Coddle Creek Tributary
(Indian Run) Stream Restoration
Project # 94

Baseline Monitoring Document and As Built Baseline Report

Cabarrus County, North Carolina

Prepared for:

North Carolina Department of Environmental and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

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FINAL
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EXECUTIVE SUMMARY

The Coddle Creek Tributary (Indian Run) Stream Restoration Project, completed in March 2011, enhanced or restored a total of 2,270 linear feet of stream in the Upper Rocky River watershed including restoring 6.17 acres of riparian buffer. In addition, approximately 1,502 linear feet of stream was preserved within the 19.61 acre conservation easement. The project is located in the USGS Hydrologic Unit (HU) 03040105020010 of the Yadkin Pee-Dee River Basin. This HU is within the EEP's Upper Rocky River Local Watershed Plan and is also listed as a Targeted Local Watershed (TLW) in EEP's Lower Yadkin Pee-Dee River Basin Restoration Priorities Plan 2009. The project goals and objectives are listed below.

Project Goals

- Improve local water quality by reestablishing stream stability and capacity to transport watershed flows and sediment load.
- Provide additional floodplain storage by increasing the capacity of the stream to mitigate flood flows.
- Restore aquatic and riparian habitat.
- Reducing non-point source sedimentation and nutrient inputs into the project reaches.

Project Objectives

- Restore/enhance 2,270 linear feet of stables stream channel morphology, supported by instream habitat and grade/bank stabilization structures.
- Preserve 1,502 linear feet of stream within the conservation easement.
- Eliminate accelerated bank erosion by creating a bankfull bench, floodplain, and laying back slopes.
- Reestablish a native riparian buffer.

The project site, which is protected by a 19.61-acre permanent conservation easement held by the State of North Carolina, is situated in Cabarrus County in the Southern Outer Piedmont ecoregion of the Piedmont physiographic province. Coddle Creek, from 0.2 miles upstream of NC Highway 73 (NC-73) to Rocky River, is currently listed on the NC 303(d) List as biologically impaired (NCDENR 2010). In addition to the current non-supporting use classification for the lower portions of Coddle Creek, anticipated high rates of development in the watershed pose critical challenges in managing the region's aquatic resources. Land Use / Land Cover analysis indicates that more than 90 percent of the 1.5- square mile Indian Run watershed is currently pervious with a dominance of forested lands, and about 8 to 10 percent is impervious land (Figures 3a & 3b). It is likely that the majority of the watershed will be built-out within 10 to 20 years. Anticipated impervious cover (as a percentage of the total watershed) is likely to approach 25 to 30 percent at built-out conditions.

Two reference reaches located in Mecklenburg County were used in the design process, Dixon Branch located in Huntersville and a section of UT to Reedy Creek located in Charlotte. Based on the reference and existing site conditions, the upper reach was restored according to a Priority Level III approach and the lower reach utilized a Priority Level II approach.

Above Rocky River Road (upper reach), the road culvert's elevation did not accommodate a Priority I or II restoration, so a bankfull bench was constructed to re-establish some floodprone area and provide relief for future increases in impervious cover within the watershed. Below Rocky River Road (lower reach), approximately 975 linear feet of the channelized reach was restored to a natural planform of a meandering C4-type stream. This Priority II restoration strategy includes building a bankfull bench (ranging from 90

to 120 feet in width) along the meandering channel approximately 900 feet from the confluence with Coddle Creek.

The riparian buffer was planted with species representing an Alluvial Forest grading to a Bottomland Forest Community as defined in the Classification of the *Natural Communities of North Carolina, Third Approximation*, by M.P. Schafale and A.S. Weakley (1990).

The baseline monitoring May 2011 established the stream and vegetation monitoring components. The stream monitoring consists of a full longitudinal profile of the restored reaches, and eight cross-sections, four riffles and four pools. Eleven vegetation monitoring plots were established throughout the planted riparian buffer. These plots will be monitored every year according to the latest CVS-EEP vegetation monitoring protocol. The site will be monitored for at least five years or until the success criteria are met. The first year of monitoring will be in May 2012.

1.0 PROJECT GOALS, BACKGROUND, AND ATTRIBUTES

1.1 Location and Setting

The Coddle Creek Tributary Stream Restoration Project is located in Cabarrus County, North Carolina. The project reach is also known as Indian Run, a second order tributary of Coddle Creek, the latter draining to the Rocky River within the lower North Carolina portions of the Yadkin-Pee Dee River Basin. The restoration project reach extends approximately 1,295 linear feet upstream in the NNE direction from the streams crossing with Rocky River Road and approximately 975 linear feet SSW downstream of the Rocky River Road crossing (Figures 1, Appendix A). In addition to the restoration reach, approximately 1,502 linear feet of stream and 19.61 acres of riparian buffer were also preserved within the EEP conservation easement.

The United States Geological Survey (USGS) 14-digit Hydrologic Unit Code (HUC) is 03040105020010 within North Carolina Division of Water Quality (NCDWQ) sub-basin 03-07-11 (upper Rocky River watershed, above confluence with Reedy Creek). This HUC is within the EEP's Upper Rocky River Local Watershed Plan and is also listed as a Targeted Local Watershed (TLW) in EEP's Lower Yadkin Pee-Dee River Basin Restoration Priorities Plan 2009.

The Coddle Creek watershed is one of the targeted high priority restoration areas within the EEP plan for the Lower Yadkin River Basin. In addition to the current non-supporting use classification for the lower portions of Coddle Creek, anticipated high rates of development in the watershed pose critical challenges in managing the region's aquatic resources. Indian Run, with a drainage area of approximately 1.5-square miles, was previously modified and straightened in the lower 1,700 linear feet above the confluence with Coddle Creek. The reach above Rocky River Road had signs bed incision as well as bank erosion. This reach was characterized by unstable banks with moderate to high BEHI. Cross-sectional information for the upper and lower reaches (when compared to reference reach and regime data) indicated entrenchment with the bankfull stage approximately three to six feet below the top of bank elevation.

1.2 Goals and Objectives

This restoration project aimed at restoring a degraded section of Indian Run to a stable channel using natural channel restoration methodologies. Below Rocky River Road, approximately 975 linear feet of the reach was restored to a natural planform of meandering C-type steam. Above Rocky River Road, on-site restrictions did not accommodate raising the channel bed, which would allow the stream to access its historic floodplain. Therefore, a bankfull bench was created along 1,295 linear feet of stream to recover some of the floodprone area and provide relief for larger storm flows.

Project Goals

- Improve local water quality by reestablishing stream stability and capacity to transport watershed flows and sediment load.
- Provide additional floodplain storage by increasing the capacity of the stream to mitigate flood flows.
- Restore aquatic and riparian habitat.
- Reducing non-point source sedimentation and nutrient inputs into the project reaches.

Project Objectives

- Restore 2,270 linear feet of stables stream channel morphology, supported by instream habitat and grade/bank stabilization structures.
- Preserve 1,502 linear feet of stream within the conservation easement.
- Eliminate accelerated bank erosion by creating a bankfull bench, floodplain, and laying back slopes.
- Reestablish a native riparian buffer.

1.3 Structure, Restoration Type, and Approach

The project involved restoration of 2,270 linear feet (lf) of stream and replanting of 8.51 acres of floodplain along a tributary to Coddle Creek. Approximately 6.17 acres of riparian buffer was restored and 4.11 acres were preserved within the conservation easement. A recorded conservation easement consisting of 19.61 acres (ac) will protect the stream reach and riparian buffers in perpetuity. Refer to Table 1 (Appendix A) and Figure 3 (Appendix D) for a table and detailed plan view of the project components.

Upper Reach - Rocky River Road to the Utility Crossing

The restoration in this upper reach extends 1,295 linear feet upstream from the Rocky River Road culvert. A minimum 100-ft conservation buffer occurs along this entire reach (shown on the As-Build drawings and Figure 3-Appendix D). This reach was restored using a Priority III approach. The easement along this portion of the project didn't provide enough area to create a full floodplain; however, where possible a floodplain was excavated. The remaining area had a bankfull bench excavated and side slopes laid back to assist with high flows. The vertical alignment reestablished the riffle-pool sequence and increased the lateral and vertical stability. The installation of cross vanes and artificial sills provide grade control along the reach.

Lower Reach - Rocky River Road to Upstream of Utility Crossing

This reach extends from Rocky River Road downstream approximately 975 linear feet. The stream lies within an open green space common area for two residential subdivisions located north and south of the reach (Autumn Ridge and Boulder Creek communities). This reach was restored using a Priority II approach. The stream was constructed to meet the design criteria for a natural Rosgen C4-type stream as a design goal. A floodplain bench was created adjacent to the banks of the new stream channel to provide relief and additional floodplain storage during high flows. The conservation buffer is approximately 170 feet in width along the stream, which includes both the proposed stream alignment and portions of the filled-in existing channel. The vertical alignment reestablished the riffle-pool sequence and increased the lateral and vertical stability. The installation of cross vanes and artificial sills provide grade control along the reach.

The riparian buffer was planted with species representing an Alluvial Forest grading to a Bottomland Forest Community as defined in the *Classification of the Natural Communities of North Carolina, Third Approximation*, by M.P. Schafale and A.S. Weakley (1990).

1.4 History, Contacts and Attribute Data

The project was initiated by the EEP in the summer of 2004. The final stream restoration plan was developed by HDR Engineering, Inc of the Carolinas in conjunction with Habitat Assessment and Restoration Program, Inc. (HARP) in 2007. The final design of the project was completed in 2009 by HDR Engineering. Land Mechanic Designs Inc. began construction in fall 2010 with maintenance work and final planting following in March 2011. Refer to Tables 2-4 in Appendix A for additional project and contact details.

2.0 SUCCESS CRITERIA

Channel stability and vegetation survival will all be monitored annually on the project site. Post-restoration monitoring will be conducted for a minimum of five years or until the success criteria are met following the completion of construction.

2.1 Morphometric Parameters and Channel Stability

Considering the typical 5-year timeframe for mitigation monitoring, the determination of success for stream projects is often based primarily on the degree of morphological stability. The absence of any change over these timeframes will certainly be interpreted as stability, but is not a pre-requisite. To the contrary, it is typical for streams to demonstrate variation over a 5-year monitoring period in the form of sustainable rates of change or stable patterns of variation (dynamic stability). Considering the young state of woody buffers and the fact that design parameters are estimates and therefore never a perfect match for the watershed regimes, restored streams typically adjust or shift to some extent after their exposure to varying flows in the years that immediately follow construction. However, these changes should be moderate and exhibit little discernable trends. Annual variation is to be expected, but over time and with buffer development should generally demonstrate a reduction in amplitude and demonstrate dynamic maintenance around some central tendency that represents acceptable distributions for design parameters and/or stable stream types. Key among these are those parameters that indicate lateral and vertical stability and intended levels of floodplain connection. If some trends or patterns become evident, they should be modest or indicate migration toward another stable form. Lastly, all of this must be evaluated in the context of hydrologic events to which the system is exposed over the monitoring period.

2.1.1 Dimension

Dimensional stability will be based on comparisons of overlays of annual cross-section plots and their calculated parameters to the as-built conditions, design distributions, and distributions for stable stream types. Parameters such as cross-sectional area and the channel's width to depth ratio should demonstrate modest overall change and patterns of variation that are in keeping with above description of dynamic stability. The stream dimension should not demonstrate trends of enlargement either through downcutting or widening, however, modest year-to-year variation or oscillation in channel elevation or width demonstrating maintenance around baseline or design distributions is acceptable. Changes from depositional processes resulting in the development of constructive features on the banks and floodplain, such as an inner berm, channel narrowing, natural levees, and general floodplain deposition will be acceptable forms of change and indicative of stability.

The entire project will also be visually cataloged for areas of bank instability and represented as proportions of overall bank footage. The overall proportion, severity, spatial distribution, and temporal trends in this parameter will be assessed to serve as an additional indicator of dimensional stability. In general, stability proportions (stable bank/total bank) below 85% would be of concern. Considering temporal trends, a higher percentage in a given year may also be of concern if it represents a data point in a trend of decreasing stability. Instability dominated by surface scour versus mass wasting would be an example of differing severity and the latter would be more concerning than the former. Erosion in meanders versus riffle reaches would generate differing levels of concern because erosion in the former is more likely given greater bank shear stress, whereas instability concentrated in riffle/run reaches might be more indicative of an overall design flaw.

2.1.2 Pattern and Profile

Reach profiles should not exhibit any consistent trends in thalweg degradation over any significant continuous portion of its length. Some aggradation will be acceptable and will not be actionable unless it is apparently causal for widening/bank erosion. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design/as-built size distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallower with greater water surface slopes.

2.1.3 Substrate

Pebble count data should indicate the progression towards or the maintenance of the known size distributions from the design phase. The absence of any significant trends in bed aggradation or deposition should represent stable conditions in terms of sediment input and transport functionality. While stream projects are designed to transport bedload in equilibrium and carry overall sediment loads at bankfull, fines can be transported even at low discharges and upstream instability beyond design projections can also lead to deposition as storm events recede in areas of energy dissipation such as restoration reaches. This can have the effect of obscuring bedform and fining of riffles especially in the first few years after the implementation of a stream project. In many cases subsequent narrowing and reduction of width/depth ratios as a project develops/stabilizes can then increase transport efficiency and return bedform to intended distributions, but some fining can persist due to upstream disturbance.

2.1.4 Sediment Transport

Maintenance of sediment transport will be evident by the monitored riffle cross sections and profile. There should be no evidence of any significant trend in aggradation or degradation and shear stress values should fall within the acceptable range of values.

2.1.5 Vegetation

The vegetative success of the restoration site will be based on criteria established in the USACE Stream Mitigation Guidelines (2003). Vegetation monitoring will be considered successful if a minimum of 260

planted stems/acre are surviving at the end of five years. The interim measure of vegetative success for the site will be the survival of a minimum of 320 planted stems/acre in year three and 288 stems/acre at the end of year four. During monitoring, any encroachments into the conservation easement should be reported to NCEEP and remediated.

2.1.6 Hydrology

Two bankfull events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years. A crest gauge was installed along the reach on September 22, 2011. Other signs of bankfull flow including wrack lines, sediment deposition, and actual observance of flow will also be noted as documentation of bankfull events.

3.0 MONITORING PLAN GUIDELINES

3.1 Dimension

A total of eight permanent cross-sections (4 riffles, 4 pools) have been installed along the project reach. Each cross section was marked on both banks with permanent conduit. A common benchmark has been established for cross-sections to facilitate comparison of year-to-year data. The annual cross-section survey will include points measured at all breaks in slope including top of bank, bankfull, edge of water, and thalweg if the features are present. Dimensional data will be compared from year to year to ensure project stability. Refer to Figure 3 in Appendix D for locations of the cross-sections.

3.2 Pattern and Profile

Pattern measurements have been taken for the as-built condition and are documented in this report. Future pattern measurements will not be taken unless there is evidence that significant geomorphological adjustments have occurred.

A longitudinal profile will be completed each year of the monitoring period for the entire length of the restored channel. Measurements will include thalweg, water surface, inner berm, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g. riffle, run, pool, and glide).

3.3 Substrate

Pebble counts will be conducted at all of the permanent cross-sections each year of the monitoring period and be used to calculate the D50 and D84, and the sediment distribution at the cross-sections.

3.4 Sediment Transport

Sediment transport analyses will be conducted during the five year monitoring period. Sample data, along with riffle cross section and longitudinal profile data, will be analyzed to calculate the shear stress of the restored reach. These values will be compared to design parameters and ranges of stable competency values to determine if the restored reach's values are acceptable.

3.5 Visual Assessment

A visual assessment of the stream to include an assessment of the bank, bed, easement boundary, and site vegetation will be completed each year to document the necessary parameters required for the EEP monitoring report.

3.6 Vegetation

Eight 10m x 10m and three 5m x 20m ($100m^2$) vegetation sample plots will be quantitatively monitored for a minimum of five years. The plots will be monitored as per the CVS-EEP Protocol for Recording Vegetation, Version 4.2 (CVS-EEP 2008) at Level II. Refer to Figure 3 in Appendix D for the locations of the vegetation plots. Any vegetative problem areas in the project will be noted and reported in each subsequent monitoring report. Vegetative problem areas may include areas that either lack vegetation or include populations of exotic vegetation.

3.7 Photo Stations

Twenty-three representative photo station points have been identified and located using GPS for the stream reach. The stations are shown on Figure 3 in Appendix D. Generally, the stations are set up along the outside of each meander bend. Two photos will be taken, upstream and downstream, at each location at approximately the same time each year (late April – mid May).

3.8 Watershed

Any changes to land use in the watershed that could result in changes to flow within the project stream will be assessed annually throughout the monitoring period. Any large hydrologic events in the watershed, such as tropical storms or hurricanes, will also be documented.

3.9 Monitoring Plan View

A plan view of the monitoring scheme is presented in Figure 3 in Appendix D.

3.10 Maintenance and Contingency Plans

Problem areas at the restoration site will be dealt with accordingly based on the severity of the problem and at the discretion of the EEP. Site maintenance may include reinstallation of coir matting, removal of debris from the channel, stabilization of bank erosion with protective structures, invasive species control, or adjustments to in-stream structures. All maintenance activities will be documented in the yearly monitoring reports.

4.0 As-built Conditions/Baseline (Year 0)

Site grading was complete in March 2011. Planting was completed in March 2011 and the baseline vegetation data collection occurred on May 4 and 11, 2011. The as-built survey was completed by Stewart Proctor, Pllc from March 15 to March 18, 2011. Morphological surveying was completed by HDR Engineering on May 12, 2011. The As-Built Plan View is located in Appendix D.

4.1 Profile

The entire length of the reach was surveyed by HDR using a rod and level to assess baseline conditions. Multiple parameters were located including top of bank, thalweg, and water surface. The longitudinal profile is shown in Appendix B. A significant difference can be seen with regard to bankfull and water surface measurements between the upper and lower reaches. The reason for this is that data collection dates were separated by a rainfall event. The channel slope lies within the design parameters for this reach.

4.2 Dimension

Eight cross sections were surveyed by HDR staff on May 4, 11 and 12, 2011. The baseline morphological data is presented in Tables 5 and 6 in Appendix B, along with the cross-sectional data. The channel cross-section dimensions lie within the design parameters for this reach.

4.3 Pattern

The pattern of the channel was obtained during the as-built survey and the baseline morphology survey. The location is illustrated on the component map in Appendix A as well as in the As-Built plan sheets in Appendix D. Morphological calculations are included in Table 5 in Appendix B. The pattern values lie within the design parameters for a stable channel.

4.4 Substrate

Pebble counts were taken during baseline monitoring. D50 values for upper and lower reaches seem to be low; however, the values are inconclusive as the channel bed material is still in the process of being established following construction.

4.5 Sediment Transport

See Tables 5a and 5b for design and baseline competency calculations. Based on shear stress calculations for design and baseline (including average slope and riffle cross section data), there are no significant indications of potential aggradation or degradation. From visual assessment, there are a few instances of sediment buildup in the stream bed, although these seem to be the result of storm events prior to establishment of vegetation.

4.6 Verification of Plantings

HDR staff completed the baseline vegetation monitoring on May 4 and 11, 2011. Monitoring was conducted in 11 vegetation plots (6 on the upper reach and 5 on the lower reach). Most of the plots occur within the newly created floodplain/riparian area with a few running upslope slightly.

According to the data collected, the average plant density among the 11 plots is 827 stems/acre with the range from 1,214 to 526 stems/acre. The highest plant densities occurred in plots 1 and 6 with over 1,000 stems/acre. Two plots do not meet the planting baseline of 680 planted stems/acre. The two plots are identified as Plot 7 and 11 which are near the beginning of the lower project reach and have been heavily

impacted by off road vehicle vandalism. Currently, all plots are meeting the interim 3-year vegetation success criteria of 320 stems/acre. Baseline monitoring data is provided in the Appendix C data tables.

4.7 Photo Documentation

Photos were taken at the 23 photo stations, 16 on the upper reach and 7 on the lower reach) on May 12, 2011. The location of the stations can be seen in Figure 3 in Appendix D and photos are located in Appendix B. Baseline vegetation station photos were taken on May 4 and 11, 2011 during the baseline vegetation monitoring. Vegetation station photos for the baseline monitoring year are provided in Appendix C.

4.8 Hydrology

No groundwater monitoring gauges were installed onsite; however, a crest gauge was installed and evidence of a bankfull event was noted along the site in wrack lines, vegetation lying over, and ponded water on the floodplain.

5.0 REFERENCES CITED

HDR Engineering, Inc. 2007. Final Stream Restoration Plan for Indian Run (Trib. to Coddle Creek).

HDR Engineering, Inc. 2009. Indian Run Stream Restoration Final Plans (90%).

Lee, Michael T., R. K. Peet, S. D. Roberts, and T. R. Wentworth. 2006. CVS-EEP Protocol for Recording Vegetation. Version 4.0. (http://cvs.bio.unc.edu/methods.htm.)

North Carolina Ecosystem Enhancement Program. 2010. Baseline Monitoring Document: Format, Data Requirements, and Content Guidance.

Rosgen, D. L. 1997. Applied River Morphology. Wildland Hydrology Books, Pagosa Springs, CO.

U.S. Army Corps of Engineers, Wilmington District. 2003. Stream Mitigation Guidelines. North Carolina Division of Water Quality (DWQ), U.S. Environmental Protection Agency, Region IV (EPA), Natural Resources Conservation Service (NRCS) and the North Carolina Wildlife Resources Commission (WRC).

