REEDY BRANCH
FINAL MONTORING REPORT
MONITORING YEAR 4
2008

EEP Project # 301

Alamance County, North Carolina

Submitted to:

NCDENR-EEP

1652 Mail Service Center

Raleigh, NC 27699

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EEP Project # 301
Alamance County, North Carolina

Original Design Firm:
ECOLOGIC ASSOCIATES PC
218-4 Swing Road
Greensboro, NC 27409

Submitted to:

Ecosystem Enhancement Program

NCDENR-EEP
1652 Mail Service Center
Raleigh, NC 27699

Monitoring Firm:

SEPI Engineering Group

1025 Wade Avenue
Raleigh, North Carolina 27605
Phone: (919)789-9977
Project Manager:
Phillip Todd
ptodd@sepiengineering.com

REEDY BRANCH STREAM RESTORATION
MONITORING YEAR 4 REPORT

CONDUCTED FOR:
NCDENR ECOSYSTEM ENHANCEMENT PROGRAM

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Executive Summary

Reedy Branch is a typical stream within this and surrounding watersheds, exhibiting instability and degradation in response to current and historical land use practices. Reedy Branch is a tributary of Cane Creek in the Cape Fear River Basin. The project site is located off of Quakenbush Road near Snow Camp, NC. Cattle pasture and chicken production make up the farm surrounding the restoration site. The restored stream is enclosed in a moderately dense wooded area and contains large bedrock outcrops as well other sporadic occurrences of bedrock throughout the reach. The site is located in the Carolina Slate Belt, known for shallow soils and high run-off during storm events resulting in very "flashy" flows and streams that tend to dry out during the summer as was confirmed during Monitoring Year 3. The main goal of this restoration project was to improve water quality in the Cape Fear River basin. Overall, Reedy Branch covers approximately 3,155 linear feet of stream. The reach is moderately to highly sinuous. The construction phase of the project included the improvement of bank stability and in-stream feature morphology while saving as much native forest vegetation as possible and preserving or enhancing several small wetlands located adjacent to the channel.

Current monitoring for the site consists of evaluating both stream morphology and riparian vegetation. The stream monitoring included a longitudinal survey, cross section surveys, pebble counts, problem area identification, and photo documentation. The vegetation assessment included a tally of planted vegetation in permanent vegetation plots, vegetation-specific problem area identification (i.e. bare areas and invasive species), and photo documentation. It should be noted that Monitoring Year 1 vegetation plot stem count totals are unknown (i.e. never reported to SEPI). The planted stems were not originally marked after vegetation installation. Therefore, all stem density and survivability calculations from vegetation plots stem counts are based upon using Monitoring Year 2 'planted' stem counts as a baseline. SEPI project scientists had to use their best judgement to determine which stems were 'planted' versus which were 'volunteers.' The determination of which species were likely 'planted' stems was based on the species listed in the planting plan.

The overall pattern, dimension, and profile have remained stable through Monitoring Year 4. The channel bed substrate size distributions have remained fairly consistent through Monitoring Year 4, with the exception of cross sections 1 and 3 where a silt fining effect was observed between monitoring years. This silt presumably came from an upstream source because these two cross sections are on the upstream end of the project. The silt probably collects in the riffles as they go dry. Silt is last particle class to fall out of entrainment as discharge decreases and gets filtered out by grass that grows in the channel as the riffles go dry. In addition, a significant coarsening was observed a cross section 5 (pool) where fining was observed in Monitoring Year 3.

Much of the bank erosion listed in previous monitoring years has healed over time and much of the aggradation has cleared. There are several continuing problems with in-stream structures. Several crossvanes were rated severe, and there were several rootwads noted to be placed too high on the bank.

At the end of Monitoring Year 4, it may be concluded that 'planted seedling' tree survival may be inhibited to some degree in many areas by high densities of Japanese stilt grass (i.e., all vegetation plots were noted to have at least some Japanese stilt grass). Japanese stilt grass is known to limit native understory plants in sunny to shady and wet to dry areas. In addition, the invasion of this Japanese stilt grass may be facilitated by heavy browsing in areas with dense deer

populations (USFS 2005), such as the Reedy Branch site. 'Planted stem' survival has been limited to a level below the final Monitoring Year 5 goal of 260 only in plots 6, 7, 8, 10, and 11. The overall the 'planted' seedling density across all plots is 463 stems per acre, meeting the Monitoring Year 5 stem density goal.

1.0 PROJECT BACKGROUND

1.1 Project Objectives

Reedy Branch is a typical stream within this and surrounding watersheds, exhibiting instability and degradation in response to current and historical land use practices. The main goal of this restoration project was to improve water quality in the Cape Fear River basin. The specific objectives of this project were to:

1. Improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer;
2. Reestablish stable channel dimension, pattern, and profile;
3. Restore a functioning floodplain;
4. Enhance aquatic and terrestrial habitats in the stream corridor;
5. Assist the landowner to dedicate the entire floodplain as a wildlife area; and,
6. Provide at least one stable cattle crossing across the main channel.

1.2 Project Structure, Restoration Type, and Approach

Overall, Reedy Branch covers approximately 3,100 linear feet of stream. The reach is moderately to highly sinuous as it meanders through a valley length of approximately 2,550 feet. The construction phase of the project included the improvement of bank stability and in-stream feature morphology while saving as much native forest vegetation as possible and preserving or enhancing several small wetlands located adjacent to the channel. In some areas, minor changes to the proposed pattern were made to save large trees or avoid bedrock. The restoration involved construction of a smaller dimension and restoring a stable pattern. Crossvanes, single-arm weirs, and existing bedrock all were used to control grade at the tops of riffles. Rootwads were used to protect the outside of meander bends. Vertical banks were laid back to create a bankfull bench and establish a stable growing surface to reduce bank height ratio. The pattern of the creek also was adjusted to eliminate some overly-sharp meanders in the existing channel. The narrow confines of the valley required that the new channel cross the existing channel at several locations. These crossing points required clay channel plugs to prevent water from seeping into the old channel. After completion of the restoration, the cattle were fenced out of the entire floodplain. The floodplain was then placed under a conservation easement by the landowner. Since the creek bisects the Kiser farm, two cattle crossings were constructed across the restoration.

Table I. Project Restoration Components
Reedy Branch/EEP Project Number 301

Project Segment or Reach ID	Pre-Existing Footage	Type	Approach	As-Built Footage	As-Built Stationing	Monitoring Year 4 Stationing	Comments
Reedy Branch	*	Restoration	PII	3,155	0+00 - 31+55	10+00 – 41+16	New channel construction

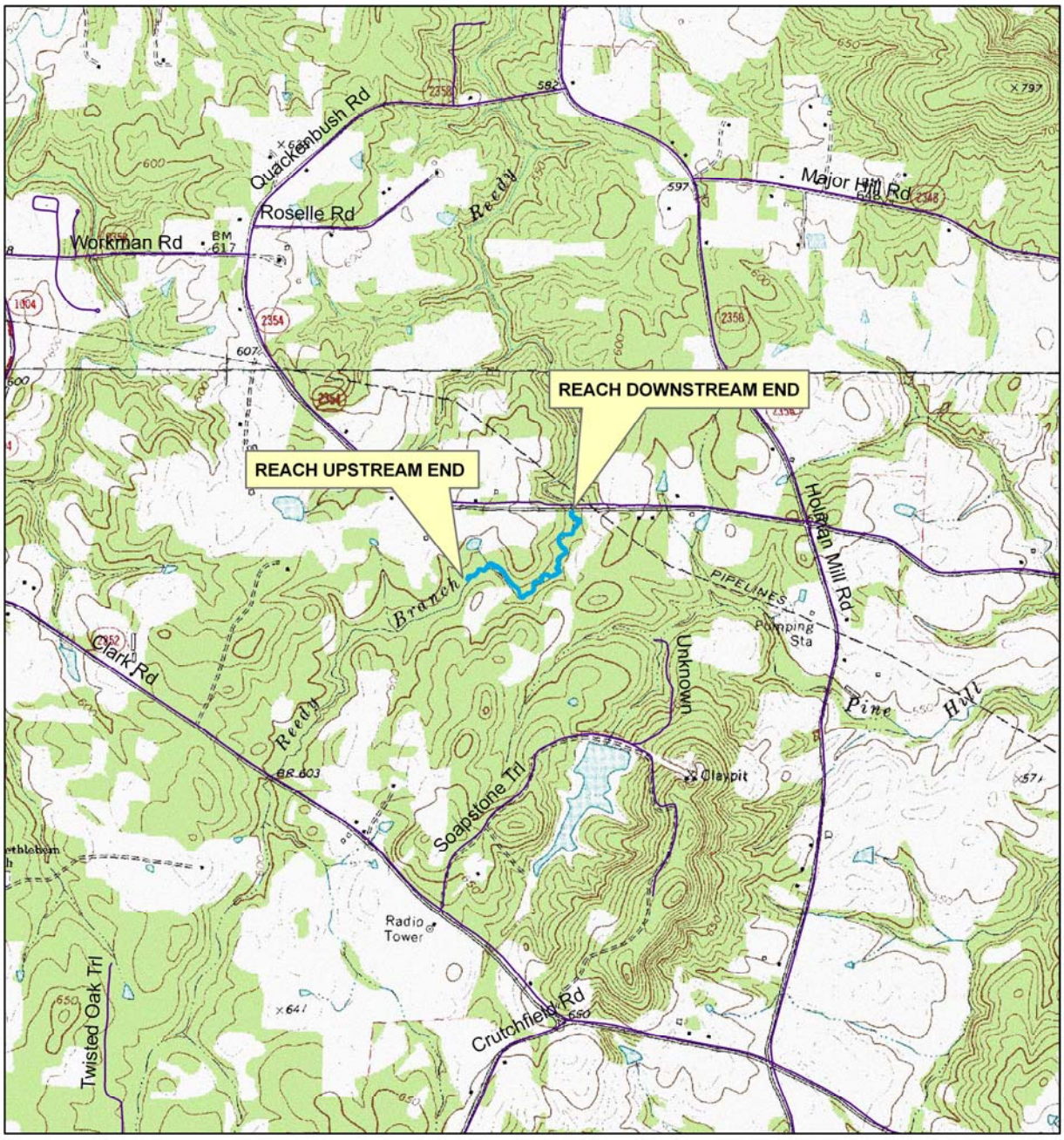
*Information unavailable to SEPI.
"P" in the Approach column refers to Priority Level.

1.3 Project Location and Setting

This project is near Snow Camp, North Carolina in south-central Alamance County. To reach the site from Raleigh, go west on US 64 to Siler City. In Siler City, go north on Martin Luther King Boulevard; the North Carolina Atlas and Gazetteer (DeLorme 1997) labels the road as Snow Camp Road. Continue north toward the community of Snow Camp (approximately 12 miles). Before entering Snow Camp, take a right on SR 2358 (Workman Rd). Continue on Workman Road approximately 1 mile then take a right on Quakenbush Road. Continue on Quakenbush Road for approximately 1½ miles to a small road crossing over Reedy Branch. The road crossing is at the downstream end of the project. Reedy Branch extends upstream (south) of Quakenbush Road. Figure 1 shows the location of Reedy Branch.

