment ratio
1.0	low bank height ratio

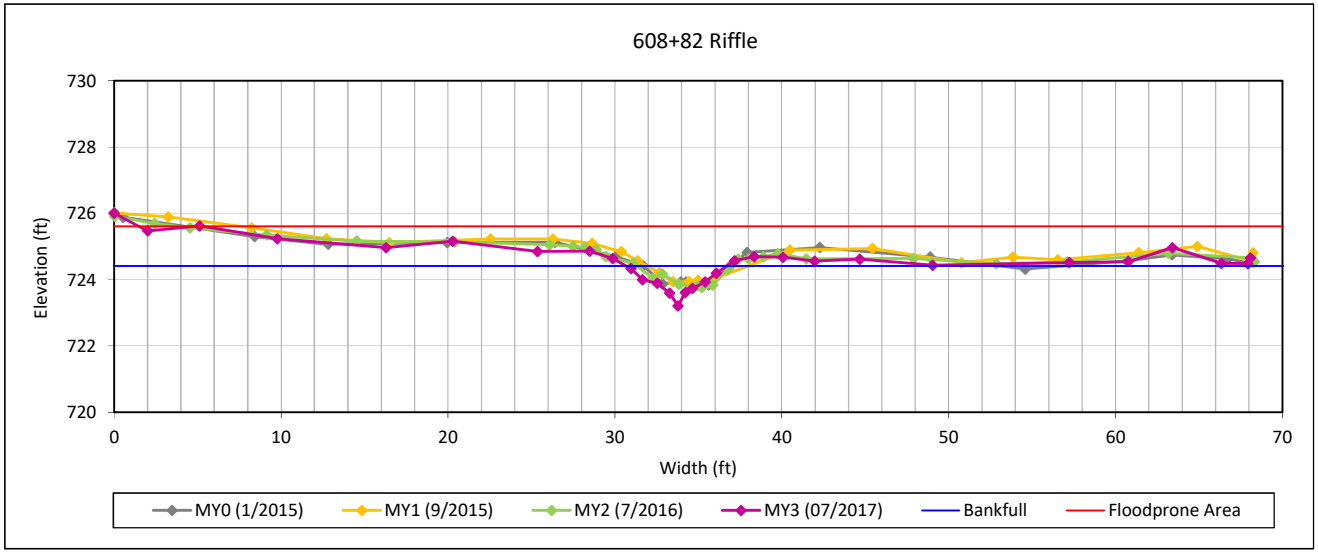
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 9, UT2B R2



Bankfull Dimensions	
3.1	x-section area (ft.sq.)
6.0	width (ft)
0.5	mean depth (ft)
1.2	max depth (ft)
6.6	wetted parimeter (ft)
0.5	hyd radi (ft)
11.8	width-depth ratio
66.3	W flood prone area (ft)
11.0	entrenchment ratio
1.1	low bank height ratio

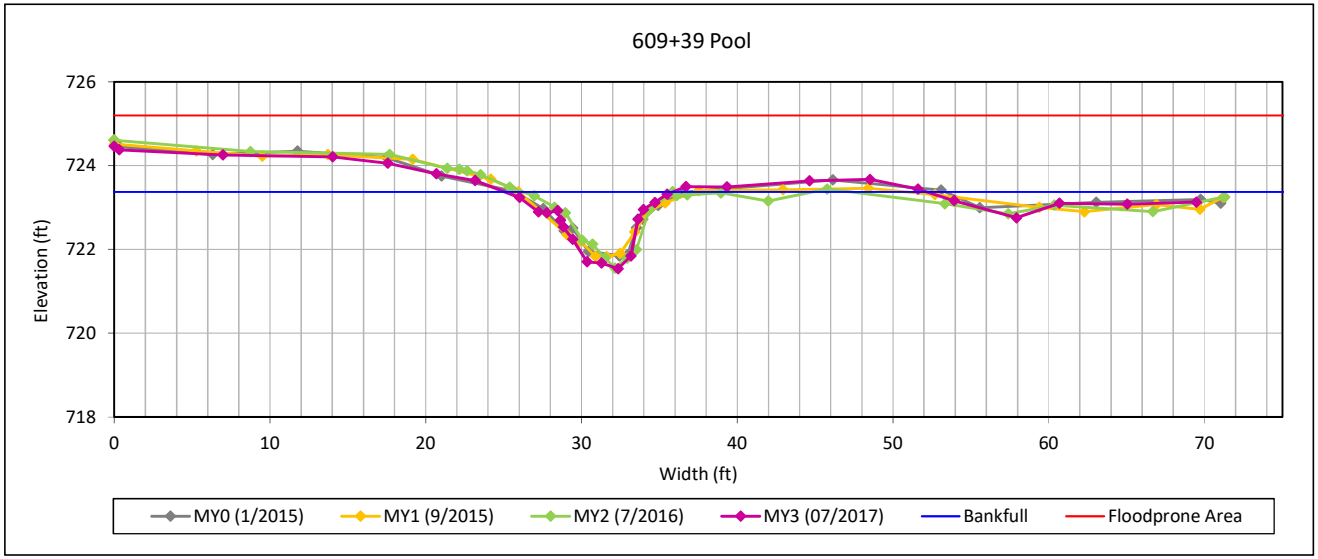
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 10, UT2B R2



Bankfull Dimensions	
9.0	x-section area (ft.sq.)
10.7	width (ft)
0.8	mean depth (ft)
1.8	max depth (ft)
11.9	wetted parimeter (ft)
0.8	hyd radi (ft)
12.8	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

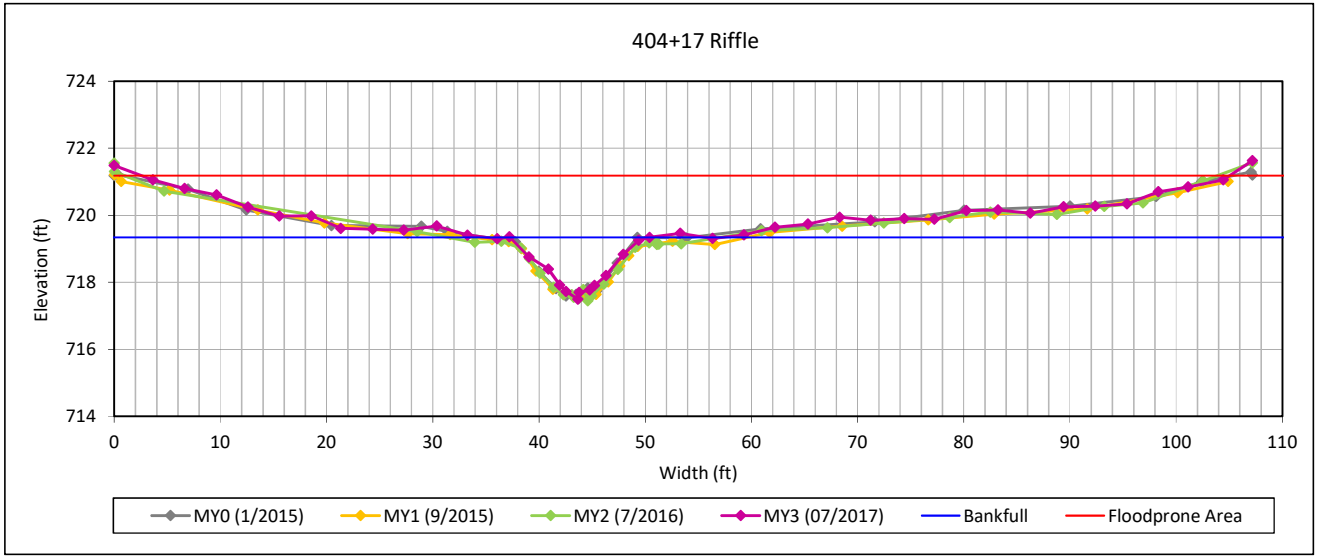
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 11, UT2 R1



Bankfull Dimensions	
11.7	x-section area (ft.sq.)
13.8	width (ft)
0.8	mean depth (ft)
1.8	max depth (ft)
14.5	wetted parimeter (ft)
0.8	hyd radi (ft)
16.4	width-depth ratio
103.0	W flood prone area (ft)
7.4	entrenchment ratio
1.0	low bank height ratio

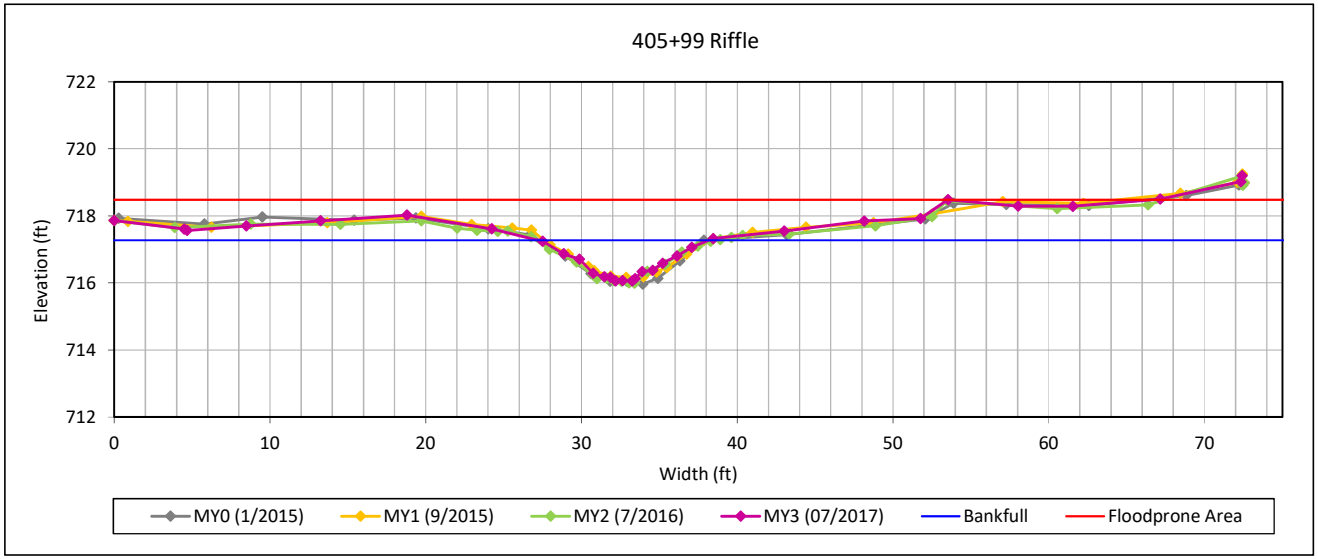
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 12, UT2 R1



Bankfull Dimensions	
7.1	x-section area (ft.sq.)
10.9	width (ft)
0.6	mean depth (ft)
1.2	max depth (ft)
11.3	wetted parimeter (ft)
0.6	hyd radi (ft)
16.9	width-depth ratio
66.4	W flood prone area (ft)
6.1	entrenchment ratio
1.0	low bank height ratio