Appendix A

General Tables and Figures

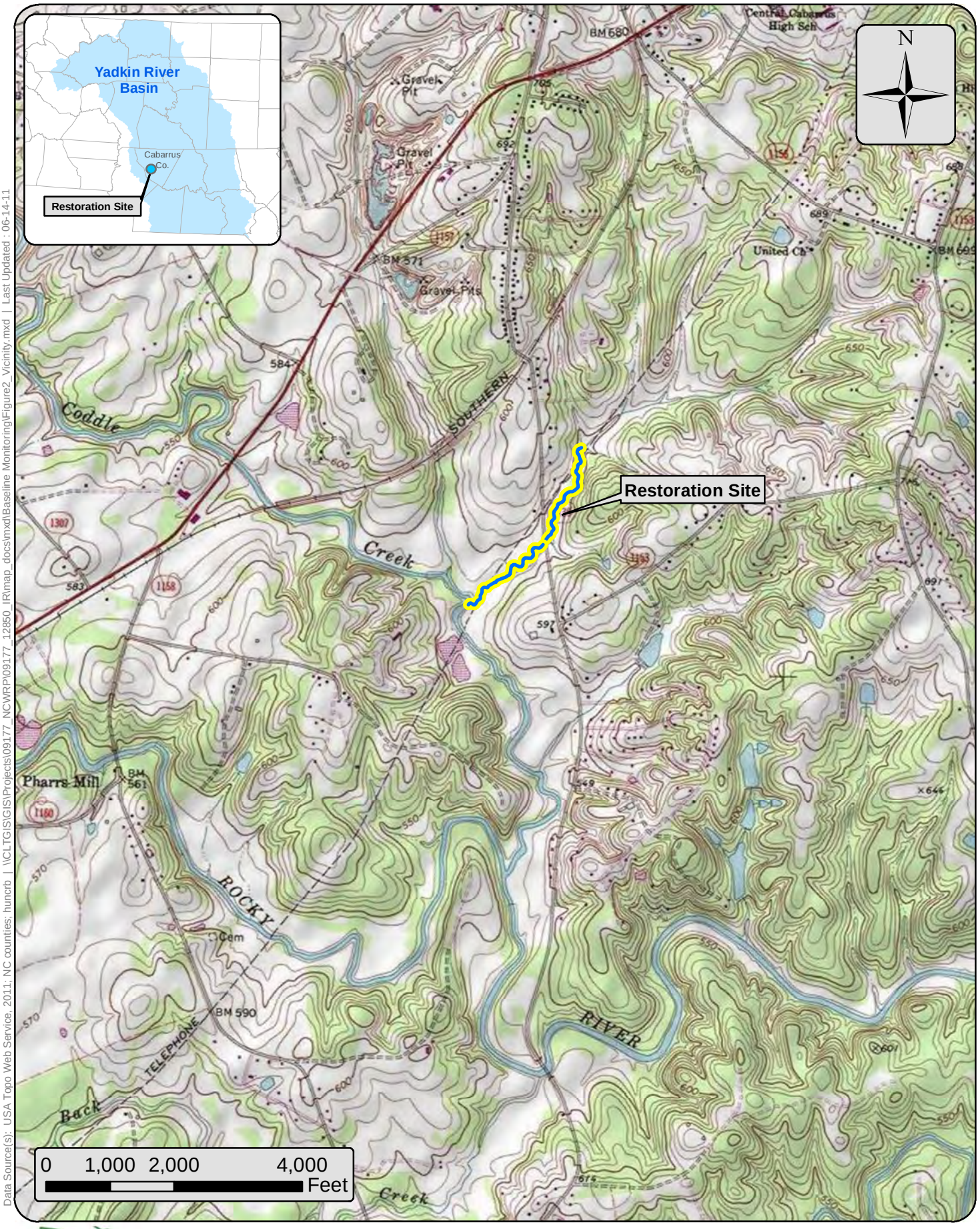
Restoration Site Vicinity

Figure 1

Coddle Creek Tributary (Indian Run) | Baseline Monitoring | Cabarrus County, NC
NC Ecosystem Enhancement Program | Project No. 94

Ecosystem Enhancement Program

HDR ONE COMPANY | Many Solutions



Data Source(s): USA Topo Web Service, 2011; NC counties; huncrb | \\CLTGIS\GIS\Projects\09177_NCWRP\09177_12850_IR\map_docs\mxd\Baseline Monitoring\Figure2_Vicinity.mxd | Last Updated : 06-14-11

Ecosystem Enhancement Program

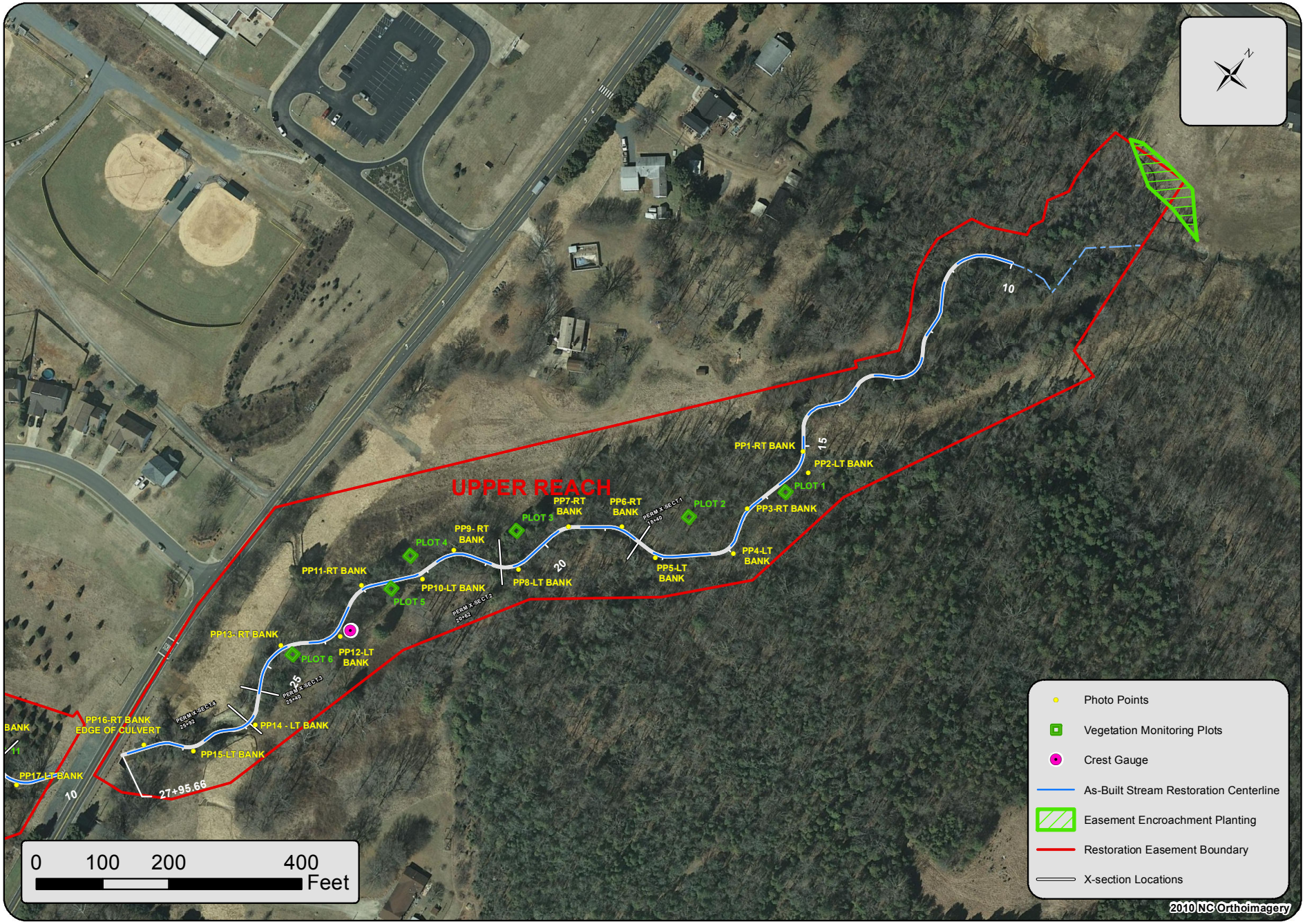
HDR ONE COMPANY | Many Solutions

USGS Concord SE Quad

Figure 2

Coddle Creek Tributary (Indian Run) | Baseline Monitoring | Cabarrus County, NC
NC Ecosystem Enhancement Program | Project No. 94

Data Source(s): NC Orthoimagery, 2010; Easement; Stream centerline; HDR Monitoring GPS data, 2011 | \\CLTGIS\GIS\Projects\09177_NCWRP\09177_12850_IR\map_docs\mxd\Baseline Monitoring\Figure3_a.mxd | Last Updated : 06-15-11



Coddle Creek Tributary (Indian Run) Upper Reach

Figure 3A

Current Condition Plan View | Baseline Monitoring | Cabarrus County, NC
NC Ecosystem Enhancement Program | Project No. 94

Ecosystem Enhancement Program

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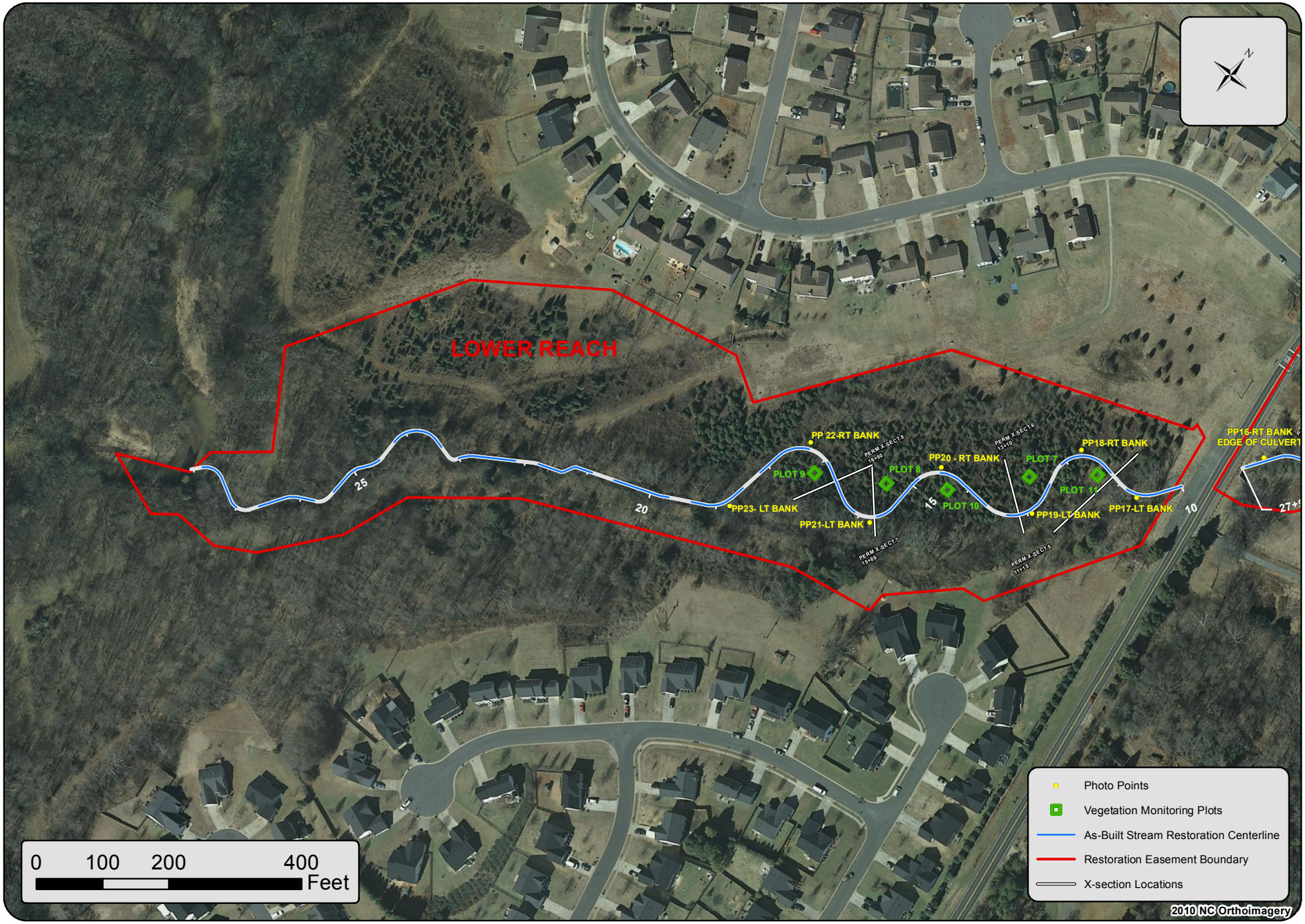
Data Source(s): NC Orthoimagery, 2010; Easement; Stream centerline; HDR Monitoring GPS data, 2011 | \\CLTGIS\GIS\Projects\09177_NCWRP\09177_12850_IR\map_docs\mxd\Baseline Monitoring\Figure3_b.mxd | Last Updated : 06-15-11



Coddle Creek Tributary (Indian Run) Lower Reach

Figure 3B

Current Condition Plan View | Baseline Monitoring | Cabarrus County, NC
NC Ecosystem Enhancement Program | Project No. 94

Ecosystem Enhancement Program

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Table 1a. Project Components Coddle Creek Tributary (Indian Run) / 94									
Project Component or Reach ID	**Existing Feet/Acres**	**Restoration Level**	**Approach**	**Footage or Acreage**	**Stationing**	**Mitigation Ratio**	**Mitigation Units**	**BMP Elements**	**Comment**
Reach 1 - Upper	1330 lf	E	P3	1295 lf	15+00 – 27+95	1.5:1	863		Restored bankfull dimension within the existing channel, utilized a partial floodplain bench to restore floodprone conditions, and enhanced existing pattern and profile.
Reach 1 - Upper	671 lf	P		671 lf					Preserved channel in its existing condition within the conservation easement.
Reach 2 - Lower	735 lf	R	P2	975 lf	10+00 – 19+75	1:1	975		Fully restored pattern, dimension and profile, excavated a new channel within an adjoining floodplain bench to restore floodplain conditions.
Reach 2 - Lower	915 lf	P		915 lf					Preserved channel in its existing condition within the conservation easement.

Table 1b. Component Summations Coddle Creek Tributary (Indian Run) / 94							
Restoration Level	**Stream (lf)**	**Stream Mitigation Units (lf)**	**Riparian Wetland (Ac)**		**Planted Area (Ac)**	**Potential Buffer Area (Ac)**	**Total Conservation Area (Ac)**	**BMP**
			Riverine	Non-Riverine				
Restoration (Lower)	975	975			4.21	2.58	10.11	
Enhancement (Upper)	1295	863			4.30	3.59	9.50	
Preservation	1586	317				4.11		
Totals (Feet/Acres)	**3,856**	**2,155**			**8.51**	**10.28**	**19.61**	

Table 2. Project Activity and Reporting History
Coddle Creek Tributary (Indian Run) / 94

Elapsed Time Since Grading Complete: 0 yrs 3 months
Elapsed Time Since Planting Complete: 0 yrs 3 Months
Number of Reporting Years: 0

Activity or Deliverable	Data Collection Complete	Completion or Delivery
Restoration Plan	Jun-07	Aug-07
Final Design – Construction Plans	Jun-07	Jul-09
Construction/Grading	NA	Mar-11
Planting	NA	Mar-11
Final Inspection	NA	Mar-11
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	May-11	Aug-11
Year 1 Monitoring		
Year 2 Monitoring		
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table Coddle Creek Tributary (Indian Run) / 94	
Designer	HDR Engineering Inc. of the Carolinas
	3733 National Drive, Suite 207, Raleigh, NC 27612
Primary project design POC	Jonathan Henderson, PE (919) 785-1118
Construction Contractor	Land Mechanic Designs, Inc.
	126 Circle G Lane, Willow Spring, NC 27592
Construction contractor POC	Lloyd Glover, (919) 639-6132
Survey Contractor	Stewart Proctor Pllc
	319 Chapanoke Road #106, Raleigh, NC 27603
Survey contractor POC	Herb Proctor, (919) 799-1855
Planting Contractor	HARP, Inc.
	301 McCullough Drive, 4th Floor, Charlotte, NC 28262
Planting contractor POC	Alan Peoples, (704) 841-2841
Seeding Contractor	Land Mechanic Designs, Inc.
	126 Circle G Lane, Willow Spring, NC 27592
Contractor point of contact	Lloyd Glover, (919) 639-6132
Seed Mix Sources	Green Resource, Charlotte, NC
	Phone: (704) 927-3100
Nursery Stock Suppliers	Cure Nursery, Pittsboro, NC - (919) 542-6186
	ArborGen, Blenheim, SC - (843) 528-3203
	Foggy Mountain Nursery llc, Creston, NC - (336) 384-5323
	Habitat and Restoration Plants, Lexington, NC - (336) 362-6776
	NC Division of Forest Resources, Greensboro, NC - (919) 731-7988
Monitoring Performers - Baseline & Year 1	HDR Engineering Inc. of the Carolinas
	3733 National Drive, Suite 207, Raleigh, NC 27612
Stream Monitoring POC	Wyatt Yelverton, PE (919) 232-6623
Vegetation Monitoring POC	Vickie Miller, AICP, PWS (919) 232-6637

Table 4. Project Attribute Table Coddle Creek Tributary (Indian Run) / 94		
Project County	Cabarrus	
Physiographic Region	Piedmont	
Ecoregion	Southern Outer Piedmont	
Project River Basin	Yadkin / Pee Dee	
USGS HUC for Project (14 digit)	3040105020010	
NCDWQ Sub-basin for Project	03 - 07 - 11	
Within extent of EEP Watershed Plan?	Lower Yadkin River Basin	
WRC Hab Class (Warm, Cool, Cold)	Warm	
% of project easement fenced or demarcated	100% marked with EEP easement signage	
Beaver activity observed during design phase?	No	
Restoration Component Attribute Table		
	UPPER	LOWER
Drainage area (ac)	1.5	
Stream order	2nd	
Restored length (feet)	1295	975
Perennial or Intermittent	Per	
Watershed type (Rural, Urban, Developing etc.)	Devel.	
Watershed LULC Distribution (e.g.)		
Medium Density Residential	11	
Low Density Residential / Open Fields/ Lawns	34	
Forested	52	
Watershed impervious cover (%)	3	
NCDWQ AU/Index number	-	
NCDWQ classification	C	
303d listed?	No	
Upstream of a 303d listed segment?	Yes	
Reasons for 303d listing or stressor	Bio. Integ.	Turbidity
Total acreage of easement	9.50	10.11
Total vegetated acreage within the easement	9.50	10.11
Total planted acreage as part of the restoration	4.30	4.21
Rosgen classification of pre-existing	Imp. C4	Ditch
Rosgen classification of As-built	C4	C4
Valley type	VIII	VIII
Valley slope	0.63%	0.61%
Valley side slope range (e.g. 2-3.%)	-	-
Valley toe slope range (e.g. 2-3.%)	-	-
Cowardin classification	NA	
Trout waters designation	No	
Species of concern, endangered etc.? (Y/N)	No	
Dominant soil series and characteristics		
Series	Chewacla	
Depth	U	U
Clay%	U	U
K	U	U
T	U	U

Appendix B

Morphological Summary Data and Plots

Table 5a. Baseline Stream Data Summary
Coddle Creek Tributary (Indian Run) / 94 - Segment/Reach: Upper (1295 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)							20.0				8.0			9.2				20.0		19.3	20.1		20.8		2
Floodprone Width (ft)							53.7				20.0			92.0				35.0		35.4	62.1		88.7		2
Bankfull Mean Depth (ft)							3.1				1.2			1.5				1.6		1.0	1.2		1.4		2
[1]Bankfull Max Depth (ft)							4.6				1.3			1.9				1.8		1.6	1.9		2.1		2
Bankfull Cross Sectional Area (ft^2)							61.3				11.3			12.3				29.3		19.9	24.7		29.5		2
Width/Depth Ratio							6.5				5.3			7.5				12.0		14.7	16.8		18.8		2
Entrenchment Ratio							2.7				2.5			10.0				1.8		1.7	3.2		4.6		2
[1]Bank Height Ratio											1.6			1.7				1.0		1.0	1.0		1.0		2
Profile																									
Riffle Length (ft)							11.5													11.0	27.9	24.5	62.0	16.2	8
Riffle Slope (ft/ft)							0.027				0.017			0.033				0.0117		0.006	0.013	0.011	0.031	0.008	8
Pool Length (ft)							40				10.8			14.0						18.0	31.6	30.0	55.0	12.2	7
Pool Max depth (ft)							4.79				2.0			2.7				2.85		2.6	3.3	3.3	3.8	0.5	6
Pool Spacing (ft)							10				4.4			47.2			52.0		101.0	47.0	91.4	91.0	126.0	25.4	7
Pattern																									
Channel Beltwidth (ft)							130.0				20.0			69.0			50.0		173.0	50.0	55.6	54.0	67.0	6.7	5
Radius of Curvature (ft)							25.0				6.0			37.0			20.0		60.0	30.0	44.9	50.0	65.0	9.0	16
Rc:Bankfull width (ft/ft)							1.3				0.7			4.6			0.7		4.6	1.6	2.2		3.1		
Meander Wavelength (ft)							115.0				48.0			85.0			104.0		213.0	135.0	168.4	171.5	208.0	21.3	8
Meander Width Ratio							5.8				2.5			8.6			2.5		8.6	2.6	2.8		3.2		

Transport parameters						
Reach Shear Stress (competency) lb/f^2		0.53		0.47	0.42	
Max part size (mm) mobilized at bankfull		38.7		35.4	32.0	
Stream Power (transport capacity) W/m^2						
Additional Reach Parameters						
Rosgen Classification		Impaired C4	C4	C4	C4	
Bankfull Velocity (fps)		5.4		3.49		
Bankfull Discharge (cfs)		328.4				
Valley length (ft)		1638		1548	1122	
Channel Thalweg length (ft)		1900		1796	1295	
Sinuosity (ft)		1.16	1.3	1.16	1.15	
Water Surface Slope (Channel) (ft/ft)		0.0051	0.0061 - 0.0130	0.0047	0.0056	
BF slope (ft/ft)		0.0051		0.0047	0.0057	
[3]Bankfull Floodplain Area (acres)						
[4]% of Reach with Eroding Banks						
Channel Stability or Habitat Metric						
Biological or Other						

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

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

Table 5b. Baseline Stream Data Summary
Coddle Creek Tributary (Indian Run) / 94 - Segment/Reach: Lower (975 feet)

Parameter	Gauge[2]	Regional Curve			Pre-Existing Condition						Reference Reach(es) Data						Design			Monitoring Baseline					
Dimension and Substrate - Riffle Only		LL	UL	Eq.	Min	Mean	Med	Max	SD[5]	n	Min	Mean	Med	Max	SD[5]	n	Min	Med	Max	Min	Mean	Med	Max	SD[5]	n
Bankfull Width (ft)							20.0				8.0			9.2				20.0		20.4	21.7		22.9		2
Floodprone Width (ft)							75.0				20.0			92.0				100.0		96.4	123.4		150.3		2
Bankfull Mean Depth (ft)							3.7				1.2			1.5				1.7		1.3	1.3		1.3		2
[1]Bankfull Max Depth (ft)							5.1				1.3			1.9				1.8		2.1	2.2		2.2		2
Bankfull Cross Sectional Area (ft^2)							74.5				11.3			12.3				29.3		27.1	28.0		28.8		2
Width/Depth Ratio							5.4				5.3			7.5				12.0		15.3	16.8		18.2		2
Entrenchment Ratio							3.8				2.5			10.0				5.0		4.7	5.7		6.6		2
[1]Bank Height Ratio											1.6			1.7				1.1		1.0	1.0		1.0		2
Profile																									
Riffle Length (ft)							6.0													18.0	32.0	31.0	48.0	12.3	5
Riffle Slope (ft/ft)							0.035				0.017			0.033				0.0114		0.0057	0.0090	0.0076	0.0150	0.0042	4
Pool Length (ft)							81.0				10.8			14.0						14.0	47.4	35.0	48.0	30.5	7
Pool Max depth (ft)							5.8				2.0			2.7				2.85		2.4	3.0	3.1	3.5	0.4	6
Pool Spacing (ft)							7.5				4.4			47.2			52		101	92.0	112.8	114.0	131.0	19.7	4
Pattern																									
Channel Beltwidth (ft)											20.0			69.0			50.0		173.0	67.0	77.2	75.0	89.0	9.1	5
Radius of Curvature (ft)											6.0			37.0			35.0		56.0	45.0	48.9	50.0	50.0	3.9	7
Rc:Bankfull width (ft/ft)											0.7			4.6			0.7		4.6	2.2	2.3		2.2		
Meander Wavelength (ft)											48.0			85.0			104.0		213.0	190.0	204.2	210.0	211.0	9.4	5
Meander Width Ratio											2.5			8.6			2.5		8.6	3.3	3.6		3.9		

Transport parameters						
Reach Shear Stress (competency) lb/f^2		0.53		0.36	0.34	
Max part size (mm) mobilized at bankfull		38.7		27.3	25.4	
Stream Power (transport capacity) W/m^2						
Additional Reach Parameters						
Rosgen Classification		Modified Channel	C4	C4	C4	
Bankfull Velocity (fps)		5.9		3.49		
Bankfull Discharge (cfs)		442.9				
Valley length (ft)		1550		1550	763	
Channel Thalweg length (ft)		1700		1922	975	
Sinuosity (ft)		1.1	1.3	1.24	1.28	
Water Surface Slope (Channel) (ft/ft)		0.0052	0.0061 - 0.0130	0.0035	0.0042	
BF slope (ft/ft)		0.0052		0.0035	0.0042	
[3]Bankfull Floodplain Area (acres)						
[4]% of Reach with Eroding Banks						
Channel Stability or Habitat Metric						
Biological or Other						

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

1 = The distributions for these parameters can include information from both the cross-section surveys and the longitudinal profile. 2 = For projects with a proximal USGS gauge in-line with the project reach (added bankfull verification - rare).

3. Utilizing survey data produce an estimate of the bankfull floodplain area in acres, which should be the area from the top of bank to the toe of the terrace riser/slope.