Reedy Branch is a tributary of Cane Creek in the Cape Fear River Basin. The Reedy Branch watershed above the restoration reach drains about 1.6 square miles. The creek starts about one-half mile south of the Alamance and Chatham County line and flows generally North to its confluence with Cane Creek, about 1.6 miles east of Snow Camp, NC. The watershed consists primarily of woodland and farmland. The agriculture in the watershed mainly consists of row crops and cattle grazing.

The project is located entirely on property owned by Sam and Deborah Kiser. Cattle pasture and chicken production make up the Kiser Farm surrounding the restoration site. There are four modern chicken houses within sight of the restoration reach with a population of about 500,000 birds. Some of the chicken litter is land applied to the pastures surrounding the restoration site, while some is trucked to nearby farms. The restored stream is enclosed in a moderately dense wooded area and contains large bedrock outcrops as well other sporadic occurrences of bedrock throughout the reach. The site is located in the Carolina Slate Belt, known for shallow soils and high run-off during storm events resulting in very "flashy" flows. The creeks in this region often dry up during the hot summer months. The Monitoring Year 1 performers reported that Reedy Branch had been essentially dry with only standing pools for the entire three years of drought that preceded the restoration. This trend has been verified for all subsequent monitoring years, including this year.


REACH DOWNSTREAM END
REACH UPSTREAM END
Quackenbush Rd
Roselle Rd
Workman Rd
Reedy
Major Hill Rd
Holman Mill Rd
PIPELINES
Pumping Sta
Unknown
Pine Hill
Clark Rd
Reedy Branch
SR 1603
Soapstone Trl
Claypit
Radio Tower
Twisted Oak Trl
Crutchfield Rd
REEDY BRANCH
SITE VICINITY MAP
Ecosystem Enhancement PROGRAM
FIGURE 1
ALAMANCE COUNTY NC
N
W
E
S
Surveyed Stream Centerline
(2008 Survey)
1,000 500 0 1,000 Feet
ALAMANCE

1.4 History and Background

Historically, cattle had access to all parts of the stream. This resulted in various negative impacts to the stream. The stream had steep banks with frequent erosion, completely trampled aquatic habitat, a heavily browsed riparian zone, several areas of pattern instability, and frequent debris jams.

Since completion of this project and fencing in of the floodplain and riparian buffer, cattle have been excluded from the stream the entire valley.

Table II. Project Activity and Reporting History

Reedy Branch/EEP Project Number 301

Activity or Report	Scheduled Completion	Data Collection Complete	Actual Completion or Delivery
Restoration Plan			September 17, 2002
Final Design - 90%			September 17, 2002
Construction			November 1, 2003
Temporary S&E mix applied to entire project area			November 1, 2003
Permanent seed mix applied to entire project area			December 1, 2003
Vegetative Planting			January 1, 2003
Mitigation Plan/ As-built (Year 0 Monitoring - baseline)		February 2005	August 1, 2005
Repair Work			Fall 2004
Repair Work			May 1, 2005
Year 1 monitoring		May 2005	August 2005
Year 2 monitoring	December 2007	June 2006	December 2006
Year 3 monitoring	December 2007	November 2007	December 2007
Year 4 monitoring	December 2008	November 2008	November 15, 2008
Year 5 monitoring	December 2009		
Year 5+ monitoring			

Table III. Project Contacts Table	
Reedy Branch/EEP Project Number 301	
Designer Mark Taylor	EcoLogic 218-4 Swing Road Greensboro, NC 27409 336-335-1108
Construction Contractor	Phillips and Jordan, Inc. 8245 Chapel Hill Road Cary, NC 27513 919-388-4222
Planting Contractor	Ecologic
Seeding Contractor	Ecologic
2005 Monitoring Performers	EcoLogic Associates, P.C. 4321-A South Elm-Eugene Street, Greensboro, NC 27406 336-335-1108
2006-2008 Monitoring Performers	SEPI Engineering Group 1025 Wade Avenue Raleigh, NC 27605 919-789-9977
Stream Monitoring POC	Ira Poplar-Jeffers
Vegetation Monitoring POC	Phil Beach
Wetland Monitoring POC	NA

Table IV. Project Background Table	
Reedy Branch/EEP Project Number 301	
Project County	Alamance
Drainage Area	1.6 square miles
Drainage impervious cover estimate (%)	10%
Stream Order	Second
Physiographic Region	Piedmont
Ecoregion	Carolina Slate Belt
Rosgen Classification of As-built	C5
Cowardin Classification	N/A
Dominant soil types	Herndon
Reference site ID	UT to Varnals Creek
USGS HUC for Project and Reference	03030002 Haw River
NCDWQ Sub-basin for Project and Reference	03-06-04
NCDWQ classification for Project and Reference	16-28-3
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	100%
% of project easement demarcated with bollards (if fencing absent)	N/A

2.0 PROJECT MONITORING METHODOLOGY

2.1 Vegetation Methodology

For this monitoring project, a total of twelve (12) plots were studied. Plot sizes measure 10 meters by 10 meters (or equivalent to 100 square meters), depending on buffer width. The vegetation monitoring was not the Carolina Vegetation Survey (CVS) protocol, but was based on the number of stems for the targeted species that were planted for the stream restoration project. The planted material in the plot (previously marked with flagging) was identified by species and a tally of each species was kept and recorded in a field book. Any stems for a given species in a given plot that were not flagged and were counted over and above the baseline total were considered volunteers.

It should be noted that Monitoring Year 1 vegetation plot stem count totals are unknown (i.e. never reported to SEPI). The planted stems were not originally marked after vegetation installation. Therefore, all stem density and survivability calculations from vegetation plots stem counts are based upon using Monitoring Year 2 'planted' stem counts as a baseline. SEPI project scientists had to use their best judgement to determine which stems were 'planted' versus which were 'volunteers.' The determination of which species were likely 'planted' stems was based on the species listed in the planting plan.

2.2 Stream Methodology

The project monitoring for the stream channel included a longitudinal survey, cross-sectional surveys, pebble counts, problem area identification, and photo documentation. These activities were performed for the entire monitored reach. The stationing was based on thalweg. The methodology for each portion of the stream monitoring is described in detail below.

2.2.1 Longitudinal Profile and Plan View

A longitudinal profile was surveyed with a Nikon DTM-520 Total Station, prism, and a TDS Recon Pocket PC. The heads of features (i.e., riffles, runs, pools, and glides) were surveyed, as well as the point of maximum depth of each pool, boundaries of problem areas, and any other significant slope-breaks or points of interest. At the head of each feature and at the maximum pool depth, the thalweg, water surface, edge of water, left and right bankfull, and left and right top of bank (if different than bankfull) were surveyed. All profile measurements were calculated from this survey, including channel and valley length and length of each feature, water surface slope for the reach and each pool and riffle, bankfull slope, and pool spacing. This survey also was used to draw plan view figures with Microstation v8 (Bentley Systems, Inc., Exton, PA), and all pattern measurements (i.e. meander length, radius of curvature, belt width, meander width ratio, and sinuosity) were measured from the plan view. Stationing was calculated along the thalweg.

2.2.2 Permanent Cross Sections

Six permanent cross sections (four riffles and two pools) were surveyed. The beginning and end of each permanent cross section were originally marked with a wooden stake and metal conduit. Cross sections were installed perpendicular to the stream flow. Each survey noted all changes in slope, tops of both banks, left and right bankfull, edges of water, thalweg, and water surface. The cross sections were then plotted, and Monitoring Year 4 data was overlain on data from each of the three previous monitoring years for comparison. All dimension measurements (i.e. bankfull width, floodprone width, bankfull mean depth, cross sectional area, width-to-depth ratio, entrenchment ratio, bank height ratio, wetted perimeter, and hydraulic radius) were extracted from these plots and compared all previous monitoring data.

2.2.3 Pebble Counts

A modified Wolman pebble count (Rosgen 1994), consisting of 50 samples, was conducted at each permanent cross section. The cumulative percentages were plotted, and the D50 and D84 particle sizes were calculated and compared to data from all previous monitoring years.

2.3 Photo Documentation

Permanent photo points were established during Monitoring Year 1. A set of three photographs (facing upstream, facing downstream, and facing the channel) were taken at each photo point with a digital camera. Two photographs were taken at each cross-section (facing upstream and downstream). A representative photograph of each vegetation plot was taken at the designated corner of the vegetation plot and in the same direction as the Monitoring Years 2 and 3 photographs. An arrow was placed on the designated corner of each vegetation plot on the plan view sheets to document the corner and direction of each photograph. Photos were also taken of all significant stream and vegetation problem areas.

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 Vegetation Assessment

3.1.1 Soils Data

Preliminary Soil Data					
Series	**Max Depth (in.)**	**% Clay on Surface**	**K**	**T**	**OM %**
Herndon (HdB2)	68	5.0 - 27.0	0.48	*	0.5 - 1.0
Herndon (HeC3)	68	27.0 - 35.0	0.35	*	0.0 - 0.5
Herndon (HdC2)	68	5.0 - 27.0	0.48	*	0.5 - 1.0
Mixed alluvial (Mc)	<<<< High variability of data >>>>				

* This information was not available from the Natural Resources Conservation Service (NRCS).

3.1.2 Vegetative Problem Area Plan View

There is good herbaceous vegetation growth along all of the monitored stream reach. Japanese stilt grass (*Microstegium vimineum*) has been established along the entire stream reach with limited areas where it does not dominate. Multiflora rose (*Rosa multiflora*) also was found in several spots along the project corridor, and there are several areas within the channel that are exhibiting pickerelweed (*Pontederia cordata*) growth (Table VI). Although not considered a 'problem,' it should be noted that cattails, which are sometimes considered to be invasive, were noted within the channel in several locations. The vegetation problem area plan view sheets (Appendix C) show the location of the vegetation plots and areas not dominated by Japanese stilt grass.

