



MONITORING YEAR 4 ANNUAL REPORT

Final

HOPEWELL STREAM MITIGATION SITE

Randolph County, NC
DEQ Contract No. 004642
DMS Project N 95352

Data Collection Period: February – October 2018
Submission Date: December 13, 2018

PREPARED FOR:



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

Mitigation Project Name Hopewell Stream Mitigation Site
 DMS ID 95352
 River Basin Yadkin
 Cataloging Unit 03040104

County Randolph
 Date Project Instituted 6/12/2012
 Date Prepared 5/22/2018

USACE Action ID 2012-01111
 NCDWR Permit No 2013-0933

Credit Release Milestone	Stream Credits						Wetland Credits							
	Scheduled Releases (Stream)	Warm	Cool	Cold	Anticipated Release Year (Stream)	Actual Release Date (Stream)	Scheduled Releases (Forested)	Riparian Riverine	Riparian Non-riverine	Non-riparian	Scheduled Releases (Coastal)	Coastal	Anticipated Release Year (Wetland)	Actual Release Date (Wetland)
Potential Credits (Mitigation Plan)	7,463,400													
Potential Credits (As-Built Survey)	7,412,133													
1 (Site Establishment)	N/A				N/A	N/A	N/A				N/A		N/A	N/A
2 (Year 0 / As-Built)	30%	2,223,640			2015	4/16/2015	30%				30%		N/A	N/A
3 (Year 1 Monitoring)	10%	741,213			2016	4/25/2016	10%				10%		N/A	N/A
4 (Year 2 Monitoring)	10%	741,213			2017	4/3/2017	10%				15%		N/A	N/A
5 (Year 3 Monitoring)	10%	741,213			2018	4/25/2018	15%				20%		N/A	N/A
6 (Year 4 Monitoring)	5%				2019		5%				10%		N/A	N/A
7 (Year 5 Monitoring)	10%				2020		15%				15%		N/A	N/A
8 (Year 6 Monitoring)	5%				2021		5%				N/A		N/A	N/A
9 (Year 7 Monitoring)	10%				2022		10%				N/A		N/A	N/A
Stream Bankfull Standard	10%	741,213			2017	4/3/2017	N/A				N/A		N/A	N/A
Total Credits Released to Date		5,188,493												

DEBITS (released credits only)

	Ratios															
	1	1.5	2.5	5	1	3	2	5	1	3	2	5	1	3	2	5
	Stream Restoration	Stream Enhancement I	Stream Enhancement II	Stream Preservation	Riparian Restoration	Riparian Creation	Riparian Enhancement	Riparian Preservation	Nonriparian Restoration	Nonriparian Creation	Nonriparian Enhancement	Nonriparian Preservation	Coastal Marsh Restoration	Coastal Marsh Creation	Coastal Marsh Enhancement	Coastal Marsh Preservation
As-Built Amounts (feet and acres)	4,037,000	866,000	6,584,000	821,000												
As-Built Amounts (mitigation credits)	4,037,000	577,333	2,633,600	164,200												
Percentage Released	70%	70%	70%	70%												
Released Amounts (feet / acres)	2,825,900	606,200	4,608,800	574,700												
Released Amounts (credits)	2,825,900	404,133	1,843,520	114,940												
NCDWR Permit	USACE Action ID	Project Name														
2016-0299	2002-01260	NCDOT TIP R-2536 - Asheboro Bypass, Randolph County														
		2,422,200	519,600	3,950,400	492,600											
Remaining Amounts (feet / acres)	403,700	86,600	658,400	82,100												
Remaining Amounts (credits)	403,700	57,733	263,360	16,420												

Contingencies (if any): None


 Signature of Wilmington District Official Approving Credit Release

9/6/18
 Date

- 1 - For DMS, no credits are released during the first milestone
- 2 - For DMS projects, the second credit release milestone occurs automatically when the as-built report (baseline monitoring report) has been made available to the NCIRT by posting it to the NCEEP Portal, provided the following criteria have been met:
 - 1) Approval of the final Mitigation Plan
 - 2) Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property
 - 3) Completion of all physical and biological improvements to the mitigation site pursuant to the mitigation plan
 - 4) Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required
- 3 - A 10% reserve of credits is to be held back until the bankfull event performance standard has been met

PREPARED BY:



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Charlotte, NC 28203

Phone: 704.332.7754
Fax: 704.332.3306



December 13, 2018

Mr. Harry Tsomides
Project Manager
Division of Mitigation Services
5 Ravenscroft Dr., Suite 102
Asheville, NC 28801

RE: Monitoring Year 4 Annual Report – Final Submittal
Hopewell Stream Mitigation Site
DMS Project No. 95352
DEQ Contract No. 004642

Dear Mr. Tsomides:

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

DMS comment; Section 1.2.1 – It is indicated that invasives “will continue to be monitored and controlled as necessary...”. While a lot of progress has been made over the past year, DMS observed recently that several areas were still abundant with invasives. Please provide a little more detail on which reaches still need the most treatment, when that will be performed, etc.

*Wildlands response; Additional treatment will most likely be needed to address Chinese privet (*Ligustrum sinense*) on Little River Reaches 1 and 2, UT2B Reach 1, and UT2C Reach 1. The area of the project most recently treated with a foliar spray application in October 2018 will need time to demonstrate the effectiveness of the foliar treatment. Follow up treatments are scheduled to occur annually during the fall of subsequent monitoring years. Areas needing additional treatment have been added to the report text along with the timing of these future treatments.*

DMS comment; Section 1.2.3 – Please summarize ongoing fencing work / alignment issues.

Wildlands response; Ongoing fencing issues have been included in the report. In addition, the conservation easement GIS shapefile was updated in the MY4 figures to reflect the final As-Built easement.

Four (4) hard copies of the Final Monitoring Report and a full electronic submittal has been mailed to the DMS western field office. Please contact me at 704-332-7754 x110 if you have any questions.

Sincerely,

Kirsten Y. Gimbert
Project Manager
kgimbert@wildlandseng.com

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 (MY) 4 assessments and site visits were completed between February and October 2018 to assess the conditions of the project. Overall, the Site has met the required stream and vegetation success criteria for MY4. The overall average stem density for the Site is 447 stems per acre and is therefore meeting the interim MY5 requirement of 260 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 the Site has met the MY7 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 4 Annual Report

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Section 1: PROJECT OVERVIEW

The 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 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 4 Data Assessment

Annual monitoring and quarterly site visits were conducted during MY4 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 MY4 vegetation and stream surveys were completed in July 2018.

1.2.1 Vegetative Assessment

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 MY7. The interim measure of vegetative success for the Site is the survival of 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 by the United States Army Corps of Engineers in consultation with the NC Interagency Review Team.

The 2018 vegetation monitoring resulted in an average stem density of 447 stems per acre, which is well above the interim requirement of 260 stems/acre required at MY5 and approximately 31% 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. In MY4, stem heights averaged 7.4 feet which is a 51% increase in height compared to the MY3 stem height average of 4.5 feet. All plots are on track to meet the success criteria required for MY7. Refer to Appendix 2 for vegetation plot photographs and the vegetation condition assessment table and Appendix 3 for vegetation data tables.

Significant efforts were implemented during construction to control the invasive species within the Site and additional follow up treatments have been and may continue to be necessary throughout the post-construction monitoring period. Invasive species treatments have been implemented annually with the primary focus on the non-native invasive shrub, Chinese privet (*Ligustrum sinense*). During 2018, pockets of Chinese privet were treated throughout the Site including previously treated areas where re-sprouting was occurring. Additional treatment of Chinese privet will be necessary on Little River Reaches 1 and 2, UT2B Reach 1, and UT2C Reach 1. In addition to the above, the non-native tree of heaven (*Ailanthus altissima*) noted in isolated areas was treated in MY4. Areas of Chinese privet and tree of heaven account for approximately 5% of the overall easement acreage. These areas will continue to be monitored and controlled on an annual basis during the fall of subsequent years. One other non-native species of concern noted at the Site multiflora rose (*Rosa multiflora*) was not negatively impacting planted stem densities.

Small bare areas (<1% of the planted acreage) noted during previous monitoring years along the upper section of UT1B Reach 1 have established herbaceous cover as a result of re-seeding, liming, and fertilizing during MY2. No bare areas are reported in MY4. A few pockets of dense sweetgum (*Liquidambar styraciflua*) volunteers are present in the upper section of UT1B Reach 1 and UT2 Reach 2 as a result of mature sweetgums within the reaches. The natural recruitment of this native, early successional species has resulted in a small monoculture (~0.2 acres) in these areas.

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

1.2.2 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. During MY4, minor aggradation was documented at cross sections 1 and 2 (UT2A – Reach 1). The slight adjustment in channel dimension will be monitored in subsequent years and currently doesn't indicate instability. Changes observed at cross section 7 (UT2 - Reach 2) between MY1 and MY2 were the result of pool scouring at this location. No additional scouring was observed in MY3 or MY4. Minor riffle scour observed in MY3 at cross section 9 (UT2B – Reach 2) wasn't documented during the MY4 survey suggesting the channel has adjusted back towards the design bed elevation. During MY4 the bankfull stage was adjusted at cross section 9 because the bankfull elevation appears to have been set slightly below top of bank during the baseline assessment. As a result, bankfull area and depth increased at this cross section.

Pool scouring at cross section 10 (UT2B – Reach 2) has resulted in an increase in bankfull depth. Vegetation root mat growth has continued within the channel at cross section 14 (UT1B – Reach 1) which has resulted in an increase in the bankfull elevation. 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, the majority of 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.

1.2.3 Areas of Concern/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.

The changes in cross sectional area and depth noted for cross sections 1, 2, and 14 will continue to be monitored during subsequent years for signs of instability and a maintenance plan will be established if deemed necessary.

Several sections of perimeter fence will be repaired in late 2018/early 2019. Repairs will address areas where fence was installed incorrectly and deviates inside the conservation easement boundaries including sections on the north side of UT1A, the northwest and south sides of UT1B, northeast side of UT2A, and the northeast side of UT2C. Repairs will also be made to a portion of damaged fencing near the crossing along Little River Reach 2.

1.2.4 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. The success criteria have already been met for the seven-year monitoring period after MY2. During MY4, at least one bankfull event was recorded on all restoration reaches during annual monitoring, except UT2C Reach 2. Refer to Appendix 5 for hydrologic data.

1.3 Monitoring Year 4 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 interim MY5 and final MY7 success criteria. 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 MY7 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

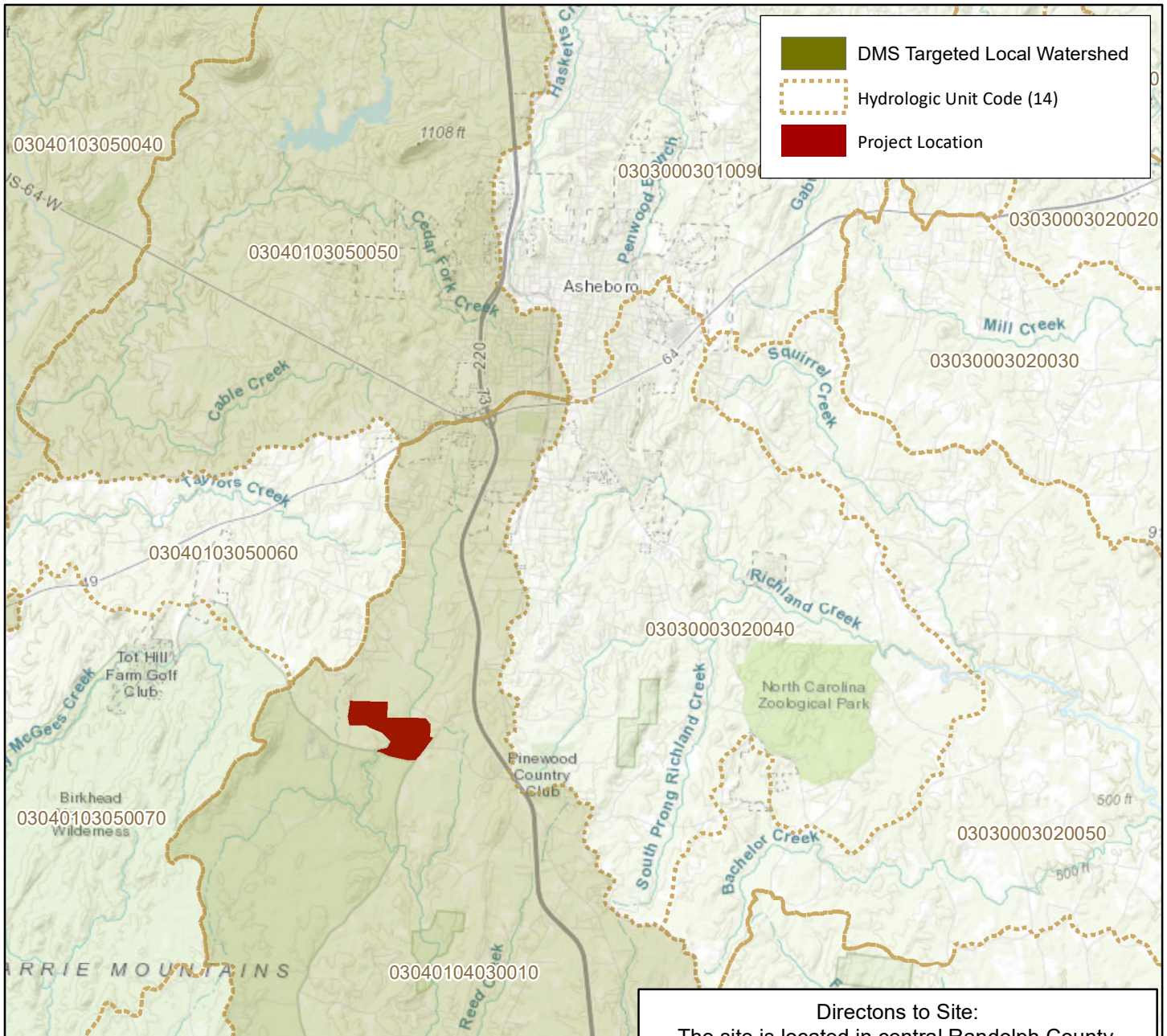
Geomorphic data were collected following the standards outlined in *The Stream Channel Reference Site: An Illustrated Guide to Field Techniques* (Harrelson et al., 1994) and in *Stream Restoration: A Natural Channel Design Handbook* (Doll et al., 2003). All Integrated Current Condition Mapping was recorded 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.
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- 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 activities requires prior coordination with DMS.

Directions 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.

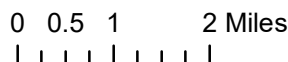


Figure 1 Vicinity Map
 Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018
 Randolph County, NC

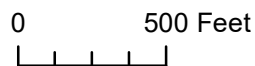
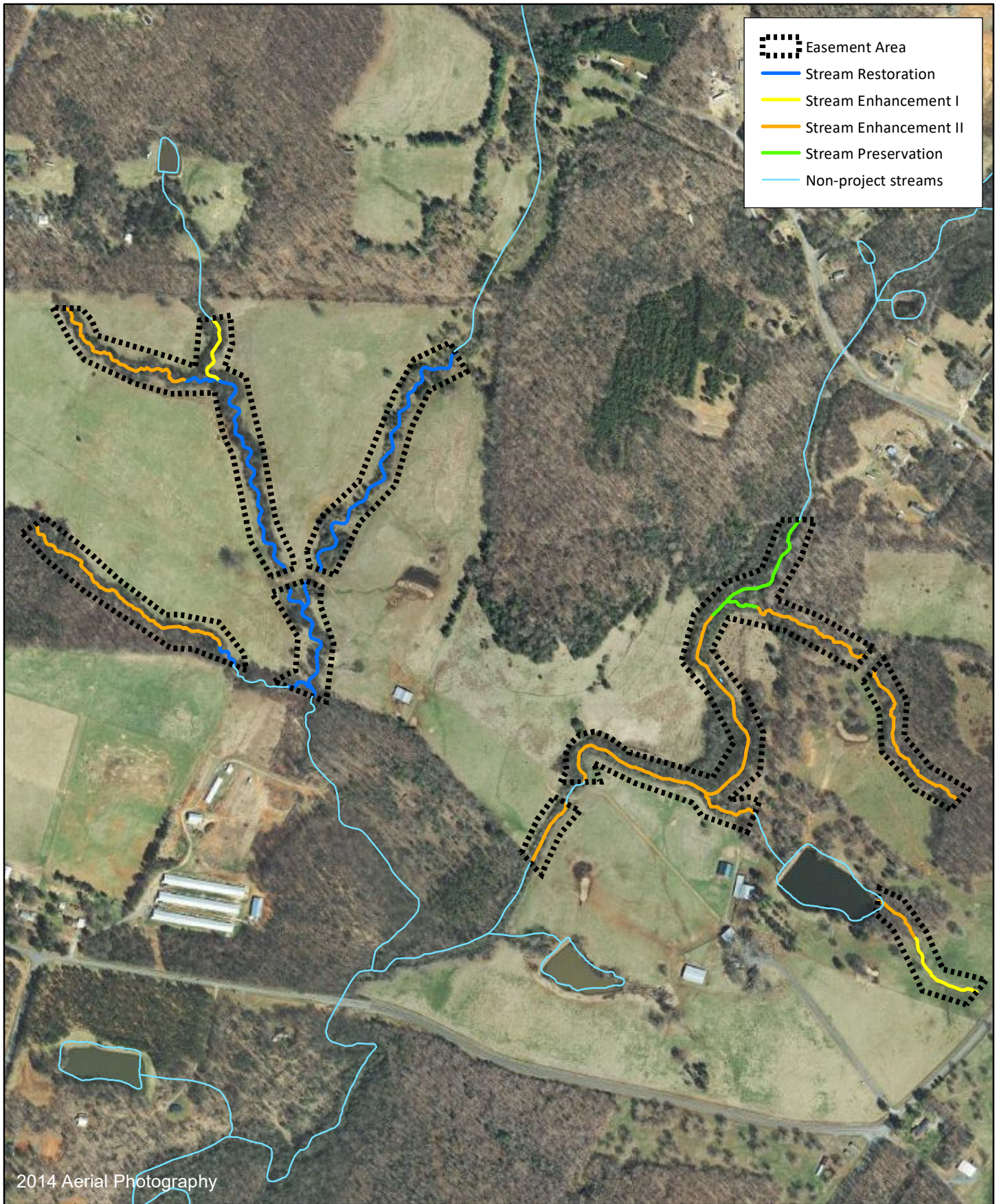


Figure 2 Project Component Map
 Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018
 Randolph County, NC

Table 1. Project Components and Mitigation Credits

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

Mitigation Credits									
	Stream		Riparian Wetland		Non-Riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorous Nutrient Offset
Type	R	RE	R	RE	R	RE			
Totals	7,247.933	164.200	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	140.800		
Little River Reach 2	107+04 - 126+53 128+06 - 131+57	2,374	Fencing / Invasives Control	EII	2,300	2.5:1	920.000		
UT1A Reach 1	200+00 - 208+95 209+84 - 217+00	1,611	Fencing / Invasives Control	EII	1,611	2.5:1	644.400		
UT1A Reach 2	217+00 - 218+17	117	Preservation	P	117	5:1	23.400		
UT1B Reach 1	300+87 - 305+67	475	Fencing / Invasives Control	EI	480	1.5:1	320.000		
UT1B Reach 2 & 3	305+67 - 308+25 350+00 - 353+17	580	Fencing / Invasives Control	EII	575	2.5:1	230.000		
UT2 Reach 1 & 2	400+00 - 415+47 416+35 - 423+16	2,419	Priority 1	Restoration	2,228	1:1	2,228.000		
UT2A Reach 1	500+39 - 504+25	386	Fencing / Invasives Control	EI	386	1.5:1	257.333		
UT2A Reach 2	504+25 - 516+21 517+00 - 518+68	1,368	Priority 1	Restoration	1,364	1:1	1,364.000		
UT2B Reach 1	600+00 - 608+48	848	Fencing / Invasives Control	EII	848	2.5:1	339.200		
UT2B Reach 2	608+48 - 610+46	114	Priority 1	Restoration	198	1:1	198.000		
UT2C Reach 1	700+00 - 712+50	1,215	Fencing / Invasives Control	EII	1,250	2.5:1	500.000		
UT2C Reach 2	712+50 - 713+60	326	Priority 1	Restoration	110	1:1	110.000		
UT2C Reach 3	800+00 - 801+37		Priority 1	Restoration	137	1:1	137.000		

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 4 - 2018

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	Stream Survey	September 2015	December 2015
	Vegetation Survey	September 2015	
Invasive Plant Control		April 2016	
Bare Areas (UT2A) Limed/Fertilized/Seeded		April 2016	
Year 2 Monitoring	Stream Survey	August 2016	December 2016
	Vegetation Survey	August 2016	
Invasive Plant Control		February 2017	
Year 3 Monitoring	Stream Survey	July 2017	December 2017
	Vegetation Survey	July 2017	
Invasive Plant Control		October 2017	
Year 4 Monitoring	Stream Survey	July 2018	December 2018
	Vegetation Survey	July 2018	
Invasive Plant Control		October 2018	
Year 5 Monitoring		2019	December 2019
Year 6 Monitoring		2020	December 2020
Year 7 Monitoring		2021	December 2021

¹Seed 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 4 - 2018

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	Dykes and Son Nursery
Bare Roots	Bruton Natural Systems, Inc
Live Stakes	Wildlands Engineering, Inc.
Monitoring Performers	Kirsten Gimbert 704.332.7754, ext. 110
Monitoring, POC	

