Farrar Dairy Stream and Wetland Restoration Site
Mitigation Plan
Contract # D06002

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EXECUTIVE SUMMARY

The Farrar Dairy Site is located in the Sand Hills physiographic province in Harnett County, North Carolina. The project will provide mitigation for stream and wetland impacts within the 8-digit hydrologic cataloging unit 03030004 in the Cape Fear River Basin by restoring, enhancing, and preserving 13,044 linear feet of stream and 112 acres of wetland, generating 11,881 stream mitigation units (SMU's) and 64.06 wetland mitigation units (WMU's). The goals of the project include restoring the riparian buffers and forested wetlands as well as creating a stable stream and wetland complex through an interconnected floodplain corridor. In order to achieve these goals, the project objectives included connecting the new stream planform to its original floodplain, filling and plugging ditches in the drained hydric soils to restore saturated hydrologic conditions, planting a functional Coastal Plain Small Swamp Stream community to create an effective riparian buffer and wetland complex, and removing cattle from the riparian areas with livestock exclusion fencing.

The project watershed drains from the northeast toward the southeast with a contributing area of approximately 5.7 square miles at the downstream limits. The rural watershed faces low to moderate development pressure from the surrounding area. The stream and wetland design along with the restoration plan were completed in May 2008, construction began in October 2008, and the site was planted prior to the 2009 growing season.

The stream restoration included eight separate reaches, which were either enhanced or restored using a combination of Priority 1 and 2 approaches. The wetland mitigation is comprised of five areas that combine preservation, enhancement, and restoration. In-stream structures, such as step pools and log drops were used to control grade throughout the restored stream's profile. The main channel through the site, the North Prong of Anderson Creek (NPAC), was restored to a C5 type channel, while its associated tributaries were restored or enhanced to C5/B5c, E5, and C5 type channels. The as-built survey and baseline monitoring found only minimal deviations from the designed cross-sections and profile. During construction, several large rain events caused minor problem areas on the restored stream channels. These issues and the repairs associated with them caused some small alterations to the stream profiles and dimension. These changes have been recorded on the as-built site plan. Since construction, the site has become well vegetated and the streams have remained stable throughout the storm events that have occurred since construction was completed.

The wetlands on the site were restored, enhanced, and preserved. The Priority 1 stream restoration restored the hydrology to the wetlands adjacent to the stream. Along with the restoration of these previously drained wetlands, other wetlands were enhanced by removing berms, treating invasive species, creating microtopography, and partially filling open water impoundments. The stream buffer and wetland restoration and enhancement areas were planted with bare root trees and shrubs and live stakes in March 2009.

The site will be monitored for at least five years beginning in 2009 through 2013 or until the success criteria are achieved. Reports will be submitted to the EEP each year. The planted riparian buffer and wetland must meet the success criteria of a site average of 320 planted stems/acre at the end of the monitoring period based on the vegetation monitoring plots. The baseline monitoring counted an average of 640 stems/acre in the 15 stream vegetation monitoring plots and 543 stems/acre in the 30 wetland vegetation monitoring plots. The water table of the restored wetlands must be within 12" of the soils surface continuously for at least 5% (12 days) of the 240-day growing season. Wetland hydrology will be monitored with a system of automatic gauges that record water table depth. Stream success will be assessed utilizing measurements of stream dimension, pattern, and profile as well as through site photographs. Two bankfull events also must occur on the restored streams over the monitoring period in separate monitoring years.

1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Farrar Dairy Site occupies portions of nine parcels. The site is located off of Farrar Dairy Road in southern Hartnett County, North Carolina, and approximately is 8.5 miles southwest of Lillington, North Carolina (Figure 1). To reach the site from Raleigh, drive south out of Raleigh on US 401 toward Fuquay-Varina, continuing south from Fuquay-Varina on US-401/US-421 toward Lillington. Turn right onto NC-210 and continue south through Lillington for approximately 6.5 miles to Darroch Road. Turn right onto Darroch Road and continue approximately 3 miles to Powell Farm Road. Turn left onto Powell Farm Road, drive approximately 1.5 miles and the entrance to the site will be on the left through the driveway of the red ranch style home.

1.2 Project Goals and Objectives

The project goals are to:

- Restore the site's riparian buffers and forested wetlands.
- Create a stable stream and wetland complex through an interconnected floodplain corridor.

In order to meet these goals, the following objectives were accomplished:

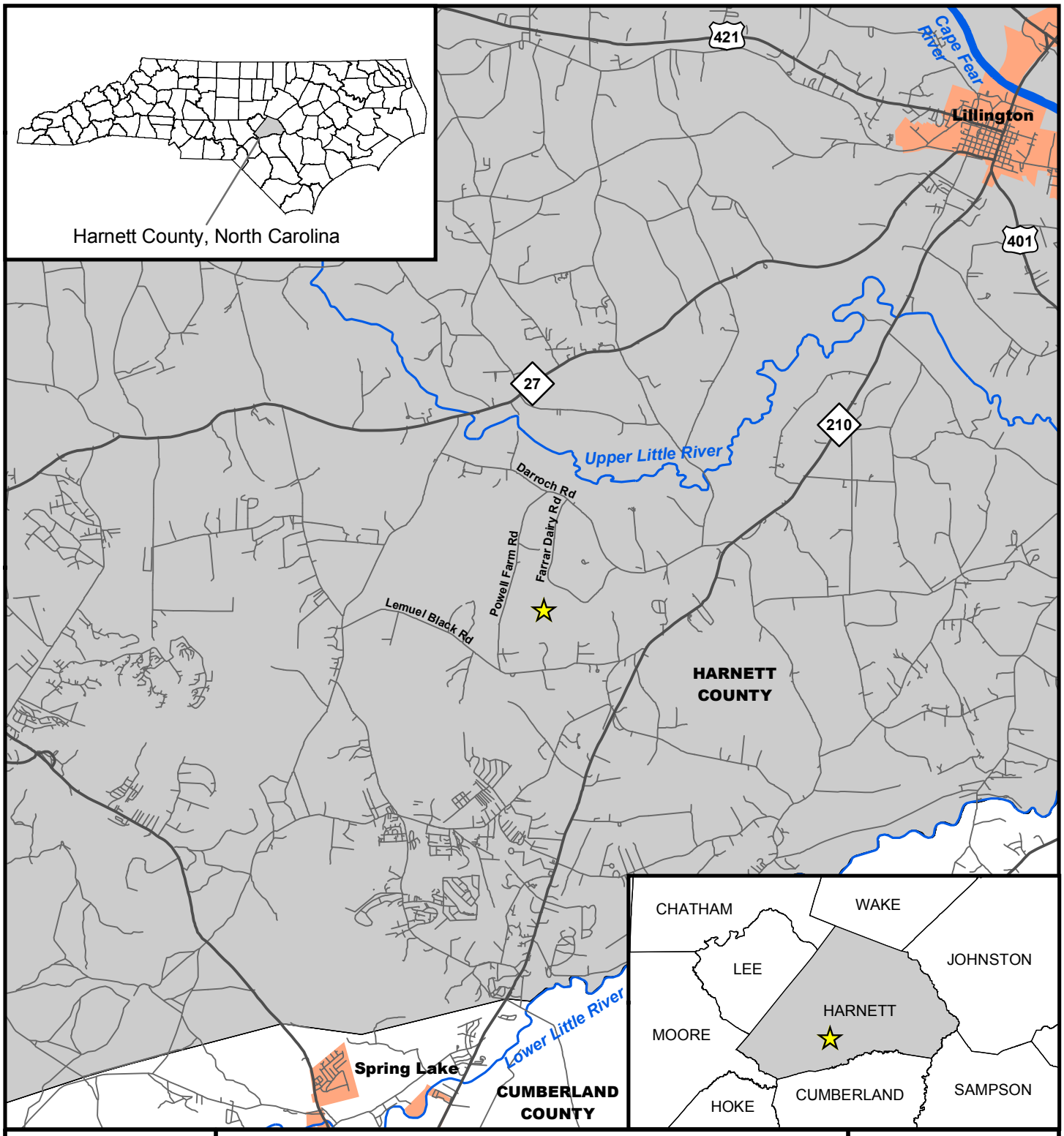
- Connected the new stream planform to its original floodplain.
- Fill and plug ditches in the drained hydric soils to restore saturated hydrologic conditions to the upper soil horizons.
- Plant a functional Coastal Plain Small Swamp Stream community to create an effective riparian buffer and wetland complex.
- Exclude livestock from the riparian and wetland areas with fencing.

1.3 Project Structure, Restoration Type and Approach

The project streams at the Farrar Dairy Site had become degraded primarily through poor grazing management and vegetation removal. Historically, the mainstem of the NPAC was altered to maximize the use of an agricultural field adjacent to Powell Farm Road. The other significant hydrologic alterations to the site included ditching wetlands and straightening the incoming tributaries to more efficiently convey water through the property. Due to the clearing of the riparian areas, the streams were experiencing significant bank erosion prior to restoration. Severe incision was also occurring on almost all of the reaches. In addition to the ditching that was installed in the historic wetlands, ponds were also built to attract migratory waterfowl. To correct these problems, restoration and enhancement of 13,044 linear feet of channel and 112 acres of wetlands were accomplished utilizing a Priority 1 approach for the stream (Table 1).

1.3.1 Project Streams

The three design reaches of NPAC were restored using a Priority 1 approach, creating a stable C5 channel. The reach breaks are separated by the confluences with T2 and T3. Following the Priority 1 approach, the channel was relocated to its historic location and the bed elevation was brought up reconnecting the stream to the original floodplain. At Station 10+00, the restored channel begins online at the culvert under Powell Farm Road. At Station 21+00, the channel leaves the pre-restoration location and flows through the adjacent forest in the location of its historic channel. The new channel comes back online at the end of the project at Station 76+00.



KCI TECHNOLOGIES

Figure 1. Vicinity Map

- Project Site Location
- Major Roads
- Other Roads
- Major Rivers
- Municipalities
- County Boundaries

N W E S

1:126,720

1 inch equals 2 miles

2 1 0 2 Miles

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T1.1 and T1.2 (Station 80+00 to 88+25 and Station 90+00 to 99+80, respectively) were both restored to C5/B5c headwater channels. At the confluence of these two channels, T1 begins. T1 (Station 100+00 to 108+84) was restored using the same approach as T1.1 and T1.2. A 31'-wide easement exception occurs at Station 101+00, where a ford crossing was installed for the landowner. The restoration created a new planform, profile, and dimension and increased the sinuosity of these previously straightened channels with a combination of Priority 1 and 2 approaches. Grade control structures such as log sills and step pools were installed along the new channels to create a stable profile. This restoration created a bankfull bench in entrenched sections and reconnected the stream to the existing floodplain in others.

T2 was divided into two reaches based on the changing slope of the tributary. T2A (Station 110+00 to 115+00) was restored to a C5/B5c stream and T2B (Station 115+00 to 120+22) was restored to an E5 stream type. The hydrologic source for the channel is a seep at the top of T2A. The restoration created a new planform, profile, and dimension and increased the sinuosity of the previously straightened channel with a combination of Priority 1 and 2 approaches. Grade control structures such as log sills and step pools were installed along the new channels to create a stable profile. This restoration created a bankfull bench in some places and reconnected the stream to the existing floodplain in others.

T3 (Station 130+00 to 141+67) is comprised of a single reach that was restored to a C5 channel. This channel was restored using a Priority 1 approach, with a new planform, profile, and dimension being reconnected to the original floodplain. Two drainage ditches that were adjacent to T3 were filled, reestablishing T3 as the primary hydrologic feature in this area.

T4 is separated into two reaches. The first reach (Station 150+00 to 151+80) was enhanced (EII) by planting portions of the easement that had been logged and removing significant amounts of logging debris that had accumulated in the channel, creating unstable conditions. The second reach (Station 151+80 to 164+20) is preservation. Near Station 162+00, the stream flows out of the easement for approximately 100 feet, but then comes back into the easement. The stationing continues from where the stream left the easement.

In-stream structures, including log sills, log drops, riffle grade controls, and offset rock cross vanes, were used to stabilize the restored channels. These structures are designed to reduce bank erosion, influence secondary circulation in the near-bank region of stream bends, provide grade control and promote efficient sediment transport. The log sill and log drop structures enhance in-stream pool habitat by creating a scouring obstruction, maintaining pool depths and providing habitat cover. Coir fiber matting, seeding, and mulching were used to provide temporary stabilization on the newly graded stream banks and live stakes were planted to provide long term rooting strength to the stream banks.

1.3.2 Project Wetlands

Wetland Area 1 preserves approximately 46 acres of well vegetated palustrine forested, scrub-shrub and emergent wetlands that are along the floodplain of the NPAC. The preservation area is dominated by various wetland sedges, rushes and persistent emergent vegetation, but also contains large scrub-shrub alder thickets that are permanently inundated.

Starting from the west and continuing to the east, Wetland Area 2 is located in the general vicinity of Tributary 1. Portions of this area, which is comprised of six wetlands separated by the restored stream, were historically cleared as part of the site's agricultural operations. This area was enhanced through the planting of bare root material. This wetland also borders the restored NPAC, and because NPAC has been reconnected to its floodplain, overbank flooding inundates the adjacent wetlands.

Enhancement in Wetland Area 3 took place in the central portion of the site. The area includes a shallow pond and adjacent overbank areas of the NPAC. Wetland Area 3 is located adjacent to a section of NPAC where overbank flows will have regular access to the floodplain, thus restoring hydrology to the wetlands. This area was planted with wetland trees and shrubs and graded to eliminate the man-made berms that impounded excess surface water.

Wetland Area 4 is located in an area that was heavily manipulated by the landowner to create a series of shallow impoundments intended to attract migratory waterfowl. The impoundments contain water control structures that allowed the landowner to manipulate water levels within the impoundments. These ponds were regraded to create a mosaic of vegetated wet hummocks throughout the wetland. Wetland W4 serves as a transitional area between the ponded features and the wetland preservation area. This area was planted with bare root seedlings and treated to control invasive species.

Wetland Area 5 includes all the site's restored wetlands. These areas are within the floodplain of the NPAC and its tributaries, which had historically been hydrologically altered to allow for agricultural production. Four main construction techniques were utilized to restore these wetland areas:

1. Raising the elevation of the NPAC and its tributaries to re-establish an active floodplain connected to the adjacent wetlands.
2. Filling existing ditches and removing tile drains to discourage rapid groundwater discharge to surface water receptors.
3. Scarifying the top 0.5'of organic surface soil to re-establish soil structure and allow for increased surface storage (microtopography). This material was not removed from the site, but simply re-worked to maximize the ability of the surface soils to retain surface and groundwater hydrology.
4. Planting species of wetland plants and shrubs.

Table 1 below provides a summary of the mitigation actions and units generated from this project.

Table 1. Project Restoration Components
Farrar Dairy Site

Project Streams

Project Segment / Reach ID	Pre- Project Footage	Mitigation Type	Approach	As - Built Footage	As-Built Stationing	Stream Mitigation Units	Comment
NPAC	4,565	Restoration	P1	6,746	10+00-77+46	6,714*	The stream was relocated with a new planform, profile, and dimension.
T1.1	864	Restoration	P1/2	825	80+00-88+25	825	The stream was relocated with a new planform, profile, and dimension.
T1.2	995	Restoration	P1/2	980	90+00-99+80	980	The stream was relocated with a new planform, profile, and dimension.
T1	389	Restoration	P1/2	884	100+00-108+84	853*	The stream was relocated with a new planform, profile, and dimension.
T2A	977	Restoration	P1/2	500	110+00-115+00	500	The stream was relocated with a new planform, profile, and dimension.
T2B		Restoration	P1/2	522	115+00-120+22	522	The stream was relocated with a new planform, profile, and dimension.
T3	1,335	Restoration	P1	1,167	130+00-141+67	1,167	The stream was relocated with a new planform, profile, and dimension.
T4.1	180	Enhancement II	-	180	150+00-151+80	72	The logged portions of the easement were planted and problematic logging debris was removed from the stream channel.
T4.2	1,240	Preservation	-	1,240	151+80-164+20	248	
Total				**13,044**		**11,881**	

* Easement exceptions for landowner ford crossings were excluded for these calculations.

Project Wetlands

Project Segment	Primary Soil Type	Mitigation Type	Acreage	Community Type	Wetland Mitigation Units	Comment
Area 1	Wehadkee	Preservation	45.93	Coastal Plain Small Stream Swamp	9.19	Protected by permanent conservation easement.
Area 2	Wehadkee	Enhancement	6.88	Coastal Plain Small Stream Swamp	3.44	The unvegetated portions of the wetland were planted and the hydrology was enhanced by the adjacent Priority 1 stream restoration.
Area 3	Wehadkee	Enhancement	2.57	Coastal Plain Small Stream Swamp	1.29	The unvegetated portions of the wetland were planted and the berms of a waterfowl impoundment were removed to enhance the hydrology.
Area 4	Wehadkee	Enhancement	12.67	Coastal Plain Small Stream Swamp	6.34	The unvegetated portions of the wetland were planted and the spoil from a waterfowl impoundment was distributed through the area to provide topographic relief through the wetland.
Area 5	Wehadkee	Restoration	43.8	Coastal Plain Small Stream Swamp	43.8	The unvegetated portions of the wetland were planted and hydrology was restored by filling ditches and by reconnecting the wetland to the floodplain of NPAC.

Figure 2 - Farrar Dairy Stream and Wetland Restoration Site Map

KCI TECHNOLOGIES

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- Project Easement Boundary
- Enhancement II
- Preservation
- Restoration
- Other Streams
- Reach Breaks
- Wetland Restoration (43.8 ac)
- Wetland Enhancement (22.1 ac)
- Wetland Preservation (45.9 ac)

1:7,200
1 inch equals 600 feet

600 300 0 600 Feet

Source: Orthoimagery 2008, Harnett County GIS/Land Records

T1.2
T1.1
T1
NPAC-1
Wetland Area 2 Enhancement
Wetland Area 3 Enhancement
Wetland Area 4 Enhancement
Wetland Area 1 Preservation
T2A
T2B
NPAC-2
NPAC-3
T3
Wetland Area 5 Restoration
T4.2
T4.1

1.4 Project History, Contacts and Data

Table 2. Project Activity and Reporting History Farrar Dairy Site		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	2007	May 08
Final Design	2007	May 08
Construction	N/A	Mar 09
Planting - Stream and Wetland	N/A	Mar 09
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	May 09	Jun 09

Table 3. Project Contact Table Farrar Dairy Site	
Design Firm	KCI Technologies, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Tim Morris Phone: (919) 278-2512 Fax: (919) 783-9266
Construction Contractor	Land Mechanics, Inc. 126 Circle G Lane Willow Springs, NC 27592 Contact: Mr. Lloyd Glover Phone: (919) 639-6132 Fax: (919) 639-7079
Planting Contractor	Bruton Nurseries and Landscapes PO Box 1197 Freemont, NC 27830 Contact: Mr. Charlie Bruton Phone: (919) 242-6555
Monitoring Performers	
MY-00 - MY-05	KCI Technologies, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Adam Spiller Phone: (919) 278-2514 Fax: (919) 783-9266

Table 4. Project Background Table Farrar Dairy Site		
Project County		Harnett County
Physiographic Region		Coastal Plain
Ecoregion		Sand Hills
Project River Basin		Cape Fear
USGS HUC for Project and Reference		03030004110010 (Anderson Creek)
		03030004150050 (Little Rockfish Creek - reference)
		03030002050100 (UT to Wilkinson Creek - reference)
NCDWQ Sub-basin for Project and Reference		03-06-14 (Anderson Creek)
		03-06-15 (Little Rockfish Creek - reference)
		03-06-04 (UT to Wilkinson Creek - reference)
Drainage Area		5.7 sq. mi.
Stream Order		First and Second Order
Watershed Type (Rural, Urban, Developing, etc.)		Rural
Watershed LULC Distribution	Urban	<1%
	Ag-Row Crop	21%
	Ag-Livestock	1%
	Forested	72%
	Water/Wetlands	6%
Watershed impervious cover (%)		3%
Rosgen Classification of As-built (Stream)		C5 (NPAC)
		C5/B5c (T1.1, T1.2, T1, T2A, T2B, T3, T4)
NCDWQ Classification for Project		Class C (Anderson Creek)
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		166.9 Acres
Total planted acreage		93.0 Acres
WRC Class (Warm, Cool, Cold)		Warm
Species of concern, endangered etc.		None
Pre-construction Beaver activity?		Yes
Dominant Soil Types		Wehadkee loam and Gilead sandy loam
% of Project Easement Fenced		85%

2.0 PROJECT MONITORING / AS-BUILT CONDITIONS

2.1 Monitoring Features

Permanent monuments, marking monitoring feature locations, were established on-site. The beginning and end of each permanent cross-section was marked with rebar monuments. Vegetation plots were installed with flagged metal conduit at each corner and a flagged PVC pipe was installed at the photo corner. Two automatic recording gauges were installed along the NPAC to record water levels indicating when bankfull events occur. Eight automatic recording gauges were installed in the site's wetlands, seven in the wetland restoration areas and one in the preservation wetland, as a reference, to record hydrology data throughout the growing season. The locations of these monitoring features and the permanent photo points are marked in the As-Built Plan (Appendix A).

2.2 Monitoring Guidelines

Stream data will be calculated from the monitored longitudinal profiles and cross-sections (Tables 5 and 6). Twenty-nine permanent cross-sections were established and will be used to evaluate stream dimension: 12 cross-sections on NPAC, 3 cross-sections each on T1.1, T1.2, T1, and 4 cross-sections each on T2 and T3. Pebble counts will be performed at each cross-section (Appendix B). Cross-sections will be surveyed each year using a total station in order to calculate data such as area and width to depth ratio. A total of over 4,850 linear feet of longitudinal profile will be surveyed. The monitored longitudinal profile will be split into seven representative portions. Two profiles will be taken along the NPAC and will be 1,500 and 600 feet long, while the profiles along T1.1, T1.2, T1, T2, and T3 will be approximately 500 feet each. The profiles will be surveyed with a total station and will record elevations of bed features, water surface levels, and bankfull elevations (Appendix C). Various morphological parameters will be calculated from this information such as bankfull slopes, pool-to-pool spacing, and feature lengths. Stem counts of planted trees and shrubs will be conducted in 15 10 meter x 10 meter vegetation monitoring plots along the stream (Appendix D). These 15 plots will be monitored per the CVS-EEP vegetation monitoring guidelines. Stem counts of planted trees and shrubs will also be conducted in 20 10 meter x 10 meter vegetation monitoring plots in the restored and enhanced wetlands (Appendix D). The stream and wetland gauges on-site will be checked and/or downloaded every other month. The stream gauges will be analyzed to ascertain whether bankfull events have occurred and the wetland gauges will be analyzed to determine if the wetland success criteria is being met. Visual monitoring of the stream, wetland, and riparian buffer will be conducted with annual site walks and site photos will be taken from 30 permanent photo points located throughout the site (Appendix E).

2.3 As-Built Conditions

Baseline stream monitoring data were collected throughout April and May 2009. Any changes made to the design during construction are documented on the As-Built Site Plan in Appendix A. Most of the project was constructed as designed, but field conditions caused small adjustments to be made. Large rain events during construction caused small instabilities in isolated portions of the stream bed and banks. These areas were stabilized with structures, which are indicated on the As-Built Plan.

Table 5 below compares the designed morphological values and ratios to the as-built values and ratios. There are some differences between the design and as-built conditions, but they represent deviations that occurred during construction and not changes from the proposed design. None of these differences should affect the stability of the stream. The table also shows that all of the reaches were restored to streams with a bank height ratio of 1.0 and a stable width to depth ratio.

The wetlands were built as designed. The baseline vegetation data and well installation occurred in April and May of 2009.

Table 5a. NPAC-1 Baseline Stream Summary
Farrar Dairy Site

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)	13.9	16.9	14.8	24.3	4	19.5	20.3		21.0	2	19.0		18.4	19.6	20.7	4
Floodprone Width (ft)	20	32	24	60	4			300		2	>60		>60	>60	>60	4
Bankfull Mean Depth (ft)	1.2	1.9	2.1	2.2	4			2.3		2	1.6		1.4	1.5	1.6	4
Bankfull Max Depth (ft)	2.5	2.7	2.7	3.0	4	3.0	3.3		3.5	2	2.4		2.3	2.5	2.7	4
Bankfull Cross-Sectional Area (ft^2)	30.0	30.2	30.2	30.2	4	45.4	47.3		49.1	2	30.0		26.5	29.1	32.2	4
Width/Depth Ratio	6.4	10.1	7.3	19.6	4	8.4	8.8		9.1	2	12.0		12.4	13.2	14.4	4
Entrenchment Ratio	1.3	2.3	1.8	4.3	4	14.3	14.9		15.4	2	>3.0		>3.0	>3.0	>3.0	4
Bank Height Ratio	1.0	1.9	2.1	2.5	4			1.0		2	1.0		1.0	1.0	1.0	4
Pattern																
Channel Beltwidth (ft)	*					25			36		35	60	35		60	
Radius of Curvature (ft)	*					22			36		20	35	20		35	
Rc:Bankfull width (ft/ft)	*					1.0			1.8		1.1	1.8	1.0		1.8	
Meander Wavelength (ft)	*					119			325		95	150	95		150	
Meander Width Ratio	*					1.2			1.8		1.8	3.2	1.8		3.1	
Profile																
Riffle Length (ft)													11	24	38	20
Riffle Slope (ft/ft)	0.0030			0.0210		0.0010			0.0080		0.0034	0.0059	0.0007	0.0034	0.0098	20
Pool Length (ft)	8			42		27			81		20	40	9	30	57	20
Pool Spacing (ft)	60			97		68			123		65	95	62	79	99	20
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					6% / 81% / 15% / 0% / 0% / 0%							7% / 57% / 32% / 3% / 0% / 1%			
d16 / d35 / d50 / d84 / d95 (mm)						0.0 / 0.18 / 0.25 / 1.8 / 9.0							0.12 / 0.28 / 0.42 / 11 / 45			
Additional Reach Parameters																
Channel length (ft)	2,179					620					4,541		4,528			
Drainage Area (SM)	3.92					16.48					3.92		3.92			
Rosgen Classification	C/E5					E5					C5		C5			
Sinuosity	1.00					1.30					1.30		1.39			
Water Surface Slope (ft/ft)	0.0040					0.0020					0.0020		0.0020			

*There was no defined pattern for the NPAC due to the stream being channelized.
_The As-built Dimension is from the monitored riffle cross-sections on this reach.
_The As-built Pattern and Profile data is calculated from the monitored longitudinal profile for NPAC which contains parts of both NPAC 1 and 2.

Table 5b. NPAC-2 Baseline Stream Summary
Farrar Dairy Site

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)			13.2		1	19.5	20.3		21.0	2	19.6		19.5	21.1	22.6	2
Floodprone Width (ft)			>75		1			300		2	>60		>60	>60	>60	2
Bankfull Mean Depth (ft)			2.4		1			2.3		2	1.6		1.6	1.7	1.8	2
Bankfull Max Depth (ft)			3.9		1	3.0	3.3		3.5	2	2.4		2.7	3.1	3.4	2
Bankfull Cross-Sectional Area (ft^2)			31.2		1	45.4	47.3		49.1	2	32.0		35.8	35.9	35.9	2
Width/Depth Ratio			5.6		1	8.4	8.8		9.1	2	12.0		10.6	12.5	14.3	2
Entrenchment Ratio			5.7		1	14.3	14.9		15.4	2	>3.0		>3.0	>3.0	>3.0	2
Bank Height Ratio			1.0		1			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	*					25			36		35	60	35		60	
Radius of Curvature (ft)	*					22			36		20	35	20		35	
Rc:Bankfull width (ft/ft)	*					1.0			1.8		1.0	1.8	1.0		1.7	
Meander Wavelength (ft)	*					119			325		95	150	95		150	
Meander Width Ratio	*					1.2			1.8		1.8	3.1	1.7		2.8	
Profile																
Riffle Length (ft)													7	22	29	7
Riffle Slope (ft/ft)	0.0030			0.0210		0.0010			0.0080		0.0037	0.0075	0.0007	0.0099	0.0236	7
Pool Length (ft)	8			42		27			81		20	40	14	23	41	8
Pool Spacing (ft)	60			97		68			123		50	80	61	74	93	8
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					6% / 81% / 15% / 0% / 0% / 0%							21% / 45% / 31% / 2% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)						0.0 / 0.18 / 0.25 / 1.8 / 9.0							0.062 / 0.11 / 0.32 / 17 / 35			
Additional Reach Parameters																
Channel length (ft)	985					620					1,185		1,212			
Drainage Area (SM)	4.65					16.48					4.65		4.65			
Rosgen Classification	C/E5					E5					C5		C5			
Sinuosity	1.00					1.30					1.30		1.25			
Water Surface Slope (ft/ft)	0.0040					0.0020					0.0030		0.0039			

*There was no defined pattern for the NPAC due to the stream being channelized.
_The As-built Dimension is from the monitored riffle cross-sections on this reach.
_The As-built Pattern and Profile data is calculated from the monitored longitudinal profile for NPAC which contains parts of both NPAC 1 and 2.

Table 5c. NPAC-3 Baseline Stream Summary
Farrar Dairy Site

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)			13.2		1	19.5	20.3		21.0	2	21.0			24.2		1
Floodprone Width (ft)			>75		1			300		2	>60			>60		1
Bankfull Mean Depth (ft)			2.4		1			2.3		2	1.7			2.3		1
Bankfull Max Depth (ft)			3.9		1	3.0	3.3		3.5	2	2.6			3.6		1
Bankfull Cross-Sectional Area (ft^2)			31.2		1	45.4	47.3		49.1	2	36.7			55.8		1
Width/Depth Ratio			5.6		1	8.4	8.8		9.1	2	12.0			10.5		1
Entrenchment Ratio			5.7		1	14.3	14.9		15.4	2	>3.0			>3.0		1
Bank Height Ratio			1.0		1			1.0		2	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	*					25			36		35	60	35		60	
Radius of Curvature (ft)	*					22			36		20	35	22		36	
Rc:Bankfull width (ft/ft)	*					1.0			1.8		1.0	1.7	0.9		1.5	
Meander Wavelength (ft)	*					119			325		105	265	105		265	
Meander Width Ratio	*					1.2			1.8		1.7	2.9	1.4		2.5	
Profile																
Riffle Length (ft)																
Riffle Slope (ft/ft)	0.0030			0.0210		0.0010			0.0080		0.0040	0.0054				
Pool Length (ft)	8			42		27			81		10	40				
Pool Spacing (ft)	60			97		68			123		85	145				
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					6% / 81% / 15% / 0% / 0% / 0%							21% / 45% / 31% / 2% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)						0.0 / 0.18 / 0.25 / 1.8 / 9.0							0.062 / 0.11 / 0.32 / 17 / 35			
Additional Reach Parameters																
Channel length (ft)	880					620					998		1,006			
Drainage Area (SM)	4.82					16.48					4.82		4.82			
Rosgen Classification	C/E5					E5					C5		C5			
Sinuosity	1.00					1.30					1.30		1.09			
Water Surface Slope (ft/ft)	0.0040					0.0020					0.0030					

*There was no defined pattern for the NPAC due to the stream being channelized.
_The As-built Dimension is from the monitored riffle cross-sections on this reach.
_While the as-built survey was completed on NPAC-3 and revealed that the stream was built as designed, the monitored detailed longitudinal profile for NPAC does not run through NPAC-3, so no detailed profile data is available for the as-built portion of this table.

Table 5d. T1.1 Baseline Stream Summary
Farrar Dairy Site

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)	3.5	4.3		5.0	2	7.7	7.9	7.7	8.3	3	4.5		5.9	6.4	6.9	2
Floodprone Width (ft)	6	11		15	2	13	14	13	16	3	>9		15.9	22.5	29.0	2
Bankfull Mean Depth (ft)	0.4	0.5		0.6	2	0.7	0.8	0.8	0.9	3	0.5		0.3	0.4	0.4	2
Bankfull Max Depth (ft)	0.9	1.0		1.1	2	1.1	1.3	1.3	1.4	3	0.7		0.6	0.7	0.7	2
Bankfull Cross-Sectional Area (ft^2)	2.0	2.0		2.0	2	6.1	6.4	6.2	7.0	3	2.0		2.3	2.4	2.4	2
Width/Depth Ratio	6.2	9.4		12.5	2	8.5	9.8	9.6	11.4	3	10.0		15.1	17.5	19.8	2
Entrenchment Ratio	1.7	7.4		13.0	2	1.6	1.9	2.1	2.1	3	>2		2.3	3.6	4.9	2
Bank Height Ratio	1.7	3.1		4.4	2			1.0		3	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	10			21				22			13	17	13		17	
Radius of Curvature (ft)	6			13		11			23		8	13	8		13	
Rc:Bankfull width (ft/ft)	0.7			2.5		1.0			3.0		1.8	2.9	1.3		2.0	
Meander Wavelength (ft)	42			44		49			59		30	45	30		45	
Meander Width Ratio	1.1			4.1		2.0			2.9		2.9	3.8	2.0		2.7	
.																
Riffle Length (ft)	#												8	14	21	22
Riffle Slope (ft/ft)	#					0.0120			0.0280		0.0170	0.0180	0	0.0144	0.0380	22
Pool Length (ft)	#					5			9		2	5	2	5	7	21
Pool Spacing (ft)	#										15	30	19	25	31	21
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					0% / 100% / 0% / 0% / 0% / 0%							13% / 64% / 23% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)													0.07 / 0.14 / 0.29 / 8.6 / 15			
Additional Reach Parameters																
Channel length (ft)	864					204					827		825			
Drainage Area (SM)	0.02					0.15					0.02		0.02			
Rosgen Classification	G5					B4c					C5/B5c		C5			
Sinuosity	1.12					1.20					1.13		1.12			
Water Surface Slope (ft/ft)	0.0240					0.0120					0.0140		0.0131			

No flow during survey, therefore these dimensions were not recorded.

Table 5e. T1.2 Baseline Stream Summary
Farrar Dairy Site

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)	3.6	5.0		6.4	2	7.7	7.9	7.7	8.3	3	7.6		6.9	7.6	8.3	2
Floodprone Width (ft)	7	34		60	2	13	14	13	16	3	>15.2		26.0	36	45.9	2
Bankfull Mean Depth (ft)	0.9	1.3		1.6	2	0.7	0.8	0.8	0.9	3	0.8		0.7	0.8	0.8	2
Bankfull Max Depth (ft)	2.1	2.2		2.2	2	1.1	1.3	1.3	1.4	3	1.2		1.2	1.2	1.2	2
Bankfull Cross-Sectional Area (ft^2)	5.8	5.8		5.8	2	6.1	6.4	6.2	7.0	3	5.8		5.2	5.5	5.7	2
Width/Depth Ratio	2.2	4.7		7.1	2	8.5	9.8	9.6	11.4	3	10.0		9.2	10.7	12.1	2
Entrenchment Ratio	2.0	5.7		9.4	2	1.6	1.9	2.1	2.1	3	>2		3.8	4.7	5.5	2
Bank Height Ratio	1.1	1.6		2.0	2			1.0		3	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	22			34				22			17	26	17		26	
Radius of Curvature (ft)	8			11		11			23		13	20	13		20	
Rc:Bankfull width (ft/ft)	1.4			3.7		1.0			3.0		1.7	2.6	1.7		2.6	
Meander Wavelength (ft)	54			74		49			59		54	75	54		75	
Meander Width Ratio	3.9			11.3		2.0			2.9		2.2	3.4	2.2		3.4	
Profile																
Riffle Length (ft)	#												21	25	35	14
Riffle Slope (ft/ft)	#					0.0120			0.0280		0.0150	0.0180	0.0115	0.0178	0.0234	14
Pool Length (ft)	#					5			9		4	9	3	6	13	14
Pool Spacing (ft)	#										20	40	29	37	50	14
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					0% / 100% / 0% / 0% / 0% / 0%							22% / 76% / 3% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)													0.062 / 0.079 / 0.1 / 0.22 / 0.44			
Additional Reach Parameters																
Channel length (ft)	1,006					620					986		980			
Drainage Area (SM)	0.10					16.48					0.10		0.10			
Rosgen Classification	G5					E5					C5/B5c		C5/B5c			
Sinuosity	1.10					1.30					1.14		1.14			
Water Surface Slope (ft/ft)	0.0130					0.0020					0.0130		0.0142			

No flow during survey, therefore these dimensions were not recorded.

Table 5f. T1 Baseline Stream Summary
Farrar Dairy Site

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)	^					7.7	7.9	7.7	8.3	3	10.0		8.6	9.5	10.3	2
Floodprone Width (ft)	^					13	14	13	16	3	>20		>60	>60	>60	2
Bankfull Mean Depth (ft)	^					0.7	0.8	0.8	0.9	3	1.0		0.9	1.0	1.0	2
Bankfull Max Depth (ft)	^					1.1	1.3	1.3	1.4	3	1.6		1.7	1.8	1.9	2
Bankfull Cross-Sectional Area (ft^2)	^					6.1	6.4	6.2	7.0	3	10.0		8.2	9.0	9.7	2
Width/Depth Ratio	^					8.5	9.8	9.6	11.4	3	10.0		9.0	10.0	10.9	2
Entrenchment Ratio	^					1.6	1.9	2.1	2.1	3	>2		>3.0	>3.0	>3.0	2
Bank Height Ratio	^							1.0		3	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	8			16				22			23	40	23		40	
Radius of Curvature (ft)	6			20		11			23		15	25	15		25	
Rc:Bankfull width (ft/ft)	^					1.0			3.0		1.5	2.5	1.6		2.6	
Meander Wavelength (ft)	22			50		49			59		55	90	55		90	
Meander Width Ratio	^					2.0			2.9		2.3	4.0	2.4		4.2	
Profile																
Riffle Length (ft)	^												6	24	37	12
Riffle Slope (ft/ft)	^					0.0120			0.0280		0.0150	0.0180	0.0077	0.0184	0.0350	12
Pool Length (ft)	^					5			9		5	12	3	9	21	9
Pool Spacing (ft)	^										35	55	37	46	59	9
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					0% / 100% / 0% / 0% / 0% / 0%							22% / 76% / 3% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)													0.062 / 0.079 / 0.1 / 0.22 / 0.44			
Additional Reach Parameters																
Channel length (ft)	370					620					881		884			
Drainage Area (SM)	0.18					16.48					0.18		0.18			
Rosgen Classification	DA5					E5					C5/B5c		C5/B5c			
Sinuosity	1.19					1.30					1.22		1.21			
Water Surface Slope (ft/ft)	0.0100					0.0020					0.0110		0.0112			

^ These existing conditions data were not collected on T1.

Table 5g. T2A Baseline Stream Summary
Farrar Dairy Site

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)			3.6		1	7.7	7.9	7.7	8.3	3	5.0			5.7		1
Floodprone Width (ft)			4		1	13	14	13	16	3	>10			30		1
Bankfull Mean Depth (ft)			0.7		1	0.7	0.8	0.8	0.9	3	0.5			0.5		1
Bankfull Max Depth (ft)			1.0		1	1.1	1.3	1.3	1.4	3	0.8			0.8		1
Bankfull Cross-Sectional Area (ft^2)			2.5		1	6.1	6.4	6.2	7.0	3	2.5			2.8		1
Width/Depth Ratio			5.2		1	8.5	9.8	9.6	11.4	3	10.0			11.6		1
Entrenchment Ratio			1.1		1	1.6	1.9	2.1	2.1	3	>2			5.3		1
Bank Height Ratio			3.5		1			1.0		3	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	*							22			11	17	11		17	
Radius of Curvature (ft)	*					11			23		8	10	8		10	
Rc:Bankfull width (ft/ft)	*					1.0			3.0		1.6	2.0	1.4		1.8	
Meander Wavelength (ft)	*					49			59		35	45	35		45	
Meander Width Ratio	*					2.0			2.9		2.2	3.4	1.9		3.0	
Profile																
Riffle Length (ft)	#												8	15	28	17
Riffle Slope (ft/ft)	#					0.012			0.028		0.016	0.018	#	#	#	#
Pool Length (ft)	#					5			9		2	6	2	7	28	17
Pool Spacing (ft)	#										15	25	14	31	70	17
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					0% / 100% / 0% / 0% / 0% / 0%							22% / 76% / 3% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)													0.062 / 0.079 / 0.1 / 0.22 / 0.44			
Additional Reach Parameters																
Channel length (ft)	423					620					500		500			
Drainage Area (SM)	0.04					16.48					0.04		0.04			
Rosgen Classification	G5					E5					C5/B5c		C5/B5c			
Sinuosity	1.00					1.30					1.16		1.13			
Water Surface Slope (ft/ft)	0.0260					0.0020					0.0180		#			

No flow during survey, therefore these dimensions were not recorded.
*There was no defined pattern for T2 due to the stream being channelized.

Table 5h. T2B Baseline Stream Summary
Farrar Dairy Site

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)			4.5		1	6.7	7.2	7.1	7.9	3	5.3			5.2		1
Floodprone Width (ft)			8		1	34	63	68	88	3	>25			>60		1
Bankfull Mean Depth (ft)			0.6		1	0.7	0.9	0.9	1.0	3	0.5			0.5		1
Bankfull Max Depth (ft)			0.9		1	1.1	1.2	1.1	1.3	3	0.8			0.8		1
Bankfull Cross-Sectional Area (ft^2)			2.5		1	5.7	6.1	5.8	6.7	3	2.6			2.5		1
Width/Depth Ratio			8.1		1	7.4	8.9	8.0	11.3	3	11.0			10.8		1
Entrenchment Ratio			1.8		1	4.9	8.8	8.6	13	3	>2.4			>3.0		1
Bank Height Ratio			3.2		1			1.0		3	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	*					15			48		23	40	23		40	
Radius of Curvature (ft)	*					21			47		15	20	15		20	
Rc:Bankfull width (ft/ft)	*					2.7			7.0		2.8	3.8	2.9		3.8	
Meander Wavelength (ft)	*					43			84		70	90	70		90	
Meander Width Ratio	*					1.9			7.2		4.3	7.5	4.4		7.7	
Profile																
Riffle Length (ft)	#												8	15	28	17
Riffle Slope (ft/ft)	#										0.0090	0.0170	#	#	#	#
Pool Length (ft)	#										10	30	2	7	28	17
Pool Spacing (ft)	#							45			30	40	14	31	70	17
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					0% / 100% / 0% / 0% / 0% / 0%							22% / 76% / 3% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)						0.28 / 0.37 / 0.44 / 0.82 / 0.97							0.062 / 0.079 / 0.1 / 0.22 / 0.44			
Additional Reach Parameters																
Channel length (ft)	554					529					509		522			
Drainage Area (SM)	0.04					0.35					0.04		0.04			
Rosgen Classification	G5					E5					E5		E5			
Sinuosity	1.22					1.30					1.22		1.23			
Water Surface Slope (ft/ft)	0.0080					0.0070					0.0080		#			

*There was no defined pattern for T2 due to the stream being channelized.
No flow during survey, therefore these dimensions were not recorded.

Table 5i. T3 Baseline Stream Summary
Farrar Dairy Site

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)	12.3	15.9		19.5	2	19.5	20.3		21.0	2	15.5		14.9	16.7	18.4	2
Floodprone Width (ft)	50			>70	2			300		2	>31		>60	>60	>60	2
Bankfull Mean Depth (ft)	1.0	1.3		1.6	2			2.3		2	1.3		1.2	1.2	1.2	2
Bankfull Max Depth (ft)	2.3	2.8		3.2	2	3.0	3.3		3.5	2	2.0		1.9	1.9	1.9	2
Bankfull Cross-Sectional Area (ft^2)	20.0	20.1		20.1	2	45.4	47.3		49.1	2	20.0		18.4	19.9	21.4	2
Width/Depth Ratio	7.6	13.3		18.9	2	8.4	8.8		9.1	2	12.0		12.1	14.0	15.8	2
Entrenchment Ratio	3.6	3.9		4.1	2	14.3	14.9		15.4	2	>2		>3	>3	>3	2
Bank Height Ratio	1.0	1.2		1.4	2			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	*					25			36		35	45	35		45	
Radius of Curvature (ft)	*					22			36		20	28	20		28	
Rc:Bankfull width (ft/ft)	*					1.0			1.8		1.3	1.8	1.2		1.7	
Meander Wavelength (ft)	*					119			325		80	125	80		125	
Meander Width Ratio	*					1.2			1.8		2.3	2.9	2.1		2.7	
Profile																
Riffle Length (ft)	#												12	21	35	11
Riffle Slope (ft/ft)	#					0.0130			0.0280		0.0020	0.0050	0	0.0023	0.0058	11
Pool Length (ft)	#					3			25		12	20	3	13	21	9
Pool Spacing (ft)	#					30			59		45	70	45	64	115	9
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 100% / 0% / 0% / 0% / 0%					6% / 81% / 15% / 0% / 0% / 0%							22% / 76% / 3% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)						0.0 / 0.18 / 0.25 / 1.8 / 9.0							0.062 / 0.079 / 0.1 / 0.22 / 0.44			
Additional Reach Parameters																
Channel length (ft)	1,335					620					1,151		1,167			
Drainage Area (SM)	0.39					16.48					0.39		0.39			
Rosgen Classification	C5/E5					E5					C5		C5			
Sinuosity	1.00					1.30					1.17		1.17			
Water Surface Slope (ft/ft)	0.0020					0.0020					0.0030		0.0211			

*There was no defined pattern for T3 due to the stream being channelized.
No flow during survey, therefore these dimensions were not recorded.