4 = Proportion of reach exhibiting banks that are eroding based on the visual survey for comparison to monitoring data; 5. Of value/needed only if the n exceeds 3

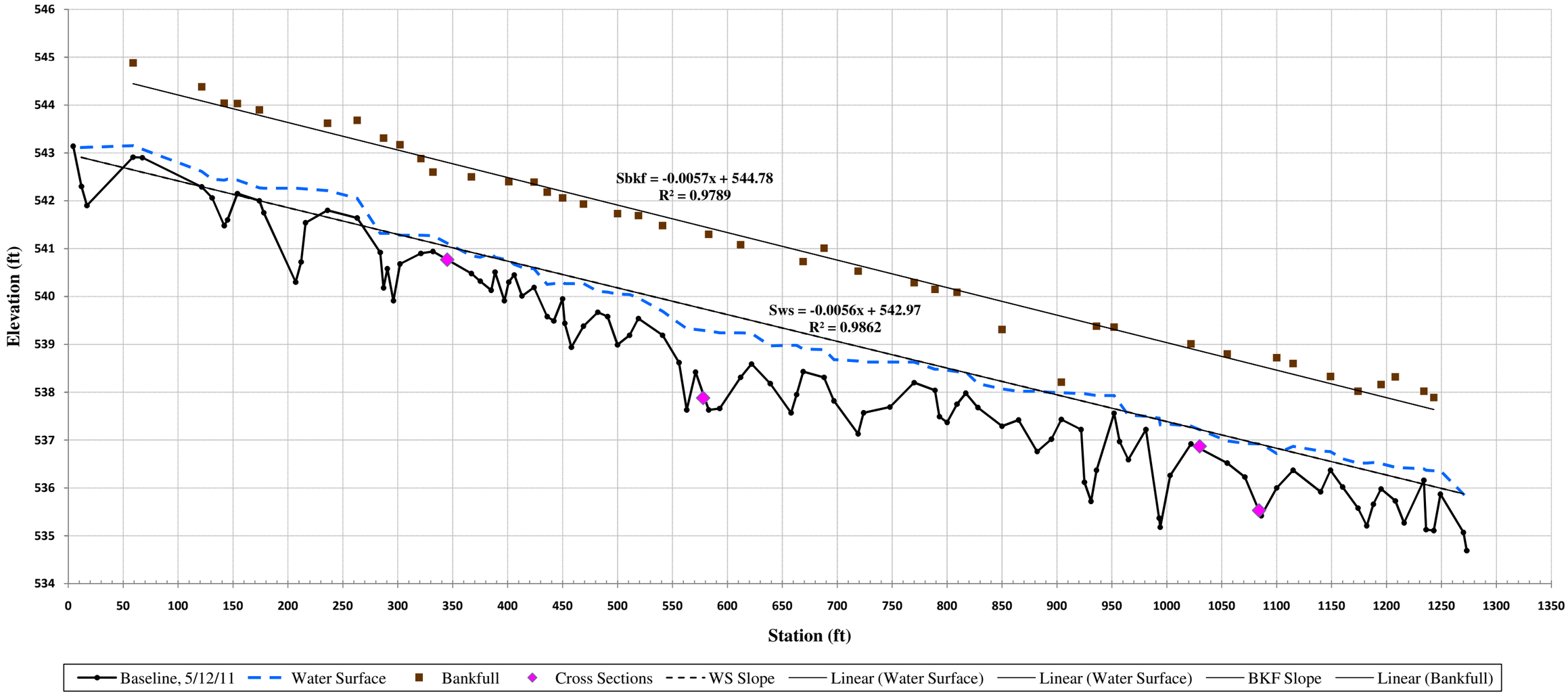
Table 6. Monitoring Data - Dimensional Morphology Summary (Dimensional Parameters – Cross Sections)

Coddle Creek Tributary (Indian Run) / 94 Segment/Reach: Upper (1295', CS's 1-4) and Lower (975', CS's 5-8)

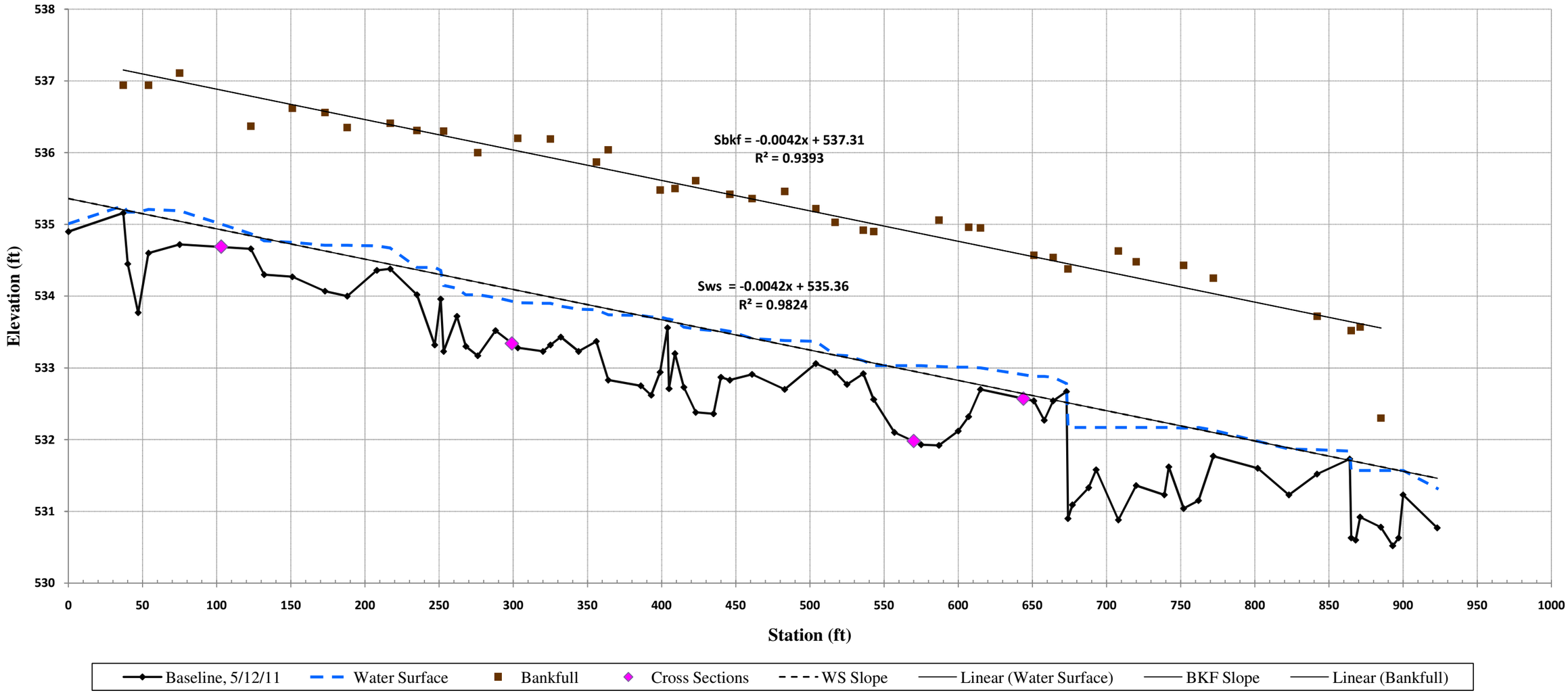
	Cross Section 1 (Riffle)							Cross Section 2 (Pool)							Cross Section 3 (Riffle)							Cross Section 4 (Pool)						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+
Record elevation (datum) used																												
Bankfull Width (ft)	19.3							34.1							20.8							33.0						
Floodprone Width (ft)	88.7							56.2							35.4							45.7						
Bankfull Mean Depth (ft)	1.0							1.2							1.4							1.3						
Bankfull Max Depth (ft)	1.6							3.3							2.1							2.6						
Bankfull Cross Sectional Area (ft^2)	19.9							39.4							29.5							43.5						
Bankfull Width/Depth Ratio	18.8							29.5							14.7							25.0						
Bankfull Entrenchment Ratio	4.6							1.6							1.7							1.4						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
Cross Sectional Area between end pins (ft^2)	421.8							457.5							248.4							358.1						
d50 (mm)	4.9							12.0							6.0							0.3						
	Cross Section 5 (Riffle)							**Cross Section 6 (Pool)**							**Cross Section 7 (Pool)**							**Cross Section 8 (Riffle)**						
Based on fixed baseline bankfull elevation[1]	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+	Base	MY1	MY2	MY3	MY4	MY5	MY+							
Record elevation (datum) used																												
Bankfull Width (ft)	22.9							19.3							69.3							20.4						
Floodprone Width (ft)	150.3							95.2							93.0							96.4						
Bankfull Mean Depth (ft)	1.3							1.5							0.7							1.3						
Bankfull Max Depth (ft)	2.1							2.4							3.0							2.2						
Bankfull Cross Sectional Area (ft^2)	28.8							28.2							48.9							27.1						
Bankfull Width/Depth Ratio	18.2							13.1							96.3							15.3						
Bankfull Entrenchment Ratio	6.6							5.0							1.3							4.7						
Bankfull Bank Height Ratio	1.0							1.0							1.0							1.0						
Cross Sectional Area between end pins (ft^2)	823.4							467.0							458.8							442.5						
d50 (mm)	1.6							0.3							0.8							0.4						

1 = Widths and depths for monitoring resurvey will be based on the baseline bankfull datum regardless of dimensional/depositional development. Input the elevation used as the datum, which should be consistent and based on the baseline datum established. If the performer has inherited the project and cann
for prior years this must be discussed with EEP. If this cannot be resolved in time for a given years report submission a footnote in this should be included that states: “It is uncertain if the monitoring datum has been consistent over the monitoring history, which may influence calcu
Additional data from a prior performer is being acquired to provide confirmation. Values will be recalculated in a future submission based on a consistent datum if determined to be necessary.”

Longitudinal Profile
Indian Run - Upper Reach
SCO Project Number - 030606201A
Station 0+00 - 14+00



Longitudinal Profile
Indian Run - Lower Reach
SCO Project Number - 030606201A
Station 0+00 - 10+00



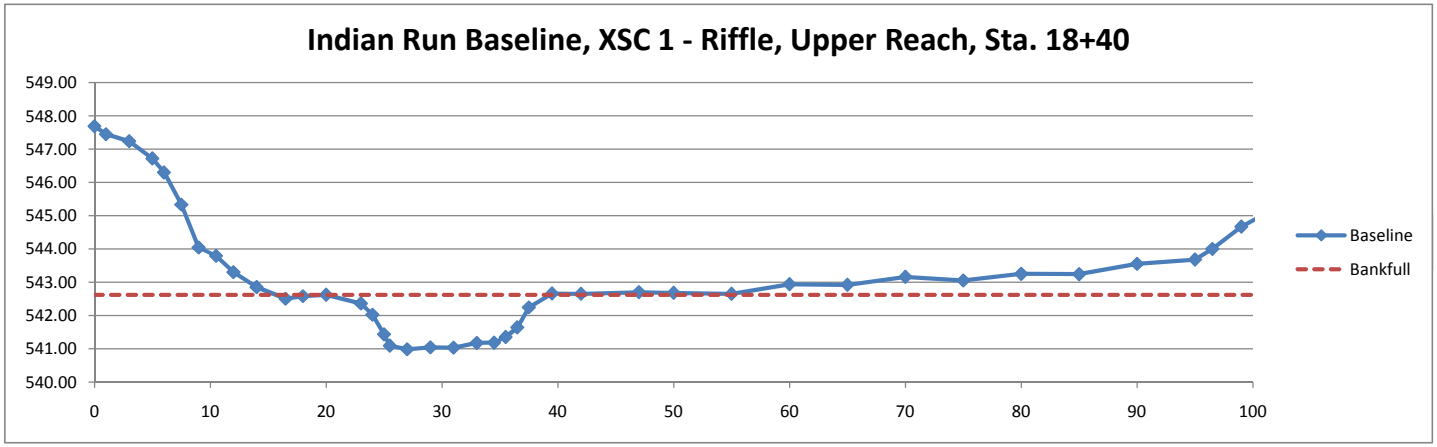
Station	Elevation
0	547.69
1	547.45
3	547.24
5	546.72
6	546.30
7.5	545.33
9	544.04
10.5	543.79
12	543.30
14	542.85
16.5	542.50
18	542.58
20	542.62
23	542.36
24	542.02
25	541.43
25.5	541.09
27	540.98
29	541.04
31	541.03
33	541.17
34.5	541.18
35.5	541.35
36.5	541.64
37.5	542.24
39.5	542.66
42	542.65
47	542.70
50	542.68
55	542.65
60	542.94
65	542.92
70	543.16
75	543.05
80	543.25
85	543.24
90	543.55
95	543.68
96.5	544.00
99	544.67
101.5	545.14
103	545.50
107	546.14
110	546.50
112.5	547.18

Reach	Indian Run, Upper Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-1, Riffle, Upper Reach, 18+40
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	542.62
Bankfull Cross Sectional Area, ft^2	19.87
Bankfull Width, ft	19.31
Max Depth at Bankfull, ft	1.64
Mean Depth at Bankfull, ft	1.03
Width/Depth Ratio	18.77
Flood Prone Width, ft	88.70
Flood Prone Area Elevation	544.26
Entrenchment Ratio	4.60
Bank Height Ratio	1.00

Stream Type	C4

Sta. 18+40 Looking Downstream



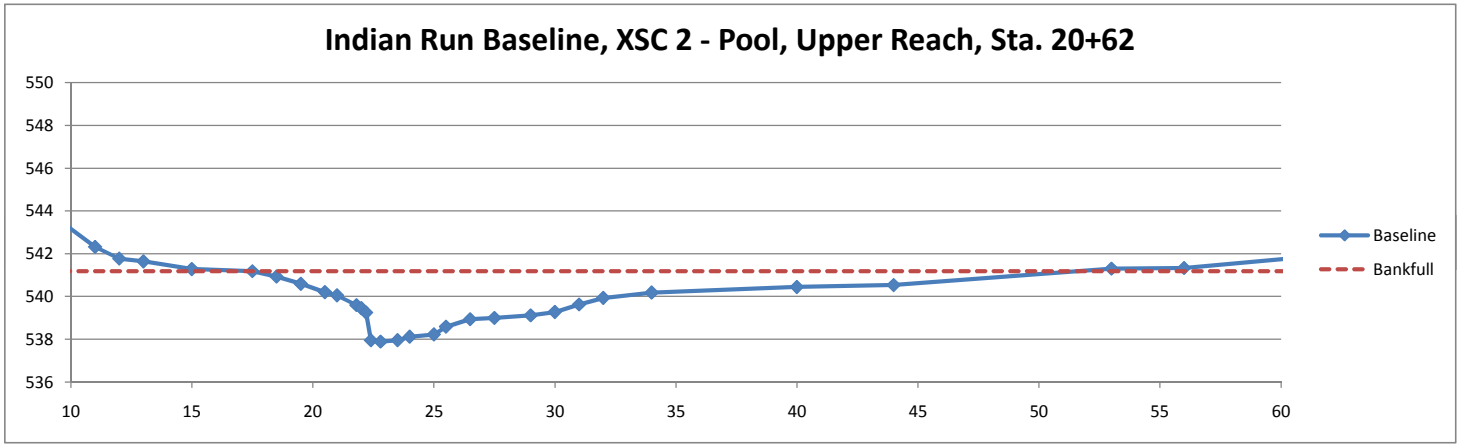
Station	Elevation
0	547.73
3.5	546.23
4.5	545.84
6	544.94
8	544.08
9.5	543.58
11	542.32
12	541.77
13	541.64
15	541.28
17.5	541.18
18.5	540.93
19.5	540.59
20.5	540.2
21	540.05
21.8	539.59
22	539.45
22.2	539.24
22.4	537.94
22.8	537.88
23.5	537.95
24	538.11
25	538.22
25.5	538.58
26.5	538.93
27.5	538.99
29	539.11
30	539.27
31	539.62
32	539.93
34	540.18
40	540.44
44	540.53
53	541.3
56	541.33
62	541.94
70	544.03
73	544.86
77	546.05
77.4	546.23
84	547.95
89	547.95

Reach	Indian Run, Upper Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-2, Pool, Upper Reach, 20+62
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	541.18
Bankfull Cross Sectional Area, ft^2	39.43
Bankfull Width, ft	34.10
Max Depth at Bankfull, ft	3.30
Mean Depth at Bankfull, ft	1.16
Width/Depth Ratio	29.49
Flood Prone Width, ft	56.20
Flood Prone Area Elevation	543.07
Entrenchment Ratio	1.60
Bank Height Ratio	1.00

Stream Type	C4

Sta. 20+62 Looking Downstream, foreground



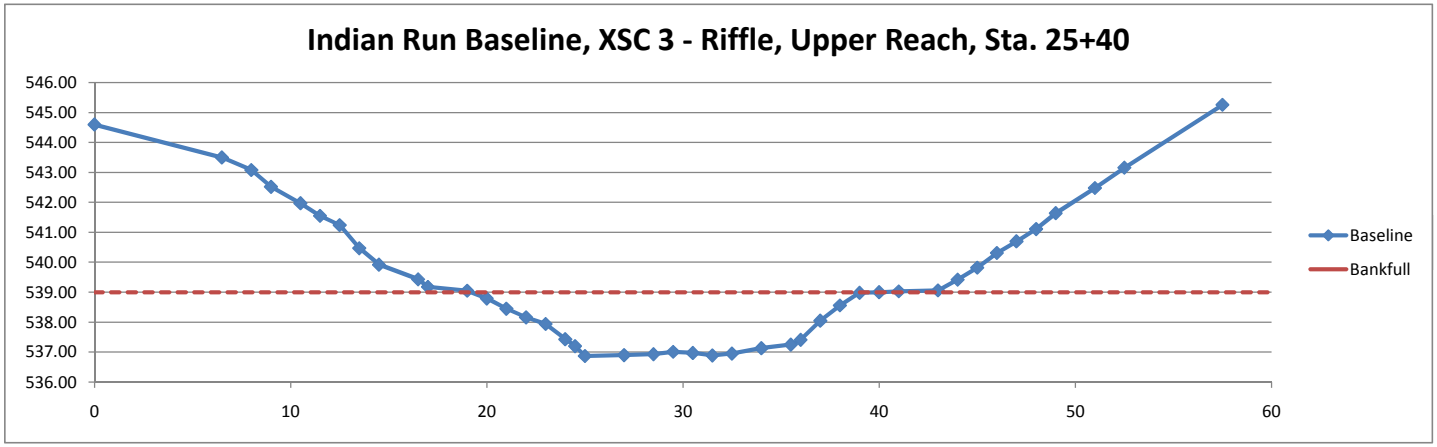
Station	Elevation
0	544.60
6.5	543.50
8	543.08
9	542.52
10.5	541.97
11.5	541.55
12.5	541.24
13.5	540.47
14.5	539.92
16.5	539.43
17	539.18
19	539.05
20	538.79
21	538.45
22	538.16
23	537.94
24	537.43
24.5	537.20
25	536.87
27	536.90
28.5	536.93
29.5	537.01
30.5	536.97
31.5	536.89
32.5	536.95
34	537.13
35.5	537.25
36	537.41
37	538.05
38	538.56
39	538.98
40	539.00
41	539.03
43	539.06
44	539.42
45	539.82
46	540.31
47	540.70
48	541.11
49	541.64
51	542.48
52.5	543.16
57.5	545.26

Reach	Indian Run, Upper Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-3, Riffle, Upper Reach, 25+40
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	539.00
Bankfull Cross Sectional Area, ft^2	29.49
Bankfull Width, ft	20.81
Max Depth at Bankfull, ft	2.13
Mean Depth at Bankfull, ft	1.42
Width/Depth Ratio	14.68
Flood Prone Width, ft	35.40
Flood Prone Area Elevation	541.13
Entrenchment Ratio	1.70
Bank Height Ratio	1.00

Stream Type	C4

Sta. 25+40, Looking Upstream



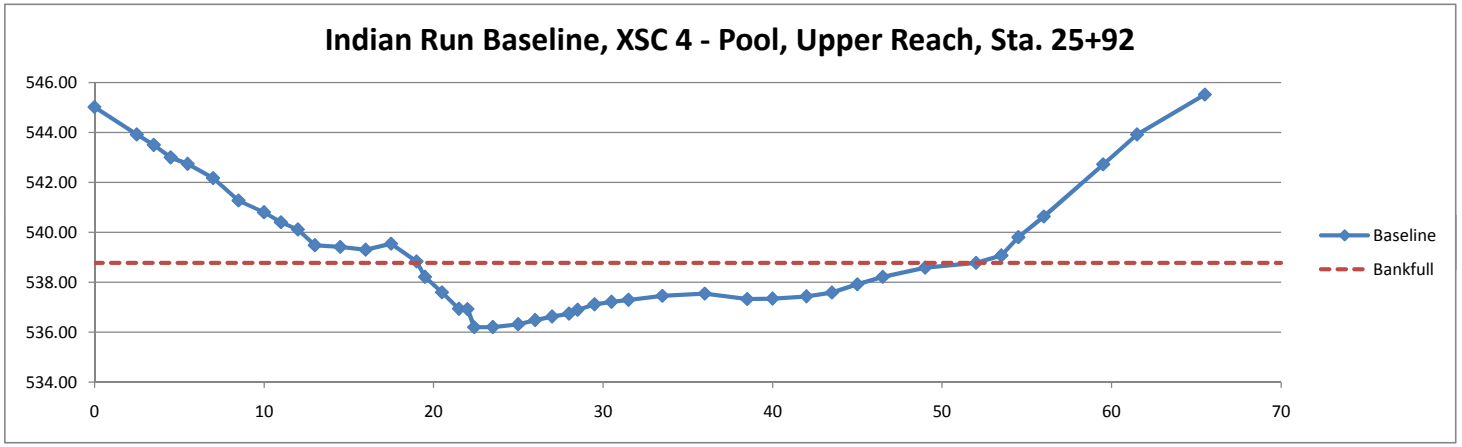
Station	Elevation
0	545.02
2.5	543.92
3.5	543.50
4.5	543.00
5.5	542.74
7	542.17
8.5	541.27
10	540.80
11	540.40
12	540.11
13	539.48
14.5	539.41
16	539.30
17.5	539.54
19	538.83
19.5	538.21
20.5	537.59
21.5	536.93
22	536.92
22.4	536.19
23.5	536.20
25	536.31
26	536.48
27	536.62
28	536.74
28.5	536.89
29.5	537.11
30.5	537.21
31.5	537.29
33.5	537.45
36	537.54
38.5	537.32
40	537.34
42	537.43
43.5	537.58
45	537.91
46.5	538.21
49	538.58
52	538.77
53.5	539.07
54.5	539.80
56	540.63
59.5	542.72
61.5	543.92
65.5	545.52

Reach	Indian Run, Upper Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-4, Pool, Upper Reach, 25+92
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	538.77
Bankfull Cross Sectional Area, ft^2	43.47
Bankfull Width, ft	32.95
Max Depth at Bankfull, ft	2.58
Mean Depth at Bankfull, ft	1.32
Width/Depth Ratio	24.98
Flood Prone Width, ft	45.70
Flood Prone Area Elevation	540.66
Entrenchment Ratio	1.40
Bank Height Ratio	1.00

Stream Type	C4

Sta. 25+92 Looking Downstream, foreground



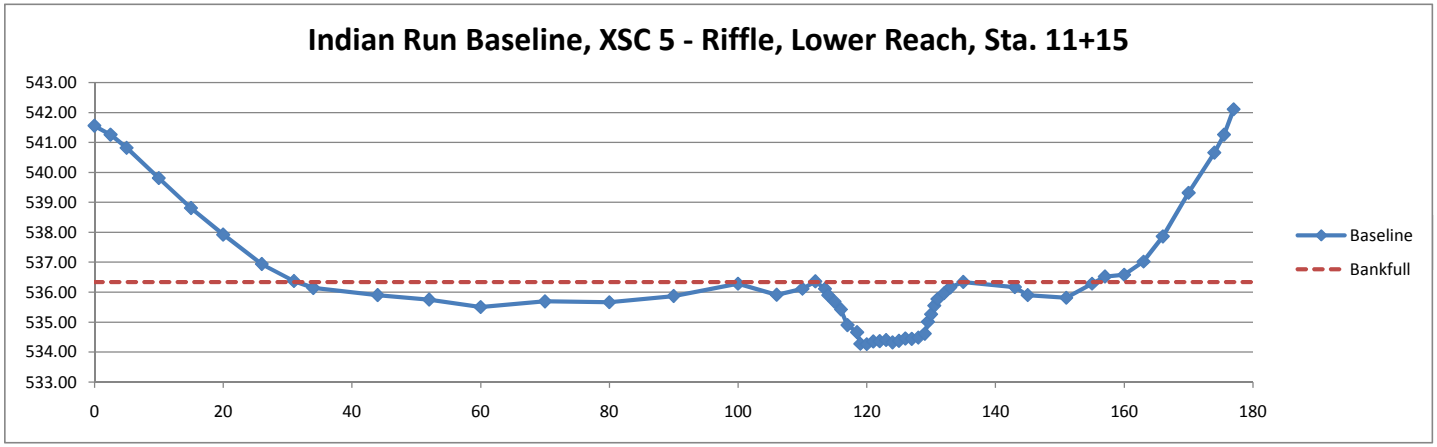
Station	Elevation
0	541.56
2.5	541.26
5	540.82
10	539.81
15	538.81
20	537.92
26	536.94
31	536.37
34	536.14
44	535.90
52	535.75
60	535.50
70	535.69
80	535.66
90	535.87
100	536.28
106	535.91
110	536.11
112	536.36
113.5	536.11
114	535.90
115	535.68
116	535.42
117	534.90
118.5	534.66
119	534.27
120	534.26
121	534.35
122	534.36
123	534.40
124	534.32
125	534.37
126	534.45
127	534.44
128	534.48
129	534.61
129.5	535.01
130	535.26
130.5	535.55
131	535.77
132	535.96
133	536.16
135	536.34
143	536.17
145	535.90
151	535.81
155	536.28
157	536.52
160	536.58

Reach	Indian Run, Lower Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-5, Riffle, Lower Reach, 11+15
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	536.34
Bankfull Cross Sectional Area, ft^2	28.84
Bankfull Width, ft	22.91
Max Depth at Bankfull, ft	2.08
Mean Depth at Bankfull, ft	1.26
Width/Depth Ratio	18.20
Flood Prone Width, ft	150.30
Flood Prone Area Elevation	538.42
Entrenchment Ratio	6.60
Bank Height Ratio	1.00