Table 4. Project Information and Attributes

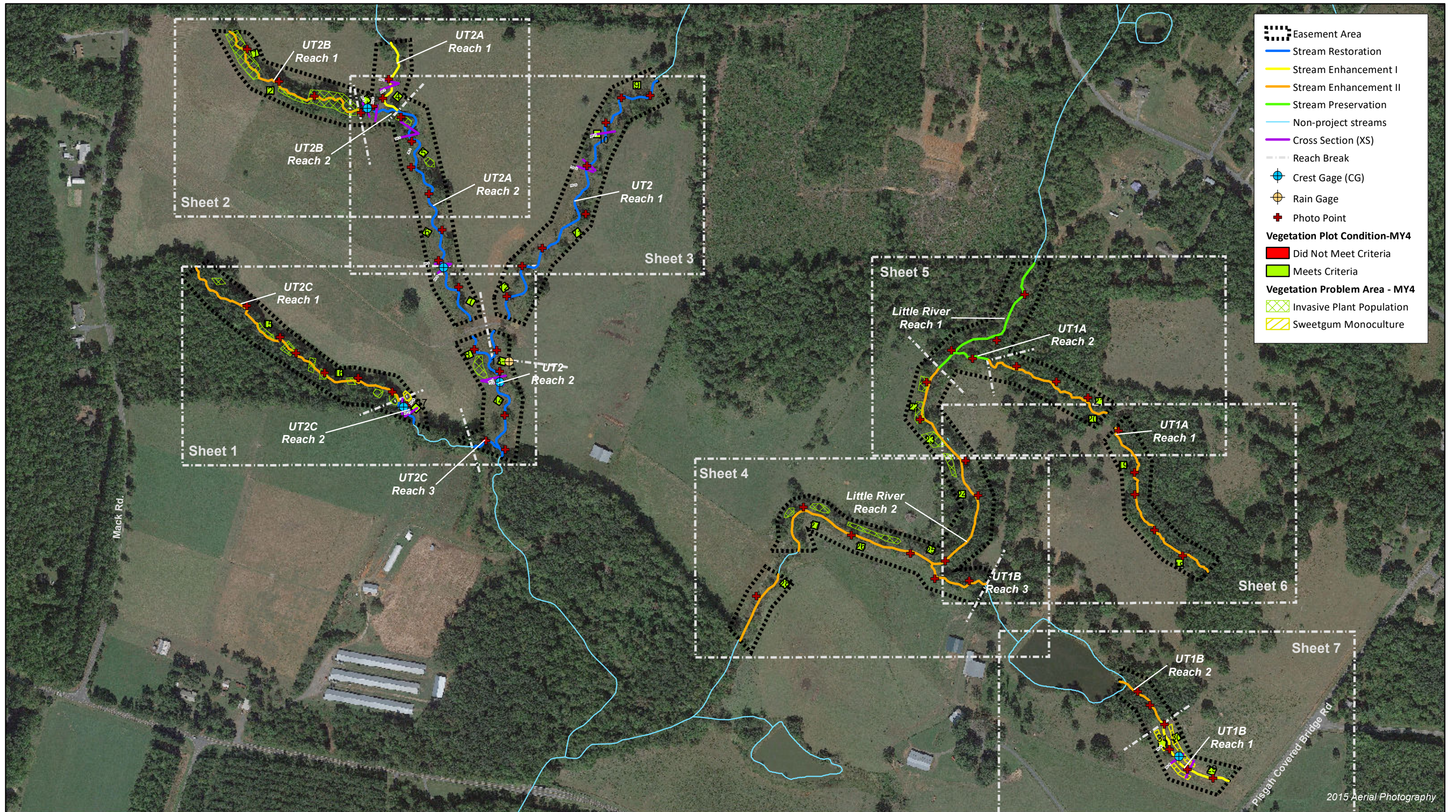
Hopewell Stream Mitigation Site

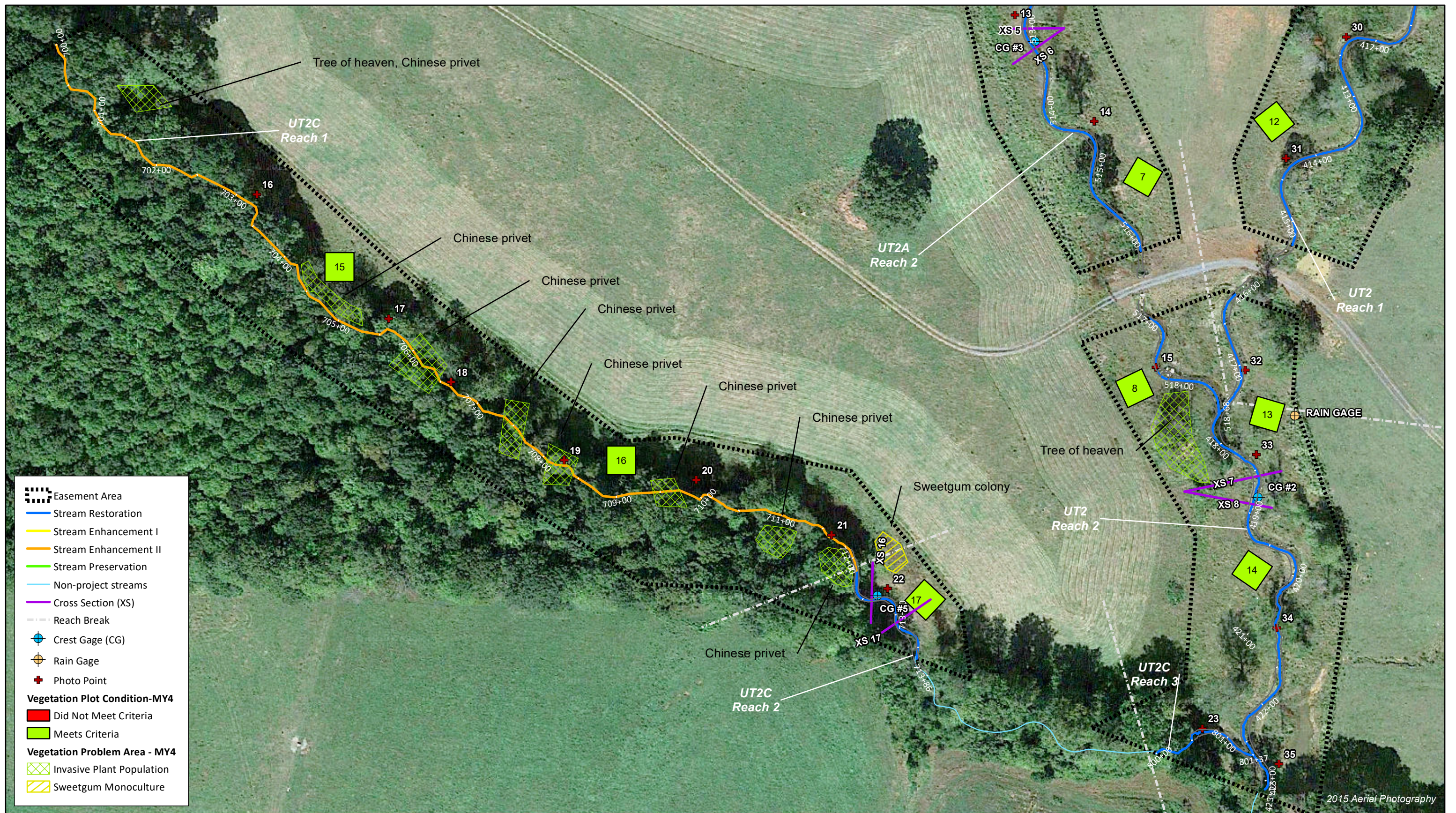
DMS Project No. 95352

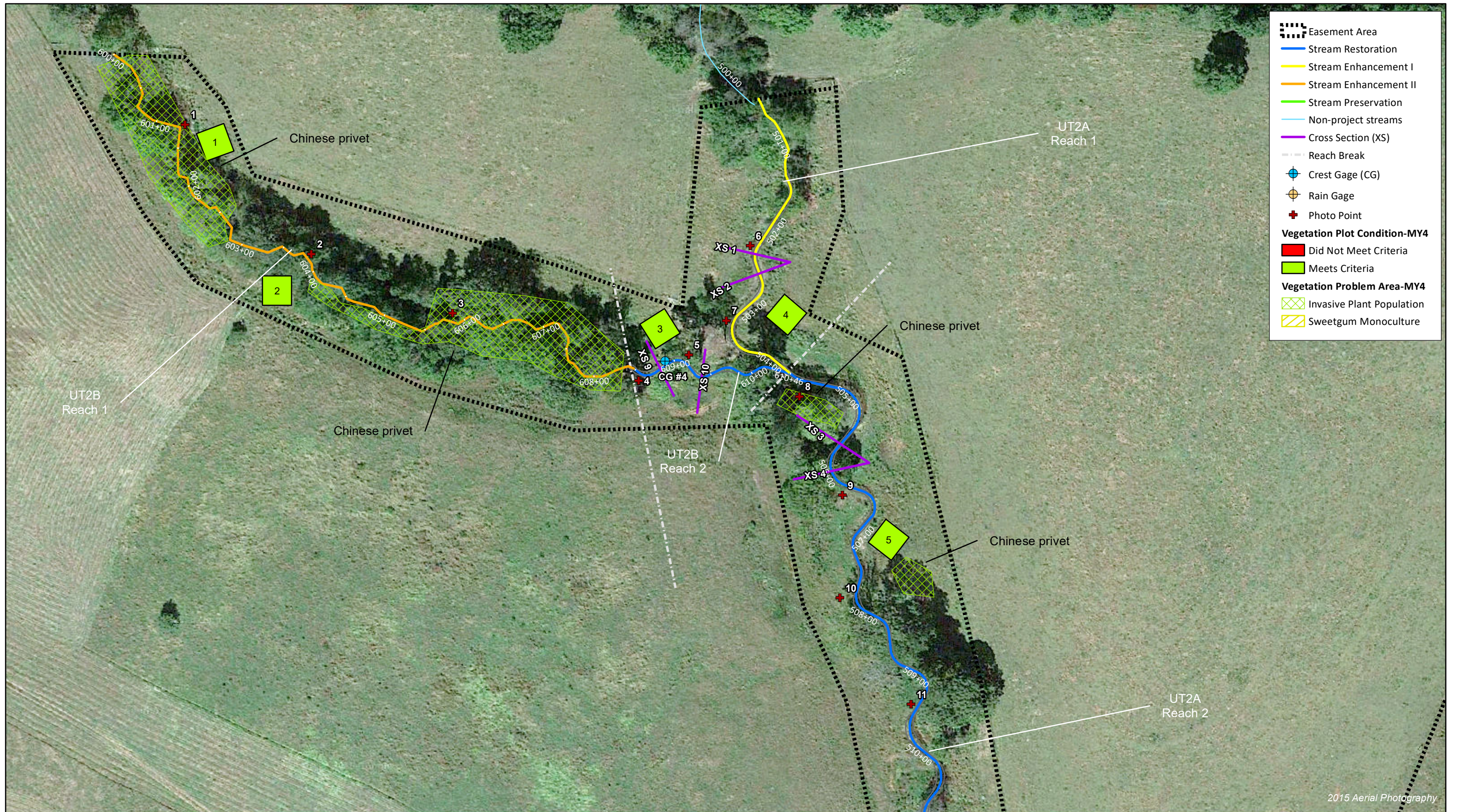
Monitoring Year 4 - 2018

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 Drainage 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 Description (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







2015 Aerial Photography

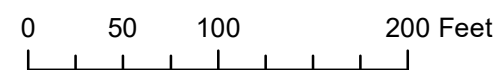
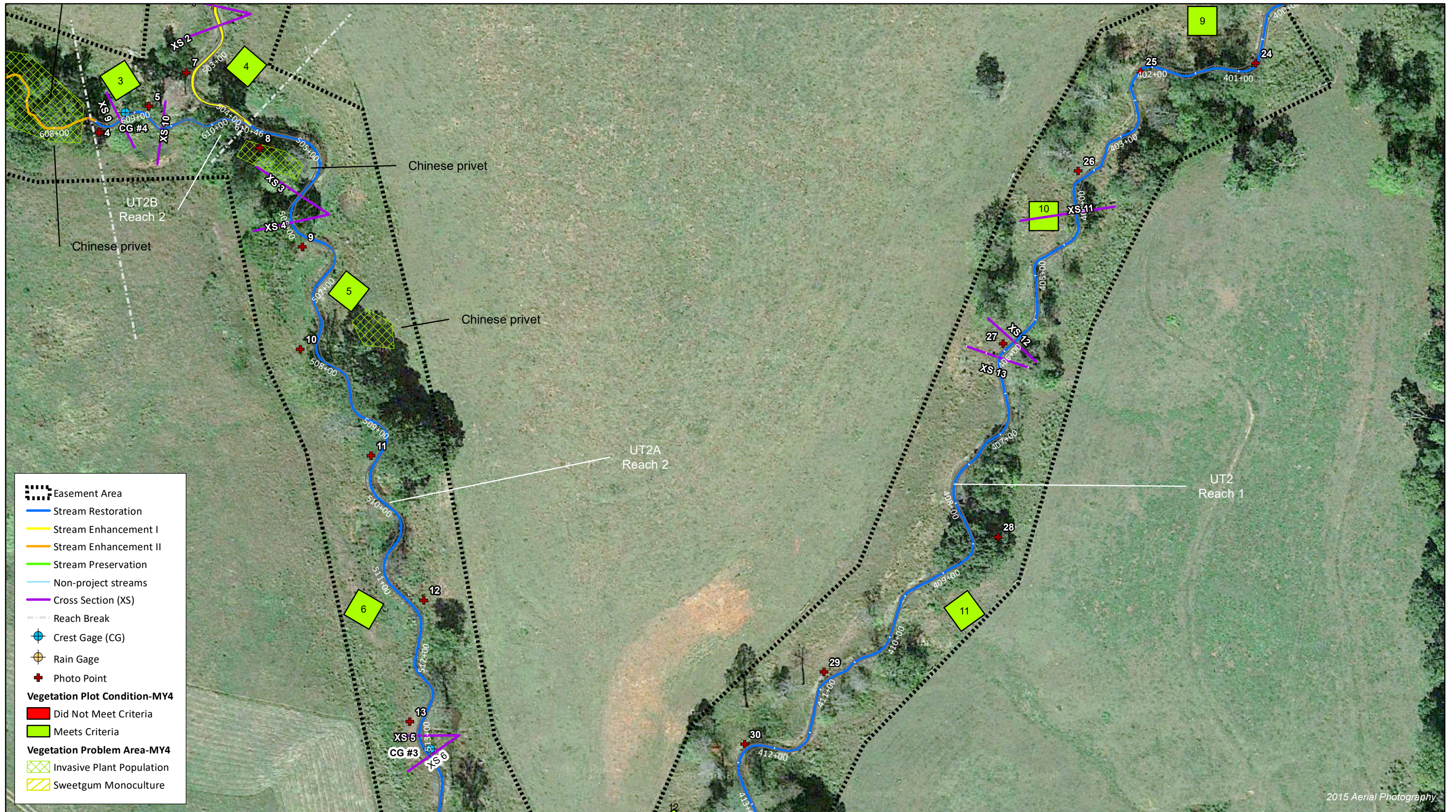
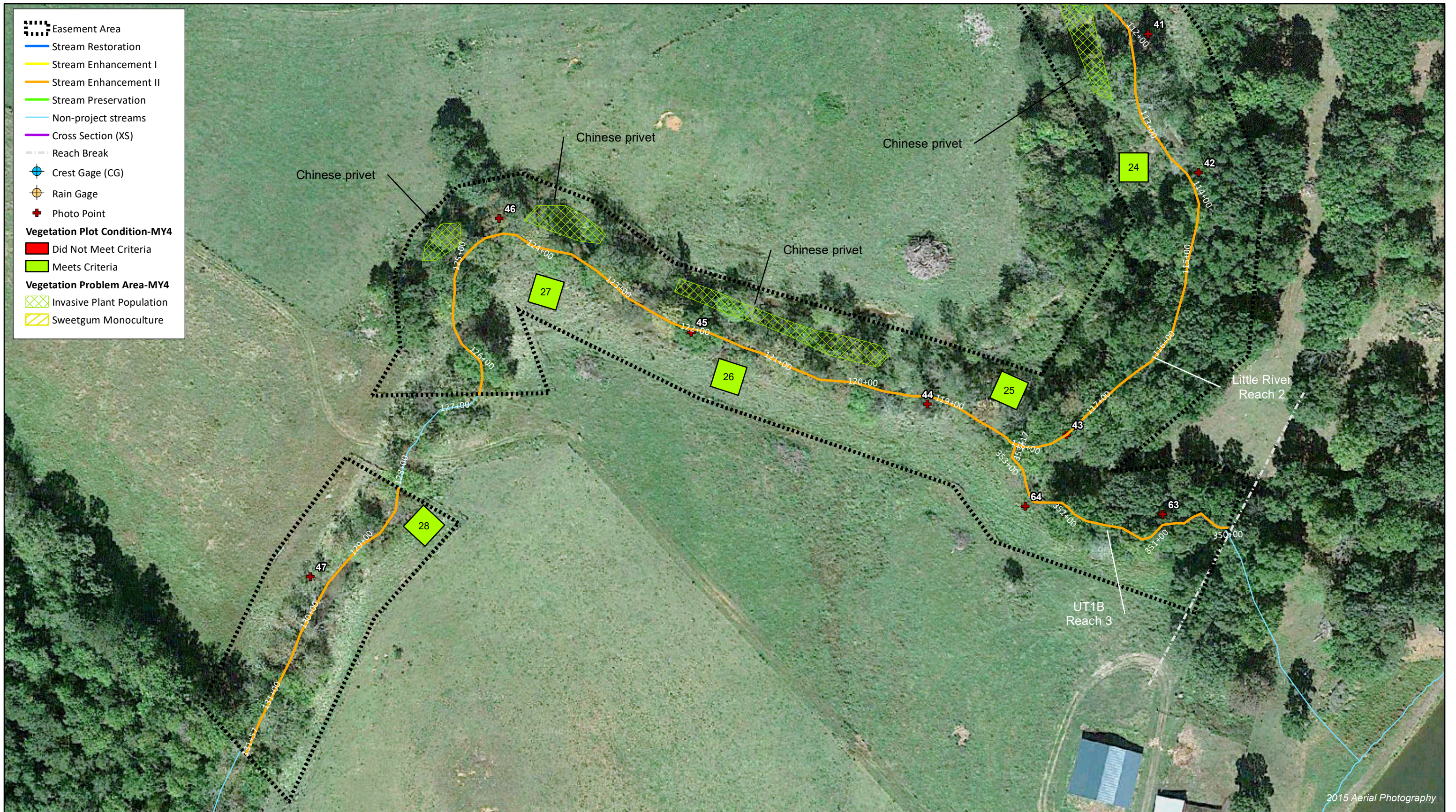


Figure 3.2 Integrated Current Condition Plan View (Sheet 2 of 7)
 Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018
 Randolph County





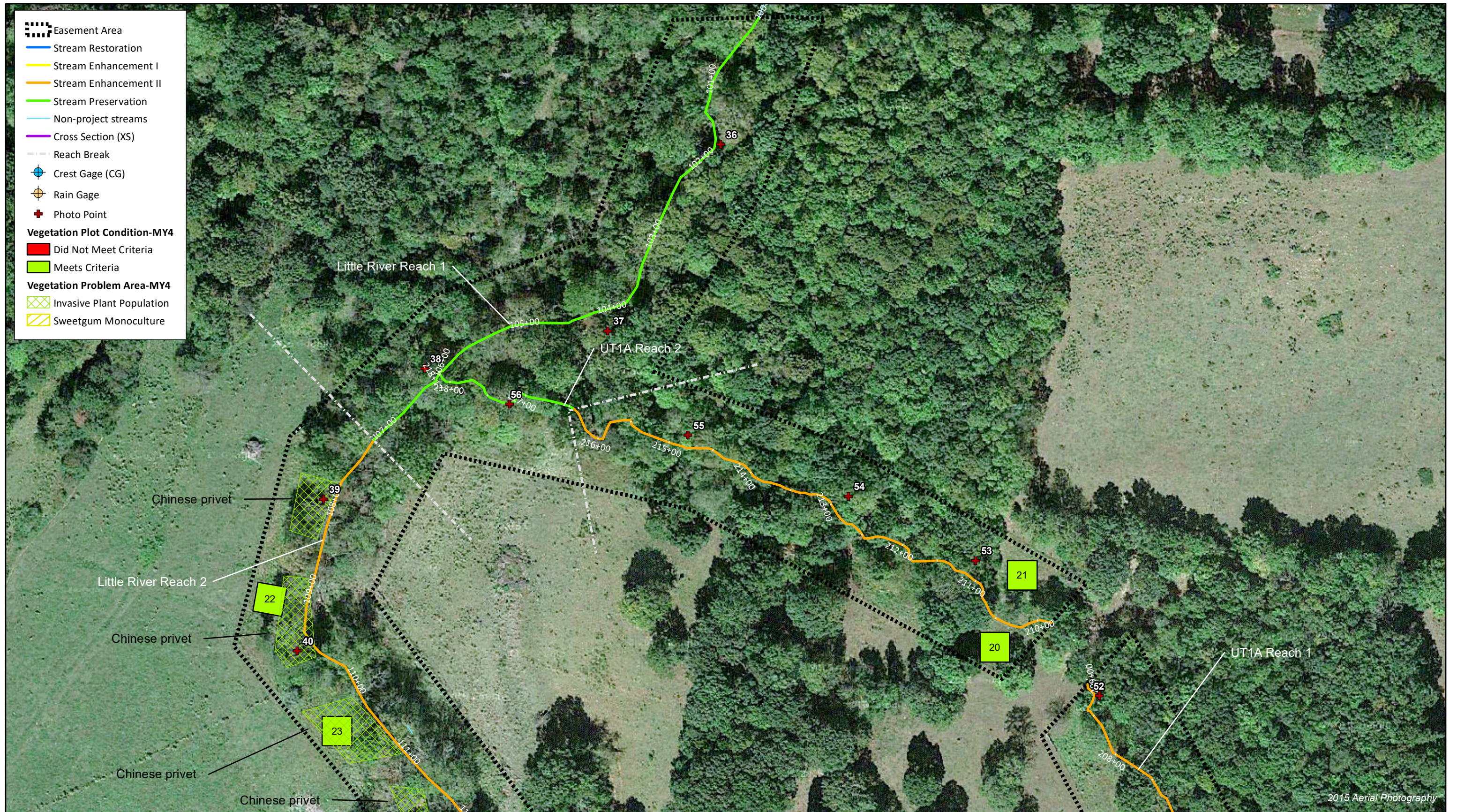




Figure 3.6 Integrated Current Condition Plan View (Sheet 6 of 7)
 Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018
 Randolph County



2015 Aerial Photography

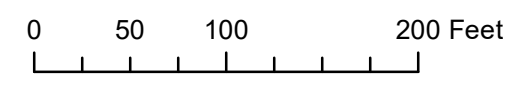


Figure 3.7 Integrated Current Condition Plan View (Sheet 7 of 7)
 Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018
 Randolph County

Table 5a. Visual Stream Morphology Stability Assessment Table

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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%			
Totals					0	0	100%	n/a	n/a	n/a
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			

¹Excludes 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 4 - 2018

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%			

¹Excludes 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 4 - 2018

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%			
Totals					0	0	100%	n/a	n/a	n/a
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%			

¹Excludes 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 4 - 2018

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%			

¹Excludes 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 4 - 2018

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%			

¹Excludes 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 4 - 2018

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%			

¹Excludes 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 4 - 2018

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	0	0	0.0%
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			0	0.0	0.0%
Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	0.25 Ac	0	0	0%
Cumulative Total			0	0.0	0.0%

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	20	1.6	4.6%
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 (07/18/2018)



UT2B R1 – Photo Point 1 looking downstream (07/18/2018)



UT2B R1 – Photo Point 2 looking upstream (07/18/2018)



UT2B R1 – Photo Point 2 looking downstream (07/18/2018)



UT2B R1 – Photo Point 3 looking upstream (07/18/2018)



UT2B R1 – Photo Point 3 looking downstream (07/18/2018)



UT2B R1 – Photo Point 4 looking upstream (07/18/2018)



UT2B R1 – Photo Point 4 looking downstream (07/18/2018)



UT2B R1 – Photo Point 5 looking upstream (07/18/2018)



UT2B R1 – Photo Point 5 looking downstream (07/18/2018)



UT2A R1 – Photo Point 6 looking upstream (07/18/2018)



UT2A R1 – Photo Point 6 looking downstream (07/18/2018)



UT2A R1 – Photo Point 7 looking upstream (07/18/2018)



UT2A R1 – Photo Point 7 looking downstream (07/18/2018)



UT2A R2 – Photo Point 8 looking upstream (07/18/2018)



UT2A R2 – Photo Point 8 looking downstream (07/18/2018)



UT2A R2 – Photo Point 9 looking upstream (07/18/2018)



UT2A R2 – Photo Point 9 looking downstream (07/18/2018)



UT2A R2 – Photo Point 10 looking upstream (07/18/2018)



UT2A R2 – Photo Point 10 looking downstream (07/18/2018)



UT2A R2 – Photo Point 11 looking upstream (07/18/2018)



UT2A R2 – Photo Point 11 looking downstream (07/18/2018)



UT2A R2 – Photo Point 12 looking upstream (07/18/2018)



UT2A R2 – Photo Point 12 looking downstream (07/18/2018)



UT2A R2 – Photo Point 13 looking upstream (07/18/2018)



UT2A R2 – Photo Point 13 looking downstream (07/18/2018)



UT2A R2 – Photo Point 14 looking upstream (07/18/2018)



UT2A R2 – Photo Point 14 looking downstream (07/18/2018)



UT2A R2 – Photo Point 15 looking upstream (07/18/2018)



UT2A R2 – Photo Point 15 looking downstream (07/18/2018)



UT2C R1 – Photo Point 16 looking upstream (07/18/2018)



UT2C R1 – Photo Point 16 looking downstream (07/18/2018)



UT2C R1 – Photo Point 17 looking upstream (07/18/2018)



UT2C R1 – Photo Point 17 looking downstream (07/18/2018)



UT2C R1 – Photo Point 18 looking upstream (07/18/2018)



UT2C R1 – Photo Point 18 looking downstream (07/18/2018)



UT2C R1 – Photo Point 19 looking upstream (07/18/2018)



UT2C R1 – Photo Point 19 looking downstream (07/18/2018)



UT2C R1 – Photo Point 20 looking upstream (07/18/2018)



UT2C R1 – Photo Point 20 looking downstream (07/18/2018)



UT2C R1 – Photo Point 21 looking upstream (07/18/2018)



UT2C R1 – Photo Point 21 looking downstream (07/18/2018)



UT2C R2 – Photo Point 22 looking upstream (07/18/2018)



UT2C R2 – Photo Point 22 looking downstream (07/18/2018)



UT2C R3 – Photo Point 23 looking upstream (07/18/2018)



UT2C R3 – Photo Point 23 looking downstream (07/18/2018)



UT2 R1 – Photo Point 24 looking upstream (07/18/2018)



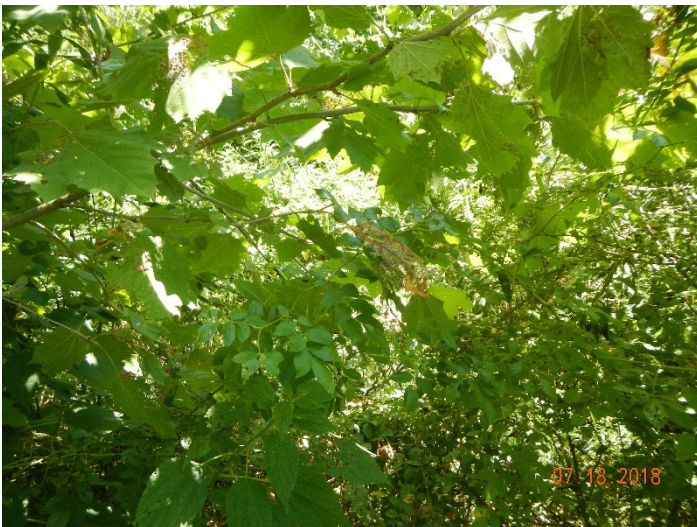
UT2 R1 – Photo Point 24 looking downstream (07/18/2018)



UT2 R1 – Photo Point 25 looking upstream (07/18/2018)



UT2 R1 – Photo Point 25 looking downstream (07/18/2018)



UT2 R1 – Photo Point 26 looking upstream (07/18/2018)



UT2 R1 – Photo Point 26 looking downstream (07/18/2018)



UT2 R1 – Photo Point 27 looking upstream (07/18/2018)



UT2 R1 – Photo Point 27 looking downstream (07/18/2018)



UT2 R1 – Photo Point 28 looking upstream (07/18/2018)



UT2 R1 – Photo Point 28 looking downstream (07/18/2018)



UT2 R1 – Photo Point 29 looking upstream (07/18/2018)



UT2 R1 – Photo Point 29 looking downstream (07/18/2018)



UT2 R1 – Photo Point 30 looking upstream (07/18/2018)



UT2 R1 – Photo Point 30 looking downstream (07/18/2018)



UT2 R1 – Photo Point 31 looking upstream (07/18/2018)



UT2 R1 – Photo Point 31 looking downstream (07/18/2018)



UT2 R1 – Photo Point 32 looking upstream (07/18/2018)



UT2 R1 – Photo Point 32 looking downstream (07/18/2018)



UT2 R2 – Photo Point 33 looking upstream (07/18/2018)



UT2 R2 – Photo Point 33 looking downstream (07/18/2018)



UT2 R2 – Photo Point 34 looking upstream (07/18/2018)



UT2 R2 – Photo Point 34 looking downstream (07/18/2018)



UT2 R2 – Photo Point 35 looking upstream (07/18/2018)



UT2 R2 – Photo Point 35 looking downstream (07/18/2018)



Little River R1 – Photo Point 36 looking upstream (07/19/2018)



Little River R1–Photo Point 36 looking downstream (07/19/2018)



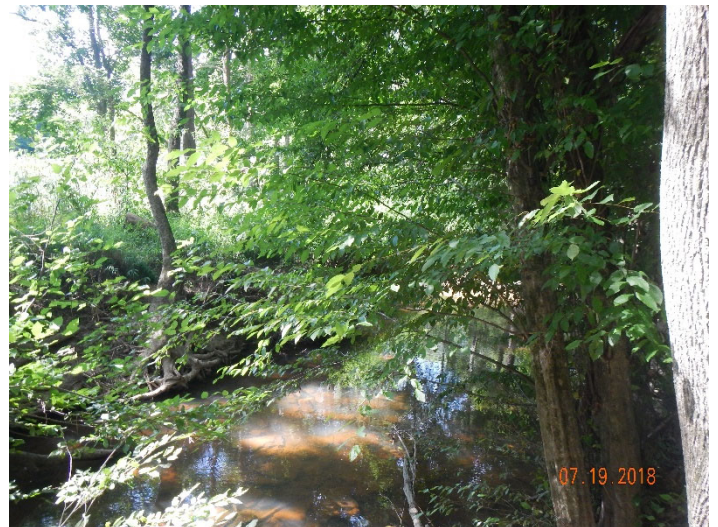
Little River R1 – Photo Point 37 looking upstream (07/19/2018)