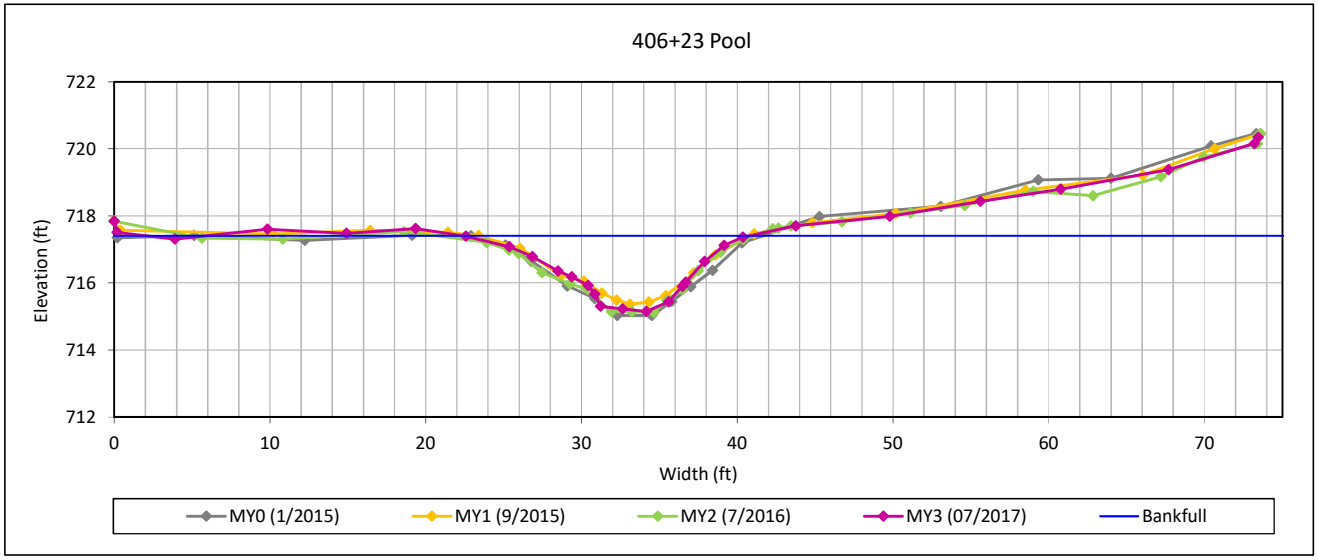
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 13, UT2 R1



Bankfull Dimensions	
19.8	x-section area (ft.sq.)
18.2	width (ft)
1.1	mean depth (ft)
2.3	max depth (ft)
19.0	wetted parimeter (ft)
1.0	hyd radi (ft)
16.7	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

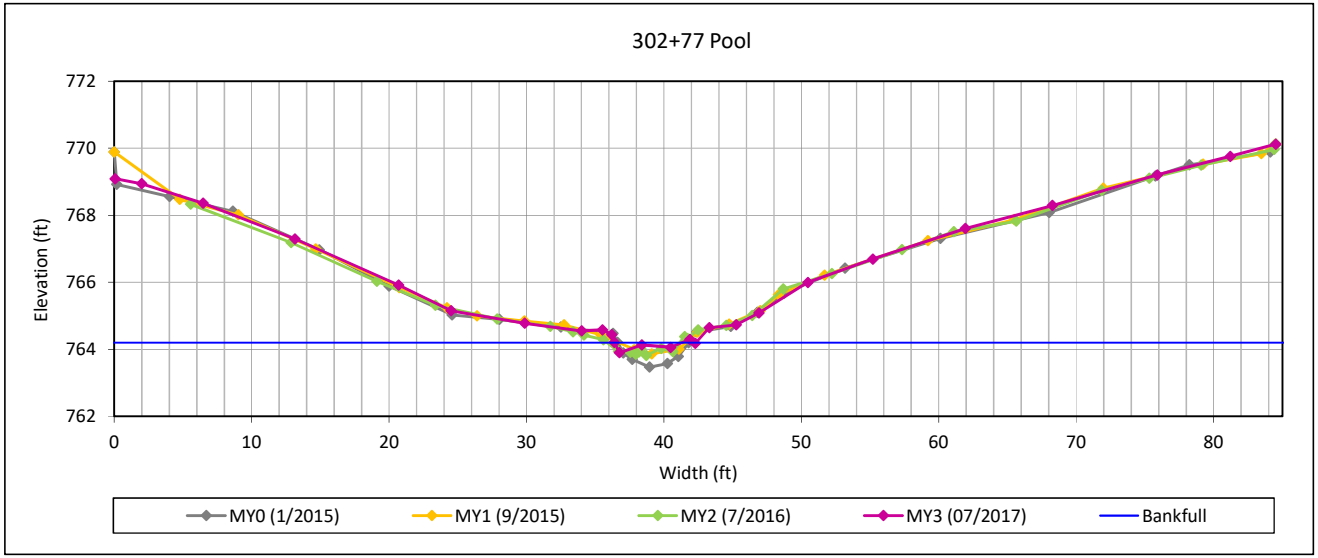
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 14, UT1B R1



Bankfull Dimensions	
0.6	x-section area (ft.sq.)
5.0	width (ft)
0.1	mean depth (ft)
0.3	max depth (ft)
5.2	wetted parimeter (ft)
0.1	hyd radi (ft)
40.5	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

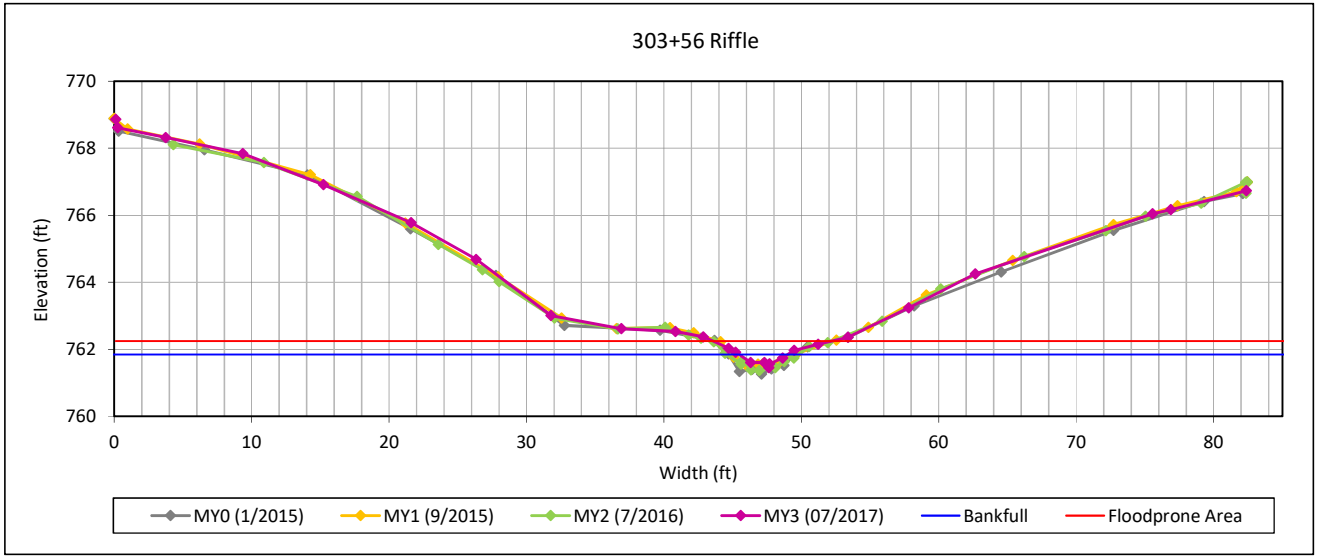
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 15, UT1B R1



Bankfull Dimensions	
0.7	x-section area (ft.sq.)
3.6	width (ft)
0.2	mean depth (ft)
0.4	max depth (ft)
3.7	wetted parimeter (ft)
0.2	hyd radi (ft)
19.0	width-depth ratio
8.6	W flood prone area (ft)
2.4	entrenchment ratio
1.3	low bank height ratio

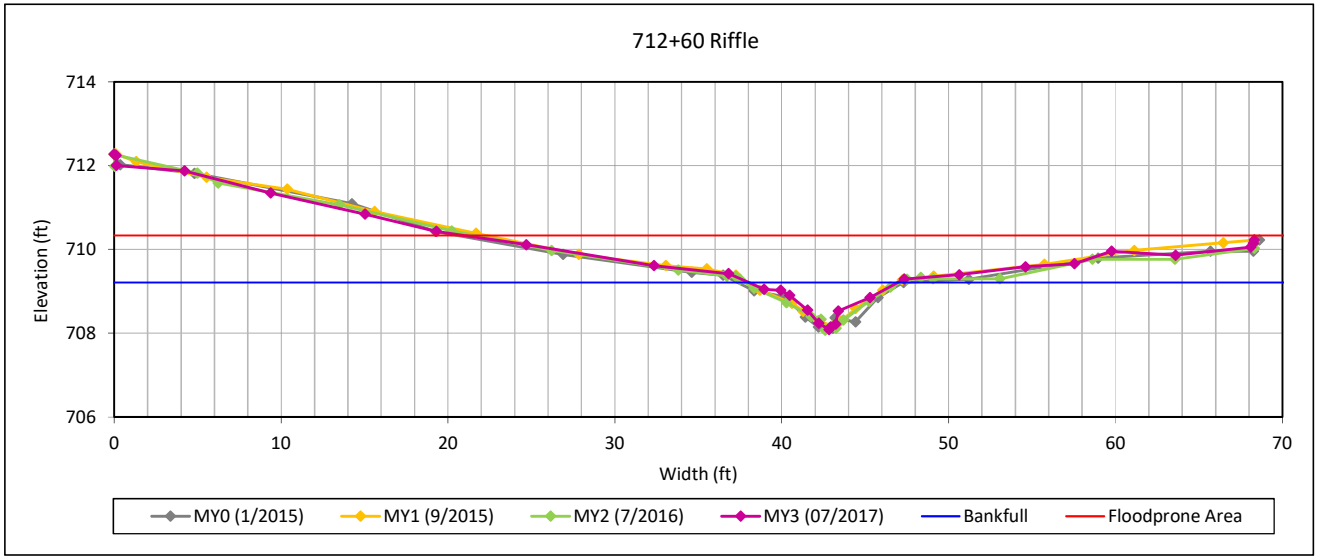
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 16, UT2C R2



Bankfull Dimensions	
3.9	x-section area (ft.sq.)
8.9	width (ft)
0.4	mean depth (ft)
1.1	max depth (ft)
9.4	wetted parimeter (ft)
0.4	hyd radi (ft)
20.3	width-depth ratio
47.3	W flood prone area (ft)
5.3	entrenchment ratio
1.1	low bank height ratio

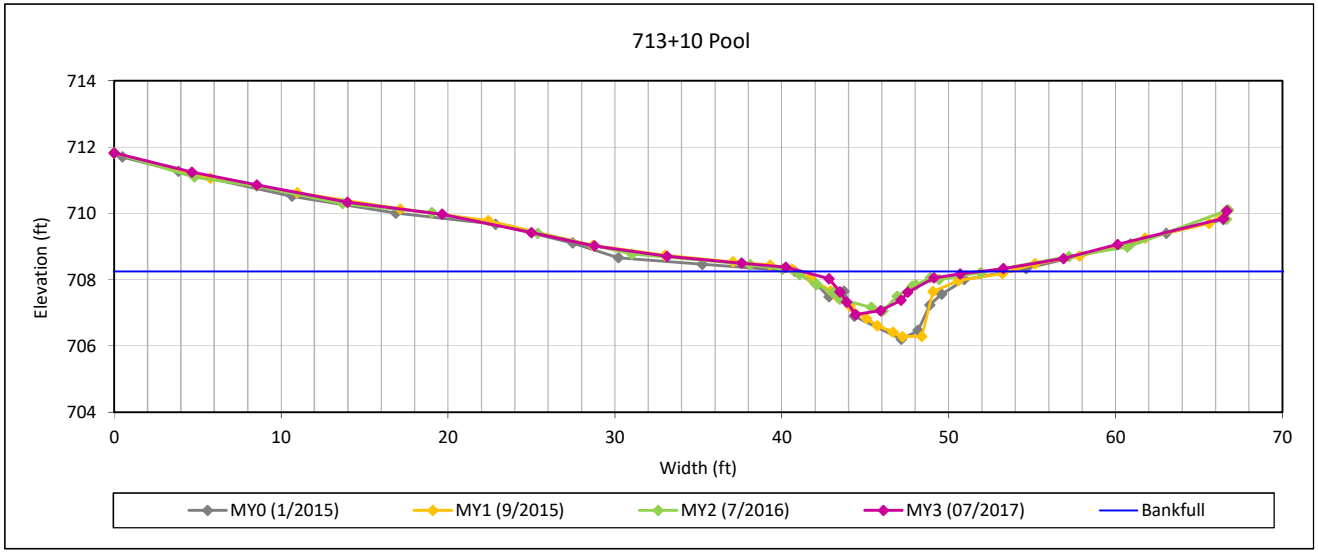
Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