Stream Type	C4

Sta. 11+15 Looking Downstream



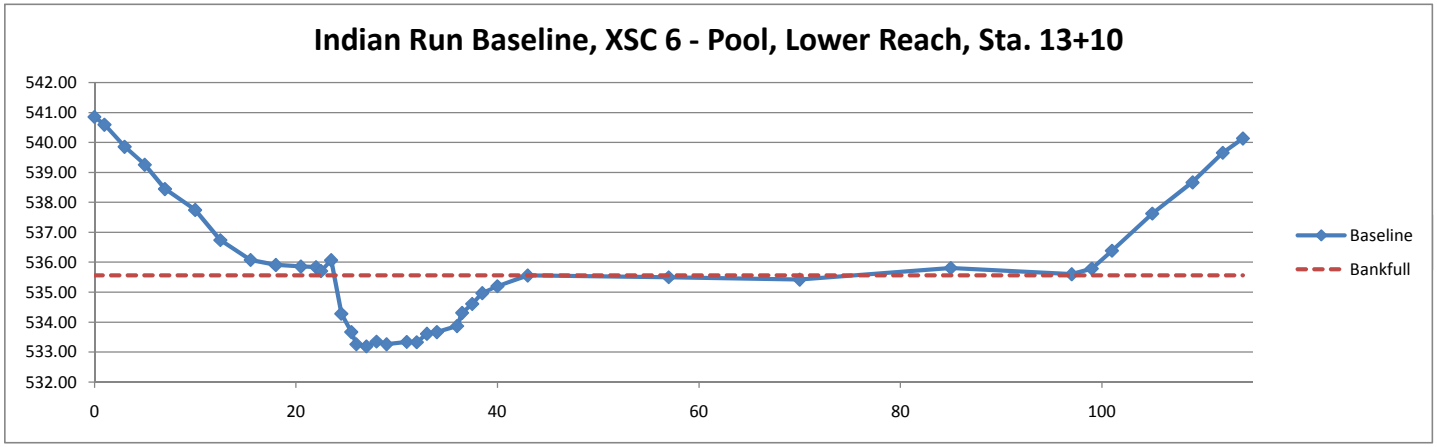
Station	Elevation
0	540.86
1	540.60
3	539.86
5	539.26
7	538.45
10	537.75
12.5	536.74
15.5	536.08
18	535.91
20.5	535.86
22	535.84
22.5	535.71
23.5	536.07
24.5	534.28
25.5	533.67
26	533.26
27	533.19
28	533.35
29	533.26
31	533.34
32	533.33
33	533.61
34	533.67
36	533.87
36.5	534.31
37.5	534.61
38.5	534.97
40	535.20
43	535.56
57	535.50
70	535.42
85	535.81
97	535.60
99	535.79
101	536.39
105	537.63
109	538.67
112	539.66
114	540.14

Reach	Indian Run, Lower Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-6, Pool, Lower Reach, 13+10
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	535.56
Bankfull Cross Sectional Area, ft^2	28.22
Bankfull Width, ft	19.26
Max Depth at Bankfull, ft	2.40
Mean Depth at Bankfull, ft	1.47
Width/Depth Ratio	13.14
Flood Prone Width, ft	95.20
Flood Prone Area Elevation	537.71
Entrenchment Ratio	5.00
Bank Height Ratio	1.00

Stream Type	C4

Sta. 13+10 Looking Downstream



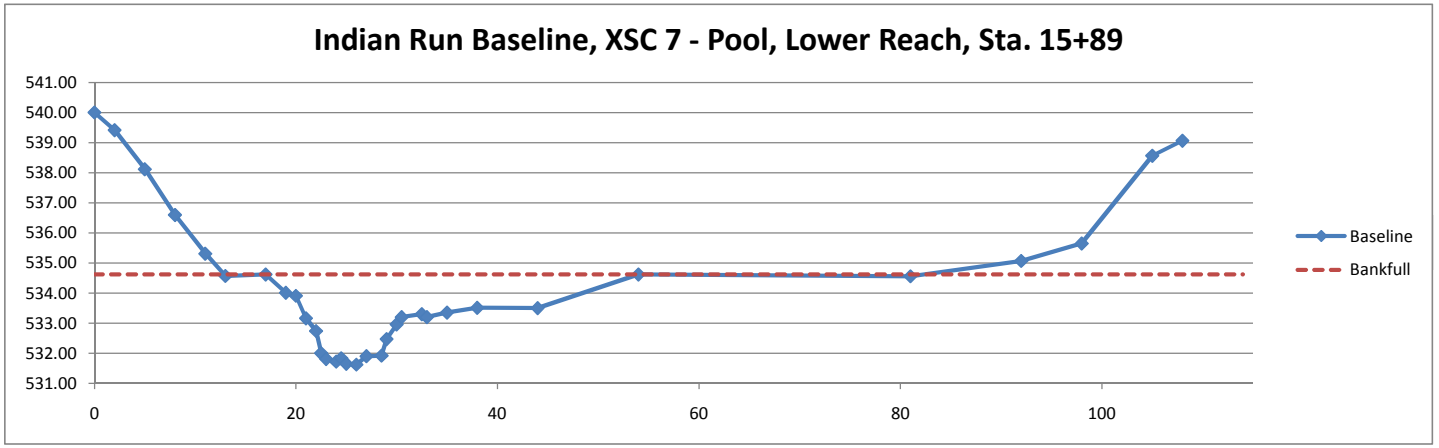
Station	Elevation
0	540.01
2	539.42
5	538.12
8	536.60
11	535.31
13	534.57
17	534.62
19	534.01
20	533.91
21	533.16
22	532.74
22.5	532.00
23	531.81
24	531.72
24.5	531.83
25	531.65
26	531.62
27	531.90
28.5	531.92
29	532.47
30	532.96
30.5	533.20
32.5	533.30
33	533.20
35	533.35
38	533.51
44	533.50
54	534.62
81	534.56
92	535.07
98	535.65
105	538.57
108	539.07

Reach	Indian Run, Lower Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-7, Pool, Lower Reach, 15+89
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	534.62
Bankfull Cross Sectional Area, ft^2	48.92
Bankfull Width, ft	69.30
Max Depth at Bankfull, ft	3.00
Mean Depth at Bankfull, ft	0.71
Width/Depth Ratio	98.17
Flood Prone Width, ft	93.00
Flood Prone Area Elevation	536.77
Entrenchment Ratio	1.30
Bank Height Ratio	1.00

Stream Type	C4

Sta. 15+89 Looking Downstream



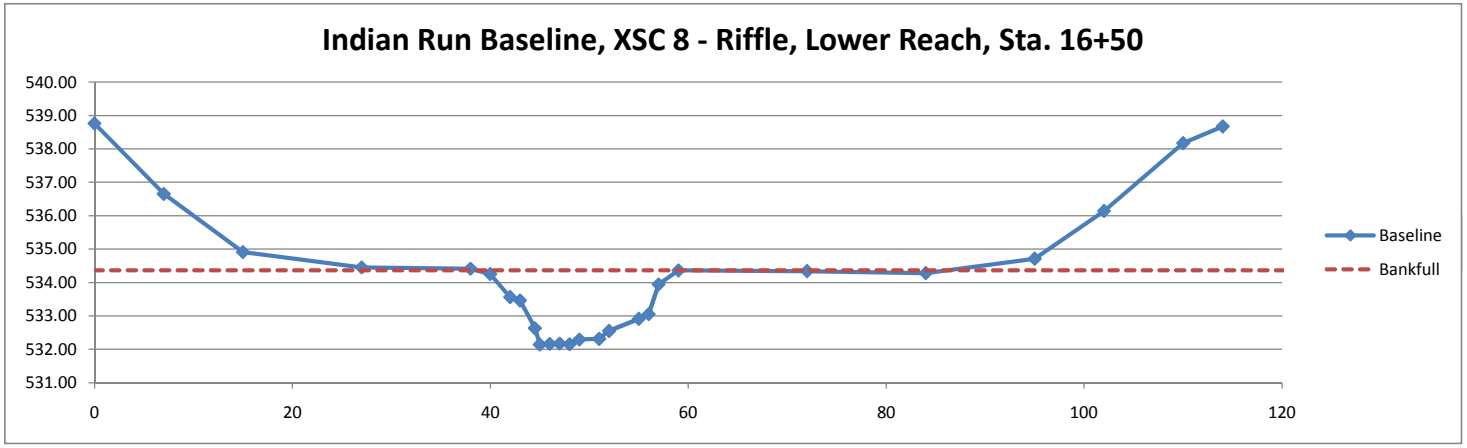
Station	Elevation
0	538.76
7	536.65
15	534.91
27	534.45
38	534.41
40	534.25
42	533.56
43	533.46
44.5	532.63
45	532.14
46	532.16
47	532.17
48	532.15
49	532.29
51	532.31
52	532.55
55	532.91
56	533.05
57	533.94
59	534.36
72	534.34
84	534.28
95	534.71
102	536.14
110	538.17
114	538.67

Reach	Indian Run, Lower Reach
River Basin	Yadkin / Pee Dee
Cross Section ID	XSC-8, Riffle, Lower Reach, 16+50
Drainage Area (Sq Mi)	1.5
Date	5/12/2011
Observers	V. Miller, C. Myers, W. Yelverton

SUMMARY DATA	
Bankfull Elevation, ft	534.36
Bankfull Cross Sectional Area, ft^2	27.10
Bankfull Width, ft	20.38
Max Depth at Bankfull, ft	2.20
Mean Depth at Bankfull, ft	1.33
Width/Depth Ratio	15.33
Flood Prone Width, ft	96.40
Flood Prone Area Elevation	536.58
Entrenchment Ratio	4.70
Bank Height Ratio	1.00

Stream Type	C4

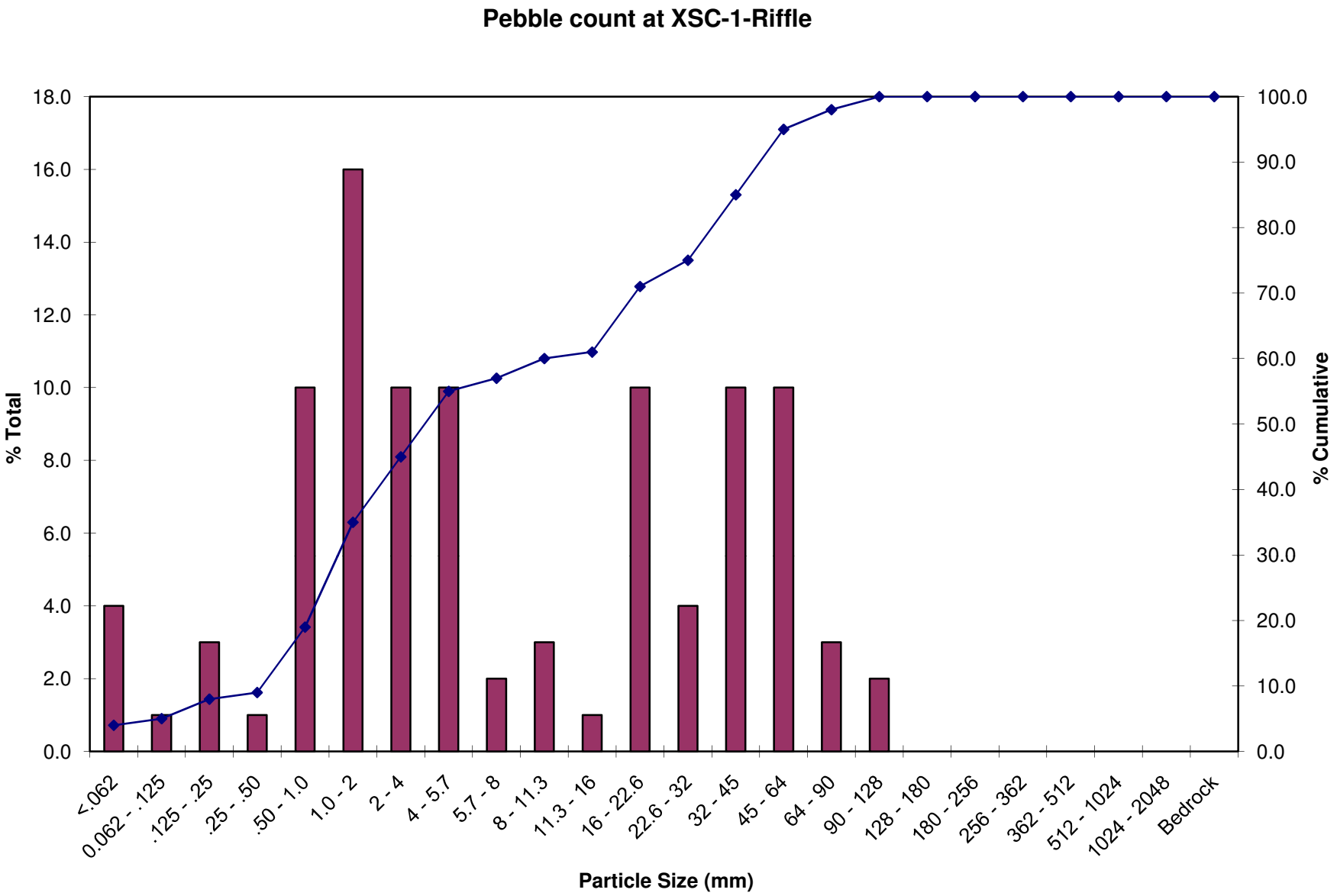
Sta. 16+50 Looking Upstream, above log struc.



Indian Run - UR XSC-1 Riffle-Pebble Count

Location: STA 18+40

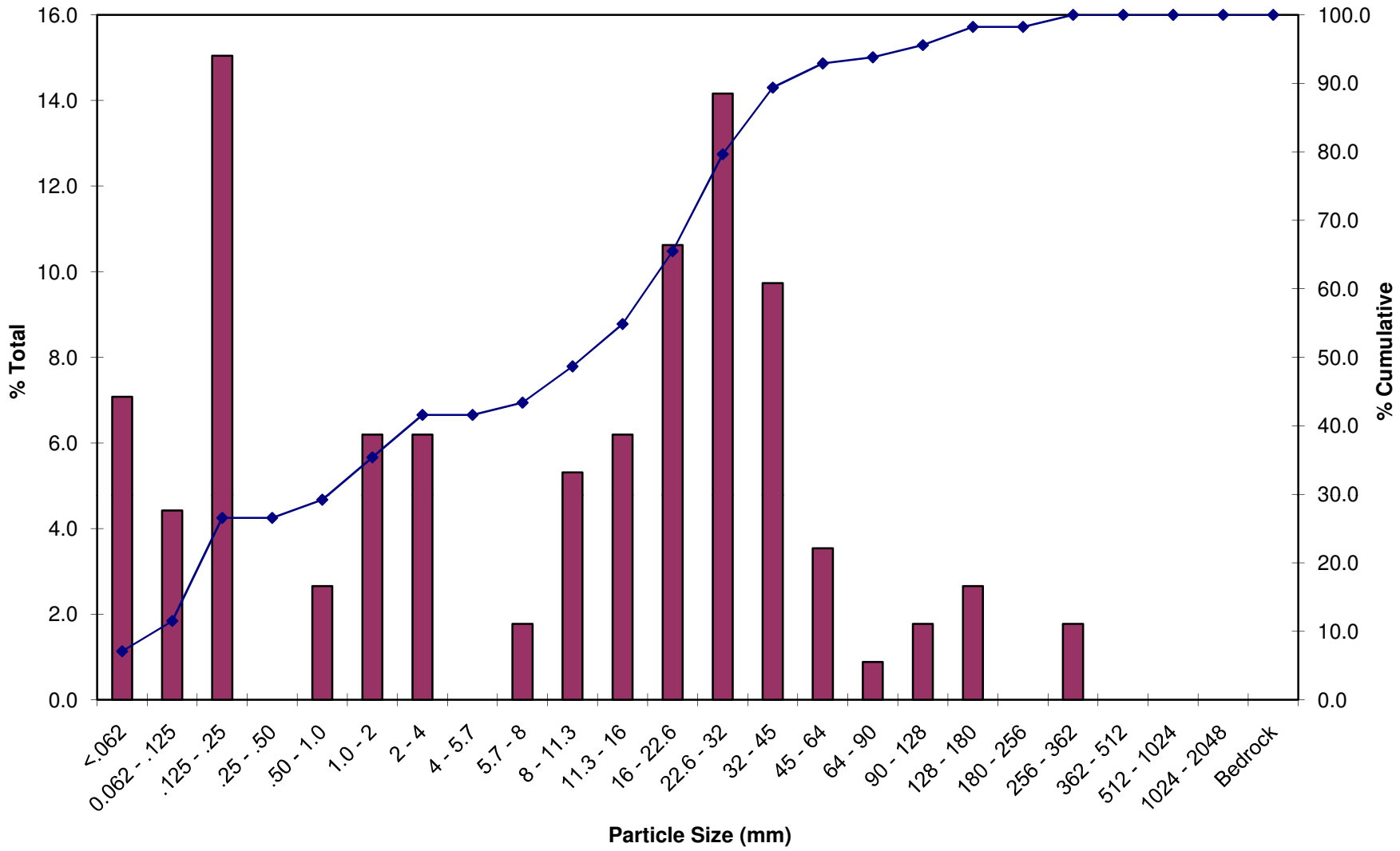
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	4	4.0	4.0
	Very Fine	0.062 - .125	SAND	1	1.0	5.0
	Fine	.125 - .25		3	3.0	8.0
	Medium	.25 - .50		1	1.0	9.0
	Coarse	.50 - 1.0		10	10.0	19.0
.04 - .08	Very Coarse	1.0 - 2		16	16.0	35.0
.08 - .16	Very Fine	2 - 4	GRAVEL	10	10.0	45.0
.16 - .22	Fine	4 - 5.7		10	10.0	55.0
.22 - .31	Fine	5.7 - 8		2	2.0	57.0
.31 .44	Medium	8 - 11.3		3	3.0	60.0
.44 - .63	Medium	11.3 - 16		1	1.0	61.0
.63 - .89	Coarse	16 - 22.6		10	10.0	71.0
.89 - 1.26	Coarse	22.6 - 32		4	4.0	75.0
1.26 - 1.77	Very Coarse	32 - 45		10	10.0	85.0
1.77 - 2.5	Very Coarse	45 - 64		10	10.0	95.0
2.5 - 3.5	Small	64 - 90	COBBLE	3	3.0	98.0
3.5 - 5.0	Small	90 - 128		2	2.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	100		


Pebble count at XSC-1-Riffle
% Total
% Cumulative
Particle Size (mm)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -UR - XSC-2 Pool Pebble Count

Location: STA 20+62

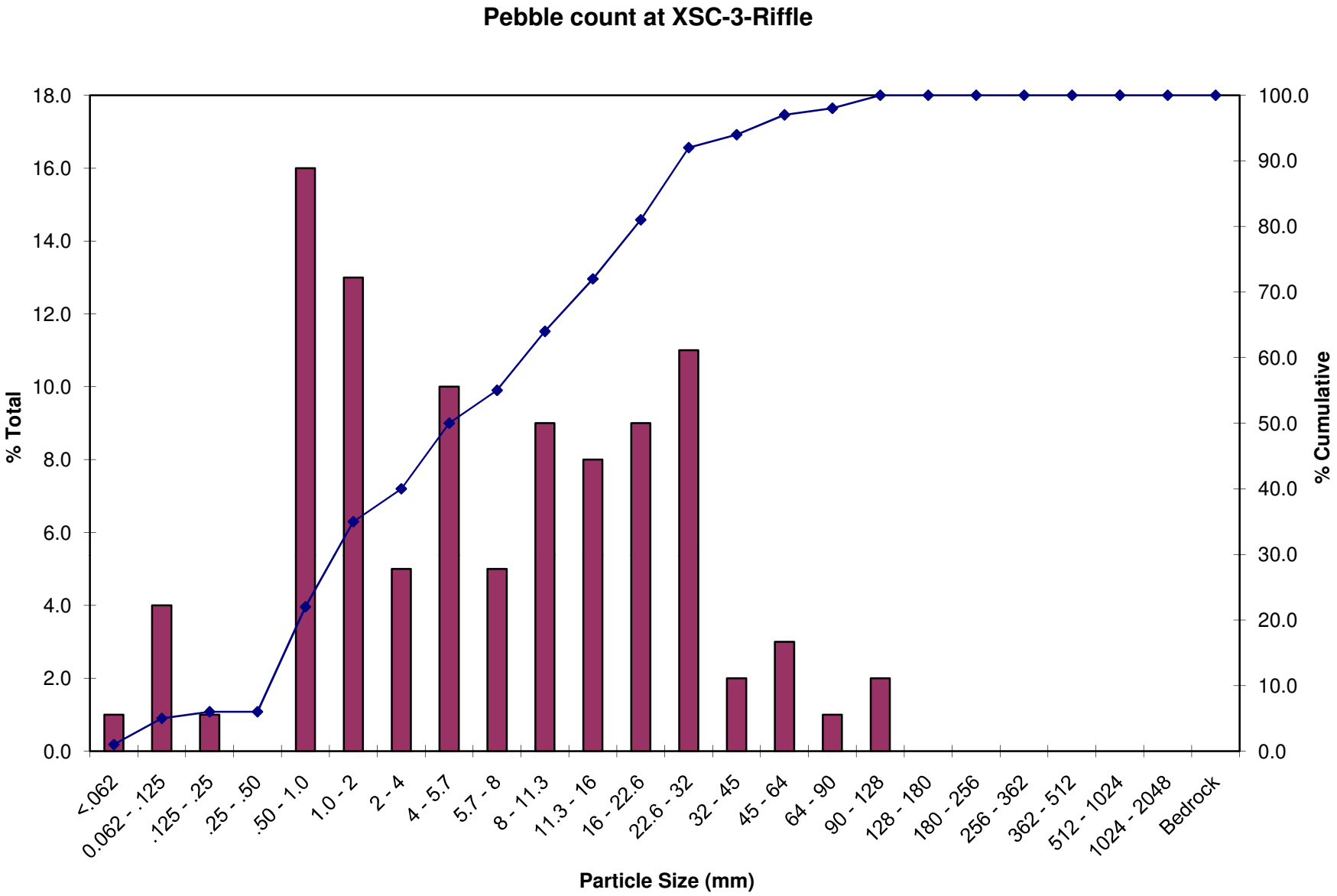
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	8	7.1	7.1
	Very Fine	0.062 - .125	SAND	5	4.4	11.5
	Fine	.125 - .25		17	15.0	26.5
	Medium	.25 - .50		0	0.0	26.5
	Coarse	.50 - 1.0		3	2.7	29.2
.04 - .08	Very Coarse	1.0 - 2		7	6.2	35.4
.08 - .16	Very Fine	2 - 4	GRAVEL	7	6.2	41.6
.16 - .22	Fine	4 - 5.7		0	0.0	41.6
.22 - .31	Fine	5.7 - 8		2	1.8	43.4
.31 .44	Medium	8 - 11.3		6	5.3	48.7
.44 - .63	Medium	11.3 - 16		7	6.2	54.9
.63 - .89	Coarse	16 - 22.6		12	10.6	65.5
.89 - 1.26	Coarse	22.6 - 32		16	14.2	79.6
1.26 - 1.77	Very Coarse	32 - 45		11	9.7	89.4
1.77 - 2.5	Very Coarse	45 - 64		4	3.5	92.9
2.5 - 3.5	Small	64 - 90	COBBLE	1	0.9	93.8
3.5 - 5.0	Small	90 - 128		2	1.8	95.6
5.0 - 7.1	Large	128 - 180		3	2.7	98.2
7.1 - 10.1	Large	180 - 256		0	0.0	98.2
10.1 - 14.3	Small	256 - 362	BOULDER	2	1.8	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	113		


Pebble count at XSC-2-Pool
% Total
% Cumulative
Particle Size (mm)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -UR - XSC-3 Riffle Pebble Count

