Cane Creek Stream Restoration Site
Mitigation Plan
Contract # D06002

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May 2009

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EXECUTIVE SUMMARY

The Cane Creek Tributary Site (CCTS) is located in the Piedmont physiographic province in northwestern Person County, North Carolina. The project will provide mitigation for stream impacts within the 8-digit hydrologic cataloging unit 03010104 in the Roanoke River Basin by restoring, enhancing, and preserving 19,059 linear feet on the CCTS, generating 14,621 stream mitigation units (SMU's.) The goals of the project include restoring the stream's riparian buffer and creating a stable stream system. In order to reach these goals, the project objectives included planting a functional Piedmont Alluvial Forest floodplain community along with Mesic Mixed Hardwood Forest to create an effective riparian buffer, removing cattle from the riparian areas with fencing, removing relic spoil piles that disrupt overland flowpaths, stopping bank erosion by developing the appropriate channel dimension, arresting bed elevation lowering, and stabilizing seep outlets.

The western portion of the project drains to the southeast and has a contributing drainage area of approximately 0.70 square mile. The eastern portion of the project also drains towards the southeast with a contributing drainage area of approximately 0.62 square mile. Each half of the project is made up of a series of headwater and first order streams. Both sides of the project drain to Cane Creek. The project watershed is rural and faces low development pressure from the surrounding area. The stream design and the restoration plan were completed in December 2007, construction began in May 2008, and the stream was planted in December 2008.

The stream restoration included thirty-four separate reaches, which have been enhanced and restored based on a combination of Priority 2 and 3 approaches. Rock cross vanes, step pools, and riffle grade controls were used to control grade throughout the profile. The streams were restored to B4, B4/1, B4c, B4/1c, Bc/C4, C/B4, and C/E4 stream types. The as-built survey and baseline monitoring found that there were minimal deviations from the designed cross-sections and profile. Due to conflicts with bedrock, small sections of the stream planform and profile were altered and some structures were moved, added, or not installed. These changes have been recorded on the as-built site plan. During construction and immediately after construction, several large rain events caused minor problem areas on the restored stream channels. These areas were repaired immediately after major stream construction was complete. The structures that were added during these repairs have been noted on the as-built site plan. In addition to the restored and enhanced reaches, there are nine preservation reaches. These reaches are intermittent headwater streams that were identified as project assets during the as-built stage.

The site was planted with bare root trees and shrubs and live stakes in December 2008. A total of 17 different species were planted at the site. The species from the original planting plan that were unavailable at the time of planting include coralberry (*Symphoricarpos orbiculatus*), spicebush (*Lindera benzoin*), winterberry (*Ilex verticillata*), possumhaw (*Viburnum nudum*), tag alder (*Alnus serrulata*), and witchhazel (*Hamamelis virginiana*). As substitutions for these species, American beautyberry (*Callicarpa americana*), pawpaw (*Asimina triloba*), silky dogwood (*Cornus amomum*), and swamp blackgum (*Nyssa biflora*) were planted. Since construction and the as-built survey, high tensile fence has been erected along most of the easement boundary. The fence is still in the process of being installed and will encompass 100% of the easement. All of the livestock on the property have been excluded from the conservation easement.

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 must meet the success criteria of 320 planted stems/acre at the end of the monitoring period. The baseline monitoring counted an average of 690 stems/acre in the 20 vegetation monitoring plots. 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 stream over the monitoring period in separate monitoring years.

1.0 PROJECT BACKGROUND

1.1 Location and Setting

The Cane Creek Tributary Site (CCTS) is spread over two separate drainage areas on two parcels. The site is located off of Cunningham Road in northwestern Person County, North Carolina. Specifically, the site is approximately 0.85 mile east of the intersection of Cunningham Road and NC 119 (Figure 1). The project is centered at approximately 36.5038 degrees north and 79.1310 degrees west (WGS84). To reach the site from Raleigh, proceed west on US-70 until it merges with I-85/US-15 south. Continue on I-85 for approximately 1.5 miles and then take exit 176B for Duke St/US-501 Bypass. Take a right off of the exit and travel on US-501 for 27.5 miles. Within the town of Roxboro, turn left onto Court St/US-158 west. Follow US-158 west 0.4 mile and turn right onto NC-57, continuing northwest for another 12.3 miles. Once within the small community of Semora, turn right onto NC-119 and drive north 0.5 mile. Turn right onto Cunningham Road and continue east for 0.85 mile. The CCTS is accessible through a metal gate on the right.

1.2 Project Goals and Objectives

The project goals are to:

- Restore the stream's riparian buffer.
- Create a stable network of headwater streams.

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

- Plant a functional Piedmont Alluvial Forest floodplain community along with a Mesic Mixed Hardwood Forest to create an effective riparian buffer.
- Arrest bed elevation lowering and stabilize seep outlets.
- Stop bank erosion by developing the appropriate channel dimension and stabilizing with vegetation.
- Remove relic spoil piles that disrupt overland flowpaths.
- Exclude livestock from the riparian areas with fencing.

1.3 Project Structure, Restoration Type and Approach

The project streams had become degraded primarily through poor grazing management and vegetation removal. Historically, the two parcels were cleared and converted into pasture except for narrow strips of riparian vegetation along the streams and intact forest in the southern portion of the western parcel. Prior to restoration, many of the project streams were experiencing severe bank erosion. Severe bed degradation was also evident throughout the different project reaches. All of the reaches exhibited areas of vertical instability. Restoration, enhancement, and preservation of 19,059 linear feet of channel was accomplished utilizing a combination of Priority 2 and 3 approaches (Table 1). Reaches T1-T6 are on the western side of the project and reaches T7-T10 are on the eastern side.

All of T1 was built as a B4c channel with small sections of C channel in those areas without constrictive valley walls. T1 has been divided into five different reaches to reflect changes in drainage area and the type of mitigation. T1-1 runs from Station 10+00 to 17+64 and stops at the confluence with T3. A second reach, T1-2, goes from this confluence with T3 at Station 17+64 until Station 21+50. Both T1-1 and T1-2 were enhanced by grading back the existing eroding banks, building a bankfull bench, and developing distinct riffles and pools (Enhancement I).

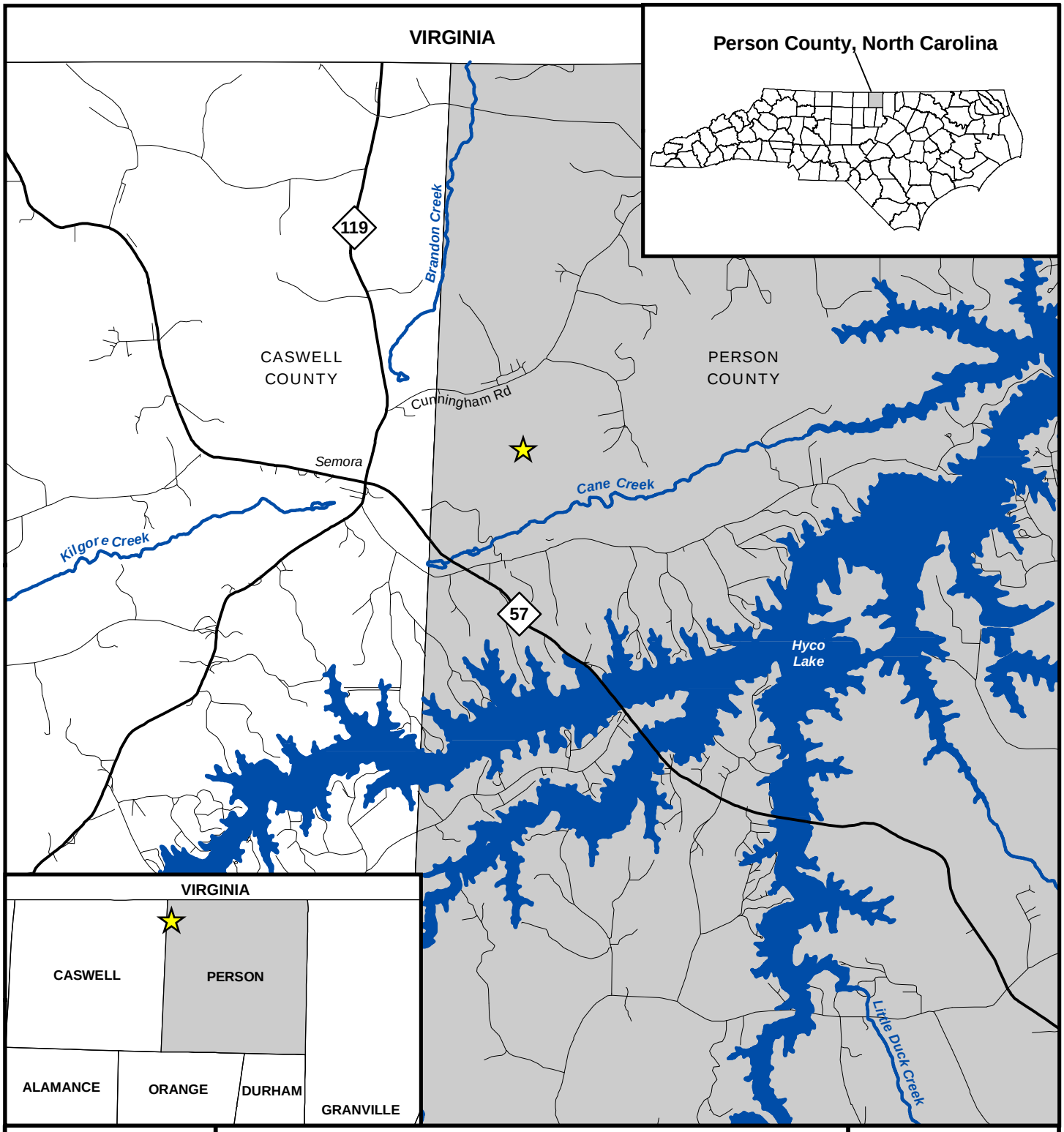

Figure 1. Vicinity Map

- Project Site Location
- Major Roads
- Other Roads
- Major Streams and Rivers
- Major Lakes and Reservoirs
- County Boundaries

N
W E
S

1:63,360
1 inch equals 1 miles

1 0.5 0 1 Miles

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Environmental Technologies and Construction, Inc.

T1 was restored from Station 21+50 until it ends at the property boundary. There are three separate reaches in this section of T1: T1-3 from Station 21+50 to 24+76 where T4 enters; T1-4 from Station 24+76 to 34+85 where T6 flows into T1, and T1-5 from Station 34+85 to 37+67. These three lower reaches of T1 were restored using a Priority 3 approach. Along this section of T1, the restoration established riffle and pool features and a new stable planform, while also utilizing existing bedrock as grade control.

T2, a B4 stream, was divided into four separate reaches. T2-1 begins at Station 50+00 and ends at Station 53+05. This reach was improved by fencing out the livestock, removing adjacent relic spoil piles to restore natural drainage to the stream, and planting the riparian buffer with native vegetation (Enhancement II). Beginning at Station 53+05 and ending at Station 55+00, T2-2 was restored using a Priority 3 approach. This reach was relocated away from a severely eroding valley wall and reconnected to the existing stream at Station 55+00. The next reach, T2-3, was enhanced by sloping back the existing eroding banks, building a bankfull bench, removing the adjacent relic spoil piles, and developing distinct riffles and pools (Enhancement I). T2-4 begins at Station 56+50, and was restored using a Priority 3 approach. This bottom section of T2 connects to T1 at Station 58+50 with a new stable pattern, dimension, and profile.

T3 is the next tributary to join T1, and is divided into two different reaches. T3-1 is a short headwater reach that runs from Stations 60+00 to 60+85 and was enhanced by shaping the existing eroding banks and defining distinct riffles and pools (Enhancement I). T3-2 was restored with dimension, profile, and pattern adjustments using a Priority 3 approach, and runs from Station 60+85 to its confluence with T1 at Station 76+97.

Similar to T3, T4 also flows into T1 and has been separated into two reaches. The entire length of T4 was restored as a B4 channel. T4-1 and T4-2 run from Station 80+00 to Station 82+53 and Station 82+53 to Station 102+81, respectively. These two reaches, which are distinguished by differences in slope were restored with dimension, profile, and pattern adjustments using a Priority 3 approach.

T5 has two reaches and both are B4 channels. T5-1 runs from Stations 110+00 to 112+64 and was enhanced by fencing out the livestock and planting the riparian buffer with native vegetation (Enhancement II). T5-2, which goes from Station 112+64 to Station 113+95 at its confluence with T1, was restored with dimension, profile, and pattern adjustments using a Priority 3 approach.

T6 and its headwater tributaries consist of B4 channels. At the top of this headwater system, there are four intermittent headwater reaches. These reaches, T6B-1 (Stations 248+38 to 250+00), T6C-1 (Stations 117+02 to 120+00), T6C-2 (Stations 300+00 to 300+80), and T6C-3 (Stations 310+00 to 310+82) are stable streams surrounded by an established vegetated buffer and were therefore preserved. Two perennial headwater reaches, T6A (Stations 240+00 to 240+90) and T6B (Stations 250+00 to 251+04), were improved with bank and seep stabilization (Enhancement II). These two reaches come together to form T6AB from Station 240+90 to 241+21. T6C, from Station 120+00 to 121+75 at its confluence with T6AB, is another headwater tributary. T6 begins at Station 121+75, the confluence of T6AB and T6C, and ends at Station 134+25, where it meets T1. T6AB, T6C, and T6 were all restored using a Priority 3 approach with dimension, profile, and pattern adjustments.

On the eastern side of the property, T7 was divided into ten different design reaches. The headwaters of T7 include two preservation reaches. These two reaches, T7A-1 (Stations 259+38 to 260+00) and T7B (Stations 320+00 to 321+25), are both stable channels bordered by a riparian buffer. T7-1 begins at Station 140+00 and continues until Station 145+25. It is a B4/C4 stream type that was improved with isolated bank stabilization, seep stabilization at the beginning of the reach, fencing out the livestock, and planting the riparian buffer with native vegetation (Enhancement II). T7A (Stations 260+00 to 261+36)

and T7C (Stations 330+00 to 330+42) are similar to T7-1 and were also improved as a B4/C4 channel with the same Enhancement II methods. T7-2 (Stations 145+25 to 148+57) was improved to a B4 stream type by sloping back the existing eroding banks and enhancing the existing riffle and pool features (Enhancement I).

T7-3 begins at Station 148+57 where T7-2 and T8 join together. T7-3 was restored as a B4c channel using Priority 2 and 3 approaches with dimension, profile, and pattern adjustments. T7-4 begins at Station 169+86 where the stream enters a more confined valley with numerous bedrock features. The B4/1 channel was improved by building an appropriate stream dimension and enhancing distinct riffle and pool features that had been degraded by cattle and excess sediment inputs (Enhancement I).

T7-5 is a short B4 reach that was restored with dimension, profile, and pattern adjustments from Station 182+28 to 183+75 using a Priority 3 approach. From Station 183+75 to Station 191+59, T7-6 has frequent bedrock in the streambed and was improved by building an appropriate stream dimension and developing distinct riffle and pool features (Enhancement I), creating a B4/1 stream type. T7-7 begins at the confluence with T10 and continues until the stream enters Cane Creek at Station 198+13. This final reach along T7 was also modified as Enhancement I by building an appropriate stream dimension and creating distinct riffle and pool features.

There are three intermittent preservation reaches on the headwater system of T8. These include T8-1 (Stations 199+06 to 200+00), T8B (Stations 340+00 to 340+59), and T8A-1(Stations 269+75 to 270+00), which are all stable streams with established riparian buffers. The remaining headwater reaches of T8 (Stations 200+00 to 204+38) and T8A (Stations 270+00 to 271+23) were improved using Enhancement I (building an appropriate stream dimension and creating distinct riffle and pool features) and Enhancement II (isolated bank stabilization, seep stabilization at the beginning of the reach, fencing out the livestock, and planting the riparian buffer with native vegetation), respectively. Both reaches are B4 stream types. T9 (Stations 210+00 to 213+68) is a similar headwater reach to T8 and received the same Enhancement I improvements as T8.

T10 runs along the eastern edge of the site and has been divided into two separate reaches. T10-1 is the longer reach and goes from Stations 220+00 to 233+00. T10-1 is a B4/1 channel and was improved with isolated bank stabilization, livestock exclusion, and riparian buffer plantings (Enhancement II). T10-2 begins at 233+00 and continues a short distance until the confluence with T7 at Station 235+94. This reach was improved using Enhancement I (building an appropriate stream dimension and creating distinct riffle and pool features) of the B4/1 channel.

Table 1 below provides the linear footage for existing and as-built stream length as well as the total stream mitigation units by reach. For this table, the existing linear footage was calculated from the existing stream centerline. In some instances, the linear footage is less for the as-built conditions than for the existing conditions. This situation can arise when the design changes the exact location of tributary confluences. In other locations, the pattern of the existing stream had an unstable meandering centerline that may have been influenced by debris blockages and cattle damage to the stream. In the as-built stream, the pattern is stable and more clearly defined, but the actual length may be shorter than the pre-restoration conditions. Some of these lengths are also slightly different than the designed lengths. On the restored reaches, this is due to occasional field changes to the pattern during. For the enhancement reaches, this is generally a result of the as-built survey being more detailed, and picking up a more accurate depiction of the pattern than was recorded in the existing conditions topographic survey.

Table 1. Project Restoration Components
Cane Creek Stream Restoration Site

Project Segment / Reach ID	Pre-Project Footage	Mitigation Type	Approach	As - Built Footage	As-Built Stationing	Stream Mitigation Units*	Comment
T1-1 and T1-2	1,087	Enhancement I	-	1,150	10+00-21+50	725 SMU*	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created around the existing bedrock, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T1-3, T1-4 and T1-5	1,688	Restoration	P3	1,617	21+50-37+67	1,617 SMU	Stable riffles and pools were established along a realigned stream planform, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T2-1	305	Enhancement II	-	305	50+00-53+05	122 SMU	Isolated eroding banks were graded to a stable slope, relic spoil piles adjacent to the stream were removed, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T2-2	227	Restoration	P2	195	53+05-55+00	195 SMU	The stream was realigned away from an unstable valley wall, relic spoil piles adjacent to the stream were removed, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T2-3	160	Enhancement I	-	150	55+00-56+50	100 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created, relic spoil piles adjacent to the stream were removed, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T2-4	151	Restoration	P3	180	56+50-58+50	180 SMU*	New riffles and pools were established along a new stream planform, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T3-1	107	Enhancement I	-	85	60+00-60+85	57 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created, the unvegetated portions of the buffer were planted, cattle exclusion fencing was erected along the easement, and entering seeps were stabilized.
T3-2	1,457	Restoration	P3	1,592	60+85-76+97	1,592 SMU*	Stable riffles and pools were established along a realigned stream planform, relic spoil piles adjacent to the stream were removed, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T4-1 and T4-2	1,979	Restoration	P3	2,281	80+00-102+81	2,261 SMU*	Stable riffles and pools were established along a realigned stream planform, relic spoil piles adjacent to the stream were removed, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T5-1	244	Enhancement II	-	242	110+00-112+64	97 SMU*	The unvegetated portions of the buffer were planted and cattle exclusion fencing was erected along the easement.
T5-2	118	Restoration	P3	132	112+64-113+95	132 SMU	Stable riffles and pools were established along a realigned stream planform creating a stable confluence with T1, the buffer was planted, and cattle exclusion fencing was erected along the easement.
			Total	7,929		7,078 SMU*	

P2 = Priority 2 P3 = Priority 3 * These SMUs have been calculated by excluding the easement exceptions, which include ford crossings for the landowner.

Table 1. Project Restoration Components, continued
Cane Creek Stream Restoration Site

Project Segment / Reach ID	Pre-Project Footage	Mitigation Type	Approach	As - Built Footage	As-Built Stationing	Stream Mitigation Units*	Comment
T6A	89	Enhancement II	-	90	240+00-240+90	36 SMU	Isolated eroding banks were graded to a stable slope, the seep where the stream originates was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T6B-1	162	Preservation	-	162	248+38-250+00	32 SMU	Installed cattle exclusion fencing along the easement.
T6B	103	Enhancement II	-	104	250+00-251+04	42 SMU	Isolated eroding banks were graded to a stable slope, the seep where the stream originates was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T6AB	30	Restoration	P3	31	240+90-241+21	31 SMU	Grade control structures were used to stabilize the bed and maintain pools, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T6C-1	297	Preservation	-	297	117+02-120+00	59 SMU	Installed cattle exclusion fencing along the easement.
T6C-2	80	Preservation	-	80	300+00-300+80	16 SMU	Installed cattle exclusion fencing along the easement.
T6C-3	82	Preservation	-	82	310+00-310+82	16 SMU	Installed cattle exclusion fencing along the easement.
T6C and T6	1,455	Restoration	P3	1,425	120+00-134+25	1,405 SMU*	New riffles and pools were established along a new stream planform, the headcut at the top of T6C was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T7A-1	62	Preservation	-	62	259+38-260+00	12 SMU	Installed cattle exclusion fencing along the easement.
T7A	136	Enhancement II	-	136	260+00-261+36	54 SMU	Isolated eroding banks were graded to a stable slope, a seep at the beginning of the reach was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T7B	125	Preservation	-	125	320+00-321+25	25 SMU	Installed cattle exclusion fencing along the easement.
T7C	42	Enhancement II	-	42	330+00-330+42	17 SMU	Removed a well house at the head of the reach, stabilized the seep, graded the banks to a stable slope, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T7-1	469	Enhancement II	-	525	140+00-145+25	210 SMU	Isolated eroding banks were graded to a stable slope, the seep where the stream originates was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T7-2	331	Enhancement I	-	332	145+25-148+57	221 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created around the existing bedrock, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T7-3	2,023	Restoration	P2/3	2,109	148+57-169+86	2,109 SMU*	New riffle and pool sequences were established along a realigned stream planform, the buffer was planted, and cattle exclusion fencing was erected along the easement.
			Total	5,602		4,285 SMU*	

P3 = Priority 3 P2/P3 = Combination of Priorities 2 and 3

* These SMUs have been calculated by excluding the easement exceptions, which include ford crossings for the landowner.

Table 1. Project Restoration Components, continued
Cane Creek Stream Restoration Site

Project Segment / Reach ID	Pre-Project Footage	Mitigation Type	Approach	As - Built Footage	As-Built Stationing	Stream Mitigation Units*	Comment
T7-4	1,246	Enhancement I	-	1,242	169+86-182+28	828 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, overwidened portions of stream were built to the appropraite cross-sectional area, distinct riffles and pools were created around the existing bedrock, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T7-5	185	Restoration	P3	147	182+28-183+75	147 SMU	The stream was realigned away from an unstable valley wall, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T7-6 and T7-7	1,365	Enhancement I	-	1,438	183+75-198+13	945 SMU*	Eroding banks were graded to a stable slope, bankfull benches were built, overwidened portions of stream were built to the appropriate cross-sectional area, distinct riffles and pools were created around the existing bedrock, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T8A-1	25	Preservation	-	25	269+75-300+00	5 SMU	Installed cattle exclusion fencing along the easement.
T8A	110	Enhancement II	-	123	270+00-271+23	49 SMU	Isolated eroding banks were graded to a stable slope, a seep at the beginning of the reach was stabilized, a log structure was added for grade control, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T8B	59	Preservation	-	59	340+00-340+59	12 SMU	Installed cattle exclusion fencing along the easement.
T8-1	94	Preservation	-	94	199+06-200+00	19 SMU	Installed cattle exclusion fencing along the easement.
T8	449	Enhancement I	-	438	200+00-204+38	292 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created with instream structures, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T9	369	Enhancement I	-	368	210+00-213+68	245 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created with instream log structures, the buffer was planted, and cattle exclusion fencing was erected along the easement.
T10-1	1,300	Enhancement II	-	1,300	220+00-233+00	520 SMU	Isolated eroding banks were graded to a stable slope, an eroding drainage swale was stabilized, the unvegetated portions of the buffer were planted, and cattle exclusion fencing was erected along the easement.
T10-2	282	Enhancement I	-	294	233+00-235+94	196 SMU	Eroding banks were graded to a stable slope, bankfull benches were built, distinct riffles and pools were created with instream structures, the buffer was planted, and cattle exclusion fencing was erected along the easement.
			Total	5,528		3,258	
			Preservation Total	986		196 SMU*	
			Enhancement II Total	2,867		1,147	
			Enhancement I Total	5,497		3,609	
			Restoration Total	9,709		9,669	
			Total of All Reaches	19,059		14,621	

P3 = Priority 3 * These SMUs have been calculated by excluding the easement exceptions, which include ford crossings for the landowner

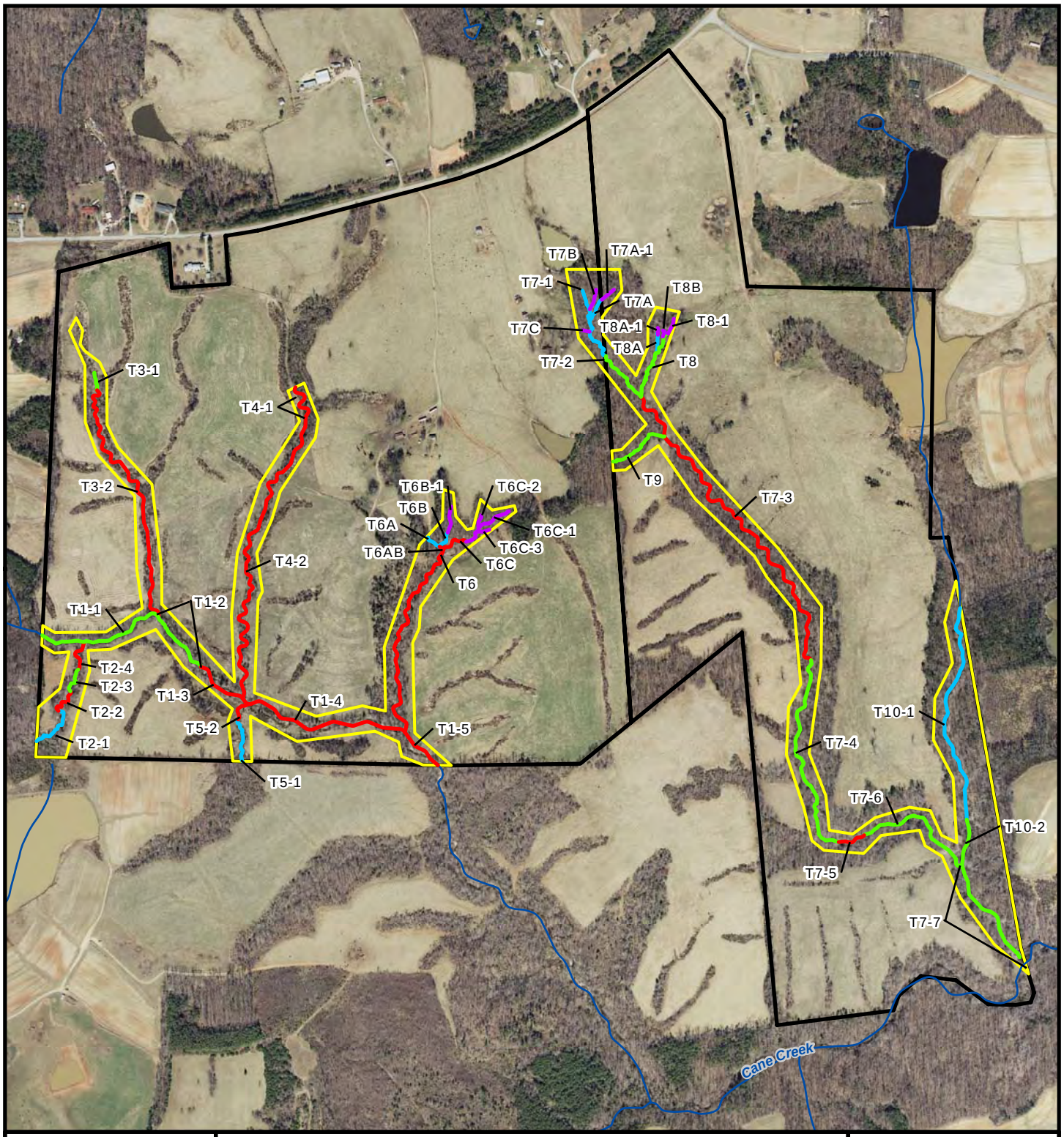

Figure 2. As-Built Site Plan

Preservation Reach
Enhancement I Reach
Enhancement II Reach
Restoration Reach
Project Easement
Other Streams
Project Parcel Boundaries

N
W
E
S

1:9,600
1 inch equals 800 feet

820 410 0 820
Feet

Image Source: Person County GIS, Orthoimagery 2004

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1.4 Project History, Contacts and Data

Table 2. Project Activity and Reporting History Cane Creek Stream Restoration Site		
Activity or Report	**Data Collection Complete**	**Completion or Delivery**
Restoration Plan	2007	Dec 07
Final Design	2007	Dec 07
Construction	N/A	Dec 08
Planting - Stream	N/A	Dec 08
Mitigation Plan / As-Built (Year 0 Monitoring - Baseline)	Jan 09	May 09

Table 3. Project Contact Table Cane Creek Stream Restoration Site	
Design Firm	KCI Technologies, Inc. Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Gary Mryncza Phone: (919) 783-9214 Fax: (919) 783-9266
Construction Contractors	Environmental Technologies and Construction Landmark Center II, Suite 220 4601 Six Forks Rd. Raleigh, NC 27609 Contact: Mr. Ryan McDavitt Phone: (919) 278-2518 Fax: (919) 783-9266
	Quartermaster Environmental P.O. Drawer 400 Shelby, NC 28150 Contact: Mr. Brooks Cole Phone: (704) 473-5021
Planting Contractor	Bruton Nurseries & Landscapes 150 Black Creek Rd. Fremont, NC 27830 Contact: Charles 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 **Collins Creek Stream Restoration Site**	
Project County	Person County
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Project River Basin	Roanoke
USGS HUC for Project and Reference	03010104061040 (UT to Cane Creek)
	03040101090010 (UT Fisher River - reference)
NCDWQ Sub-basin for Project and Reference	03-02-05 (UT to Cane Creek)
	03-07-02 (UT Fisher River - reference)
Drainage Area	1.32 sq. mi.
Stream Order	First, Second, and Third Order
Watershed Type (Rural, Urban, Developing, etc.)	Rural
Watershed LULC Distribution Urban	<1%
Ag-Row Crop	49%
Ag-Livestock	12%
Forested	35%
Water/Wetlands	1%
Watershed impervious cover (%)	<1%
Rosgen Classification of As-built (Stream)	B4 (T2-3, T2-4, T3-2, T4-1, T4-2, T5-2, T6, T6c, T7-2, T8, T9)
	B4/1 (T7-4, T7-6, T10-2)
	B4c (T7-3)
	B4c/1 (T7-7)
	B4c/C4 (T7-5)
	C/B4 (T1)
	C/E (T3-1)
	C/E4 (T2-2)
NCDWQ Classification for Project	Class C (Cane 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	52.1 Acres
Total planted acreage	32.4 Acres
WRC Class (Warm, Cool, Cold)	Warm
Species of concern, endangered etc.	None
Pre-construction Beaver activity?	No
Dominant Soil Types	Chewacla, Wehadkee, Wilkes, and Wedowee
% of Project Easement Fenced	100%

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, one on T7-5 and one on T1-5 to record water levels indicating when bankfull events occur. The locations of these monitoring features and the permanent photo points are shown 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 permanent cross-sections were established and will be used to evaluate stream dimension: two riffle and two pool cross-sections on T1-3/T1-4/T1-5, one riffle cross-section on T2-2, two riffle and one pool cross-section on T3-2, three riffle and one pool cross-section on T4-1/T4-2, one riffle cross-section on T5-2, two riffle and one pool cross-section on T6, two riffle and one pool cross-section on T7-3, and one riffle cross-section on T7-5. Annual pebble counts will be performed at each cross-section (Appendix B). Cross-sections will be surveyed each year using a total station and morphological data will be calculated. A total of 4,530 linear feet of longitudinal profile will be surveyed. The monitored longitudinal profile will be split into seven representative portions. The profiles of T1-4/T1-5, T3-2, T4-2, T6, and T7-3, are 540, 535, 840, 540, and 810 linear feet in length, respectively. Additionally, 1,330 linear feet of profile will be surveyed beginning in the first year of monitoring to cover Enhancement I reaches on T1 and T7. 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, including bankfull slopes, pool-to-pool spacing, and feature lengths. Stem counts of planted trees and shrubs will be conducted in twenty 10 x 10 meter vegetation monitoring plots (Appendix D). The vegetation monitoring will be conducted following the CVS-EEP vegetation monitoring guidelines. The stream gauges on-site will be checked and/or downloaded every other month and the data will be analyzed to ascertain whether bankfull events have occurred. Visual monitoring of the stream and riparian buffer will be conducted with annual site walks and site photos will be taken from 51 permanent photo points located throughout the site (Appendix E).

2.3 As-Built Conditions

2.3.1 Stream

Baseline stream monitoring data were collected in January 2009.

Any changes made to the design during construction are shown on the As-Built Site Plan in Appendix A. The majority of the project was implemented as designed, but unexpected field conditions caused small adjustments to be made during construction. Unknown locations of bedrock in the field caused most of the changes to the design. In some instances, this caused the designed channel alignment to be adjusted, while in other cases the profile was modified. Bedrock also provided grade control in the new channel alignment, which allowed some structures to be eliminated or modified. Toward the end of construction, several large rain events occurred at the site before the project was well stabilized by vegetation. This caused damage to the project reaches, necessitating repair. Additional structures were added as necessary to ensure stability. All of the repairs on T4 were not complete by the time the mitigation plan was prepared. These repairs will be documented in the first year monitoring report.

Table 5 below compares the designed morphological values and ratios to the as-built values and ratios of the restored streams. Overall, the site was built as designed. The differences between the design and as-built conditions can be attributed to field changes made due to site constraints and small changes in the

streams that were caused by storm events during and immediately following construction. These storm-driven changes do not represent a shift towards unstable conditions. 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. A few of the pre-restoration reaches also had bank height ratios close to 1.0 and were classified as B4c, E4, and C4 stream types. Although these stream types are not inherently unstable, as is the case with G and F stream types, these project streams were having other instability problems such as bedform and lateral instabilities. The project restored and enhanced these streams, before they could transition into even more unstable forms, creating stable C4, E4, and B4c streams.

Table 5a. T1-3 Baseline Stream Summary
Cane Creek Stream Restoration 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)			10.2		1	9.0	9.5		10.0	2	13.6					
Floodprone Width (ft)			25.4		1	13	17		20	2	30					
Bankfull Mean Depth (ft)			1.3		1	1.1	1.2		1.2	2	1.2					
Bankfull Max Depth (ft)			1.9		1	1.3	1.4		1.5	2	1.9					
Bankfull Cross-Sectional Area (ft^2)			12.9		1	10.4	10.6		10.7	2	16.4					
Width/Depth Ratio			8.1		1	8.0	9.0		10.0	2	11.0					
Entrenchment Ratio			2.5		1	1.3	1.8		2.3	2	2.2					
Bank Height Ratio			1.8		1			1.0		2	1.0					
Pattern																
Channel Beltwidth (ft)			21					45			40	70	40	54	70	3
Radius of Curvature (ft)	7			19		13			42		30	40	30	35	40	4
Rc:Bankfull width (ft/ft)	0.7			1.9		1.3			4.4		2.2	3.0				
Meander Wavelength (ft)	90			117		93			136		160	170	160		170	2
Meander Width Ratio			2.0			4.5			5.0		3.0	5.0				
Profile																
Riffle Length (ft)													8	49	86	7
Riffle Slope (ft/ft)	0.0138			0.0427		0.013			0.028		0.010	0.014	0.006	0.012	0.030	7
Pool Length (ft)	13			38		3			25		10	20	16	19	26	6
Pool Spacing (ft)	21			49		30			59		75	100	56	94	152	5
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 13% / 87% / 0% / 0% / 0%					0% / 15% / 78% / 7% / 0% / 0%							0% / 34% / 66% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	6.0 / 9.0 / 11 / 21 / 30					2.0 / 4.2 / 6.9 / 30 / 70							0.6 / 2.1 / 4.5 / 15 / 28			
Additional Reach Parameters																
Channel length (ft)	313					297					324		326			
Drainage Area (SM)	0.60					0.38					0.60		0.60			
Rosgen Classification	E4					B4c					C/B4		C/B4			
Sinuosity	1.10					1.20					1.10		1.10			
Water Surface Slope (ft/ft)	0.0070					0.0130					0.0089		0.0089			

* This is a short restoration reach, similar to T1-4 and T1-5, and does not have any monitored cross-sections. Therefore there is no as-built dimension data.

Table 5b. T1-4/T1-5 Baseline Stream Summary
Cane Creek Stream Restoration 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)	10.5	14.1	14.5	17.0	4	9.0	9.5		10.0	2	15.0		15.3	16.4	17.4	2
Floodprone Width (ft)	19	24	20	35	4	13	17		20	1	33		39	41	42	2
Bankfull Mean Depth (ft)	1.0	1.3	1.3	1.5	4	1.1	1.2		1.2	2	1.3		1.1	1.3	1.5	2
Bankfull Max Depth (ft)	1.2	1.8	1.8	2.3	4	1.3	1.4		1.5	2	2.0		1.9	2.0	2.1	2
Bankfull Cross-Sectional Area (ft^2)	15.3	17.3	16.8	20.1	4	10.4	10.6		10.7	2	20.0		18.9	20.6	22.2	2
Width/Depth Ratio	7.2	11.8	11.4	17.2	4	8.0	9.0		10.0	2	12.0		10.5	13.3	16.0	2
Entrenchment Ratio	1.2	1.8	1.4	3.3	4	1.3	1.8		2.3	1	2.2		2.2	2.5	2.7	2
Bank Height Ratio	1.4	2.0	2.1	2.3	4			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	25			51				45			25	60	25		60	
Radius of Curvature (ft)	12			64		13			42		30	50	30	36	50	14
Rc:Bankfull width (ft/ft)	0.7			5.1		1.3			4.4		2.0	3.3	1.8	2.2	3.0	
Meander Wavelength (ft)	106			230		93			136		115	240	115		240	
Meander Width Ratio	1.5			4.7		4.5			5.0		1.7	4.0	1.5		3.7	
Profile																
Riffle Length (ft)													8	49	86	7
Riffle Slope (ft/ft)	0.0110			0.0407		0.013			0.028		0.005	0.013	0.006	0.012	0.030	7
Pool Length (ft)	11			30		3			25		10	30	16	19	26	6
Pool Spacing (ft)	29			88		30			59		50	150	56	94	152	5
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 17% / 63% / 19% / 0% / 0%					0% / 15% / 78% / 7% / 0% / 0%							0% / 7% / 86% / 4% / 0% / 3%			
d16 / d35 / d50 / d84 / d95 (mm)	1.6 / 13 / 22 / 73 / 130					2.0 / 4.2 / 6.9 / 30 / 70							6.9 / 14 / 19 / 41 / 62			
Additional Reach Parameters																
Channel length (ft)	1,290					297					1,290		1,291			
Drainage Area (SM)	0.80					0.38					0.80		0.80			
Rosgen Classification	B/G/F					B4c					C/B4		C/B4			
Sinuosity	1.07 - 1.33					1.20					1.10		1.10			
Water Surface Slope (ft/ft)	0.0072 - 0.0090					0.0130					0.0080		0.0071			

Table 5c. T2-2 Baseline Stream Summary
Cane Creek Stream Restoration 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)			4.4		1	9.0	9.5		10.0	2	7.4			7.7		1
Floodprone Width (ft)			>40		1	13	17		20	2	19			21		1
Bankfull Mean Depth (ft)			0.8		1	1.1	1.2		1.2	2	0.8			0.7		1
Bankfull Max Depth (ft)			0.9		1	1.3	1.4		1.5	2	1.3			1.2		1
Bankfull Cross-Sectional Area (ft^2)			3.3		1	10.4	10.6		10.7	2	5.7			5.4		1
Width/Depth Ratio			5.9		1	8.0	9.0		10.0	2	9.3			11.0		1
Entrenchment Ratio			>10		1	1.3	1.8		2.3	2	2.5			2.7		1
Bank Height Ratio			1		1			1.0		2	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	11			19				45			14	23	14		23	
Radius of Curvature (ft)	5			18		13			42		7	10	7	10	10	6
Rc:Bankfull width (ft/ft)	1.1			4.1		1.3			4.4		1.0	1.4	1.0		1.3	
Meander Wavelength (ft)	39			61		93			136		40	53	40		53	
Meander Width Ratio	2.5			3.3		4.5			5.0		1.9	3.1	1.8		3.0	
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 33% / 66% / 1% / 0% / 0%					0% / 15% / 78% / 7% / 0% / 0%							0% / 23% / 76% / 1% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	0.5 / 2.5 / 5.0 / 31 / 48					2.0 / 4.2 / 6.9 / 30 / 70							1.3 / 4.5 / 10 / 30 / 44			
Additional Reach Parameters																
Channel length (ft)	227					297					186		195			
Drainage Area (SM)	0.11					0.38					0.11		0.11			
Rosgen Classification	E4					B4c					C/E4		C/E4			
Sinuosity	1.70					1.20					1.40		1.50			
Water Surface Slope (ft/ft)	0.0179					0.0130					0.0231					

* This is a short reach and does not have a monitored longitudinal profile.