3.1.3 Stem Counts

Overall, the project had high stem densities, especially with the inclusion of 'volunteer' species noted in the plot count table of Appendix A. The stem density goal at Monitoring Year 5 is 260 trees/acre. In Monitoring Year 4, all plots except plots 6, 7, 8, 10, and 11 had "planted stem" densities above this goal (see Table VII of Appendix A). However, it should be noted that there were several species for which several-to-many additional stems were counted for a given species within a given plot relative to previous monitoring years. These were not counted as 'planted' even if they appeared to be. We assumed that all of these stems were 'volunteers.' With the inclusion of these 'volunteer' species, all of the vegetation plots would probably meet the Monitoring Year 5 stem density goal. Volunteer species found at Reedy Branch included the following: *Quercus rubra, Acer rubrum, Betula nigra, Carpinus caroliniana, Liriodendron tulipifera, Quercus michauxii, Juglans nigra, Platanus occidentalis, Baccharis halimifolia, Prunus serotina, Salix nigra, Liquidambar styraciflua, Quercus sp., Quercus alba, Quercus phellos, Sambucus canandensis, Ulmus alata, Pinus taeda,* and *Juniperus virginiana. Liquidambar styraciflua* were too numerous to count in several of the plots. The location of the vegetation plots are shown on the vegetative problem area plan view in Appendix C.

3.2 Stream Assessment

Considering the 5 year timeframe of standard mitigation monitoring, restored streams should demonstrate morphologic stability in order to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the several months that follow construction and some

change/variation subsequent to that is to also be expected. However, the observed change should not indicate a high rate or be unidirectional over time such that a robust trend is evident. If some trend is evident, it should be very modest or indicate migration to another stable form. Examples of the latter include depositional processes resulting in the development of constructive features on the banks and floodplain, such as an inner berm, slight channel narrowing, modest natural levees, and general floodplain deposition. Annual variation is to be expected, but over time this should demonstrate maintenance around some acceptable central tendency while also demonstrating consistency or a reduction in the amplitude of variation. Lastly, all of this must be evaluated in the context of hydrologic events to which the system is exposed over the monitoring period.

For channel dimension, cross-sectional overlays and key 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. The stream profile should not demonstrate any consistent trends in thalweg aggradation or degradation over any significant continuous portion of its length. 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. The profile 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 distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes. Substrate measurements should indicate the progression towards, or the maintenance of, the known distributions from the design phase.

In addition to these geomorphic criteria, a minimum of two bankfull events must be documented during separate monitoring years within the five year monitoring period for the monitoring to be considered complete. Table VIII documents all bankfull events recorded since the start of Monitoring Year 1. It should be noted that several rain events of over 1" in one day occurred in Monitoring Year 4 (2008); however, only the top several totals are listed below as evidence of bankfull events.

Table V. Verification of Bankfull Events			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if available)**
Monitoring Year 1	Unknown	Several bankfull events resulting from hurricanes noted in Monitoring Year 1 report.	
8/8/2006	Unknown	Crest Stage Gauge measurement of approximately 2" on stick (bottom of stick at bkf)	
1/11/2007	Unknown	Crest Stage Gauge measurement of approximately 6" on stick (bottom of stick at bkf)	
6/4/2007	6/3/2007 – 6/4/2007	According to NOAA National Weather Service daily climate data, approximately 1.45" of precipitation fell over the listed two day period. 1" of this fell on 6/3. An additional 0.4" fell on 6/5/2007. It was assumed, but not confirmed, that this event resulted in a bankfull flow.	
9/15/2008	6/23/2008 - 6/24/2008	2.84" of rain fell over this two day period according to NOAA NCDC Graham 2 ENE, NC substattion (ID 313555)	
9/15/2008	6/30/2008	1.95" of rain fell over this day according to NOAA NCDC Graham 2 ENE, NC substattion (ID 313555)	
9/15/2008	8/27/2008 - 8/28/2008	6.58" of rain fell over this two day period according to NOAA NCDC Graham 2 ENE, NC substattion (ID 313555); Prominent wrack lines observed with large amounts of debris caught in fencing well above bankfull elevation.	Photo 4 in SPA Photolog; note large amount of debris caught in fencing.
9/15/2008	9/6/2008 - 9/7/2008	2.35" of rain fell over this two day period according to NOAA NCDC Graham 2 ENE, NC substattion (ID 313555); Prominent wrack lines observed with large amounts of debris caught in fencing well above bankfull elevation.	Photo 4 in SPA Photolog; note large amount of debris caught in fencing.

3.2.1 Longitudinal Profile and Plan View

The overall water surface slope has remained consistent since Monitoring Year 1. Riffle length, riffle slope, pool length, and pool spacing have all remained consistent since Monitoring Year 1 with some slight variation observed between Monitoring Years that can probably be attributed to human error during the survey. The Monitoring Year 4 thalweg profile appears consistent with previous monitoring years (in particular with Monitoring Year 3 thalweg). There are a few areas of apparent downcutting or aggradation. These areas are probably best explained by human variation in the survey. In addition, all pattern parameters remain consistent since Monitoring Year 2. The plan view overlay remains consistent between monitoring years. Upon observation of the plan view, the observer will notice that this years' survey does not line up perfectly with the Monitoring Year 3 survey. This should not be interpreted as actual geomorphic change. The best explanation is that last year (Monitoring Year 3) there was some difficulty establishing survey control (i.e. original control points could not be located to established control). Instead, permanent cross section corners were used to establish control (less accurate), and there was some associated error with the survey that was corrected through post adjustments. However, the survey was still 'off' to some degree in the areas where the plan view overlay does not line up so well. During this years' (Monitoring Year 4) the original benchmarks established during the as-built (Year 0) survey were relocated and control was re-established to ensure accuracy and precision. No post adjustment corrections were necessary. All future surveys will use these benchmarks for control. The longitudinal profile is found in Appendix B5 and problem area plan views are in Appendix C.

3.2.2 Permanent Cross Sections

From a review of the cross-sectional survey data between across all monitoring years, it can be concluded that channel dimension has not changed significantly at any cross section. No cross sections were closely associated with any stream problem area. It appears that channel dimension of the project has remained stable since the start of monitoring.

3.2.3 Pebble Counts

The pebble size class distribution plots show that the stream bed substrate has remained consistent at all cross sections except cross sections 1 and 3. These two riffle cross sections appear to have experienced some silt fining since Monitoring Year 3. This silt presumably came from an upstream source, as these two cross sections are on the upstream end of the project. One possible explanation for the collection of these fines in riffles is that Reedy Branch has been documented to dry up during the summer of each monitoring year, likely due to the drought that has been going on during this time period, and the channel grows over with grass in the riffles. As the creek recedes every summer, silt (i.e. the last particles to fall out of entrainment in the water column) probably collects in the riffles where the grass is growing as the riffles dry up. This would contribute to the fining effect observed in these pebble count plots. In Monitoring Year 3, cross section 5 (pool) was identified having some fining of the substrate. In contrast to last year, the substrate of this cross section actually coarsened to Monitoring Year 1 conditions in Monitoring Year 4.

3.2.4 Stream Problem Areas

It appears that many of the bank erosion areas identified in previous monitoring years have healed, as only 38 total feet of eroding bank along the project in Monitoring Year 4, as compared to 223 feet in Monitoring Year 3. This decrease in bank erosion can best be explained by a noticeable boost in vegetation density within the project corridor between monitoring years. Many of the erosional areas have stabilized with rooted vegetation. The total length of observed aggraded sections has reduced greatly as well (approximately 38 feet in Monitoring Year 4, compared to 293 feet in Monitoring Year 3). The best explanation for this reduction in aggradation is two-fold. First, there were several over-bankfull flows during Monitoring Year 4 that probably flushed fines downstream. Second, several of the areas identified as aggradation during Monitoring Year 3 were actually just areas where grasses had overtaken the channel due to the channel being dry for extended periods of time (2007 drought). These grasses were taken as evidence of aggradation, when in fact, little actual aggradation occurred. This interpretation was corrected in Monitoring Year 4.

There were several problems with in-stream structures. Several crossvanes had significant structural problems or were apparently placed incorrectly to adequately dissipate sheer stress on the bank, resulting in nearby bank erosion. The most severe of these areas were at a crossvane (Station 29+67) where the bulk of the stream flow was piping around the left side, and a crossvane (Station 32+86) that has experienced significant back arm scour along the right side. Several rocks of this structure have shifted, leaving exposed matting and piping under and around several parts of the structure. In addition, there are several rootwads (e.g., Station 11+64) that appear to have been installed too high on the bank, and several debris jams (e.g., Station 23+85) were noted along the reach that may be of some concern.

The list of stream problem areas is located in Appendix B. The problem area plan view sheets are located in Appendix C.

Table VII. Categorical Stream Feature Visual Stability Assessment						
Reedy Branch (EEP Project No. 301)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
A. Riffles	Unknown	Unknown	66%	71%	81%	
B. Pools			85%	85%	90%	
C. Thalweg			88%	93%	96%	
D. Meanders			61%	66%	68%	
E. Bed General			96%	95%	99%	
F. Bank Condition			95%	96%	99%	
G. Vanes / J Hooks etc.			74%	91%	92%	
H. Wads and Boulders			80%	90%	100%	

3.3 Photo Documentation

Photos taken of the vegetation problem areas and photos of the vegetation plots are in Appendix A. Stream problem area photographs are provided in Appendix B. The photographs taken at the marked photo point locations and at the cross-sections are provided in Appendix B.

4.0 RECOMMENDATIONS AND CONCLUSIONS

The overall pattern, dimension, and profile have remained stable through Monitoring Year 4. The channel bed substrate size distributions have remained fairly consistent through Monitoring Year 4, with the exception of cross sections 1 and 3 where a silt fining effect was observed between monitoring years. This silt presumably came from an upstream source as these two cross sections are on the upstream end of the project and probably collects in the riffles as they dry up and the silt (i.e. last particles to be entrained in the water column) are filtered out by grass that grows in the channel at these riffles. In addition, a significant coarsening was observed a cross section 5 (pool) where fining was observed in Monitoring Year 3.

Although much of the bank erosion listed in previous monitoring years has healed over due to an apparent boost in stream-side rooted vegetation, and much of the aggradation has cleared, there are several continuing problems with in-stream structures. Several crossvanes were rated severe that may warrant a repair assessment. There also were several rootwads noted to be placed too high on the bank.

At the end of Monitoring Year 4, it may be concluded that ‘planted seedling’ tree survival may be inhibited to some degree in many areas by high densities of Japanese stilt grass (i.e., all vegetation plots were noted to have at least some Japanese stilt grass). However, it appears that this grass has limited ‘planted stem’ survival to a level below the final Monitoring Year 5 goal of 260 only in plots 6, 7, 8, 10, and 11. However, with the inclusion of the highly prevalent ‘volunteer’ stems in these plots, the overall stem densities would be well above the Monitoring Year 5 goal in those plots. The overall the ‘planted’ seedling density across all plots is 463 stems per acre, meeting the Monitoring Year 5 stem density goal.

