Harrell Farm Stream/Wetland Restoration
Mitigation Plan
Contract # D05025-1

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EXECUTIVE SUMMARY

The Harrell Stream and Wetland Restoration Site is located in the Coastal Plain in Edgecombe County, North Carolina. The project will mitigate stream and wetland impacts within the 8-digit hydrologic cataloging unit 03020101 in the Tar-Pamlico River Basin by restoring 6,808 linear feet on an Unnamed Tributary to Swift Creek and 15.0 acres of Coastal Plain Small Stream Swamp wetland community. The goals of the project included protecting aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed; reestablishing terrestrial and aquatic habitat, and connecting the site to the existing floodplain corridor along Swift Creek. In order to reach these goals, the project objectives included restoring 6,808 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system; connecting the stream to a functioning floodplain; filling and plugging ditches in the drained hydric soils to restore saturated hydrologic conditions for a continual 5% of the growing season, and planting tree species typical of a Coastal Plain Small Swamp Stream along the stream riparian corridor and floodplain as well as in the restored wetland.

The project watershed drains toward the southeast with a contributing area of approximately 0.69 square mile (441 acres) at the downstream limits of the site. Approximately 387.2 acres drain to the stream while 56.9 acres drain to the project wetland site. The surrounding area is predominately rural and has low development pressure at this time. The wetland design was completed in August 2006, construction began in October 2006 and the wetland was planted in February 2007. The stream design and the restoration plan were completed in April 2007, construction began in July 2007 and the stream was planted in January 2008.

The stream restoration included four separate reaches, which were restored based on a combination of Priority Levels 2 and 3. Log drop structures were used to control grade throughout the profile. The stream was restored to a B5c and C5 stream types. The as-built survey and baseline monitoring found that there were minimal deviations from the designed cross-sections and profile. The baseline monitoring revealed that the stream has already begun to exhibit the typical features associated with sand channels, such as the movement of dunes and anti-dunes along the longitudinal profile. The movement of the sand bed will cause variation in the monitored cross-sections and profiles, but these variations are expected and will be evaluated to determine if they are associated with normal stable channel processes or if they indicate a trend toward instability.

The site will be monitored for at least five years beginning in 2008 through 2012 or until the success criteria are achieved. Reports will be submitted to the EEP each year. Both the wetland and stream must meet the success criteria of 320 planted stems/acre at the end of the monitoring period. The baseline monitoring counted an average of 693 stems/acre in the 12 wetland vegetation monitoring plots and 840 stems/acre in the 18 riparian buffer vegetation monitoring plots. Stream success will be assessed utilizing measurements of stream dimension, pattern, profile, and site photographs. Four groundwater wells and a rain gauge will be used to monitor hydrology of the wetland. From the collected data, groundwater hydrographs will be developed to determine if the wetland is meeting the success criteria of groundwater within 12 inches of the soil surface continuously for at least 5% of the growing season during normal weather conditions.

The wetland was restored by plugging and filling the ditch network and recreating wetland microtopography. The site was graded to form small depression and rises throughout the site that resemble the minor elevation variations found in a natural wetland. These modifications allow precipitation and overland flow to remain on site. The removal of ditches has raised the groundwater level.

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1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Harrell Stream and Wetland Restoration Site is located approximately six miles northeast of Rocky Mount, North Carolina in Edgecombe County (Figure 1). The latitude and longitude of the project site are 36.0201 North and 77.6807 West (WGS1984). To reach the site from Raleigh, proceed east on U.S. Route 264-East/64-East (US 264E/64E) for approximately 17 miles. Continue on US 64E for another 30 miles. Take the U.S. Route 301 Bypass and then U.S. Route 301 (US 301) north into Battleboro. Make a right onto Battleboro-Leggett Road and then turn left onto Morning Star Church Road just outside of town. Proceed through Cherry Crossroads and continue for 2.25 miles. The project site is on the left side of Morning Star Church Road and is directly opposite the junction with Benson Farm Road.

1.2 Project Goals and Objectives

The goals and objectives of the restoration project are as follows:

Restoration Goals:

- Protect aquatic resources from excess nutrients, sediment, and other pollutants coming from the agricultural watershed.
- Reestablish terrestrial and aquatic habitat and connect the site to the existing floodplain corridor along Swift Creek.

Restoration Objectives:

- Restore 6,808 linear feet of stable stream channel with the appropriate pattern, profile, and dimension that can support a sand transport system.
- Connect the stream to a functioning floodplain.
- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions for 5% of the growing season.
- Plant tree species typical of a Coastal Plain Small Swamp Stream along the stream riparian corridor and floodplain as well as in the restored wetland.

1.3 Project Structure, Restoration Type and Approach

The project stream had been channelized and straightened since at least 1948. The entire site was under agricultural production, with the fields directly bordering the stream. There were no remaining vegetated buffers or in-stream features in the channel and the banks were nearly vertical. The channel was characterized as having poor streambed variability and habitat diversity. Restoration of 6,808 linear feet of channel was accomplished utilizing a combination of Priority Levels 2 and 3 (Table 1). Reach 1 (Station 10+00 to 22+26) was restored using a Priority Level 3 approach. The restoration of a B5c channel with a sinuosity of 1.06 was accomplished by building a bankfull channel with a higher width/depth ratio than the existing stream, creating distinct bed features by adding pools and riffles to the profile, and grading back the upper slopes to create an appropriate valley for the stream. Reaches 2, 3, and 4 (Stations 22+26 to 36+91, 36+91 to 51+82, and 51+82 to 78+80, respectively) were restored to a C5 channel with a Priority Level 2 restoration. The restoration established a bankfull channel with a new floodplain where the designed bankfull stage equals the new floodplain elevation (bank height ratio=1.0). Reaches 2, 3, and 4 have sinuosity values of 1.07, 1.23, and 1.10, respectively. The four different reaches are shown in Figure 2.

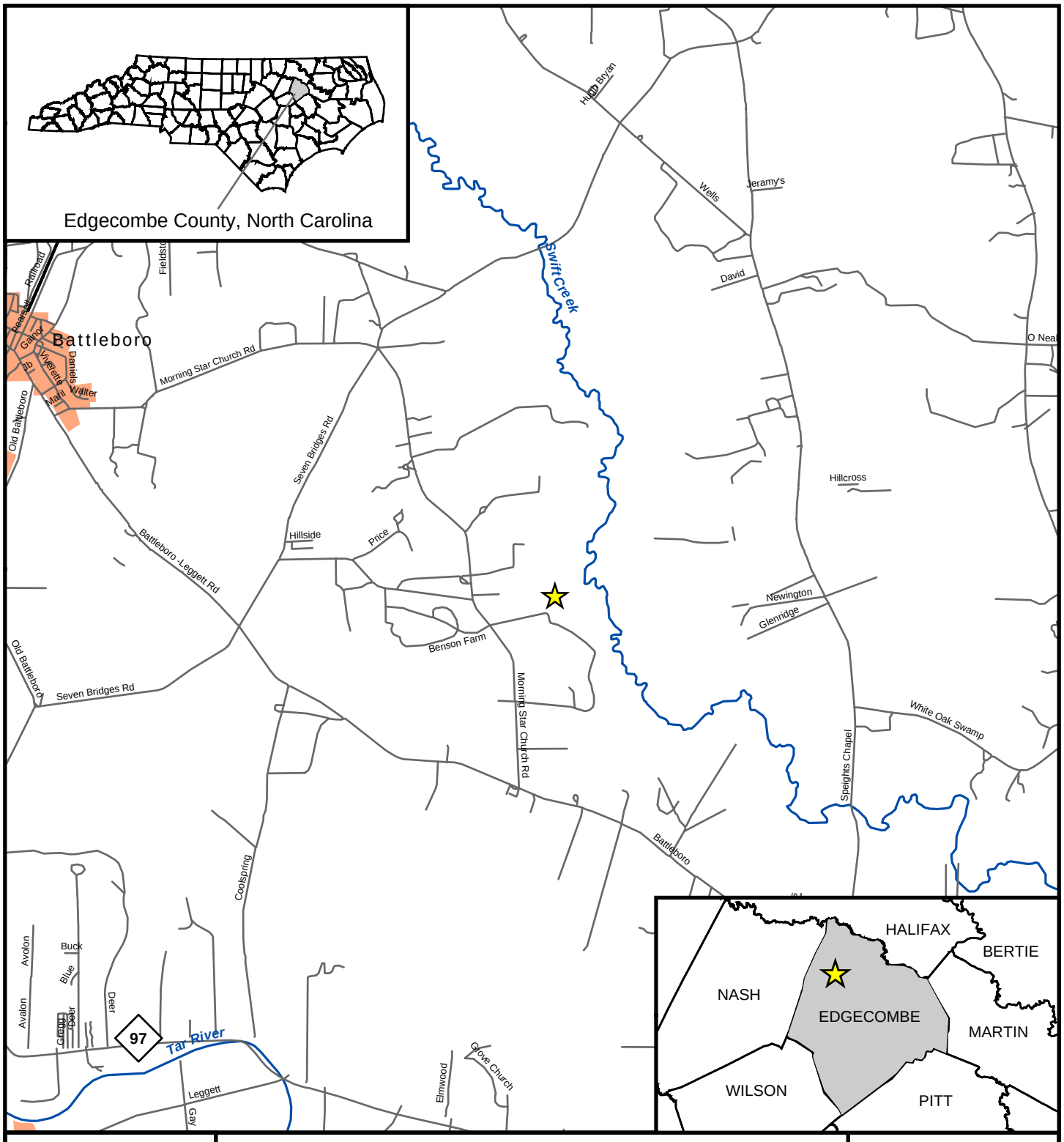

Figure 1. Vicinity Map

- Project Site Location
- Major Streams and Rivers
- Municipalities
- Roads

N
W E
S

1:63,360

1 inch equals 1 miles

1 0.5 0 1 Miles

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Ecosystem Enhancement PROGRAM

Table 1. Project Restoration Components
Harrell Stream and Wetland Restoration

Project Segment / Reach ID	Existing Feet/Acres	Type	Approach	As - Built Footage or Acreage	Stationing	Stream or Wetland Mitigation Units (SMU/WMU)
Reach 1	1,224 lf	R	P3	1,226 lf	10+00 - 22+26	1,226 SMU
Reach 2	1,389 lf	R	P2	1,465 lf	22+59 - 36+91	1,432 SMU
Reach 3	1,231 lf	R	P2	1,491 lf	36+91 - 51+82	1,491 SMU
Reach 4	2,494 lf	R	P2	2,698 lf	52+12 - 78+80	2,659 SMU
Wetland	15.0 ac	R	-	15.0 ac	-	15 WMU

R = Restoration P2 = Priority 2
P3 = Priority 3

* Two 30' farm crossings and one 10' irrigation crossing are excluded from the mitigation unit calculations.

1.4 Project History, Contacts and Data

The project watershed drains towards the southeast with a contributing area of approximately 0.69 square mile (441 acres) at the downstream limits of the site. Approximately 387.2 acres drain to the project stream while 56.9 acres drain to the project wetland site. The surrounding area is predominately rural and has low development pressure at this time. Based on a North Carolina GAP classification, the project watershed is about 94.6% agriculture, 4.2% forest and 1.2% rangeland. The site is located in a rural setting within the Southeastern Floodplains and Low Terraces ecoregion of the Coastal Plain physiographic province (Table 4).

The wetland design was completed in August 2006 and construction began in October 2006. The stream design was completed in April 2007 and construction began in July 2007 (Tables 2 & 3).

Table 2. Project Activity and Reporting History
Harrell Stream and Wetland Restoration

Activity or Report	Data Collection Complete	Completion or Delivery
Final Design - Wetland	2005 - 2006	Aug 06
Construction - Wetland	N/A	Oct 06
Planting - Wetland	N/A	Feb 07
Restoration Plan	2005 - 2006	Apr 07
Final Design - Stream	2005 - 2006	Apr 07
Construction - Stream	N/A	Sep 07
Planting - Stream	N/A	Jan 08
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	Oct 07 / Jan 08	Feb 08

KCI TECHNOLOGIES

Figure 2. Project Reaches

Reach 1
Reach 2
Reach 3
Reach 4

Easement Exception
Project Site Boundary

N
W E
S

1:8,400
1 inch equals 700 feet

700 350 0 700
Feet

Image Source: Edgecombe County GIS, 2002

KCI ASSOCIATES OF NC

ENVIRONMENTAL TECHNOLOGIES AND CONSTRUCTION, INC.

Table 3. Project Contact Table Harrell Stream and Wetland Restoration	
Design Firm	KCI Technologies, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Gary Mryncza Phone: (919) 783-9214 Fax: (919) 783-9266
Construction Contractor	Environmental Technologies and Construction Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Dan Kramer Phone: (919) 783-9214 Fax: (919) 783-9266
Planting Contractor	H & J Forest Services PO Box 458 Holly Ridge, NC 28445 Phone: (910) 512-6754
Monitoring Performers	
MY-00 - MY-05	KCI Associates of NC Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 783-9214 Fax: (919) 783-9266

Table 4. Project Background Table **Harrell Stream and Wetland Restoration**		
Project County		Edgecombe County
Physiographic Region		Coastal Plain
Ecoregion		Southeastern Floodplains and Low Terraces
Project River Basin		Tar-Pamlico
USGS HUC for Project and Reference		03020101130090 (UT to Swift Creek)
		03040101080010 (Mitchell River)
		03030002060140 (North Prong Creek)
NCDWQ Sub-basin for Project and Reference		03-03-02 (UT to Swift Creek)
		03-07-02 (Mitchell River)
		03-06-05 (North Prong Creek)
Drainage Area	Wetland	0.09 sq. mi.
	Stream	0.60 sq. mi.
Stream Order		Second Order
Watershed Type (Rural, Urban, Developing, etc.)		Rural
Watershed LULC Distribution	Urban	<1%
	Ag-Row Crop	95%
	Ag-Livestock	1%
	Forested	4%
	Water/Wetlands	<1%
Watershed impervious cover (%)		<1%
Rosgen Classification of As-built (Stream)		B5c / C5
Cowardin Classification (Wetland)		Palustrine - forested wetland
NCDWQ Classification for Project		NSW, CA
Within EEP Watershed Plan?		No
Any portion of the project segment upstream of a 303d listed segment?		No
Reasons for 303d Listing or Stressor		N/A
Total project acreage of easement		44.5 Acres
Total planted acreage		43.0 Acres
WRC Class (Warm, Cool, Cold)		warm
Species of concern, endangered etc.		none
Pre-construction Beaver activity?		Historically, according to landowner
Dominant Soil Types	Wetland	Roanoke loam series
	Stream	Roanoke loam and Wagram loamy sand series
% of Project Easement Fenced		0%

2.0 PROJECT MONITORING / AS-BUILT CONDITIONS

2.1 Monitoring Features

2.1.1 Stream

Permanent monuments, marking monitoring feature locations, were established on-site. The beginning and end of each permanent cross-section was marked with rebar set in concrete monuments. Vegetation plots were installed with flagged metal conduit at each corner and a flagged PVC pipe was installed at the photo corner. Automatic recording gauges were installed along the stream to record water levels indicating when bankfull events occur. The locations of these monitoring features and the permanent photo points are marked in the As-Built Plan (Appendix A).

2.1.2 Wetland

Permanent monuments, marking monitoring feature locations, were established on-site. Vegetation plots were installed with flagged metal conduit at each corner and flagged PVC pipe at the photo corner. An automatic recording rain gauge and automatic recording groundwater wells were installed throughout the wetland. The locations of these monitoring features and the permanent photo points are marked in the As-Built Plan (Appendix A).

2.2 Monitoring Guidelines

2.2.1 Stream

Stream data will be calculated from the monitored longitudinal profiles and cross-sections (Tables 5 and 6). Fourteen permanent cross-sections were established and will be used to evaluate stream dimension, two on Reach 1, three on Reach 2, four on Reach 3, and five on Reach 4. Pebble counts will be performed at each cross-section (Appendix B). Cross-sections will be surveyed each year using a total station and data such as area and width to depth ratio will be calculated. A total of over 3,000 linear feet of longitudinal profile will be surveyed. The total longitudinal profile will be split into four representative portions, one in each reach. The profiles for reaches 1, 2, 3, and 4 will be 635, 490, 990, and 930 linear feet, respectively. The profile will be surveyed with a total station and will record bed elevations, water surface levels, and bankfull elevations (Appendix C). Due to the project stream's sand bed channel, which is designed to undergo variation as sand moves through the channel in the form of dunes and anti-dunes, typical riffles and pools will not be measured. Stem counts of planted trees and shrubs will be conducted in the eighteen 10 meter x 10 meter vegetation monitoring plots (Appendix D). The two stream gauges on-site will be downloaded every other month and analyzed to ascertain whether bankfull events have occurred. Visual monitoring of the stream and riparian buffer will be conducted with annual site walks and site photos will be taken from 16 permanent photo points located throughout the site (Appendix E).

2.2.2 Wetland

Four groundwater monitoring wells were installed throughout the wetland to track groundwater elevations. These wells will be downloaded every other month and hydrographs will be generated from the data. At the end of each growing season, an analysis will be done comparing historical precipitation data to the current monitoring year's precipitation. This analysis will determine whether the monitoring year was a normal precipitation year, which will provide a climatic context to assess the yearly groundwater well data. Stem counts of planted trees and shrubs will be conducted in the

twelve 10 meter x 10 meter vegetation monitoring plots. Visual monitoring of the wetland will be conducted with annual site walks and site photos will be taken from five permanent photo points located throughout the site (Appendix E).

2.3 As-Built Conditions

2.3.1 Stream

Baseline stream monitoring data were collected in November 2007.

There were minimal changes to the design during construction. All in-stream structures were installed according to their locations depicted on the plans. Table 5 illustrates that the design pattern values and ratios are different from the as-built pattern values and ratios in some instances. These differences do not represent a deviation from the design; they are due to site constraints preventing the design ratios, obtained from the reference reach, from being applied uniformly to the final design.

When comparing the designed stream to the as-built conditions, there are minor variations, particularly in Reach 1. This reach was constructed as a Bc stream type due to the relatively steep grade (for the Coastal Plain) that was held between two culverts. The existing stream was also ditched and although it had a floodplain area in the adjacent agricultural field, it rarely accessed it with a bank height ratio of 2.7. For the post-restoration conditions, Cross-Section 1 shows that the stream was constructed deeper than designed in that section of Reach 1 with its as-built maximum depth 2.1 feet compared to the designed maximum depth of 1.4. The entrenchment ratio at this as-built cross-section is 2.7. Although this entrenchment ratio is smaller than the pre-restoration conditions, the stream has a bank height ratio of 1.0 and will experience bankfull events more frequently than the former channel. This restored system will allow for the stable maintenance of incoming sand material and promote bed diversity. The pre-restoration channel had little habitat with its vertical banks and a homogenous profile that flushed out entering sediment. Although there were variations from the design in Reach 1, these changes are not expected to affect the performance of the restored channel.

There are certain sections of the stream that are experiencing localized bank erosion or bed degradation. Around Station 23+00, the right bank is eroding and the bed is downcut from the impacts of an upstream culvert. The bank and bed may need to be stabilized. A riffle at Stations 33+25-33+50 has downcut into the clay bed; this section will be watched to see if it stabilizes at its current grade or continues to cut down. An entering drainage ditch at Station 37+00 has unstable, eroding banks within the project easement. To address this problem, the banks will be sloped back and stabilized. Finally, at Station 44+00, surface flow has been draining into the stream and caused bank erosion. The erosion is isolated and will be monitored to see if it stabilizes as more vegetation becomes established. In general, KCI will continue to watch any problem areas along the project stream and address any maintenance issues as they arise.

2.3.2 Wetland

There were minimal changes to the design during construction. No problem areas have developed in the wetland area.

Table 5a. Reach 1 Baseline Stream Summary
Harrell Stream and Wetland Restoration

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)		5.4			1	29.2			35		10.0			10.2		1
Floodprone Width (ft)		>70			1	44			64		>18			22		1
Bankfull Mean Depth (ft)		1.3			1	2			2.1		0.9			1.2		1
Bankfull Max Depth (ft)		2.0			1	2.7			2.8		1.4			2.1		1
Bankfull Cross-Sectional Area (ft^2)		7.3			1	62.5			68.8		9.1			12.6		1
Width/Depth Ratio		4.1			1	13.9			17.5		11.1			8.3		1
Entrenchment Ratio		13			1	1.3			2.2		>1.8			2.7		1
Bank Height Ratio		1.8			1						1.0			1.0		1
Pattern																
Channel Beltwidth (ft)						100			400		45	65	47	66	85	5
Radius of Curvature (ft)						70			220		30	80	31	55	65	8
Rc:Bankfull width (ft/ft)						2.2			12.5		3.0	8.0	3.0	5.4	6.4	
Meander Wavelength (ft)						140			500		50	200	166	260	420	7
Meander Width Ratio						3			14		4	10	4.6	6.5	8.3	
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)						0.007			0.027							
Pool Length (ft)																
Pool Spacing (ft)						115			400							
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	100% / - / - / - / - / -					- / 11% / 89% / - / - / -							7% / 85% / 8% / - / - / -			
d16 / d35 / d50 / d84 / d95 (mm)	0.062 / 0.06 / 0.1 / 0 / 0					2.6 / 5.7 / 7.1 / - / 15							0.15 / 0.36 / 0.54 / 1.1 / 6			
Additional Reach Parameters																
Channel length (ft)	1,224										1,265		1,226			
Drainage Area (SM)	0.20					6.00					0.20		0.20			
Rosgen Classification	E5					B4c					B5c		B5c			
Sinuosity	1.00					1.10					1.03		1.06			
Water Surface Slope (ft/ft)	0.0067					0.0084					0.0067		0.0067			
BF slope (ft/ft)											0.0067		0.0068			

Table 5b. Reach 2 Baseline Stream Summary
Harrell Stream and Wetland Restoration

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-Built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	5.7	6.1		6.5	2	13.6	15.7		17..8	2	10.0		9.2	10.2	11.5	3
Floodprone Width (ft)	>65			>70	2	325	463		600	2	>30		56	>59	>67	3
Bankfull Mean Depth (ft)	1.2	1.25		1.3	2	1.5	1.6		1.7	2	1.1		1.0	1.1	1.1	3
Bankfull Max Depth (ft)	1.9	1.9		1.9	2	2.6	2.8		3.0	2	1.4		1.6	1.7	1.9	3
Bankfull Cross-Sectional Area (ft^2)	7.5	7.75		8	2	22.6	24.4		26.2	2	11.2		8.8	10.5	12.5	3
Width/Depth Ratio	4.3	4.8		5.3	2	8.2	10.1		11.9	2	9.1		9.3	9.8	10.6	3
Entrenchment Ratio	10.8	11.1		11.4	2	23.8	28.8		33.7	2	>3.0		4.8	5.9	6.8	3
Bank Height Ratio	1.4	1.6		1.8	2	1.0	1.0		1.0	2	1.0		1.0	1.0	1.0	3
Pattern																
Channel Beltwidth (ft)							158				45	60	24	32	41	8
Radius of Curvature (ft)						37	158		40		30	50	30	36	43	14
Rc:Bankfull width (ft/ft)						2.1			2.3		3	5	2.9	3.5	4.2	
Meander Wavelength (ft)						94			143		100	200	125	157	186	8
Meander Width Ratio							8.9				4	10	2.4	3.1	4.0	
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)																
Pool Length (ft)																
Pool Spacing (ft)																
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	88% / 12% / - / - / - / -					11% / 89% / - / - / - / -							3% / 81% / 16% / - / - / -			
d16 / d35 / d50 / d84 / d95 (mm)	0.062 / 0.06 / 0.1 / - / -					0.075 / 0.14 / 0.2 / 0.4 / 0.6							0.3 / 0.7 / 0.9 / 3.5 / 9.8			
Additional Reach Parameters																
Channel length (ft)	1,400										1,465		1,465			
Drainage Area (SM)	0.23					3.04					0.23		0.23			
Rosgen Classification	E5					C5					C5		C5			
Sinuosity	1.00					1.28					1.05		1.07			
Water Surface Slope (ft/ft)	0.0023					0.0024					0.0023		0.0021			
BF slope (ft/ft)											0.0023		0.0022			

Table 5c. Reach 3 Baseline Stream Summary
Harrell Stream and Wetland Restoration

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	6.4	7.6	7.7	8.6	4	13.6	15.7		17.8	2	12.0		11.8	12.8	14.1	4
Floodprone Width (ft)	>65			>80	4	325	463		600	2	>30		>50	>57	>61	4
Bankfull Mean Depth (ft)	1.4	1.6	1.5	1.9	4	1.5	1.6		1.7	2	1.4		1.2	1.3	1.4	4
Bankfull Max Depth (ft)	2.4	2.7	2.7	2.8	4	2.6	2.8		3.0	2	2.0		1.9	2.1	2.5	4
Bankfull Cross-Sectional Area (ft^2)	10.4	11.6	12.0	12.1	4	22.6	24.4		26.2	2	16.8		14.4	16.2	19.1	4
Width/Depth Ratio	3.3	5.0	5.3	6.2	4	8.2	10.1		11.9	2	8.6		8.9	10.1	10.8	4
Entrenchment Ratio	7.6	9.5	9.8	10.9	4	23.8	28.8		33.7	2	>2.5		3.8	4.5	5.0	4
Bank Height Ratio	1.5	1.6	1.6	1.7	4	1.0	1.0		1.0	2	1.0		1.0	1.0	1.0	4
Pattern																
Channel Beltwidth (ft)							158				60	100	41	70	107	11
Radius of Curvature (ft)						37	158		40		40	60	21	35	46	13
Rc:Bankfull width (ft/ft)						2.1			2.3		3.0	5.0	1.6	2.7	3.6	
Meander Wavelength (ft)						94			143		120	240	158	183	225	11
Meander Width Ratio							8.9				4.0	10.0	3.2	5.5	8.4	
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)																
Pool Length (ft)																
Pool Spacing (ft)																
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	65% / 35% / - / - / - / -					11% / 89% / - / - / - / -							7% / 81% / 12% / - / - / -			
d16 / d35 / d50 / d84 / d95	0.062 / 0.06 / 0.1 / - / -					0.075 / 0.14 / 0.2 / 0.4 / 0.6							0.2 / 0.5 / 0.8 / 1.9 / 5.9			
Additional Reach Parameters																
Channel length (ft)	1,225										1,560		1,491			
Drainage Area (SM)	0.42					3.04					0.42		0.42			
Rosgen Classification	E5					C5					C5		C5			
Sinuosity	1.00					1.28					1.27		1.23			
Water Surface Slope (ft/ft)	0.0023					0.0024					0.0023		0.0042			
BF slope (ft/ft)											0.0023		0.0042			

Table 5d. Reach 4 Baseline Stream Summary
Harrell Stream and Wetland Restoration

Parameter	Pre-Existing Condition					Reference Reach(es) Data					Design		As-built			
Dimension - Riffle	Min	Mean	Med	Max	n	Min	Mean	Med	Max	n	Min	Max	Min	Mean	Max	n
Bankfull Width (ft)	8.4	9.5	9.6	10.4	3	13.6	15.7		17..8	2	13.4		13.1	14.2	16.5	5
Floodprone Width (ft)	>65			>70	3	325	463		600	2	>30		>57	>61	>67	5
Bankfull Mean Depth (ft)	1.1	1.5	1.2	2.2	3	1.5	1.6		1.7	2	1.6		1.3	1.4	1.7	5
Bankfull Max Depth (ft)	1.7	2.5	2.7	3.0	3	2.6	2.8		3.0	2	2.3		2.0	2.2	2.5	5
Bankfull Cross-Sectional Area (ft^2)	10.4	13.8	12.7	18.4	3	22.6	24.4		26.2	2	21.6		17.9	20.5	28.2	5
Width/Depth Ratio	3.8	7.0	8.5	8.8	3	8.2	10.1		11.9	2	8.4		8.8	9.9	10.8	5
Entrenchment Ratio	7.1	7.2	7.2	7.3	3	23.8	28.8		33.7	2	>2.2		3.6	4.4	5.0	5
Bank Height Ratio	0.9	1.0	1.0	1.2	3	1.0	1.0		1.0	2	1.0		1.0	1.0	1.0	5
Pattern																
Channel Beltwidth (ft)							158				50	90	32	59	101	18
Radius of Curvature (ft)						37	158		40		40	70	30	50	63	17
Rc:Bankfull width (ft/ft)						2.1			2.3		3	5	2.1	3.5	4.0	
Meander Wavelength (ft)						94			143		130	260	196	233	300	18
Meander Width Ratio							8.9				4	10	2.3	4.2	7.1	
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)																
Pool Length (ft)																
Pool Spacing (ft)																
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	50% / 16% / 34% / - / - / -					11% / 89% / - / - / - / -							7.8% / 77.2% / 15% / - / -			
d16 / d35 / d50 / d84 / d95	0.062 / 0.062 / 0.062 / 3.1 / 4.3					0.075 / 0.14 / 0.2 / 0.4 / 0.6							0.6 / 1.1 / 1.3 / 2.4 / 5.0			
Additional Reach Parameters																
Channel length (ft)	2,500										2,697		2,696			
Drainage Area (SM)	0.61					3.04					0.605		0.605			
Rosgen Classification	E5					C5					C5		C5			
Sinuosity	1.00					1.28					1.08		1.10			
Water Surface Slope (ft/ft)	0.0023					0.0024					0.0023		0.0025			
BF slope (ft/ft)											0.0023		0.0021			

Table 6. Morphology and Hydraulic Monitoring Summary
Harrell Stream and Wetland Restoration

Parameter	X-Section 1	X-Section 2	X-Section 3	X-Section 4	X-Section 5	X-Section 6	X-Section 7
Reach	1	1	2	2	2	3	3
Dimension							
Bankfull Width (ft)	10.2	12.4	11.5	9.8	9.2	14.1	12.1
Floodprone Width (ft)	22	25	>55	>67	>56	>60	>61
Bankfull Mean Depth (ft)	1.2	1.4	1.1	1.1	1.0	1.4	1.2
Bankfull Max Depth (ft)	2.1	2.2	1.9	1.7	1.6	2.5	1.9
Bankfull Cross-Sectional Area (ft^2)	12.6	17.1	12.5	10.3	8.8	19.1	14.4
Bankfull Width/Depth Ratio	8.3	9.0	10.6	9.3	9.6	10.4	10.2
Bankfull Entrenchment Ratio	2.7	2.8	4.8	6.8	6.1	4.3	5.0
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate							
d50 (mm)	0.54	1.1	0.6	1.3	0.89	0.59	0.78
d84 (mm)	1.1	1.8	1.4	4.4	4.6	2	2

Parameter	X-Section 8	X-Section 9	X-Section 10	X-Section 11	X-Section 12	X-Section 13	X-Section 14
Reach	3	3	4	4	4	4	4
Dimension							
Bankfull Width (ft)	13.0	11.8	13.5	14.0	16.8	13.1	13.6
Floodprone Width (ft)	>50	>58	>67	>57	>61	>60	>62
Bankfull Mean Depth (ft)	1.2	1.3	1.3	1.3	1.7	1.5	1.4
Bankfull Max Depth (ft)	1.9	2.0	2.0	2.1	2.5	2.4	2.1
Bankfull Cross-Sectional Area (ft^2)	15.6	15.6	17.9	18.2	28.2	19.4	19.0
Bankfull Width/Depth Ratio	10.8	8.9	10.2	10.8	10.0	8.8	9.7
Bankfull Entrenchment Ratio	3.8	4.9	5.0	4.1	3.6	4.6	4.6
Bankfull Bank Height Ratio	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Substrate							
d50 (mm)	1	0.9	1	1.4	1.4	1.5	1.3
d84 (mm)	1.9	1.7	2.6	2	3	2.6	1.8

2.3.3 Vegetation

Baseline vegetation monitoring data were collected in the wetland in June 2007 and in the riparian buffer in February 2008. Within each monitoring plot, stem height and vigor were recorded. Plot photos from all the vegetation plots can be found in Appendix D.

The results of the baseline monitoring show an average of 840 stems per acre along the stream (Table 7a) and 693 stems per acre in the wetland (Table 7b). An attempt to identify all trees was made, but with the dormant conditions many were unidentifiable. All trees will be positively identified during first year monitoring.

Table 7a. Riparian Buffer Stem Density and Species Count by Plot
Harrell Stream and Wetland Restoration

Plot Number	River Birch *Betula nigra*	American Beautyberry *Callicarpa americana*	Shagbark Hickory *Carya ovata*	Sugarberry *Celtis laevigata*	Silky Dogwood *Cornus amomum*	Persimmon *Diospyros viginiana*	Green Ash *Fraxinus pennsylvanica*	Sycamore *Platanus occidentalis*	Southern Red Oak *Quercus falcuta*	Swamp Chestnut Oak *Quercus michauxii*	Willow Oak *Quercus phellos*	Black Willow *Salix nigra*	Elderberry *Sambucus canadensis*	Possumhaw *Viburnum nudum*	Unknown	Total (Year 0)	Density-Year 0 (Stems/Acre)
1					8				6		2		5		7	28	1,120
2									2		2				14	18	720
3		1			5						1		6		15	28	1,120
4	4	2									2				4	12	480
5	4				8						1	1	7		9	30	1,200
6	3	1													8	12	480
7					8								3		17	28	1,120
8															12	12	480
9	4				9					1	2	5	1		9	31	1,240
10								4			1				10	15	600
11					6							1	2		13	22	880
12	4							3							8	15	600
13					6			1					2		20	29	1,160
14	2	1								1	1				11	16	640
15	4				10		1	3					2		8	28	1,120
16	1							1			1				12	15	600
17					2					1	2	1	6		10	22	880
18	7	2					1				3				4	17	680
															Average Density		840

Table 7b. Wetland Stem Density and Species Count by Plot
Harrell Stream and Wetland Restoration

Plot Number	Green Ash *Fraxinus pennsylvanica*	American Beautyberry *Callicarpa americana*	Water Hickory *Carya aquatica*	Buttonbush *Cephalanthus occidentalis*	Cherrybark Oak *Quercus pagoda*	Swamp Chestnut Oak *Quercus michauxii*	Willow Oak *Quercus phellos*	Laurel Oak *Quercus laurifolia*	Bald Cypress *Taxodium distichum*	Possumhaw *Viburnum nudum*	Oak species *Quercus spp.*	Unknown	Total (Year 0)	Density-Year 0 (Stems/Acre)
1	4	1		1	1	3		1	1		1		13	520
2				1	4		2					9	16	640
3				3		1			7		2	2	15	600
4	2			4	3	1	1	2			2	5	20	800
5	4				1	5			4			1	15	600
6				4	3	1	2		3	1	4		18	720
7			1			2	1					13	17	680
8		1	7	3					4			4	19	760
9	2	2		1	4	1	1	1	1		2	1	16	640
10	3	1		3				4	1		1	2	15	600
11		3	3	2					8			1	17	680
12		2	4	10					9			2	27	1,080
												Average Density		693

3.0 SUCCESS CRITERIA

3.1 Stream Stability

Cross-section measurements should show little or no change from the as-built cross-sections. Annual measurements of the longitudinal profile should indicate a stable bedform with little change from the as-built survey. Sediment transport should remain relatively unchanged with respect to aggradation and deposition of sediments. Due to the nature of a sand channel, it is expected that the bed will vary due to the movement of dunes and anti-dunes along the profile. This will create variation in the yearly monitoring of the cross-sections and longitudinal profiles and each monitoring report will evaluate these changes to determine whether they are minor adjustments associated with the movement of the sand bed and increasing stability or whether they indicate movement toward an unstable condition.

3.2 Vegetation

Wetland and riparian vegetation must meet a minimum survival success rate of 320 stems/acre after five years. If monitoring indicates that the specified survival rate is not being met, appropriate corrective actions will be developed, which could include invasive species control, the removal of dead/dying plants, and replanting.

3.3 Hydrology

Within the five-year monitoring period a minimum of two bankfull events must occur in separate years of the restored stream. If stream gauge data reveal that this criterion is not met, probable causes for this will be determined.

The wetland groundwater monitoring wells must show that the groundwater is within 12 inches of the soil surface continuously for at least 5% of the growing season during normal weather conditions. The growing season for the site extends from March 21 to November 11 for a total of 235 days. Based on this growing season, success will be achieved at the project site if the water table is within 12 inches of the soil surface for 12 consecutive days or more during the growing season.

4.0 MAINTENANCE AND CONTINGENCY PLAN

The site will be monitored for any problem areas that could arise and any such issues will be dealt with according to severity. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to in-stream structures. Any maintenance activities will be documented in the yearly monitoring reports.

Appendix A

As-Built Plans

CONTRACT #: D05025-1

KCI JOB# : 12054239

STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D05025-1	1	23

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

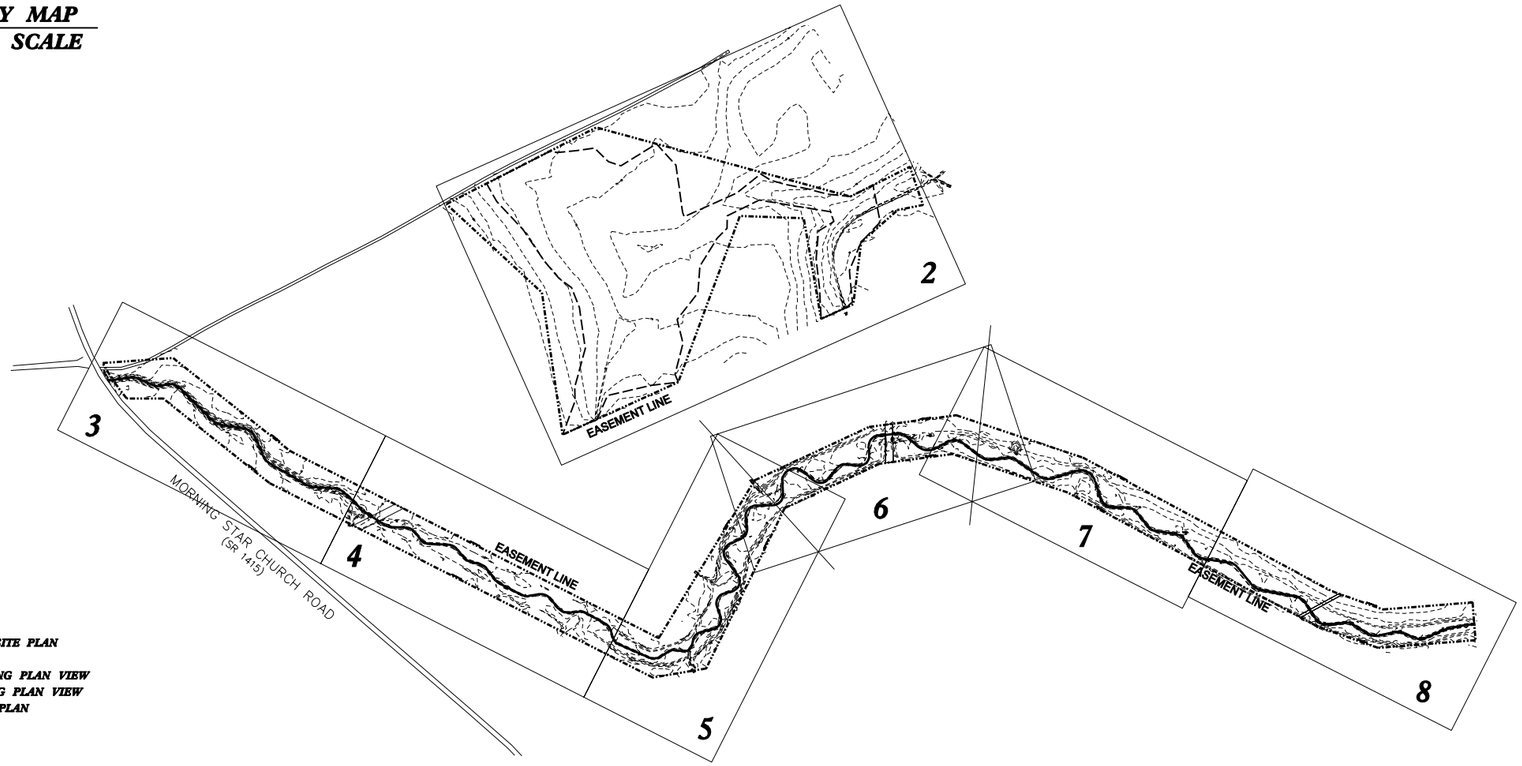
STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

EDGECOMBE COUNTY

LOCATION: HARRELL SITE
MORNING STAR CHURCH ROAD
EDGECOMBE CO., NORTH CAROLINA

TYPE OF WORK: STREAM AND WETLAND RESTORATION

VICINITY MAP
NOT TO SCALE



NC GRID NORTH

INDEX OF SHEETS

1	*AS-BUILT*
1A	*LEGEND*
2	*WETLAND REDLINE SITE PLAN*
3 THRU 8	*STREAM AS-BUILT*
9	*WETLAND MONITORING PLAN VIEW*
10 THRU 15	*STREAM MONITORING PLAN VIEW*
16 THRU 22	*AS-BUILT PLANTING PLAN*

AS-BUILT PLAN

GRAPHIC SCALES

PLANS: –40 –20 0 40 80

PROFILE (HORIZONTAL): –40 –20 0 40 80

PROFILE (VERTICAL): –4 –2 0 4 8

PROJECT LENGTH

STREAM RESTORATION LENGTH = 6,880 FEET

WETLAND RESTORATION ACREAGE = 15.0 ACRES

Prepared in the Office of:

KCI ASSOCIATES OF NC
ENGINEERS•PLANNERS•ECOLOGISTS
SUITE 220 LANDMARK CENTER II
4601 SIX FORKS RD., RALEIGH, NC

JOSEPH J. PFEIFFER, PWS
PROFESSIONAL WETLAND SCIENTIST

STEVEN F. STOKES, LSS
SOIL SCIENTIST

GARY M. MRYNCZA, P.E., P.H.
PROJECT ENGINEER

ADAM SPILLER / ALEX FRENCH
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

P.E.