Table 5d. T3-2 Baseline Stream Summary
Cane Creek Stream Restoration 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)	3.4	5.8	5.2	10.9	6	9.0	9.5		10.0	2	7.8		7.8	8.1	8.3	2
Floodprone Width (ft)	6	27	8	78	6	13	17		20	2	16		21	23	24	2
Bankfull Mean Depth (ft)	0.5	0.7	0.8	0.9	6	1.1	1.2		1.2	2	0.7		0.5	0.5	0.5	2
Bankfull Max Depth (ft)	1.0	1.2	1.1	1.3	6	1.3	1.4		1.5	2	1.1		0.9	0.9	0.9	2
Bankfull Cross-Sectional Area (ft^2)	2.5	3.9	4.1	5.1	6	10.4	10.6		10.7	2	5.6		3.9	4.1	4.2	2
Width/Depth Ratio	4.3	9.2	7.0	23.3	6	8.0	9.0		10.0	2	10.9		15.6	16.0	16.4	2
Entrenchment Ratio	1.1	6.5	1.6	16.3	6	1.3	1.8		2.3	2	2.1		2.7	2.8	2.9	2
Bank Height Ratio	1.0	1.9	2.0	3.2	6			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	20			25				45			40	45	25		45	
Radius of Curvature (ft)	8			30		13			42		10	30	10		30	
Rc:Bankfull width (ft/ft)	1.4			7.1		1.3			4.4		1.3	3.8	1.2		3.7	
Meander Wavelength (ft)	80			420		93			136		48	130	45		130	
Meander Width Ratio	3.4			6.0		4.5			5.0		5.1	5.8	3.1		5.6	
.																
Riffle Length (ft)													7	23	56	11
Riffle Slope (ft/ft)	0.0102			0.0640		0.013			0.028		0.014	0.045	0.005	0.022	0.036	11
Pool Length (ft)	6			23		3			25		6	20	4	9	23	13
Pool Spacing (ft)	11			68		30			59		25	90	14	37	55	12
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 72% / 27% / 1% / 0% / 0%					0% / 15% / 78% / 7% / 0% / 0%							12% / 25% / 61% / 3% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	0.28 / 0.47 / 0.7 / 9 / 27					2.0 / 4.2 / 6.9 / 30 / 70							0.11 / 1.5 / 11 / 35 / 54			
Additional Reach Parameters																
Channel length (ft)	1,457					297					1,554		1,592			
Drainage Area (SM)	0.08					0.38					0.08		0.08			
Rosgen Classification	G4					B4c					B4		B4			
Sinuosity	1.10					1.20					1.20		1.20			
Water Surface Slope (ft/ft)	0.0202					0.0130					0.0215		0.0174			

Table 5e. T4-1 Baseline Stream Summary
Cane Creek Stream Restoration 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	5.4	5.1	6.7	3	9.0	9.5		10.0	2	6.2			8.5		1
Floodprone Width (ft)	6	8	8	10	3	13	17		20	2	12			24		1
Bankfull Mean Depth (ft)	1.1	1.2	1.1	1.4	3	1.1	1.2		1.2	2	0.5			0.5		1
Bankfull Max Depth (ft)	1.4	1.5	1.5	1.7	3	1.3	1.4		1.5	2	0.8			1.0		1
Bankfull Cross-Sectional Area (ft^2)	5.4	6.2	6.1	7.2	3	10.4	10.6		10.7	2	3.0			4.1		1
Width/Depth Ratio	3.3	4.8	4.8	6.2	3	8.0	9.0		10.0	2	12.4			17.6		1
Entrenchment Ratio	1.5	1.5	1.5	1.6	3	1.3	1.8		2.3	2	2.0			2.8		1
Bank Height Ratio	3.1	3.8	4.1	4.2	3			1.0		2	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	15			58				45			39	50	40		60	
Radius of Curvature (ft)	7			26		13			42		15	20	15	16	20	5
Rc:Bankfull width (ft/ft)	1.0			5.8		1.3			4.4		2.4	3.2	1.8	1.9	2.4	
Meander Wavelength (ft)	35			290		93			136		77	95	70		90	
Meander Width Ratio	2.2			12.9		4.5			5.0		6.3	8.1	4.7		7.1	
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 19% / 73% / 7% / 0% / 1%					0% / 15% / 78% / 7% / 0% / 0%							73% / 5% / 22% / 1% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1.5 / 11 / 17 / 45 / 78					2.0 / 4.2 / 6.9 / 30 / 70							0.1 / 0.1 / 0.1 / 13 / 32			
Additional Reach Parameters																
Channel length (ft)	190					297					266		253			
Drainage Area (SM)	0.06					0.38					0.06		0.06			
Rosgen Classification	G4					B4c					B4		B4			
Sinuosity	1.70					1.20					1.40		1.40			
Water Surface Slope (ft/ft)	0.0179					0.0130					0.0231					

* The monitored longitudinal profile for T4 is on T4-2.

Table 5f. T4-2 Baseline Stream Summary
Cane Creek Stream Restoration 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	5.4	5.1	6.7	3	9.0	9.5		10.0	2	9.2		8.6	8.9	9.1	2
Floodprone Width (ft)	6	8	8	10	3	13	17		20	2	18		24	25	26	2
Bankfull Mean Depth (ft)	1.1	1.2	1.1	1.4	3	1.1	1.2		1.2	2	0.8		0.6	0.8	0.9	2
Bankfull Max Depth (ft)	1.4	1.5	1.5	1.7	3	1.3	1.4		1.5	2	1.2		1.2	1.5	1.7	2
Bankfull Cross-Sectional Area (ft^2)	5.4	6.2	6.1	7.2	3	10.4	10.6		10.7	2	7.1		5.9	6.9	7.9	2
Width/Depth Ratio	3.3	4.8	4.8	6.2	3	8.0	9.0		10.0	2	11.5		9.4	11.7	14.0	2
Entrenchment Ratio	1.5	1.5	1.5	1.6	3	1.3	1.8		2.3	2	2.0		2.6	2.8	3.0	2
Bank Height Ratio	3.1	3.8	4.1	4.2	3			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	15			58				45			25	60	20		65	
Radius of Curvature (ft)	7			26		13			42		10	30	10		30	
Rc:Bankfull width (ft/ft)	1.0			5.8		1.3			4.4		1.1	3.3	1.1		3.4	
Meander Wavelength (ft)	35			290		93			136		50	130	50		130	
Meander Width Ratio	2.2			12.9		4.5			5.0		2.7	6.5	2.2		7.3	
Profile																
Riffle Length (ft)													5	23	56	15
Riffle Slope (ft/ft)	0.0134			0.0381		0.013			0.028		0.009	0.030	0.005	0.025	0.063	15
Pool Length (ft)	10			35		3			25		5	40	1	11	28	19
Pool Spacing (ft)	20			80		30			59		30	85	7	46	94	18
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 19% / 73% / 7% / 0% / 1%					0% / 15% / 78% / 7% / 0% / 0%							1% / 47% / 51% / 1% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	1.5 / 11 / 17 / 45 / 78					2.0 / 4.2 / 6.9 / 30 / 70							0.4 / 1.1 / 2.4 / 30 / 52			
Additional Reach Parameters																
Channel length (ft)	1,789					297					1,967		2,008			
Drainage Area (SM)	0.10					0.38					0.10		0.10			
Rosgen Classification	G4					B4c					B4		B4			
Sinuosity	1.10					1.20					1.20		1.20			
Water Surface Slope (ft/ft)	0.0224					0.0130					0.0181		0.0141			

Table 5g. T5-2 Baseline Stream Summary
Cane Creek Stream Restoration 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)			3.3		1	9.0	9.5		10.0	2	5.0			5.9		1
Floodprone Width (ft)			4		1	13	17		20	2	10			21		1
Bankfull Mean Depth (ft)			0.7		1	1.1	1.2		1.2	2	0.5			0.4		1
Bankfull Max Depth (ft)			0.9		1	1.3	1.4		1.5	2	0.8			0.8		1
Bankfull Cross-Sectional Area (ft^2)			2.3		1	10.4	10.6		10.7	2	2.5			2.4		1
Width/Depth Ratio			4.7		1	8.0	9.0		10.0	2	10.0			14.5		1
Entrenchment Ratio			1.3		1	1.3	1.8		2.3	2	2.0			3.6		1
Bank Height Ratio			2.7		1			1.0		2	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)								45			15	30	15		30	
Radius of Curvature (ft)						13			42		15		15			
Rc:Bankfull width (ft/ft)						1.3			4.4		3.0		2.5			
Meander Wavelength (ft)						93			136		45	63	50		60	
Meander Width Ratio						4.5			5.0		3.0	6.0	2.5		5.1	
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%						0% / 15% / 78% / 7% / 0% / 0%							40% / 41% / 20% / 0% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)						2.0 / 4.2 / 6.9 / 30 / 70							0.1 / 0.1 / 0.2 / 4.2 / 9.8			
Additional Reach Parameters																
Channel length (ft)	118					297					121		132			
Drainage Area (SM)	0.02					0.38					0.02		0.02			
Rosgen Classification	G4					B4c					B4		B4			
Sinuosity	1.10					1.20					1.20		1.20			
Water Surface Slope (ft/ft)	0.0590					0.0130					0.0550					

* This is a short reach and does not have a monitored longitudinal profile.

Table 5f. T6 Baseline Stream Summary
Cane Creek Stream Restoration 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)	3.4	4.4		5.3	2	9.0	9.5		10.0	2	8.0		6.3	6.7	7.1	2
Floodprone Width (ft)	4	6		8	2	13	17		20	2	16		16.7	17.2	18.6	2
Bankfull Mean Depth (ft)	0.4	0.6		0.8	2	1.1	1.2		1.2	2	0.7		0.5	0.6	0.6	2
Bankfull Max Depth (ft)	0.5	0.8		1.0	2	1.3	1.4		1.5	2	1.1		0.8	0.9	0.9	2
Bankfull Cross-Sectional Area (ft^2)	1.3	2.7		4.0	2	10.4	10.6		10.7	2	5.7		3.4	3.5	3.6	2
Width/Depth Ratio	7.0	7.9		8.7	2	8.0	9.0		10.0	2	11.4		11.0	12.9	14.8	2
Entrenchment Ratio	1.1	1.3		1.5	2	1.3	1.8		2.3	2	2.0		2.6	2.7	2.7	2
Bank Height Ratio	3.0	4.9		6.8	2			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	16			36				45			36	40	30		40	
Radius of Curvature (ft)	3			16		13			42		10	35	10		35	
Rc:Bankfull width (ft/ft)	0.6			4.7		1.3			4.4		1.3	4.4	1.5		5.2	
Meander Wavelength (ft)	14			116		93			136		72	120	50		120	
Meander Width Ratio	2.6			34.1		4.5			5.0		4.5	5.0	4.5		6.0	
Profile																
Riffle Length (ft)													11	25	49	12
Riffle Slope (ft/ft)	0.009			0.030		0.013			0.028		0.013	0.025	0.010	0.024	0.040	12
Pool Length (ft)	9			13		3			25		6	15	2	6	14	14
Pool Spacing (ft)	26			48		30			59		25	70	5	36	68	13
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 52% / 45% / 1% / 1% / 1%					0% / 15% / 78% / 7% / 0% / 0%							1% / 14% / 81% / 3% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	0.5 / 0.9 / 1.7 / 11 / 20					2.0 / 4.2 / 6.9 / 30 / 70							5.6 / 34 / 40 / 56 / 63			
Additional Reach Parameters																
Channel length (ft)	1,275					297					1,230		1,230			
Drainage Area (SM)	0.07					0.38					0.07		0.07			
Rosgen Classification	G					B4c					B4		B4			
Sinuosity	1.20					1.20					1.20		1.20			
Water Surface Slope (ft/ft)	0.0245					0.0130					0.0240		0.0301			

Table 5f. T7-3 Baseline Stream Summary
Cane Creek Stream Restoration 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)	5.0	6.1	6.5	6.9	3	9.0	9.5		10.0	2	8.2		9.0	9.1	9.1	2
Floodprone Width (ft)	8	9	9	9	3	13	17		20	2	16		15.4	16.9	18.4	2
Bankfull Mean Depth (ft)	0.9	0.9	0.9	1.0	3	1.1	1.2		1.2	2	0.7		0.7	0.8	0.8	2
Bankfull Max Depth (ft)	1.1	1.2	1.3	1.3	3	1.3	1.4		1.5	2	1.1		0.9	1.1	1.3	2
Bankfull Cross-Sectional Area (ft^2)	5.0	5.6	5.9	6.0	3	10.4	10.6		10.7	2	6.0		6.4	7.7	9.0	2
Width/Depth Ratio	6.0	7.0	7.2	7.9	3	8.0	9.0		10.0	2	11.2		11.6	12.3	12.9	2
Entrenchment Ratio	1.2	1.3	1.3	1.4	3	1.3	1.8		2.3	2	2.0		1.7	1.9	2.0	2
Bank Height Ratio	2.8	3.3	3.2	3.8	3			1.0		2	1.0		1.0	1.0	1.0	2
Pattern																
Channel Beltwidth (ft)	24			42				45			29	47	30		60	
Radius of Curvature (ft)	22			58		13			42		15	35	15		35	
Rc:Bankfull width (ft/ft)	3.2			9.7		1.3			4.4		1.8	4.3	1.6		3.8	
Meander Wavelength (ft)	52			115		93			136		55	106	50		110	
Meander Width Ratio	3.5			7		4.5			5.0		3.5	5.7	3.3		6.6	
Profile																
Riffle Length (ft)													15	26	40	15
Riffle Slope (ft/ft)	0.007			0.012		0.013			0.028		0.020	0.030	0.002	0.018	0.035	15
Pool Length (ft)	6			12		3			25		7	30	6	16	54	15
Pool Spacing (ft)	17			42		30			59		32	86	38	55	101	14
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%	0% / 37% / 62% / 1% / 0% / 0%					0% / 15% / 78% / 7% / 0% / 0%							6% / 33% / 54% / 6% / 0% / 0%			
d16 / d35 / d50 / d84 / d95 (mm)	0.3 / 1.4 / 5.4 / 15 / 25					2.0 / 4.2 / 6.9 / 30 / 70							0.3 / 1.4 / 6.6 / 45 / 95			
Additional Reach Parameters																
Channel length (ft)	2,023					297					2,088		2,109			
Drainage Area (SM)	0.18					0.38					0.18		0.18			
Rosgen Classification	G4c					B4c					B4c		B4c			
Sinuosity	1.10					1.20					1.10		1.15			
Water Surface Slope (ft/ft)	0.0132					0.0130					0.0128		0.0211			

Table 5g. T7-5 Baseline Stream Summary
Cane Creek Stream Restoration 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)						9.0	9.5		10.0	2	10.4			11.5		1
Floodprone Width (ft)						13	17		20	2	21			21		1
Bankfull Mean Depth (ft)						1.1	1.2		1.2	2	0.9			0.9		1
Bankfull Max Depth (ft)						1.3	1.4		1.5	2	1.2			1.3		1
Bankfull Cross-Sectional Area (ft^2)						10.4	10.6		10.7	2	9.0			10.7		1
Width/Depth Ratio						8.0	9.0		10.0	2	12.0			12.4		1
Entrenchment Ratio						1.3	1.8		2.3	2	2.0			1.9		1
Bank Height Ratio								1.0		2	1.0			1.0		1
Pattern																
Channel Beltwidth (ft)	28							45			20	25	20		25	
Radius of Curvature (ft)	12					13			42		20	25	20		25	
Rc:Bankfull width (ft/ft)						1.3			4.4		1.9	2.4	1.7		2.2	
Meander Wavelength (ft)	62					93			136		64	68	60		70	
Meander Width Ratio						4.5			5.0		2.0	2.5	1.7		2.2	
Substrate and Transport Parameters																
SC% / Sa% / G% / C% / B% / Be%						0% / 15% / 78% / 7% / 0% / 0%							0% / 23% / 63% / 2% / 0% / 12%			
d16 / d35 / d50 / d84 / d95 (mm)						2.0 / 4.2 / 6.9 / 30 / 70							0.9 / 4.4 / 11 / 34 / 55			
Additional Reach Parameters																
Channel length (ft)	185					297					154		147			
Drainage Area (SM)	0.24					0.38					0.24		0.24			
Rosgen Classification	E4					B4c					B4c/C4		B4c/C4			
Sinuosity	1.20					1.20					1.08		1.05			
Water Surface Slope (ft/ft)	0.0145					0.0130					0.0193					

* This is a short reach and does not have a monitored longitudinal profile.

Table 6. Morphology and Hydraulic Monitoring Summary Cane Creek Stream Restoration Site										
Parameter	X-Section 1 Pool	X-Section 2 Riffle	X-Section 3 Pool	X-Section 4 Riffle	X-Section 5 Riffle	X-Section 6 Pool	X-Section 7 Riffle	X-Section 8 Riffle	X-Section 9 Riffle	X-Section 10 Riffle
Reach	T1-3	T1-4	T1-4	T1-5	T2-2	T3-2	T3-2	T3-2	T4-1	T4-2
Dimension										
Bankfull Width (ft)	12.6	17.4	14.2	15.3	7.7	12.3	7.8	8.3	8.5	9.1
Floodprone Width (ft)	-	39	-	42	21	-	21	24	24	24
Bankfull Mean Depth (ft)	1.6	1.1	1.5	1.5	0.7	1.1	0.5	0.5	0.5	0.6
Bankfull Max Depth (ft)	2.8	1.9	2.5	2.1	1.2	2.2	0.9	0.9	1.0	1.2
Bankfull Cross-Sectional Area (ft^2)	20.2	18.9	21.9	22.2	5.4	13.3	3.9	4.2	4.1	5.9
Bankfull Width/Depth Ratio	-	16.0	-	10.5	11.0	-	15.6	16.4	17.6	14.0
Bankfull Entrenchment Ratio	-	2.2	-	2.7	2.7	-	2.7	2.9	2.8	2.6
Bankfull Bank Height Ratio	-	1.0	-	1.0	1.0	-	1.0	1.0	1.0	1.0
Substrate										
d50 (mm)	4.5	15	1.8	24	10	1.1	0.3	26	0.1	8
d84 (mm)	15	40	12	44	30	10	6.9	42	13	39

Parameter	X-Section 11 Riffle	X-Section 12 Pool	X-Section 13 Riffle	X-Section 14 Riffle	X-Section 15 Pool	X-Section 16 Riffle	X-Section 17 Pool	X-Section 18 Riffle	X-Section 19 Riffle	X-Section 20 Riffle
Reach	T4-2	T4-2	T5-2	T6	T6	T6	T7-3	T7-3	T7-3	T7-5
Dimension										
Bankfull Width (ft)	8.6	10.7	5.9	7.1	4.1	6.3	7.3	9.0	9.1	11.5
Floodprone Width (ft)	26	-	21	18.6	-	16.7	-	18.4	15.4	21.3
Bankfull Mean Depth (ft)	0.9	1.1	0.4	0.5	0.8	0.6	1.1	0.8	0.7	0.9
Bankfull Max Depth (ft)	1.7	2.5	0.8	0.8	1.2	0.9	2.0	1.3	0.9	1.3
Bankfull Cross-Sectional Area (ft^2)	7.9	12.3	2.4	3.4	3.1	3.6	7.7	9.0	6.4	10.7
Bankfull Width/Depth Ratio	9.4	-	14.5	14.8	-	11.0	-	11.6	12.9	12.4
Bankfull Entrenchment Ratio	3.0	-	3.6	2.6	-	2.7	-	2.0	1.7	1.9
Bankfull Bank Height Ratio	1.0	-	1.0	1.0	-	1.0	-	1.0	1.0	1.0
Substrate										
d50 (mm)	1.2	0.2	0.2	44	4.4	35	0.3	21	1.9	11
d84 (mm)	16	0.8	4.2	57	20	56	0.5	58	19	34

2.3.2 Vegetation

The site was planted with bare root trees and shrubs and live stakes in December 2008. A total of 17 different species were planted at the site. The species from the planting plan that were unavailable at the time of planting included coralberry (*Symphoricarpos orbiculatus*), spicebush (*Lindera benzoin*), winterberry (*Ilex verticillata*), possumhaw (*Viburnum nudum*), tag alder (*Alnus serrulata*), and witchhazel (*Hamamelis virginiana*). As substitutions for these species, American beautyberry (*Callicarpa americana*), pawpaw (*Asimina triloba*), silky dogwood (*Cornus amomum*), and swamp blackgum (*Nyssa biflora*) were planted.

Baseline vegetation monitoring data from the 20 vegetation plots were collected in January 2009. The vegetation monitoring follows the CVS/EEP vegetation monitoring protocol. Plot photos from all the vegetation plots can be found in Appendix D.

The results of the baseline monitoring show an average of 690 stems per acre in the riparian area (Table 7). 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. Stem Count by Plot and Species
Cane Creek Stream Restoration Site

	Species	Total Planted Stems	# plots	avg # stems	plot CCTS-A-0001	plot CCTS-A-0002	plot CCTS-A-0003	plot CCTS-A-0004	plot CCTS-A-0005	plot CCTS-A-0006	plot CCTS-A-0007	plot CCTS-A-0008	plot CCTS-A-0009	plot CCTS-A-0010	plot CCTS-A-0011	plot CCTS-A-0012	plot CCTS-A-0013	plot CCTS-A-0014	plot CCTS-A-0015	plot CCTS-A-0016	plot CCTS-A-0017	plot CCTS-A-0018	plot CCTS-A-0019	plot CCTS-A-0020
	Betula nigra	10	4	3	1														1	7		1		
	Carya spp.	2	1	2					2															
	Cornus amomum	98	14	7	9	1	3	7		9	7		10	4	3			19		12	4		4	6
	Diospyros virginiana	3	3	1														1	1					1
	Fraxinus pennsylvanica	13	6	2		3	2	1		3	2				2									
	Liriodendron tulipifera	5	2	3	2								3											
	Platanus occidentalis	12	6	2	1	1	3		3									2			2			
	Quercus spp.	46	12	4		2	4	1	4	1	2	2			9	8	8		2					3
	Quercus falcata	3	2	2	1							2												
	Quercus michauxii	13	5	3								2						1	8	1			1	
	Quercus phellos	3	2	2			1															2		
	Salix spp.	21	5	4	2			7		3			2		7									
	Salix nigra	2	1	2																2				
	Salix sericea	4	3	1														1		1			2	
	Sambucus canadensis	3	2	2						2													1	
	Unknown	103	16	6	12	6	3	5	6	5	9	5	5	10		7	3				6	11	8	2
TOT:	**16**	**341**	**16**		**28**	**13**	**16**	**21**	**15**	**23**	**20**	**11**	**20**	**14**	**21**	**15**	**11**	**24**	**12**	**23**	**12**	**14**	**16**	**12**

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. Any observed variation in the annual monitoring of the cross-sections and longitudinal profiles will be evaluated to determine whether they are minor adjustments associated with normal sediment transport and increasing stability 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

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

3.3 Hydrology

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

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# : 12054725-01

CONTRACT #: D06002

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

STATE	CONTRACT NUMBER	SHEET NO.	TOTAL SHEETS
N.C.	D06002	1	35

A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	
SYM.	DESCRIPTION	DATE	APPROVED
REVISIONS			

PERSON COUNTY

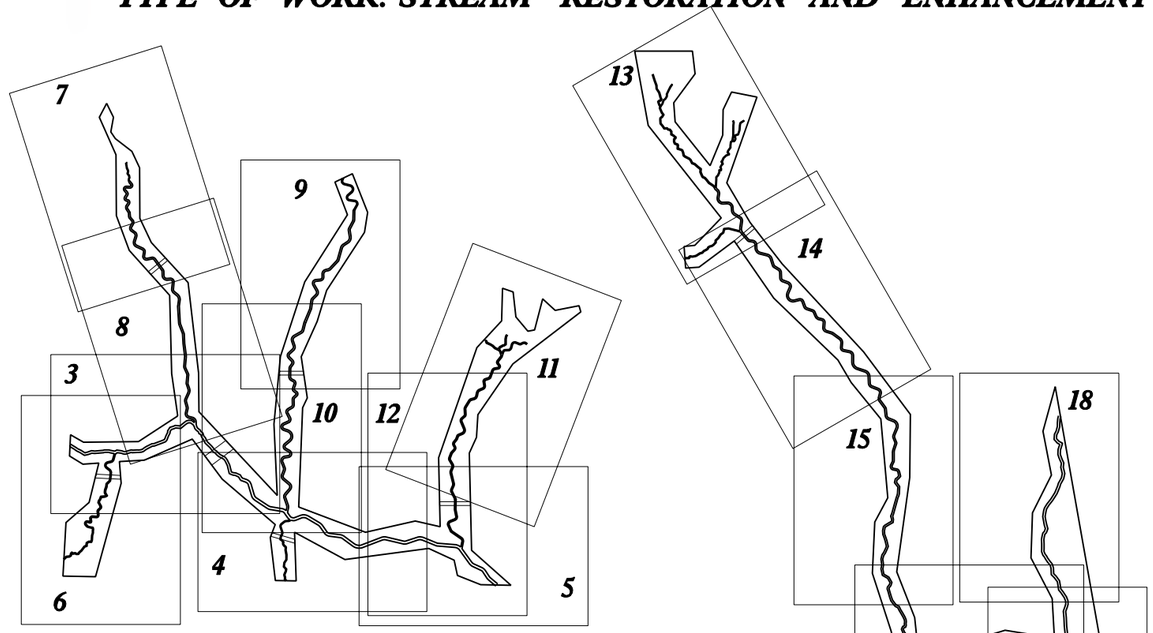
LOCATION: CANE CREEK TRIBUTARY SITE
UNNAMED TRIBUTARIES TO CANE CREEK
SEMORA, NORTH CAROLINA

TYPE OF WORK: STREAM RESTORATION AND ENHANCEMENT

VICINITY MAP
NOT TO SCALE

DIRECTIONS TO SITE

TO REACH THE SITE FROM RALEIGH, PROCEED WEST ON US-70 UNTIL IT MERGES WITH I-85/US-15 SOUTH. CONTINUE ON I-85 FOR APPROXIMATELY 1.5 MILES AND THEN TAKE EXIT 176B FOR DUKE ST/US-501 BYPASS. TAKE A RIGHT OFF OF THE EXIT AND TRAVEL ON US-501 FOR 27.5 MILES. WITHIN THE TOWN OF ROXBORO, TURN LEFT ONTO COURT ST/US-158 WEST. FOLLOW US-158 WEST 0.4 MILE AND TURN RIGHT ONTO NC-57, CONTINUING NORTHWEST FOR ANOTHER 12.3 MILES. ONCE WITHIN THE SMALL COMMUNITY OF SEMORA, TURN RIGHT ONTO NC-119 AND DRIVE NORTH 0.5 MILE. TURN RIGHT ONTO CUNNINGHAM ROAD AND CONTINUE EAST FOR 0.85 MILE. THE SITE WILL BE ACCESSIBLE BY A METAL GATE ON THE RIGHT.



INDEX OF SHEETS

1	*TITLE SHEET*
2	*AS-BUILT LEGEND*
3 THRU 18	*AS-BUILT SITE PLAN*
19 THRU 34	*MONITORING PLAN VIEW*
35	*AS-BUILT PLANTING PLAN*

NC GRID NAD 83

AS-BUILT PLAN
MAY 2009

GRAPHIC SCALE

–40 –20 0 40 80
PLANS

PROJECT DATA

STREAM RESTORATION LENGTH = 9,709 FEET

STREAM ENHANCEMENT I LENGTH = 5,497 FEET

STREAM ENHANCEMENT II LENGTH = 2,867 FEET

STREAM PRESERVATION LENGTH = 986 FEET

CONSTRUCTION COMPLETED: DECEMBER 2008

Prepared in the Office of:

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

GARY M. MRYNCZA, PE
PROJECT ENGINEER

ADAM SPILLER / KRISTIN KNIGHT-MENG
NATURAL CHANNEL DESIGN

PROJECT ENGINEER

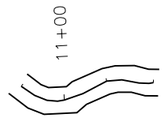
P.E.

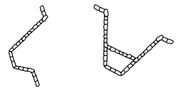
SIGNATURE:

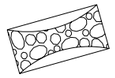
Prepared for:

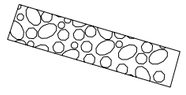
Ecosystem Enhancement PROGRAM

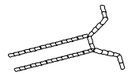
GUY PEARCE
CONTRACT ADMINISTRATOR

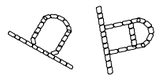


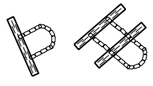


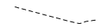


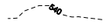


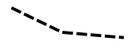












PROJECT LEGEND

STREAM RESTORATION

As–Built Thalweg, Stationing, and Top of Bank	
As–Built Cross Vane	
As–Built Riffle Grade Control/Constructed Riffle	
As–Built Stone Toe Protection	
As–Built Ford Crossing	
As–Built Channel Constrictor	
As–Built Drainage Stabilization	
As–Built Boulder Step Pools	
As–Built Log Step Pools	
As–Built Seep Stabilization	
Bedrock	

TOPOGRAPHY

Minor Contour Line	
Major Contour Line	

MONITORING

Cross–Section	
Photo Point	
Vegetation Plots	
Longitudinal Profile	
Stream Gauge	■

AS–BUILT NOTE:

THE AS–BUILT SITE PLAN (SHEETS 3–18) DEPICTS THE AS–BUILT CONDITIONS. ANY DEVIATIONS FROM THE DESIGN PLANS ARE SPECIFICALLY CALLED OUT WITH NOTES. IF THERE ARE NOT ASSOCIATED NOTES WITH A SPECIFIC SECTION THEN THAT SECTION WAS BUILT AS DESIGNED.

REVISIONS

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

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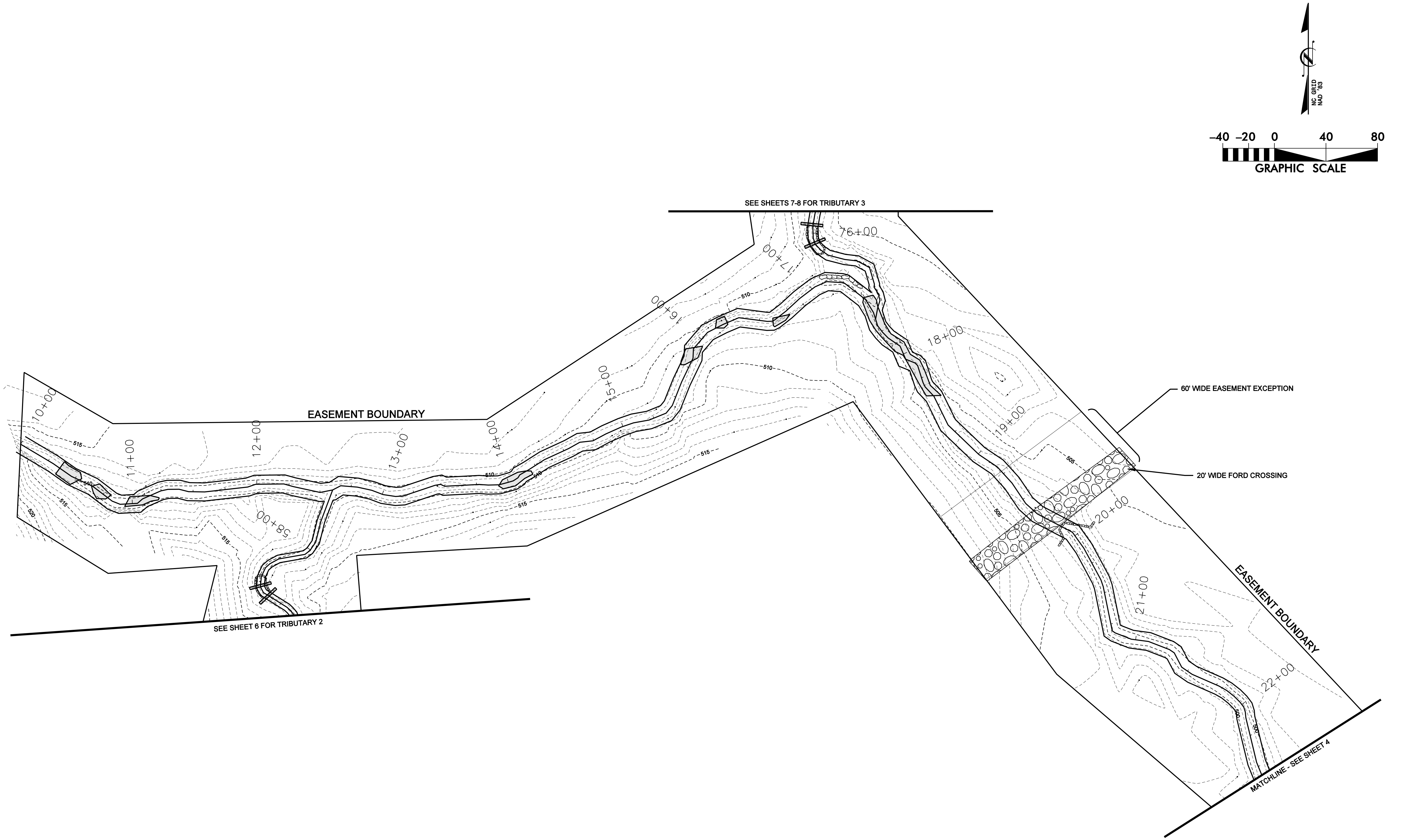
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

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

AS-BUILT
LEGEND

SHEET 2 OF 35



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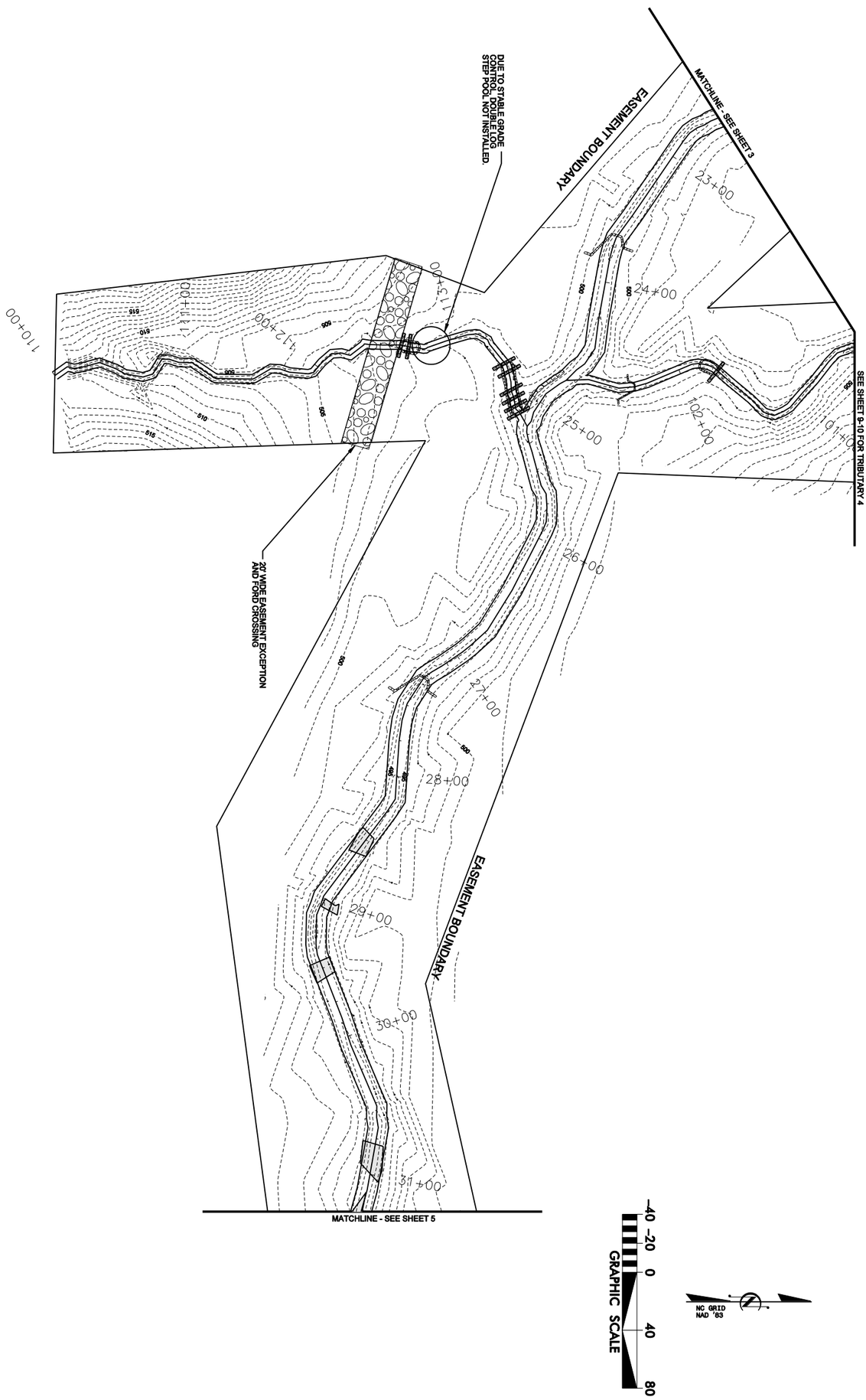
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T1-1, T1-2, T1-3: STATION 10+00 TO STATION 22+57

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT
SITE PLAN

SHEET 3 OF 35



SHEET 4 OF 35	AS-BUILT SITE PLAN	DATE: MAR 2009 SCALE: 1"=80'	CANE CREEK STREAM RESTORATION PROJECT SEMORA, PERSON COUNTY, NORTH CAROLINA T1-3,T1-4: STATION 22+57 TO STATION 31+26

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REVISIONS			
STAL	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

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CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T1-4, T1-5: STATION 31+26 TO STATION 37+67

DATE: MAR 2009

SCALE: 1"=80'

AS-BUILT SITE PLAN

NC GRID
NAD '83

–40 –20 0 40 80
GRAPHIC SCALE

50+00
52+00
53+00
54+00
55+00
56+00
57+00
10+00
11+00
12+00
13+00
58+00

SEEP AREA

20' WIDE EASEMENT EXCEPTION
AND FORD CROSSING

EASEMENT BOUNDARY

EASEMENT BOUNDARY

DUE TO BEDROCK GRADE
CONTROL, CROSS VANE
NOT INSTALLED.