Cross Section Plots

Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Cross Section 17, UT2C R2



Bankfull Dimensions	
5.7	x-section area (ft.sq.)
10.8	width (ft)
0.5	mean depth (ft)
1.3	max depth (ft)
11.3	wetted parimeter (ft)
0.5	hyd radi (ft)
20.4	width-depth ratio
---	W flood prone area (ft)
---	entrenchment ratio
---	low bank height ratio

Survey Date: 7/2017
Field Crew: Wildlands Engineering

View Downstream

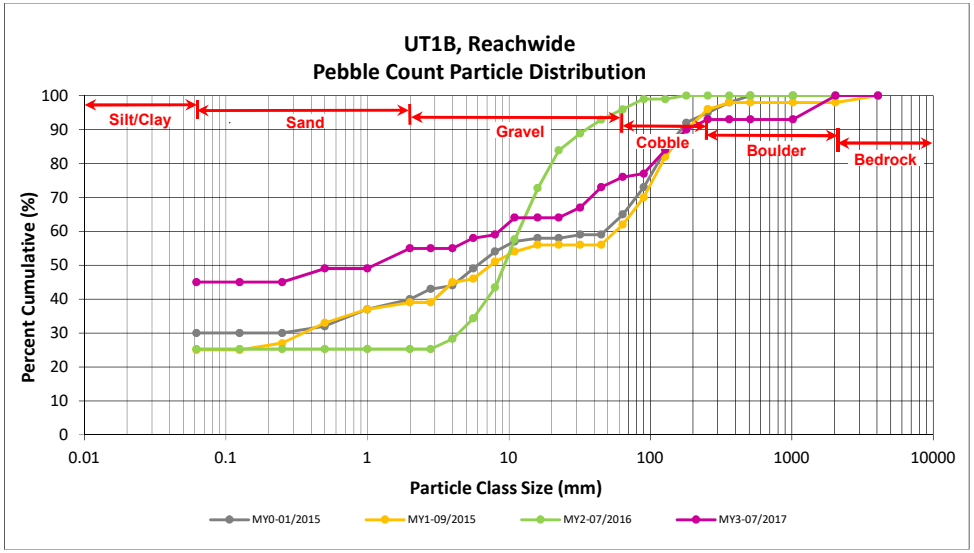
Reachwide and Cross Section Pebble Count Plots

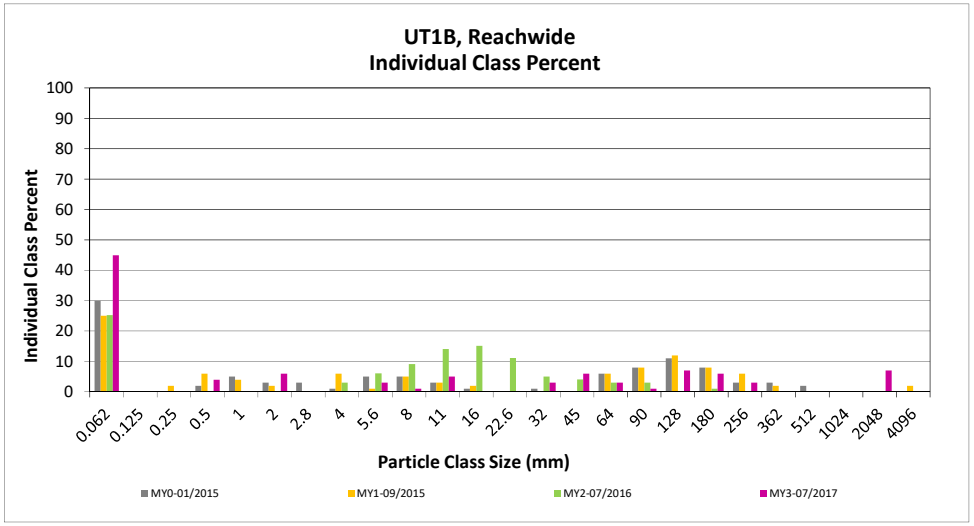
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT1B, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	39	45	45	45
SAND	Very fine	0.062	0.125					45
	Fine	0.125	0.250					45
	Medium	0.25	0.50	3	1	4	4	49
	Coarse	0.5	1.0					49
	Very Coarse	1.0	2.0		6	6	6	55
GRAVEL	Very Fine	2.0	2.8					55
	Very Fine	2.8	4.0					55
	Fine	4.0	5.6	3		3	3	58
	Fine	5.6	8.0	1		1	1	59
	Medium	8.0	11.0	3	2	5	5	64
	Medium	11.0	16.0					64
	Coarse	16.0	22.6					64
	Coarse	22.6	32	3		3	3	67
	Very Coarse	32	45	4	2	6	6	73
	Very Coarse	45	64	3		3	3	76
COBBLE	Small	64	90	1		1	1	77
	Small	90	128	7		7	7	84
	Large	128	180	6		6	6	90
	Large	180	256	3		3	3	93
BOULDER	Small	256	362					93
	Small	362	512					93
	Medium	512	1024					93
	Large/Very Large	1024	2048	7		7	7	100
BEDROCK	Bedrock	2048	>2048					100
			Total	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	1.1
D_{84} =	128.0
D_{95} =	1248.3
D_{100} =	2048.0





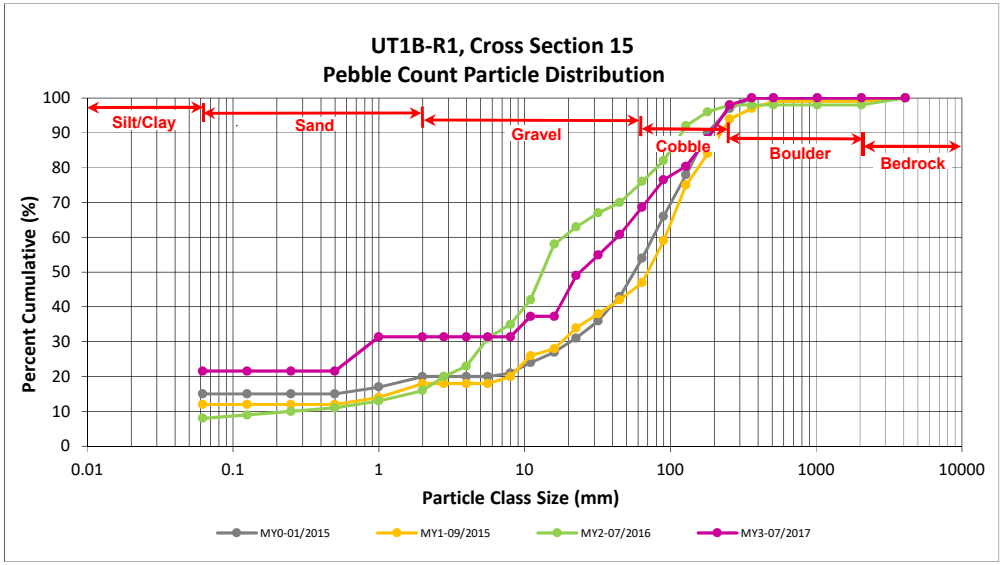
Reachwide and Cross Section Pebble Count Plots

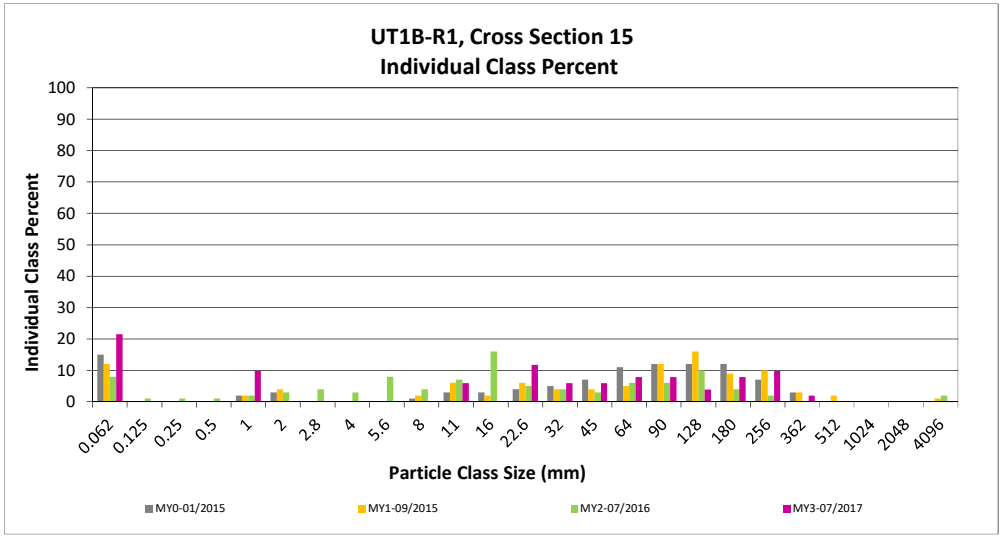
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT1B-R1, Cross Section 15

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	22	22	22
SAND	Very fine	0.062	0.125			22
	Fine	0.125	0.250			22
	Medium	0.25	0.50			22
	Coarse	0.5	1.0	10	10	31
	Very Coarse	1.0	2.0			31
GRAVEL	Very Fine	2.0	2.8			31
	Very Fine	2.8	4.0			31
	Fine	4.0	5.6			31
	Fine	5.6	8.0			31
	Medium	8.0	11.0	6	6	37
	Medium	11.0	16.0			37
	Coarse	16.0	22.6	12	12	49
	Coarse	22.6	32	6	6	55
	Very Coarse	32	45	6	6	61
	Very Coarse	45	64	8	8	69
COBBLE	Small	64	90	8	8	76
	Small	90	128	4	4	80
	Large	128	180	8	8	88
	Large	180	256	10	10	98
BOULDER	Small	256	362	2	2	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**102**	**100**	**100**

Cross Section 15	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	9.74
D_{50} =	23.9
D_{84} =	149.7
D_{95} =	229.5
D_{100} =	362.0





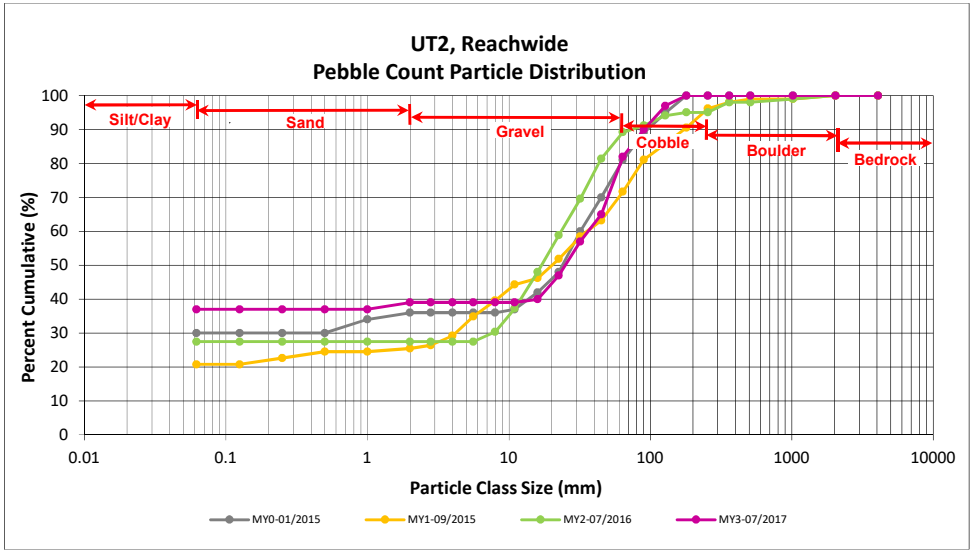
Reachwide and Cross Section Pebble Count Plots

