YEAR 5 MONITORING REPORT

UT TO NEUSE RIVER (BIG DITCH)
STREAM RESTORATION SITE

Wayne County, North Carolina
SCO No.: 090776201
DMS Project No.: 92682
DWR Project Id No.: 10-0343
USACE Action Id No.: SAW-2010-01782

Prepared for:

NCDEQ-Division of Mitigation Services (DMS)
217 West Jones St. Suite 3000A
Raleigh, NC 27603
October 18, 2018

Prepared by:

HDR | ICA
555 Fayetteville Street, Suite 900
Raleigh, North Carolina 27601
919.232.6600

I HEREBY CERTIFY THAT THE DOCUMENT CONTAINED HEREIN, UT NEUSE RIVER (BIG DITCH) YEAR 5 MONITORING REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION.

SIGNED SEALED, AND DATED THIS _____ DAY OF _____ 2018.

Chris L. Smith, PE

HDR | ICA

October 18, 2018

Jeff Schaffer
DMS Eastern Supervisor/Project Manager
NC Division of Mitigation Services
217 West Jones Street, Suite 3000A
Raleigh, North Carolina 27603

RE: NCDEQ – Division of Mitigation Services
UT Neuse Stream Restoration Project
DEQ Contract Number: 005391
DMS Project Number: 92682
Response to DMS Review Comments on Draft Year 5 Monitoring Report for UT Neuse (Big Ditch)

Mr. Schaffer:

As per your letter dated October 15, 2018, we have reviewed and addressed DMS review comments as follows:

1. Digital Files:

a. CCPV_ProblemAreass shapefile is missing the spatial reference.

The spatial reference has been updated to NAD 1983 State Plane North Carolina (US Feet).

b. UTNeuse_Tob_BMP, UTNeuse_Toes and Veg_Plots have the wrong geographic coordinate system. Please Change from GCS_WGS_1984_CORS96 to Geographic Coordinate System, NAD 1983 State Plane North Carolina (US Feet).

All shapefiles have been updated to NAD 1983 State Plane North Carolina (US Feet).

c. Does HDR have GIS shapefiles for an Asset Map for this project? If so, please provide.

An Asset Map and associated shapefiles have been included on the USB flash drive.

2. Section 1.2:

a. First paragraph, page 2 – Please state the success criteria for vegetation for this project (360 stems/acre)

The project success criteria of 360 stems/acre is now stated in the first paragraph of page 2.

b. Second paragraph, page 2 - Revise third and fourth sentences to read "River Works, Inc. has been contracted by the North Carolina Division of Mitigation Services to perform invasive species treatments. Three treatments are scheduled to take place between August 2018 and June 2019. River Works, Inc. will also conduct supplemental planting during the 2018/2019 dormant season."

The third and fourth sentences of the second paragraph- page 2 have been revised to read as mentioned above.

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c. Third paragraph, page 2, states that loblolly pine became the dominant species in Plots 8 and 9, but Table 9 in Appendix C does not show any loblolly pines in Plot 9. Make necessary correction either to narrative or Table 9.

Table 9 has been updated to include the presence of loblolly pine in Plot 9.

3. Appendix B:

a. CCPV Figure 2.1 shows two fallen trees across the channel but there is no discussion in the report narrative regarding these trees or any impacts current or potential they might have on the projects. Clarify if they are causing or could potentially cause problems for this project.

The fallen trees have been removed from the CCPV.

b. In addition, during an October 10, 2018 site visit by DMS staff, it did not appear that these trees were laying across the channel. Either revise the figure showing the correct position of these trees or provide photos showing them across the channel.

The fallen trees have been removed from the CCPV.

c. No areas of encroachment were noted on CCPV or in Table 6. Verify that there is no encroachment into the conservation easement.

No areas of encroachment were noted during field visits.

4. Appendix D, Table 11: Provide a footnote showing the method of calculating Bank Height Ratio (BHR). Please refer to the Standard Measurement of the BHR monitoring parameter guidance (see attached) prepared by a technical workgroup comprised of DMS staff, mitigation providers, and select members of the IRT on the. This was sent to the DMS listserve and all providers on September 18, 2018.

A footnote has been included in Appendix D, Table 11 discussing the new standard measurement for Bank Height Ratio (BHR).

If you have any questions or need additional information, please do not hesitate to give me a call (919.900.1650).

Sincerely,
HDR | ICA

Kenton Beal

October 26, 2018

Jeff Schaffer
DMS Eastern Supervisor/Project Manager
NC Division of Mitigation Services
217 West Jones Street, Suite 3000A
Raleigh, North Carolina 27603

RE: NCDEQ – Division of Mitigation Services
UT Neuse Stream Restoration Project
DEQ Contract Number: 005391
DMS Project Number: 92682
Response to DMS Review Comments on Draft Year 5 Monitoring Report for UT Neuse (Big Ditch)

Mr. Schaffer:

As per your letter dated October 24, 2018, we have reviewed and addressed DMS review comments as follows:

1. Digital Files: The Veg_Plots layers still do not appear to be rendering in the correct location. See the attached pdf map.

   The veg plots have been edited and are now rendering in the appropriate location.

2. Appendix D, Table 11:

   a. DMS discovered an error in the revised Table 11. See cell highlighted in red in the attached.

      The error in Table 11 has been revised.

   b. DMS also made edits to HDR's footnote language, written in red in the attached.

      The revision has been included in the revised Table 11.

3. The digital files do not include the actual Excel spreadsheets with the cross-section overlays per the digital drawing requirements.

   The Excel spreadsheet with the cross-section overlays has been attached to the response email.

If you have any questions or need additional information, please do not hesitate to give me a call (919.900.1650).

Sincerely,
HDR | ICA

Kenton Beal

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1.0 EXECUTIVE SUMMARY

The following report summarizes the vegetation establishment and stream stability for Year 5 of monitoring at the UT Neuse River (Big Ditch) Stream Restoration Site in Wayne County, North Carolina.

1.1 Goals and Objectives

The primary goals of the UT Neuse River (Big Ditch) stream restoration site include:

- Reducing sediment loading in the UT
- Improving water quality
- Providing/enhancing flood attenuation
- Restoring and enhancing aquatic riparian habitat

These goals will be achieved through the following objectives:

- Restore a stable dimension, pattern and profile to the UT that will deter degradation of side slopes and mass wasting of banks.
- Stabilize the UT by planting live stakes and bare roots along the channel banks to promote root growth.
- Enhancing the capacity of the site to mitigate flood flows by excavating a 5 foot floodplain bench off of each channel bank and sloping terrace side slopes at a 5:1 grade.
- Enhancing in stream habitat by creating an undulating bedform (shallows/deeps) by placing woody structures in the channel that provide shading, natural food sources, and protective areas for propagation.
- Reducing sedimentation and nutrients from adjacent urban areas by establishing a native riparian buffer through existing open/grassed fields that are currently regularly maintained.
- Improve terrestrial habitat by restoring a forested riparian corridor through a highly urbanized environment which has historically experienced vegetation maintenance and forest segmentation.
- Reduce nutrients and other pollutant inputs by retrofitting a contributing conveyance to a stormwater wetland BMP.

1.2 Vegetation

Bare root seedlings of tree species were planted at a density of approximately 680 stems per acre on 8-foot centers. Planted species include river birch (*Betula nigra*), pignut hickory (*Carya glabra*), mockernut hickory (*Carya tomentosa)*, green ash *(Fraxinus pennsylvanica)*, tulip poplar *(Lirodendron tulipifera)*, American sycamore *(Platanus occidentalis)*, scarlet oak *(Quercus coccinea)*, cherry bark oak *(Quercus falcate car pagodafolia)*, water oak *(Quercus nigra)*, southern red oak *(Quercus falcata)*, and persimmon *(Diospyros virginiana)*. Containerized plants included smooth alder

(Alnus serrulata), white fringe tree *(Chioanthus virginicus)*, winter berry *(Ilex verticillata)*, and sweetbay magnolia *(Magnolia virginiana).*

Planted stems have performed poorly across the site but natural recruitment has remained strong through the final year of monitoring. All nine plots fail to reach success criteria based on planted stems alone. Smaller trees and trees noted with lower vigor in Year 4 monitoring, were outcompeted by a dense herbaceous layer and invasive species in Year 5. All of the Plots except Plots 1 and 2 meet stem density criteria when including natural recruits. The site as a whole meets the project success criteria of 360 stems/acre when including natural recruits. Stem density was calculated at 396 stems per acre for Year 5.

A dense community of Johnson grass (*Sorghum halepens*) still remains throughout the Site. Crapemyrtle *(Lagerstroemia indica)* volunteers have also continued to establish throughout the site. Areas of dense morning glory and trumpet vine remain isolated to only the upstream third of the Site. River Works, Inc. has been contracted by the North Carolina Department of Mitigation Services to perform invasive species removal. Three treatments are scheduled to take place between August 2018 and June 2019. River Works, Inc will also conduct supplemental planting during the 2018/2019 dormant season.

Loblolly pine (Pinus taeda) has established in the bare and thin grass areas downstream of Cross Section 4 and became the dominant species in Plots 8 and 9. Natural recruits of hardwood species continue to increase in Plots 8 and 9 as well.

1.3 Stream Stability

Following five years of monitoring, the majority of the UT to Neuse River Site appears to be stable. UT Neuse pattern and profile are largely consistent with previous monitoring years and the majority of scour is occurring in pools. Some areas of bank erosion documented in Year 4 have stabilized over the last monitoring year. As vegetation continues to mature along the banks it is expected that the remaining areas of erosion will stabilize over time.

The left arm of the log cross vane at STA 24+08 has become dislodged at the downstream side and collapsed into the pool. The upstream side of the arm remains secured to the head of the structure and water is still flowing over the sill and right arm as designed. Bank erosion is isolated to the left side of the scour pool and behind the left arm. The structure does not appear to be causing any adverse effects downstream at this time.

Cross Section geometry has experienced minor fluctuations from previous monitoring years. Bank height ratios continue to increase at Cross Sections 1 and 4 due to heavy deposition along the banks. Bankfull areas are consistent with Year 4 for all monitored cross sections indicating a stable reach.

The site has experienced at least ten bankfull flows through the five years of monitoring. Bankfull event records are provided in Table 13. Additional overbank evidence includes debris and detritus lines, vegetation bent in the downstream direction, and exposed roots within the floodplain and on terrace slopes.

1.4 Wetlands
No wetland monitoring areas were established for this project report.

1.5 Note
Summary information and statistics related to performance of various project and monitoring elements can be found in tables and figures in the report appendices. Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report and in the Mitigation Plan documents available on DMS's website. All raw data supporting tables and figures in the appendices is available from DMS upon request.