Little River R1–Photo Point 37 looking downstream (07/19/2018)



Little River R1 – Photo Point 38 looking upstream (07/19/2018)



Little River R1–Photo Point 38 looking downstream (07/19/2018)



Little River R2 – Photo Point 39 looking upstream (07/19/2018)



Little River R2–Photo Point 39 looking downstream (07/19/2018)



Little River R2 – Photo Point 40 looking upstream (07/19/2018)



Little River R2-Photo Point 40 looking downstream (07/19/2018)



Little River R2 – Photo Point 41 looking upstream (07/19/2018)



Little River R2-Photo Point 41 looking downstream (07/19/2018)



Little River R2 – Photo Point 42 looking upstream (07/19/2018)



Little River R2-Photo Point 42 looking downstream (07/19/2018)



Little River R2 – Photo Point 43 looking upstream (07/19/2018)



Little River R2–Photo Point 43 looking downstream (07/19/2018)



Little River R2 – Photo Point 44 looking upstream (07/19/2018)



Little River R2–Photo Point 44 looking downstream (07/19/2018)



Little River R2 – Photo Point 45 looking upstream (07/19/2018)



Little River R2–Photo Point 45 looking downstream (07/19/2018)



Little River R2 – Photo Point 46 looking upstream (07/19/2018)



Little River R2–Photo Point 46 looking downstream (07/19/2018)



Little River R2 – Photo Point 47 looking upstream (07/19/2018)



Little River R2–Photo Point 47 looking downstream (07/19/2018)



UT1A R1 – Photo Point 48 looking upstream (07/19/2018)



UT1A R1 – Photo Point 48 looking downstream (07/19/2018)



UT1A R1 – Photo Point 49 looking upstream (07/19/2018)



UT1A R1 – Photo Point 49 looking downstream (07/19/2018)



UT1A R1 – Photo Point 50 looking upstream (07/19/2018)



UT1A R1 – Photo Point 50 looking downstream (07/19/2018)



UT1A R1 – Photo Point 51 looking upstream (07/19/2018)



UT1A R1 – Photo Point 51 looking downstream (07/19/2018)



UT1A R1 – Photo Point 52 looking upstream (07/19/2018)



UT1A R1 – Photo Point 52 looking downstream (07/19/2018)



UT1A R1 – Photo Point 53 looking upstream (07/19/2018)



UT1A R1 – Photo Point 53 looking downstream (07/19/2018)



UT1A R1 – Photo Point 54 looking upstream (07/19/2018)



UT1A R1 – Photo Point 54 looking downstream (07/19/2018)



UT1A R1 – Photo Point 55 looking upstream (07/19/2018)



UT1A R1 – Photo Point 55 looking downstream (07/19/2018)



UT1A R1 – Photo Point 56 looking upstream (07/19/2018)



UT1A R1 – Photo Point 56 looking downstream (07/19/2018)



UT1B R1 – Photo Point 57 looking upstream (07/19/2018)



UT1B R1 – Photo Point 57 looking downstream (07/19/2018)



UT1B R1 – Photo Point 58 looking upstream (07/19/2018)



UT1B R1 – Photo Point 58 looking downstream (07/19/2018)



UT1B R1 – Photo Point 59 looking upstream (07/19/2018)



UT1B R1 – Photo Point 59 looking downstream (07/19/2018)



UT1B R1 – Photo Point 60 looking upstream (07/19/2018)



UT1B R1 – Photo Point 60 looking downstream (07/19/2018)



UT1B R2 – Photo Point 61 looking upstream (07/19/2018)



UT1B R2 – Photo Point 61 looking downstream (07/19/2018)



UT1B R2 – Photo Point 62 looking upstream (07/19/2018)



UT1B R2 – Photo Point 62 looking downstream (07/19/2018)



UT1B R3 – Photo Point 63 looking upstream (07/19/2018)



UT1B R3 – Photo Point 63 looking downstream (07/19/2018)



UT1B R3 – Photo Point 64 looking upstream (07/19/2018)



UT1B R3 – Photo Point 64 looking downstream (07/19/2018)

Vegetation Photographs



Vegetation Plot 1 – (07/16/2018)



Vegetation Plot 2 – (07/16/2018)



Vegetation Plot 3 – (07/16/2018)



Vegetation Plot 4 – (07/16/2018)



Vegetation Plot 5 – (07/16/2018)



Vegetation Plot 6 – (07/16/2018)



Vegetation Plot 7 – (07/16/2018)



Vegetation Plot 8 – (07/16/2018)



Vegetation Plot 9 – (07/16/2018)



Vegetation Plot 10 – (07/16/2018)



Vegetation Plot 11 – (07/16/2018)



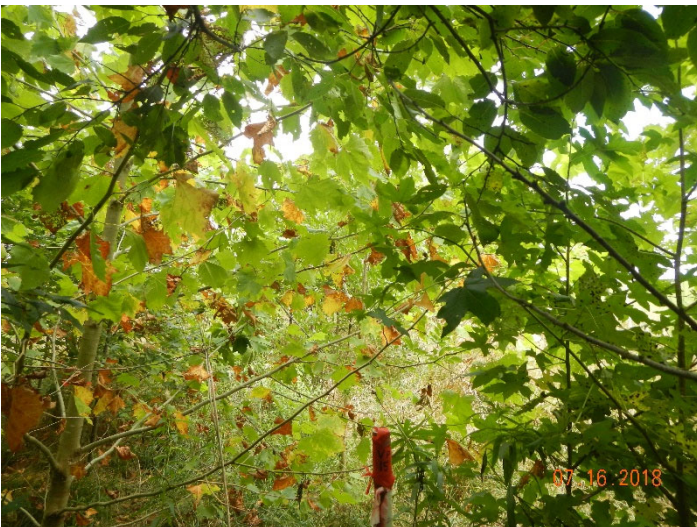
Vegetation Plot 12 – (07/16/2018)



Vegetation Plot 13 – (07/16/2018)



Vegetation Plot 14 – (07/16/2018)



Vegetation Plot 15 – (07/16/2018)



Vegetation Plot 16 – (07/16/2018)



Vegetation Plot 17 – (07/16/2018)



Vegetation Plot 18 – (07/17/2018)



Vegetation Plot 19 – (07/17/2018)



Vegetation Plot 20 – (07/17/2018)



Vegetation Plot 21 – (07/17/2018)



Vegetation Plot 22 – (07/17/2018)



Vegetation Plot 23 – (07/17/2018)



Vegetation Plot 24 – (07/17/2018)



Vegetation Plot 25 – (07/17/2018)



Vegetation Plot 26 – (07/17/2018)



Vegetation Plot 27 – (07/17/2018)



Vegetation Plot 28 – (07/17/2018)



Vegetation Plot 29 – (07/17/2018)



Vegetation Plot 30 – (07/17/2018)



Vegetation Plot 31 – (07/17/2018)

APPENDIX 3. Vegetation Plot Data

Table 7. Vegetation Plot Criteria Attainment Table

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

Plot	MY4 Success Criteria Met (Y/N)	Tract Mean
1	Y	100%
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	
17	Y	
18	Y	
19	Y	
20	Y	
21	Y	
22	Y	
23	Y	
24	Y	
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 4 - 2018

Report Prepared By	Ian Eckardt
Date Prepared	7/31/2018 17:13
Database Name	cvs-eep-entrytool-v2.5.0 Hopewell MY4.mdb
Database Location	Q:\ActiveProjects\005-02133 Hopewell Mitigation FDP\Monitoring\Monitoring Year 4 (2018)\Vegetation Assessment
Computer Name	IAN
File Size	61997056
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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)															
			Vegetation Plot 1			Vegetation Plot 2			Vegetation Plot 3			Vegetation Plot 4			Vegetation Plot 5			
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	
<i>Acer rubrum</i>	Red maple	Tree										30			20			
<i>Alnus serrulata</i>	Hazel alder	Shrub																
<i>Betula nigra</i>	River birch	Tree				1	1	1					1	1	1			
<i>Carya</i>	Hickory	Tree																
<i>Celtis laevigata</i>	Sugarberry	Tree																
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree																
<i>Crataegus</i>	Hawthorn	Tree																
<i>Diospyros virginiana</i>	Common persimmon	Tree																
<i>Fraxinus pennsylvanica</i>	Green ash	Tree				1	1	1	6	6	6	5	5	5				
<i>Juglans nigra</i>	Black walnut	Tree																
<i>Juniperus virginiana</i>	Eastern redcedar	Tree																
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			25			15			70			75				2
<i>Liriodendron tulipifera</i>	Tuliptree	Tree													1	1		9
<i>Nyssa sylvatica</i>	Blackgum	Tree																
<i>Pinus</i>	Pine	Tree									15			9				
<i>Pinus rigida</i>	Pitch pine	Tree																
<i>Pinus serotina</i>	Pond pine	Tree																
<i>Platanus occidentalis</i>	American sycamore	Tree	3	3	3	1	1	1				7	7	17	2	2		2
<i>Prunus serotina</i>	Black cherry	Tree																
<i>Quercus</i>	Oak	Tree																
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree	4	4	4	3	3	3	2	2	2				3	3		3
<i>Quercus phellos</i>	Willow oak	Tree	2	2	2	1	1	1	4	4	4				3	3		3
<i>Quercus rubra</i>	Northern red oak	Tree	2	2	2	3	3	3							2	2		2
<i>Rhus glabra</i>	Smooth sumac	Shrub																
<i>Robinia pseudoacacia</i>	Black locust	Tree																
<i>Salix nigra</i>	Black willow	Tree																
<i>Salix sericea</i>	Silky willow	Shrub																
<i>Sambucus canadensis</i>	Common elderberry	Shrub			4													
<i>Ulmus alata</i>	Winged elm	Tree																
Stem count			11	11	40	10	10	25	12	12	127	13	13	127	11	11		21
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	7	3	3	6	3	3	6	5	5		6
Stems per ACRE			445	445	1,619	405	405	1,012	486	486	5,140	526	526	5,140	445	445		850

- 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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)														
			Vegetation Plot 6			Vegetation Plot 7			Vegetation Plot 8			Vegetation Plot 9			Vegetation Plot 10		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i> L.	Boxelder	Tree															
<i>Acer rubrum</i>	Red maple	Tree															
<i>Alnus serrulata</i>	Hazel alder	Shrub															
<i>Betula nigra</i>	River birch	Tree				1	1	1	3	3	3	2	2	2	1	1	8
<i>Carya</i>	Hickory	Tree															
<i>Celtis laevigata</i>	Sugarberry	Tree															
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree															
<i>Crataegus</i>	Hawthorn	Tree															
<i>Diospyros virginiana</i>	Common persimmon	Tree			4					2						5	
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	3	3	3	1	1	1				1	1	43	2	2	3
<i>Juglans nigra</i>	Black walnut	Tree															1
<i>Juniperus virginiana</i>	Eastern redcedar	Tree															
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			2			1									
<i>Liriodendron tulipifera</i>	Tuliptree	Tree	1	1	2	1	1	1							4	4	8
<i>Nyssa sylvatica</i>	Blackgum	Tree															
<i>Pinus</i>	Pine	Tree											3				
<i>Pinus rigida</i>	Pitch pine	Tree															
<i>Pinus serotina</i>	Pond pine	Tree															
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1	1	8	8	8	5	5	5	7	7	7	2	2	2
<i>Prunus serotina</i>	Black cherry	Tree															
<i>Quercus</i>	Oak	Tree															
<i>Quercus alba</i>	White Oak	Tree															
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree	4	4	4	3	3	3	1	1	1	1	1	1			
<i>Quercus phellos</i>	Willow oak	Tree										1	1	1	1	1	1
<i>Quercus rubra</i>	Northern red oak	Tree							1	1	1	1	1	1	5	5	5
<i>Rhus glabra</i>	Smooth sumac	Shrub															
<i>Robinia pseudoacacia</i>	Black locust	Tree															
<i>Salix nigra</i>	Black willow	Tree									1						
<i>Salix sericea</i>	Silky willow	Shrub															
<i>Sambucus canadensis</i>	Common elderberry	Shrub															
<i>Ulmus alata</i>	Winged elm	Tree															
Stem count			9	9	16	14	14	15	10	10	13	13	13	58	15	15	33
Size (ares)			1			1			1			1			1		
Size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			4	4	6	5	5	6	4	4	6	6	6	7	6	6	8
Stems per ACRE			364	447	647	567	567	607	405	405	526	526	526	2,347	607	607	1,335

- 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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)														
			Vegetation Plot 11			Vegetation Plot 12			Vegetation Plot 13			Vegetation Plot 14			Vegetation Plot 15		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo L.</i>	Boxelder	Tree															
<i>Acer rubrum</i>	Red maple	Tree															
<i>Alnus serrulata</i>	Hazel alder	Shrub															
<i>Betula nigra</i>	River birch	Tree	3	3	3	2	2	2			1	1	1	1	1	1	
<i>Carya</i>	Hickory	Tree															
<i>Celtis laevigata</i>	Sugarberry	Tree															
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree															
<i>Crataegus</i>	Hawthorn	Tree															
<i>Diospyros virginiana</i>	Common persimmon	Tree									13			1		28	
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	3	3	3	3	3	3	2	2	2	1	1	2	2	2	
<i>Juglans nigra</i>	Black walnut	Tree			3												
<i>Juniperus virginiana</i>	Eastern redcedar	Tree															
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			1									1		7	
<i>Liriodendron tulipifera</i>	Tuliptree	Tree				2	2	4			2	3	3	11		1	
<i>Nyssa sylvatica</i>	Blackgum	Tree									2						
<i>Pinus</i>	Pine	Tree															
<i>Pinus rigida</i>	Pitch pine	Tree			2									6			
<i>Pinus serotina</i>	Pond pine	Tree															
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1	1	4	4	4	9	9	20			3	9	9	
<i>Prunus serotina</i>	Black cherry	Tree															
<i>Quercus</i>	Oak	Tree															
<i>Quercus alba</i>	White Oak	Tree															
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree	2	2	2	1	1	1				5	5	5	1	1	
<i>Quercus phellos</i>	Willow oak	Tree										1	1	1			
<i>Quercus rubra</i>	Northern red oak	Tree				2	2	2	1	1	1	1	1	2	2	2	
<i>Rhus glabra</i>	Smooth sumac	Shrub															
<i>Robinia pseudoacacia</i>	Black locust	Tree															
<i>Salix nigra</i>	Black willow	Tree															
<i>Salix sericea</i>	Silky willow	Shrub															
<i>Sambucus canadensis</i>	Common elderberry	Shrub															
<i>Ulmus alata</i>	Winged elm	Tree						16									
Stem count			9	9	15	14	14	32	12	12	41	12	12	33	15	15	51
Size (ares)			1			1			1			1			1		
Size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			8	8	20	6	6	7	3	3	7	6	6	10	5	5	8
Stems per ACRE			364	447	607	567	567	1,295	486	486	1,659	486	486	1,335	607	607	2,064

- 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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)														
			Vegetation Plot 16			Vegetation Plot 17			Vegetation Plot 18			Vegetation Plot 19			Vegetation Plot 20		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo L.</i>	Boxelder	Tree															
<i>Acer rubrum</i>	Red maple	Tree															
<i>Alnus serrulata</i>	Hazel alder	Shrub															
<i>Betula nigra</i>	River birch	Tree	1	1	1	3	3	3	3	3	3	1	1	1	4	4	4
<i>Carya</i>	Hickory	Tree															
<i>Celtis laevigata</i>	Sugarberry	Tree															
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree															
<i>Crataegus</i>	Hawthorn	Tree															
<i>Diospyros virginiana</i>	Common persimmon	Tree															
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	4	4	4	4	4	4	2	2	2	5	5	5	5	5	5
<i>Juglans nigra</i>	Black walnut	Tree			1												
<i>Juniperus virginiana</i>	Eastern redcedar	Tree															
<i>Liquidambar styraciflua</i>	Sweetgum	Tree						51			35			25			5
<i>Liriodendron tulipifera</i>	Tuliptree	Tree				1	1	24									5
<i>Nyssa sylvatica</i>	Blackgum	Tree															
<i>Pinus</i>	Pine	Tree															
<i>Pinus rigida</i>	Pitch pine	Tree						14									
<i>Pinus serotina</i>	Pond pine	Tree															
<i>Platanus occidentalis</i>	American sycamore	Tree	6	6	6	4	4	5	2	2	12	4	4	7	1	1	1
<i>Prunus serotina</i>	Black cherry	Tree															
<i>Quercus</i>	Oak	Tree															
<i>Quercus alba</i>	White Oak	Tree															2
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree	2	2	2	1	1	1									
<i>Quercus phellos</i>	Willow oak	Tree															
<i>Quercus rubra</i>	Northern red oak	Tree				1	1	1	1	1	1				4	4	4
<i>Rhus glabra</i>	Smooth sumac	Shrub															
<i>Robinia pseudoacacia</i>	Black locust	Tree									2						
<i>Salix nigra</i>	Black willow	Tree															
<i>Salix sericea</i>	Silky willow	Shrub															
<i>Sambucus canadensis</i>	Common elderberry	Shrub															
<i>Ulmus alata</i>	Winged elm	Tree															
Stem count			13	13	14	14	14	103	8	8	55	10	10	38	14	14	26
Size (ares)			1			1			1			1			1		
Size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			8	8	20	6	6	8	4	4	6	3	3	4	4	4	7
Stems per ACRE			526	447	567	567	567	4,168	324	324	2,226	405	405	1,538	567	567	1,052

- 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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)														
			Vegetation Plot 21			Vegetation Plot 22			Vegetation Plot 23			Vegetation Plot 24			Vegetation Plot 25		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo L.</i>	Boxelder	Tree															
<i>Acer rubrum</i>	Red maple	Tree															
<i>Alnus serrulata</i>	Hazel alder	Shrub															
<i>Betula nigra</i>	River birch	Tree	2	2	2	2	2	2	2	2	2			1	1	1	
<i>Carya</i>	Hickory	Tree															
<i>Celtis laevigata</i>	Sugarberry	Tree															
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree															
<i>Crataegus</i>	Hawthorn	Tree															
<i>Diospyros virginiana</i>	Common persimmon	Tree						19					1			1	
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	1	1	1	3	3	3	2	2	31	1	1	1	1	1	
<i>Juglans nigra</i>	Black walnut	Tree															
<i>Juniperus virginiana</i>	Eastern redcedar	Tree															
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			25								2			1	
<i>Liriodendron tulipifera</i>	Tuliptree	Tree	1	1	7												
<i>Nyssa sylvatica</i>	Blackgum	Tree															
<i>Pinus</i>	Pine	Tree															
<i>Pinus rigida</i>	Pitch pine	Tree															
<i>Pinus serotina</i>	Pond pine	Tree															
<i>Platanus occidentalis</i>	American sycamore	Tree	2	2	2	1	1	1	6	6	6	4	4	9	4	4	
<i>Prunus serotina</i>	Black cherry	Tree															
<i>Quercus</i>	Oak	Tree															
<i>Quercus alba</i>	White Oak	Tree															
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree				3	3	3									
<i>Quercus phellos</i>	Willow oak	Tree	2	2	2												
<i>Quercus rubra</i>	Northern red oak	Tree	4	4	4							2	2	2	2	2	
<i>Rhus glabra</i>	Smooth sumac	Shrub															
<i>Robinia pseudoacacia</i>	Black locust	Tree															
<i>Salix nigra</i>	Black willow	Tree															
<i>Salix sericea</i>	Silky willow	Shrub															
<i>Sambucus canadensis</i>	Common elderberry	Shrub															
<i>Ulmus alata</i>	Winged elm	Tree						5			10			1		1	
Stem count			12	12	43	9	9	33	10	10	49	7	7	16	8	8	16
Size (ares)			1			1			1			1			1		
Size (ACRES)			0.02			0.02			0.02			0.02			0.02		
Species count			8	8	20	4	4	6	3	3	4	3	3	6	4	4	7
Stems per ACRE			486	447	1,740	364	364	1,335	405	405	1,983	283	283	647	324	324	647

- 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 4 - 2018

Scientific Name	Common Name	Species Type	Current Plot Data (MY4 2018)																	
			Vegetation Plot 26			Vegetation Plot 27			Vegetation Plot 28			Vegetation Plot 29			Vegetation Plot 30			Vegetation Plot 31		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo L.</i>	Boxelder	Tree									1									
<i>Acer rubrum</i>	Red maple	Tree																		
<i>Alnus serrulata</i>	Hazel alder	Shrub																		
<i>Betula nigra</i>	River birch	Tree	1	1	1							1	1	1	1	1	1			
<i>Carya</i>	Hickory	Tree																		
<i>Celtis laevigata</i>	Sugarberry	Tree																1	1	
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree																		
<i>Crataegus</i>	Hawthorn	Tree																		
<i>Diospyros virginiana</i>	Common persimmon	Tree																		
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	2	2	3	4	4	24	5	5	5	2	2	2	4	4	4	5	5	
<i>Juglans nigra</i>	Black walnut	Tree												1			5		2	
<i>Juniperus virginiana</i>	Eastern redcedar	Tree																		
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			1			1						30			80		45	
<i>Liriodendron tulipifera</i>	Tuliptree	Tree				1	1	2				1	1	1				1	1	
<i>Nyssa sylvatica</i>	Blackgum	Tree																		
<i>Pinus</i>	Pine	Tree																		
<i>Pinus rigida</i>	Pitch pine	Tree																		
<i>Pinus serotina</i>	Pond pine	Tree																		
<i>Platanus occidentalis</i>	American sycamore	Tree	1	1	1	4	4	4	4	4	4	1	1	36						
<i>Prunus serotina</i>	Black cherry	Tree																		
<i>Quercus</i>	Oak	Tree																		
<i>Quercus alba</i>	White Oak	Tree																		
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree				3	3	3												
<i>Quercus phellos</i>	Willow oak	Tree	1	1	1	1	1	1							1	1	1			
<i>Quercus rubra</i>	Northern red oak	Tree	3	3	3							4	4	4	4	4	4	3	3	
<i>Rhus glabra</i>	Smooth sumac	Shrub																		
<i>Robinia pseudoacacia</i>	Black locust	Tree																		
<i>Salix nigra</i>	Black willow	Tree																		
<i>Salix sericea</i>	Silky willow	Shrub																		
<i>Sambucus canadensis</i>	Common elderberry	Shrub																		
<i>Ulmus alata</i>	Winged elm	Tree																		
Stem count			8	8	10	13	13	35	9	9	10	9	9	75	10	10	95	10	10	
Size (ares)			1			1			1			1			1			1		
Size (ACRES)			0.02			0.02			0.02			0.02			0.02			0.02		
Species count			8	8	20	5	5	6	2	2	2	5	5	7	4	4	6	4	4	
Stems per ACRE			324	447	405	526	526	1,416	364	364	405	364	364	3,035	405	405	3,845	405	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 9g. Planted and Total Stems (Species by Plot with Annual Means)

Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018

Scientific Name	Common Name	Species Type	Annual Means														
			MY4 (7/2018)			MY3 (7/2017)			MY2 (8/2016)			MY1 (9/2015)			MY0 (1/2015)		
			PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer negundo</i>	Boxelder	Tree			1												
<i>Acer rubrum</i>	Red maple	Tree			50			45						2			
<i>Alnus serrulata</i>	Hazel alder	Shrub						1			1						
<i>Betula nigra</i>	River birch	Tree	38	38	43	37	37	47	37	37	42	44	44	51	53	53	
<i>Carya</i>	Hickory	Tree												1			
<i>Celtis laevigata</i>	Sugarberry	Tree	1	1	1	1	1	2	1	1	1						
<i>Chamaecyparis thyoides</i>	Atlantic white cedar	Tree												1			
<i>Crataegus</i>	Hawthorn	Tree									1						
<i>Diospyros virginiana</i>	Common persimmon	Tree			61			93			82			51			
<i>Fraxinus pennsylvanica</i>	Green ash	Tree	80	80	131	79	79	113	86	86	133	85	85	116	92	92	
<i>Juglans nigra</i>	Black walnut	Tree			13			13			14						
<i>Juniperus virginiana</i>	Eastern redcedar	Tree						4						1			
<i>Liquidambar styraciflua</i>	Sweetgum	Tree			500			565			261			102			
<i>Liriodendron tulipifera</i>	Tuliptree	Tree	17	17	76	17	17	98	24	24	64	24	24	28	52	52	
<i>Nyssa sylvatica</i>	Blackgum	Tree						2			1						
<i>Pinus</i>	Pine	Tree			24			25									
<i>Pinus rigida</i>	Pitch pine	Tree			22			25									
<i>Pinus serotina</i>	Pond pine	Tree									1						
<i>Platanus occidentalis</i>	American sycamore	Tree	103	103	171	105	105	133	110	110	146	108	108	115	114	114	
<i>Prunus serotina</i>	Black cherry	Tree									4						
<i>Quercus</i>	Oak	Tree						5			2						
<i>Quercus alba</i>	White Oak	Tree			2												
<i>Quercus michauxii</i>	Swamp chestnut oak	Tree	39	39	40	42	42	42	45	45	45	45	45	45	46	46	
<i>Quercus phellos</i>	Willow oak	Tree	18	18	20	20	20	20	34	34	34	36	36	36	71	71	
<i>Quercus rubra</i>	Northern red oak	Tree	48	48	51	52	52	55	58	58	61	60	60	62	69	69	
<i>Rhus glabra</i>	Smooth sumac	Shrub						7									
<i>Robinia pseudoacacia</i>	Black locust	Tree			2			1									
<i>Salix nigra</i>	Black willow	Tree			1												
<i>Salix sericea</i>	Silky willow	Shrub						1									
<i>Sambucus canadensis</i>	Common Elderberry	Shrub			4						3						
<i>Ulmus alata</i>	Winged elm	Tree			33			4						1			
Stem count			344	344	1,246	353	353	1,301	395	395	896	402	402	612	497	497	497
Size (ares)			31			31			31			31			31		
Size (ACRES)			0.77			0.77			0.77			0.77			0.77		
Species count			8	8	20	8	8	22	8	8	18	7	7	14	7	7	7
Stems per ACRE			447	447	1,618	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 4 - 2018