Table 6a. Morphology and Hydraulic Monitoring Summary
Farrar Dairy Site

Parameter	X-Section 1 Riffle	X-Section 2 Pool	X-Section 3 Riffle	X-Section 4 Pool	X-Section 5 Riffle	X-Section 6 Pool	X-Section 7 Riffle	X-Section 8 Riffle	X-Section 9 Pool	X-Section 10 Riffle
Reach	NPAC-1	NPAC-1	NPAC-1	NPAC-1	NPAC-1	NPAC-1	NPAC-1	NPAC-2	NPAC-2	NPAC-2
Dimension										
Bankfull Width (ft)	19.6	20.9	19.6	18.9	18.4	20.4	20.7	19.5	22.9	22.6
Floodprone Width (ft)	>60	-	>60	-	>60	-	>60	>60	-	>60
Bankfull Mean Depth (ft)	1.6	1.4	1.4	1.3	1.4	1.3	1.6	1.8	1.6	1.6
Bankfull Max Depth (ft)	2.4	3.3	2.5	2.8	2.3	3.0	2.7	3.4	3.4	2.7
Bankfull Cross-Sectional Area (ft^2)	31.0	29.2	26.6	24.7	26.5	26.6	32.2	35.9	36.0	35.8
Bankfull Width/Depth Ratio	12.4	-	14.4	-	12.8	-	13.3	10.6	-	14.3
Bankfull Entrenchment Ratio	>3.0	-	>3.0	-	>3.0	-	>3.0	>3.0	-	>3.0
Bankfull Bank Height Ratio	1.0	-	1.0	-	1.0	-	1.0	1.0	-	1.0
Substrate										
d50 (mm)	0.076	0.088	0.062	0.54	0.083	0.12	0.062	0.062	0.11	0.064
d84 (mm)	0.22	0.65	0.11	0.82	0.37	0.29	0.098	0.067	0.66	3.1

Parameter	X-Section 11 Riffle	X-Section 12 Pool	X-Section 13 Riffle	X-Section 14 Pool	X-Section 15 Riffle	X-Section 16 Pool	X-Section 17 Riffle	X-Section 18 Riffle	X-Section 19 Pool	X-Section 20 Riffle
Reach	NPAC-3	NPAC-3	T1.1	T1.1	T1.1	T1.2	T1.2	T1.2	T1	T1
Dimension										
Bankfull Width (ft)	24.2	22.3	6.9	7.1	5.9	8.9	8.3	6.9	9.5	10.3
Floodprone Width (ft)	>60	-	15.9	-	29	-	45.9	26	-	>60
Bankfull Mean Depth (ft)	2.3	1.9	0.3	0.7	0.4	0.7	0.7	0.8	1.1	0.9
Bankfull Max Depth (ft)	3.6	3.2	0.7	1.3	0.6	1.6	1.2	1.2	2.4	1.9
Bankfull Cross-Sectional Area (ft^2)	55.8	42.0	2.4	5.1	2.3	6.4	5.7	5.2	10.9	9.7
Bankfull Width/Depth Ratio	10.5	-	19.8	-	15.1	-	12.1	9.2	-	10.9
Bankfull Entrenchment Ratio	>3.0	-	2.3	-	4.9	-	5.5	3.8	-	>3.0
Bankfull Bank Height Ratio	1.0	-	1.0	-	1.0	-	1.0	1.0	-	1.0
Substrate										
d50 (mm)	0.71	0.35	0.062	0.062	0.062	0.31	0.062	0.062	0.062	0.062
d84 (mm)	0.9	0.45	0.072	0.062	0.088	0.48	0.083	0.098	0.12	0.1

Table 6b. Morphology and Hydraulic Monitoring Summary continued
Farrar Dairy Site

Parameter	X-Section 21 Riffle	X-Section 22 Pool	X-Section 23 Riffle	X-Section 24 Pool	X-Section 25 Riffle	X-Section 26 Riffle	X-Section 27 Pool	X-Section 28 Pool	X-Section 29 Riffle
Reach	T1	T2	T2	T2	T2	T3	T3	T3	T3
Dimension									
Bankfull Width (ft)	8.6	7.5	5.7	7.1	5.2	18.4	19.2	23.3	14.9
Floodprone Width (ft)	>60	-	30	-	>60	>60	-	-	>60
Bankfull Mean Depth (ft)	1.0	0.7	0.5	0.6	0.5	1.2	1.3	1.2	1.2
Bankfull Max Depth (ft)	1.7	1.1	0.8	1.1	0.8	1.9	2.5	2.6	1.9
Bankfull Cross-Sectional Area (ft^2)	8.2	5.1	2.8	4.2	2.5	21.4	24.2	29.1	18.4
Bankfull Width/Depth Ratio	9.0	-	11.6	-	10.8	15.8	-	-	12.1
Bankfull Entrenchment Ratio	>3.0	-	5.3	-	>3.0	>3.0	-	-	>3.0
Bankfull Bank Height Ratio	1.0	-	1.0	-	1.0	1.0	-	-	1.0
Substrate									
d50 (mm)	0.53	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
d84 (mm)	2.0	0.062	16.0	0.062	0.062	0.092	0.1	0.062	0.062

Baseline vegetation monitoring data were collected in April 2009. Plot photos from all the vegetation plots can be found in Appendix D.

The results of the baseline monitoring show an average of 640 stems/acre sampled along the stream buffer and 543 stems/acre sampled in the wetland plots (Table 7 and Appendix D). An attempt to identify all trees was made, but since monitoring was conducted while the trees were dormant, many were unidentifiable. All trees will be positively identified during first year monitoring.

Table 7. Planted Stem Density by Plot
Farrar Dairy Site

Stream Plots

Plot Number	Density (stems/ac)	Plot Number	Density (stems/ac)	Plot Number	Density (stems/ac)
1	880	6	560	11	680
2	720	7	840	12	520
3	320	8	560	13	720
4	840	9	600	14	520
5	760	10	520	15	560

Wetland Plots

Plot Number	Density (stems/ac)	Plot Number	Density (stems/ac)	Plot Number	Density (stems/ac)
16	400	26	520	36	640
17	560	27	480	37	480
18	400	28	480	38	520
19	1,000	29	520	39	520
20	520	30	440	40	600
21	520	31	440	41	600
22	840	32	400	42	680
23	920	33	440	43	480
24	520	34	480	44	560
25	440	35	400	45	480

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. In sand channels, like the project streams, it is expected that in normal sand channel dynamics large amounts of sand may move through the system as dunes on the stream bottom. These dune features may cause some variations in the monitored cross-sections and profiles, but these will be evaluated to determine whether they are minor adjustments associated with normal sediment transport or whether they indicate movement toward an unstable condition. If any changes occur, they will be discussed within the yearly monitoring reports.

3.2 Vegetation

Stream and wetland 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 on the restored streams must occur in separate years. If stream gauge data reveal that this criterion is not met, probable causes for this will be determined.

Using criteria from the 1987 Corps Wetland Delineation Manual as a guide, the objective for the wetland restoration site is to establish continuous saturated or inundated hydrologic conditions for at least 12.5 percent of the growing season as defined by NRCS. If soil and vegetation data support a wetland determination, wetland hydrology may also be considered established (as per the 1987 Corps Manual) if well data from the site, or wetland hydrology indicators determine that the water table is within 12 inches of the soil surface for between 5% and 12.5% of the growing season during normal weather conditions. A "normal" year is based on NRCS climatological data for Harnett County, and using the 30^{th} to 70^{th} percentile thresholds as the range of normal, as documented in the USACE Technical Report "Accessing and Using Meterological Data to Evaluate Wetland Hydrology, April 2000." According to the Harnett County Soil Survey, the growing season is considered to extend from March 16 to November 11, yielding 240 days. Therefore, success will be achieved if the water table is within 12 inches of the soil surface for at least 12 consecutive days during the growing season.

4.0 MAINTENANCE AND CONTINGENCY PLAN

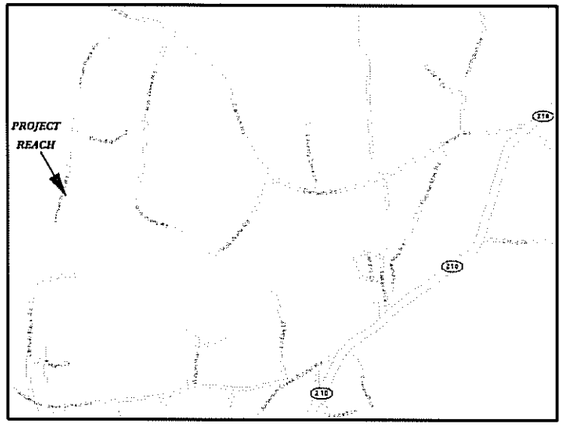
The site will be monitored for any problem areas that could arise and any such issues will be dealt with according to severity. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, or adjustments to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

Appendix A

As-Built Plans

KCI JOB# : 12065438

CONTRACT #: D06002



VICINITY MAP
NOT TO SCALE

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D06002	1	31

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
NO.	DESCRIPTION	DATE	APPROVED
	REVISIONS		

HARNETT COUNTY

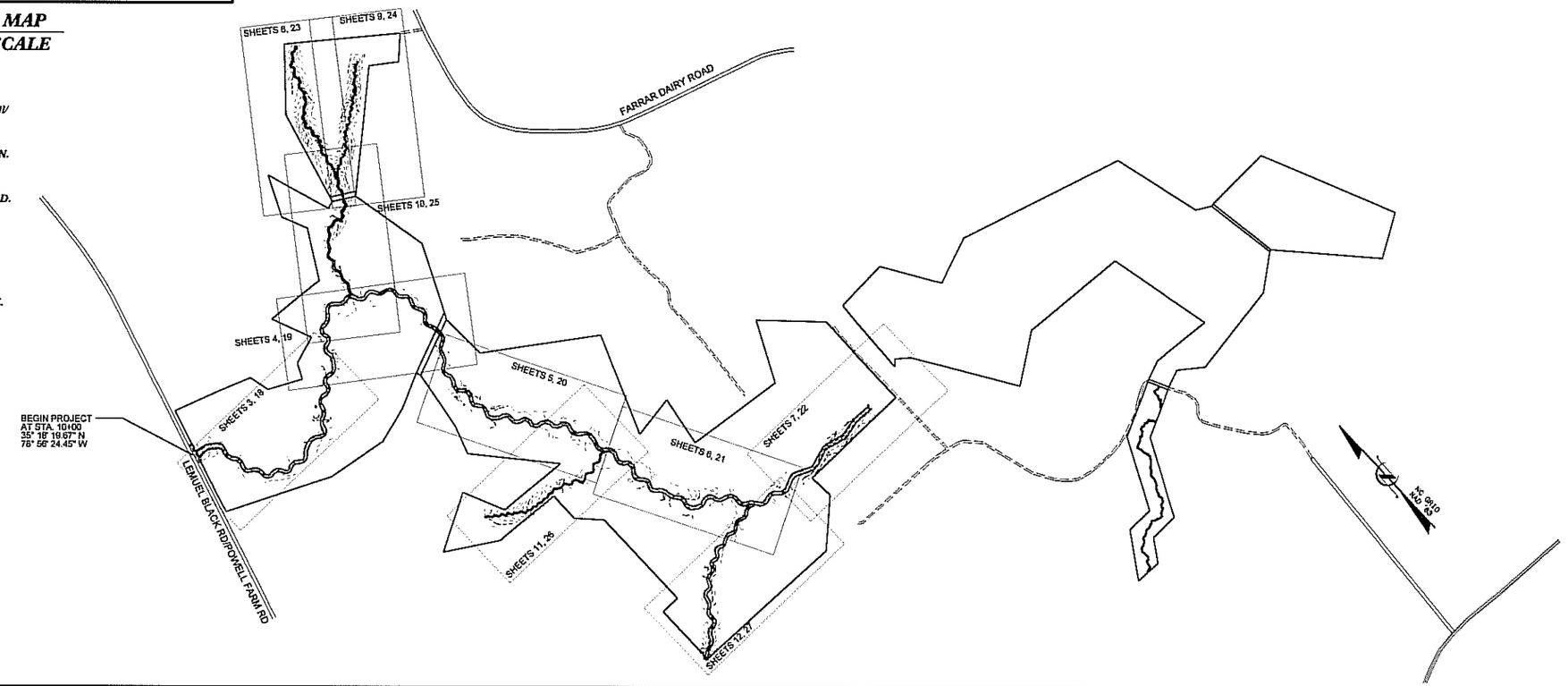
AS–BUILT PLAN

LOCATION: FARRAR DAIRY
1175 FARRAR DAIRY ROAD
LILLINGTON, NORTH CAROLINA 27546

TYPE OF WORK: STREAM AND WETLAND MITIGATION

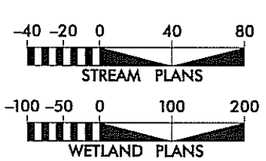
DIRECTIONS TO SITE

PROCEED SOUTH OUT OF RALEIGH ON US 401/ US–421/CAPITAL DRIVE TOWARDS FUQUAY–VARINA, CONTINUING SOUTH FROM FUQUAY–VARINA ON US–401/US–421 TOWARDS LILLINGTON. TURN RIGHT ONTO NC–210 AND CONTINUE SOUTH THROUGH LILLINGTON FOR APPROXIMATELY 6.5 MILES TO DARROCH ROAD. TURN RIGHT ONTO DARROCH ROAD AND CONTINUE APPROXIMATELY 3 MILES TO POWELL FARM ROAD. TURN LEFT ONTO POWELL FARM ROAD, DRIVE APPROXIMATELY 1.5 MILES AND THE ENTRANCE TO THE SITE WILL BE ON THE LEFT THROUGH THE DRIVEWAY OF THE RED RANCH STYLE HOME.



INDEX OF SHEETS

GRAPHIC SCALES



PROJECT DATA

STREAM RESTORATION LENGTH = 11,624 FEET

STREAM ENHANCEMENT II LENGTH = 180 FEET

STREAM PRESERVATION LENGTH = 1,240 FEET

WETLAND ENHANCEMENT = 22.3 ACRES

WETLAND PRESERVATION = 45.9 ACRES

WETLAND RESTORATION = 43.8 ACRES

Prepared in the Office of:

KCI Associates of North Carolina, P.A.
SUITE 220 LANDMARK CENTER II, 4601 SIX FORKS RD., RALEIGH, NC
ENGINEERS • PLANNERS • ECOLOGISTS

TIM MORRIS — *WETLAND DESIGN*

TIM MORRIS / ALEX FRENCH — *NATURAL CHANNEL DESIGN*

PROJECT ENGINEER

GARY MICHAEL MRYNCZA

08.04.09

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MRYNCZA

SIGNATURE: *P.E.*

Prepared for:

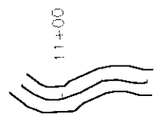
Ecosystem Enhancement PROGRAM

GUY PEARCE
CONTRACT ADMINISTRATOR

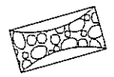
PROJECT LEGEND

STREAM RESTORATION

As–Built Thalweg, Stationing, and Top of Bank

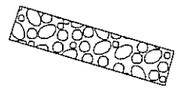


As–Built Riffle Grade Control/Constructed Riffle



As–Built Stone Toe Protection

As–Built Ford Crossing



As–Built Drainage Stabilization

As–Built Boulder Step Pools

As–Built Log Drop

As–Built Log Sill

WETLAND MITIGATION

As–Built Microtopography

As–Built Deep Harrowing

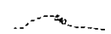
As–Built Filled Ditches

As–Built Seep Stabilization

TOPOGRAPHY

As–Built Minor Contour Line

As–Built Major Contour Line



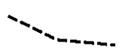
MONITORING

Cross–Section

Photo Point

Vegetation Plots

Longitudinal Profile



Monitoring Gauge

AS–BUILT NOTE:

THE AS–BUILT SITE PLAN (SHEETS 3–17) DEPICTS THE AS–BUILT CONDITIONS. ANY DEVIATIONS FROM THE DESIGN PLANS ARE SPECIFICALLY CALLED OUT WITH NOTES. IF THERE ARE NO ASSOCIATED NOTES WITH A SPECIFIC SECTION, THEN THAT SECTION WAS BUILT AS DESIGNED.

REVISIONS

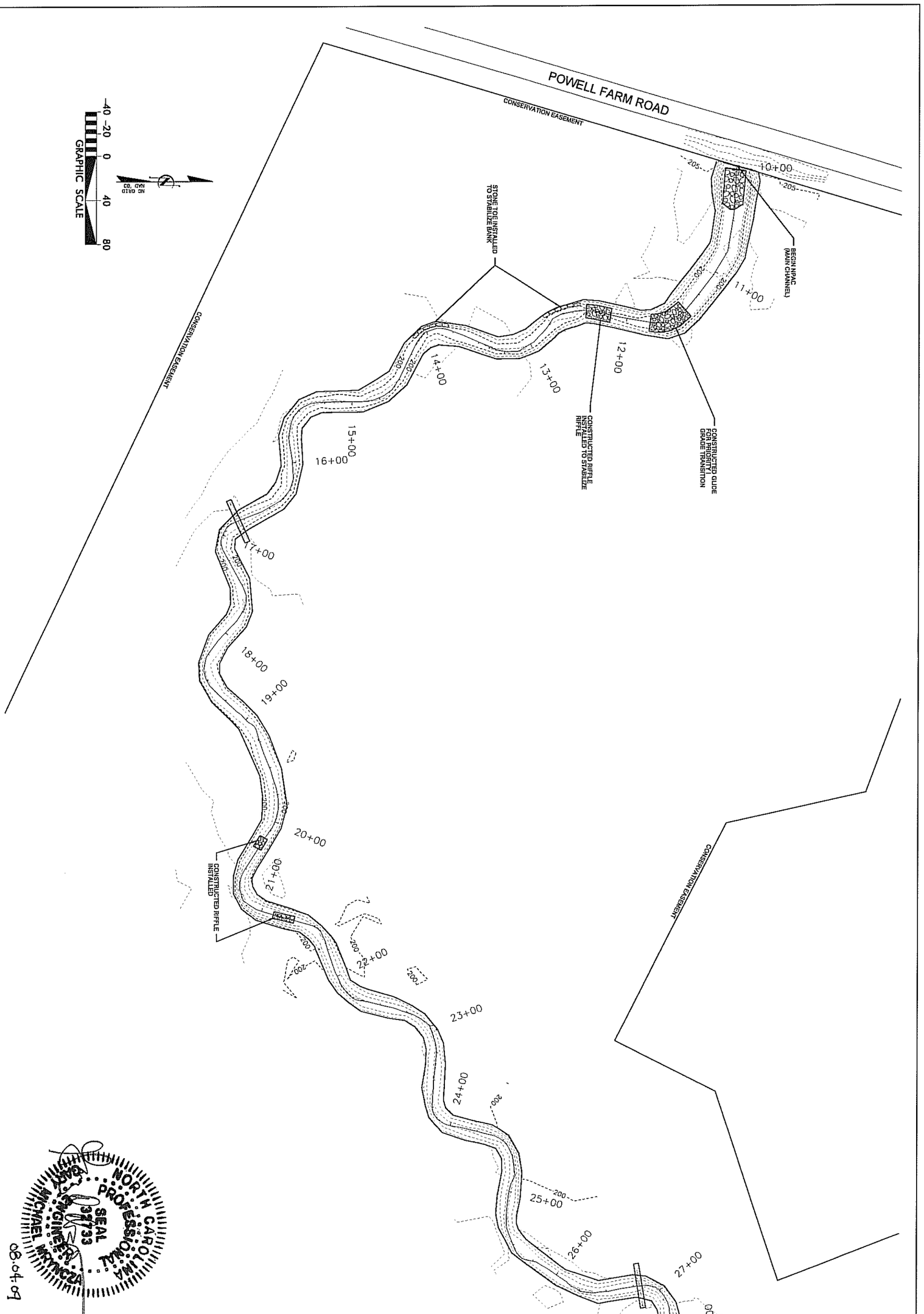
NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: N.T.S.

AS-BUILT LEGEND



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 37733 MICHAEL MINNICH

8.04.09

SHEET 3 OF 31	AS-BUILT SITE PLAN	DATE: JUNE 2009	SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 10+00 TO STATION 27+17

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Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS

SEE SHEETS 6 - 10 FOR T1.1, T1.2, AND T1
CONSERVATION EASEMENT
CONSERVATION EASEMENT
108+00
28+
29+00
30+00
31+00
32+00
33+00
34+00
35+00
36+00
37+00
38+00
39+00
DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMMODATE LATERAL DRAINAGE
EASEMENT EXCEPTION WITH 10' WIDE GRAVEL ROAD AND FORD CROSSING
MATCHLINE - SEE SHEET 3
MATCHLINE - SEE SHEET 5
-40 -20 0 40 80
GRAPHIC SCALE
NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MRYNCZA
08.04.09

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		
SYM.	DESCRIPTION	DATE	APPROVED	

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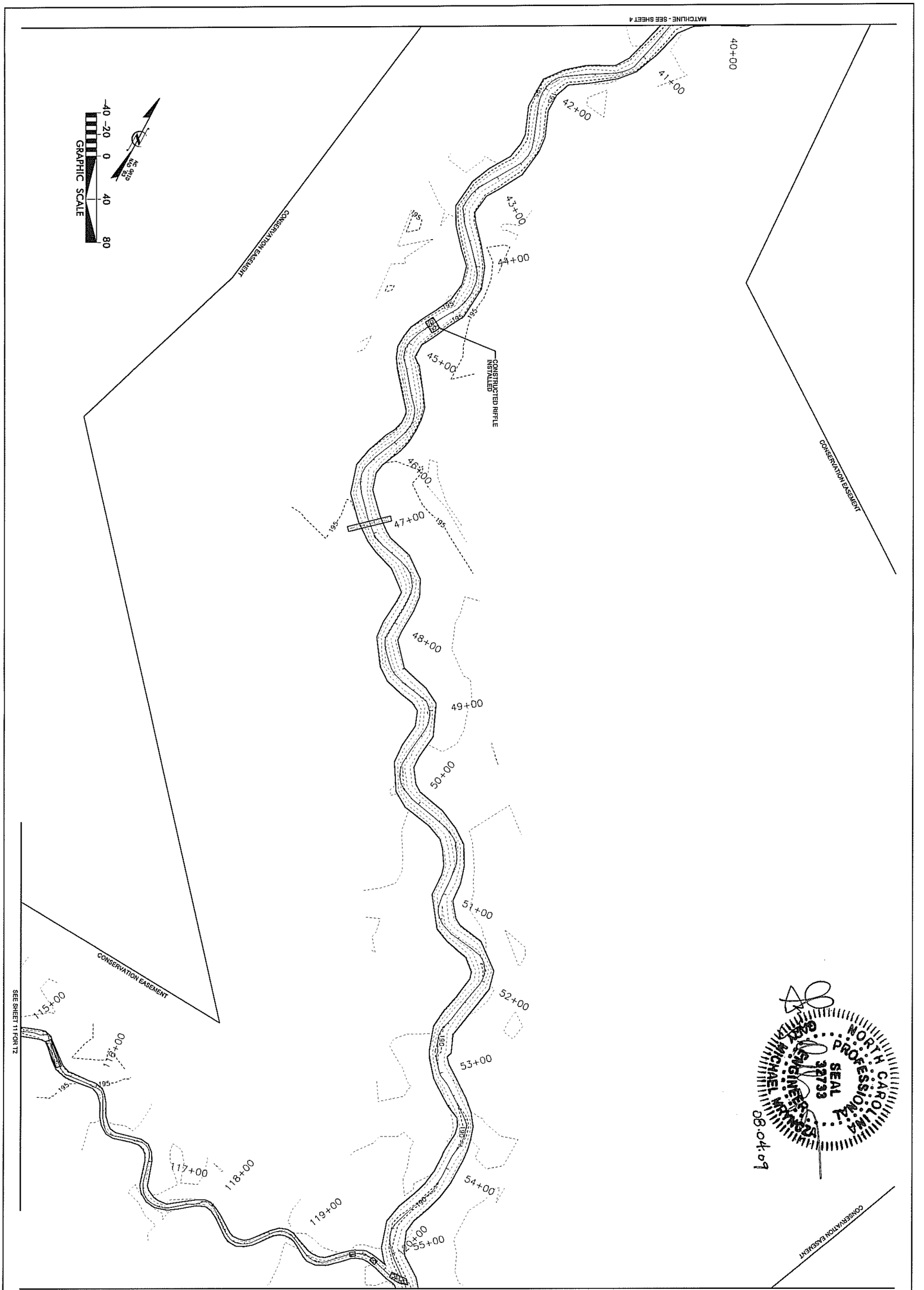
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 27+17 TO STATION 40+51

DATE: JUNE 2009
SCALE: 1"=40'

AS-BUILT
SITE PLAN

SHEET 4 OF 31



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 32733 MICHAEL WYNNE

08.04.09

SHEET 5 OF 31	AS-BUILT SITE PLAN	DRG. JUNE 2009	SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 40+51 TO STATION 55+39

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Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS

SEAL 32733
GARY MICHAEL MRYNCZA
08.04.09

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
SYM.	DESCRIPTION	DATE	APPROVED

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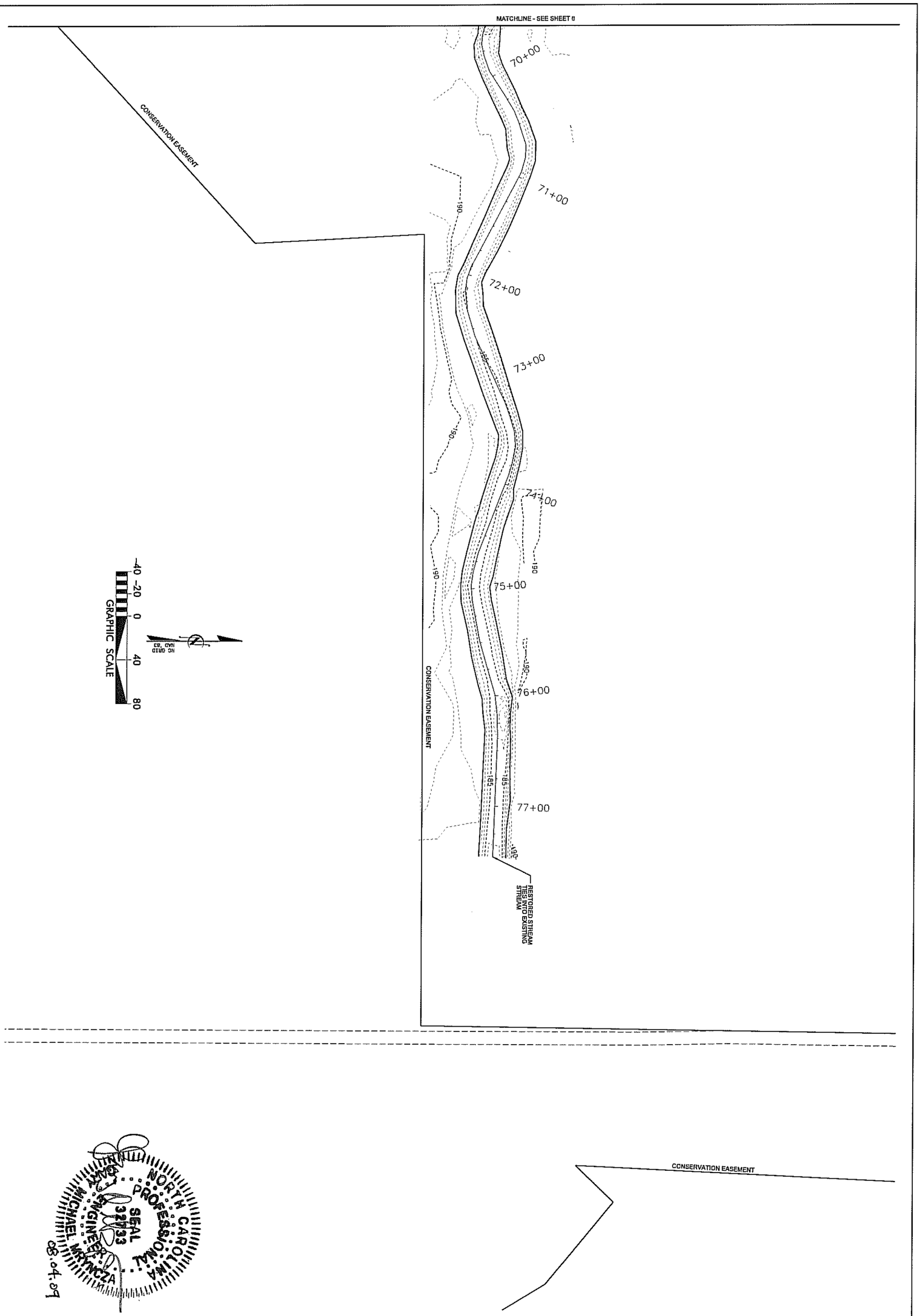
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 55+39 TO STATION 69+51

DATE: JUNE 2009
SCALE: 1"=40'

AS-BUILT
SITE PLAN

SHEET 6 OF 31



SHEET 7 OF 31

AS-BUILT SITE PLAN

DATE: JUNE 2009

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 69+51 TO STATION 77+46

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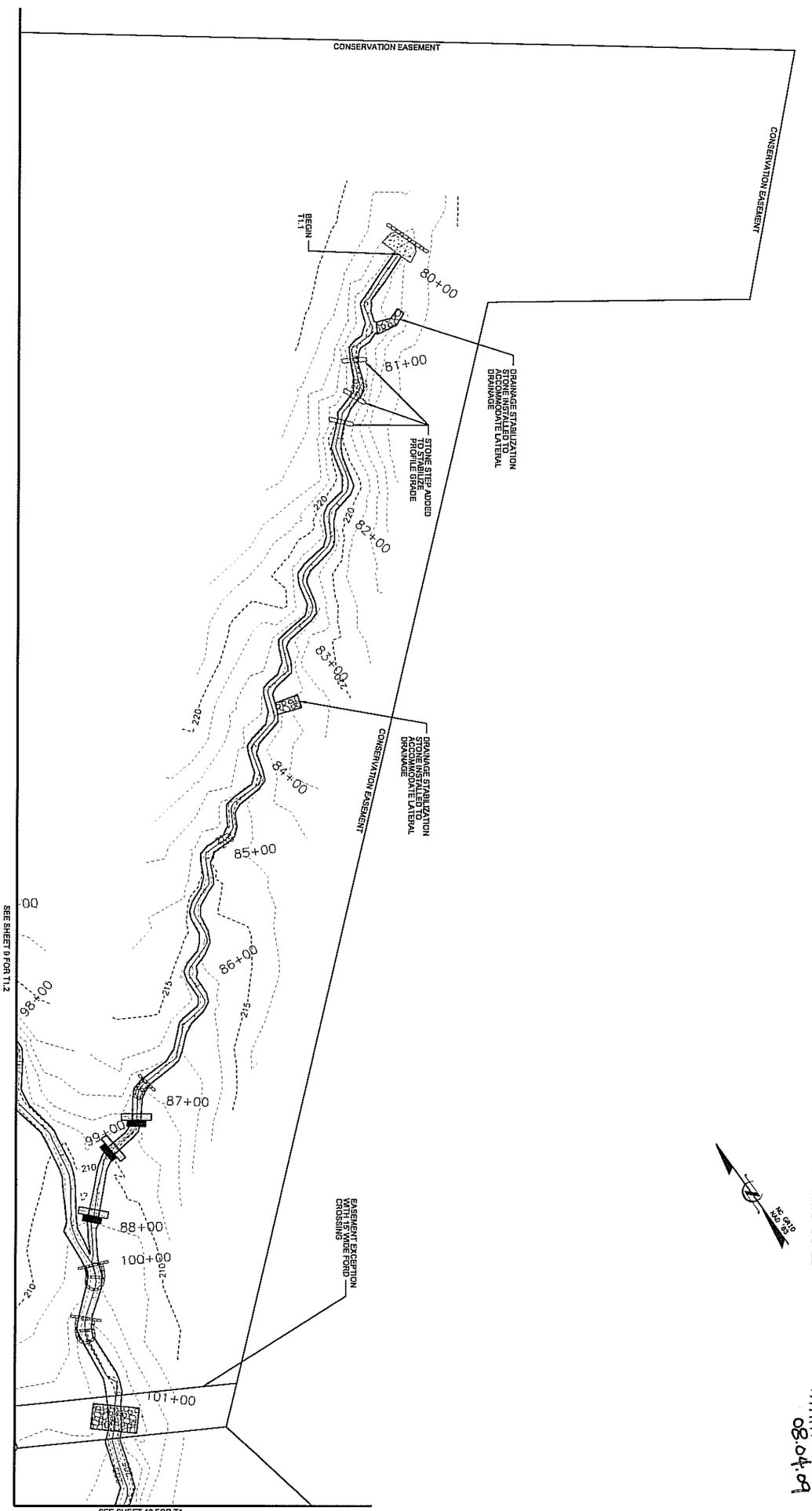
RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement Program

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
B	REVISED MAIN CHANNEL ENDING PROFILE	DEC 2008	

REVISIONS



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 19733 MICHAEL MRTYNCZA 08.04.09

SHEET 8 OF 31	AS-BUILT SITE PLAN	DATE: JUNE 2009 SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T1.1 - STATION 80+00 TO STATION 88+25

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RALEIGH, NORTH CAROLINA 27609

Ecosystem Enhancement Program

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
S/ML	DESCRIPTION	DATE	APPROVED

REVISIONS

SEE SHEET 8 FOR T1.1

SEE SHEET 10 FOR T1

BEGIN T1.2

CONSERVATION EASEMENT

STONE STEP ADDED TO STABILIZE PROFILE GRADE

EASEMENT EXCEPTION WITH 15' WIDE FORD CROSSING

CONSERVATION EASEMENT

CONSERVATION EASEMENT

90+00 91+00 92+00 93+00 94+00 95+00 96+00 97+00 98+00 99+00 87+00 88+00 100+00 101+00

220 215 210

-40 -20 0 40 80

GRAPHIC SCALE

NC GRID NAD 1983

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MARANCA

08.04.09

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T1.2 - STATION 90+00 TO STATION 99+80

DATE: JUNE 2009
SCALE: 1"=40'

AS-BUILT
SITE PLAN

SHEET 9 OF 31

-40 -20 0 40 80

GRAPHIC SCALE

NC GRID NAD 83

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MARANCA

08.04.09

SEE SHEETS 8 AND 9 FOR T1.1 AND T1.2

EASEMENT EXCEPTION WITH 15' FORD CROSSING

CONSERVATION EASEMENT

BEGIN T1

CONSERVATION EASEMENT

CONSERVATION EASEMENT

DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMMODATE LATERAL DRAINAGE

STONE STEP ADDED TO STABILIZE PROFILE GRADE

SEE SHEET 4 FOR NPAC

SEE SHEET 4 FOR NPAC

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

Ecosystem Enhancement Program

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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

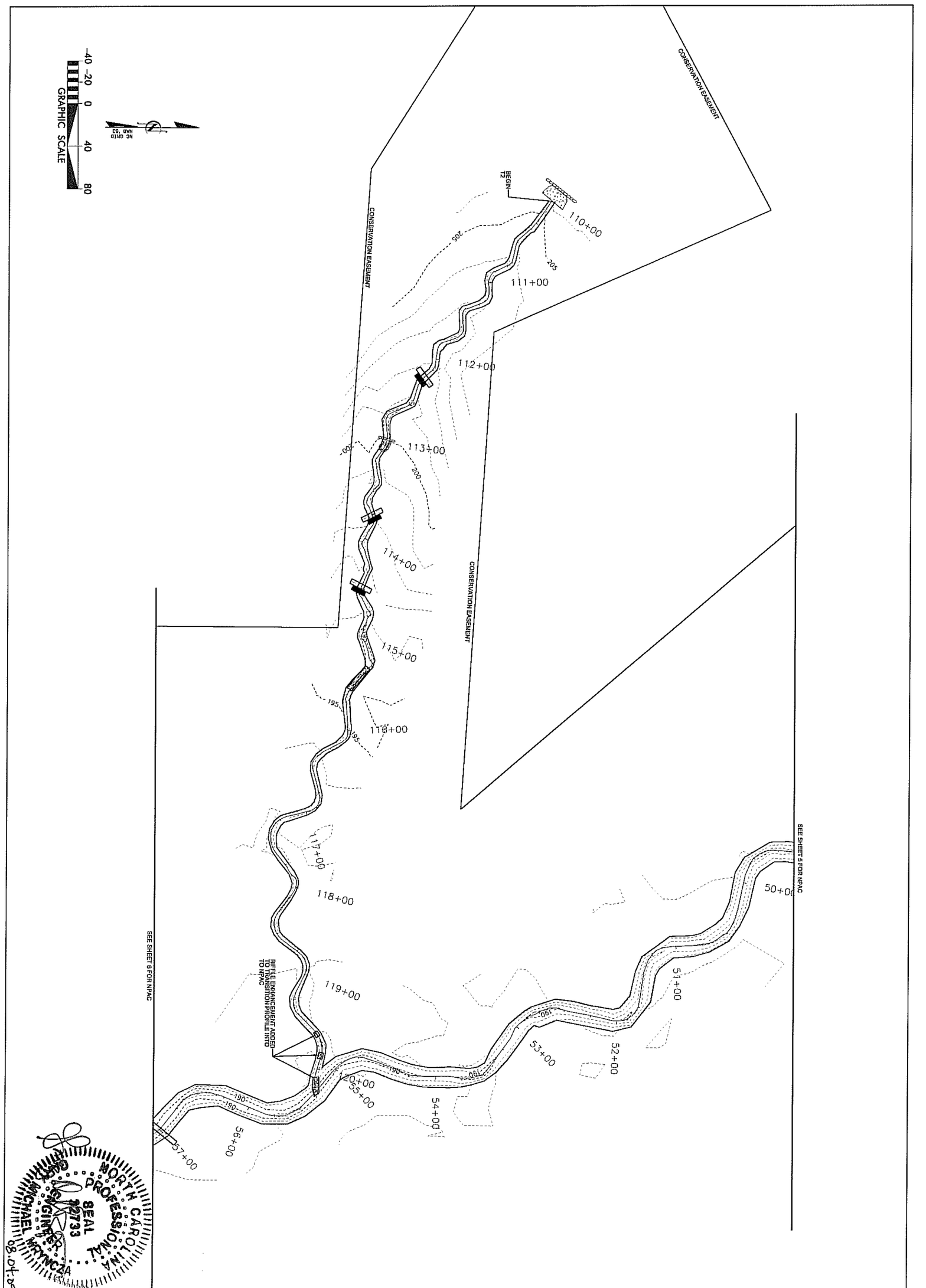
T1 - STATION 100+00 TO STATION 108+84

DATE: JUNE 2009

SCALE: 1"=40'

AS-BUILT
SITE PLAN

SHEET 10 OF 31



SEAL 22733 NORTH CAROLINA PROFESSIONAL ENGINEER MICHAEL MAYNCZA 08.04.07

SHEET 11 OF 31	AS-BUILT SITE PLAN
DATE: JUNE 2009	SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T2 - STATION 110+00 TO STATION 120+22

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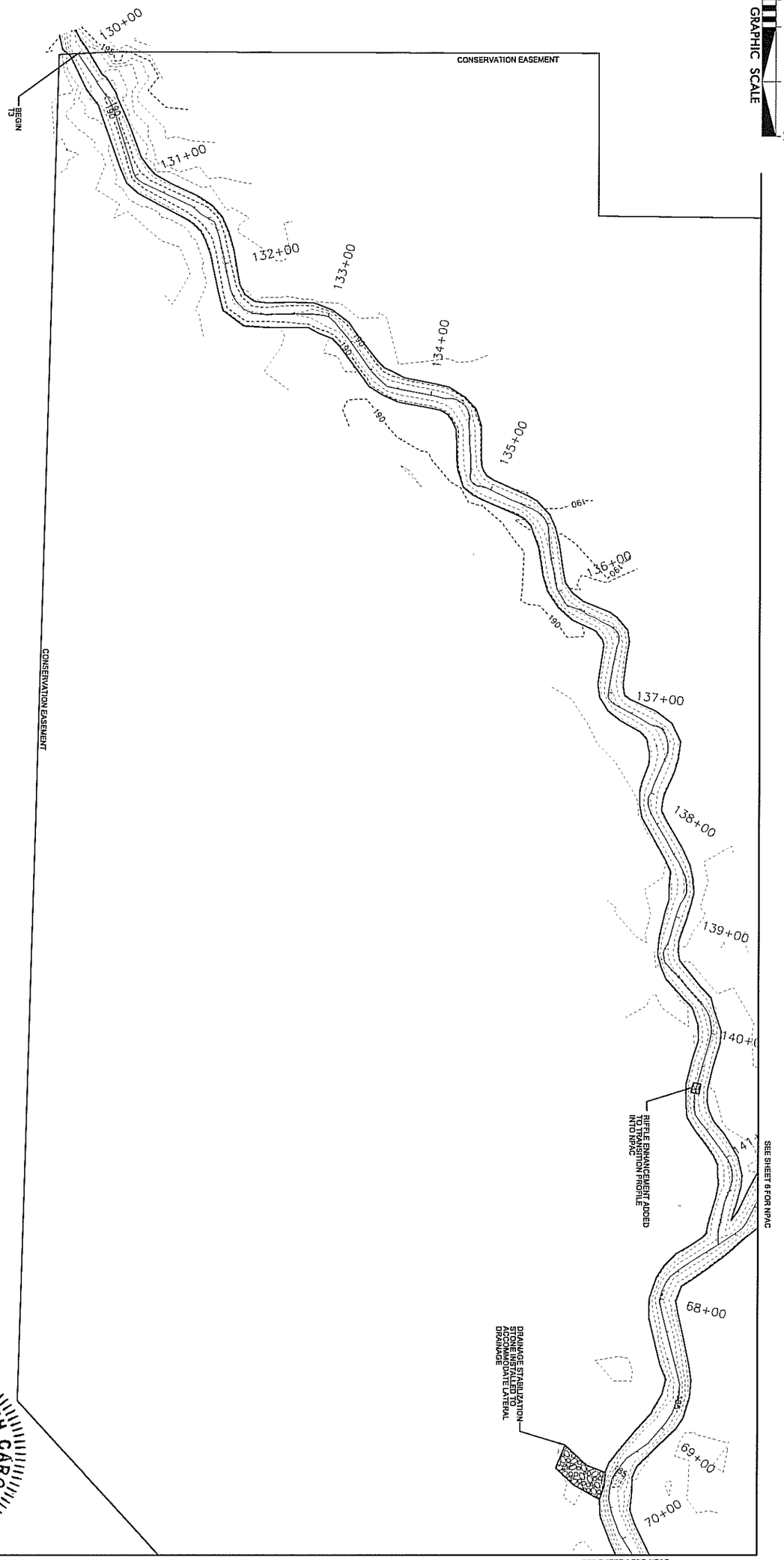
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS



NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 32733 MICHAEL MRTNCZA

8.04.09

SHEET 12 OF 31

AS-BUILT SITE PLAN

DATE: JUNE 2009

SCALE: 1"=40'

FARRAR DAIRY
STREAM AND WETLAND MITIGATION

LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

T3 - STATION 130+00 TO STATION 141+67

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4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

Ecosystem Planning Group

SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS

WETLAND MITIGATION TYPE

RESTORATION

ENHANCEMENT

PRESERVATION

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MRYNCZA

08.04.09

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
NO.	DESCRIPTION	DATE	APPROVED