LOG STEP POOL INSTALLED
INSTEAD OF CROSS VANE

SEE SHEETS 3-5 FOR TRIBUTARY 1

REVISIONS			
STAL	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

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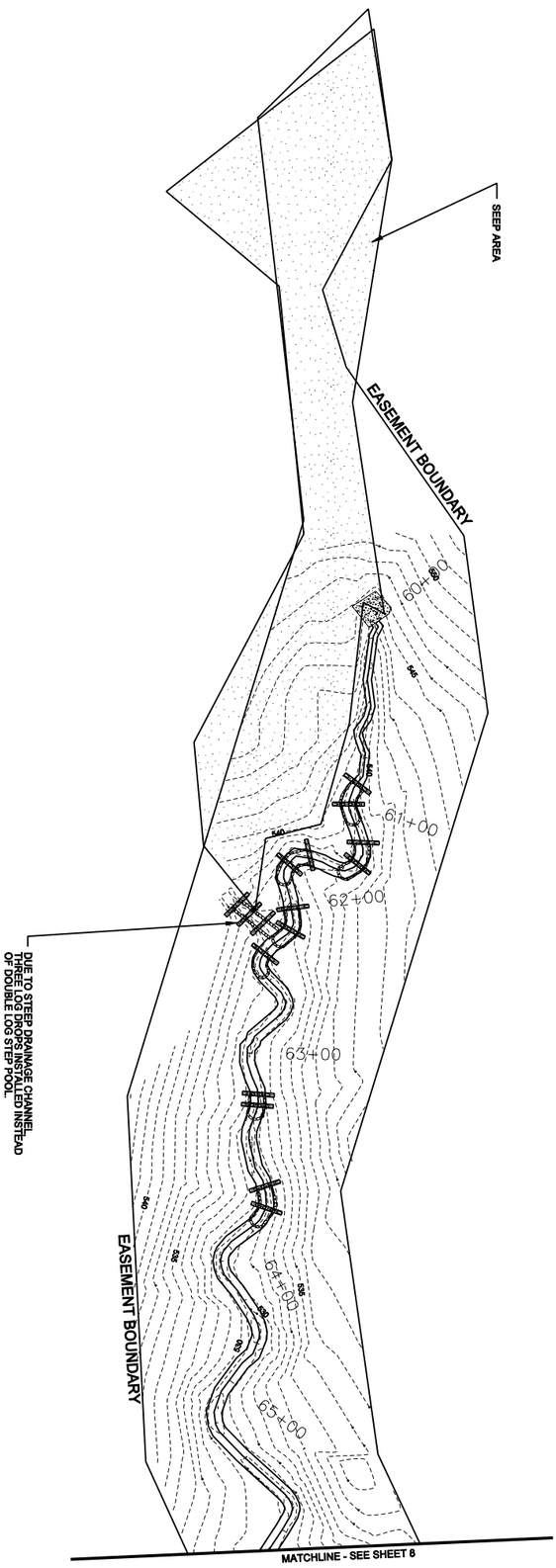
CANE CREEK
STREAM RESTORATION PROJECT

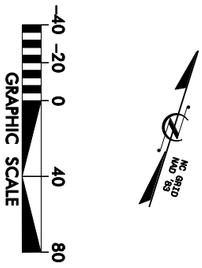
SEMORA, PERSON COUNTY, NORTH CAROLINA

T2-1, T2-2, T2-3, T2-4: STATION 50+00 TO STATION 58+50

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT
SITE PLAN





SHEET 7 OF 35

AS-BUILT
SITE PLAN

DATE: MAR 2009
SCALE: 1"=80'

CANE CREEK
STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T3-1, T3-2: STATION 60+00 TO STATION 66+13

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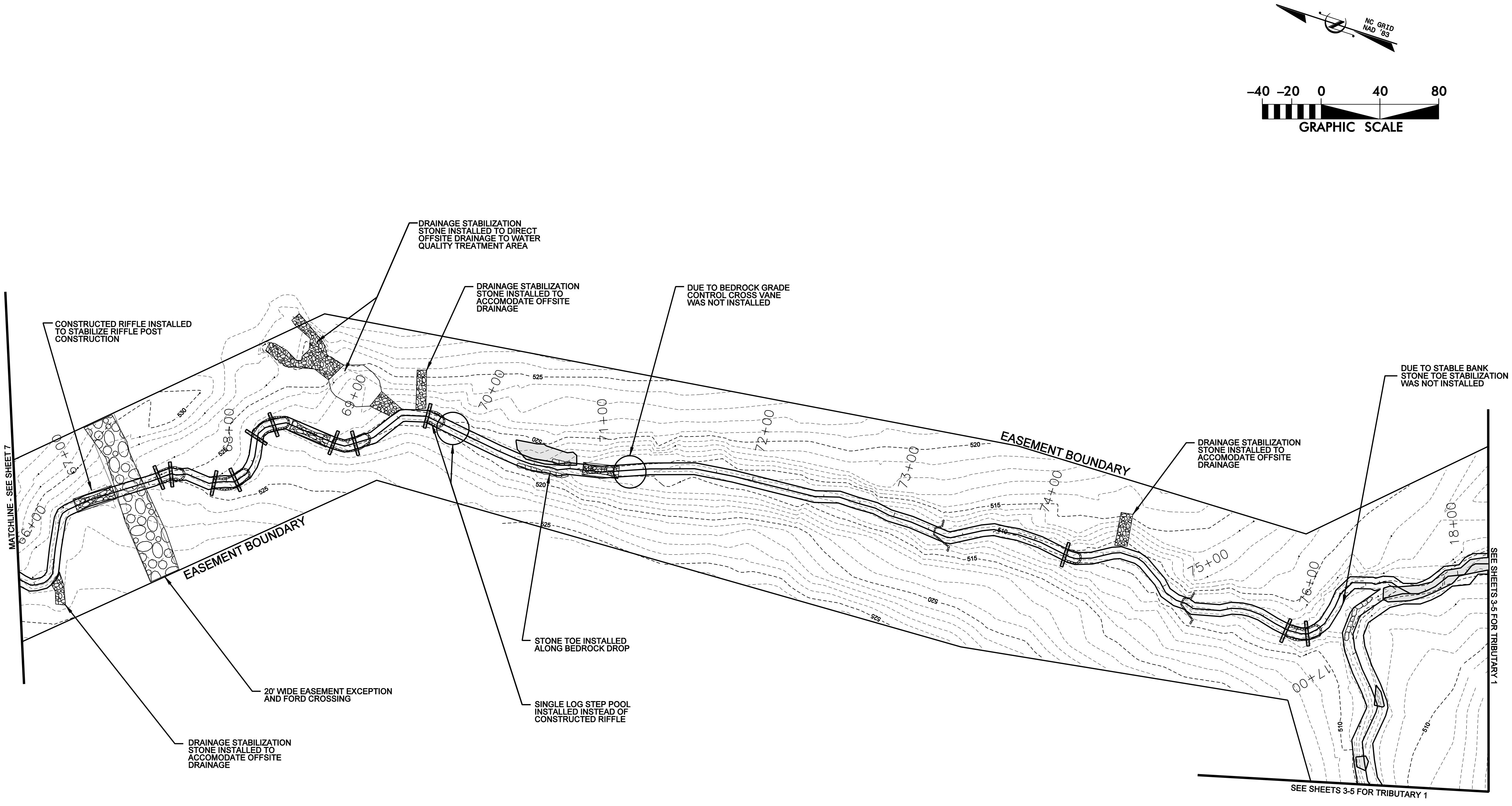
SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

REVISIONS



DRAINAGE STABILIZATION STONE INSTALLED TO DIRECT OFFSITE DRAINAGE TO WATER QUALITY TREATMENT AREA

DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMODATE OFFSITE DRAINAGE

DUE TO BEDROCK GRADE CONTROL CROSS VANE WAS NOT INSTALLED

CONSTRUCTED RIFFLE INSTALLED TO STABILIZE RIFFLE POST CONSTRUCTION

DUE TO STABLE BANK STONE TOE STABILIZATION WAS NOT INSTALLED

DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMODATE OFFSITE DRAINAGE

STONE TOE INSTALLED ALONG BEDROCK DROP

20' WIDE EASEMENT EXCEPTION AND FORD CROSSING

SINGLE LOG STEP POOL INSTALLED INSTEAD OF CONSTRUCTED RIFFLE

DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMODATE OFFSITE DRAINAGE

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

REVISIONS

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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T3-2: STATION 66+13 TO STATION 76+98

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT
SITE PLAN

SHEET 9 OF 35

AS-BUILT SITE PLAN

DATE: MAR 2009

SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T4-1, T4-2: STATION 80+00 TO STATION 91+49

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

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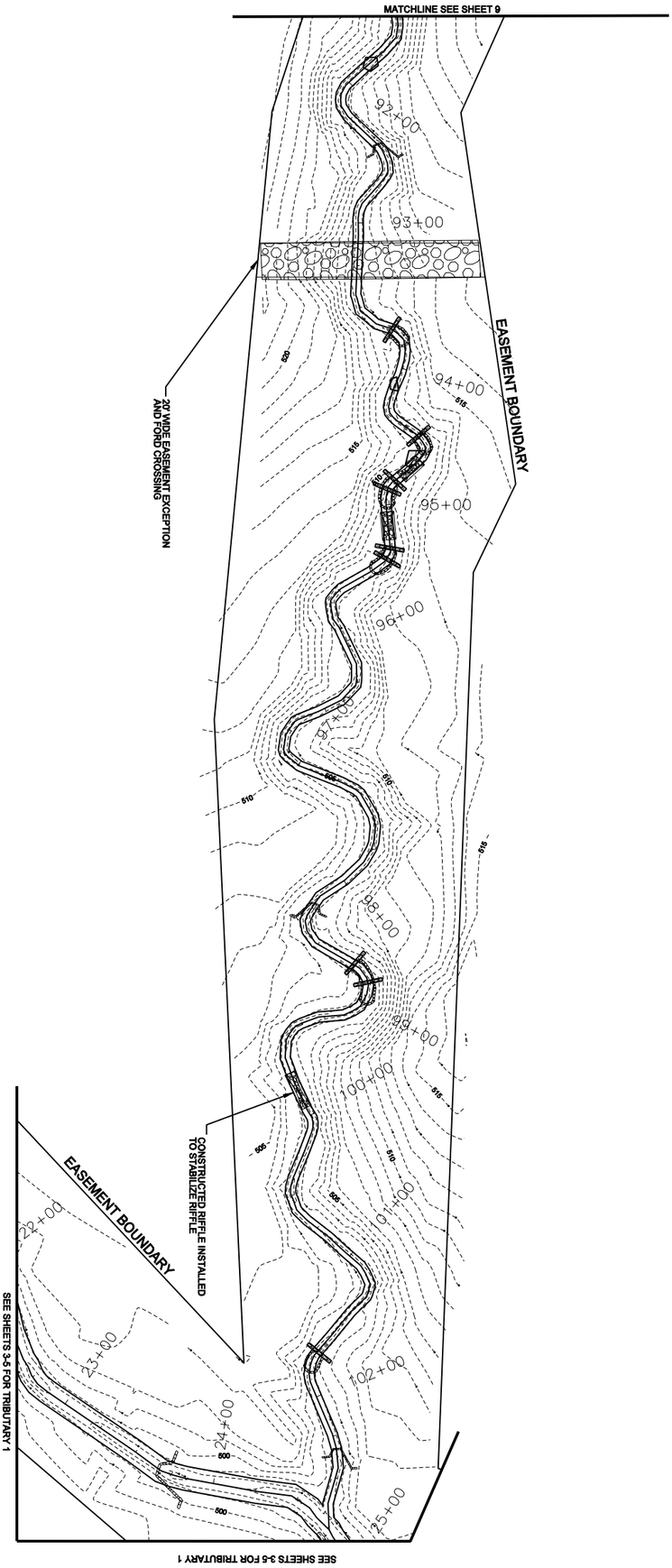

SHEET 10 OF 35

AS-BUILT
SITE PLAN

DATE: MAR 2009
SCALE: 1"=80'

CANE CREEK
STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T4-2: STATION 91+49 TO STATION 102+81

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

REVISIONS

REVISIONS

A	SUBMITTED WITH MITIGATION PLAN	SYM.	DESCRIPTION	DATE / APPROVED
				MAR 2009

Ecosystem Enhancement PROGRAM

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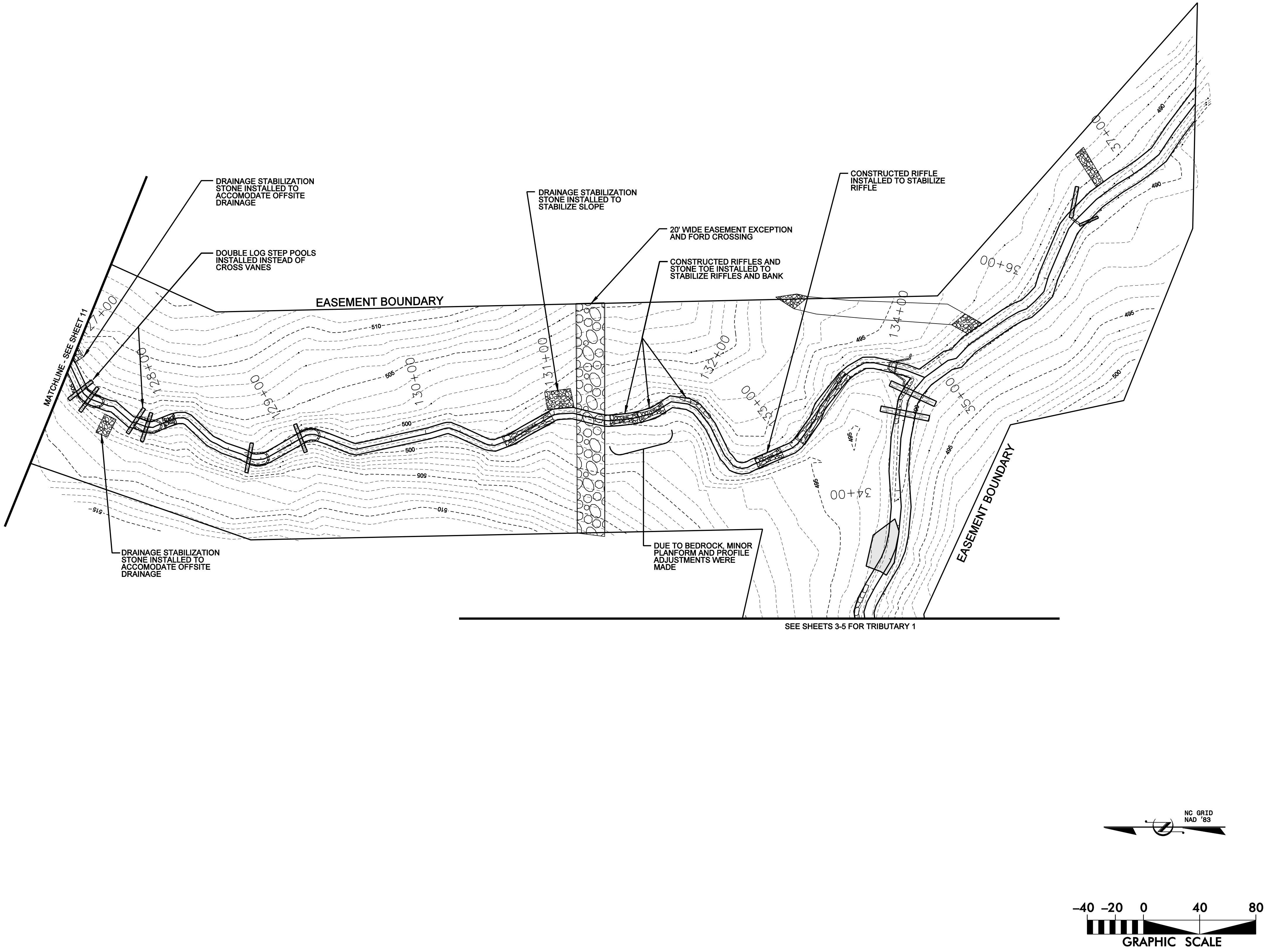
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

T6A, T6B, T6B-1, T6C-1, T6C-2, T6C-3, T6AB, T6C, T6:STA 300+00 TO 300+80, STA 310+00 TO 310+82, STA 240+00 TO 241+21, STA 248+38 TO 251+04, AND STA 117+02 TO 127+10

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT SITE PLAN

SHEET 11 OF 35



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

REVISIONS

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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

T6: STATION 127+10 TO STATION 134+25

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT
SITE PLAN

SHEET 12 OF 35

EASEMENT BOUNDARY

DRAINAGE STABILIZATION STONE INSTALLED

LOG STEP POOL MOVED DOWNSTREAM TO BETTER ACCOMODATE EXISTING BEDROCK FEATURES

LOG STEP POOLS INSTALLED TO STABILIZE EXISTING HEADCUTS

EXISTING HEADCUTTING SEEP STABILIZED WITH STONE

DRAINAGE STABILIZATION STONE INSTALLED TO ACCOMODATE OFFSITE DRAINAGE

CONSTRUCTED RIFFLES INSTALLED TO STABILIZE RIFFLES

MATCHLINE - SEE SHEET 14

EASEMENT BOUNDARY

DOUBLE LOG STEP POOL INSTALLED TO STABILIZE PROFILE

STONE TOE INSTALLED TO PROTECT UNDERCUT TREE ON STREAM BANK

DUE TO BEDROCK DROP, LOG STEP POOL WAS NOT INSTALLED

LOG STEP POOLS MOVED UPSTREAM TO BETTER ACCOMODATE EXISTING PROFILE FEATURES

REMOVED OLD WELL HOUSE AND STABILIZED SEEP

STONE TOE INSTALLED TO PROTECT UNDERCUT TREE ON STREAM BANK

NC GRID NAD 83

–40 –20 0 40 80

GRAPHIC SCALE

REVISIONS

	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

Ecosystem Enhancement Program

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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

T7A, T7A-1, T7B, T7C, T7-1, T7-2, T7-3, T8, T8A, T8A-1, T8-1, T8B, T9:
STA 260+00 TO 261+36, STA 140+00 TO 151+57, STA 270+00 TO 271+23,
STA 200+00 TO 204+38, AND STA 210+00 TO 213+68

DATE: MAR 2009

SCALE: 1"=80'

AS-BUILT SITE PLAN

SHEET 13 OF 35

20' WIDE EASEMENT EXCEPTION AND FORD CROSSING
EASEMENT BOUNDARY
MATCHLINE - SEE SHEET 13
153+00
154+00
155+00
156+00
157+00
158+00
159+00
160+00
161+00
162+00
163+00
164+00
525
530
535
540
545
550
555
560
565
570
575
580
585
590
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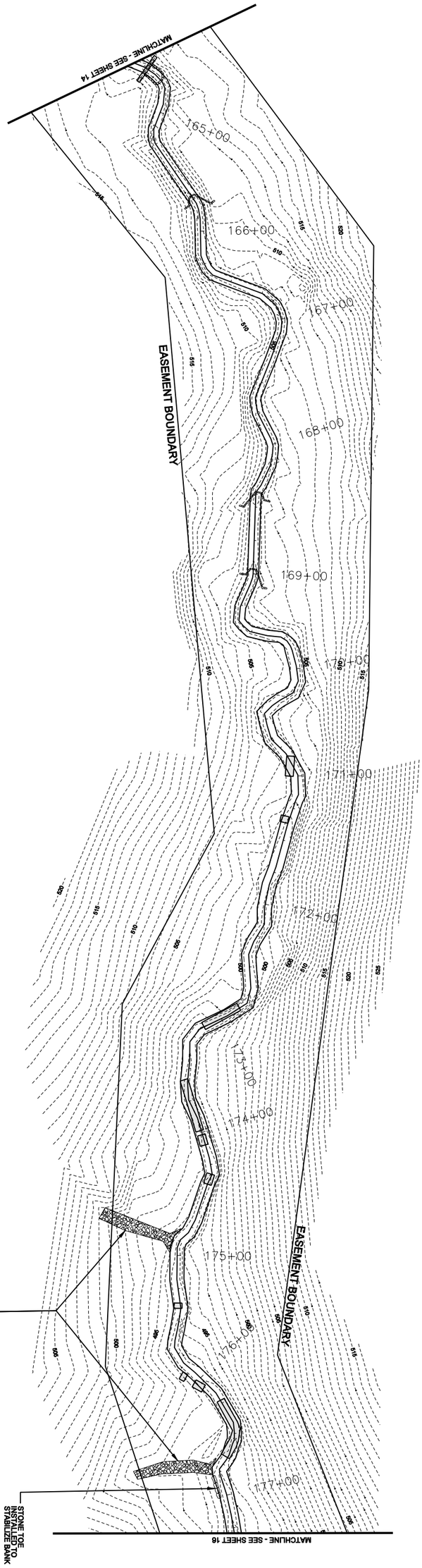
715
720



GRAPHIC SCALE
-40 -20 0 40 80

NC GRID NAD '83

SHEET 15 OF 35

AS-BUILT SITE PLAN

DATE: MAR 2009
SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T7-3, T7-4: STATION 16+50 TO STATION 177+29

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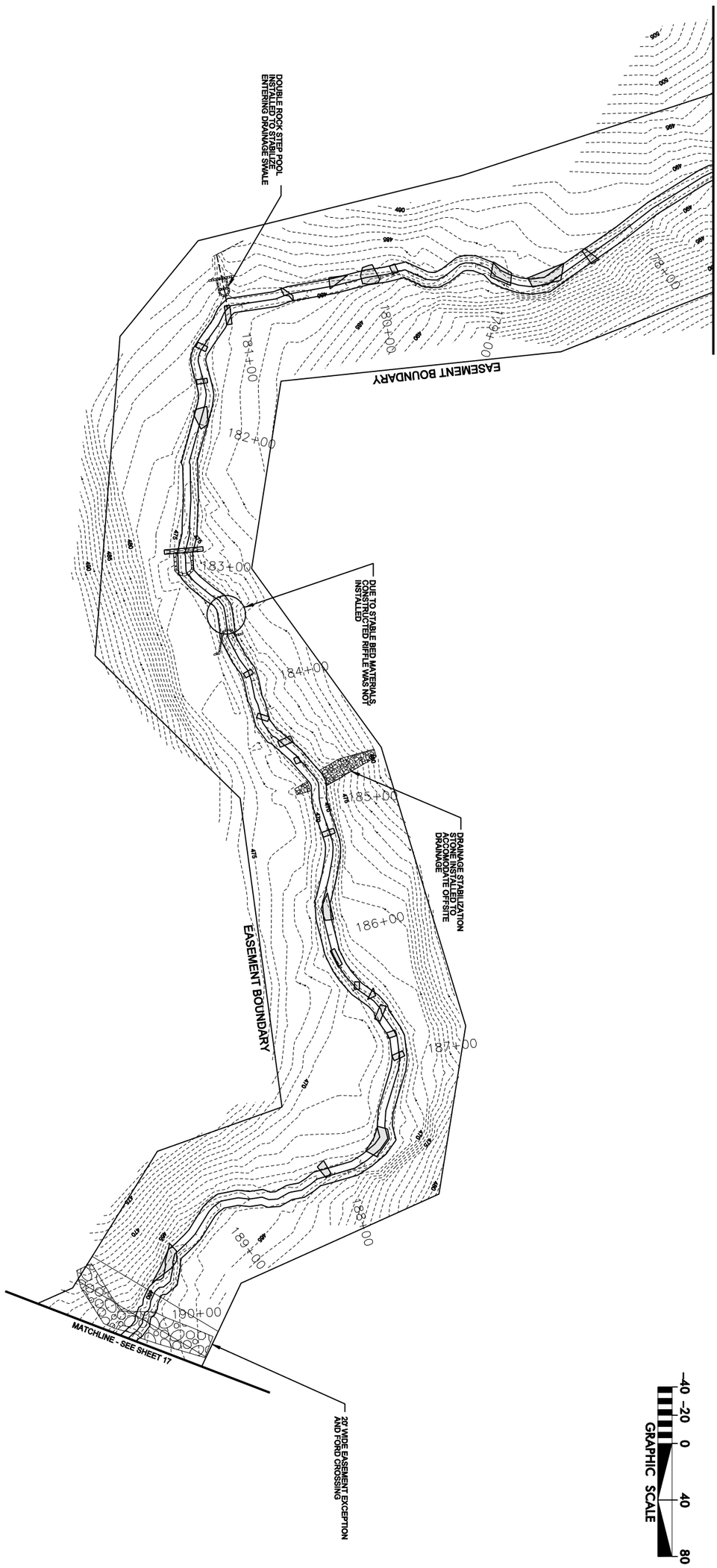
SYM.	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

REVISIONS



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

REVISIONS

CANE CREEK
STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T7-4, T7-5, T7-6: STATION 177+29 TO STATION 190+18

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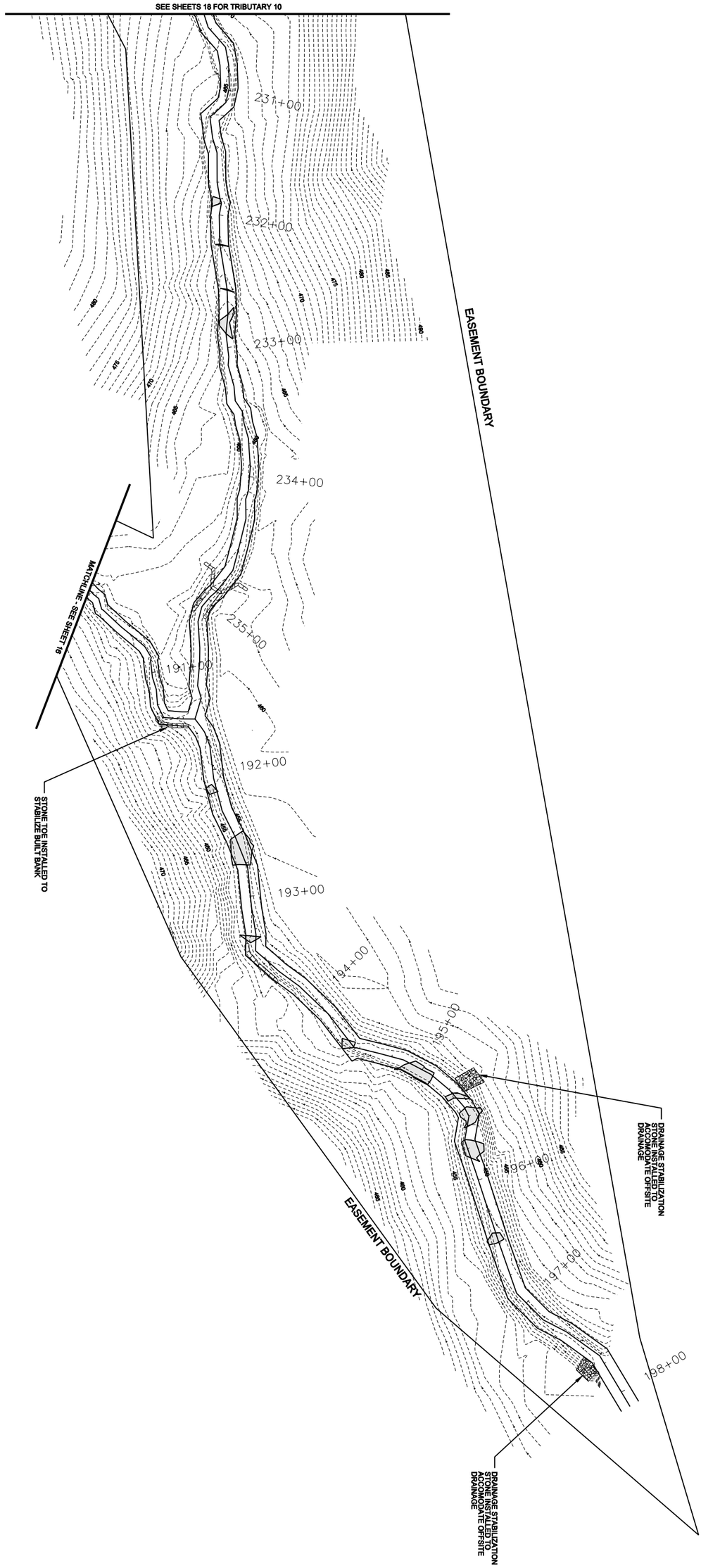
AS-BUILT
SITE PLAN

DATE: MAR 2009
SCALE: 1"=80'



GRAPHIC SCALE
-40 -20 0 40 80

NC 6010 NAD '83

SHEET 17 OF 35	AS-BUILT SITE PLAN	DATE: MAR 2009 SCALE: 1"=80'

CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T7-6, T7-7, AND T10: STA 190+18 TO 198+13 AND STA 230+37 TO 235+91

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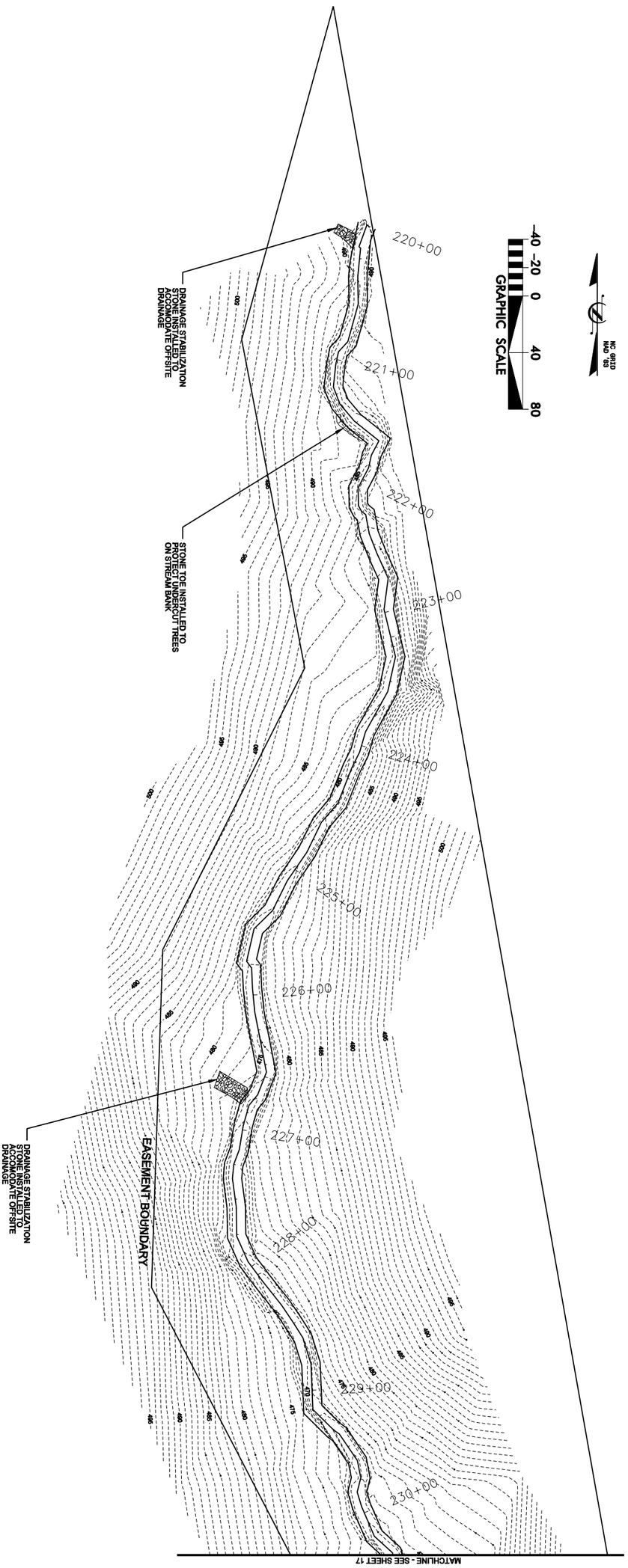

SHEET 18 OF 35

AS-BUILT SITE PLAN

DATE: MAR 2009

SCALE: 1"=50'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T10: STATION 220+00 TO STATION 230+37

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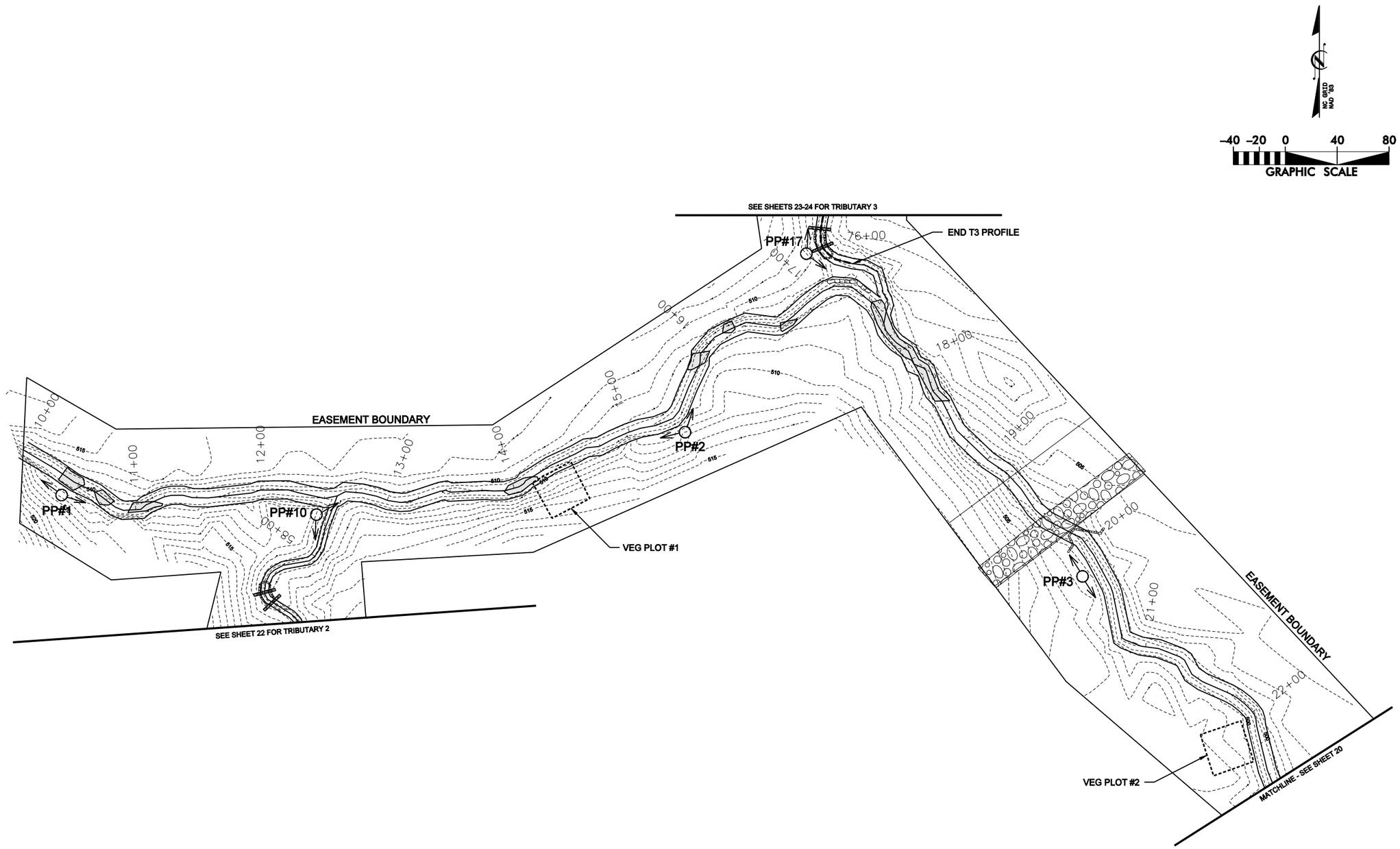

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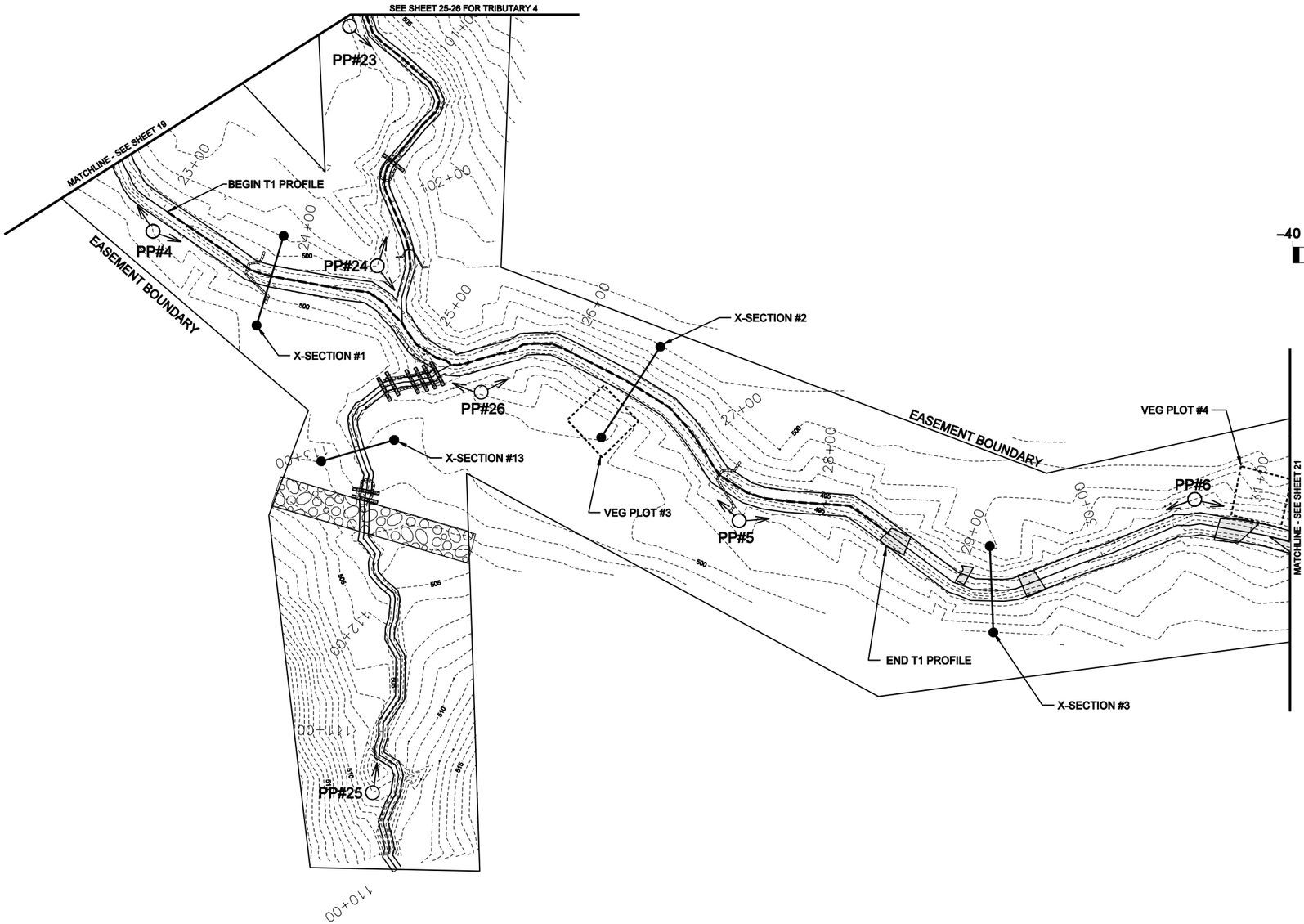
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T1-1, T1-2, T1-3: STATION 10+00 TO STATION 22+57

DATE: MAR 2009
SCALE: 1"=80'