2.0 METHODOLOGY
The Year 5 Monitoring survey was completed utilizing total station equipment. Each cross section is marked with two rebar monuments at their beginning and ending points. The rebar has been located vertically and horizontally in NAD 83 State Plane. Surveying these monuments throughout the site ensure proper orientation. The survey data was imported into MicroStation for verification. RIVERMorph was used to analyze the profile and cross section data. Tables and figures were created using Microsoft Excel.

The channel is entirely a sand bed system; therefore, a pebble count was not conducted. It should be noted that the restored channel is dominated by sand, not detritus as was the case in pre-restoration conditions.

Vegetation monitoring was completed using CVS level II methods, for 9, 100 square meter vegetation plots (Lee et al. 2008). The taxonomic standard for vegetation used for this document was Flora of the Southern and Mid-Atlantic States (Weakley 2011).

3.0 REFERENCES

Lee, M.T., R.K. Peet, S.D. Roberts, and T.R. Wentworth. 2008. CVS-EEP Protocol for Recording Vegetation. Version 4.2. North Carolina Department of Environment and Natural Resources, Ecosystem Enhancement Program. Raleigh, North Carolina.

NCDENR-Ecosystem Enhancement Program. 2014. Baseline Monitoring Document and As-Built Baseline Report, UT to Neuse River (Big Ditch) Stream Restoration Project, Wayne County, North Carolina.

United States Army Corps of Engineers, United States Environmental Protection Agency, North Carolina Wildlife Resources Commission, North Carolina Division of Water Quality (USACE et al.). 2003. Stream Mitigation Guidelines.

Weakley, Alan S. 2011. Flora of the Carolinas, Virginia, Georgia, and Surrounding Areas (online). Available: http://www.herbarium.unc.edu/FloraArchives/Weakley Flora_2006-Jan.pdf [January 6, 2006]. University of North Carolina Herbarium, North Carolina Botanical Garden, University of North Carolina, Chapel Hill, North Carolina.

4.0 APPENDICES

Appendix A. Background Tables

Table 1. Project Components and Mitigation Credits
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Mitigation Credits										
	Stream (at sewer crossing)	Stream	Total Stream	Riparian Buffer* (square feet)			Nitrogen Buffer Offset			
							Buffer Restoration **			
Type	R	R	R	TOB to 50'	50' to 100'	100' to 200'	Buffer Zone	<= 50'	50'-100'	100' - 200'
Restored LF or FT^2	60	2,072	2,132	157,756	107,778	78,632		157,756	107,778	78,632
Credit Ratio	2:1	1:1	1:1 & 2:1	1:1	1:1	4:1		1:1	1:1	1:1
Totals	30	2,072	2,102	157,756	107,778	19,658	Pound Reduction	0	5,624	4,103

Project Components						
Project Component - or- Reach ID	Stationing/Location	Existing Footage/ Acreage	Approach (PI, PII, etc)	Restoration -or- Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
UT	10+00 - 31+32	2,113	PII	R	2,132	1:1 (2:1 at 60' sewer crossing)
Riparian Buffers	TOB to 50'	-	-	R	3.62	1:1
	50' - 100'	-	-	R	2.47	1:1
	100'-200'	-	-	R	0.45	4:1

Component Summation			
Restoration Level	Stream (linear feet)	Buffer (square ft.)	Buffer Nitrogen Nutrient Offset (lbs)
Restoration	2,132	344,166	9,727

BMP Elements				
Element	Size (AC)	Function	1 yr Total Nitrogen Reduction (lbs)	30 yr. Total Nitrogen Reduction (lbs)
Stormwater Wetland	0.253	Quality/	49	1,470

* - Riparian Buffer areas may be used for stream & riparian buffer mitigation, or nutrient offset credit (Estimating/Calculating Riparian Buffer Credits, EEP PPPM Section 8.3.1.2).

** - Stream and Riparian Buffer Mitigation Credit Numbers were adjusted based on proposed DWQ guidelines (Draft Regulatory Guidance for the Calculation of Stream and Buffer Mitigation Credit for Buffer width different from standard minimum widths. Version 4.5, July 20, 2010.)

Table 2. Project Activity and Reporting History
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	January 2010	February 2010
Final Design – Construction Plans	January 2011	May 2012
Construction	January 23, 2013	September 5, 2013
Temporary S&E Mix Applied to Entire Project Area	January 23, 2013	September 5, 2013
Permanent Seed Mix Applied to Entire Project Area	January 23, 2013	September 5, 2013
Bare Root, Containerized, and B&B plantings for Entire Project Area	January 14, 2014	January 15, 2014
Mitigation Plan/As-built (Year 0 Monitoring-Baseline)	September 17, 2013	February 28, 2014
Year 1 Monitoring	April 28, 2014	December, 2014
Year 2 Monitoring	August 31, 2015	November, 2015
Year 3 Monitoring	August 23, 2016	October, 2016
Year 4 Monitoring	August 16, 2017	October, 2017
Year 5 Monitoring	July 19, 2018	August, 2018

Table 3. Project Contacts Table
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

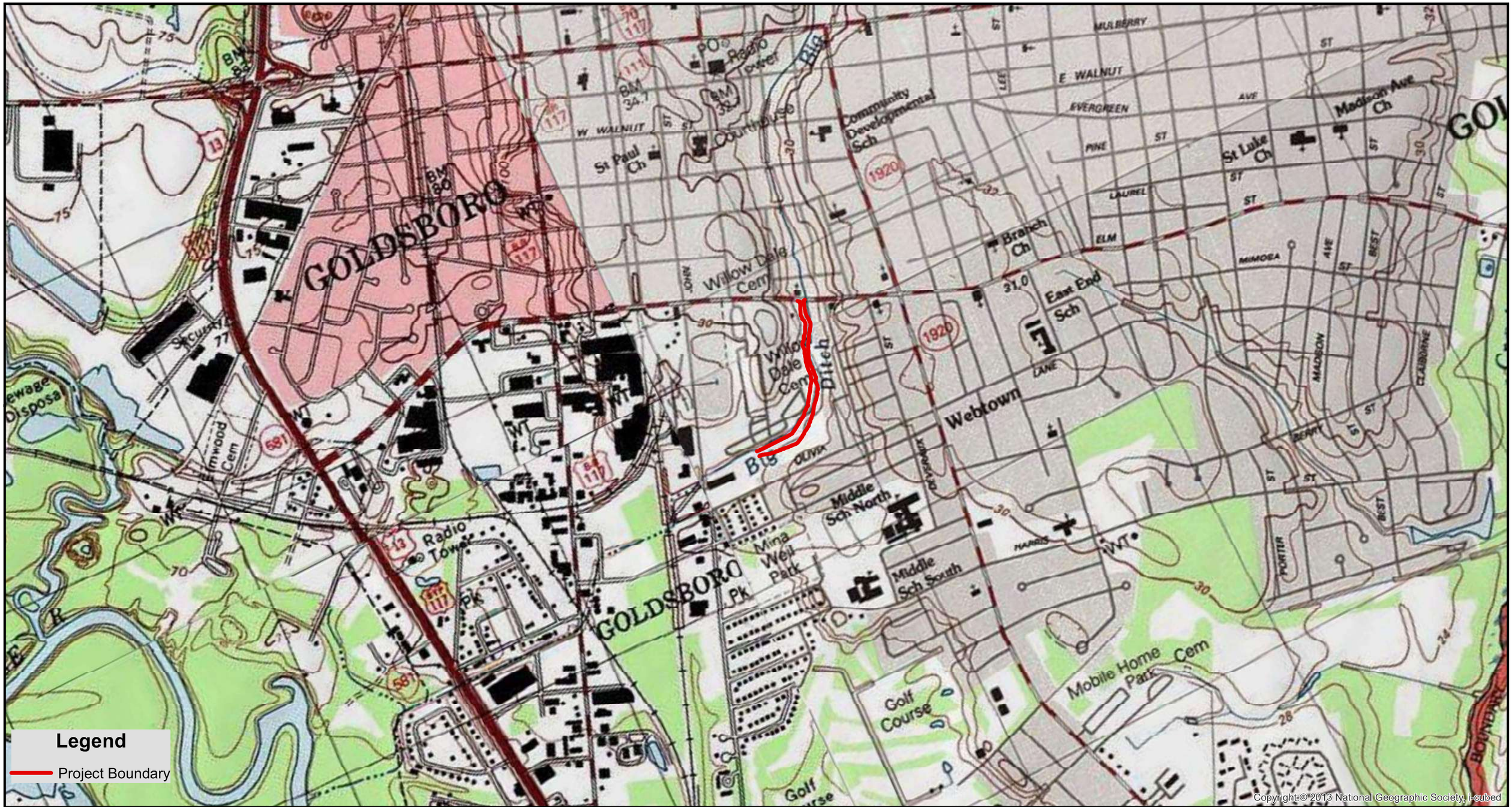
Designer Primary project design POC	HDR|ICA Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Kevin Williams (919) 851-6066
Construction Contractor Construction Contractor POC	Carolina Environmental Contracting, Inc. Joanne Cheatham P.O. Box 1905 Mount Airy, NC 27030 (336) 320-3849
Planting Contractor Planting Contractor POC	Carolina Sylvics, Inc. Mary-Margaret McKinney 908 Indian Trail Road Edenton, North Carolina 27932 (252) 482-8491
Seeding Contractor Seeding Contractor POC	Carolina Environmental Contracting, Inc. Joanne Cheatham P.O. Box 1905 Mount Airy, NC 27030 (336) 320-3849
Seed Mix Sources	Green Resources – Triangle Office
Nursery Stock Suppliers	1) NC Division of Forest Resources 2) Native Roots Nursery
Monitoring Performers	HDR|ICA Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Ben Furr (919) 900-1613
Stream Monitoring POC	HDR|ICA Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Ben Furr (919) 900-1613
Vegetation Monitoring POC	HDR|ICA Engineering 555 Fayetteville Street, Suite 900 Raleigh, North Carolina 27601 Ben Furr (919) 900-1613

Table 4. Project Attributes Table
UT Neuse (Big Ditch) (DMS Project ID No. 92682)

Project Information	
Project Name	UT Neuse (Big Ditch)
Project County	Wayne
Project Area (acres)	10
Project Coordinates	035º 22' 24" N, 077º 59' 40'' W
Project Watershed Summary Information	
Physiographic Region	Southeastern Plains
Ecoregion	Southeastern Floodplains and Low Terraces
Project River Basin	Neuse
USGS 8-digit HUC	03020201
USGS 14-digit HUC	03020201200040
NCDWQ Subbasin	03-04-12
Project Drainage Area	2.27 sq. mi (at end of restoration reach)
Watershed Land Use	Forested = 20% Cultivated Cropland = 5% Urban = 74% Surface Water = 1%