REVISIONS

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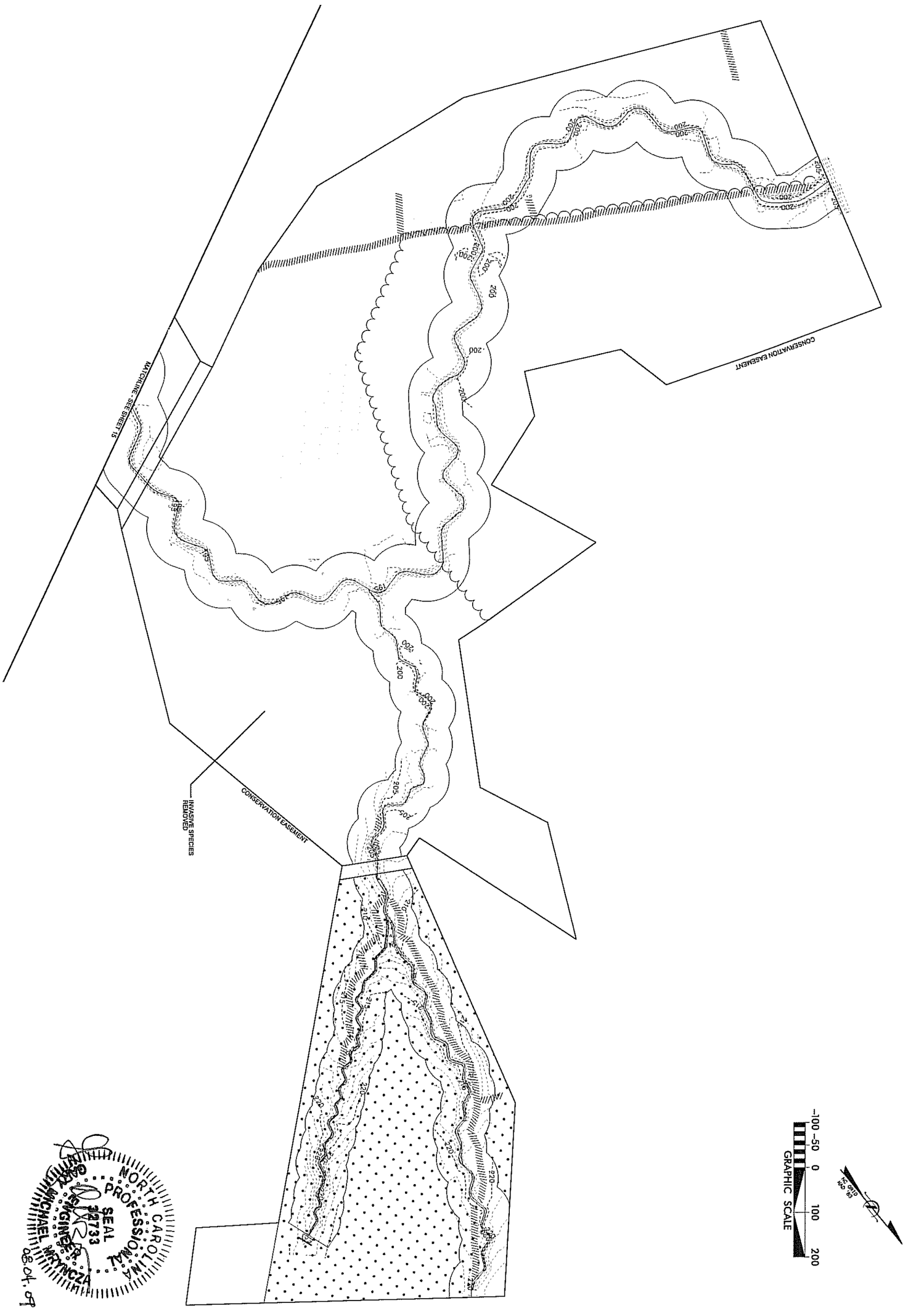
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=400'

AS-BUILT WETLAND OVERVIEW

SHEET 13 OF 31



FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

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Ecosystem Enhancement Program

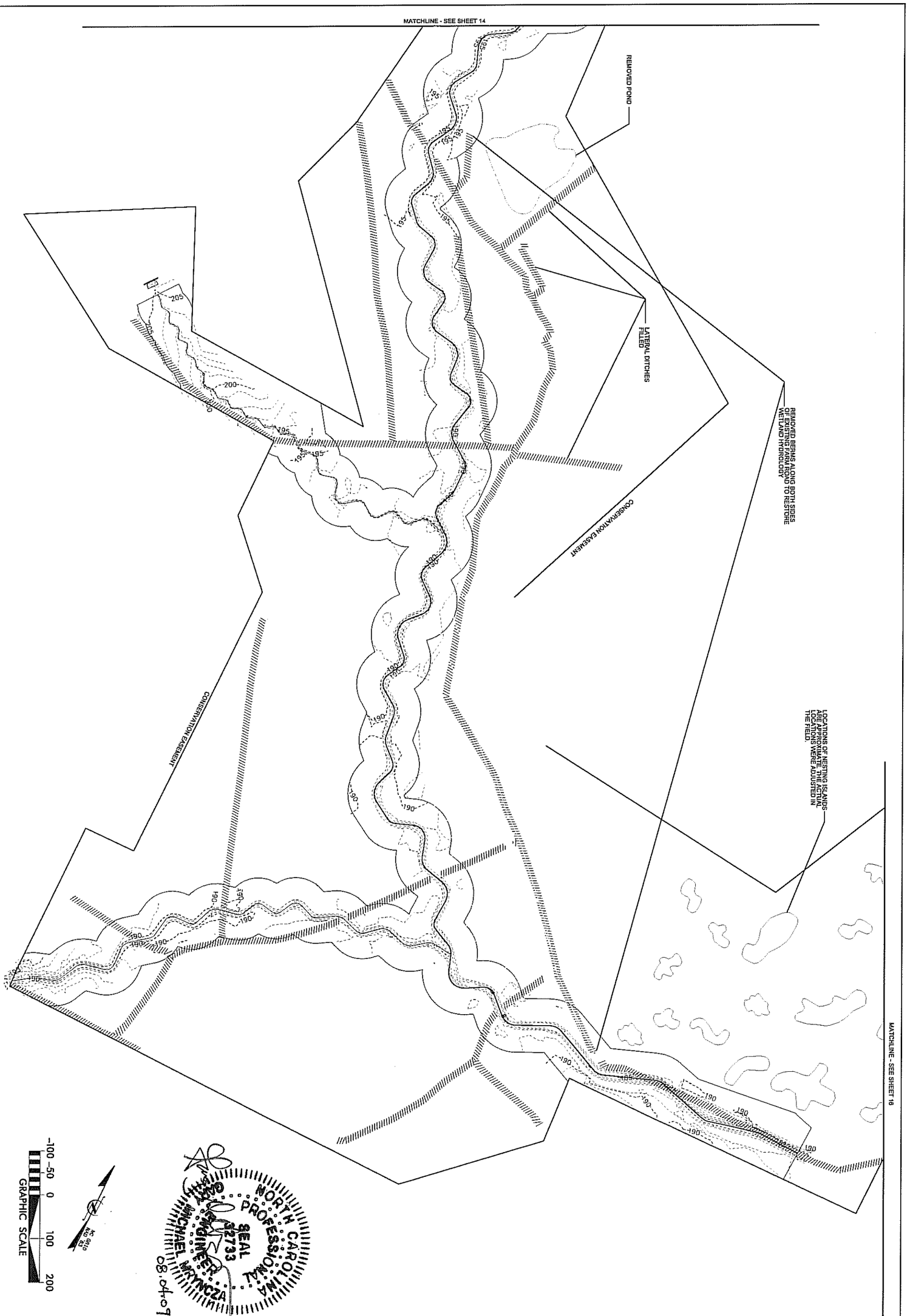
SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

REVISIONS

AS-BUILT WETLAND SITE PLAN

DATE: JUNE 2009
SCALE: 1"=100'

SHEET 14 OF 31



A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
SYM.	DESCRIPTION	DATE	APPROVED

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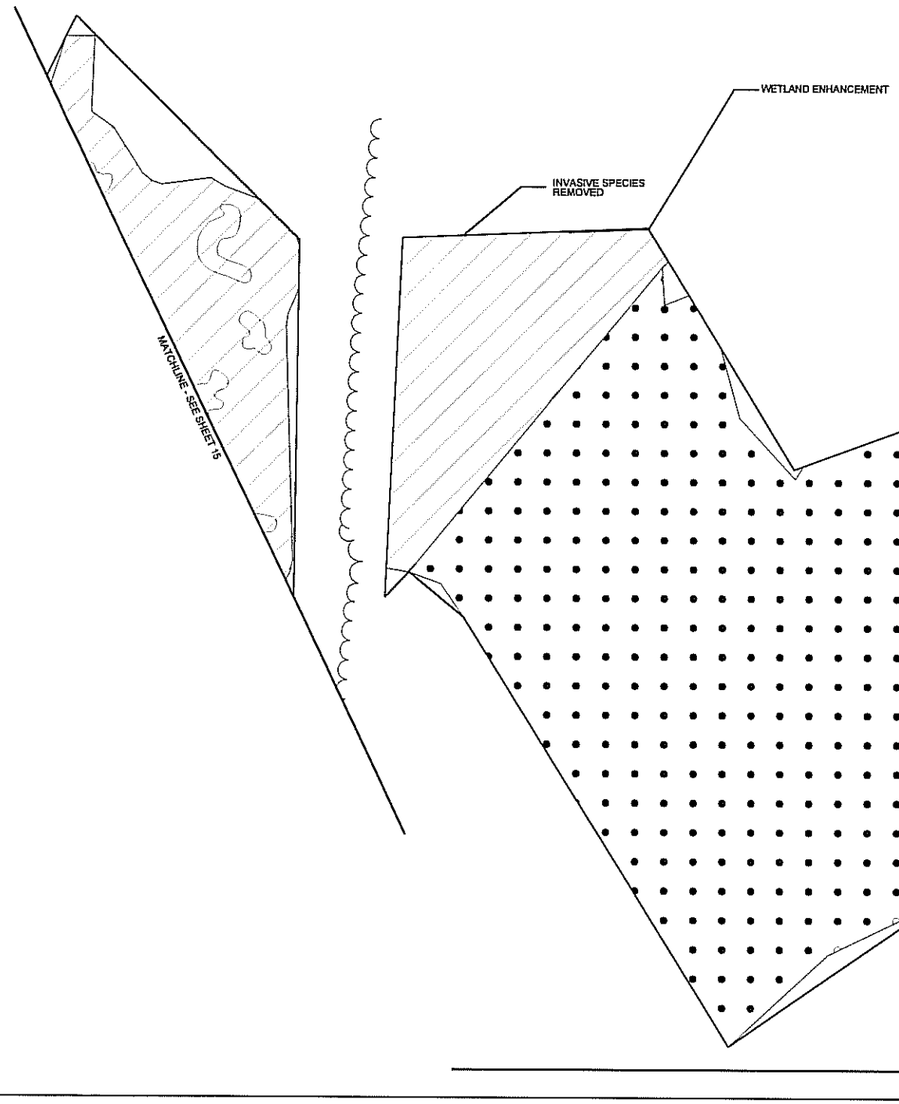
Ecosystem Planning & Restoration

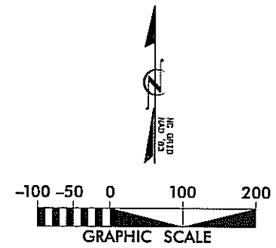
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

AS-BUILT WETLAND SITE PLAN

DATE: JUNE 2009
SCALE: 1"=100'

SHEET 15 OF 31





A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		
STAL	DESCRIPTION	DATE	APPROVED	

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NORTH CAROLINA PROFESSIONAL SEAL 032733 ENGINEER GARY MICHAEL MAYNCZA
08.04.09

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT
WETLAND
SITE PLAN

SHEET 16 OF 31

MATCHLINE - SEE SHEET 16

WETLAND PRESERVATION

EASEMENT EXCEPTION

CONSERVATION EASEMENT

CONSERVATION EASEMENT

EASEMENT EXCEPTION

T4.2
STREAM PRESERVATION

REFERENCE
WETLAND
GAUGE

T4
REACH BREAK

T4.1
STREAM ENHANCEMENT II

NORTH CAROLINA
PROFESSIONAL
SEAL
32733
ENGINEER
GARY MICHAEL MARANCA
08.04.09

NO SCALE

-100 -50 0 100 200
GRAPHIC SCALE

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

Ecosystem Planning & Restoration

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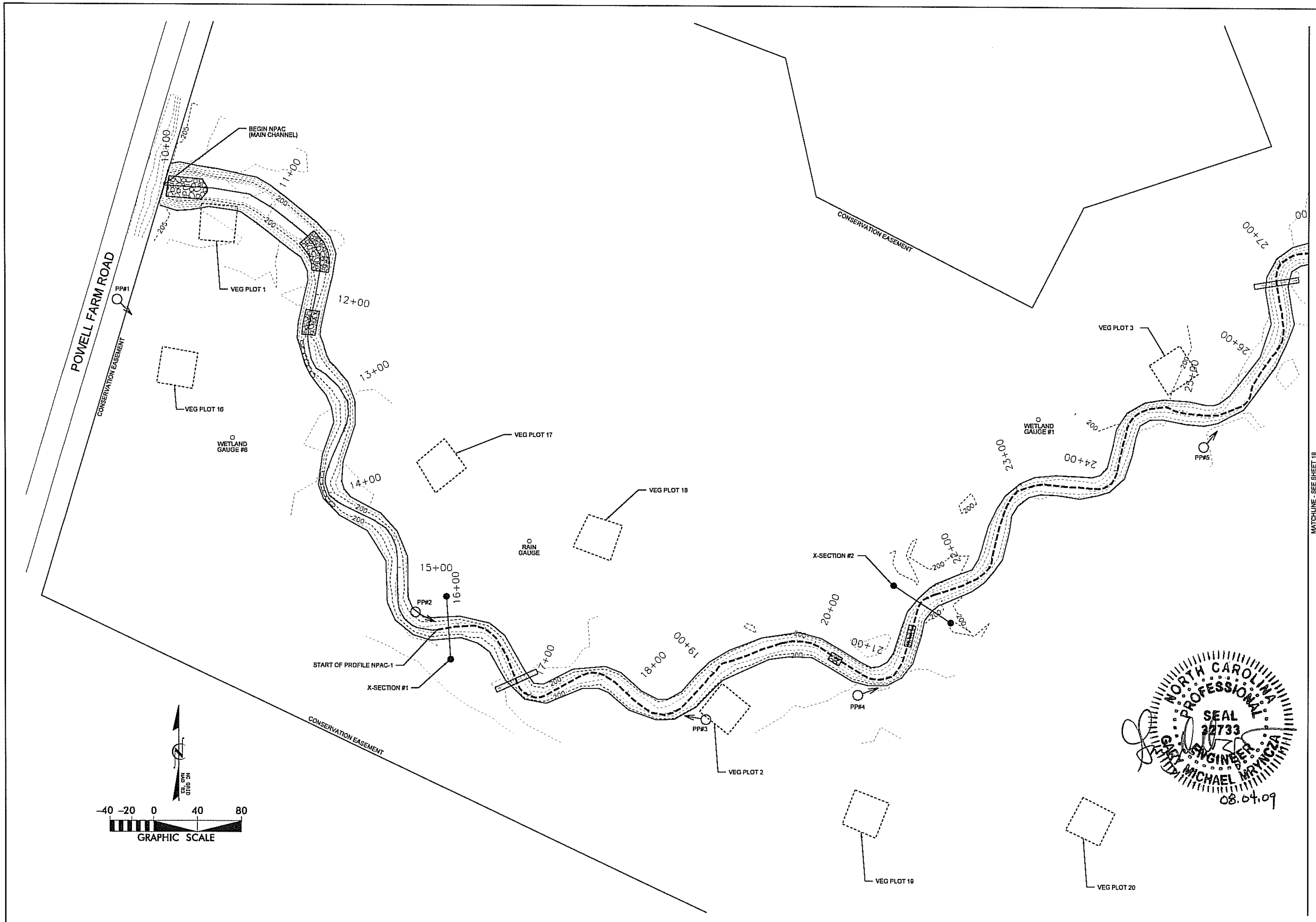
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT
WETLAND
SITE PLAN

SHEET 17 OF 31



A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
SYM.	DESCRIPTION	DATE	APPROVED

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 10+00 TO STATION 27+17

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 18 OF 31

SEE SHEETS 23 - 25 FOR T1.1, T1.2, AND T1

CONSERVATION EASEMENT

CONSERVATION EASEMENT

X-SECTION #21

PP#28

VEG PLOT 4

END OF PROFILE NPAC-1

END OF PROFILE T1

PP#6

PP#7

X-SECTION #3

VEG PLOT 21

VEG PLOT 22

X-SECTION #4

VEG PLOT 23

PP#8

MATCHLINE - SEE SHEET 18

MATCHLINE - SEE SHEET 20

VEG PLOT 5

NC 49/10 NAD 83

-40 -20 0 40 80

GRAPHIC SCALE

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MRYNCZA

08.04.09

REVISIONS				
NO.	DESCRIPTION	DATE	APPROVED
A.	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 27+17 TO STATION 40+51

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 19 OF 31

CONSERVATION EASEMENT

40+00

MATCHLINE - SEE SHEET 19

41+00

42+00

VEG PLOT 24

X-SECTION #5

43+00

44+00

PP#9

PP#10

PP#11

45+00

VEG PLOT 25

X-SECTION #6

46+00

47+00

48+00

49+00

50+00

VEG PLOT 6

VEG PLOT 45

CONSERVATION EASEMENT

VEG PLOT 26

WETLAND GAUGE #2

VEG PLOT 27

X-SECTION #7

51+00

52+00

53+00

VEG PLOT 28

VEG PLOT 7

54+00

PP#12

PP#13

PP#14

VEG PLOT 44

119+00

X-SECTION #25

118+00

END OF PROFILE T2

117+00

X-SECTION #24

116+00

PP#29

115+00

CONSERVATION EASEMENT

SEE SHEET 26 FOR T2

MATCHLINE - SEE SHEET 21

NC GRID NAD 83

-40 -20 0 40 80

GRAPHIC SCALE

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MATTHEWS

08.04.09

REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

Ecosystem Enhancement Program

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RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 40+51 TO STATION 55+39

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 20 OF 31

NORTH CAROLINA
PROFESSIONAL
SEAL
32733
ENGINEER
GARY MICHAEL MRYNCZA
08.04.09
CONSERVATION EASEMENT
CONSERVATION EASEMENT
CONSERVATION EASEMENT
MATCHLINE - SEE SHEET 20
MATCHLINE - SEE SHEET 22
VEG PLOT 28
VEG PLOT 20
VEG PLOT 30
VEG PLOT 32
VEG PLOT 9
WETLAND GAUGE #4
56+00
57+00
58+00
59+00
60+00
61+00
62+00
63+00
64+00
65+00
66+00
67+00
68+00
69+00
START OF PROFILE NPAC-2
X-SECTION #8
PP#15
PP#16
PP#17
PP#18
END OF PROFILE NPAC-2
X-SECTION #10
STREAM GAUGE #2
141+00
140+00
139+00
138+00
137+00
136+00
END OF PROFILE T3
VEG PLOT 35
VEG PLOT 43
VEG PLOT 41
X-SECTION #9
VEG PLOT 8
WETLAND GAUGE #5
PP#32
X-SECTION #29
WETLAND GAUGE #3
VEG PLOT 42
VEG PLOT 40
VEG PLOT 15
X-SECTION #28
VEG PLOT 39
X-SECTION #27
PP#31
VEG PLOT 36
NC GRID NAD 83
-40 -20 0 40 80
GRAPHIC SCALE
SEE SHEET 27 FOR T3

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009

REVISIONS

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RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 55+39 TO STATION 69+51

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

VEG PLOT 31

MATCHLINE - SEE SHEET 21

70+00

71+00

X-SECTION #11

72+00

73+00

X-SECTION #12

74+00

75+00

76+00

77+00

190

185

CONSERVATION EASEMENT

VEG PLOT 33

CONSERVATION EASEMENT

CONSERVATION EASEMENT

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MARINCIC

08.04.09

N

NC GRID

-40 -20 0 40 80

GRAPHIC SCALE

REVISIONS

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
B	REVISED MAIN CHANNEL GRADING PROFILE		

DESCRIPTION | DATE | APPROVED

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1601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
NPAC - STATION 69+51 TO STATION 77+46

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 22 OF 31

-40 -20 0 40 80
GRAPHIC SCALE

NC GRID NAD 83

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MARANCA
08.04.09

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009		
NO.	DESCRIPTION	DATE	APPROVED	

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T1.1 - STATION 80+00 TO STATION 88+25

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 23 OF 31

SEE SHEET 23 FOR T1.1

X-SECTION #14

END OF PROFILE T1.1

X-SECTION #15

X-SECTION #18

END OF PROFILE T1.2

X-SECTION #17

X-SECTION #16

BEGIN T1.2

CONSERVATION EASEMENT

PP#22

PP#23

VEG PLOT 11

START OF PROFILE T1.2

CONSERVATION EASEMENT

SEE SHEET 25 FOR T1

-40 -20 0 40 80

GRAPHIC SCALE

NC GRID NAD '83

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER CARL MICHAEL MYNCZA

08.04.09

REVISIONS

NO.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

Ecosystem Enhancement Program

KCI ASSOCIATES OF NC

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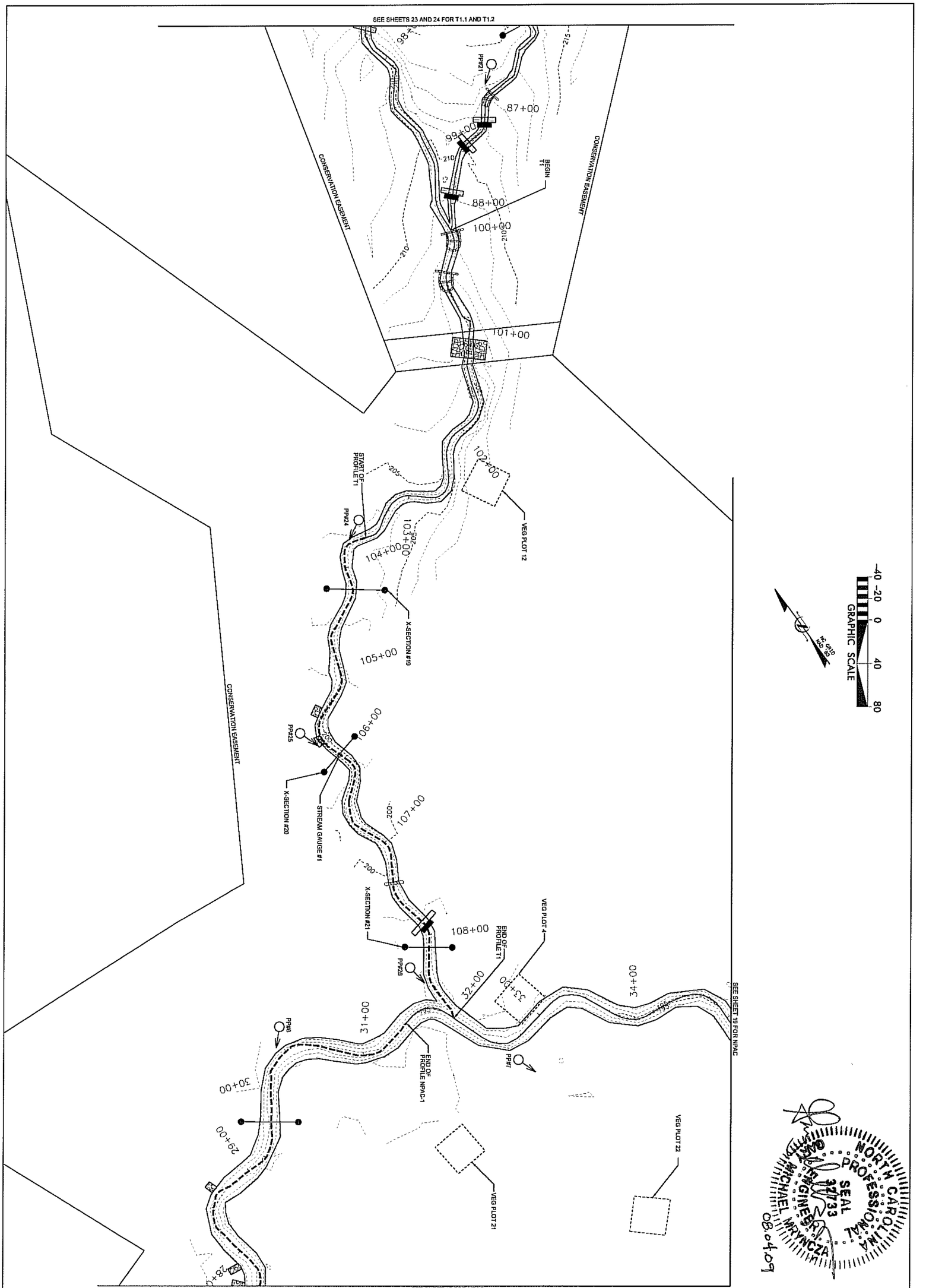
Raleigh, North Carolina 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T1.2 - STATION 90+00 TO STATION 99+80

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 24 OF 31

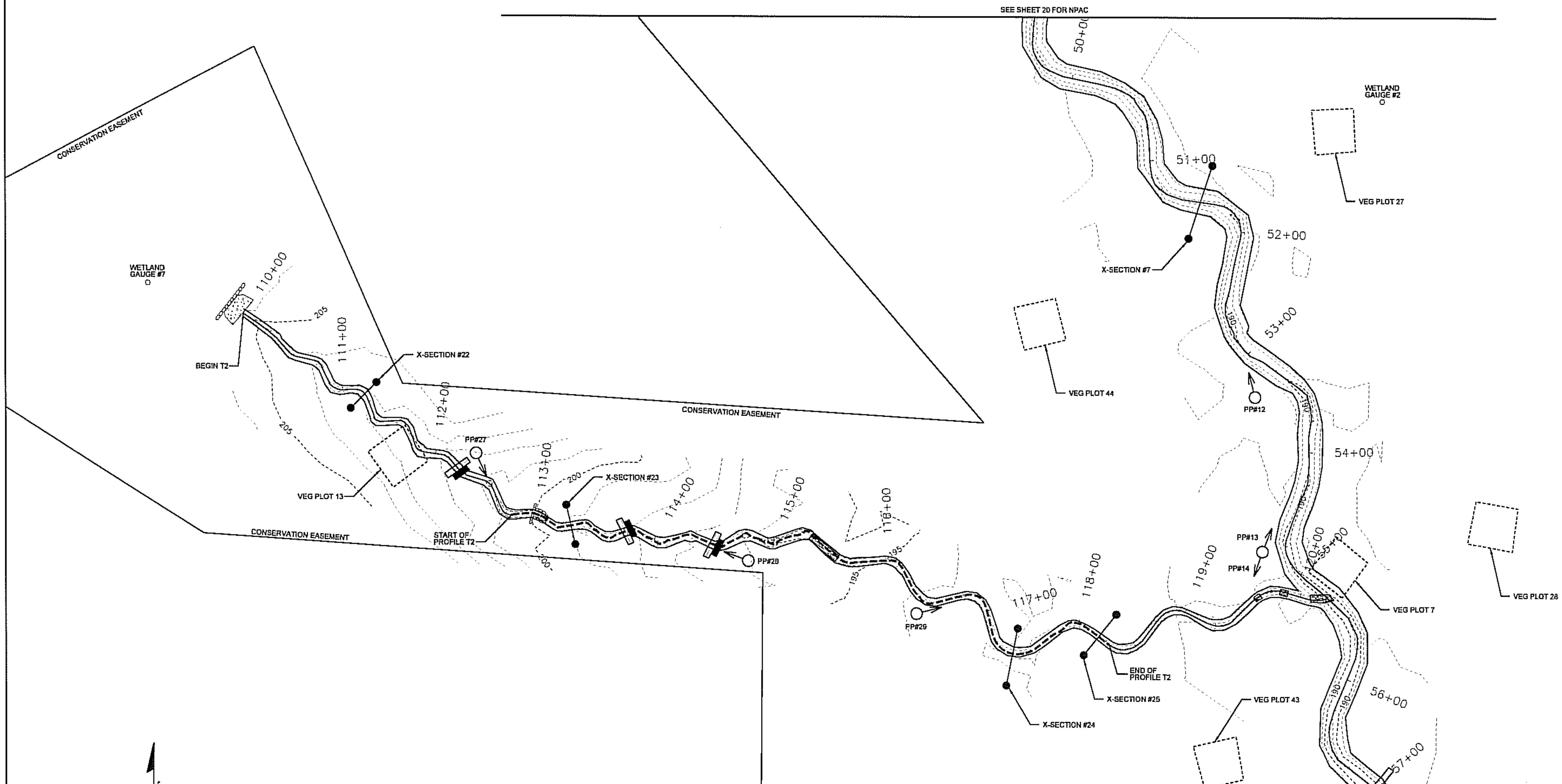


MONITORING PLAN VIEW	FARRAR DAIRY STREAM AND WETLAND MITIGATION LILLINGTON, HARNETT COUNTY, NORTH CAROLINA T1 - STATION 100+00 TO STATION 108+84	KCI ASSOCIATES OF NC ENGINEERS • PLANNERS • SCIENTISTS 4601 SIX FORKS ROAD RALEIGH, NORTH CAROLINA 27609

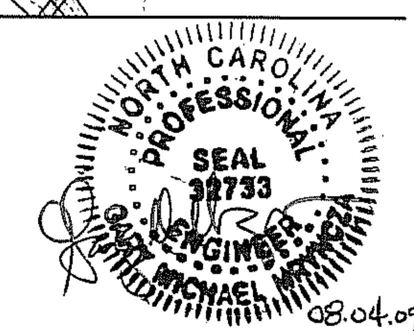
SHEET 28 OF 31	DATE: JUNE 2009
	SCALE: 1"=40'

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
SYM.	DESCRIPTION	DATE	APPROVED

REVISIONS



SEE SHEET 20 FOR NPAC
CONSERVATION EASEMENT
WETLAND GAUGE #7
WETLAND GAUGE #2
110+00
111+00
112+00
113+00
114+00
115+00
116+00
117+00
118+00
119+00
50+00
51+00
52+00
53+00
54+00
56+00
57+00
BEGIN T2
X-SECTION #22
X-SECTION #23
X-SECTION #24
X-SECTION #25
X-SECTION #7
START OF PROFILE T2
END OF PROFILE T2
VEG PLOT 13
VEG PLOT 44
VEG PLOT 27
VEG PLOT 28
VEG PLOT 7
VEG PLOT 43
PP#27
PP#28
PP#29
PP#12
PP#13
PP#14
SEE SHEET 21 FOR NPAC
NC GRID NAD '83
-40 -20 0 40 80
GRAPHIC SCALE



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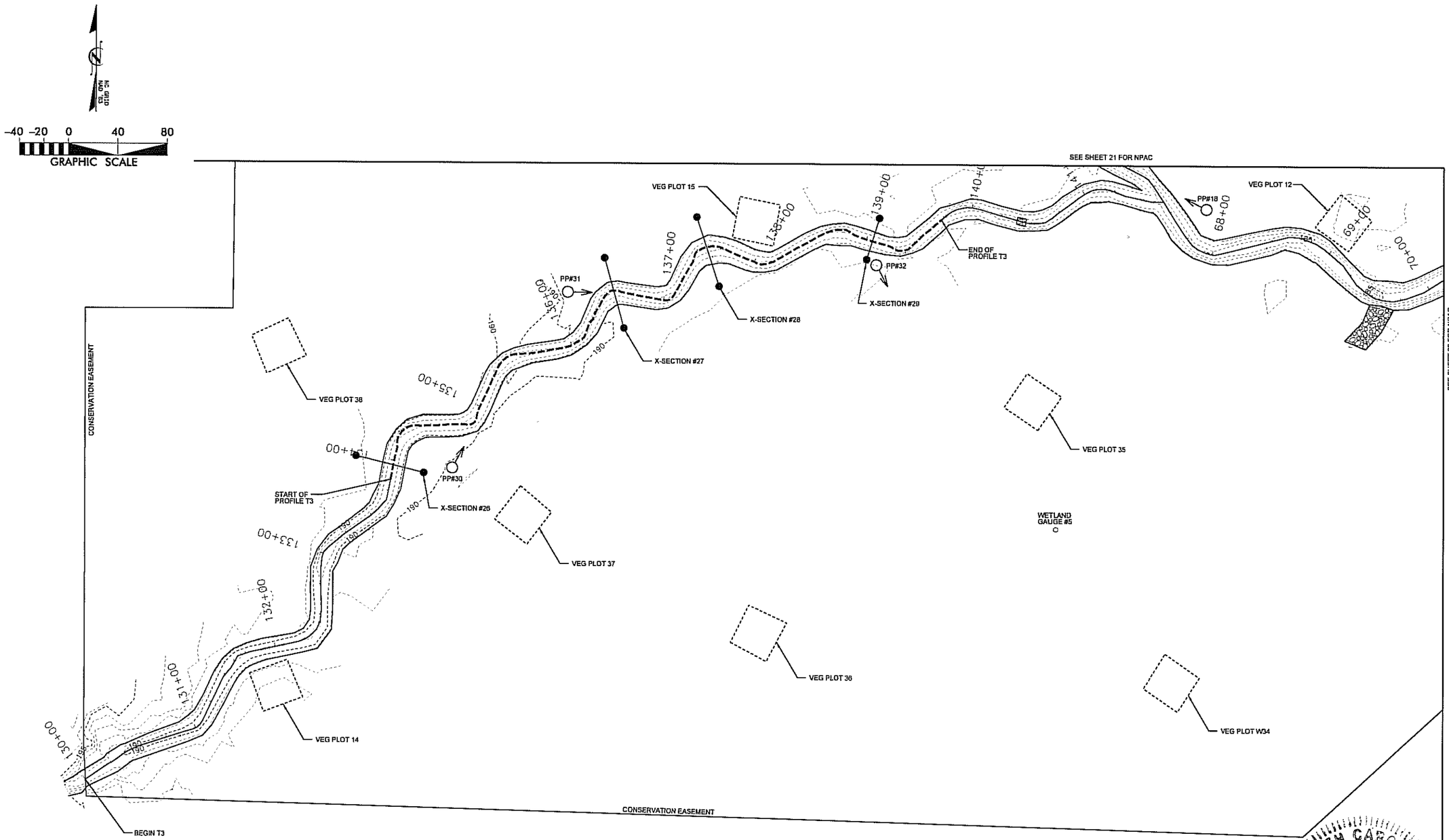
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T2 - STATION 110+00 TO STATION 120+22

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 26 OF 31



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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA
T3 - STATION 130+00 TO STATION 141+67

DATE: JUNE 2009
SCALE: 1"=40'

MONITORING PLAN VIEW

SHEET 27 OF 31

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MARANCA
08.04.09

ZONE B1/B2
LOWER RIVERINE PLANTING AREA

ZONE C
UPPER RIVERINE PLANTING AREA

ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

ZONE F
HABITAT ENHANCEMENT ZONE

USM UPLAND SEED MIX

EXISTING TREES

(SEE SHEET 31 FOR ZONE DESCRIPTIONS)

NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER MICHAEL MATTOCKS
08.04.09

-100 -50 0 100 200
GRAPHIC SCALE

NC GRID NAD 83

REVISIONS

	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	

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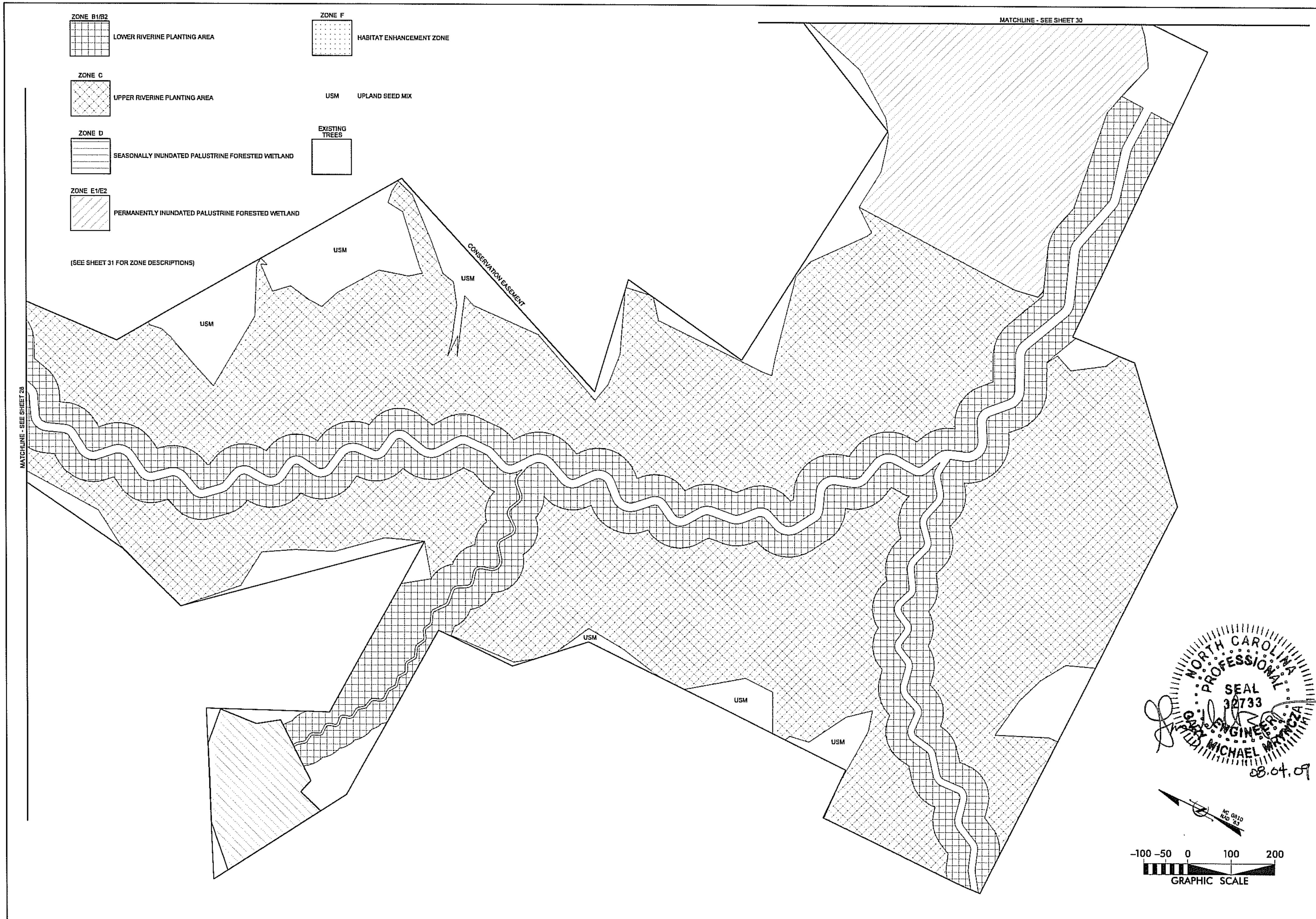
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 28 OF 31


ZONE B1/B2
LOWER RIVERINE PLANTING AREA
ZONE C
UPPER RIVERINE PLANTING AREA
ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND
ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND
ZONE F
HABITAT ENHANCEMENT ZONE
USM
UPLAND SEED MIX
EXISTING TREES
(SEE SHEET 31 FOR ZONE DESCRIPTIONS)
MATCHLINE - SEE SHEET 30
MATCHLINE - SEE SHEET 28
CONSERVATION EASEMENT
USM
USM
USM
USM
USM
USM
NC GRID NAD 83
-100 -50 0 100 200
GRAPHIC SCALE
NORTH CAROLINA
PROFESSIONAL
SEAL
32733
ENGINEER
GARY MICHAEL MRYNCZA
08.04.09

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	DESCRIPTION	DATE	APPROVED

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FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 29 OF 31

ZONE B1/B2
LOWER RIVERINE PLANTING AREA

ZONE C
UPPER RIVERINE PLANTING AREA

ZONE D
SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND

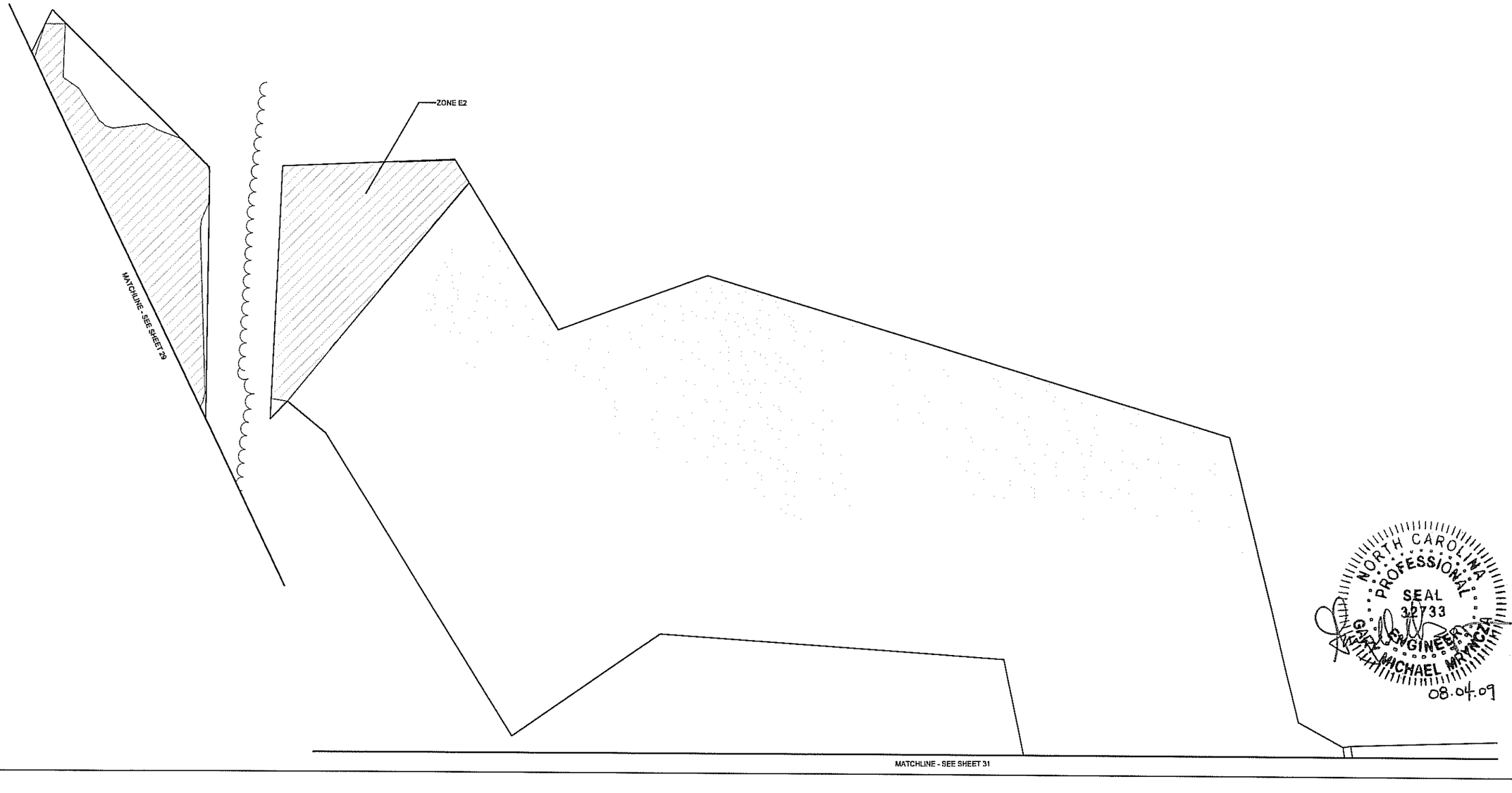
ZONE E1/E2
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND

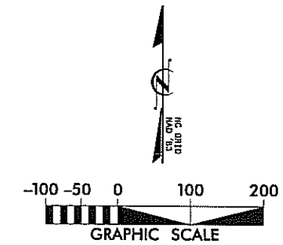
ZONE F
HABITAT ENHANCEMENT ZONE

USM UPLAND SEED MIX

EXISTING TREES

(SEE SHEET 31 FOR ZONE DESCRIPTIONS)





NORTH CAROLINA PROFESSIONAL SEAL 32733 ENGINEER GARY MICHAEL MAYNARD
08.04.09

A	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	STAL	APPROVED

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RALEIGH, NORTH CAROLINA 27609

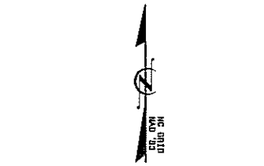
FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

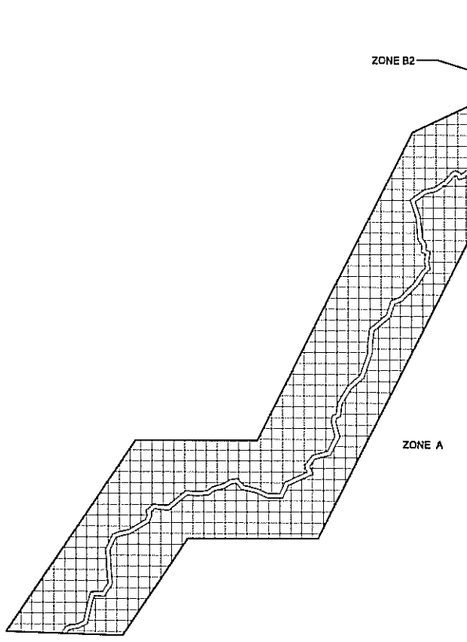
DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 30 OF 31

MATCHLINE - SEE SHEET 30





PLANTING PLAN AND SPECIES COMPOSITION

* UNDISTURBED FORESTED AREAS WITHIN PLANTING ZONES WERE NOT PLANTED

ZONE A

STREAM ZONE = 2.07 ACRES (90,172 SQUARE FEET)
ZONE NOT DISPLAYED ON PLANS. INSTALL LIVE STAKES FROM BOTTOM BANK TO TOP OF BANK ON ALL STREAMS EXCEPT T4.