Hopewell-UT2 Reaches 1 and 2

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data						Design				As-Built/Baseline							
		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)	N/A	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)		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	1.0	1.0	1.0	1.0	1.0				
D50 (mm)		0.100		12.5											24.2	28.0	45.8						
Pattern																							
Riffle Length (ft)	N/A				---	---	---	---	---	---	---	---	---	---	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)					---	---	---	---	---	---	---	---	---	---	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)																							
Channel Beltwidth																							
Channel Beltwidth (ft)	N/A	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)		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%	N/A																						
SC%/Sa%/G%/C%/B%/Be%																							
d16/d35/d50/d84/d95/d100		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)	N/A	0.38	0.59	2.90	1.10	0.50	0.96	0.37	0.38	0.59	0.38	0.59	0.38	0.59	0.38	0.59	0.38	0.59					
Watershed Impervious Cover Estimate (%)		1%	1%	---	---	---	---	---	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%				
Rosgen Classification		G5/4	G4	B/C	E4b	E4/C4	E4	E4	C4	C4	C4	C4	C4	C4	C4	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)		46	62	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Q-Mannings		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	
Valley Length (ft)		1,465	428	---	---	---	---	---	1,465	428	1,465	428	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	1.0	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 4 - 2018

Hopewell-UT2A Reaches 1 and 2

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data	Design				As-Built/Baseline														
		UT2A Reach 1		UT2A Reach 2			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)	N/A	6.2		6.0		7.9		9.0		10.0		10.3		9.8		10.9									
Floodprone Width (ft)		40		6		10		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		1.2									
Bankfull Cross-sectional Area (ft ²)		6.2		6.1		6.2		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									
Bank Height Ratio		1.4		2.3		2.9		1.0		1.0		1.0		1.0		1.0									
D50 (mm)		0.1		0.1								30.9		34.3		39.8									
Profile																									
Riffle Length (ft)	N/A							---		---		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)								---		---		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)	N/A	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)		1.3		5.0		1.0		3.5		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%	N/A																								
SC%/Sa%/G%/C%/B%/Be%																									
d16/d35/d50/d84/d95/d100		SC/SC/0.1/3/7		SC/SC/0.1/3/7										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)	N/A	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)		18		25																					
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		1.3		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 4 - 2018

Hopewell-UT2B Reach 2 and UT2C Reaches 2 and 3

Parameter	Gage	Pre-Restoration Condition				Reference Reach Data	Design				As-Built/Baseline									
		UT2B		UT2C			UT2B Reach 2		UT2C Reach 2 & 3		UT2B Reach 2		UT2C Reach 2 & 3							
		Min	Max	Min	Max	See Table 10a.	Min	Max	Min	Max	Min	Max	Min	Max						
Dimension and Substrate - Riffle																				
Bankfull Width (ft)	N/A	3.4	5.1	4.2	6.4	See Table 10a.	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)		2.2	2.3	3.8	4.2		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)	N/A					See Table 10a.	---		---		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)							---		---		10	21	3	25						
Pool Max Depth (ft)		---		1.1			1.2		0.6		1.0		1.1		1.5					
Pool Spacing (ft)		---		---			---		8		33		12		51					
Pool Volume (ft ³)		---		---			---		19		36		23		36					
Pattern																				
Channel Beltwidth (ft)	N/A	25	32	33	46	See Table 10a.	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)		2.9	3.9	1.4	3.1		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%	N/A					See Table 10a.														
SC%/Sa%/G%/C%/B%/Be%																				
d16/d35/d50/d84/d95/d100		SC/SC/2.1/18/107		SC/0.8/6/45/78							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)	N/A	0.03		0.08		See Table 10a.	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)		9		15																
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		1.1		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 4 - 2018

Hopewell-UT1B Reach 1

Parameter	Gage	Pre-Restoration		Reference Reach Data	Design		As-Built/Baseline	
		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 4 - 2018

Dimension and Substrate	Cross-Section 1, UT2A Reach 1 (Pool)								Cross-Section 2, UT2A Reach 1 (Riffle)								Cross-Section 3, UT2A Reach 2 (Riffle)									
	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7		
Bankfull Elevation (ft) ¹	722.6	722.6	722.6	722.6	722.9				722.4	722.4	722.4	722.4	722.4	722.6				719.7	719.7	719.7	719.7	719.7	719.7			
Low Bank Elevation (ft)	722.6	722.6	722.6	722.6	722.6				722.4	722.4	722.4	722.4	722.4					719.7	719.7	719.7	719.7	719.7				
Bankfull Width (ft)	12.1	12.7	12.7	13.1	14.7				10.3	9.7	10.1	10.7	11.9					9.8	10.3	10.2	10.2	10.2				
Floodprone Width (ft)	---	---	---	---	---				>87	>88	>88	>88	>87					>88	>87	>92	>75	>89				
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.2	1.1				0.8	0.8	0.8	0.7	0.7					0.7	0.7	0.8	0.5	0.7				
Bankfull Max Depth (ft)	2.7	2.5	2.5	2.7	2.4				1.6	1.3	1.4	1.3	1.5					1.1	1.1	1.3	1.0	1.2				
Bankfull Cross-Sectional Area (ft ²)	16.8	16.5	16.5	15.1	16.8				8.0	7.6	7.6	7.0	8.0					6.8	6.7	7.7	5.6	6.8				
Bankfull Width/Depth Ratio	8.7	9.8	9.8	11.4	12.8				13.3	12.4	13.3	16.3	17.7					14.0	15.8	13.6	18.6	15.3				
Bankfull Entrenchment Ratio	---	---	---	---	---				>8	>9	>9	>8	>7					>9	>8	>9	>7	>9				
Bankfull Bank Height Ratio	---	---	---	---	---				1.0	1.0	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	37.9					39.8	26.3	26.9	43.3	48.3				
Dimension and Substrate	Cross-Section 4, UT2A Reach 2 (Pool)								Cross-Section 5, UT2A Reach 2 (Pool)								Cross-Section 6, UT2A Reach 2 (Riffle)									
	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7		
Bankfull Elevation (ft) ¹	719.6	719.6	719.6	719.6	719.6				713.5	713.5	713.5	713.5	713.4					713.4	713.4	713.4	713.4	713.4				
Low Bank Elevation (ft)	719.6	719.6	719.6	719.6	719.6				713.5	713.5	713.5	713.5	713.5					713.4	713.4	713.4	713.4	713.4				
Bankfull Width (ft)	12.1	12.1	12.7	11.8	11.9				12.7	12.8	12.6	12.6	12.3					10.9	14.0	13.8	10.9	11.1				
Floodprone Width (ft)	---	---	---	---	---				---	---	---	---	---					63	66	69	67	63				
Bankfull Mean Depth (ft)	1.4	1.3	1.3	1.3	1.4				1.0	0.9	1.1	1.0	1.0					0.7	0.6	0.7	0.7	0.7				
Bankfull Max Depth (ft)	3.0	2.7	2.8	3.1	2.9				1.6	1.7	1.8	1.9	1.8					1.2	1.2	1.4	1.3	1.4				
Bankfull Cross-Sectional Area (ft ²)	16.7	15.6	16.7	16.0	16.7				12.3	12.1	11.1	13.0	12.3					8.0	9.0	9.2	8.0	8.0				
Bankfull Width/Depth Ratio	8.8	9.4	9.7	8.8	8.5				13.2	13.5	12.4	12.2	12.3					14.9	21.8	20.6	14.8	15.5				
Bankfull Entrenchment Ratio	---	---	---	---	---				---	---	---	---	---					5.7	4.7	5.0	6.1	5.6				
Bankfull Bank Height Ratio	---	---	---	---	---				---	---	---	---	---					1.0	1.0	1.0	1.0	1.0				
d50 (mm)	---	---	---	---	---				---	---	---	---	---					34.3	41.6	29.1	18.6	62.8				
Dimension and Substrate	Cross-Section 7, UT2 Reach 2 (Pool)								Cross-Section 8, UT2 Reach 2 (Riffle)								Cross-Section 9, UT2B Reach 2 (Riffle) ²									
	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7		
Bankfull Elevation (ft) ¹	705.9	705.9	705.9	705.9	705.9				705.0	705.0	705.0	705.0	705.0					724.8	724.8	724.8	724.8	724.7				
Low Bank Elevation (ft)	705.9	705.9	705.9	705.9	705.9				705.0	705.0	705.0	705.0	705.0					724.8	724.8	724.8	724.8	724.8				
Bankfull Width (ft)	32.2	32.4	32.8	32.7	16.8				13.1	13.1	13.5	13.9	13.3					7.9	9.6	8.3	8.5	7.3				
Floodprone Width (ft)	---	---	---	---	---				>55	>60	>60	>59	>61					>67	>62	>68	>68	>68				
Bankfull Mean Depth (ft)	1.2	1.3	1.6	1.5	2.3				1.1	1.2	1.2	1.1	1.1					0.6	0.5	0.6	0.7	0.7				
Bankfull Max Depth (ft)	3.8	3.6	5.1	5.1	4.5				1.5	1.8	1.9	1.7	1.7					1.0	0.9	1.1	1.6	1.2				
Bankfull Cross-Sectional Area (ft ²)	38.6	41.8	52.1	50.1	38.6				14.6	16.2	16.5	14.4	14.6					4.9	5.0	5.2	6.1	4.9				
Bankfull Width/Depth Ratio	26.9	25.1	20.7	21.4	7.3				11.8	10.6	11.1	13.6	12.1					12.8	18.4	13.2	11.8	11.0				
Bankfull Entrenchment Ratio	---	---	---	---	---				>4	>5	>5	>4	>5					>8	>7	>8	>8	>9				
Bankfull Bank Height Ratio	---	---	---	---	---				1.0	1.0	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	23.3					25.4	33.7	11.0	22.6	22.6				
Dimension and Substrate	Cross-Section 10, UT2B Reach 2 (Pool)																									
	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7																		
Bankfull Elevation (ft) ¹	723.4	723.4	723.4	723.4	723.3																					
Low Bank Elevation (ft)	723.4	723.4	723.4	723.4	723.4																					
Bankfull Width (ft)	10.8	11.3	10.5	10.7	9.8																					
Floodprone Width (ft)	---	---	---	---	---																					
Bankfull Mean Depth (ft)	0.8	0.8	0.7	0.8	0.8																					
Bankfull Max Depth (ft)	1.5	1.5	1.8	1.8	1.9																					
Bankfull Cross-Sectional Area (ft ²)	8.3	8.6	7.8	9.0	8.3																					
Bankfull Width/Depth Ratio	14.1	14.8	14.0	12.8	11.6																					
Bankfull Entrenchment Ratio	---	---	---	---	---																					
Bankfull Bank Height Ratio	---	---	---	---	---																					
d50 (mm)	---	---	---	---	---																					

¹ Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

² Bankfull dimension calculations were adjusted at Cross-Section 9 between MY0 and MY3 because the baseline bankfull elevation was set low and fell within the active channel.

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

Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018

Dimension and Substrate	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)										
	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
Bankfull Elevation (ft) ¹	719.3	719.3	719.3	719.3	719.3				717.3	717.3	717.3	717.3	717.5				717.4	717.4	717.4	717.4	717.7				764.2	764.2	764.2	764.2	764.7			
Low Bank Elevation (ft)	719.3	719.3	719.3	719.3	719.3				717.3	717.3	717.3	717.3	717.3				717.4	717.4	717.4	717.4	717.4				764.7	764.7	764.7	764.7	764.7			
Bankfull Width (ft)	14.2	13.7	13.9	13.8	12.9				10.6	10.6	11.2	10.9	10.7				19.6	17.4	17.1	18.2	17.1				5.2	4.9	5.3	5.0	5.3			
Floodprone Width (ft)	101	105	104	103	101				>68	>57	>68	>66	>68				---	---	---	---	---				---	---	---	---	---			
Bankfull Mean Depth (ft)	0.9	1.0	1.0	0.8	1.0				0.8	0.7	0.7	0.6	0.8				1.2	1.1	1.3	1.1	1.4				0.5	0.2	0.2	0.1	0.5			
Bankfull Max Depth (ft)	1.7	1.8	1.9	1.8	1.9				1.3	1.1	1.3	1.2	1.3				2.4	2.0	2.3	2.3	2.6				0.7	0.3	0.4	0.3	0.8			
Bankfull Cross-Sectional Area (ft ²)	12.7	14.1	14.0	11.7	12.7				8.4	7.3	7.7	7.1	8.4				23.1	18.5	21.5	19.8	23.1				2.5	1.0	1.2	0.6	2.5			
Bankfull Width/Depth Ratio	15.8	13.3	13.8	16.4	13.1				13.2	15.6	16.2	16.9	13.6				16.7	16.4	13.6	16.7	12.6				10.4	23.3	22.5	40.5	11.1			
Bankfull Entrenchment Ratio	7.1	7.6	7.4	7.4	7.8				>7	>5	>6	>6	>6				---	---	---	---	---				---	---	---	---	---			
Bankfull Bank Height Ratio	1.0	1.0	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	56.2				24.2	22.1	12.8	25.4	25.5				---	---	---	---	---				---	---	---	---	---			
Dimension and Substrate	Cross-Section 15, UT1B Reach 1 (Riffle)							Cross-Section 16, UT2C Reach 2 (Riffle)							Cross-Section 17, UT2C Reach 2 (Pool)																	
	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7	Base	MY1	MY2	MY3	MY4	MY5	MY6	MY7								
Bankfull Elevation (ft) ¹	761.9	761.9	761.9	761.9	762.0				709.2	709.2	709.2	709.2	709.5				708.3	708.3	708.3	708.3	709.0											
Low Bank Elevation (ft)	761.9	761.9	761.9	761.9	761.9				709.2	709.2	709.2	709.2	709.2				708.3	708.3	708.3	708.3	708.3											
Bankfull Width (ft)	4.8	4.6	5.2	3.6	6.0				9.9	9.0	9.3	8.9	8.4				13.0	12.8	11.8	10.8	8.2											
Floodprone Width (ft)	12	8	10	9	12				>48	>45	>47	>47	>48				---	---	---	---	---											
Bankfull Mean Depth (ft)	0.4	0.2	0.3	0.2	0.3				0.5	0.5	0.5	0.4	0.6				0.9	0.8	0.5	0.5	1.4											
Bankfull Max Depth (ft)	0.6	0.3	0.5	0.4	0.7				1.1	1.0	1.1	1.1	1.3				2.0	2.0	1.2	1.3	2.4											
Bankfull Cross-Sectional Area (ft ²)	1.8	1.0	1.5	0.7	1.8				5.3	4.6	4.9	3.9	5.3				11.2	10.7	5.9	5.7	11.2											
Bankfull Width/Depth Ratio	13.3	22.1	18.8	19.0	20.0				18.4	17.5	17.6	20.3	13.2				15.1	15.3	23.8	20.4	6.1											
Bankfull Entrenchment Ratio	2.6	1.6	1.9	2.4	2.1				>5	>5	>5	>5	>6				---	---	---	---	---											
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.3	<1.0				1.0	1.0	1.0	1.1	<1.0				---	---	---	---	---											
d50 (mm)	56.3	69.7	13.3	23.9	11.0				18.4	10.8	8.0	11.5	22.6				---	---	---	---	---											

¹ Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12a. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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		6.0							
Floodprone Width (ft)	12		8		10		9		12							
Bankfull Mean Depth	0.4		0.2		0.3		0.2		0.3							
Bankfull Max Depth	0.6		0.3		0.5		0.4		0.7							
Bankfull Cross Sectional Area (ft ²)	1.8		1.0		1.5		0.7		1.8							
Width/Depth Ratio	13.3		22.1		18.8		19.0		20							
Entrenchment Ratio	2.6		1.6		1.9		2.4		2.1							
Bank Height Ratio	1.0		1.0		1.0		1.3		<1.0							
D50 (mm)	56.3		69.7		13.3		23.9		11.0							
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	SC/SC/1.1/128/1248/2048	SC/SC/3.8/24.4/50.9/90											
% of Reach with Eroding Banks	0%		0%	0%	0%	0%										

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12b. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site
 DMS Project No. 95352
 Monitoring Year 4 - 2018

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	10.7	12.9							
Floodprone Width (ft)	>68	101	>57	105	>68	104	>66	103	>68	101							
Bankfull Mean Depth	0.8	0.9	0.7	1.0	0.7	1.0	0.6	0.8	0.8	1.0							
Bankfull Max Depth	1.3	1.7	1.1	1.8	1.3	1.9	1.2	1.8	1.3	1.9							
Bankfull Cross Sectional Area (ft ²)	8.4	12.7	7.3	14.1	7.7	14.0	7.1	11.7	8.4	12.7							
Width/Depth Ratio	13.2	15.8	13.3	15.6	13.8	16.2	13.6	16.4	13.1	13.6							
Entrenchment Ratio	>7	7.1	>5	7.6	>6	7.4	>6	7.4	>6	7.8							
Bank Height Ratio	1.0		1.0		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	25.5	56.2							
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	SC/SC/25/70/116/180	SC/5.6/23/77/143/512											
% of Reach with Eroding Banks	0%		0%	0%	0%	0%											

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12c. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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		13.3							
Floodprone Width (ft)	>55		>60		>60		>59		>61							
Bankfull Mean Depth	1.0		1.2		1.2		1.0		1.1							
Bankfull Max Depth	1.5		1.8		1.9		1.7		1.7							
Bankfull Cross Sectional Area (ft ²)	14.8		16.2		16.5		14.4		14.6							
Width/Depth Ratio	15.8		10.6		11.1		13.6		12.1							
Entrenchment Ratio	>4		>5		>5		>4		>5							
Bank Height Ratio	1.0		1.0		1.0		1.0		1.0							
D50 (mm)	45.8		25.7		23.4		38.7		23.3							
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		SC/SC/1.7/41/76/180		SC/SC/0.5/54/101/180							
% of Reach with Eroding Banks	0%		0%		0%		0%		0%							

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12d. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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		11.9							
Floodprone Width (ft)	>87		>88		>88		>87		>87							
Bankfull Mean Depth	0.8		0.8		0.8		0.7		0.7							
Bankfull Max Depth	1.6		1.3		1.4		1.3		1.5							
Bankfull Cross Sectional Area (ft ²)	8.0		7.6		7.6		7.0		8.0							
Width/Depth Ratio	13.3		12.4		13.3		16.3		17.7							
Entrenchment Ratio	>8		>9		>9		>8		>7							
Bank Height Ratio	1.0		1.0		1.0		1.0		<1.0							
D50 (mm)	30.9		40.3		27.7		0.3		37.9							
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		---		---		SC/SC/0.3/73/121/180		SC/SC/38/104/152/180							
% of Reach with Eroding Banks	0%		0%		0%		0%		0%							

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12e. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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	10.2	11.1						
Floodprone Width (ft)	63	>88	66	>87	69	>92	67	>75	63	>89						
Bankfull Mean Depth	0.7		0.6	0.7	0.7	0.8	0.5	0.7	0.7	0.7						
Bankfull Max Depth	1.1	1.2	1.1	1.2	1.3	1.4	1.0	1.3	1.2	1.4						
Bankfull Cross Sectional Area (ft ²)	6.8	8.0	6.7	9.0	7.7	9.2	5.6	8.0	6.8	8.0						
Width/Depth Ratio	14.0	14.9	15.8	21.8	13.6	20.6	14.8	18.6	15.3	15.5						
Entrenchment Ratio	5.7	>9	4.7	>8	5.0	>9	6.1	>7	5.6	>9						
Bank Height Ratio	1.0		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	48.3	62.8						
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		SC/SC/12/61/110/180		SC/SC/0.4/83/137/256							
% of Reach with Eroding Banks	0%		0%		0%		0%		0%							

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abkf as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

Table 12f. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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)	7.9		9.6		8.3		8.5		7.3							
Floodprone Width (ft)	>67		>62		>68		>68		>68							
Bankfull Mean Depth	0.6		0.5		0.6		0.7		0.7							
Bankfull Max Depth	1.0		0.9		1.1		1.6		1.2							
Bankfull Cross Sectional Area (ft ²)	4.9		5.0		5.2		6.1		4.9							
Width/Depth Ratio	12.8		18.4		13.2		11.8		11.0							
Entrenchment Ratio	>8		>7		>8		>8		>9							
Bank Height Ratio	1.0		1.0		1.0		1.0		1.1							
D50 (mm)	25.4		33.7		11.0		22.6		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)	1.1	1.9														
Meander Wave Length (ft)	40	62														
Meander Width Ratio	1.1	2.4														
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		SC/SC/1.7/41/76/180		SC/SC/0.5/54/101/180							
% of Reach with Eroding Banks	0%		0%		0%		0%		0%							

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abfk as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

³ Bankfull dimension calculations were adjusted at Cross-Section 9 between MY0 and MY3 because the baseline bankfull elevation was set low and fell within the active channel.

Table 12g. Monitoring Data - Stream Reach Data Summary

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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		8.4							
Floodprone Width (ft)	>48		>45		>47		>47		>48							
Bankfull Mean Depth	0.5		0.5		0.5		0.4		0.6							
Bankfull Max Depth	1.1		1.0		1.1		1.1		1.3							
Bankfull Cross Sectional Area (ft ²)	5.3		4.6		5.3		3.9		5.3							
Width/Depth Ratio	18.4		17.5		17.6		20.3		13.2							
Entrenchment Ratio	>5		>5		>5		>5		>6							
Bank Height Ratio	1.0		1.0		1.0		1.0		<1.0							
D50 (mm)	18.4		10.8		8.0		11.5		22.6							
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		0.28/1.3/3.5/17/30/90		0.74/8.4/14/35/76/256							
% of Reach with Eroding Banks	0%		0%		0%		0%		0%							

¹ (---): Data was not provided

² Prior to MY4, bankfull dimensions were calculated using a fixed bankfull elevation. For MY4 through MY7, bankfull elevation is calculated using a fixed Abfk as described in the Standard Measurement of the BHR Monitoring Parameter document provided by NCIRT and NCDMS (9/2018).

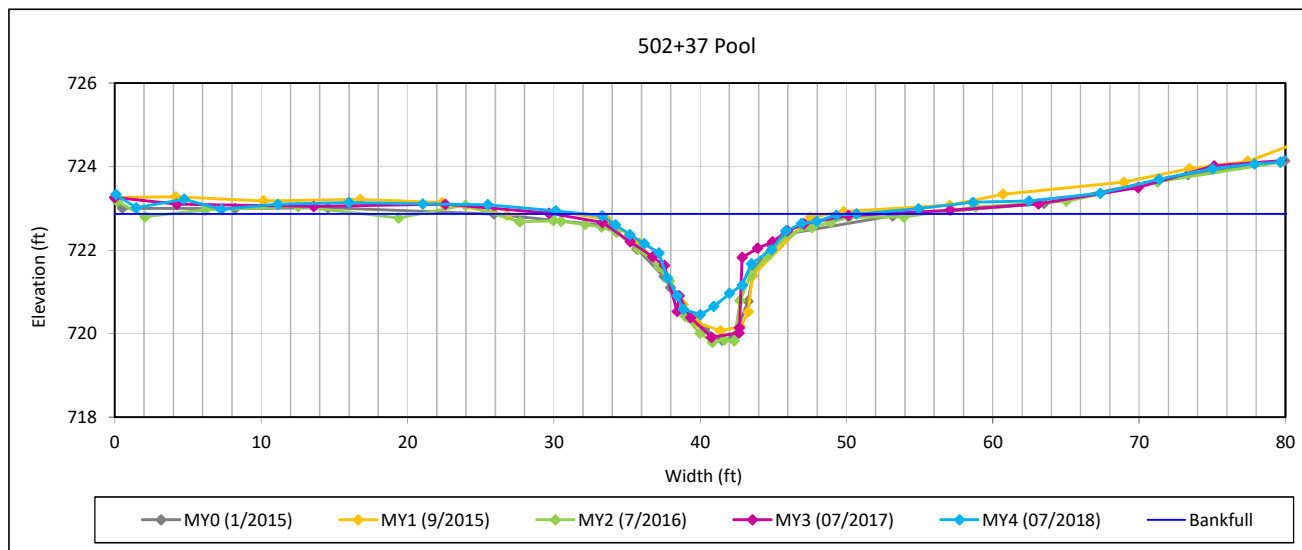
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 1, UT2A Reach 1



Bankfull Dimensions

16.8	x-section area (ft.sq.)
14.7	width (ft)
1.1	mean depth (ft)
2.4	max depth (ft)
15.7	wetted perimeter (ft)
1.1	hyd radi (ft)
12.8	width-depth ratio

Survey Date: 7/2018
Field Crew: Wildlands Engineering



View Downstream

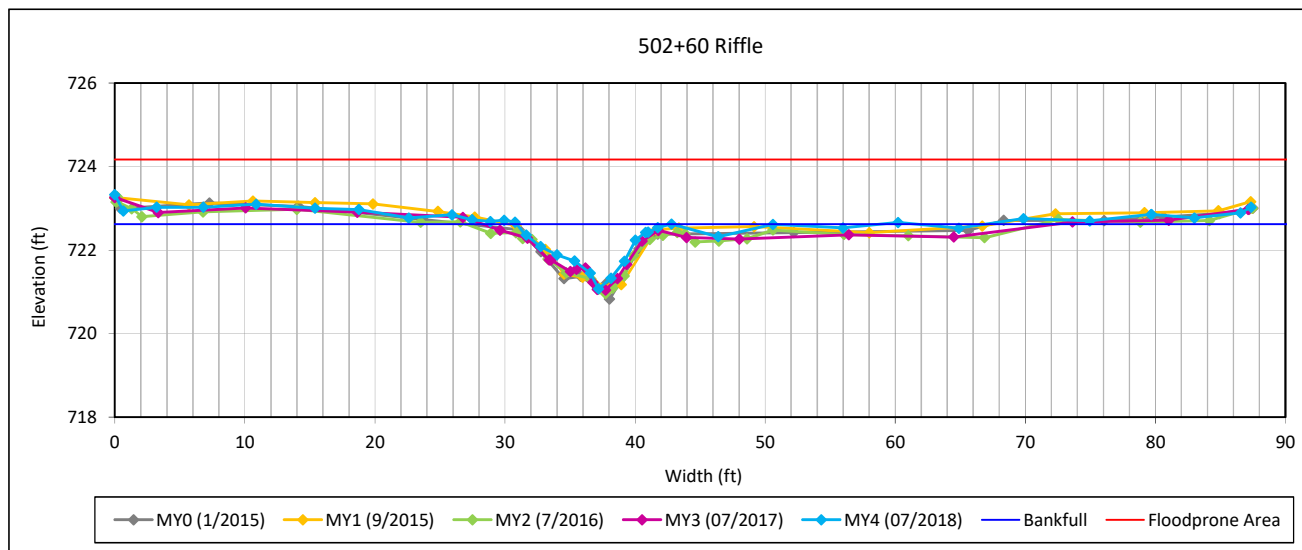
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 2, UT2A Reach 1