Reach Summary Information	
Parameters	**UT Neuse (Big Ditch)**
Restored length	2,132
Drainage Area	2.27 sq. mi.
NCDWQ Index Number	27-(56)
NCDWQ Classification	WS-IV, NSW, C
Valley Type/Morphological Description	VIII/B/E5
Dominant Soil Series	Bibb/Norfolk loamy sand
Drainage Class	Bibb – poorly drained; Norfolk – well drained
Soil Hydric Status	Bibb – hydric; Norfolk – non-hydric
Slope	0.0017
FEMA Classification	AE & X
Native Vegetation Community	Coastal Plain Levee Forest

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the U.S. –Sections 404 and 401	Yes	Yes	Restoration Plan
Endangered Species Act	Yes	Yes	Restoration Plan
Historic Preservation Act	Yes	Yes	Restoration Plan
CZMA/CAMA	No	--	--
FEMA Floodplain Compliance	Yes	In Progress	LOMR
Essential Fisheries Habitat	No	--	--



HDR | ICA

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Project Vicinity Map

0 0.2 0.4 0.8 1.2 1.6 Miles

Figure 1

Appendix B. Visual Assessment Data

Figures 2.0-2.4 Current Condition Plan View

09/08/99

CONTRACT: UT TO NEUSE (BIG DITCH) DENR# D090525

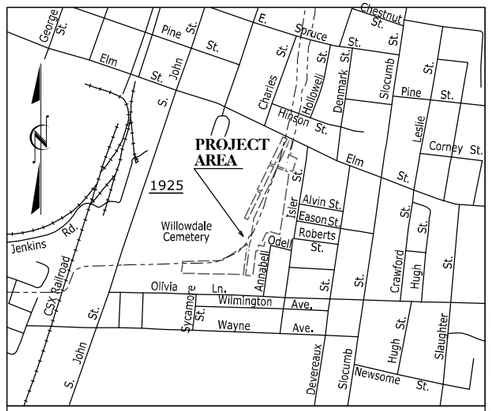
CURRENT CONDITIONS PLAN VIEW (CCPV)
UT TO NEUSE (BIG DITCH)

STATE		FIGURE NO.
N.C.	UT TO NEUSE (BIG DITCH)	2.0

LOCATION: WAYNE COUNTY, NORTH CAROLINA

LAT: 35°22'24" N **LONG: 77°59'40" W**

TYPE OF WORK: CCPV PLANS – YEAR 5



VICINITY MAP

LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LOD – LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

YEAR 5 CONDITIONS

BANKBED CONDITION
- MODERATE EROSION
- MINOR EROSION
- BANK WIDENING
- WRACK LINES
- HOLEGULLY

VEGETATION PROBLEM AREAS
- INVASIVE POPULATION
- THIN GRASS
- NO GRASS (BARE)

VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

DISTURBED AREA = 11.13 AC.

GRAPHIC SCALES

50 25 0 50 100
PLANS

DESIGN DATA

DESIGN STREAM TYPE	=	B/E 6
BANKFULL AREA (FT^2) CROSS-SECTIONED	=	16.3
BANKFULL WIDTH (FT)	=	14.0
MAX DEPTH (FT)	=	1.75
WIDTH /DEPTH RATIO	=	12
DRAINAGE AREA (MI^2)	=	2.05
BANKFULL SLOPE(FT/FT)	=	0.0017

PROJECT LENGTH

EXISTING STREAM LENGTH	=	2,113.9 FT
ASBUILT STREAM LENGTH	=	2,132.2 FT

R. KEVIN WILLIAMS
PROJECT ENGINEER

CHRISTOPHER L. SMITH
PROJECT DESIGNER

RYAN V. SMITH
PROJECT MANAGER

Prepared In the Office of:

HDR | ICA

10/17/2018
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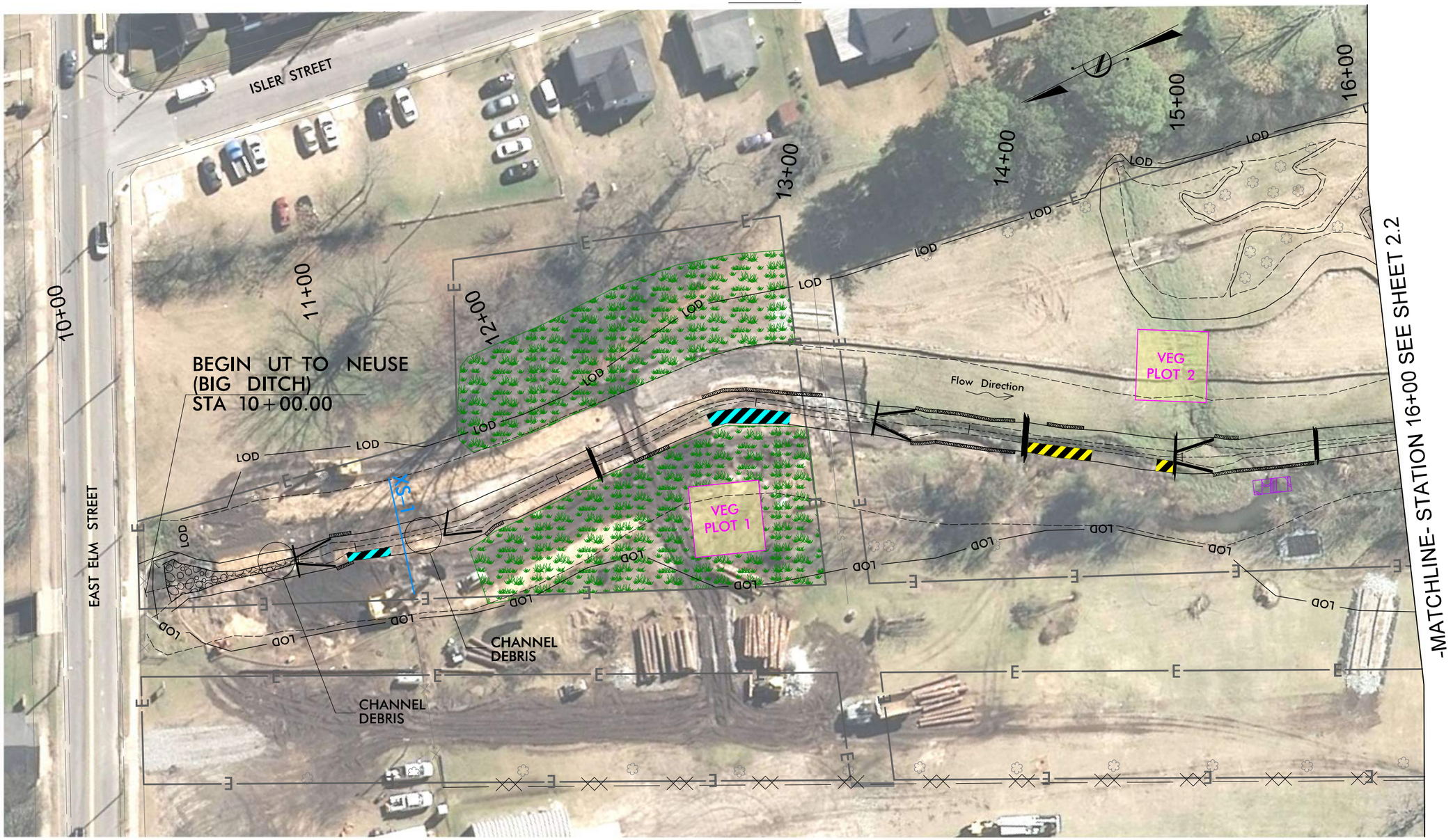
HDR/ICA

CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- LIMITS OF DISTURBANCE
- MONITORING CROSS SECTION
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

YEAR 5 CONDITIONS

BANK/BED CONDITION
- MODERATE EROSION
- MINOR EROSION

- WRACK LINES

VEGETATION PROBLEM AREAS
- INVASIVE POPULATION

VEGETATION PLOT CONDITIONS
- CRITERIA MET
- CRITERIA UNMET

HDR | ICA

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 10+00 – STA 16+00

GRAPHIC SCALE
50 0 25 50
PLANS

DATE: 04-04-18

CCPV
YEAR 5

FIGURE
2.1

10/17/2018
4:07:14 PM
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CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5