MONITORING
PLAN VIEW

SHEET 19 OF 35



NO. GRID
NAD 83

–40 –20 0 40 80
GRAPHIC SCALE

REVISIONS

		DESCRIPTION	DATE	APPROVED
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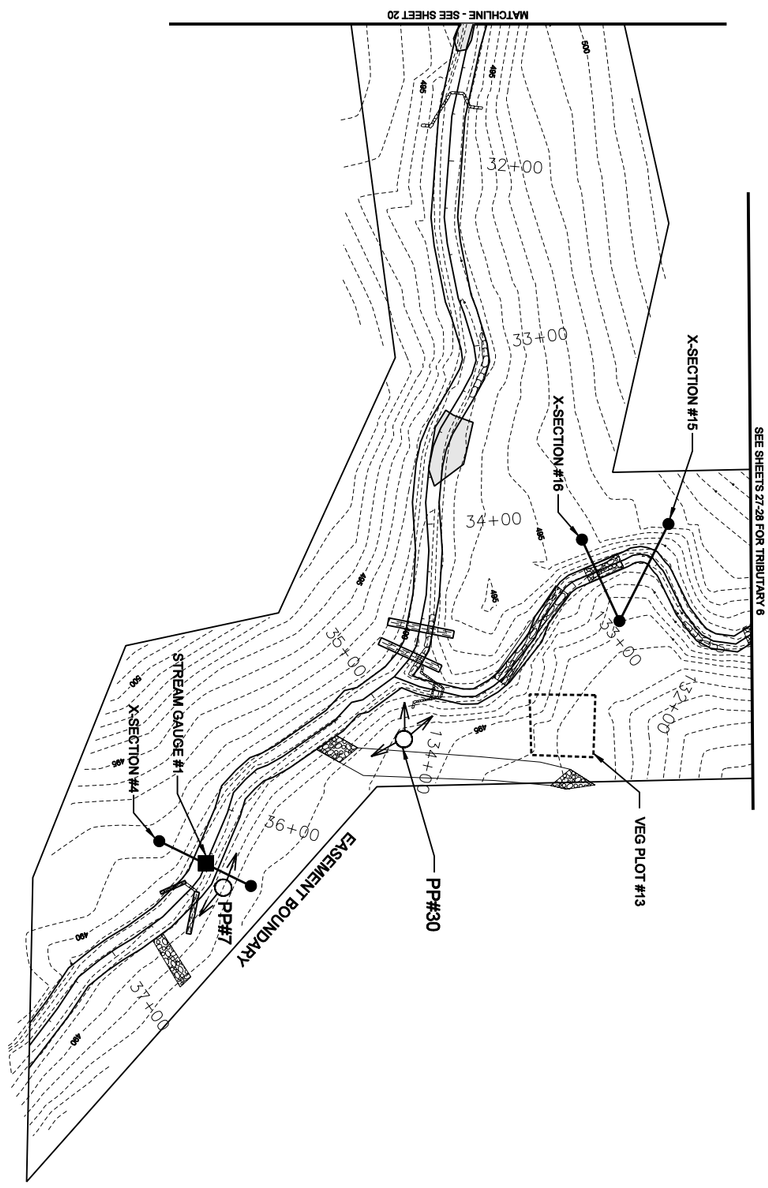
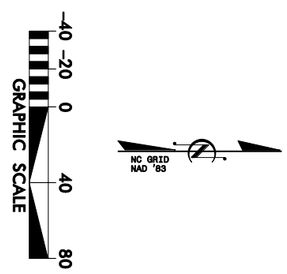
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T1-3,T1-4: STATION 22+57 TO STATION 31+26

DATE: MAR 2009
SCALE: 1"=80'

MONITORING
PLAN VIEW

SHEET 20 OF 35





SHEET 21 OF 35

MONITORING PLAN VIEW

DATE: MAR 2009

SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T1-4, T1-5: STATION 31+26 TO STATION 37+67

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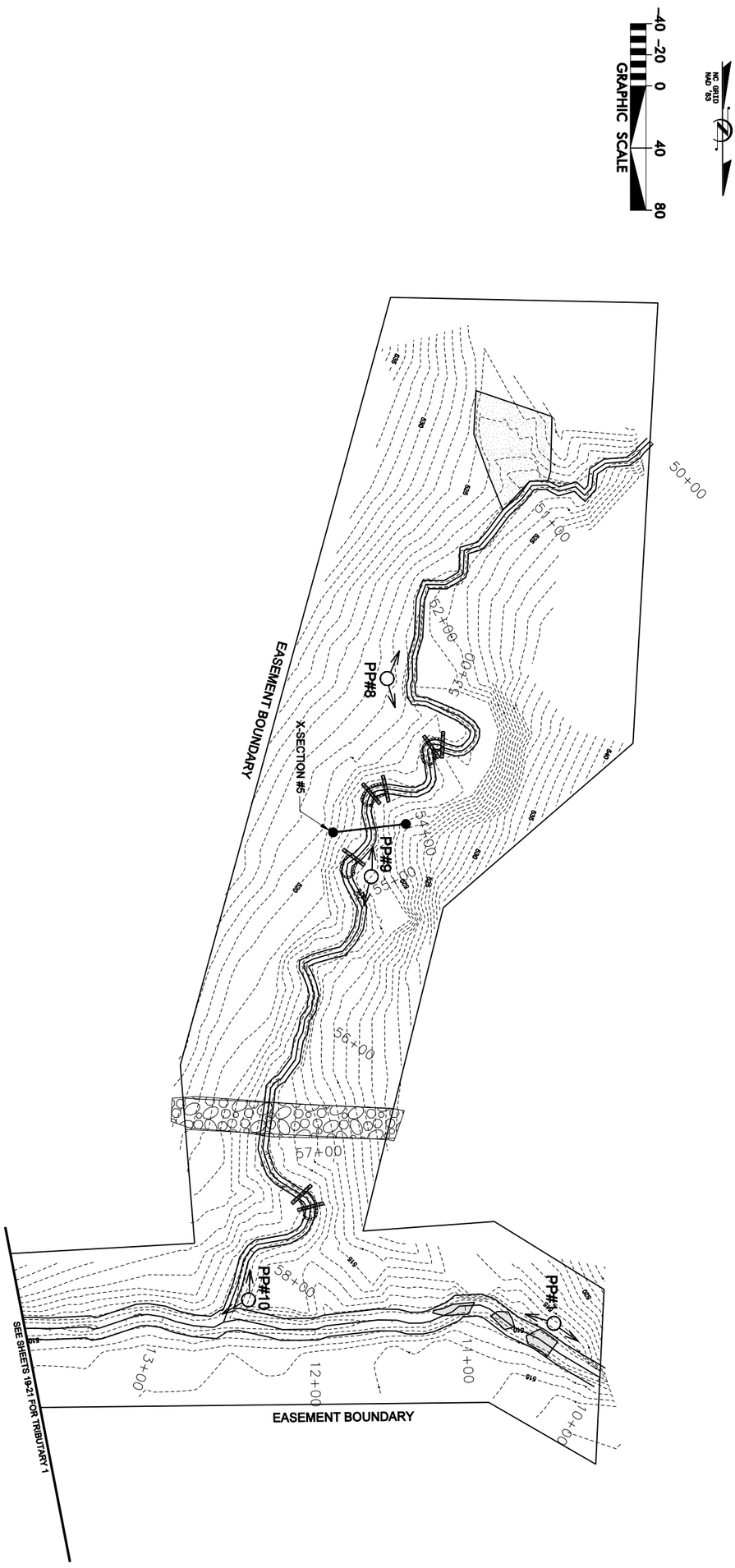
REVISIONS



SHEET 22 OF 35

MONITORING PLAN VIEW

DATE: MAR 2009

SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T2-1, T2-2, T2-3, T2-4: STATION 50+00 TO STATION 58+50

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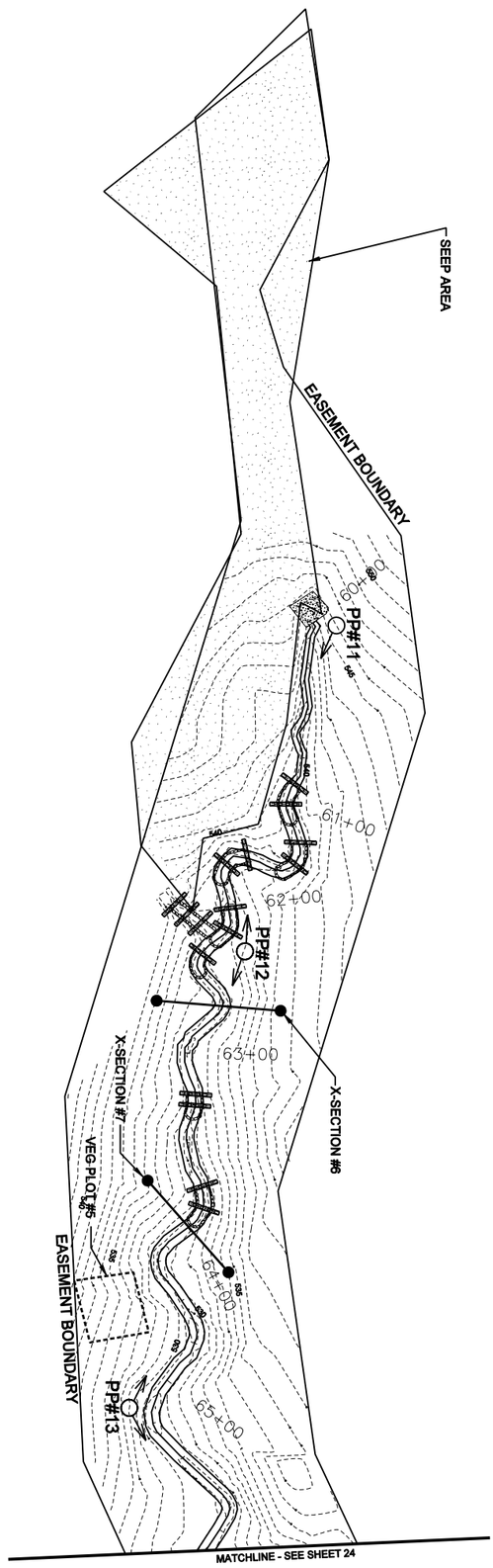
REVISIONS



SHEET 23 OF 35

MONITORING PLAN VIEW

DATE: MAR 2009

SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T3-1, T3-2: STATION 60+00 TO STATION 66+13

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REVISIONS

REVISIONS			
STAL	DESCRIPTION	DATE	APPROVED
A	SUBMITTED WITH MITIGATION PLAN	MAR 2009	

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RALEIGH, NORTH CAROLINA 27609

CANE CREEK STREAM RESTORATION PROJECT

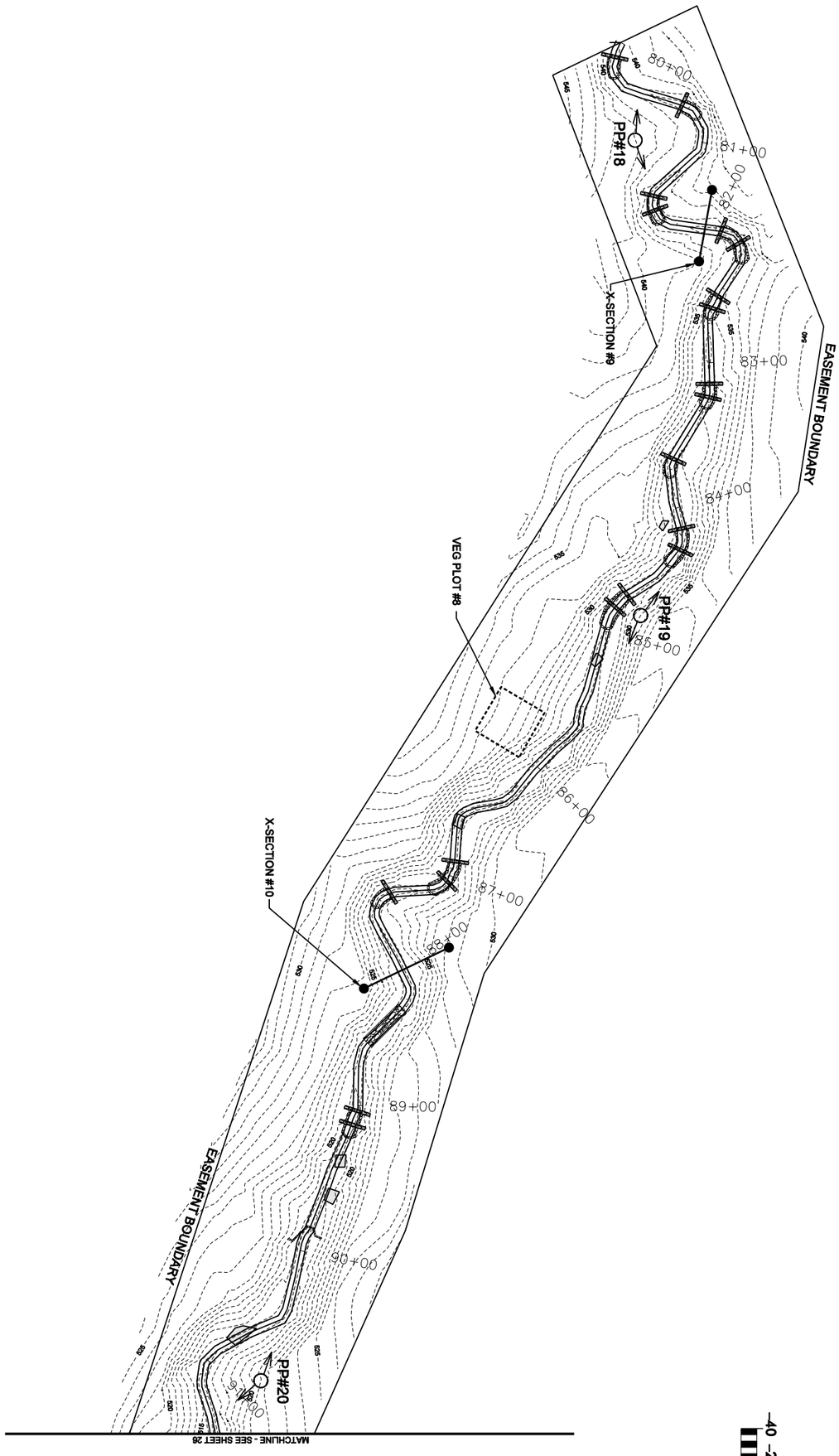
SEMORA, PERSON COUNTY, NORTH CAROLINA

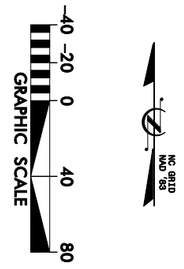
T3-2: STATION 66+13 TO STATION 76+98

DATE: MAR 2009

SCALE: 1"=80'

MONITORING PLAN VIEW





SHEET 25 OF 35

MONITORING PLAN VIEW

DATE: MAR 2009

SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T4-1, T4-2: STATION 80+00 TO STATION 91+49

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CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T4-2: STATION 91+49 TO STATION 102+81

DATE: MAR 2009

SCALE: 1"=80'

MONITORING PLAN VIEW

SHEET 26 OF 35

NC GRID NAD '83

–40 –20 0 40 80

GRAPHIC SCALE

REVISIONS

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				MAR 2009

Ecosystem Enhancement PROGRAM

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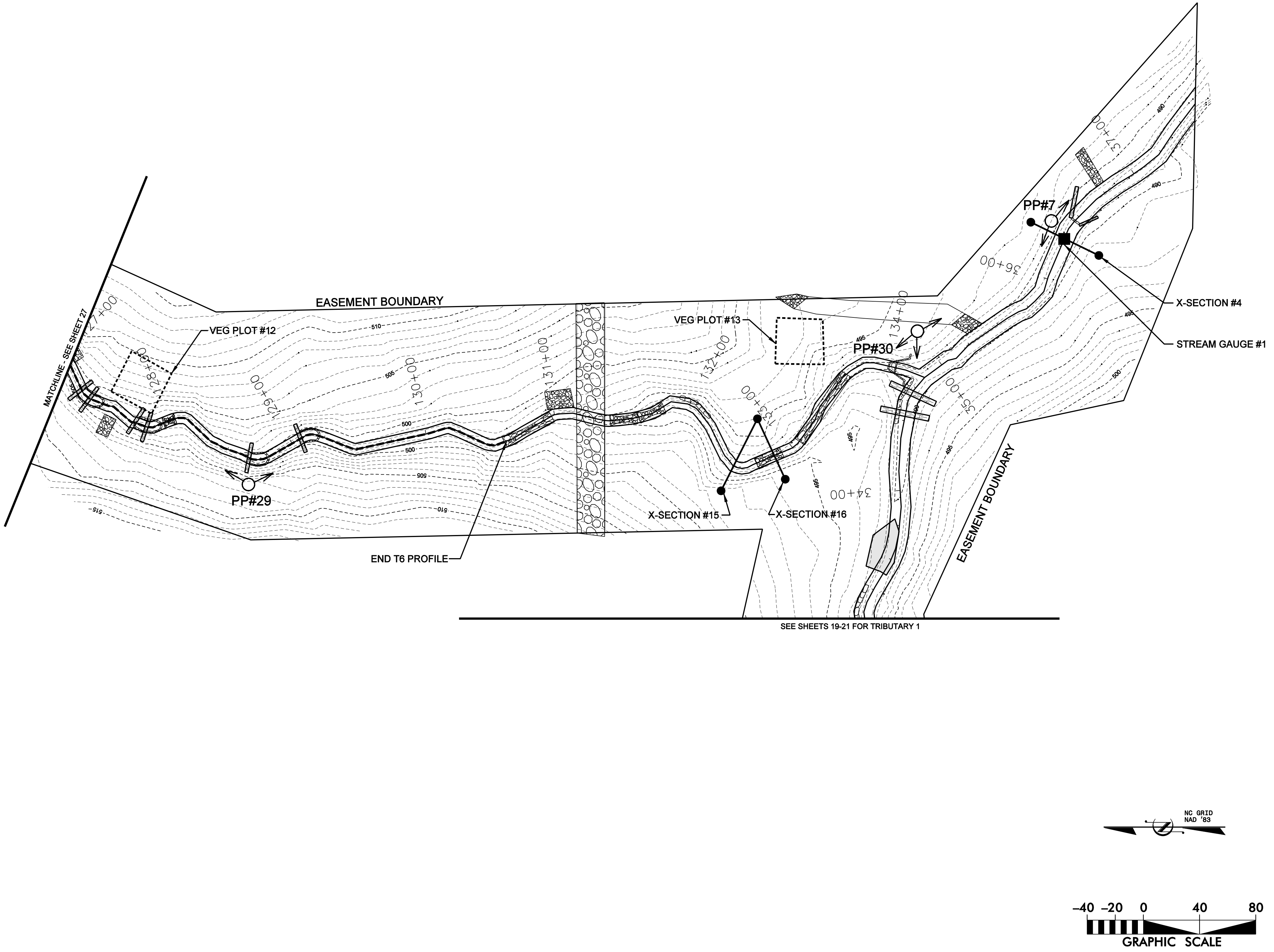
CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

T6A, T6B, T6B-1, T6C-1, T6C-2, T6C-3, T6AB, T6C, T6:STA 300+00 TO 300+80, STA 310+00 TO 310+82, STA 240+00 TO 241+21, STA 248+38 TO 251+04, AND STA 117+02 TO 127+10

DATE: MAR 2009
SCALE: 1"=80'

MONITORING PLAN VIEW

SHEET 27 OF 35



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

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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T6: STATION 127+10 TO STATION 134+25

DATE: MAR 2009
SCALE: 1"=80'

MONITORING
PLAN VIEW

SHEET 28 OF 35

EASEMENT BOUNDARY

PP#43

VEG PLOT #20

PP#31

PP#32

PP#44

VEG PLOT #14

PP#46

PP#45

EASEMENT BOUNDARY

MATCHLINE - SEE SHEET 30

NC GRID NAD 83

–40 –20 0 40 80

GRAPHIC SCALE

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

Ecosystem Enhancement Program

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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

T7A, T7A-1, T7B, T7C, T7-1, T7-2, T7-3, T8, T8A, T8A-1, T8-1, T8B, T9:
STA 260+00 TO 261+38, STA 140+00 TO 151+57, STA 270+00 TO 271+23,
STA 200+00 TO 204+38, AND STA 210+00 TO 213+68

DATE: MAR 2009

SCALE: 1"=80'

MONITORING PLAN VIEW

SHEET 29 OF 35

A	SUBMITTED WITH MITIGATION PLAN		MAR 2009	
		DESCRIPTION	DATE	APPROVED
		REVISIONS		

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CANE CREEK STREAM RESTORATION PROJECT

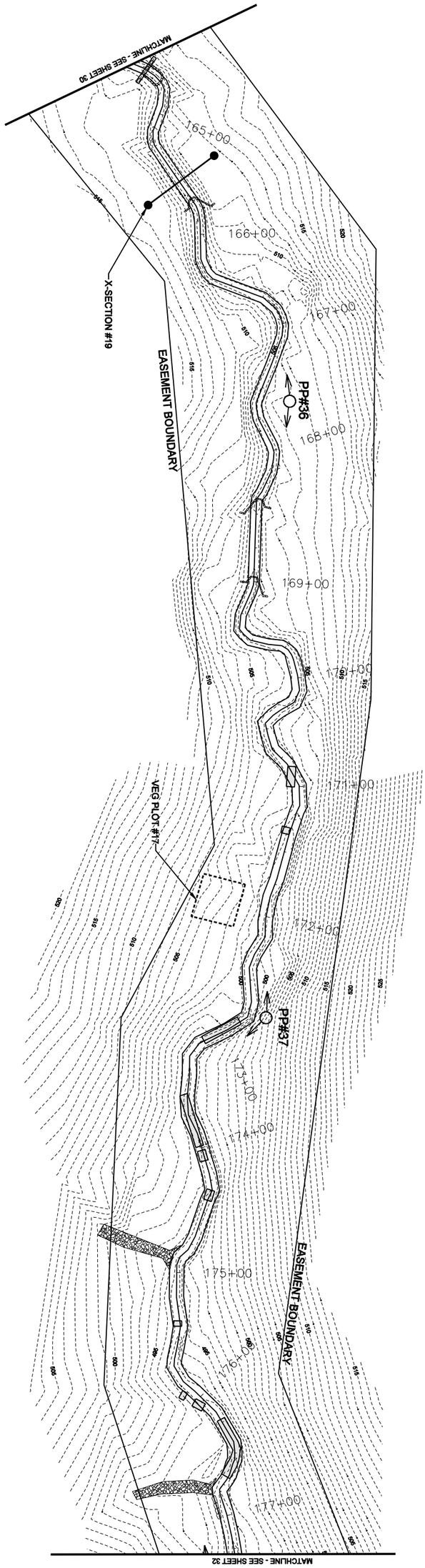
SEMORA, PERSON COUNTY, NORTH CAROLINA

T7-3: STATION 151+57 TO STATION 164+50

DATE: MAR 2009

SCALE: 1"=80'

MONITORING PLAN VIEW



GRAPHIC SCALE
-40 -20 0 40 80

NC GRID
NAD 83

CANE CREEK
STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T7-3, T7-4: STATION 16+50 TO STATION 177+29

MONITORING
PLAN VIEW

SHEET 31 OF 35

DATE: MAR 2009
SCALE: 1"=80'

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SYM.	DESCRIPTION	DATE	APPROVED
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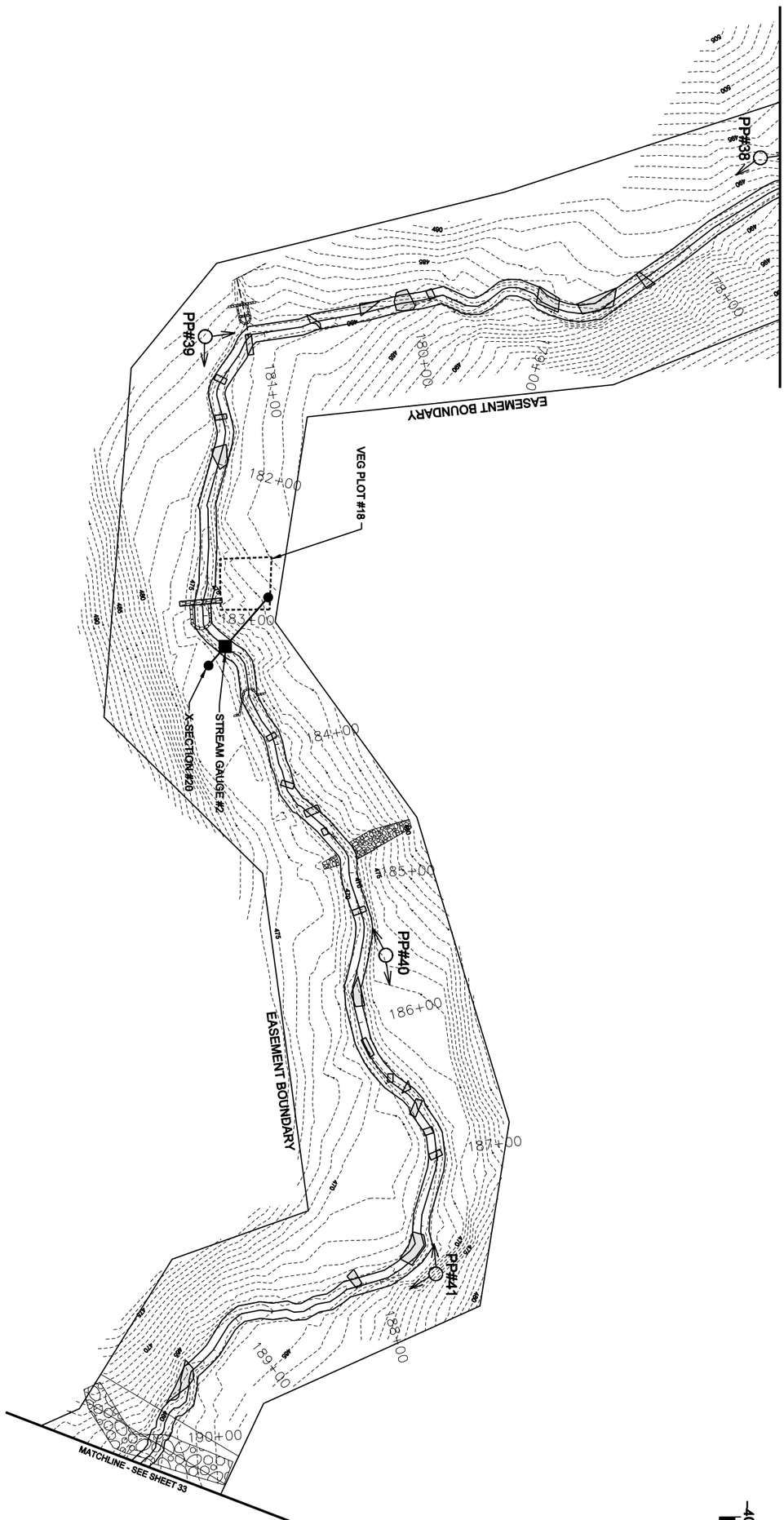
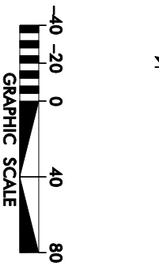
REVISIONS





SHEET 32 OF 35

MONITORING PLAN VIEW

DATE: MAR 2009
SCALE: 1"=80'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T7-4, T7-5, T7-6: STATION 177+29 TO STATION 190+18

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SYM.	DESCRIPTION	DATE	APPROVED
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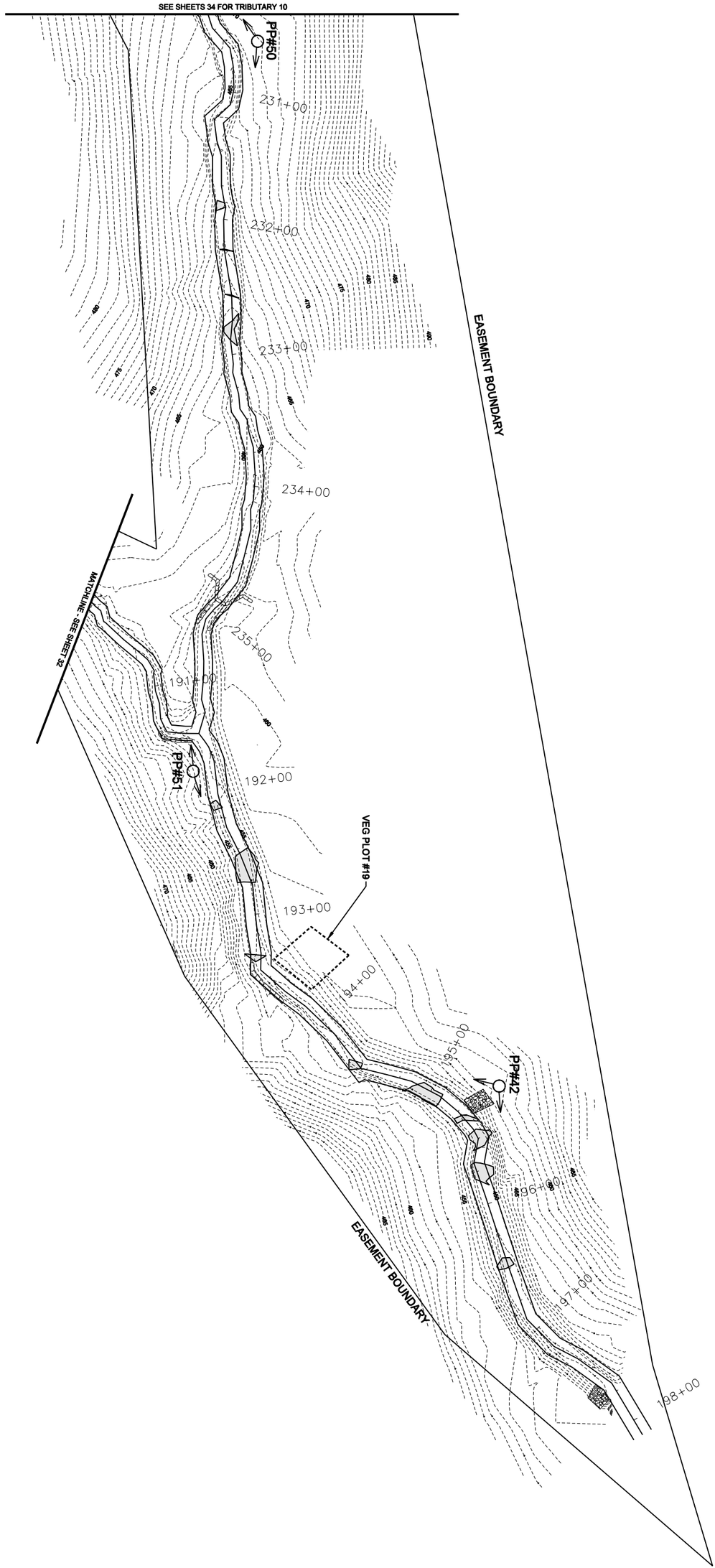
REVISIONS



GRAPHIC SCALE
-40 -20 0 40 80

NC GRID NAD 83

SHEET 33 OF 35	MONITORING PLAN VIEW	DATE: MAR 2009 SCALE: 1"=80'

CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA
T7-6, T7-7, AND T10: STA 190+18 TO 198+13 AND STA 230+37 TO 235+91

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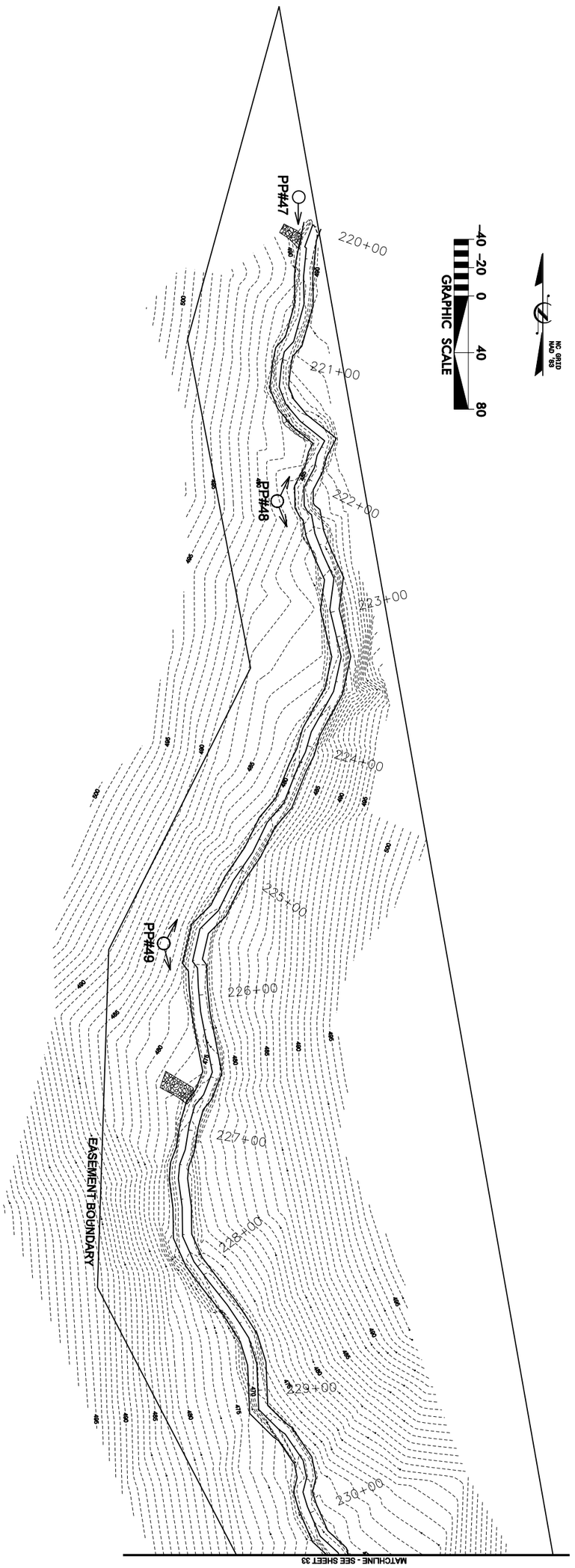
REVISIONS



MONITORING PLAN VIEW

SHEET 34 OF 35

DATE: MAR 2009

SCALE: 1"=50'

CANE CREEK STREAM RESTORATION PROJECT

SEMORA, PERSON COUNTY, NORTH CAROLINA

T10: STATION 220+00 TO STATION 230+37

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AS-BUILT PLANTING PLAN AND SPECIES COMPOSITION

THERE ARE TWO DISTINCT PLANTING ZONES ON THE RESTORATION SITE. THE FIRST IS THE STREAM ZONE, WHICH OCCURS FROM THE BOTTOM OF THE BANK TO THE TOP OF THE BANK WITHIN THE LIMITS OF THE RESTORED BANKFULL CHANNEL. THE SECOND PLANTING ZONE IS THE RIPARIAN BUFFER, WHICH STARTS AT THE TOP OF THE BANK OF THE BANKFULL CHANNEL AND CONTINUES TO THE CONSERVATION EASEMENT BOUNDARY. THIS ZONE CONSISTS OF A GRADATION FROM A PIEDMONT ALLUVIAL FOREST COMMUNITY TYPE CLOSE TO THE STREAM TO A MESIC MIXED HARDWOOD FOREST COMMUNITY TYPE AS THE ELEVATION INCREASES WITHIN THE CONSERVATION EASEMENT. THE LIVE STAKES WERE INSTALLED ON THREE FOOT CENTERS AND THE RIPARIAN BUFFER WAS PLANTED AT A DENSITY OF 680 STEMS PER ACRE. THE SPECIES PLANTED IN EACH ZONE ARE DESCRIBED BELOW, WITH THE RIPARIAN BUFFER SPECIES DIVIDED BY COMMUNITY TYPE IN WHICH THEY WOULD COMMONLY OCCUR. AREAS OF THE SITE THAT WERE NOT CLEARED WERE NOT PLANTED.