Bankfull Dimensions

8.0	x-section area (ft.sq.)
11.9	width (ft)
0.7	mean depth (ft)
1.5	max depth (ft)
12.4	wetted perimeter (ft)
0.6	hyd radi (ft)
17.7	width-depth ratio
87.4	W flood prone area (ft)
7.3	entrenchment ratio
<1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

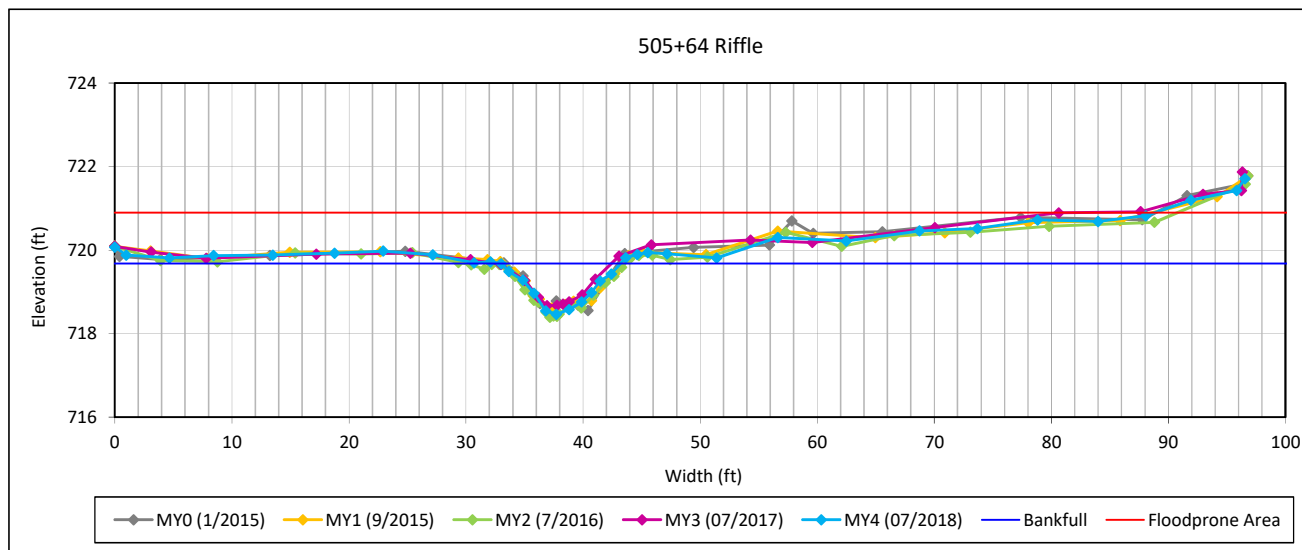
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 3, UT2A Reach 2



Bankfull Dimensions

6.8	x-section area (ft.sq.)
10.2	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
10.5	wetted perimeter (ft)
0.6	hyd radi (ft)
15.3	width-depth ratio
89.0	W flood prone area (ft)
8.7	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

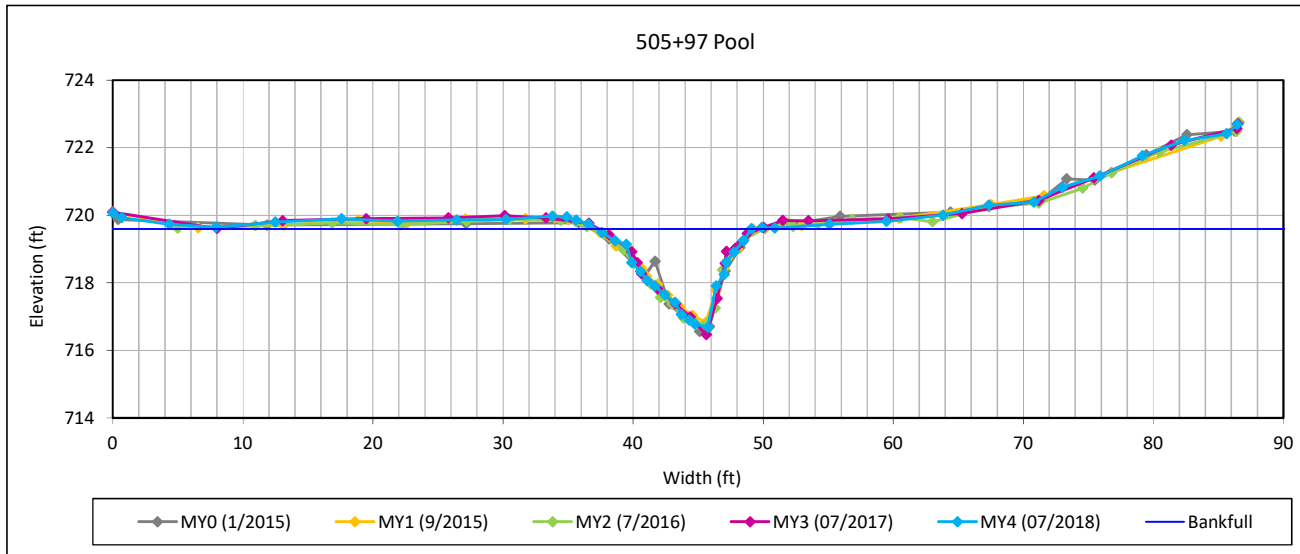
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 4, UT2A Reach 2



Bankfull Dimensions

16.7	x-section area (ft.sq.)
11.9	width (ft)
1.4	mean depth (ft)
2.9	max depth (ft)
13.9	wetted parimeter (ft)
1.2	hyd radi (ft)
8.5	width-depth ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

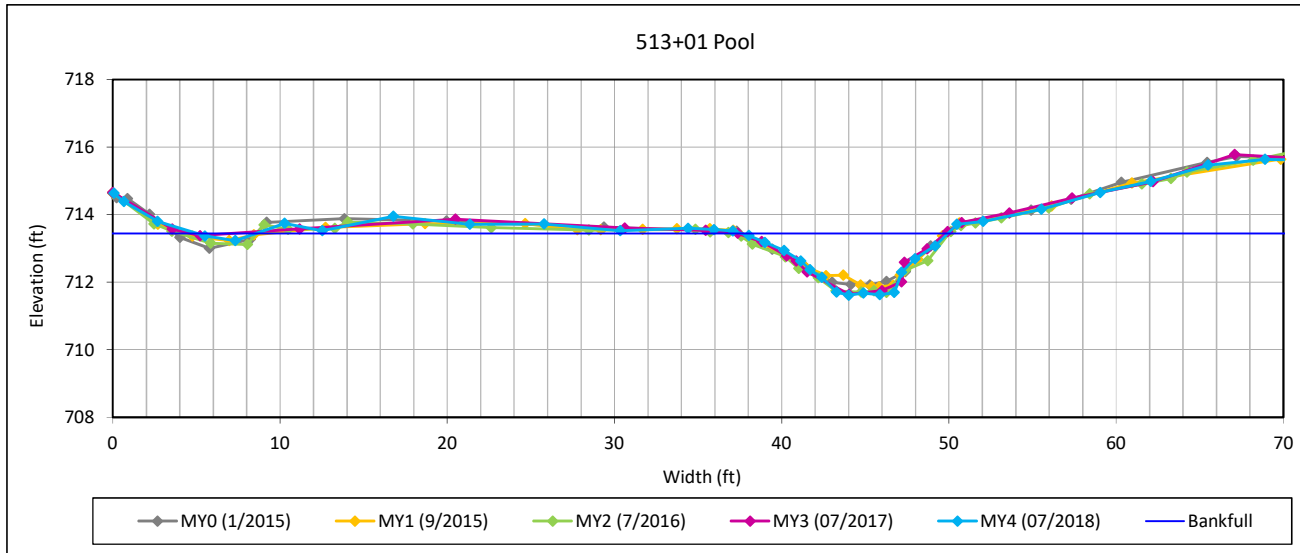
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 5, UT2A Reach 2



Bankfull Dimensions

12.3	x-section area (ft.sq.)
12.3	width (ft)
1.0	mean depth (ft)
1.8	max depth (ft)
13.2	wetted parimeter (ft)
0.9	hyd radi (ft)
12.3	width-depth ratio

Survey Date: 7/2018
Field Crew: Wildlands Engineering



View Downstream

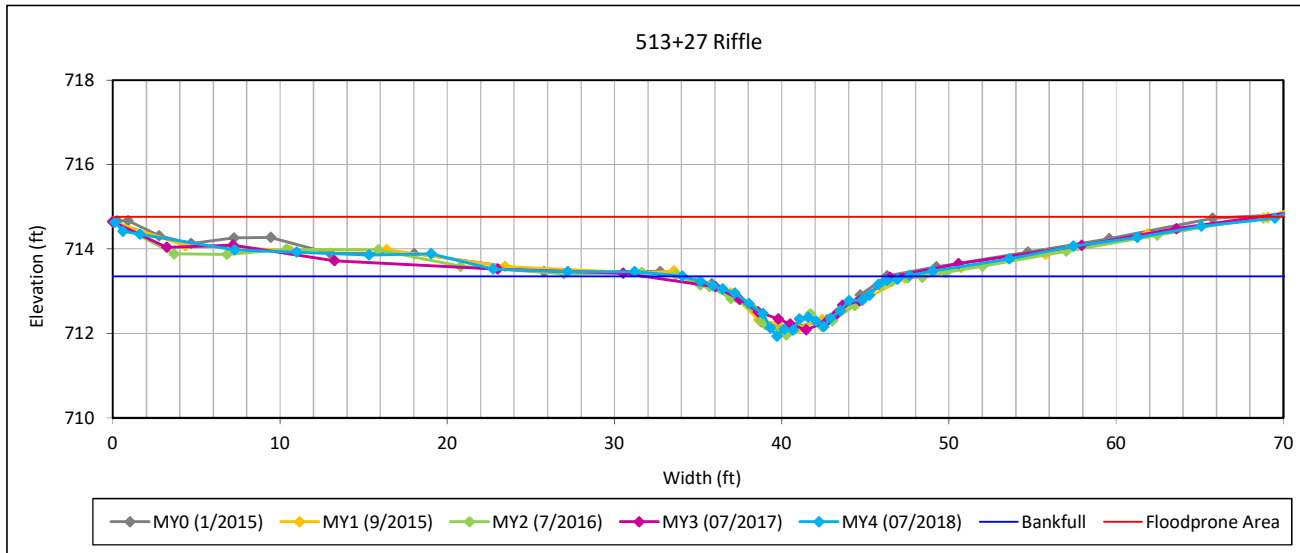
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 6, UT2A R2



Bankfull Dimensions

8.0	x-section area (ft.sq.)
11.1	width (ft)
0.7	mean depth (ft)
1.4	max depth (ft)
11.7	wetted parimeter (ft)
0.7	hyd radi (ft)
15.5	width-depth ratio
62.5	W flood prone area (ft)
5.6	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

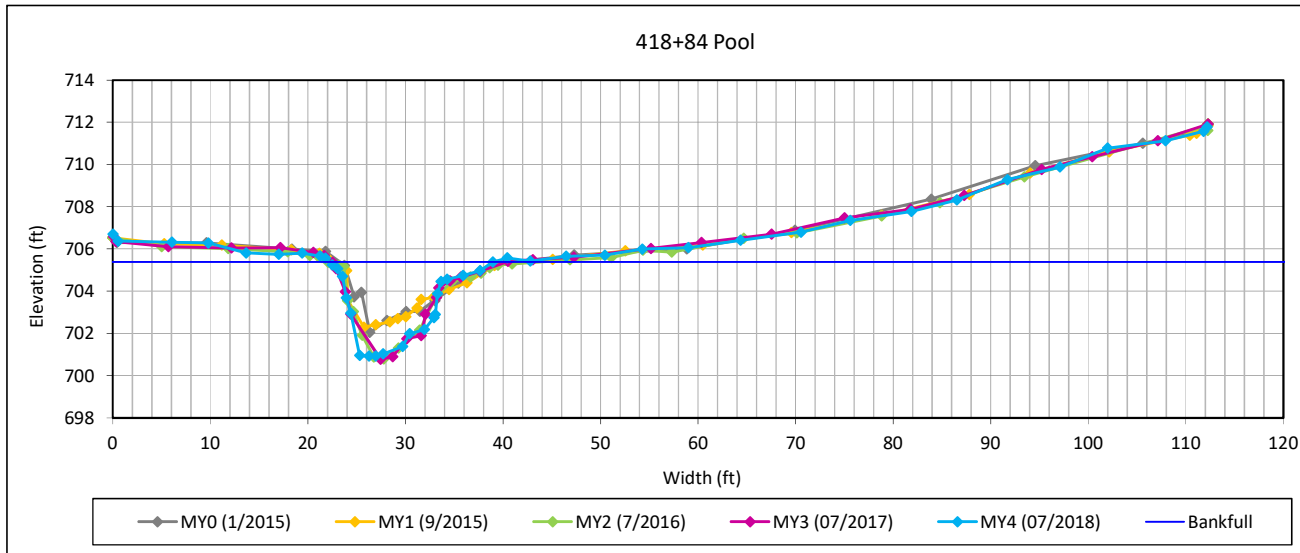
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 7, UT2 R2



Bankfull Dimensions

38.6	x-section area (ft.sq.)
16.8	width (ft)
2.3	mean depth (ft)
4.5	max depth (ft)
21.0	wetted parimeter (ft)
1.8	hyd radi (ft)
7.3	width-depth ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

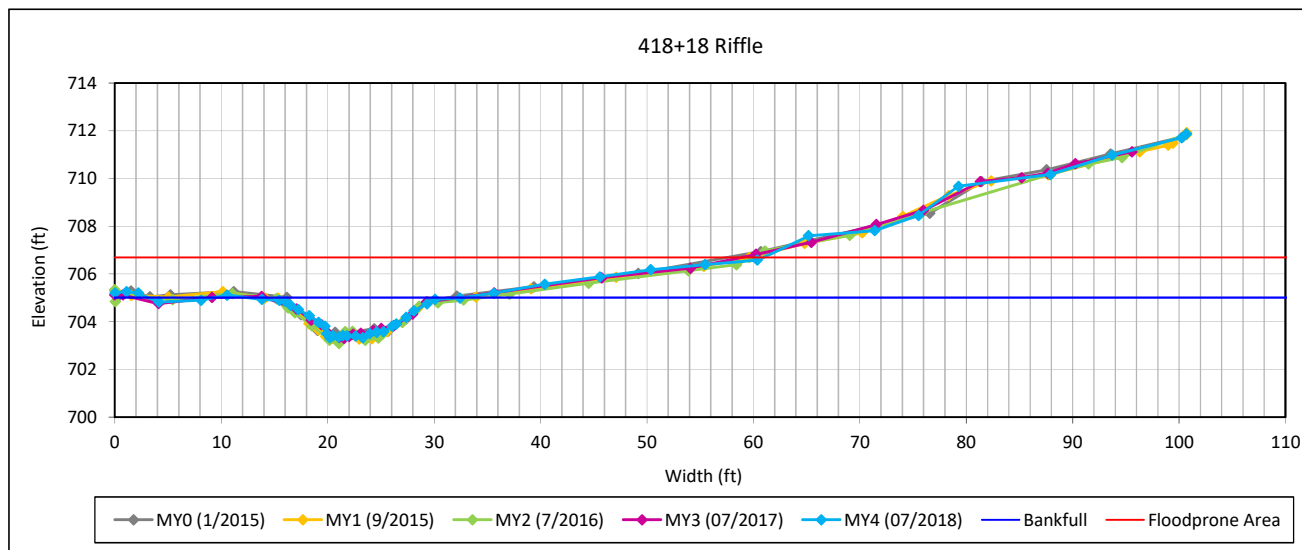
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 8, UT2 R2



Bankfull Dimensions

14.6	x-section area (ft.sq.)
13.3	width (ft)
1.1	mean depth (ft)
1.7	max depth (ft)
13.9	wetted perimeter (ft)
1.1	hyd radi (ft)
12.1	width-depth ratio
61.0	W flood prone area (ft)
4.6	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

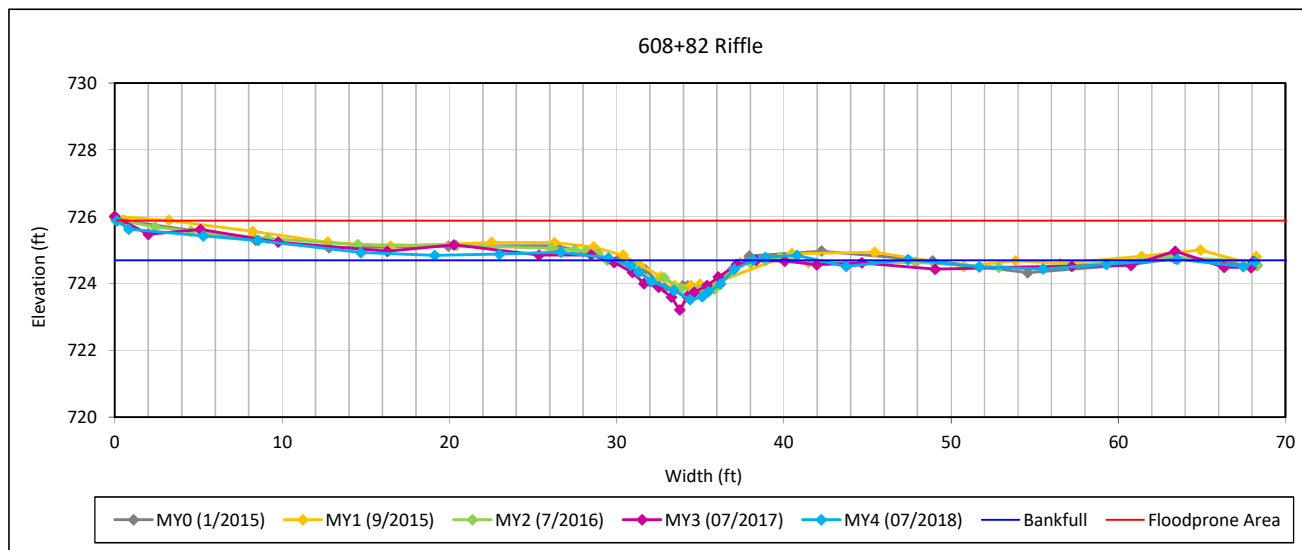
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 9, UT2B R2



Bankfull Dimensions

4.9	x-section area (ft.sq.)
7.3	width (ft)
0.7	mean depth (ft)
1.2	max depth (ft)
7.7	wetted parimeter (ft)
0.6	hyd radi (ft)
11.0	width-depth ratio
68.0	W flood prone area (ft)
9.3	entrenchment ratio
1.1	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

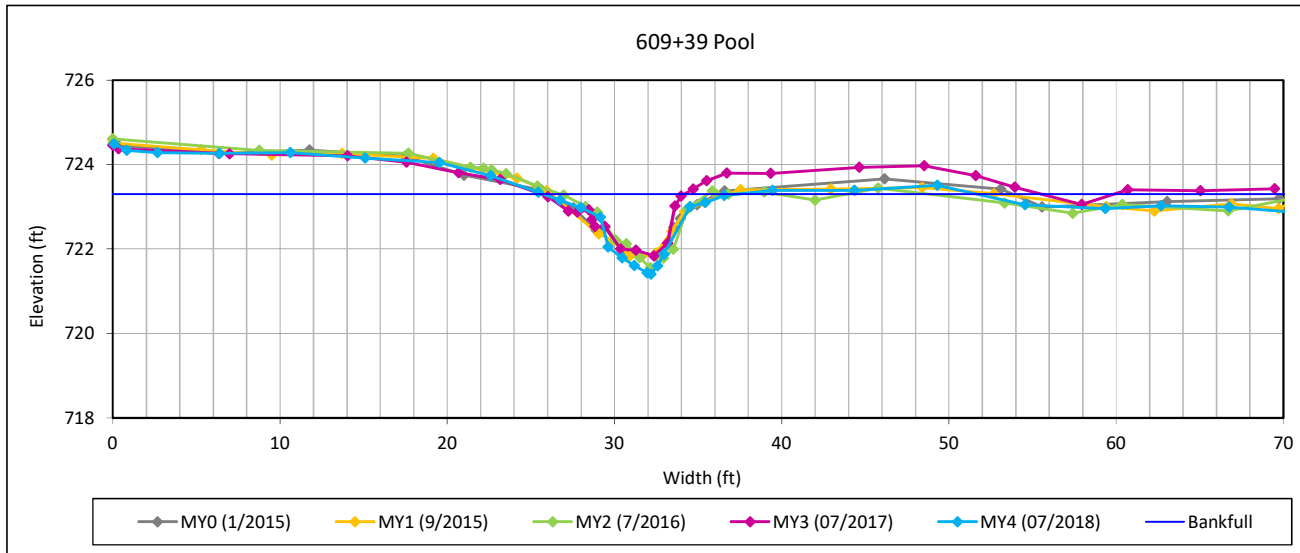
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 10, UT2B R2



Bankfull Dimensions

8.3	x-section area (ft.sq.)
9.8	width (ft)
0.8	mean depth (ft)
1.9	max depth (ft)
10.8	wetted parimeter (ft)
0.8	hyd radi (ft)
11.6	width-depth ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

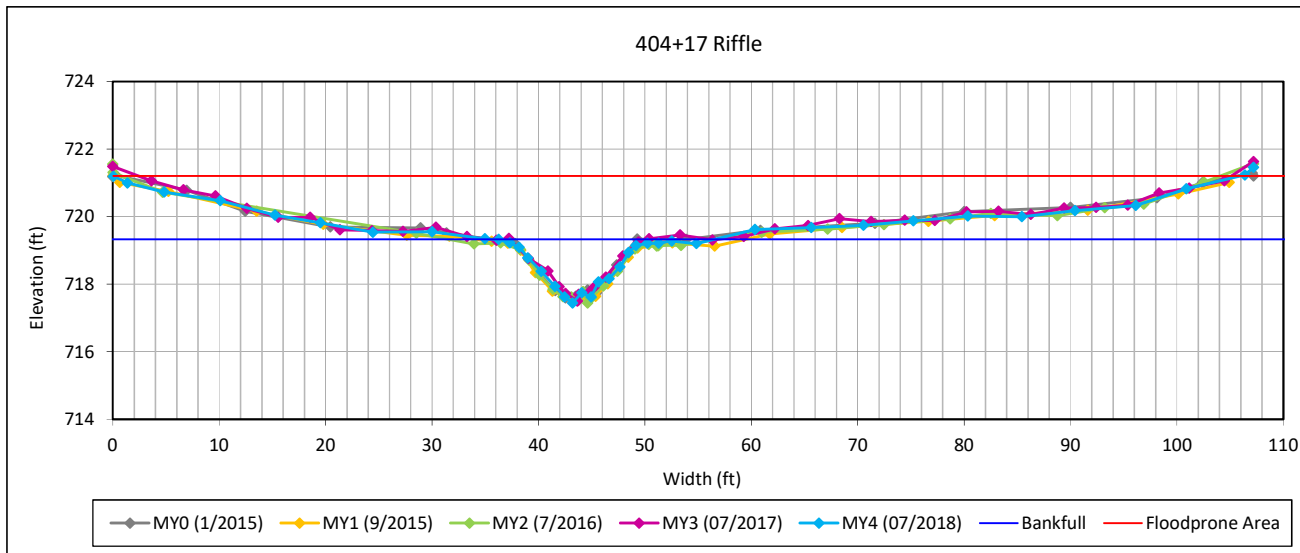
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 11, UT2 R1



Bankfull Dimensions

12.7	x-section area (ft.sq.)
12.9	width (ft)
1.0	mean depth (ft)
1.9	max depth (ft)
13.6	wetted parimeter (ft)
0.9	hyd radi (ft)
13.1	width-depth ratio
101.3	W flood prone area (ft)
7.8	entrenchment ratio
1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

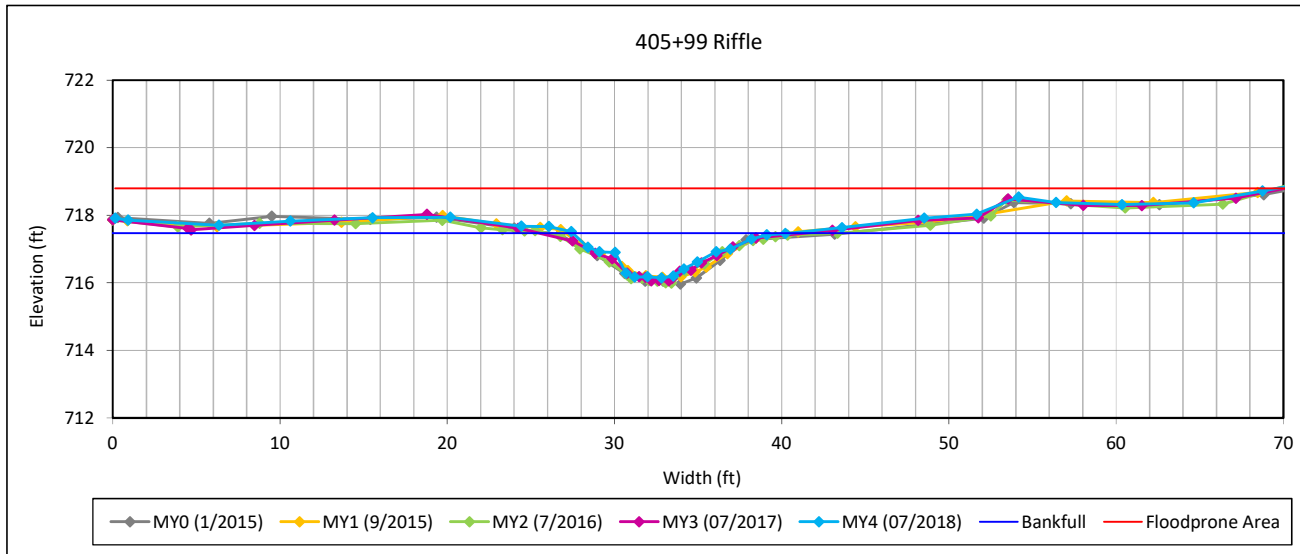
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 12, UT2 R1