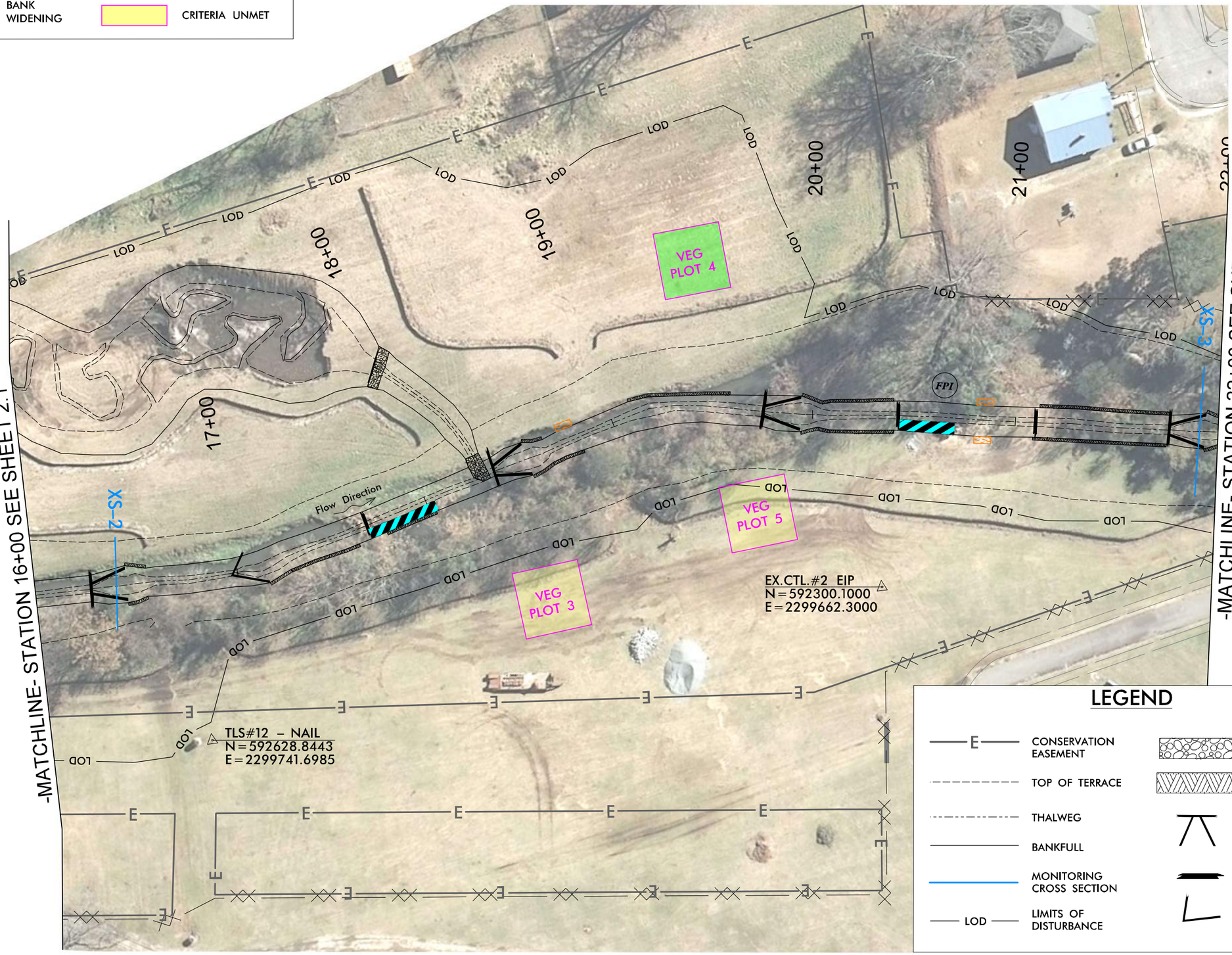
YEAR 5 CONDITIONS

BANK/BED CONDITION

- MINOR EROSION
- BANK WIDENING

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET



LEGEND

- CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

GRAPHIC SCALE
50 0 25
25
PLANS

DATE: 04-04-18

CCPV YEAR 5

FIGURE 2.2

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 16+00 – STA 22+00

HDR | ICA

10/17/2018
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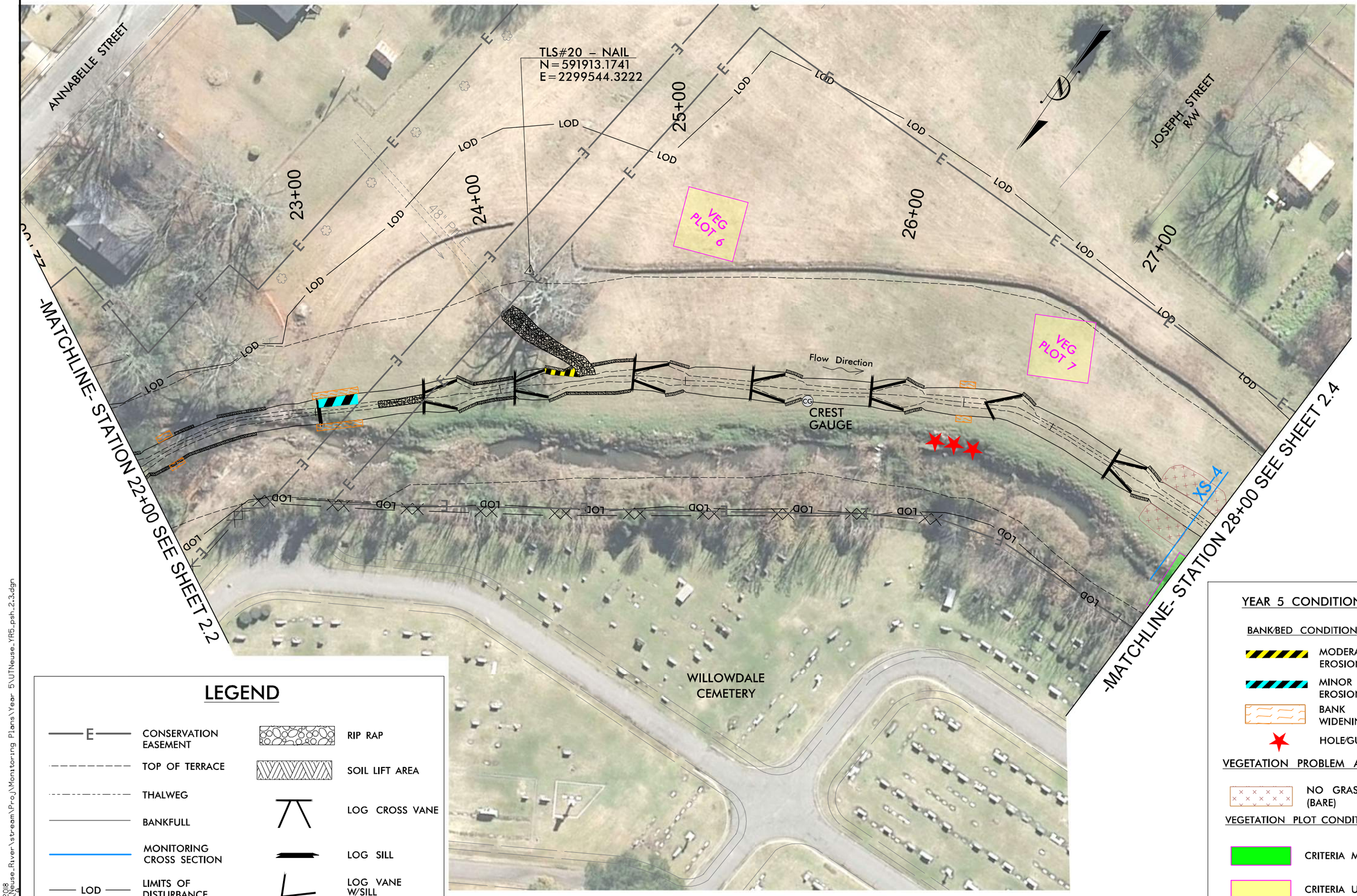
CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



LEGEND

- E — CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LOD — LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE
- LOG SILL
- LOG VANE W/SILL

YEAR 5 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- BANK WIDENING
- HOLE/GULLY

VEGETATION PROBLEM AREAS

- NO GRASS (BARE)

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

HDR | ICA

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 22+00 – STA 28+00

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 04-04-18

CCPV
YEAR 5

FIGURE
2.3

10/17/2018
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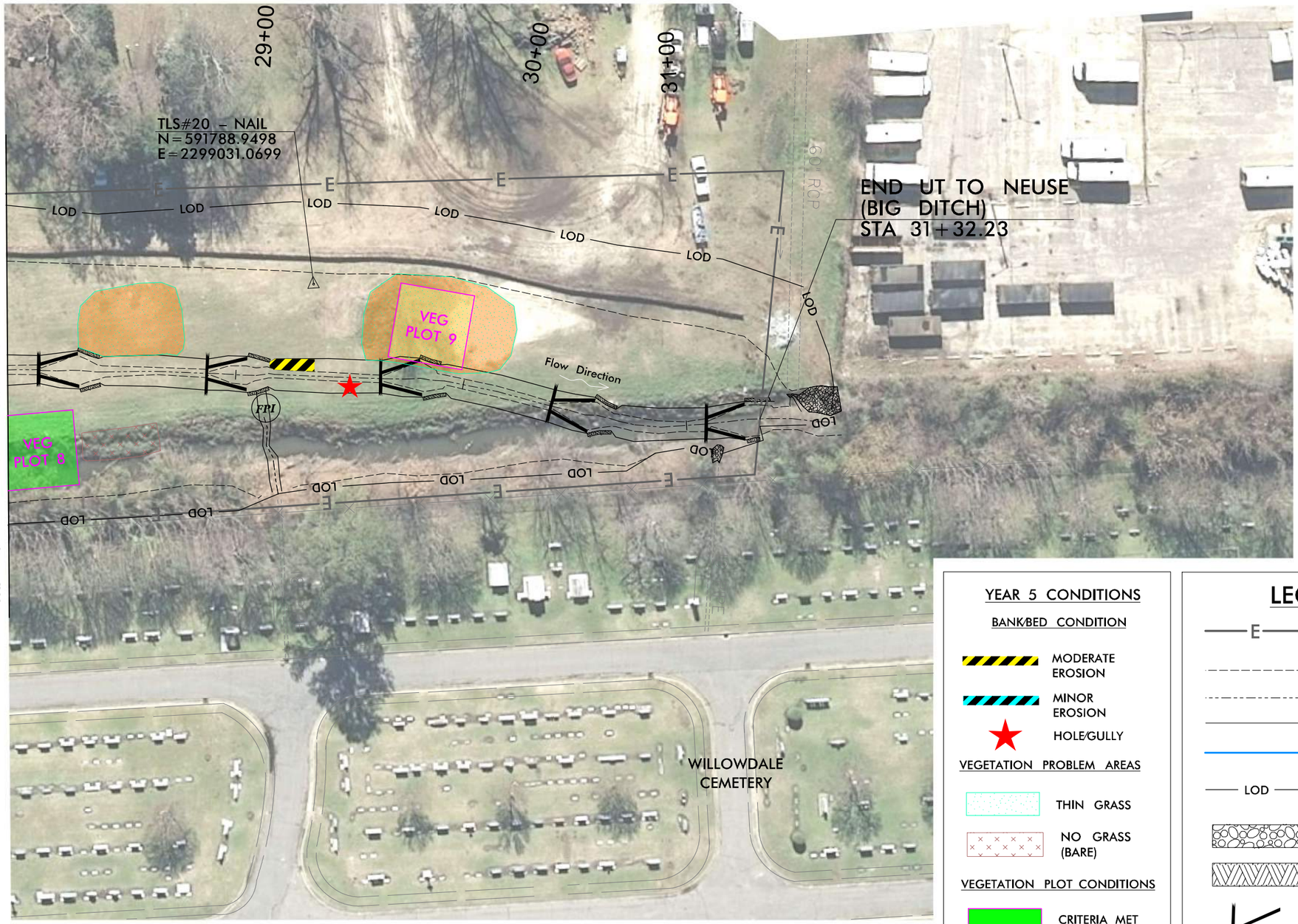
CURRENT CONDITIONS PLAN VIEW (CCPV)
YEAR 5



YEAR 5 CONDITIONS

BANK/BED CONDITION

- MODERATE EROSION
- MINOR EROSION
- HOLE/GULLY

VEGETATION PROBLEM AREAS

- THIN GRASS
- NO GRASS (BARE)

VEGETATION PLOT CONDITIONS

- CRITERIA MET
- CRITERIA UNMET

LEGEND

- E — CONSERVATION EASEMENT
- TOP OF TERRACE
- THALWEG
- BANKFULL
- MONITORING CROSS SECTION
- LOD — LIMITS OF DISTURBANCE
- RIP RAP
- SOIL LIFT AREA
- LOG CROSS VANE

HDR | ICA

UT TO NEUSE (BIG DITCH)
STREAM RESTORATION PROJECT
WAYNE COUNTY, NORTH CAROLINA
STA 28+00 – STA 31+32.23

GRAPHIC SCALE
50 25 0 25
PLANS

DATE: 04-04-18

CCPV
YEAR 5

FIGURE
2.4

10/17/2018
C:\Projects\Neuse_River\stream\Proj\Monitoring Plans\Year 5\UTNeuse_YR5_psh_2.4.dgn

Table 5. Visual Stream Morphology Stability Assessment
UT to Neuse River Site, 09-0776201
UT to Neuse River : 2,132 feet