STREAM ZONE = 3.9 ACRES

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

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

NOTE: NO SINGLE LIVE STAKING SPECIES COMPOSES MORE THAN 40% OF THE TOTAL NUMBER OF LIVE STAKES INSTALLED

RIPARIAN BUFFER PLANTING ZONE = 29.0 ACRES

12" - 18" BARE ROOT MATERIAL
680 STEMS/ACRE (8' X 8' SPACING), RANDOM SPECIES PLACEMENT

PIEDMONT ALLUVIAL FOREST COMMUNITY

COMMON NAME	SCIENTIFIC NAME
GREEN ASH	FRAXINUS PENNSYLVANICA
BEAUTYBERRY	CALLICARPA AMERICANA
SYCAMORE	PLATANUS OCCIDENTALIS
RIVER BIRCH	BETULA NIGRA
SWAMP CHESTNUT OAK	QUERCUS MICHAUXII
WILLOW OAK	QUERCUS PHELLOS
PERSIMMON	DIOSPYROS VIRGINIANA
SILKY DOGWOOD	CORNUS AMOMUM
SWAMP BLACKGUM	NYSSA BIFLORA
YELLOW POPLAR	LIRIODENDRON TULIPIFERA

MESIC MIXED HARDWOOD FOREST COMMUNITY

COMMON NAME	SCIENTIFIC NAME
PERSIMMON	DIOSPYROS VIRGINIANA
SHAGBARK HICKORY	CARYA OVATA
S. RED OAK	QUERCUS FALCATA
BLACK WALNUT	JUGLANS NIGRA
PAWPAW	ASIMINA TRILOBA
TULIP POPLAR	LIRIODENDRON TULIPIFERA

REVISIONS

	DESCRIPTION	DATE	APPROVED
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CANE CREEK
STREAM RESTORATION PROJECT
SEMORA, PERSON COUNTY, NORTH CAROLINA

DATE: MAR 2009
SCALE: 1"=80'

AS-BUILT PLANTING PLAN

Appendix B

Cross-Section Plots and Pebble Counts

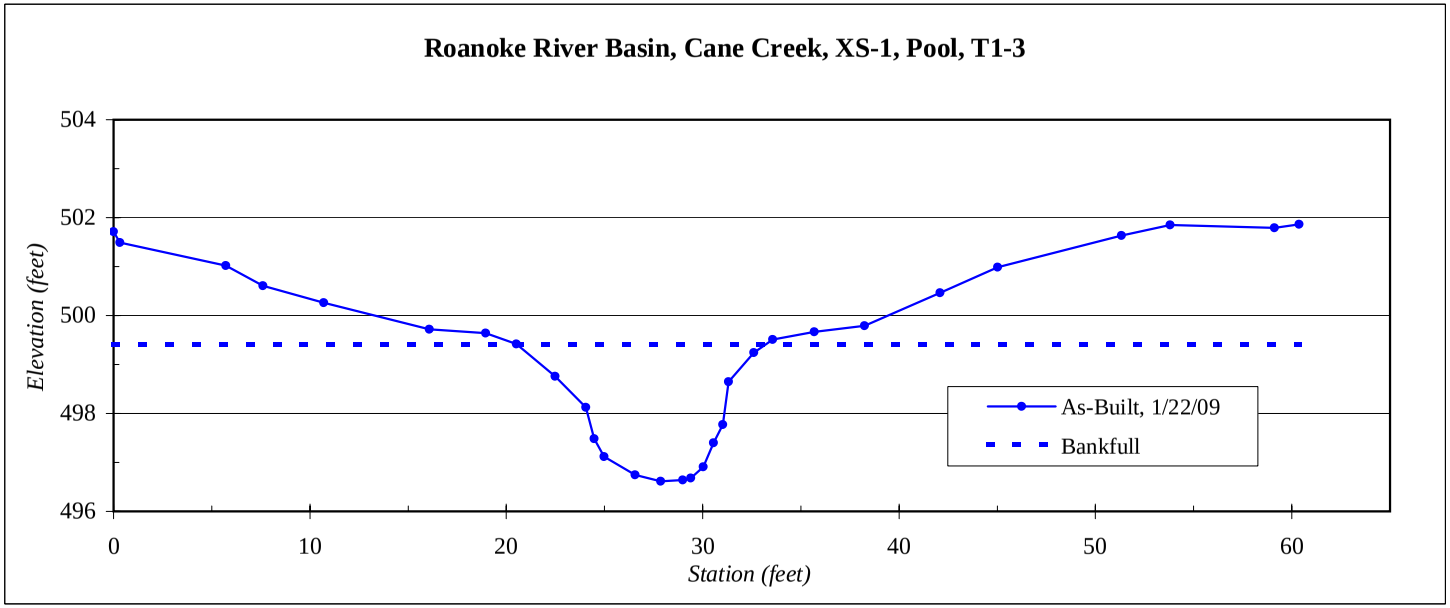
Cross-Section Plots

River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-1, Pool, T1-3
Drainage Area (sq mi):	0.49
Date:	1/22/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	501.71
0.3	501.49
5.7	501.02
7.6	500.61
10.7	500.26
16.1	499.72
18.9	499.64
20.5	499.42
22.5	498.76
24.1	498.12
24.5	497.48
25.0	497.12
26.6	496.74
27.9	496.62
29.0	496.64
29.4	496.68
30.0	496.91
30.5	497.40
31.0	497.77
31.3	498.64
32.6	499.24
33.6	499.51
35.7	499.67
38.3	499.79
42.1	500.46
45.0	500.99
51.3	501.63
53.8	501.85
59.1	501.79
60.4	501.86

SUMMARY DATA	
Bankfull Elevation:	499.4
Bankfull Cross-Sectional Area:	20.2
Bankfull Width:	12.6
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.8
Mean Depth at Bankfull:	1.6
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C/B4

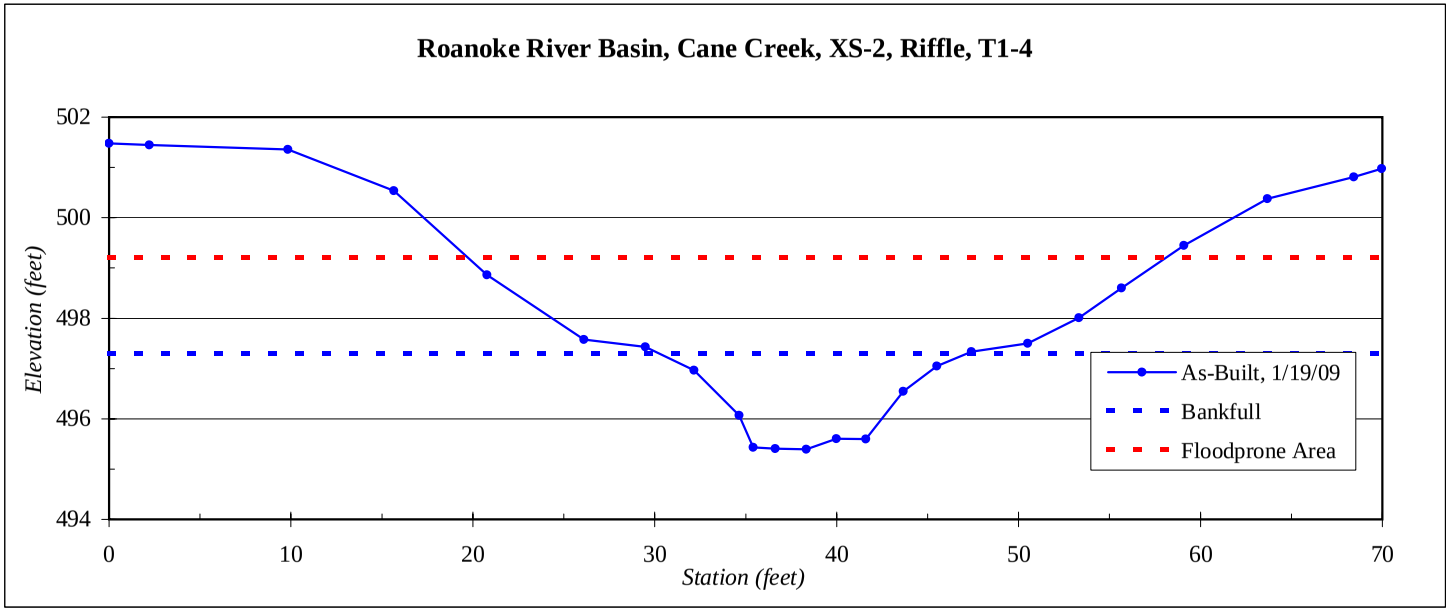


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-2, Riffle, T1-4
Drainage Area (sq mi):	0.62
Date:	1/19/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	501.48
2.2	501.45
9.8	501.36
15.7	500.53
20.8	498.86
26.1	497.57
29.5	497.43
32.2	496.96
34.6	496.07
35.4	495.43
36.6	495.41
38.3	495.39
40.0	495.60
41.6	495.60
43.7	496.54
45.5	497.05
47.4	497.33
50.5	497.50
53.3	498.01
55.7	498.60
59.1	499.45
63.7	500.38
68.4	500.81
70.0	500.97

SUMMARY DATA	
Bankfull Elevation:	497.3
Bankfull Cross-Sectional Area:	18.9
Bankfull Width:	17.4
Flood Prone Area Elevation:	499.2
Flood Prone Width:	38.8
Max Depth at Bankfull:	1.9
Mean Depth at Bankfull:	1.1
W / D Ratio:	16.0
Entrenchment Ratio:	2.2
Bank Height Ratio:	1.0

Stream Type	C/B4

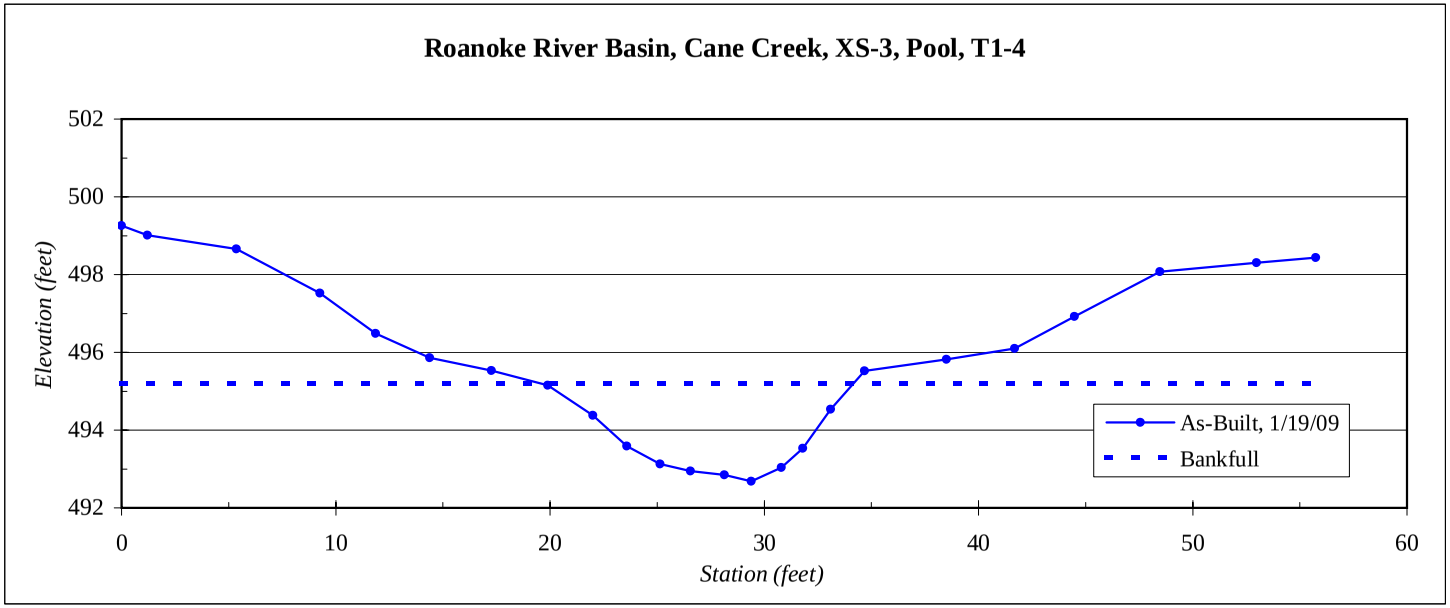


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-3, Pool, T1-4
Drainage Area (sq mi):	0.62
Date:	1/19/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	499.26
1.2	499.01
5.4	498.66
9.3	497.52
11.9	496.49
14.4	495.86
17.3	495.53
19.9	495.15
22.0	494.38
23.6	493.58
25.1	493.12
26.6	492.94
28.1	492.85
29.4	492.68
30.8	493.04
31.8	493.53
33.1	494.53
34.7	495.52
38.5	495.82
41.7	496.10
44.5	496.92
48.5	498.07
53.0	498.30
55.7	498.43

SUMMARY DATA	
Bankfull Elevation:	495.2
Bankfull Cross-Sectional Area:	21.9
Bankfull Width:	14.2
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.5
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	C/B4

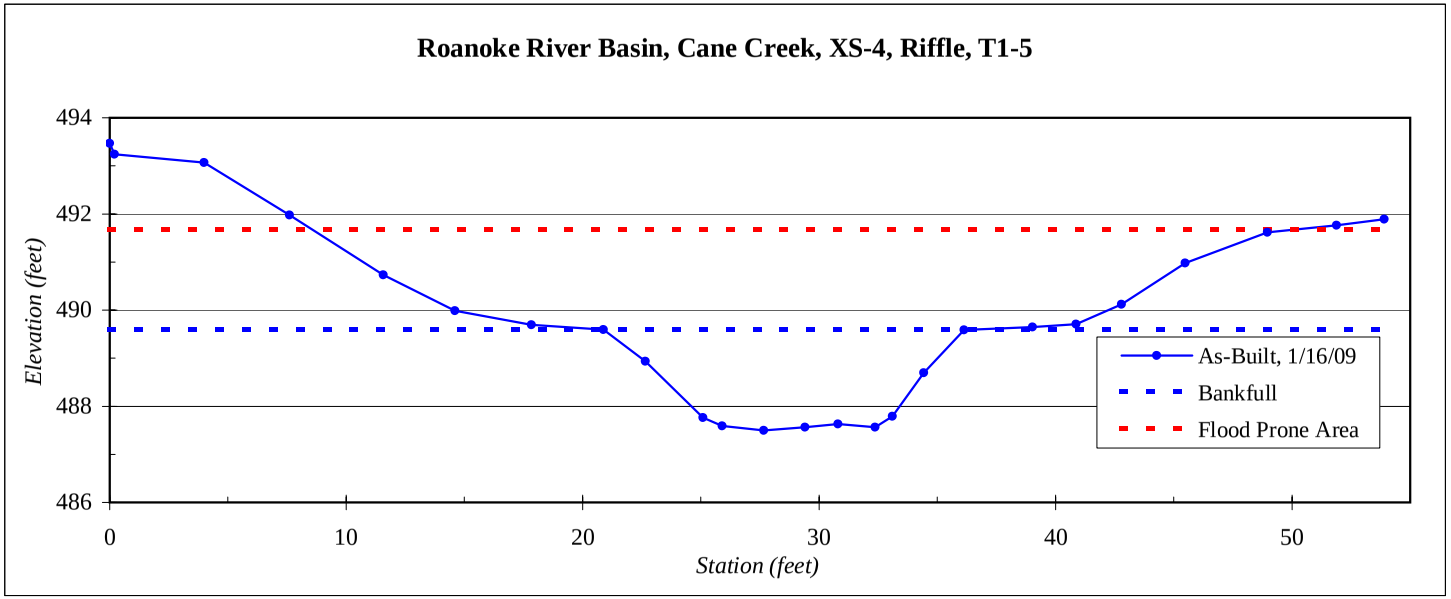


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-4, Riffle, T1-5
Drainage Area (sq mi):	0.70
Date:	1/16/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	493.47
0.2	493.24
4.0	493.07
7.6	491.97
11.6	490.73
14.6	489.99
17.8	489.69
20.9	489.59
22.7	488.93
25.1	487.76
25.9	487.59
27.7	487.50
29.4	487.57
30.8	487.63
32.4	487.56
33.1	487.79
34.4	488.69
36.1	489.59
39.0	489.64
40.9	489.71
42.8	490.12
45.5	490.98
49.0	491.62
51.9	491.77
53.9	491.89

SUMMARY DATA	
Bankfull Elevation:	489.6
Bankfull Cross-Sectional Area:	22.2
Bankfull Width:	15.3
Flood Prone Area Elevation:	491.7
Flood Prone Width:	41.7
Max Depth at Bankfull:	2.1
Mean Depth at Bankfull:	1.5
W / D Ratio:	10.5
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

Stream Type	C/B4

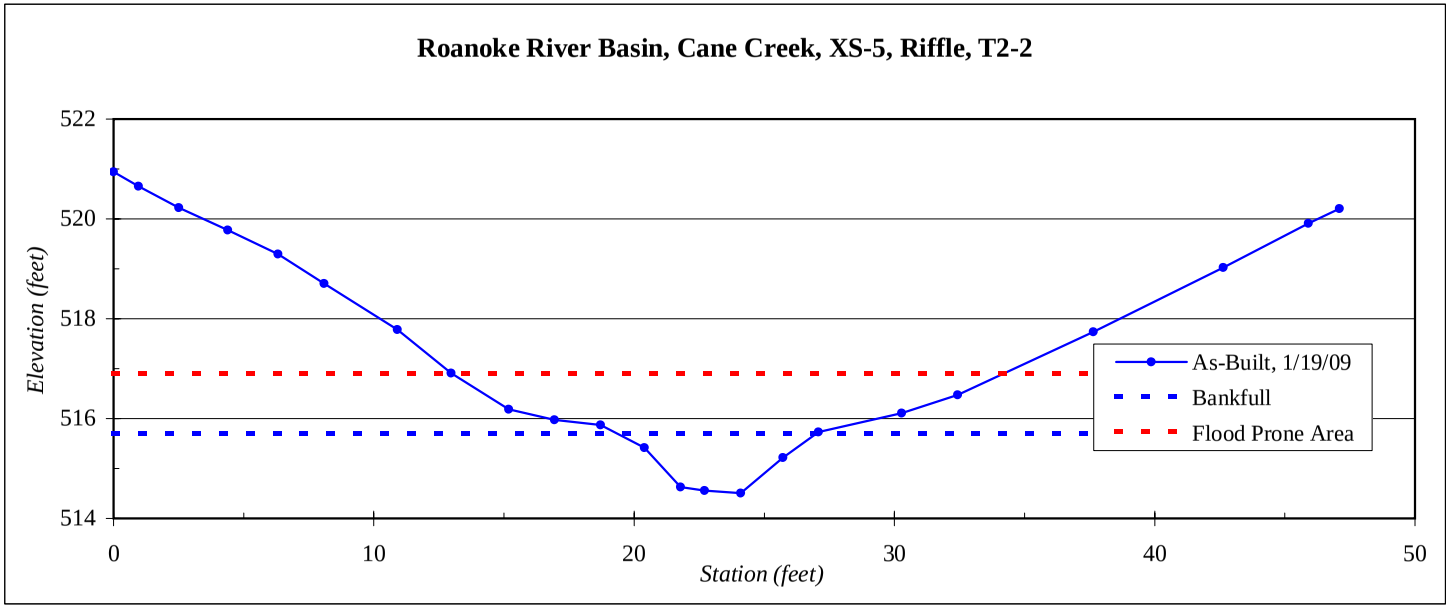


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-5, Riffle, T2-2
Drainage Area (sq mi):	0.11
Date:	1/19/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	520.94
1.0	520.65
2.5	520.22
4.4	519.78
6.3	519.29
8.1	518.71
10.9	517.78
13.0	516.91
15.2	516.19
16.9	515.97
18.7	515.87
20.4	515.42
21.8	514.63
22.7	514.56
24.1	514.50
25.7	515.22
27.1	515.73
30.3	516.11
32.4	516.48
37.6	517.74
42.6	519.03
45.9	519.91
47.1	520.21

SUMMARY DATA	
Bankfull Elevation:	515.7
Bankfull Cross-Sectional Area:	5.4
Bankfull Width:	7.7
Flood Prone Area Elevation:	516.9
Flood Prone Width:	21.1
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.7
W / D Ratio:	11.0
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

Stream Type	C/E4

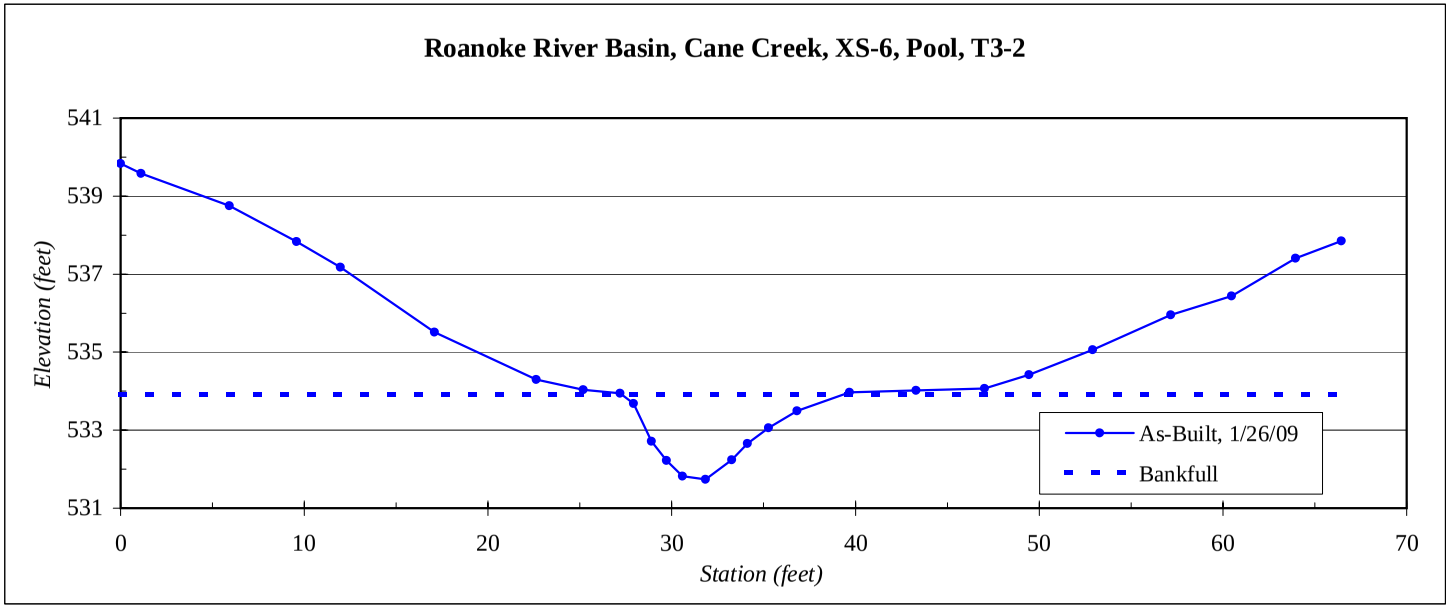


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-6, Pool, T3-2
Drainage Area (sq mi):	0.08
Date:	1/26/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	539.84
1.1	539.58
5.9	538.75
9.6	537.84
12.0	537.18
17.1	535.51
22.6	534.29
25.2	534.04
27.2	533.95
27.9	533.69
28.9	532.72
29.7	532.22
30.6	531.82
31.8	531.74
33.3	532.24
34.1	532.65
35.3	533.06
36.8	533.49
39.7	533.97
43.3	534.02
47.0	534.07
49.5	534.42
52.9	535.06
57.2	535.95
60.5	536.44
64.0	537.41
66.4	537.85

SUMMARY DATA	
Bankfull Elevation:	533.9
Bankfull Cross-Sectional Area:	13.3
Bankfull Width:	12.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.2
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	B4

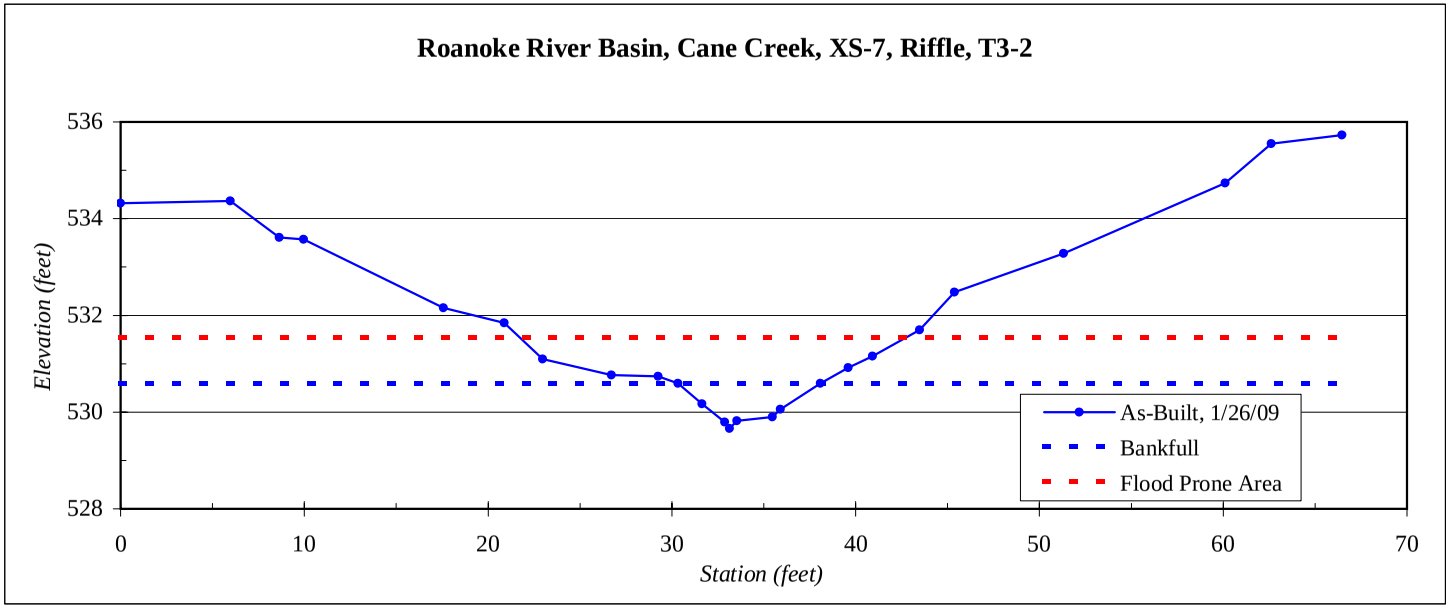


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-7, Riffle, T3-2
Drainage Area (sq mi):	0.08
Date:	1/26/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	534.32
6.0	534.36
8.6	533.61
10.0	533.57
17.6	532.16
20.9	531.85
23.0	531.10
26.7	530.76
29.2	530.74
30.3	530.60
31.6	530.17
32.9	529.80
33.1	529.66
33.5	529.82
35.5	529.90
35.9	530.06
38.1	530.59
39.6	530.92
40.9	531.16
43.5	531.70
45.4	532.48
51.3	533.28
60.1	534.74
62.6	535.55
66.5	535.73

SUMMARY DATA	
Bankfull Elevation:	530.6
Bankfull Cross-Sectional Area:	3.9
Bankfull Width:	7.8
Flood Prone Area Elevation:	531.5
Flood Prone Width:	21
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.5
W / D Ratio:	15.6
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

Stream Type	B4

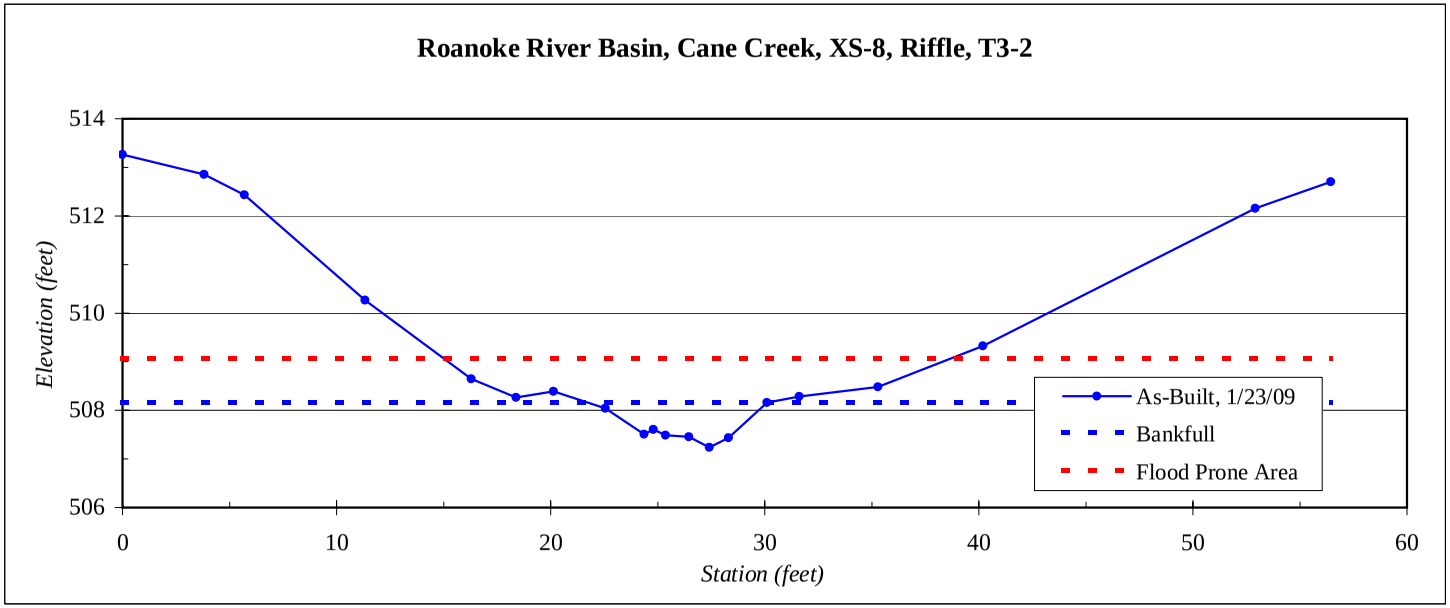


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-8, Riffle, T3-2
Drainage Area (sq mi):	0.08
Date:	1/23/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	513.27
3.8	512.86
5.7	512.43
11.3	510.27
16.3	508.65
18.4	508.27
20.1	508.39
22.6	508.04
24.4	507.51
24.8	507.61
25.4	507.49
26.5	507.46
27.4	507.24
28.3	507.43
30.1	508.16
31.6	508.29
35.3	508.48
40.2	509.32
52.9	512.16
56.4	512.70

SUMMARY DATA	
Bankfull Elevation:	508.2
Bankfull Cross-Sectional Area:	4.2
Bankfull Width:	8.3
Flood Prone Area Elevation:	509.1
Flood Prone Width:	23.7
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.5
W / D Ratio:	16.4
Entrenchment Ratio:	2.9
Bank Height Ratio:	1.0

Stream Type	B4

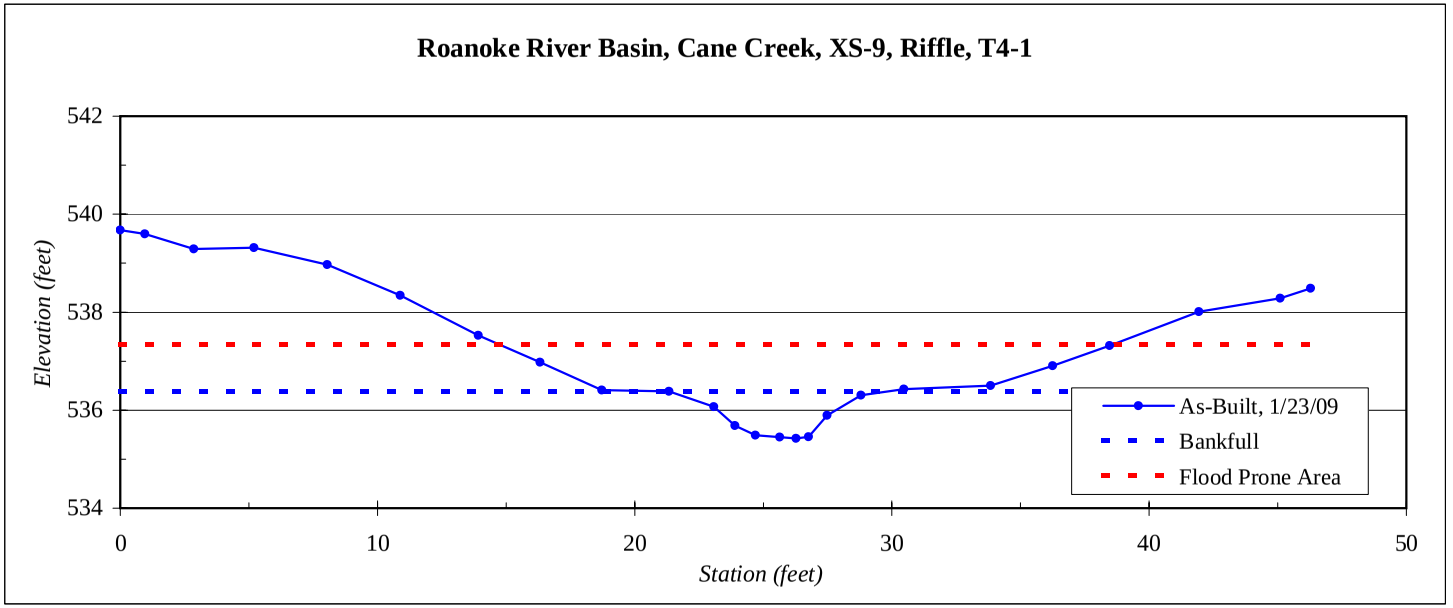


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-9, Riffle, T4-1
Drainage Area (sq mi):	0.10
Date:	1/23/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	539.67
1.0	539.60
2.9	539.29
5.2	539.32
8.0	538.97
10.9	538.34
13.9	537.53
16.3	536.98
18.7	536.41
21.3	536.38
23.1	536.07
23.9	535.69
24.7	535.49
25.6	535.45
26.3	535.43
26.8	535.46
27.5	535.89
28.8	536.30
30.5	536.43
33.8	536.50
36.3	536.91
38.5	537.32
41.9	538.01
45.1	538.29
46.3	538.49

SUMMARY DATA	
Bankfull Elevation:	536.4
Bankfull Cross-Sectional Area:	4.1
Bankfull Width:	8.5
Flood Prone Area Elevation:	537.3
Flood Prone Width:	23.8
Max Depth at Bankfull:	1.0
Mean Depth at Bankfull:	0.5
W / D Ratio:	17.6
Entrenchment Ratio:	2.8
Bank Height Ratio:	1.0

Stream Type	B4

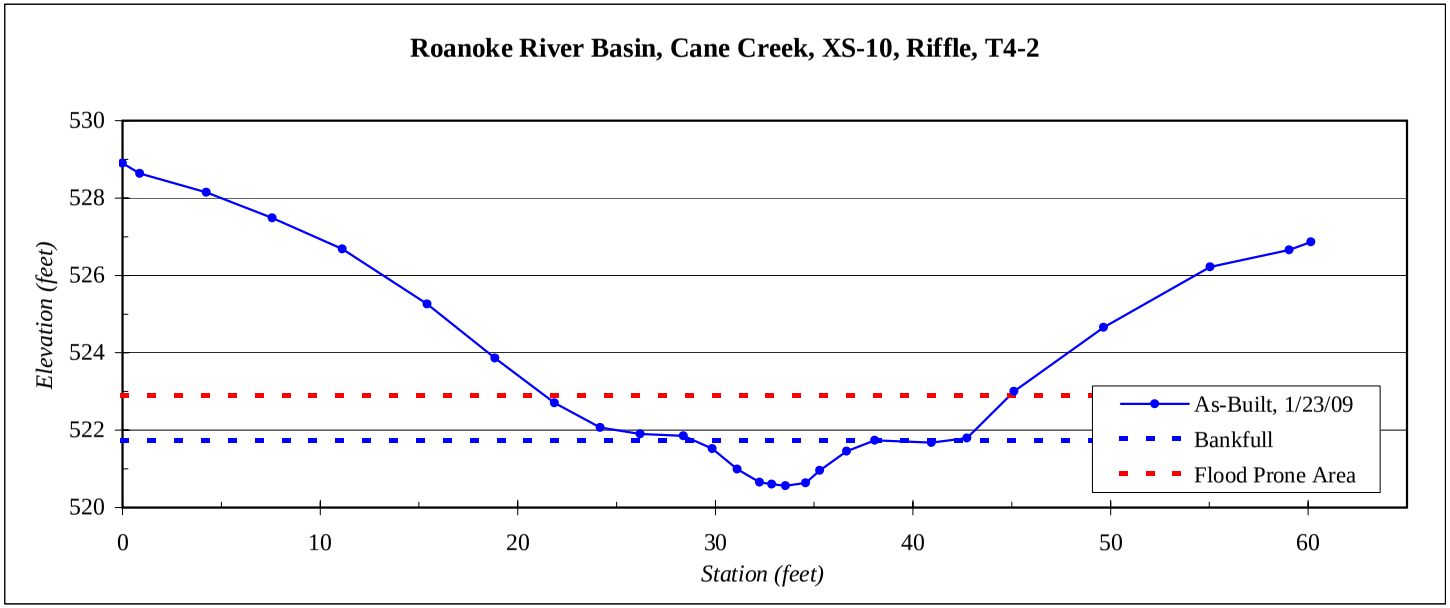


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-10, Riffle, T4-2
Drainage Area (sq mi):	0.10
Date:	1/23/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	528.90
0.9	528.64
4.3	528.15
7.6	527.49
11.1	526.68
15.4	525.26
18.8	523.86
21.9	522.70
24.2	522.07
26.2	521.91
28.4	521.85
29.8	521.53
31.1	520.99
32.2	520.65
32.9	520.61
33.6	520.56
34.6	520.63
35.3	520.96
36.7	521.45
38.1	521.74
40.9	521.68
42.7	521.80
45.1	523.00
49.7	524.65
55.0	526.22
59.0	526.66
60.1	526.87

SUMMARY DATA	
Bankfull Elevation:	521.7
Bankfull Cross-Sectional Area:	5.9
Bankfull Width:	9.1
Flood Prone Area Elevation:	522.9
Flood Prone Width:	23.6
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.6
W / D Ratio:	14.0
Entrenchment Ratio:	2.6
Bank Height Ratio:	1.0

Stream Type	B4

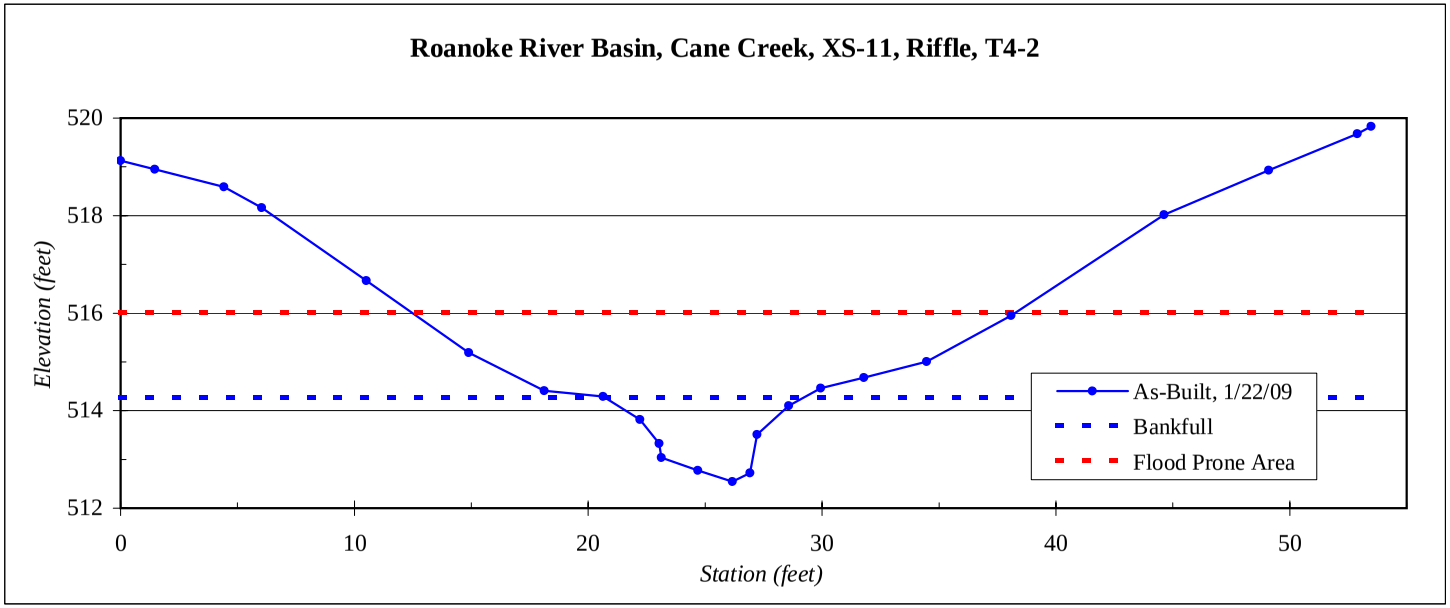


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-11, Riffle, T4-2
Drainage Area (sq mi):	0.10
Date:	1/22/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	519.12
1.5	518.95
4.4	518.59
6.0	518.16
10.5	516.66
14.9	515.19
18.1	514.41
20.6	514.29
22.2	513.82
23.0	513.33
23.1	513.04
24.7	512.78
26.2	512.55
26.9	512.72
27.2	513.51
28.6	514.10
29.9	514.46
31.8	514.68
34.5	515.01
38.1	515.95
44.6	518.02
49.1	518.93
52.9	519.68
53.5	519.83

SUMMARY DATA	
Bankfull Elevation:	514.3
Bankfull Cross-Sectional Area:	7.9
Bankfull Width:	8.6
Flood Prone Area Elevation:	516.0
Flood Prone Width:	26
Max Depth at Bankfull:	1.7
Mean Depth at Bankfull:	0.9
W / D Ratio:	9.4
Entrenchment Ratio:	3.0
Bank Height Ratio:	1.0

Stream Type	B4

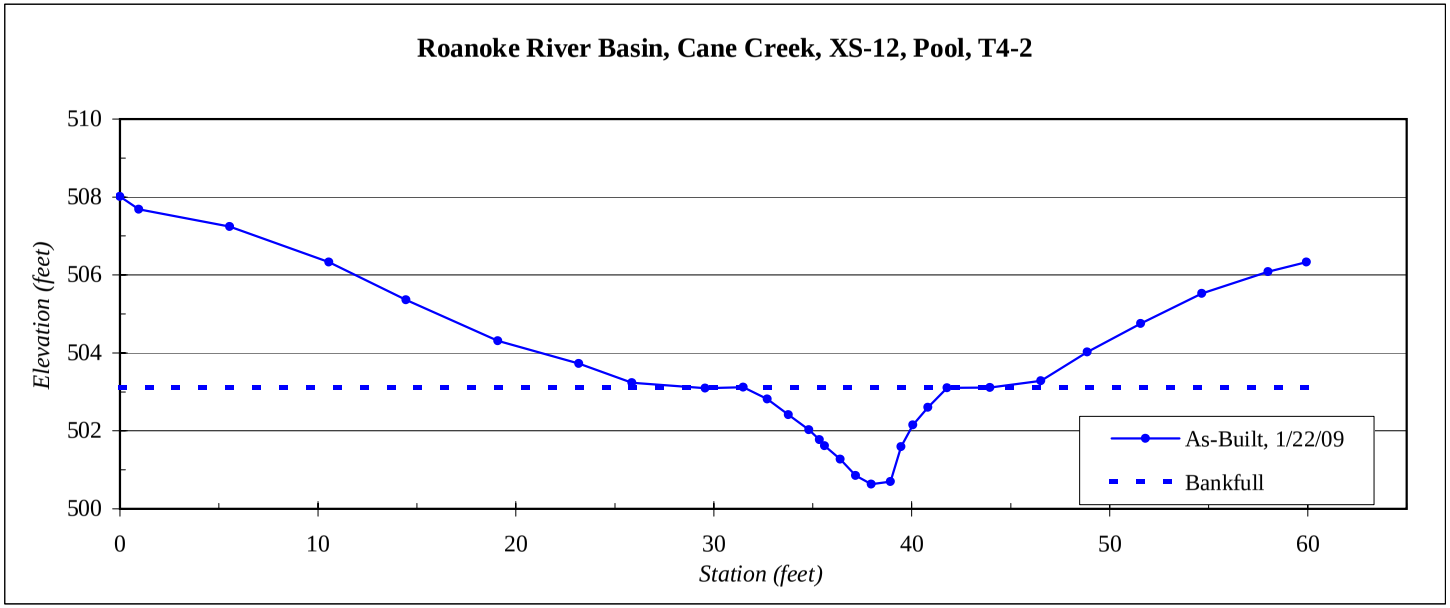


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-12, Pool, T4-2
Drainage Area (sq mi):	0.10
Date:	1/22/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	508.01
1.0	507.69
5.5	507.25
10.5	506.33
14.5	505.36
19.1	504.31
23.2	503.73
25.9	503.23
29.6	503.10
31.5	503.12
32.7	502.82
33.8	502.41
34.8	502.03
35.3	501.77
35.6	501.61
36.4	501.27
37.2	500.86
37.9	500.64
38.9	500.70
39.5	501.60
40.1	502.15
40.8	502.61
41.8	503.10
43.9	503.11
46.5	503.29
48.9	504.02
51.6	504.75
54.7	505.53
58.0	506.08
59.9	506.33