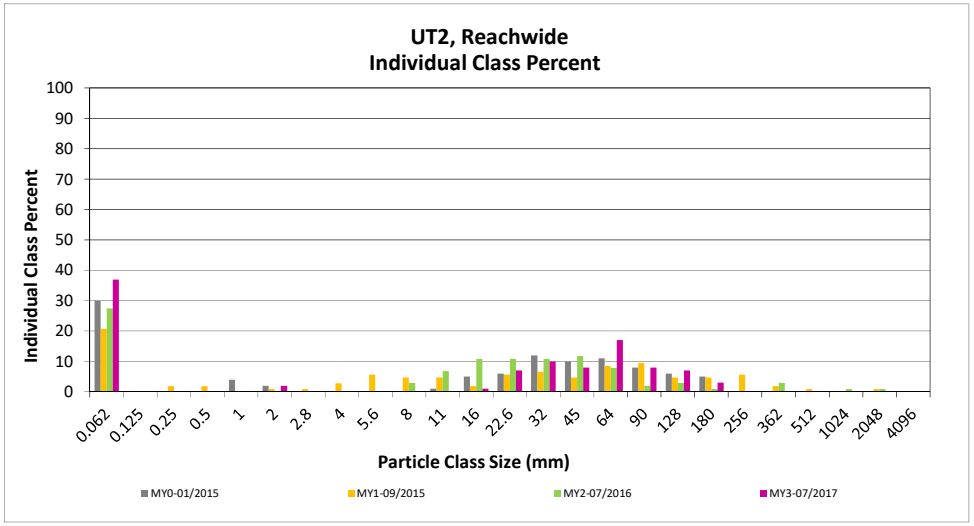
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	10	27	37	37	37
SAND	Very fine	0.062	0.125					37
	Fine	0.125	0.250					37
	Medium	0.25	0.50					37
	Coarse	0.5	1.0					37
	Very Coarse	1.0	2.0	1	1	2	2	39
GRAVEL	Very Fine	2.0	2.8					39
	Very Fine	2.8	4.0					39
	Fine	4.0	5.6					39
	Fine	5.6	8.0					39
	Medium	8.0	11.0					39
	Medium	11.0	16.0		1	1	1	40
	Coarse	16.0	22.6	6	1	7	7	47
	Coarse	22.6	32	8	2	10	10	57
	Very Coarse	32	45	4	4	8	8	65
	Very Coarse	45	64	10	7	17	17	82
COBBLE	Small	64	90	5	3	8	8	90
	Small	90	128	4	3	7	7	97
	Large	128	180	2	1	3	3	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	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	25.1
D_{84} =	69.7
D_{95} =	115.7
D_{100} =	180.0





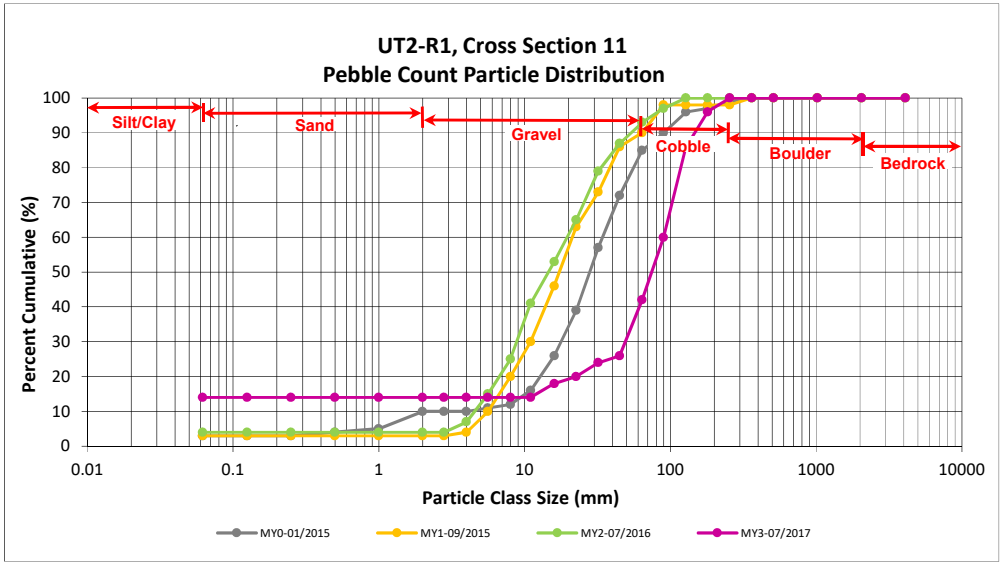
Reachwide and Cross Section Pebble Count Plots

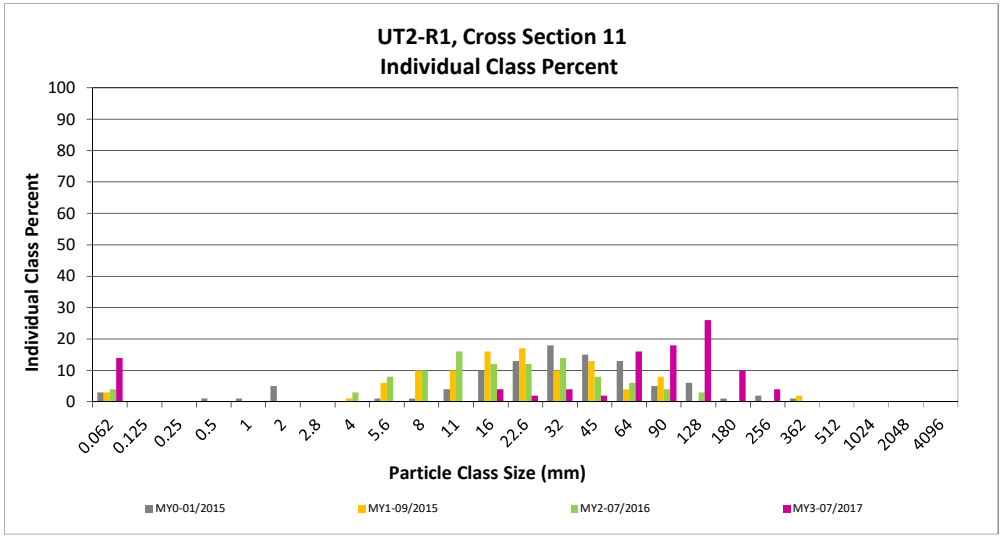
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2-R1, Cross Section 11

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	14	14	14
SAND	Very fine	0.062	0.125			14
	Fine	0.125	0.250			14
	Medium	0.25	0.50			14
	Coarse	0.5	1.0			14
	Very Coarse	1.0	2.0			14
GRAVEL	Very Fine	2.0	2.8			14
	Very Fine	2.8	4.0			14
	Fine	4.0	5.6			14
	Fine	5.6	8.0			14
	Medium	8.0	11.0			14
	Medium	11.0	16.0	4	4	18
	Coarse	16.0	22.6	2	2	20
	Coarse	22.6	32	4	4	24
	Very Coarse	32	45	2	2	26
	Very Coarse	45	64	16	16	42
COBBLE	Small	64	90	18	18	60
	Small	90	128	26	26	86
	Large	128	180	10	10	96
	Large	180	256	4	4	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 11	
Channel materials (mm)	
D_{16} =	13.27
D_{35} =	54.86
D_{50} =	74.5
D_{84} =	124.6
D_{95} =	174.0
D_{100} =	256.0





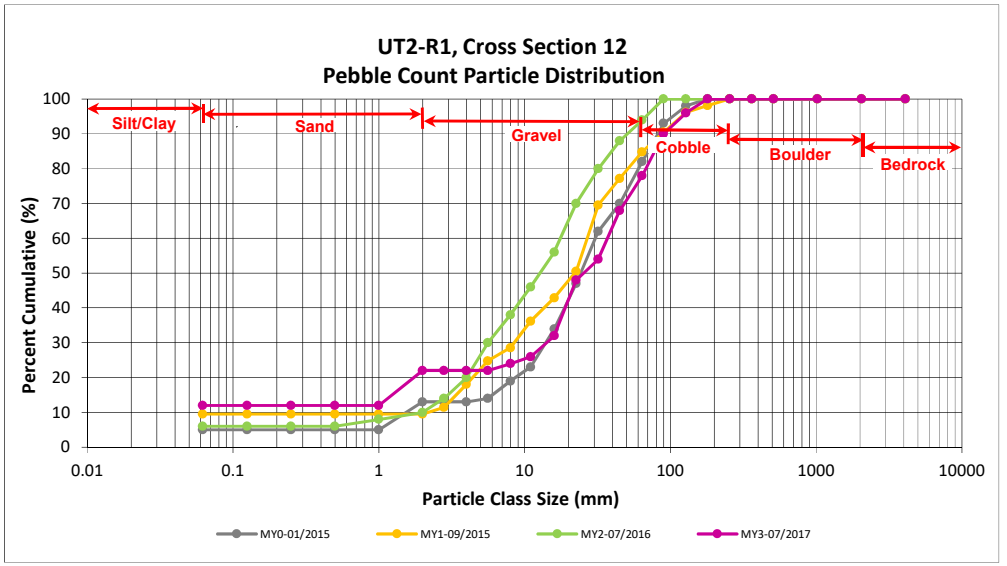
Reachwide and Cross Section Pebble Count Plots

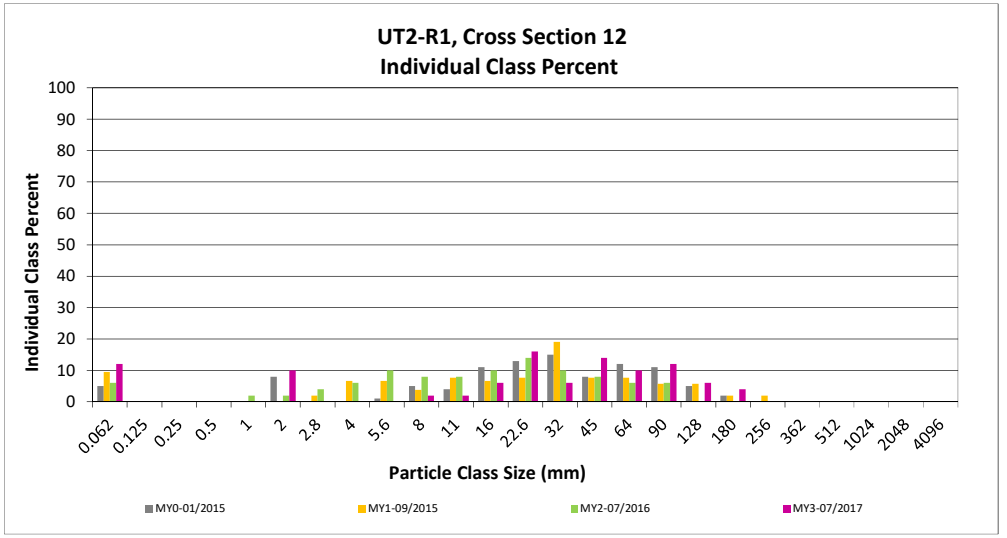
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2-R1, Cross Section 12