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

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

NOTE: NO SINGLE LIVE STAKING SPECIES COMPOSED MORE THAN 40% OF THE 11,542 TOTAL NUMBER OF LIVE STAKES INSTALLED

ZONE B1/B2

B1 - STREAM RESTORATION
LOWER RIVERINE PLANTING AREA = 21.13 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	2300
SUGARBERRY	CELTIS LAEVIGATA	904
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	1040
SILKY DOGWOOD	CORNUS AMOMUM	1400
GREEN ASH	FRAXINUS PENNSYLVANICA	1900
WATER TUPELO	NYSSA AQUATICA	847
LAUREL OAK	QUERCUS LAURIFOLIA	950
		9241

B2 - STREAM ENHANCEMENT
LOWER RIVERINE PLANTING AREA = 3.67 ACRES

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
RIVER BIRCH	BETULA NIGRA	68
SUGARBERRY	CELTIS LAEVIGATA	38
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	42
SILKY DOGWOOD	CORNUS AMOMUM	92
GREEN ASH	FRAXINUS PENNSYLVANICA	75
WATER TUPELO	NYSSA AQUATICA	34
LAUREL OAK	QUERCUS LAURIFOLIA	40
		407

ZONE C

UPPER RIVERINE PLANTING AREA = 42.41 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
SILKY DOGWOOD	CORNUS AMOMUM	908
GREEN ASH	FRAXINUS PENNSYLVANICA	3925
LAUREL OAK	QUERCUS LAURIFOLIA	3110
WATER HICKORY	CARYA AQUATICA	100
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII	4000
CHERRYBARK OAK	QUERCUS PAGODA	2100
PIN OAK	QUERCUS PALUSTRIS	2100
WILLOW OAK	QUERCUS PHELLOS	1900
PERSIMMON	DIOSPYROS VIRGINIANA	300
		18,443

ZONE D

SEASONALLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.95 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
BUTTONBUSH	CEPHALANTHUS OCCIDENTALIS	216
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	221
WATER TUPELO	NYSSA AQUATICA	119
OVERCUP OAK	QUERCUS LYRATA	200
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	308
BALD CYPRESS	TAXODIUM DISTICHUM	342
		1,406

ZONE E1/E2

E1 - WETLAND RESTORATION
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 8.43 ACRES
PLANT ALL OF ZONE E AS E1 UNLESS OTHERWISE INDICATED

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	840
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	1406
BALD CYPRESS	TAXODIUM DISTICHUM	1502
		3,808

E2 - WETLAND ENHANCEMENT
PERMANENTLY INUNDATED PALUSTRINE FORESTED WETLAND = 2.25 ACRES

12" - 18" BARE ROOT MATERIAL
100 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

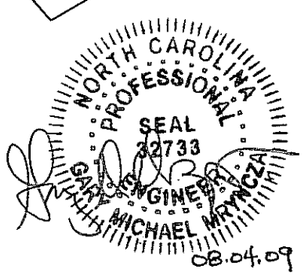
COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
ATLANTIC WHITE CEDAR	CHAMAECYPARIS THYOIDES	51
BLACK WILLOW (CUTTINGS)	SALIX NIGRA	86
BALD CYPRESS	TAXODIUM DISTICHUM	96
		233

ZONE F

HABITAT ENHANCEMENT ZONE = 4.03 ACRES

12" - 18" BARE ROOT MATERIAL
436 STEMS/ACRE (10' X 10' SPACING), RANDOM SPECIES PLACEMENT

COMMON NAME	SCIENTIFIC NAME	# OF PLANTS
SUGARBERRY	CELTIS LAEVIGATA	250
PERSIMMON	DIOSPYROS VIRGINIANA	300
YELLOW POPLAR	LIRIODENDRON TULIPIFERA	400
SYCAMORE	PLATANUS OCCIDENTALIS	300
WHITE OAK	QUERCUS ALBA	500
		1,750



USM UPLAND SEED MIX = 13.42 ACRES

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
5 LBS	BUCKWHEAT	FAGOPYRUM ESCULENTUM
5 LBS	SUNFLOWER	HELIANTHUS SPECIES
5 LBS	GRAIN SORGHUM	SORGHUM BICOLOR
5 LBS	BROWNTOP MILLET	UROCHLOA RAMOSA
20 LBS/ACRE		

WSM WETLAND SEED MIX = 71.34 ACRES

PLANTED IN ZONES B, C, D, AND E (ON ISLANDS ONLY FOR ZONE E)

SEED/ACRE	COMMON NAME	SCIENTIFIC NAME
1.25 LBS	ORCHARD GRASS	DACTYLIS GLOMERATA
1.25 LBS	BIG BLUESTEM	ANDROPOGON GERARDII
1.25 LBS	VIRGINIA WILD RYE	ELYMUS VIRGINICUS
1.25 LBS	RIVER OATS	CHASMANTHIUM LATIFOLIUM
1.25 LBS	PURPLE TOP	VERBENA BONARIENSIS
6.25 LBS	DEER TONGUE	PANICUM CLADESTINUM
6.25 LBS	SWITCH GRASS	PANICUM VIRGATUM
6.25 LBS	RYE GRAIN	SECALE CEREALE
25 LBS/ACRE		

EXISTING TREES

DO NOT PLANT IN FORESTED AREAS UNLESS OTHERWISE INDICATED.

REVISIONS

A.	SUBMITTED WITH MITIGATION PLAN	JUNE 2009	
NO.	DESCRIPTION	DATE	APPROVED

KCI ASSOCIATES OF NC
ENGINEERS • PLANNERS • SCIENTISTS
4601 SIX FORKS ROAD
RALEIGH, NORTH CAROLINA 27609

FARRAR DAIRY
STREAM AND WETLAND MITIGATION
LILLINGTON, HARNETT COUNTY, NORTH CAROLINA

DATE: JUNE 2009
SCALE: 1"=100'

AS-BUILT PLANTING PLAN

SHEET 31 OF 31

Appendix B

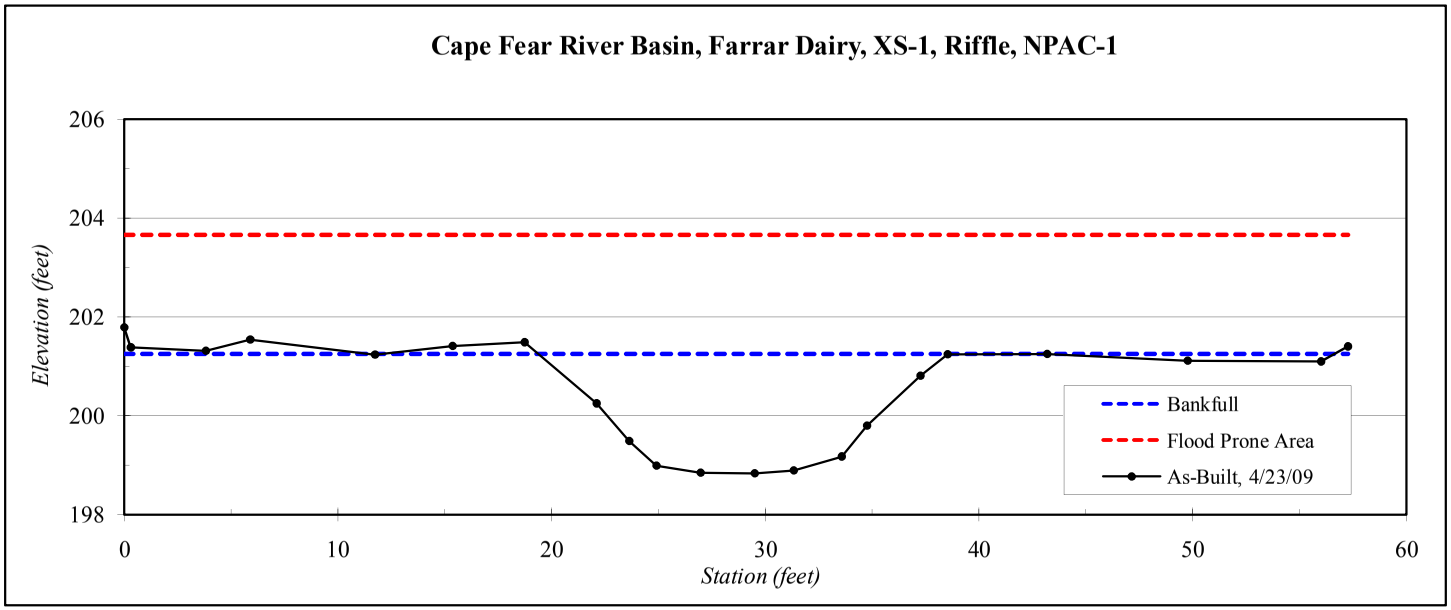
Cross-Section Plots and Pebble Counts

River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-1, Riffle, NPAC-1
Drainage Area (sq mi):	3.92
Date:	4/23/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	201.79
0.3	201.38
3.8	201.32
5.9	201.54
11.7	201.24
15.4	201.42
18.7	201.49
22.1	200.25
23.6	199.49
24.9	198.99
27.0	198.85
29.5	198.84
31.3	198.89
33.6	199.18
34.8	199.80
37.3	200.81
38.5	201.25
43.2	201.25
49.8	201.11
56.0	201.10
57.3	201.40

SUMMARY DATA	
Bankfull Elevation:	201.3
Bankfull Cross-Sectional Area:	31.0
Bankfull Width:	19.6
Flood Prone Area Elevation:	203.7
Flood Prone Width:	>60
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.6
W / D Ratio:	12.4
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

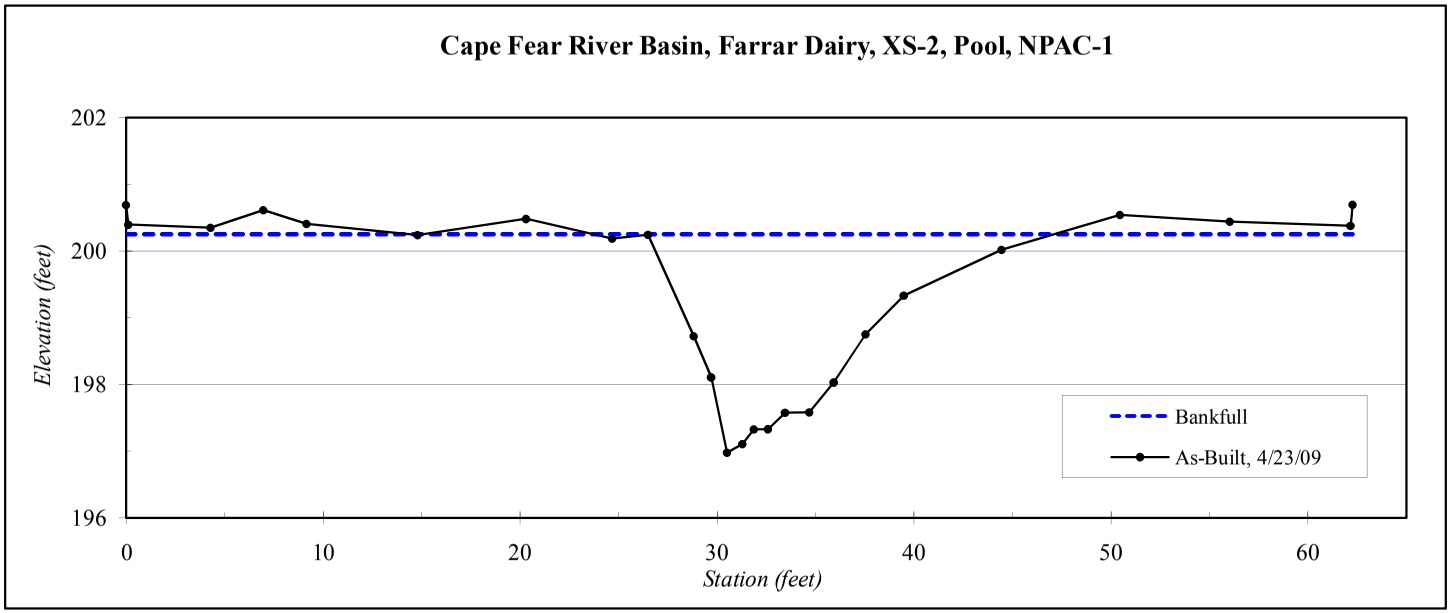


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-2, Pool, NPAC-1
Drainage Area (sq mi):	3.92
Date:	4/23/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	200.69
0.1	200.39
4.3	200.35
7.0	200.61
9.2	200.41
14.8	200.24
20.3	200.48
24.7	200.19
26.5	200.25
28.8	198.72
29.7	198.11
30.5	196.98
31.3	197.11
31.9	197.33
32.6	197.33
33.5	197.57
34.7	197.58
35.9	198.03
37.5	198.75
39.5	199.33
44.4	200.02
50.5	200.54
56.0	200.44
62.2	200.38
62.3	200.69

SUMMARY DATA	
Bankfull Elevation:	200.3
Bankfull Cross-Sectional Area:	29.2
Bankfull Width:	20.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.3
Mean Depth at Bankfull:	1.4
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

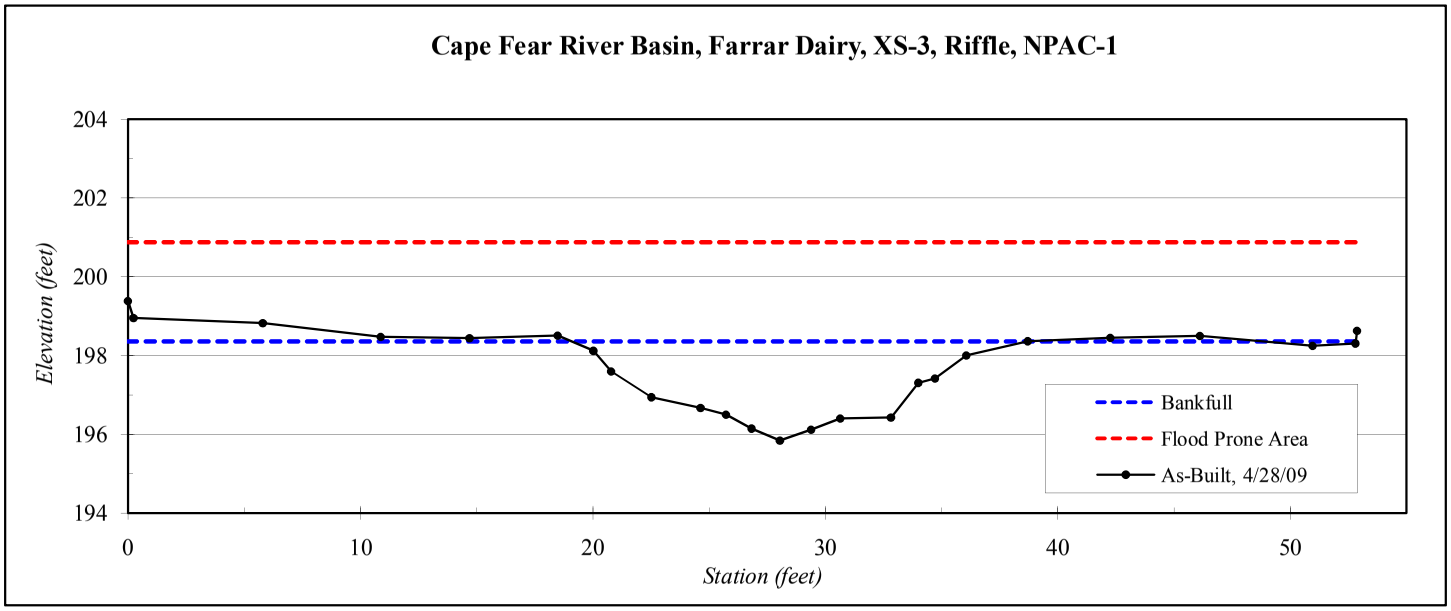


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-3, Riffle, NPAC-1
Drainage Area (sq mi):	3.92
Date:	4/28/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	199.38
0.2	198.95
5.8	198.82
10.9	198.48
14.7	198.44
18.5	198.51
20.0	198.12
20.8	197.60
22.5	196.94
24.6	196.67
25.7	196.50
26.8	196.15
28.0	195.84
29.4	196.12
30.6	196.40
32.8	196.42
34.0	197.31
34.7	197.42
36.1	198.00
38.7	198.36
42.3	198.45
46.1	198.50
51.0	198.25
52.8	198.31
52.9	198.63

SUMMARY DATA	
Bankfull Elevation:	198.4
Bankfull Cross-Sectional Area:	26.6
Bankfull Width:	19.6
Flood Prone Area Elevation:	200.9
Flood Prone Width:	>60
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.4
W / D Ratio:	14.4
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

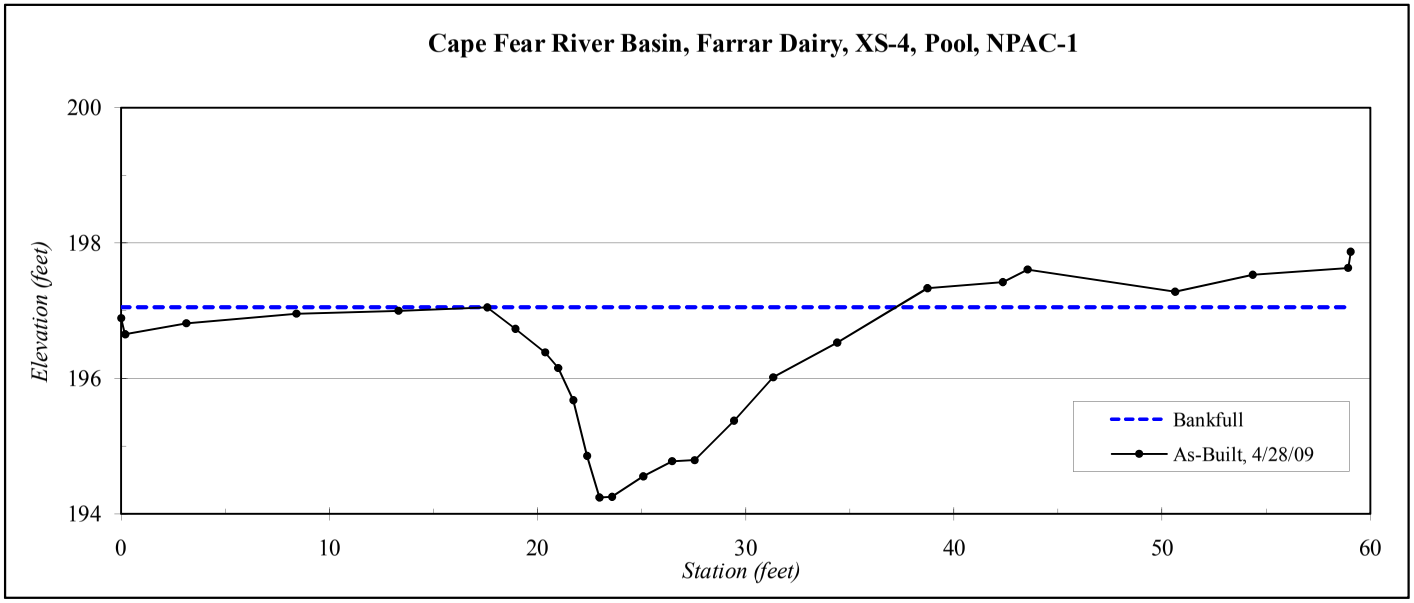


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-4, Pool, NPAC-1
Drainage Area (sq mi):	4.10
Date:	4/28/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	196.89
0.2	196.65
3.1	196.81
8.4	196.96
13.3	197.00
17.6	197.05
18.9	196.73
20.4	196.38
21.0	196.15
21.7	195.68
22.4	194.86
23.0	194.24
23.6	194.26
25.1	194.56
26.5	194.78
27.6	194.80
29.4	195.38
31.3	196.02
34.4	196.53
38.7	197.33
42.4	197.42
43.5	197.61
50.6	197.28
54.4	197.53
58.9	197.63
59.1	197.87

SUMMARY DATA	
Bankfull Elevation:	197.1
Bankfull Cross-Sectional Area:	24.7
Bankfull Width:	18.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

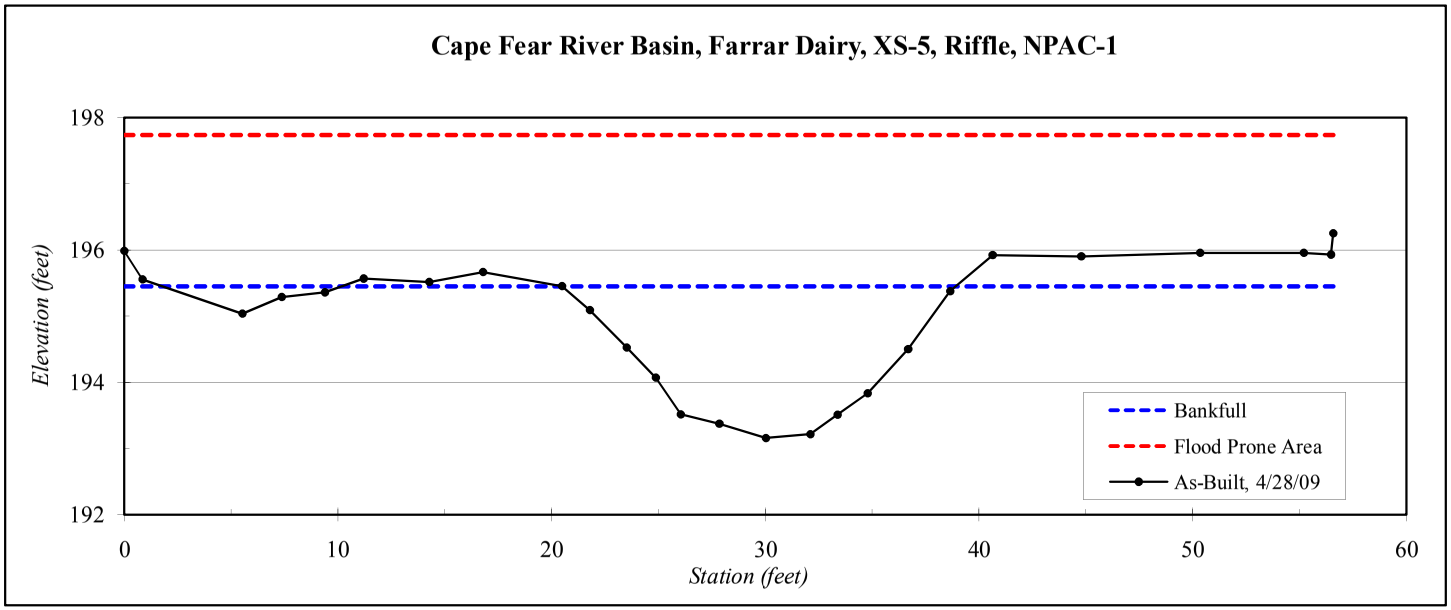


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-5, Riffle, NPAC-1
Drainage Area (sq mi):	4.10
Date:	4/28/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	195.99
0.8	195.55
5.5	195.04
7.4	195.29
9.4	195.36
11.2	195.57
14.3	195.52
16.8	195.67
20.5	195.45
21.8	195.09
23.5	194.53
24.9	194.07
26.0	193.52
27.8	193.38
30.0	193.16
32.1	193.22
33.4	193.51
34.8	193.83
36.7	194.50
38.6	195.38
40.6	195.92
44.8	195.90
50.3	195.96
55.2	195.96
56.5	195.93
56.6	196.25

SUMMARY DATA	
Bankfull Elevation:	195.5
Bankfull Cross-Sectional Area:	26.5
Bankfull Width:	18.4
Flood Prone Area Elevation:	197.7
Flood Prone Width:	>60
Max Depth at Bankfull:	2.3
Mean Depth at Bankfull:	1.4
W / D Ratio:	12.8
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

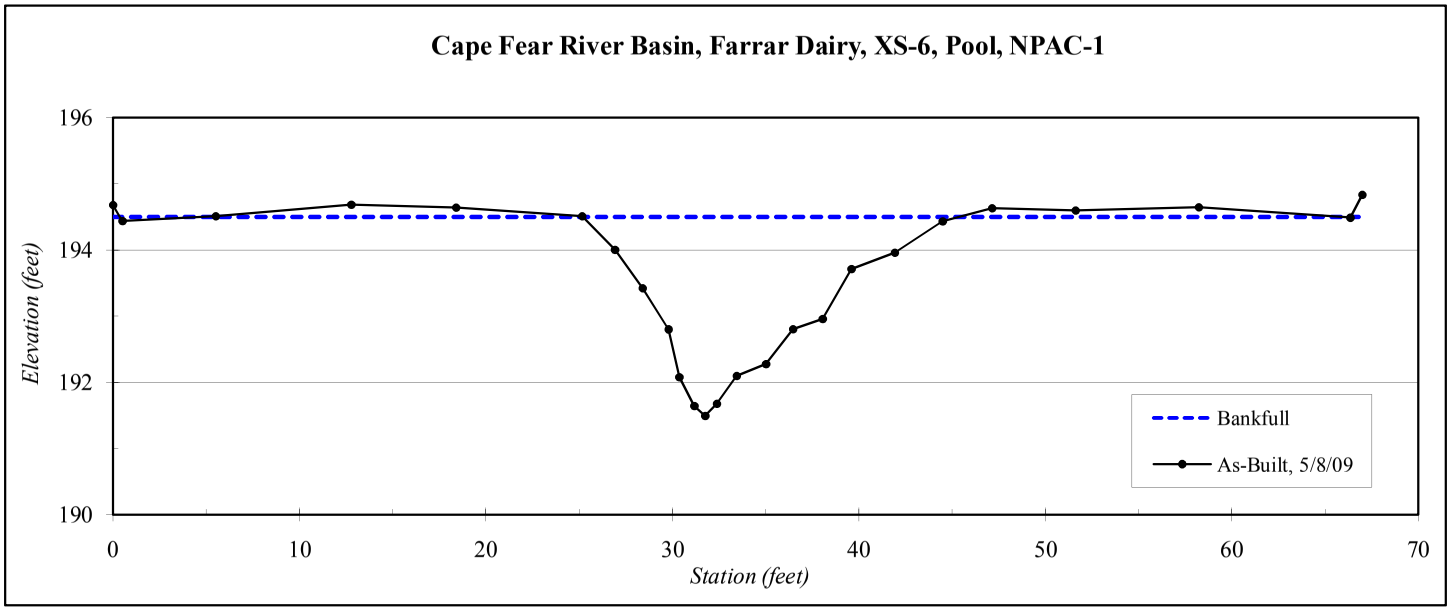


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-6, Pool, NPAC-1
Drainage Area (sq mi):	4.1
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	194.68
0.5	194.44
5.5	194.51
12.8	194.69
18.4	194.64
25.2	194.51
26.9	194.00
28.4	193.42
29.8	192.80
30.4	192.08
31.2	191.64
31.8	191.49
32.4	191.68
33.4	192.10
35.0	192.28
36.5	192.81
38.1	192.96
39.6	193.71
41.9	193.96
44.5	194.43
47.1	194.63
51.6	194.60
58.2	194.65
66.4	194.49
67.0	194.83

SUMMARY DATA	
Bankfull Elevation:	194.5
Bankfull Cross-Sectional Area:	26.6
Bankfull Width:	20.4
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.0
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

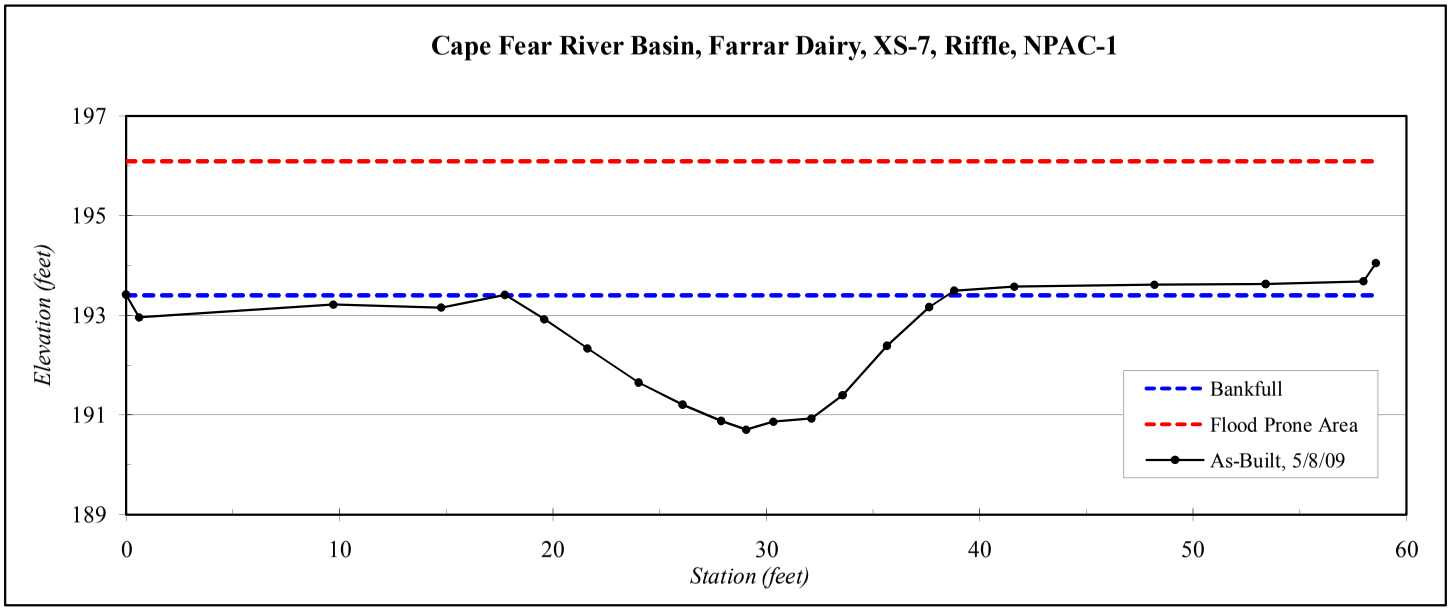


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-7, Riffle, NPAC-1
Drainage Area (sq mi):	4.1
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	193.42
0.6	192.96
9.7	193.22
14.8	193.16
17.8	193.41
19.6	192.92
21.6	192.34
24.0	191.65
26.1	191.21
27.9	190.88
29.1	190.71
30.3	190.86
32.1	190.93
33.6	191.40
35.7	192.39
37.6	193.17
38.8	193.49
41.6	193.58
48.2	193.61
53.4	193.63
58.0	193.68
58.6	194.05

SUMMARY DATA	
Bankfull Elevation:	193.4
Bankfull Cross-Sectional Area:	32.2
Bankfull Width:	20.7
Flood Prone Area Elevation:	196.1
Flood Prone Width:	>60
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.6
W / D Ratio:	13.3
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

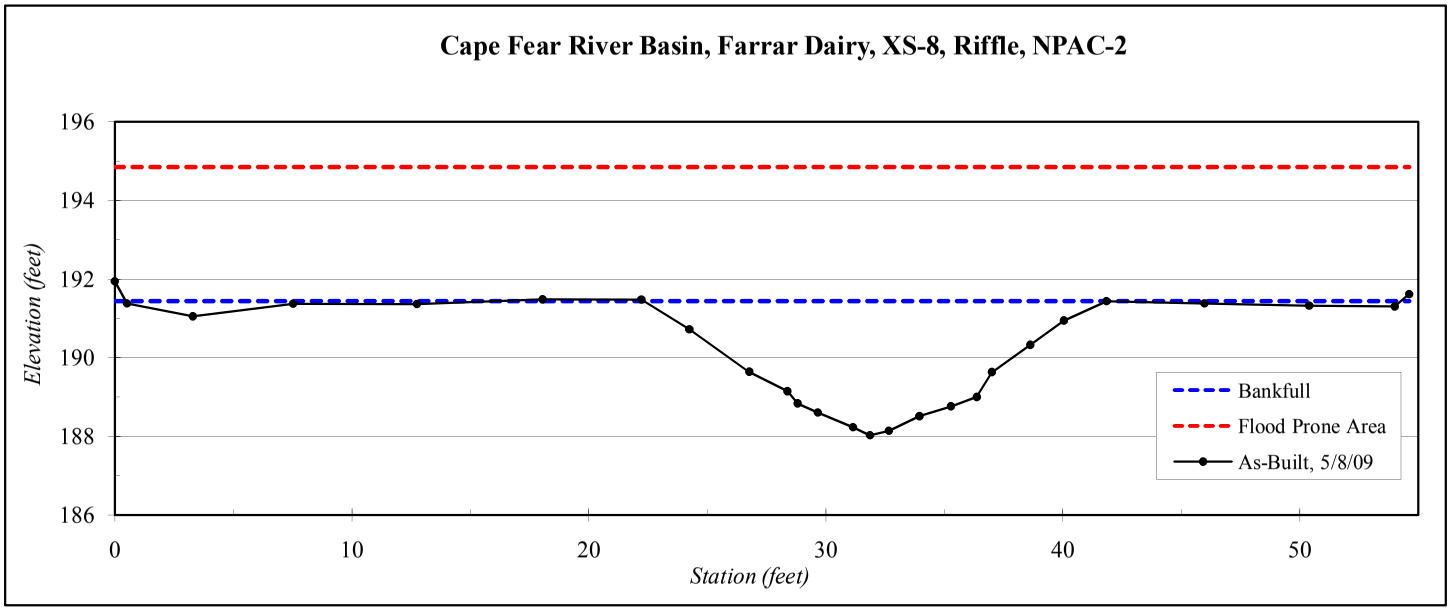


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-8, Riffle, NPAC-2
Drainage Area (sq mi):	4.1
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	191.94
0.5	191.38
3.3	191.05
7.5	191.38
12.7	191.37
18.1	191.48
22.2	191.48
24.2	190.72
26.8	189.64
28.4	189.15
28.8	188.84
29.7	188.61
31.1	188.23
31.9	188.03
32.7	188.14
33.9	188.51
35.3	188.77
36.4	189.00
37.0	189.64
38.6	190.33
40.0	190.95
41.8	191.44
46.0	191.38
50.4	191.33
54.0	191.31
54.6	191.62

SUMMARY DATA	
Bankfull Elevation:	191.4
Bankfull Cross-Sectional Area:	35.9
Bankfull Width:	19.5
Flood Prone Area Elevation:	194.9
Flood Prone Width:	>60
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	1.8
W / D Ratio:	10.6
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

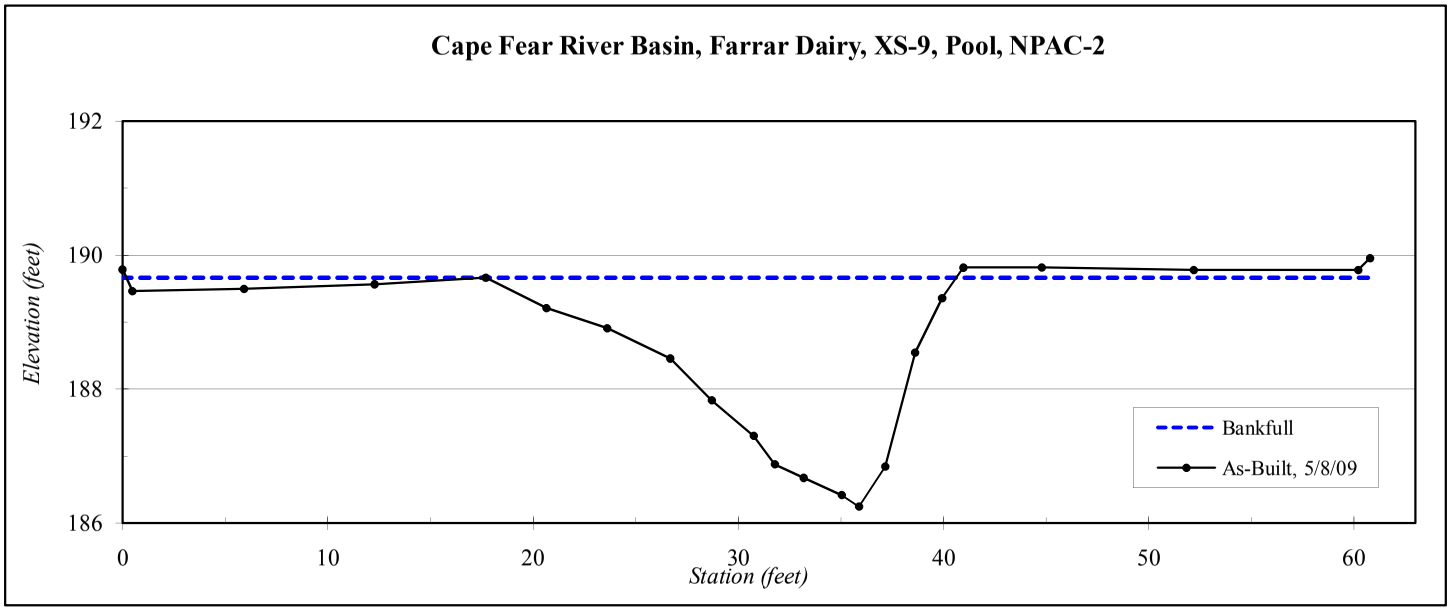


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-9, Pool, NPAC-2
Drainage Area (sq mi):	4.65
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.78
0.5	189.46
5.9	189.49
12.3	189.56
17.7	189.66
20.7	189.21
23.6	188.91
26.7	188.46
28.7	187.83
30.8	187.30
31.8	186.87
33.2	186.67
35.0	186.42
35.9	186.24
37.2	186.84
38.6	188.55
39.9	189.36
41.0	189.81
44.8	189.82
52.2	189.78
60.2	189.78
60.8	189.95

SUMMARY DATA	
Bankfull Elevation:	189.7
Bankfull Cross-Sectional Area:	36.0
Bankfull Width:	22.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.4
Mean Depth at Bankfull:	1.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

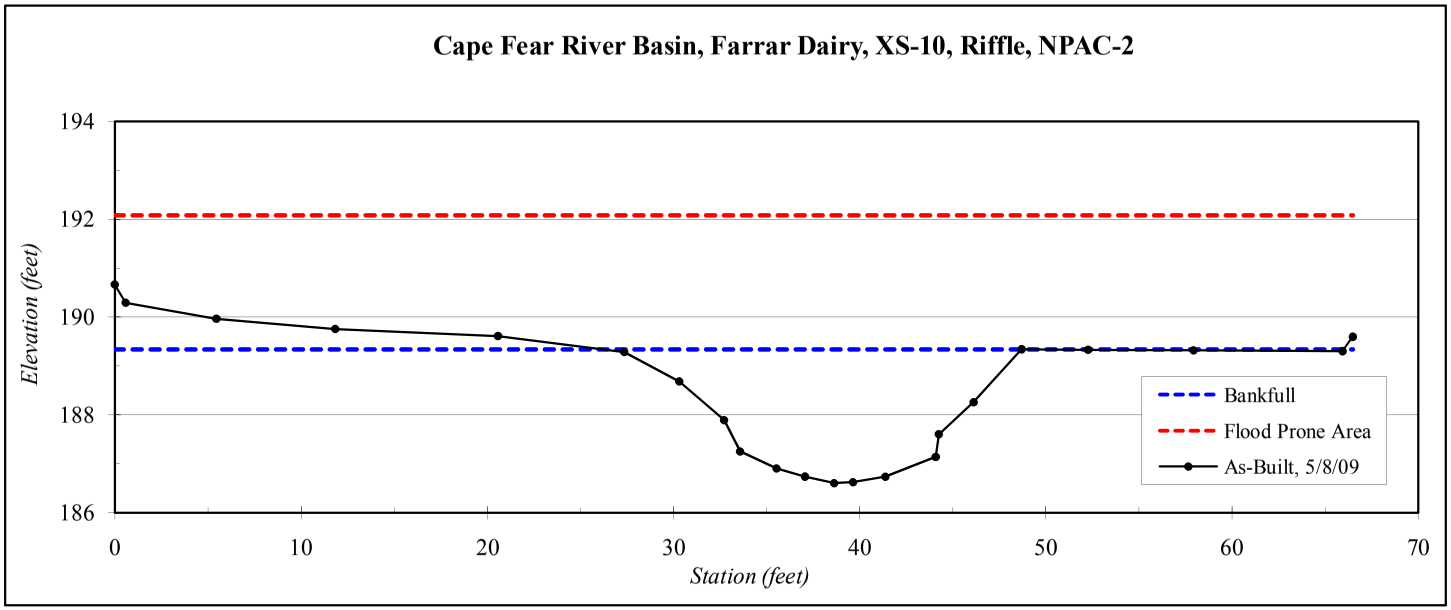


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-10, Riffle, NPAC-2
Drainage Area (sq mi):	4.65
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	190.66
0.6	190.29
5.5	189.96
11.8	189.76
20.6	189.61
27.4	189.28
30.3	188.68
32.7	187.89
33.6	187.25
35.5	186.90
37.1	186.74
38.6	186.60
39.6	186.62
41.4	186.73
44.1	187.14
44.2	187.60
46.1	188.26
48.7	189.34
52.3	189.33
57.9	189.32
65.9	189.30
66.5	189.59

SUMMARY DATA	
Bankfull Elevation:	189.3
Bankfull Cross-Sectional Area:	35.8
Bankfull Width:	22.6
Flood Prone Area Elevation:	192.1
Flood Prone Width:	>60
Max Depth at Bankfull:	2.7
Mean Depth at Bankfull:	1.6
W / D Ratio:	14.3
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

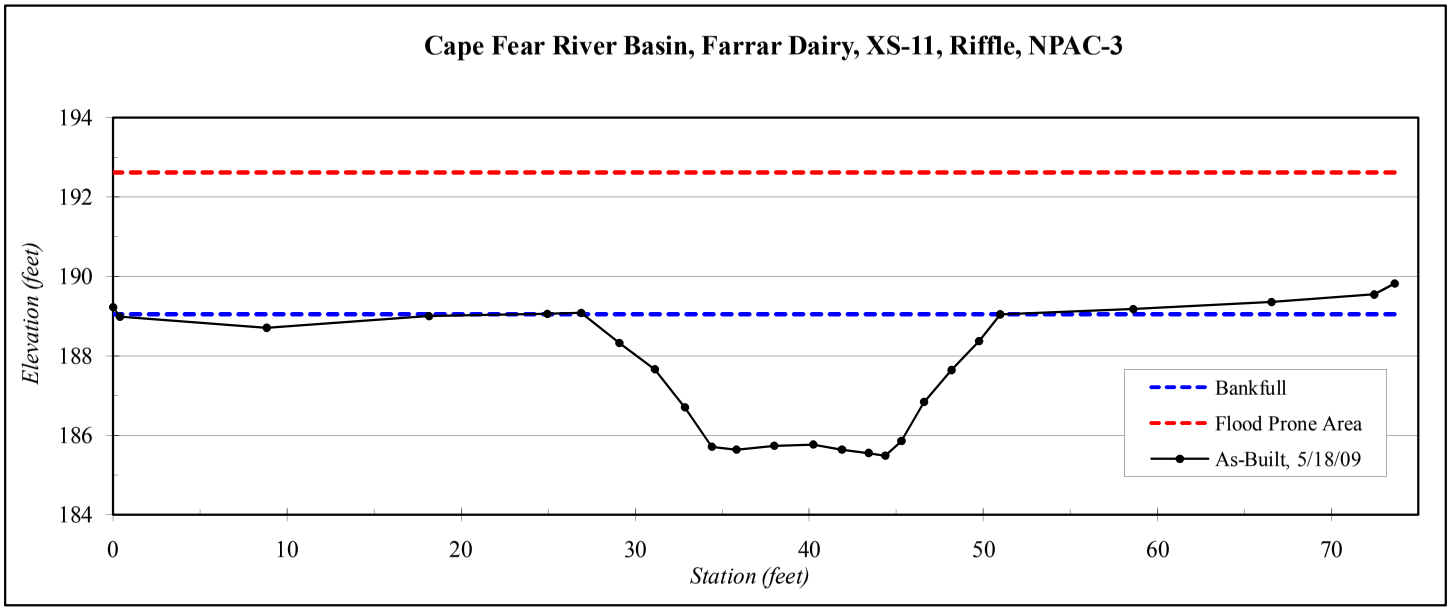


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-11, Riffle, NPAC-3
Drainage Area (sq mi):	4.82
Date:	5/18/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.23
0.4	188.99
8.8	188.71
18.1	189.00
24.9	189.06
26.9	189.08
29.1	188.32
31.1	187.66
32.9	186.70
34.4	185.71
35.8	185.64
38.0	185.73
40.2	185.77
41.9	185.63
43.4	185.55
44.4	185.48
45.3	185.86
46.6	186.84
48.2	187.64
49.8	188.37
51.0	189.05
58.6	189.18
66.6	189.35
72.5	189.55
73.6	189.82

SUMMARY DATA	
Bankfull Elevation:	189.1
Bankfull Cross-Sectional Area:	55.8
Bankfull Width:	24.2
Flood Prone Area Elevation:	192.6
Flood Prone Width:	>60
Max Depth at Bankfull:	3.6
Mean Depth at Bankfull:	2.3
W / D Ratio:	10.5
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