SUMMARY DATA	
Bankfull Elevation:	503.1
Bankfull Cross-Sectional Area:	12.3
Bankfull Width:	10.7
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.5
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	B4

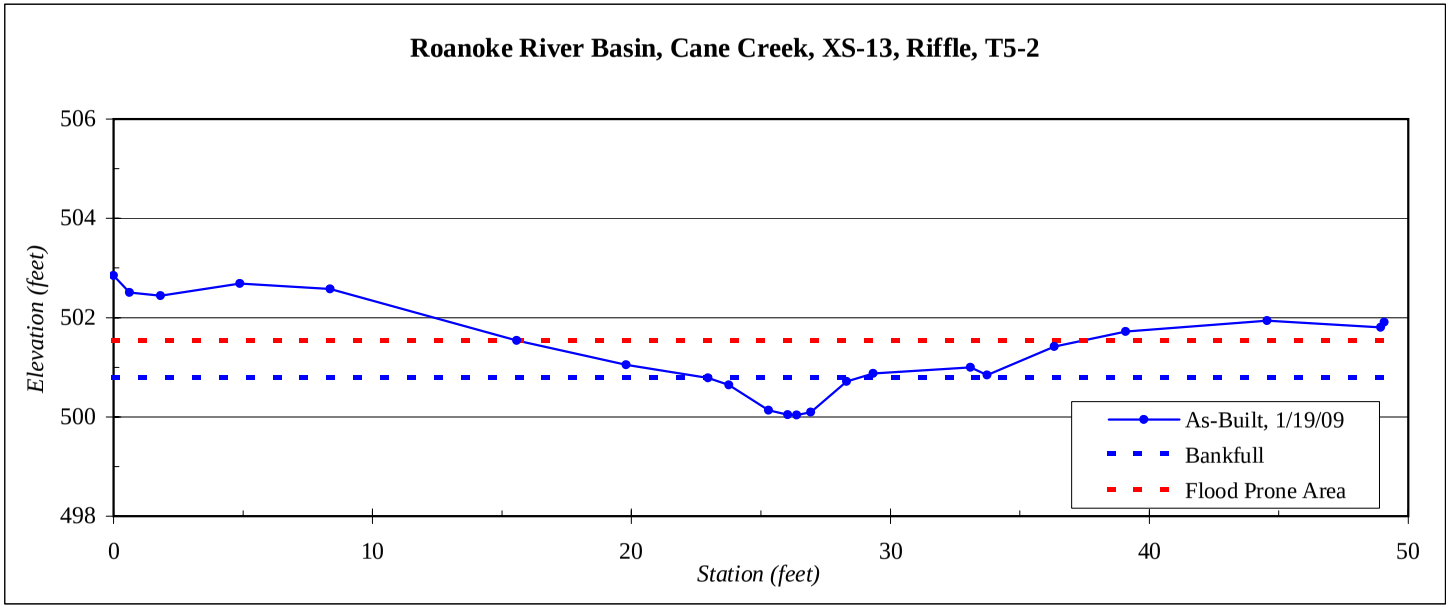


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-13, Riffle, T5-2
Drainage Area (sq mi):	0.02
Date:	1/19/2009
Field Crew:	B. Roberts, A. Davis

Station	Elevation
0.0	502.85
0.6	502.51
1.8	502.44
4.9	502.69
8.4	502.58
15.6	501.54
19.8	501.05
23.0	500.79
23.8	500.64
25.3	500.14
26.0	500.04
26.4	500.04
26.9	500.09
28.3	500.71
29.3	500.87
33.1	501.00
33.7	500.84
36.3	501.42
39.1	501.72
44.6	501.94
48.9	501.80
49.1	501.91

SUMMARY DATA	
Bankfull Elevation:	500.8
Bankfull Cross-Sectional Area:	2.4
Bankfull Width:	5.9
Flood Prone Area Elevation:	501.5
Flood Prone Width:	21.0
Max Depth at Bankfull:	0.8
Mean Depth at Bankfull:	0.4
W / D Ratio:	14.5
Entrenchment Ratio:	3.6
Bank Height Ratio:	1.0

Stream Type	B4

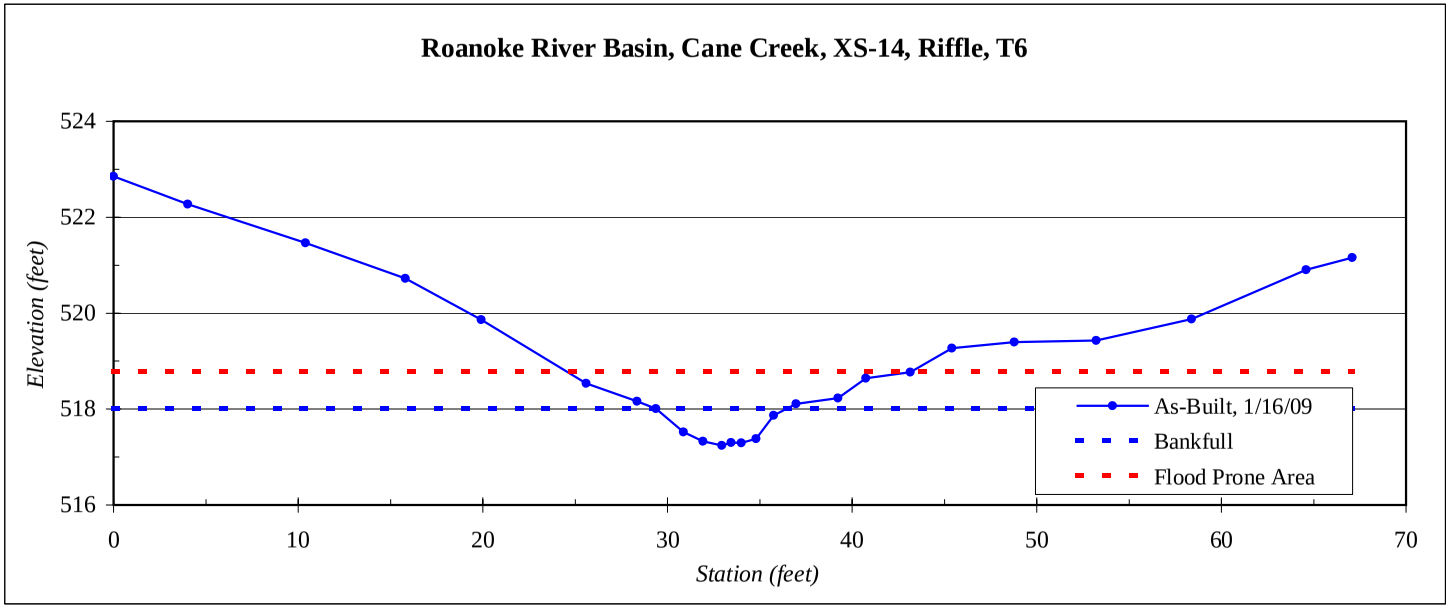


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-14, Riffle, T6
Drainage Area (sq mi):	0.07
Date:	1/16/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	522.85
4.0	522.27
10.4	521.47
15.8	520.72
19.9	519.87
25.6	518.53
28.4	518.16
29.4	518.01
30.9	517.52
31.9	517.33
32.9	517.24
33.4	517.30
34.0	517.30
34.8	517.38
35.8	517.87
37.0	518.11
39.2	518.23
40.7	518.64
43.2	518.77
45.4	519.27
48.8	519.40
53.2	519.43
58.4	519.88
64.6	520.91
67.1	521.16

SUMMARY DATA	
Bankfull Elevation:	518.0
Bankfull Cross-Sectional Area:	3.4
Bankfull Width:	7.1
Flood Prone Area Elevation:	518.8
Flood Prone Width:	18.6
Max Depth at Bankfull:	0.8
Mean Depth at Bankfull:	0.5
W / D Ratio:	14.8
Entrenchment Ratio:	2.6
Bank Height Ratio:	1.0

Stream Type	B4

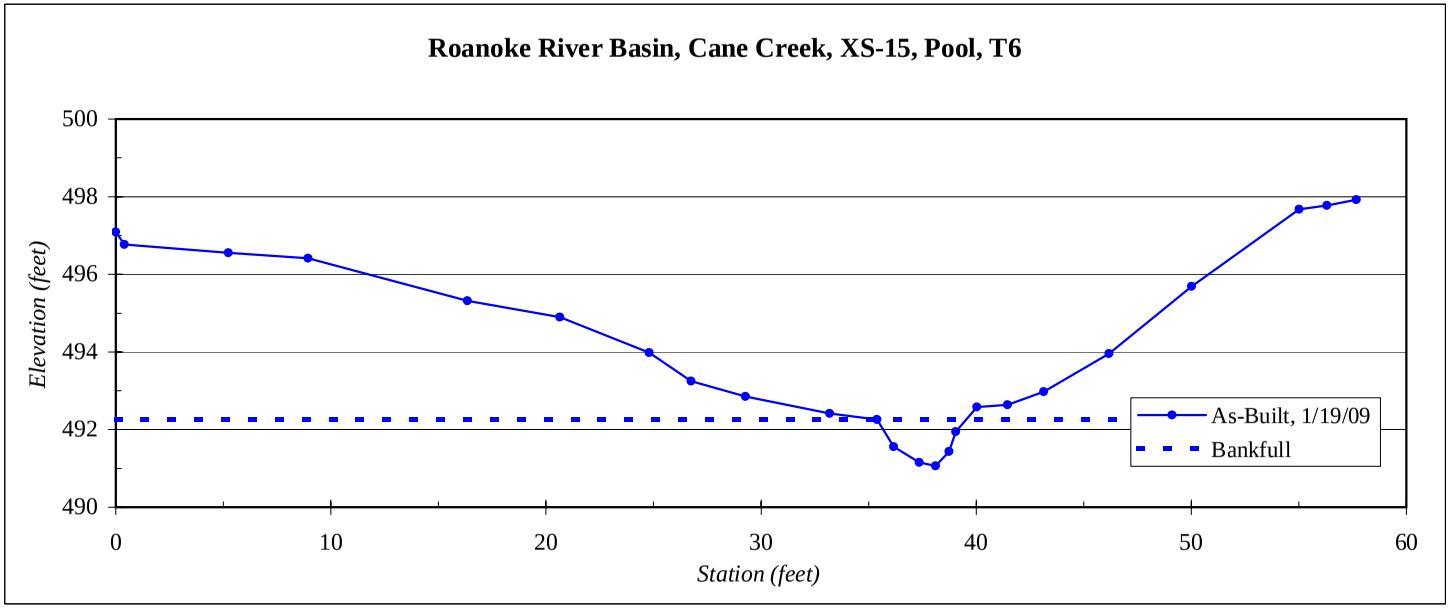


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-15, Pool, T6
Drainage Area (sq mi):	0.07
Date:	1/16/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	497.09
0.4	496.77
5.2	496.56
8.9	496.41
16.4	495.32
20.7	494.90
24.8	493.98
26.7	493.25
29.3	492.85
33.2	492.41
35.4	492.26
36.2	491.56
37.4	491.15
38.1	491.06
38.7	491.44
39.1	491.95
40.0	492.58
41.5	492.64
43.1	492.98
46.2	493.96
50.0	495.68
55.0	497.67
56.3	497.78
57.7	497.93

SUMMARY DATA	
Bankfull Elevation:	492.3
Bankfull Cross-Sectional Area:	3.1
Bankfull Width:	4.1
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	1.2
Mean Depth at Bankfull:	0.8
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	B4

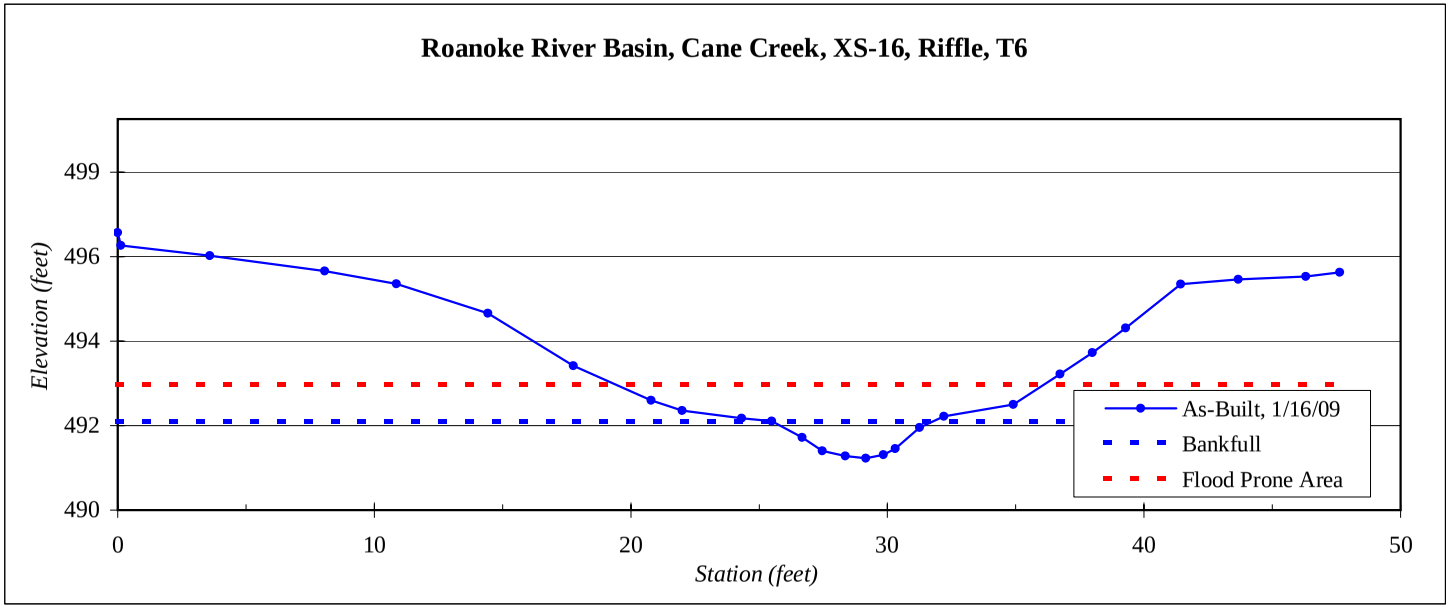


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-16, Riffle, T6
Drainage Area (sq mi):	0.07
Date:	1/16/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	497.10
0.1	496.77
3.6	496.50
8.1	496.11
10.9	495.79
14.4	495.03
17.8	493.69
20.8	492.80
22.0	492.55
24.3	492.35
25.5	492.27
26.7	491.86
27.5	491.52
28.4	491.38
29.2	491.33
29.8	491.42
30.3	491.57
31.3	492.11
32.2	492.39
34.9	492.70
36.7	493.48
38.0	494.03
39.3	494.66
41.4	495.78
43.7	495.90
46.3	495.98
47.6	496.08

SUMMARY DATA	
Bankfull Elevation:	492.3
Bankfull Cross-Sectional Area:	3.6
Bankfull Width:	6.3
Flood Prone Area Elevation:	493.2
Flood Prone Width:	16.7
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.6
W / D Ratio:	11.0
Entrenchment Ratio:	2.7
Bank Height Ratio:	1.0

Stream Type	B4

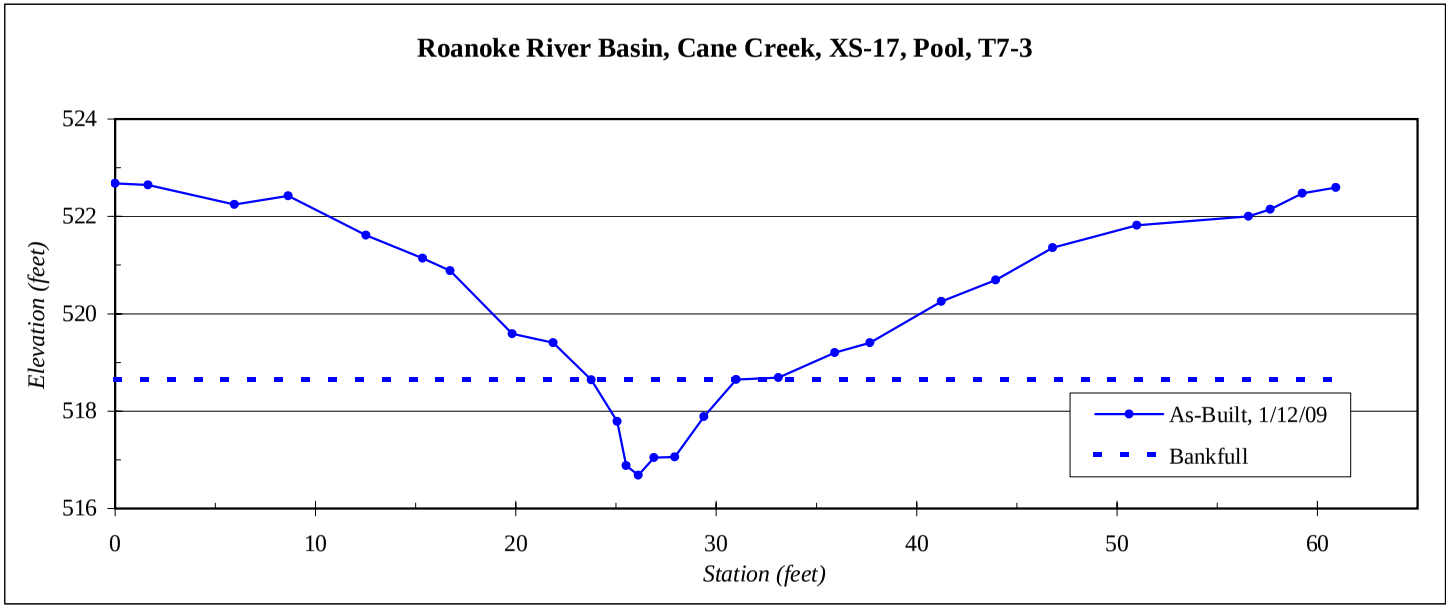


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-17, Pool, T7-3
Drainage Area (sq mi):	0.18
Date:	1/12/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	522.68
1.6	522.65
6.0	522.24
8.6	522.42
12.5	521.62
15.3	521.14
16.7	520.88
19.8	519.59
21.9	519.41
23.8	518.64
25.1	517.79
25.5	516.88
26.1	516.68
26.9	517.04
27.9	517.06
29.4	517.89
31.0	518.65
33.1	518.69
35.9	519.20
37.7	519.40
41.2	520.25
43.9	520.69
46.8	521.36
51.0	521.82
56.6	522.00
57.7	522.14
59.3	522.48
60.9	522.59

SUMMARY DATA	
Bankfull Elevation:	518.7
Bankfull Cross-Sectional Area:	7.7
Bankfull Width:	7.3
Flood Prone Area Elevation:	-
Flood Prone Width:	-
Max Depth at Bankfull:	2.0
Mean Depth at Bankfull:	1.1
W / D Ratio:	-
Entrenchment Ratio:	-
Bank Height Ratio:	-

Stream Type	B4c

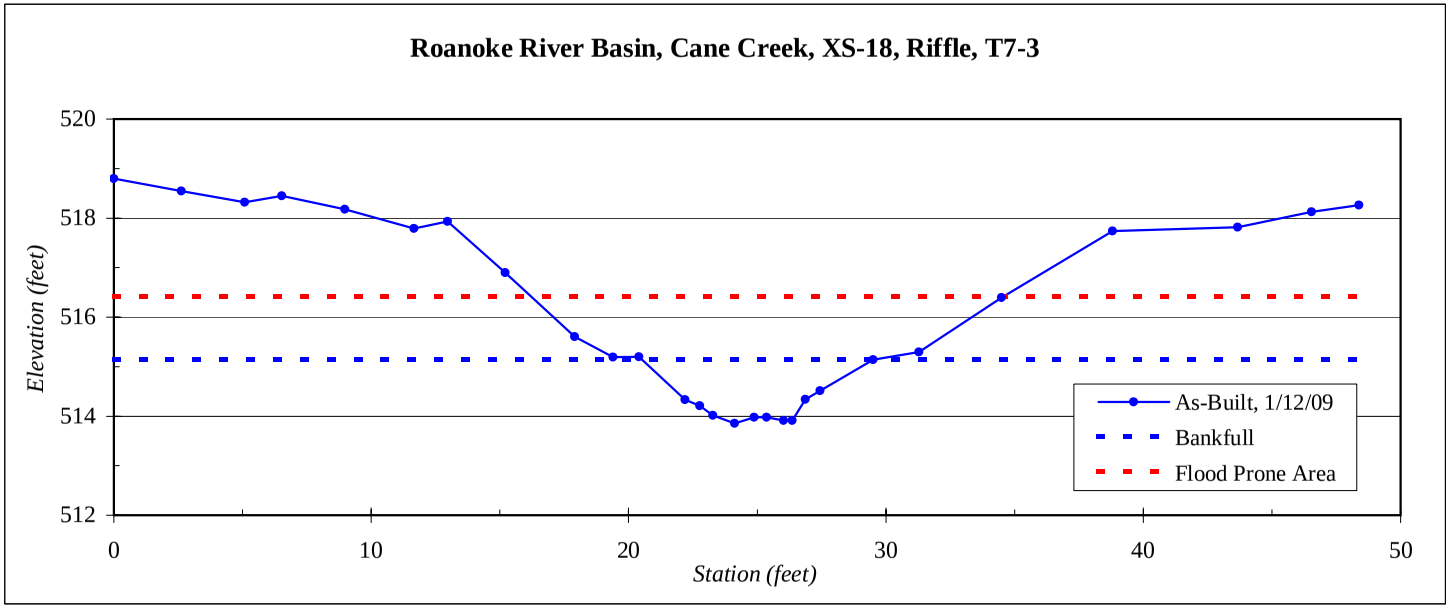


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-18, Riffle, T7-3
Drainage Area (sq mi):	0.18
Date:	1/12/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	518.79
2.6	518.54
5.1	518.32
6.5	518.45
9.0	518.18
11.7	517.79
13.0	517.93
15.2	516.90
17.9	515.60
19.4	515.20
20.4	515.20
22.2	514.33
22.8	514.21
23.3	514.02
24.1	513.85
24.9	513.98
25.4	513.98
26.0	513.91
26.4	513.91
26.9	514.34
27.4	514.52
29.5	515.14
31.3	515.30
34.5	516.40
38.8	517.74
43.7	517.82
46.5	518.13
48.4	518.26

SUMMARY DATA	
Bankfull Elevation:	515.1
Bankfull Cross-Sectional Area:	7.0
Bankfull Width:	9.0
Flood Prone Area Elevation:	516.4
Flood Prone Width:	18.4
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.8
W / D Ratio:	11.6
Entrenchment Ratio:	2.0
Bank Height Ratio:	1.0

Stream Type	B4c

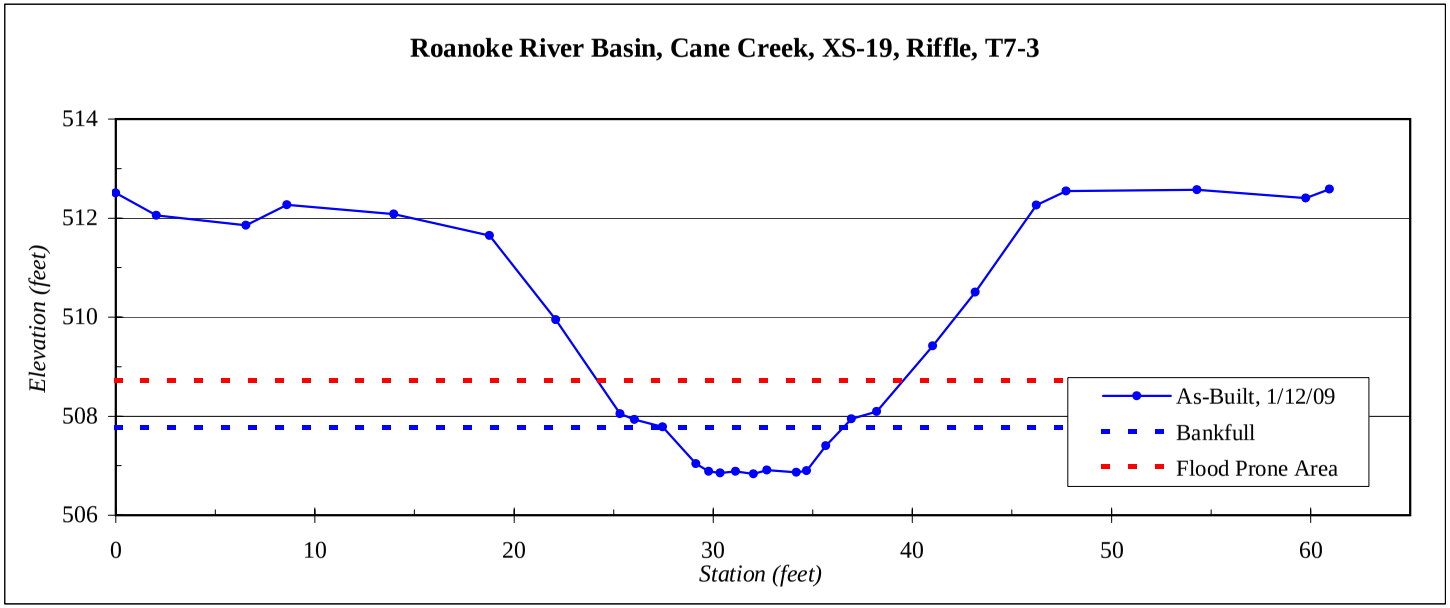


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-19, Riffle, T7-3
Drainage Area (sq mi):	0.18
Date:	1/12/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	512.51
2.0	512.05
6.5	511.86
8.6	512.27
14.0	512.08
18.8	511.65
22.1	509.95
25.3	508.05
26.0	507.93
27.5	507.78
29.1	507.04
29.8	506.88
30.4	506.85
31.1	506.89
32.0	506.83
32.7	506.91
34.2	506.87
34.7	506.90
35.7	507.40
36.9	507.95
38.2	508.10
41.0	509.42
43.2	510.51
46.2	512.26
47.7	512.55
54.3	512.57
59.8	512.40
60.9	512.59

SUMMARY DATA	
Bankfull Elevation:	507.8
Bankfull Cross-Sectional Area:	6.4
Bankfull Width:	9.1
Flood Prone Area Elevation:	508.7
Flood Prone Width:	15.4
Max Depth at Bankfull:	0.9
Mean Depth at Bankfull:	0.7
W / D Ratio:	12.9
Entrenchment Ratio:	1.7
Bank Height Ratio:	1.0

Stream Type	B4c

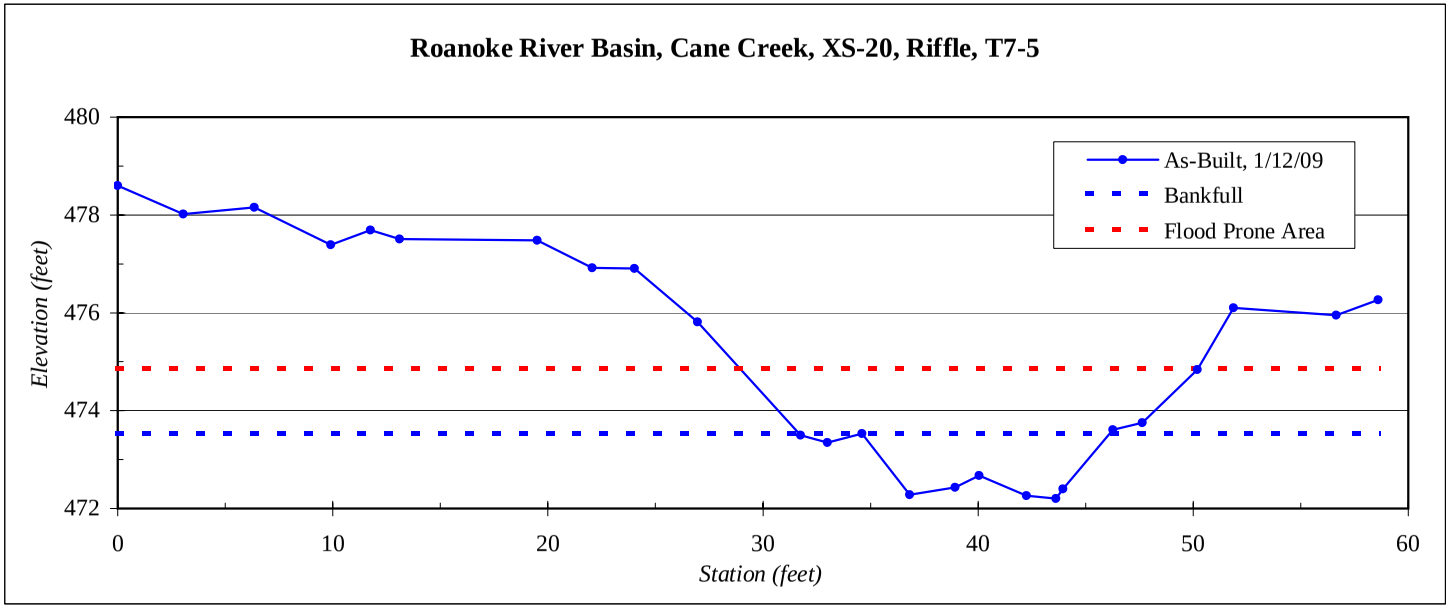


River Basin:	Roanoke
Watershed:	Cane Creek
XS ID	XS-20, Riffle, T7-5
Drainage Area (sq mi):	0.26
Date:	1/12/2009
Field Crew:	B. Roberts, M. Stokes

Station	Elevation
0.0	478.60
3.0	478.02
6.4	478.15
9.9	477.39
11.7	477.69
13.1	477.51
19.5	477.48
22.1	476.92
24.0	476.91
27.0	475.81
31.7	473.50
33.0	473.34
34.6	473.53
36.8	472.28
38.9	472.43
40.0	472.67
42.3	472.26
43.6	472.20
43.9	472.40
46.3	473.61
47.6	473.75
50.2	474.84
51.9	476.10
56.7	475.95
58.6	476.27

SUMMARY DATA	
Bankfull Elevation:	473.5
Bankfull Cross-Sectional Area:	10.7
Bankfull Width:	11.5
Flood Prone Area Elevation:	474.9
Flood Prone Width:	21.3
Max Depth at Bankfull:	1.3
Mean Depth at Bankfull:	0.9
W / D Ratio:	12.4
Entrenchment Ratio:	1.9
Bank Height Ratio:	1.0

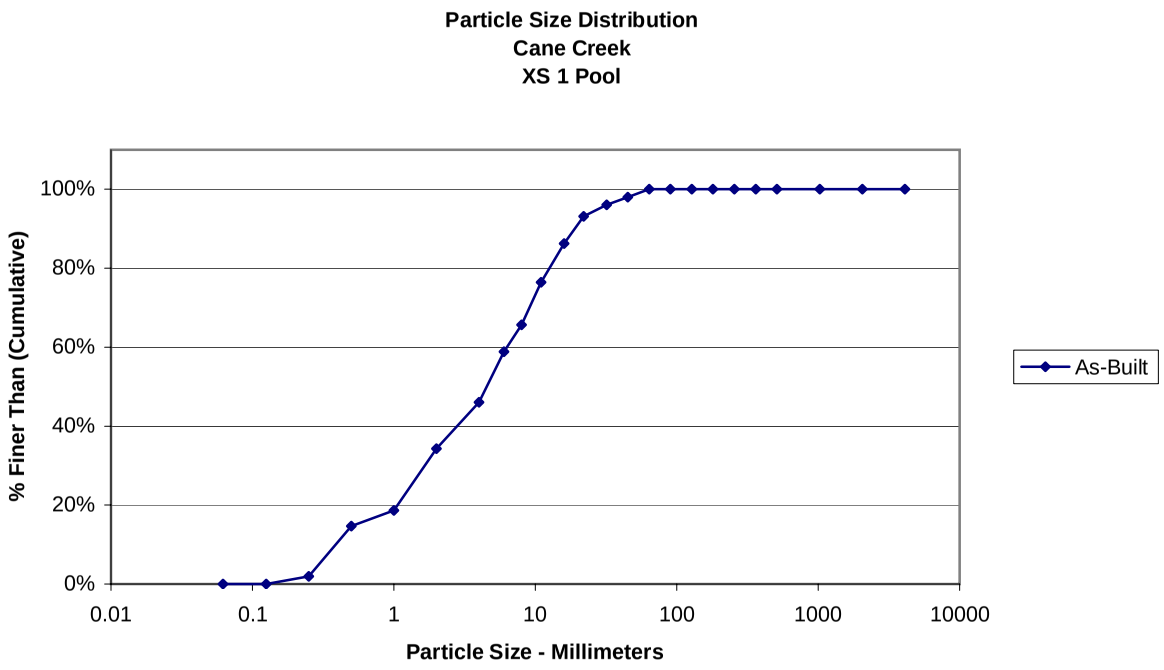
Stream Type	B4c/C4



Pebble Count Plots

Cross-Section 1 Pool - As-Built, Trib 1			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	2
Medium	.25 - .50	N	13
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	16
Very Fine	2 - 4		12
Fine	4 - 5.7	G	13
Fine	5.7 - 8	R	7
Medium	8 - 11.3	A	11
Medium	11.3 - 16	V	10
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		2
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	102

Note:



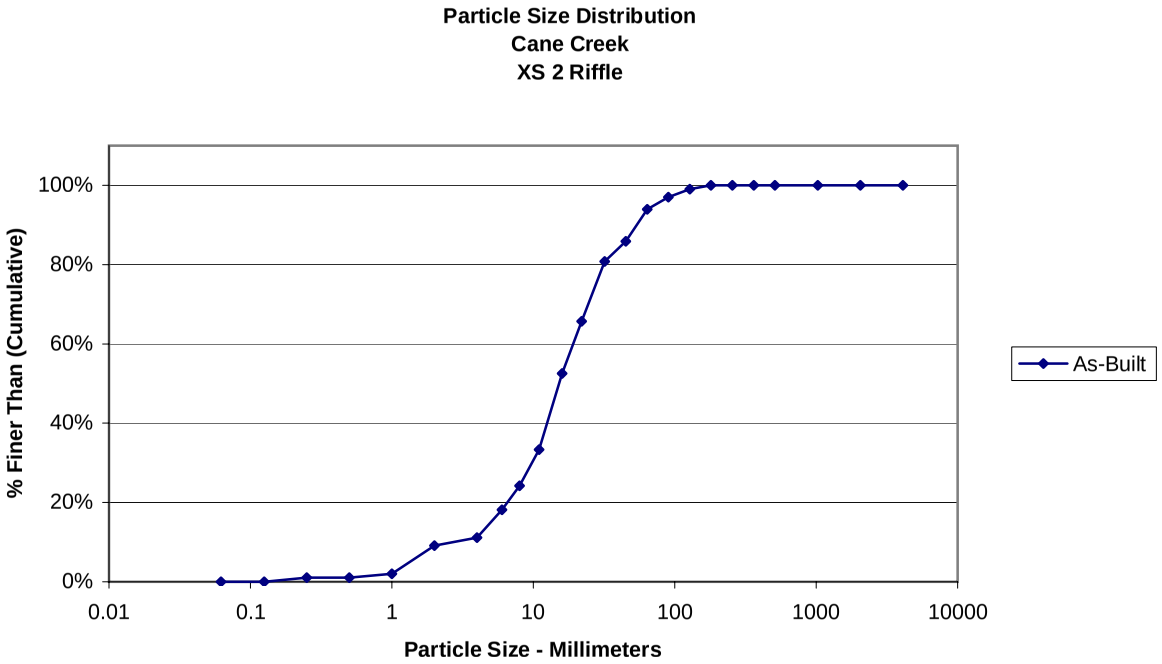
Size (mm)	
D16	0.63
D35	2.1
D50	4.5
D65	7.8
D84	15
D95	28

Size Distribution	
mean	3.1
dispersion	5.2
skewness	-0.14

Type	
silt/clay	0%
sand	34%
gravel	66%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 2 Riffle - As-Built, Trib 1			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	1
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		2
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	6
Medium	8 - 11.3	A	9
Medium	11.3 - 16	V	19
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	15
Very Coarse	32 - 45	S	5
Very Coarse	45 - 64		8
Small	64 - 90	C	3
Small	90 - 128	O	2
Large	128 - 180	B	1
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	99

Note:



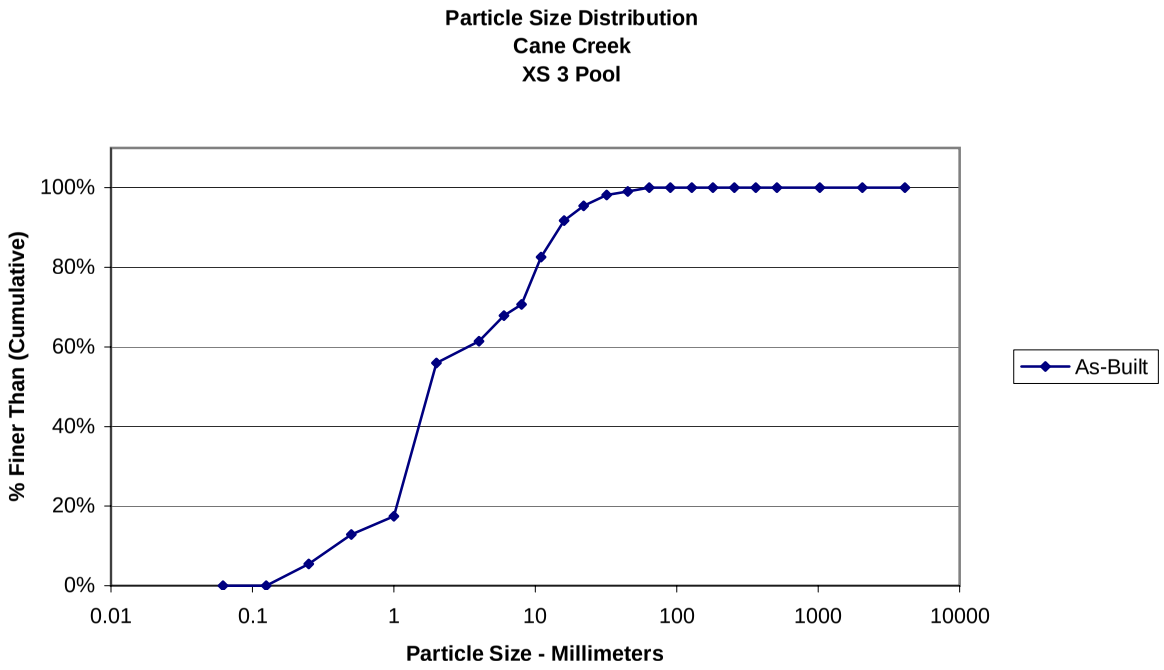
Size (mm)	
D16	5.3
D35	11
D50	15
D65	22
D84	40
D95	72

Size Distribution	
mean	14.6
dispersion	2.7
skewness	-0.01

Type	
silt/clay	0%
sand	9%
gravel	85%
cobble	6%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 3 Pool - As-Built, Trib 1			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	6
Medium	.25 - .50	N	8
Coarse	.50 - 1	D	5
Very Coarse	1 - 2	S	42
Very Fine	2 - 4		6
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	13
Medium	11.3 - 16	V	10
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	1
Very Coarse	45 - 64		1
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	109