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	12	12	12
SAND	Very fine	0.062	0.125			12
	Fine	0.125	0.250			12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0			12
	Very Coarse	1.0	2.0	10	10	22
GRAVEL	Very Fine	2.0	2.8			22
	Very Fine	2.8	4.0			22
	Fine	4.0	5.6			22
	Fine	5.6	8.0	2	2	24
	Medium	8.0	11.0	2	2	26
	Medium	11.0	16.0	6	6	32
	Coarse	16.0	22.6	16	16	48
	Coarse	22.6	32	6	6	54
	Very Coarse	32	45	14	14	68
	Very Coarse	45	64	10	10	78
COBBLE	Small	64	90	12	12	90
	Small	90	128	6	6	96
	Large	128	180	4	4	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 12	
Channel materials (mm)	
D_{16} =	1.32
D_{35} =	17.07
D_{50} =	25.4
D_{84} =	75.9
D_{95} =	120.7
D_{100} =	180.0





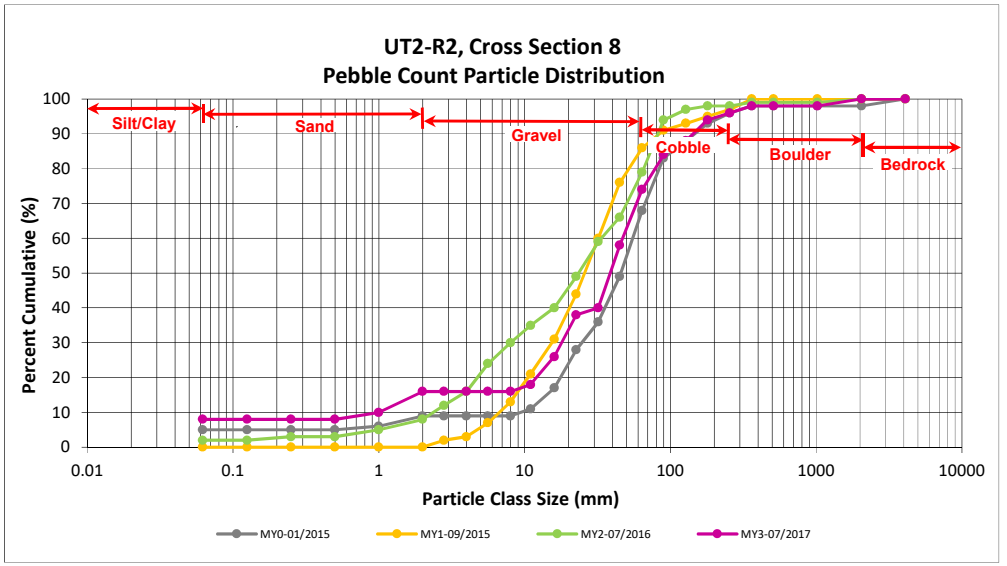
Reachwide and Cross Section Pebble Count Plots

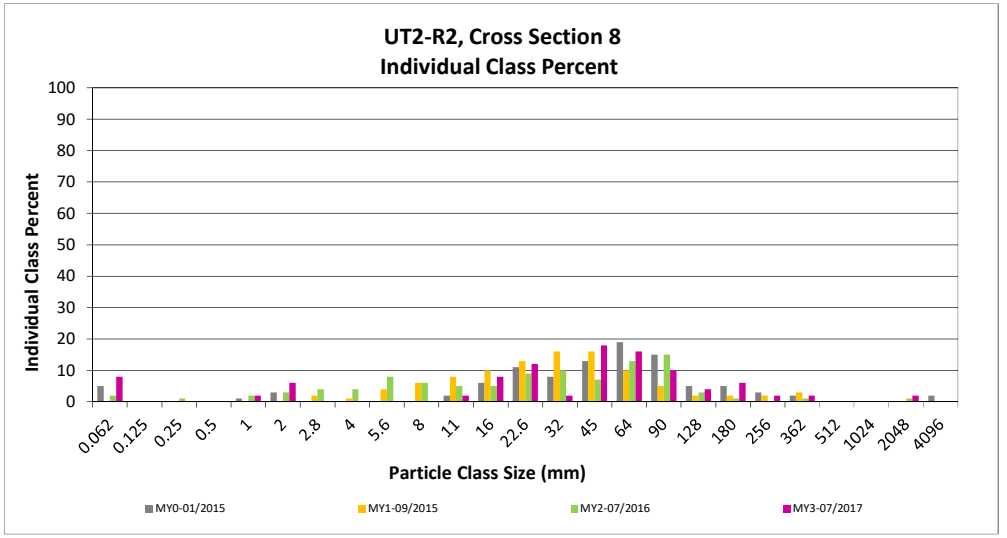
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2-R2, Cross Section 8

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	8	8	8
SAND	Very fine	0.062	0.125			8
	Fine	0.125	0.250			8
	Medium	0.25	0.50			8
	Coarse	0.5	1.0	2	2	10
	Very Coarse	1.0	2.0	6	6	16
GRAVEL	Very Fine	2.0	2.8			16
	Very Fine	2.8	4.0			16
	Fine	4.0	5.6			16
	Fine	5.6	8.0			16
	Medium	8.0	11.0	2	2	18
	Medium	11.0	16.0	8	8	26
	Coarse	16.0	22.6	12	12	38
	Coarse	22.6	32	2	2	40
	Very Coarse	32	45	18	18	58
	Very Coarse	45	64	16	16	74
COBBLE	Small	64	90	10	10	84
	Small	90	128	4	4	88
	Large	128	180	6	6	94
	Large	180	256	2	2	96
BOULDER	Small	256	362	2	2	98
	Small	362	512			98
	Medium	512	1024			98
	Large/Very Large	1024	2048	2	2	100
BEDROCK	Bedrock	2048	>2048			100
			Total	**100**	**100**	**100**

Cross Section 8	
Channel materials (mm)	
D_{16} =	2.00
D_{35} =	20.73
D_{50} =	38.7
D_{84} =	90.0
D_{95} =	214.7
D_{100} =	2048.0





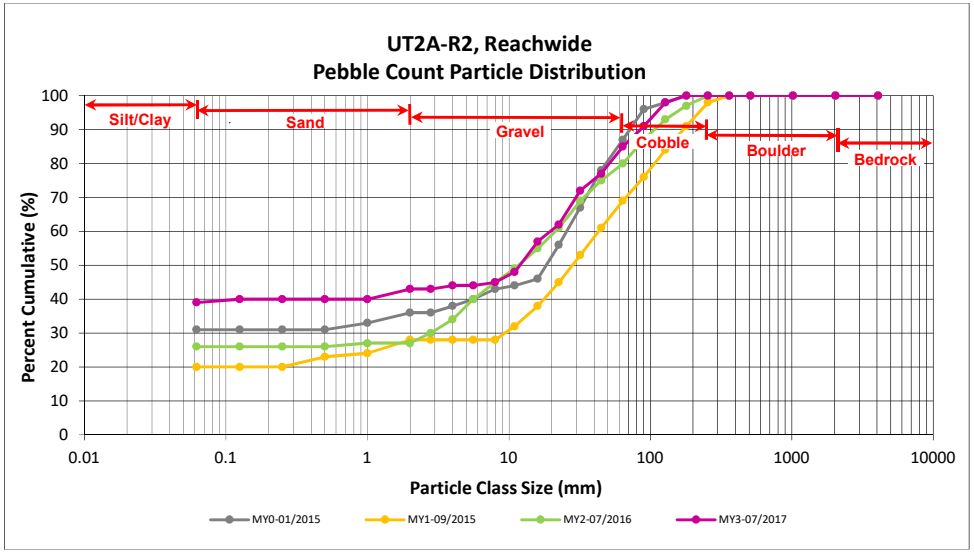
Reachwide and Cross Section Pebble Count Plots

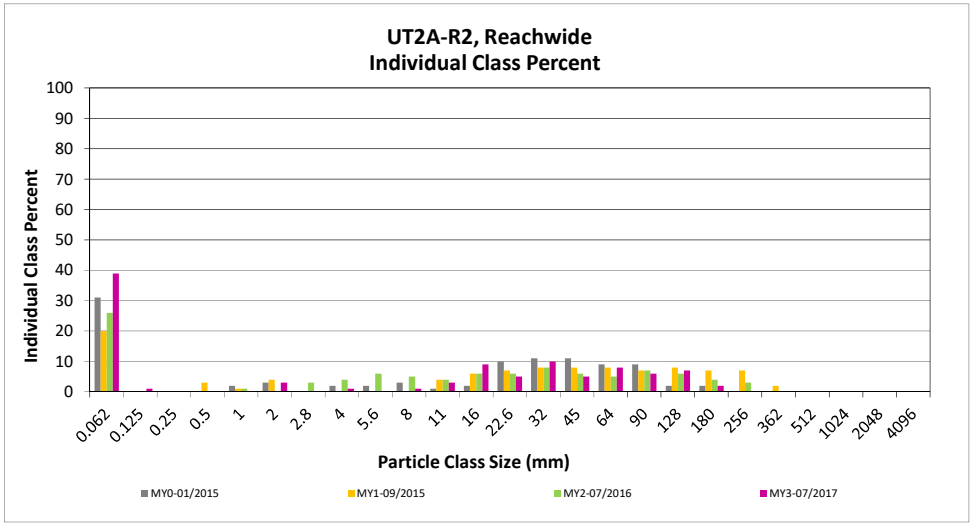
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2A-R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	4	35	39	39	39
SAND	Very fine	0.062	0.125		1	1	1	40
	Fine	0.125	0.250					40
	Medium	0.25	0.50					40
	Coarse	0.5	1.0					40
	Very Coarse	1.0	2.0	1	2	3	3	43
GRAVEL	Very Fine	2.0	2.8					43
	Very Fine	2.8	4.0		1	1	1	44
	Fine	4.0	5.6					44
	Fine	5.6	8.0	1		1	1	45
	Medium	8.0	11.0	3		3	3	48
	Medium	11.0	16.0	5	4	9	9	57
	Coarse	16.0	22.6		5	5	5	62
	Coarse	22.6	32	4	6	10	10	72
	Very Coarse	32	45	3	2	5	5	77
	Very Coarse	45	64	7	1	8	8	85
COBBLE	Small	64	90	4	2	6	6	91
	Small	90	128	6	1	7	7	98
	Large	128	180	2		2	2	100
	Large	180	256					100
BOULDER	Small	256	362					100
	Small	362	512					100
	Medium	512	1024					100
	Large/Very Large	1024	2048					100
BEDROCK	Bedrock	2048	>2048					100
			Total	**40**	**60**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	12.0
D_{84} =	61.2
D_{95} =	110.1
D_{100} =	180.0





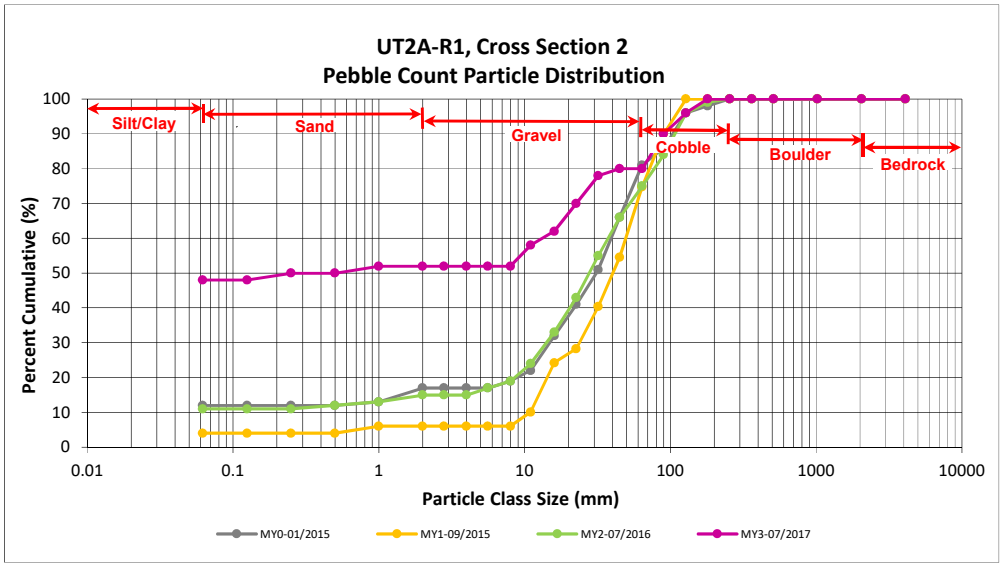
Reachwide and Cross Section Pebble Count Plots