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APPENDIX A1

VEGETATION DATA TABLES

Table A1. Stem counts for each species arranged by plot for Reedy Branch

Species	Plots												Year 2 Totals	Year 3 Totals	Year 4 Totals	Survival %
	1	2	3	4	5	6	7	8	9	10	11	12				
Shrubs																
Cornus ammomum	1												1 (LS 1)	1 (LS 1)	1 (LS 1)	100%
Trees																
Betula nigra													2	0	0	0%
Carpinus caroliniana	30	5	18	6	3	3	1	2	1	1	1	3	84	80	74	88%
Carya tomentosa		2											5	2	2	40%
Diospyros virginiana													4	1	0	0%
Juglans nigra					2				1				7	3	3	43%
Platanus occidentalis	1		2	1	4	3	2	1	7	5	3	5	46	41	34	74%
Salix nigra			2										21 (LS 2)	4	2	10%
Sambucus canandensis													1	0	0	0%
Quercus alba		5	2										9	8	7	78%
Quercus michauxii		1		1			1					2	10	8	5	50%
Quercus phellos			10	1									13	12	11	85%
Quercus sp.													1	1	0	0%
Rhus copallina													1	0	0	0%
Ulmus alata													1	1	0	0%
Total including live stake	32	13	34	9	9	6	4	3	9	6	4	10	278	162	139	50%
Stems per acre	1280	520	1360	360	360	240	160	120	360	240	160	400	927	540	463	
Total excluding live stake	31	13	34	9	9	6	4	3	9	6	4	10	275	161	138	50%
Stems per acre	1240	520	1360	360	360	240	160	120	360	240	160	400	917	537	460	

Note: Survival was calculated between Monitoring Year 2 and Monitoring Year 4 totals.

**Volunteers of the following species, not initially recorded as planted, were counted: Quercus rubra, Acer rubrum, Betula nigra, Carpinus caroliniana, Liriodendron tulipifera, Quercus michauxii, Juglans nigra, Platanus occidentalis, Baccharis halimifolia, Prunus serotina, Salix nigra, Liquidambar styraciflua, Quercus sp., Quercus alba, Quercus phellos, Sambucus canandensis, Ulmus alata, Pinus taeda, and Juniperus virginiana.*

**Liquidambar styraciflua were too numerous to count where new volunteers were noted.*

Table A2. Vegetative Problem Areas

Feature/Issue	Station # / Range	Probable Cause	Photo #
Microstegium virmineum	Occurred within entire project	Encroachment offsite and/or pre-existing seed source.	3
Pontederia cordata	11+88 to 11+95	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	12+96 to 13+00	Encroachment offsite and/or pre-existing seed source.	
Rosa multiflora	14+75 (Left Bank)	Encroachment offsite and/or pre-existing seed source.	
Rosa multiflora	16+03 (Right Bank)	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	18+30 to 18+41	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	20+92 to 21+00	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	21+47 to 21+52	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	22+79 to 22+87	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	27+19 to 27+32	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	27+42 to 27+51	Encroachment offsite and/or pre-existing seed source.	
Ailanthus altissima	27+60 to 27+73 (Right Bank)	Encroachment offsite and/or pre-existing seed source.	2
Pontederia cordata	28+98 to 29+04	Encroachment offsite and/or pre-existing seed source.	
Rosa multiflora	29+24 to 29+59 (Right Bank)	Encroachment offsite and/or pre-existing seed source.	
Ailanthus altissima	34+67 to 34+69 (Left Bank)	Encroachment offsite and/or pre-existing seed source.	2
Ailanthus altissima	35+73 to 37+32 (Left Bank)	Encroachment offsite and/or pre-existing seed source.	
Pontederia cordata	38+58 to 38+78	Encroachment offsite and/or pre-existing seed source.	1
Rosa multiflora	40+67 to 40+74 (Right Bank)	Encroachment offsite and/or pre-existing seed source.	
Rosa multiflora	40+63 to 40+84 (Left Bank)	Encroachment offsite and/or pre-existing seed source.	
Rosa multiflora	40+84 to 41+05 (Right Bank)	Encroachment offsite and/or pre-existing seed source.	4

APPENDIX A2

PHOTOLOG VEGETATION PROBLEM AREAS

APPENDIX A2
PHOTOLOG – REEDY BRANCH

PROBLEM AREAS (Vegetation)

Photo 1. Representative Pickerelweed (*Pontederia cordata)* growing in the center portion of the picture (Station No. 11+88; view upstream; 11-6-2008).

Photo 2. Representative Tree of Heaven (*Ailanthus altissima)* (Station No. 34+67; view upstream/left bank; 11-6-2008).

Photo 3. Representative Japanese grass (*Microstegium virmineum)* taking up most of photo (i.e., dormant brown grass) (Approximate Station No. 26+00; view downstream/left bank; 11-6-2008).

Photo 4. Representative Multiflora rose (*Rosa multiflora)* growing on the left bank on left side of photo (Station No. 40+63; view downstream/left bank; 11-6-2008).

APPENDIX A3

PHOTOLOG VEGETATION PLOTS

APPENDIX A3
PHOTOLOG REEDY BRANCH

VEGETATION PLOTS


Photo 1: Vegetation Plot 1 (10-13-2008).


Photo 2: Vegetation Plot 2 (10-13-2008).


Photo 3: Vegetation Plot 3 (10-13-2008).


Photo 4: Vegetation Plot 4 (10-13-2008).


Photo 5: Vegetation Plot 5 (10-13-2008).


Photo 6: Vegetation Plot 6 (10-13-2008).

Photo 7: Vegetation Plot 7 (10-13-2008).

Photo 8: Vegetation Plot 8 (10-13-2008).

Photo 9: Vegetation Plot 9 (10-13-2008).

Photo 10: Vegetation Plot 10 (10-13-2008).

Photo 11: Vegetation Plot 11 (10-22-2008).

Photo 12: Vegetation Plot 12 (10-22-2008).

APPENDIX B1

PHOTOLOG STREAM PROBLEM AREAS

APPENDIX B1
PHOTOLOG Reedy Creek

PROBLEM AREAS

Photo 1: Representative bank erosion problem area (Station No. 24+29; view of right bank; 2-25-2008).

Photo 2: Representative undercut problem area (Station No. 23+41; view of right bank; 2-25-2008).

Photo 3: Representative cross-vane problem area (Station No. 32+85; view downstream; 2-25-2008).

Photo 4: Representative cattle crossing fence damage problem area (Station No. 15+; view downstream on 10-13-2008). Note major damage to the fencing at this crossing and debris caught in fencing above bankfull elevation (i.e. evidence of bankfull flow).

Photo 5: Representative problem crossvane (Station No. 32+86, view upstream on 2-25-2008).

Photo 6: Representative debris jam (35+27, view downstream on 2-25-2008).

Photo 7: Representative problem jhook; Piping is occurring around right arm of j-hook (Station No. 13+07, view upstream on 11-6-2008).

Photo 8: Representative problem rootwad (rootwad placed too high (11+64, view downstream on 11-6-2008).

APPENDIX B2

PHOTOLOG OF CROSS-SECTIONS AND PHOTO POINTS

APPENDIX B2
PHOTOLOG – REEDY BRANCH

CROSS-SECTIONS & PHOTOPOINTS

Cross-Section 1: View Downstream (7-21-2008)

Cross-Section 1: View Upstream (7-21-2008)

Cross-Section 2: View Downstream (8-11-2008)

Cross-Section 2: View Upstream (8-11-2008)

Cross-Section 3: View Downstream (8-11-2008)

Cross-Section 3: View Upstream (8-11-2008)

Cross-Section 4: View Downstream (8-11-2008)

Cross-Section 4: View Upstream (8-11-2008)

Cross-Section 5: View Downstream (10-22-2008)

Cross-Section 5: View Upstream (10-22-2008)

Cross-Section 6: View Downstream (10-22-2008)

Cross-Section 6: View Upstream (10-22-2008)


Photo point 1 (7-21-2008).


Photo point 2 (7-21-2008).


Photo point 3 (7-21-2008).


Photo point 4 (7-21-2008).


Photo point 5 (7-21-2008).


Photo point 6 (7-21-2008).


Photo point 7 (7-21-2008).


Photo point 8 (7-21-2008).


Photo point 9 (7-21-2008).


Photo point 10 (8-11-2008).


Photo point 11 (8-11-2008).


Photo point 12 (8-11-2008).


Photo point 13 (8-11-2008).


Photo point 14 (8-11-2008).


Photo point 15 (8-11-2008).


Photo point 16 (8-11-2008).


Photo point 17 (8-11-2008).


Photo point 18 (8-11-2008).


Photo point 19 (8-11-2008).


Photo point 20 (8-11-2008).


Photo point 21 (8-11-2008).


Photo point 22 (8-11-2008).


Photo point 23 (8-11-2008).


Photo point 24 (8-11-2008).


Photo point 25 (8-11-2008).


Photo point 26 (8-11-2008).


Photo point 27 (8-11-2008).


Photo point 28 (8-12-2008).


Photo point 29 (8-12-2008).


Photo point 30 (8-12-2008).


Photo point 31 (8-12-2008).


Photo point 32 (8-12-2008).


Photo point 33 (8-12-2008).


Photo point 34 (8-12-2008).


Photo point 35 (8-12-2008).


Photo point 36 (8-12-2008).

Photo point 37 (8-12-2008).

APPENDIX B3

STREAM DATA TABLES

Table VIII. Baseline Morphology and Hydraulic Summary

Reedy Branch (EEP Project No. 301)

Parameter	USGS Gage Data (Cane Creek)			Regional Curve Interval			Pre-Existing Condition			Project Reference Stream			Design			As-built		
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Dimension																		
BF Width (ft)			27.8						27.10	9.75	11.8				18	18.9	26.1	18.9
Floodprone Width (ft)			92						142	26	85				142	80	100	90
BF Cross Sectional Area (ft)			78.7						37.90	7.2	7.8				21.6	21.9	23.2	21.9
BF Mean Depth (ft)			2.8						1.40	0.6	0.8				1.2	0.9	1.2	1.16
Max Depth (ft)			3.7						2.50	1.1	2.5				2.5	2.1	2.7	2.7
Width/Depth Ratio			9.8						19.40	7.9	19.3				15	16.3	29.3	16.3
Entrenchment Ratio			3.3						5.20	2.7	7.2				7.9	3.1	5.3	4.8
Bank Heigh Ratio			1						1.10	1	1.15				1	n/a	n/a	n/a
Wetted Perimeter (ft)																19.9	46.5	31.1
Hydraulic Radius (ft)																0.9	1.4	1.1
Pattern																		
Channel Belthwidth (ft)			150						80.80	15	23				34.2	37	170	81
Radius of Curvature (ft)			75						17.10	13.4	17.1				43.2	10.9	24	17.1
Meander Wavelength (ft)			390						128	59	79				120.6	60	280	128
Meader Width Ratio			5.4						2.98	1.2	1.9				1.9	2	9	4.3
Profile																		
Riffle Length																7	35	16
Riffle Slope (ft/ft)																0.0011	0.0410	0.0100
Pool Length (ft)			55						26	6.3	11				36	16	41	29
Pool Spacing (ft)			94						84	24	35				63	29	150	59
Substrate																		
d50 (mm)			73						21	8	8.7				21	n/a	n/a	0.8
d84 (mm)			249						175	92	97				175	n/a	n/a	6.5
Additional Reach Parameters																		
Valley Length (ft)																		2990
Channel Length (ft)																		3155
Sinuosity			1.1						1.3	1.15	1.4				1.2			1.35
Water Surface Slope (ft/ft)			0.0070						0.0037	0.0180	0.0400		0.022	0.012				0.0033
BF Slope (ft/ft)																		0.0031
Rosgen Classification			C4/1						C4/1			C4/1			C4/1			C5
*Habitat Index																		
*Macrobenthos																		