Bankfull Dimensions

8.4	x-section area (ft.sq.)
10.7	width (ft)
0.8	mean depth (ft)
1.3	max depth (ft)
11.2	wetted parimeter (ft)
0.8	hyd radi (ft)
13.6	width-depth ratio
68.1	W flood prone area (ft)
6.4	entrenchment ratio
<1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

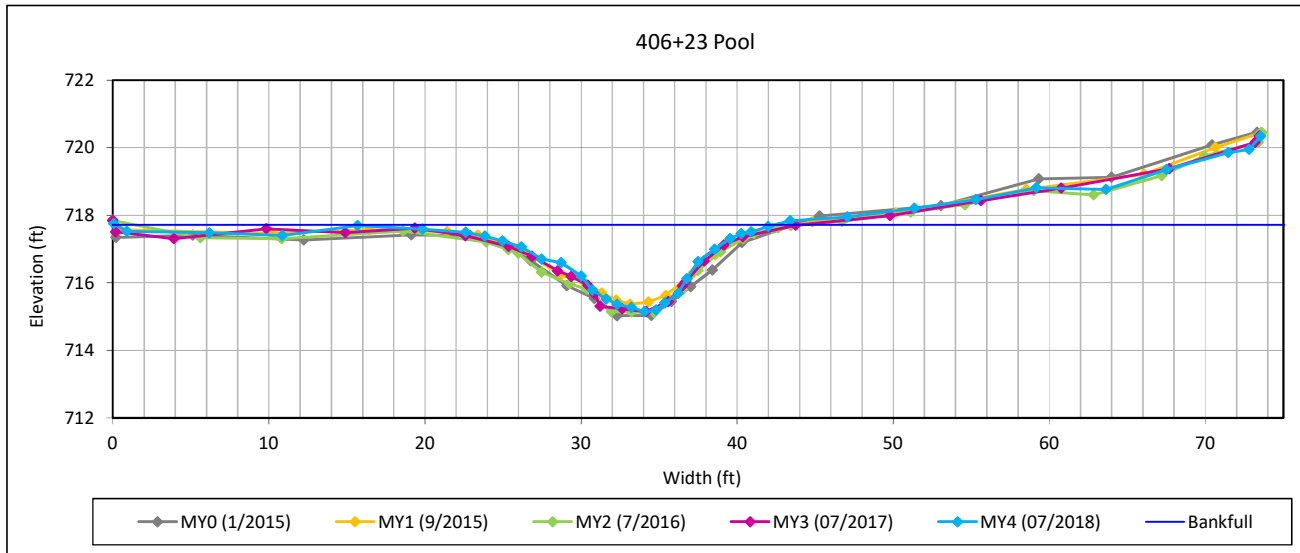
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 13, UT2 R1



Bankfull Dimensions

23.1	x-section area (ft.sq.)
17.1	width (ft)
1.4	mean depth (ft)
2.6	max depth (ft)
17.9	wetted parimeter (ft)
1.3	hyd radi (ft)
12.6	width-depth ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

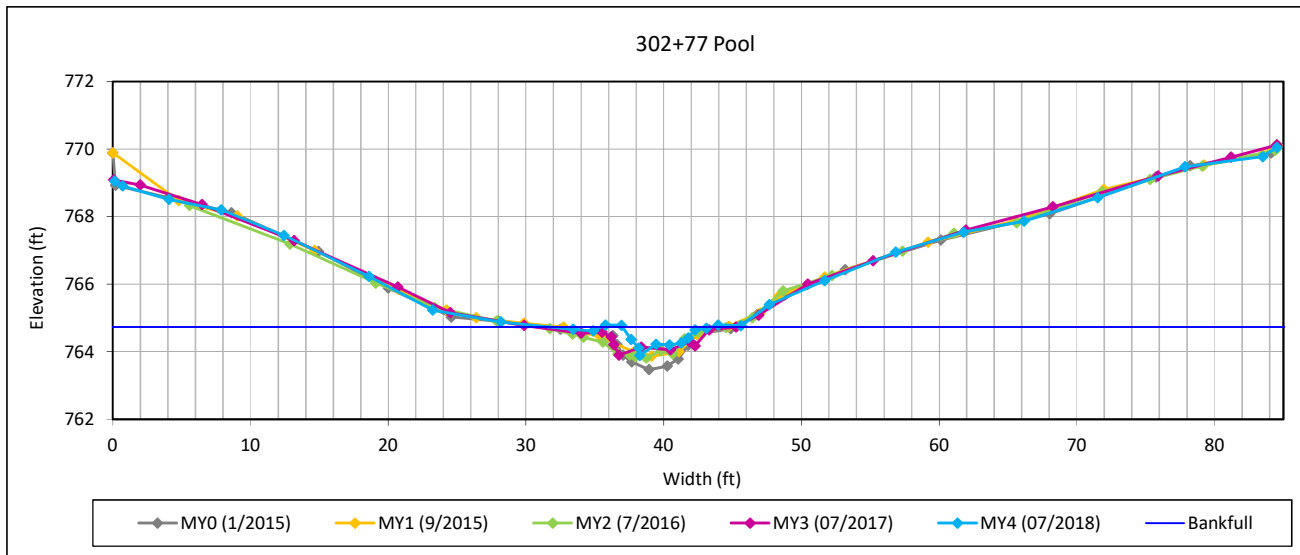
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 14, UT1B R1



Bankfull Dimensions

2.5	x-section area (ft.sq.)
5.3	width (ft)
0.5	mean depth (ft)
0.8	max depth (ft)
5.7	wetted parimeter (ft)
0.4	hyd radi (ft)
11.1	width-depth ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

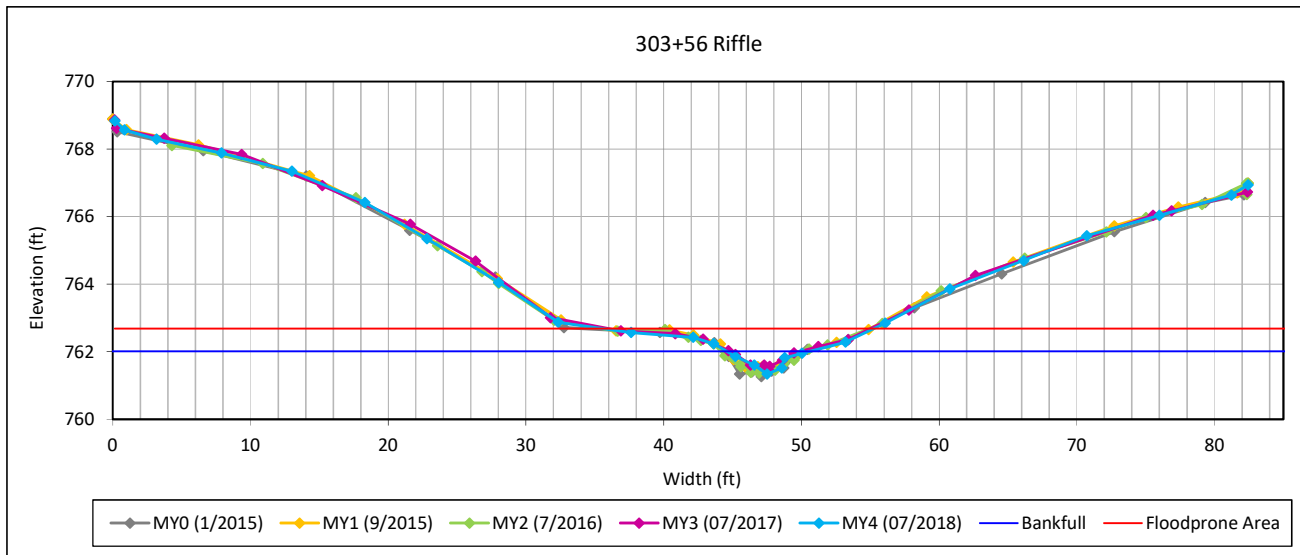
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 15, UT1B R1



Bankfull Dimensions

1.8	x-section area (ft.sq.)
6.0	width (ft)
0.3	mean depth (ft)
0.7	max depth (ft)
6.3	wetted parimeter (ft)
0.3	hyd radi (ft)
20.0	width-depth ratio
12.3	W flood prone area (ft)
2.1	entrenchment ratio
<1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

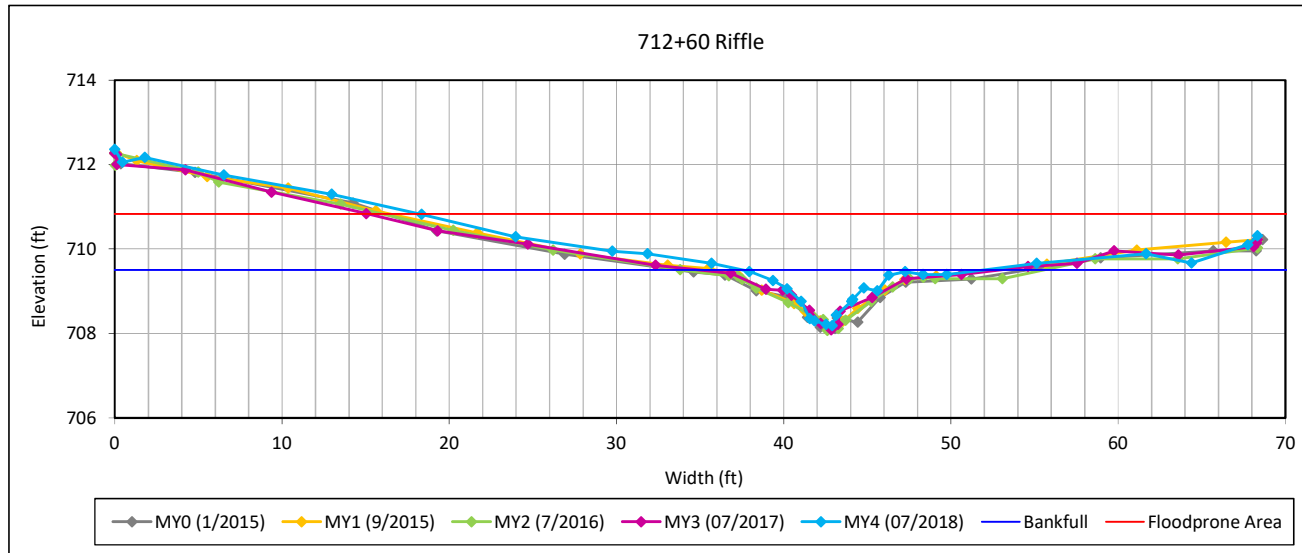
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 16, UT2C R2



Bankfull Dimensions

5.3	x-section area (ft.sq.)
8.4	width (ft)
0.6	mean depth (ft)
1.3	max depth (ft)
8.9	wetted parimeter (ft)
0.6	hyd radi (ft)
13.2	width-depth ratio
47.6	W flood prone area (ft)
5.7	entrenchment ratio
<1.0	low bank height ratio

Survey Date: 7/2018

Field Crew: Wildlands Engineering



View Downstream

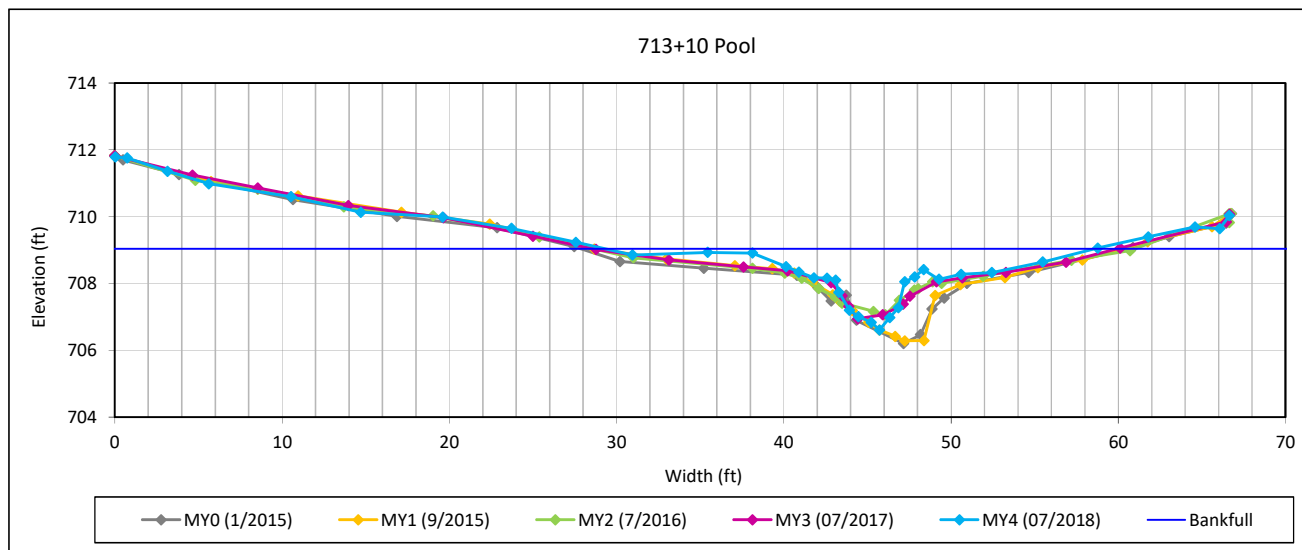
Cross-Section Plots

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4

Cross-Section 17, UT2C R2



Bankfull Dimensions

11.2	x-section area (ft.sq.)
8.2	width (ft)
1.4	mean depth (ft)
2.4	max depth (ft)
9.5	wetted perimeter (ft)
1.2	hyd radi (ft)
6.1	width-depth ratio

Survey Date: 7/2018
Field Crew: Wildlands Engineering



View Downstream

Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

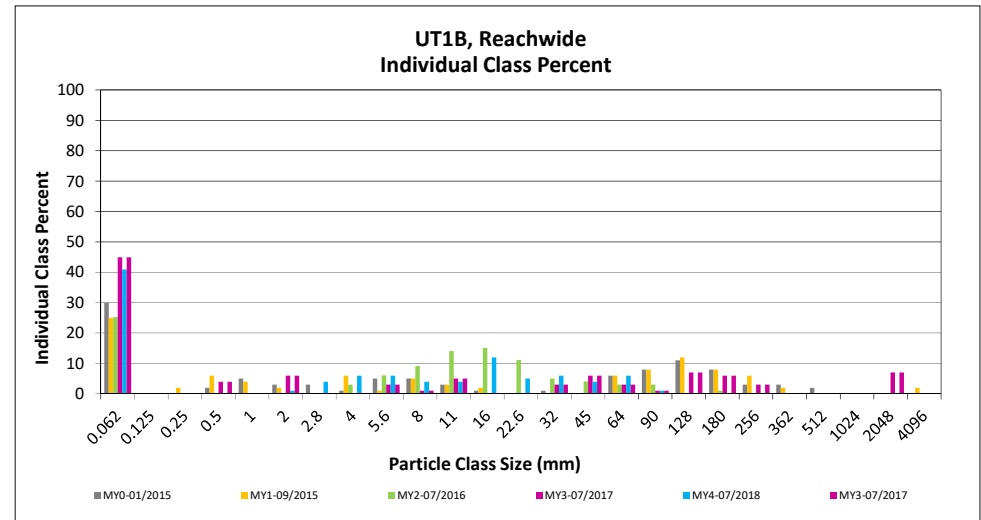
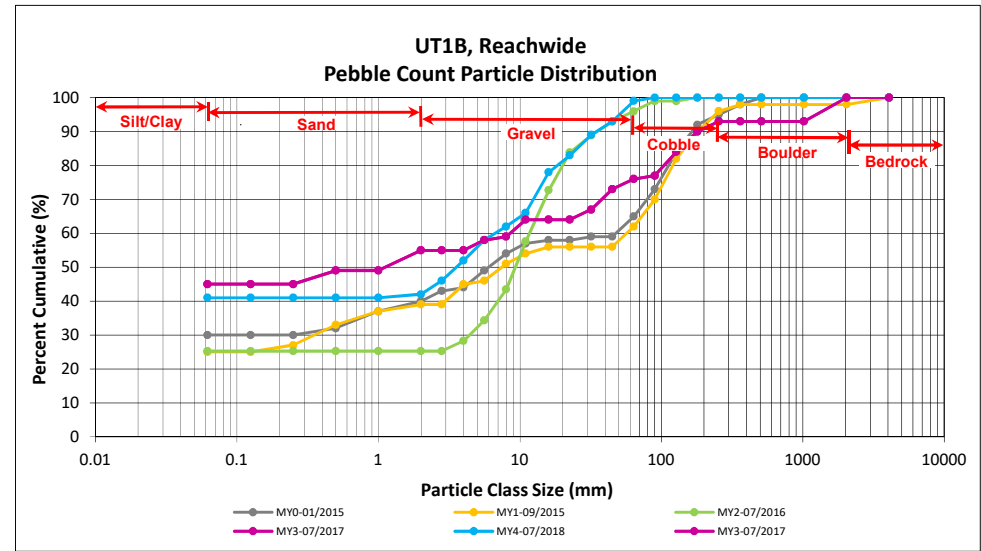
DMS Project No. 95352

Monitoring Year 4 - 2018

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
BEDROCK	Large/Very Large	1024	2048	7		7	7	100
	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

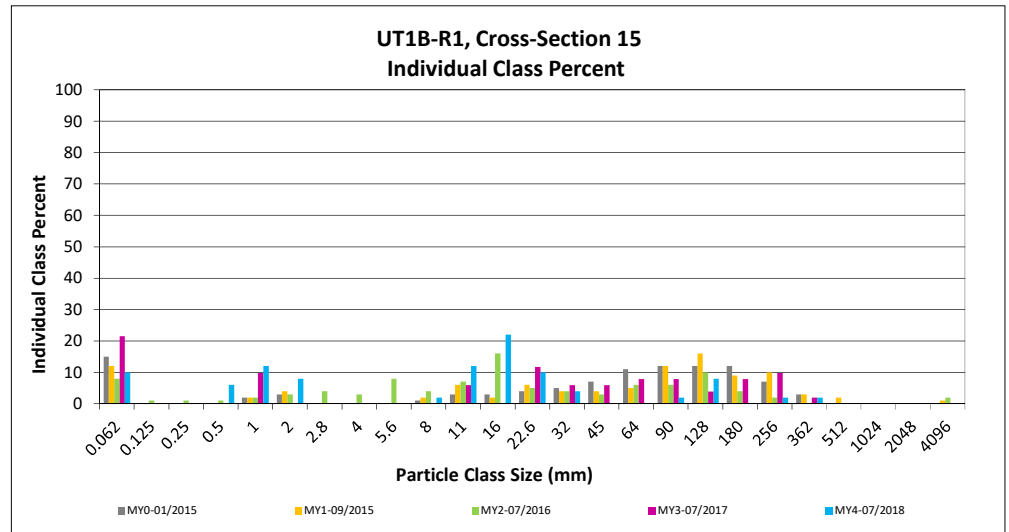
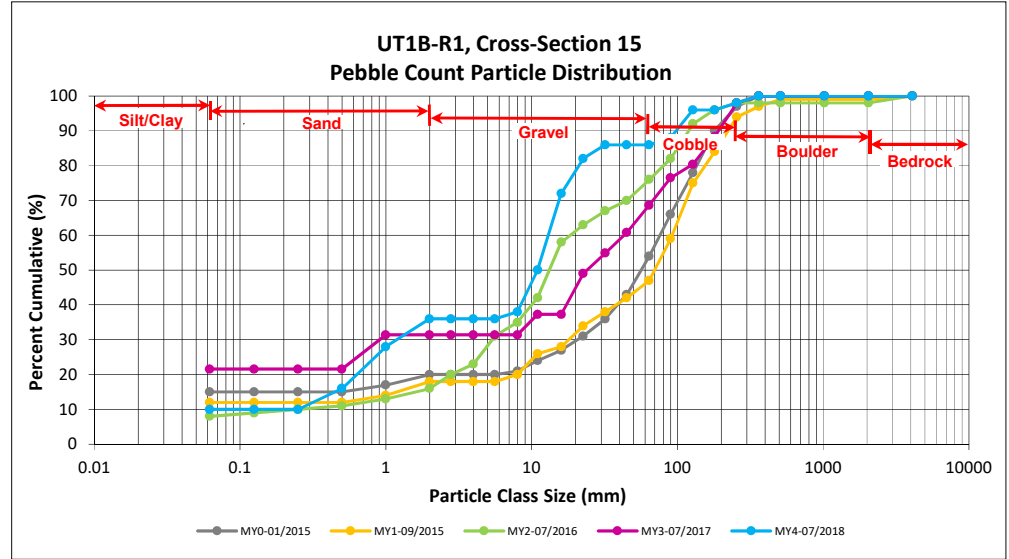
DMS Project No. 95352

Monitoring Year 4 - 2018

UT1B-R1, Cross-Section 15

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	10	10	10
SAND	Very fine	0.062	0.125			10
	Fine	0.125	0.250			10
	Medium	0.25	0.50	6	6	16
	Coarse	0.5	1.0	12	12	28
	Very Coarse	1.0	2.0	8	8	36
GRAVEL	Very Fine	2.0	2.8			36
	Very Fine	2.8	4.0			36
	Fine	4.0	5.6			36
	Fine	5.6	8.0	2	2	38
	Medium	8.0	11.0	12	12	50
	Medium	11.0	16.0	22	22	72
	Coarse	16.0	22.6	10	10	82
	Coarse	22.6	32	4	4	86
	Very Coarse	32	45			86
	Very Coarse	45	64			86
COBBLE	Small	64	90	2	2	88
	Small	90	128	8	8	96
	Large	128	180			96
	Large	180	256	2	2	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				100	100	100

Cross-Section 15 Channel materials (mm)	
D ₁₆ =	0.50
D ₃₅ =	1.83
D ₅₀ =	11.0
D ₈₄ =	26.9
D ₉₅ =	122.5
D ₁₀₀ =	362.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

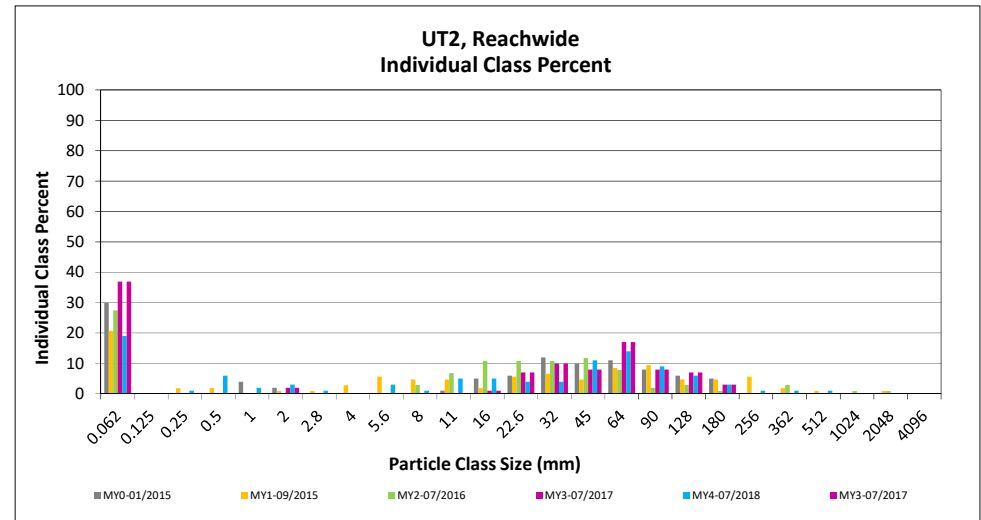
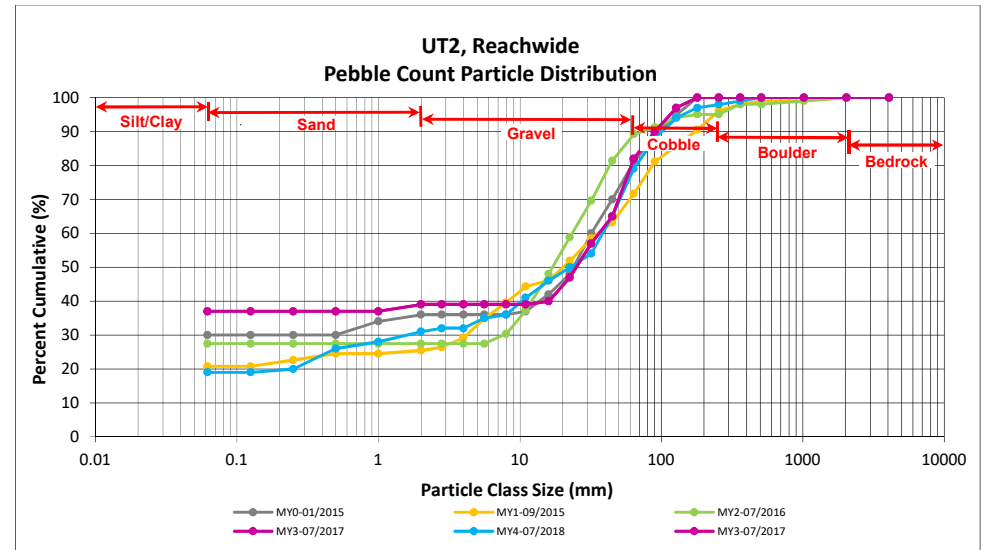
DMS Project No. 95352

Monitoring Year 4 - 2018

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
BOULDER	Large	180	256					100
	Small	256	362					100
BOULDER	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