Location: STA 25+40

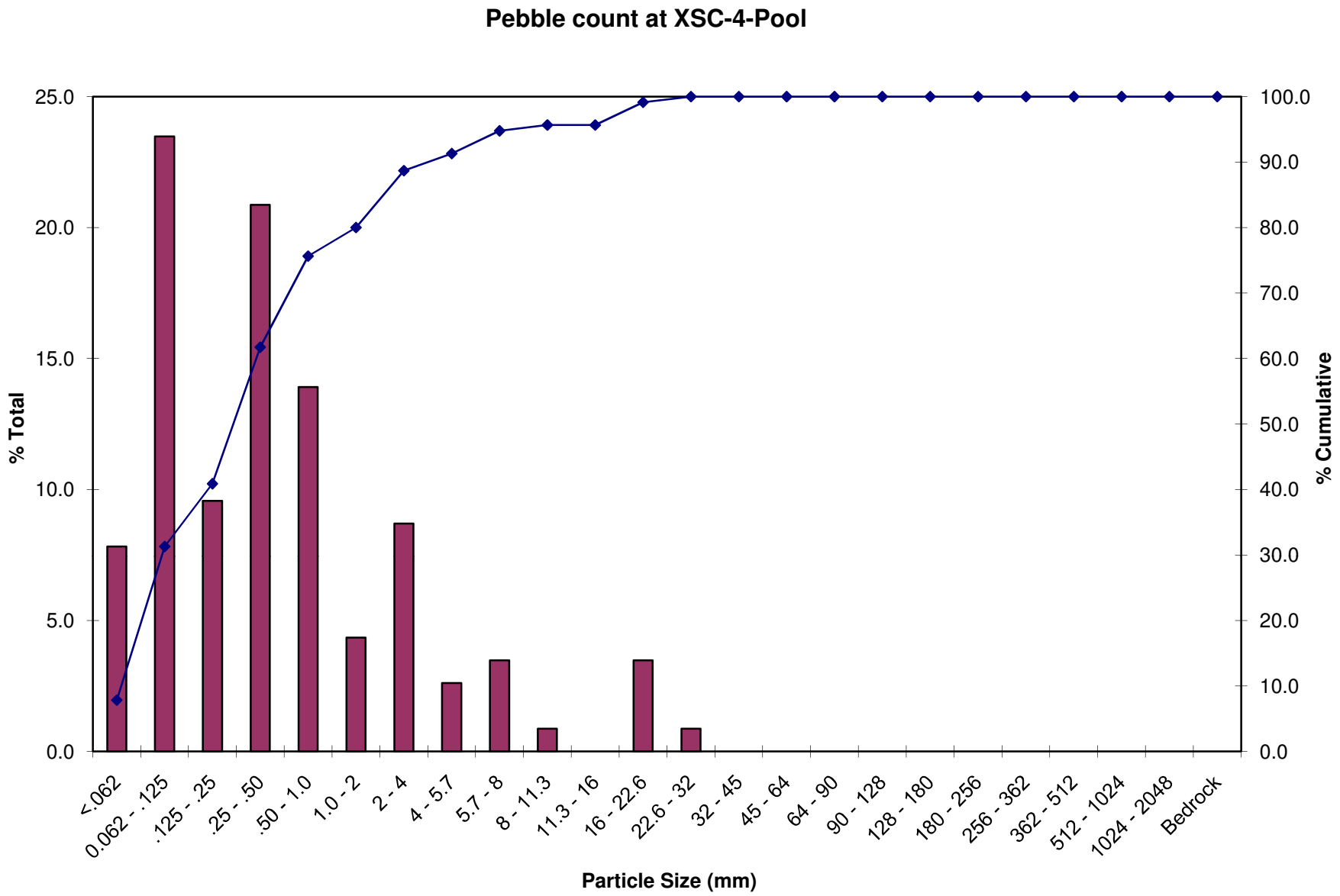
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	1	1.0	1.0
	Very Fine	0.062 - .125	SAND	4	4.0	5.0
	Fine	.125 - .25		1	1.0	6.0
	Medium	.25 - .50		0	0.0	6.0
	Coarse	.50 - 1.0		16	16.0	22.0
.04 - .08	Very Coarse	1.0 - 2		13	13.0	35.0
.08 - .16	Very Fine	2 - 4	GRAVEL	5	5.0	40.0
.16 - .22	Fine	4 - 5.7		10	10.0	50.0
.22 - .31	Fine	5.7 - 8		5	5.0	55.0
.31 .44	Medium	8 - 11.3		9	9.0	64.0
.44 - .63	Medium	11.3 - 16		8	8.0	72.0
.63 - .89	Coarse	16 - 22.6		9	9.0	81.0
.89 - 1.26	Coarse	22.6 - 32		11	11.0	92.0
1.26 - 1.77	Very Coarse	32 - 45		2	2.0	94.0
1.77 - 2.5	Very Coarse	45 - 64		3	3.0	97.0
2.5 - 3.5	Small	64 - 90	COBBLE	1	1.0	98.0
3.5 - 5.0	Small	90 - 128		2	2.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	100		


Pebble count at XSC-3-Riffle
% Total
% Cumulative
Particle Size (mm)
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -UR - XSC-4 Pool Pebble Count

Location: STA 25+92

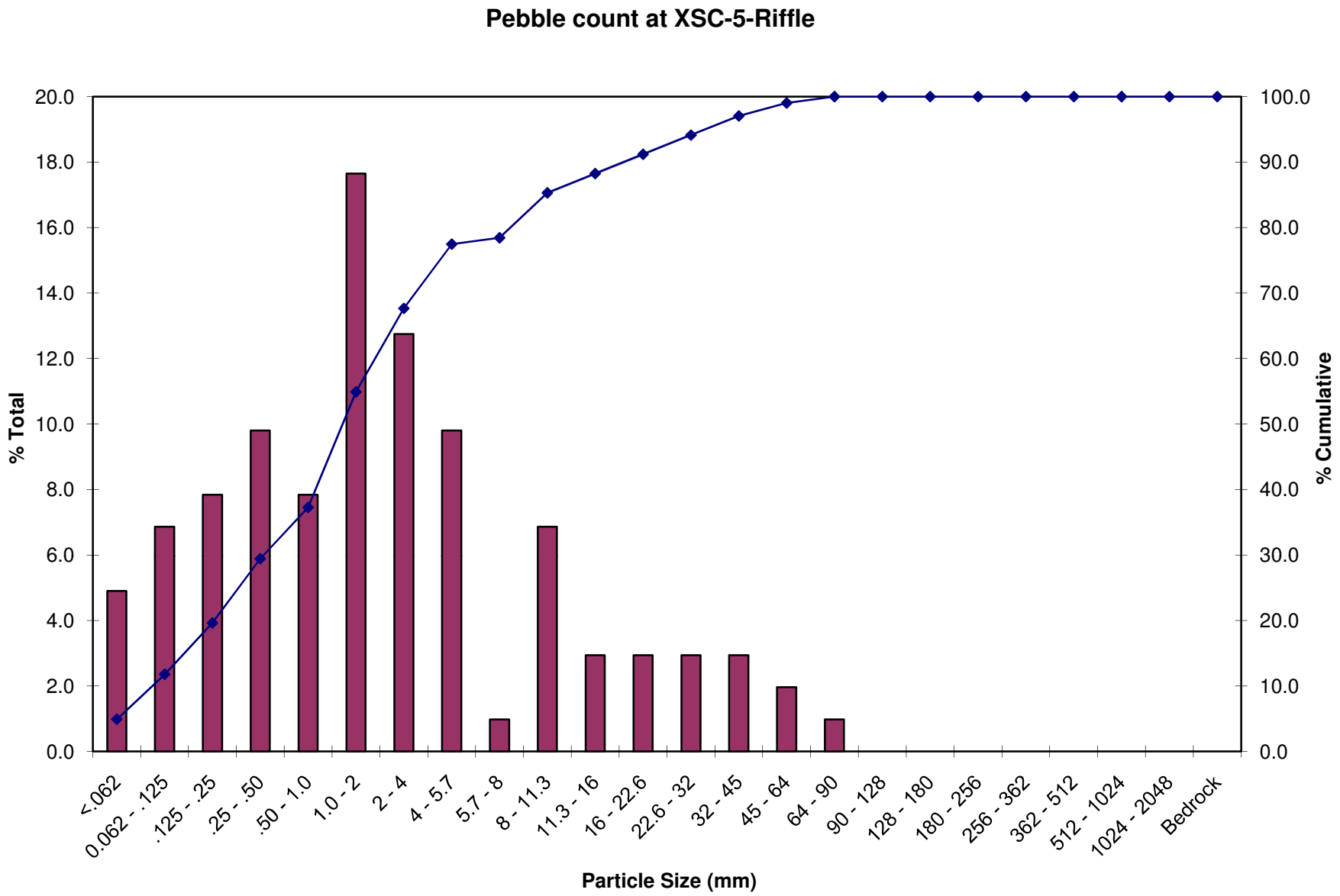
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	9	7.8	7.8
	Very Fine	0.062 - .125	SAND	27	23.5	31.3
	Fine	.125 - .25		11	9.6	40.9
	Medium	.25 - .50		24	20.9	61.7
	Coarse	.50 - 1.0		16	13.9	75.7
.04 - .08	Very Coarse	1.0 - 2		5	4.3	80.0
.08 - .16	Very Fine	2 - 4	GRAVEL	10	8.7	88.7
.16 - .22	Fine	4 - 5.7		3	2.6	91.3
.22 - .31	Fine	5.7 - 8		4	3.5	94.8
.31 .44	Medium	8 - 11.3		1	0.9	95.7
.44 - .63	Medium	11.3 - 16		0	0.0	95.7
.63 - .89	Coarse	16 - 22.6		4	3.5	99.1
.89 - 1.26	Coarse	22.6 - 32		1	0.9	100.0
1.26 - 1.77	Very Coarse	32 - 45		0	0.0	100.0
1.77 - 2.5	Very Coarse	45 - 64		0	0.0	100.0
2.5 - 3.5	Small	64 - 90	COBBLE	0	0.0	100.0
3.5 - 5.0	Small	90 - 128		0	0.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	115		


Pebble count at XSC-4-Pool
% Total
% Cumulative
Particle Size (mm)
25.0
20.0
15.0
10.0
5.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -LR - XSC-5 Riffle Pebble Count

Location: STA 11+15

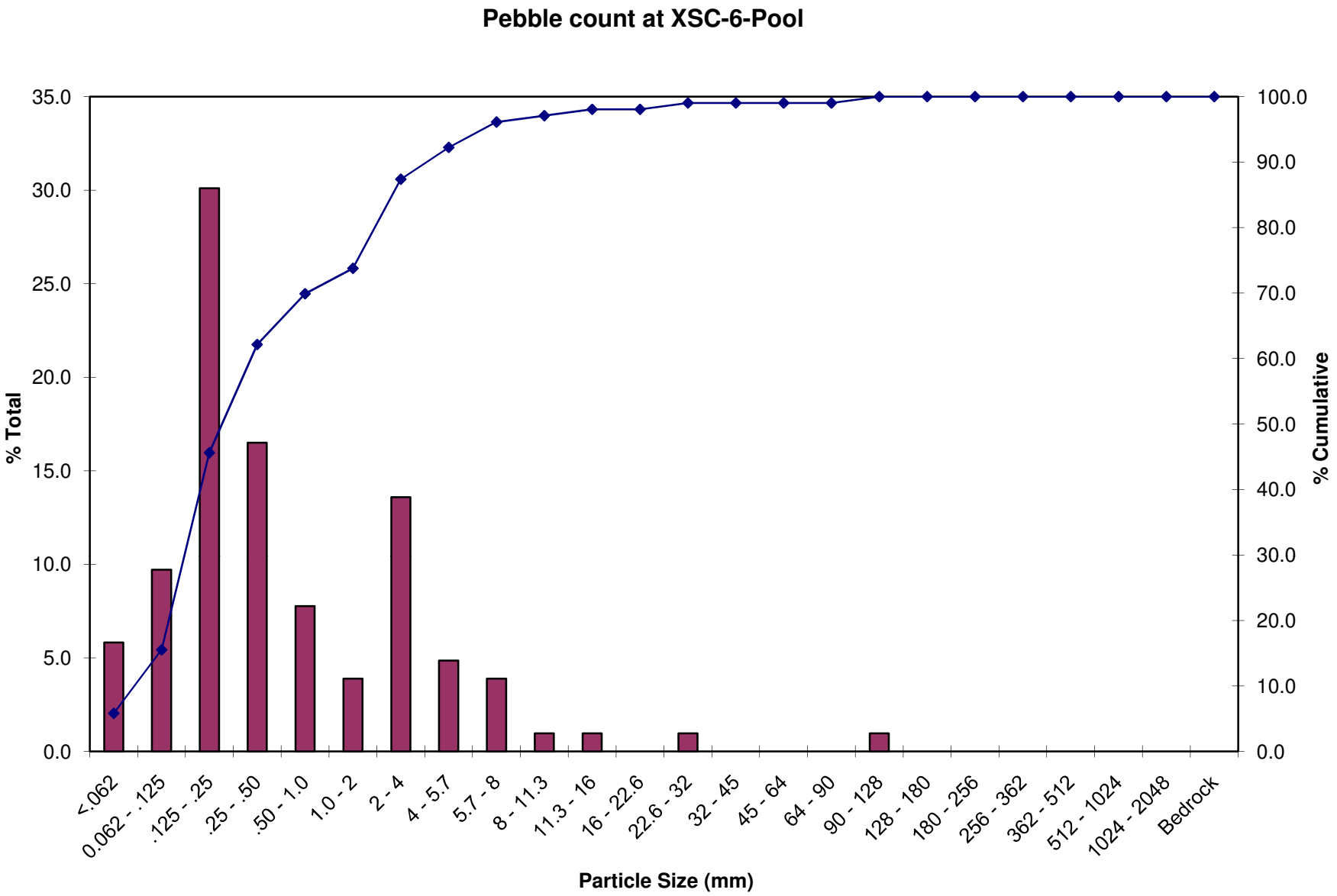
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	5	4.9	4.9
	Very Fine	0.062 - .125	SAND	7	6.9	11.8
	Fine	.125 - .25		8	7.8	19.6
	Medium	.25 - .50		10	9.8	29.4
	Coarse	.50 - 1.0		8	7.8	37.3
.04 - .08	Very Coarse	1.0 - 2		18	17.6	54.9
.08 - .16	Very Fine	2 - 4	GRAVEL	13	12.7	67.6
.16 - .22	Fine	4 - 5.7		10	9.8	77.5
.22 - .31	Fine	5.7 - 8		1	1.0	78.4
.31 .44	Medium	8 - 11.3		7	6.9	85.3
.44 - .63	Medium	11.3 - 16		3	2.9	88.2
.63 - .89	Coarse	16 - 22.6		3	2.9	91.2
.89 - 1.26	Coarse	22.6 - 32		3	2.9	94.1
1.26 - 1.77	Very Coarse	32 - 45		3	2.9	97.1
1.77 - 2.5	Very Coarse	45 - 64		2	2.0	99.0
2.5 - 3.5	Small	64 - 90	COBBLE	1	1.0	100.0
3.5 - 5.0	Small	90 - 128		0	0.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	102		


Pebble count at XSC-5-Riffle
% Total
% Cumulative
Particle Size (mm)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -LR - XSC-6 Pool Pebble Count

Location: STA 13+10

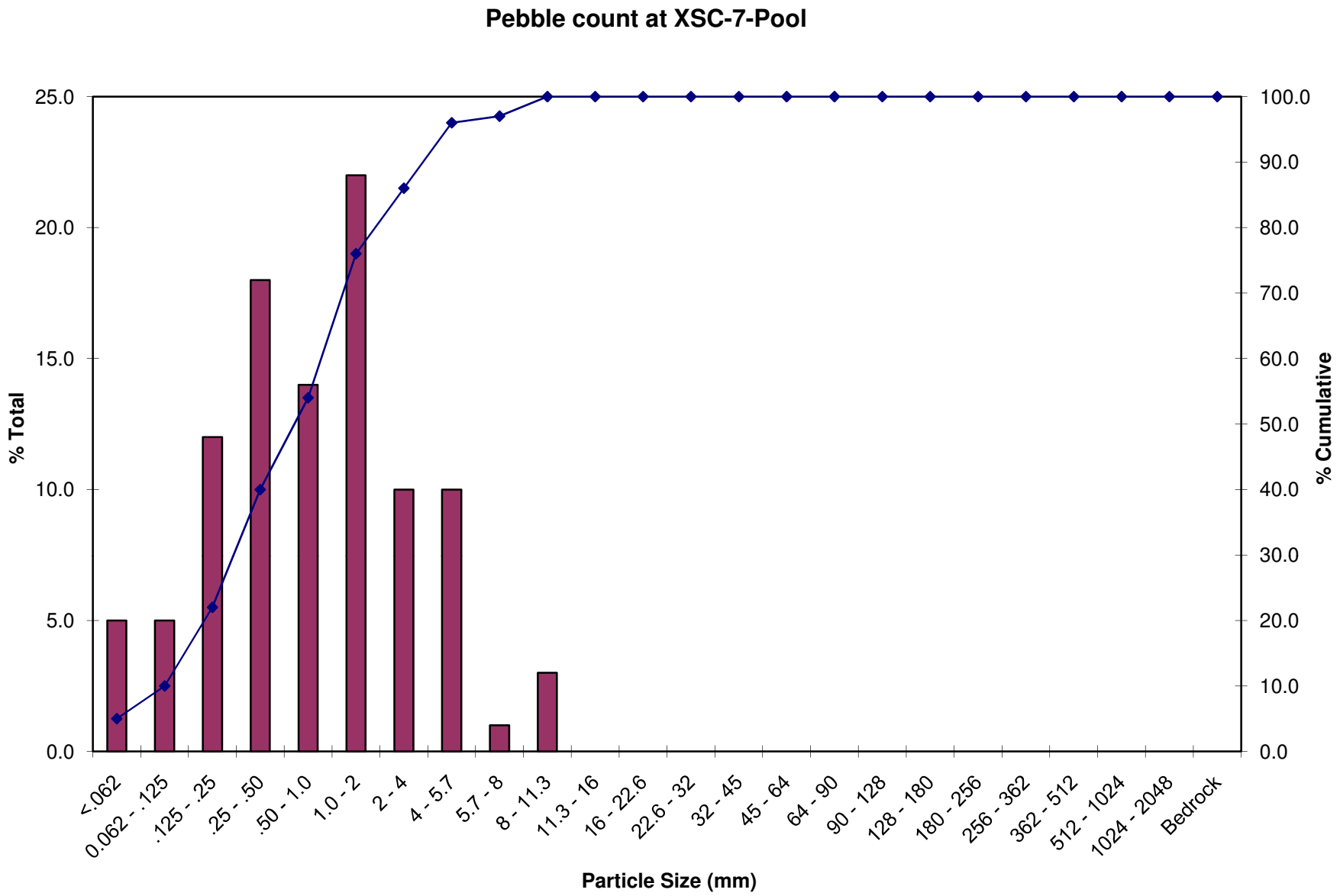
Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	6	5.8	5.8
	Very Fine	0.062 - .125	SAND	10	9.7	15.5
	Fine	.125 - .25		31	30.1	45.6
	Medium	.25 - .50		17	16.5	62.1
	Coarse	.50 - 1.0		8	7.8	69.9
.04 - .08	Very Coarse	1.0 - 2		4	3.9	73.8
.08 - .16	Very Fine	2 - 4	GRAVEL	14	13.6	87.4
.16 - .22	Fine	4 - 5.7		5	4.9	92.2
.22 - .31	Fine	5.7 - 8		4	3.9	96.1
.31 .44	Medium	8 - 11.3		1	1.0	97.1
.44 - .63	Medium	11.3 - 16		1	1.0	98.1
.63 - .89	Coarse	16 - 22.6		0	0.0	98.1
.89 - 1.26	Coarse	22.6 - 32		1	1.0	99.0
1.26 - 1.77	Very Coarse	32 - 45		0	0.0	99.0
1.77 - 2.5	Very Coarse	45 - 64		0	0.0	99.0
2.5 - 3.5	Small	64 - 90	COBBLE	0	0.0	99.0
3.5 - 5.0	Small	90 - 128		1	1.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	103		


Pebble count at XSC-6-Pool
% Total
% Cumulative
Particle Size (mm)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -LR - XSC-7 Pool Pebble Count

Location: STA 15+89

Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	5	5.0	5.0
	Very Fine	0.062 - .125	SAND	5	5.0	10.0
	Fine	.125 - .25		12	12.0	22.0
	Medium	.25 - .50		18	18.0	40.0
	Coarse	.50 - 1.0		14	14.0	54.0
.04 - .08	Very Coarse	1.0 - 2		22	22.0	76.0
.08 - .16	Very Fine	2 - 4	GRAVEL	10	10.0	86.0
.16 - .22	Fine	4 - 5.7		10	10.0	96.0
.22 - .31	Fine	5.7 - 8		1	1.0	97.0
.31 .44	Medium	8 - 11.3		3	3.0	100.0
.44 - .63	Medium	11.3 - 16		0	0.0	100.0
.63 - .89	Coarse	16 - 22.6		0	0.0	100.0
.89 - 1.26	Coarse	22.6 - 32		0	0.0	100.0
1.26 - 1.77	Very Coarse	32 - 45		0	0.0	100.0
1.77 - 2.5	Very Coarse	45 - 64		0	0.0	100.0
2.5 - 3.5	Small	64 - 90	COBBLE	0	0.0	100.0
3.5 - 5.0	Small	90 - 128		0	0.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	100		


Pebble count at XSC-7-Pool
% Total
% Cumulative
Particle Size (mm)
25.0
20.0
15.0
10.0
5.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Indian Run -LR - XSC-8 Riffle Pebble Count

Location: STA 16+50

Inches	Particle	Millimeters		Count	%Total	% Cum.
	Silt/Clay	<.062	SILT/CLAY	18	17.1	17.1
	Very Fine	0.062 - .125	SAND	11	10.5	27.6
	Fine	.125 - .25		4	3.8	31.4
	Medium	.25 - .50		26	24.8	56.2
	Coarse	.50 - 1.0		5	4.8	61.0
.04 - .08	Very Coarse	1.0 - 2		9	8.6	69.5
.08 - .16	Very Fine	2 - 4	GRAVEL	20	19.0	88.6
.16 - .22	Fine	4 - 5.7		10	9.5	98.1
.22 - .31	Fine	5.7 - 8		1	1.0	99.0
.31 .44	Medium	8 - 11.3		1	1.0	100.0
.44 - .63	Medium	11.3 - 16		0	0.0	100.0
.63 - .89	Coarse	16 - 22.6		0	0.0	100.0
.89 - 1.26	Coarse	22.6 - 32		0	0.0	100.0
1.26 - 1.77	Very Coarse	32 - 45		0	0.0	100.0
1.77 - 2.5	Very Coarse	45 - 64		0	0.0	100.0
2.5 - 3.5	Small	64 - 90	COBBLE	0	0.0	100.0
3.5 - 5.0	Small	90 - 128		0	0.0	100.0
5.0 - 7.1	Large	128 - 180		0	0.0	100.0
7.1 - 10.1	Large	180 - 256		0	0.0	100.0
10.1 - 14.3	Small	256 - 362	BOULDER	0	0.0	100.0
14.3 - 20	Small	362 - 512		0	0.0	100.0
20 - 40	Medium	512 - 1024		0	0.0	100.0
40 - 80	Large - Very Lg	1024 - 2048		0	0.0	100.0
	Bedrock	Bedrock		0	0.0	100.0
			Total Counted	105		