Major Channel Category	Channel Sub-Category	Metric	Number Stable, Performing as Intended	Total Number in As-built	Number of Unstable Segments	Amount of Unstable Footage	% Stable, Performing as Intended	Number with Stabilizing Woody Vegetation	Footage with Stabilizing Woody Vegetation	Adjusted % for Stabilizing Woody Vegetation
1. Bed	**1. Vertical Stability** (Riffle and Run units)	1. Aggradation - Bar formation/growth sufficient to significantly deflect flow laterally (not to include point bars)			0	0	100%			
		2. Degradation - Evidence of downcutting			0	0	100%			
	2. Riffle Condition	1. Texture/Substrate - Riffle maintains coarser substrate	All	N/A			100%			
	3. Meander Pool Condition	1. Depth Sufficient	30	30			100%			
		2. Length appropriate	30	30			100%			
	4. Thalweg Position	1. Thalweg centering at upstream of meander bend (Run)	All	N/A			100%			
		2. Thalweg centering at downstream of meander (Glide)	All	N/A			100%			
2. Bank	**1. Scoured/Eroding**	Bank lacking vegetative cover resulting simply from poor growth and/or scour and erosion			11	248	88.4%	N/A	N/A	N/A
	2. Undercut	Banks undercut/overhanging to the extent that mass wasting appears likely. Does NOT included 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 collaps			0	0	100%	N/A	N/A	N/A
				Totals	11	248	88.4%	N/A	N/A	N/A
3. Engineered Structures	**1. Overall Integrity**	Structures physically intact with no dislodged boulders or logs	27	28			96%			
	2. Grade Control	Grade control structures exhibiting maintenance of grade across the sill.	7	7			100%			
	2a. Piping	Structures lacking any substantial flow underneath sills or arms.	3	3			100%			
	3. Bank Protection	Bank erosion within the structures extent of influence does not exceed 15%. (See guidance for this table in EEP monitoring guidance document)	18	18			100%			
	4. Habitat	Pool forming structures maintaing ~ Max Pool Depth : Mean Bankfull Depth ratio > 1.6 Rootwads/logs providing some cover at base-flow.	21	21			100%			

Table 6. Vegetation Condition Assessment UT to Neuse River Site, 09-00776201 UT to Neuse River: 2,132 feet						
Planted Acreage = 9.1						
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreage**	**% of Planted Acreage**
1. Bare Areas	Very limited ground cover (grass).	All bare or sparse areas were mapped.	See legend on CCPV (includes thin grass, no grass, and minor wash areas).	3	0.06	0.7
2. Low Stem Density Areas	Planted woody stem densities clearly below target levels based on MY5 stem count criteria. All Plots except Plots 1 and 2 are meeting stem count criteria when including natural recruits.	All areas were mapped.	Vegetation Plots 1-9	9	0.22	2.4
3. Areas of Poor Growth Rates or Vigor	Areas with woody stems of a size class that are obviously small given the monitoring year.	None	N/A	N/A	N/A	N/A
Easement Acreage = 9.94 ac						
Vegetation Category	**Definitions**	**Mapping Threshold**	**CCPV Depiction**	**Number of Polygons**	**Combined Acreadge**	**% of Planted Acreage**
4. Invasive Areas of Concern	Areas or points (if too small to render as polygons at map scale).	0.1	See legend on CCPV	2	0.37	4.1
5. Easement Encroachment Areas	Areas or points (if too small to render as polygons at map scale).	None	N/A	N/A	N/A	N/A

Appendix C. Vegetation Plot Data

Figures 3.0-3.13. Vegetation Plot Photos and Problem Area Photos

3.0 Vegetation Plot 1

3.1 Vegetation Plot 2

3.2 Vegetation Plot 3

3.3 Vegetation Plot 4

3.4 Vegetation Plot 5

3.5 Vegetation Plot 6

3.6 Vegetation Plot 7

3.7 Vegetation Plot 8

3.8 Vegetation Plot 9

3.9 Minor Erosion Station 11+00

3.10 Minor Erosion Station 13+00

3.11 Moderate Erosion Station 14+50

3.12 Moderate Erosion Station 20+60

3.13 Left arm of Log Cross Vane at Station 24+08

3.14 Moderate Erosion Station 29+25

Table 7. Vegetation Plot Mitigation Success Summary

UT Neuse (Big Ditch) (DMS Project ID No. 92682)						
Plot ID	**Community Type**	**Planting Zone ID**	**CVS Level**	**Planted Stems**	**Planted Stems Per Acre**	**Survival Threshold Met?**
1	Coastal Plain Levee Forest	CPLF	II	5	162	No
2	Coastal Plain Levee Forest	CPLF	II	5	121	No
3	Coastal Plain Levee Forest	CPLF	II	2	81	No*
4	Coastal Plain Levee Forest	CPLF	II	8	283	No*
5	Coastal Plain Levee Forest	CPLF	II	3	121	No*
6	Coastal Plain Levee Forest	CPLF	II	3	81	No*
7	Coastal Plain Levee Forest	CPLF	II	4	162	No*
8	Coastal Plain Levee Forest	CPLF	II	9	283	No*
9	Coastal Plain Levee Forest	CPLF	II	4	121	No*
Average Planted Stems Per Acre					157	

*Plots meet survival threshold when including natural recruits.

Table 8. CVS Vegetation Metadata

Report Prepared By	alex d digeronimo
Date Prepared	7/19/2018 10:52
database name	cvs-eep-entrytool-v2.3.1 – MY5, KB.mdb
database location	Z:\UT_Neuse\Docs\Monitoring
computer name	RAL-CND7204PSL
file size	45481984
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
Planted Stems by Plot and Spp	A matrix of the count of PLANTED living stems of each species for each plot; dead and missing stems are excluded.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
Project Code	92682
project Name	UT NEUSE (BIG DITCH)
Description	STREAM AND RIPARIAN BUFFER MITIGATION
River Basin	Neuse
length(ft)	2127
stream-to-edge width (ft)	80
area (sq m)	31613.56
Required Plots (calculated)	9
Sampled Plots	9

Table 9. CVS Stem Count Total and Planted by Plot and Species

Table 9. Stem Count Total and Planted by Plot and Species
EEP Project Code 92682. Project Name: UT NEUSE (BIG DITCH)

			Current Plot Data (MY5 2018)																	
			92682-ICA-0001			92682-ICA-0002			92682-ICA-0003			92682-ICA-0004			92682-ICA-0005			92682-ICA-0006		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree																		
Amelanchier	serviceberry	Tree																		
Baccharis halimifolia	eastern baccharis	Shrub																		1
Betula nigra	river birch	Tree	1	1	1							1	1	1				1	1	1
Carpinus caroliniana	American hornbeam	Tree																		
Carya	hickory	Tree									3									
Carya alba	mockernut hickory	Tree																		
Carya glabra	pignut hickory	Tree															1			
Cercis canadensis	eastern redbud	Tree															2			
Chionanthus virginicus	white fringetree	Shrub Tree			2															
Cornus amomum	silky dogwood	Shrub																		
Diospyros virginiana	common persimmon	Tree									3	1	1	1						
Fraxinus pennsylvanica	green ash	Tree			1	1	1	1	1	1	1									
Lagerstroemia indica	crapemyrtle	Exotic			4						3						2			2
Liquidambar styraciflua	sweetgum	Tree									1			2			3			
Liriodendron tulipifera	tuliptree	Tree				1	1	1	1	1	1				1	1	1			1
Ostrya virginiana	hophornbeam	Tree	1	1	1															
Pinus taeda	loblolly pine	Tree																		6
Platanus occidentalis	American sycamore	Tree										1	1	1						
Populus deltoides	eastern cottonwood	Tree																		
Prunus serotina	black cherry	Tree																		
Pyrus calleryana	Callery pear	Exotic												1						
Quercus falcata	southern red oak	Tree																		
Quercus laurifolia	laurel oak	Tree																		
Quercus michauxii	swamp chestnut oak	Tree																		
Quercus nigra	water oak	Tree																		
Quercus pagoda	cherrybark oak	Tree				1	1	1				1	1	1				1	1	1
Quercus phellos	willow oak	Tree																		
Quercus rubra	northern red oak	Tree	1	1	1							2	2	2	2	2	2			
Rhus copallinum	flameleaf sumac	shrub																		
Salix nigra	black willow	Tree										1	1	1						
Styphnolobium japonicum	japanese pagoda tree	Exotic																		1
Ulmus americana	American elm	Tree	1	1	1															
		Stem count	4	4	7	3	3	3	2	2	9	7	7	9	3	3	9	2	2	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	4	4	6	3	3	3	2	2	5	6	6	8	2	2	5	2	2	5
		Stems per ACRE	161.9	161.9	283.3	121.4	121.4	121.4	80.94	80.94	364.2	283.3	283.3	364.2	121.4	121.4	364.2	80.94	80.94	404.7

Color for Density

Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

Table 9. Stem Count Total and Planted by Plot and Species
EEP Project Code 92682. Project Name: UT NEUSE (BIG DITCH)