Table IX. Morphology and Hydraulic Monitoring Summary

Reedy Branch

Segment/Reach: Reedy Branch (EEP Project No. 301)

Parameter	Cross Section 1 Riffle						Cross Section 2 Pool						Cross Section 3 Riffle						Cross Section 4 Riffle						Cross Section 5 Pool						Cross Section 6 Riffle					
Dimension	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+	MY1	MY2	MY3	MY4	MY5	MY+
BF Width (ft)	26.1	21.9	22.8	20.0				24.4	23.0	24.6				16.6	16.2	16.8			18.9	20.8	18.8	17.9			44.8	17.9	17.5	19.0				22.4	20.9	20.5		
Floodporne Width (ft)	80	88+	88+	88+				NA	NA	NA				59+	59+	59+			100	85+	85+	85+			NA	NA	NA	NA				46+	46+	60+		
BFCross Sectional Area (ft)	23.2	24.7	23.2	21.2				44.5	40.3	44.9				18.5	18.0	18.8			21.9	25.4	25.0	27.0			63.0	37.8	38.4	41.9				31.2	27.9	29.6		
BF Mean Depth (ft)	0.9	1.1	1.0	1.1				1.8	1.7	1.8				1.1	1.1	1.1			1.2	1.2	1.3	1.5			1.4	2.1	2.2	2.2				1.4	1.3	1.5		
Width/Depth Ratio	29.3	19.5	22.5	18.8				NA	NA	NA				14.8	14.6	15.1			16.3	17.0	14.1	11.9			NA	NA	NA	NA				16.1	15.7	14.2		
Entrenchment Ratio	3.1	4.0+	3.9+	4.4+				NA	NA	NA				3.6+	3.6+	3.5+			5.3	4.0+	4.5+	4.75+			NA	NA	NA	NA				2.1+	2.2+	2.9+		
Bank Height Ratio	1.0	1.0	1.0	1.00				NA	NA	NA				1.0	1.0	1.03			1.0	1.0	1.0	1.03			NA	NA	NA	NA				1.0	1.1	1.0		
Wetted Perimeter (ft)	27.0	24.3	23.9	21.2				26.5	24.5	25.9				23.7	17.3	17.9			19.9	38.3	20.0	19.3			46.5	21.3	20.1	21.3				25.5	22.2	22.0		
Hydraulic radius (ft)	0.9	1.1	1.0	0.9				1.7	1.6	1.7				0.8	1.0	0.9			1.1	0.7	1.3	0.9			1.4	1.8	1.9	2.0				1.2	1.3	0.9		
Substrate																																				
d50 (mm)	1	0.11	1.2	0.062				0.1	0.2	0.95				0.085	0.08	0.062			1.7	0.12	0.06	2			0.4	0.06	1.6	1.5				0.2	1.7	1.75		
d84 (mm)	17	6.5	20	2.5				0.35	0.95	4.9				0.22	0.12	0.062			11	0.9	1.95	29			9	1.8	1.1	21				32	27	21		

Parameter	MY-01 (2005)			MY-02 (2006)			MY-03 (2007)			MY-04 (2008)			MY-05 (2005)			MY+ (2009)		
Pattern	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med
Channel Beltwidth (ft)	37.0	170.0	80.9	13.7	165.2	44.3	25.6	173.8	48.4	30.1	169.2	54.0						
Radius of Curvature (ft)	10.9	24.0	17.1	18.4	106.0	40.3	17.6	122.8	39.9	13.8	117.7	41.9						
Meander Wavelenght (ft)	60.0	280.0	128.0	80.5	273.0	156.0	75.2	299.2	143.8	70.1	284.9	163.8						
Meander Width Ratio	2.0	9.0	4.3	0.6	7.5	2.0	1.2	8.1	2.3	1.5	8.3	2.6						
Profile																		
Riffle length (ft)	8.0	38.0	17.0	2.6	93.5	11.6	2.8	97.6	21.2	3.4	115.6	23.1						
Riffle slope (ft/ft)	0.0011	0.05	0.015	0.000	0.054	0.025	0.000	0.053	0.014	0.000	0.199	0.027						
Pool length (ft)	16.0	40.0	29.0	3.9	155.3	44.4	9.8	139.1	36.7	9.2	176.1	48.6						
Pool spacing (ft)	27.0	152.0	59.0	9.1	744.9	64.7	15.4	195.7	64.9	9.2	291.7	76.2						
Additional Reach Parameters																		
Valley Length (ft)	2290			2550			2390			2390								
Channel Length (ft)	3090			3096			3130			3116								
Sinuosity	1.35			1.21			1.31			1.30								
Water Surface Slope (ft/ft)	0.0036			0.0036			0.0036			0.0035								
BF slope (ft/ft)	0.0051			0.0033			0.0032			0.0031								
Rosgen Classification	C5			C5			C5			C5/6								
Habitat Index	NA			NA			NA			NA								
Macrobenthos	NA			NA			NA			NA								

Table B1. Stream Problem Areas

Reedy Branch (EEP Project #301)

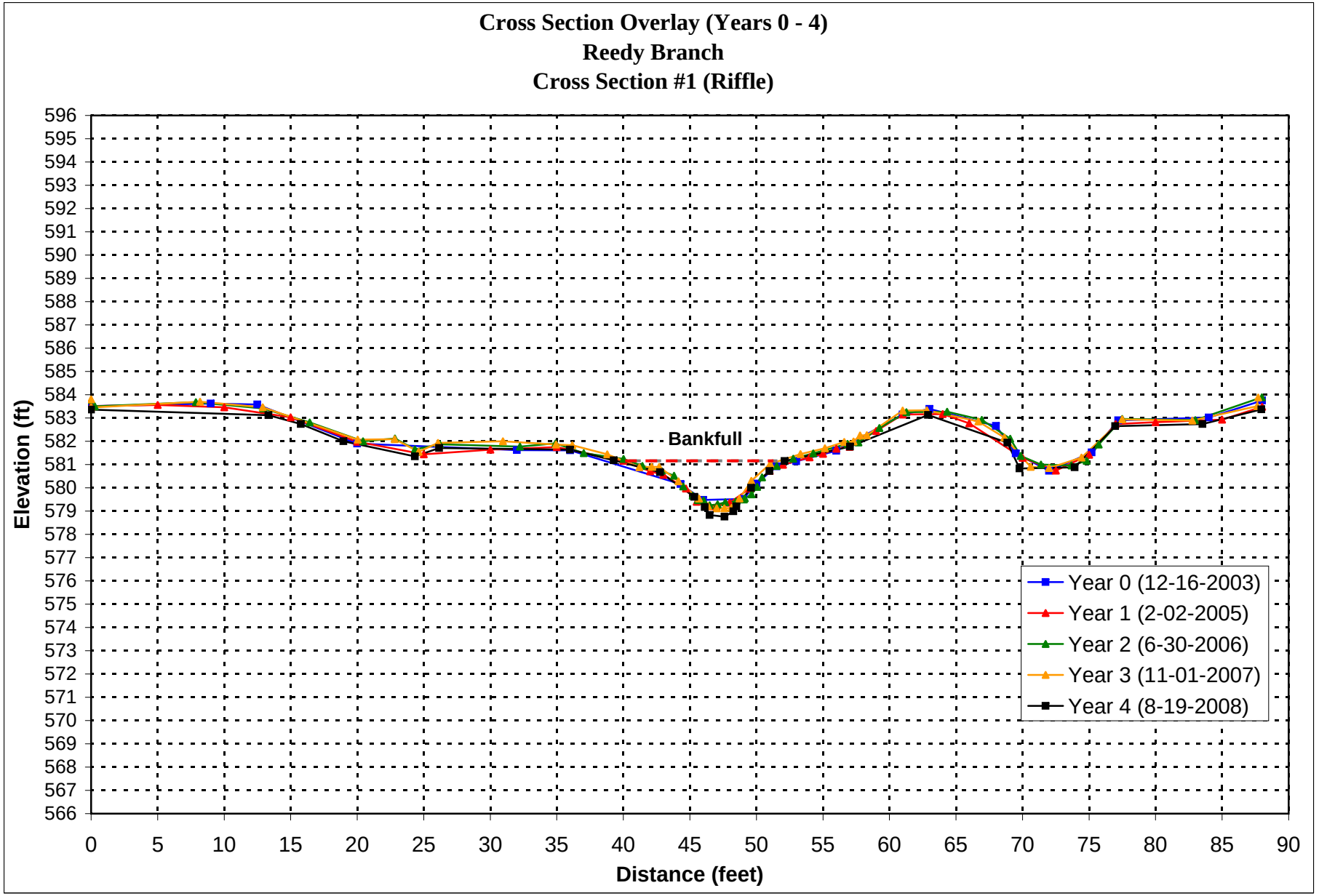
Feature Issue	Station numbers	Suspected Cause	Photo number
Aggradation	10+37.34 10+45.80	Channel built too wide; narrowing to a stable dimension.	
Crossvane	10+87.16	Minor piping around structure.	
Rootwad	11+64.31	Possibly placed too high.	8
J-Hook	13+07.02	Piping around right arm/bank.	7
Cattle Crossing	15+75	Fencing on downstream end of cattle crossing has major damage from flood.	4
Root Wad	20+83.29	Angle or placement location is possible cause of erosion of both banks just upstream.	
Bank Erosion (right)	23+41.73 23+58.71	Inadequate bank protection; soil stability characteristics.	2
Cattle Crossing	23+70	Fencing on downstream end of cattle crossing has damage from flood.	
Debri Jam	23+85.22	Dead tree deposited during flood causing jam.	
Bank Erosion (left)	24+29.24 24+35.50	Bank just upstream of rock vane has inadequate protection during high flows and has been stripped of most vegetation.	1
Rock Vane	24+35.50	Placed too far along the meander to protect the eroding bank on the upstream end of this structure.	
Crossvane	25+55	Piping under center stone.	
Crossvane (severe)	29+66.87	The bulk of the flow is piping around/under the large rock on the left side of the structure.	
Aggradation	29+95.53 30+06.18	Channel built too wide; narrowing to a stable dimension. Grass spanning channel.	
Crossvane (severe)	32+85.55	Significatnt back arm scour on right side of structure. Some rocks appear to have come loose, leaving exposed matting.	3 & 5
Debris Jam	35+27.19	Tree (DBH approximately 25") fell into channel to cause jam.	6
Aggradation	35+86.58 36+05.71	Resultant sediment deposition from adjacent bank erosion.	
Debris Jam	36+11.17	Dead tree deposited during flood causing jam.	
Crossvane	39+55.30	Angle or placement location is possible cause of erosion of both banks just downstream.	
Bank Erosion (right)	40+88.57 41+02.80	Minor scour; healing over.	