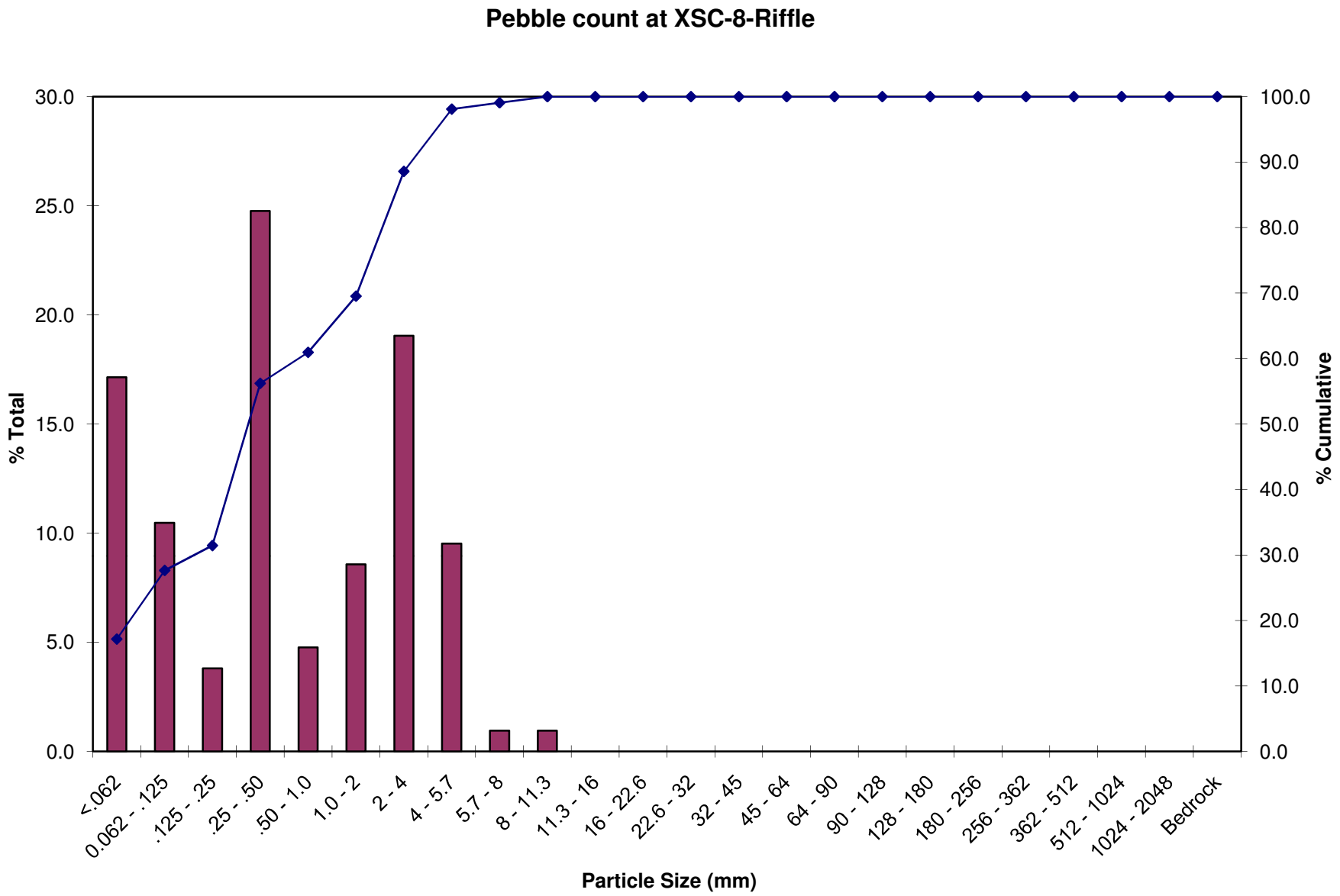

Pebble count at XSC-8-Riffle
% Total
% Cumulative
Particle Size (mm)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
<.062
0.062 - .125
.125 - .25
.25 - .50
.50 - 1.0
1.0 - 2
2 - 4
4 - 5.7
5.7 - 8
8 - 11.3
11.3 - 16
16 - 22.6
22.6 - 32
32 - 45
45 - 64
64 - 90
90 - 128
128 - 180
180 - 256
256 - 362
362 - 512
512 - 1024
1024 - 2048
Bedrock

Photo Station 1 Downstream (5/12/2011 Year 0)

Photo Station 1 Upstream (5/12/2011 Year 0)

Photo Station 2 Downstream (5/12/2011 Year 0)

Photo Station 2 Upstream (5/12/2011 Year 0)

Photo Station 3 Downstream (5/12/2011 Year 0)

Photo Station 3 Upstream (5/12/2011 Year 0)

Photo Station 4 Downstream (5/12/2011 Year 0)

Photo Station 4 Upstream (5/12/2011 Year 0)

Photo Station 5 Downstream (5/12/2011 Year 0)

Photo Station 5 Upstream (5/12/2011 Year 0)

Photo Station 6 Downstream (5/12/2011 Year 0)

Photo Station 6 Upstream (5/12/2011 Year 0)

Photo Station 7 Downstream (5/12/2011 Year 0)

Photo Station 7 Upstream (5/12/2011 Year 0)

Photo Station 8 Downstream (5/12/2011 Year 0)

Photo Station 8 Upstream (5/12/2011 Year 0)

Photo Station 9 Downstream (5/12/2011 Year 0)

Photo Station 9 Upstream (5/12/2011 Year 0)

Photo Station 10 Downstream (5/12/2011 Year 0)

Photo Station 10 Upstream (5/12/2011 Year 0)

Photo Station 11 Downstream (5/12/2011 Year 0)

Photo Station 11 Upstream (5/12/2011 Year 0)

Photo Station 12 Downstream (5/12/2011 Year 0)

Photo Station 12 Upstream (5/12/2011 Year 0)

Photo Station 13 Downstream (5/12/2011 Year 0)

Photo Station 13 Upstream (5/12/2011 Year 0)

Photo Station 14 Downstream (5/12/2011 Year 0)

Photo Station 14 Upstream (5/12/2011 Year 0)

Photo Station 15 Downstream (5/12/2011 Year 0)

Photo Station 15 Upstream (5/12/2011 Year 0)

Photo Station 16 Downstream (5/12/2011 Year 0)

Photo Station 16 Upstream (5/12/2011 Year 0)

Photo Station 17 Downstream (5/12/2011 Year 0)

Photo Station 17 Upstream (5/12/2011 Year 0)

Photo Station 18 Downstream (5/12/2011 Year 0)

Photo Station 18 Upstream (5/12/2011 Year 0)

Photo Station 19 Downstream (5/12/2011 Year 0)

Photo Station 19 Upstream (5/12/2011 Year 0)

Photo Station 20 Downstream (5/12/2011 Year 0)

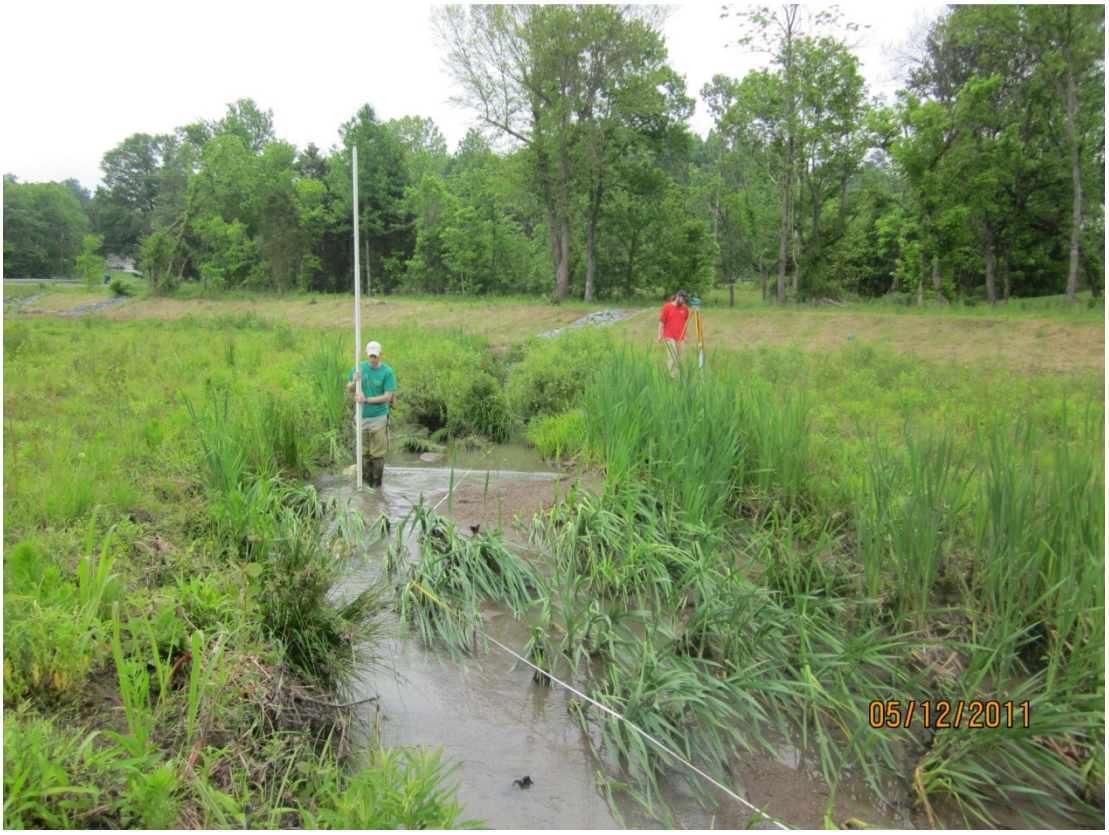


Photo Station 20 Upstream (5/12/2011 Year 0)

Photo Station 21 Downstream (5/12/2011 Year 0)

Photo Station 21 Upstream (5/12/2011 Year 0)

Photo Station 22 Downstream (5/12/2011 Year 0)

Photo Station 22 Upstream (5/12/2011 Year 0)

Photo Station 23 Downstream (5/12/2011 Year 0)

Photo Station 23 Upstream (5/12/2011 Year 0)

Appendix C

Vegetation Data

Table 7. Planted Vegetation				
Species		**Common Name**	**Size**	**Quantity**
Symphoricarpos orbiculatus		Coral-berry	Gallon	70
Lindera benzoin		Spicebush	Gallon	65
Calycanthus floridus		Sweetshrub	Gallon	70
Callicarpa americana		Beautyberry	Tubling	95
Sambucus canadensis		Elderberry	Tubling	95
Cephalantus occidentalis		Button bush	Tubling	95
Alnus serrulata		Tag alder	Tubling	95
Juglans nigra		Black walnut	Bare root	300
Cornus amomum		Silky dogwood	Bare root	700
Acer rubrum		Red maple	Bare root	800
Quercus nigra		Water oak	Bare root	300
Quercus phellos		Willow oak	Bare root	500
Diospyros virginiana		Persimmon	Bare root	400
Betula nigra		River birch	Bare root	1100
Celtis laevigata		Sugarberry	Bare root	1100
Alnus serrulata		Tag alder	Bare root	600
Fraxinus pennsylvanica		Green ash	Bare root	500
Cornus amomum		Silky dogwood	Live stakes	740
Salix sericea		Silky willow	Live stakes	740
Physocarpus opulifolius		Ninebark	Live stakes	740
Sambucus canadensis		Elderberry	Live stakes	740
Juglans nigra		Black willow	Live stakes	740
			Total	**10585**

Table 8. Vegetation Plot Data

Species	Common Name	Total Stems	Total Planted Stems	Avg # stems	094-HDR-0001-year:2011		094-HDR-0002-year:2011		094-HDR-0003-year:2011		094-HDR-0004-year:2011		094-HDR-0005-year:2011		094-HDR-0006-year:2011		094-HDR-0007-year:2011		094-HDR-0008-year:2011		094-HDR-0009-year:2011		094-HDR-0010-year:2011		094-HDR-0011-year:2011	
					P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	V
Acer rubrum	red maple	38	30	5.43	11		3		5				5		4	8	1								1	
Alnus serrulata	hazel alder	19	19	2.71	4						2		4		2		5				1		1			
Betula nigra	river birch	28	28	4	2								3		3				1		5		5		9	
Callicarpa americana	American beautyberry	8	8	2			2				3		1		2											
Calycanthus floridus	eastern sweetshrub	2	2	1					1						1											
Celtis laevigata	sugarberry	15	15	3											1		3		8		2				1	
Cornus amomum	silky dogwood	32	32	3.56	1		4				8				3		3		5		6		1		1	
Diospyros virginiana	common persimmon	23	21	3.29	2		5		2	2			1		3						3		5			
Fraxinus pennsylvanica	green ash	21	21	4.2	6		4		7		2		2													
Juglans nigra	black walnut	6	6	1.5					1		3		1		1											
Populus deltoides	eastern cottonwood	655	0	163.75														109		307		165		74		
Quercus nigra	water oak	12	12	2.4					2				1		3								5		1	
Quercus phellos	willow oak	21	21	2.33	3		3		2		3		1		1				4				1		3	
Salix nigra	black willow	8	8	2									1		1		1						5			
Sambucus canadensis	common elderberry	2	2	1	1										1											
Stem Count		**890**	**225**		**30**	**0**	**21**	**0**	**20**	**2**	**21**	**0**	**20**	**0**	**26**	**8**	**13**	**109**	**18**	**307**	**17**	**165**	**23**	**74**	**16**	**0**
Species Count					**8**	**0**	**6**	**0**	**7**	**1**	**6**	**0**	**10**	**0**	**13**	**1**	**5**	**1**	**4**	**1**	**5**	**1**	**7**	**1**	**6**	**0**
Planted Stems / acre					**1214**		**850**		**809**		**850**		**809**		**1052**		**526**		**728**		**688**		**931**		**648**	
Total Stems					**30**		**21**		**22**		**21**		**20**		**34**		**122**		**325**		**182**		**97**		**16**	
Total Stems / acre					**1214**		**850**		**890**		**850**		**809**		**1376**		**4937**		**13152**		**7365**		**3925**		**647**	

*P – Planted, V – Volunteer

Vegetation Plot 1 – 5mx20m (5/12/2011 Year 0)

Vegetation Plot 2 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 3 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 4 – 5mx20m (5/12/2011 Year 0)

Vegetation Plot 5 – 5mx20m (5/12/2011 Year 0)

Vegetation Plot 6 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 7 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 8 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 9 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 10 – 10mx10m (5/12/2011 Year 0)

Vegetation Plot 11 – 10mx10m (5/12/2011 Year 0)

Appendix D

Record Drawings and Final Report

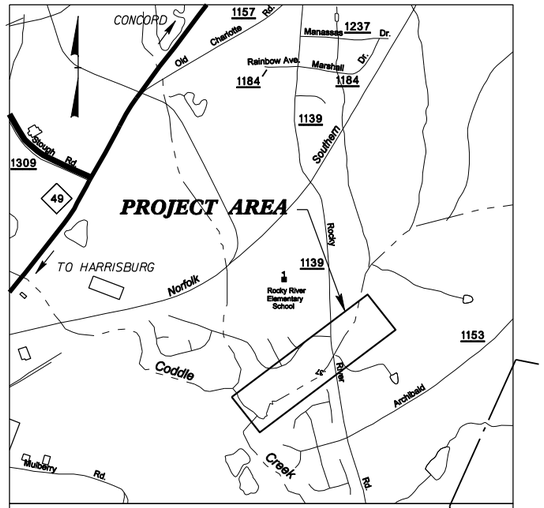
STATE	SCO PROJECT NO.	SHEET NO.	TOTAL SHEETS
N.C.	030606201	1	

STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

INDIAN RUN TRIBUTARY TO CODDLE CREEK STREAM RESTORATION PROJECT

LOCATION: CABARRUS COUNTY, NORTH CAROLINA
Latitude 35.343141, Longitude 80.593842

RECORD DRAWINGS



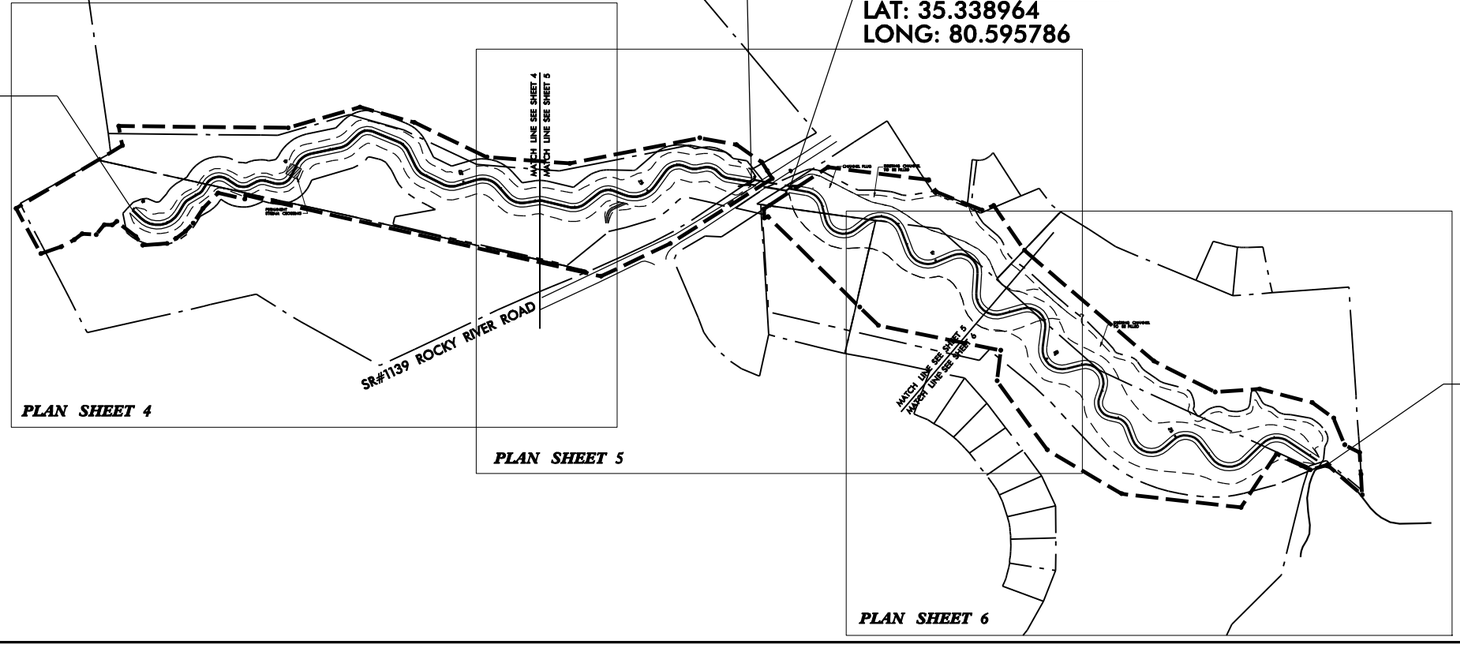
LOCATION MAP

BEGIN UPPER REACH
INDIAN RUN
STA. 10+00.00
LAT: 35.353141
LONG:80.593842

END UPPER REACH
INDIAN RUN
STA. 27+95.66
LAT: 35.339184
LONG: 80.595615

BEGIN LOWER REACH
INDIAN RUN
STA. 10+00.00
LAT: 35.338964
LONG: 80.595786

END LOWER REACH
INDIAN RUN
STA. 28+03.54
LAT: 35.336328
LONG:80.599628



PLAN SHEET 4

PLAN SHEET 5

PLAN SHEET 6

INDEX OF SHEETS

PROJECT: SCO#:030606201

9/23/2011
R:\EEP-WRP\Indian Run\Construction\As-Builts\As_built_plansheets\IndianRun_tsh_asbuilt.dgn
mmeis

GRAPHIC SCALES

50′ 25′ 0 50′ 100′
PLANS

50′ 25′ 0 50′ 100′
PROFILE (HORIZONTAL)

5′ 2.5′ 0 5′ 10′
PROFILE (VERTICAL)

DESIGN DATA

DESIGN STREAM TYPE	=	C4
BANKFULL AREA (SQ. FT)	=	29.26
BANKFULL WIDTH (FT)	=	20.00
BANKFULL DEPTH (FT)	=	1.78
WIDTH/DEPTH RATIO	=	12.00

PROJECT DATA

COMPLETED PRIORITY II STREAM LENGTH (LOWER REACH, BELOW ROCKY RIVER RD.)	=	975 LN. FEET
COMPLETED PRIORITY III STREAM LENGTH (UPPER REACH, ABOVE ROCKY RIVER RD.)	=	1,295 LN. FEET
TOTAL DISTURBED AREA	=	11.31 ACRES

Prepared for:
Ecosystem Enhancement Program

Prepared In the Office of:
HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

ROBIN HOFFMAN
EEP PROJECT MANAGER

TIM BAUMGARTNER
EEP REVIEW COORDINATOR

JONATHAN HENDERSON, P.E.
HDR PROJECT MANAGER

JAMES R. RICE, P.E.
HDR PROJECT DESIGN ENGINEER

PROJECT DESIGN ENGINEER

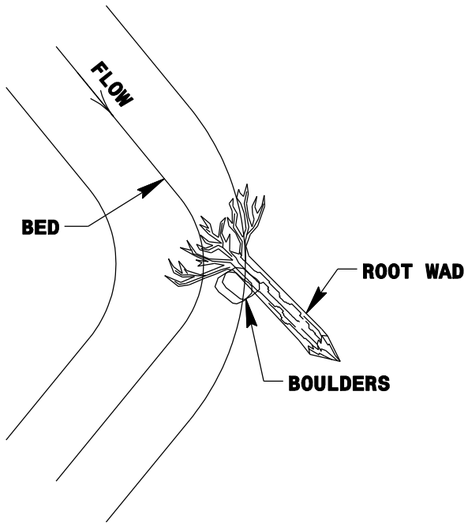
NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

P.E.

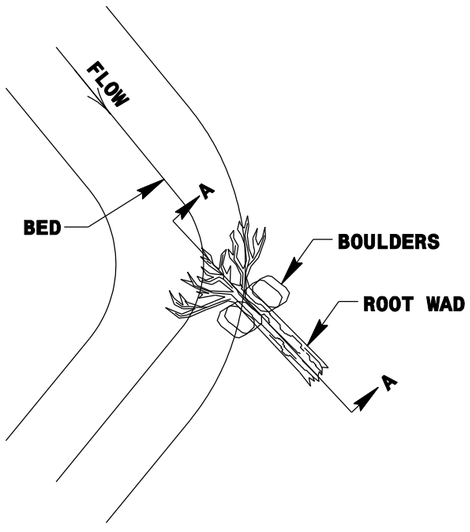
SIGNATURE:

REVISIONS

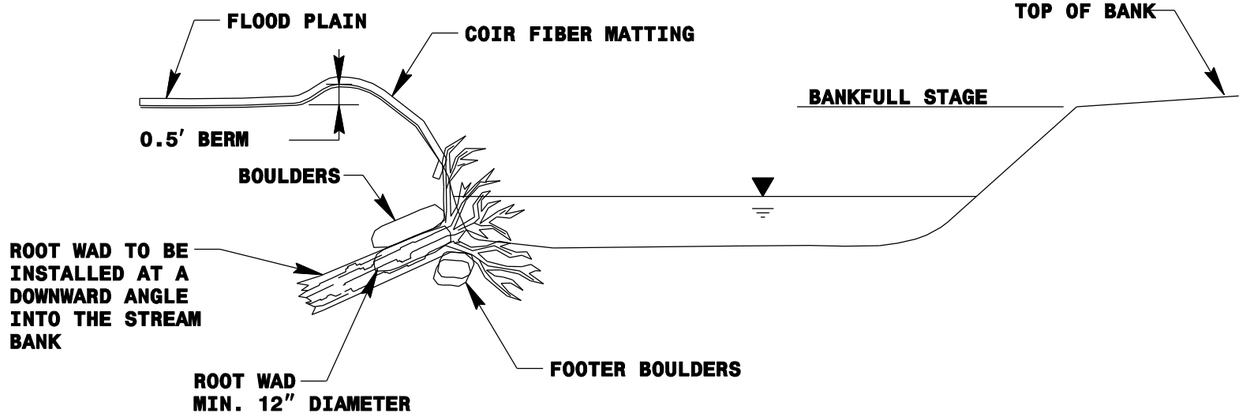
ROOT WAD



PLAN VIEW
DRIVE POINT METHOD



PLAN VIEW
TRENCHING METHOD



SECTION A-A

NOTES:

ORIENT ROOT WADS SO THAT THE STREAM FLOW MEETS THE ROOT WAD STRAIGHT ON, DEFLECTING THE WATER AWAY FROM THE BANK.

METHODS OF INSTALLATION:

DRIVE POINT METHOD:

SHARPEN THE END OF THE LOG BEFORE "DRIVING" AT A DOWNWARD ANGLE INTO THE BANK. BOULDER SHOULD BE PLACED ON EACH SIDE OF THE ROOT WAD TO PIN IT IN PLACE. THE BOULDERS SHALL BE APPROXIMATELY 30" X 30" X 24" . ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.

TRENCHING METHOD:

IF THE ROOT WAD CANNOT BE DRIVEN INTO THE BANK OR THE BANK NEEDS TO BE RECONSTRUCTED, THE TRENCHING METHOD SHOULD BE USED. THIS METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. IN THIS CASE, FOOTER BOUDERS SHOULD BE INSTALLED UNDERNEATH THE ROOT WAD IN A TRENCH EXCAVATED PARALLEL TO THE BANK AND WELL BELOW THE STREAM BED. BOULDERS SHOULD BE PLACED ON EACH SIDE OF THE ROOTWAD TO PIN IT IN PLACE. THE BOULDERS SHOULD BE APPROXIMATELY 30" X 30" X 24" . ONE-THIRD OF THE ROOTWAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS.