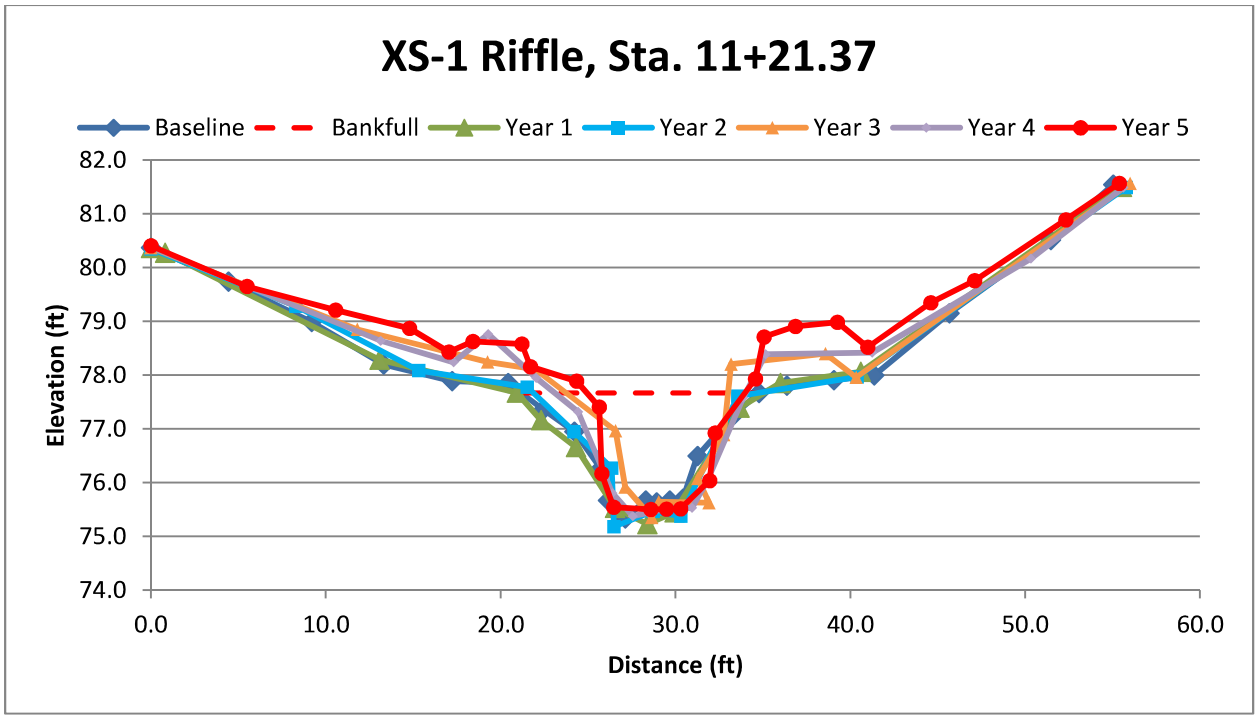
			Current Plot Data (MY5 2018)									Annual Means																
			92682-ICA-0007			92682-ICA-0008			92682-ICA-0009			MY5 (2018)			MY4 (2017)			MY3 (2016)			MY2 (2015)			MY1 (2014)			MY0 (2014)		
Scientific Name	Common Name	Species Type	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T	PnoLS	P-all	T
Acer rubrum	red maple	Tree																					2					
Amelanchier	serviceberry	Tree																									1	1	1
Baccharis halimifolia	eastern baccharis	Shrub												1			1											
Betula nigra	river birch	Tree			2						1	3	3	6	3	3	4	3	3	6	3	3	4	6	6	6	8	8	8
Carpinus caroliniana	American hornbeam	Tree															2											
Carya	hickory	Tree												3												3		
Carya alba	mockernut hickory	Tree																									2	2	2
Carya glabra	pignut hickory	Tree				1	1	1				1	1	2	4	4	4	2	2	4	3	3	4	9	9	9	11	11	11
Cercis canadensis	eastern redbud	Tree												2														
Chionanthus virginicus	white fringetree	Shrub Tree												2				1	1	1	1	1	1				1	1	1
Cornus amomum	silky dogwood	Shrub															2						5					
Diospyros virginiana	common persimmon	Tree				2	2	2				3	3	6	4	4	4	2	2	6	2	2	5	6	6	6	7	7	7
Fraxinus pennsylvanica	green ash	Tree										2	2	3	2	2	2				1	1	3	3	3	3	3	3	3
Lagerstroemia indica	crapemyrtle	Exotic												11			35			16			8						
Liquidambar styraciflua	sweetgum	Tree			2						5			13			11			6			9					
Liriodendron tulipifera	tuliptree	Tree	1	1	1						2	4	4	7	4	4	4	2	2	2	7	7	9	14	14	14	17	17	17
Ostrya virginiana	hophornbeam	Tree				1	1	1				2	2	2	2	2	2										1	1	1
Pinus taeda	loblolly pine	Tree			11			10			7			16						6									
Platanus occidentalis	American sycamore	Tree										1	1	1	1	1	1	1	1	1	3	3	3	3	3	4	5	5	5
Populus deltoides	eastern cottonwood	Tree															1												
Prunus serotina	black cherry	Tree			1									1			3												
Pyrus calleryana	Callery pear	Exotic												1															
Quercus falcata	southern red oak	Tree																		2									
Quercus laurifolia	laurel oak	Tree																		1									
Quercus michauxii	swamp chestnut oak	Tree			1				1	1	1	1	1	2	1	1	1	1	1	1									
Quercus nigra	water oak	Tree	1	1	1				1	1	1	2	2	2	3	3	3	4	4	4	4	4	4	4	4	4	8	8	8
Quercus pagoda	cherrybark oak	Tree	1	1	1	1	1	1				5	5	5	6	6	6	5	5	5	6	6	7	8	8	8	9	9	9
Quercus phellos	willow oak	Tree	1	1	1			1	1	1	1	2	2	3	2	2	2	2	2	4	2	2	5	2	2	2			
Quercus rubra	northern red oak	Tree				2	2	3				7	7	8	9	9	10	8	8	9	12	12	12	16	16	16	21	21	21
Rhus copallinum	flameleaf sumac	shrub															2												
Salix nigra	black willow	Tree										1	1	1	1	1	11	1	1	1	1	1	1	1	1	1			
Styphnolobium japonicum	japanese pagoda tree	Exotic												1															
Ulmus americana	American elm	Tree									1	1	1	2	1	1	1												
		Stem count	4	4	21	7	7	19	3	3	19	35	35	88	43	43	77	32	32	59	45	45	74	72	72	76	94	94	94
		size (ares)	1			1			1			9			9			9			9			9			9		
		size (ACRES)	0.02			0.02			0.02			0.22			0.22			0.22			0.22			0.22			0.22		
		Species count	4	4	9	5	5	7	3	3	7	14	14	21	14	14	22	12	12	17	12	12	16	11	11	12	13	13	13
		Stems per ACRE	161.9	161.9	849.8	283.3	283.3	768.9	121.4	121.4	768.9	157.4	157.4	395.7	193.3	193.3	346.2	145.5	145.5	268.2	204.5	204.5	336.4	327.3	327.3	345.5	427.3	427.3	427.3

Color for Density

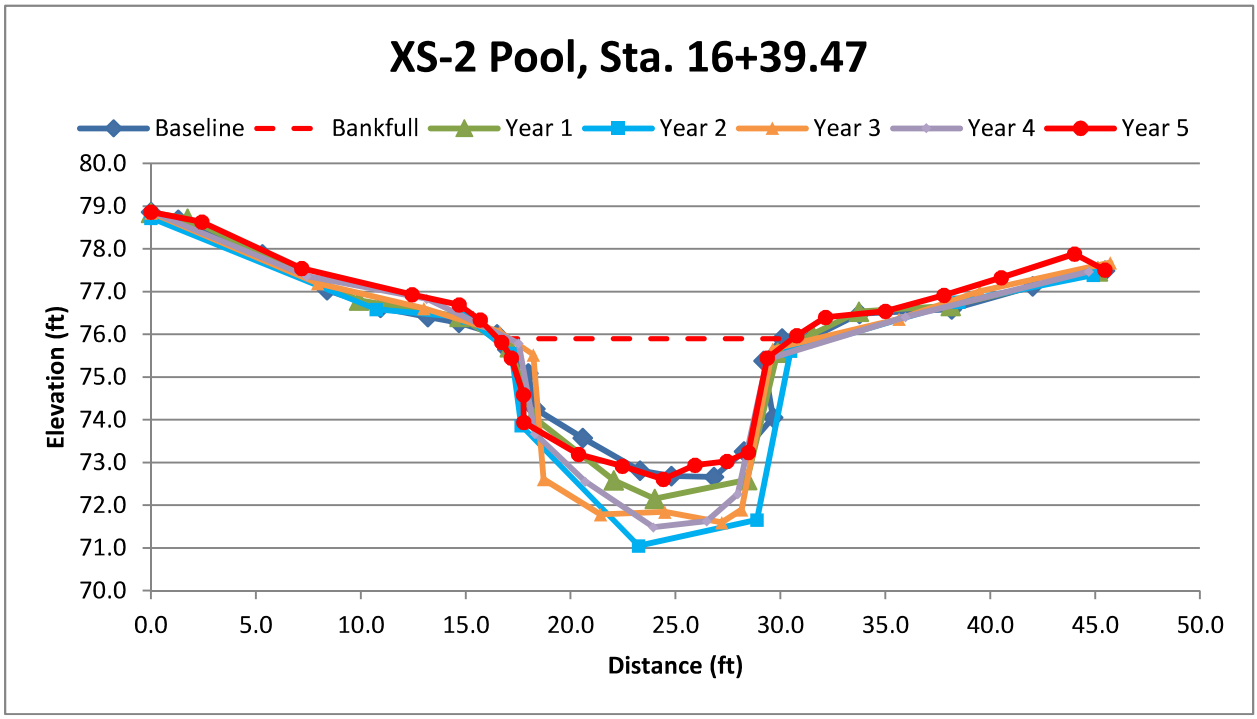
Exceeds requirements by 10%
Exceeds requirements, but by less than 10%
Fails to meet requirements, by less than 10%
Fails to meet requirements by more than 10%

Appendix D. Stream Survey Data
Figure 4.0-4.3 Cross Section Plots

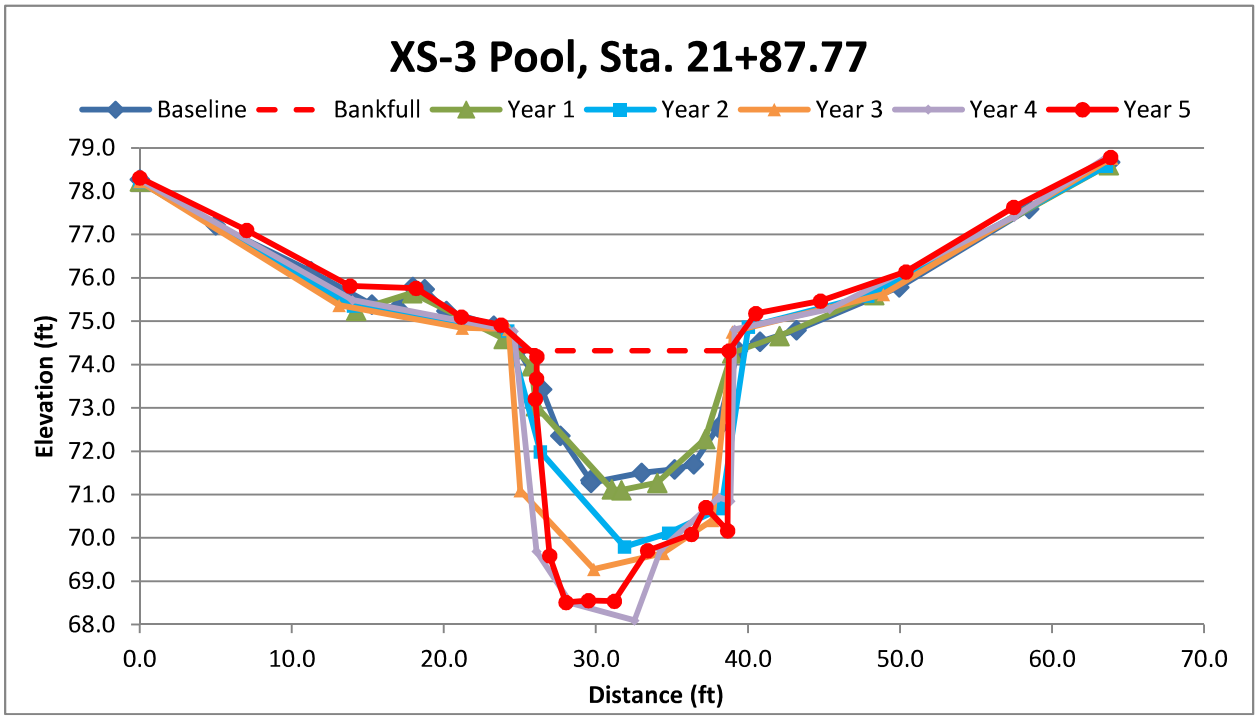
4.0


XS-1 Riffle, Sta. 11+21.37
Baseline
Bankfull
Year 1
Year 2
Year 3
Year 4
Year 5
Elevation (ft)
82.0
81.0
80.0
79.0
78.0
77.0
76.0
75.0
74.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Distance (ft)