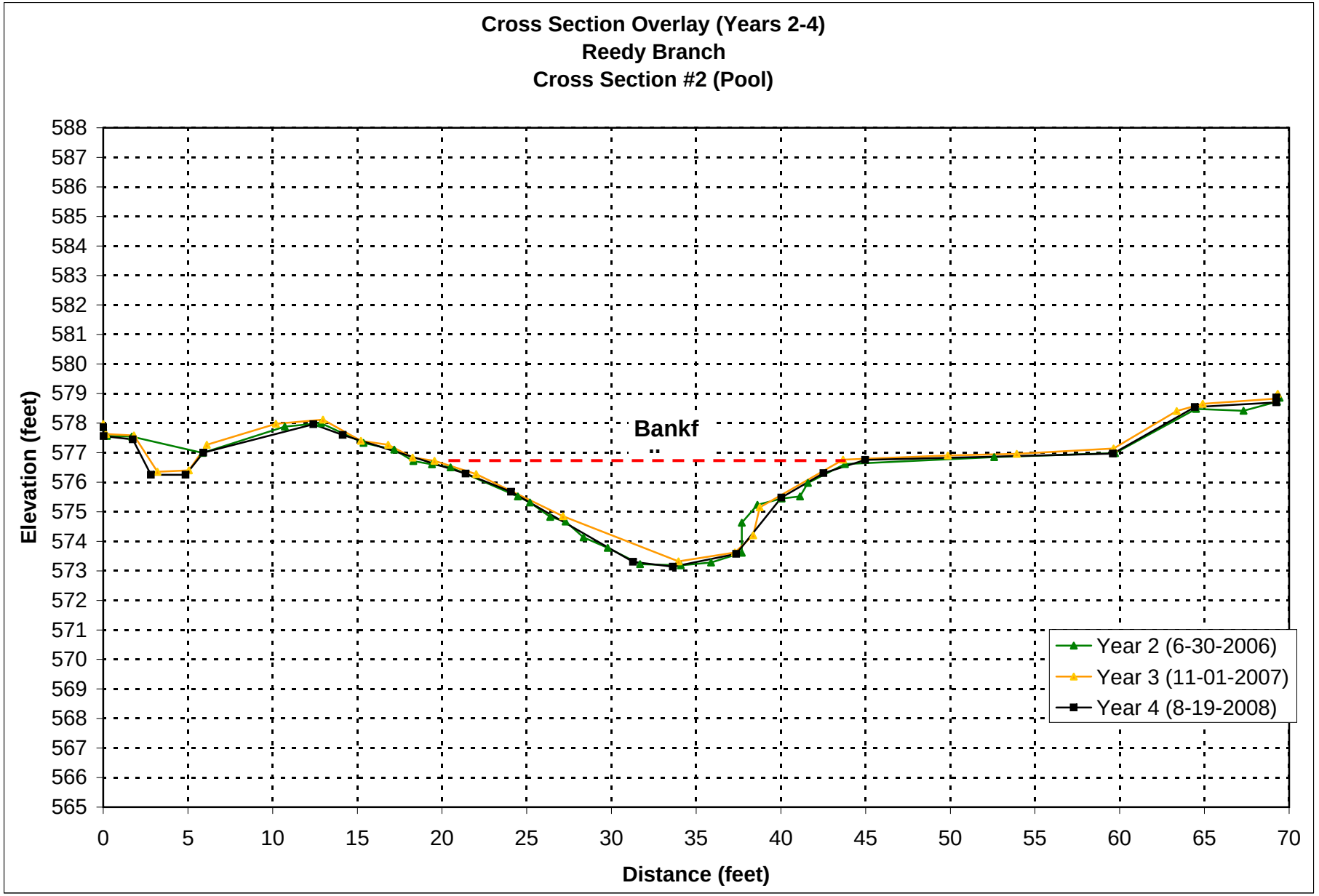
Table B2. Visual Morphological Stability Assessment Reedy Branch						
Feature Category	**Metric (per As-built and reference baselines)**	**(#Stable) Number Performing as Intended**	**Total Number per As-built**	**Total Number / feet in unstable state**	**% Performing in Stable Condition**	**Feature Performance Mean or Total**
A. Riffles	1. Present	21	21	NA	100%	
	2. Armor stable	17	21	NA	81%	
	3. Facet grade appears stable	12	21	NA	57%	
	4. Minimal evidence of embedding/fining	19	21	NA	90%	
	5. Length appropriate	16	21	NA	76%	**81%**
B. Pools	1. Present	24	24	NA	100%	
	2. Sufficiently deep	22	24	NA	92%	
	3. Length appropriate	19	24	NA	79%	**90%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering	13	14	NA	93%	
	2. Downstream of meander (glide/inflection) centering	14	14	NA	100%	**96%**
D. Meanders	1. Outer bend in state of limited/controlled erosion	27	29	NA	93%	
	2. Of those eroding, # w/concomitant point bar formation	0	2	NA	0%	
	3. Apparent Rc within specifications*	23	29	NA	79%	
	4. Sufficient floodplain access and relief	29	29	NA	100%	**68%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	3/38.2	99%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting	NA	NA	0/0	100%	**99%**
F. Bank Condition	1. Actively eroding, wasting, or slumping bank	NA	NA	3/37.5	99%	**99%**
G. Vanes / J Hooks	1. Free of back or arm scour	21	23	NA	91%	
	2. Height appropriate	23	23	NA	100%	
	3. Angle and geometry appear appropriate	21	23	NA	91%	
	4. Free of piping or other structural failures	20	23	NA	87%	**92%**
H. Wads and Boulders	1. Free of scour	30	30	NA	100%	
	2. Footing stable	30	30	NA	100%	**100%**

*The range of Rc values from the as-built did not make sense for the project. So the range from Monitoring Year 2 was used for comparison.