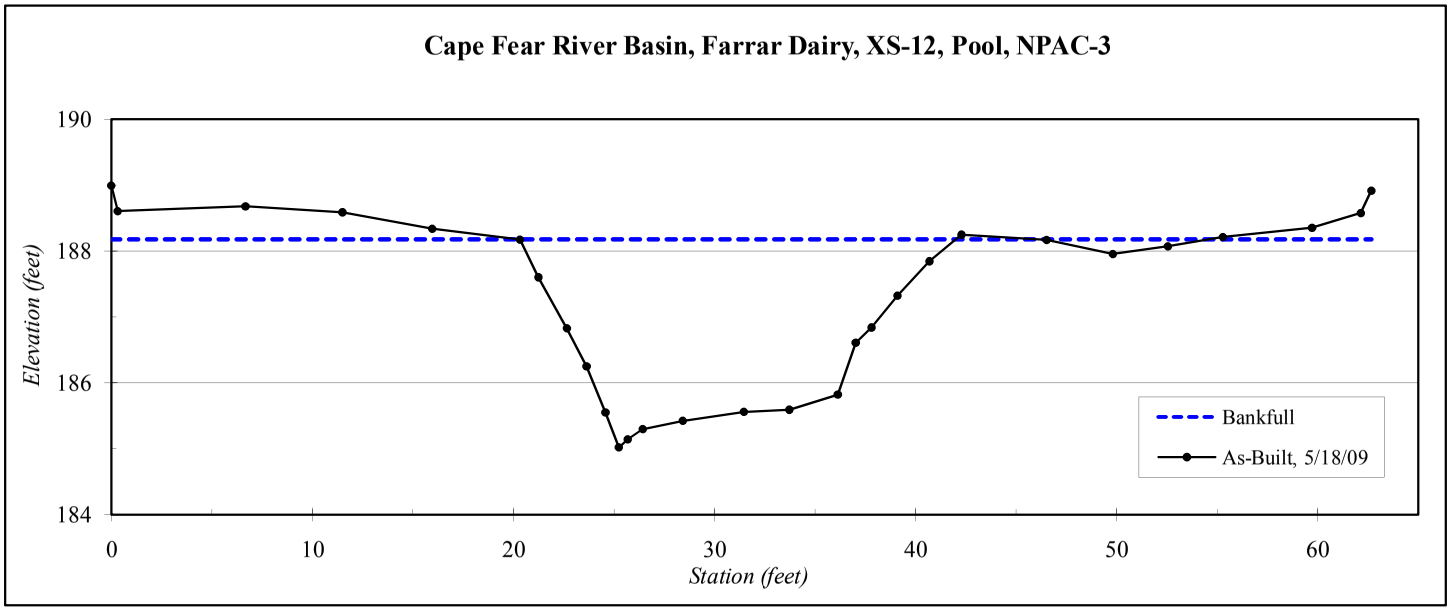


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-12, Pool, NPAC-3
Drainage Area (sq mi):	4.82
Date:	5/18/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.00
0.3	188.61
6.7	188.68
11.5	188.59
16.0	188.34
20.3	188.18
21.2	187.60
22.7	186.83
23.6	186.25
24.6	185.55
25.2	185.02
25.7	185.14
26.4	185.30
28.4	185.42
31.5	185.56
33.7	185.59
36.1	185.82
37.0	186.61
37.8	186.84
39.1	187.33
40.7	187.85
42.3	188.25
46.5	188.17
49.8	187.96
52.5	188.07
55.3	188.21
59.7	188.35
62.1	188.58
62.7	188.92

SUMMARY DATA	
Bankfull Elevation:	188.2
Bankfull Cross-Sectional Area:	42.0
Bankfull Width:	22.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	3.2
Mean Depth at Bankfull:	1.9
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

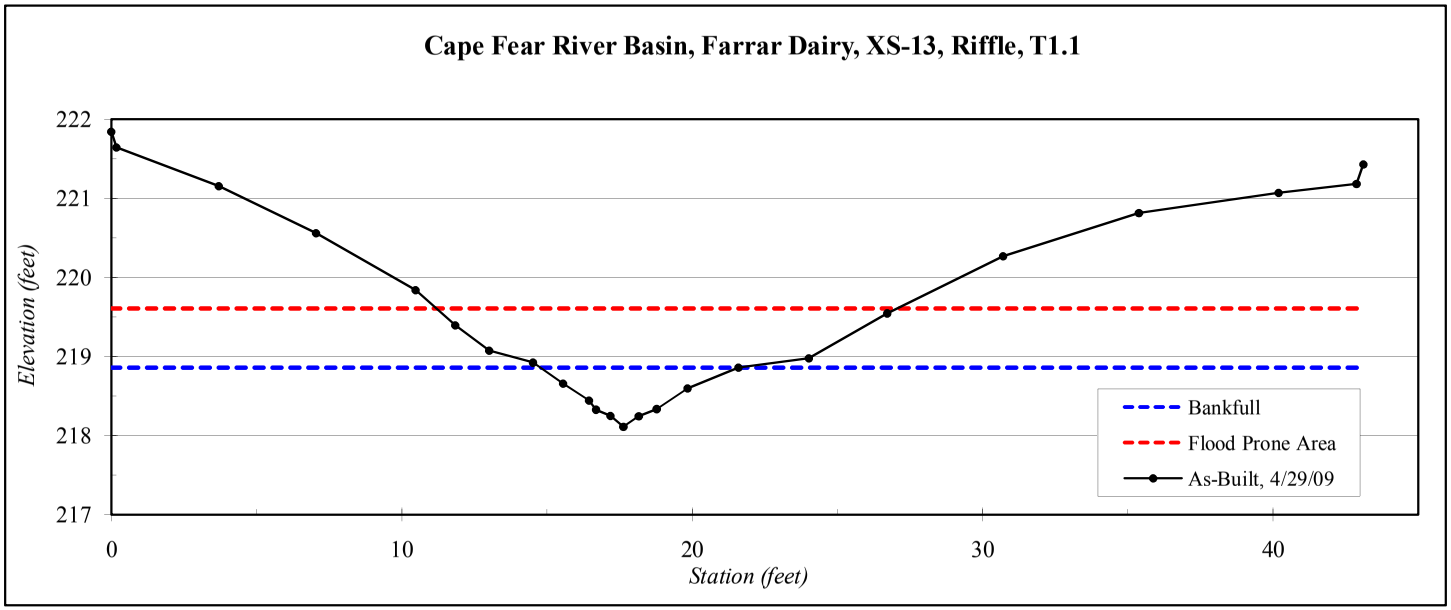


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-13, Riffle, T1.1
Drainage Area (sq mi):	0.02
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	221.84
0.2	221.65
3.7	221.16
7.1	220.56
10.5	219.84
11.8	219.39
13.0	219.07
14.5	218.92
15.6	218.66
16.5	218.44
16.7	218.33
17.2	218.25
17.6	218.11
18.2	218.24
18.8	218.34
19.8	218.60
21.6	218.86
24.0	218.98
26.7	219.55
30.7	220.27
35.4	220.81
40.2	221.07
42.9	221.18
43.1	221.43

SUMMARY DATA	
Bankfull Elevation:	218.9
Bankfull Cross-Sectional Area:	2.4
Bankfull Width:	6.9
Flood Prone Area Elevation:	219.6
Flood Prone Width:	15.9
Max Depth at Bankfull:	0.7
Mean Depth at Bankfull:	0.3
W / D Ratio:	19.8
Entrenchment Ratio:	2.3
Bank Height Ratio:	1.0

Stream Type	C5

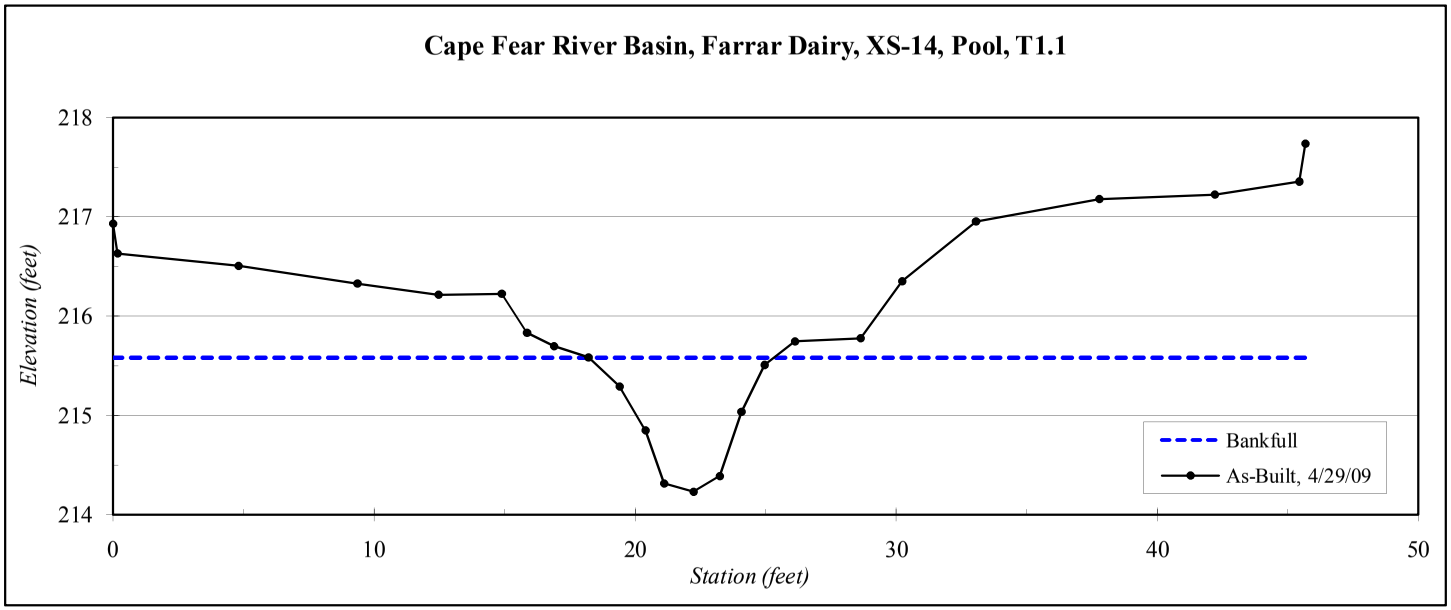


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-14, Pool, T1.1
Drainage Area (sq mi):	0.02
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	216.93
0.2	216.63
4.8	216.51
9.4	216.33
12.5	216.22
14.9	216.23
15.9	215.83
16.9	215.70
18.2	215.59
19.4	215.29
20.4	214.85
21.1	214.31
22.2	214.23
23.2	214.39
24.1	215.04
25.0	215.51
26.1	215.75
28.6	215.78
30.2	216.35
33.1	216.95
37.8	217.18
42.2	217.23
45.4	217.36
45.7	217.74

SUMMARY DATA	
Bankfull Elevation:	215.6
Bankfull Cross-Sectional Area:	5.1
Bankfull Width:	7.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.7
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

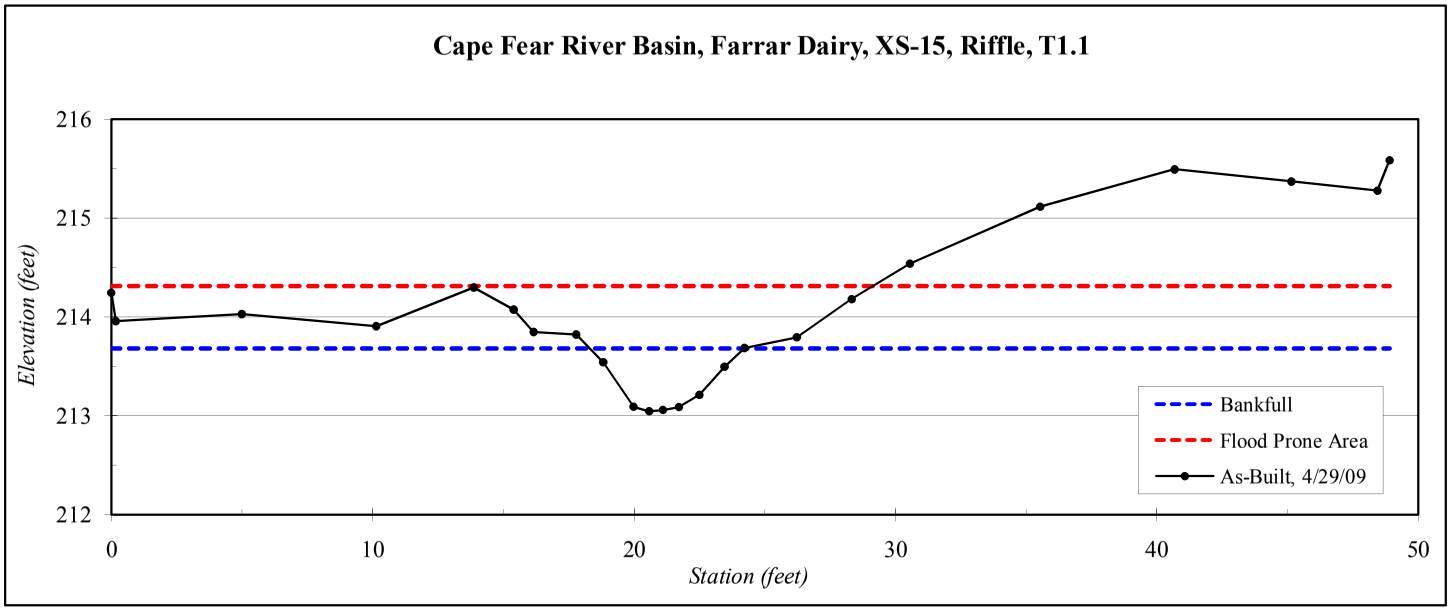


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-15, Riffle, T1.1
Drainage Area (sq mi):	0.02
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	214.25
0.2	213.96
5.0	214.03
10.1	213.91
13.9	214.30
15.4	214.07
16.2	213.85
17.8	213.82
18.8	213.54
20.0	213.09
20.6	213.05
21.1	213.06
21.7	213.09
22.5	213.21
23.5	213.50
24.2	213.69
26.2	213.79
28.3	214.18
30.6	214.54
35.5	215.12
40.7	215.49
45.1	215.37
48.4	215.28
48.9	215.59

SUMMARY DATA	
Bankfull Elevation:	213.7
Bankfull Cross-Sectional Area:	2.3
Bankfull Width:	5.9
Flood Prone Area Elevation:	214.3
Flood Prone Width:	29
Max Depth at Bankfull:	0.6
Mean Depth at Bankfull:	0.4
W / D Ratio:	15.1
Entrenchment Ratio:	4.9
Bank Height Ratio:	1.0

Stream Type	C5

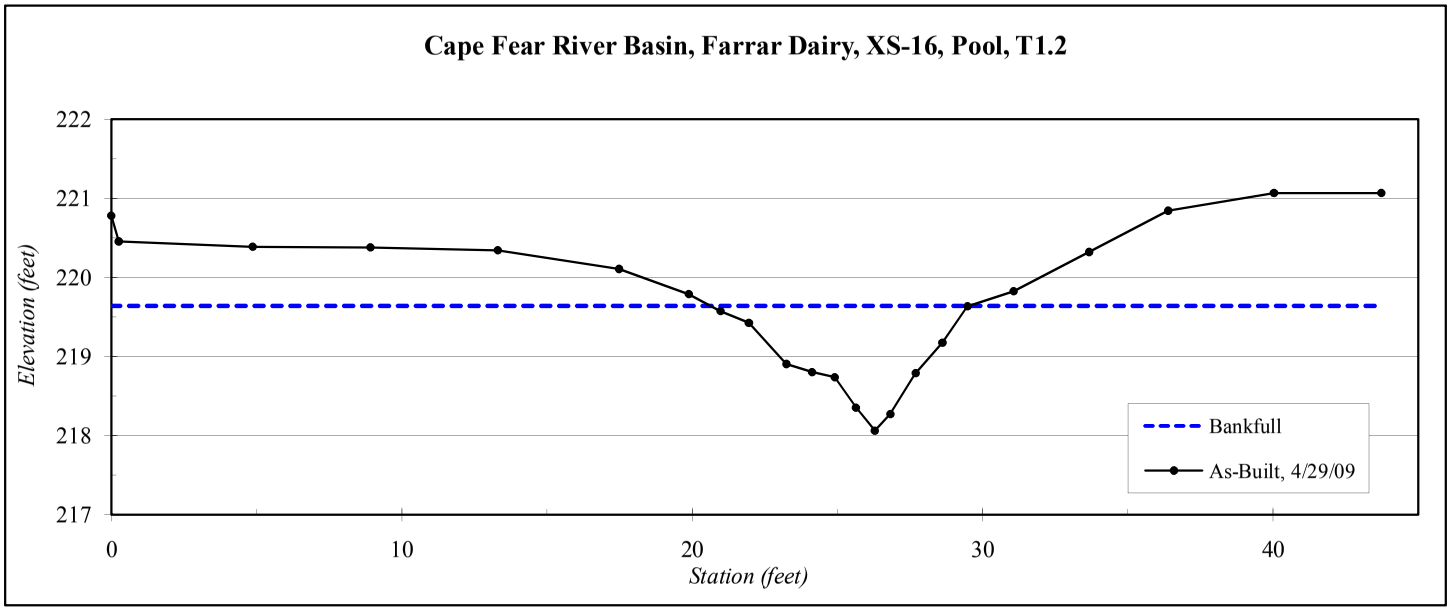


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-16, Pool, T1.2
Drainage Area (sq mi):	0.10
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	220.78
0.3	220.46
4.9	220.39
8.9	220.38
13.3	220.34
17.5	220.11
19.9	219.79
21.0	219.57
21.9	219.43
23.2	218.91
24.1	218.80
24.9	218.74
25.6	218.36
26.3	218.06
26.8	218.27
27.7	218.79
28.6	219.18
29.5	219.64
31.1	219.83
33.7	220.32
36.4	220.84
40.0	221.07
43.7	221.07

SUMMARY DATA	
Bankfull Elevation:	219.6
Bankfull Cross-Sectional Area:	6.4
Bankfull Width:	8.9
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.6
Mean Depth at Bankfull:	0.7
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

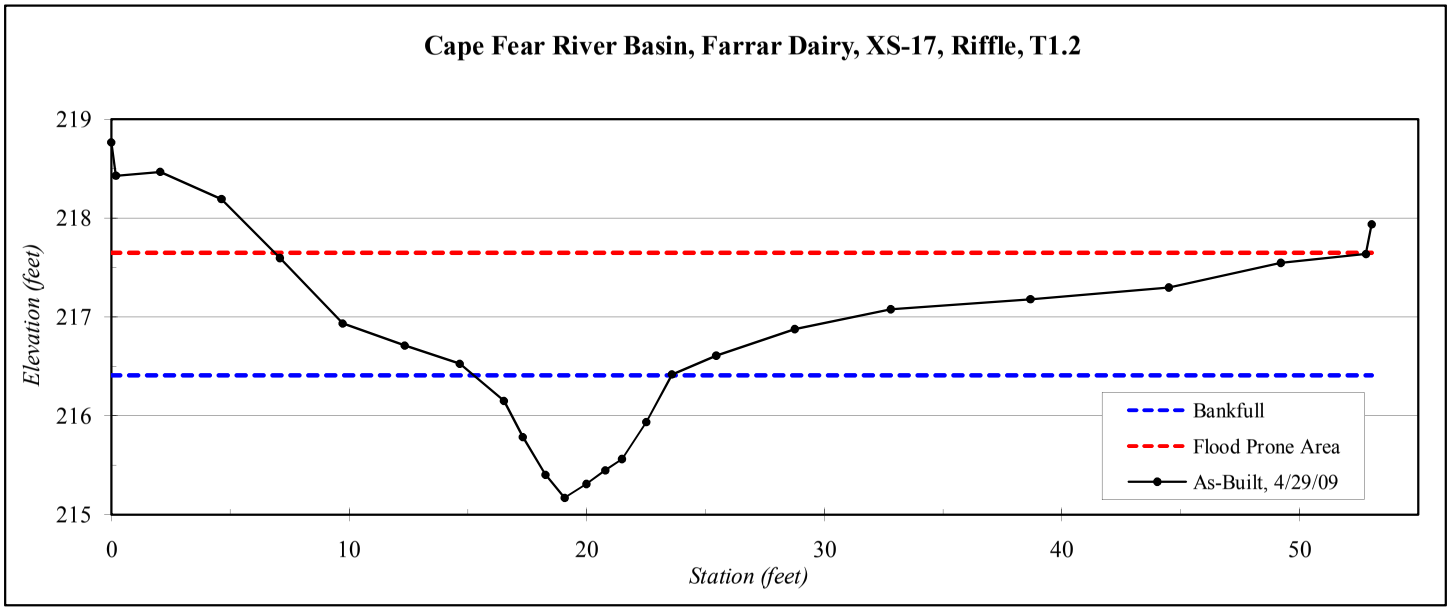


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-17, Riffle, T1.2
Drainage Area (sq mi):	0.10
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	218.77
0.2	218.43
2.1	218.47
4.6	218.19
7.1	217.60
9.7	216.93
12.3	216.71
14.7	216.53
16.5	216.15
17.3	215.78
18.3	215.40
19.1	215.17
20.0	215.31
20.8	215.45
21.5	215.56
22.5	215.94
23.6	216.42
25.5	216.61
28.8	216.88
32.8	217.08
38.7	217.18
44.5	217.30
49.2	217.55
52.8	217.64
53.0	217.94

SUMMARY DATA	
Bankfull Elevation:	216.4
Bankfull Cross-Sectional Area:	5.7
Bankfull Width:	8.3
Flood Prone Area Elevation:	217.6
Flood Prone Width:	45.9
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	12.1
Entrenchment Ratio:	5.5
Bank Height Ratio:	1.0

Stream Type	C5

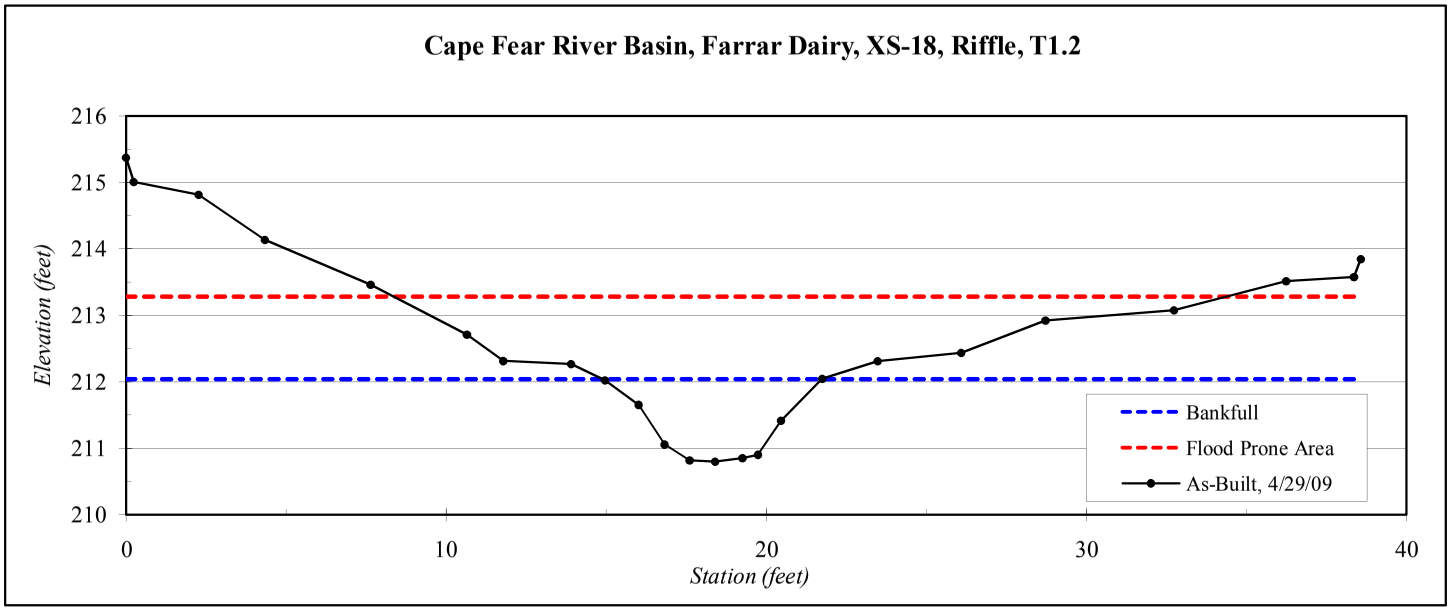


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-18, Riffle, T1.2
Drainage Area (sq mi):	0.10
Date:	4/29/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	215.37
0.2	215.01
2.3	214.82
4.3	214.13
7.6	213.46
10.7	212.71
11.8	212.31
13.9	212.27
15.0	212.02
16.0	211.65
16.8	211.06
17.6	210.82
18.4	210.80
19.3	210.85
19.7	210.90
20.5	211.42
21.7	212.05
23.5	212.31
26.1	212.43
28.7	212.92
32.7	213.08
36.2	213.51
38.4	213.58
38.6	213.85

SUMMARY DATA	
Bankfull Elevation:	212.0
Bankfull Cross-Sectional Area:	5.2
Bankfull Width:	6.9
Flood Prone Area Elevation:	213.3
Flood Prone Width:	26
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	9.2
Entrenchment Ratio:	3.8
Bank Height Ratio:	1.0

Stream Type	E5

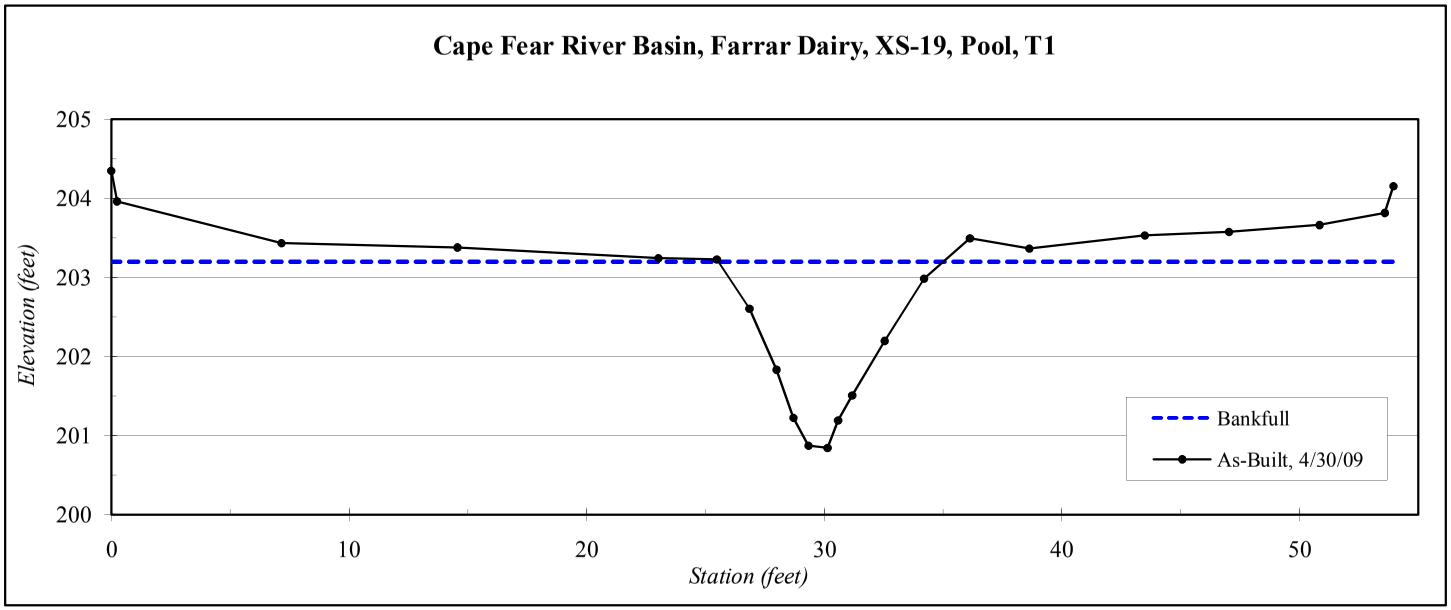


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-19, Pool, T1
Drainage Area (sq mi):	0.18
Date:	4/30/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	204.35
0.2	203.96
7.2	203.44
14.6	203.38
23.0	203.24
25.5	203.23
26.9	202.60
28.0	201.83
28.7	201.23
29.3	200.87
30.1	200.84
30.6	201.19
31.2	201.51
32.5	202.20
34.2	202.99
36.1	203.50
38.6	203.37
43.5	203.53
47.0	203.58
50.8	203.66
53.6	203.82
53.9	204.16

SUMMARY DATA	
Bankfull Elevation:	203.2
Bankfull Cross-Sectional Area:	10.9
Bankfull Width:	9.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.4
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E5

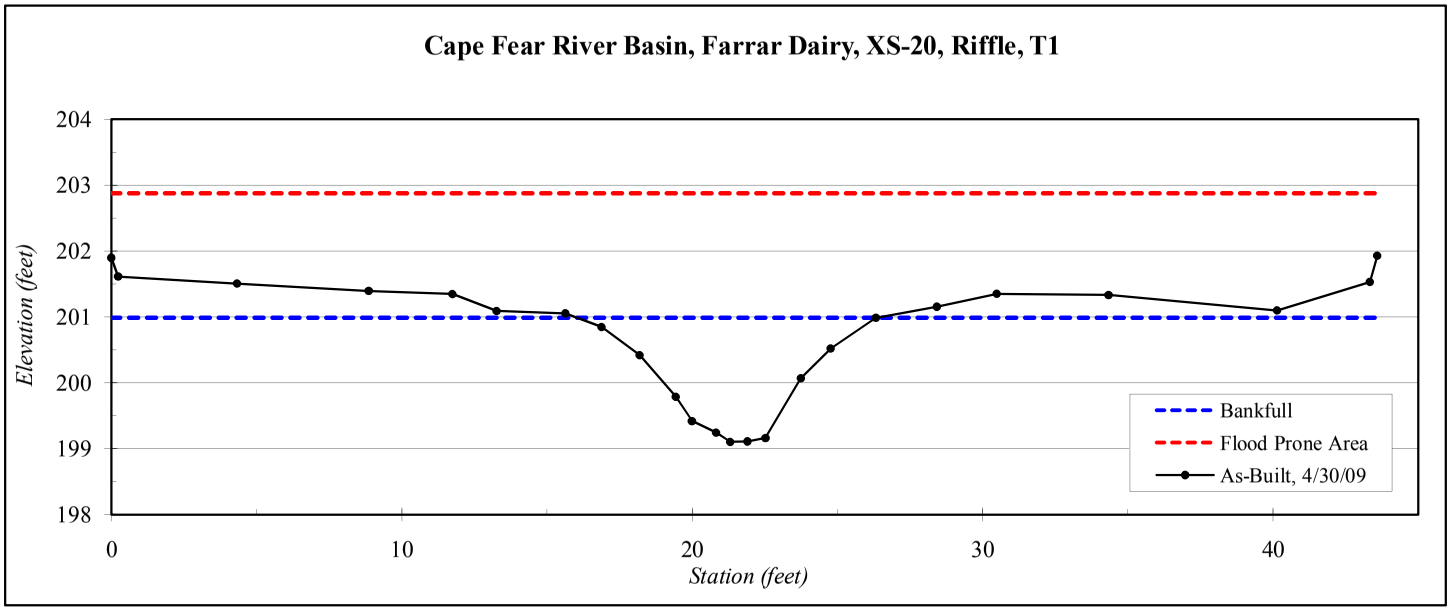


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-20, Riffle, T1
Drainage Area (sq mi):	0.18
Date:	4/30/2009
Field Crew:	A. French, B. Roberts

Station	Elevation
0.0	201.90
0.2	201.62
4.3	201.51
8.9	201.40
11.7	201.35
13.3	201.09
15.6	201.05
16.9	200.85
18.2	200.42
19.4	199.79
20.0	199.42
20.8	199.24
21.3	199.10
21.9	199.11
22.5	199.16
23.7	200.07
24.8	200.52
26.3	200.99
28.4	201.16
30.5	201.35
34.3	201.33
40.1	201.10
43.3	201.53
43.6	201.93

SUMMARY DATA	
Bankfull Elevation:	201.0
Bankfull Cross-Sectional Area:	9.7
Bankfull Width:	10.3
Flood Prone Area Elevation:	202.9
Flood Prone Width:	>60
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	0.9
W / D Ratio:	10.9
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	E5

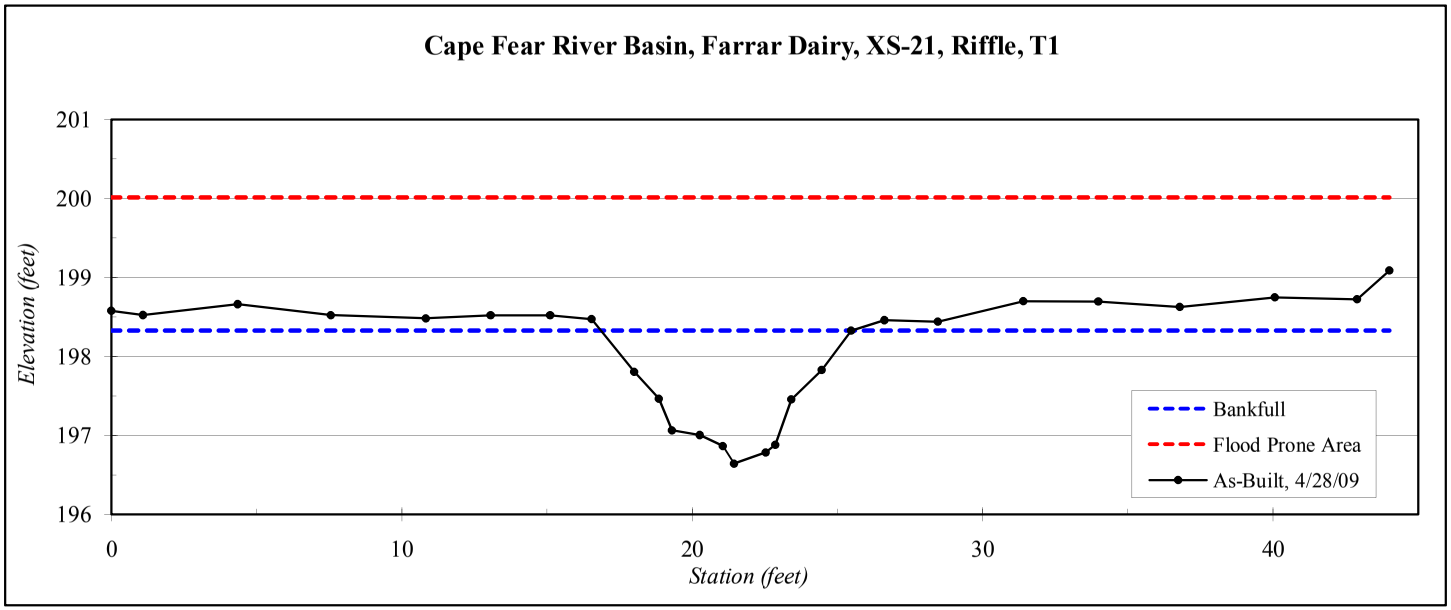


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-21, Riffle, T1
Drainage Area (sq mi):	0.18
Date:	4/28/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	198.58
1.1	198.53
4.4	198.66
7.6	198.52
10.8	198.48
13.1	198.52
15.1	198.52
16.5	198.47
18.0	197.81
18.8	197.47
19.3	197.06
20.3	197.01
21.1	196.87
21.4	196.64
22.5	196.79
22.9	196.88
23.4	197.46
24.5	197.83
25.5	198.33
26.6	198.46
28.5	198.44
31.4	198.70
34.0	198.70
36.8	198.63
40.1	198.75
42.9	198.73
44.0	199.09

SUMMARY DATA	
Bankfull Elevation:	198.3
Bankfull Cross-Sectional Area:	8.2
Bankfull Width:	8.6
Flood Prone Area Elevation:	200.0
Flood Prone Width:	>60
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	1.0
W / D Ratio:	9.0
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	E5

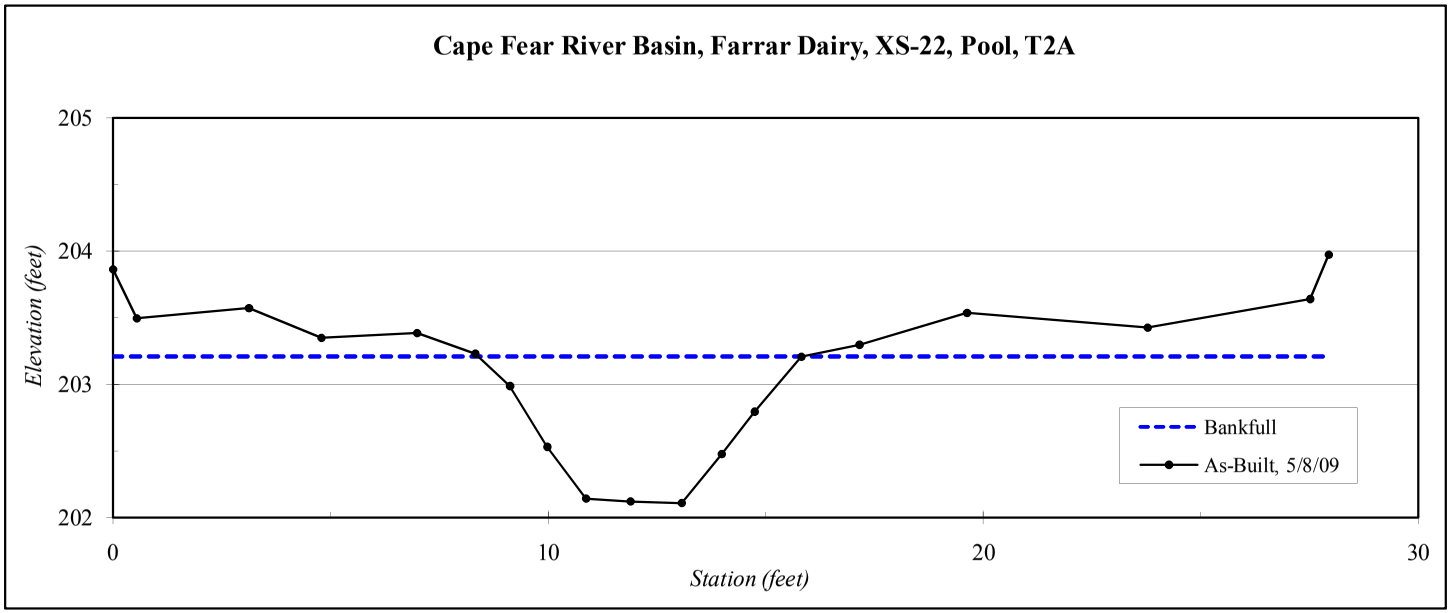


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-22, Pool, T2A
Drainage Area (sq mi):	0.04
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	203.86
0.5	203.49
3.1	203.57
4.8	203.35
7.0	203.38
8.3	203.23
9.1	202.99
10.0	202.53
10.9	202.14
11.9	202.12
13.1	202.11
14.0	202.48
14.7	202.79
15.8	203.21
17.2	203.30
19.6	203.54
23.8	203.43
27.5	203.64
27.9	203.97

SUMMARY DATA	
Bankfull Elevation:	203.2
Bankfull Cross-Sectional Area:	5.1
Bankfull Width:	7.5
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.7
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E5

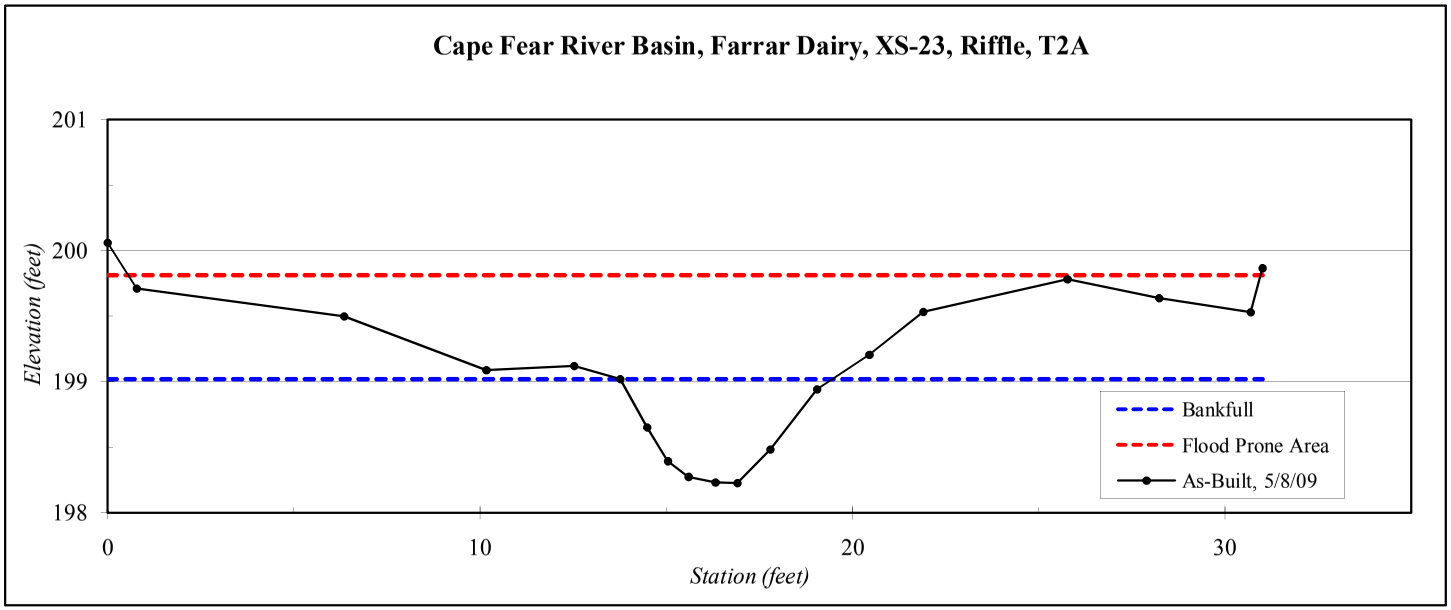


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-23, Riffle, T2A
Drainage Area (sq mi):	0.04
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	200.06
0.8	199.71
6.3	199.50
10.2	199.09
12.5	199.12
13.8	199.02
14.5	198.65
15.0	198.39
15.6	198.27
16.3	198.23
16.9	198.23
17.8	198.48
19.0	198.94
20.5	199.21
21.9	199.53
25.8	199.78
28.2	199.64
30.7	199.53
31.0	199.87

SUMMARY DATA	
Bankfull Elevation:	199.0
Bankfull Cross-Sectional Area:	2.8
Bankfull Width:	5.7
Flood Prone Area Elevation:	199.8
Flood Prone Width:	30
Max Depth at Bankfull:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	11.6
Entrenchment Ratio:	5.3
Bank Height Ratio:	1.0

Stream Type	E5

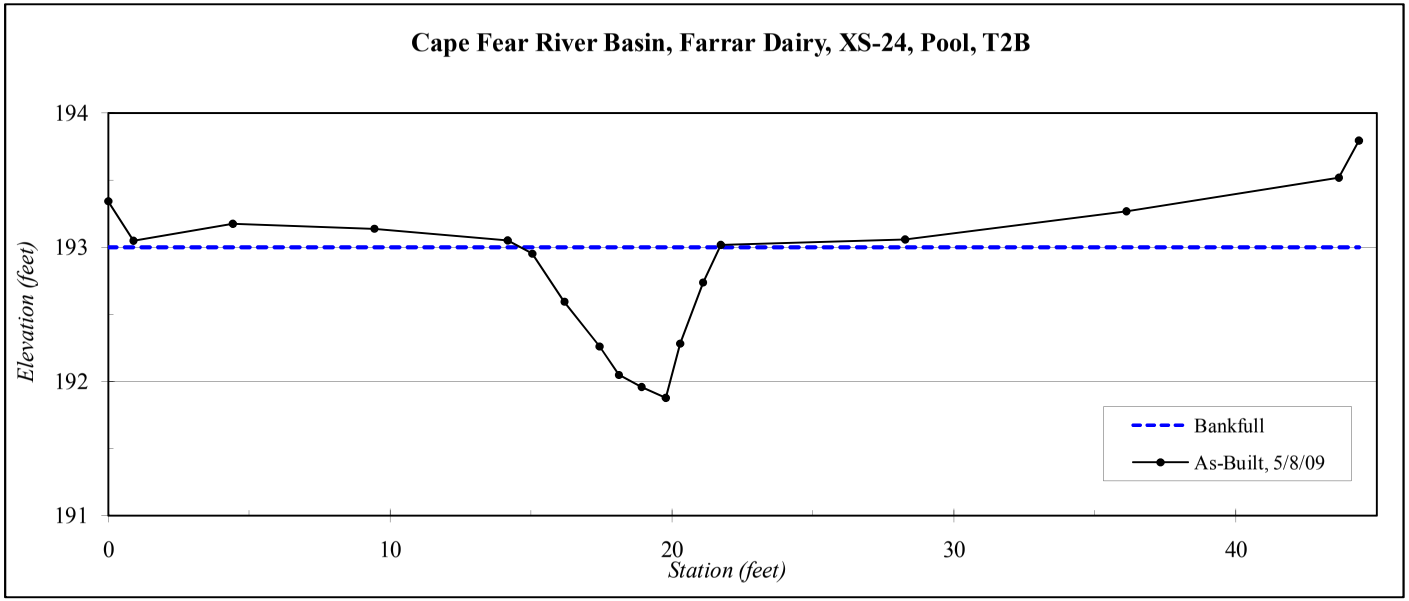


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-24, Pool, T2B
Drainage Area (sq mi):	0.04
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	193.34
0.9	193.05
4.4	193.17
9.4	193.14
14.2	193.05
15.0	192.95
16.2	192.59
17.4	192.26
18.1	192.05
18.9	191.96
19.8	191.88
20.3	192.28
21.1	192.74
21.7	193.02
28.3	193.06
36.1	193.27
43.7	193.52
44.4	193.79