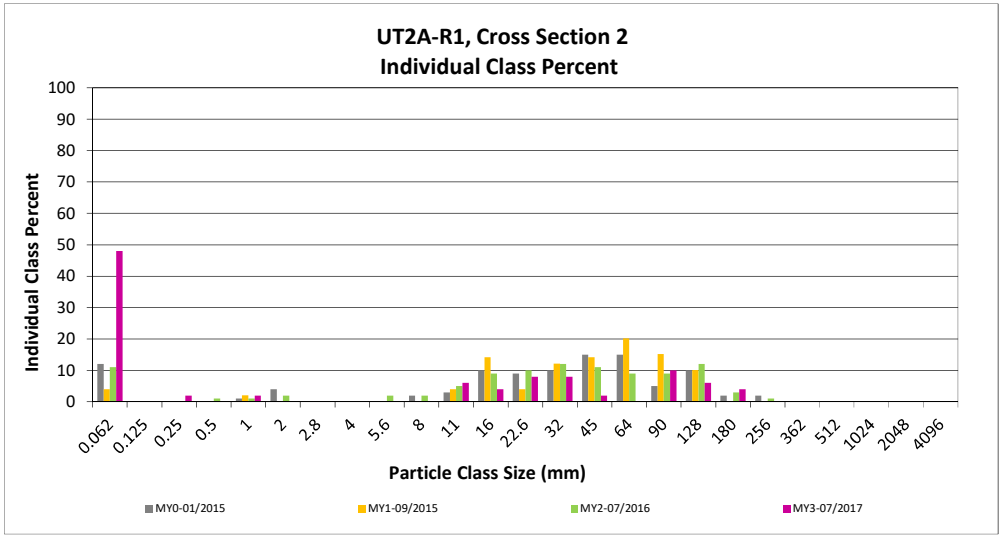
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2A-R1, Cross Section 2

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	48	48	48
SAND	Very fine	0.062	0.125			48
	Fine	0.125	0.250	2	2	50
	Medium	0.25	0.50			50
	Coarse	0.5	1.0	2	2	52
	Very Coarse	1.0	2.0			52
GRAVEL	Very Fine	2.0	2.8			52
	Very Fine	2.8	4.0			52
	Fine	4.0	5.6			52
	Fine	5.6	8.0			52
	Medium	8.0	11.0	6	6	58
	Medium	11.0	16.0	4	4	62
	Coarse	16.0	22.6	8	8	70
	Coarse	22.6	32	8	8	78
	Very Coarse	32	45	2	2	80
	Very Coarse	45	64			80
COBBLE	Small	64	90	10	10	90
	Small	90	128	6	6	96
	Large	128	180	4	4	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 2	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	0.3
D_{84} =	73.4
D_{95} =	120.7
D_{100} =	180.0





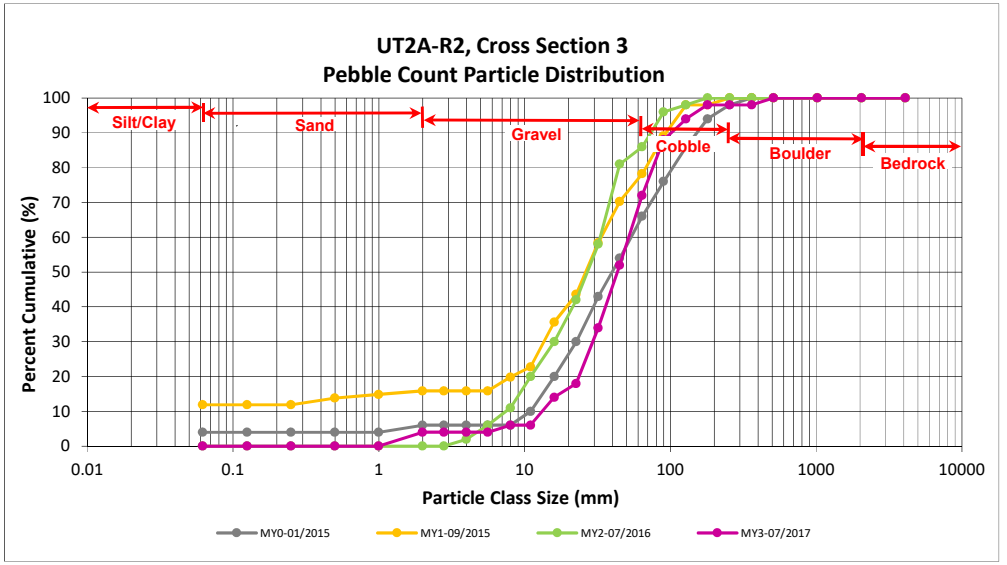
Reachwide and Cross Section Pebble Count Plots

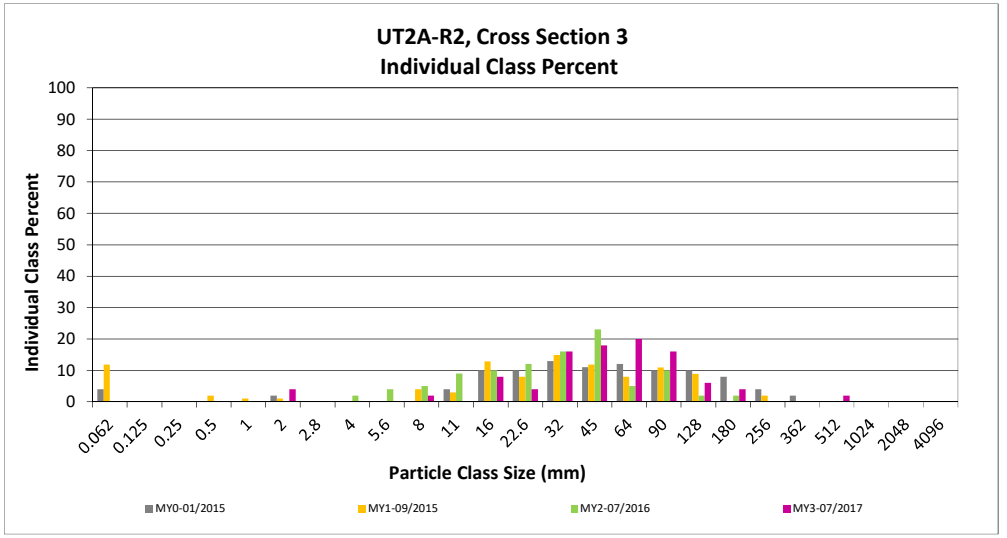
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2A-R2, 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			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	2	4	4
GRAVEL	Very Fine	2.0	2.8			4
	Very Fine	2.8	4.0			4
	Fine	4.0	5.6			4
	Fine	5.6	8.0	1	2	6
	Medium	8.0	11.0			6
	Medium	11.0	16.0	4	8	14
	Coarse	16.0	22.6	2	4	18
	Coarse	22.6	32	8	16	34
	Very Coarse	32	45	9	18	52
	Very Coarse	45	64	10	20	72
COBBLE	Small	64	90	8	16	88
	Small	90	128	3	6	94
	Large	128	180	2	4	98
	Large	180	256			98
BOULDER	Small	256	362			98
	Small	362	512	1	2	100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
			Total	**50**	**100**	**100**

Cross Section 3	
Channel materials (mm)	
D_{16} =	19.02
D_{35} =	32.61
D_{50} =	43.3
D_{84} =	82.6
D_{95} =	139.4
D_{100} =	512.0





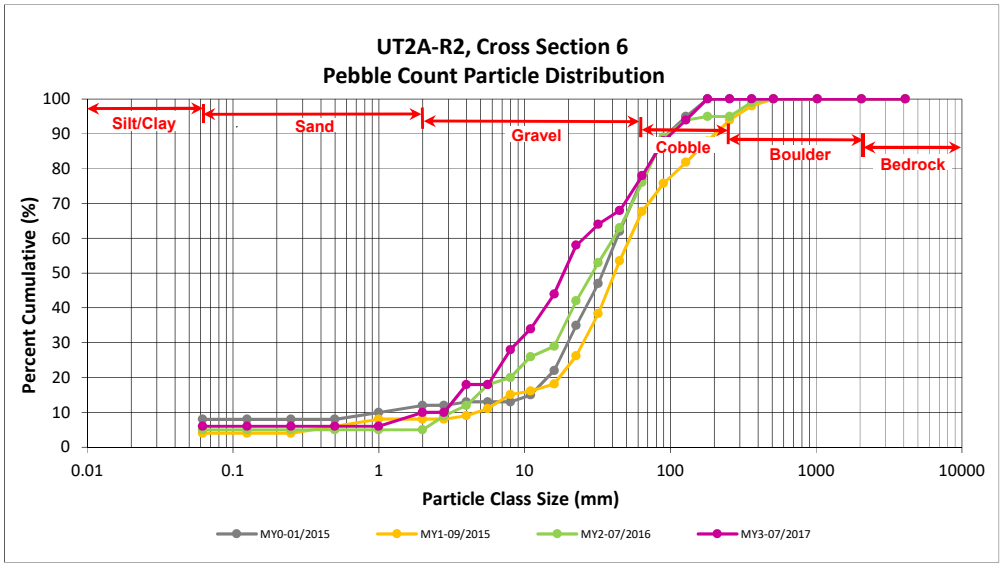
Reachwide and Cross Section Pebble Count Plots

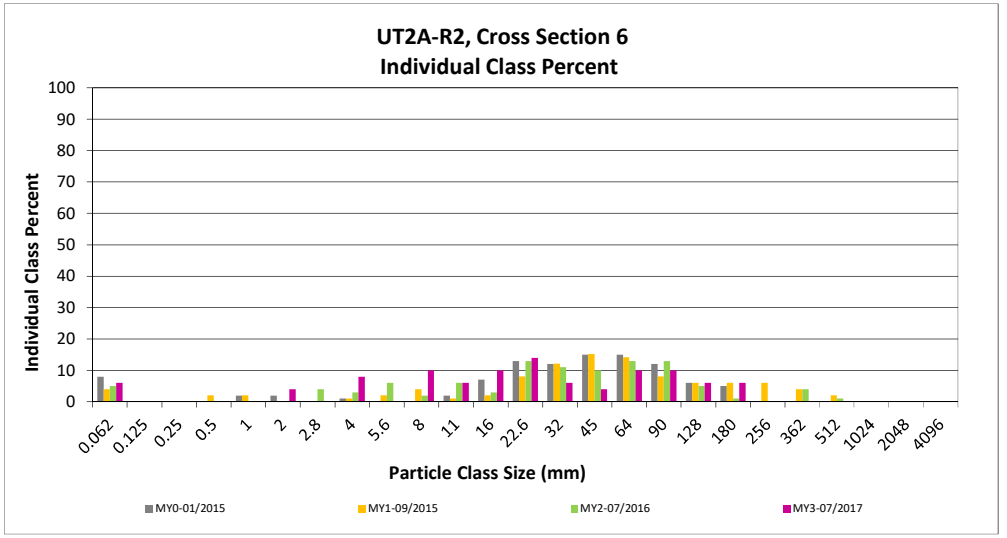
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2A-R2, 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	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0			6
	Very Coarse	1.0	2.0	4	4	10
GRAVEL	Very Fine	2.0	2.8			10
	Very Fine	2.8	4.0	8	8	18
	Fine	4.0	5.6			18
	Fine	5.6	8.0	10	10	28
	Medium	8.0	11.0	6	6	34
	Medium	11.0	16.0	10	10	44
	Coarse	16.0	22.6	14	14	58
	Coarse	22.6	32	6	6	64
	Very Coarse	32	45	4	4	68
	Very Coarse	45	64	10	10	78
COBBLE	Small	64	90	10	10	88
	Small	90	128	6	6	94
	Large	128	180	6	6	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 6	
Channel materials (mm)	
D_{16} =	3.66
D_{35} =	11.42
D_{50} =	18.6
D_{84} =	78.5
D_{95} =	135.5
D_{100} =	180.0