SIGNATURE:

Prepared for:

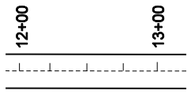
Ecosystem Enhancement PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

PROJECT LEGEND

STREAM AND WETLAND RESTORATION

As–Built Thalweg, Stationing, and Top of Bank



As–Built Log Drop

As–Built Stone Outlet Protection

Filled Drainage Ditch

Microtopography Development

As–Built Ditch Plug

Wetand Restoration Limits

TOPOGRAPHY

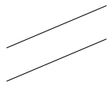
Minor Contour Line

Major Contour Line

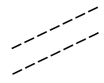
MISCELLANEOUS

Control Point

Paved Road



Unpaved Road



MONITORING

Cross–Section

Photo Point

Vegetation Plots

Monitoring Gauge

REVISIONS

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RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

DATE: FEB 2008
SCALE:

AS-BUILT LEGEND

SHEET 2 OF 22

WETLAND RED LINE SITE PLAN

DATE: FEB 2008

SCALE: 1"=120'

HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

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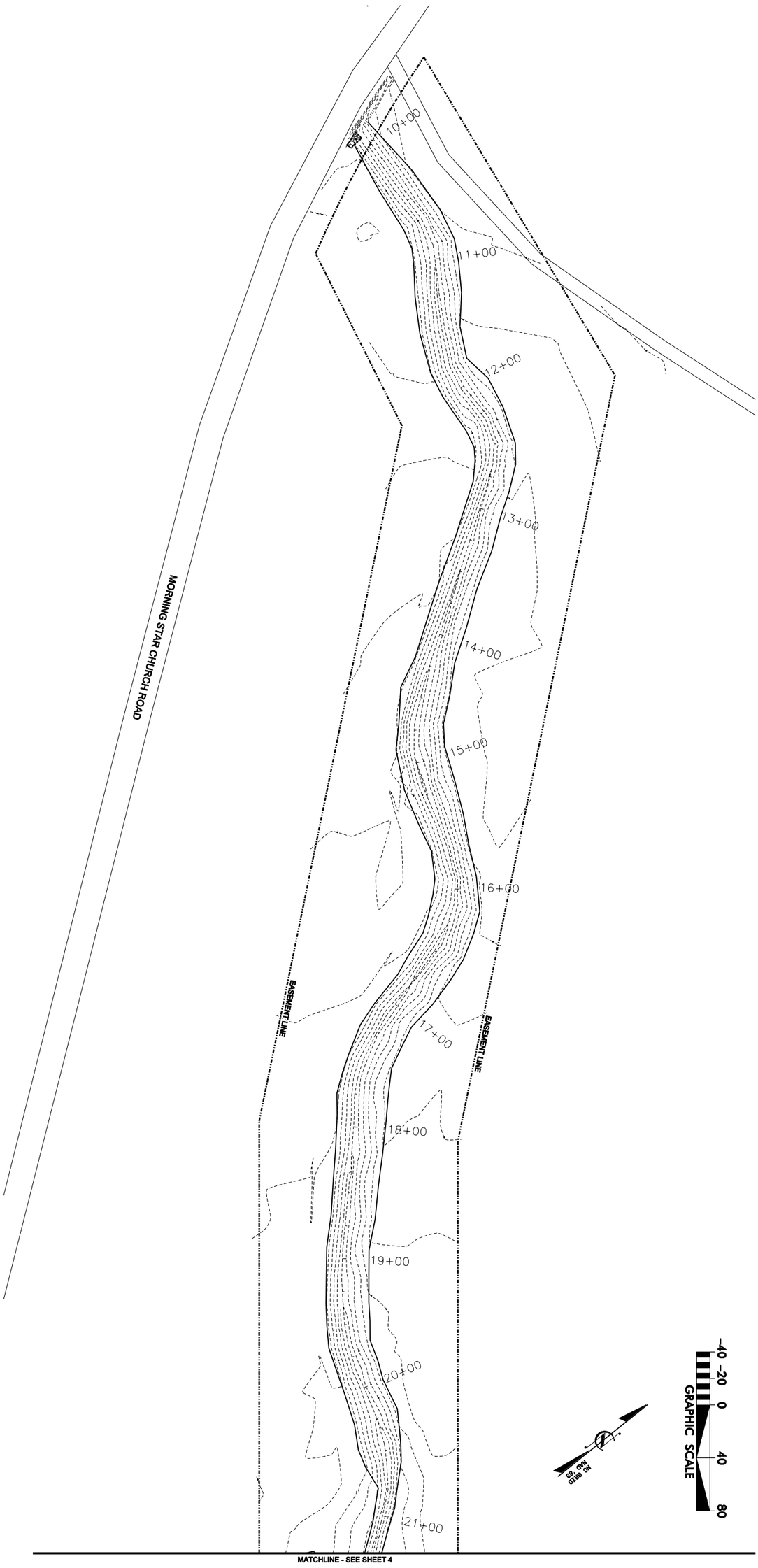
REVISIONS



SHEET 3 OF 22

STREAM AS-BUILT

DATE: FEB 2008

SCALE: 1"=80'

HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 10+00 TO STATION 21+29

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Ecosystem Enhancement

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

C	REVISED PER DWQ COMMENTS	APRIL 2007		
SYM.	DESCRIPTION	DATE	APPROVED	

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HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 21+29 TO STATION 33+64

DATE: FEB 2008

SCALE: 1"=80'

STREAM AS-BUILT

REVISIONS

	DESCRIPTION	DATE	APPROVED
C	REVISED PER DWQ COMMENTS	APRIL 2007	

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HARRELL SITE
STREAM AND WETLAND RESTORATION

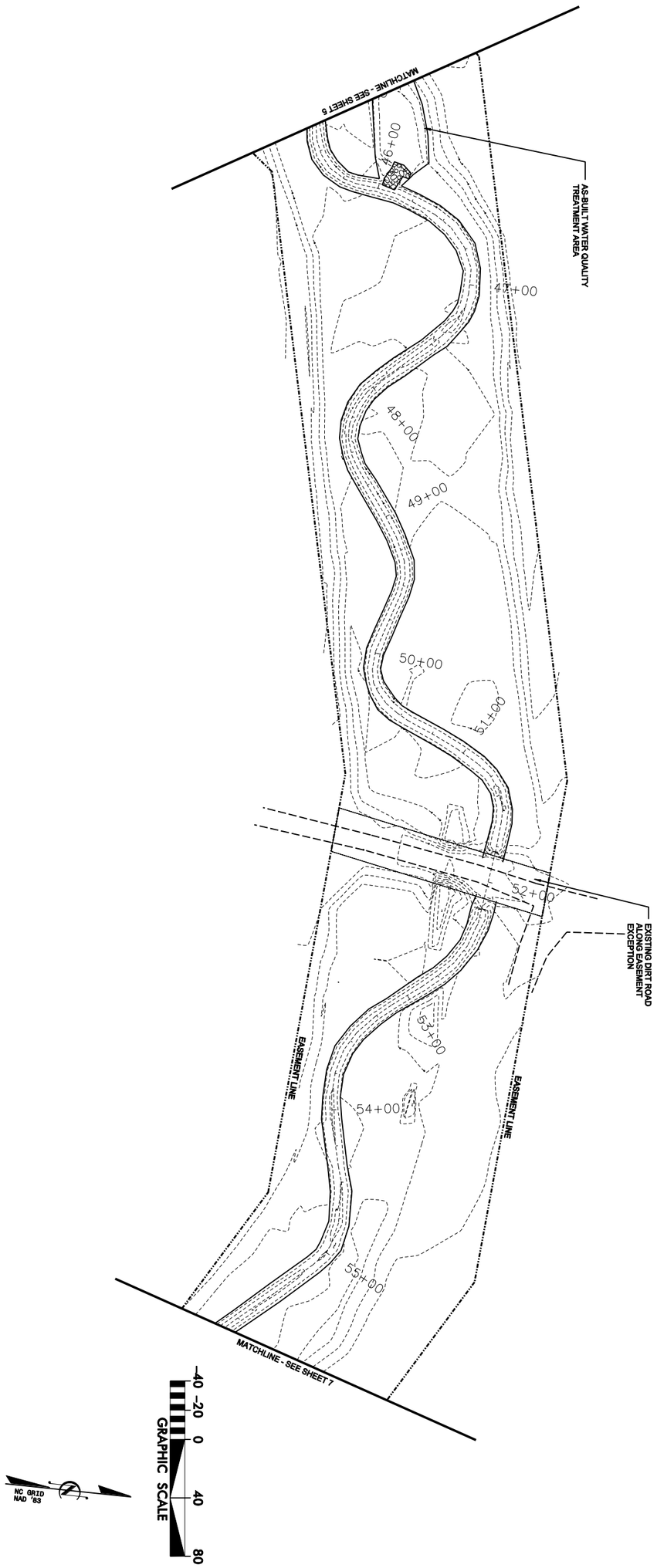
EDGECOMBE CO., NORTH CAROLINA

STATION 33+64 TO STATION 45+31

DATE: FEB 2008

SCALE: 1"=80'

STREAM AS-BUILT



SHEET 6 OF 22

STREAM AS-BUILT

DATE: FEB 2008

SCALE: 1"=80'

HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 45+31 TO STATION 55+86

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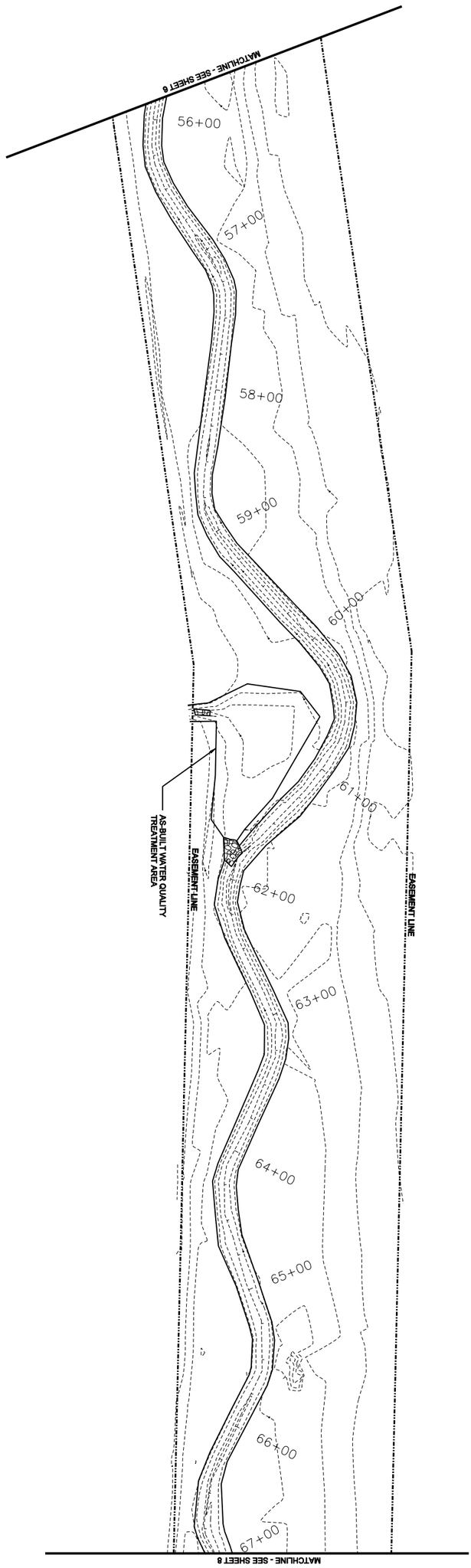
Ecosystem Enhancement

SYM.	DESCRIPTION	DATE	APPROVED
C	REVISED PER DWQ COMMENTS	APRIL 2007	

REVISIONS



C	REVISED PER DWQ COMMENTS	APRIL 2007	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 55+86 TO STATION 66+94

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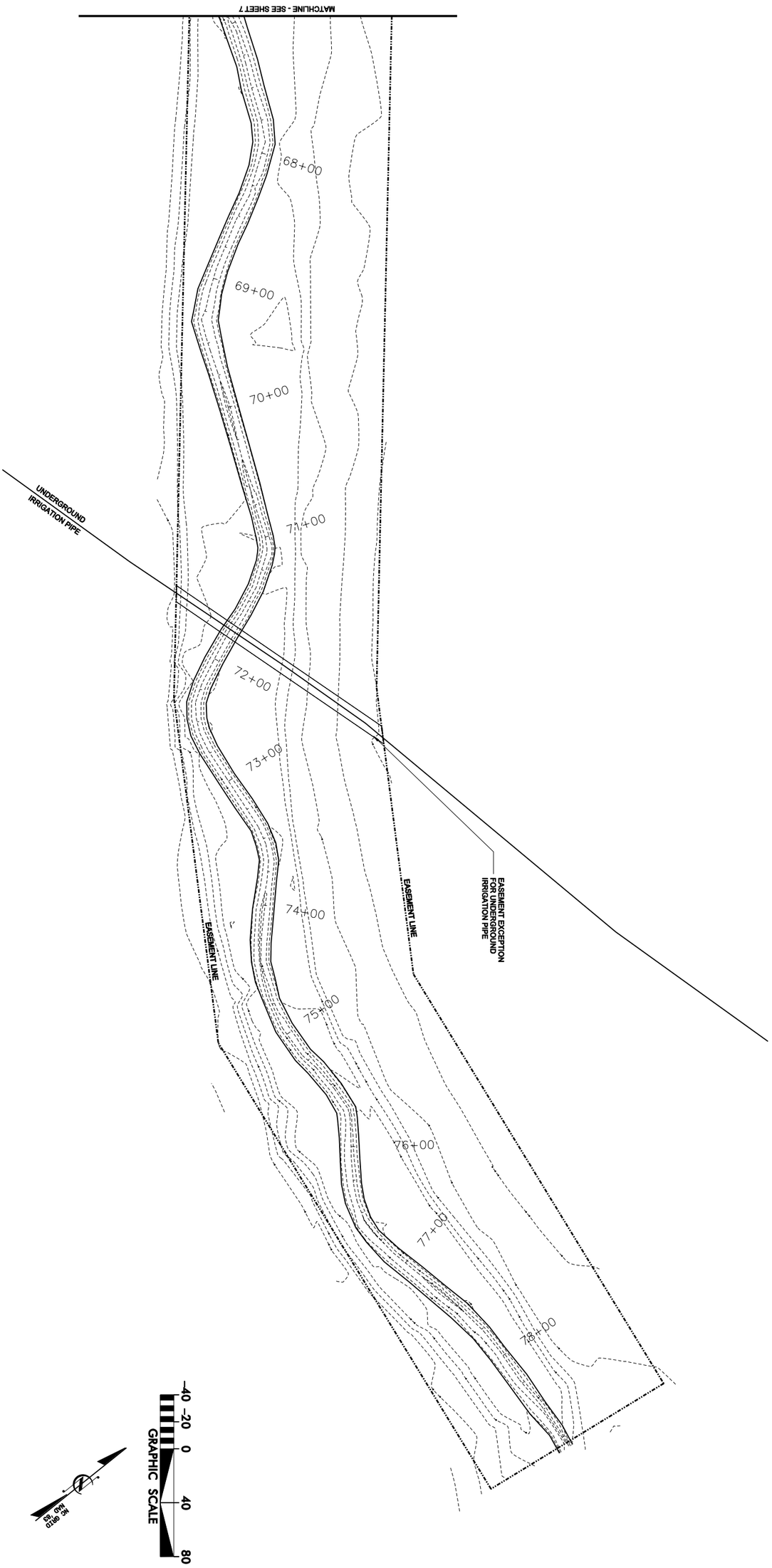
Ecosystem Enhancement PROGRAM

STREAM
AS-BUILT

SHEET 7 OF 22

DATE: FEB 2008
SCALE: 1"=80'



SHEET 8 OF 22

STREAM AS-BUILT

DATE: FEB 2008

SCALE: 1"=80'

HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

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SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

PP# W2

CONSERVATION EASEMENT

VEG PLOT W7

VEG PLOT W6

VEG PLOT W9

WETLAND GAUGE 2

WETLAND GAUGE 3

VEG PLOT W5

WETLAND RESTORATION BOUNDARY (15 ACRES)

VEG PLOT W8

VEG PLOT W10

VEG PLOT W11

PP# W3

VEG PLOT W3

VEG PLOT W2

WETLAND GAUGE 1

VEG PLOT W4

VEG PLOT W12

PP# W5

WETLAND GAUGE 4

VEG PLOT W1

PP# W1

PP# W4

NC GRID MAG NO

–60 –30 0 60 120

GRAPHIC SCALE

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED

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HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

DATE: FEB 2008
SCALE: 1"=120'

WETLAND MONITORING PLAN VIEW

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	REVISIONS		

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HARRELL SITE
STREAM AND WETLAND RESTORATION

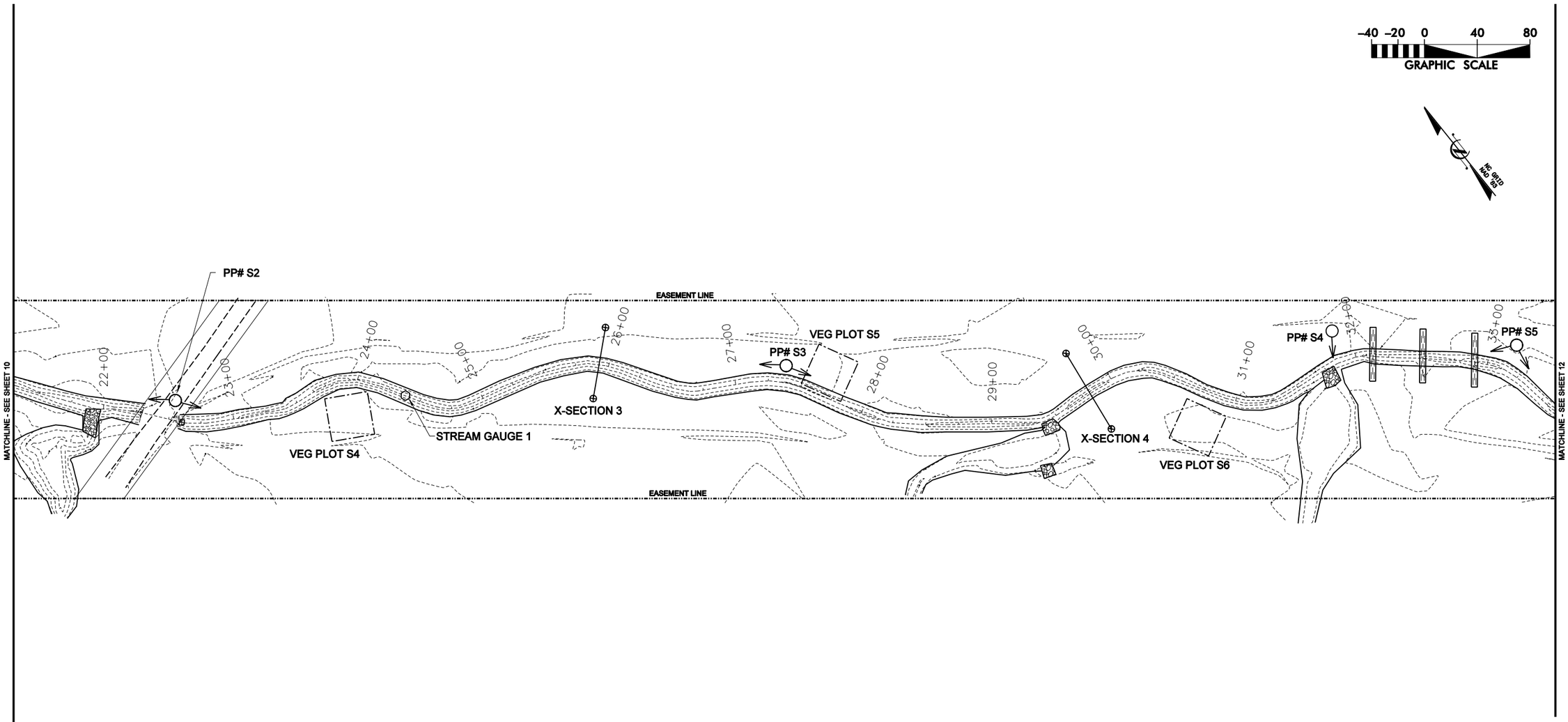
EDGECOMBE CO., NORTH CAROLINA

STATION 10+00 TO STATION 21+29

DATE: FEB 2008

SCALE: 1"=80'

STREAM MONITORING PLAN VIEW



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SYM.	DESCRIPTION	DATE	APPROVED	

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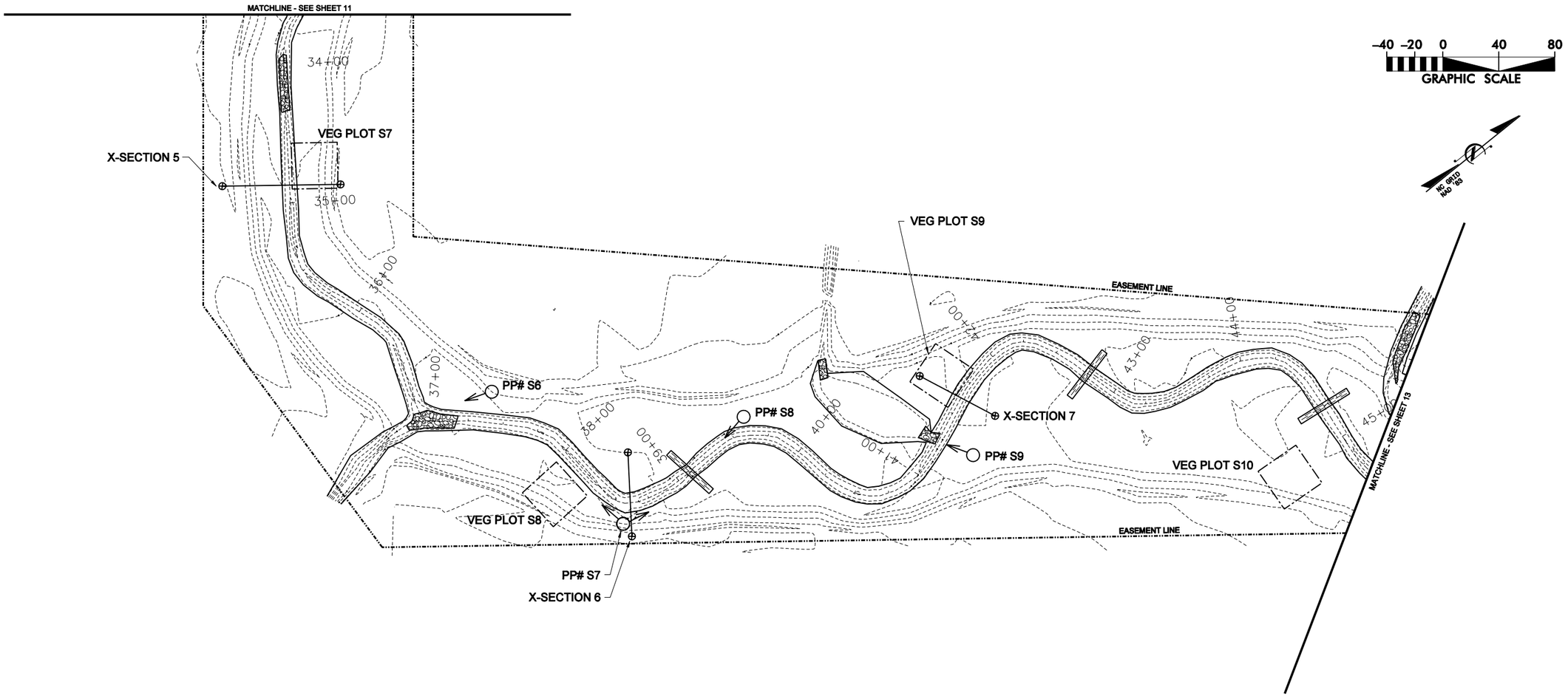
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

STATION 21+29 TO STATION 33+64

DATE: FEB 2008
SCALE: 1"=80'

STREAM MONITORING PLAN VIEW

SHEET 11 OF 22



	DESCRIPTION	DATE	APPROVED
C	REVISED PER DWQ COMMENTS	APRIL 2007	

REVISIONS

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STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

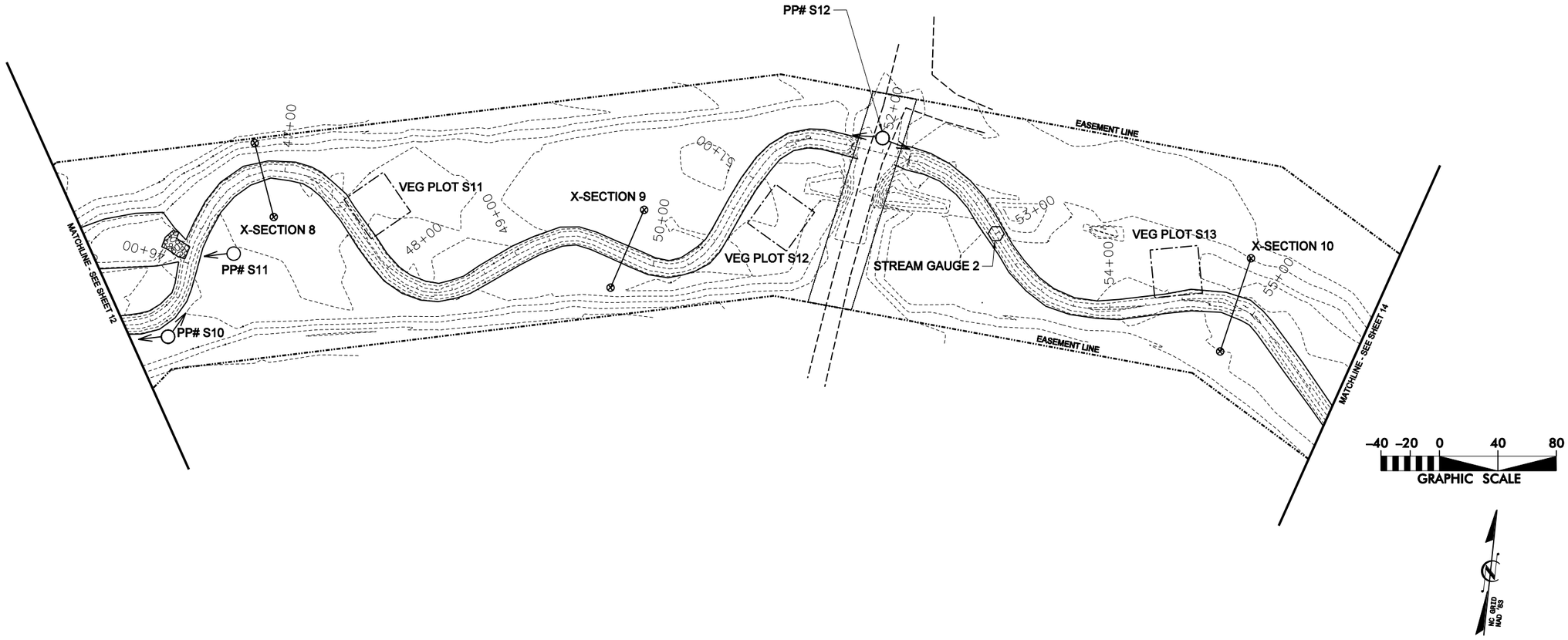
STATION 33+64 TO STATION 45+31

DATE: FEB 2008

SCALE: 1"=80'

STREAM MONITORING PLAN VIEW

SHEET 12 OF 22



C	REVISED PER DWQ COMMENTS	APRIL 2007		
SYM.	DESCRIPTION	DATE	APPROVED	

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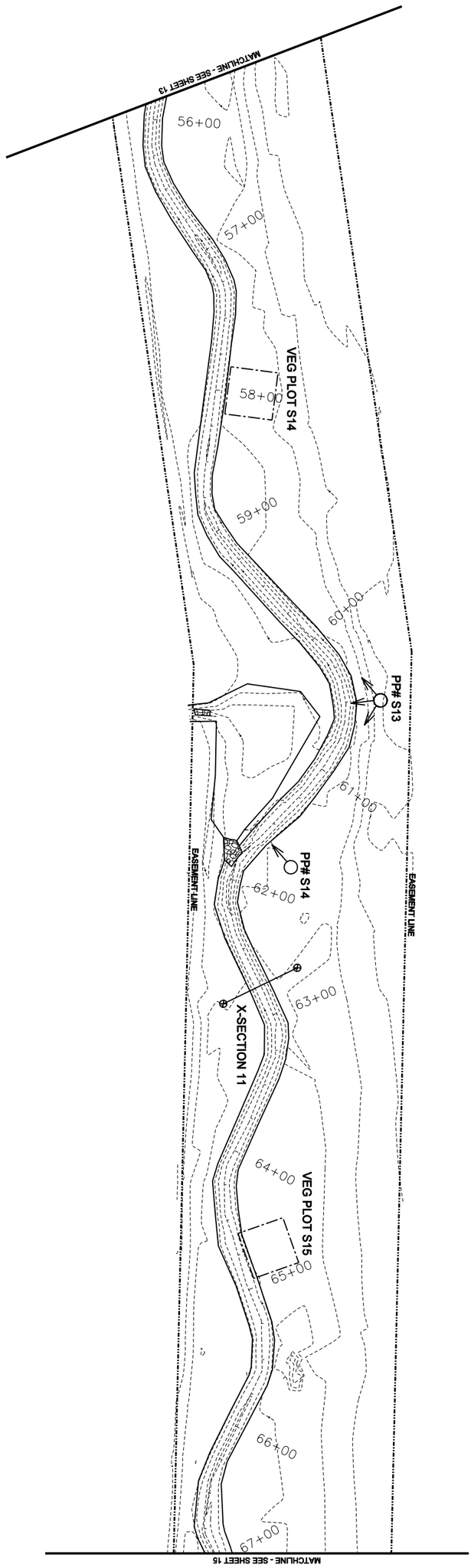
RALEIGH, NORTH CAROLINA 27609

HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA
STATION 45+31 TO STATION 55+86

DATE: FEB 2008
SCALE: 1"=80'

STREAM MONITORING PLAN VIEW

SHEET 13 OF 22



C	REVISED PER DWQ COMMENTS	APRIL 2007	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 55+86 TO STATION 66+94

KCI ASSOCIATES OF NC
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RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement PROGRAM

STREAM MONITORING PLAN VIEW

SHEET 14 OF 22

DATE: FEB 2008
SCALE: 1"=80'

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

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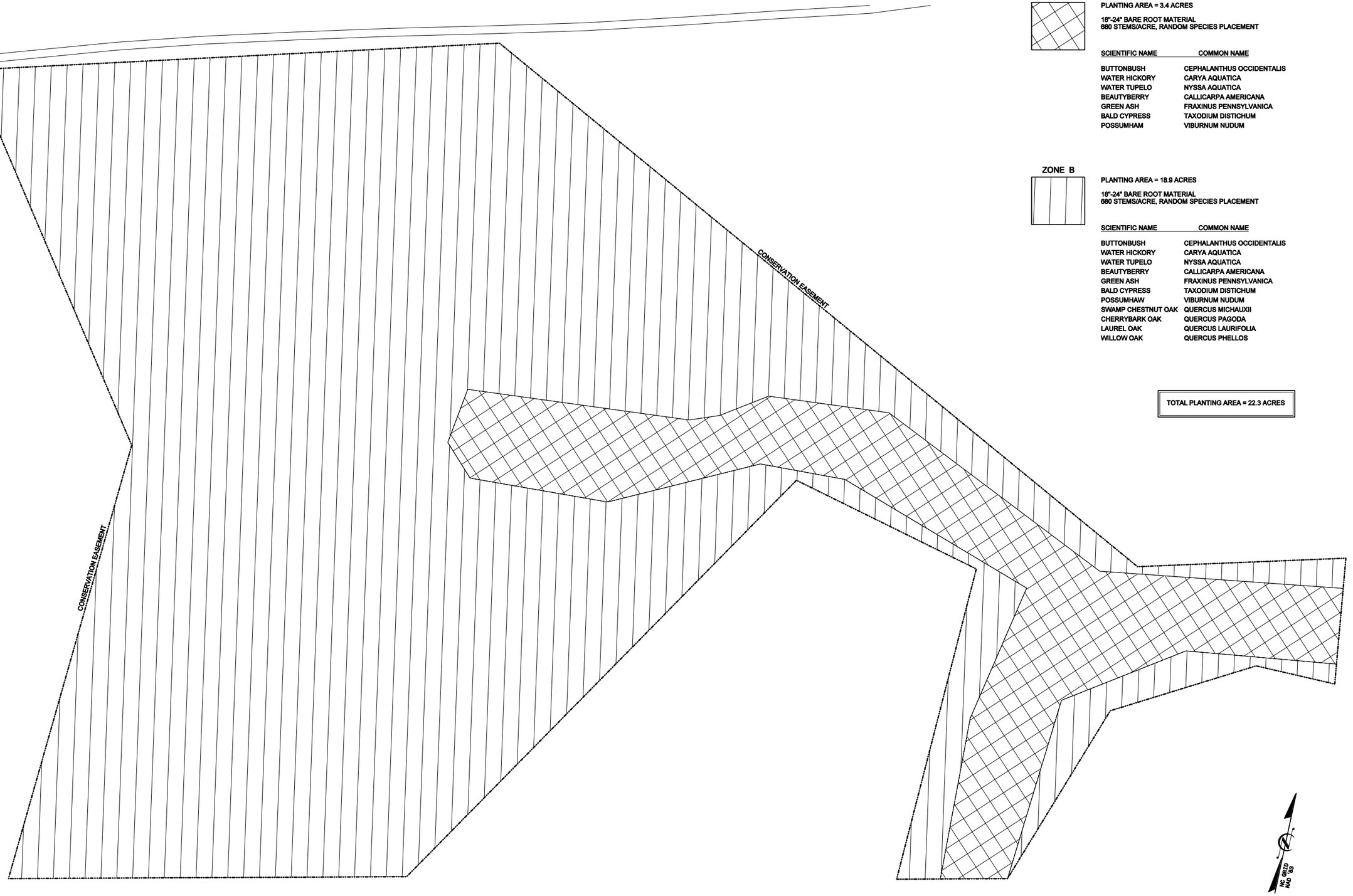
HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA
STATION 66+94 TO STATION 78+80

DATE: FEB 2008
SCALE: 1"=80'

STREAM MONITORING PLAN VIEW

SHEET 15 OF 22



ZONE A

PLANTING AREA = 3.4 ACRES

18"-24" BARE ROOT MATERIAL
680 STEMS/ACRE, RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS
WATER HICKORY	CARYA AQUATICA
WATER TUPELO	NYSSA AQUATICA
BEAUTYBERRY	CALLICARPA AMERICANA
GREEN ASH	FRAXINUS PENNSYLVANICA
BALD CYPRESS	TAXODIUM DISTICHUM
POSSUMHAM	VIBURNUM NUDUM

ZONE B

PLANTING AREA = 18.9 ACRES

18"-24" BARE ROOT MATERIAL
680 STEMS/ACRE, RANDOM SPECIES PLACEMENT

SCIENTIFIC NAME	COMMON NAME
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS
WATER HICKORY	CARYA AQUATICA
WATER TUPELO	NYSSA AQUATICA
BEAUTYBERRY	CALLICARPA AMERICANA
GREEN ASH	FRAXINUS PENNSYLVANICA
BALD CYPRESS	TAXODIUM DISTICHUM
POSSUMHAW	VIBURNUM NUDUM
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII
CHERRYBARK OAK	QUERCUS PAGODA
LAUREL OAK	QUERCUS LAURIFOLIA
WILLOW OAK	QUERCUS PHELLOS

TOTAL PLANTING AREA = 22.3 ACRES

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED

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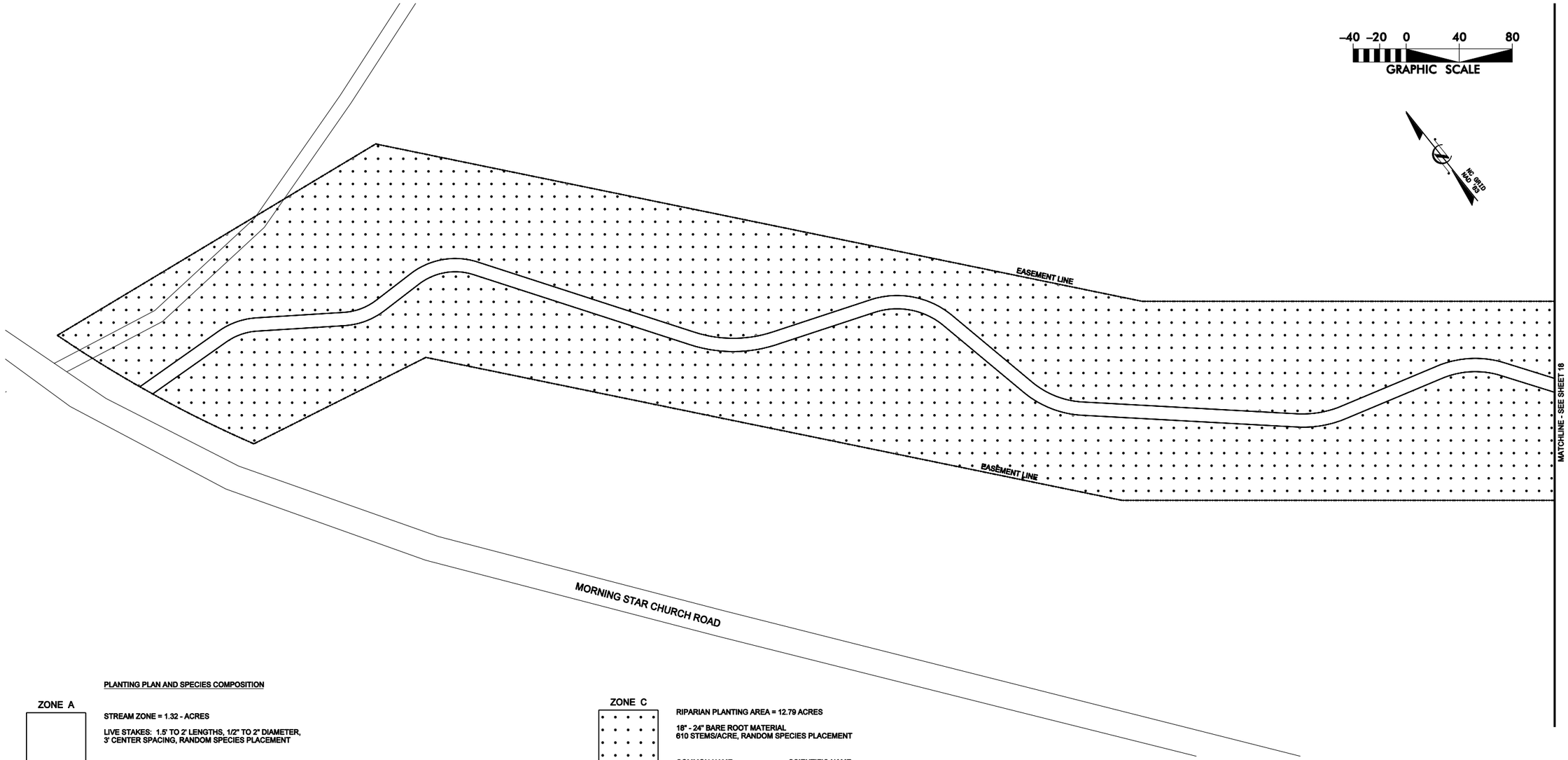
HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

DATE: FEB 2008
SCALE: 1"=120'

WETLAND AS-BUILT PLANTING PLAN

SHEET 16 OF 22



PLANTING PLAN AND SPECIES COMPOSITION

ZONE A

STREAM ZONE = 1.32 - ACRES

LIVE STAKES: 1.5' TO 2' LENGTHS, 1/2" TO 2" DIAMETER, 3' CENTER SPACING, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
BLACK WILLOW	SALIX NIGRA
SILKY WILLOW	SALIX SERICEA
SILKY DOGWOOD	CORNUS AMOMUM
ELDERBERRY	SAMBUCUS CANADENSIS

ZONE B

FLOODPLAIN PLANTING AREA = 7.62 ACRES

18" - 24" BARE ROOT MATERIAL
610 STEMS/ACRE, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
BEAUTYBERRY	CALLICARPA AMERICANA
POSSUMHAW	VIBURNUM NUDUM
GREEN ASH	FRAXINUS PENNSYLVANICA
SYCAMORE	PLATANUS OCCIDENTALIS
SUGARBERRY	CELTIS LAEVIGATA
RIVER BIRCH	BETULA NIGRA
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII
WILLOW OAK	QUERCUS PHELLOS
PERSIMMON	DIOSPYROS VIRGINIANA

ZONE C

RIPARIAN PLANTING AREA = 12.79 ACRES

18" - 24" BARE ROOT MATERIAL
610 STEMS/ACRE, RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME
BEAUTYBERRY	CALLICARPA AMERICANA
POSSUMHAW	VIBURNUM NUDUM
PERSIMMON	DIOSPYROS VIRGINIANA
SHAGBARK HICKORY	CARYA OVATA
WILLOW OAK	QUERCUS PHELLOS
S. RED OAK	QUERCUS FALCATA

EASEMENT EXCEPTION
(NOT PLANTED)

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

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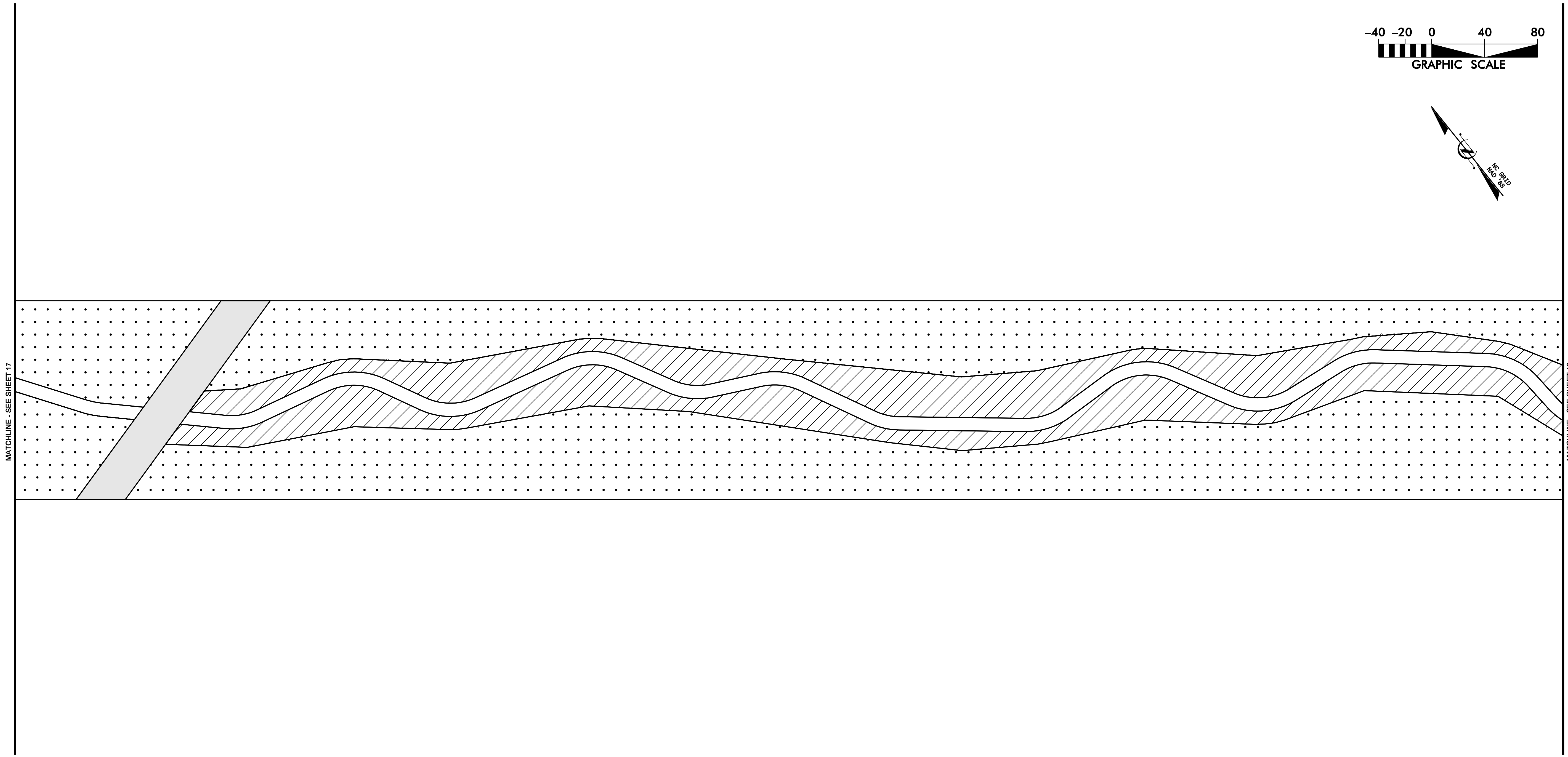
HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA
STATION 10+00 TO STATION 21+29

DATE: FEB 2008
SCALE: 1"=80'

STREAM AS-BUILT PLANTING PLAN

SHEET 17 OF 22



ZONE A
STREAM ZONE PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

EASEMENT EXCEPTION (NOT PLANTED)

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

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HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA
STATION 21+29 TO STATION 33+64

DATE: FEB 2008
SCALE: 1"=80'

STREAM AS- BUILT PLANTING PLAN

SHEET 18 OF 22

MATCHLINE - SEE SHEET 18

MATCHLINE - SEE SHEET 20

–40 –20 0 40 80

GRAPHIC SCALE

NC GRID NAD 83

ZONE A

STREAM ZONE PLANTING AREA

ZONE B

FLOODPLAIN PLANTING AREA

ZONE C

RIPARIAN PLANTING AREA

EASEMENT EXCEPTION (NOT PLANTED)

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

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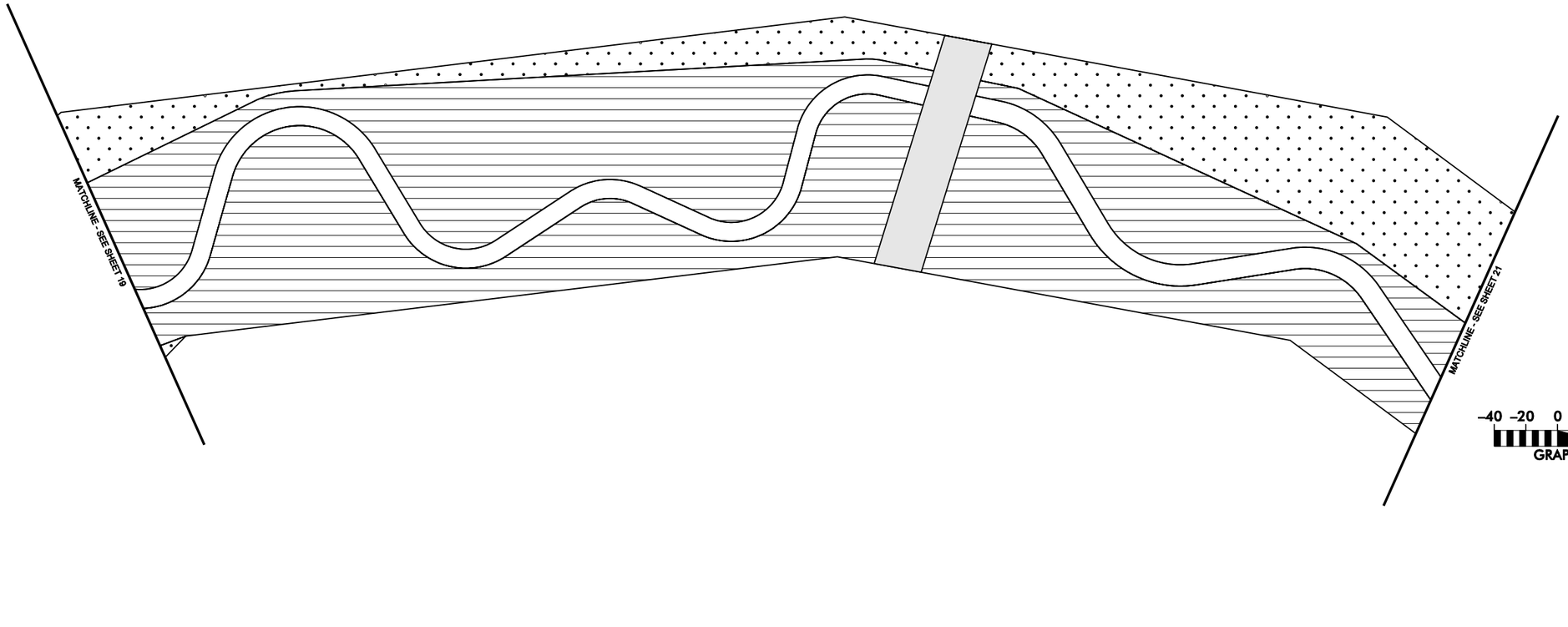
HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