SUMMARY DATA	
Bankfull Elevation:	193.0
Bankfull Cross-Sectional Area:	4.2
Bankfull Width:	7.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.1
Mean Depth at Bankfull:	0.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	E5

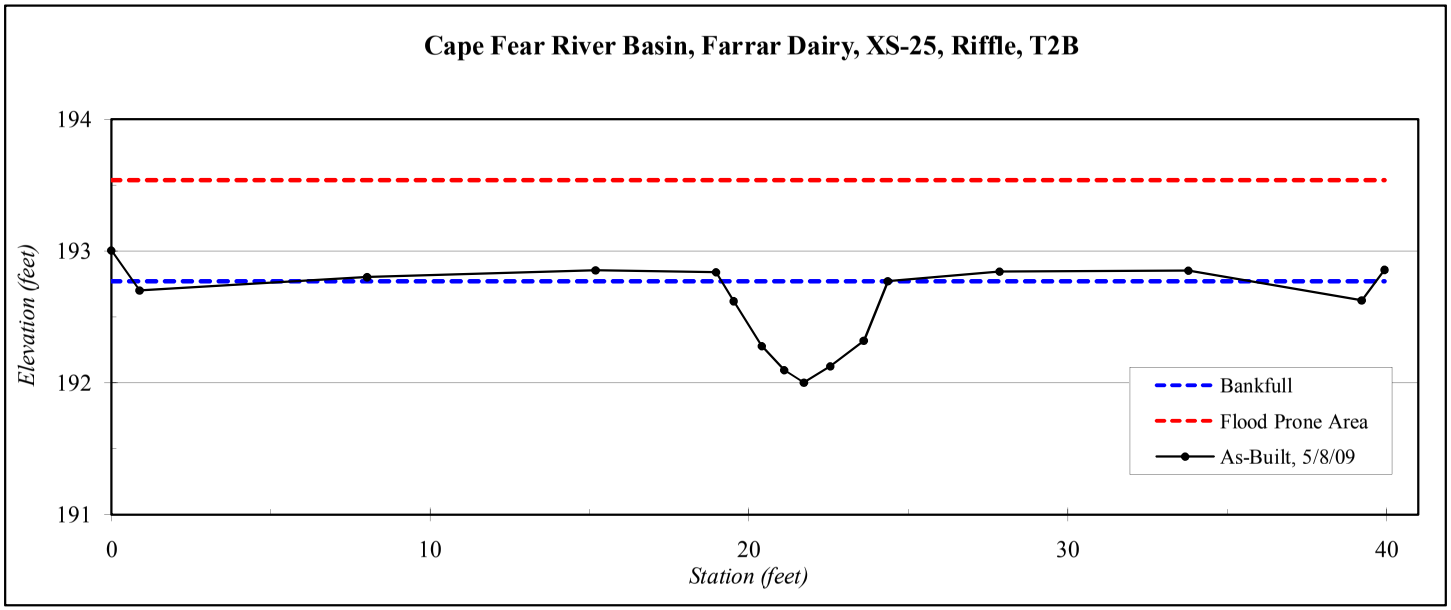


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-25, Riffle, T2B
Drainage Area (sq mi):	0.04
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	193.00
0.9	192.70
8.0	192.80
15.2	192.85
19.0	192.84
19.5	192.62
20.4	192.28
21.1	192.10
21.7	192.00
22.6	192.12
23.6	192.32
24.4	192.77
27.9	192.84
33.8	192.85
39.2	192.63
39.9	192.86

SUMMARY DATA	
Bankfull Elevation:	192.8
Bankfull Cross-Sectional Area:	2.5
Bankfull Width:	5.2
Flood Prone Area Elevation:	193.5
Flood Prone Width:	>60
Max Depth at Bankfull:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	10.8
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	E5

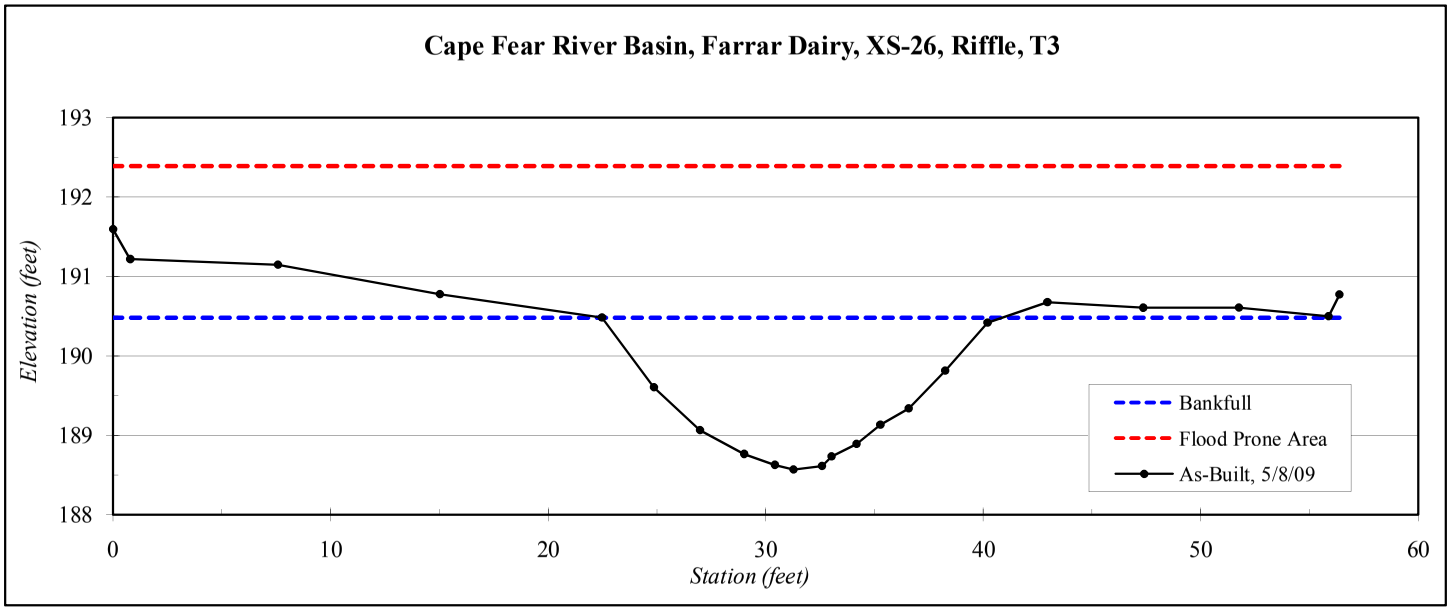


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-26, Riffle, T3
Drainage Area (sq mi):	0.39
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	191.60
0.8	191.22
7.6	191.15
15.0	190.78
22.5	190.48
24.9	189.60
27.0	189.07
29.0	188.76
30.4	188.63
31.3	188.57
32.6	188.61
33.0	188.73
34.2	188.89
35.3	189.13
36.6	189.34
38.3	189.81
40.2	190.42
43.0	190.68
47.4	190.61
51.8	190.61
55.9	190.50
56.4	190.77

SUMMARY DATA	
Bankfull Elevation:	190.5
Bankfull Cross-Sectional Area:	21.4
Bankfull Width:	18.4
Flood Prone Area Elevation:	192.4
Flood Prone Width:	>60
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	15.8
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5

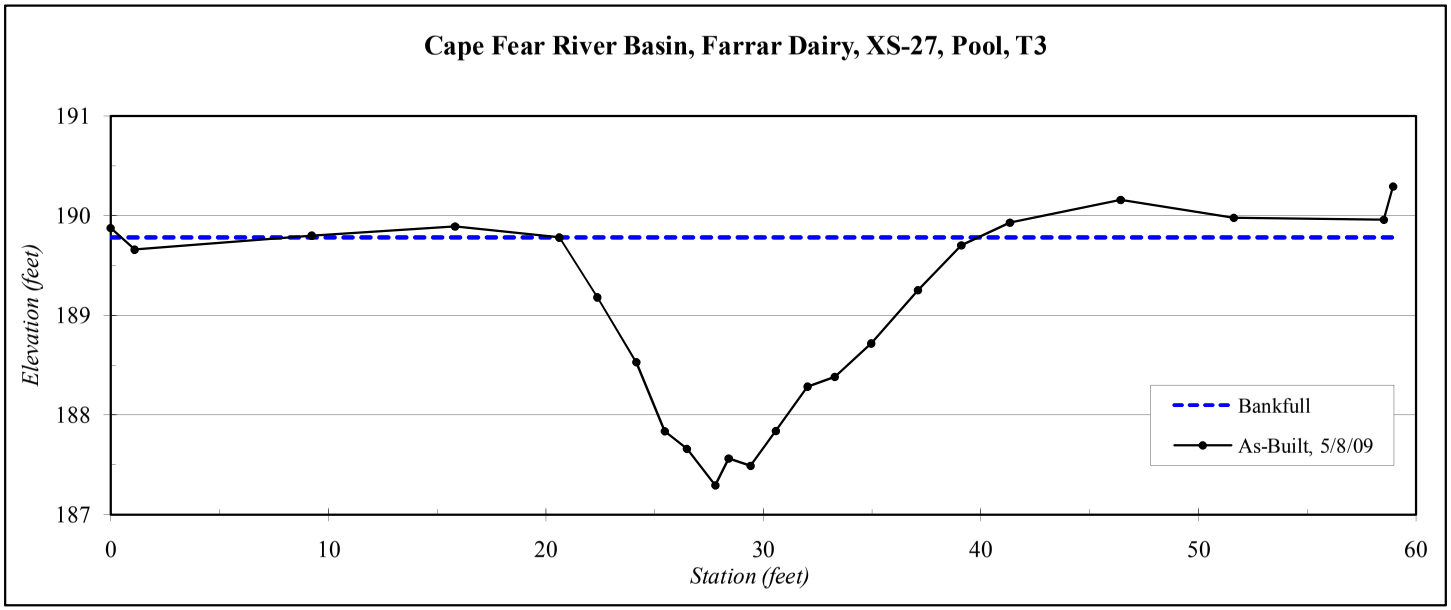


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-27, Pool, T3
Drainage Area (sq mi):	0.39
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.87
1.1	189.66
9.2	189.80
15.8	189.89
20.6	189.78
22.4	189.18
24.2	188.53
25.5	187.84
26.5	187.66
27.8	187.29
28.4	187.56
29.4	187.49
30.6	187.84
32.0	188.28
33.3	188.38
35.0	188.72
37.1	189.25
39.1	189.70
41.3	189.93
46.4	190.16
51.6	189.98
58.5	189.96
58.9	190.29

SUMMARY DATA	
Bankfull Elevation:	189.8
Bankfull Cross-Sectional Area:	24.2
Bankfull Width:	19.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.3
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

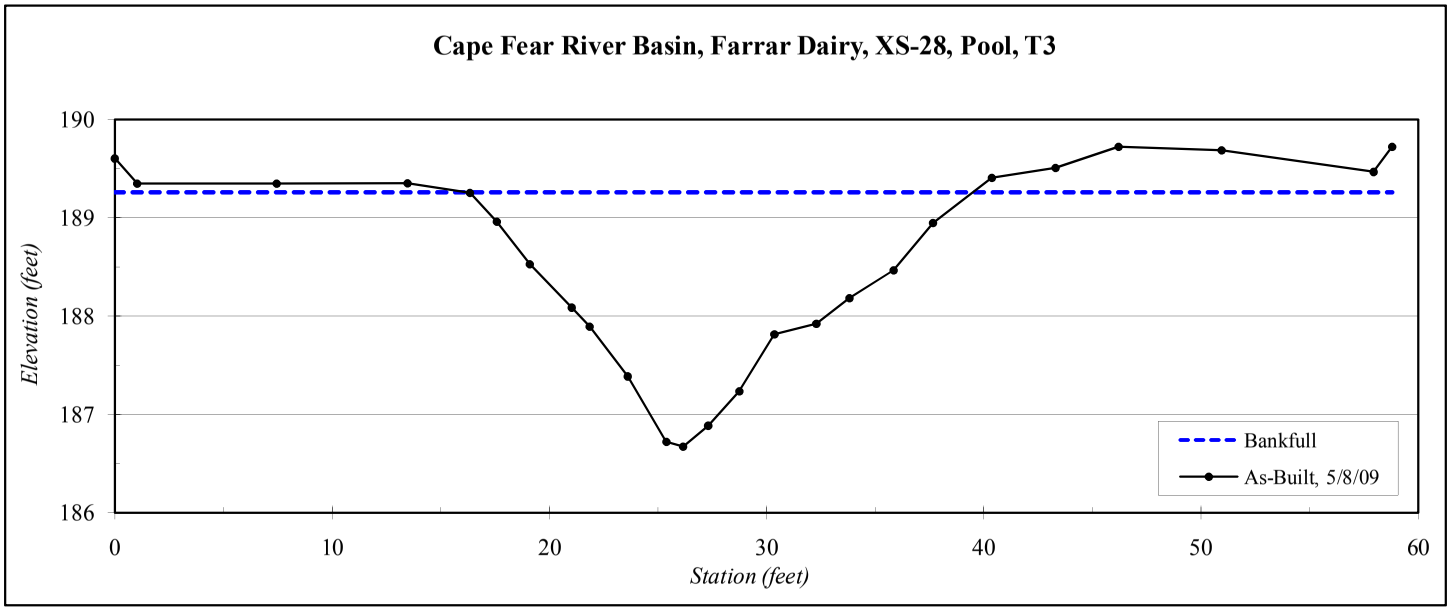


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-28, Pool, T3
Drainage Area (sq mi):	0.39
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.60
1.0	189.35
7.4	189.35
13.5	189.35
16.3	189.26
17.6	188.96
19.1	188.53
21.0	188.09
21.9	187.89
23.6	187.39
25.4	186.72
26.2	186.67
27.3	186.88
28.7	187.23
30.4	187.82
32.3	187.92
33.8	188.18
35.8	188.47
37.7	188.95
40.4	189.41
43.3	189.51
46.2	189.72
51.0	189.69
57.9	189.47
58.8	189.72

SUMMARY DATA	
Bankfull Elevation:	189.3
Bankfull Cross-Sectional Area:	29.1
Bankfull Width:	23.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.6
Mean Depth at Bankfull:	1.2
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C5

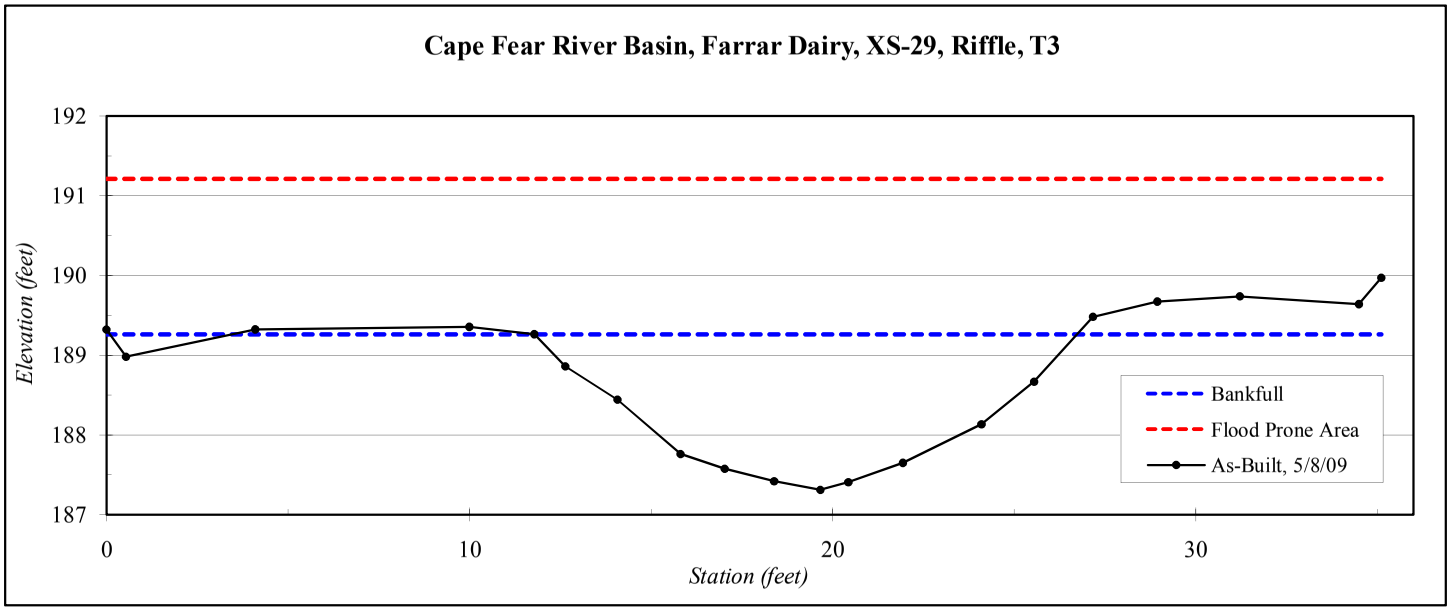


River Basin:	Cape Fear
Watershed:	Farrar Dairy
XS ID	XS-29, Riffle, T3
Drainage Area (sq mi):	0.39
Date:	5/8/2009
Field Crew:	A. French, K. O'Briant

Station	Elevation
0.0	189.32
0.5	188.98
4.1	189.32
10.0	189.35
11.8	189.26
12.6	188.86
14.1	188.44
15.8	187.76
17.0	187.58
18.4	187.42
19.7	187.31
20.4	187.41
21.9	187.65
24.1	188.13
25.5	188.67
27.2	189.48
28.9	189.67
31.2	189.74
34.5	189.64
35.1	189.97

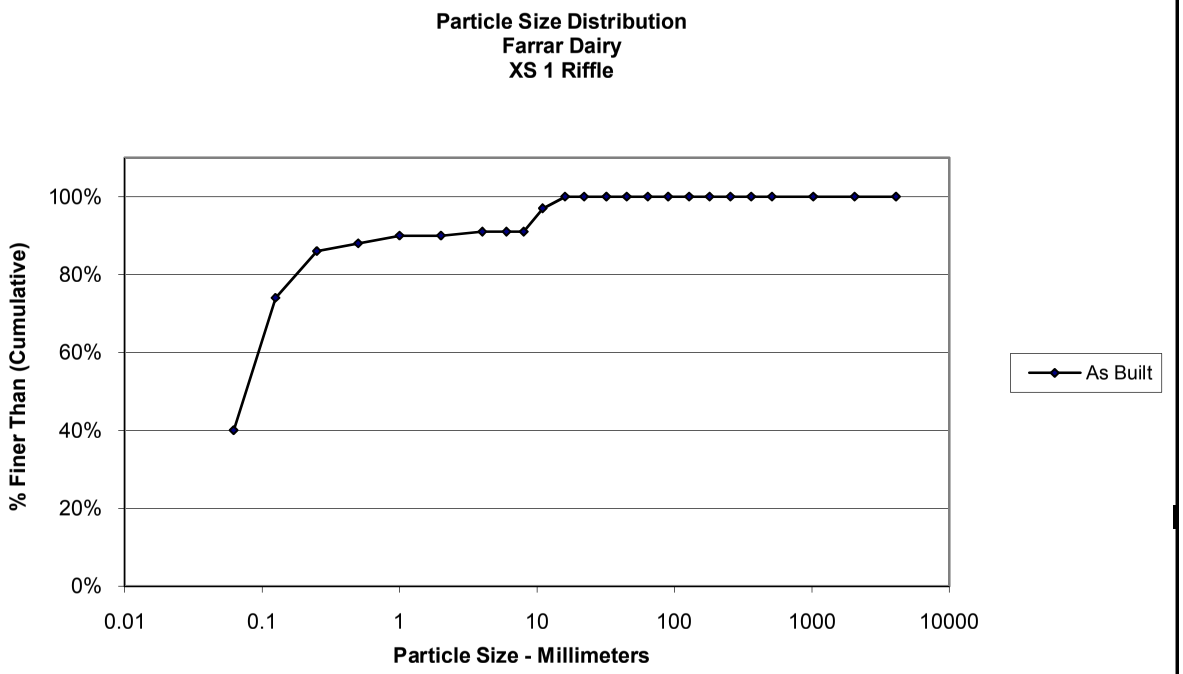
SUMMARY DATA	
Bankfull Elevation:	189.3
Bankfull Cross-Sectional Area:	18.4
Bankfull Width:	14.9
Flood Prone Area Elevation:	191.2
Flood Prone Width:	>60
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.2
W / D Ratio:	12.1
Entrenchment Ratio:	>3.0
Bank Height Ratio:	1.0

Stream Type	C5



Cross-Section 1 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	40
Very Fine	.062 - .125	S	34
Fine	.125 - .25	A	12
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	
Very Fine	2 - 4		1
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	6
Medium	11.3 - 16	V	3
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



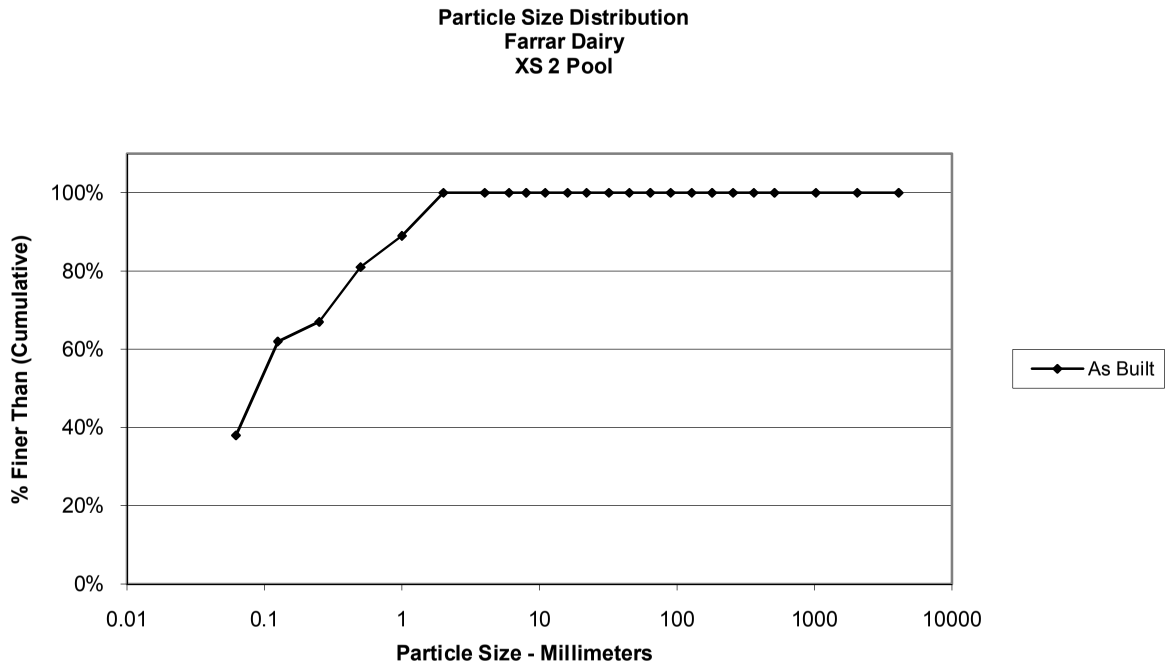
Size (mm)	
D16	0.062
D35	0.062
D50	0.076
D65	0.1
D84	0.22
D95	9.9

Size Distribution	
mean	0.1
dispersion	2.1
skewness	0.25

Type	
silt/clay	40%
sand	50%
gravel	10%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	38
Very Fine	.062 - .125	S	24
Fine	.125 - .25	A	5
Medium	.25 - .50	N	14
Coarse	.50 - 1	D	8
Very Coarse	1 - 2	S	11
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



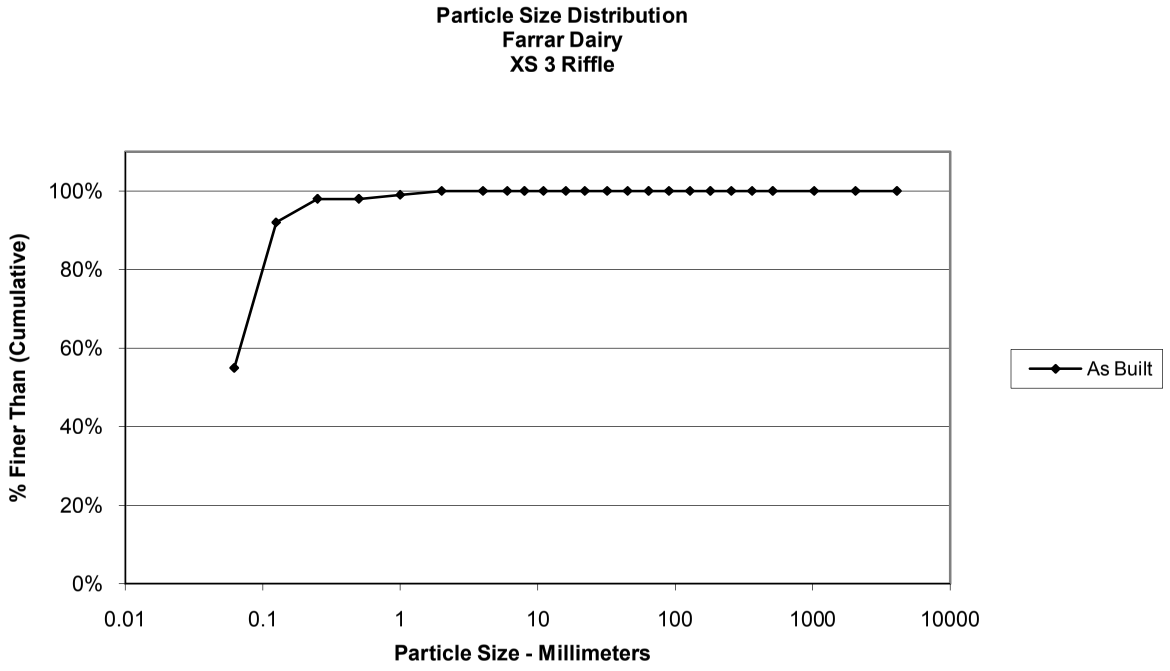
Size (mm)	
D16	0.062
D35	0.062
D50	0.088
D65	0.19
D84	0.65
D95	1.5

Size Distribution	
mean	0.2
dispersion	4.4
skewness	0.35

Type	
silt/clay	38%
sand	62%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	55
Very Fine	.062 - .125	S	37
Fine	.125 - .25	A	6
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	1
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



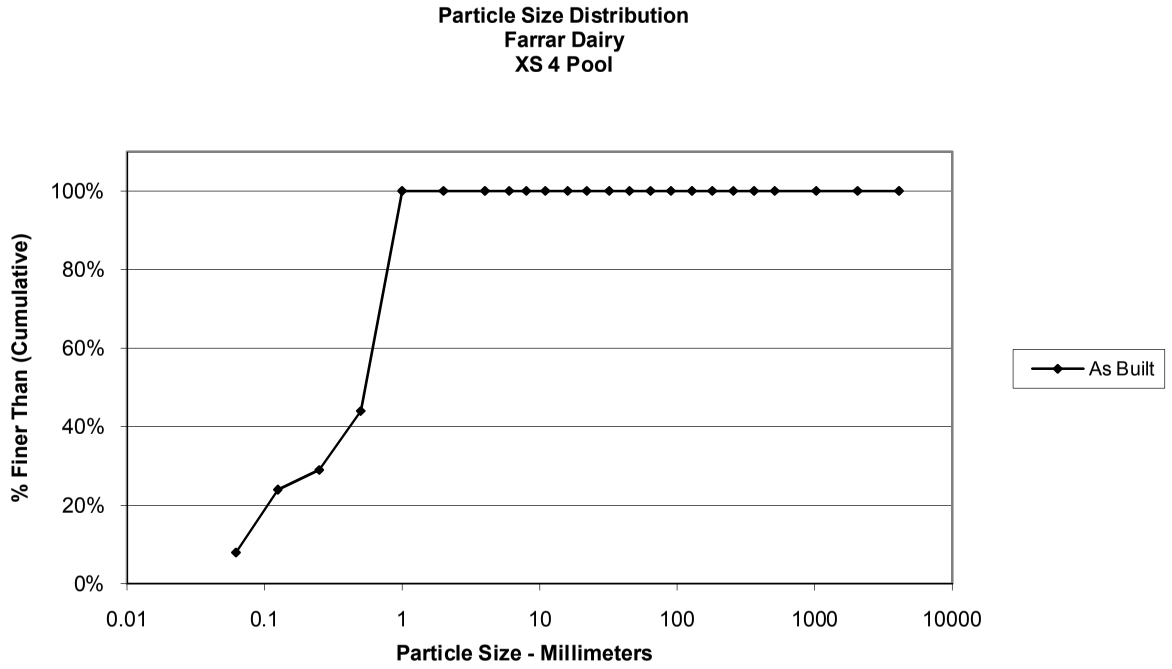
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.075
D84	0.11
D95	0.18

Size Distribution	
mean	0.1
dispersion	1.4
skewness	0.25

Type	
silt/clay	55%
sand	45%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	8
Very Fine	.062 - .125	S	16
Fine	.125 - .25	A	5
Medium	.25 - .50	N	15
Coarse	.50 - 1	D	56
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



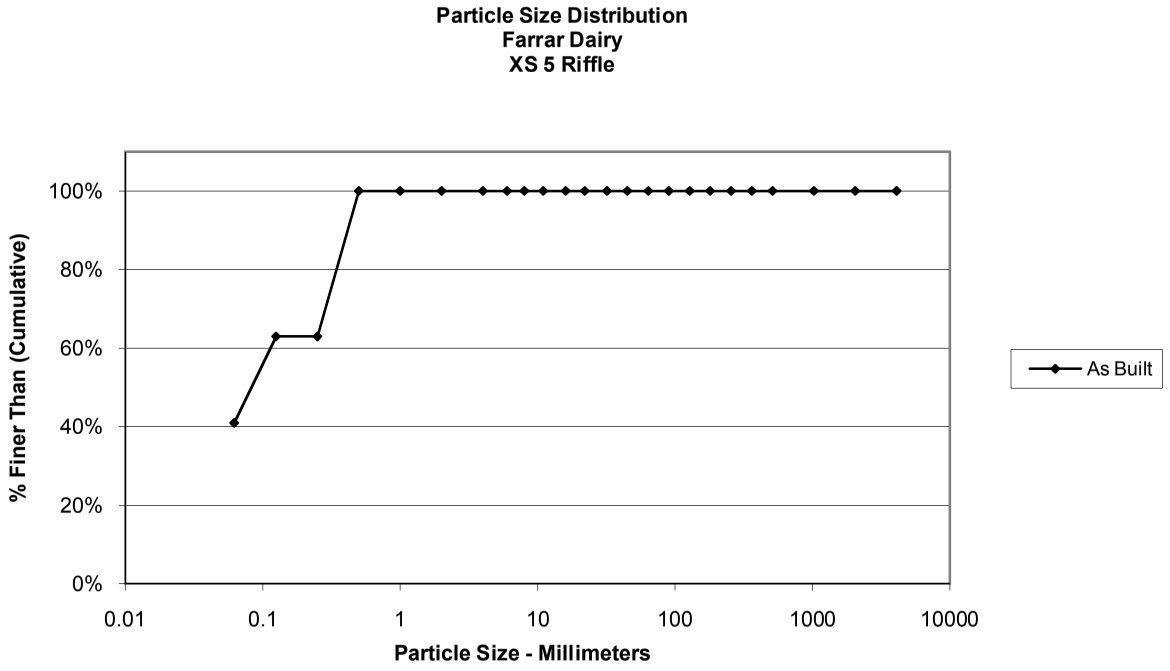
Size (mm)	
D16	0.088
D35	0.33
D50	0.54
D65	0.65
D84	0.82
D95	0.94

Size Distribution	
mean	0.3
dispersion	3.8
skewness	-0.31

Type	
silt/clay	8%
sand	92%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	41
Very Fine	.062 - .125	S	22
Fine	.125 - .25	A	
Medium	.25 - .50	N	37
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



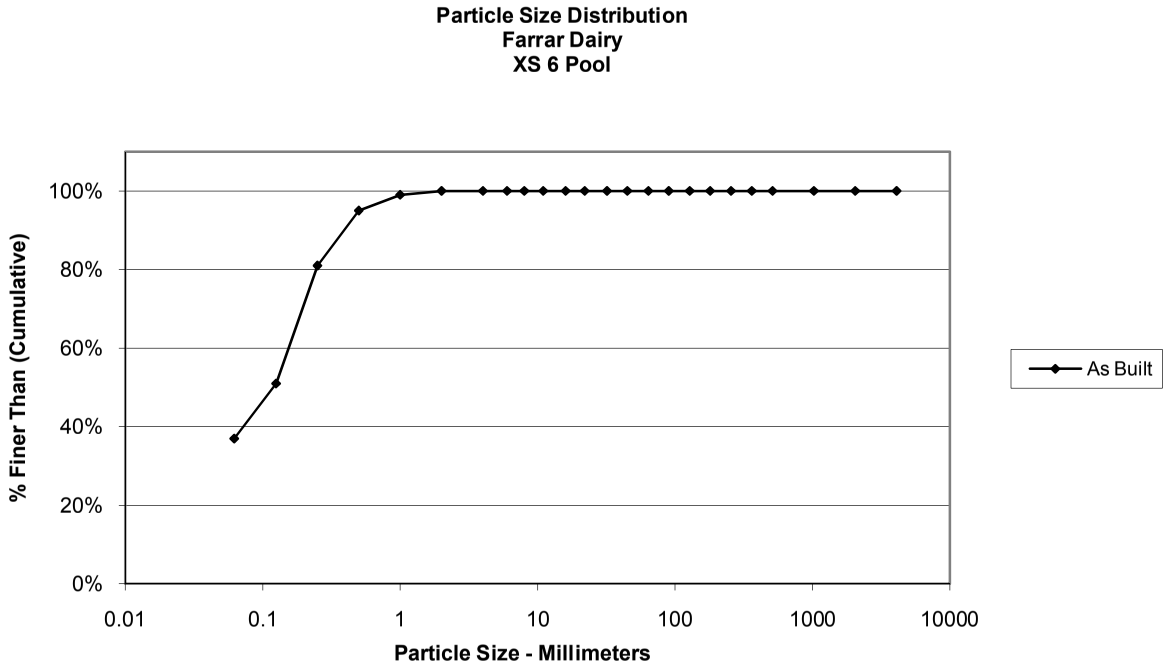
Size (mm)	
D16	0.062
D35	0.062
D50	0.083
D65	0.26
D84	0.37
D95	0.46

Size Distribution	
mean	0.2
dispersion	2.9
skewness	0.30

Type	
silt/clay	41%
sand	59%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	37
Very Fine	.062 - .125	S	14
Fine	.125 - .25	A	30
Medium	.25 - .50	N	14
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	1
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



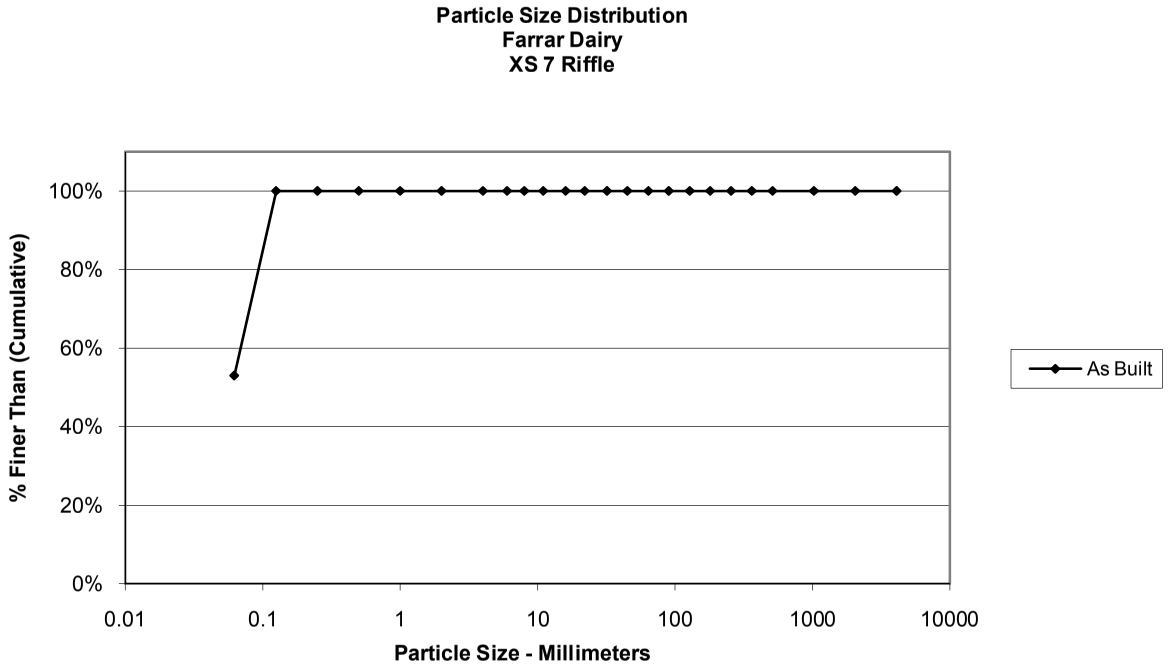
Size (mm)	
D16	0.062
D35	0.062
D50	0.12
D65	0.17
D84	0.29
D95	0.5

Size Distribution	
mean	0.1
dispersion	2.2
skewness	0.06

Type	
silt/clay	37%
sand	63%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	53
Very Fine	.062 - .125	S	47
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



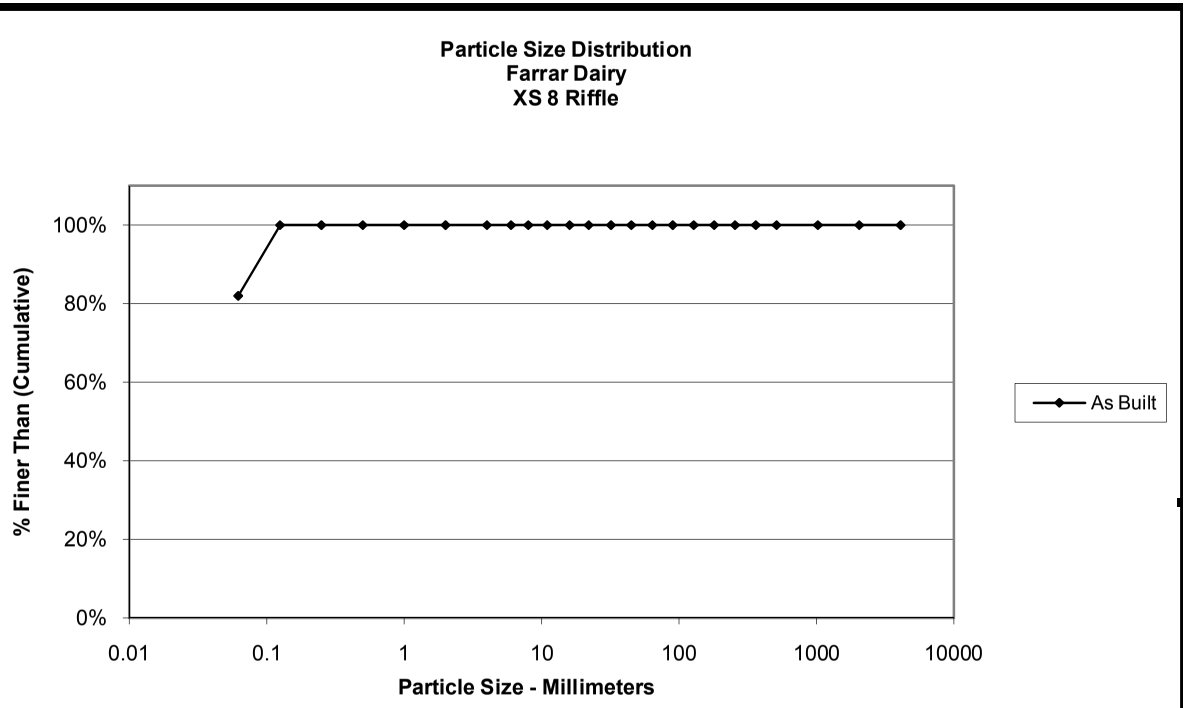
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.074
D84	0.098
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.22

Type	
silt/clay	53%
sand	47%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 8 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	82
Very Fine	.062 - .125	S	18
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



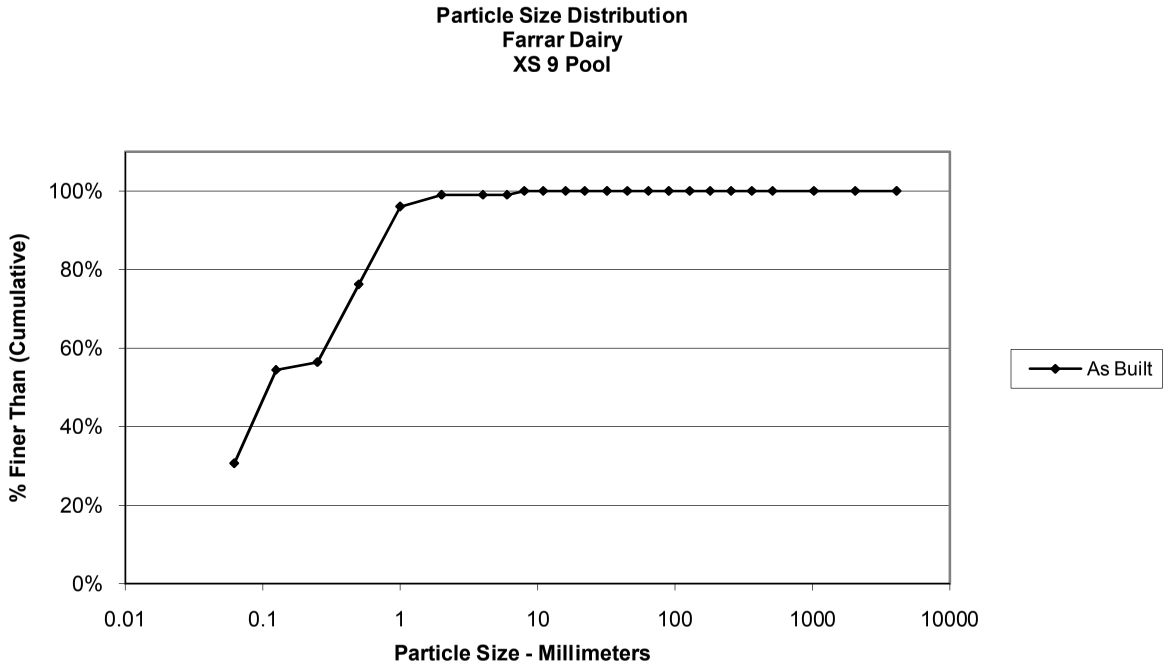
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.067
D95	0.1

Size Distribution	
mean	0.1
dispersion	1.0
skewness	0.09

Type	
silt/clay	82%
sand	18%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	31
Very Fine	.062 - .125	S	24
Fine	.125 - .25	A	2
Medium	.25 - .50	N	20
Coarse	.50 - 1	D	20
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	101

Note:



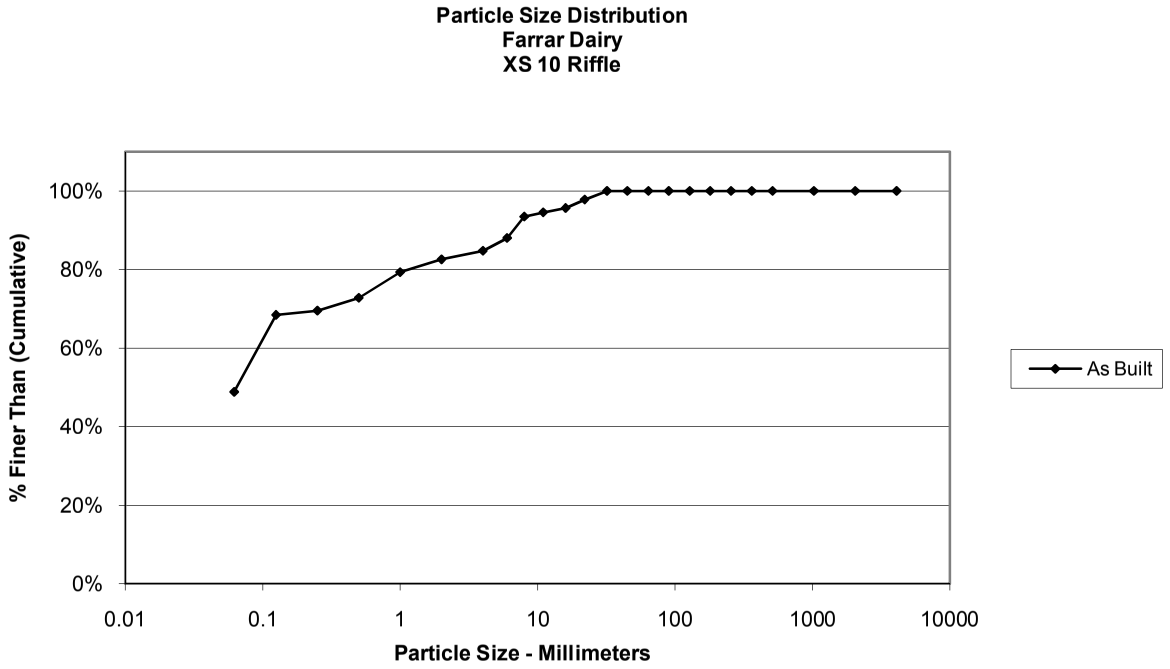
Size (mm)	
D16	0.062
D35	0.07
D50	0.11
D65	0.34
D84	0.66
D95	0.96

Size Distribution	
mean	0.2
dispersion	3.9
skewness	0.26

Type	
silt/clay	31%
sand	68%
gravel	1%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 10 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	45
Very Fine	.062 - .125	S	18
Fine	.125 - .25	A	1
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	6
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		2
Fine	4 - 5.7	G	3
Fine	5.7 - 8	R	5
Medium	8 - 11.3	A	1
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	92

Note:



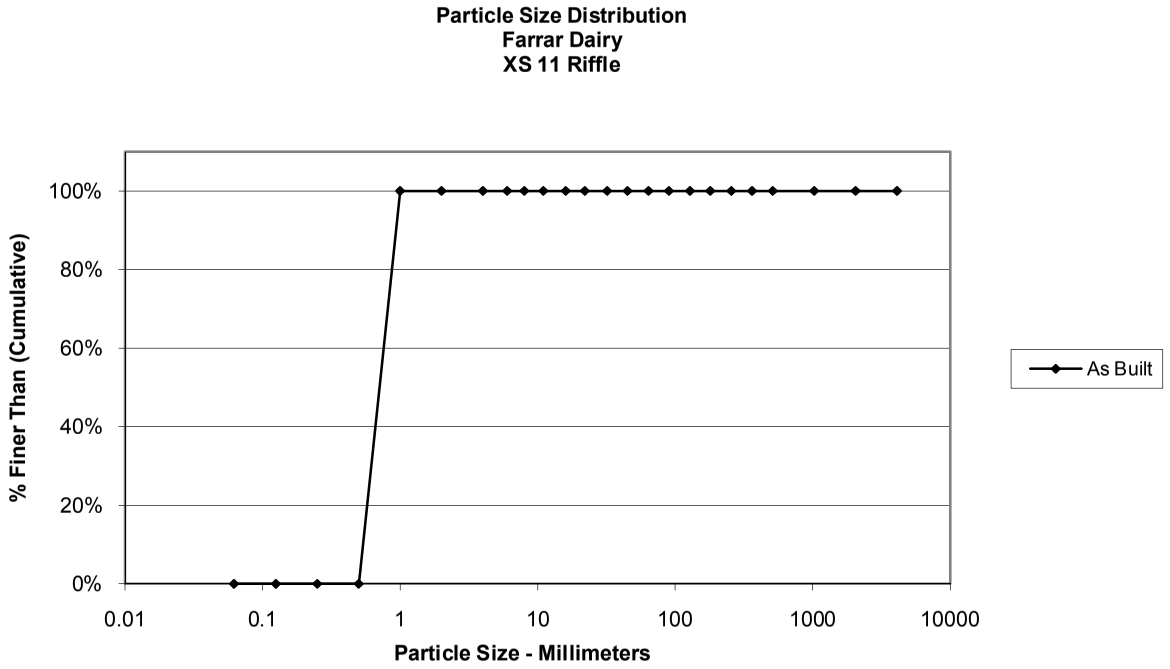
Size (mm)	
D16	0.062
D35	0.062
D50	0.064
D65	0.11
D84	3.1
D95	13

Size Distribution	
mean	0.4
dispersion	24.7
skewness	0.64

Type	
silt/clay	49%
sand	34%
gravel	17%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 11 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	100
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



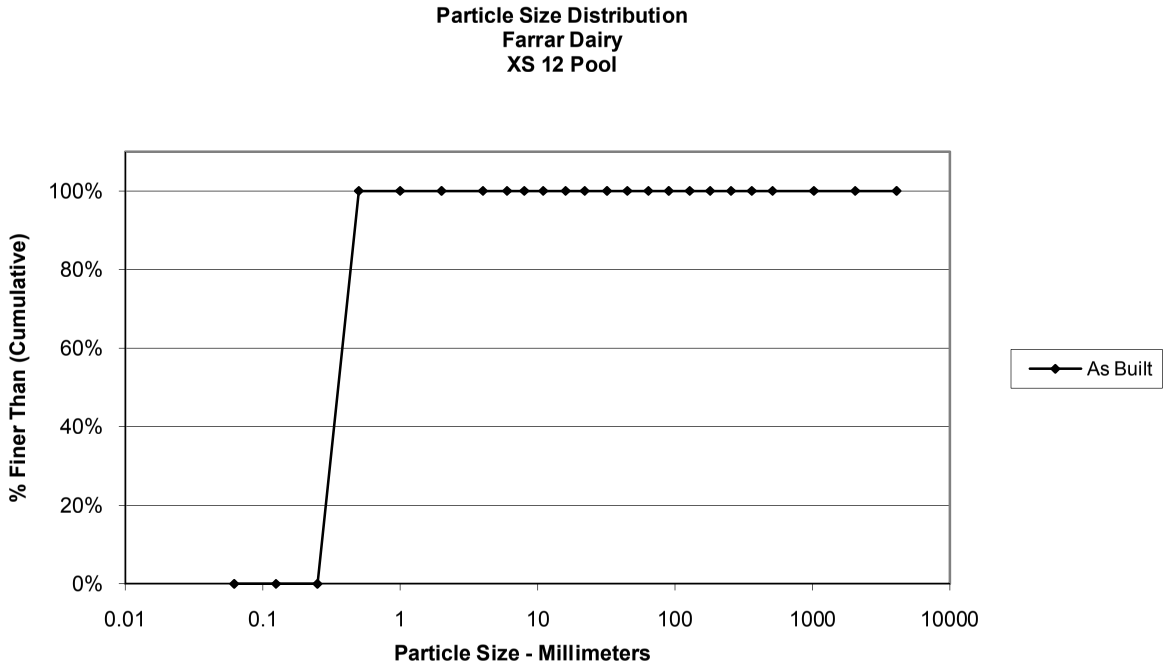
Size (mm)	
D16	0.56
D35	0.64
D50	0.71
D65	0.78
D84	0.9
D95	0.97

Size Distribution	
mean	0.7
dispersion	1.3
skewness	0.00

Type	
silt/clay	0%
sand	100%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 12 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	100
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



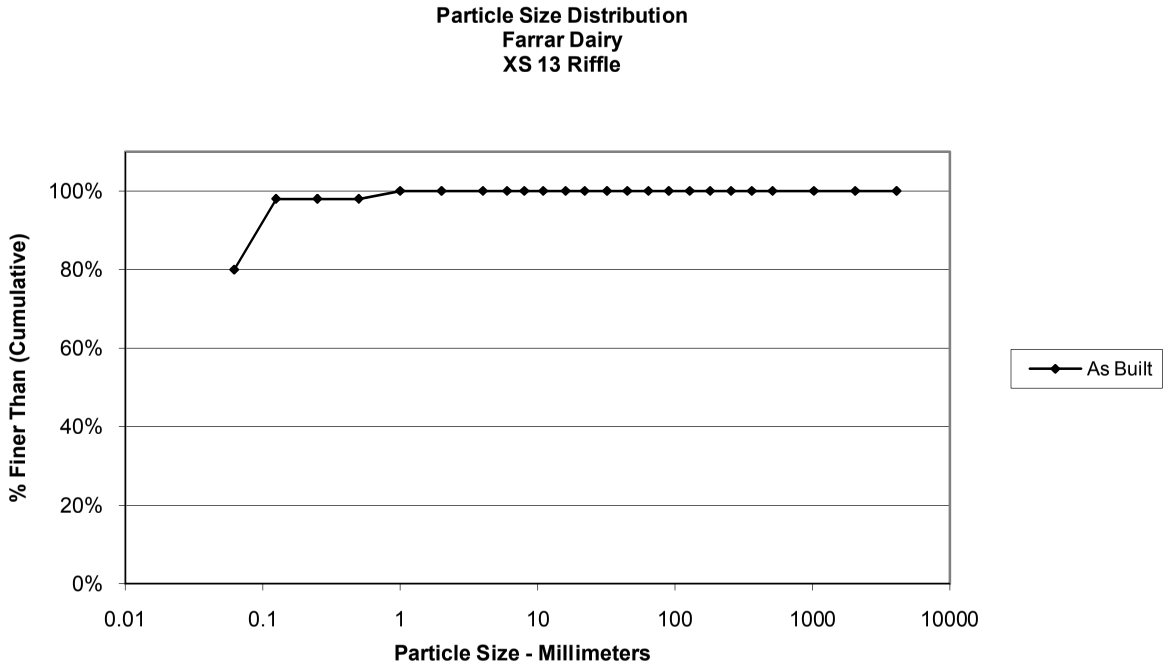
Size (mm)	
D16	0.28
D35	0.32
D50	0.35
D65	0.39
D84	0.45
D95	0.48

Size Distribution	
mean	0.4
dispersion	1.3
skewness	0.01

Type	
silt/clay	0%
sand	100%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 13 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	80
Very Fine	.062 - .125	S	18
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



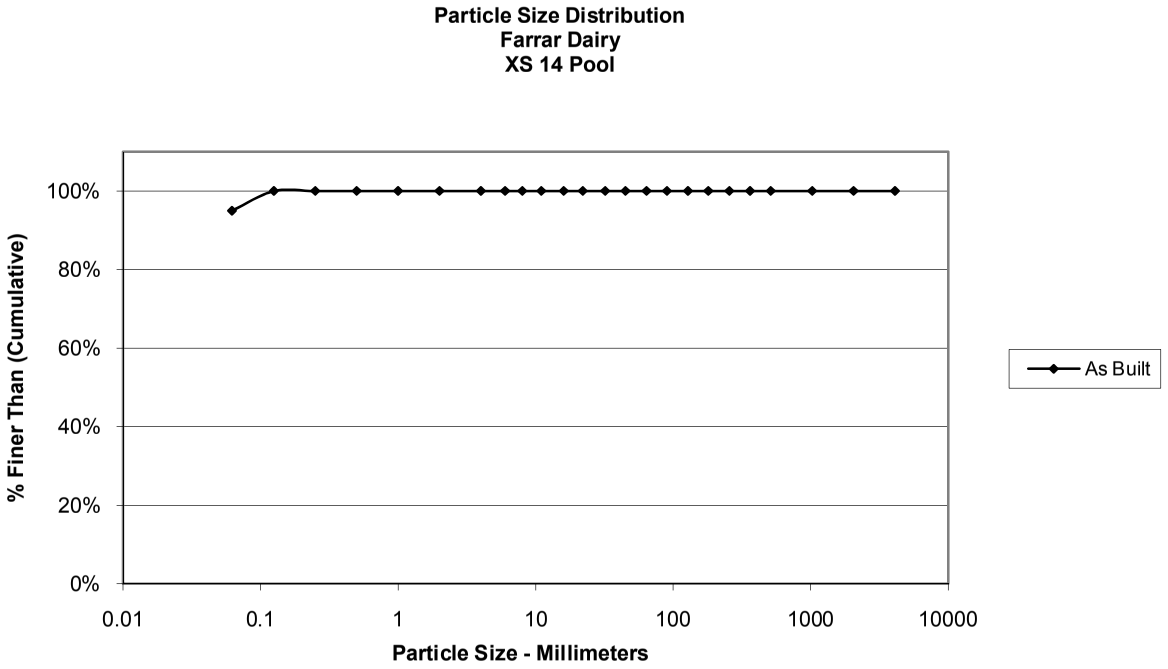
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.072
D95	0.11

Size Distribution	
mean	0.1
dispersion	1.1
skewness	0.13

Type	
silt/clay	80%
sand	20%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 14 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	95
Very Fine	.062 - .125	S	5
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



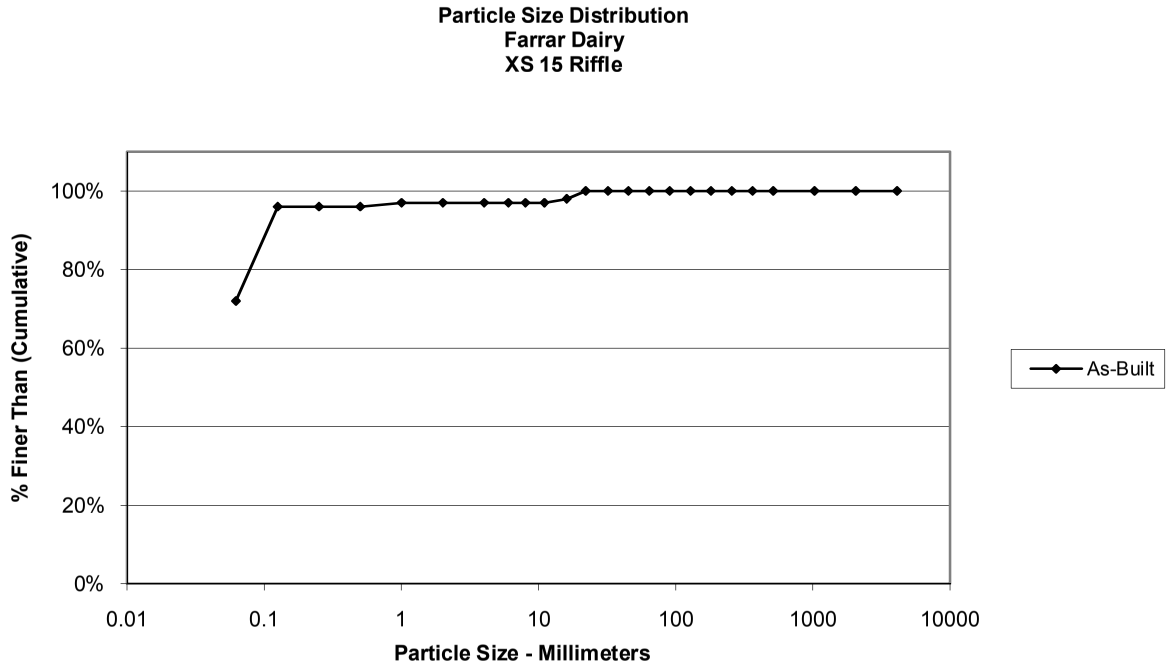
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	95%
sand	5%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 15 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	72
Very Fine	.062 - .125	S	24
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



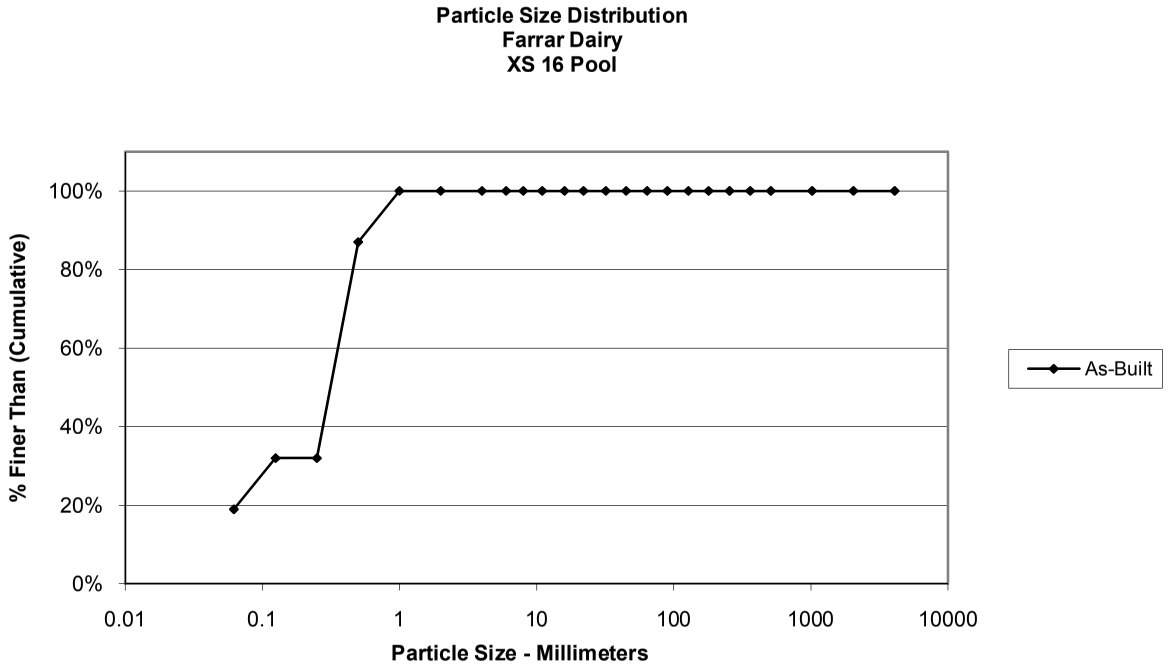
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.088
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.2
skewness	0.19

Type	
silt/clay	72%
sand	25%
gravel	3%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 16 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	19
Very Fine	.062 - .125	S	13
Fine	.125 - .25	A	
Medium	.25 - .50	N	55
Coarse	.50 - 1	D	13
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



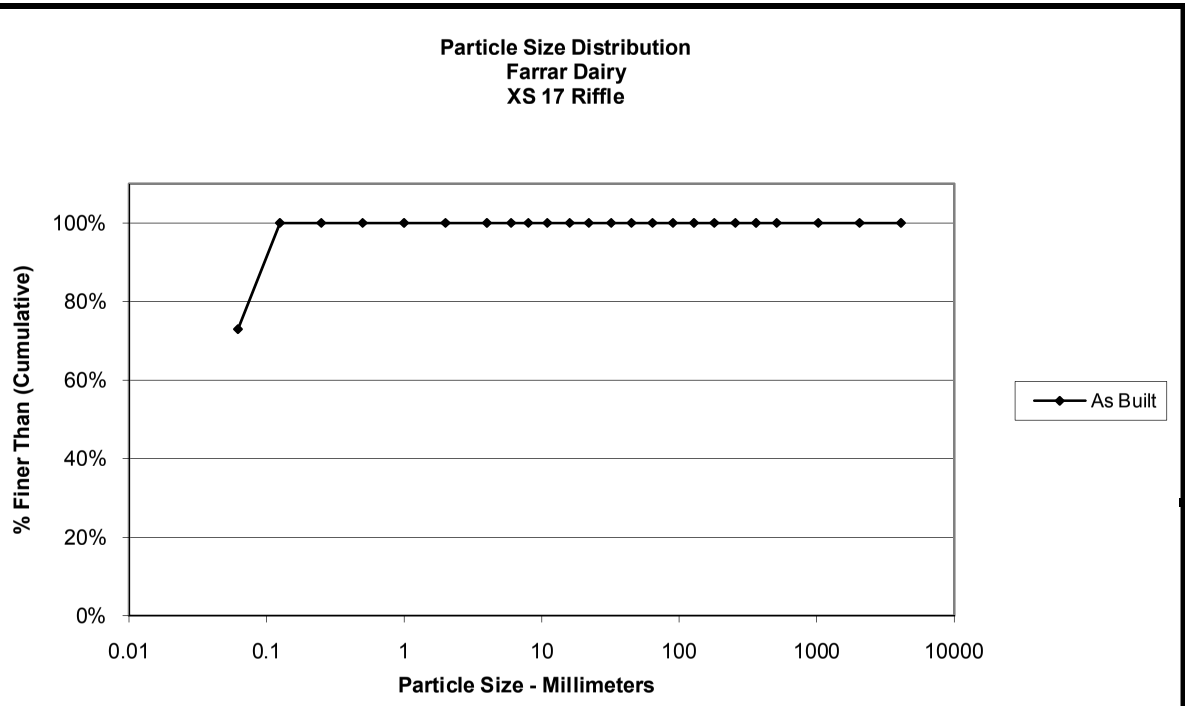
Size (mm)	
D16	0.062
D35	0.26
D50	0.31
D65	0.38
D84	0.48
D95	0.77

Size Distribution	
mean	0.2
dispersion	3.3
skewness	-0.27

Type	
silt/clay	19%
sand	81%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 17 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	73
Very Fine	.062 - .125	S	27
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



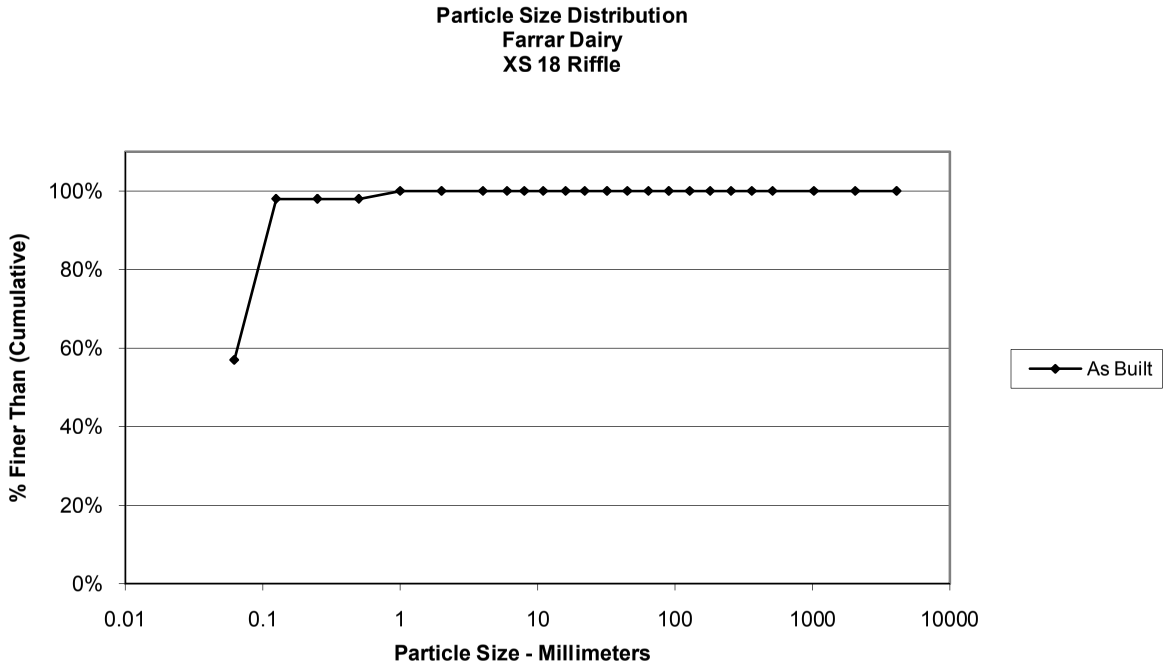
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.083
D95	0.11

Size Distribution	
mean	0.1
dispersion	1.2
skewness	0.18

Type	
silt/clay	73%
sand	27%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 18 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	57
Very Fine	.062 - .125	S	41
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



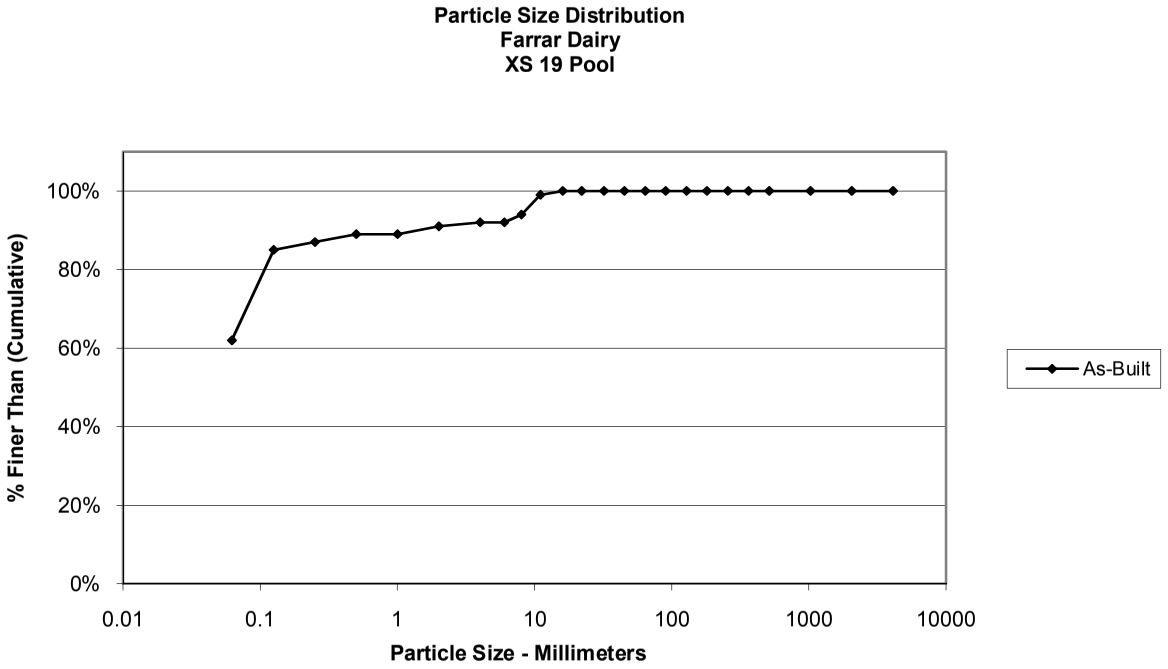
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.071
D84	0.098
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.22

Type	
silt/clay	57%
sand	43%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 19 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	62
Very Fine	.062 - .125	S	23
Fine	.125 - .25	A	2
Medium	.25 - .50	N	2
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	2
Very Fine	2 - 4		1
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



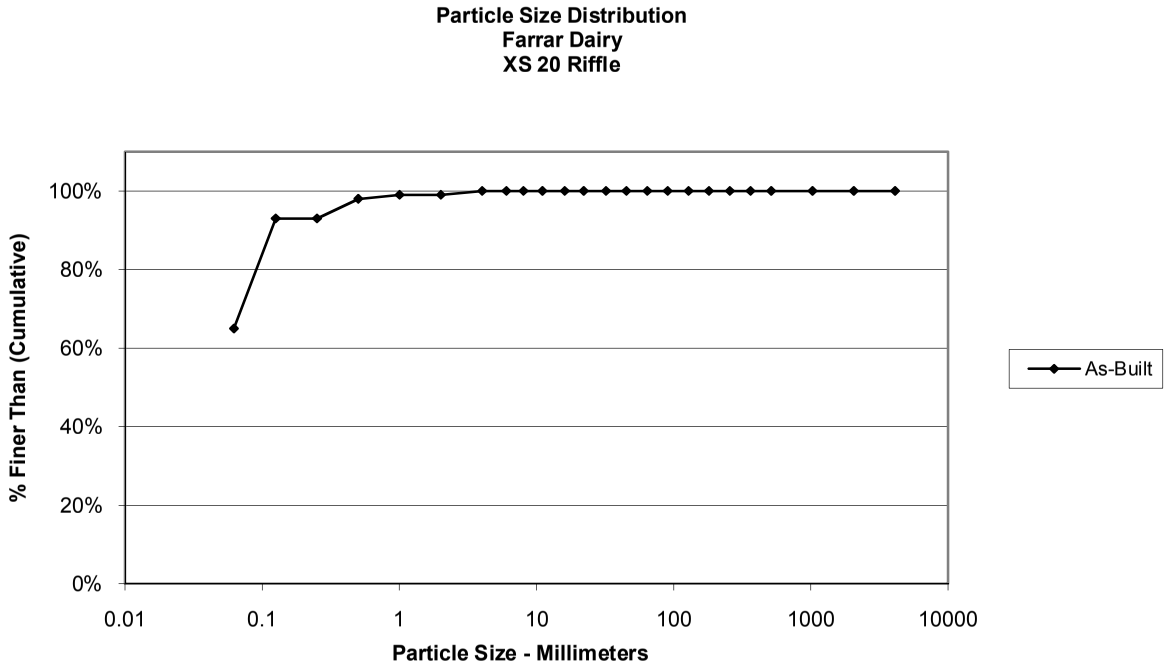
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.068
D84	0.12
D95	8.5

Size Distribution	
mean	0.1
dispersion	1.5
skewness	0.27

Type	
silt/clay	62%
sand	29%
gravel	9%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 20 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	65
Very Fine	.062 - .125	S	28
Fine	.125 - .25	A	
Medium	.25 - .50	N	5
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	
Very Fine	2 - 4		1
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



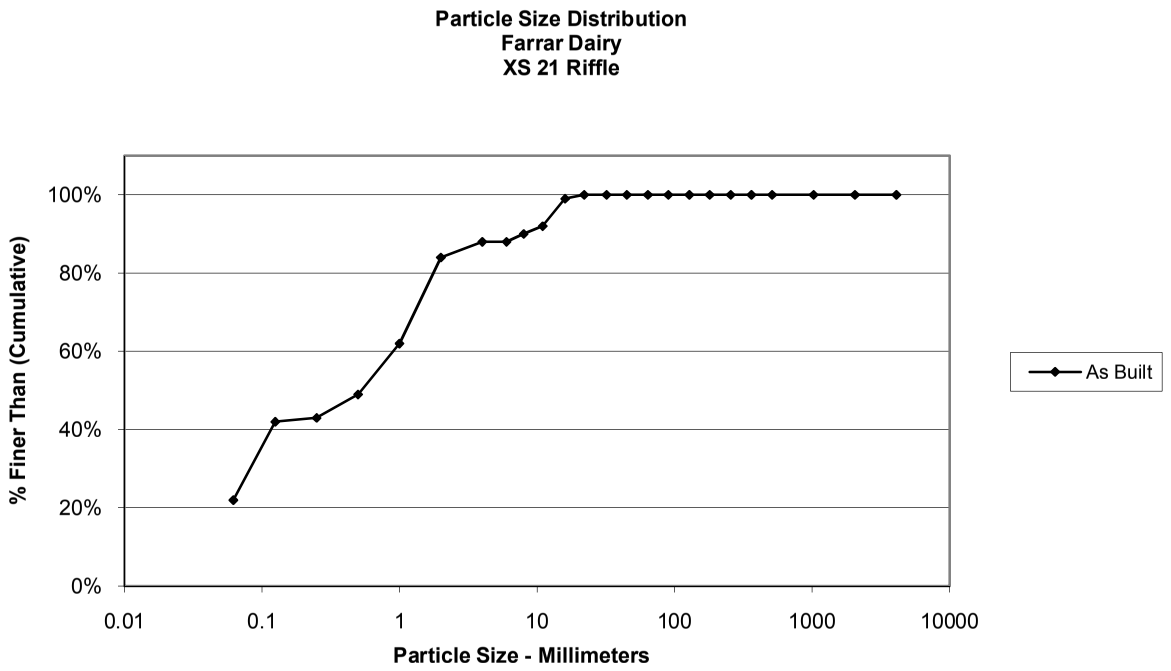
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.1
D95	0.33

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.23

Type	
silt/clay	65%
sand	34%
gravel	1%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 21 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	22
Very Fine	.062 - .125	S	20
Fine	.125 - .25	A	1
Medium	.25 - .50	N	6
Coarse	.50 - 1	D	13
Very Coarse	1 - 2	S	22
Very Fine	2 - 4		4
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	2
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



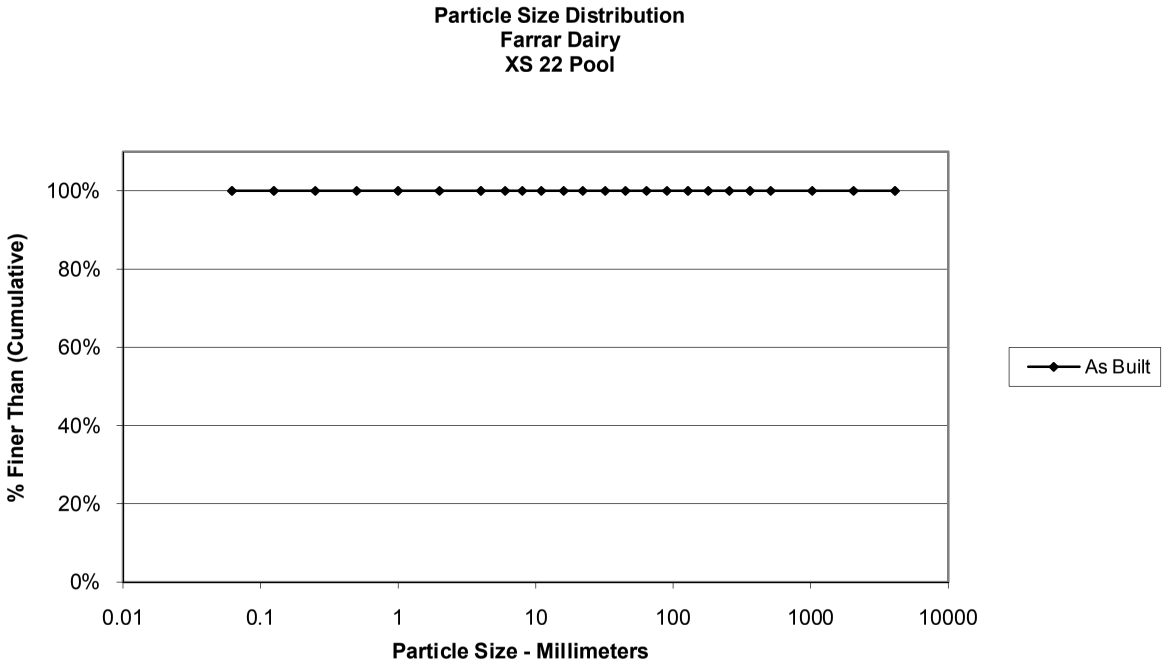
Size (mm)	
D16	0.062
D35	0.098
D50	0.53
D65	1.1
D84	2
D95	13

Size Distribution	
mean	0.4
dispersion	6.2
skewness	-0.14

Type	
silt/clay	22%
sand	62%
gravel	16%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 22 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	100
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



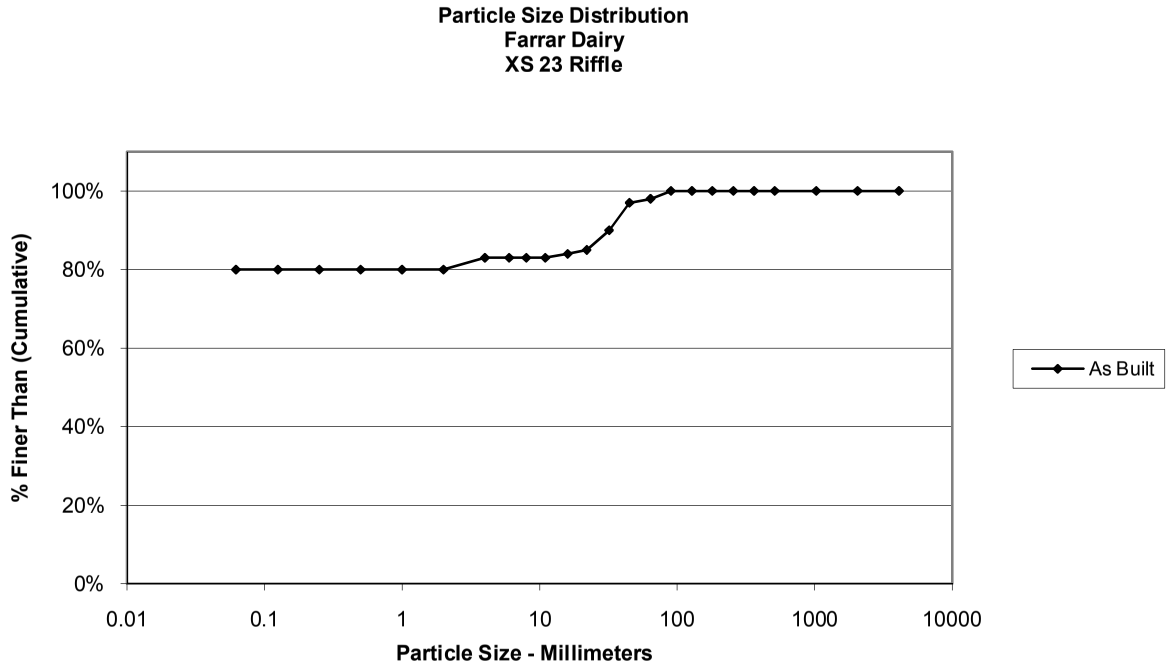
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 23 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	80
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		3
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	1
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	7
Very Coarse	45 - 64		1
Small	64 - 90	C	2
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



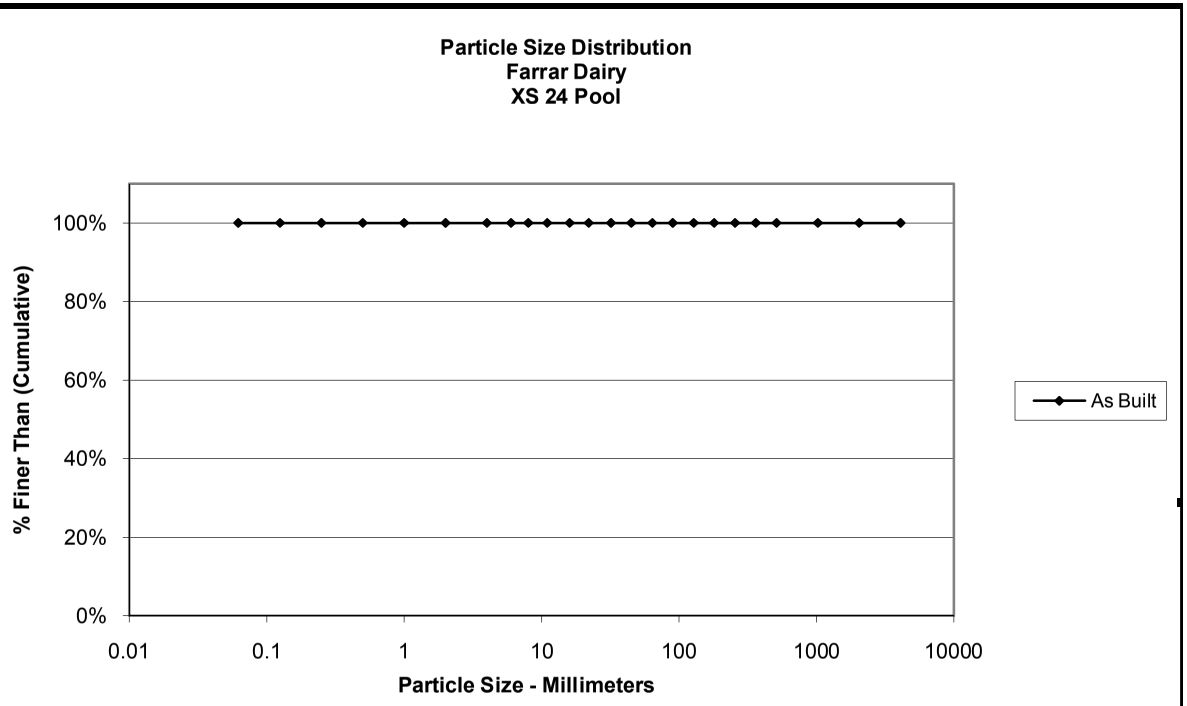
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	16
D95	41

Size Distribution	
mean	1.0
dispersion	129.5
skewness	0.78

Type	
silt/clay	80%
sand	0%
gravel	18%
cobble	2%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 24 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	100
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



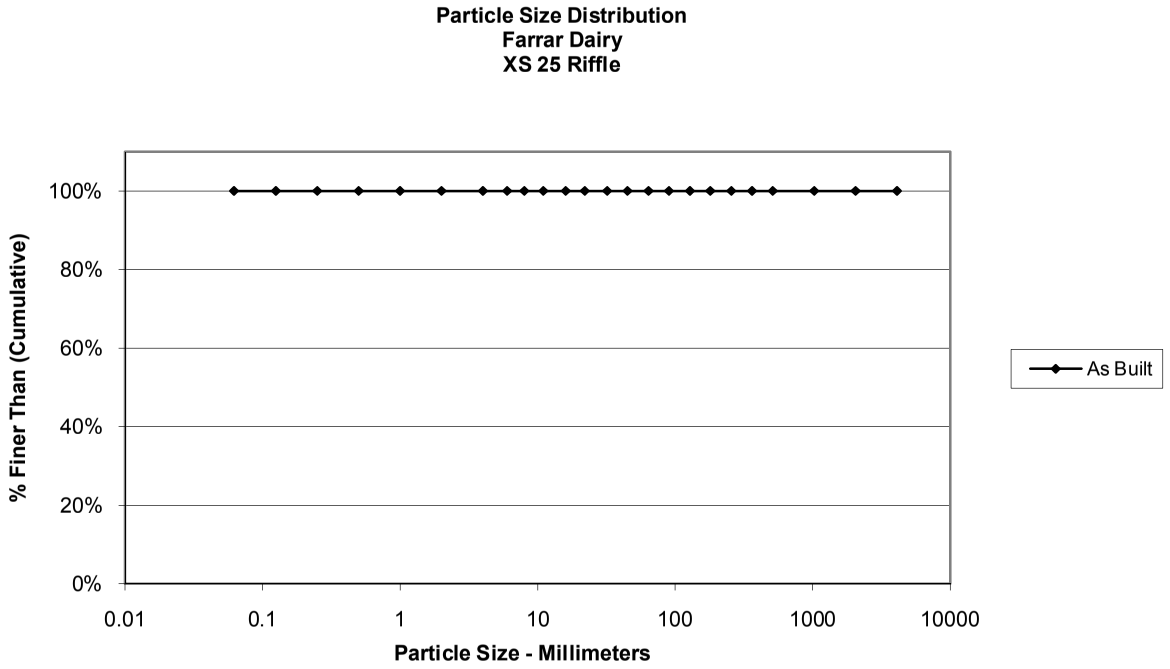
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 25 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	100
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



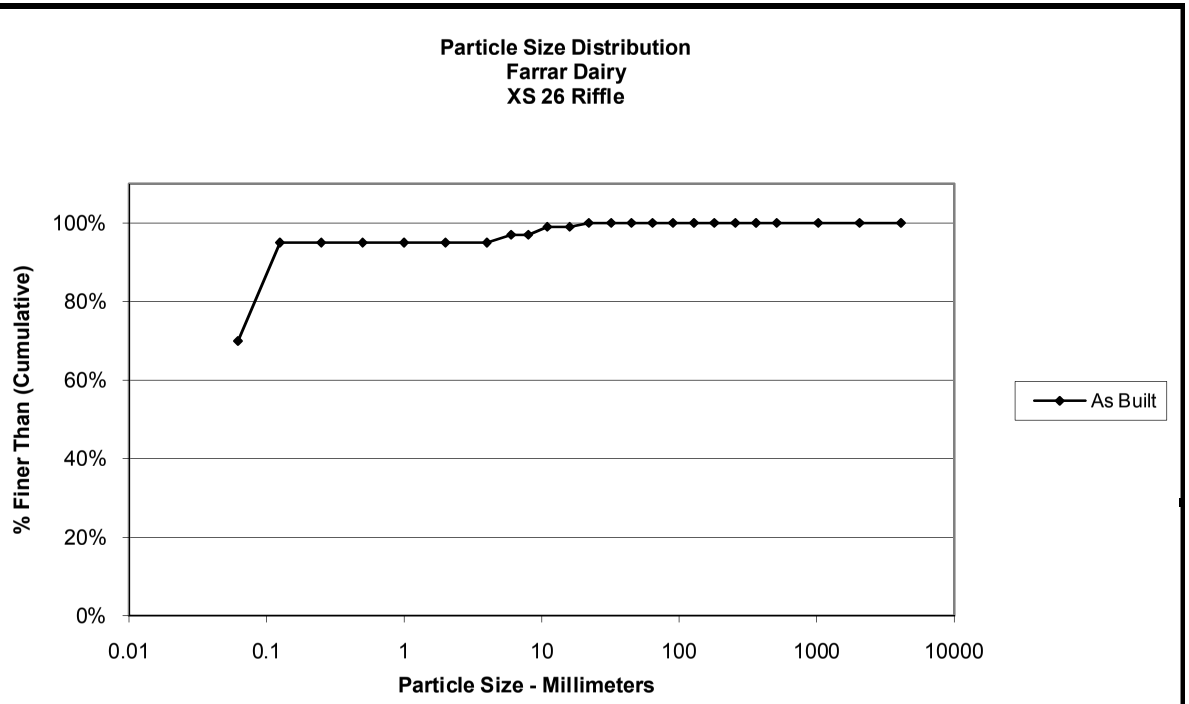
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 26 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	70
Very Fine	.062 - .125	S	25
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