Note:



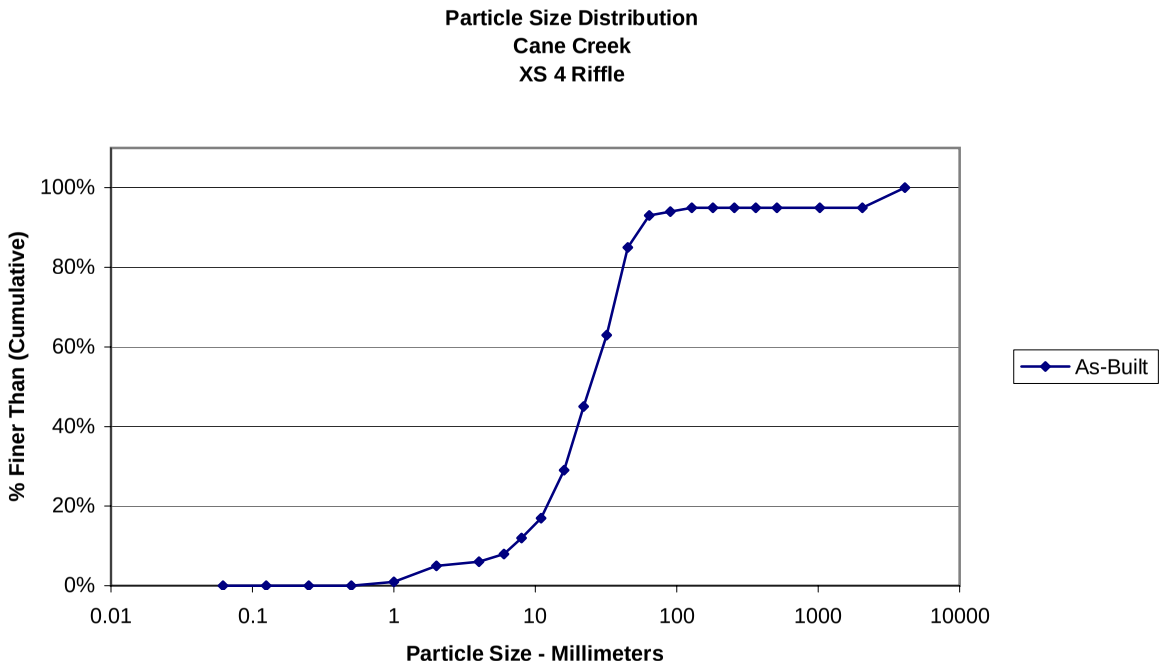
Size (mm)	
D16	0.81
D35	1.4
D50	1.8
D65	5
D84	12
D95	21

Size Distribution	
mean	3.1
dispersion	4.4
skewness	0.22

Type	
silt/clay	0%
sand	56%
gravel	44%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 4 Riffle - As-Built, Trib 1			
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	1
Very Coarse	1 - 2	S	4
Very Fine	2 - 4		1
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	12
Coarse	16 - 22.6	E	16
Coarse	22.6 - 32	L	18
Very Coarse	32 - 45	S	22
Very Coarse	45 - 64		8
Small	64 - 90	C	1
Small	90 - 128	O	1
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	5
		Total	100

Note:



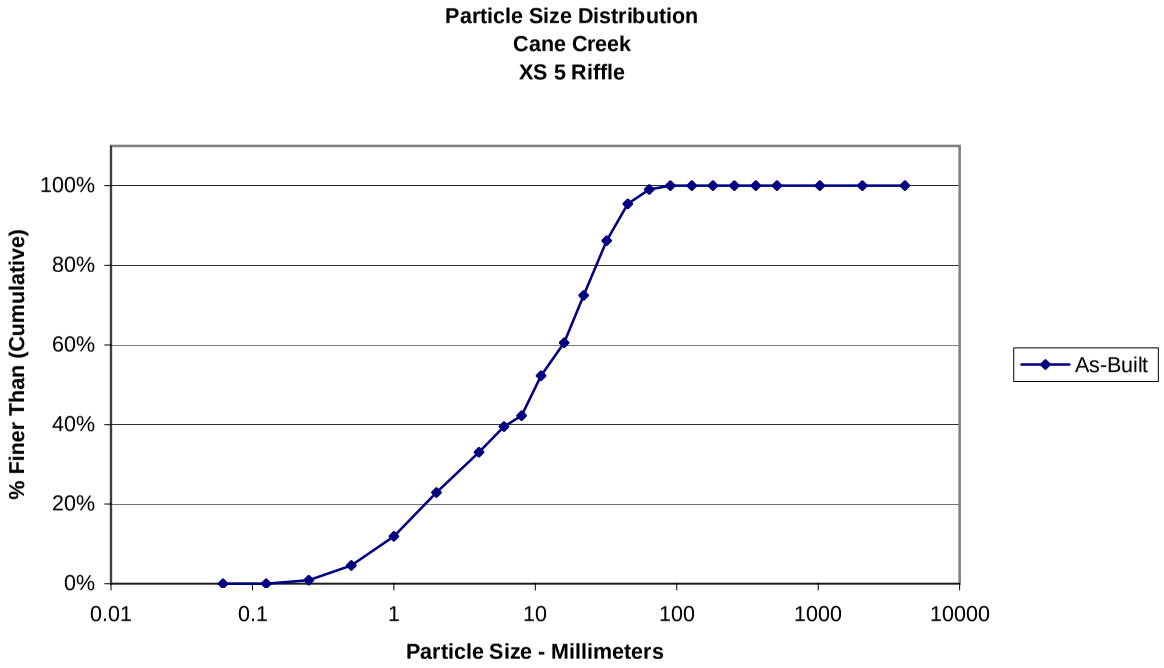
Size (mm)	
D16	10
D35	18
D50	24
D65	33
D84	44
D95	57

Size Distribution	
mean	21.0
dispersion	2.1
skewness	-0.07

Type	
silt/clay	0%
sand	5%
gravel	88%
cobble	2%
boulder	0%
bedrock	5%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 5 Riffle - As-Built, Trib 2			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	1
Medium	.25 - .50	N	4
Coarse	.50 - 1	D	8
Very Coarse	1 - 2	S	12
Very Fine	2 - 4		11
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	11
Medium	11.3 - 16	V	9
Coarse	16 - 22.6	E	13
Coarse	22.6 - 32	L	15
Very Coarse	32 - 45	S	10
Very Coarse	45 - 64		4
Small	64 - 90	C	1
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	109

Note:



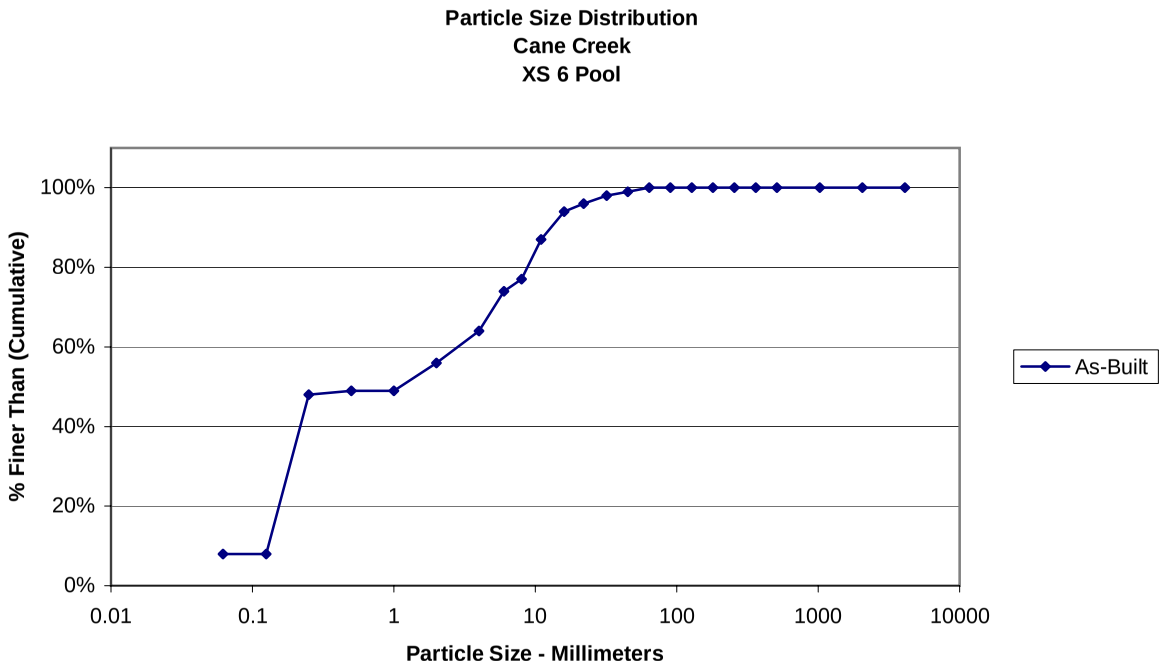
Size (mm)	
D16	1.3
D35	4.5
D50	10
D65	18
D84	30
D95	44

Size Distribution	
mean	6.2
dispersion	5.3
skewness	-0.18

Type	
silt/clay	0%
sand	23%
gravel	76%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 6 Pool - As-Built, Trib 3			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	8
Very Fine	.062 - .125	S	
Fine	.125 - .25	A	40
Medium	.25 - .50	N	1
Coarse	.50 - 1	D	
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		8
Fine	4 - 5.7	G	10
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	10
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	1
Very Coarse	45 - 64		1
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:



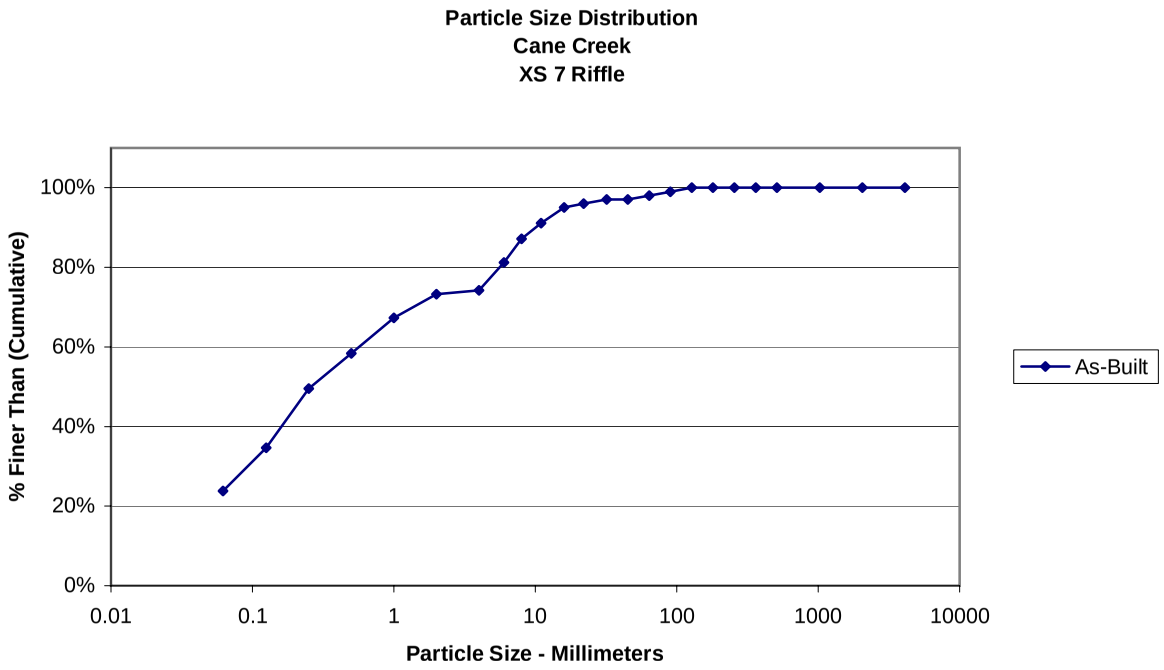
Size (mm)	
D16	0.14
D35	0.2
D50	1.1
D65	4.2
D84	10
D95	19

Size Distribution	
mean	1.2
dispersion	8.5
skewness	0.02

Type	
silt/clay	8%
sand	48%
gravel	44%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 7 Riffle - As-Built, Trib 3			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	24
Very Fine	.062 - .125	S	11
Fine	.125 - .25	A	15
Medium	.25 - .50	N	9
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	6
Very Fine	2 - 4		1
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	6
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	4
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	1
Very Coarse	32 - 45	S	
Very Coarse	45 - 64		1
Small	64 - 90	C	1
Small	90 - 128	O	1
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:



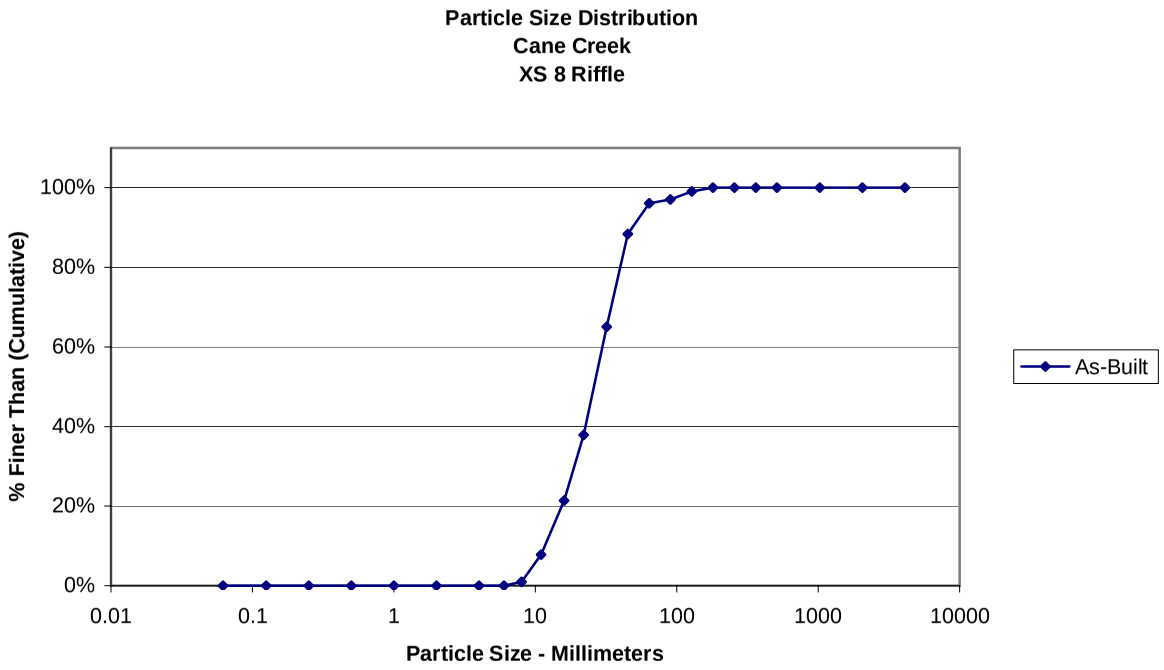
Size (mm)	
D16	0.062
D35	0.13
D50	0.26
D65	0.83
D84	6.9
D95	16

Size Distribution	
mean	0.7
dispersion	15.4
skewness	0.28

Type	
silt/clay	24%
sand	50%
gravel	25%
cobble	2%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 8 Riffle - As-Built, Trib 3			
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	
Very Coarse	1 - 2	S	
Very Fine	2 - 4		
Fine	4 - 5.7	G	
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	7
Medium	11.3 - 16	V	14
Coarse	16 - 22.6	E	17
Coarse	22.6 - 32	L	28
Very Coarse	32 - 45	S	24
Very Coarse	45 - 64		8
Small	64 - 90	C	1
Small	90 - 128	O	2
Large	128 - 180	B	1
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	103

Note:



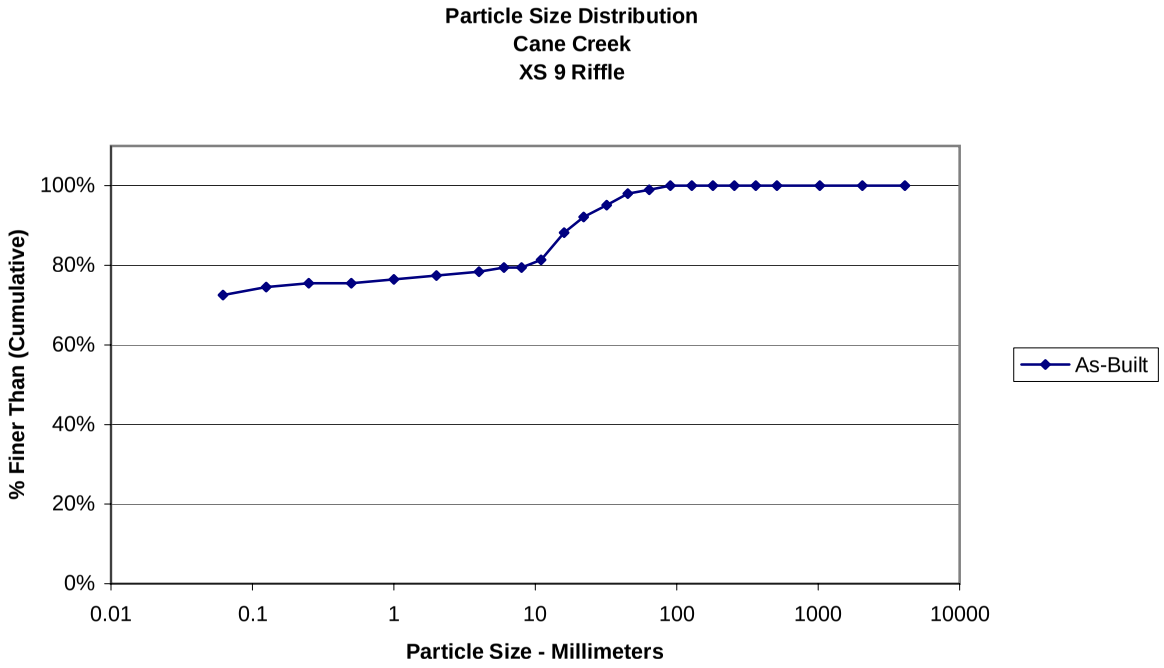
Size (mm)	
D16	14
D35	21
D50	26
D65	32
D84	42
D95	61

Size Distribution	
mean	24.2
dispersion	1.7
skewness	-0.04

Type	
silt/clay	0%
sand	0%
gravel	96%
cobble	4%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 9 Riffle - As-Built, Trib 4			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	74
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	1
Medium	.25 - .50	N	
Coarse	.50 - 1	D	1
Very Coarse	1 - 2	S	1
Very Fine	2 - 4		1
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	2
Medium	11.3 - 16	V	7
Coarse	16 - 22.6	E	4
Coarse	22.6 - 32	L	3
Very Coarse	32 - 45	S	3
Very Coarse	45 - 64		1
Small	64 - 90	C	1
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	102

Note:



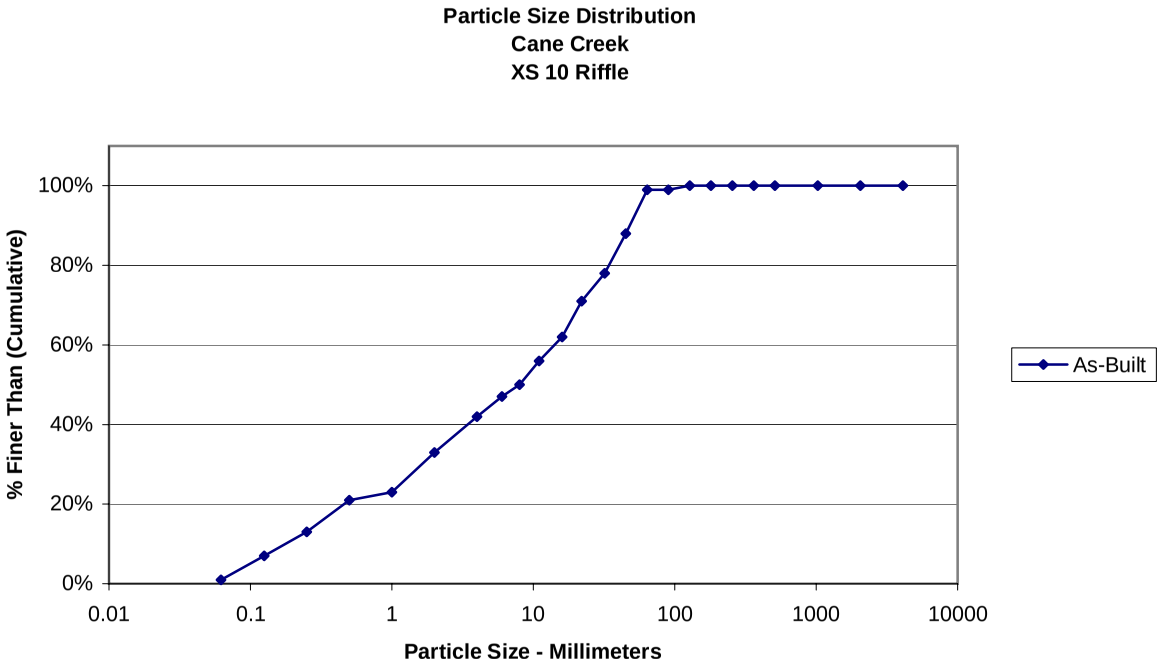
Size (mm)	
D16	0.062
D35	0.062
D50	0.062
D65	0.062
D84	13
D95	32

Size Distribution	
mean	0.9
dispersion	105.3
skewness	0.76

Type	
silt/clay	73%
sand	5%
gravel	22%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 10 Riffle - As-Built, Trib 4			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	1
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	6
Medium	.25 - .50	N	8
Coarse	.50 - 1	D	2
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		9
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	6
Medium	11.3 - 16	V	6
Coarse	16 - 22.6	E	9
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	10
Very Coarse	45 - 64		11
Small	64 - 90	C	
Small	90 - 128	O	1
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:



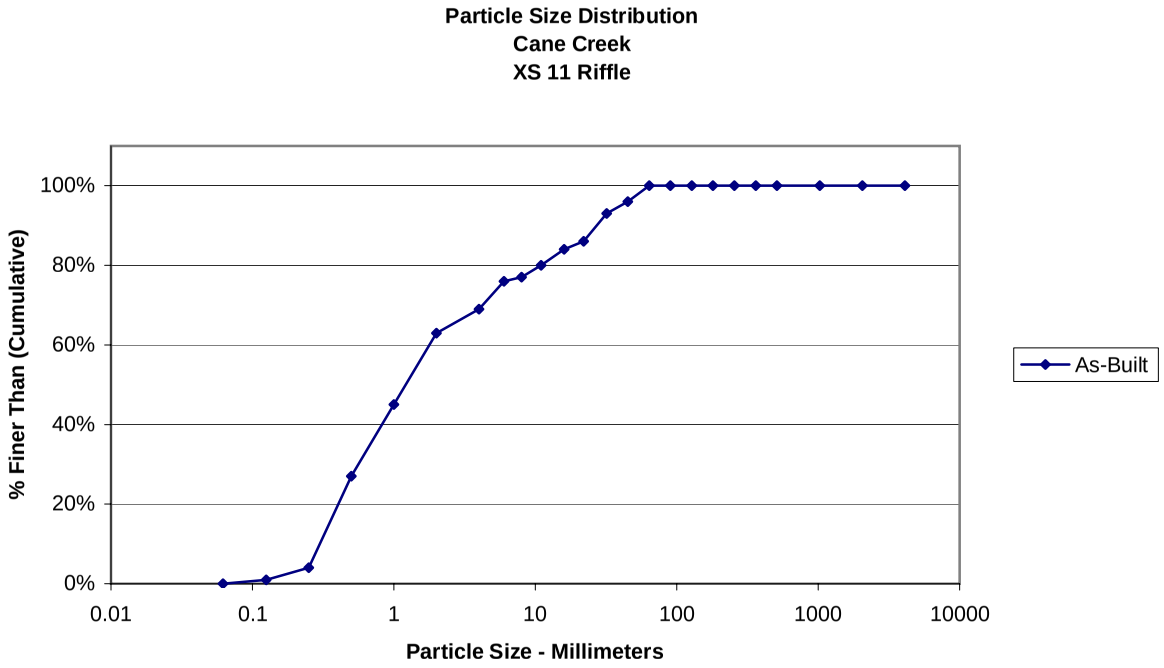
Size (mm)	
D16	0.32
D35	2.3
D50	8
D65	18
D84	39
D95	56

Size Distribution	
mean	3.5
dispersion	14.9
skewness	-0.25

Type	
silt/clay	1%
sand	32%
gravel	66%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 11 Riffle - As-Built, Trib 4			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	1
Fine	.125 - .25	A	3
Medium	.25 - .50	N	23
Coarse	.50 - 1	D	18
Very Coarse	1 - 2	S	18
Very Fine	2 - 4		6
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	1
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	4
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	7
Very Coarse	32 - 45	S	3
Very Coarse	45 - 64		4
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:



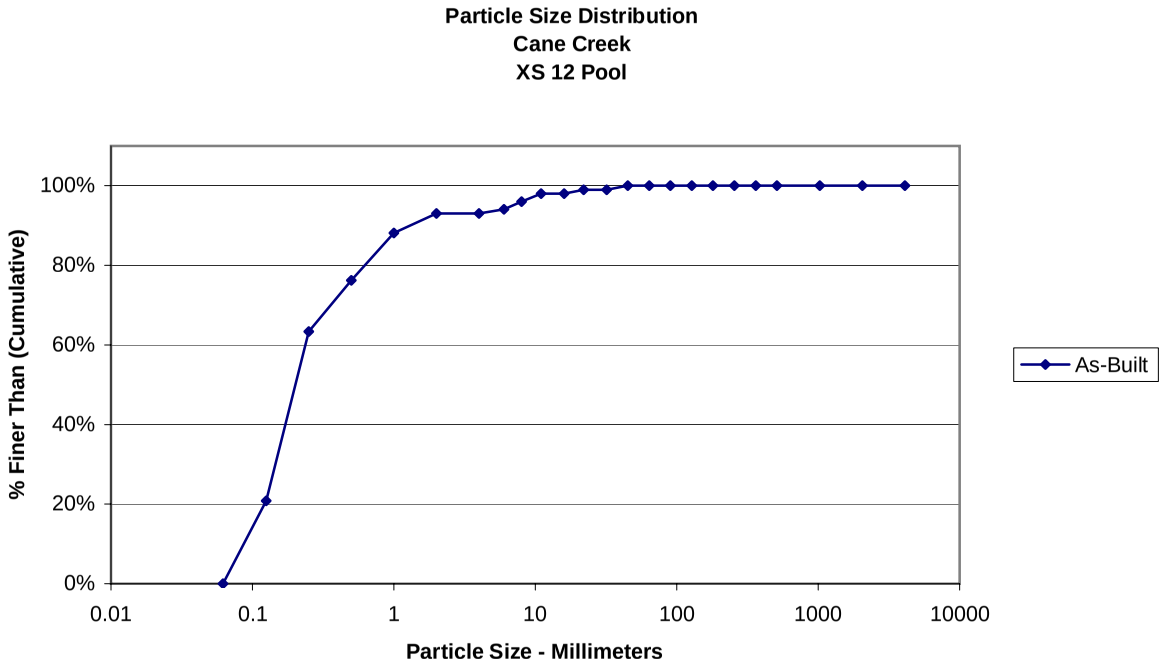
Size (mm)	
D16	0.36
D35	0.68
D50	1.2
D65	2.5
D84	16
D95	40

Size Distribution	
mean	2.4
dispersion	8.3
skewness	0.23

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

Cross-Section 12 Pool - As-Built, Trib 4			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	21
Fine	.125 - .25	A	43
Medium	.25 - .50	N	13
Coarse	.50 - 1	D	12
Very Coarse	1 - 2	S	5
Very Fine	2 - 4		
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	2
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	1
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:



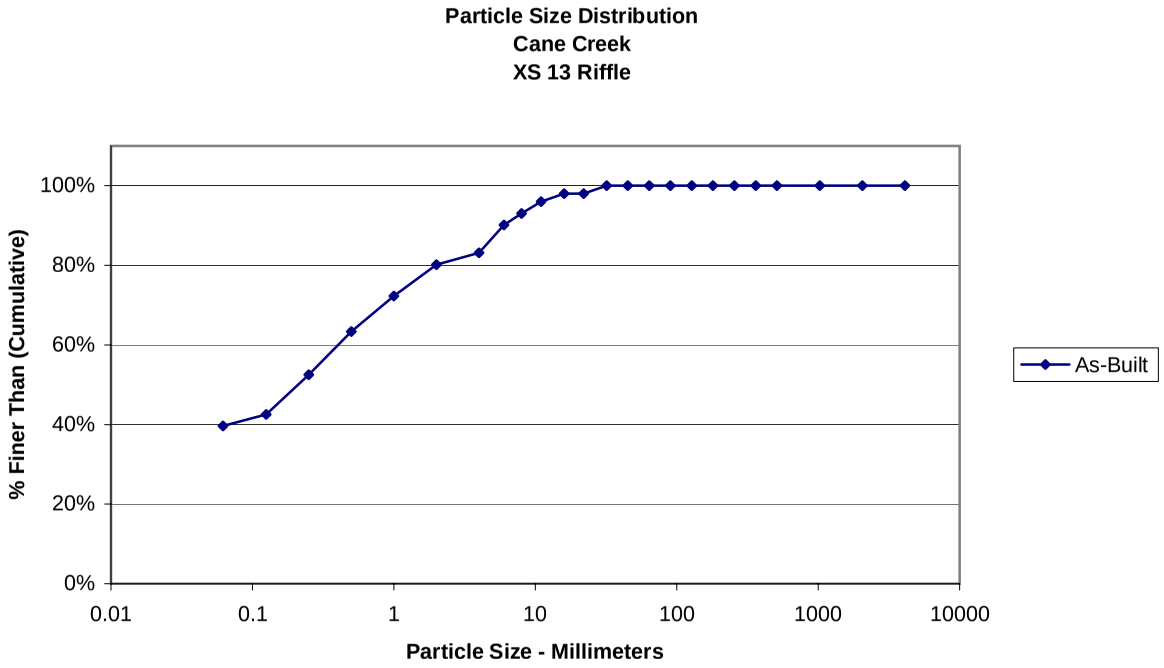
Size (mm)	
D16	0.11
D35	0.16
D50	0.2
D65	0.27
D84	0.79
D95	6.9

Size Distribution	
mean	0.3
dispersion	2.9
skewness	0.18

Type	
silt/clay	0%
sand	93%
gravel	7%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 13 Riffle - As-Built, Trib 5			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	40
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	10
Medium	.25 - .50	N	11
Coarse	.50 - 1	D	9
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		3
Fine	4 - 5.7	G	7
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	3
Medium	11.3 - 16	V	2
Coarse	16 - 22.6	E	
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	101

Note:



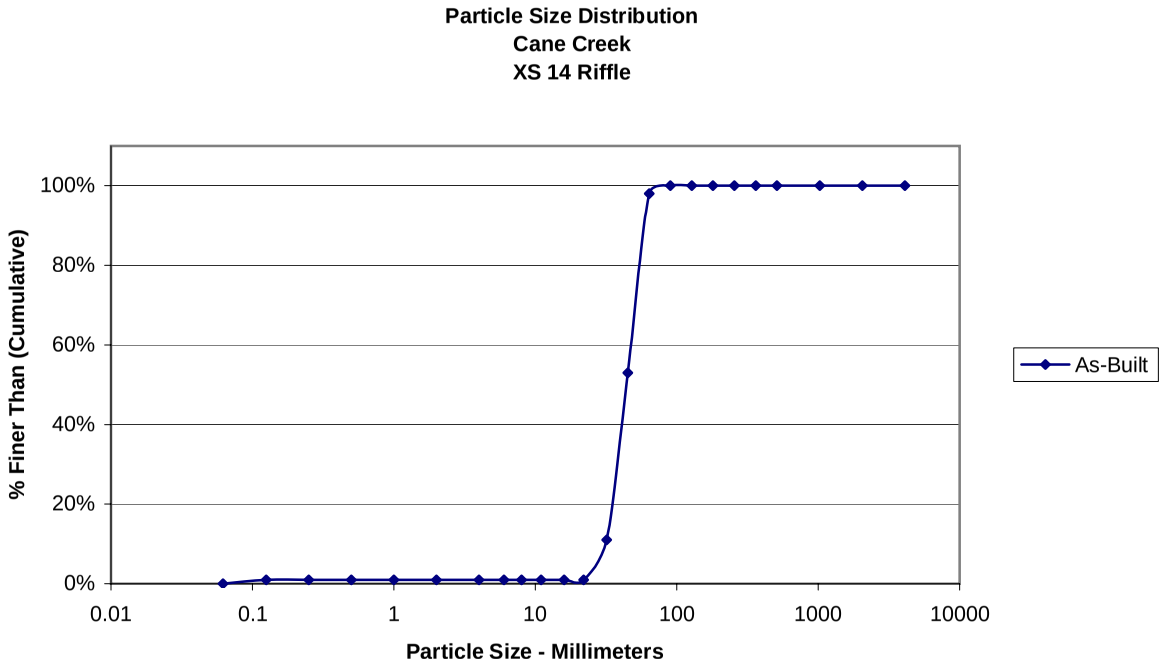
Size (mm)	
D16	0.062
D35	0.062
D50	0.21
D65	0.57
D84	4.2
D95	9.8

Size Distribution	
mean	0.5
dispersion	11.7
skewness	0.28

Type	
silt/clay	40%
sand	41%
gravel	20%
cobble	0%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 14 Riffle - As-Built, Trib 6			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	1
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	10
Very Coarse	32 - 45	S	42
Very Coarse	45 - 64		45
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:



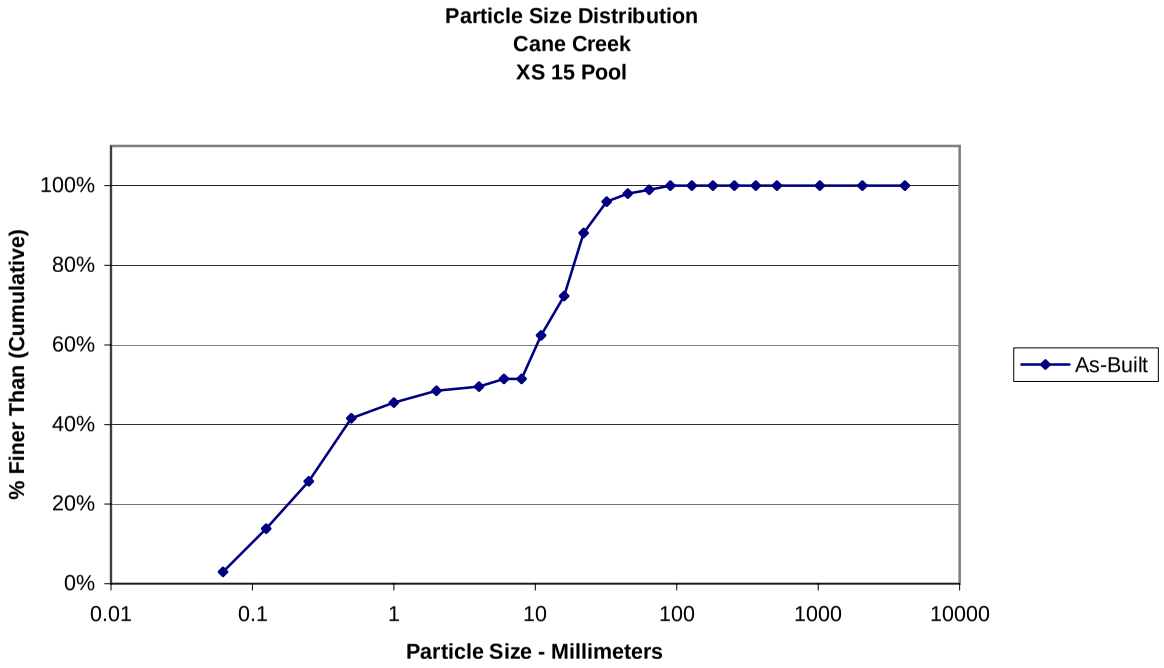
Size (mm)	
D16	33
D35	39
D50	44
D65	49
D84	57
D95	63

Size Distribution	
mean	43.4
dispersion	1.3
skewness	-0.01

Type	
silt/clay	0%
sand	1%
gravel	97%
cobble	2%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 15 Pool - As-Built, Trib 6			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	3
Very Fine	.062 - .125	S	11
Fine	.125 - .25	A	12
Medium	.25 - .50	N	16
Coarse	.50 - 1	D	4
Very Coarse	1 - 2	S	3
Very Fine	2 - 4		1
Fine	4 - 5.7	G	2
Fine	5.7 - 8	R	
Medium	8 - 11.3	A	11
Medium	11.3 - 16	V	10
Coarse	16 - 22.6	E	16
Coarse	22.6 - 32	L	8
Very Coarse	32 - 45	S	2
Very Coarse	45 - 64		1
Small	64 - 90	C	1
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:



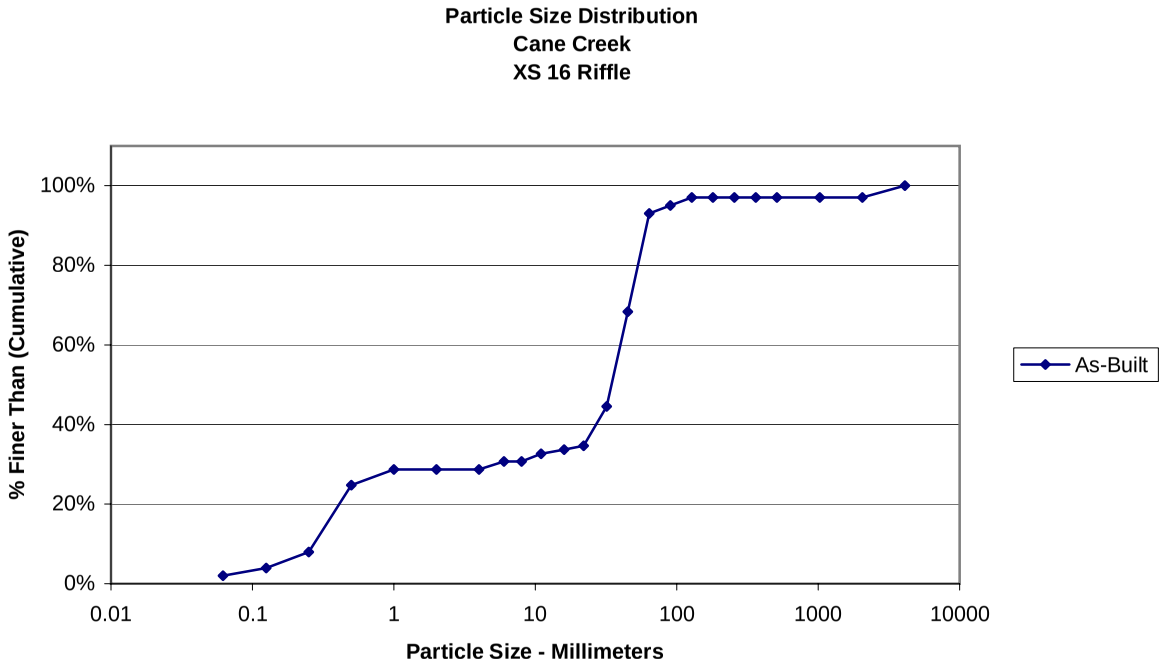
Size (mm)	
D16	0.14
D35	0.37
D50	4.4
D65	12
D84	20
D95	30

Size Distribution	
mean	1.7
dispersion	18.0
skewness	-0.29

Type	
silt/clay	3%
sand	46%
gravel	50%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 16 Riffle - As-Built, Trib 6			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	2
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	4
Medium	.25 - .50	N	17
Coarse	.50 - 1	D	4
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	1
Coarse	16 - 22.6	E	1
Coarse	22.6 - 32	L	10
Very Coarse	32 - 45	S	24
Very Coarse	45 - 64		25
Small	64 - 90	C	2
Small	90 - 128	O	2
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	3
		Total	101