STATION 33+64 TO STATION 45+31

DATE: FEB 2008
SCALE: 1"=80'

STREAM AS-BUILT PLANTING PLAN



ZONE A
STREAM ZONE PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

EASEMENT EXCEPTION (NOT PLANTED)

REVISIONS

SYM.	DESCRIPTION	DATE	APPROVED

Ecosystem Enhancement

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HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA
STATION 45+31 TO STATION 55+86

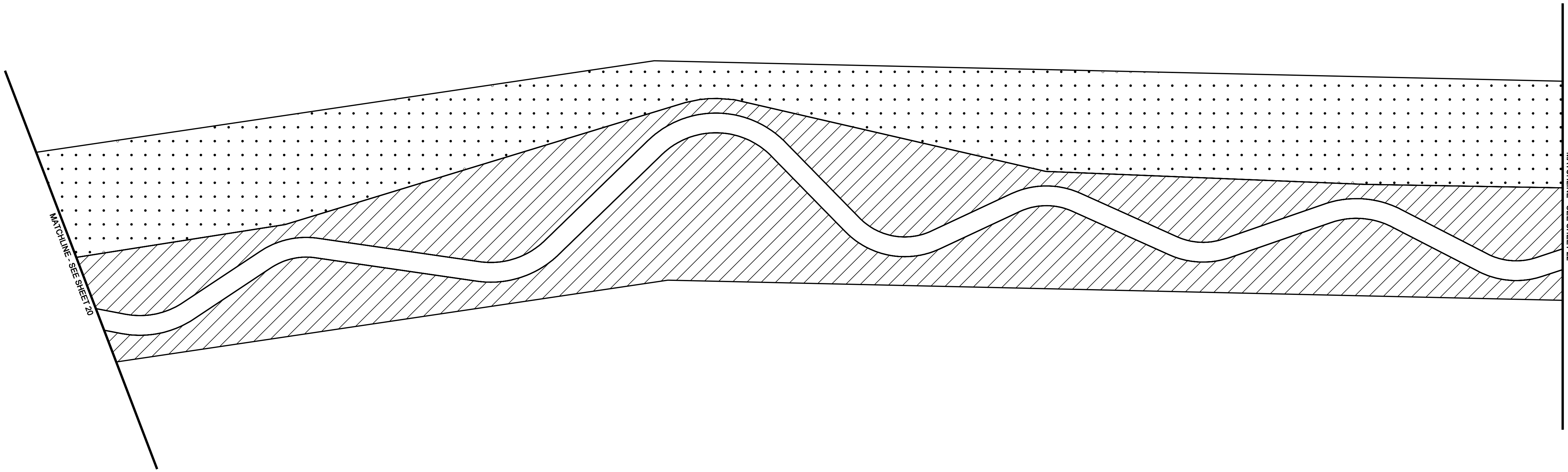
DATE: FEB 2008
SCALE: 1"=80'

STREAM AS-BUILT PLANTING PLAN

SHEET 20 OF 22

-40 -20 0 40 80
GRAPHIC SCALE

NC GRID NAD 83



ZONE A
STREAM ZONE PLANTING AREA

ZONE B
FLOODPLAIN PLANTING AREA

ZONE C
RIPARIAN PLANTING AREA

EASEMENT EXCEPTION (NOT PLANTED)

SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS

Ecosystem Enhancement PROGRAM

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HARRELL SITE
STREAM AND WETLAND RESTORATION
EDGECOMBE CO., NORTH CAROLINA

STATION 55+86 TO STATION 66+94

DATE: FEB 2008
SCALE: 1"=80'

STREAM AS-BUILT PLANTING PLAN

SHEET 21 OF 22

MATCHLINE - SEE SHEET 21

–40 –20 0 40 80

GRAPHIC SCALE

NAD 1983 GRID NORTH

ZONE A

STREAM ZONE PLANTING AREA

EASEMENT EXCEPTION (NOT PLANTED)

ZONE B

FLOODPLAIN PLANTING AREA

ZONE C

RIPARIAN PLANTING AREA

SYM.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

Ecosystem Enhancement

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HARRELL SITE
STREAM AND WETLAND RESTORATION

EDGECOMBE CO., NORTH CAROLINA

STATION 66+94 TO STATION 78+80

DATE: FEB 2008

SCALE: 1"=80'

STREAM AS-BUILT PLANTING PLAN

SHEET 22 OF 22

Appendix B

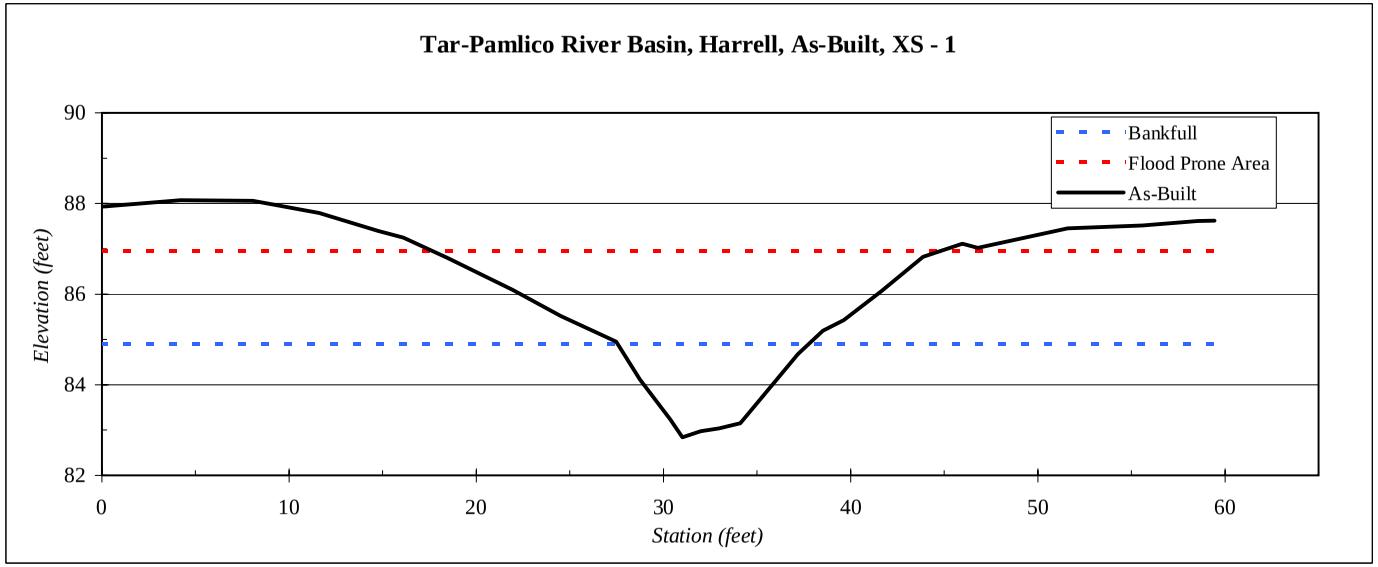
Cross-Section Plots and Pebble Counts

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 1
Drainage Area (sq mi):	0.20
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	87.93
0.3	87.94
4.2	88.08
8.1	88.06
11.6	87.79
14.8	87.40
16.1	87.25
18.4	86.80
21.9	86.09
24.5	85.52
27.5	84.95
28.7	84.12
30.4	83.24
31.0	82.84
32.0	82.98
33.0	83.04
34.1	83.15
35.6	83.87
37.2	84.68
38.5	85.19
39.6	85.42
41.6	86.06
43.9	86.83
46.0	87.11
46.8	87.02
51.6	87.45
55.6	87.51
58.6	87.62
59.4	87.62

SUMMARY DATA	
Bankfull Elevation:	84.9
Bankfull Cross-Sectional Area:	12.6
Bankfull Width:	10.2
Flood Prone Area Elevation:	87.0
Flood Prone Width:	27
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.2
W / D Ratio:	8.3
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

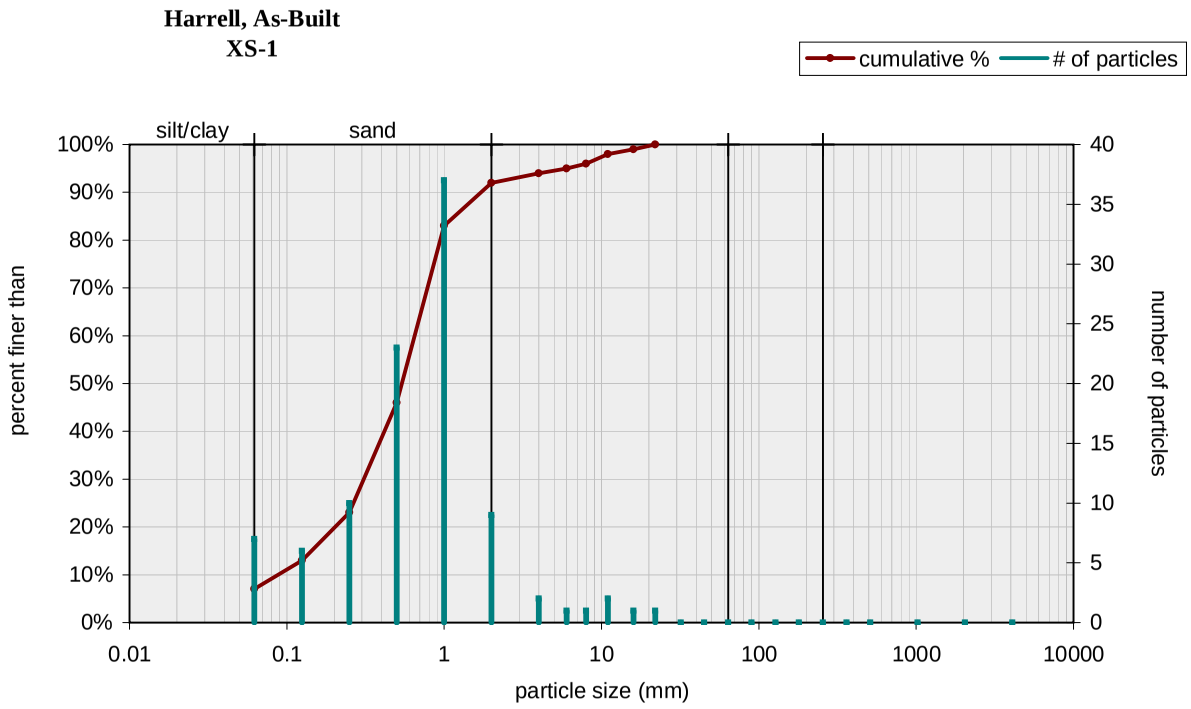
Stream Type	B5c



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**7**
very fine sand	0.062 - 0.125	**6**
fine sand	0.125 - 0.25	**10**
medium sand	0.25 - 0.5	**23**
coarse sand	0.5 - 1	**37**
very coarse sand	1 - 2	**9**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**1**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-1



Size (mm)	
D16	0.15
D35	0.36
D50	0.54
D65	0.71
D84	1.1
D95	6

Size Distribution	
mean	0.4
dispersion	2.8
skewness	-0.13

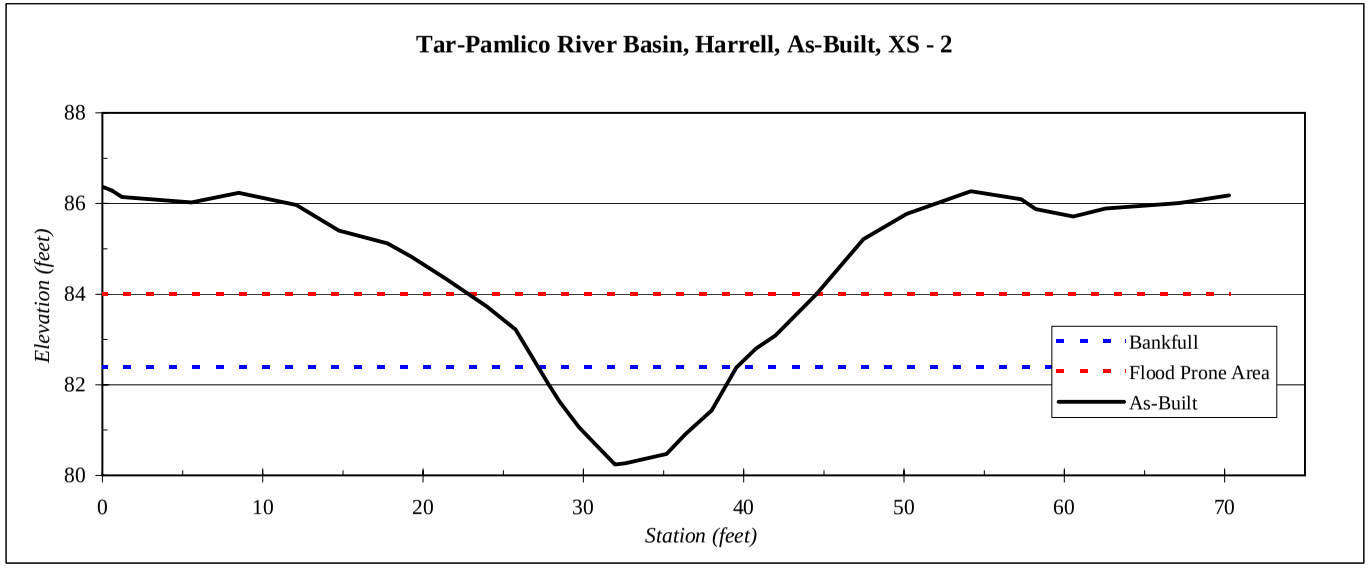
Type	
silt/clay	7%
sand	85%
gravel	8%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 2
Drainage Area (sq mi):	0.20
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	86.37
0.6	86.28
1.2	86.14
5.6	86.02
8.5	86.24
12.1	85.97
14.7	85.40
17.8	85.12
19.3	84.82
21.4	84.34
24.0	83.72
25.8	83.22
27.8	82.01
28.5	81.63
29.7	81.07
30.6	80.74
32.0	80.24
32.6	80.27
35.2	80.47
36.3	80.90
38.0	81.43
39.5	82.38
40.7	82.79
42.0	83.09
44.5	84.00
47.4	85.21
50.2	85.77
54.2	86.27
57.3	86.09
58.2	85.88
60.5	85.72
62.6	85.89
67.2	86.01
70.3	86.18

SUMMARY DATA	
Bankfull Elevation:	82.4
Bankfull Cross-Sectional Area:	17.1
Bankfull Width:	12.4
Flood Prone Area Elevation:	84.0
Flood Prone Width:	25
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.4
W / D Ratio:	9.0
Entrenchment Ratio:	2.8
Bank Height Ratio:	1.0

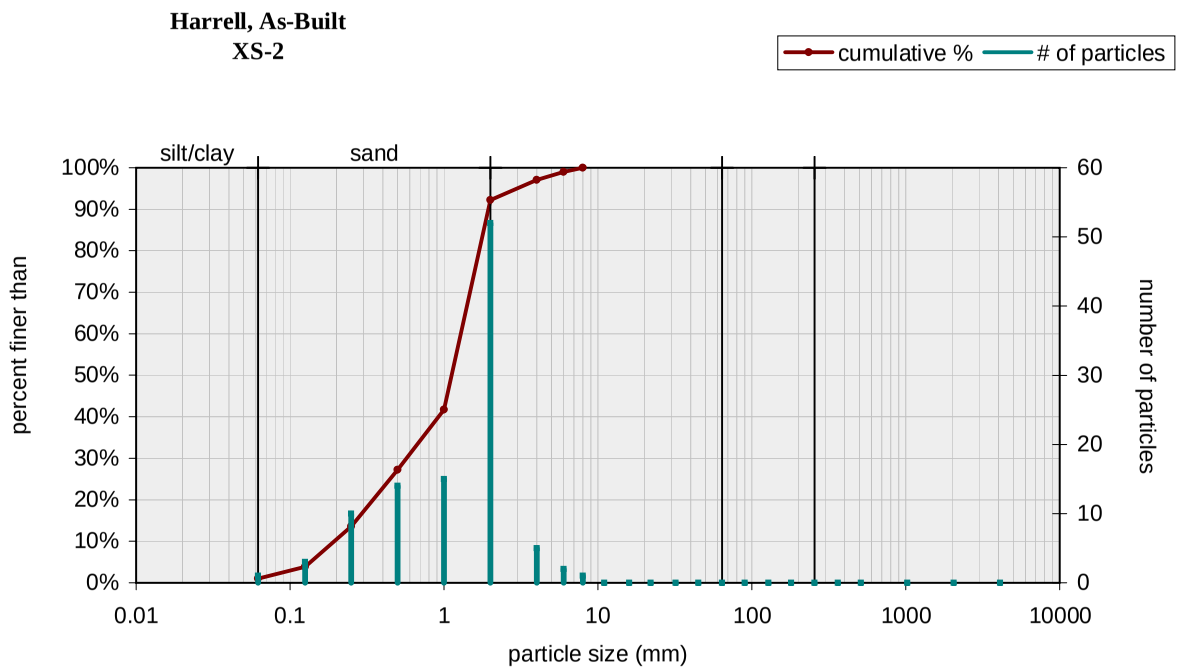
Stream Type	B5c



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	**3**
fine sand	0.125 - 0.25	**10**
medium sand	0.25 - 0.5	**14**
coarse sand	0.5 - 1	**15**
very coarse sand	1 - 2	**52**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		103
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		103

Note: XS-2



Size (mm)		
D16	0.28	3.4
D35	0.73	12
D50	1.1	17
D65	1.4	20
D84	1.8	29
D95	3	39

Size Distribution	
mean	0.7
dispersion	2.8
skewness	-0.21

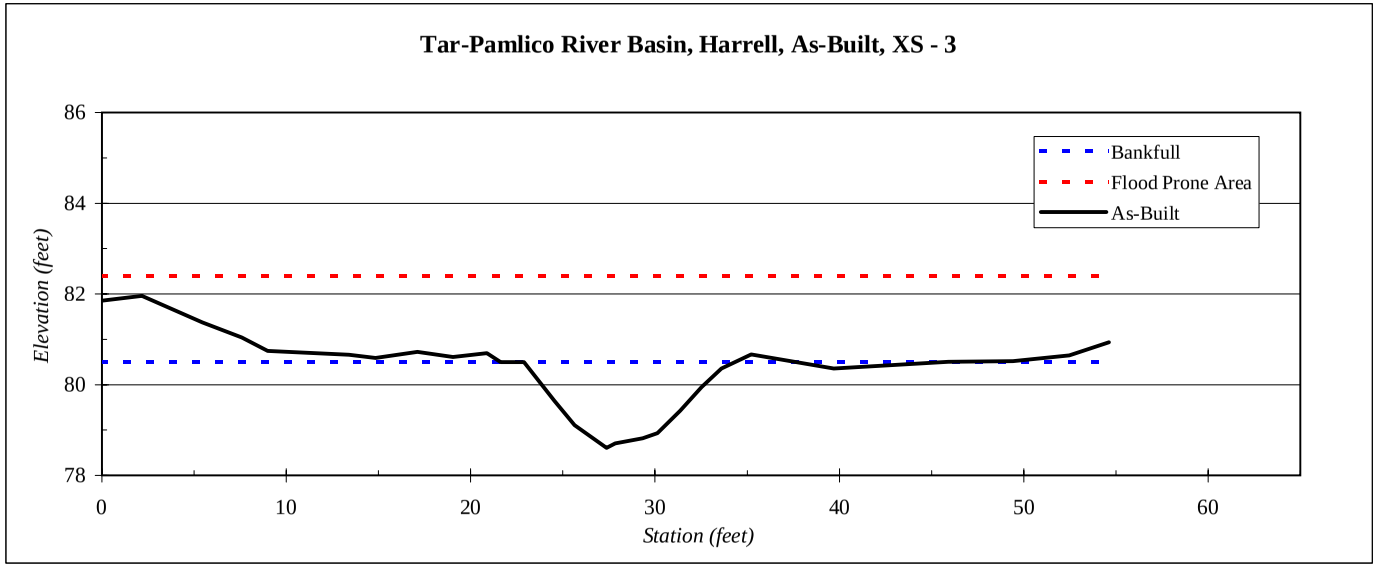
Type	
silt/clay	1%
sand	91%
gravel	8%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 3
Drainage Area (sq mi):	0.23
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	81.85
2.2	81.96
5.4	81.37
7.6	81.04
9.0	80.74
13.4	80.66
14.8	80.59
17.1	80.72
19.0	80.61
20.9	80.70
21.6	80.50
22.9	80.50
24.5	79.64
25.6	79.11
27.4	78.60
27.8	78.70
29.3	78.82
30.1	78.93
31.4	79.42
32.5	79.95
33.6	80.36
35.2	80.66
39.7	80.36
45.9	80.51
49.4	80.52
52.5	80.64
54.6	80.93

SUMMARY DATA	
Bankfull Elevation:	80.5
Bankfull Cross-Sectional Area:	12.5
Bankfull Width:	11.5
Flood Prone Area Elevation:	82.4
Flood Prone Width:	>55
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	10.6
Entrenchment Ratio:	4.8
Bank Height Ratio:	1.0

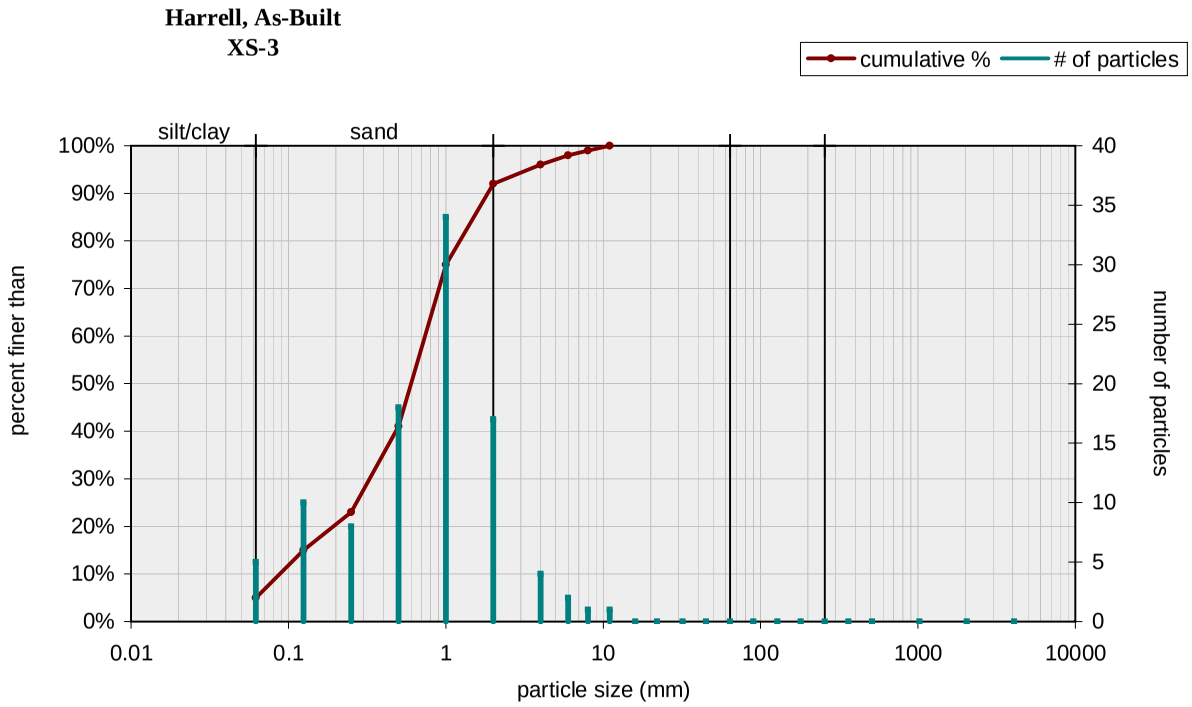
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**5**
very fine sand	0.062 - 0.125	**10**
fine sand	0.125 - 0.25	**8**
medium sand	0.25 - 0.5	**18**
coarse sand	0.5 - 1	**34**
very coarse sand	1 - 2	**17**
very fine gravel	2 - 4	**4**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-3



Size (mm)	
D16	0.14
D35	0.4
D50	0.6
D65	0.82
D84	1.4
D95	3.4

Size Distribution	
mean	0.4
dispersion	3.3
skewness	-0.13

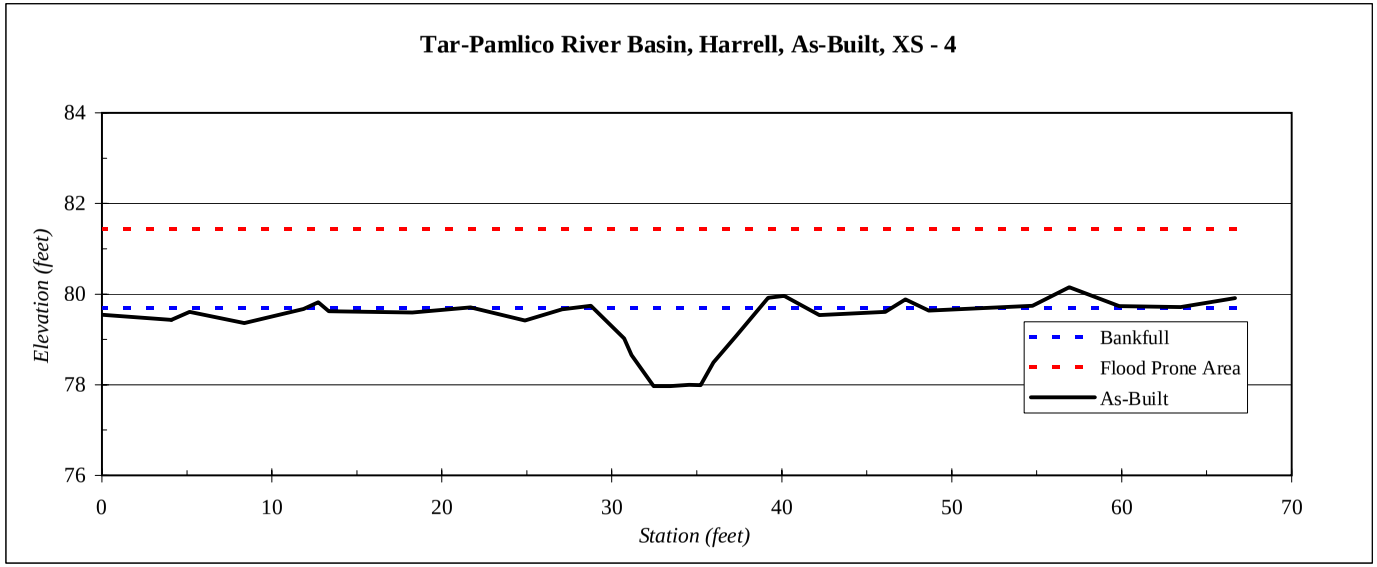
Type	
silt/clay	5%
sand	87%
gravel	8%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 4
Drainage Area (sq mi):	0.23
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	79.55
4.1	79.43
5.2	79.61
8.4	79.36
11.9	79.67
12.7	79.82
13.4	79.62
18.3	79.59
21.7	79.70
24.9	79.42
27.1	79.67
28.8	79.74
30.7	79.02
31.2	78.65
32.5	77.97
33.4	77.97
34.5	78.00
35.2	77.99
36.0	78.49
37.3	79.09
39.2	79.92
40.1	79.96
42.2	79.54
46.1	79.61
47.3	79.88
48.6	79.64
54.7	79.74
56.9	80.15
59.8	79.74
63.5	79.71
66.7	79.91

SUMMARY DATA	
Bankfull Elevation:	79.7
Bankfull Cross-Sectional Area:	10.3
Bankfull Width:	9.8
Flood Prone Area Elevation:	81.4
Flood Prone Width:	>67
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.1
W / D Ratio:	9.3
Entrenchment Ratio:	6.8
Bank Height Ratio:	1.0

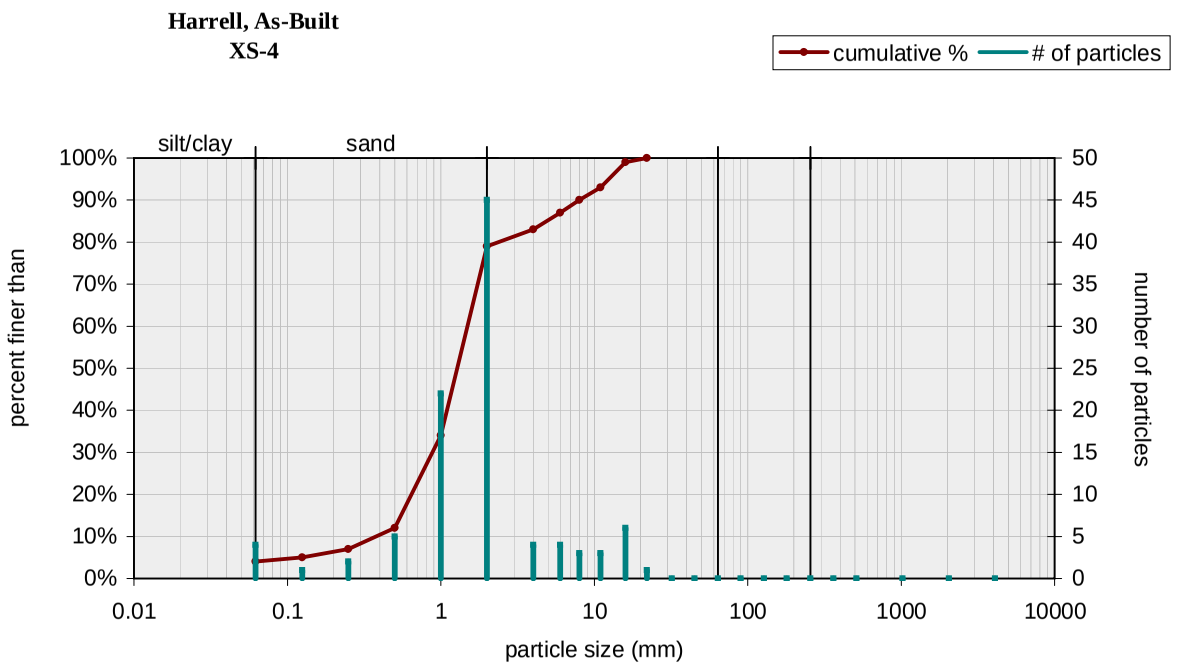
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**4**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	**2**
medium sand	0.25 - 0.5	**5**
coarse sand	0.5 - 1	**22**
very coarse sand	1 - 2	**45**
very fine gravel	2 - 4	**4**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**6**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-4



Size (mm)		
D16	0.57	3.4
D35	1	12
D50	1.3	17
D65	1.6	20
D84	4.4	29
D95	12	39

Size Distribution	
mean	1.6
dispersion	2.8
skewness	0.09

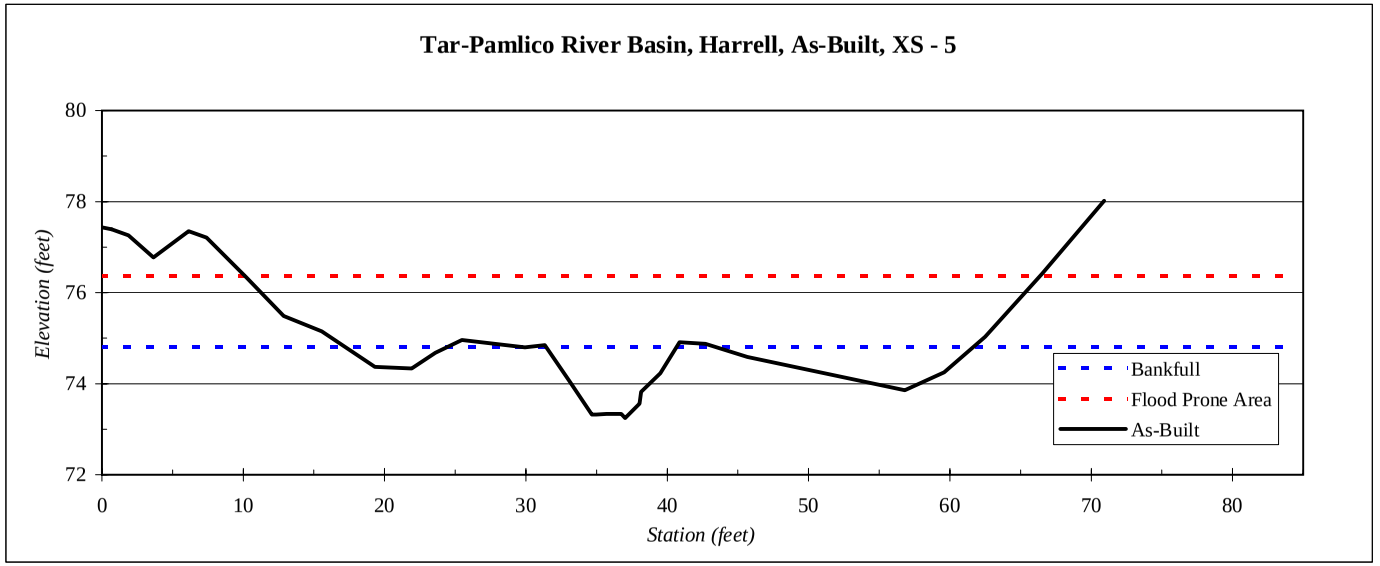
Type	
silt/clay	4%
sand	75%
gravel	21%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 5
Drainage Area (sq mi):	0.23
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	77.44
0.7	77.39
1.9	77.26
3.6	76.77
6.1	77.35
7.4	77.21
10.2	76.34
12.9	75.49
15.5	75.15
19.3	74.37
21.9	74.34
23.6	74.68
25.5	74.96
29.9	74.80
31.3	74.84
33.1	74.05
34.7	73.32
35.0	73.32
35.7	73.33
36.7	73.34
37.0	73.24
38.0	73.56
38.2	73.82
39.5	74.23
40.9	74.91
42.7	74.87
45.7	74.59
50.8	74.25
56.8	73.86
59.6	74.25
62.5	75.03
66.5	76.41
70.9	78.02
72.2	78.19
73.9	77.94
75.1	77.55
78.0	78.00
82.0	78.07
84.5	78.22

SUMMARY DATA	
Bankfull Elevation:	74.8
Bankfull Cross-Sectional Area:	8.8
Bankfull Width:	9.2
Flood Prone Area Elevation:	76.4
Flood Prone Width:	56
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	1.0
W / D Ratio:	9.6
Entrenchment Ratio:	6.1
Bank Height Ratio:	1.0

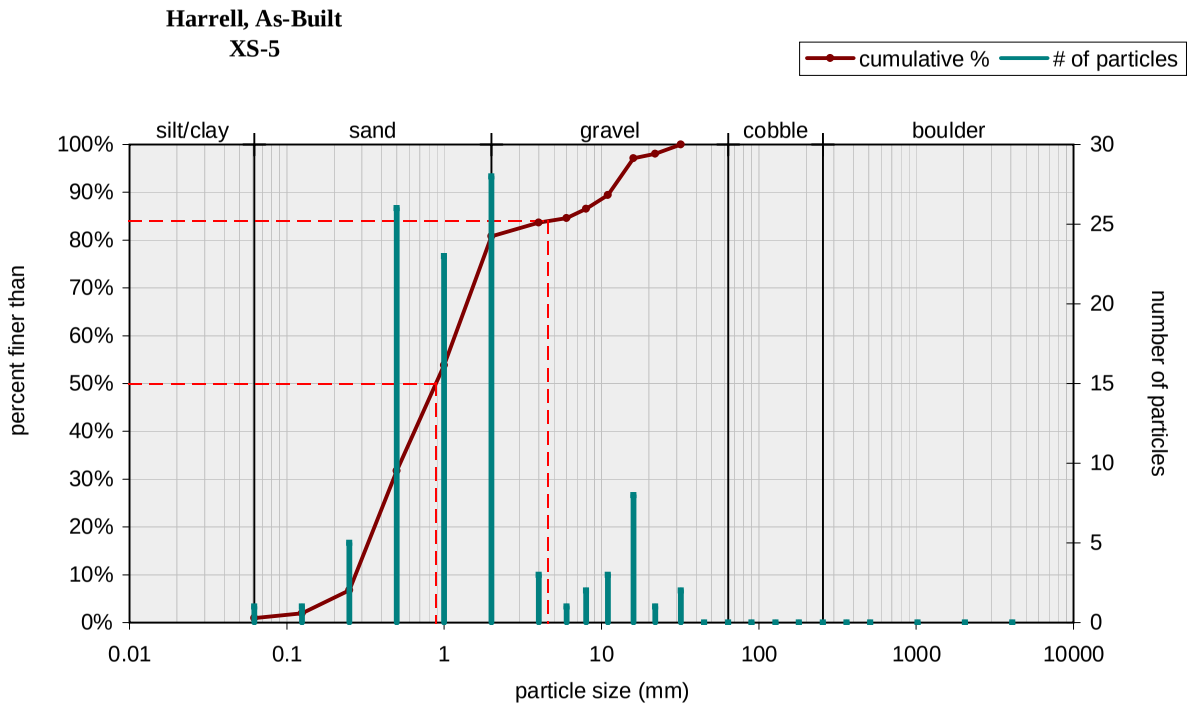
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**1**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	**5**
medium sand	0.25 - 0.5	**26**
coarse sand	0.5 - 1	**23**
very coarse sand	1 - 2	**28**
very fine gravel	2 - 4	**3**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**2**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**8**
coarse gravel	16 - 22	**1**
coarse gravel	22 - 32	**2**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		104
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		104

Note: XS-5



Size (mm)	
D16	0.32
D35	0.55
D50	0.89
D65	1.3
D84	4.6
D95	14

Size Distribution	
mean	1.2
dispersion	4.0
skewness	0.13

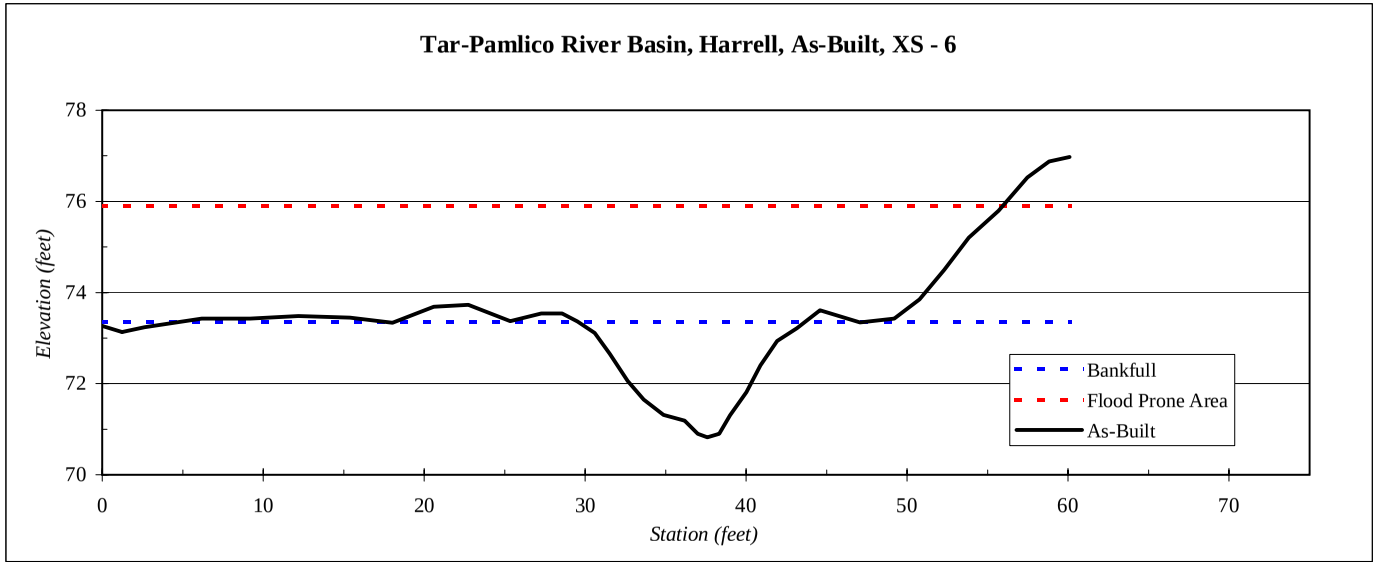
Type	
silt/clay	1%
sand	80%
gravel	19%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 6
Drainage Area (sq mi):	0.42
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.00	73.3
1.24	73.1
2.63	73.2
6.18	73.4
9.19	73.4
12.19	73.5
15.39	73.4
18.04	73.3
20.58	73.7
22.74	73.7
25.35	73.4
27.27	73.5
28.56	73.5
29.51	73.4
30.58	73.1
31.52	72.7
32.64	72.1
33.63	71.6
34.87	71.3
36.19	71.2
36.99	70.9
37.59	70.8
38.32	70.9
39.01	71.3
40.02	71.8
40.89	72.4
41.92	72.9
43.15	73.2
44.58	73.6
47.07	73.3
49.20	73.4
50.76	73.8
52.31	74.5
53.84	75.2
55.68	75.8
57.47	76.5
58.82	76.9
60.09	77.0

SUMMARY DATA	
Bankfull Elevation:	73.4
Bankfull Cross-Sectional Area:	19.1
Bankfull Width:	14.1
Flood Prone Area Elevation:	75.9
Flood Prone Width:	>60
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.4
W / D Ratio:	10.4
Entrenchment Ratio:	4.3
Bank Height Ratio:	1.0

Stream Type	C5

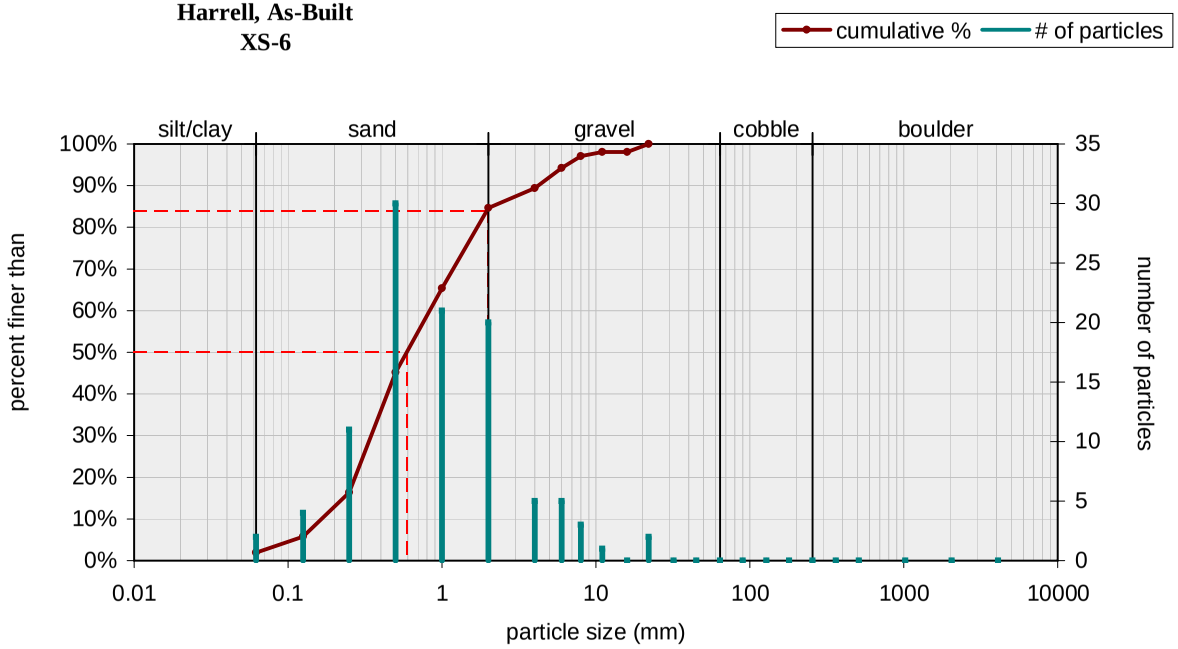


Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	**4**
fine sand	0.125 - 0.25	**11**
medium sand	0.25 - 0.5	**30**
coarse sand	0.5 - 1	**21**
very coarse sand	1 - 2	**20**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**2**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		104
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		104