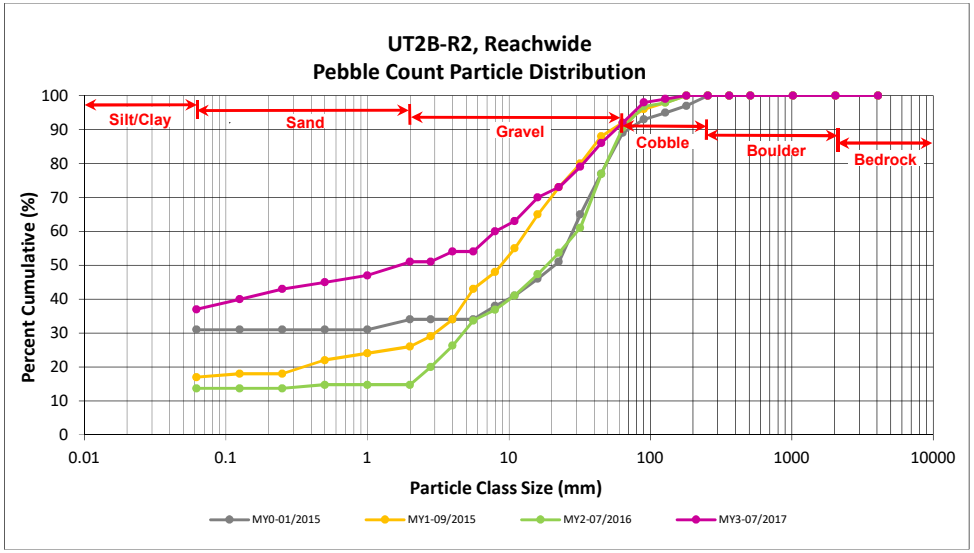
Reachwide and Cross Section Pebble Count Plots

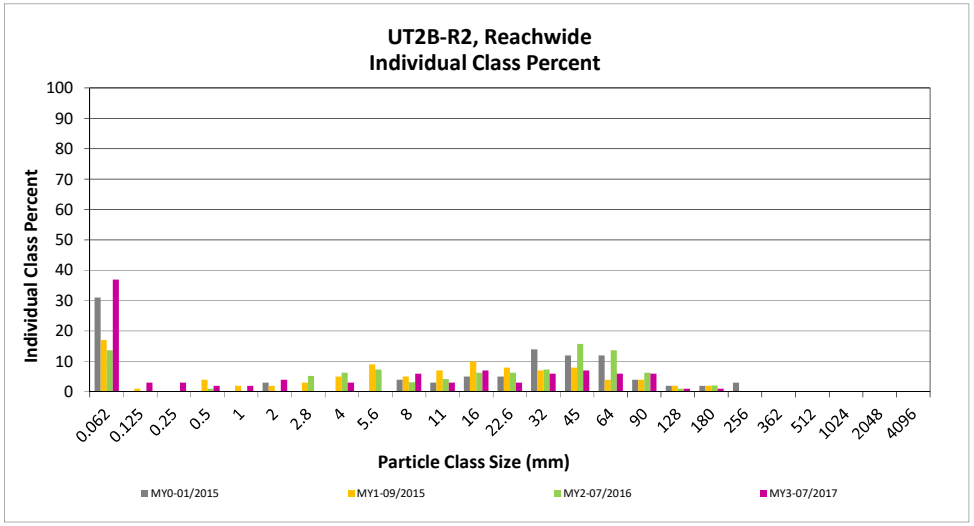
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2B-R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	31	37	37	37
SAND	Very fine	0.062	0.125		3	3	3	40
	Fine	0.125	0.250	1	2	3	3	43
	Medium	0.25	0.50		2	2	2	45
	Coarse	0.5	1.0	1	1	2	2	47
	Very Coarse	1.0	2.0	2	2	4	4	51
GRAVEL	Very Fine	2.0	2.8					51
	Very Fine	2.8	4.0	2	1	3	3	54
	Fine	4.0	5.6					54
	Fine	5.6	8.0	2	4	6	6	60
	Medium	8.0	11.0	1	2	3	3	63
	Medium	11.0	16.0	3	4	7	7	70
	Coarse	16.0	22.6	3		3	3	73
	Coarse	22.6	32	3	3	6	6	79
	Very Coarse	32	45	5	2	7	7	86
	Very Coarse	45	64	4	2	6	6	92
COBBLE	Small	64	90	5	1	6	6	98
	Small	90	128	1		1	1	99
	Large	128	180	1		1	1	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	**40**	**60**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	Silt/Clay
D_{35} =	Silt/Clay
D_{50} =	1.7
D_{84} =	40.8
D_{95} =	75.9
D_{100} =	180.0





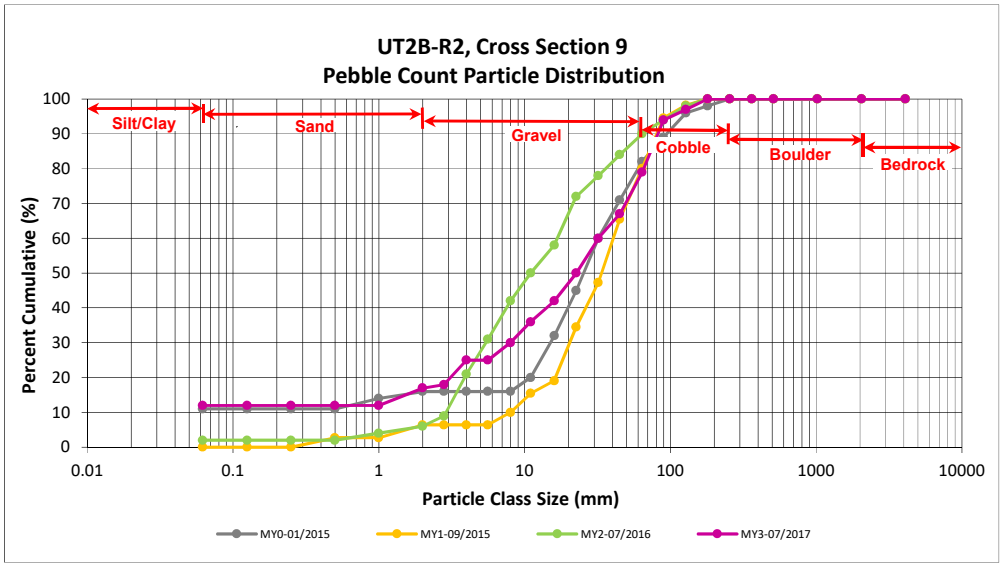
Reachwide and Cross Section Pebble Count Plots

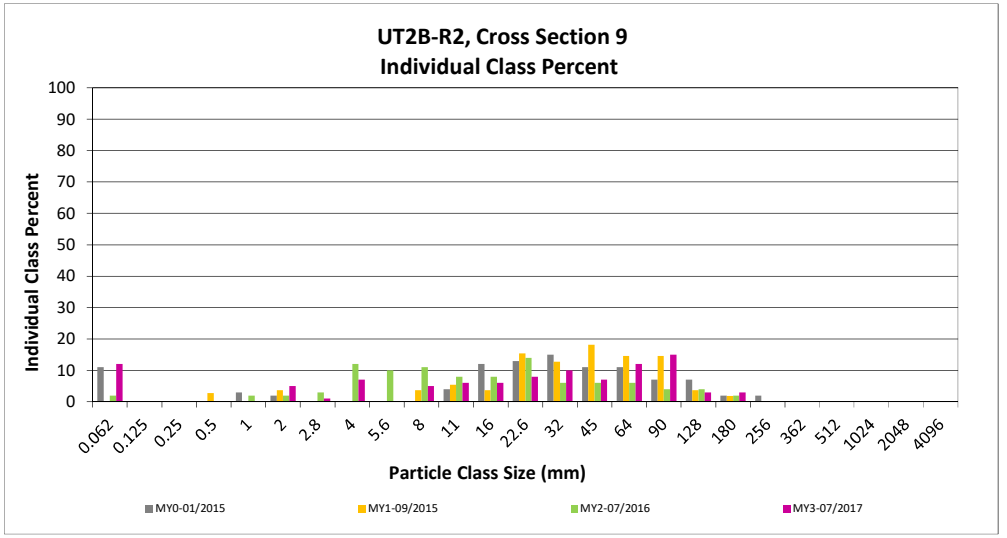
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2B-R2, Cross Section 9

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	12	12	12
SAND	Very fine	0.062	0.125			12
	Fine	0.125	0.250			12
	Medium	0.25	0.50			12
	Coarse	0.5	1.0			12
	Very Coarse	1.0	2.0	5	5	17
GRAVEL	Very Fine	2.0	2.8	1	1	18
	Very Fine	2.8	4.0	7	7	25
	Fine	4.0	5.6			25
	Fine	5.6	8.0	5	5	30
	Medium	8.0	11.0	6	6	36
	Medium	11.0	16.0	6	6	42
	Coarse	16.0	22.6	8	8	50
	Coarse	22.6	32	10	10	60
	Very Coarse	32	45	7	7	67
	Very Coarse	45	64	12	12	79
COBBLE	Small	64	90	15	15	94
	Small	90	128	3	3	97
	Large	128	180	3	3	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 9	
Channel materials (mm)	
D_{16} =	1.74
D_{35} =	10.43
D_{50} =	22.6
D_{84} =	71.7
D_{95} =	101.2
D_{100} =	180.0





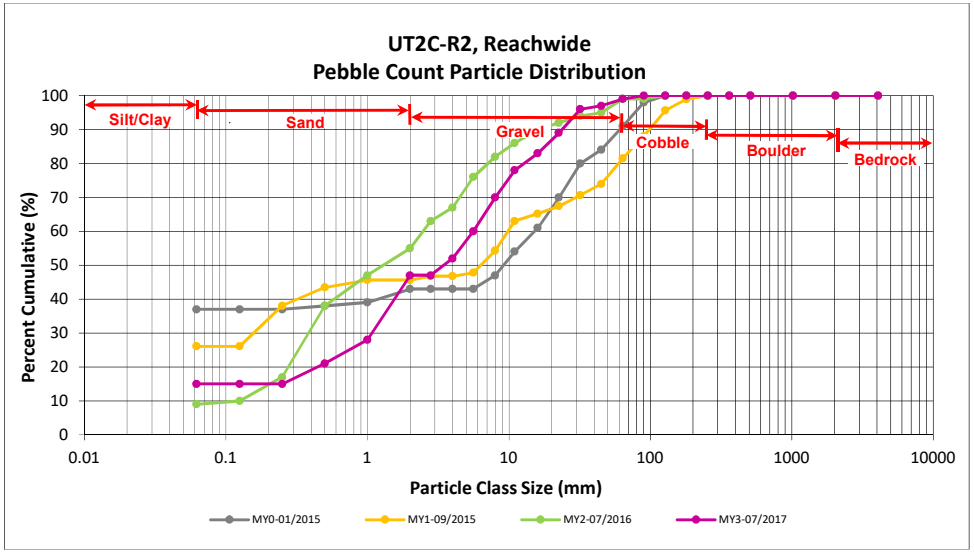
Reachwide and Cross Section Pebble Count Plots