4.1


XS-2 Pool, Sta. 16+39.47
Baseline
Bankfull
Year 1
Year 2
Year 3
Year 4
Year 5
Elevation (ft)
80.0
79.0
78.0
77.0
76.0
75.0
74.0
73.0
72.0
71.0
70.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Distance (ft)

4.2


XS-3 Pool, Sta. 21+87.77
Baseline
Bankfull
Year 1
Year 2
Year 3
Year 4
Year 5
Elevation (ft)
79.0
78.0
77.0
76.0
75.0
74.0
73.0
72.0
71.0
70.0
69.0
68.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Distance (ft)

4.3

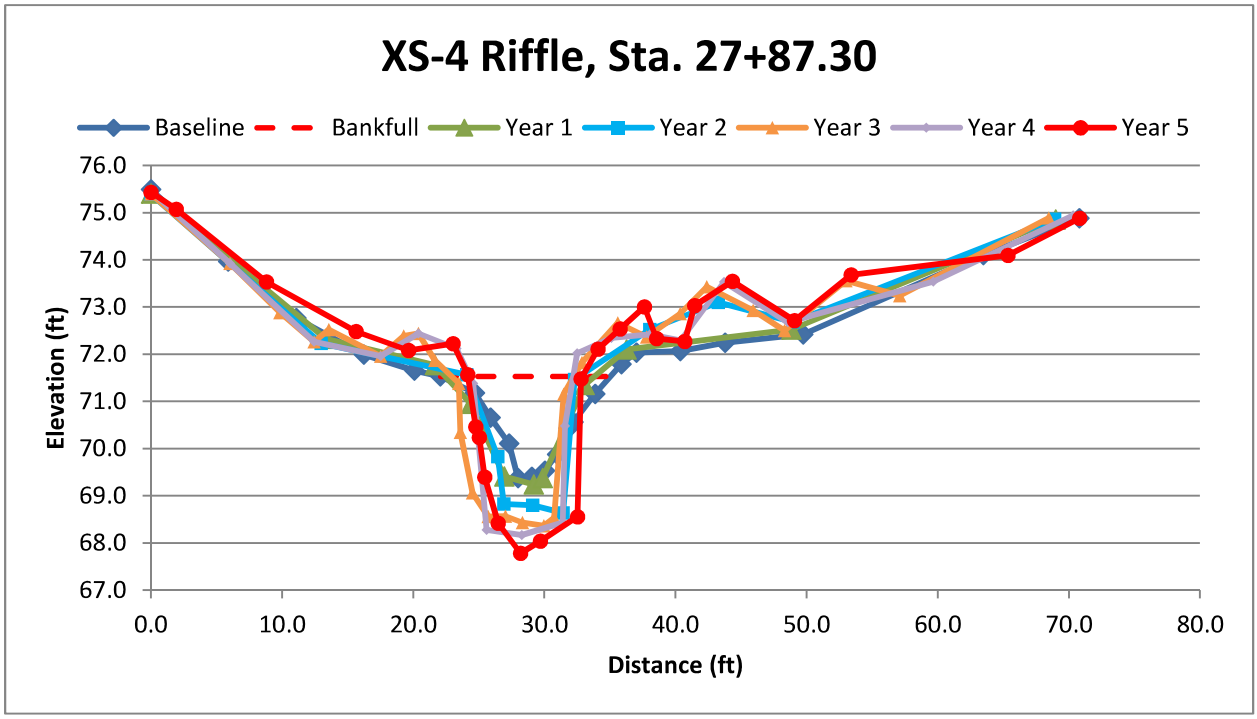

XS-4 Riffle, Sta. 27+87.30
Baseline
Bankfull
Year 1
Year 2
Year 3
Year 4
Year 5
Elevation (ft)
76.0
75.0
74.0
73.0
72.0
71.0
70.0
69.0
68.0
67.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
Distance (ft)

Figure 5.1-5.2 Longitudinal Profile Plot

Figure 5.1 UT Neuse - Longitudinal Profile

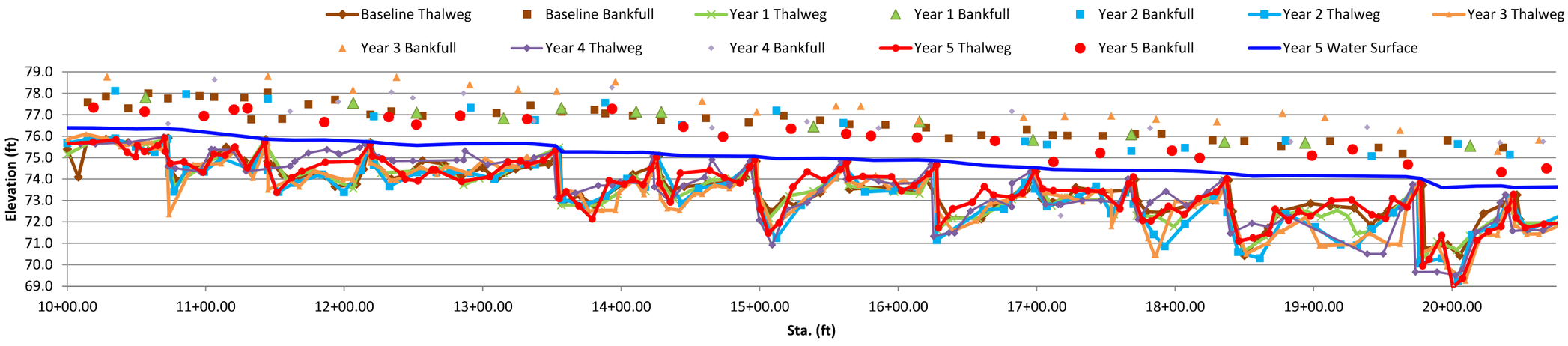


Figure 5.2 UT Neuse - Longitudinal Profile

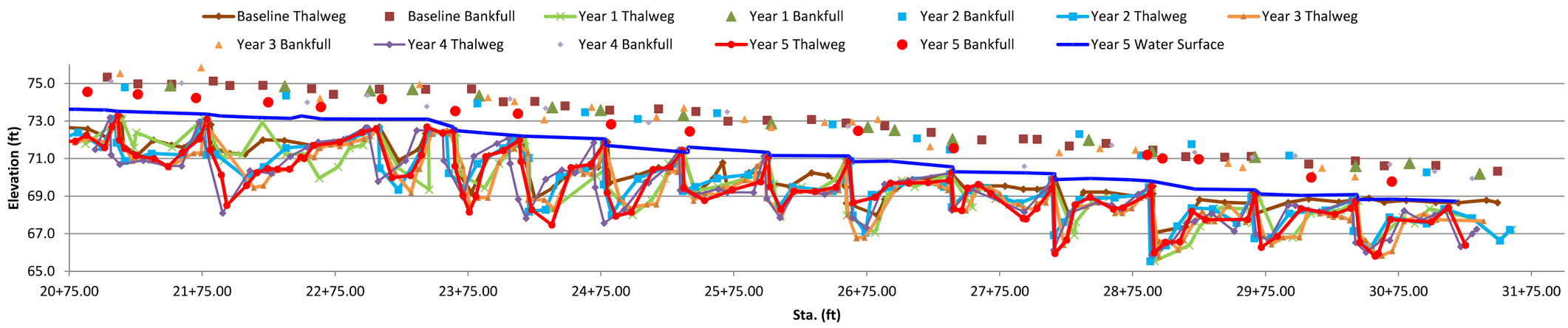


Table 10. Baseline Stream Data Summary
UT Neuse (Big Ditch), DMS Project ID No. 92682
UT Neuse: 2,132 LF

Parameter	Regional Curve			Pre-Existing Condition	Reference - Johnson Mill	Design	As-built/Baseline					
Dimension and Substrate - Riffle	Eq.			Mean	Mean	Mean	Min	Mean	Med	Max	SD	n
Bankfull Width (ft)	14.20			8.90	21.20	14.00	13.00	13.30	13.30	13.60	0.42	2
Floodprone Width (ft)				16.60	34.90	36.00	46.70	49.85	49.85	53.00	4.45	2
Bankfull Mean Depth (ft)	1.60			1.01	2.25	1.17	1.00	1.10	1.10	1.20	0.14	2
Bankfull Max Depth (ft)				1.43	2.42	1.75	2.20	2.25	2.25	2.30	0.07	2
Bankfull Cross Sectional Area (ft^2)	23.30			9.02	47.59	16.30	13.00	14.30	14.30	15.60	1.84	2
Width/Depth Ratio				8.90	9.40	12.00	11.80	12.40	12.40	13.00	0.85	2
Entrenchment Ratio				1.85	1.65	2.60	3.40	3.75	3.75	4.10	0.49	2
Bank Height Ratio				5.80	1.00	1.00	1.00	1.00	1.00	1.00	0.00	2
d50 (mm)				sand	sand	sand						
Profile												
Riffle Length (ft)							38.64	59.42	60.26	82.92	16.99	8
Riffle Slope (ft/ft)				0.0100	0.0010	0.0021	0.0014	0.0021	0.0020	0.0034	0.0007	8
Pool Length (ft)							28.34	48.34	52.08	73.96	12.02	25
Pool Max depth (ft)				1.50	3.56	2.33	2.78	3.86	3.79	5.14	0.64	25
Pool Spacing (ft)				23.14-86.74	91.07-129.97	56.0-84.0	22.39	79.14	73.37	155.21	29.55	24
Pool Cross Sectional Area (ft^2)							31.10	31.15	31.15	31.20	0.07	2
Pattern												
Channel Beltwidth (ft)				Channelized	50-1500	28-980						
Radius of Curvature (ft)				Channelized	43-235	42-70						
Rc: Bankfull Width (ft/ft)				Channelized	2.0-11.1	3.0-5.0						
Meander Wavelength (ft)				Channelized	250-400	140-280						
Meander Width Ratio				Channelized	2.36-70.85	2.0-70.0						
Substrate, bed and transport parameters												
Ri% / P%							36%/46%					
SC% / Sa% / G% / C% / B% / Be%												
d16 / d35 / d50 / d84 / d95/ di^p / di^{sp} (mm)												
Reach Shear Stress (competency) lb/ft^2				0.282	0.116	0.113						
Max part size (mm) mobilized at bankfull												
Unit Stream Power (transport capacity) lbs/ft.s				0.964	0.200	0.193	0.223					
Additional Reach Parameters												
Drainage Area (SM)				2.05	13.50	2.05						
Impervious cover estimate (%)												
Rosgen Classification				G/B 5	B5	B/E 5	E5					
Bankfull Velocity (fps)					1.50	1.70	1.75					
Bankfull Discharge (cfs)				25.00	80.90	25.00	25.00					
Valley length (ft)				2106		2106.00	2106.00					
Channel Thalweg length (ft)				2113		2128.00	2150.00					
Sinuosity (ft)				1.00	1.10	1.01	1.02					
Water Surface Slope (Channel) (ft/ft)				0.0055	0.0010	0.0017	0.0044					
BF slope (ft/ft)						0.0017	0.0044					
Bankfull Floodplain Area (acres)												
Proportion over wide (%)												
Entrenchment Class (ER Range)												
Incision Class (BHR Range)												
BEHI VL% / L% / M% / H% / VH% / E%												
Channel Stability or Habitat Metric												
Biological or Other												