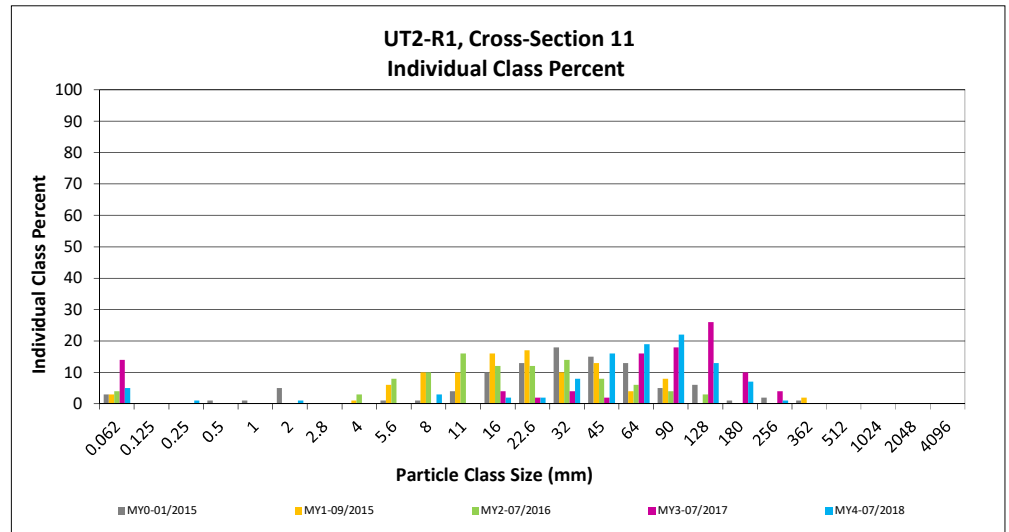
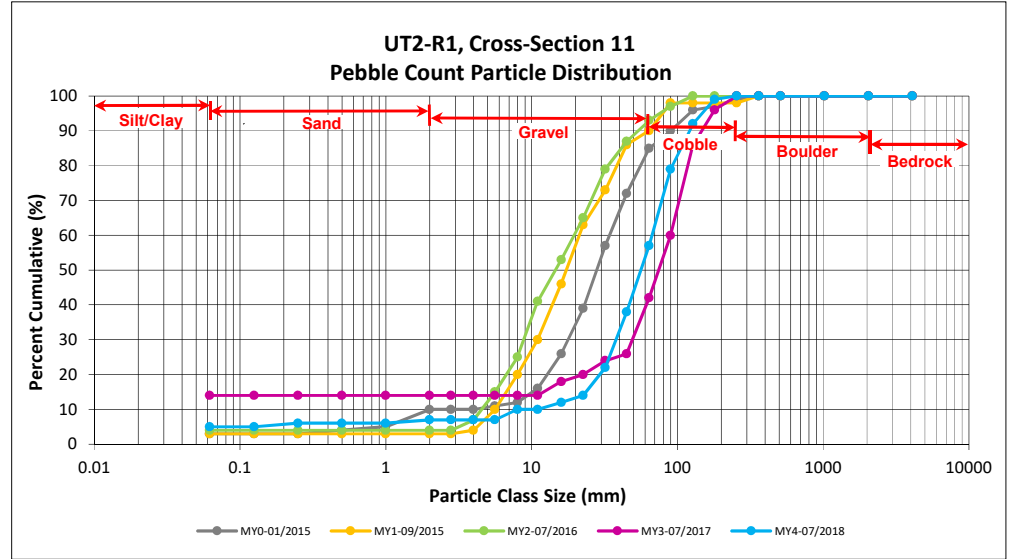
DMS Project No. 95352

Monitoring Year 4 - 2018

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	5	5	5
SAND	Very fine	0.062	0.125			5
	Fine	0.125	0.250	1	1	6
	Medium	0.25	0.50			6
	Coarse	0.5	1.0			6
	Very Coarse	1.0	2.0	1	1	7
GRAVEL	Very Fine	2.0	2.8			7
	Very Fine	2.8	4.0			7
	Fine	4.0	5.6			7
	Fine	5.6	8.0	3	3	10
	Medium	8.0	11.0			10
	Medium	11.0	16.0	2	2	12
	Coarse	16.0	22.6	2	2	14
	Coarse	22.6	32	8	8	22
	Very Coarse	32	45	16	16	38
	Very Coarse	45	64	19	19	57
COBBLE	Small	64	90	22	22	79
	Small	90	128	13	13	92
	Large	128	180	7	7	99
	Large	180	256	1	1	100
BOULDER	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				100	100	100

Cross-Section 11 Channel materials (mm)	
D ₁₆ =	24.65
D ₃₅ =	42.21
D ₅₀ =	56.2
D ₈₄ =	103.1
D ₉₅ =	148.1
D ₁₀₀ =	256.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

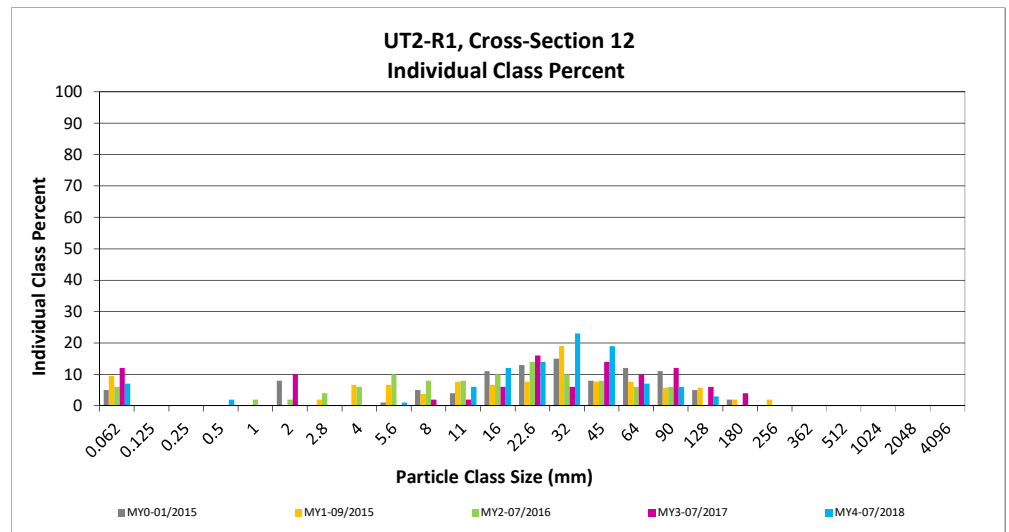
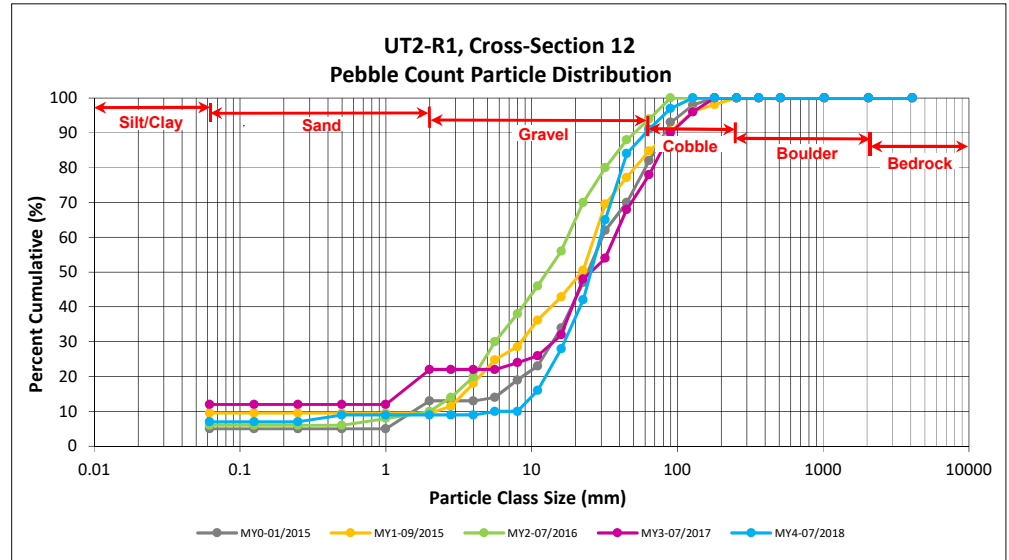
DMS Project No. 95352

Monitoring Year 4 - 2018

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	7	7	7
SAND	Very fine	0.062	0.125			7
	Fine	0.125	0.250			7
	Medium	0.25	0.50	2	2	9
	Coarse	0.5	1.0			9
	Very Coarse	1.0	2.0			9
GRAVEL	Very Fine	2.0	2.8			9
	Very Fine	2.8	4.0			9
	Fine	4.0	5.6	1	1	10
	Fine	5.6	8.0			10
	Medium	8.0	11.0	6	6	16
	Medium	11.0	16.0	12	12	28
	Coarse	16.0	22.6	14	14	42
	Coarse	22.6	32	23	23	65
	Very Coarse	32	45	19	19	84
	Very Coarse	45	64	7	7	91
COBBLE	Small	64	90	6	6	97
	Small	90	128	3	3	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 12 Channel materials (mm)	
D ₁₆ =	11.00
D ₃₅ =	19.02
D ₅₀ =	25.5
D ₈₄ =	45.0
D ₉₅ =	80.3
D ₁₀₀ =	128.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

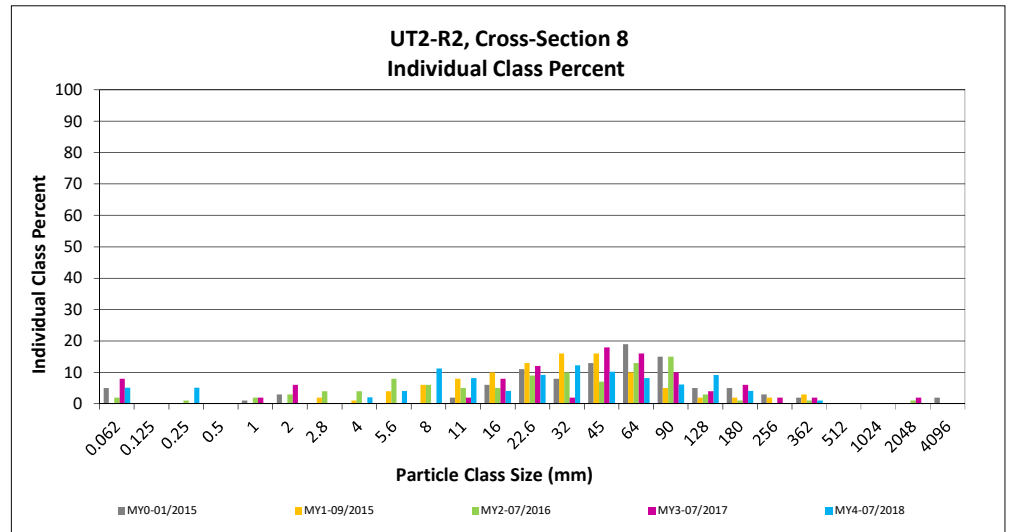
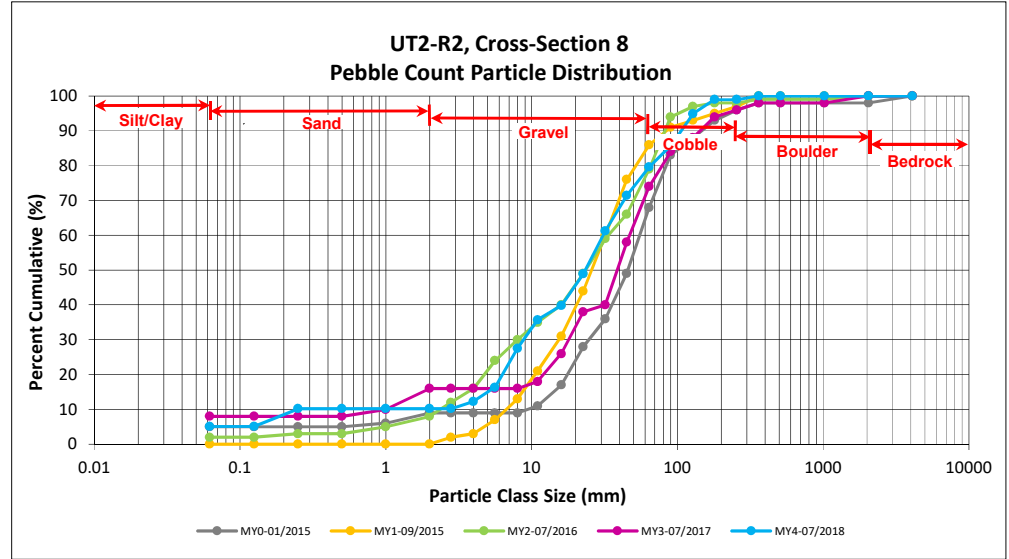
DMS Project No. 95352

Monitoring Year 4 - 2018

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	5	5	5
SAND	Very fine	0.062	0.125			5
	Fine	0.125	0.250	5	5	10
	Medium	0.25	0.50			10
	Coarse	0.5	1.0			10
	Very Coarse	1.0	2.0			10
GRAVEL	Very Fine	2.0	2.8			10
	Very Fine	2.8	4.0	2	2	12
	Fine	4.0	5.6	4	4	16
	Fine	5.6	8.0	11	11	28
	Medium	8.0	11.0	8	8	36
	Medium	11.0	16.0	4	4	40
	Coarse	16.0	22.6	9	9	49
	Coarse	22.6	32	12	12	61
	Very Coarse	32	45	10	10	71
	Very Coarse	45	64	8	8	80
COBBLE	Small	64	90	6	6	86
	Small	90	128	9	9	95
	Large	128	180	4	4	99
	Large	180	256			99
BOULDER	Small	256	362	1	1	100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
BEDROCK	Bedrock	2048	>2048			100
Total				98	100	100

Cross-Section 8 Channel materials (mm)	
D ₁₆ =	5.45
D ₃₅ =	10.70
D ₅₀ =	23.3
D ₈₄ =	81.8
D ₉₅ =	129.1
D ₁₀₀ =	362.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

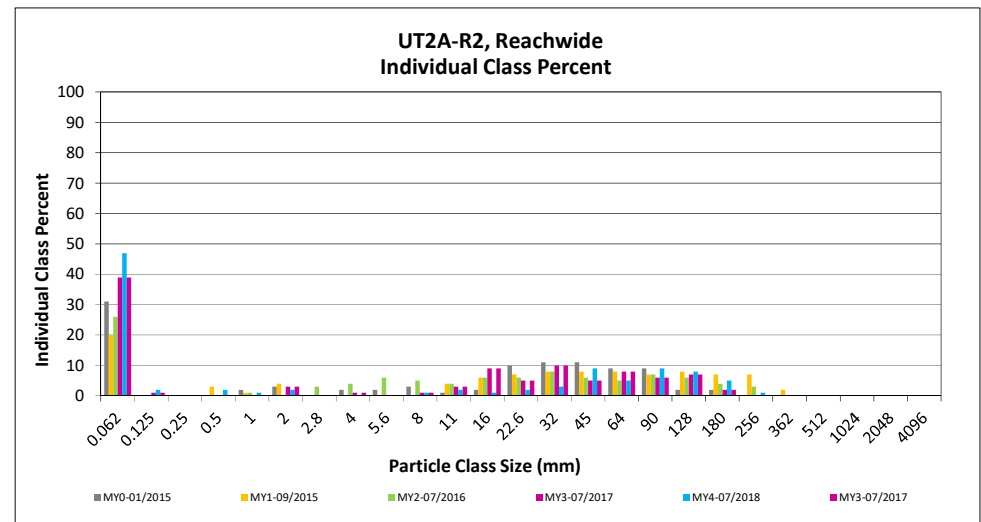
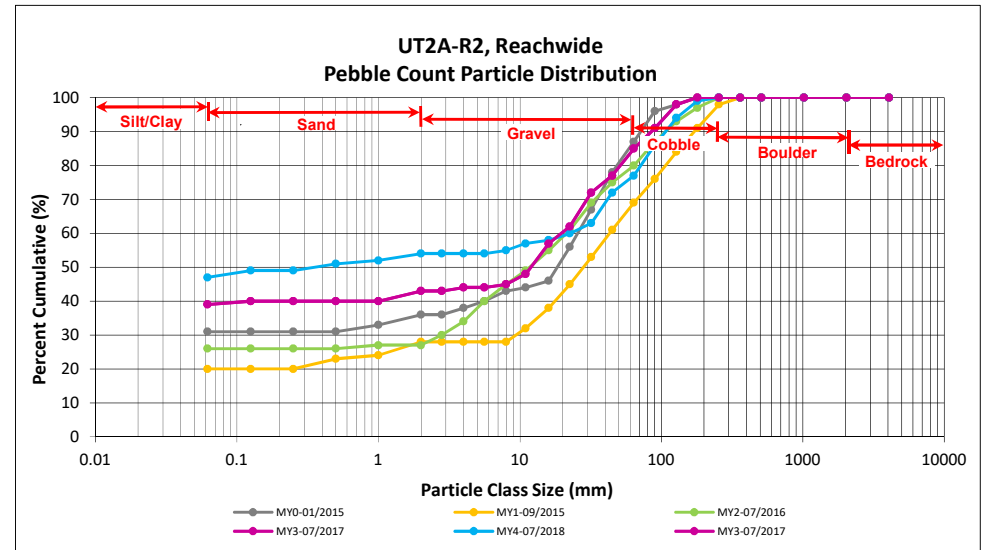
DMS Project No. 95352

Monitoring Year 4 - 2018

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
BOULDER	Large	180	256					100
	Small	256	362					100
BOULDER	Small	362	512					100
	Medium	512	1024					100
BOULDER	Large/Very Large	1024	2048					100
	Large/Very Large	2048	>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

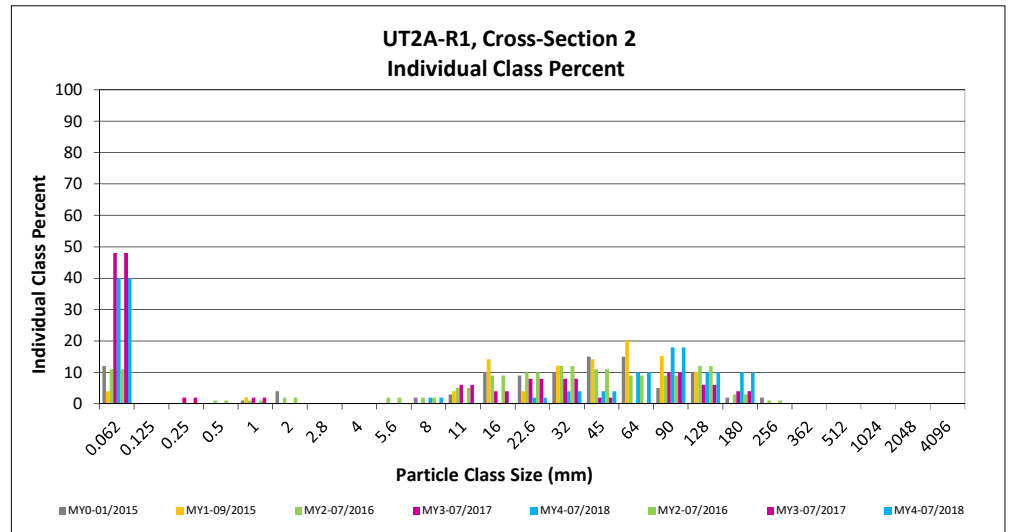
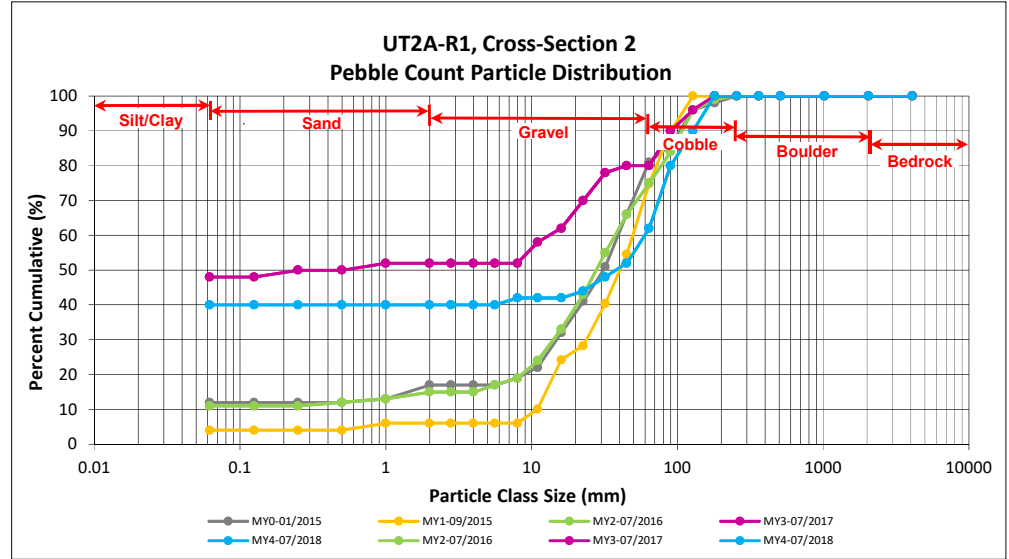
DMS Project No. 95352

Monitoring Year 4 - 2018

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	20	40	40
SAND	Very fine	0.062	0.125			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			40
GRAVEL	Very Fine	2.0	2.8			40
	Very Fine	2.8	4.0			40
	Fine	4.0	5.6			40
	Fine	5.6	8.0	1	2	42
	Medium	8.0	11.0			42
	Medium	11.0	16.0			42
	Coarse	16.0	22.6	1	2	44
	Coarse	22.6	32	2	4	48
	Very Coarse	32	45	2	4	52
	Very Coarse	45	64	5	10	62
COBBLE	Small	64	90	9	18	80
	Small	90	128	5	10	90
	Large	128	180	5	10	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	100	100

Cross-Section 2 Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	Silt/Clay
D ₅₀ =	37.9
D ₈₄ =	103.6
D ₉₅ =	151.8
D ₁₀₀ =	180.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

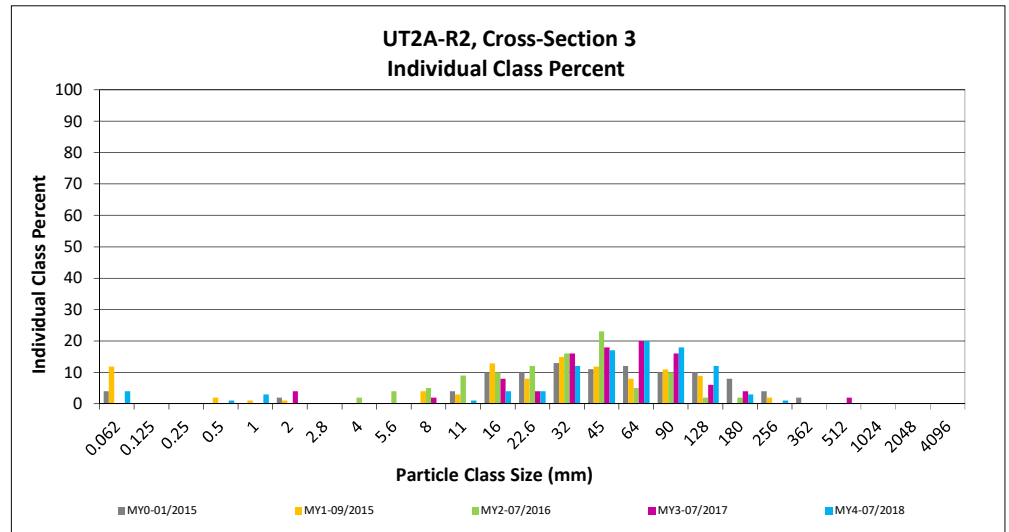
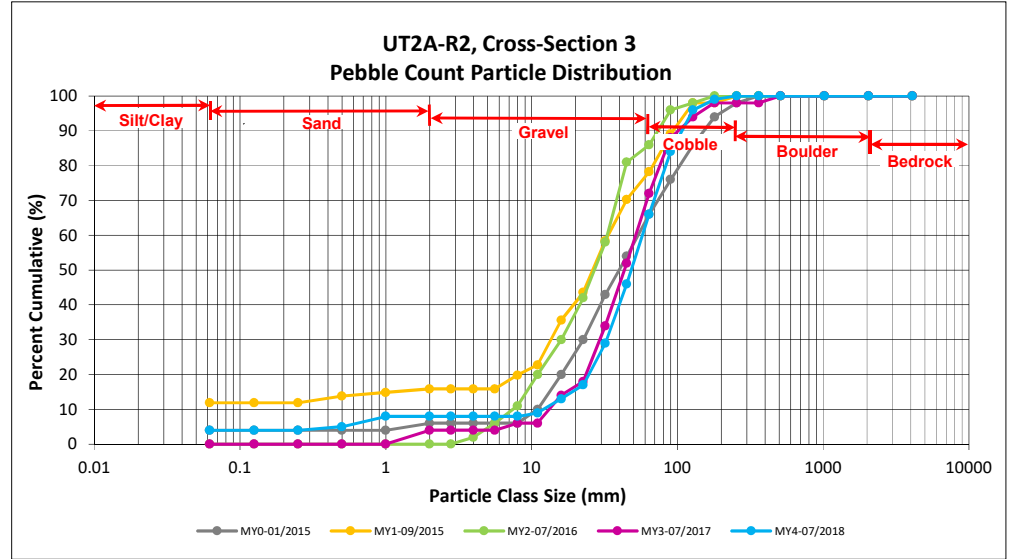
DMS Project No. 95352

Monitoring Year 4 - 2018

UT2A-R2, Cross-Section 3

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	4	4	4
<i>SAND</i>	Very fine	0.062	0.125			4
	Fine	0.125	0.250			4
	Medium	0.25	0.50	1	1	5
	Coarse	0.5	1.0	3	3	8
	Very Coarse	1.0	2.0			8
<i>GRAVEL</i>	Very Fine	2.0	2.8			8
	Very Fine	2.8	4.0			8
	Fine	4.0	5.6			8
	Fine	5.6	8.0			8
	Medium	8.0	11.0	1	1	9
	Medium	11.0	16.0	4	4	13
	Coarse	16.0	22.6	4	4	17
	Coarse	22.6	32	12	12	29
	Very Coarse	32	45	17	17	46
	Very Coarse	45	64	20	20	66
<i>COBBLE</i>	Small	64	90	18	18	84
	Small	90	128	12	12	96
	Large	128	180	3	3	99
	Large	180	256	1	1	100
<i>BOULDER</i>	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
	Large/Very Large	1024	2048			100
<i>BEDROCK</i>	Bedrock	2048	>2048			100
Total				100	100	100

Cross-Section 3 Channel materials (mm)	
D ₁₆ =	20.73
D ₃₅ =	36.09
D ₅₀ =	48.3
D ₈₄ =	90.0
D ₉₅ =	124.3
D ₁₀₀ =	256.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