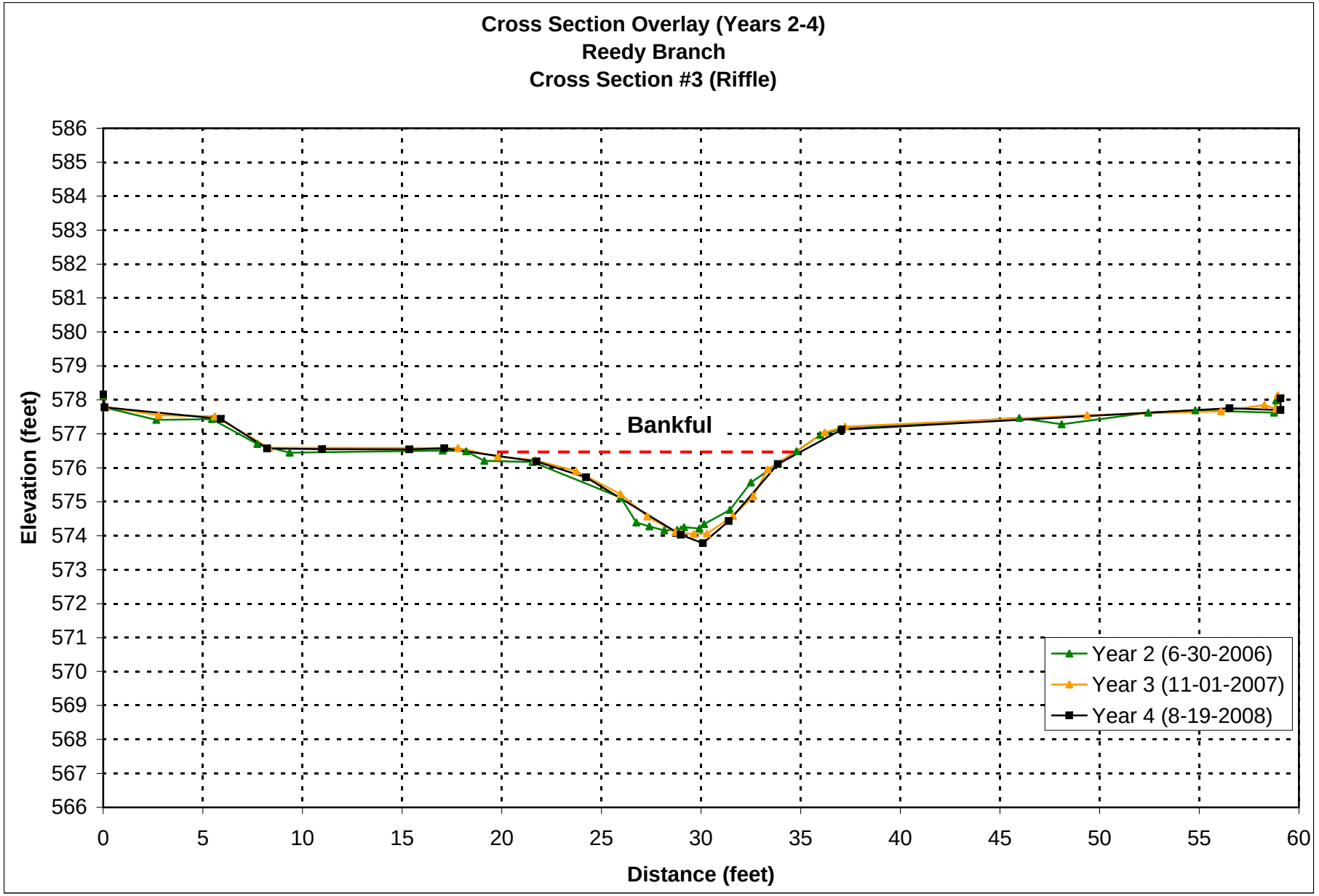
APPENDIX B4

STREAM CROSS-SECTIONS

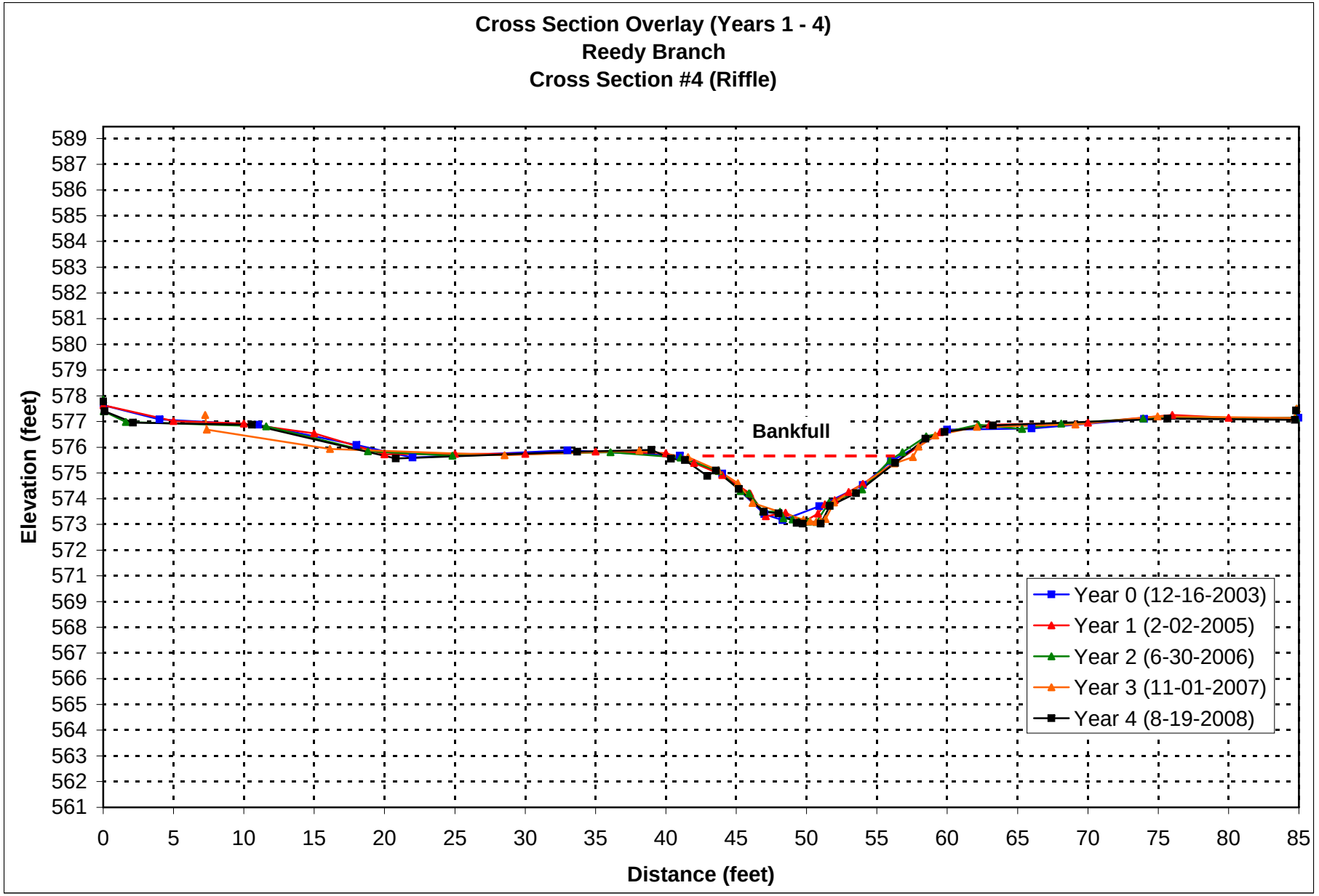

Cross Section Overlay (Years 0 - 4)
Reedy Branch
Cross Section #1 (Riffle)
Elevation (ft)
596
595
594
593
592
591
590
589
588
587
586
585
584
583
582
581
580
579
578
577
576
575
574
573
572
571
570
569
568
567
566
Bankfull
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
Distance (feet)
Year 0 (12-16-2003)
Year 1 (2-02-2005)
Year 2 (6-30-2006)
Year 3 (11-01-2007)
Year 4 (8-19-2008)

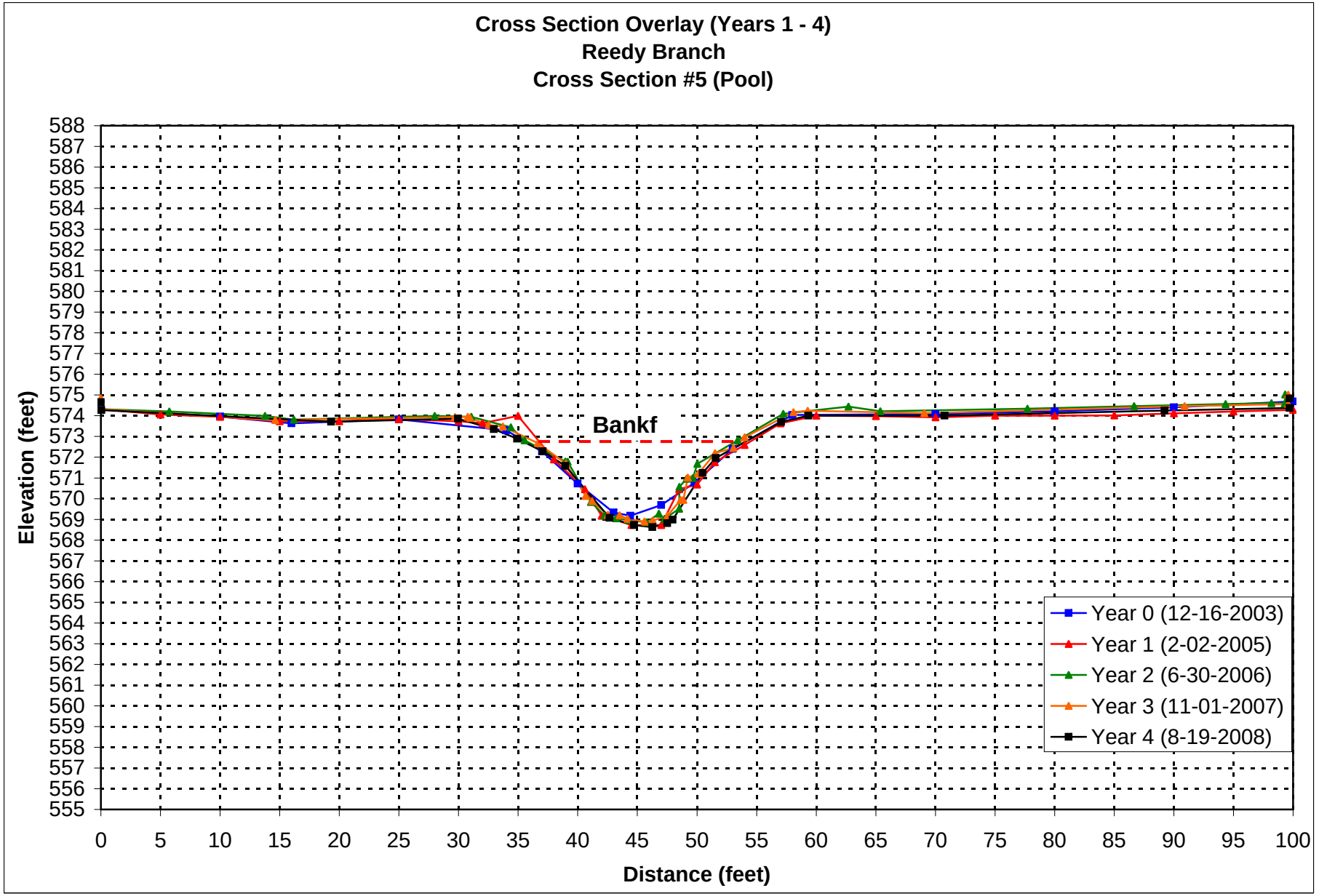


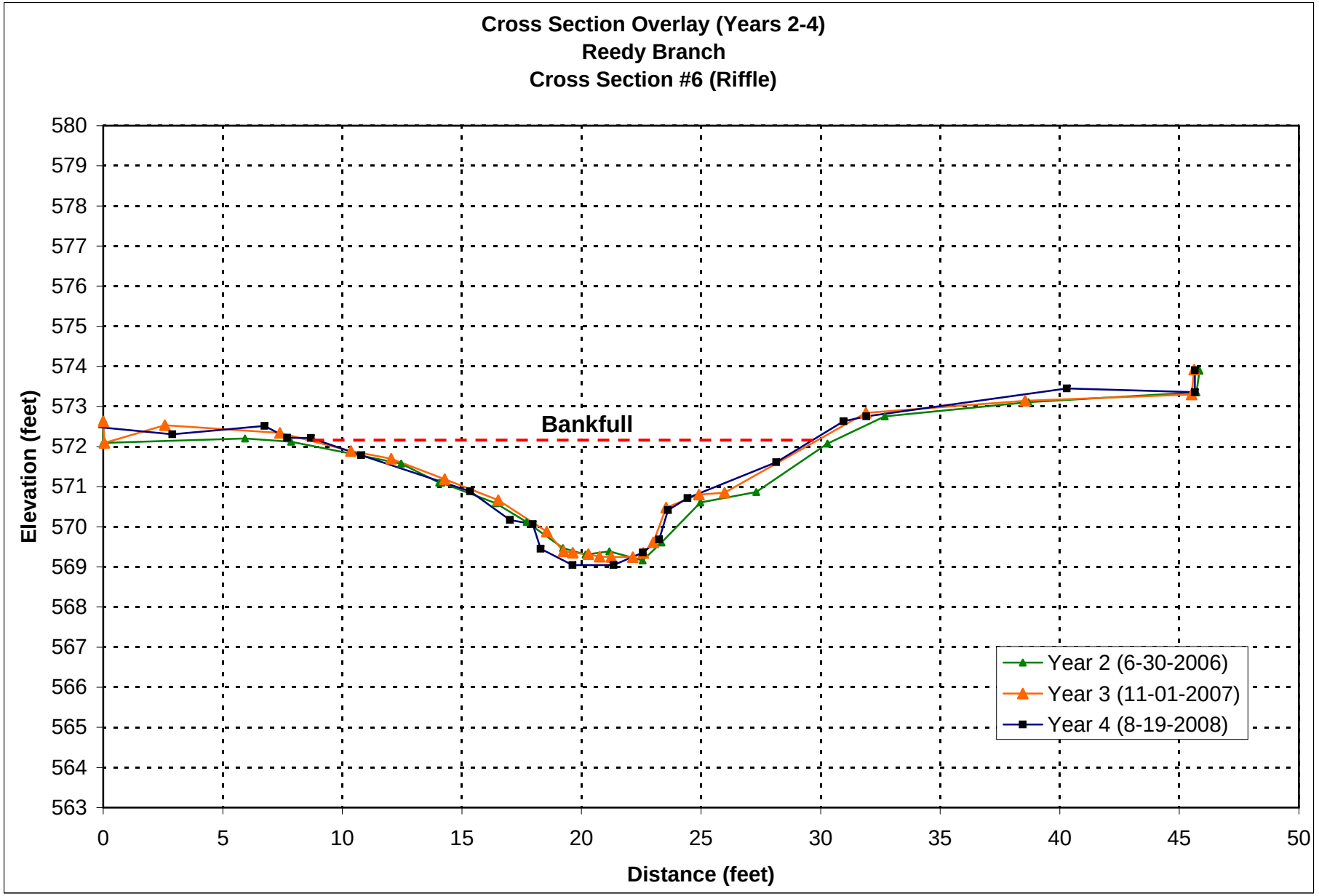
*Year 1 data was not collected.