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

UT Neuse (Big Ditch) (DMS Project No. 92682)

UT Neuse: 2,132 LF

	Cross Section 1 (Riffle)							Cross Section 2 (Pool)						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	13.60	14.14	11.54	9.32	9.10	9.04		13.40	15.42	13.42	14.59	14.33	14.04	
Floodprone Width (ft)	46.70	47.68	47.07	45.90	37.23	43.41		45.50	45.13	44.92	45.72	45.72	45.46	
Bankfull Mean Depth (ft)	1.20	1.28	1.33	1.30	1.34	1.53		2.30	2.45	3.37	2.90	2.73	2.31	
Bankfull Max Depth (ft)	2.30	2.44	2.43	2.31	1.95	2.18		3.20	3.85	4.56	4.30	4.31	3.22	
Bankfull Cross Sectional Area (ft^2)	15.60	18.09	15.37	12.11	12.18	13.87		31.10	37.82	45.2	42.34	39.15	32.50	
Bankfull Width/Depth Ratio	11.80	11.05	8.68	7.17	6.79	5.91		5.80	6.29	3.98	5.03	5.25	6.08	
Bankfull Entrenchment Ratio	3.40	3.37	4.08	4.93	4.09	4.80		3.40	2.93	3.35	3.13	3.19	3.24	
Low Bank Height (ft)	---	---	---	---	---	2.38		---	---	---	---	---	3.29	
Bankfull Bank Height Ratio*	1.00	1.00	1.00	1.11	1.32	1.09		1.00	1.00	1.00	1.00	1.00	1.02	
	Cross Section 3 (Pool)							**Cross Section 4 (Riffle)**						
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Bankfull Width (ft)	14.40	17.55	17.45	14.45	14.19	13.07		13.00	13.24	8.09	8.94	7.54	8.72	
Floodprone Width (ft)	53.10	60.27	63.58	63.94	63.94	63.85		53.00	59.47	59.04	64.26	64.26	70.23	
Bankfull Mean Depth (ft)	2.20	2.00	3.37	4.11	4.75	4.62		1.00	1.30	2.00	2.44	2.68	2.86	
Bankfull Max Depth (ft)	3.00	3.49	5.07	5.04	6.22	3.49		2.20	2.53	2.82	3.16	3.22	2.28	
Bankfull Cross Sectional Area (ft^2)	31.20	35.19	58.73	59.38	67.41	60.34		13.00	17.22	16.20	21.80	20.24	24.91	
Bankfull Width/Depth Ratio	6.60	8.78	5.18	3.52	2.99	2.83		13.00	10.18	4.04	3.66	2.81	3.05	
Bankfull Entrenchment Ratio	3.70	3.43	3.64	4.43	4.51	4.88		4.10	4.49	7.30	7.19	8.52	8.05	
Low Bank Height (ft)	---	---	---	---	---	6.50		---	---	---	---	---	3.7	
Bankfull Bank Height Ratio*	1.00	1.00	1.00	1.04	1.07	1.86		1.00	1.00	1.00	1.00	1.19	1.62	

*Base- MY4-Widths and depths for each resurvey based on the baseline bankfull datum regardless of dimensional/depositional development. BHR calculation for MY5 applied the AB Bankfull area to the year 5 cross section survey to determine MY5 Max depth and BHR in keeping with revised calculation method agreed upon by the Industry technical workgroup in 2018.

Table 12. Monitoring Data - Stream Reach Data Summary

UT to Neuse River Site, DMS Project No. 92682

UT Neuse: 2,132 LF

Parameter	Baseline			MY-1			MY-2			MY-3			MY-4			MY-5		
Dimension and substrate - Riffle only	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	13.00	13.30	13.60	13.24	13.69	14.14	8.09	9.82	11.54	8.94	9.13	9.32	7.54	8.32	9.10	8.72	8.88	9.04
Floodprone Width (ft)	46.70	49.85	53.00	47.68	53.58	59.47	47.07	53.06	59.04	45.90	55.08	64.26	45.90	55.05	64.26	43.41	56.82	70.23
Bankfull Mean Depth (ft)	1.00	1.10	1.20	1.28	1.29	1.30	1.33	1.67	2.00	1.30	1.87	2.44	1.34	2.01	2.68	1.53	2.20	2.86
Bankfull Max Depth (ft)	2.20	2.25	2.30	2.44	2.49	2.53	2.43	2.63	2.82	2.31	2.74	3.16	1.95	2.58	3.22	2.17	2.96	3.75
Bankfull Cross Sectional Area (ft^2)	13.00	14.30	15.60	17.22	17.66	18.09	15.37	15.79	16.20	12.11	16.96	21.80	12.18	16.21	20.24	13.87	19.39	24.91
Bankfull Width/Depth Ratio	11.80	12.40	13.00	10.18	10.62	11.05	4.04	6.36	8.68	3.66	5.42	7.17	2.81	4.80	6.79	3.05	4.48	5.91
Bankfull Entrenchment Ratio	3.40	3.75	4.10	3.37	3.93	4.49	4.08	5.69	7.30	4.93	6.06	7.19	5.04	6.78	8.52	4.80	6.43	8.05
Bankfull Bank Height Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.06	1.11	1.19	1.25	1.32	1.32	1.36	1.39
Profile																		
Riffle Length (ft)	38.64	59.42	82.92	11.51	18.03	50.98	19.83	30.74	41.18	5.92	28.20	73.01	11.51	36.26	77.29	19.19	46.42	84.21
Riffle Slope (ft/ft)	0.0014	0.0021	0.0034	0.01	0.02	0.02	0.01	0.04	0.07	0.01	0.01	0.02	0.001	0.01	0.02	0.003	0.01	0.04
Pool Length (ft)	28.34	48.34	73.96	42.65	74.83	139.02	27.97	56.61	109.40	60.19	74.91	139.12	32.89	69.87	132.49	11.93	39.36	90.02
Pool Max Depth (ft)	2.78	3.86	5.14	1.17	2.64	4.10	4.56	4.82	5.07	3.53	4.78	6.12	2.73	4.86	6.79	2.71	3.92	5.72
Pool Spacing (ft)	22.39	79.14	155.21	47.39	79.56	178.52	43.76	70.24	125.53	67.09	81.96	140.11	52.62	78.15	151.29	23.02	69.64	131.86
Pattern																		
Channel Beltwidth (ft)	36.50	48.58	79.96															
Radius of Curvature (ft)	143.00	160.16	171.56															
Rc:Bankfull Width (ft/ft)	14.79	18.06	23.16															
Meander Wavelength (ft)	201.80	263.54	346.54															
Meander Width Ratio	2.41	3.33	5.34															
Additional Reach Parameters																		
Rosgen Classification	E5			E5			E5			E5			E5			E5		
Channel Thalweg length (ft)	2,132			2,132			2,132			2,132			2,132			2,132		
Sinuosity (ft)	1.03			1.03			1.03			1.03			1.03			1.03		
Water Surface Slope (Channel) (ft/ft)	0.00442			0.00348			0.0035			0.0033			0.0036			0.0036		
BF slope (ft/ft)	0.00436			0.00357			0.0037			0.0034			0.0038			0.0035		
[3]Ri% / P%	36 / 64			32 / 68			42 / 58			36 / 64			30 / 70			35 / 65		
[3]SC% / Sa% / G% / C% / B% / Be%																		
[3]d16 / d35 / d50 / d84 / d95																		
[2]% of Reach with Eroding Banks																		
Channel Stability or Habitat Metric																		
Biological or Other																		

Shaded cells indicate that these will typically not be filled in.

1 = The distributions for these paramenters can include information from both thte cross-section surveys and the longitudinal profile.

2 = Proportion of reach exhibiting banks that are eroding based on the visual survey from visual assessment table

3 = Riffle, Run, Pool, Glide, Step; Silt/Clay, Sand, Gravel, Cobble, Boulder, Bedrock; dip = max pave, disp = max subpave

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

Appendix E. Hydrologic Data

Table 13. Verification of Bankfull Events

Date	Crest Gauge Info		Gauge Reading (ft)	Gauge Elevation (ft)	Crest Elevation (ft)	Bankfull Elevation (ft)	Height above Bankfull (ft)	Photo
	Site	Sta.						
4/28/2014	XS 4	26+00	1.46	70.8	72.26	71.53	0.73	6.1
8/20/2014	XS 4	26+00	3.04	70.8	73.84	71.53	2.31	6.2
3/13/2015	XS 4	26+00	Visual	Visual	Visual	Debris lines above bankfull	Debris lines above bankfull	6.3
9/02/2015	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.4
2/26/2016	XS 4	26+00	Visual	Visual	Visual	Crest gauge damaged by high flow	Crest gauge damaged by high flow	6.5
8/11/2016	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.6
1/31/2017	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.7
8/16/2017	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.8
3/15/2018	XS 4	26+00	3.77	70.8	74.57	71.53	3.04	6.9
7/19/2018	XS 4	26+00	2.29	70.8	73.09	71.53	1.56	6.10

Figure 6.1–6.10 Crest Gauge Photos

Figure 6.1 Crest Gauge 8/20/2014

Figure 6.2 Crest Gauge 4/28/2014

Figure 6.3 Crest Gauge 3/13/2015

Figure 6.4 Crest Gauge 9/02/2015

Figure 6.5 Damaged Crest Gauge 2/26/2016

Figure 6.6 Crest Gauge 8/11/2016

Figure 6.7 Crest Gauge 1/30/2017

Figure 6.8 Crest Gauge 8/16/2017

Figure 6.9 Crest Gauge 3/15/2018

Figure 6.10 Crest Gauge 7/19/2018