Note:



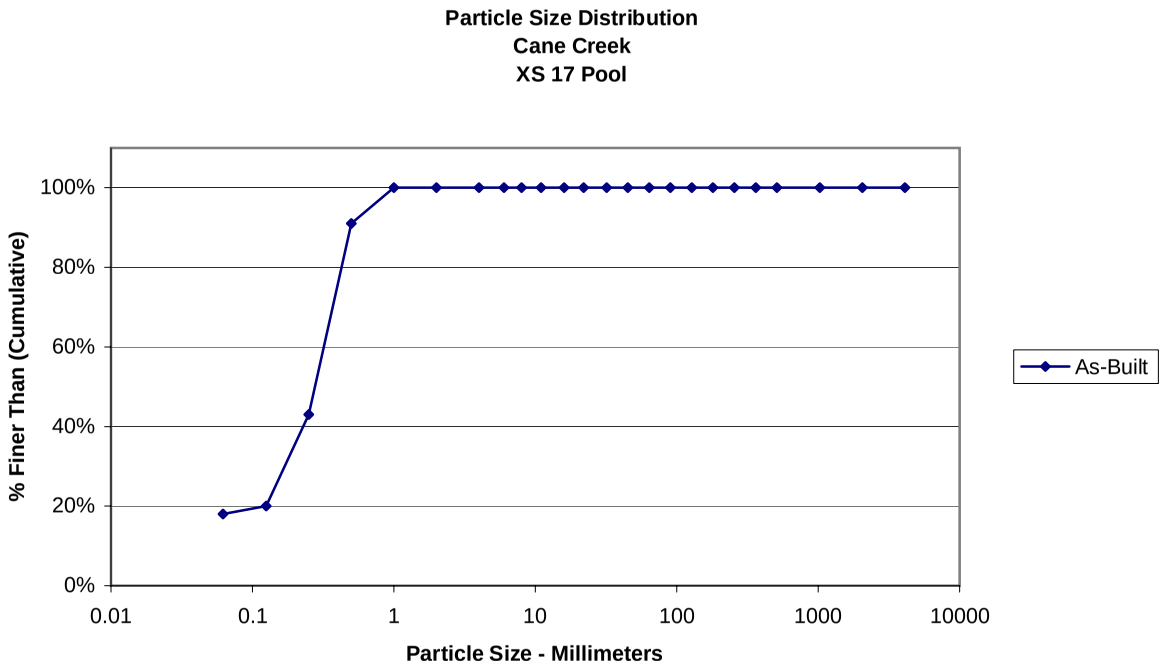
Size (mm)	
D16	0.35
D35	22
D50	35
D65	43
D84	56
D95	89

Size Distribution	
mean	4.4
dispersion	50.8
skewness	-0.60

Type	
silt/clay	2%
sand	27%
gravel	64%
cobble	4%
boulder	0%
bedrock	3%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 17 Pool - As-Built, Trib 7			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	18
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	23
Medium	.25 - .50	N	48
Coarse	.50 - 1	D	9
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:



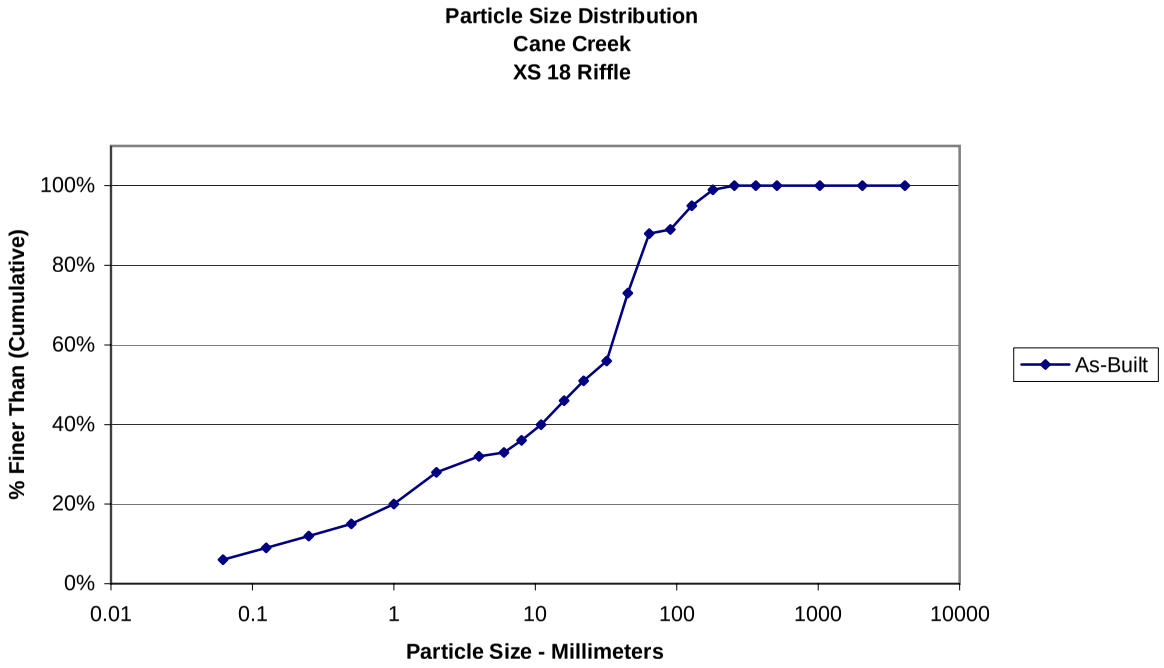
Size (mm)	
D16	0.062
D35	0.2
D50	0.28
D65	0.34
D84	0.45
D95	0.68

Size Distribution	
mean	0.2
dispersion	3.1
skewness	-0.24

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

Cross-Section 18 Riffle - As-Built, Trib 7			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	6
Very Fine	.062 - .125	S	3
Fine	.125 - .25	A	3
Medium	.25 - .50	N	3
Coarse	.50 - 1	D	5
Very Coarse	1 - 2	S	8
Very Fine	2 - 4		4
Fine	4 - 5.7	G	1
Fine	5.7 - 8	R	3
Medium	8 - 11.3	A	4
Medium	11.3 - 16	V	6
Coarse	16 - 22.6	E	5
Coarse	22.6 - 32	L	5
Very Coarse	32 - 45	S	17
Very Coarse	45 - 64		15
Small	64 - 90	C	1
Small	90 - 128	O	6
Large	128 - 180	B	4
Large	180 - 256	L	1
Small	256 - 362	B	
Small	362 - 512	L	
Medium	512 - 1024	D	
Lrg- Very Lrg	1024 - 2048	R	
Bedrock	>2048	BDRK	
		Total	100

Note:



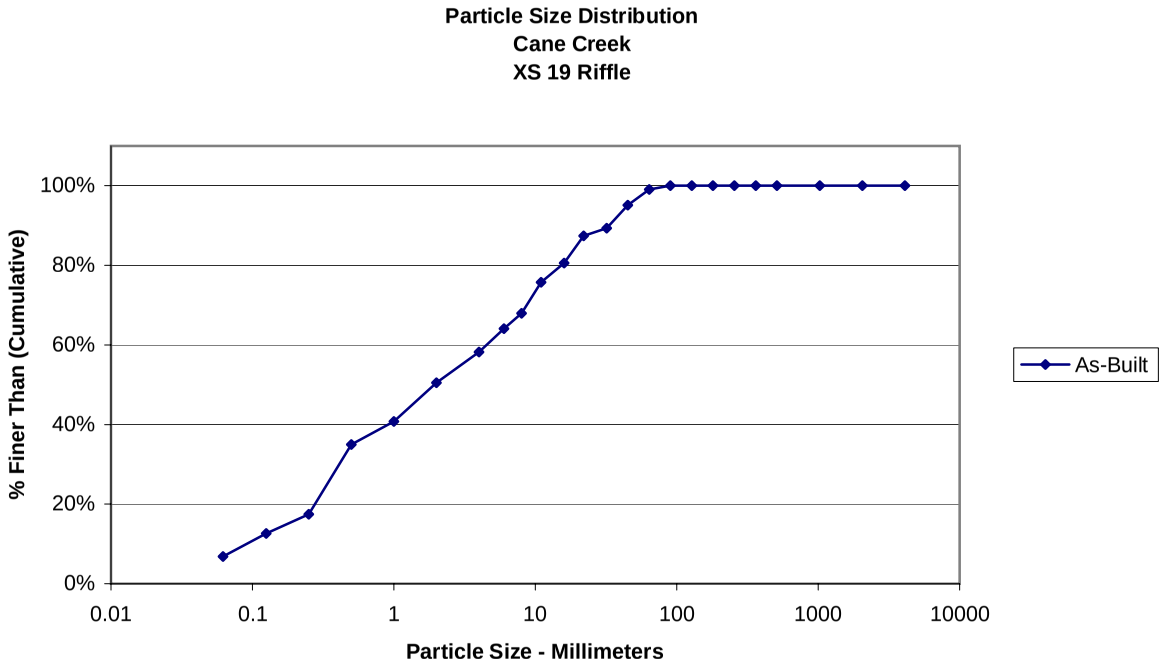
Size (mm)	
D16	0.57
D35	7.3
D50	21
D65	38
D84	58
D95	130

Size Distribution	
mean	5.7
dispersion	19.8
skewness	-0.40

Type	
silt/clay	6%
sand	22%
gravel	60%
cobble	12%
boulder	0%
bedrock	
hardpan	
wood/det	
artificial	

Cross-Section 19 Riffle - As-Built, Trib 7			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	7
Very Fine	.062 - .125	S	6
Fine	.125 - .25	A	5
Medium	.25 - .50	N	18
Coarse	.50 - 1	D	6
Very Coarse	1 - 2	S	10
Very Fine	2 - 4		8
Fine	4 - 5.7	G	6
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	8
Medium	11.3 - 16	V	5
Coarse	16 - 22.6	E	7
Coarse	22.6 - 32	L	2
Very Coarse	32 - 45	S	6
Very Coarse	45 - 64		4
Small	64 - 90	C	1
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	103

Note:



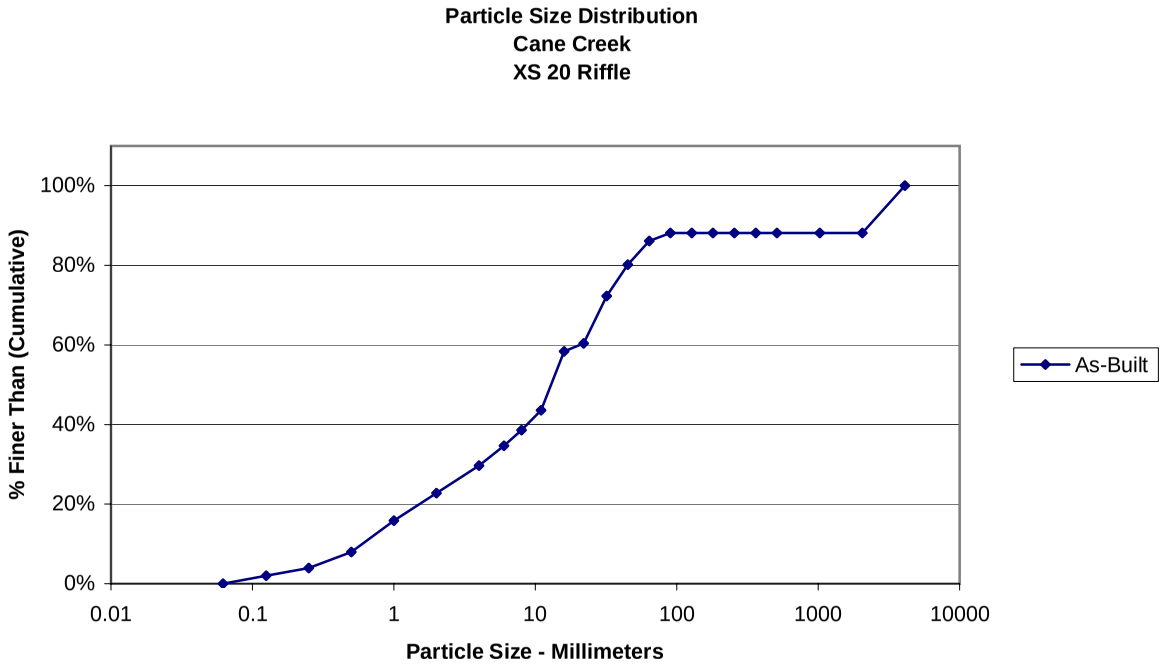
Size (mm)	
D16	0.2
D35	0.5
D50	1.9
D65	6.4
D84	19
D95	45

Size Distribution	
mean	1.9
dispersion	9.8
skewness	0.01

Type	
silt/clay	7%
sand	44%
gravel	49%
cobble	1%
boulder	0%
bedrock	0%
hardpan	0%
wood/det	0%
artificial	0%

Cross-Section 20 Riffle - As-Built, Trib 7			
Particle	Millimeter		Count
Silt/Clay	< 0.062	S/C	
Very Fine	.062 - .125	S	2
Fine	.125 - .25	A	2
Medium	.25 - .50	N	4
Coarse	.50 - 1	D	8
Very Coarse	1 - 2	S	7
Very Fine	2 - 4		7
Fine	4 - 5.7	G	5
Fine	5.7 - 8	R	4
Medium	8 - 11.3	A	5
Medium	11.3 - 16	V	15
Coarse	16 - 22.6	E	2
Coarse	22.6 - 32	L	12
Very Coarse	32 - 45	S	8
Very Coarse	45 - 64		6
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	12
		Total	101

Note:



Size (mm)	
D16	0.86
D35	4.4
D50	11
D65	16
D84	34
D95	55

Size Distribution	
mean	5.4
dispersion	7.9
skewness	-0.24

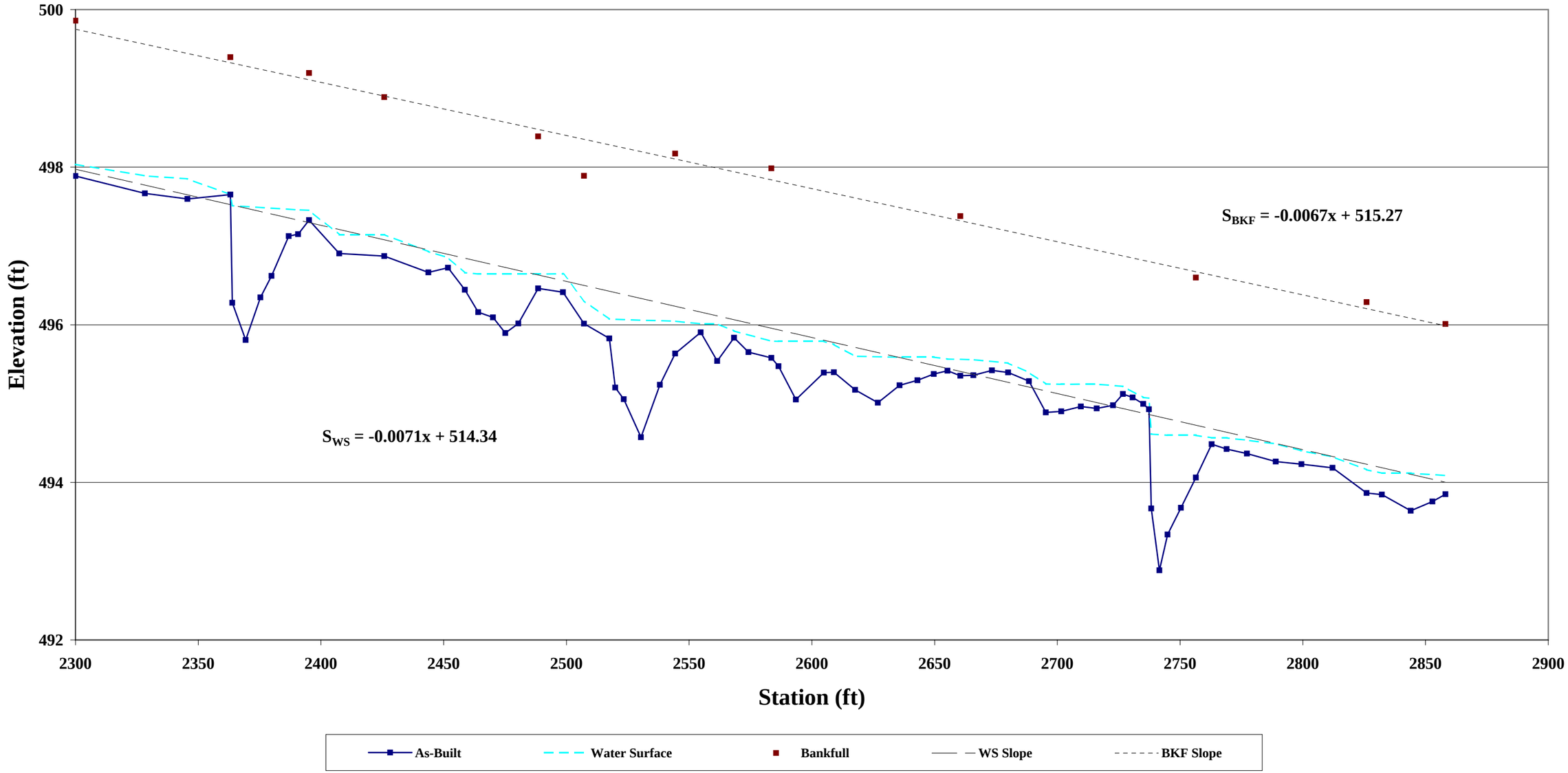
Type	
silt/clay	0%
sand	23%
gravel	63%
cobble	2%
boulder	0%
bedrock	12%
hardpan	0%
wood/det	0%
artificial	0%

Appendix C

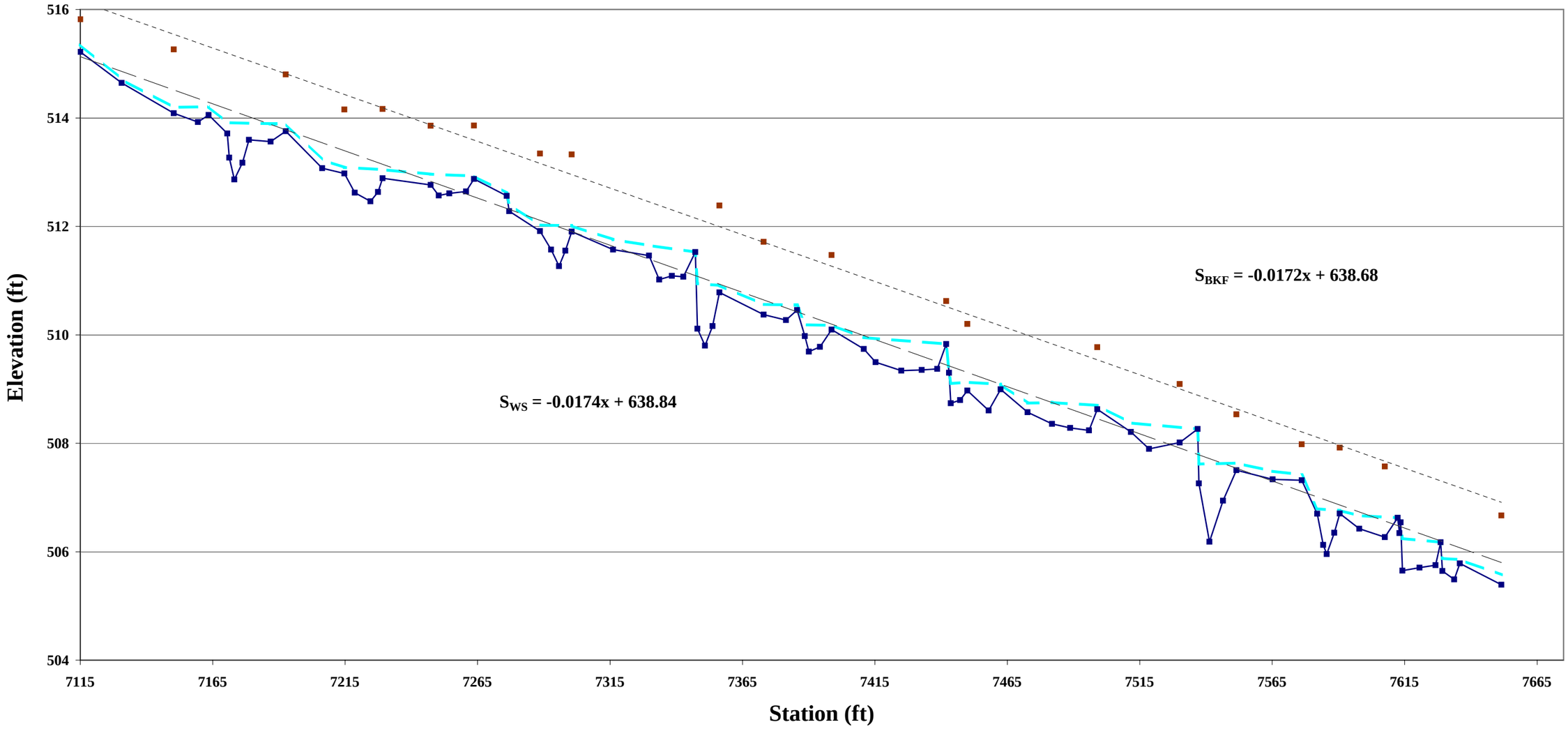
Longitudinal Profiles

Longitudinal Profile

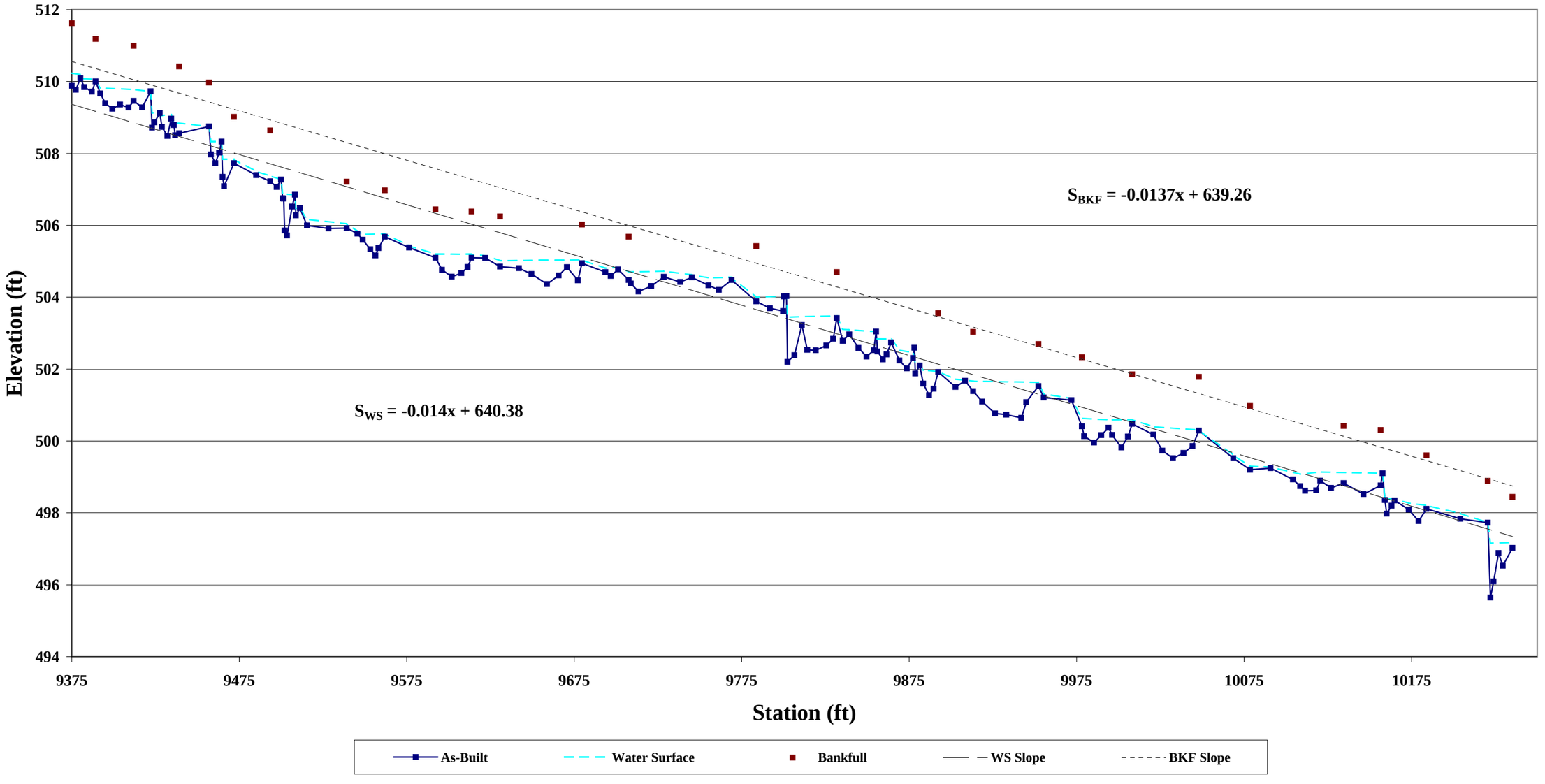
Cane Creek Tributary Site
Longitudinal Profile
Tributary 1, As-Built
Stations 23+00 - 28+58



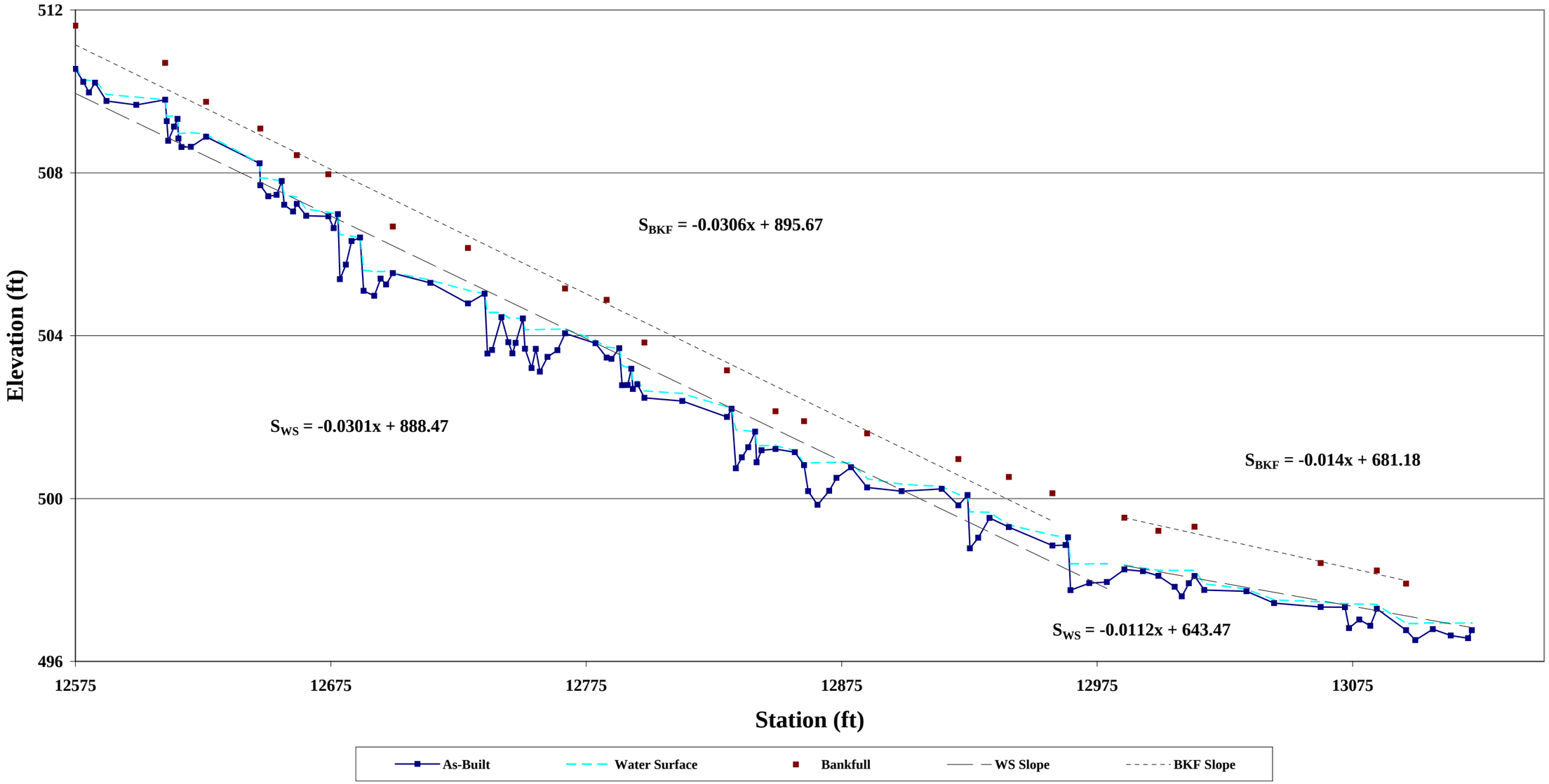
Cane Creek Tributary Site
Longitudinal Profile
Tributary 3, As-Built
Stations 71+15 - 76+51



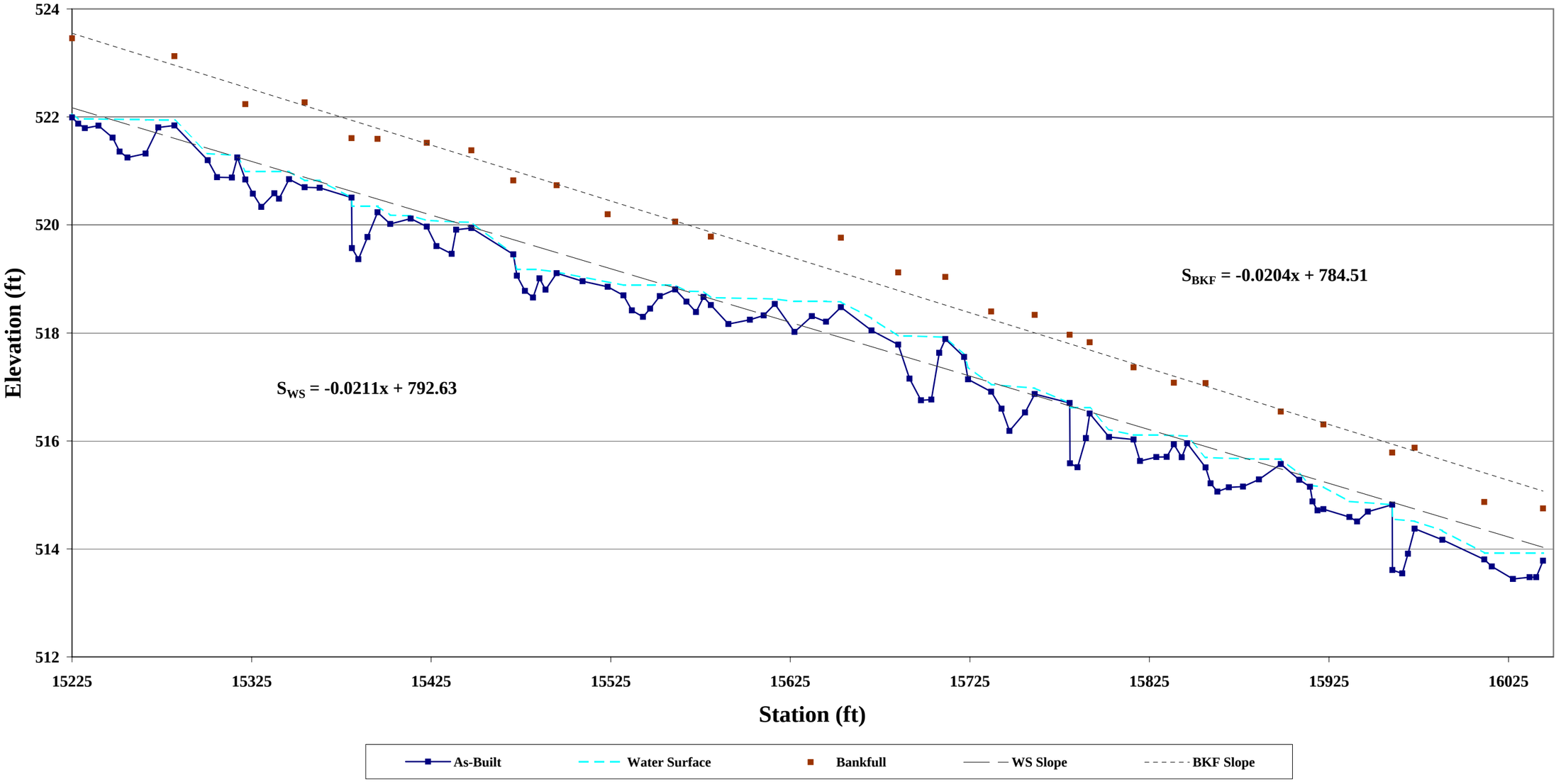
Cane Creek Tributary Site
Longitudinal Profile
Tributary 4, As-Built
Stations 93+75 - 102+35



Cane Creek Tributary Site
Longitudinal Profile
Tributary 6, As-Built
Stations 125+75 - 131+21



Cane Creek Tributary Site
Longitudinal Profile
Tributary 7, As-Built
Stations 152+25 - 160+44



Appendix D

Vegetation Plot Photos

Vegetation Plot 1: View looking toward plot center from origin corner. 1/12/09 – As-Built

Vegetation Plot 2: View looking toward plot center from origin corner. 1/12/09 – As-Built

Vegetation Plot 3: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 4: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 5: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 6: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 7: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 8: View looking toward plot center from origin corner. 1/16/09 – As-Built

Vegetation Plot 9: View looking toward plot center from origin corner. 1/16/09 – As-Built

Vegetation Plot 10: View looking toward plot center from origin corner. 1/12/09 – As-Built

Vegetation Plot 11: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 12: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 13: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 14: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 15: View looking toward plot center from origin corner. 1/2/09 – As-Built

Vegetation Plot 16: View looking toward plot center from origin corner. 1/2/09 – As-Built

Vegetation Plot 17: View looking toward plot center from origin corner. 1/5/09 – As-Built

Vegetation Plot 18: View looking toward plot center from origin corner. 1/2/09 – As-Built

Vegetation Plot 19: View looking toward plot center from origin corner. 1/2/09 – As-Built

Vegetation Plot 20: View looking toward plot center from origin corner. 1/2/09 – As-Built

Appendix E

Stream Photos

PP#1U – As-Built – 1/26/09

PP#1D – As-Built – 1/26/09

PP#2U – As-Built – 1/26/09

PP#2D – As-Built – 1/26/09

PP#3U – As-Built – 1/26/09

PP#3D – As-Built – 1/26/09

PP#4U – As-Built – 1/26/09

PP#4D – As-Built – 1/26/09

PP#5U – As-Built – 1/26/09

PP#5D – As-Built – 1/26/09

PP#6U – As-Built – 1/26/09

PP#6D – As-Built – 1/26/09

PP#7 – As-Built – 1/26/09

PP#8U – As-Built – 1/26/09

PP#8D – As-Built – 1/26/09

PP#9U – As-Built – 1/26/09

PP#9D – As-Built – 1/26/09

PP#10U – As-Built – 1/26/09

PP#10D – As-Built – 1/26/09

PP#11 – As-Built – 1/26/09

PP#12U – As-Built – 1/26/09

PP#12D – As-Built – 1/26/09

PP#13U – As-Built – 1/26/09

PP#13D – As-Built – 1/26/09

PP#14U – As-Built – 1/26/09

PP#14D – As-Built – 1/26/09

PP#15U – As-Built – 1/26/09

PP#15D – As-Built – 1/26/09

PP#16U – As-Built – 1/26/09

PP#16D – As-Built – 1/26/09

PP#17U – As-Built – 1/26/09

PP#17D – As-Built – 1/26/09

PP#18U – As-Built – 1/26/09

PP#18D – As-Built – 1/26/09

PP#19U – As-Built – 1/26/09

PP#19D – As-Built – 1/26/09

PP#20U – As-Built – 1/26/09

PP#20D – As-Built – 1/26/09

PP#21U – As-Built – 1/26/09

PP#21D – As-Built – 1/26/09

PP#22U – As-Built – 1/26/09

PP#22D – As-Built – 1/26/09

PP#23U – As-Built – 1/26/09

PP#23D – As-Built – 1/26/09

PP#24U – As-Built – 1/26/09

PP#24D – As-Built – 1/26/09

PP#25 – As-Built – 1/26/09

PP#26U – As-Built – 1/26/09

PP#26D – As-Built – 1/26/09

PP#27UL – As-Built – 1/26/09

PP#27UR – As-Built – 1/26/09

PP#27D – As-Built – 1/26/09

PP#28U – As-Built – 1/26/09

PP#28D – As-Built – 1/26/09

PP#29U – As-Built – 1/26/09

PP#29D – As-Built – 1/26/09

PP#30UL – As-Built – 1/26/09

PP#30UR – As-Built – 1/26/09

PP#30D – As-Built – 1/26/09

PP#31U – As-Built – 1/26/09

PP#31D – As-Built – 1/26/09

PP#32U – As-Built – 1/26/09

PP#32D – As-Built – 1/26/09

PP#33U – As-Built – 1/26/09

PP#33D – As-Built – 1/26/09

PP#34U – As-Built – 1/26/09

PP#34D – As-Built – 1/26/09

PP#35U – As-Built – 1/26/09

PP#35D – As-Built – 1/26/09

PP#36U – As-Built – 1/26/09

PP#36D – As-Built – 1/26/09

PP#37U – As-Built – 1/26/09

PP#37D – As-Built – 1/26/09

PP#38U – As-Built – 1/26/09

PP#38D – As-Built – 1/26/09

PP#39U – As-Built – 1/26/09

PP#39D – As-Built – 1/26/09

PP#40U – As-Built – 1/26/09

PP#40D – As-Built – 1/26/09

PP#41U – As-Built – 1/26/09

PP#41D – As-Built – 1/26/09

PP#42U – As-Built – 1/26/09

PP#42D – As-Built – 1/26/09

PP#43U – As-Built – 1/26/09

PP#43D – As-Built – 1/26/09

PP#44U – As-Built – 1/26/09

PP#44D – As-Built – 1/26/09

PP#45U – As-Built – 1/26/09

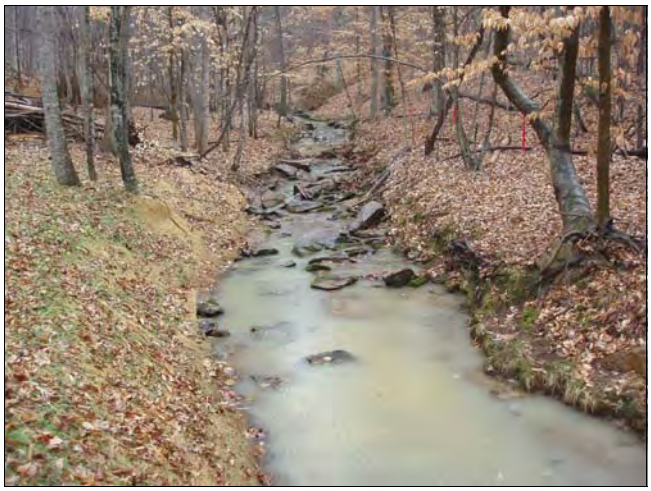
PP#45D – As-Built – 1/26/09

PP#46 – As-Built – 1/26/09

PP#47 – As-Built – 1/26/09

PP#48U – As-Built – 1/26/09

PP#48D – As-Built – 1/26/09



PP#49U – As-Built – 1/26/09

PP#49D – As-Built – 1/26/09

PP#50U – As-Built – 1/26/09

PP#50D – As-Built – 1/26/09

PP#51U – As-Built – 1/26/09

PP#51D – As-Built – 1/26/