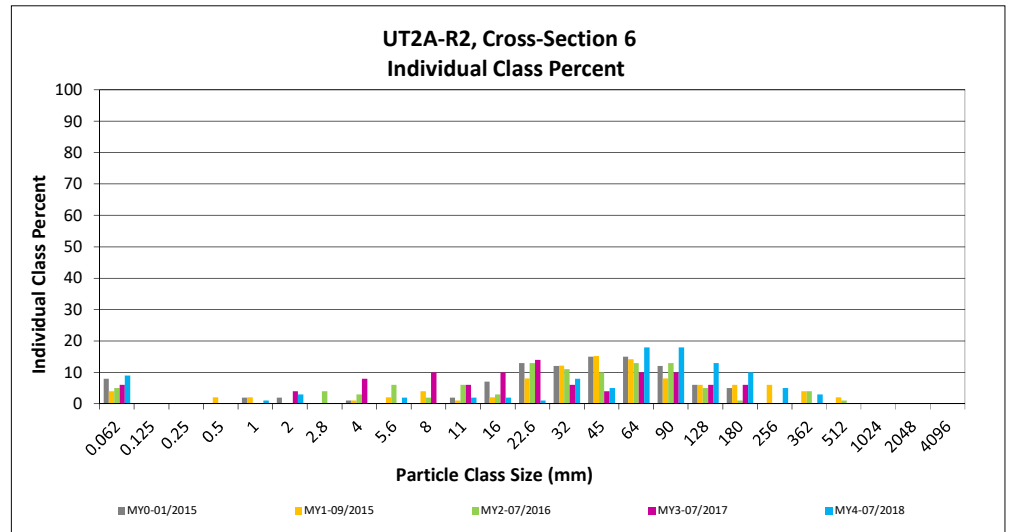
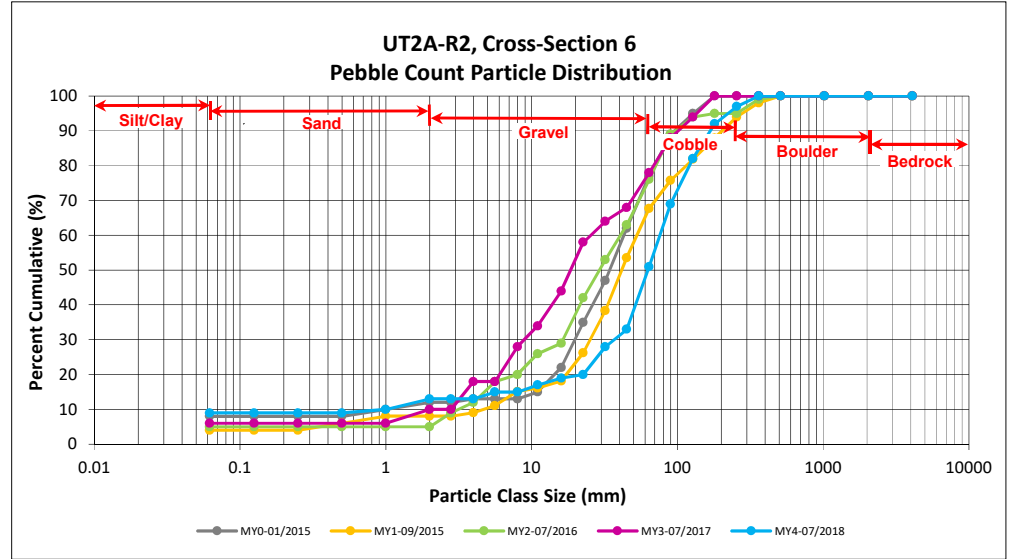
DMS Project No. 95352

Monitoring Year 4 - 2018

UT2A-R2, Cross-Section 6

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
<i>SILT/CLAY</i>	Silt/Clay	0.000	0.062	9	9	9
<i>SAND</i>	Very fine	0.062	0.125			9
	Fine	0.125	0.250			9
	Medium	0.25	0.50			9
	Coarse	0.5	1.0	1	1	10
	Very Coarse	1.0	2.0	3	3	13
<i>GRAVEL</i>	Very Fine	2.0	2.8			13
	Very Fine	2.8	4.0			13
	Fine	4.0	5.6	2	2	15
	Fine	5.6	8.0			15
	Medium	8.0	11.0	2	2	17
	Medium	11.0	16.0	2	2	19
	Coarse	16.0	22.6	1	1	20
	Coarse	22.6	32	8	8	28
	Very Coarse	32	45	5	5	33
	Very Coarse	45	64	18	18	51
<i>COBBLE</i>	Small	64	90	18	18	69
	Small	90	128	13	13	82
	Large	128	180	10	10	92
	Large	180	256	5	5	97
<i>BOULDER</i>	Small	256	362	3	3	100
	Small	362	512			100
	Medium	512	1024			100
<i>BEDROCK</i>	Large/Very Large	1024	2048			100
	Bedrock	2048	>2048			100
Total				100	100	100

Cross-Section 6 Channel materials (mm)	
D ₁₆ =	9.38
D ₃₅ =	46.80
D ₅₀ =	62.8
D ₈₄ =	137.0
D ₉₅ =	222.4
D ₁₀₀ =	362.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

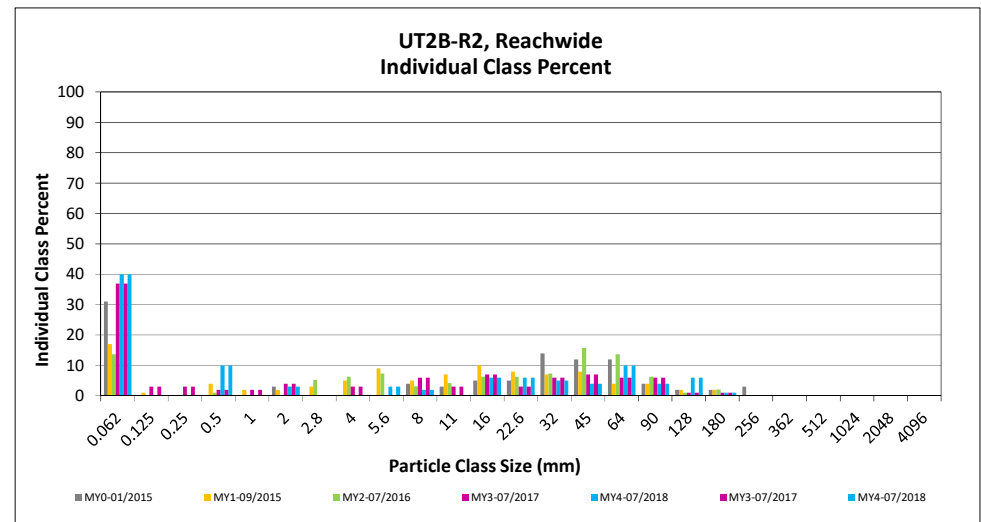
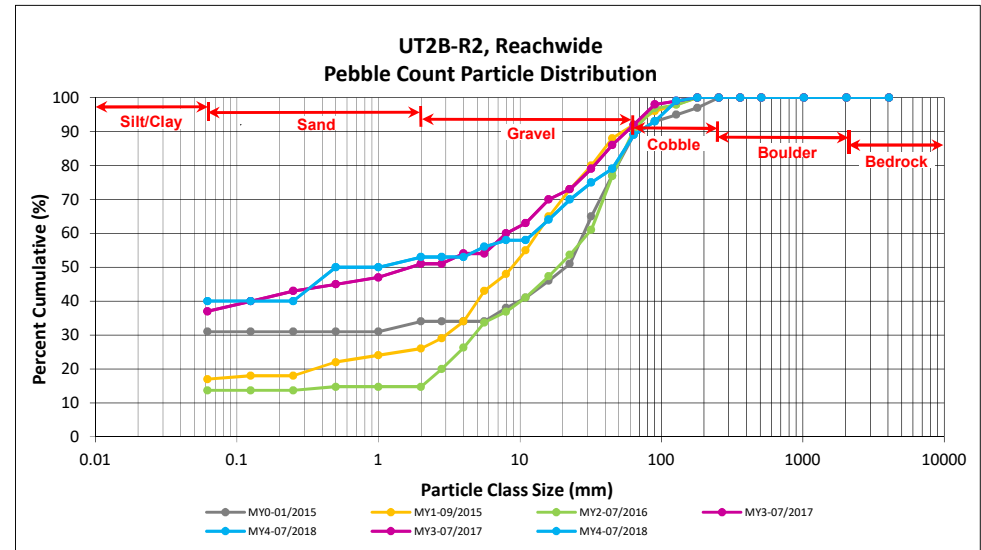
DMS Project No. 95352

Monitoring Year 4 - 2018

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	13	27	40	40	40
SAND	Very fine	0.062	0.125					40
	Fine	0.125	0.250					40
	Medium	0.25	0.50	3	7	10	10	50
	Coarse	0.5	1.0					50
	Very Coarse	1.0	2.0	2	1	3	3	53
GRAVEL	Very Fine	2.0	2.8					53
	Very Fine	2.8	4.0					53
	Fine	4.0	5.6	2	1	3	3	56
	Fine	5.6	8.0	1	1	2	2	58
	Medium	8.0	11.0					58
	Medium	11.0	16.0	3	3	6	6	64
	Coarse	16.0	22.6	3	3	6	6	70
	Coarse	22.6	32	1	4	5	5	75
	Very Coarse	32	45	4		4	4	79
	Very Coarse	45	64	7	3	10	10	89
COBBLE	Small	64	90	4		4	4	93
	Small	90	128	6		6	6	99
	Large	128	180	1		1	1	100
BOULDER	Large	180	256					100
	Small	256	362					100
	Small	362	512					100
BOULDER	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 =	0.5
D ₈₄ =	53.7
D ₉₅ =	101.2
D ₁₀₀ =	180.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

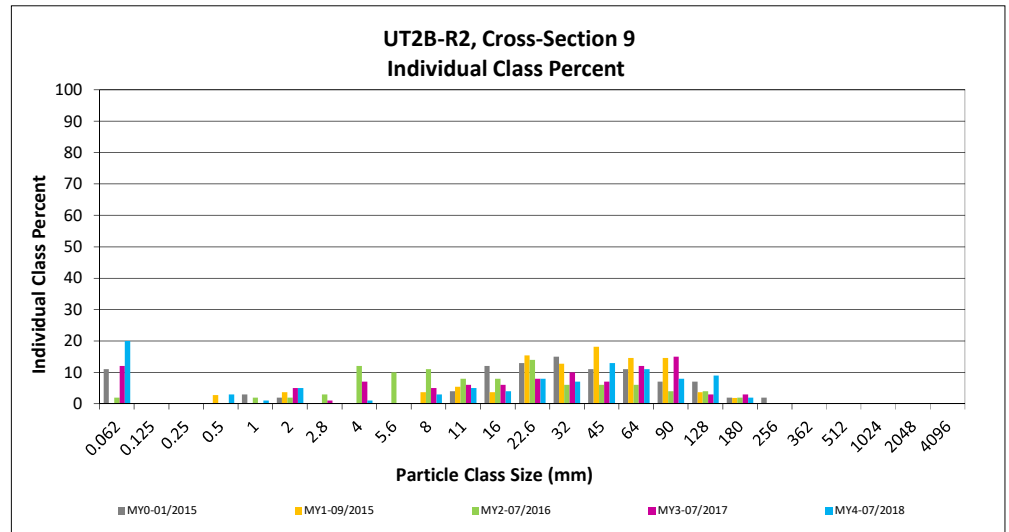
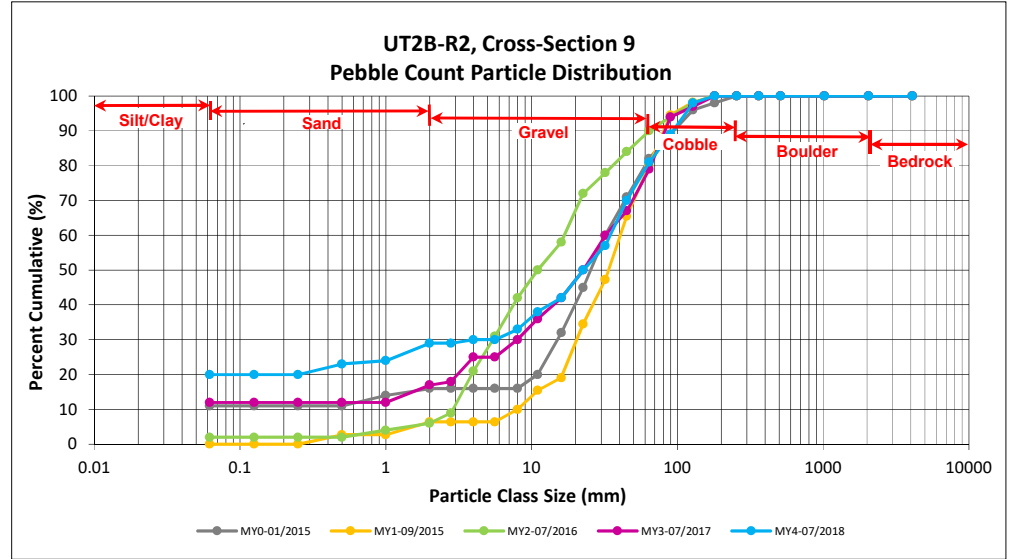
DMS Project No. 95352

Monitoring Year 4 - 2018

UT2B-R2, Cross-Section 9

Particle Class		Diameter (mm)		Riffle 100-Count	Summary	
		min	max		Class Percentage	Percent Cumulative
SILT/CLAY	Silt/Clay	0.000	0.062	20	20	20
SAND	Very fine	0.062	0.125			20
	Fine	0.125	0.250			20
	Medium	0.25	0.50	3	3	23
	Coarse	0.5	1.0	1	1	24
	Very Coarse	1.0	2.0	5	5	29
GRAVEL	Very Fine	2.0	2.8			29
	Very Fine	2.8	4.0	1	1	30
	Fine	4.0	5.6			30
	Fine	5.6	8.0	3	3	33
	Medium	8.0	11.0	5	5	38
	Medium	11.0	16.0	4	4	42
	Coarse	16.0	22.6	8	8	50
	Coarse	22.6	32	7	7	57
	Very Coarse	32	45	13	13	70
COBBLE	Very Coarse	45	64	11	11	81
	Small	64	90	8	8	89
	Small	90	128	9	9	98
	Large	128	180	2	2	100
BOULDER	Large	180	256			100
	Small	256	362			100
	Small	362	512			100
	Medium	512	1024			100
BEDROCK	Large/Very Large	1024	2048			100
	Bedrock	2048	>2048			100
Total				100	100	100

Cross-Section 9 Channel materials (mm)	
D ₁₆ =	Silt/Clay
D ₃₅ =	9.09
D ₅₀ =	22.6
D ₈₄ =	72.7
D ₉₅ =	113.8
D ₁₀₀ =	180.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

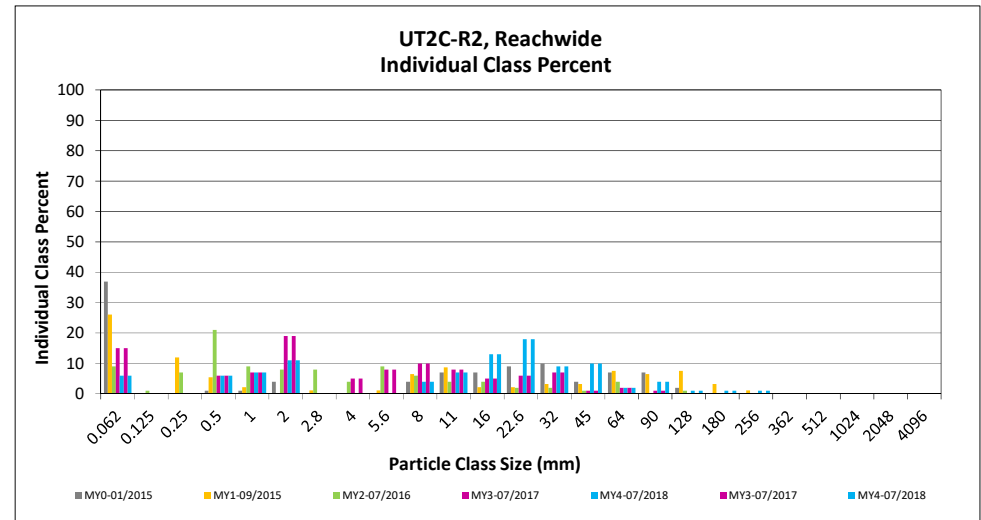
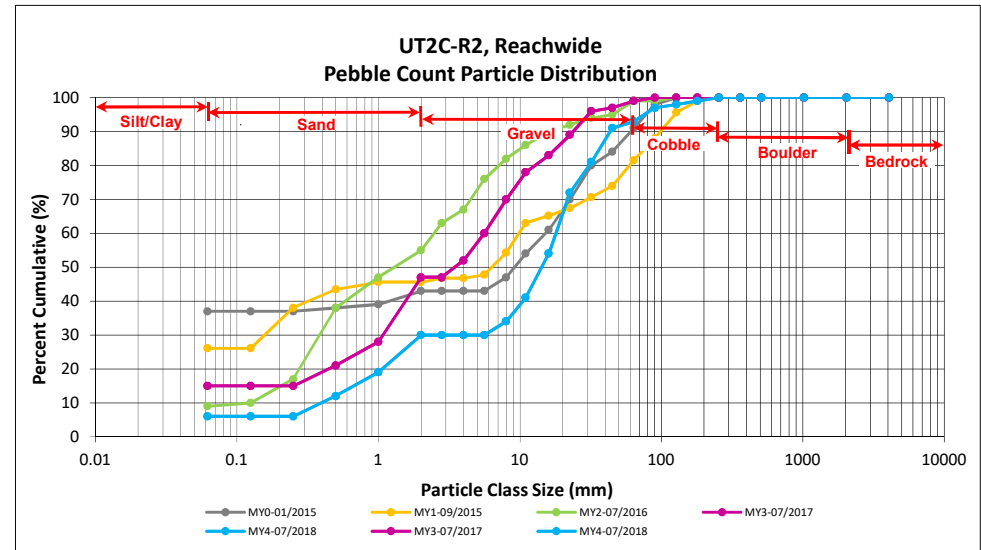
DMS Project No. 95352

Monitoring Year 4 - 2018

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	1	5	6	6	6
SAND	Very fine	0.062	0.125					6
	Fine	0.125	0.250					6
	Medium	0.25	0.50		6	6	6	12
	Coarse	0.5	1.0	1	6	7	7	19
	Very Coarse	1.0	2.0	6	5	11	11	30
GRAVEL	Very Fine	2.0	2.8					30
	Very Fine	2.8	4.0					30
	Fine	4.0	5.6					30
	Fine	5.6	8.0	2	2	4	4	34
	Medium	8.0	11.0	2	5	7	7	41
	Medium	11.0	16.0	8	5	13	13	54
	Coarse	16.0	22.6	12	6	18	18	72
	Coarse	22.6	32	7	2	9	9	81
	Very Coarse	32	45	5	5	10	10	91
	Very Coarse	45	64	2		2	2	93
COBBLE	Small	64	90	3	1	4	4	97
	Small	90	128	1		1	1	98
	Large	128	180		1	1	1	99
BOULDER	Large	180	256		1	1	1	100
	Small	256	362					100
	Small	362	512					100
BOULDER	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 =	0.74
D ₃₅ =	8.37
D ₅₀ =	14.3
D ₈₄ =	35.4
D ₉₅ =	75.9
D ₁₀₀ =	256.0



Reachwide and Cross-Section Pebble Count Plots

Hopewell Stream Mitigation Site

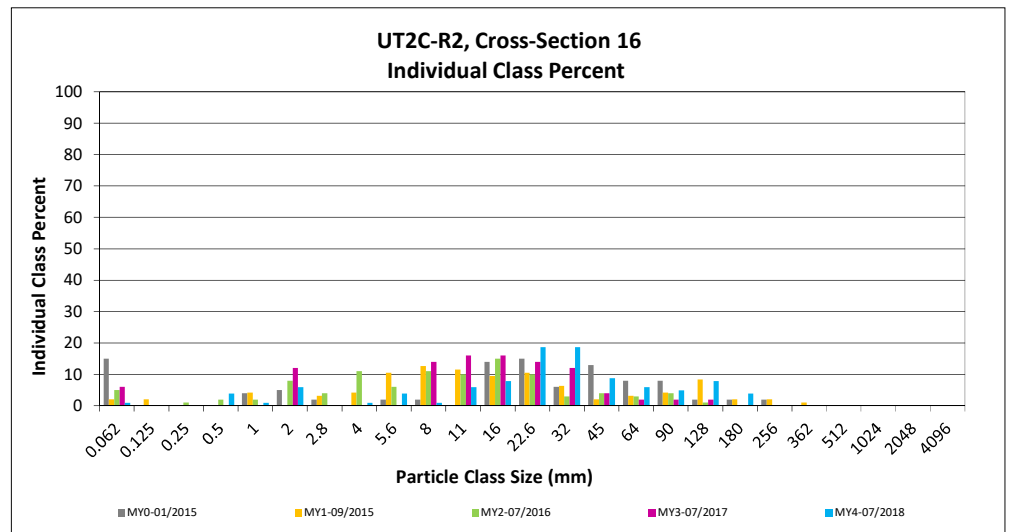
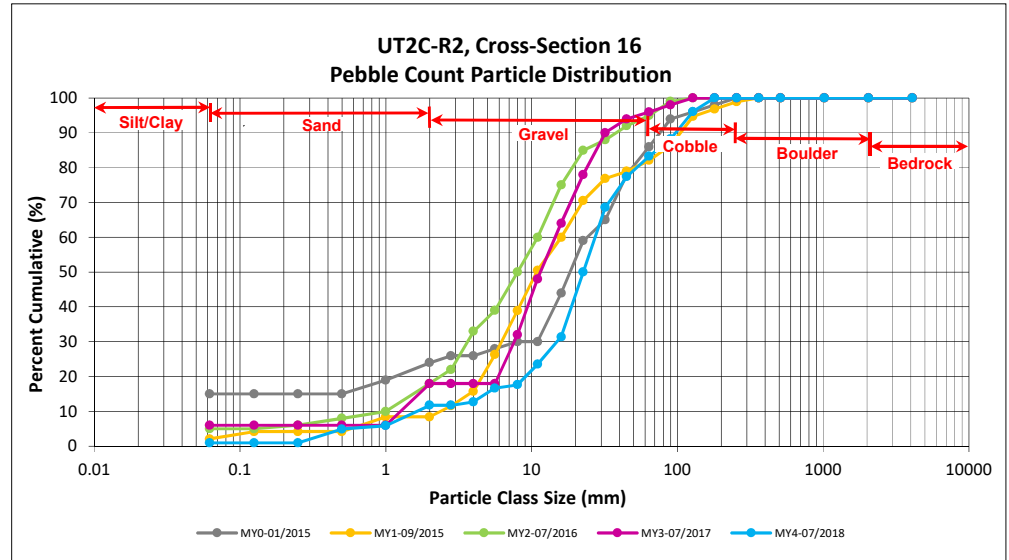
DMS Project No. 95352

Monitoring Year 4 - 2018

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	1	1	1
SAND	Very fine	0.062	0.125			1
	Fine	0.125	0.250			1
	Medium	0.25	0.50	4	4	5
	Coarse	0.5	1.0	1	1	6
	Very Coarse	1.0	2.0	6	6	12
GRAVEL	Very Fine	2.0	2.8			12
	Very Fine	2.8	4.0	1	1	13
	Fine	4.0	5.6	4	4	17
	Fine	5.6	8.0	1	1	18
	Medium	8.0	11.0	6	6	24
	Medium	11.0	16.0	8	8	31
	Coarse	16.0	22.6	19	19	50
	Coarse	22.6	32	19	19	69
	Very Coarse	32	45	9	9	77
	Very Coarse	45	64	6	6	83
COBBLE	Small	64	90	5	5	88
	Small	90	128	8	8	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				102	100	100

Cross-Section 16 Channel materials (mm)	
D ₁₆ =	5.29
D ₃₅ =	17.11
D ₅₀ =	22.6
D ₈₄ =	67.0
D ₉₅ =	121.9
D ₁₀₀ =	180.0



APPENDIX 5. Hydrology Summary Data

Table 13. Verification of Bankfull Events

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

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
	MY4	7/8/2017	7/8/2017	Stream Gage
		9/1/2017	9/1/2017	Stream Gage
8/31/2018		8/31/2018	Stream Gage	
9/16/2018		9/16/2018	Stream Gage	
9/27/2018		9/27/2018	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
	MY4	3/14/2018	Unknown	Crest Gage
		7/23/2018	7/23/2018	Stream Gage
		7/25/2018	7/25/2018	Stream Gage
		8/3/2018	8/3/2018	Stream Gage
8/20/2018		8/20/2018	Stream Gage	
8/31/2018		8/31/2018	Stream Gage	
9/16/2018		9/16/2018	Stream Gage	
10/11/2018		10/11/2018	Stream Gage	
10/17/2018	Unknown	Crest Gage		

Table 13. Verification of Bankfull Events

Hopewell Stream Mitigation Site

DMS Project No. 95352

Monitoring Year 4 - 2018

Reach	Monitoring Year	Date of Data Collection	Date of Occurrence	Method
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
	MY4	9/1/2017	9/1/2017	Stream Gage
		3/14/2018	Unknown	Crest Gage
		7/23/2018	7/23/2018	Stream Gage
		8/20/2018	8/20/2018	Stream Gage
		8/31/2018	8/31/2018	Stream Gage
	UT2B Reach 2	MY1	9/16/2018	9/16/2018
10/17/2018			Unknown	Crest Gage
3/25/2015			Unknown	Crest Gage
MY2		7/9/2015	Unknown	Crest Gage
		10/3/2015	10/3/2015	Stream Gage
		1/25/2016	1/25/2016	Stream Gage
MY3		2/16/2016	2/16/2016	Stream Gage
		4/19/2016	Unknown	Crest 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
MY4		6/21/2017	6/21/2017	Stream Gage
		9/16/2018	9/16/2018	Stream Gage
UT2C Reach 2		MY1	10/3/2015	10/3/2015
	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
	MY4	7/23/2018	7/23/2018	Stream Gage
		8/20/2018	8/20/2018	Stream Gage
10/17/2018		Unknown	Crest Gage	