RECORD DRAWINGS

SHEET ADDED WHEN ROOTWADS REPLACED BRUSH MATTRESSES DUE TO BEING OUT OF PLANTING SEASON

50 0 100
SCALE

PROJECT ENGINEER

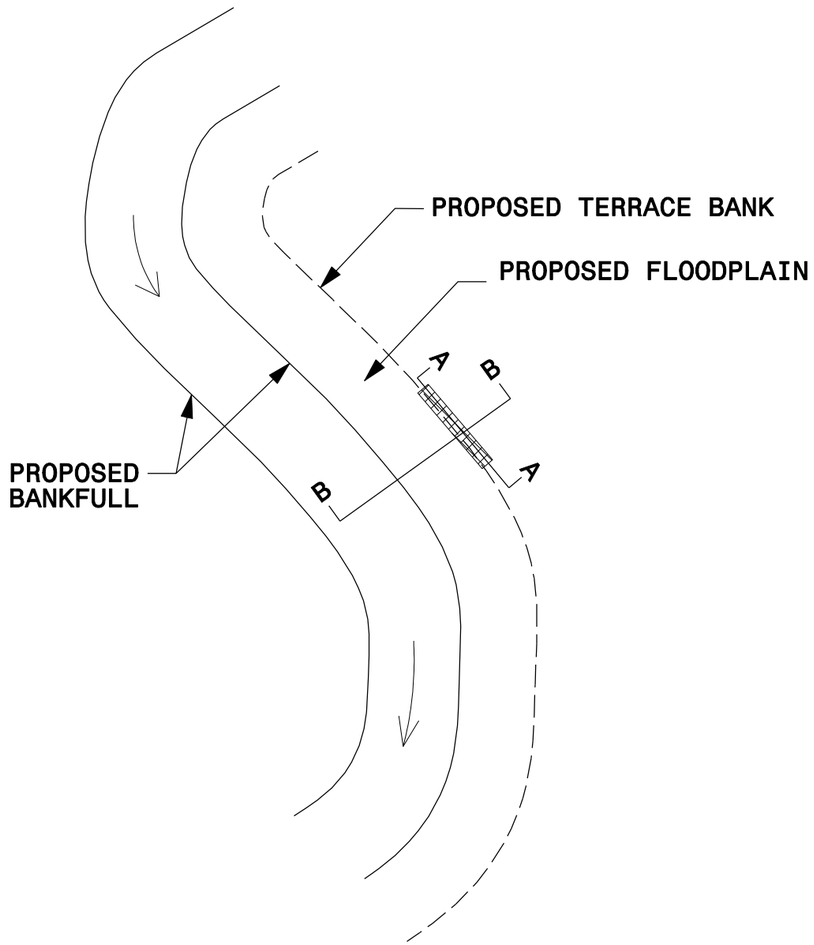
NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201
SHEET 21

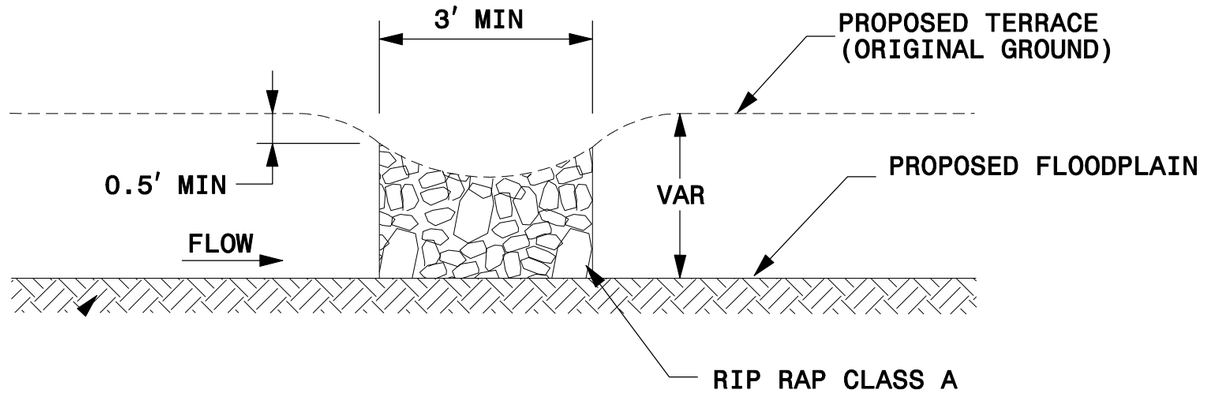
HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

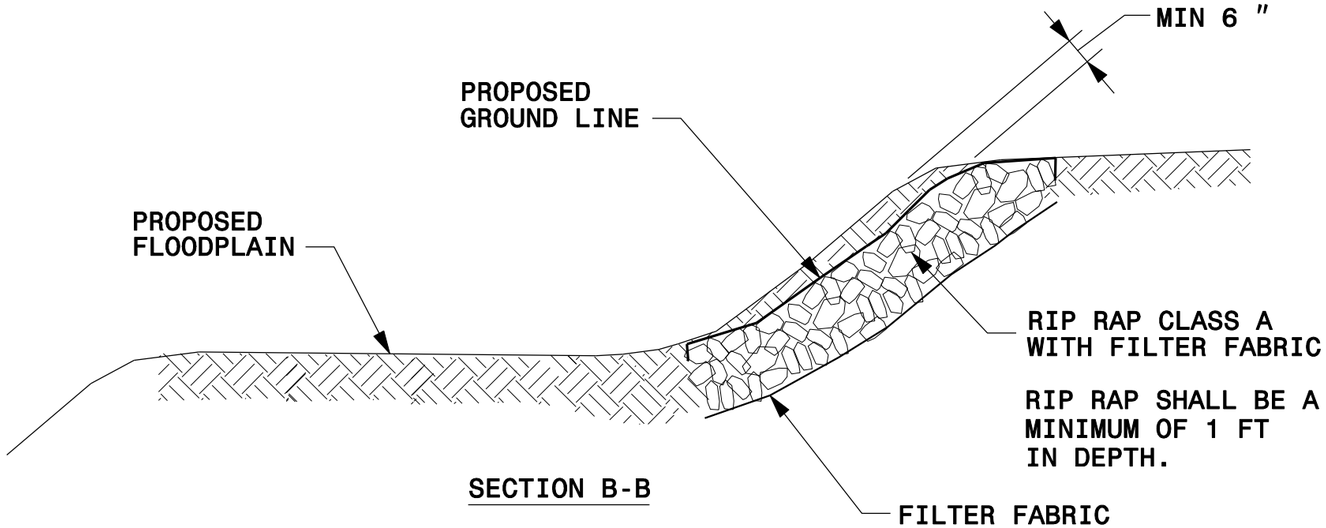
FLOODPLAIN INTERCEPTOR



PLAN VIEW



SECTION A-A



SECTION B-B

NOTE:
FLOODPLAIN INTERCEPTORS SHALL BE PLACED ON-SITE AT AREAS SPECIFIED BY DESIGNER.

RECORD DRAWINGS

SHEET ADDED WHEN OFFSITE WATER ERODED THE BANKS WHEN ENTERING THE FLOODPLAIN

50 0 100
SCALE

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201 SHEET 2J

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

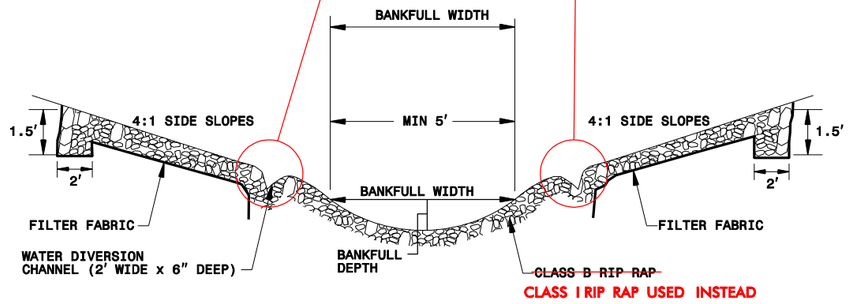
REVISIONS

8/23/2011
R:\EEP-WRP\Indian Run\Construction\As-Builts\As.built_plansheets\indianrun_record_drawing_details.dgn
dmyers

EROSION CONTROL DETAILS

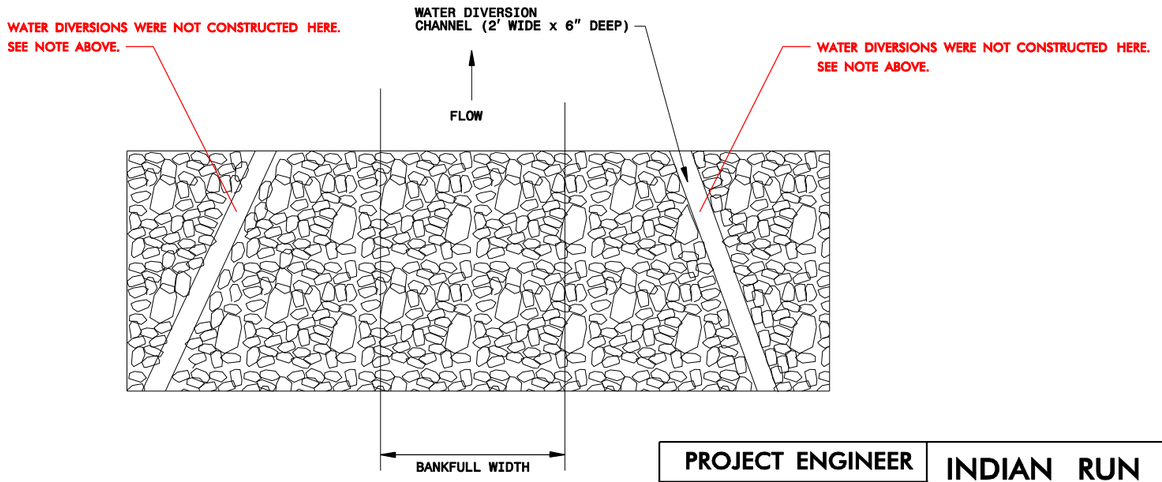
PERMANENT STREAM CROSSING TYPE II

WATER DIVERSIONS WERE NOT CONSTRUCTED HERE
BECAUSE OF THE SIZE OF ROCK USED FOR THE CROSSING.
THE PURPOSE OF THESE DIVERSIONS WERE TO PREVENT
HIGH FLOWS WASHING OUT SMALLER ROCK FROM CROSSING.
SINCE LARGER ROCK WAS USED, THE DIVERSIONS WERE NOT NECESSARY.

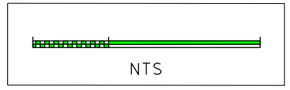


NOTE: CHANNEL CROSS-SECTIONAL GEOMETRY SHALL BE CONSISTENT WITH THE TYPICAL RIFFLE CROSS-SECTION

CROSS-SECTION



PLAN VIEW



RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201
SHEET EC-2E

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

REVISIONS

REVISIONS

PLAN VIEW

PORTION OF UPPER REACH, UPSTREAM OF SEWER CROSSING WAS NOT CONSTRUCTED DUE TO FIBER OPTIC LINE AND EASEMENT CONFLICTS

DESIGNED STRUCTURE BUILT AND DAMAGED DURING STORM EVENT POST CONSTRUCTION. VANE ARM REPLACED AND BOULDERS BURIED BELOW GRADE FOR BANK PROTECTION

FLOODPLAIN CREATED TO PROVIDE ADDITIONAL FLOODPLAIN STORAGE

PERMANENT STREAM CROSSING EXTENDED TO REDUCE EROSION

BEGIN UPPER REACH INDIAN RUN
STA. 10+00.00
LAT: 35.343141
LONG: 80.593842

TOP OF BANK

EXISTING BEDROCK PREVENTED INSTALLATION OF LOG CROSS VANE. STRUCTURE MODIFIED UTILIZING ONE LOG VANE ARM AND ROCK SILL INTO RIGHT BANK

ROOT WADS USED IN PLACE OF BRUSH MATTRESS FOR BANK PROTECTION

FOOTBRIDGE TO BE REMOVED

TOE OF FLOOD PLAIN

TOP OF FLOOD PLAIN

PERMANENT STREAM CROSSING

STOCKPILE LIMITS

STOCKPILE LIMITS

STATE OF NORTH CAROLINA
PIN: 5528435540
DB 578 PG 274

ADDITIONAL WASTE MATERIAL STORED ON SITE FROM ADDITIONAL FLOODPLAIN GRADING

MATCH LINE SHEET 5 STA. 22+11.24

UPPER REACH CURVE DATA

PC STA.	NORTHING	EASTING	CURVE #	PT STA.	NORTHING	EASTING	RADIUS	POOL LOCATION	BKF. ELEV.	EXISTING ELEV. @PC
10+00.00	583,628.23	1,524,722.76	BEGIN	N/A	N/A	N/A	N/A	N/A		
10+28.38	583,617.52	1,524,696.48	R-1	11+36.53	583,527.17	1,524,670.23	60.0'	RIGHT	547.14	546.02
11+62.40	583,506.09	1,524,685.24	R-2	11+77.56	583,492.08	1,524,690.60	30.0'	LEFT	546.82	544.49
12+07.96	583,461.88	1,524,694.04	R-3	12+22.51	583,448.37	1,524,699.06	30.0'	RIGHT	546.45	544.56
12+40.30	583,433.67	1,524,709.08	R-4	12+97.61	583,383.22	1,524,698.97	36.0'	LEFT	546.23	544.77
13+21.61	583,370.13	1,524,678.87	R-5	13+60.47	583,336.88	1,524,662.64	36.0'	RIGHT	545.93	543.05
13+75.65	583,321.76	1,524,663.94	R-6	14+02.46	583,296.75	1,524,656.28	35.0'	LEFT	545.74	543.51
14+25.34	583,278.96	1,524,641.88	R-7	14+73.96	583,234.16	1,524,642.53	35.0'	RIGHT	545.46	543.55
15+04.56	583,210.93	1,524,662.45	R-8	15+50.23	583,168.23	1,524,673.46	50.0'	LEFT	545.08	542.59
16+23.78	583,096.21	1,524,658.54	R-9	16+51.74	583,068.69	1,524,660.62	50.0'	RIGHT	544.18	542.75
16+79.91	583,042.27	1,524,670.41	R-10	17+20.19	583,005.10	1,524,662.08	35.0'	LEFT	543.83	541.90
17+85.91	582,959.12	1,524,615.12	R-11	18+22.43	582,944.89	1,524,582.37	50.0'	LEFT	543.02	542.14
18+63.08	582,943.08	1,524,541.76	R-12	18+95.88	582,931.35	1,524,511.75	50.0'	RIGHT	542.51	541.92
19+45.88	582,899.12	1,524,473.53	R-13	19+82.91	582,867.36	1,524,456.18	50.0'	RIGHT	541.90	540.54
20+33.64	582,817.06	1,524,449.62	R-14	20+89.56	582,776.10	1,524,415.89	50.0'	LEFT	541.27	541.09
21+25.33	582,764.77	1,524,381.97	R-15	21+75.06	582,729.90	1,524,349.42	50.0'	RIGHT	541.10	539.75

LEGEND

- CONSTRUCTION LIMIT
- LOG CROSS VANE
- BRUSH MATRESS
- CHANNEL PLUG
- ROCK CROSS VANE
- CORRECT CONSERVATION EASEMENT
- NEW CONSTRUCTION LIMIT
- BOUNDARY MARKER
- PROPERTY LINE
- EXISTING CENTERLINE OF STREAM
- LOG SILL
- LOG VANE W/ROOTWAD
- LOG VANE W/ROOTWAD AND SILL
- DIVERSION DITCH
- ROCK BOULDERS
- ROOT WADS
- FLOODPLAIN INTERCEPTOR
- BANKFULL BENCH
- TOP OF BANK

UPPER REACH STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	1/2 BKF. ELEVATION
LOG CROSS VANE	10+28.38	546.02	547.14	546.25
LOG VANE W/ROOTWAD	11+14.50	545.81	547.14	546.25
LOG VANE W/ROOTWAD	12+40.30	545.10	546.23	545.34
LOG VANE W/ROOTWAD & SILL	13+21.61	544.25	545.93	545.04
LOG VANE W/ROOTWAD	14+25.34	544.34	545.46	544.57
ROCK CROSS VANE	15+04.56	543.31	545.09	544.20
LOG SILL	15+65.00	543.13	544.90	
LOG VANE W/ROOTWAD	16+23.78	543.05	544.18	543.29
LOG VANE W/ROOTWAD & SILL	16+79.91	542.70	543.83	542.94
LOG VANE W/ROOTWAD	17+85.91	541.89	543.02	542.13
LOG CROSS VANE	18+75.38	541.18	542.51	541.62
LOG VANE W/ROOTWAD	19+45.88	540.77	541.90	541.01
LOG VANE W/ROOTWAD & SILL	21+25.33	539.94	541.10	540.21

50 0 100
SCALE

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)

CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET 4

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

10/3/2011
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PLAN VIEW

UPPER REACH CURVE DATA

PC STA.	NORTHING	EASTING	CURVE #	PT STA.	NORTHING	EASTING	RADIUS	POOL LOCATION	BKF. ELEV.	EXISTING ELEV. @PC
22+07.37	582,698.61	1,524,341.31	R-16	22+19.24	582,688.00	1,524,336.16	30.0'	LEFT	540.79	538.72
22+84.08	582,636.36	1,524,296.95	R-17	23+29.12	582,593.69	1,524,288.35	50.0'	RIGHT	540.04	539.39
23+69.01	582,555.05	1,524,298.27	R-18	24+10.66	582,516.69	1,524,287.69	40.0'	LEFT	539.57	538.93
24+36.55	582,498.47	1,524,269.30	R-19	25+22.65	582,419.17	1,524,259.10	65.0'	RIGHT	539.22	538.23
25+66.02	582,381.84	1,524,281.18	R-20	26+18.62	582,333.32	1,524,275.17	40.0'	LEFT	539.09	538.18
26+32.36	582,323.57	1,524,265.50	R-21	26+52.45	582,306.18	1,524,255.96	36.0'	RIGHT	538.90	537.05
26+69.76	582,289.30	1,524,252.13	R-22	27+03.09	582,264.41	1,524,231.78	36.0'	LEFT	538.70	537.44
27+16.96	582,258.73	1,524,219.12	R-23	27+37.62	582,245.45	1,524,203.66	36.0'	RIGHT	538.47	536.57
27+95.66	582,196.74	1,524,172.11	END	N/A	N/A	N/A	N/A	N/A	537.31	536.59

LOWER REACH CURVE DATA

PC STA.	NORTHING	EASTING	CURVE #	PT STA.	NORTHING	EASTING	RADIUS	POOL LOCATION	BKF. ELEV.	EXISTING ELEV. @PC
10+00.00	582,117.49	1,524,119.81	BEGIN	N/A	N/A	N/A	N/A	N/A		536.31
10+42.20	582,082.28	1,524,096.56	LR-1	10+99.44	582,060.44	1,524,047.00	50.0'	LEFT	536.58	536.87
11+34.33	582,065.91	1,524,012.53	LR-2	12+25.19	582,009.23	1,523,960.72	46.0'	RIGHT	536.18	542.07
12+60.48	581,975.01	1,523,969.34	LR-3	13+64.99	581,905.38	1,523,912.34	56.0'	LEFT	535.78	541.13
14+18.01	581,907.95	1,523,859.38	LR-4	14+98.47	581,858.50	1,523,806.96	50.0'	RIGHT	535.17	540.00
15+42.85	581,814.13	1,523,806.53	LR-5	16+34.61	581,774.62	1,523,740.82	50.0'	LEFT	534.67	539.76
16+84.14	581,797.42	1,523,696.85	LR-6	17+79.45	581,760.15	1,523,624.34	50.0'	RIGHT	534.10	538.79

END UPPER REACH
INDIAN RUN
STA. 27+95.66
LAT: 35.339184
LONG: 80.595615

BEGIN LOWER REACH
INDIAN RUN
STA. 10+00.00
LAT: 35.338964
LONG: 80.595786

LOG CROSS VANE USED INSTEAD OF ROCK CROSS VANE

10X12 BOX CULVERT

ROCK WALL ADDED TO HELP DIRECT STREAM FLOW INTO NEWLY CONSTRUCTED CHANNEL

BOULDER CREEK HOMEOWNERS ASSOC.
PIN: 5528410953
DB 2641 PG 104

ADDED ROOT WAD

ADDED ROOT WADS

STOCKPILE AREA

STOCKPILE LIMITS

STATE OF NORTH CAROLINA
PIN: 5528435540
DB 578 PG 274

ROCKY RIVER ROAD

AS PART OF STORM REPAIR, TRIBUTARY TIE IN WAS ARMORED TO PROTECT AGAINST FLASHY STORMWATER DIRECTED TO STREAM IN THIS LOCATION

SANITARY SEWER LINE WITH 30' RW

AUTUMN RIDGE II HOMEOWNERS ASSOC.
PIN: 5528310585
MB 32 PG 8

TOP OF FLOOD PLAIN

TOE OF FLOOD PLAIN

MATCH LINE SHEET 4 STA. 22+11.24

MATCH LINE SHEET 6 STA. 17+39.17

LEGEND

- CONSTRUCTION LIMIT
- CORRECT CONSERVATION EASEMENT
- LOG CROSS VANE
- BRUSH MATRESS
- CHANNEL PLUG
- ROCK CROSS VANE
- EXISTING CHANNEL TO BE FILLED
- BOUNDARY MARKER
- PROPERTY LINE
- EXISTING CENTERLINE OF STREAM
- LOG SILL
- LOG VANE W/ROOTWAD
- LOG VANE W/ROOTWAD AND SILL
- FLOODPLAIN INTERCEPTOR
- ROOT WADS
- ROCK BOULDERS
- DIVERSION DITCH
- ROCK WALL
- BANKFULL BENCH
- TOP OF BANK

UPPER REACH STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	1/2 BKF. ELEVATION
LOG CROSS VANE	22+84.08	538.77	539.90	539.01
LOG VANE W/ROOTWAD	23+69.01	538.28	539.40	538.68
LOG CROSS VANE	24+99.34	537.73	539.08	538.19
LOG VANE W/ROOTWAD	25+66.02	537.43	538.55	537.66
LOG VANE W/ROOTWAD	26+73.07	536.95	538.17	537.28
ROCK CROSS VANE	27+46.45	536.76	538.00	537.11

LOWER REACH STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	1/2 BKF. ELEVATION
ROCK CROSS VANE	10+42.20	534.80	536.58	535.69
LOG VANE W/ROOTWAD	11+34.33	534.40	536.18	535.29
LOG VANE W/ROOTWAD & SILL	12+60.48	534.00	535.78	534.89
LOG VANE W/ROOTWAD	13+41.00	533.52	535.78	534.89
LOG CROSS VANE	14+18.01	533.39	535.17	534.28
LOG VANE W/ROOTWAD	15+42.85	532.89	534.67	533.78
LOG VANE W/ROOTWAD & SILL	16+84.14	532.32	534.10	533.21

50 0 100
SCALE

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)

CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET 5

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

REVISIONS

8/23/2011
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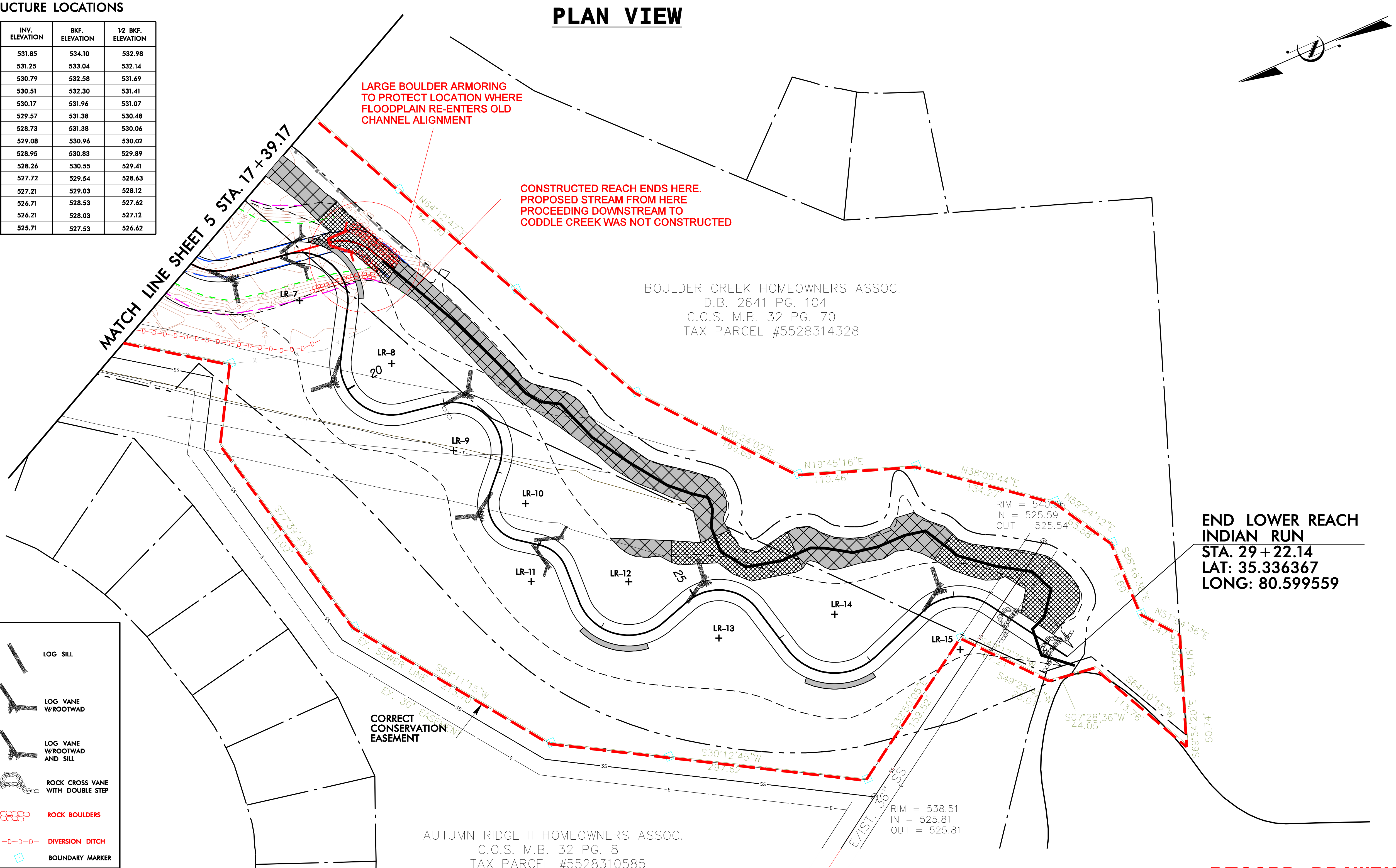
REVISIONS