Note: XS-6

Harrell, As-Built
XS-6



Size (mm)		
D16	0.24	3.4
D35	0.39	12
D50	0.59	17
D65	0.99	20
D84	2	29
D95	6.5	39

Size Distribution	
mean	0.7
dispersion	2.9
skewness	0.07

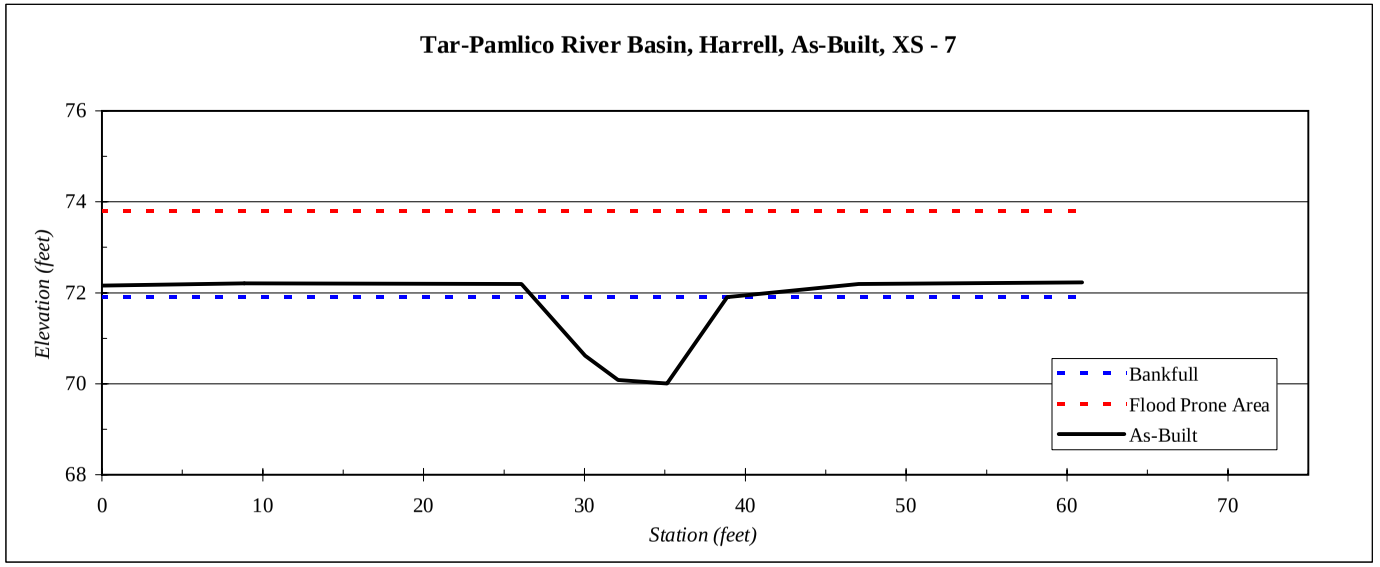
Type	
silt/clay	2%
sand	83%
gravel	15%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 7
Drainage Area (sq mi):	0.42
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	72.16
8.8	72.21
26.1	72.19
30.0	70.61
32.1	70.08
35.1	70.00
38.9	71.90
47.0	72.20
60.9	72.23

SUMMARY DATA	
Bankfull Elevation:	71.9
Bankfull Cross-Sectional Area:	14.4
Bankfull Width:	12.1
Flood Prone Area Elevation:	73.8
Flood Prone Width:	>61
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	10.2
Entrenchment Ratio:	5.0
Bank Height Ratio:	1.0

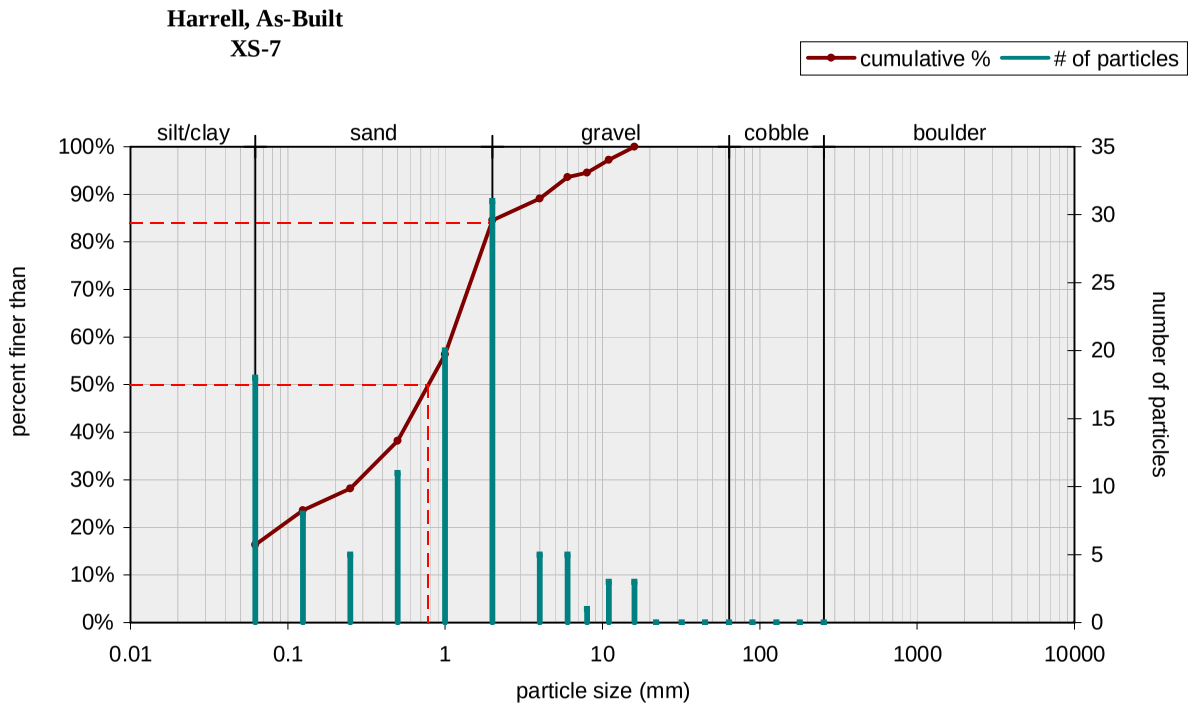
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**18**
very fine sand	0.062 - 0.125	**8**
fine sand	0.125 - 0.25	**5**
medium sand	0.25 - 0.5	**11**
coarse sand	0.5 - 1	**20**
very coarse sand	1 - 2	**31**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**3**
medium gravel	11 - 16	**3**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		110
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		110

Note: XS-7



Size (mm)	
D16	0.062
D35	0.4
D50	0.78
D65	1.2
D84	2
D95	8.4

Size Distribution	
mean	0.4
dispersion	7.6
skewness	-0.28

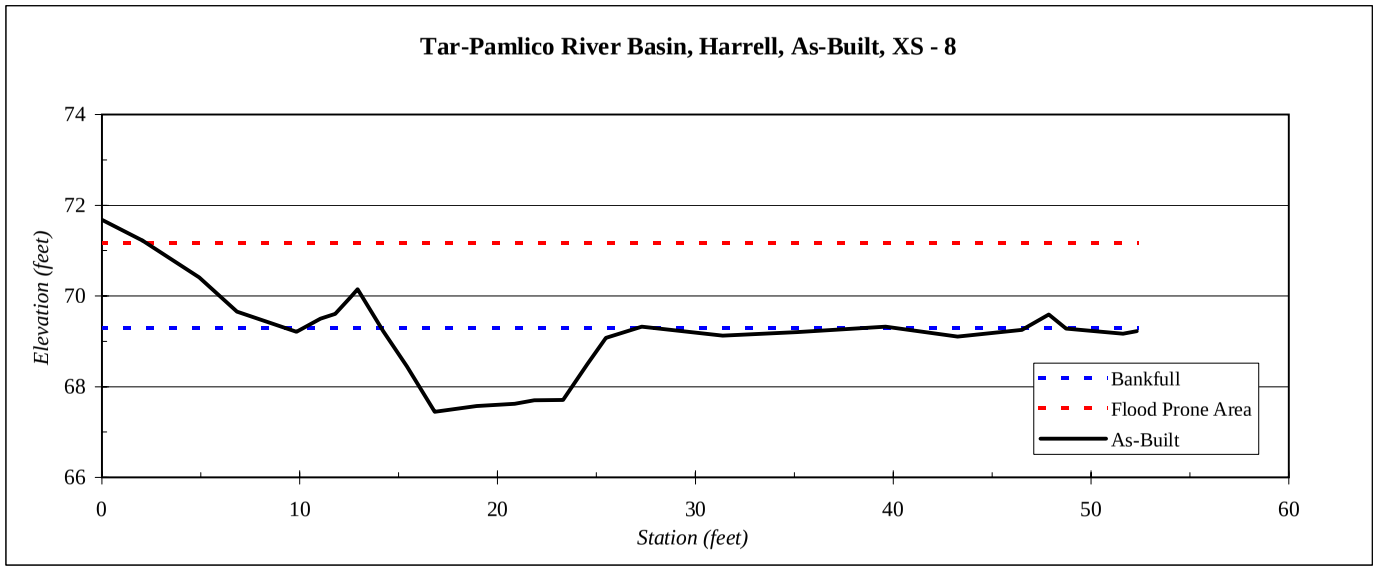
Type	
silt/clay	16%
sand	68%
gravel	15%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 8
Drainage Area (sq mi):	0.42
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	71.68
2.1	71.22
4.9	70.41
6.8	69.65
9.8	69.21
11.1	69.50
11.8	69.61
12.6	69.97
12.9	70.15
14.2	69.22
15.4	68.45
16.8	67.44
18.9	67.57
20.9	67.62
21.9	67.70
23.3	67.71
24.5	68.50
25.5	69.08
27.3	69.32
31.4	69.13
35.1	69.20
39.6	69.32
43.3	69.10
46.5	69.25
47.9	69.59
48.7	69.28
51.6	69.17
52.3	69.22

SUMMARY DATA	
Bankfull Elevation:	69.3
Bankfull Cross-Sectional Area:	15.6
Bankfull Width:	13.0
Flood Prone Area Elevation:	71.2
Flood Prone Width:	>50
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	10.8
Entrenchment Ratio:	3.8
Bank Height Ratio:	1.0

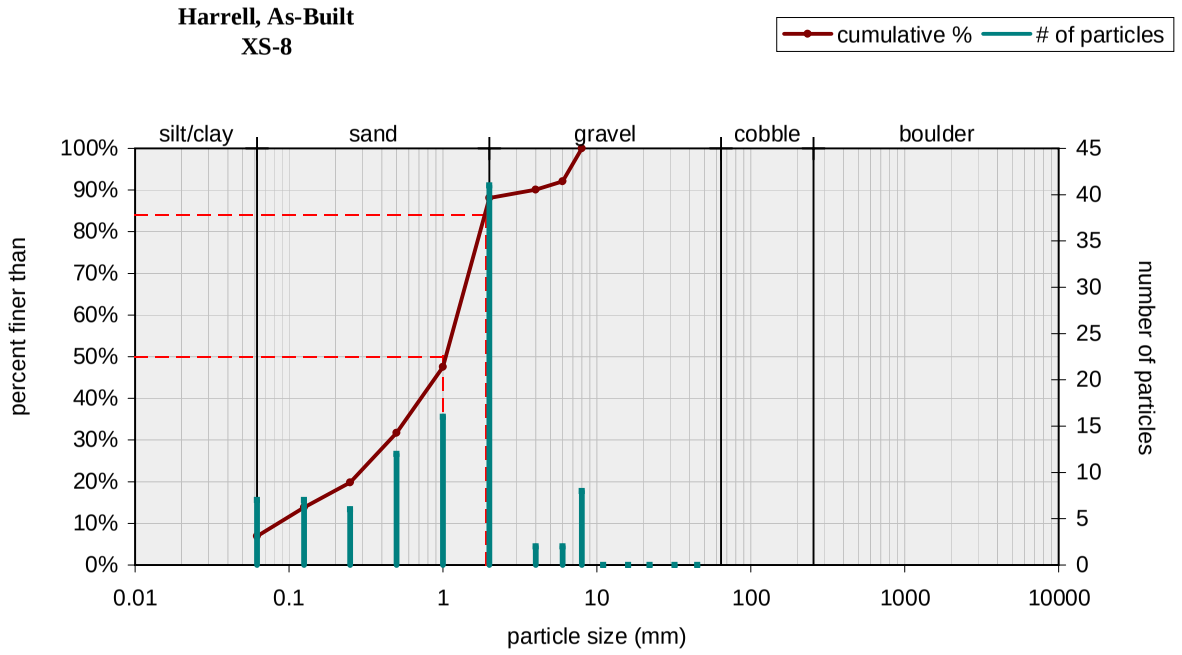
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**7**
very fine sand	0.062 - 0.125	**7**
fine sand	0.125 - 0.25	**6**
medium sand	0.25 - 0.5	**12**
coarse sand	0.5 - 1	**16**
very coarse sand	1 - 2	**41**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**8**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		101
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		101

Note: XS-8



Size (mm)		
D16	0.16	3.4
D35	0.58	12
D50	1	17
D65	1.3	20
D84	1.9	29
D95	6.7	39

Size Distribution	
mean	0.6
dispersion	4.1
skewness	-0.25

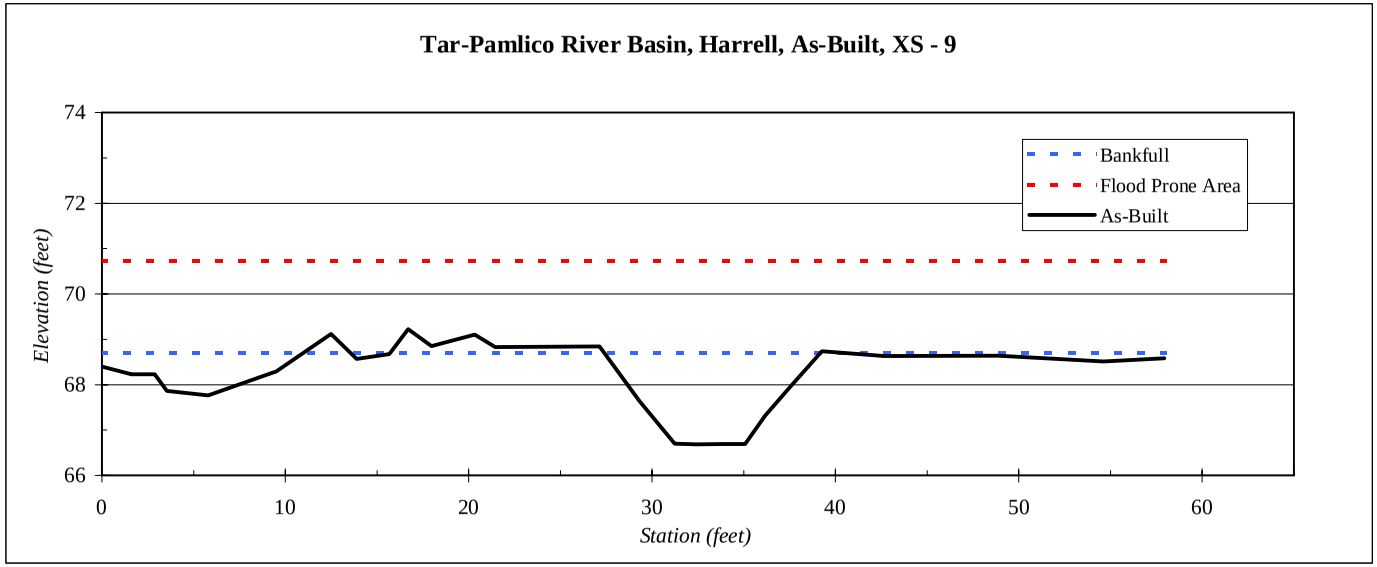
Type	
silt/clay	7%
sand	81%
gravel	12%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 9
Drainage Area (sq mi):	0.42
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	68.40
1.6	68.23
2.9	68.23
3.6	67.86
5.8	67.76
9.5	68.29
12.5	69.12
13.9	68.57
15.7	68.67
16.7	69.22
18.0	68.85
20.3	69.10
21.4	68.83
27.1	68.84
29.3	67.64
31.2	66.70
32.5	66.68
33.9	66.69
35.1	66.69
36.2	67.31
37.6	67.96
39.3	68.74
42.7	68.63
48.9	68.64
54.6	68.51
57.9	68.58

SUMMARY DATA	
Bankfull Elevation:	68.7
Bankfull Cross-Sectional Area:	15.6
Bankfull Width:	11.8
Flood Prone Area Elevation:	70.7
Flood Prone Width:	>58
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	8.9
Entrenchment Ratio:	4.9
Bank Height Ratio:	1.0

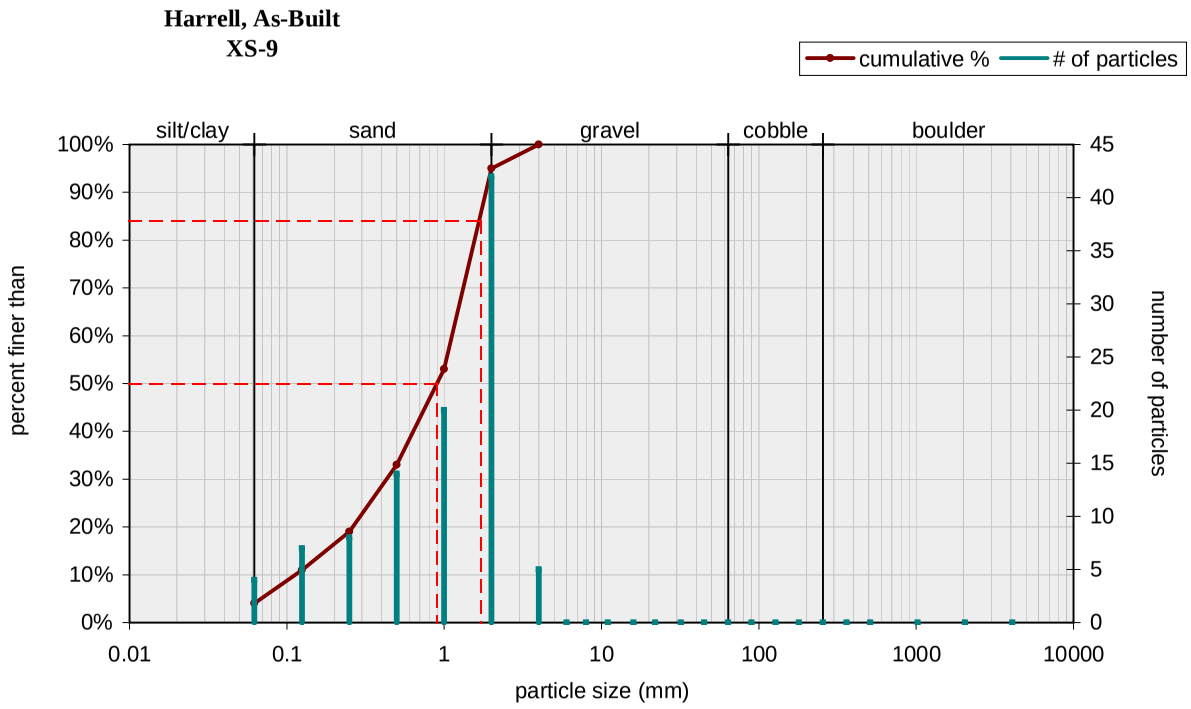
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**4**
very fine sand	0.062 - 0.125	**7**
fine sand	0.125 - 0.25	**8**
medium sand	0.25 - 0.5	**14**
coarse sand	0.5 - 1	**20**
very coarse sand	1 - 2	**42**
very fine gravel	2 - 4	**5**
fine gravel	4 - 6	**0**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-9



Size (mm)	
D16	0.19
D35	0.54
D50	0.9
D65	1.2
D84	1.7
D95	2

Size Distribution	
mean	0.6
dispersion	3.3
skewness	-0.20

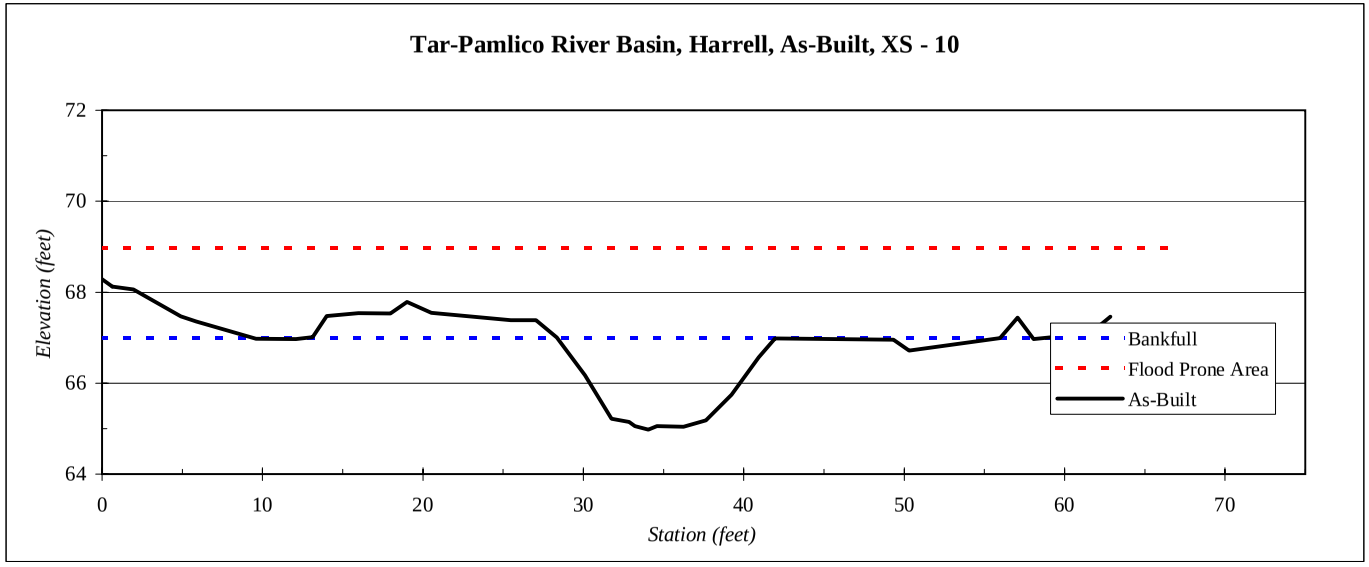
Type	
silt/clay	4%
sand	91%
gravel	5%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 10
Drainage Area (sq mi):	0.61
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	68.28
0.6	68.13
2.0	68.06
4.9	67.47
5.9	67.36
9.6	66.98
12.1	66.97
13.1	67.01
14.0	67.48
16.0	67.54
18.0	67.53
19.0	67.78
20.5	67.55
25.5	67.39
27.1	67.38
28.3	67.00
30.1	66.18
31.8	65.22
32.8	65.14
33.2	65.05
34.1	64.98
34.6	65.05
36.2	65.04
37.6	65.18
39.2	65.75
40.9	66.57
42.0	66.98
49.3	66.95
50.3	66.72
56.0	66.99
57.1	67.44
58.1	66.97
61.6	67.10
62.9	67.46
63.9	67.25
67.2	67.43

SUMMARY DATA	
Bankfull Elevation:	67.0
Bankfull Cross-Sectional Area:	17.9
Bankfull Width:	13.5
Flood Prone Area Elevation:	69.0
Flood Prone Width:	>67
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	10.2
Entrenchment Ratio:	5.0
Bank Height Ratio:	1.0

Stream Type	C5



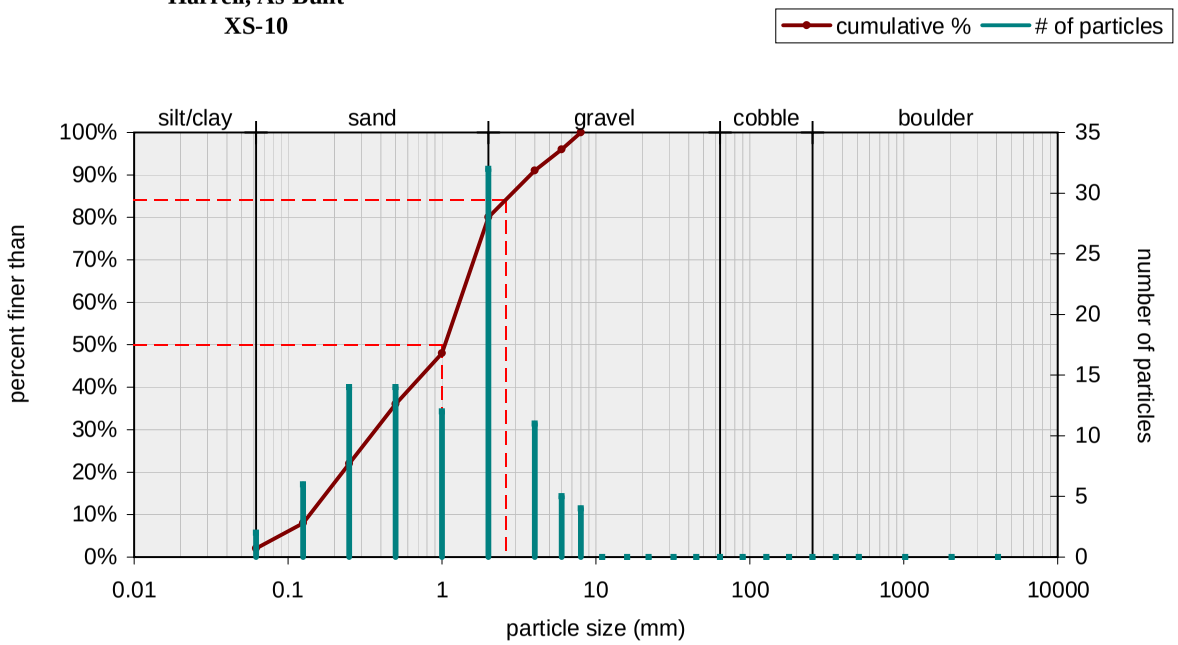
Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	**6**
fine sand	0.125 - 0.25	**14**
medium sand	0.25 - 0.5	**14**
coarse sand	0.5 - 1	**12**
very coarse sand	1 - 2	**32**
very fine gravel	2 - 4	**11**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**

total particle count:	100
bedrock ----------	**0**
clay hardpan ----------	
detritus/wood ----------	
artificial ----------	
total count:	100

Note: XS-10

Harrell, As-Built
XS-10



Size (mm)		
D16	0.19	3.4
D35	0.48	12
D50	1	17
D65	1.4	20
D84	2.6	29
D95	5.5	39

Size Distribution	
mean	0.7
dispersion	3.9
skewness	-0.14

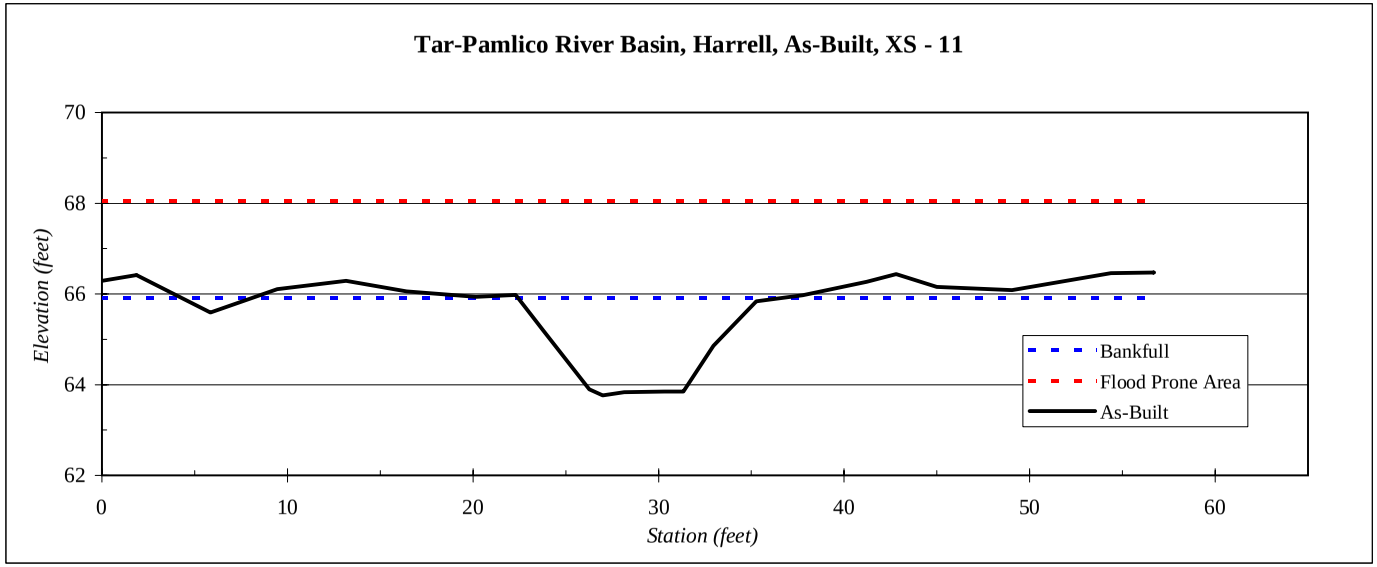
Type	
silt/clay	2%
sand	78%
gravel	20%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 11
Drainage Area (sq mi):	0.61
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	66.29
1.9	66.42
5.8	65.59
9.5	66.11
13.2	66.29
16.4	66.05
20.2	65.94
22.3	65.98
23.8	65.20
26.3	63.90
27.0	63.76
28.1	63.83
30.3	63.85
31.3	63.85
33.0	64.86
35.3	65.84
37.8	65.97
41.2	66.27
42.8	66.44
45.0	66.15
49.0	66.08
54.4	66.46
56.7	66.47
56.7	66.47

SUMMARY DATA	
Bankfull Elevation:	65.9
Bankfull Cross-Sectional Area:	18.2
Bankfull Width:	14.0
Flood Prone Area Elevation:	68.0
Flood Prone Width:	>57
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.3
W / D Ratio:	10.8
Entrenchment Ratio:	4.1
Bank Height Ratio:	1.0

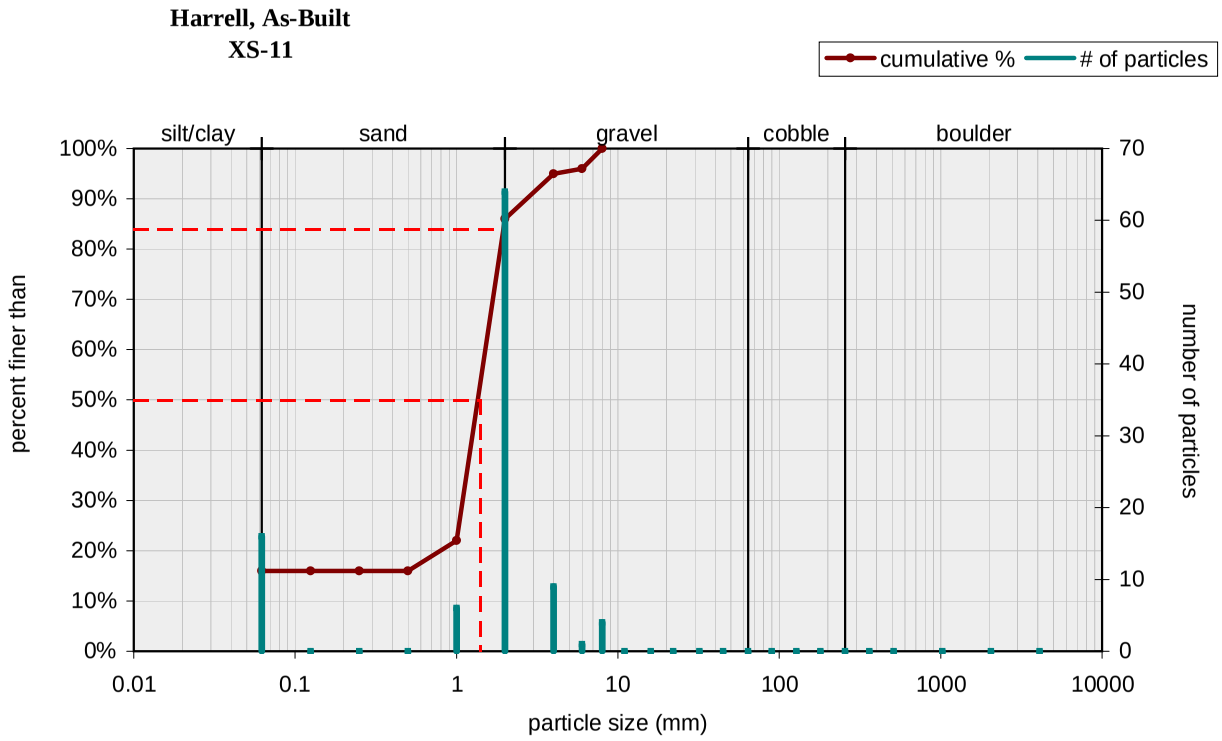
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**16**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**6**
very coarse sand	1 - 2	**64**
very fine gravel	2 - 4	**9**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-11



Size (mm)	
D16	0.062
D35	1.2
D50	1.4
D65	1.6
D84	2
D95	4

Size Distribution	
mean	0.4
dispersion	12.0
skewness	-0.49

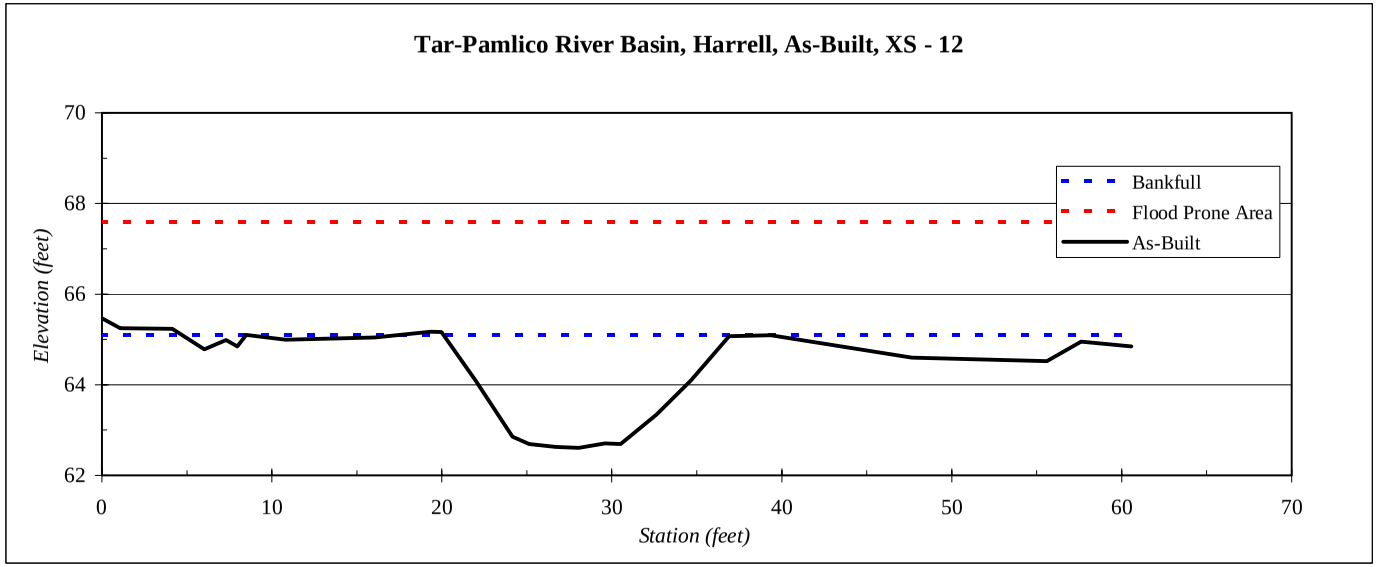
Type	
silt/clay	16%
sand	70%
gravel	14%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 12
Drainage Area (sq mi):	0.61
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	65.47
1.1	65.25
4.1	65.23
6.0	64.78
7.3	64.99
8.0	64.84
8.5	65.10
10.8	64.99
16.1	65.04
19.4	65.17
20.0	65.17
22.0	64.09
24.2	62.86
25.1	62.69
26.7	62.63
28.0	62.61
29.6	62.70
30.5	62.69
32.6	63.34
34.7	64.09
36.9	65.11
39.3	65.11
47.7	64.60
55.6	64.52
57.6	64.95
60.6	64.85

SUMMARY DATA	
Bankfull Elevation:	65.1
Bankfull Cross-Sectional Area:	28.2
Bankfull Width:	16.8
Flood Prone Area Elevation:	67.6
Flood Prone Width:	>61
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.7
W / D Ratio:	10.0
Entrenchment Ratio:	3.6
Bank Height Ratio:	1.0

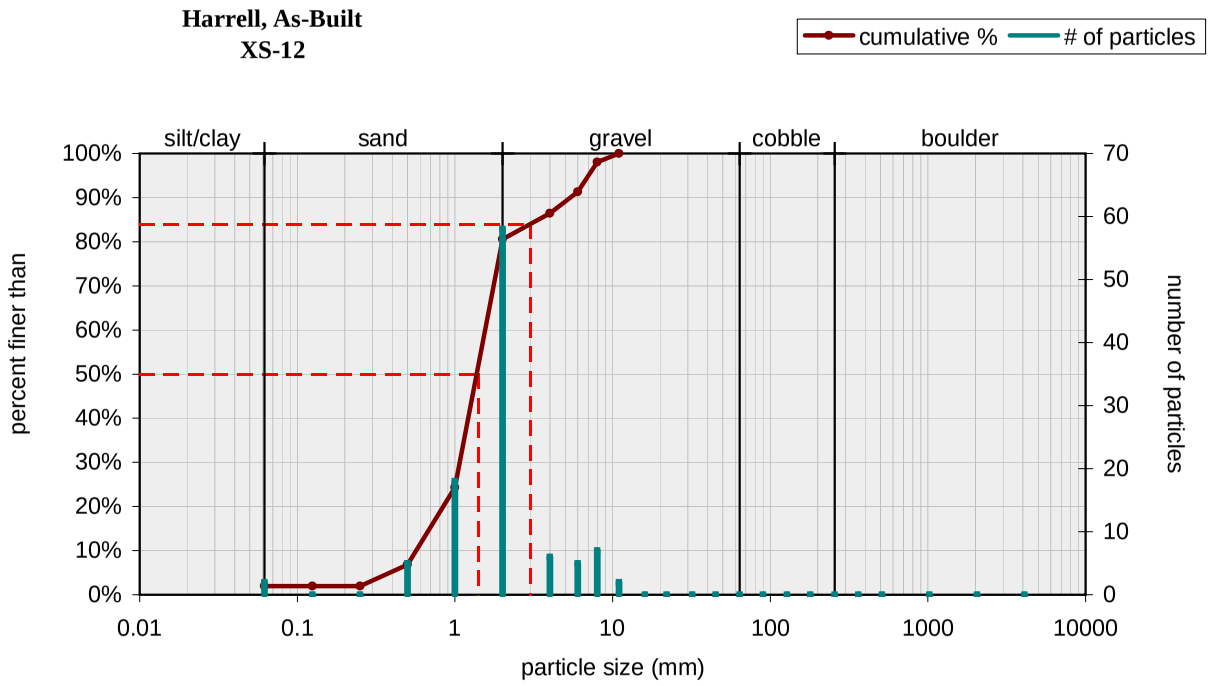
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**2**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**5**
coarse sand	0.5 - 1	**18**
very coarse sand	1 - 2	**58**
very fine gravel	2 - 4	**6**
fine gravel	4 - 6	**5**
fine gravel	6 - 8	**7**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		103
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		103

Note: XS-12



Size (mm)		
D16	0.72	3.4
D35	1.1	12
D50	1.4	17
D65	1.7	20
D84	3	29
D95	7	39

Size Distribution	
mean	1.5
dispersion	2.0
skewness	0.03

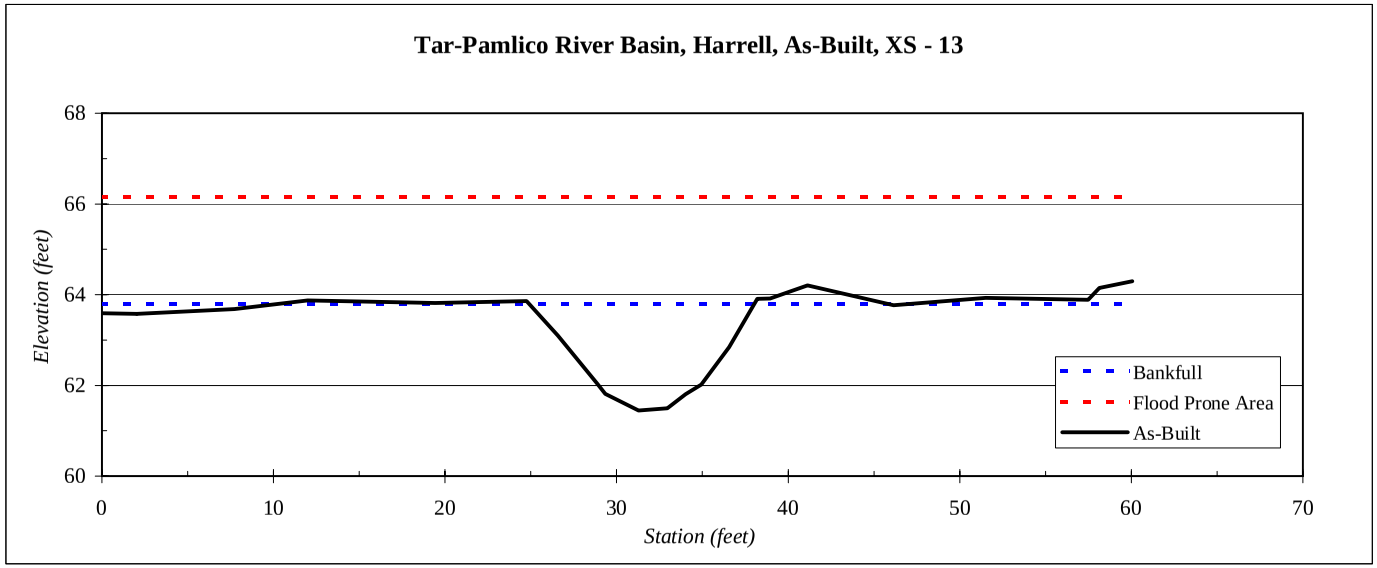
Type	
silt/clay	2%
sand	79%
gravel	19%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 13
Drainage Area (sq mi):	0.61
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	63.59
2.0	63.57
7.7	63.68
12.0	63.87
19.4	63.82
24.8	63.86
26.6	63.10
28.8	62.05
29.3	61.82
31.3	61.45
33.0	61.49
34.0	61.80
34.9	62.02
36.6	62.84
38.2	63.91
38.9	63.91
41.1	64.21
46.1	63.77
51.5	63.93
57.5	63.89
58.1	64.15
60.1	64.30

SUMMARY DATA	
Bankfull Elevation:	63.8
Bankfull Cross-Sectional Area:	19.4
Bankfull Width:	13.1
Flood Prone Area Elevation:	66.2
Flood Prone Width:	>60
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.5
W / D Ratio:	8.8
Entrenchment Ratio:	4.6
Bank Height Ratio:	1.0