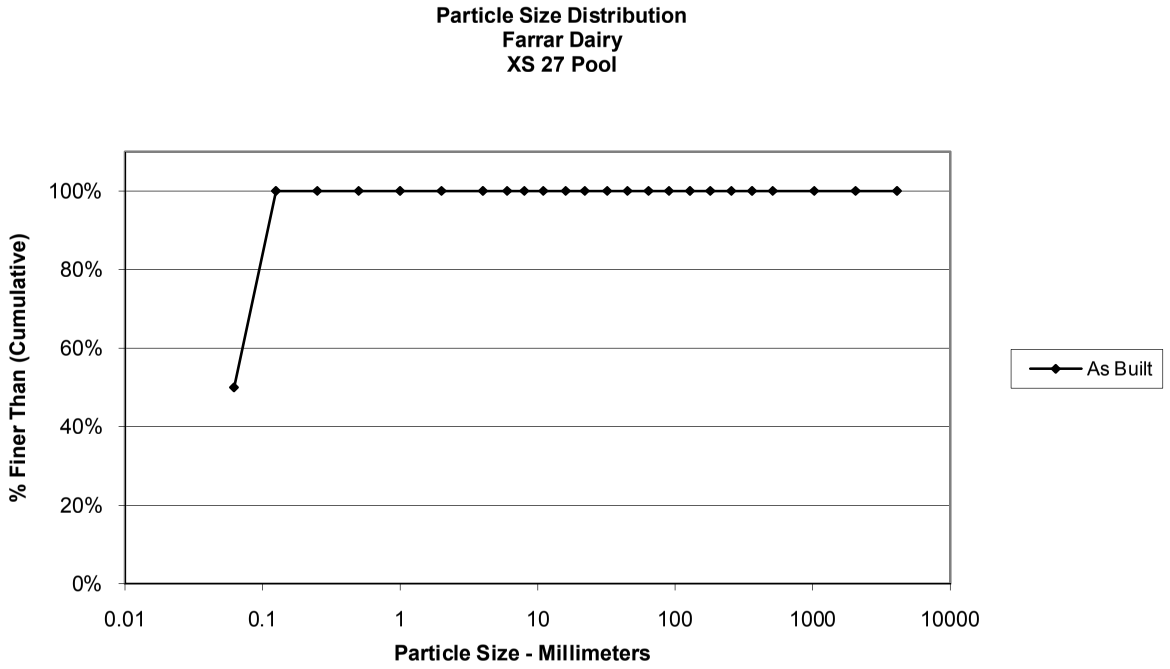
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.092
D95	0.13

Size Distribution	
mean	0.1
dispersion	1.2
skewness	0.21

Type	
silt/clay	70%
sand	25%
gravel	5%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 27 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	50
Very Fine	.062 - .125	S	50
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



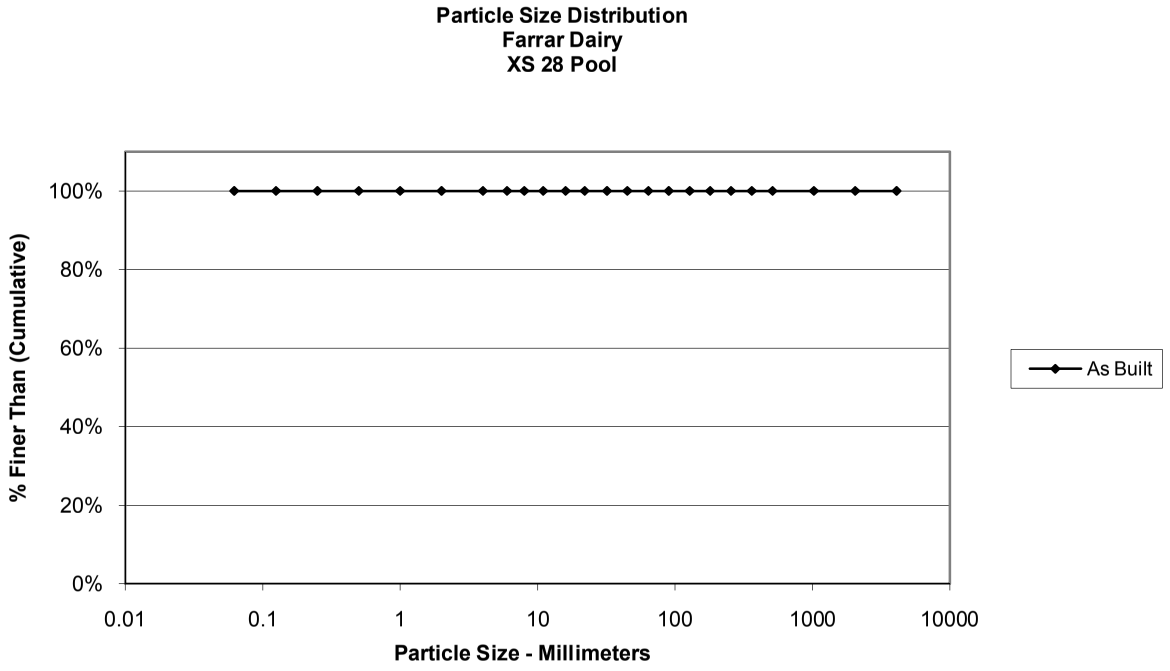
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.077
D84	0.1
D95	0.12

Size Distribution	
mean	0.1
dispersion	1.3
skewness	0.23

Type	
silt/clay	50%
sand	50%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 28 Pool - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	100
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



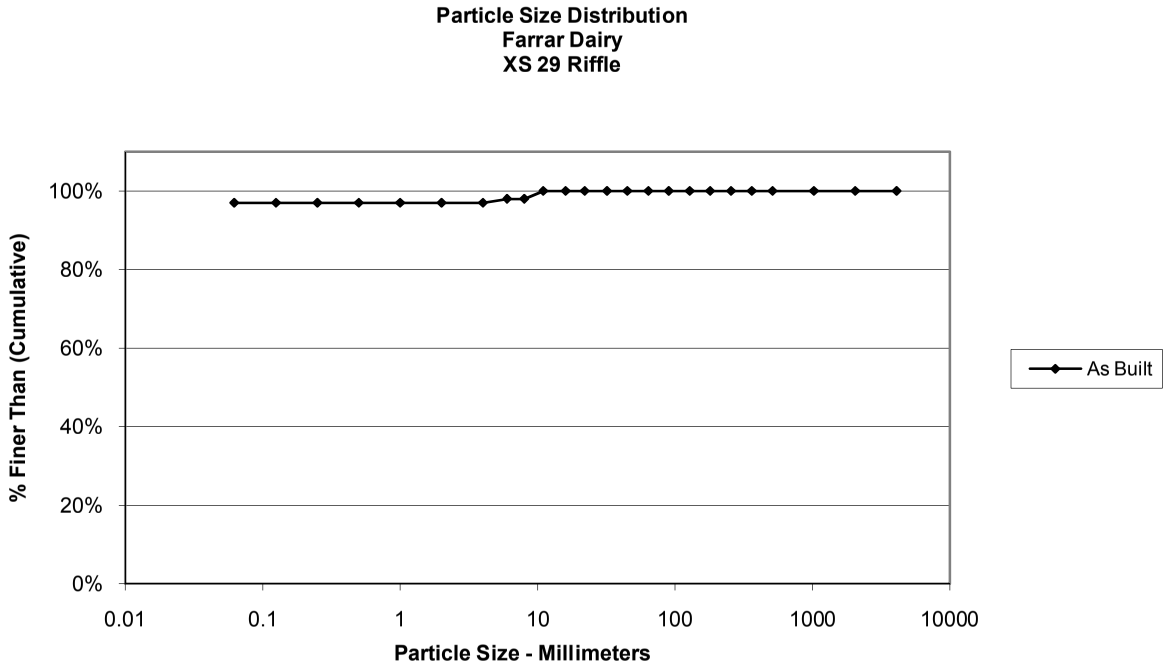
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	100%
sand	0%
gravel	0%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 29 Riffle - As-Built			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	97
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	
Medium	.25 - .50	N	
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	
Coarse	16 - 22.6	E	
Coarse	22.6 - 32	L	
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		
Small	64 - 90	C	
Small	90 - 128	O	
Large	128 - 180	B	
Large	180 - 256	L	
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	0.062
D95	0.062

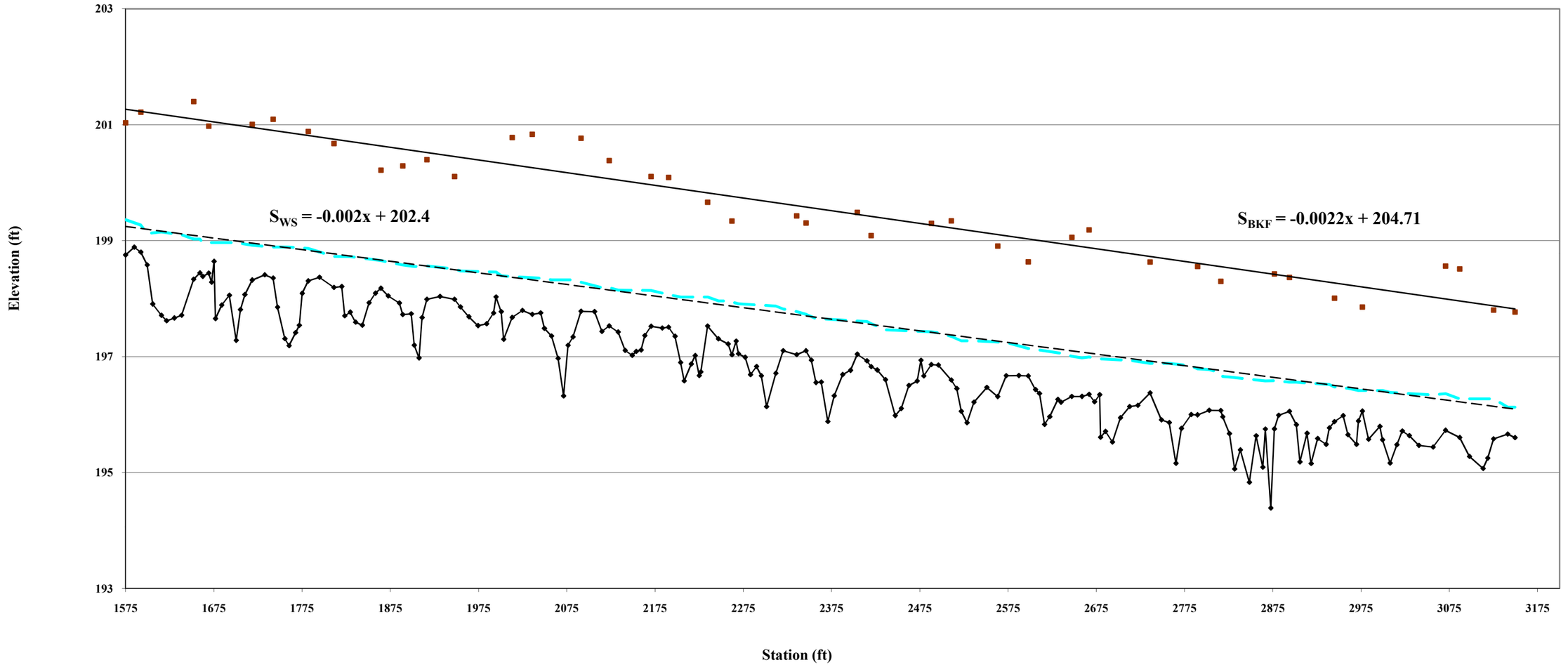
Size Distribution	
mean	0.1
dispersion	1.0
skewness	---

Type	
silt/clay	97%
sand	0%
gravel	3%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

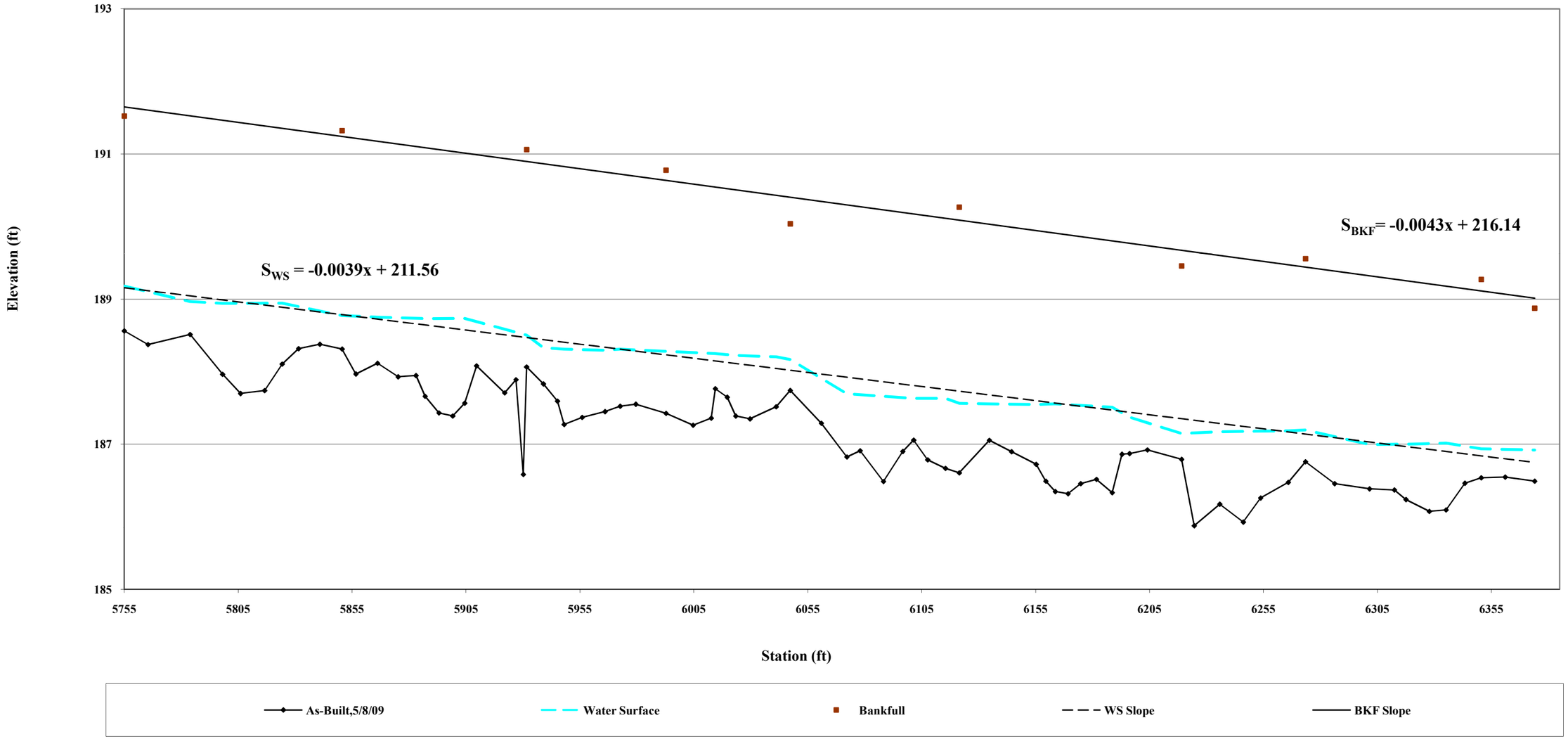
Appendix C

Longitudinal Profiles

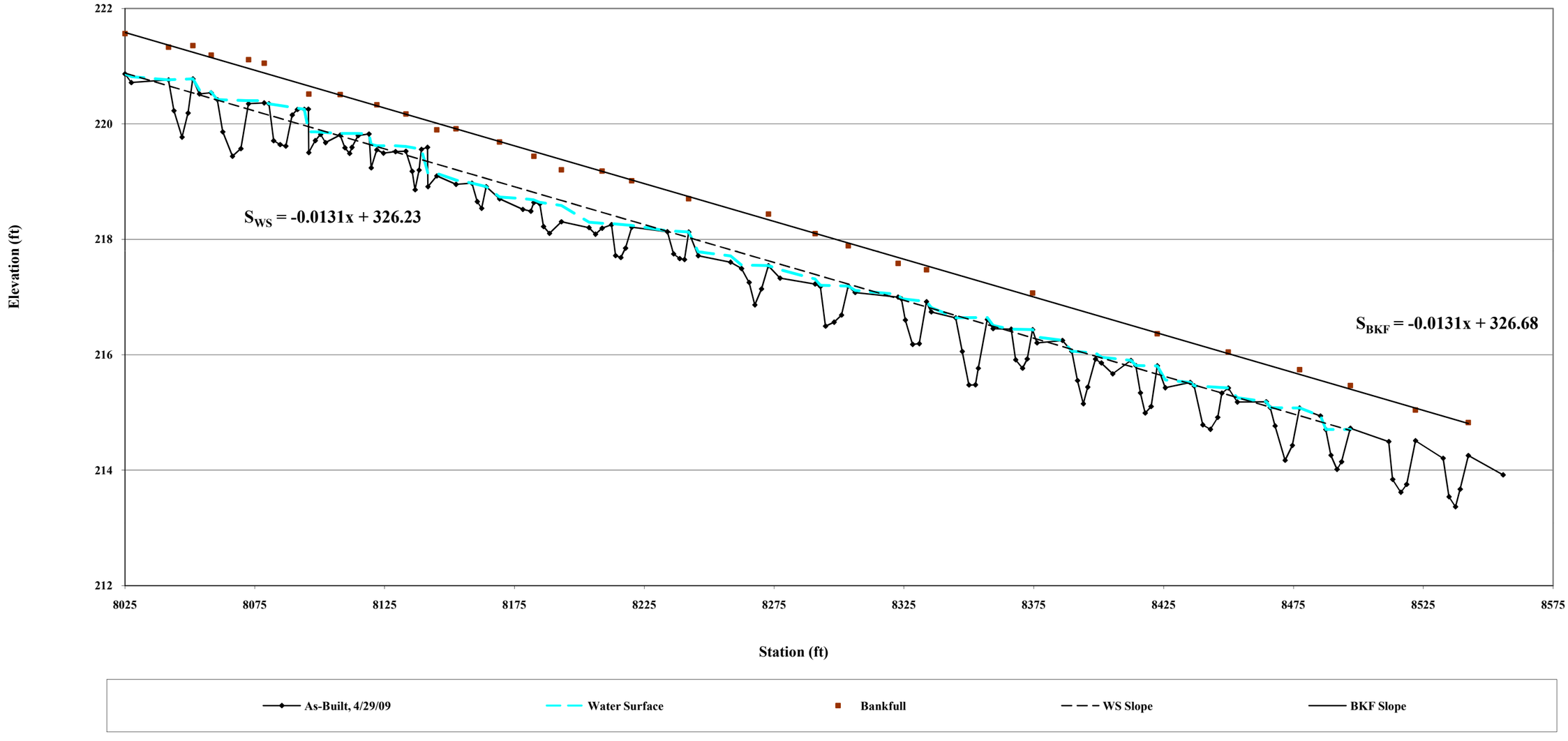
Farrar Dairy Longitudinal Profile
NPAC-1, As-Built
Stations 15+75 - 31+75



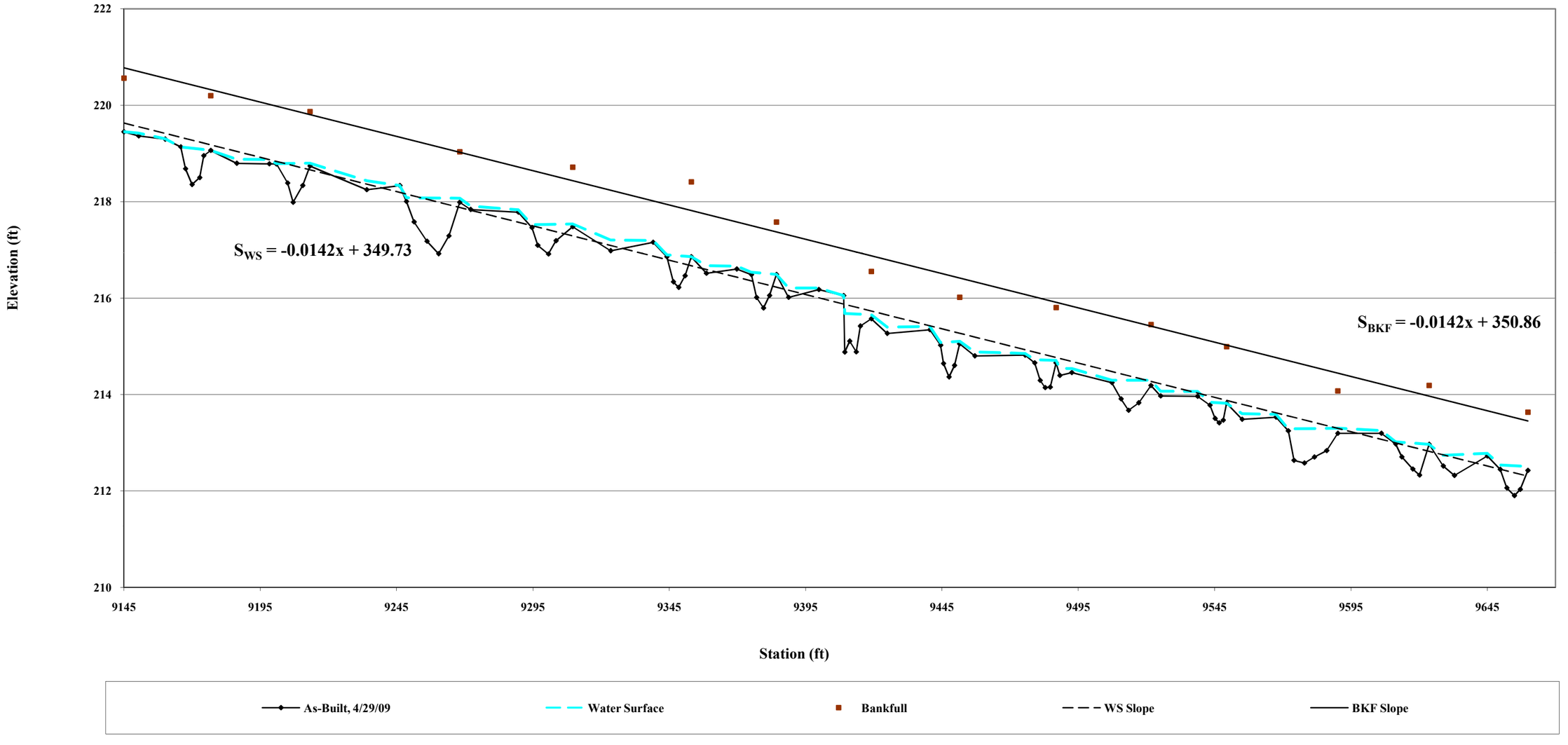
Farrar Dairy Longitudinal Profile
NPAC-2, As-Built
Stations 57+55 - 63+77



Farrar Dairy Longitudinal Profile
Tributary 1.1, As-Built
Stations 80+25 - 85+75

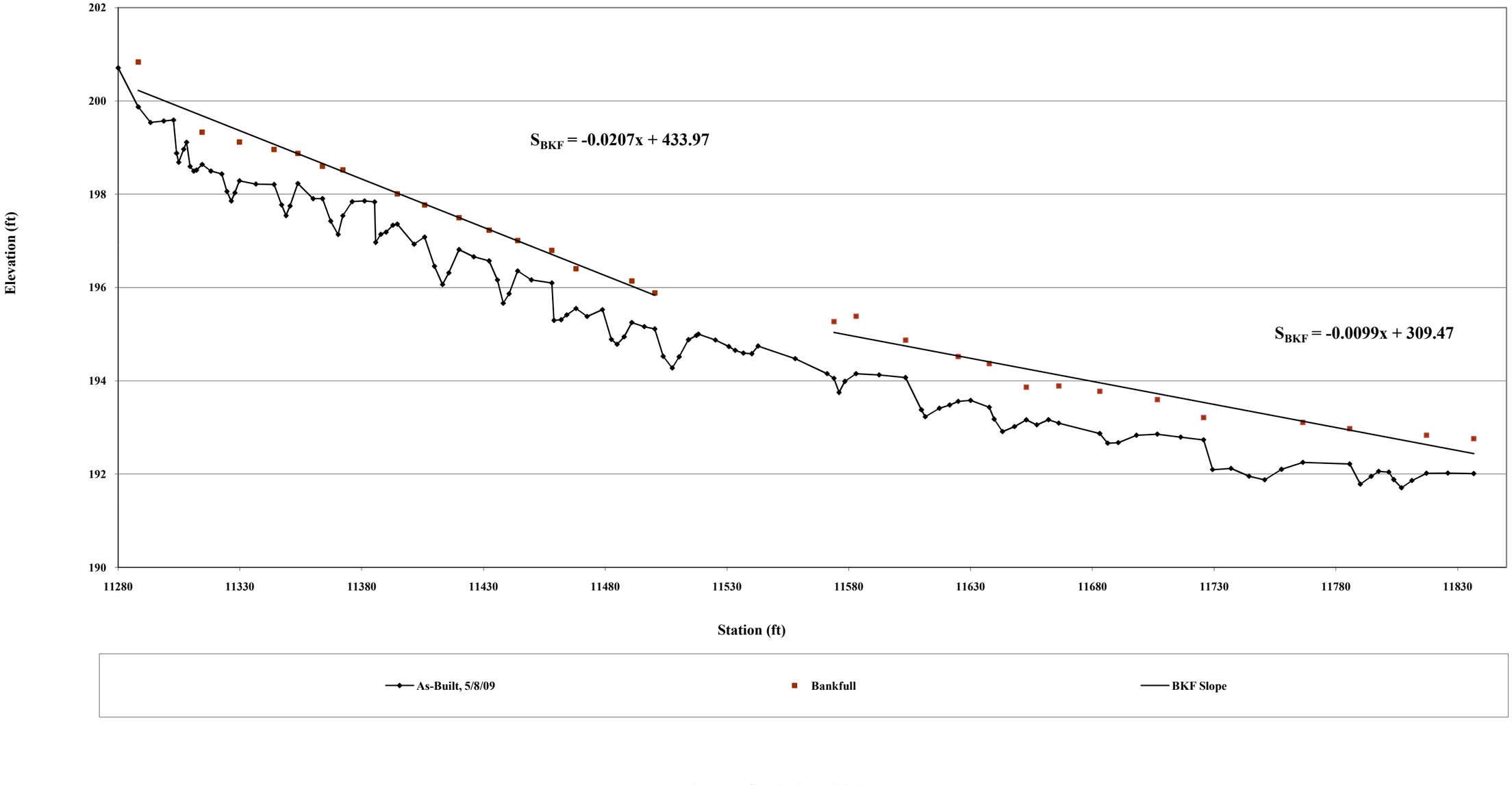


Farrar Dairy Longitudinal Profile
Tributary 1.2, As-Built
Stations 91+45 - 96+70



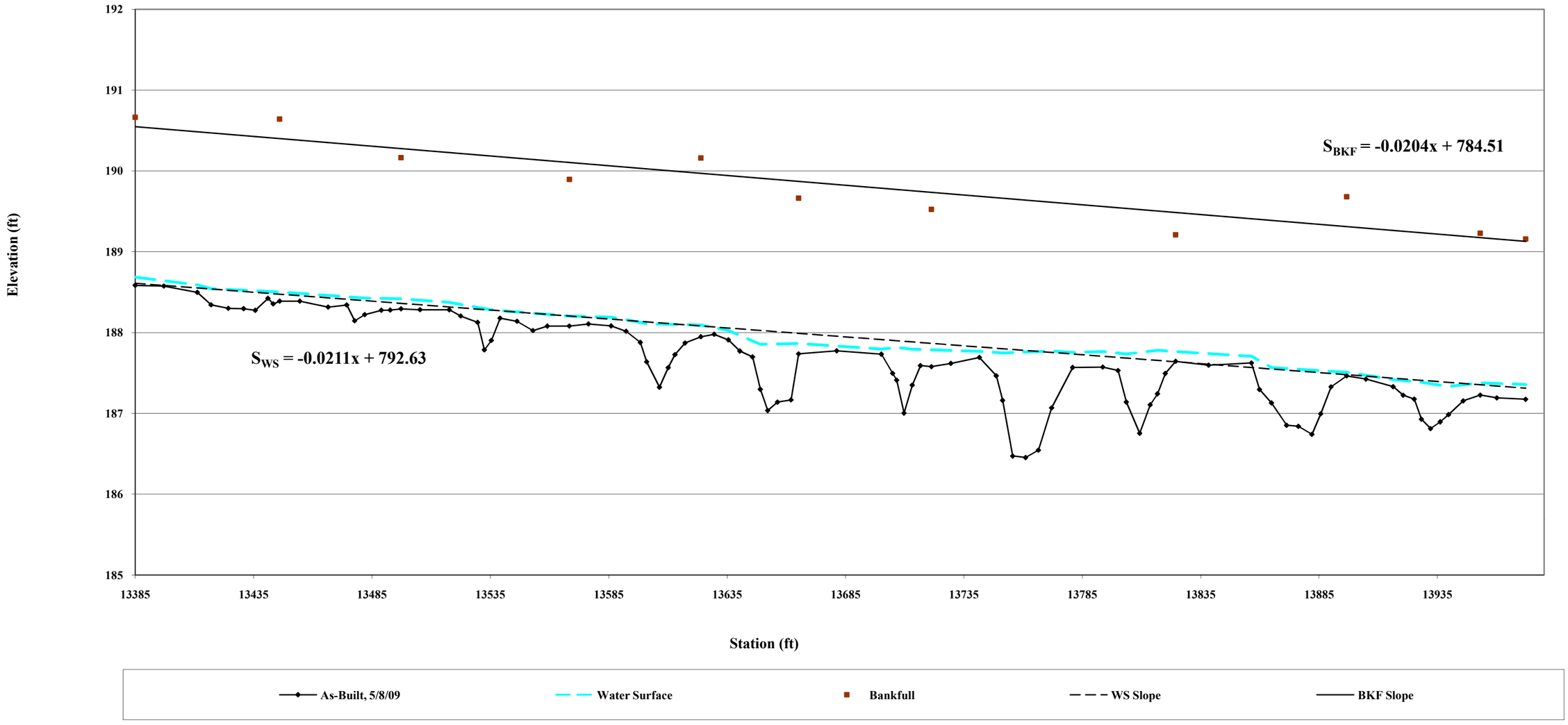
Longitudinal Profile
Tributary 1, As-Built
Stations 103+50 - 108+77

Longitudinal Profile
Tributary 2, As-Built
Stations 112+80 - 118+37



*No WS due to no flow in channel during survey.

Longitudinal Profile
Tributary 3, As-Built
Stations 133+85 - 139+73



Appendix D

Vegetation Data

Table D1. Stream Buffer Stem Density By Plot
Project Name: Farrar Dairy Stream and Wetland Restoration
Date : 3/25/09
Crew : B. Roberts

Plot #	River Birch *Betula nigra*	Beautyberry *Callicarpa americana*	Sugarberry *Celtis laevigata*	Silky Dogwood *Cornus amomum*	Green Ash *Fraxinus pennsylvanica*	Tulip Poplar *Liriodendron tulipifera*	Sycamore *Platanus occidentalis*	Oak sp. *Quercus sp.*	Laurel Oak *Quercus laurifolia*	Overcup Oak *Quercus lyrata*	Willow Oak *Quercus phellos*	Willow sp. *Salix sp.*	Black Willow *Salix nigra*	Elderberry *Sambucus canadensis*	Unknown	Total (As-Built)	Density-(As-Built)
1	3		1	12				2							4	22	880
2	1	4			4				3	1	3				2	18	720
3			2					1							5	8	320
4	4		1	12	1			2							1	21	840
5	1	1	1	3	2			4							7	19	760
6	3			7				1	2						1	14	560
7	3		2	4	2							9	1			21	840
8	5		3	1	4						1					14	560
9	10	5														15	600
10						1	3	6		1					2	13	520
11				2		4		2		1		4		4		17	680
12	6				4										3	13	520
13	6				2							4		6		18	720
14	7			3	2										1	13	520
15	5	5		2	1										1	14	560
															Total Average Density (Stems/Acre)		640

Table D2. Wetland Stem Density By Plot
Project Name: Farrar Dairy Stream and Wetland Restoration
Date : 3/25/09
Crew : B. Roberts

Plot #	River Birch *Betula nigra*	Beautyberry *Callicarpa americana*	Silky Dogwood *Cornus amomum*	Green Ash *Fraxinus pennsylvanica*	Oak sp. *Quercus sp.*	Laurel Oak *Quercus laurifolia*	Overcup Oak *Quercus lyrata*	Swamp Chestnut Oak *Quercus michauxii*	Cherrybark Oak *Quercus pagoda*	Pin Oak *Quercus palustris*	Willow Oak *Quercus phellos*	Unknown	Total (As-Built)	Density-(As-Built)
16			1	1				1			4	3	10	400
17	1		1		1			1	3			7	14	560
18			1		6							3	10	400
19			2	2	14	3						4	25	1000
20			2	1	5			1				4	13	520
21				1	6	2					1	3	13	520
22		1		4	9	3						4	21	840
23				5	9	5					1	3	23	920
24			2		8							3	13	520
25				1	5		1					4	11	440
26		1	1	3	3	2						3	13	520
27				2	6	1						3	12	480
28					9			3					12	480
29				3	6			1				3	13	520
30				8	1			2					11	440
31				4	2				3			2	11	440
32					7							3	10	400
33			5		4							2	11	440
34				4								8	12	480
35				2					6			2	10	400
36				1	2			1	1		1	10	16	640
37				7								5	12	480
38					2	3						8	13	520
39				3	2	1		1		2		4	13	520
40			1	7	5							2	15	600
41			6	1	1	1			2			4	15	600
42			3	3	5	1			1			4	17	680
43			1	2	3	4			1	1			12	480
44				3	6	1						4	14	560
45					4	5		1			2		12	480
Total Average Density (Stems/Acre)														543

Stream and Wetland Vegetation Plot Photos

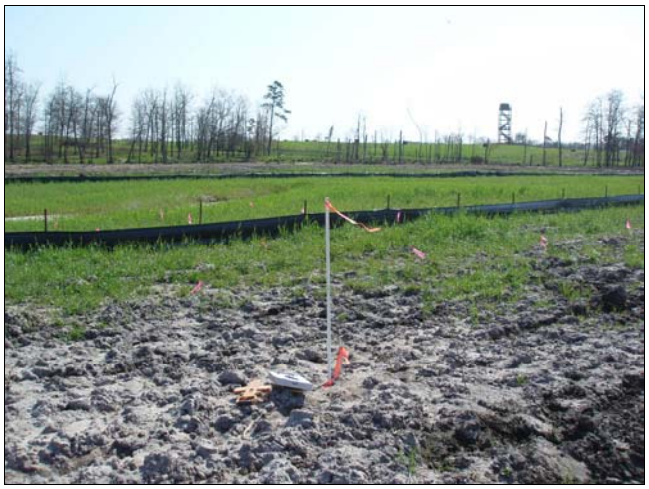
Vegetation Plot 1 – As-Built – 3/23/09

Vegetation Plot 2 – As-Built – 3/23/09

Vegetation Plot 3 – As-Built – 3/23/09

Vegetation Plot 4 – As-Built – 3/23/09

Vegetation Plot 5 – As-Built – 3/24/09



Vegetation Plot 6 – As-Built – 3/24/09

Vegetation Plot 7 – As-Built – 3/24/09

Vegetation Plot 8 – As-Built – 3/25/09

Vegetation Plot 9 – As-Built – 3/25/09

Vegetation Plot 10 – As-Built – 3/23/09

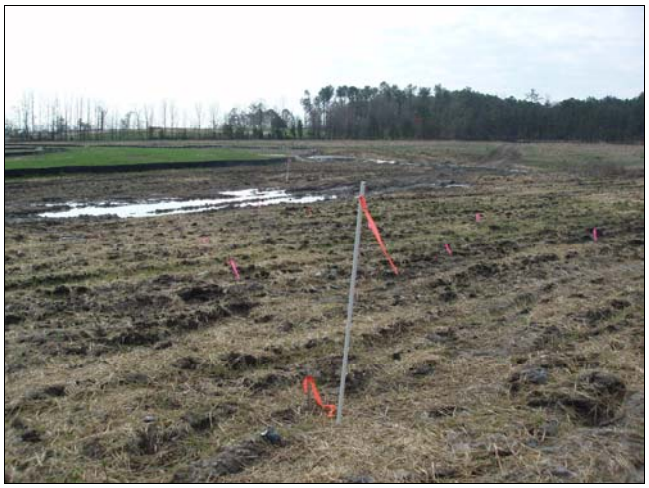
Vegetation Plot 11 – As-Built – 3/23/09

Vegetation Plot 12 – As-Built – 3/23/09

Vegetation Plot 13 – As-Built – 3/24/09

Vegetation Plot 14 – As-Built – 3/25/09

Vegetation Plot 15 – As-Built – 3/25/09



Vegetation Plot 16 – As-Built – 3/23/09

Vegetation Plot 17 – As-Built – 3/23/09

Vegetation Plot 18 – As-Built – 3/23/09

Vegetation Plot 19 – As-Built – 3/23/09

Vegetation Plot 20 – As-Built – 3/23/09

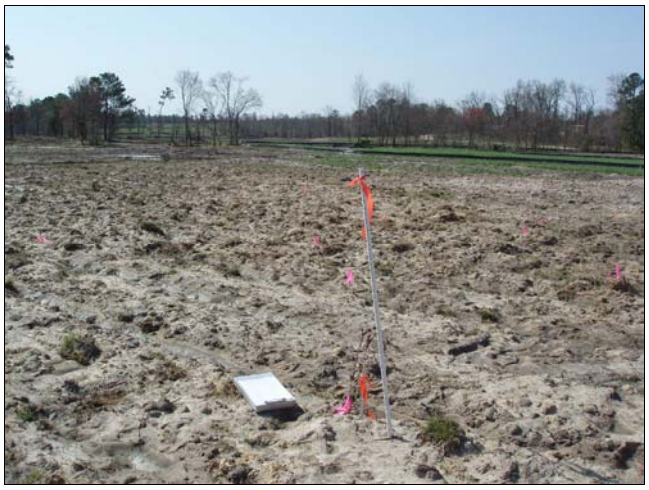
Vegetation Plot 21 – As-Built – 3/23/09

Vegetation Plot 22 – As-Built – 3/23/09

Vegetation Plot 23 – As-Built – 3/24/09

Vegetation Plot 24 – As-Built – 3/24/09

Vegetation Plot 25 – As-Built – 3/24/09



Vegetation Plot 26 – As-Built – 3/24/09

Vegetation Plot 27 – As-Built – 3/24/09

Vegetation Plot 28 – As-Built – 3/24/09

Vegetation Plot 29 – As-Built – 3/24/09

Vegetation Plot 30 – As-Built – 3/24/09

Vegetation Plot 31 – As-Built – 3/25/09

Vegetation Plot 32 – As-Built – 3/25/09

Vegetation Plot 33 – As-Built – 3/25/09

Vegetation Plot 34 – As-Built – 3/25/09

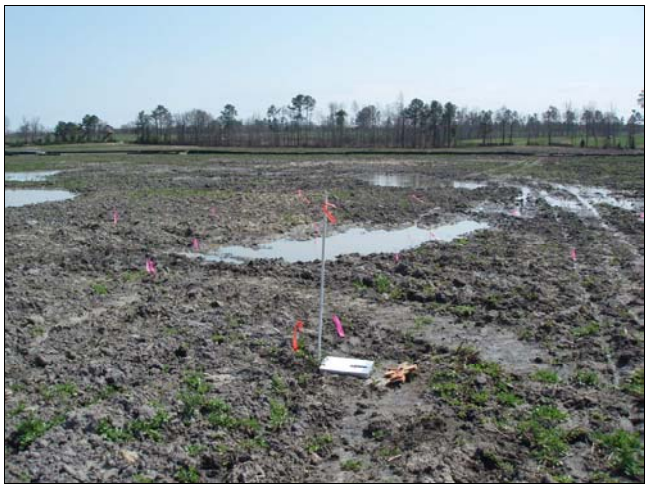
Vegetation Plot 35 – As-Built – 3/25/09

Vegetation Plot 36 – As-Built – 3/25/09

Vegetation Plot W37 – As-Built – 3/25/09

Vegetation Plot 38 – As-Built – 3/25/09

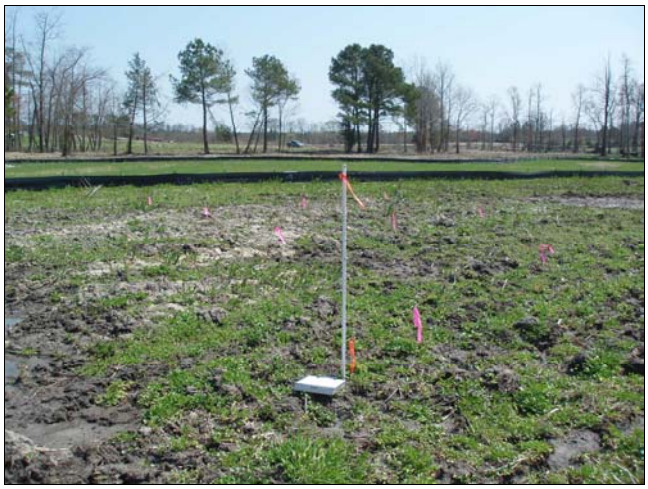
Vegetation Plot 39 – As-Built – 3/25/09



Vegetation Plot 40 – As-Built – 3/24/09

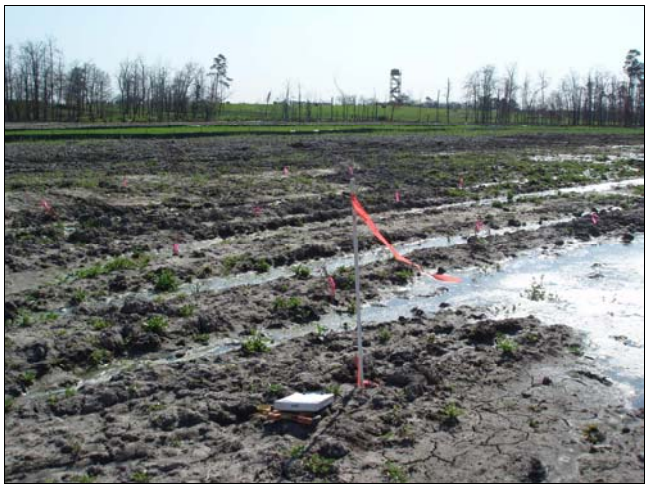
Vegetation Plot 41 – As-Built – 3/24/09

Vegetation Plot 42 – As-Built – 3/24/09



Vegetation Plot 43 – As-Built – 3/24/09

Vegetation Plot 44 – As-Built – 3/24/09



Vegetation Plot 45 – As-Built – 3/24/09

Appendix E

Photo Points

Stream and Wetland Photo Points

PP 1 – As-Built – 5/28/09

PP 2 – As-Built – 5/28/09

PP 3 – As-Built – 5/28/09

PP 4 – As-Built – 5/28/09

PP 5 – As-Built – 5/28/09

PP 6 – As-Built – 5/28/09

PP 7 – As-Built – 5/28/09

PP 8 – As-Built – 5/28/09

PP 9 – As-Built – 5/28/09

PP 10 – As-Built – 5/28/09

PP 11 – As-Built – 5/28/09

PP 12 – As-Built – 5/28/09

PP 13 – As-Built – 5/28/09

PP 14 – As-Built – 5/28/09

PP 15 – As-Built – 5/28/09

PP 16 – As-Built – 5/28/09

PP 17 – As-Built – 5/28/09

PP 18 – As-Built – 5/28/09

PP 19 – As-Built – 5/28/09

PP 20 – As-Built – 5/28/09

PP 21 – As-Built – 5/28/09

PP 22 – As-Built – 5/28/09

PP 23 – As-Built – 5/28/09

PP 24 – As-Built – 5/28/09

PP 25 – As-Built – 5/28/09

PP 26 – As-Built – 5/28/09

PP 27 – As-Built – 5/28/09

PP 28 – As-Built – 5/28/09

PP 29 – As-Built – 5/28/09

PP 30 – As-Built – 5/28/09

PP 31 – As-Built – 5/28/09

PP 32 – As-Built – 5/28/09

PP 33 – As-Built – 5/28/09

PP 34 – As-Built – 5/28/09

PP 35 – As-Built – 5/28/09