LOWER REACH STRUCTURE LOCATIONS

STRUCTURE TYPE	STATION	INV. ELEVATION	BKF. ELEVATION	1/2 BKF. ELEVATION
LOG VANE W/ROOTWAD	17+56.51	531.85	534.10	532.98
LOG CROSS VANE	18+73.22	531.25	533.04	532.14
LOG CROSS VANE	20+10.23	530.79	532.58	531.69
LOG CROSS VANE	20+86.90	530.51	532.30	531.41
LOG CROSS VANE	21+75.00	530.17	531.96	531.07
LOG VANE W/ROOTWAD & SILL	23+46.30	529.57	531.38	530.48
LOG VANE W/ROOTWAD	23+87.24	528.73	531.38	530.06
LOG VANE W/ROOTWAD & SILL	25+55.49	529.08	530.96	530.02
LOG VANE W/ROOTWAD & SILL	26+02.48	528.95	530.83	529.89
LOG CROSS VANE	26+77.66	528.26	530.55	529.41
ROCK CROSS VANE	27+17.89	527.72	529.54	528.63
ROCK CROSS VANE	27+25.52	527.21	529.03	528.12
ROCK CROSS VANE	27+33.96	526.71	528.53	527.62
ROCK CROSS VANE	27+42.12	526.21	528.03	527.12
ROCK CROSS VANE	27+49.84	525.71	527.53	526.62

PLAN VIEW



LEGEND

- CONSTRUCTION LIMIT
- CORRECT CONSERVATION EASEMENT
- LOG CROSS VANE
- BRUSH MATRESS
- CHANNEL PLUG
- ROCK CROSS VANE
- EXISTING CHANNEL TO BE FILLED
- LOG SILL
- LOG VANE W/ROOTWAD
- LOG VANE W/ROOTWAD AND SILL
- ROCK CROSS VANE WITH DOUBLE STEP
- ROCK BOULDERS
- —D—D—D— DIVERSION DITCH
- BOUNDARY MARKER

LOWER REACH CURVE DATA

PC STA.	NORTHING	EASTING	CURVE #	PT STA.	NORTHING	EASTING	RADIUS	POOL LOCATION	BKF. ELEV.	EXISTING ELEV. @PC
18+73.22	581,667.34	1,523,610.98	LR-7	19+18.97	581,632.50	1,523,584.43	45.0'	LEFT	533.04	534.90
19+80.09	581,602.77	1,523,531.02	LR-8	19+85.70	581,600.40	1,523,525.94	40.0'	LEFT	532.73	530.79
21+16.81	581,553.26	1,523,403.60	LR-9	21+24.22	581,548.38	1,523,398.25	10.0'	RIGHT	532.25	529.93
21+38.55	581,635.56	1,523,391.85	LR-10	21+46.18	581,530.61	1,523,386.29	10.0'	LEFT	532.14	530.17
21+77.37	581,520.04	1,523,356.94	LR-11	21+86.83	581,515.81	1,523,348.50	40.0'	RIGHT	531.96	529.95
22+77.71	581,465.84	1,523,272.60	LR-12	22+94.95	581,453.60	1,523,260.65	40.0'	RIGHT	531.61	529.08
23+05.06	581,445.02	1,523,255.30	LR-13	23+17.56	581,440.59	1,523,244.47	10.0'	LEFT	531.56	528.41
23+46.30	581,447.35	1,523,216.53	LR-14	24+19.97	581,407.12	1,523,167.15	40.0'	RIGHT	531.38	529.93
24+49.39	581,377.72	1,523,168.14	LR-15	24+76.08	581,352.69	1,523,160.40	40.0'	LEFT	531.23	528.86
24+87.68	581,343.34	1,523,153.53	LR-16	25+12.06	581,320.63	1,523,145.78	40.0'	RIGHT	531.18	528.98
25+55.11	581,277.59	1,523,144.74	LR-17	25+76.67	581,260.23	1,523,133.78	20.0'	LEFT	530.96	529.38
26+02.48	581,248.57	1,523,110.75	LR-18	26+24.28	581,212.88	1,523,094.87	40.0'	RIGHT	530.83	529.10
26+78.02	581,188.40	1,523,066.47	LR-19	27+15.32	581,179.42	1,523,033.75	25.0'	LEFT	530.05	528.08
27+53.49	581,196.97	1,522,999.85	LR-20	27+84.97	581,190.63	1,522,971.11	25.0'	RIGHT	527.03	534.24
28+03.54	581,176.72	1,522,971.11	END	N/A	N/A	N/A	N/A	N/A	529.11	523.78

PLANTING LEGEND

- ZONE 1
- ZONE 2
- ZONE 3

50 0 100
SCALE

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 31986 JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)

CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET 6

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

9/23/2011
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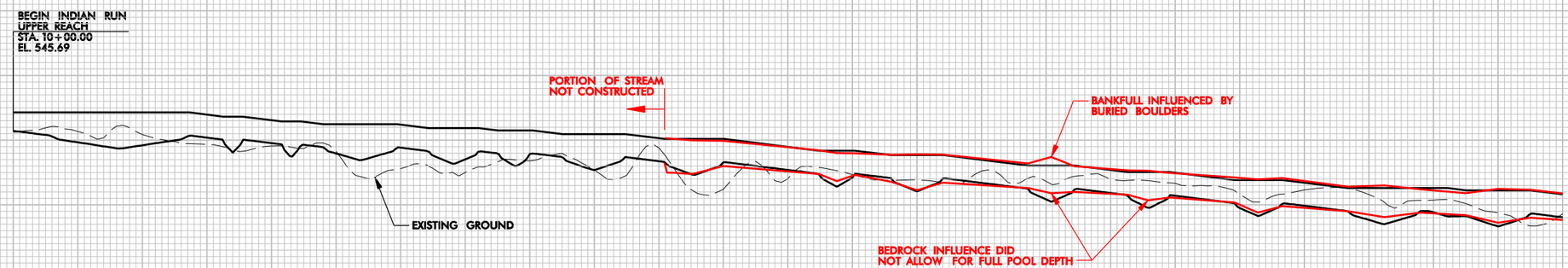
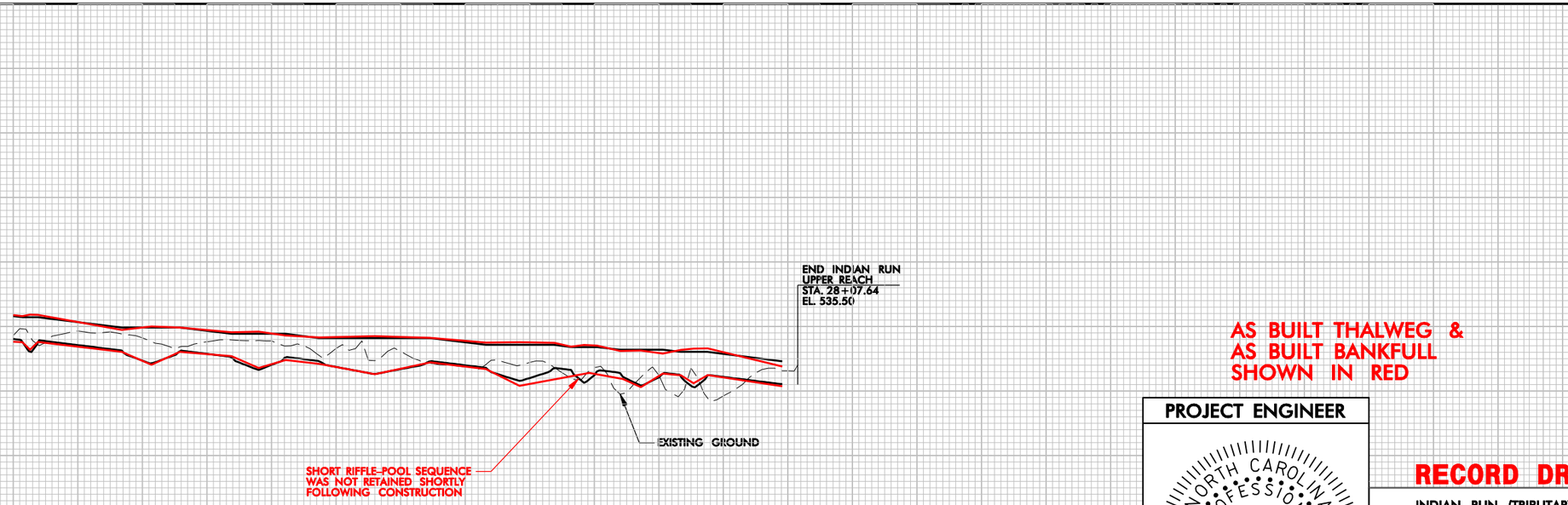


AS BUILT THALWEG &
AS BUILT BANKFULL
SHOWN IN RED

UPPER REACH



AS BUILT THALWEG &
AS BUILT BANKFULL
SHOWN IN RED

UPPER REACH

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

RECORD DRAWINGS

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET 7

Ecosystem Enhancement Program

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

9/23/2011
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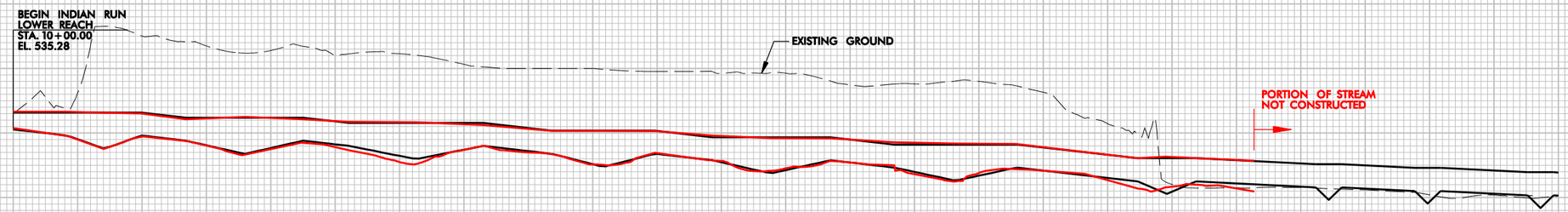

LOWER REACH

**AS BUILT THALWEG &
AS BUILT BANKFULL
SHOWN IN RED**

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00

22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00

540 535 530 525 520

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

RECORD DRAWINGS

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET 8

Ecosystem Enhancement Program

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

9/23/2011
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8/23/99

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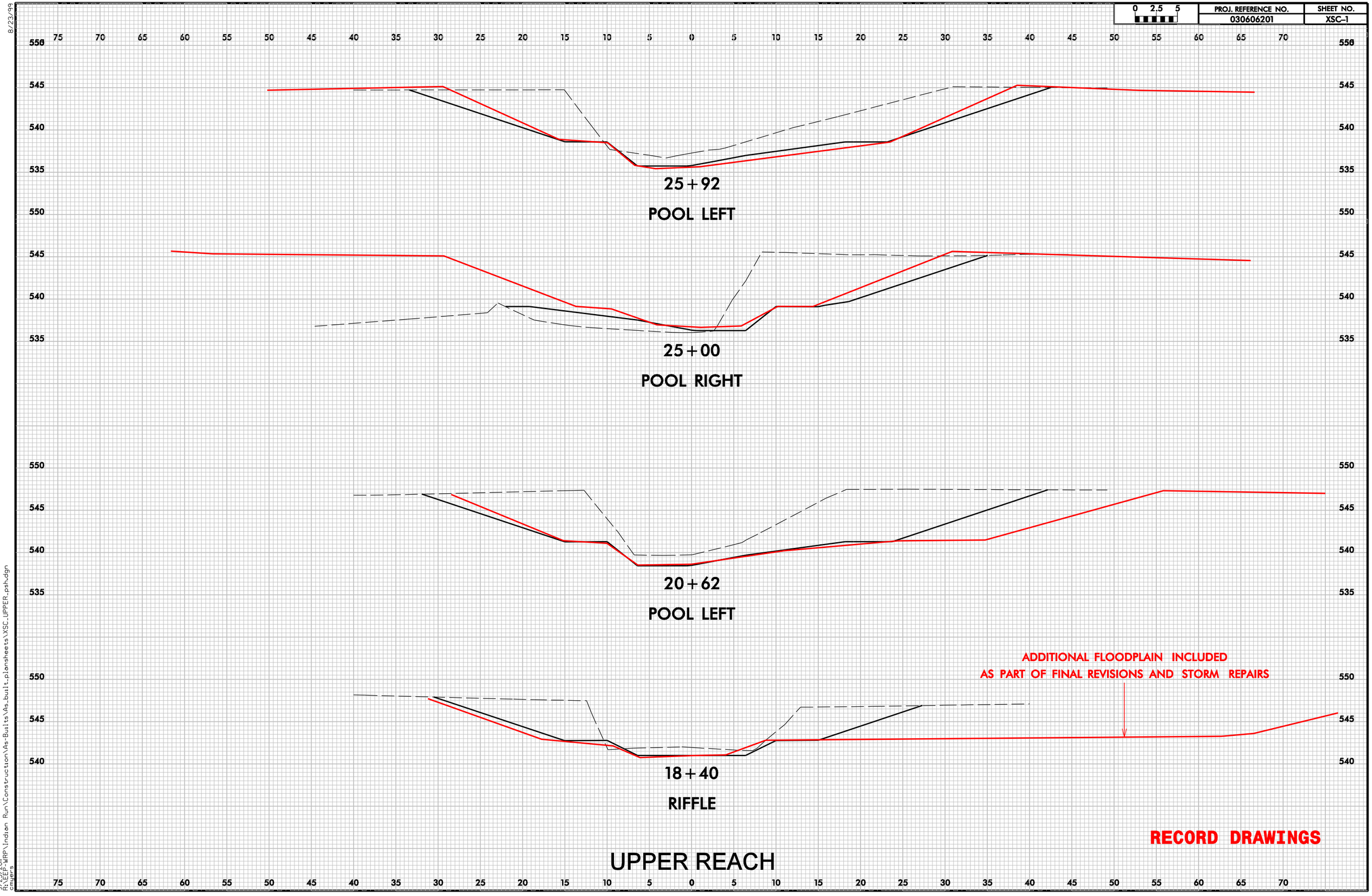
	030606201	XSC-1



RECORD DRAWINGS

UPPER REACH

9/23/2011
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cmyers

8/23/99

0 2.5 5	PROJ. REFERENCE NO.	SHEET NO.
	030606201	XSC–13

75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

545 540 535 530

16+50
RIFFLE

15+89
POOL LEFT

13+10
POOL LEFT

11+15
RIFFLE

RECORD DRAWINGS

–LOWER REACH–

9/23/2011
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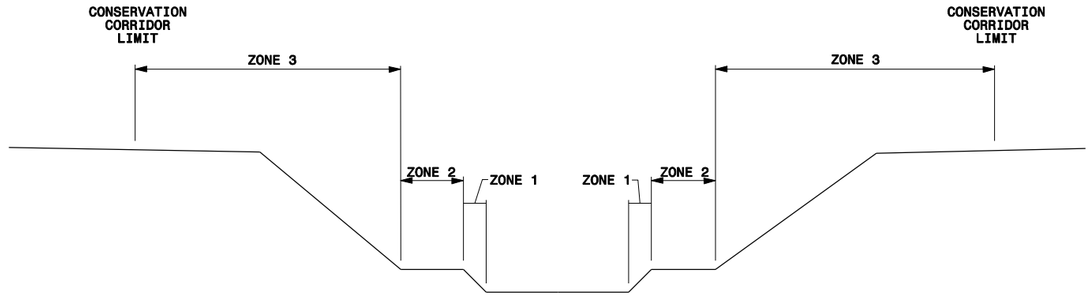
cmyer-s

REVISIONS

PLANTING DETAILS



ZONE 1

LIVE STAKES

Species Name	Common Name
Cephalanthus occidentalis	Button bush
Cornus amomum	Silky dogwood
Salix higra	Black willow
Physocarpus opulifolius	Ninebark
Salix sericea	Silky willow
Sambucus canadensis	Elderberry
Symphoricarpos orbiculatus	Coral-berry

A minimum of 4 out of the 7 species to be installed approx. 3' on center (4840 stakes/acre)

TEMPORARY SEEDING

Species Name	Common Name
Secale cereale	Rye grain (for cool season)

Applied at a rate of 50lbs per acre

PERMANENT SEED MIX

Species Name	Common Name
Andropogon gerardii	Big bluestem
Panicum clandestinum	Deertongue
Chasmanthium latifolium	River oats
Elymus virginicus	Virginia wildrye
Tripsacum dactyloides	Eastern gama grass
Eragrostis spectabilis	Purple love grass

A minimum of 4 out of the 6 species applied at 40 lbs/acre from April 1st to July 1st

ZONE 2

CONTAINERIZED/PLUG

Species Name	Common Name
Alnus serrulata	Tag alder
Asimina triloba	Pawpaw
Callicarpa americana	Beautyberry
Calycanthus floridus	Sweet-shrub
Cephalanthus occidentalis	Button bush
Itea virginica	Virginia willow
Lindera benzoin	Spicebush
Sambucus canadensis	Elderberry
Symphoricarpos orbiculatus	Coral-berry

A minimum of 5 out of the 10 species to be installed approx. 15' on center. 30-40% container, the remainder to be plugs.

BARE ROOT

Species Name	Common Name
Cornus amomum	Silky dogwood
Almus serrulata	Tag alder
Acer rubrum	Red maple
Betula nigra	River birch
Celtis laevigata	Sugarberry
Fraxinus pennsylvanica	Green Ash
Nyssa sylvatica	Black gum
Platanus occidentalis	Sycamore
Quercus nigra	Water oak
Quercus phellos	Willow oak

A minimum of 6 out of the 10 species to be installed approx. 8' on center (680 bare roots/acre)

ZONE 3

BARE ROOT

Species Name	Common Name
Acer rubrum	Red maple
Betula nigra	River birch
Celtis laevigata	Sugarberry
Fraxinus pennsylvanica	Green Ash
Nyssa sylvatica	Black gum
Platanus occidentalis	Sycamore
Quercus nigra	Water oak
Quercus phellos	Willow oak
Diospyros virginiana	Persimmon
Juglans nigra	Black walnut

A minimum of 6 out of the 10 species to be installed approx. 8' on center (680 bare roots/acre)

SEE SPECIAL PROVISIONS FOR SPECIFICATIONS

NTS

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201
SHEET PL-2A

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

8/23/2011
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dmeek

PLANTING PLAN

REVISIONS

NO PLANTINGS ON UNCONSTRUCTED PORTION OF UPPER REACH. PLANTINGS ANTICIPATED FOR THIS SECTION WERE SPREAD THROUGHOUT THE CONSTRUCTED PORTION OF SITE. ALL DESIGN PLANTING AMOUNTS WERE USED.

BEGIN UPPER REACH
INDIAN RUN
STA. 10+00.00
LAT: 35.343141
LONG: 80.593842

ADDITIONAL ZONE 2-FLOODPLAIN

CONSTRUCTION LIMIT

PROPERTY LINE

FOOTBRIDGE TO BE REMOVED

CONSERVATION EASEMENT

EXISTING CENTERLINE OF STREAM

PERMANENT STREAM CROSSING

48" OAK TO BE RETAINED

BELLSOUTH PHONE LINE

EXISTING SANITARY SEWER WITH 30' R/W

ADDITIONAL ZONE 2-FLOODPLAIN

EASEMENT ENCROACHING PLANTING

20' SSRW

MATCH LINE SHEET PL-4 STA. 22+11.24

LEGEND

- ZONE 1 – STREAMSIDE
- ZONE 2 – FLOODPLAIN
- ZONE 3– UPLAND

50 0 100
SCALE

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201
SHEET PL-3

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

8/23/2011
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mmoss

PLANTING PLAN

REVISIONS

END UPPER REACH
INDIAN RUN
STA. 27+95.66
LAT: 35.339184
LONG: 80.595615

BEGIN LOWER REACH
INDIAN RUN
STA. 10+00.00
LAT: 35.338964
LONG: 80.595786

CONSERVATION EASEMENT
CONSTRUCTION LIMIT
PROPERTY LINE
10X12 BOX CULVERT
CHANNEL PLUG
EXISTING CHANNEL TO BE FILLED
CONSTRUCTION LIMITS
EXCAVATION LIMITS
EXISTING CENTERLINE OF STREAM

MATCH LINE SHEET PL-3 STA. 22+11.24

STATE OF NORTH CAROLINA
PIN: 5528435540
DB 578 PG 274

ROCKY RIVER ROAD

ADDITIONAL ZONE 2-FLOODPLAIN

BOULDER CREEK HOMEOWNERS ASSOC.
PIN: 5528410953
DB 2641 PG 104

SANITARY SEWER LINE WITH 30' R/W

BELLSOUTH FIBER OPTIC

AUTUMN RIDGE II HOMEOWNERS ASSOC.
PIN: 5528310585
MB 32 PG 8

CONSERVATION EASEMENT

AUTUMN RIDGE II HOMEOWNERS ASSOC.
PIN: 5528310585
MB 32 PG 8

MATCH LINE SHEET PL-5 STA. 17+39.17

LEGEND

- ZONE 1 – STREAMSIDE
- ZONE 2 – FLOODPLAIN
- ZONE 3– UPLAND

50 0 100
SCALE

RECORD DRAWINGS

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)
CABARRUS COUNTY, NC
SCO PROJECT NO. 030606201
SHEET PL-4

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

8/23/2011
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dmoss

PLANTING PLAN

REVISIONS

MATCH LINE SHEET PL-4 STA. 17+39.17

PROPERTY LINE

PLANTING ENDED HERE AT END OF CONSTRUCTED AREA. PLANTINGS ANTICIPATED FROM HERE TO THE END OF THE LOWER REACH WERE SPREAD THROUGHOUT THE CONSTRUCTED PORTION OF THE SITE. ALL DESIGN PLANTING AMOUNTS WERE USED.

EXCAVATION LIMITS

EXISTING CHANNEL TO BE FILLED

BOULDER CREEK HOMEOWNERS ASSOC.
D.B. 2641 PG. 104
C.O.S. M.B. 32 PG. 70
TAX PARCEL #5528314328

CONSTRUCTION LIMITS

CONSERVATION EASEMENT

EXISTING CENTERLINE OF STREAM

AT&T FIBER OPTIC

BELLSOUTH FIBER OPTIC

CONSTRUCTION LIMITS

RIM = 541.06
IN = 525.59
OUT = 525.54

END LOWER REACH
INDIAN RUN
STA. 29+22.14
LAT: 35.336367
LONG: 80.599559

CONSERVATION EASEMENT

EXISTING SANITARY SEWER WITH 30' RW

EXISTING CENTERLINE OF CODDLE CREEK

EXIST. 36" SS

RIM = 538.51
IN = 525.81
OUT = 525.81

AUTUMN RIDGE II HOMEOWNERS ASSOC.
C.O.S. M.B. 32 PG. 8
TAX PARCEL #5528310585

RECORD DRAWINGS

LEGEND

- ZONE 1 – STREAMSIDE
- ZONE 2 – FLOODPLAIN
- ZONE 3– UPLAND

50 0 100
SCALE

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 31986 ENGINEER JAMES R. RICE

INDIAN RUN (TRIBUTARY TO CODDLE CREEK)

CABARRUS COUNTY, NC

SCO PROJECT NO. 030606201

SHEET PL-5

HDR Engineering, Inc. of the Carolinas
3733 National Drive, Suite 207 Raleigh, N.C. 27612

Ecosystem Enhancement PROGRAM

8/23/2010
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