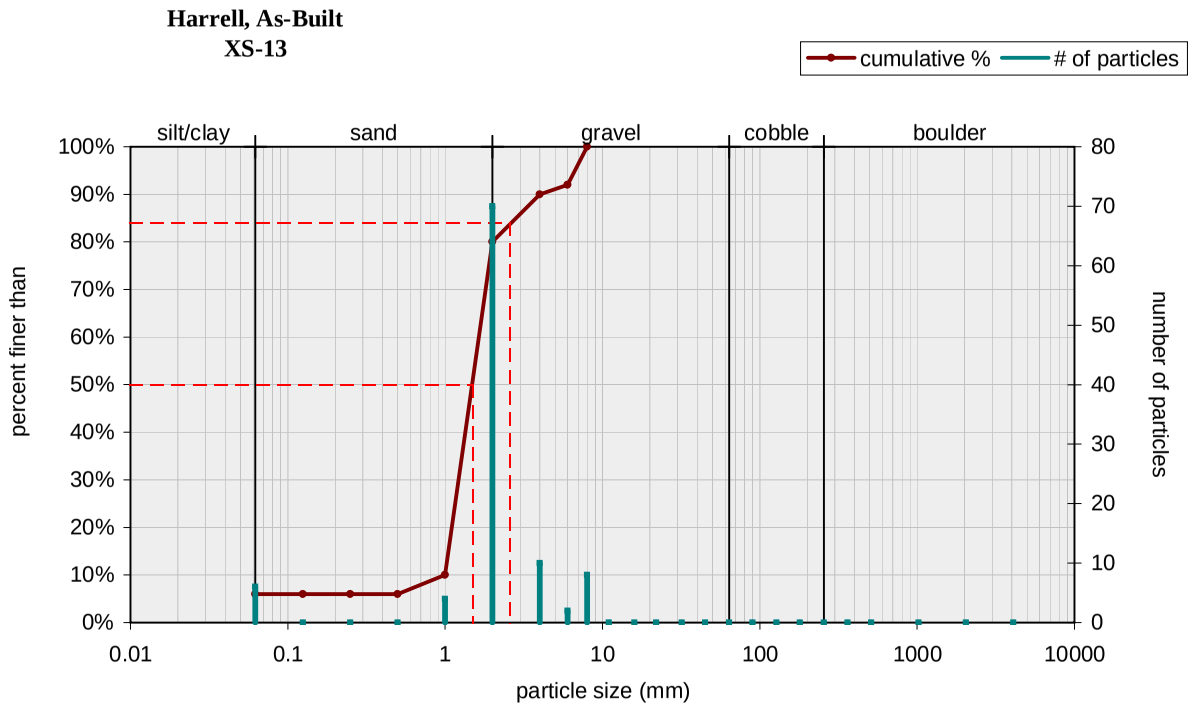
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**6**
very fine sand	0.062 - 0.125	**0**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**4**
very coarse sand	1 - 2	**70**
very fine gravel	2 - 4	**10**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**8**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-13



Size (mm)	
D16	1.1
D35	1.3
D50	1.5
D65	1.7
D84	2.6
D95	6.7

Size Distribution	
mean	1.7
dispersion	1.5
skewness	0.09

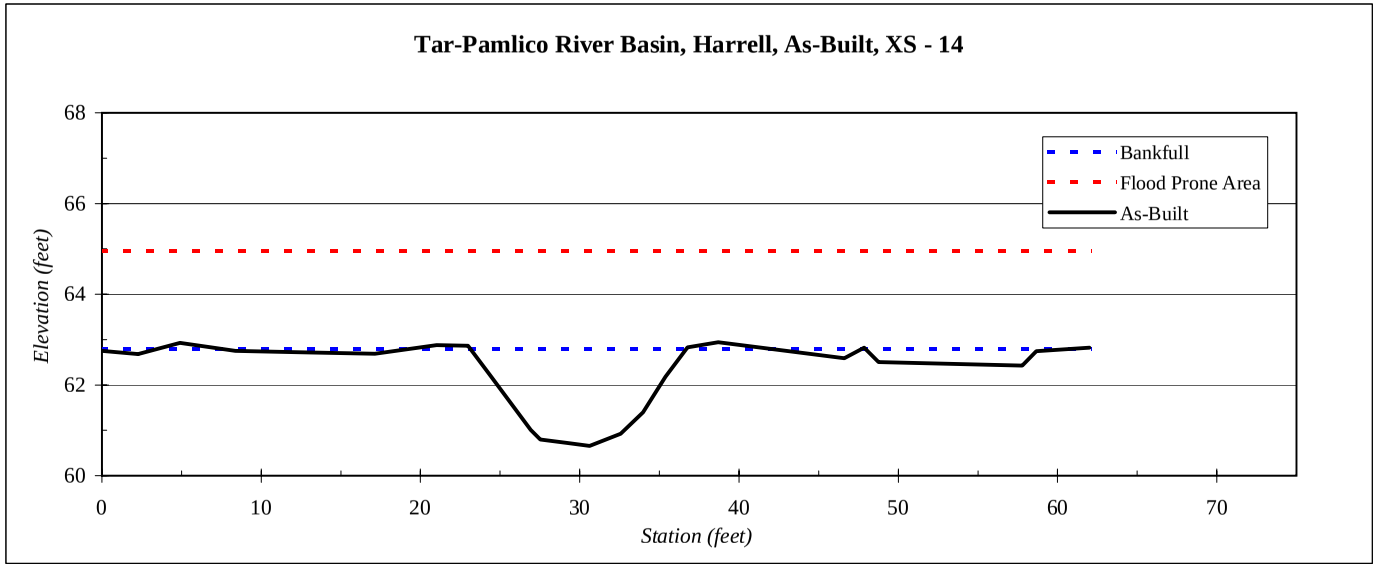
Type	
silt/clay	6%
sand	74%
gravel	20%
cobble	0%
boulder	0%

River Basin:	Tar-Pamlico
Watershed:	Harrell, As-Built
XS ID	XS - 14
Drainage Area (sq mi):	0.61
Date:	11/7/2007
Field Crew:	B. Roberts, T. King

Station	Elevation
0.0	62.75
2.3	62.68
4.9	62.93
8.4	62.75
13.0	62.72
17.1	62.69
21.0	62.88
23.0	62.86
24.4	62.21
26.9	61.01
27.5	60.79
29.2	60.72
30.6	60.65
32.6	60.93
34.0	61.39
35.4	62.18
36.8	62.83
38.7	62.94
46.6	62.59
47.9	62.82
48.8	62.51
57.8	62.43
58.7	62.74
62.0	62.82

SUMMARY DATA	
Bankfull Elevation:	62.8
Bankfull Cross-Sectional Area:	19.0
Bankfull Width:	13.6
Flood Prone Area Elevation:	64.9
Flood Prone Width:	>62
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.4
W / D Ratio:	9.7
Entrenchment Ratio:	4.6
Bank Height Ratio:	1.0

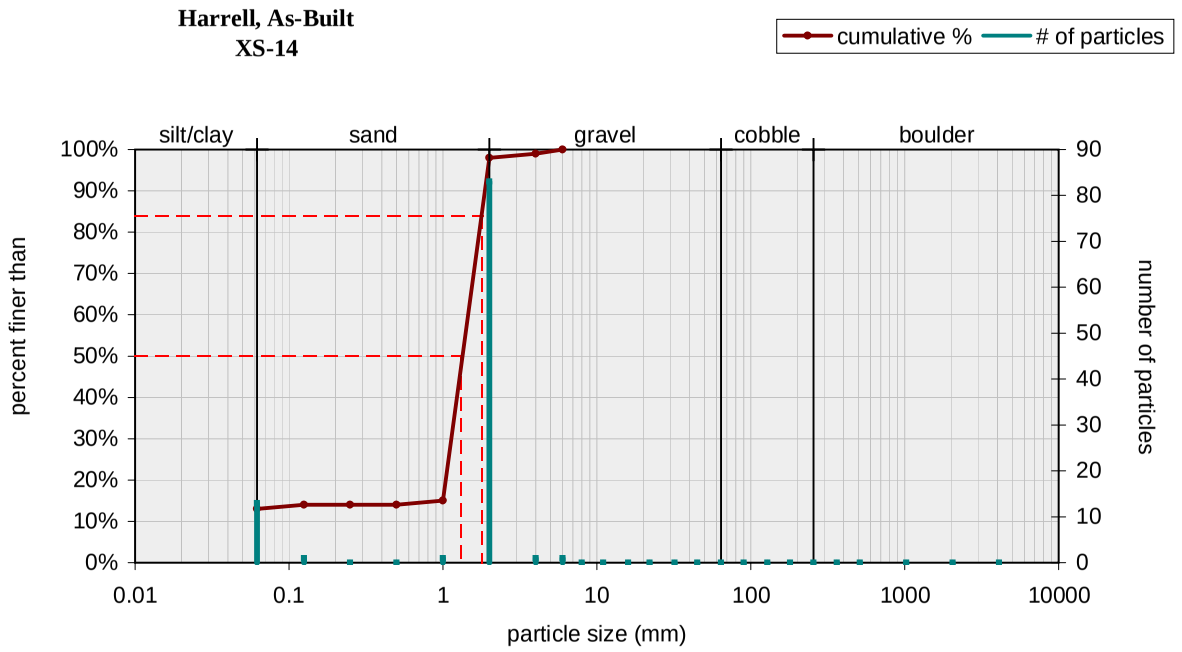
Stream Type	C5



Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**13**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	**0**
medium sand	0.25 - 0.5	**0**
coarse sand	0.5 - 1	**1**
very coarse sand	1 - 2	**83**
very fine gravel	2 - 4	**1**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**0**
medium gravel	8 - 11	**0**
medium gravel	11 - 16	**0**
coarse gravel	16 - 22	**0**
coarse gravel	22 - 32	**0**
very coarse gravel	32 - 45	**0**
very coarse gravel	45 - 64	**0**
small cobble	64 - 90	**0**
medium cobble	90 - 128	**0**
large cobble	128 - 180	**0**
very large cobble	180 - 256	**0**
small boulder	256 - 362	**0**
small boulder	362 - 512	**0**
medium boulder	512 - 1024	**0**
large boulder	1024 - 2048	**0**
very large boulder	2048 - 4096	**0**
total particle count:		100
bedrock ----------		**0**
clay hardpan ----------		
detritus/wood ----------		
artificial ----------		
total count:		100

Note: XS-14



Size (mm)		
D16	1	3.4
D35	1.2	12
D50	1.3	17
D65	1.5	20
D84	1.8	29
D95	2	39

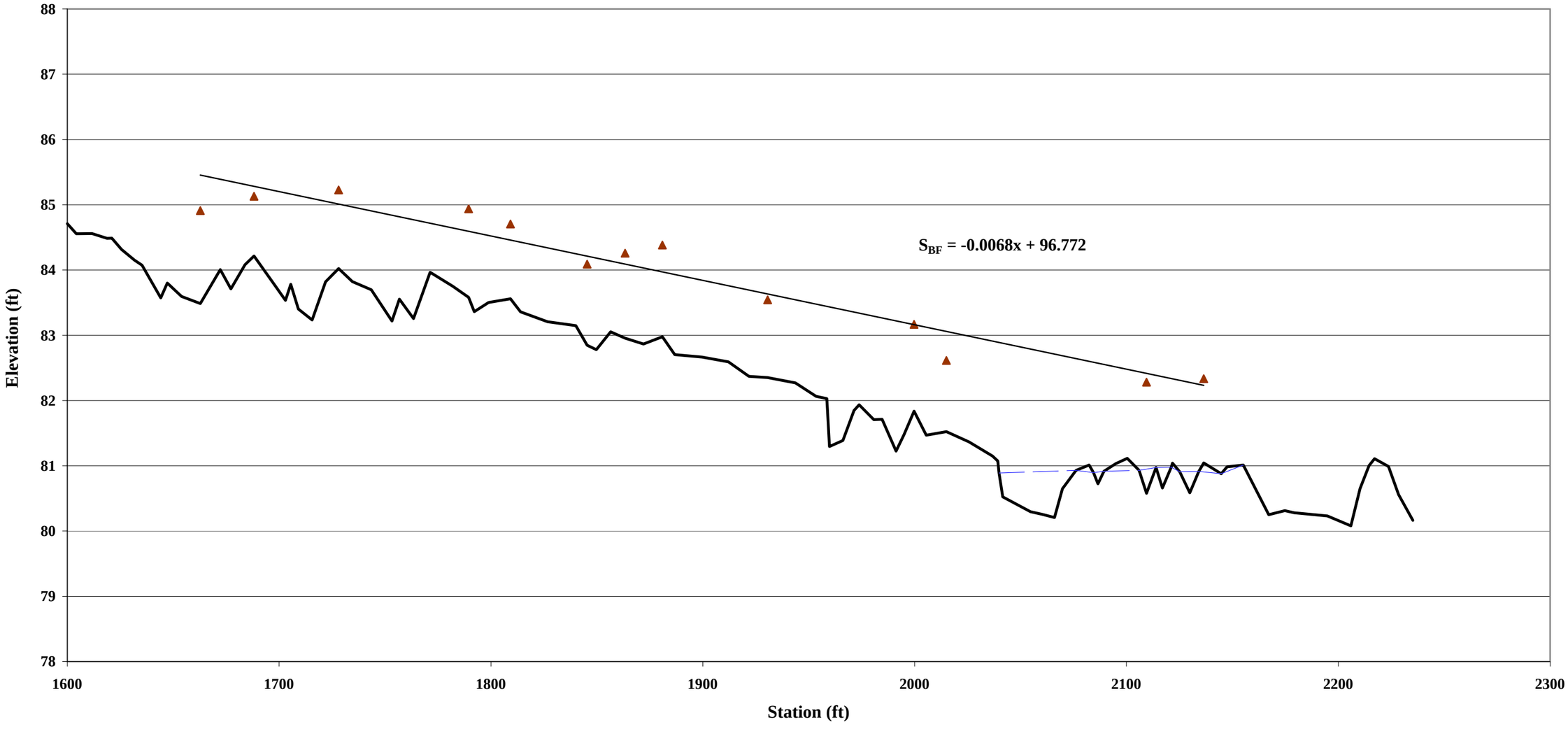
Size Distribution	
mean	1.3
dispersion	1.3
skewness	0.03

Type	
silt/clay	13%
sand	85%
gravel	2%
cobble	0%
boulder	0%

Appendix C

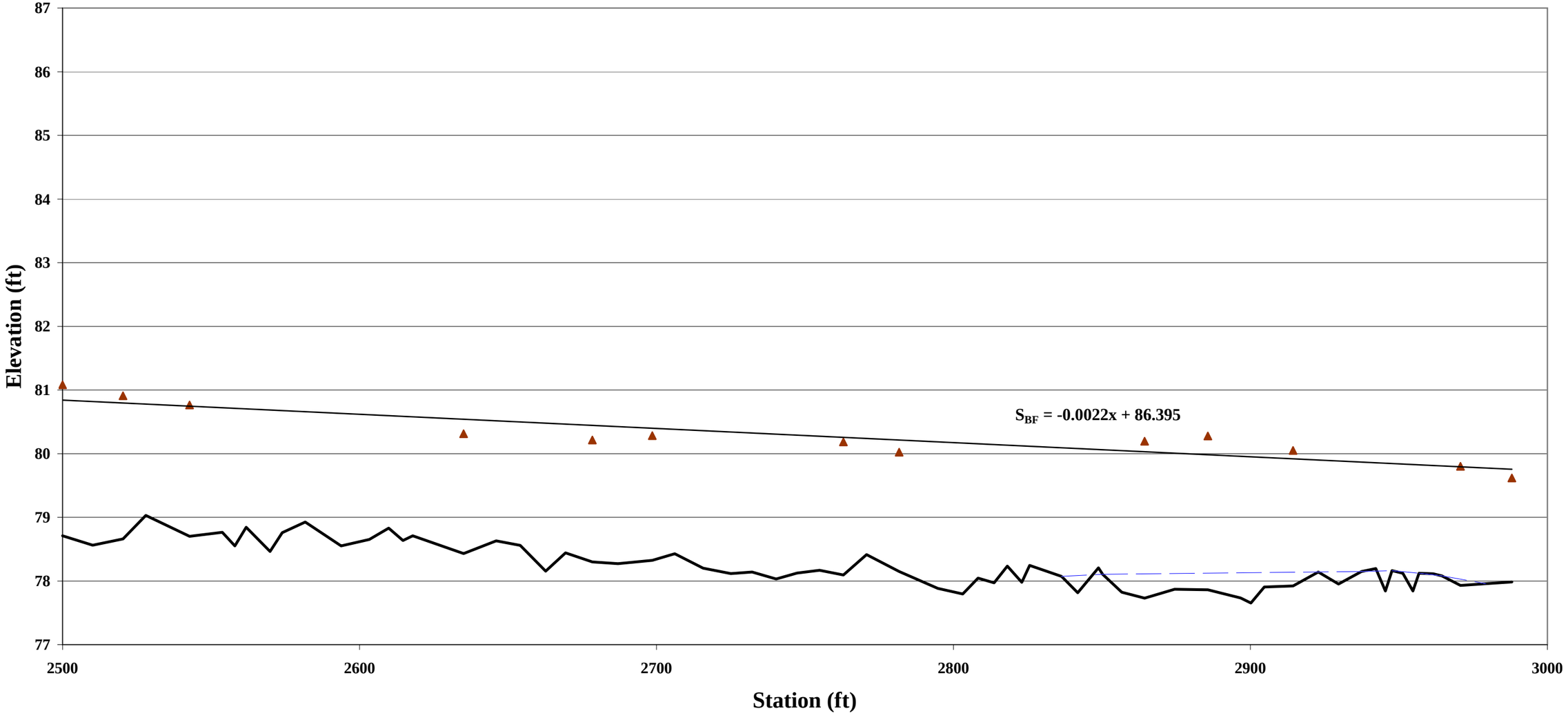
Longitudinal Profile

Longitudinal Profile
Harrell Stream Restoration
Reach 1 - Station 16+00 - 22+35



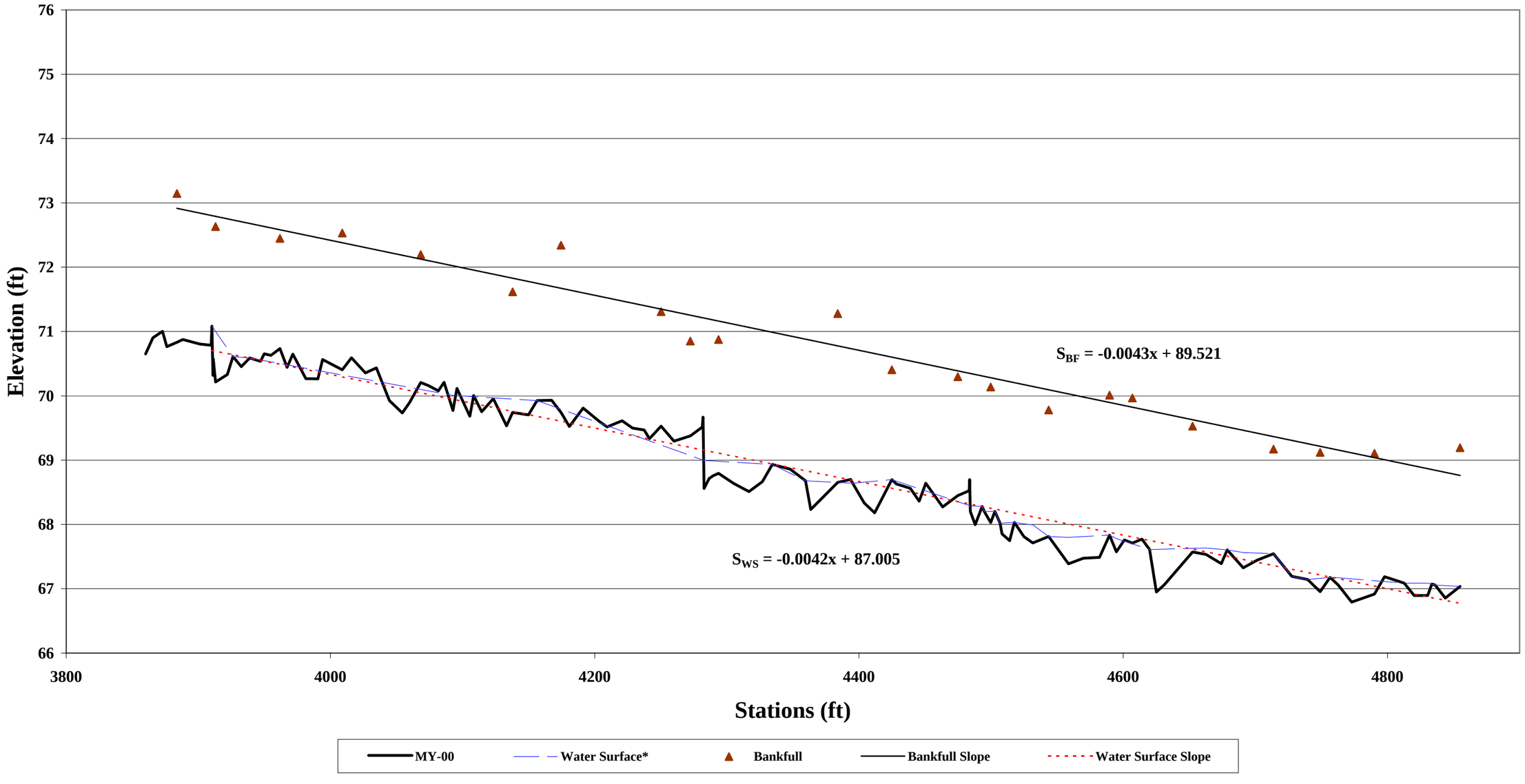
*Due to drought conditions many portions of the stream were dry.

Longitudinal Profile
Harrell Stream Restoration
Reach 2 - Station 25+00 - 29+90



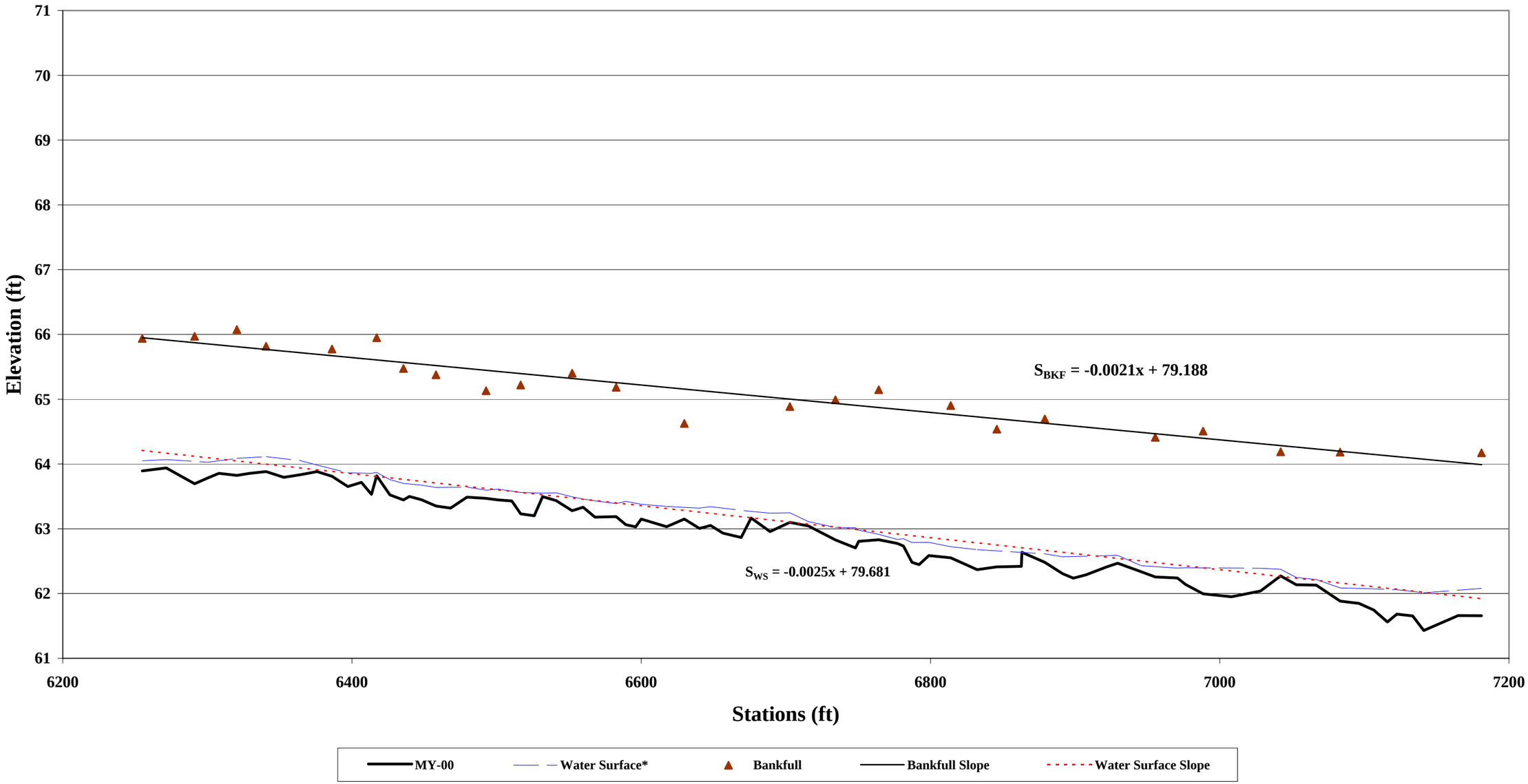
*Due to drought conditions many portions of the stream were dry.

Longitudinal Profile
Harrell Stream Restoration
Reach 3 - Station 38+60 - 48+50



*Due to drought conditions many portions of the stream were dry.

Longitudinal Profile
Harrell Stream Restoration
Reach 4 - Station 62+50 - 71+80



*Due to drought conditions many portions of the stream were dry.

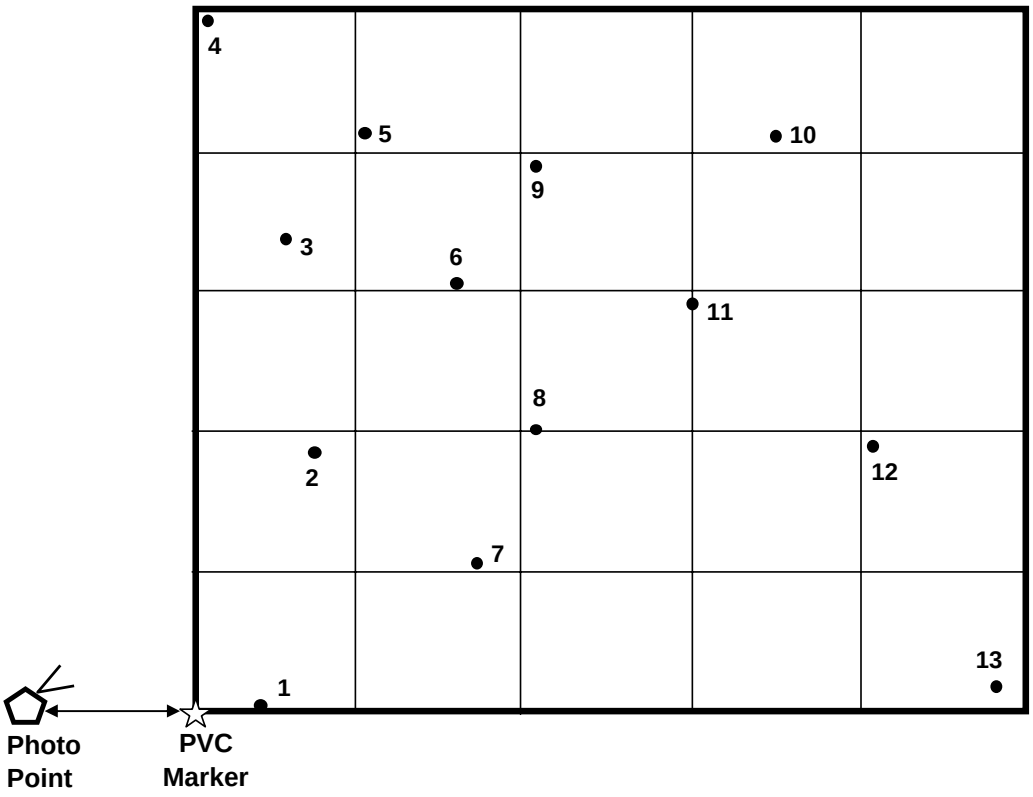
Appendix D

Vegetation Plot Data

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W1 **Date:** 6/19/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Bald Cypress (*Taxodium distichum*)	0.66	3	
2	Swamp Chestnut Oak (*Quercus michauxii*)	0.68	2	
3	Green Ash (*Fraxinus pennsylvanica*)	0.49	3	
4	Swamp Chestnut Oak (*Quercus michauxii*)	0.55	2	
5	Swamp Chestnut Oak (*Quercus michauxii*)	0.51	3	Browsed
6	Green Ash (*Fraxinus pennsylvanica*)	0.57	3	
7	Buttonbush (*Cephalanthus occidentalis*)	0.48	3	
8	Green Ash (*Fraxinus pennsylvanica*)	0.55	2	Browsed
9	Laurel Oak (*Quercus laurifolia*)	0.79	4	
10	Cherrybark Oak (*Quercus pagoda*)	0.41	3	
11	Cherrybark Oak (*Quercus pagoda*)	0.72	2	
12	Beautyberry (*Callicarpa americana*)	0.37	3	
13	Green Ash (*Fraxinus pennsylvanica*)	0.50	2	Browsed

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

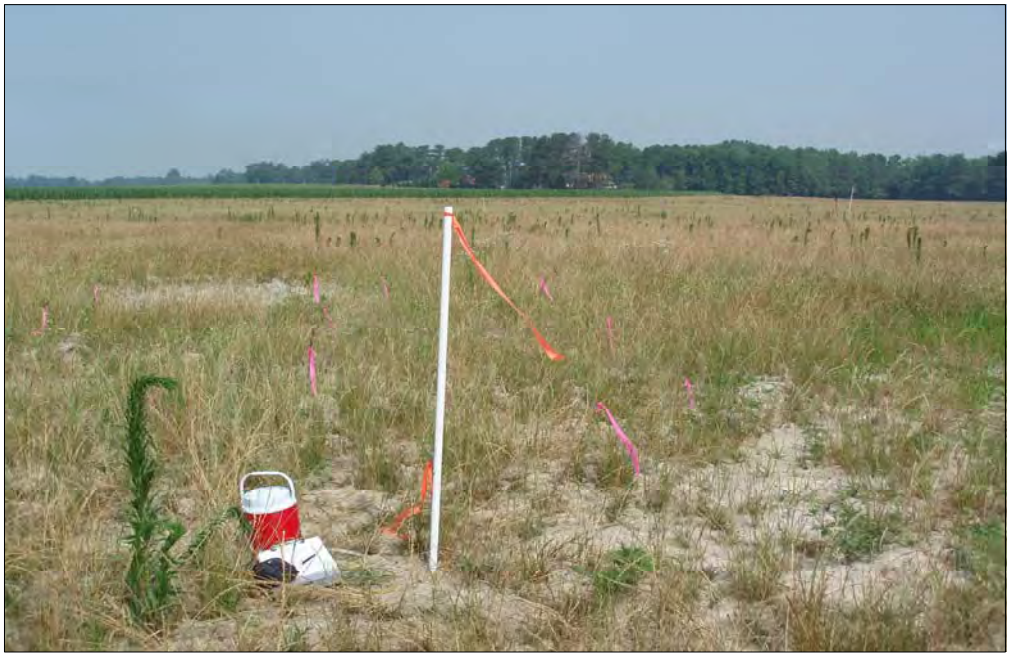
Species	Percent of Total
Bald Cypress (*Taxodium distichum*)	7.7%
Swamp Chestnut Oak (*Quercus michauxii*)	23.1%
Green Ash (*Fraxinus pennsylvanica*)	30.8%
Buttonbush (*Cephalanthus occidentalis*)	7.7%
Laurel Oak (*Quercus laurifolia*)	7.7%
Cherrybark Oak (*Quercus pagoda*)	15.4%
Beautyberry (*Callicarpa americana*)	7.7%

Density:

Total Number of Trees **13** / **0.025 acres** = **520** **trees / acre**

Survivability:

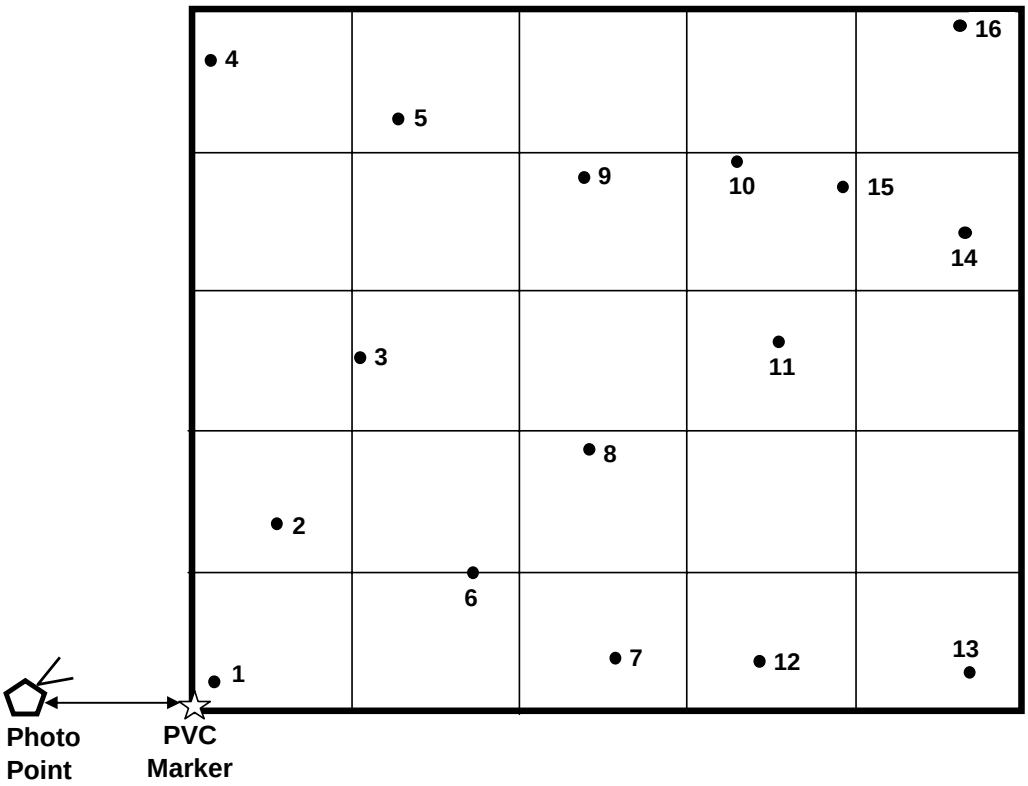
Total Number of Trees **13** / **13 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W2 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Willow Oak (*Quercus phellos*)	0.26	2	Resprout from base
2	Laurel Oak (*Quercus laurifolia*)	0.59	1	
3	Unknown	0.79	2	
4	Willow Oak (*Quercus phellos*)	0.68	3	
5	Cherrybark Oak (*Quercus pagoda*)	0.62	2	
6	Cherrybark Oak (*Quercus pagoda*)	0.62	2	
7	Cherrybark Oak (*Quercus pagoda*)	0.61	2	
8	Cherrybark Oak (*Quercus pagoda*)	0.62	2	
9	Cherrybark Oak (*Quercus pagoda*)	0.44	3	
10	Unknown	0.39	1	
11	Unknown	0.66	2	
12	Buttonbush (*Cephalanthus occidentalis*)	0.64	3	
13	Unknown	0.57	1	
14	Unknown	0.56	1	
15	Cherrybark Oak (*Quercus pagoda*)	0.60	1	
16	Unknown	0.62	1	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

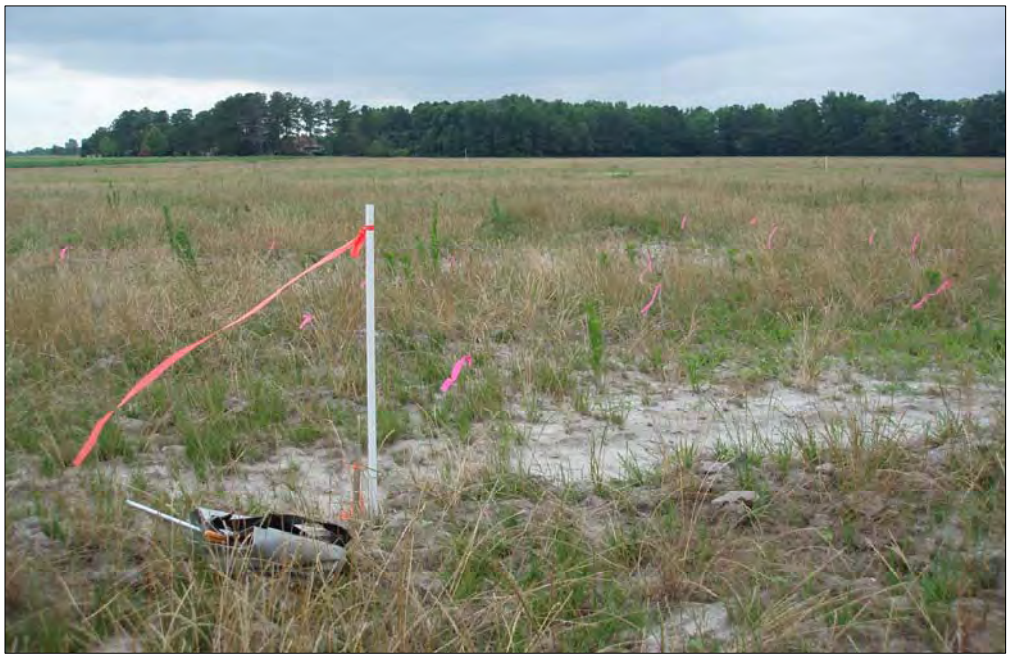
Species	Percent of Total
Willow Oak (*Quercus phellos*)	12.5%
Cherrybark Oak (*Quercus pagoda*)	37.5%
Laurel Oak (*Quercus laurifolia*)	6.3%
Buttonbush (*Cephalanthus occidentalis*)	6.3%
Unknown	37.5%

Density:

Total Number of Trees **16** / **0.025 acres** = **640** **trees / acre**

Survivability:

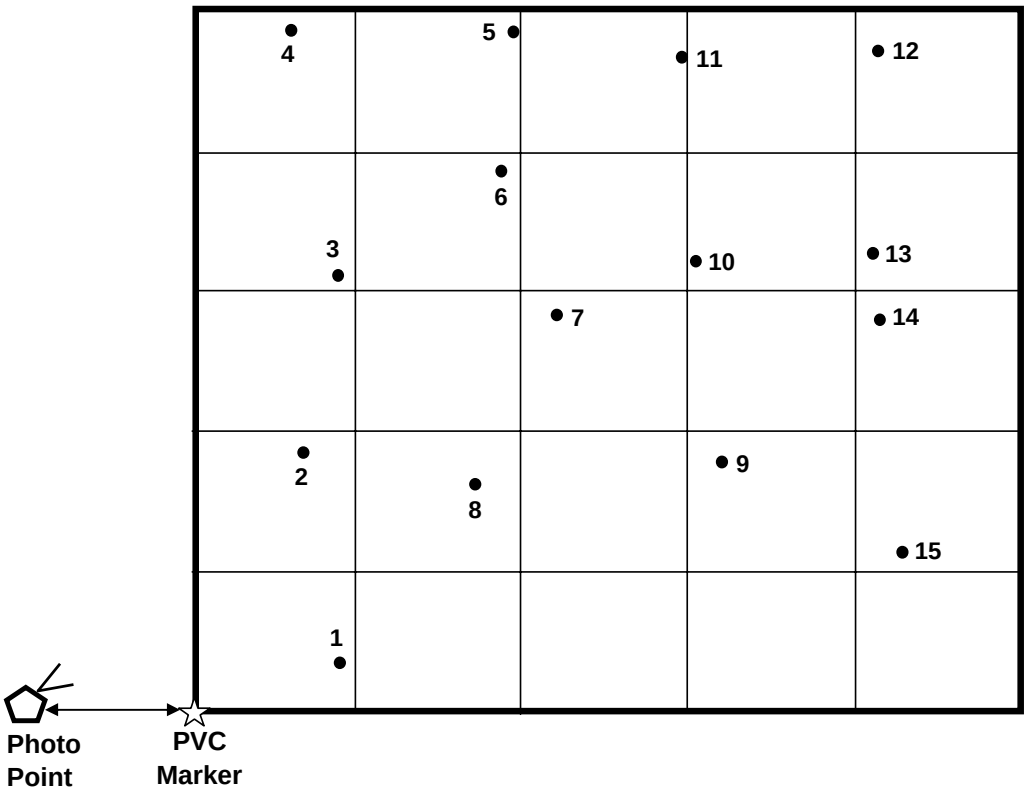
Total Number of Trees **16** / **16 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W3 **Date:** 6/19/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Bald Cypress (*Taxodium distichum*)	0.59	3	
2	Buttonbush (*Cephalanthus occidentalis*)	0.57	3	Browsed
3	Bald Cypress (*Taxodium distichum*)	0.73	3	
4	Cherrybark Oak (*Quercus pagoda*)	0.45	2	
5	*Quercus sp.*	0.60	2	
6	Bald Cypress (*Taxodium distichum*)	0.77	3	
7	Bald Cypress (*Taxodium distichum*)	0.63	3	
8	Buttonbush (*Cephalanthus occidentalis*)	0.57	3	Browsed
9	Bald Cypress (*Taxodium distichum*)	0.67	3	
10	Bald Cypress (*Taxodium distichum*)	0.82	3	
11	Unknown	0.57	1	
12	Unknown	0.65	1	
13	Swamp Chestnut Oak (*Quercus michauxii*)	0.54	3	Browsed
14	Buttonbush (*Cephalanthus occidentalis*)	0.51	2	
15	Bald Cypress (*Taxodium distichum*)	0.79	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

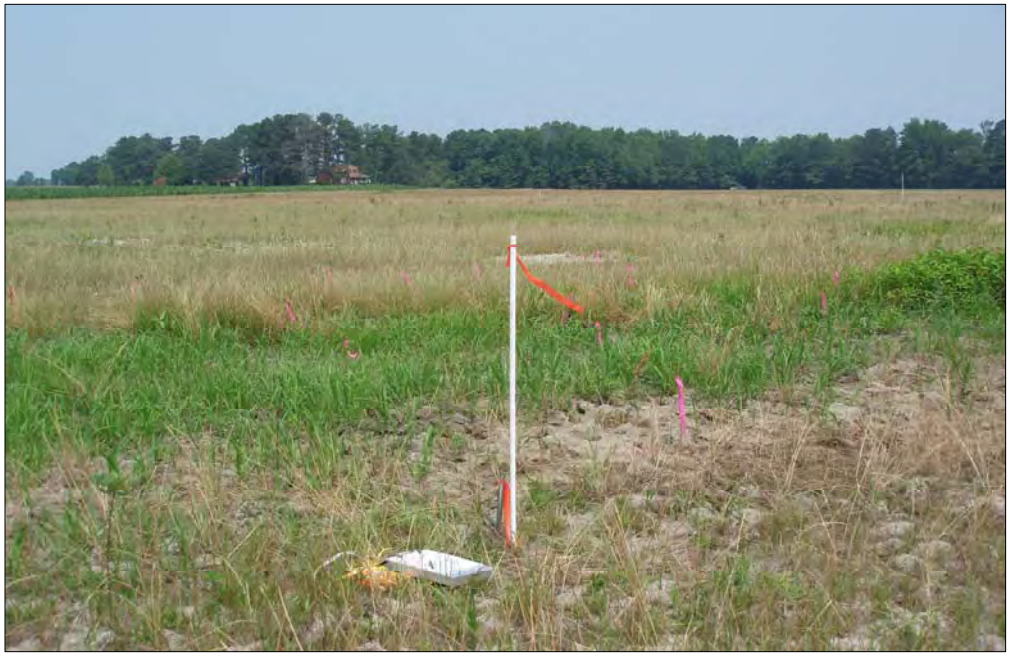
Species	Percent of Total
Bald Cypress (*Taxodium distichum*)	46.7%
Swamp Chestnut Oak (*Quercus michauxii*)	6.7%
Buttonbush (*Cephalanthus occidentalis*)	20.0%
Cherrybark Oak (*Quercus pagoda*)	6.7%
Unknown	13.3%
Quercus sp.	6.7%

Density:

Total Number of Trees **15** / **0.025 acres** = **600** **trees / acre**

Survivability:

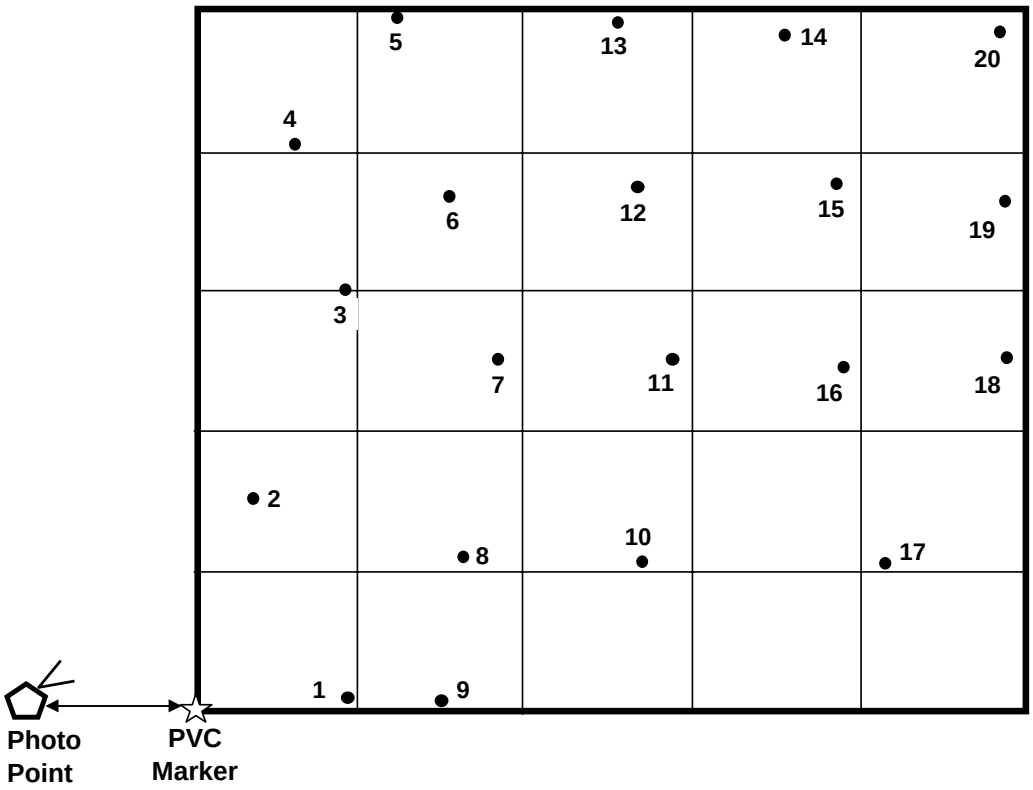
Total Number of Trees **15** / **15 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W4 **Date:** 6/19/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Green Ash (*Fraxinus pennsylvanica*)	0.64	4	
2	Cherrybark Oak (*Quercus pagoda*)	0.55	2	
3	Unknown	0.73	1	
4	Unknown	0.50	1	
5	Buttonbush (*Cephalanthus occidentalis*)	0.62	4	
6	Cherrybark Oak (*Quercus pagoda*)	0.54	1	
7	Buttonbush (*Cephalanthus occidentalis*)	0.58	3	
8	Cherrybark Oak (*Quercus pagoda*)	0.55	2	Browsed
9	Buttonbush (*Cephalanthus occidentalis*)	0.61	3	Browsed
10	Laurel Oak (*Quercus laurifolia*)	0.58	3	
11	Unknown	0.62	1	
12	Swamp Chestnut Oak (*Quercus michauxii*)	0.52	3	Browsed
13	Laurel Oak (*Quercus laurifolia*)	0.63	3	Browsed
14	Willow Oak (*Quercus phellos*)	0.64	2	Insect damage
15	Cherrybark Oak (*Quercus pagoda*)	0.50	1	
16	Buttonbush (*Cephalanthus occidentalis*)	0.58	3	Browsed
17	Cherrybark Oak (*Quercus pagoda*)	0.45	3	
18	Green Ash (*Fraxinus pennsylvanica*)	0.58	3	
19	Beautyberry (*Callicarpa americana*)	0.58	1	Browsed
20	Willow Oak (*Quercus phellos*)	0.64	2	Insect damage

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

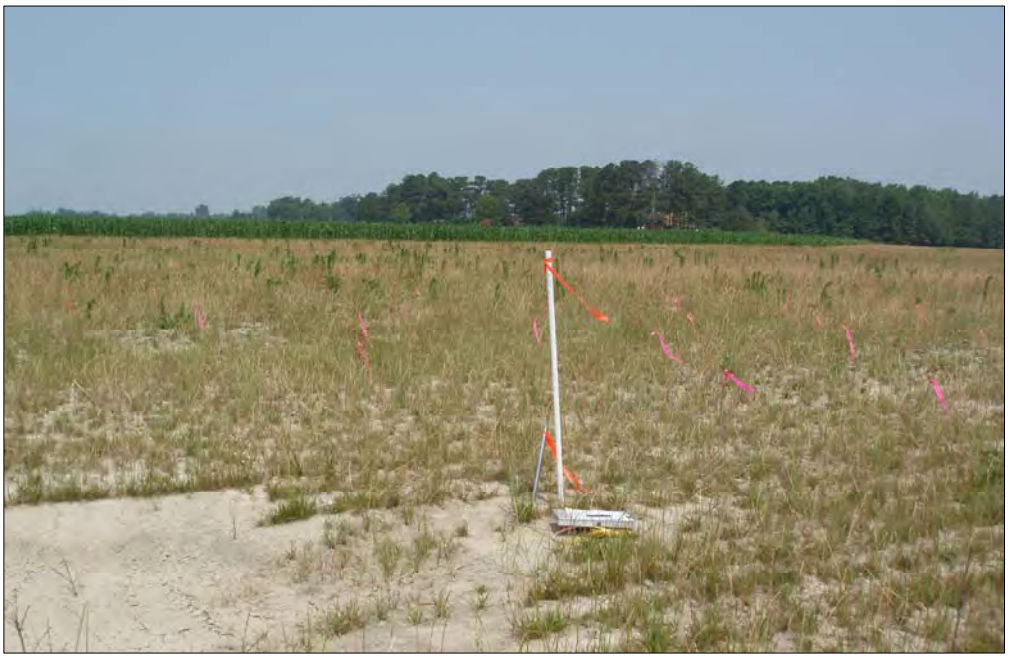
Species	Percent of Total
Green Ash (*Fraxinus pennsylvanica*)	10.0%
Cherrybark Oak (*Quercus pagoda*)	25.0%
Buttonbush (*Cephalanthus occidentalis*)	20.0%
Laurel Oak (*Quercus laurifolia*)	10.0%
Swamp Chestnut Oak (*Quercus michauxii*)	5.0%
Willow Oak (*Quercus phellos*)	10.0%
Unknown	15.0%

Density:

Total Number of Trees **20** / **0.025 acres** = **800** **trees / acre**

Survivability:

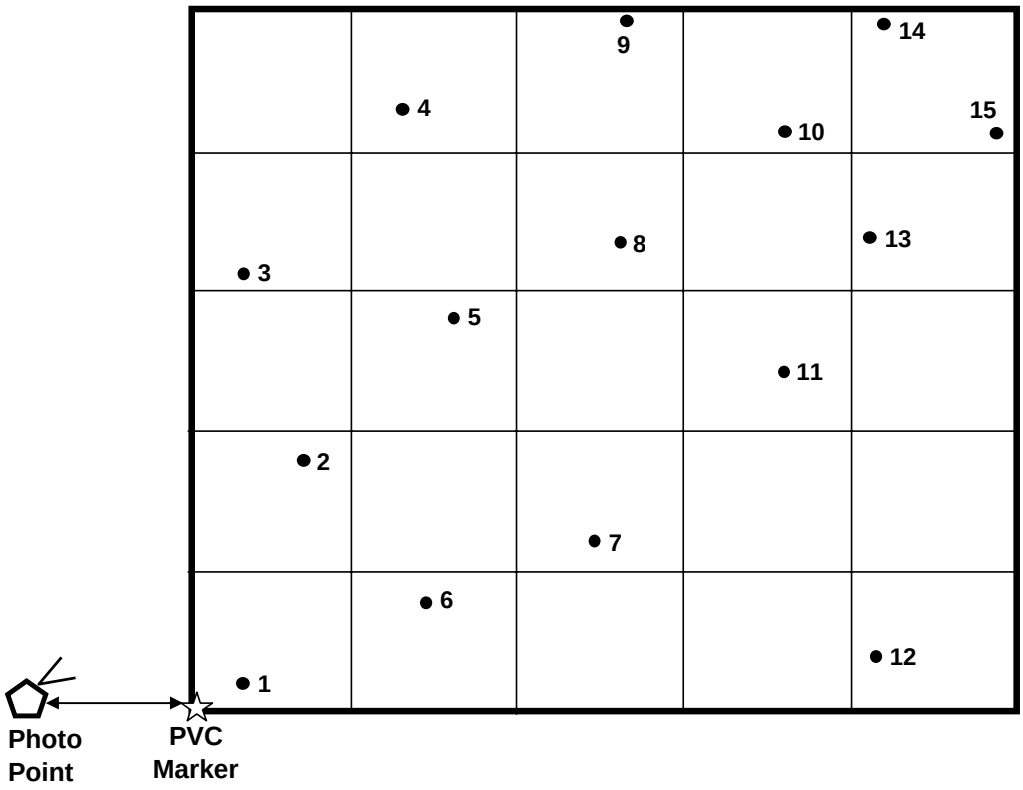
Total Number of Trees **20** / **20 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W5 **Date:** 6/19/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Beautyberry (*Callicarpa americana*)	0.54	3	Browsed
2	Bald Cypress (*Taxodium distichum*)	0.79	2	
3	Swamp Chestnut Oak (*Quercus michauxii*)	0.54	2	Browsed
4	Swamp Chestnut Oak (*Quercus michauxii*)	0.46	3	
5	Swamp Chestnut Oak (*Quercus michauxii*)	0.68	3	
6	Green Ash (*Fraxinus pennsylvanica*)	0.41	2	Insect damage
7	Green Ash (*Fraxinus pennsylvanica*)	0.38	2	Insect damage
8	Bald Cypress (*Taxodium distichum*)	0.89	3	
9	Swamp Chestnut Oak (*Quercus michauxii*)	0.62	3	
10	Swamp Chestnut Oak (*Quercus michauxii*)	0.31	3	
11	Bald Cypress (*Taxodium distichum*)	0.70	4	
12	Green Ash (*Fraxinus pennsylvanica*)	0.62	2	Insect damage
13	Cherrybark Oak (*Quercus pagoda*)	0.60	2	Insect damage
14	Bald Cypress (*Taxodium distichum*)	0.83	3	
15	Green Ash (*Fraxinus pennsylvanica*)	0.57	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

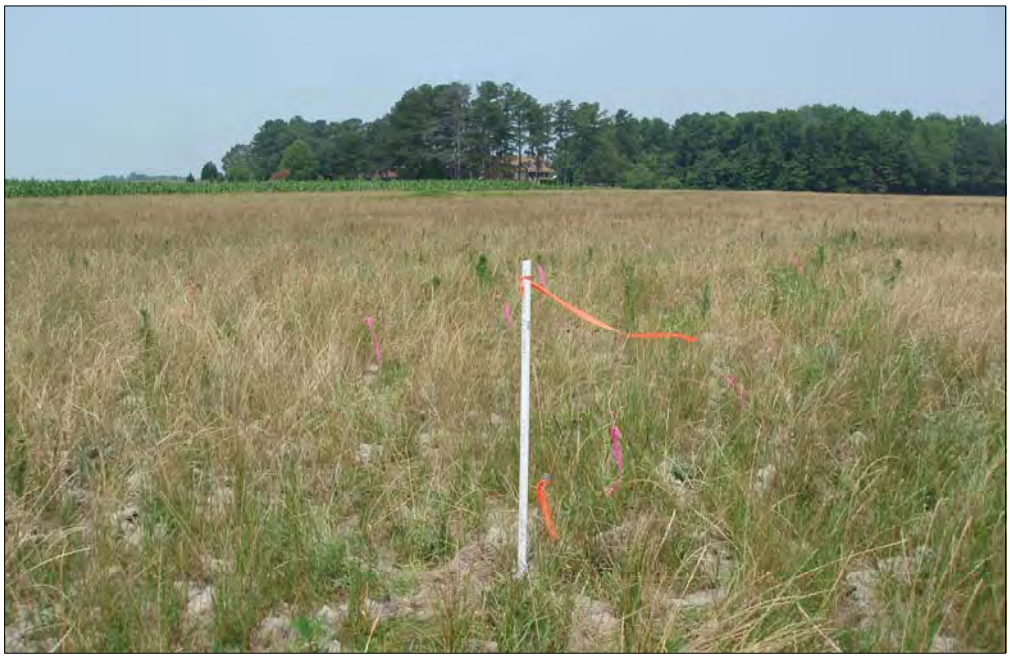
Species	Percent of Total
Bald Cypress (*Taxodium distichum*)	26.7%
Green Ash (*Fraxinus pennsylvanica*)	26.7%
Cherrybark Oak (*Quercus pagoda*)	6.7%
Swamp Chestnut Oak (*Quercus michauxii*)	33.3%
Beautyberry (*Callicarpa americana*)	6.7%

Density:

Total Number of Trees **15** / **0.025 acres** = **640** **trees / acre**

Survivability:

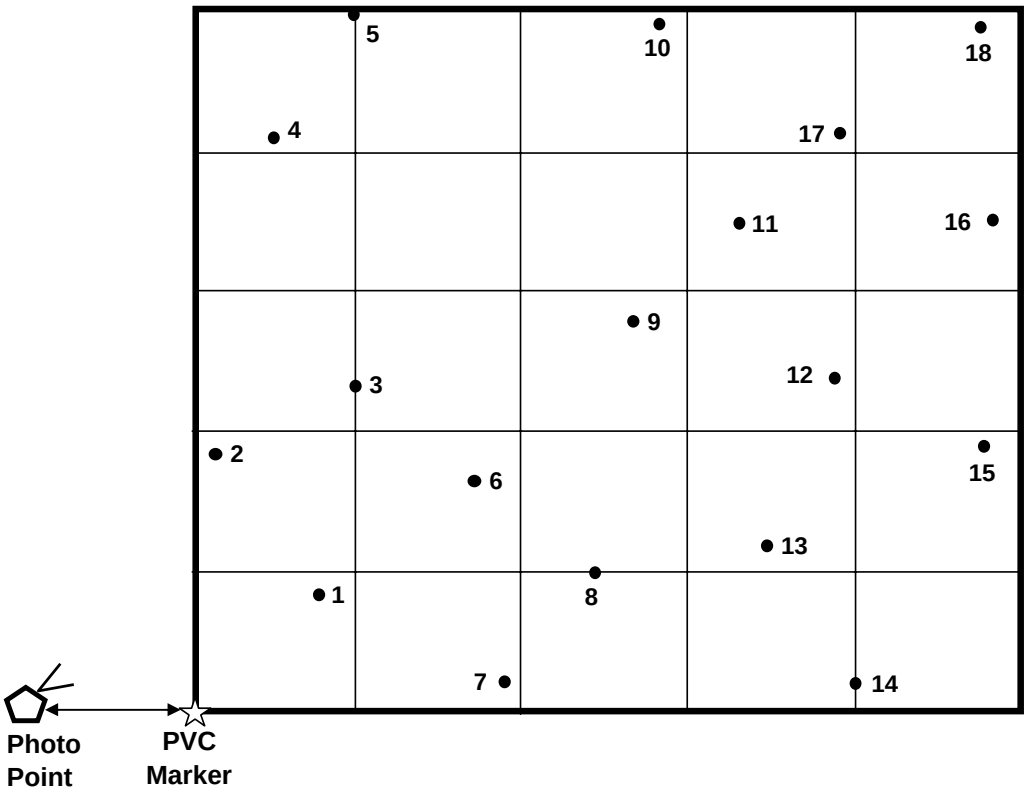
Total Number of Trees **15** / **15 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W6 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Buttonbush (*Cephalanthus occidentalis*)	0.50	3	
2	Willow Oak (*Quercus phellos*)	0.47	3	
3	Bald Cypress (*Taxodium distichum*)	0.82	3	
4	Possumhaw (*Viburnum nudum*)	0.22	4	
5	Bald Cypress (*Taxodium distichum*)	0.61	3	
6	Willow Oak (*Quercus phellos*)	0.47	3	
7	Buttonbush (*Cephalanthus occidentalis*)	0.49	2	Browsed
8	Buttonbush (*Cephalanthus occidentalis*)	0.57	3	
9	Willow Oak (*Quercus phellos*)	0.65	3	
10	Bald Cypress (*Taxodium distichum*)	0.73	3	
11	Buttonbush (*Cephalanthus occidentalis*)	0.56	3	
12	Laurel Oak (*Quercus laurifolia*)	0.40	3	
13	Buttonbush (*Cephalanthus occidentalis*)	0.50	3	
14	Laurel Oak (*Quercus laurifolia*)	0.58	1	
15	Swamp Chestnut Oak (*Quercus michauxii*)	0.66	2	
16	Laurel Oak (*Quercus laurifolia*)	0.60	3	
17	Willow Oak (*Quercus phellos*)	0.55	3	Insect damage
18	Willow Oak (*Quercus phellos*)	0.63	1	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Bald Cypress (*Taxodium distichum*)	16.7%
Possumhaw (*Viburnum nudum*)	5.6%
Willow Oak (*Quercus phellos*)	27.8%
Laurel Oak (*Quercus laurifolia*)	16.7%
Swamp Chestnut Oak (*Quercus michauxii*)	5.6%
Buttonbush (*Cephalanthus occidentalis*)	27.8%

Density:

Total Number of Trees **18** / **0.025 acres** = **720** **trees / acre**

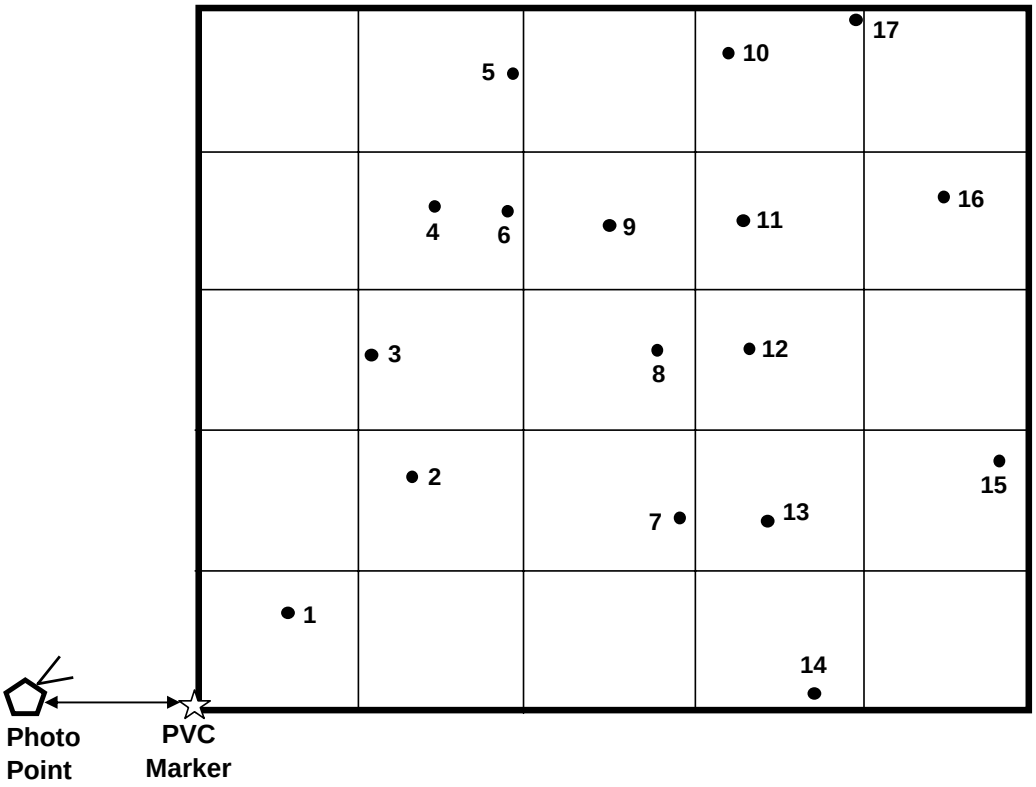
Survivability:

Total Number of Trees **18** / **18 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W7 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Swamp Chestnut Oak (*Quercus michauxii*)	0.60	3	Browsed
2	Water Hickory (*Carya aquatica*)	0.28	3	
3	Unknown	0.60	1	
4	Willow Oak (*Quercus phellos*)	0.44	3	
5	Willow Oak (*Quercus phellos*)	0.56	1	
6	Buttonbush (*Cephalanthus occidentalis*)	0.48	3	
7	Unknown	0.62	1	
8	Unknown	0.62	1	
9	Unknown	0.68	1	
10	Unknown	0.41	1	
11	Unknown	0.66	1	
12	Unknown	0.52	1	
13	Willow Oak (*Quercus phellos*)	0.63	1	
14	Willow Oak (*Quercus phellos*)	0.39	1	
15	Swamp Chestnut Oak (*Quercus michauxii*)	0.58	1	
16	Swamp Chestnut Oak (*Quercus michauxii*)	0.55	2	
17	Cherrybark Oak (*Quercus pagoda*)	0.52	1	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

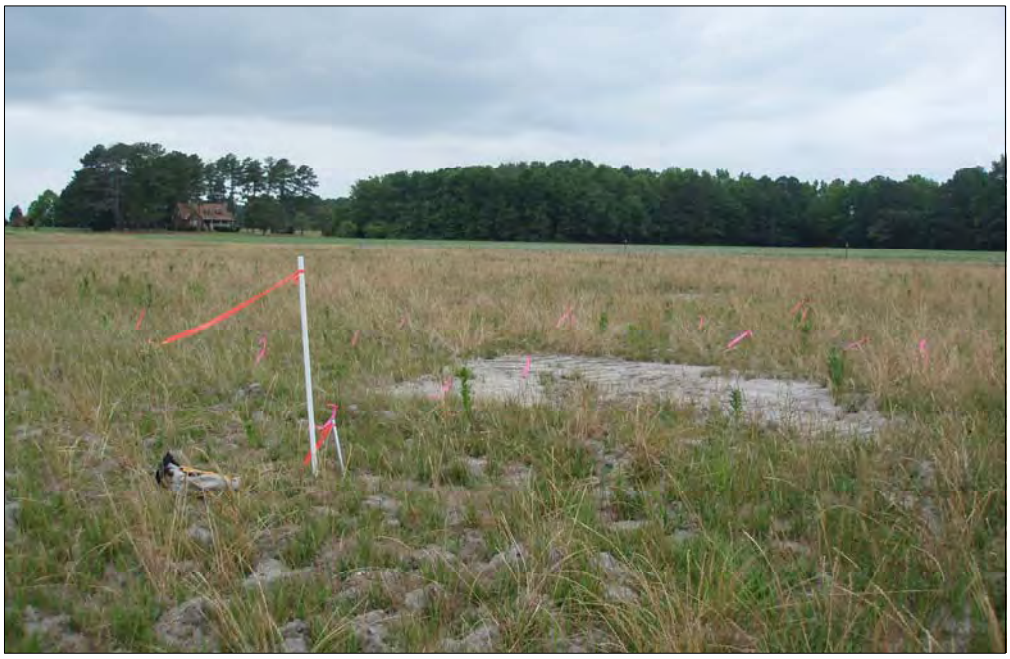
Species	Percent of Total
Willow Oak (*Quercus phellos*)	23.5%
Swamp Chestnut Oak (*Quercus michauxii*)	17.6%
Water Hickory (*Carya aquatica*)	5.9%
Cherrybark Oak (*Quercus pagoda*)	5.9%
Buttonbush (*Cephalanthus occidentalis*)	5.9%
Unknown	41.2%

Density:

Total Number of Trees **17** / **0.025 acres** = **680** **trees / acre**

Survivability:

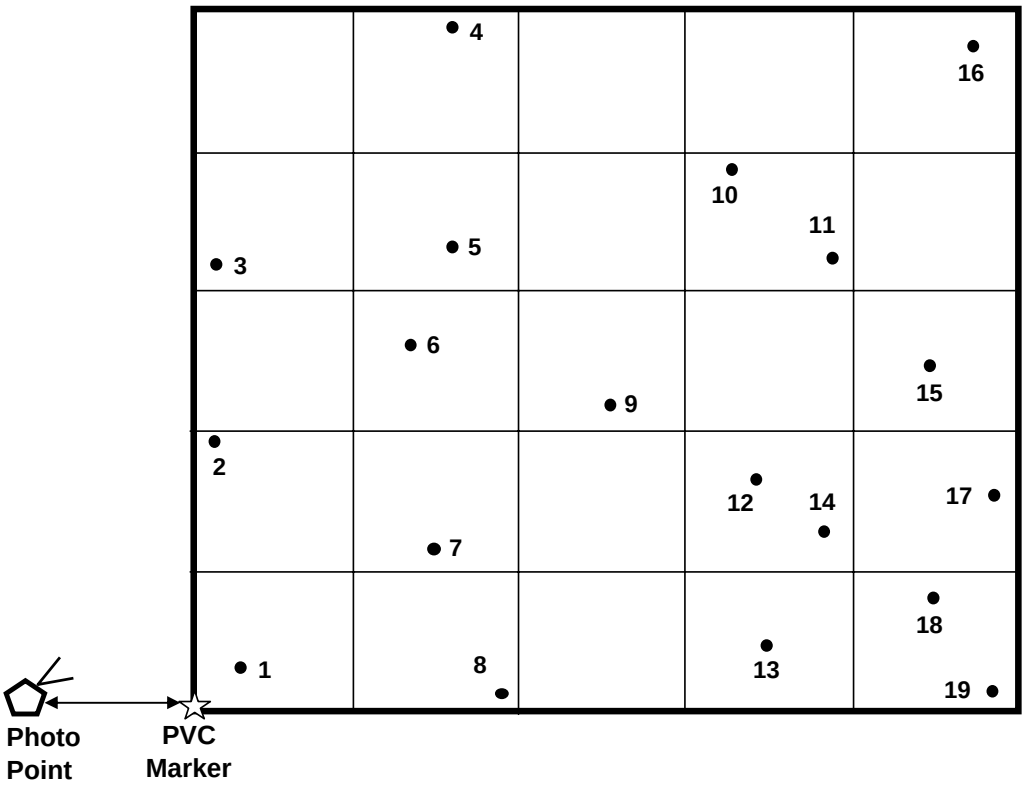
Total Number of Trees **17** / **17 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W8 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Buttonbush (*Cephalanthus occidentalis*)	0.59	2	Browsed
2	Water Hickory (*Carya aquatica*)	0.55	2	Insect damage
3	Water Hickory (*Carya aquatica*)	0.62	3	
4	Unknown	0.54	1	
5	Unknown	0.44	1	
6	Water Hickory (*Carya aquatica*)	0.47	2	
7	Bald Cypress (*Taxodium distichum*)	0.84	4	
8	Water Hickory (*Carya aquatica*)	0.65	3	
9	Bald Cypress (*Taxodium distichum*)	0.65	3	
10	Water Hickory (*Carya aquatica*)	0.70	3	
11	Water Hickory (*Carya aquatica*)	0.67	3	
12	Buttonbush (*Cephalanthus occidentalis*)	0.59	3	
13	Bald Cypress (*Taxodium distichum*)	0.79	4	
14	Water Hickory (*Carya aquatica*)	0.49	2	
15	Buttonbush (*Cephalanthus occidentalis*)	0.72	3	Browsed
16	Beautyberry (*Callicarpa americana*)	0.56	4	
17	Water Hickory (*Carya aquatica*)	0.62	1	
18	Buttonbush (*Cephalanthus occidentalis*)	0.60	3	Browsed
19	Bald Cypress (*Taxodium distichum*)	0.57	2	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

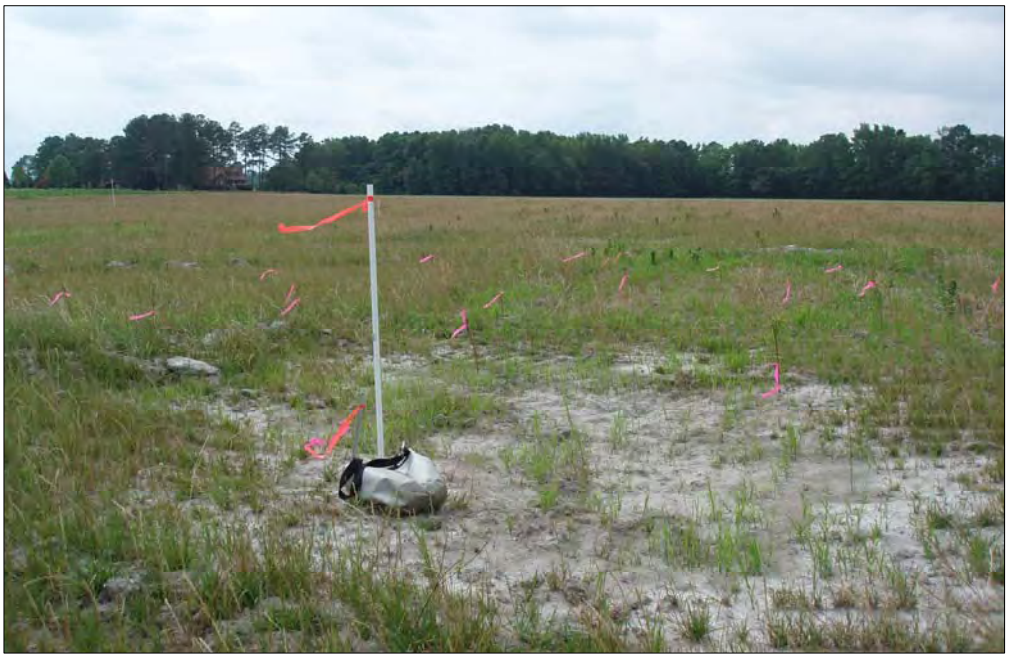
Species	Percent of Total
Water Hickory (*Carya aquatica*)	42.1%
Bald Cypress (*Taxodium distichum*)	21.1%
Buttonbush (*Cephalanthus occidentalis*)	21.1%
Beautyberry (*Callicarpa americana*)	5.3%
Unknown	10.5%

Density:

Total Number of Trees **19** / **0.025 acres** = **760** **trees / acre**

Survivability:

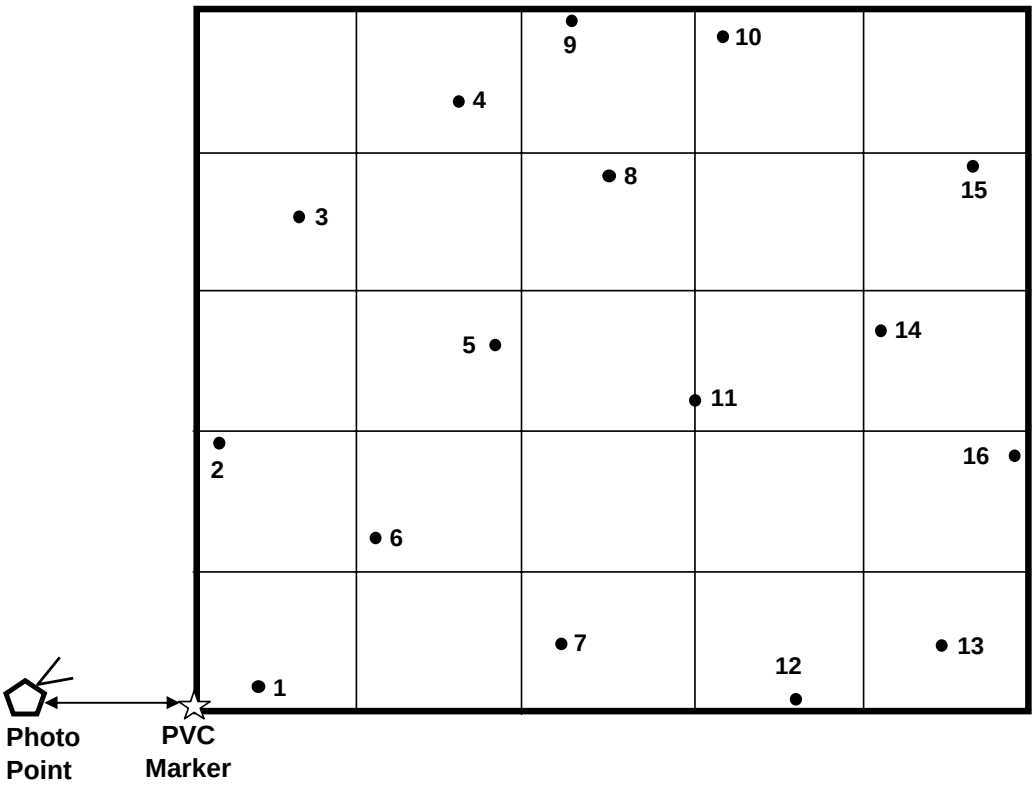
Total Number of Trees **19** / **19 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W9 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Buttonbush (*Cephalanthus occidentalis*)	0.55	3	Browsed
2	Bald Cypress (*Taxodium distichum*)	0.68	2	Browsed
3	Cherrybark Oak (*Quercus pagoda*)	0.36	3	
4	Beautyberry (*Callicarpa americana*)	0.41	3	
5	Cherrybark Oak (*Quercus pagoda*)	0.41	4	
6	Swamp Chestnut Oak (*Quercus michauxii*)	0.31	3	
7	Unknown	0.60	1	
8	Cherrybark Oak (*Quercus pagoda*)	0.30	3	
9	Beautyberry (*Callicarpa americana*)	0.26	3	
10	Cherrybark Oak (*Quercus pagoda*)	0.35	2	Insect damage
11	Green Ash (*Fraxinus pennsylvanica*)	0.54	3	
12	Laurel Oak (*Quercus laurifolia*)	0.62	4	
13	Laurel Oak (*Quercus laurifolia*)	0.49	3	
14	Green Ash (*Fraxinus pennsylvanica*)	0.66	3	
15	Willow Oak (*Quercus phellos*)	0.61	3	
16	Laurel Oak (*Quercus laurifolia*)	0.60	2	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Green Ash (*Fraxinus pennsylvanica*)	12.5%
Laurel Oak (*Quercus laurifolia*)	18.8%
Willow Oak (*Quercus phellos*)	6.3%
Cherrybark Oak (*Quercus pagoda*)	25.0%
Swamp Chestnut Oak (*Quercus michauxii*)	6.3%
Bald Cypress (*Taxodium distichum*)	6.3%
Buttonbush (*Cephalanthus occidentalis*)	6.3%
Beautyberry (*Callicarpa americana*)	12.5%
Unknown	6.3%

Density:

Total Number of Trees **16** / **0.025 acres** = **640** **trees / acre**

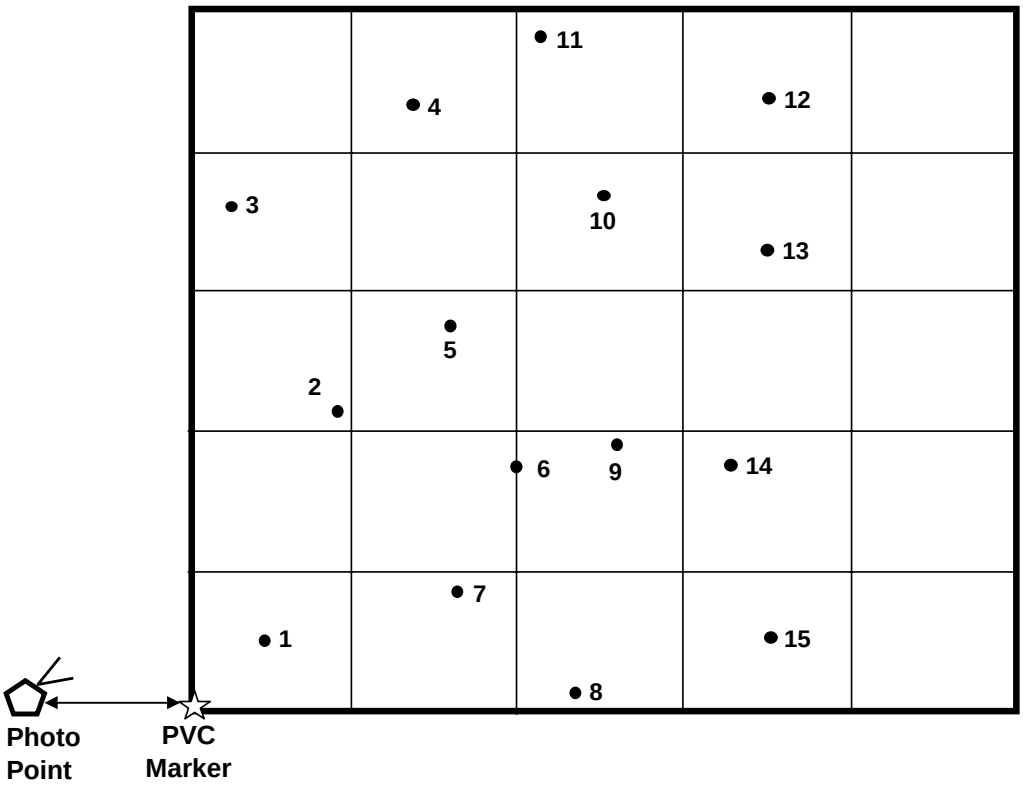
Survivability:

Total Number of Trees **16** / **16 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W10 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Laurel Oak (*Quercus laurifolia*)	0.59	3	Browsed
2	Cherrybark Oak (*Quercus pagoda*)	0.70	1	
3	Green Ash (*Fraxinus pennsylvanica*)	0.53	3	Browsed
4	Green Ash (*Fraxinus pennsylvanica*)	0.60	3	Browsed
5	Cherrybark Oak (*Quercus pagoda*)	0.52	2	
6	Bald Cypress (*Taxodium distichum*)	0.65	3	
7	Laurel Oak (*Quercus laurifolia*)	0.57	3	
8	Laurel Oak (*Quercus laurifolia*)	0.77	2	Browsed
9	Laurel Oak (*Quercus laurifolia*)	0.62	2	
10	Laurel Oak (*Quercus laurifolia*)	0.59	2	
11	Green Ash (*Fraxinus pennsylvanica*)	0.51	2	Browsed
12	Buttonbush (*Cephalanthus occidentalis*)	0.55	3	Browsed
13	Buttonbush (*Cephalanthus occidentalis*)	0.53	3	
14	Beautyberry (*Callicarpa americana*)	0.55	3	Browsed
15	Buttonbush (*Cephalanthus occidentalis*)	0.52	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

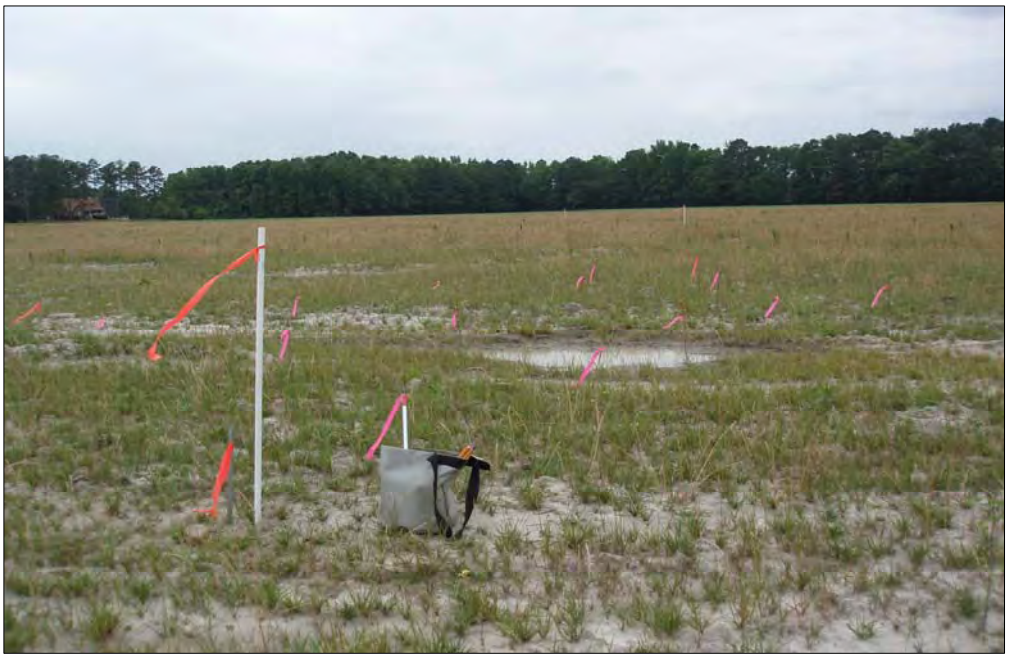
Species	Percent of Total
Laurel Oak (*Quercus laurifolia*)	33.3%
Bald Cypress (*Taxodium distichum*)	6.7%
Green Ash (*Fraxinus pennsylvanica*)	20.0%
Buttonbush (*Cephalanthus occidentalis*)	20.0%
Beautyberry (*Callicarpa americana*)	6.7%
Cherrybark Oak (*Quercus pagoda*)	13.3%

Density:

Total Number of Trees **15** / **0.025 acres** = **600** **trees / acre**

Survivability:

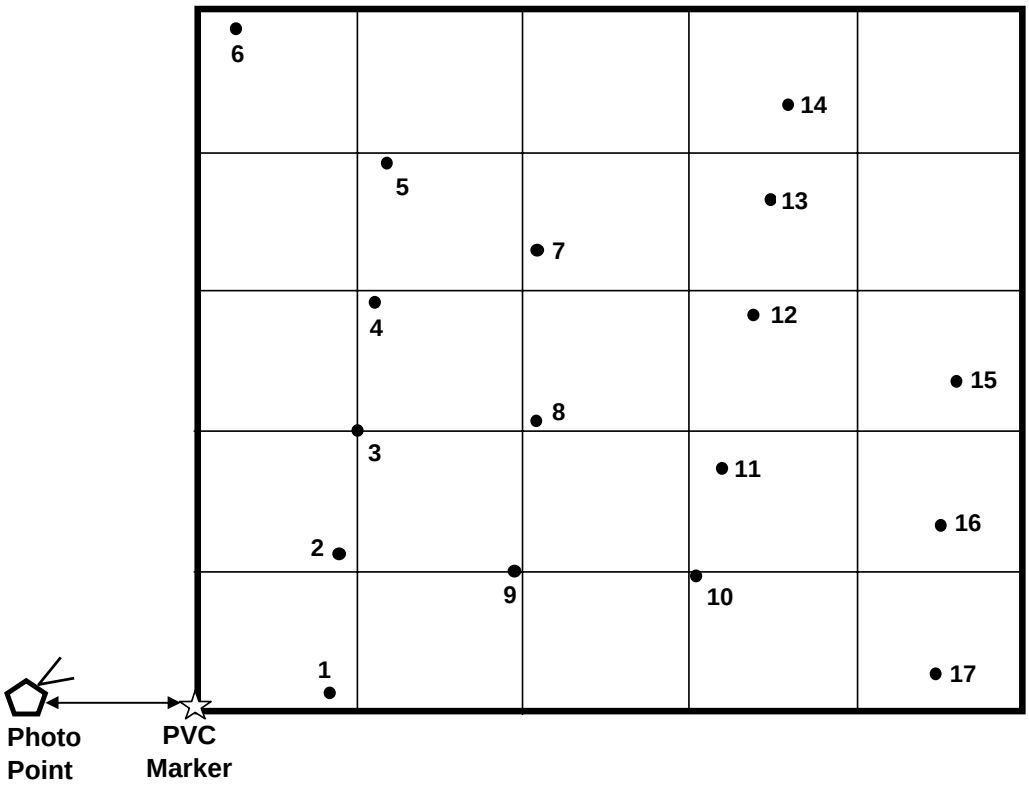
Total Number of Trees **15** / **15 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W11 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Buttonbush (*Cephalanthus occidentalis*)	0.51	3	Browsed
2	Buttonbush (*Cephalanthus occidentalis*)	0.57	2	
3	Bald Cypress (*Taxodium distichum*)	0.72	3	
4	Buttonbush (*Cephalanthus occidentalis*)	0.58	3	
5	Buttonbush (*Cephalanthus occidentalis*)	0.56	2	Browsed
6	Water Hickory (*Carya aquatica*)	0.61	3	
7	Beautyberry (*Callicarpa americana*)	0.51	3	
8	Water Hickory (*Carya aquatica*)	0.62	4	
9	Bald Cypress (*Taxodium distichum*)	0.62	4	
10	Bald Cypress (*Taxodium distichum*)	0.74	2	
11	Water Hickory (*Carya aquatica*)	0.64	4	
12	Bald Cypress (*Taxodium distichum*)	0.67	3	
13	Unknown	0.52	1	
14	Bald Cypress (*Taxodium distichum*)	0.50	2	
15	Bald Cypress (*Taxodium distichum*)	0.68	2	
16	Bald Cypress (*Taxodium distichum*)	0.63	3	
17	Bald Cypress (*Taxodium distichum*)	0.82	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Bald Cypress (*Taxodium distichum*)	47.1%
Water Hickory (*Carya aquatica*)	17.6%
Buttonbush (*Cephalanthus occidentalis*)	23.5%
Beautyberry (*Callicarpa americana*)	5.9%
Unknown	5.9%

Density:

Total Number of Trees **17** / **0.025 acres** = **680** **trees / acre**

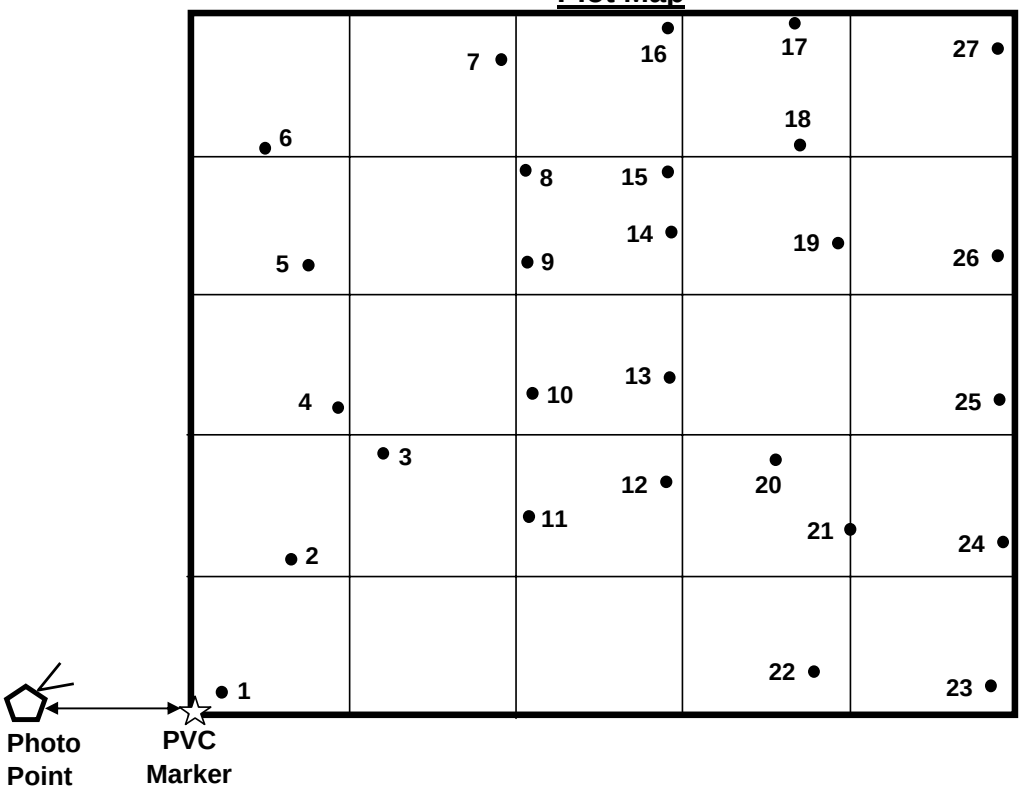
Survivability:

Total Number of Trees **17** / **17 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** W12 **Date:** 6/14/2007

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Water Hickory (*Carya aquatica*)	0.75	4	
2	Bald Cypress (*Taxodium distichum*)	0.92	4	
3	Buttonbush (*Cephalanthus occidentalis*)	0.57	3	Browsed
4	Bald Cypress (*Taxodium distichum*)	0.69	2	
5	Bald Cypress (*Taxodium distichum*)	0.87	3	
6	Bald Cypress (*Taxodium distichum*)	0.77	4	
7	Beautyberry (*Callicarpa americana*)	0.65	2	
8	Buttonbush (*Cephalanthus occidentalis*)	0.56	2	Browsed
9	Buttonbush (*Cephalanthus occidentalis*)	0.41	3	
10	Buttonbush (*Cephalanthus occidentalis*)	0.31	2	Browsed
11	Buttonbush (*Cephalanthus occidentalis*)	0.38	3	
12	Buttonbush (*Cephalanthus occidentalis*)	0.42	3	
13	Unknown	0.29	3	
14	Buttonbush (*Cephalanthus occidentalis*)	0.43	3	
15	Buttonbush (*Cephalanthus occidentalis*)	0.51	3	Browsed
16	Water Hickory (*Carya aquatica*)	0.63	4	
17	Water Hickory (*Carya aquatica*)	0.65	3	Browsed
18	Water Hickory (*Carya aquatica*)	0.63	4	
19	Buttonbush (*Cephalanthus occidentalis*)	0.34	3	Browsed
20	Buttonbush (*Cephalanthus occidentalis*)	0.54	3	
21	Bald Cypress (*Taxodium distichum*)	0.81	1	
22	Bald Cypress (*Taxodium distichum*)	0.69	3	
23	Bald Cypress (*Taxodium distichum*)	0.56	3	
24	Buttonbush (*Cephalanthus occidentalis*)	0.29	3	
25	Buttonbush (*Cephalanthus occidentalis*)	0.52	3	
26	Bald Cypress (*Taxodium distichum*)	0.77	3	
27	Bald Cypress (*Taxodium distichum*)	0.49	3	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Water Hickory (*Carya aquatica*)	14.8%
Bald Cypress (*Taxodium distichum*)	33.3%
Buttonbush (*Cephalanthus occidentalis*)	44.4%
Unknown	3.7%
Beautyberry (*Callicarpa americana*)	3.7%

Density:

Total Number of Trees **27** / **0.025 acres** = **1080** **trees / acre**

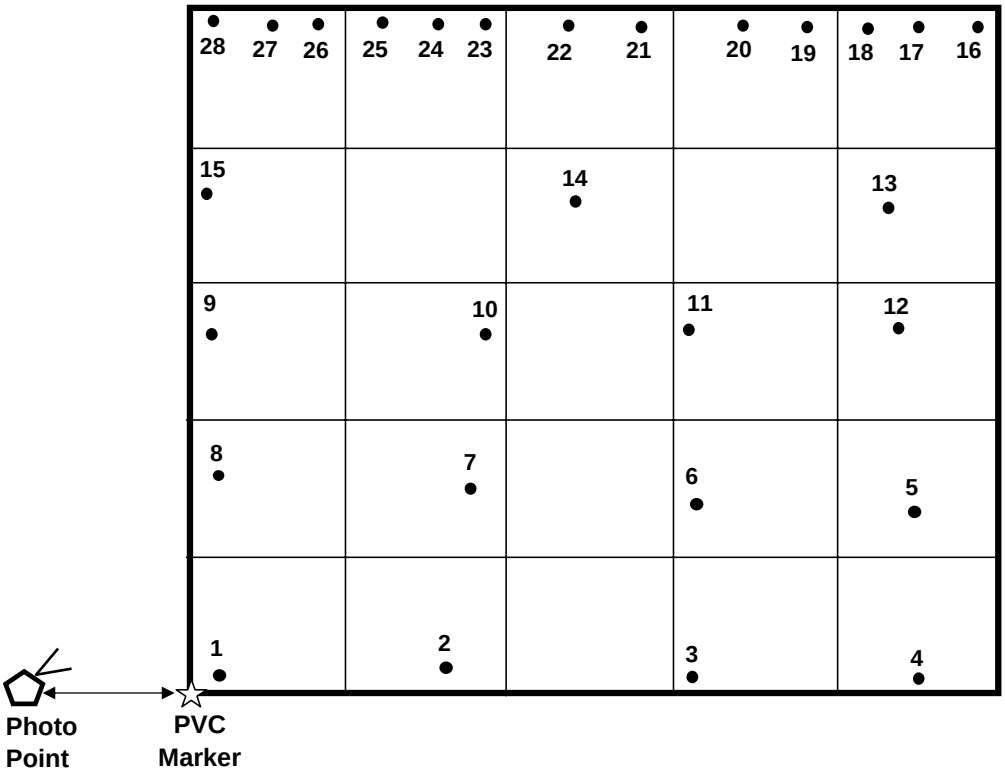
Survivability:

Total Number of Trees **27** / **27** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S1 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.42	4	
2	Unknown	0.29	4	
3	Southern Red Oak (*Quercus falcata)*	0.47	4	
4	Southern Red Oak (*Quercus falcata)*	0.40	4	
5	Southern Red Oak (*Quercus falcata)*	0.40	4	
6	Unknown	0.56	4	
7	Unknown	0.20	4	
8	Unknown	0.27	4	
9	Unknown	0.35	4	
10	Willow Oak (*Quercus phellos)*	0.54	4	
11	Willow Oak (*Quercus phellos)*	0.51	4	
12	Unknown	0.36	4	
13	Southern Red Oak (*Quercus falcata)*	0.33	4	
14	Southern Red Oak (*Quercus falcata)*	0.37	4	
15	Southern Red Oak (*Quercus falcata)*		4	
16	Silky Dogwood (*Cornus amomum)*		4	Live Stake
17	Silky Dogwood (*Cornus amomum)*		4	Live Stake
18	Silky Dogwood (*Cornus amomum)*		4	Live Stake
19	Silky Dogwood (*Cornus amomum)*		4	Live Stake
20	Silky Dogwood (*Cornus amomum)*		4	Live Stake
21	Elderberry (*Sambucus canadensis)*		4	Live Stake
22	Silky Dogwood (*Cornus amomum)*		4	Live Stake
23	Silky Dogwood (*Cornus amomum)*		4	Live Stake
24	Silky Dogwood (*Cornus amomum)*		4	Live Stake
25	Elderberry (*Sambucus canadensis)*		4	Live Stake
26	Elderberry (*Sambucus canadensis)*		4	Live Stake
27	Elderberry (*Sambucus canadensis)*		4	Live Stake
28	Elderberry (*Sambucus canadensis*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	28.6%
Southern Red Oak (*Quercus falcata*)	21.4%
Elderberry (*Sambucus canadensis*)	17.9%
Willow Oak (*Quercus phellos*)	7.1%
Unknown	25.0%

Density:

Total Number of Trees **28** / **0.025 acres** = **1120** **trees / acre**

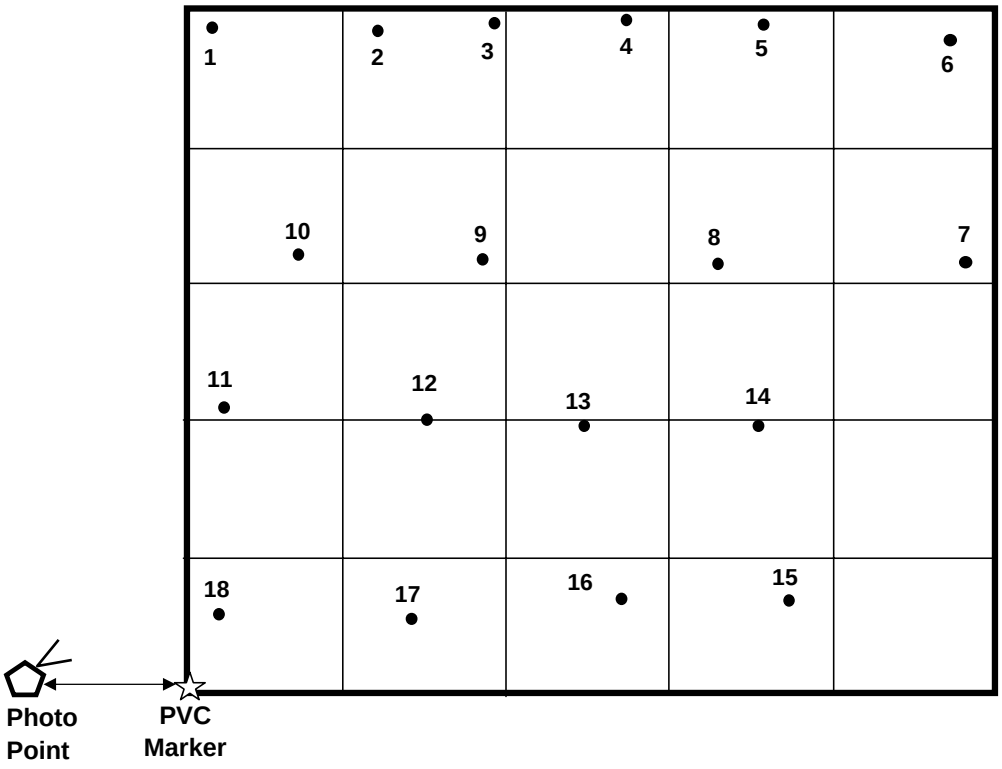
Survivability:

Total Number of Trees **28** / **28 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S2 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.51	4	
2	Unknown	0.49	4	
3	Unknown	0.29	4	
4	Southern Red Oak (*Quercus falcata*)	0.42	4	
5	Unknown	0.58	4	
6	Unknown	0.62	4	
7	Willow Oak (*Quercus phellos*)	0.22	4	
8	Unknown	0.65	4	
9	Unknown	0.49	4	
10	Unknown	0.56	4	
11	Unknown	0.22	4	
12	Unknown	0.27	4	
13	Unknown	0.16	4	
14	Southern Red Oak (*Quercus falcata*)	0.45	4	
15	Unknown	0.61	4	
16	Willow Oak (*Quercus phellos*)	0.55	4	
17	Unknown	0.65	4	
18	Unknown	0.55	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Southern Red Oak (*Quercus falcata)*	11.1%
Willow Oak (*Quercus phellos*)	11.1%
Unknown	77.8%

Density:

Total Number of Trees **18** / **0.025 acres** = **720** **trees / acre**

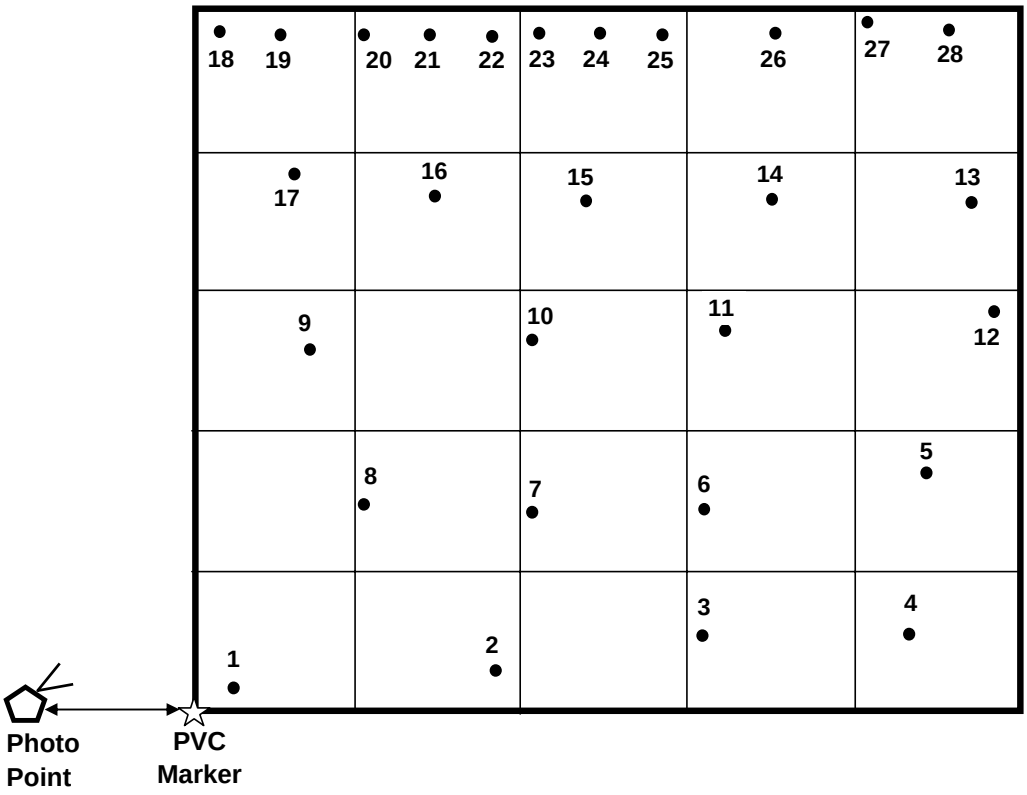
Survivability:

Total Number of Trees **18** / **18 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S3 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.53	4	
2	Unknown	0.56	4	
3	Unknown	0.57	4	
4	Beautyberry (*Callicarpa americana*)	0.46	4	
5	Unknown	0.23	4	
6	Unknown	0.20	4	
7	Unknown	0.25	4	
8	Unknown	0.22	4	
9	Unknown	0.23	4	
10	Willow Oak (*Quercus phellos*)	0.51	4	
11	Unknown	0.55	4	
12	Unknown	0.55	4	
13	Unknown	0.46	4	
14	Unknown	0.60	4	
15	Unknown	0.60	4	
16	Unknown	0.50	4	
17	Unknown	0.37	4	
18	Elderberry (*Sambucus canadensis*)		4	Live Stake
19	Elderberry (*Sambucus canadensis*)		4	Live Stake
20	Silky Dogwood (*Cornus amomum*)		4	Live Stake
21	Elderberry (*Sambucus canadensis*)		4	Live Stake
22	Elderberry (*Sambucus canadensis*)		4	Live Stake
23	Silky Dogwood (*Cornus amomum*)		4	Live Stake
24	Elderberry (*Sambucus canadensis*)		4	Live Stake
25	Elderberry (*Sambucus canadensis*)		4	Live Stake
26	Silky Dogwood (*Cornus amomum*)		4	Live Stake
27	Silky Dogwood (*Cornus amomum*)		4	Live Stake
28	Silky Dogwood (*Cornus amomum*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Elderberry (*Sambucus canadensis*)	21.4%
Silky Dogwood (*Cornus amomum*)	17.9%
Beautyberry (*Callicarpa americana*)	3.6%
Willow Oak (*Quercus phellos*)	3.6%
Unknown	53.6%

Density:

Total Number of Trees **28** / **0.025 acres** = **1120** **trees / acre**

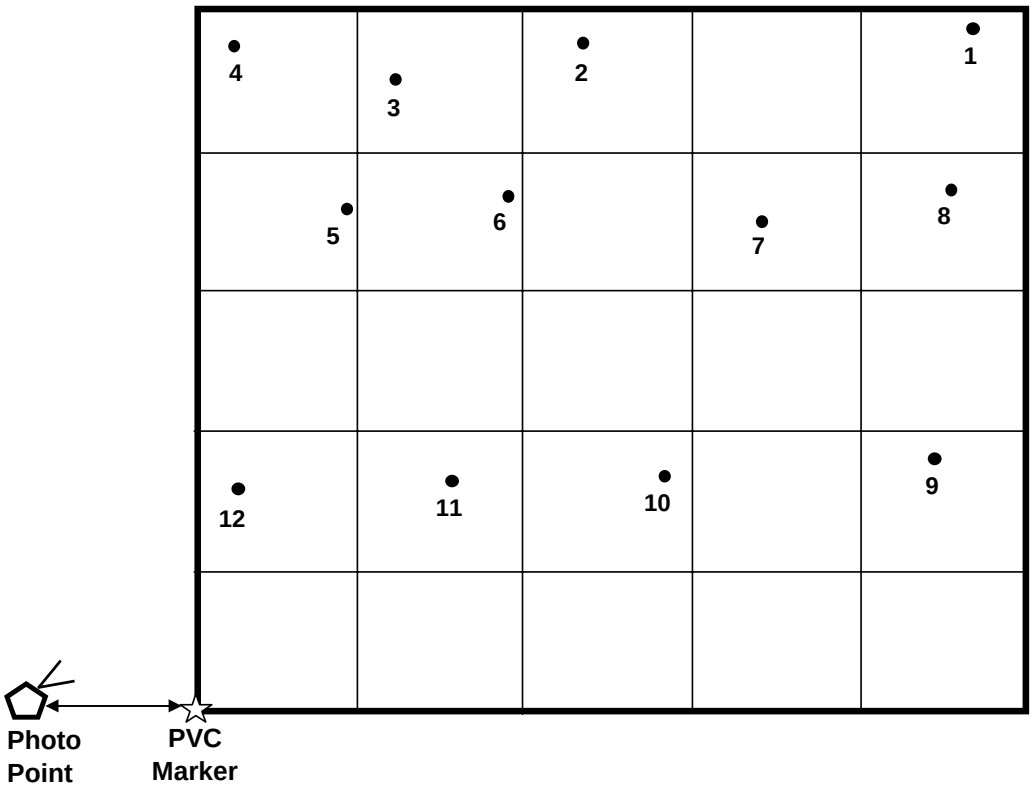
Survivability:

Total Number of Trees **28** / **28 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S4 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Beautyberry (*Callicarpa americana*)	0.53	4	
2	Unknown	0.41	4	
3	Willow Oak (*Quercus phellos)*	0.53	4	
4	Willow Oak (*Quercus phellos)*	0.45	4	
5	Unknown	0.47	4	
6	River Birch (*Betula nigra*)	0.41	4	
7	Unknown	0.46	4	
8	River Birch (*Betula nigra*)	0.27	4	
9	Unknown	0.44	4	
10	River Birch (*Betula nigra*)	0.37	4	
11	River Birch (*Betula nigra*)	0.57	4	
12	Beautyberry (*Callicarpa americana*)	0.55	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	33.3%
Beautyberry (*Callicarpa americana*)	16.7%
Willow Oak (*Quercus phellos*)	16.7%
Unknown	33.3%

Density:

Total Number of Trees **12** **/** **0.025 acres** **=** **480** **trees / acre**

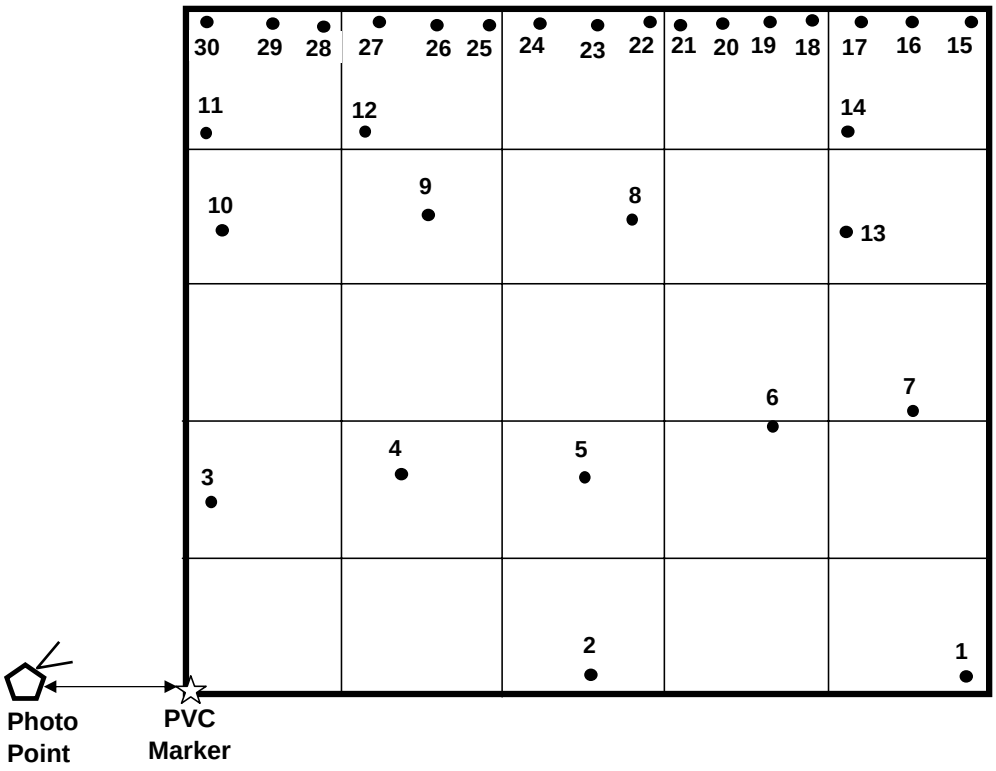
Survivability:

Total Number of Trees **12** **/** **12 trees** **x** **100** **=** **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S5 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	River Birch (*Betula nigra*)	0.54	4	
2	River Birch (*Betula nigra*)	0.55	4	
3	Unknown	0.57	4	
4	Willow Oak (*Quercus phellos*)	0.55	4	
5	Unknown	0.39	3	Roots exposed
6	Unknown	0.54	3	Roots exposed
7	Unknown	0.45	3	Roots exposed
8	Unknown	0.56	4	
9	Unknown	0.59	4	
10	Unknown	0.54	4	
11	Unknown	0.50	4	
12	River Birch (*Betula nigra*)	0.47	4	
13	River Birch (*Betula nigra*)	0.29	4	
14	Unknown	0.23	4	
15	Elderberry (*Sambucus canadensis*)		4	Live Stake
16	Elderberry (*Sambucus canadensis*)		4	Live Stake
17	Silky Dogwood (*Cornus amomum*)		4	Live Stake
18	Silky Dogwood (*Cornus amomum*)		4	Live Stake
19	Black Willow (*Salix nigra*)		4	Live Stake
20	Elderberry (*Sambucus canadensis*)		4	Live Stake
21	Silky Dogwood (*Cornus amomum*)		4	Live Stake
22	Silky Dogwood (*Cornus amomum*)		4	Live Stake
23	Elderberry (*Sambucus canadensis*)		4	Live Stake
24	Silky Dogwood (*Cornus amomum*)		4	Live Stake
25	Elderberry (*Sambucus canadensis*)		4	Live Stake
26	Silky Dogwood (*Cornus amomum*)		4	Live Stake
27	Silky Dogwood (*Cornus amomum*)		4	Live Stake
28	Elderberry (*Sambucus canadensis*)		4	Live Stake
29	Silky Dogwood (*Cornus amomum*)		4	Live Stake
30	Elderberry (*Sambucus canadensis*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	26.7%
Elderberry (*Sambucus canadensis*)	23.3%
River Birch (*Betula nigra*)	13.3%
Willow Oak (*Quercus phellos*)	3.3%
Black Willow (*Salix nigra*)	3.3%
Unknown	30.0%

Density:

Total Number of Trees **30** / **0.025 acres** = **1200** **trees / acre**

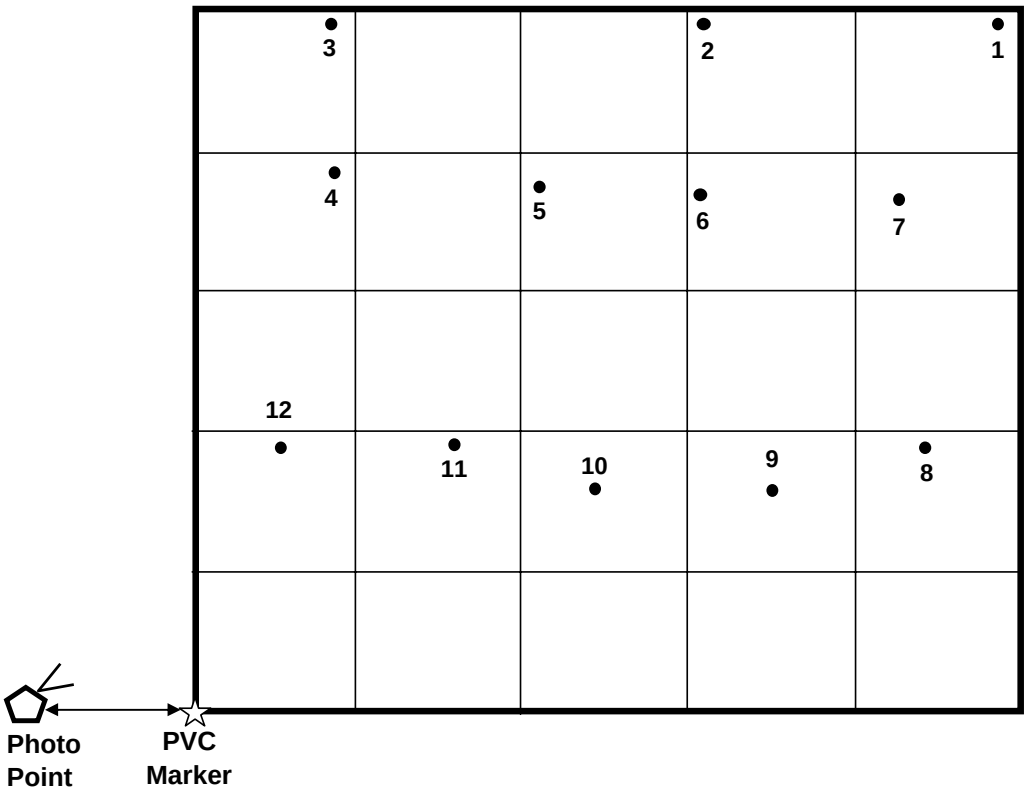
Survivability:

Total Number of Trees **30** / **30 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S6 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.44	4	
2	Unknown	0.63	4	
3	Unknown	0.54	4	
4	Beautyberry (*Callicarpa americana*)	0.56	4	
5	Unknown	0.43	4	
6	Unknown	0.47	4	
7	River Birch (*Betula nigra*)	0.57	4	
8	River Birch (*Betula nigra*)	0.39	4	
9	Unknown	0.35	4	
10	Unknown	0.23	4	
11	Unknown	0.45	4	
12	River Birch (*Betula nigra*)	0.53	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	25.0%
Beautyberry (*Callicarpa americana*)	8.3%
Unknown	66.7%

Density:

Total Number of Trees **12** / **0.025 acres** = **480** **trees / acre**

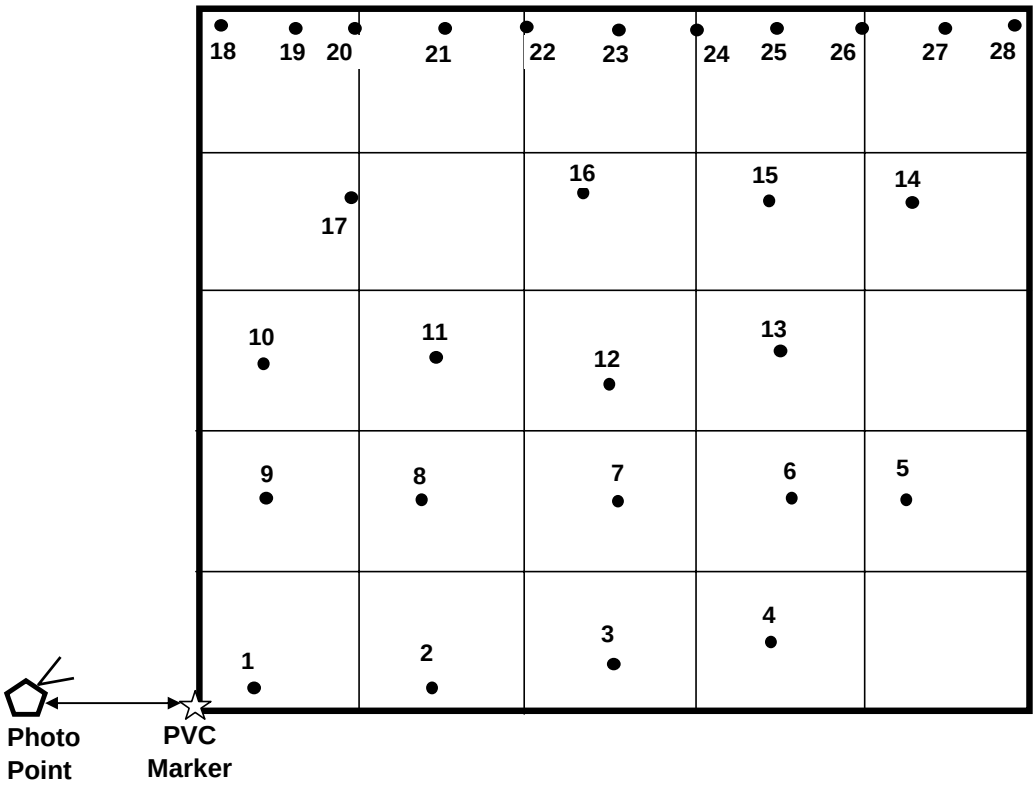
Survivability:

Total Number of Trees **12** / **12 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S7 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.26	4	
2	Unknown	0.40	4	
3	Unknown	0.30	4	
4	Unknown	0.47	4	
5	Unknown	0.36	4	
6	Unknown	0.42	4	
7	Unknown	0.38	4	
8	Unknown	0.49	4	
9	Unknown	0.29	4	
10	Unknown	0.50	4	
11	Unknown	0.22	4	
12	Unknown	0.42	4	
13	Unknown	0.47	4	
14	Unknown	0.52	4	
15	Unknown	0.54	4	
16	Unknown	0.30	4	
17	Unknown	0.51	4	
18	Silky Dogwood (*Cornus amomum*)		4	Live Stake
19	Silky Dogwood (*Cornus amomum*)		4	Live Stake
20	Silky Dogwood (*Cornus amomum*)		4	Live Stake
21	Silky Dogwood (*Cornus amomum*)		4	Live Stake
22	Silky Dogwood (*Cornus amomum*)		4	Live Stake
23	Silky Dogwood (*Cornus amomum*)		4	Live Stake
24	Silky Dogwood (*Cornus amomum*)		4	Live Stake
25	Silky Dogwood (*Cornus amomum*)		4	Live Stake
26	Elderberry (*Sambucus canadensis*)		4	Live Stake
27	Elderberry (*Sambucus canadensis*)		4	Live Stake
28	Elderberry (*Sambucus canadensis*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

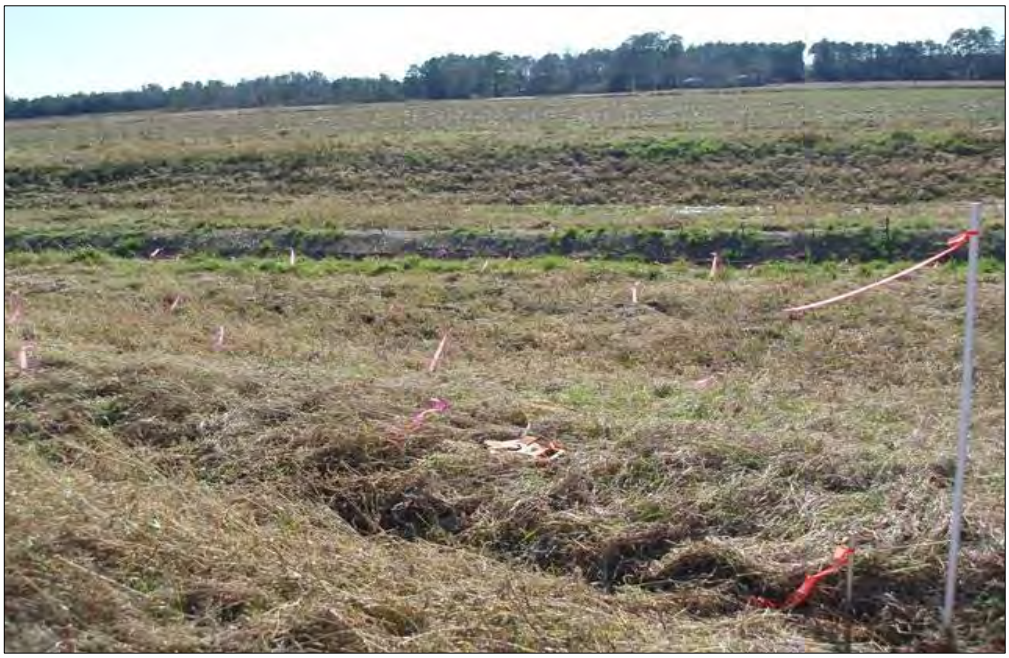
Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	28.6%
Elderberry (*Sambucus canadensis*)	10.7%
Unknown	60.7%

Density:

Total Number of Trees **28** / **0.025 acres** = **1120** **trees / acre**

Survivability:

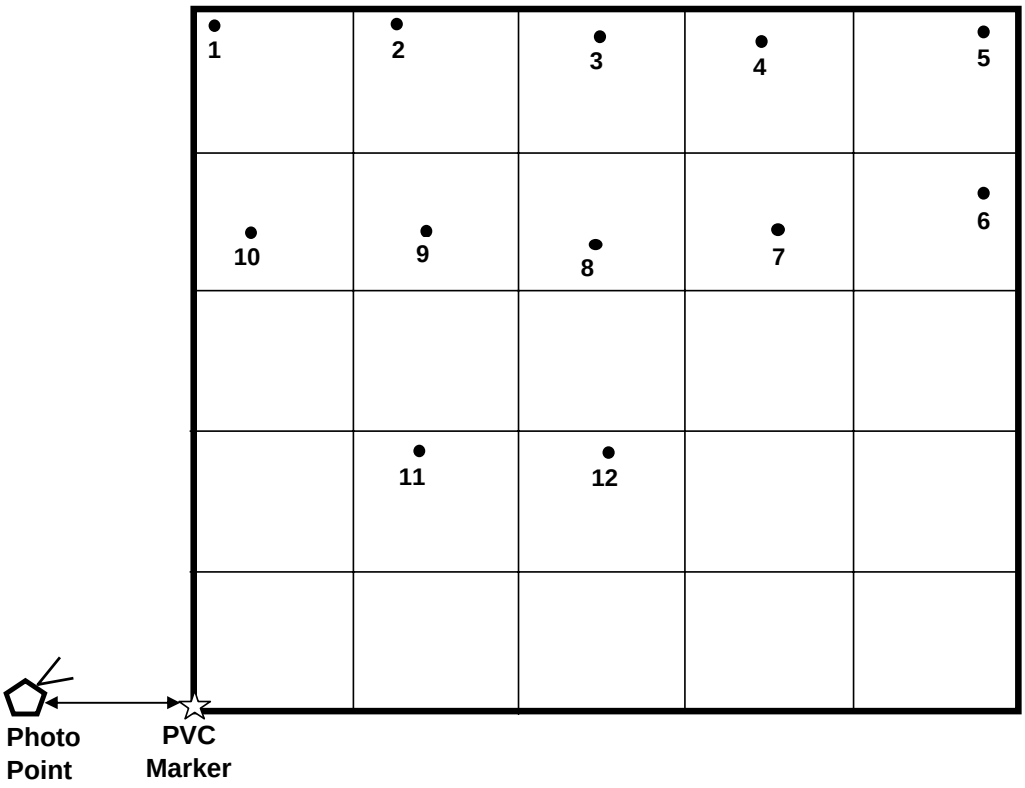
Total Number of Trees **28** / **28 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S8 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.44	4	
2	Unknown	0.44	4	
3	Unknown	0.37	4	
4	Unknown	0.28	4	
5	Unknown	0.55	4	
6	Unknown	0.55	4	
7	Unknown	0.66	4	
8	Unknown	0.62	4	
9	Unknown	0.63	4	
10	Unknown	0.64	4	
11	Unknown	0.68	4	
12	Unknown	0.52	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

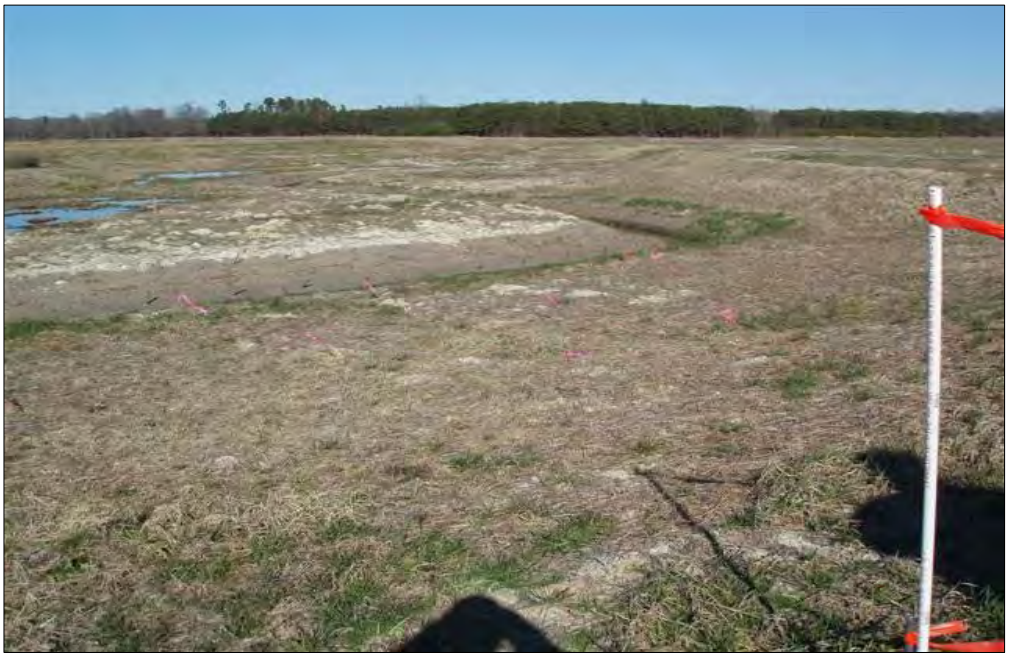
Species	Percent of Total
Unknown	100.0%

Density:

Total Number of Trees **12** / **0.025 acres** = **480** **trees / acre**

Survivability:

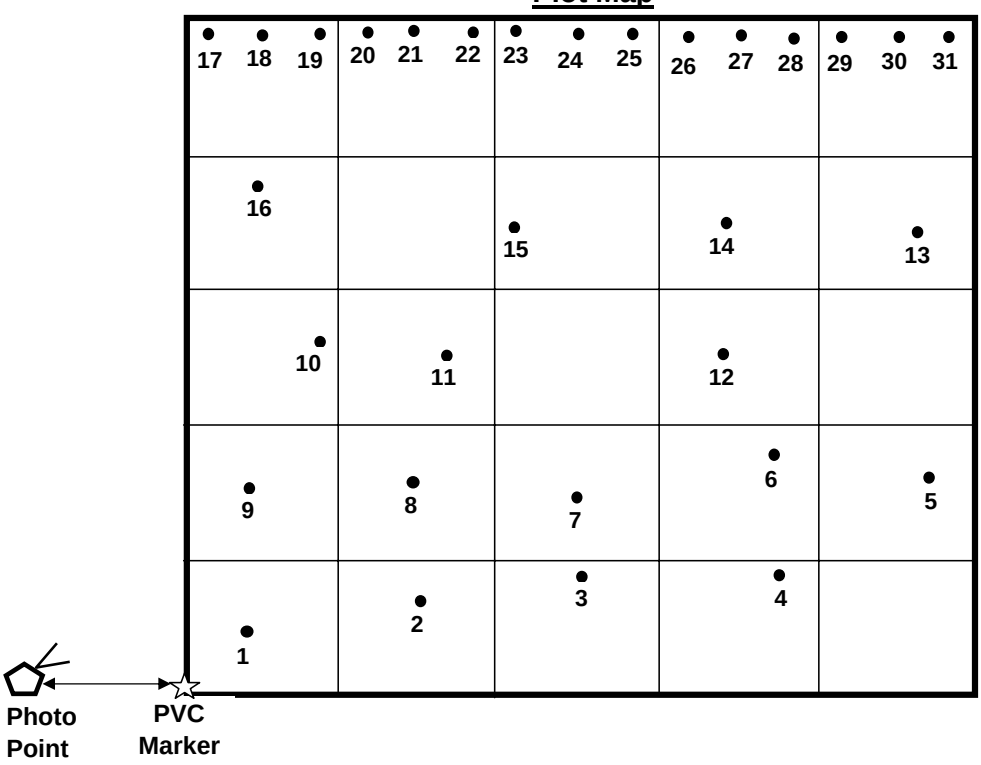
Total Number of Trees **12** / **12 trees** x **100** = **100** **% survivability**



Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S9 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.35	4	
2	Unknown	0.57	4	
3	Unknown	0.59	4	
4	Unknown	0.63	4	
5	Willow Oak (*Quercus phellos*)	0.57	4	
6	Unknown	0.30	4	
7	Unknown	0.41	4	
8	River Birch (*Betula nigra*)	0.48	4	
9	River Birch (*Betula nigra*)	0.49	4	
10	Unknown	0.78	4	
11	Willow Oak (*Quercus phellos*)	0.50	4	
12	Unknown	0.55	4	
13	Swamp Chestnut Oak (*Quercus michauxii*)	0.55	4	
14	Unknown	0.29	4	
15	River Birch (*Betula nigra*)	0.50	4	
16	River Birch (*Betula nigra*)	0.42	4	
17	Silky Dogwood (*Cornus amomum*)		4	Live Stake
18	Silky Dogwood (*Cornus amomum*)		4	Live Stake
19	Silky Dogwood (*Cornus amomum*)		4	Live Stake
20	Elderberry (*Sambucus canadensis*)		4	Live Stake
21	Black Willow (*Salix nigra*)		4	Live Stake
22	Silky Dogwood (*Cornus amomum*)		4	Live Stake
23	Silky Dogwood (*Cornus amomum*)		4	Live Stake
24	Silky Dogwood (*Cornus amomum*)		4	Live Stake
25	Silky Dogwood (*Cornus amomum*)		4	Live Stake
26	Silky Dogwood (*Cornus amomum*)		4	Live Stake
27	Silky Dogwood (*Cornus amomum*)		4	Live Stake
28	Black Willow (*Salix nigra*)		4	Live Stake
29	Black Willow (*Salix nigra*)		4	Live Stake
30	Black Willow (*Salix nigra*)		4	Live Stake
31	Black Willow (*Salix nigra*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	29.0%
Black Willow (*Salix nigra*)	16.1%
River Birch (*Betula nigra*)	12.9%
Willow Oak (*Quercus phellos*)	6.5%
Swamp Chestnut Oak (*Quercus michauxii*)	3.2%
Elderberry (*Sambucus canadensis*)	3.2%
Unknown	29.0%

Density:

Total Number of Trees **31** / **0.025 acres** = **1240** **trees / acre**

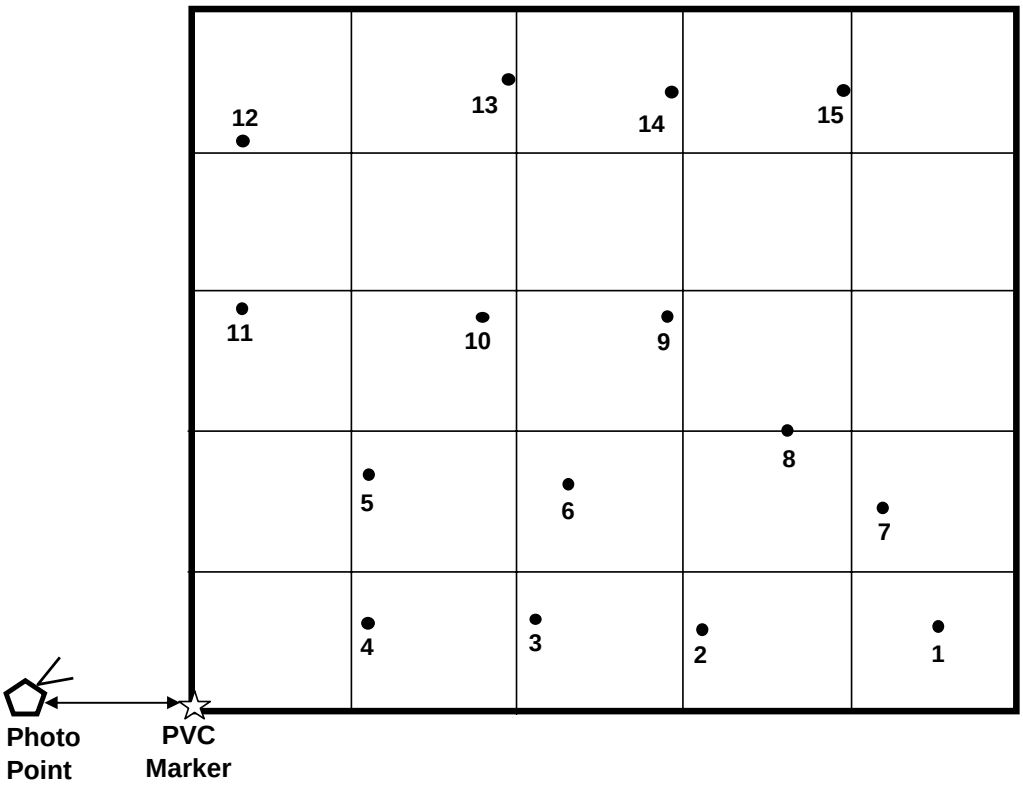
Survivability:

Total Number of Trees **31** / **31 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S10 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Sycamore (*Platanus occidentalis*)	0.60	4	
2	Sycamore (*Platanus occidentalis*)	0.59	4	
3	Sycamore (*Platanus occidentalis*)	0.57	4	
4	Sycamore (*Platanus occidentalis*)	0.59	4	
5	Unknown	0.56	4	
6	Willow Oak (*Quercus phellos*)	0.64	4	
7	Unknown	0.57	4	
8	Unknown	0.44	4	
9	Unknown	0.41	4	
10	Unknown	0.39	4	
11	Unknown	0.40	4	
12	Unknown	0.50	4	
13	Unknown	0.44	4	
14	Unknown	0.44	4	
15	Unknown	0.57	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Sycamore (*Platanus occidentalis*)	26.7%
Willow Oak (*Quercus phellos*)	6.7%
Unknown	66.7%

Density:

Total Number of Trees **15** / **0.025 acres** = **600** **trees / acre**

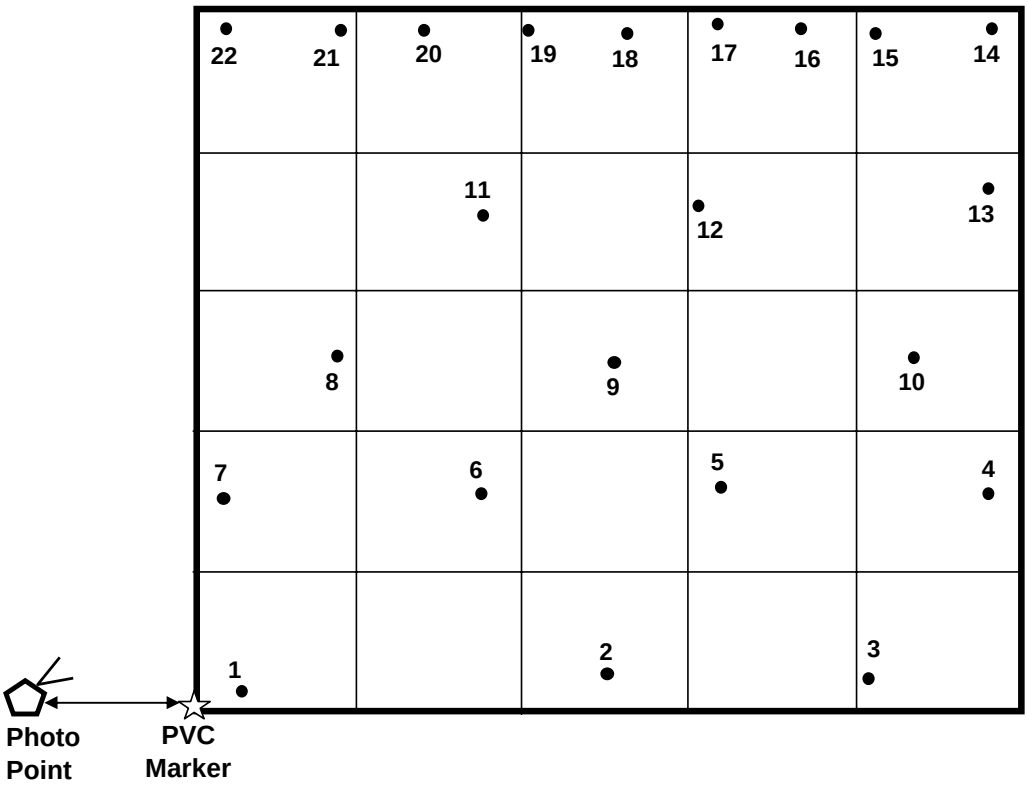
Survivability:

Total Number of Trees **15** / **15 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S11 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.57	4	
2	Unknown	0.45	4	
3	Unknown	0.50	4	
4	Unknown	0.55	4	
5	Unknown	0.70	4	
6	Unknown	0.34	4	
7	Unknown	0.56	4	
8	Unknown	0.35	4	
9	Unknown	0.49	4	
10	Unknown	0.57	4	
11	Unknown	0.51	4	
12	Unknown	0.40	4	
13	Unknown	0.60	4	
14	Elderberry (*Sambucus canadensis*)		4	Live Stake
15	Silky Dogwood (*Cornus amomum*)		4	Live Stake
16	Silky Dogwood (*Cornus amomum*)		4	Live Stake
17	Silky Dogwood (*Cornus amomum*)		4	Live Stake
18	Silky Dogwood (*Cornus amomum*)		4	Live Stake
19	Silky Dogwood (*Cornus amomum*)		4	Live Stake
20	Silky Dogwood (*Cornus amomum*)		4	Live Stake
21	Elderberry (*Sambucus canadensis*)		4	Live Stake
22	Black Willow (*Salix nigra*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	27.3%
Elderberry (*Sambucus canadensis*)	9.1%
Black Willow (*Salix nigra*)	4.5%
Unknown	59.1%

Density:

Total Number of Trees **22** / **0.025 acres** = **880** **trees / acre**

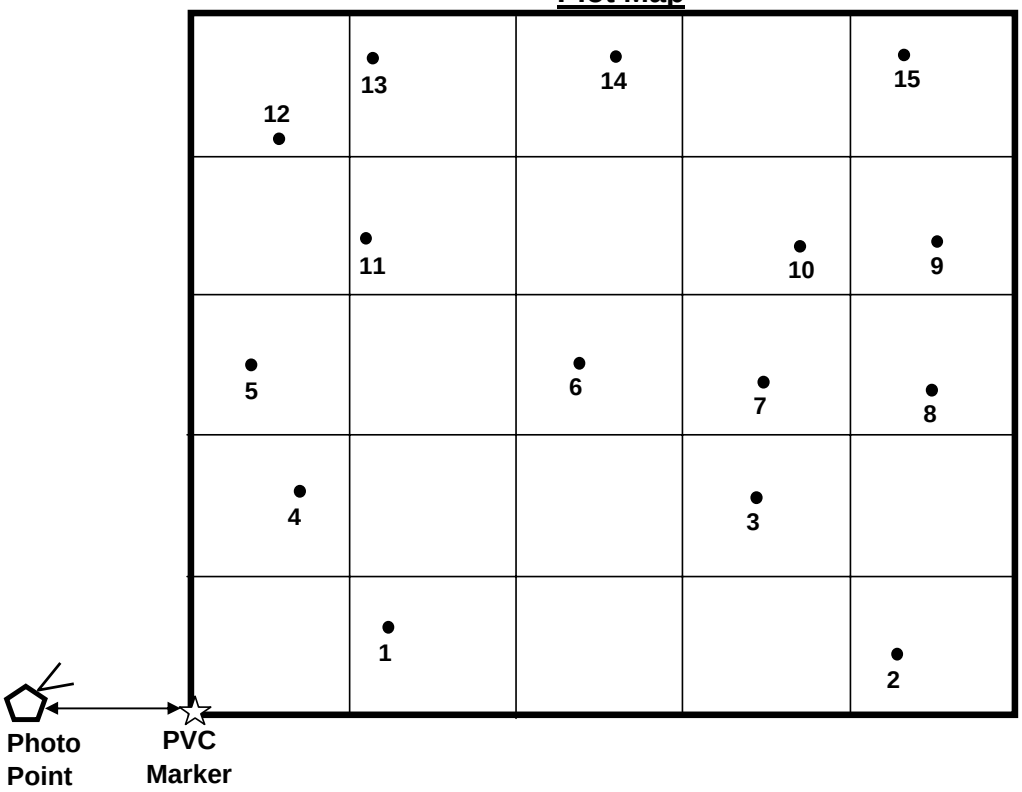
Survivability:

Total Number of Trees **22** / **22 trees** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S12 **Date:** 1/30/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Sycamore (*Platanus occidentalis*)	0.60	4	
2	Unknown	0.57	4	
3	Unknown	0.50	4	
4	Sycamore (*Platanus occidentalis*)	0.55	4	
5	Unknown	0.50	4	
6	Unknown	0.51	4	
7	River Birch (*Betula nigra*)	0.49	4	
8	Unknown	0.56	4	
9	River Birch (*Betula nigra*)	0.43	4	
10	Unknown	0.37	4	
11	Sycamore (*Platanus occidentalis*)	0.60	4	
12	Unknown	0.27	4	
13	River Birch (*Betula nigra*)	0.50	4	
14	Unknown	0.52	4	
15	River Birch (*Betula nigra*)	0.50	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	26.7%
Sycamore (*Platanus occidentalis*)	20.0%
Unknown	53.3%

Density:

Total Number of Trees **15** / **0.025 acres** = **600** **trees / acre**

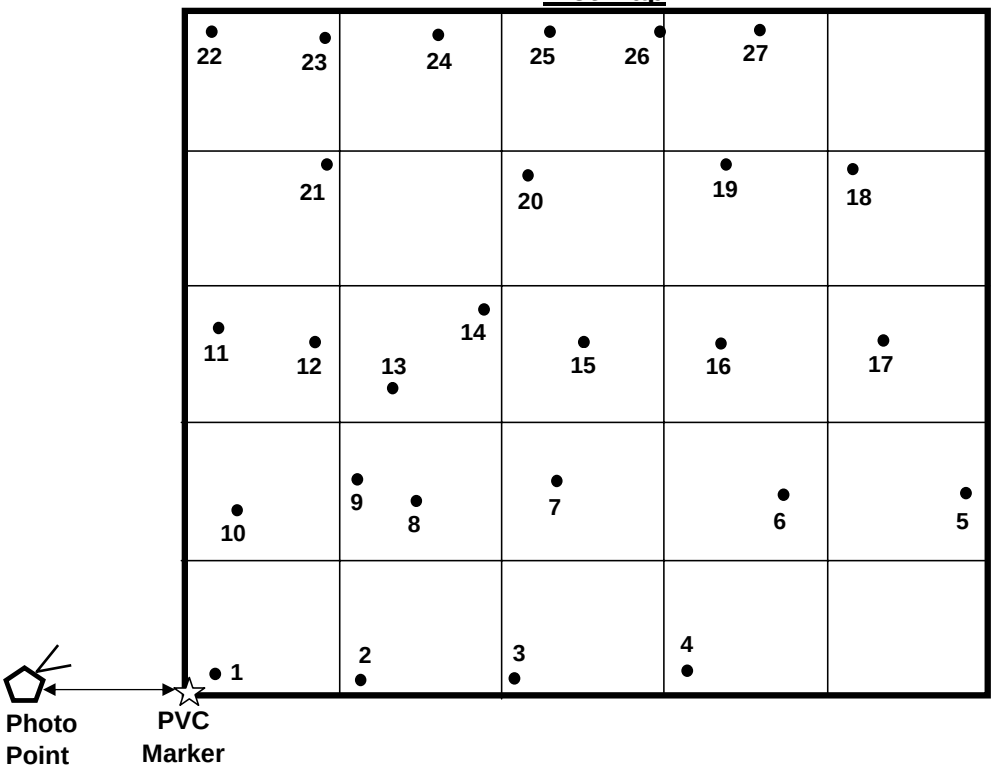
Survivability:

Total Number of Trees **15** / **15** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S13 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.37	4	
2	Unknown	0.39	4	
3	Unknown	0.44	4	
4	Unknown	0.49	4	
5	Unknown	0.60	4	
6	Sycamore (*Platanus occidentalis*)	0.51	4	
7	Unknown	0.25	4	
8	Unknown	0.30	4	
9	Unknown	0.55	4	
10	Unknown	0.51	4	
11	Unknown	0.39	4	
12	Unknown	0.40	4	
13	Unknown	0.20	4	
14	Unknown	0.30	4	
15	Unknown	0.54	4	
16	Unknown	0.36	4	
17	Unknown	0.50	4	
18	Unknown	0.21	4	
19	Unknown	0.51	4	
20	Unknown	0.48	4	
21	Unknown	0.56	4	
22	Silky Dogwood (*Cornus amomum*)		4	Live Stake
23	Silky Dogwood (*Cornus amomum*)		4	Live Stake
24	Silky Dogwood (*Cornus amomum*)		4	Live Stake
25	Elderberry (*Sambucus canadensis*)		4	Live Stake
26	Silky Dogwood (*Cornus amomum*)		4	Live Stake
27	Elderberry (*Sambucus canadensis*)		4	Live Stake
28	Silky Dogwood (*Cornus amomum*)		4	Live Stake
29	Silky Dogwood (*Cornus amomum*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	20.7%
Elderberry (*Sambucus canadensis*)	6.9%
Sycamore (*Platanus occidentalis*)	3.4%
Unknown	69.0%

Density:

Total Number of Trees **29** / **0.025 acres** = **1160** **trees / acre**

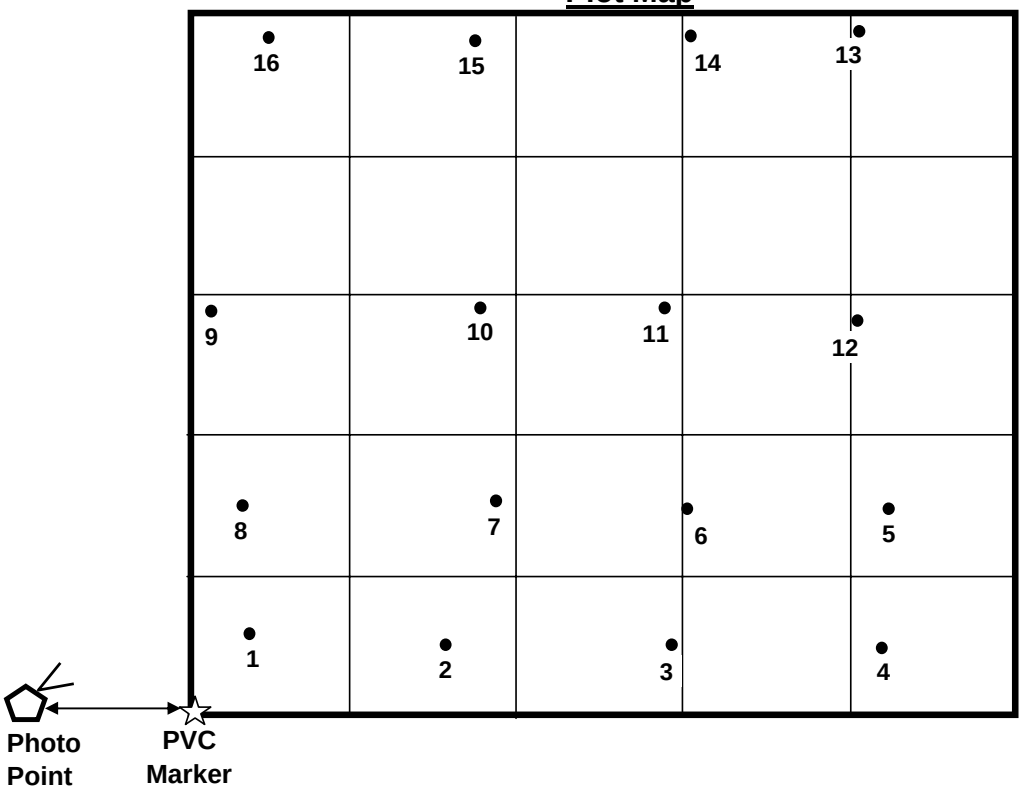
Survivability:

Total Number of Trees **29** / **29** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S14 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Beautyberry (*Callicarpa americana*)	0.65	4	
2	Unknown	0.58	4	
3	Swamp Chestnut Oak (*Quercus michauxii*)	0.52	4	
4	Unknown	0.50	4	
5	Unknown	0.45	4	
6	River Birch (*Betula nigra*)	0.50	4	
7	Unknown	0.52	4	
8	Unknown	0.53	4	
9	Willow Oak (*Quercus phellos*)	0.65	4	
10	Unknown	0.55	4	
11	Unknown	0.57	4	
12	Unknown	0.56	4	
13	River Birch (*Betula nigra*)	0.48	4	
14	Unknown	0.54	4	
15	Unknown	0.55	4	
16	Unknown	0.40	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	12.5%
Swamp Chestnut Oak (*Quercus michauxii*)	6.3%
Willow Oak (*Quercus phellos*)	6.3%
Beautyberry (*Callicarpa americana*)	6.3%
Unknown	68.8%

Density:

Total Number of Trees **16** / **0.025 acres** = **640** **trees / acre**

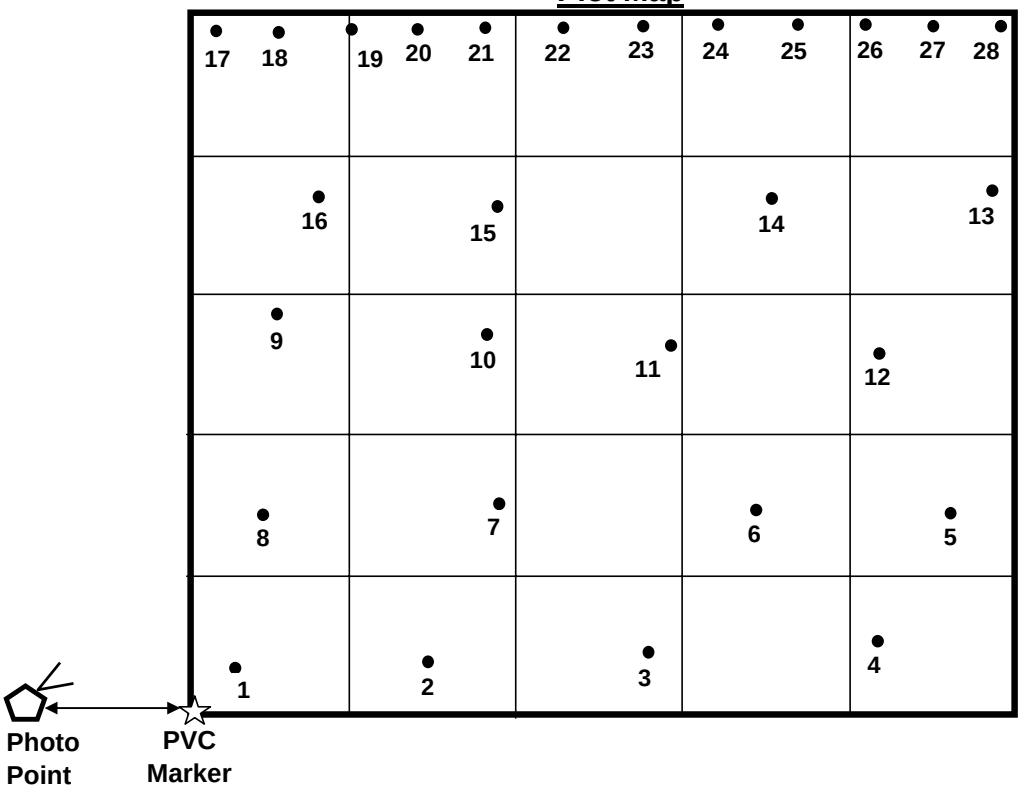
Survivability:

Total Number of Trees **16** / **16** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S15 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	River Birch (*Betula nigra*)	0.43	4	
2	River Birch (*Betula nigra*)	0.40	4	
3	River Birch (*Betula nigra*)	0.38	4	
4	River Birch (*Betula nigra*)	0.45	4	
5	Unknown	0.31	4	
6	Unknown	0.50	4	
7	Unknown	0.53	4	
8	Unknown	0.27	4	
9	Unknown	0.37	4	
10	Sycamore (*Platanus occidentalis*)	0.57	4	
11	Sycamore (*Platanus occidentalis*)	0.60	4	
12	Sycamore (*Platanus occidentalis*)	0.49	4	
13	Green Ash (*Fraxinus Pennsylvanica*)	0.61	4	
14	Unknown	0.57	4	
15	Unknown	0.58	4	
16	Unknown	0.61	4	
17	Silky Dogwood (*Cornus amomum)*		4	Live Stake
18	Silky Dogwood (*Cornus amomum)*		4	Live Stake
19	Silky Dogwood (*Cornus amomum)*		4	Live Stake
20	Silky Dogwood (*Cornus amomum)*		4	Live Stake
21	Silky Dogwood (*Cornus amomum)*		4	Live Stake
22	Silky Dogwood (*Cornus amomum)*		4	Live Stake
23	Silky Dogwood (*Cornus amomum)*		4	Live Stake
24	Silky Dogwood (*Cornus amomum)*		4	Live Stake
25	Elderberry (*Sambucus canadensis*)		4	Live Stake
26	Silky Dogwood (*Cornus amomum)*		4	Live Stake
27	Silky Dogwood (*Cornus amomum)*		4	Live Stake
28	Elderberry (*Sambucus canadensis*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Silky Dogwood (*Cornus amomum*)	35.7%
River Birch (*Betula nigra*)	14.3%
Sycamore (*Platanus occidentalis*)	10.7%
Elderberry (*Sambucus canadensis*)	7.1%
Green Ash (*Fraxinus pennsylvanica*)	3.6%
Unknown	28.6%

Density:

Total Number of Trees								
	28	**/**	**0.025 acres**		**=**	**1120**	**trees / acre**

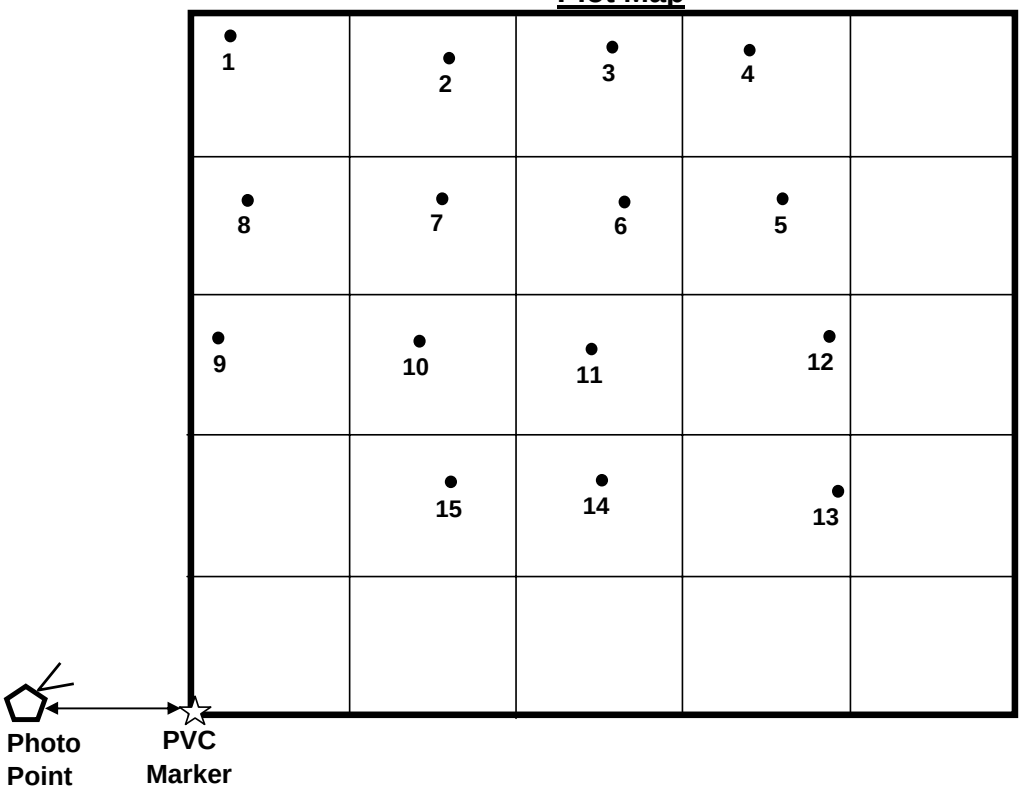
Survivability:

Total Number of Trees								
	28	**/**	**28**	**x 100**	**=**	**100**	**% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S16 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.57	4	
2	Unknown	0.58	4	
3	Unknown	0.51	4	
4	Willow Oak (*Quercus phellos*)	0.38	4	
5	Unknown	0.60	4	
6	Unknown	0.54	4	
7	Unknown	0.22	4	
8	Unknown	0.29	4	
9	Sycamore (*Platanus occidentalis*)	0.50	4	
10	Unknown	0.15	4	
11	Unknown	0.30	4	
12	Unknown	0.14	4	
13	Unknown	0.52	4	
14	Unknown	0.45	4	
15	River Birch (*Betula nigra*)	0.46	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Willow Oak (*Quercus phellos*)	6.7%
Sycamore (*Platanus occidentalis*)	6.7%
River Birch (*Betula nigra*)	6.7%
Unknown	80.0%

Density:

Total Number of Trees **15** / **0.025 acres** = **600** **trees / acre**

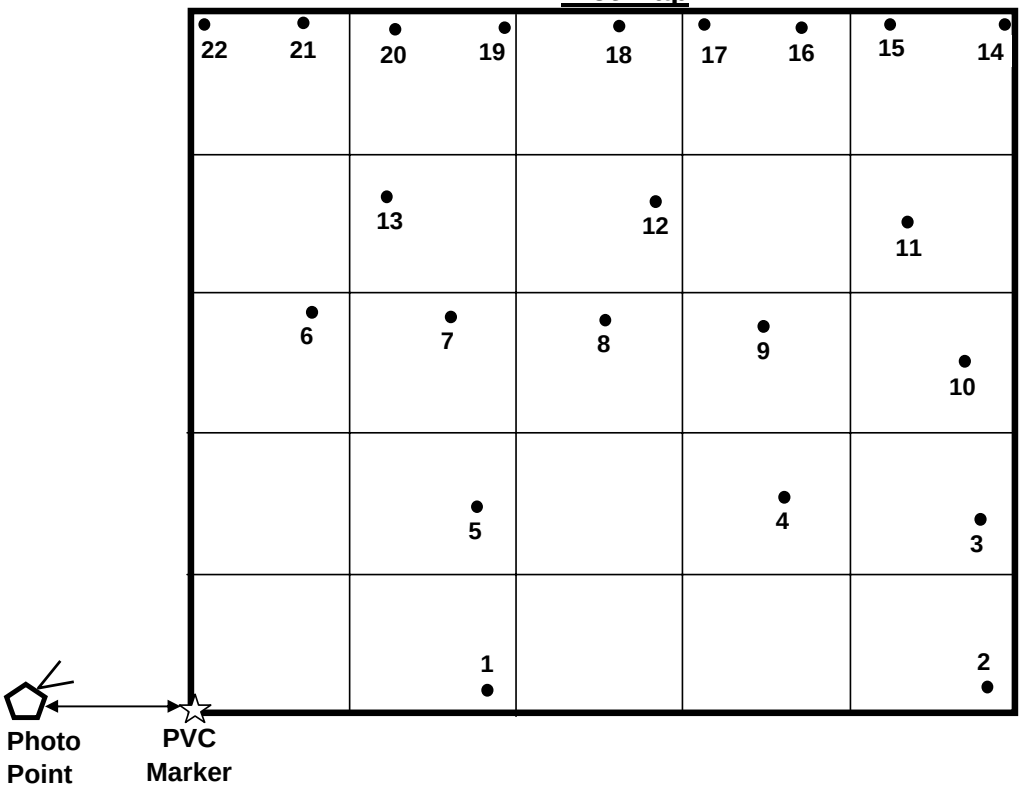
Survivability:

Total Number of Trees **15** / **27** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S17 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	Unknown	0.65	4	
2	Unknown	0.47	4	
3	Unknown	0.45	4	
4	Willow Oak (*Quercus phellos*)	0.65	4	
5	Unknown	0.40	4	
6	Unknown	0.59	4	
7	Unknown	0.58	4	
8	Unknown	0.55	4	
9	Swamp Chestnut Oak (*Quercus michauxii*)	0.34	4	
10	Unknown	0.55	4	
11	Willow Oak (*Quercus phellos*)	0.55	4	
12	Unknown	0.14	4	
13	Unknown	0.58	4	
14	Silky Dogwood (*Cornus amomum*)		4	Live Stake
15	Elderberry (*Sambucus canadensis*)		4	Live Stake
16	Black Willow (*Salix nigra*)		4	Live Stake
17	Elderberry (*Sambucus canadensis*)		4	Live Stake
18	Elderberry (*Sambucus canadensis*)		4	Live Stake
19	Elderberry (*Sambucus canadensis*)		4	Live Stake
20	Elderberry (*Sambucus canadensis*)		4	Live Stake
21	Elderberry (*Sambucus canadensis*)		4	Live Stake
22	Silky Dogwood (*Cornus amomum*)		4	Live Stake

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
Elderberry (*Sambucus canadensis*)	27.3%
Silky Dogwood (*Cornus amomum*)	9.1%
Willow Oak (*Quercus phellos*)	9.1%
Swamp Chestnut Oak (*Quercus michauxii*)	4.5%
Black Willow (*Salix nigra*)	4.5%
Unknown	45.5%

Density:

Total Number of Trees **22** / **0.025 acres** = **880** **trees / acre**

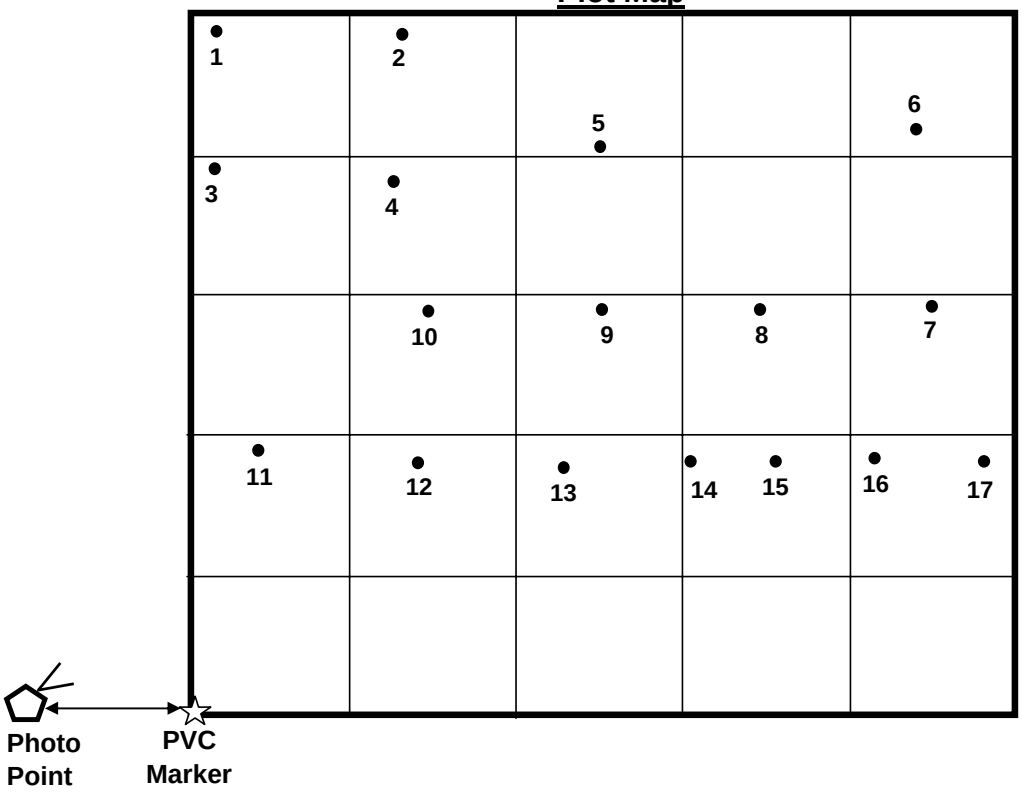
Survivability:

Total Number of Trees **22** / **22** x **100** = **100** **% survivability**

Vegetation Monitoring Worksheet

Site: Harrell **Plot:** S18 **Date:** 1/31/2008

Plot Map



ID	Species	Height (m)	Vigor	Comment
1	River Birch (*Betula nigra*)	0.55	4	
2	River Birch (*Betula nigra*)	0.51	4	
3	Unknown	0.39	4	
4	Unknown	0.26	4	
5	Beautyberry (*Callicarpa americana*)	0.54	4	
6	Willow Oak (*Quercus phellos*)	0.35	4	
7	Beautyberry (*Callicarpa americana*)	0.59	4	
8	Unknown	0.59	4	
9	Green Ash (*Fraxinus pennsylvanica*)	0.57	4	
10	Unknown	0.46	4	
11	River Birch (*Betula nigra*)	0.55	4	
12	River Birch (*Betula nigra*)	0.51	4	
13	River Birch (*Betula nigra*)	0.55	4	
14	Willow Oak (*Quercus phellos*)	0.34	4	
15	River Birch (*Betula nigra*)	0.50	4	
16	River Birch (*Betula nigra*)	0.51	4	
17	Willow Oak (*Quercus phellos*)	0.43	4	

Vigor: 4=excellent, 3=good, 2=weak, 1=unlikely to survive year

Species	Percent of Total
River Birch (*Betula nigra*)	41.2%
Willow Oak (*Quercus phellos*)	17.6%
Beautyberry (*Callicarpa americana*)	11.8%
Green Ash (*Fraxinus pennsylvanica*)	5.9%
Unknown	23.5%

Density:

Total Number of Trees **17** / **0.025 acres** = **680** **trees / acre**

Survivability:

Total Number of Trees **17** / **17** x **100** = **100** **% survivability**

Appendix E

Permanent Photo Point Photos

Photo Point W1: View looking north from southwest corner of wetland. 2/15/08 – As-Built

Photo Point W1: View looking east from southwest corner of wetland. 2/15/08 – As-Built

Photo Point W2: View looking east from northwest corner of wetland. 11/7/07 – As-Built

Photo Point W2: View looking southeast from northwest corner of wetland. 2/15/08 – As-Built

Photo Point W3: View looking east from middle corner of wetland. 2/15/08 – As-Built

Photo Point W3: View looking west from middle corner of wetland. 2/15/08 – As-Built

Photo Point W3: View looking southwest from middle corner of wetland. 2/15/08 – As-Built

Photo Point W4: View looking north towards wetland gauge one. 2/15/08 – As-Built

Photo Point W5: View looking west located at the downstream end of site. 2/15/08 – As-Built

Photo Point S1: View looking upstream near Station 12+75. 11/7/07 – As-Built

Photo Point S1: View looking downstream, near Station 12+75. 11/7/07 – As-Built

Photo Point S2: View looking upstream from farm road near Station 21+30. 11/7/07 – As-Built

Photo Point S2: View looking downstream from farm road near Station 21+30. 11/7/07 - As-Built

Photo Point S3: View looking upstream near Station 27+60. 11/7/07 – As-Built

Point S3: View looking downstream near Station 27+60. 11/7/07 – As-Built

Photo Point S4: View of water quality treatment structure near Station 32+25. 11/7/07 – As-Built

Photo Point S5: View looking at log drop structures, near Station 33+35. 11/7/07 – As-Built

Photo Point S5: View looking downstream near Station 33+35. 11/7/07 – As-Built

Photo Point S6: View of drainage ditch reinforcement, near Station 37+25. 11/7/07 – As-Built

Photo Point S7: View looking upstream near Station 39+00. 11/7/07 – As-Built

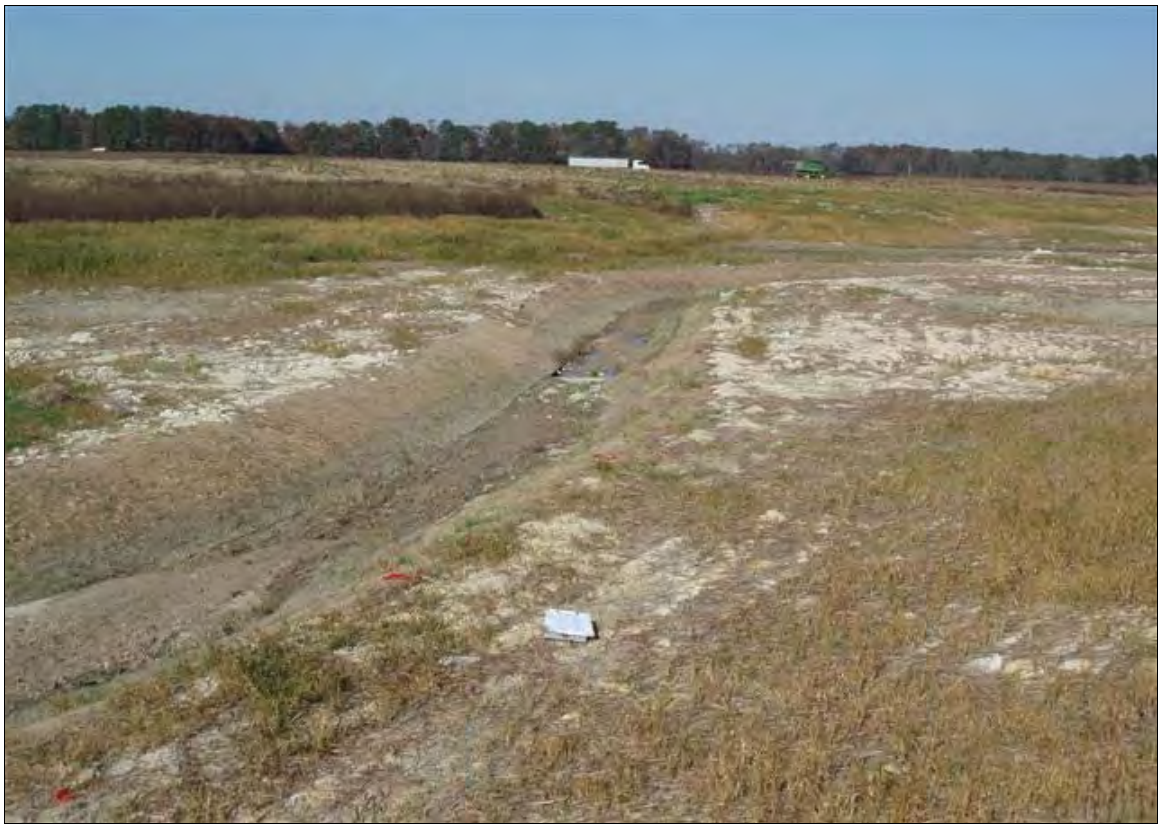


Photo Point S7: View looking downstream near Station 39+00. 11/7/07 – As-Built

Photo Point S8: View of log drop structure near Station 39+50. 11/7/07 – As-Built

Photo Point S9: View of water quality treatment structure near Station 41+75. 11/7/07 – As-Built

Photo Point S10: View looking upstream near Station 46+15. 11/7/07 – As-Built

Photo Point S10: View looking downstream near Station 46+15. 11/7/07 – As-Built

Photo Point S11: View of water quality treatment structure near Station 47+00. 11/7/07 - As-Built

Photo Point S12: View looking upstream near Station 52+00. 11/7/07 – As-Built

Photo Point S12: View looking downstream near Station 52+00. 11/7/07 – As-Built

Photo Point S13: View looking upstream near Station 61+50. 11/7/07 – As-Built

Photo Point S13: View of water quality treatment structure near Station 61+50. 11/7/07 - As-Built

Photo Point S13: View looking downstream near Station 61+50. 11/7/07 – As-Built

Photo Point S14: View of water quality treatment structure near Station 62+60. 11/7/07 - As-Built

Photo Point S15: View looking upstream near Station 69+00. 11/7/07 – As-Built

Photo Point S15: View looking downstream near Station 69+00. 11/7/07 – As-Built

Photo Point S16: View looking upstream near Station 76+75. 11/7/07 – As-Built

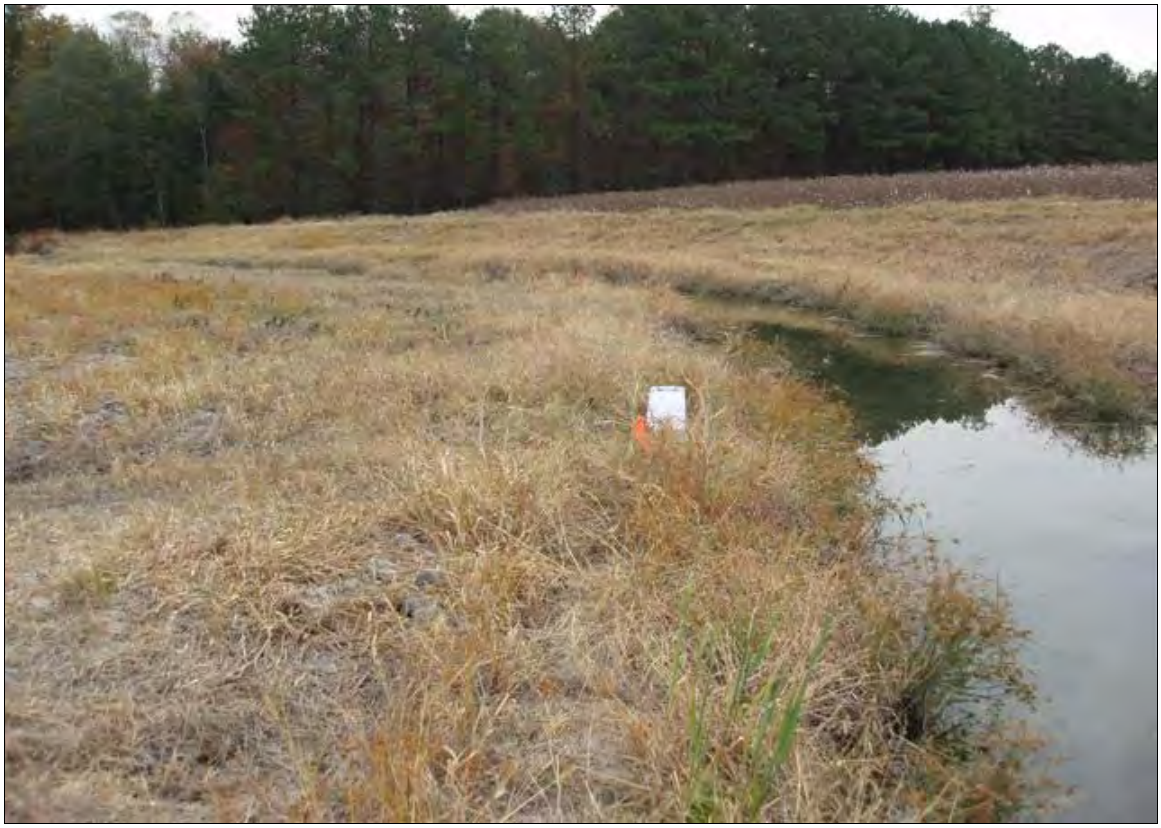


Photo Point S16B: View looking downstream toward project end before joining Swift Creek near Station 76+75. 11/7/07 – As-Built