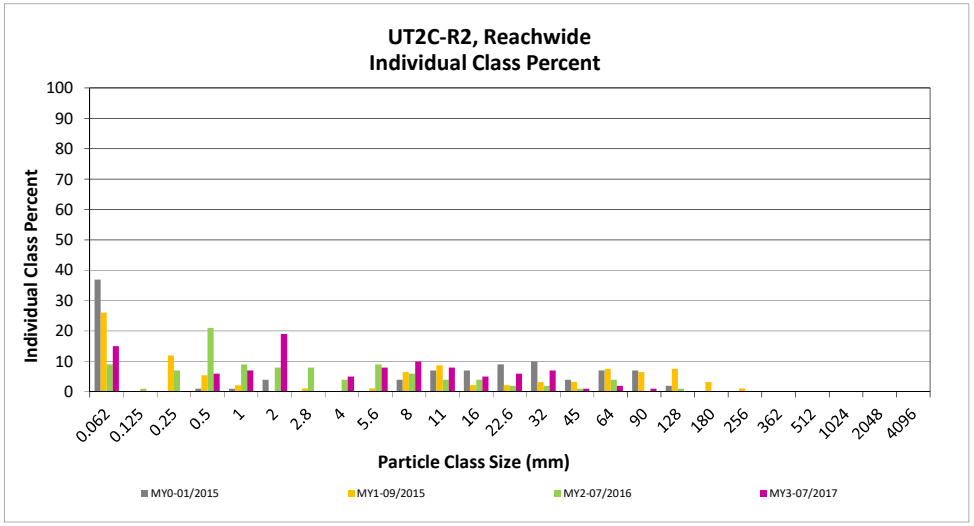
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2C-R2, Reachwide

Particle Class		Diameter (mm)		Particle Count			Reach Summary	
		min	max	Riffle	Pool	Total	Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	3	12	15	15	15
SAND	Very fine	0.062	0.125					15
	Fine	0.125	0.250					15
	Medium	0.25	0.50		6	6	6	21
	Coarse	0.5	1.0	2	5	7	7	28
	Very Coarse	1.0	2.0	6	13	19	19	47
GRAVEL	Very Fine	2.0	2.8					47
	Very Fine	2.8	4.0	5		5	5	52
	Fine	4.0	5.6		8	8	8	60
	Fine	5.6	8.0	7	3	10	10	70
	Medium	8.0	11.0	6	2	8	8	78
	Medium	11.0	16.0	4	1	5	5	83
	Coarse	16.0	22.6	6		6	6	89
	Coarse	22.6	32	7		7	7	96
	Very Coarse	32	45	1		1	1	97
	Very Coarse	45	64	2		2	2	99
COBBLE	Small	64	90	1		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	**50**	**50**	**100**	**100**	**100**

Reachwide	
Channel materials (mm)	
D_{16} =	0.28
D_{35} =	1.29
D_{50} =	3.5
D_{84} =	16.9
D_{95} =	30.4
D_{100} =	90.0





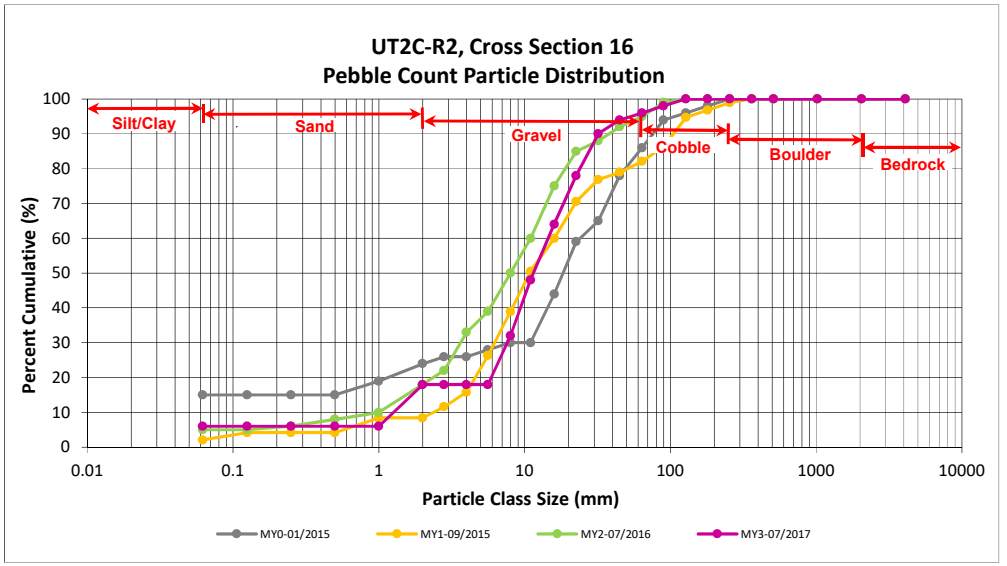
Reachwide and Cross Section Pebble Count Plots

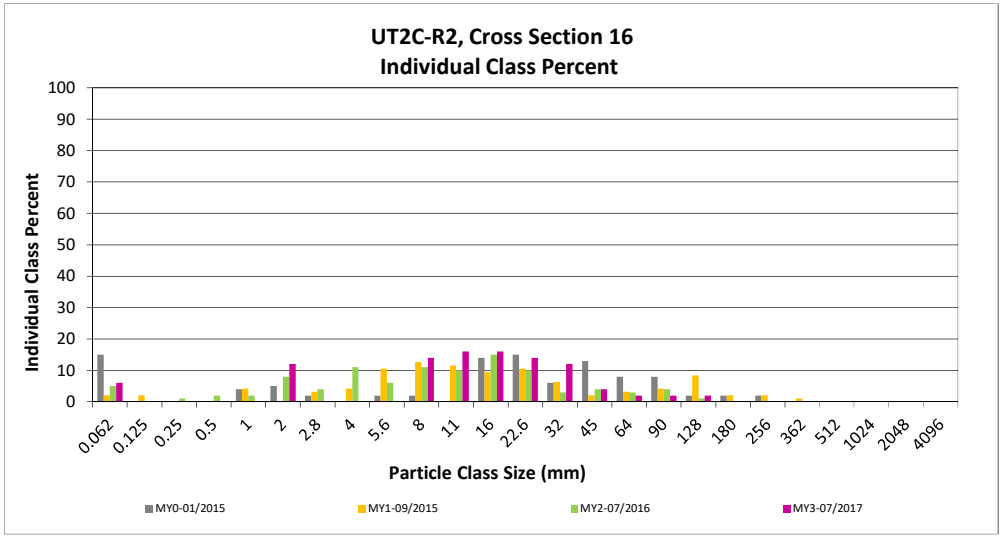
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

UT2C-R2, Cross Section 16

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	6	6	6
SAND	Very fine	0.062	0.125			6
	Fine	0.125	0.250			6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0			6
	Very Coarse	1.0	2.0	12	12	18
GRAVEL	Very Fine	2.0	2.8			18
	Very Fine	2.8	4.0			18
	Fine	4.0	5.6			18
	Fine	5.6	8.0	14	14	32
	Medium	8.0	11.0	16	16	48
	Medium	11.0	16.0	16	16	64
	Coarse	16.0	22.6	14	14	78
	Coarse	22.6	32	12	12	90
	Very Coarse	32	45	4	4	94
	Very Coarse	45	64	2	2	96
COBBLE	Small	64	90	2	2	98
	Small	90	128	2	2	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 16	
Channel materials (mm)	
D_{16} =	1.78
D_{35} =	8.49
D_{50} =	11.5
D_{84} =	26.9
D_{95} =	53.7
D_{100} =	128.0





APPENDIX 5. Hydrology Summary Data

Table 13. Verification of Bankfull Events
Hopewell Stream Mitigation Site
DMS Project No. 95352
Monitoring Year 3 - 2017

Reach	Monitoring Year	Date of Data Collection	Date of Occurrence	Method
UT1 B Reach 1	MY1	3/25/2015	Unknown	Crest Gage
		7/9/2015	Unknown	Crest Gage
		8/6/2015	8/6/2015	Stream Gage
		10/3/2015	10/3/2015	Stream Gage
		11/5/2015	11/2/2015	Crest/Stream Gage
	MY2	2/16/2016	2/16/2016	Stream Gage
		4/19/2016	Unknown	Crest Gage
	MY3	1/2/2017	1/2/2017	Stream Gage
		4/6/2017	4/6/2017	Stream Gage
		4/24/2017	4/24/2017	Stream Gage
		5/5/2017	5/5/2017	Stream Gage
		5/24/2017	5/24/2017	Stream Gage
		6/21/2017	6/21/2017	Stream Gage
		7/8/2017	7/8/2017	Stream Gage
		9/1/2017	9/1/2017	Stream Gage
UT2 Reach 2	MY1	7/9/2015	Unknown	Crest Gage
		10/3/2015	10/3/2015	Stream Gage
		11/5/2015	11/2/2015	Crest/Stream Gage
	MY2	1/6/2016	1/6/2016	Stream Gage
		2/3/2016	2/3/2016	Stream Gage
		2/10/2016	2/10/2016	Stream Gage
		2/16/2016	2/16/2016	Stream Gage
		3/27/2016	3/27/2016	Stream Gage
		4/19/2016	Unknown	Crest Gage
		6/15/2016	6/15/2016	Stream Gage
	MY3	4/24/2017	4/24/2017	Stream Gage
		5/5/2017	5/5/2017	Stream Gage
		6/5/2017	6/5/2017	Stream Gage
		9/1/2017	9/1/2017	Stream Gage
UT2A Reach 2	MY1	3/25/2015	Unknown	Crest Gage
		10/3/2015	10/3/2015	Stream Gage
		11/5/2015	11/2/2015	Crest Gage
	MY2	1/20/2016	1/20/2016	Stream Gage
		6/15/2016	6/15/2016	Stream Gage
	MY3	1/9/2017	1/9/2017	Stream Gage
		5/5/2017	5/5/2017	Stream Gage
		6/21/2017	6/21/2017	Stream Gage
		7/8/2017	7/8/2017	Stream Gage
		9/1/2017	9/1/2017	Stream Gage
UT2B Reach 2	MY1	3/25/2015	Unknown	Crest Gage
		7/9/2015	Unknown	Crest Gage
		10/3/2015	10/3/2015	Stream Gage
	MY2	1/25/2016	1/25/2016	Stream Gage
		2/16/2016	2/16/2016	Stream Gage
		4/19/2016	Unknown	Crest Gage
	MY3	4/6/2017	4/6/2017	Stream Gage
		4/24/2017	4/24/2017	Stream Gage
		5/5/2017	5/5/2017	Stream Gage
		5/24/2017	5/24/2017	Stream Gage
		6/21/2017	6/21/2017	Stream Gage
UT2C Reach 2	MY1	10/3/2015	10/3/2015	Stream Gage
		11/5/2015	11/2/2015	Crest Gage
	MY2	1/6/2016	1/7/2016	Stream Gage
		1/20/2016	1/20/2016	Stream Gage
		2/14/2016	2/15/2016	Stream Gage
		4/19/2016	Unknown	Crest Gage
	MY3	1/9/2017	1/9/2017	Stream Gage