*Year 1 data was not collected.


Cross Section Overlay (Years 1 - 4)
Reedy Branch
Cross Section #4 (Riffle)
Elevation (feet)
589
587
586
585
584
583
582
581
580
579
578
577
576
575
574
573
572
571
569
568
567
566
565
564
563
562
561
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
Distance (feet)
Bankfull
Year 0 (12-16-2003)
Year 1 (2-02-2005)
Year 2 (6-30-2006)
Year 3 (11-01-2007)
Year 4 (8-19-2008)


Cross Section Overlay (Years 1 - 4)
Reedy Branch
Cross Section #5 (Pool)
Elevation (feet)
588
587
586
585
584
583
582
581
580
579
578
577
576
575
574
573
572
571
570
569
568
567
566
565
564
563
562
561
560
559
558
557
556
555
Bankf
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
Distance (feet)
Year 0 (12-16-2003)
Year 1 (2-02-2005)
Year 2 (6-30-2006)
Year 3 (11-01-2007)
Year 4 (8-19-2008)



*Year 1 data was not collected.

Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Sep-08
Monitoring Year	4

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	583.36	
13.34	583.12	
15.76	582.74	
18.97	582.00	
24.33	581.35	
26.15	581.71	
35.99	581.64	
39.28	581.18	
42.76	580.67	
45.33	579.61	
46.12	579.17	
46.48	578.83	
47.61	578.76	
48.27	578.99	
48.50	579.20	
49.60	580.00	
50.99	580.72	
52.12	581.15	
57.04	581.77	
62.89	583.13	
68.87	581.94	
69.77	580.83	
73.92	580.88	
76.97	582.65	
83.52	582.74	
87.95	583.37	

Bankfull/Top of Bank Hydraulic Geometry

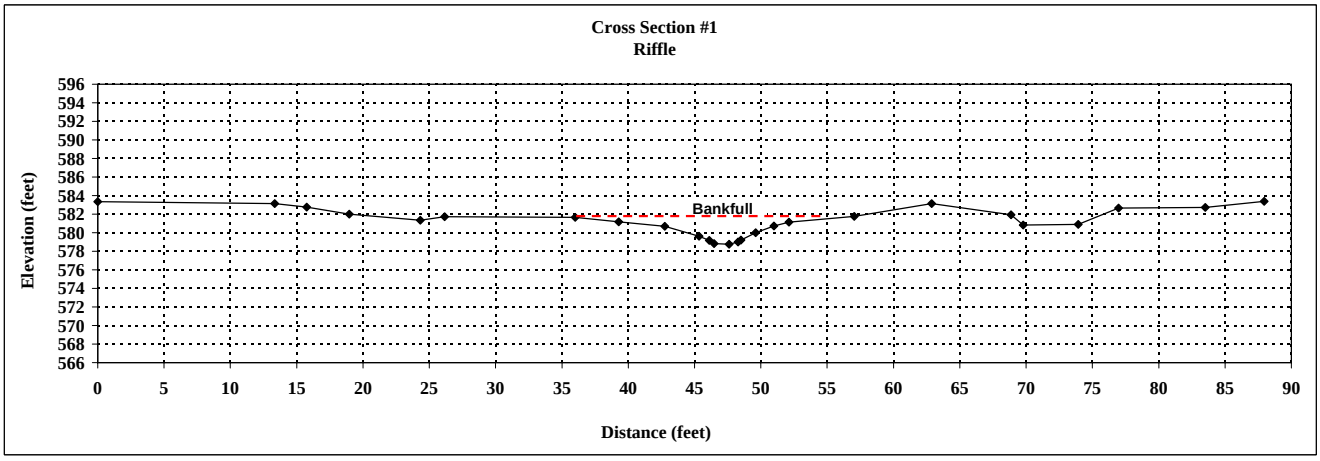
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	3.3	0.5	3.32	0.8
	3.5	1.0	3.52	2.5
	2.6	2.0	2.78	3.8
	0.8	2.5	0.91	1.8
	0.4	2.8	0.49	0.9
	1.1	2.9	1.13	3.2
	0.7	2.7	0.70	1.8
	0.2	2.4	0.31	0.6
	1.1	1.6	1.36	2.2
	1.4	0.9	1.56	1.8
	1.1	0.5	1.21	0.8
	3.8	0.0	3.86	0.9
TOTALS	20.0		21.2	21.2

SUMMARY DATA (BANKFULL)

A(BKF)	21.20	W(FPA)	88+
W(BKF)	19.96	WP	21.16
Max d	2.88	Hydraulic Radius	0.94
Mean d	1.06	Wetted Perimeter=	WP
W/D	18.80	Area=	A
Bank Height	2.88	Width=	W
Entrenchment	4.4+	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			28.0

Bankfull datum* = 581.64 (post adjust)

*Datum reset during Monitoring Year 4 based on datum adjustment (survey tied to MY-0 bechmarks).



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Sep-08
Monitoring Year	4

STATION (Feet)	ELEVATION (Feet)	NOTES
0.00	577.86	
0.03	577.56	
1.75	577.45	
2.82	576.25	
4.86	576.25	
5.91	577.00	
12.41	577.96	
14.14	577.60	
21.39	576.29	
24.07	575.68	
31.28	573.31	
33.62	573.14	
37.36	573.57	
40.03	575.48	Thalweg
42.52	576.30	R Bank Toe
44.97	576.75	REW
59.60	576.97	
64.44	578.54	
69.25	578.71	
69.25	578.87	

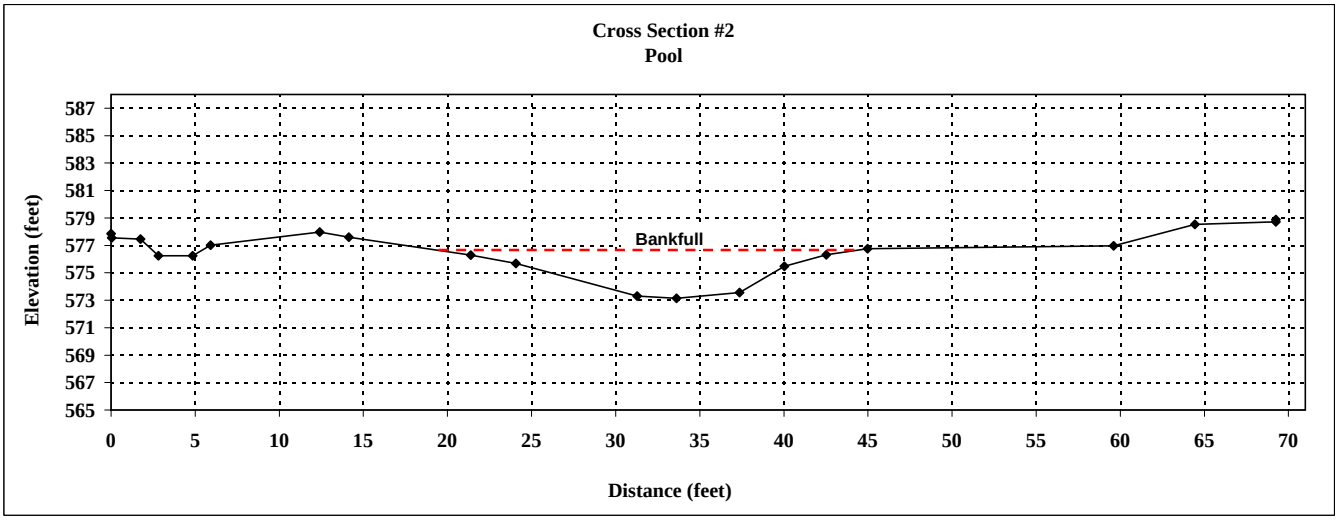
Bankfull/Top of Bank Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	1.8	0.3	1.82	0.3
	2.7	0.9	2.75	1.7
	7.2	3.3	7.59	15.3
	2.3	3.5	2.35	7.9
	3.7	3.0	3.77	12.2
	2.7	1.1	3.28	5.6
	2.5	0.3	2.62	1.8
	1.7	0.0	1.71	0.3
TOTALS	24.6		25.9	44.9

SUMMARY DATA

A(BKF)	44.93
W(BKF)	24.60
Max d	3.47
Mean d	1.83
Wet. P	25.88
Hyd. R	1.74

Bankfull datum* = 576.61 (post adjust)
*Datum reset during Monitoring Year 3.



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Sep-08
Monitoring Year	4

STATION (Feet)	ELEVATION (Feet)
0.00	578.16
0.07	577.78
5.90	577.44
8.23	576.57
10.98	576.55
15.36	576.54
17.12	576.58
21.74	576.19
24.23	575.72
28.98	574.03
30.09	573.78
31.39	574.43
33.86	576.11
37.06	577.12
56.52	577.76
59.08	577.70
59.08	578.04

NOTES

Bankfull/Top of Bank Hydraulic Geometry

	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	3.5	0.3	3.53	0.5
	2.5	0.8	2.53	1.3
	4.8	2.5	5.04	7.7
	1.1	2.7	1.14	2.9
	1.3	2.1	1.45	3.1
	2.5	0.4	2.99	3.0
	1.2	0.0	1.23	0.2
TOTALS	16.8		17.9	18.8

SUMMARY DATA (BANKFULL)

A(BKF)	18.77	W(FPA)	59+
W(BKF)	16.81	WP	17.92
Max d	2.71	Hydraulic Radius	0.94
Mean d	1.12	Wetted Perimeter=	WP
W/D	15.05	Area=	A
Bank Height	2.80	Width=	W
Entrenchment	3.5+	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			28.0

Bankfull datum* = 576.49 (post adjust)
*Datum reset during Monitoring Year 3.

Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	39692.00
Monitoring Year	4.00

STATION (Feet)	ELEVATION* (Feet)	NOTES
0.00	577.69	
0.10	577.30	
2.12	576.82	
10.58	576.74	
20.81	575.35	
33.70	575.62	
38.97	575.70	
40.36	575.34	
41.36	575.28	
42.94	574.63	
43.56	574.86	
45.18	574.10	
46.95	573.16	
48.01	573.09	
49.30	572.70	
49.73	572.67	
51.01	572.67	
51.66	573.40	
53.53	573.92	
56.30	575.17	
58.45	576.16	
59.81	576.44	
63.25	576.71	
75.66	576.98	
84.72	576.94	
84.80	577.32	

Bankfull/Top of Bank Hydraulic Geometry

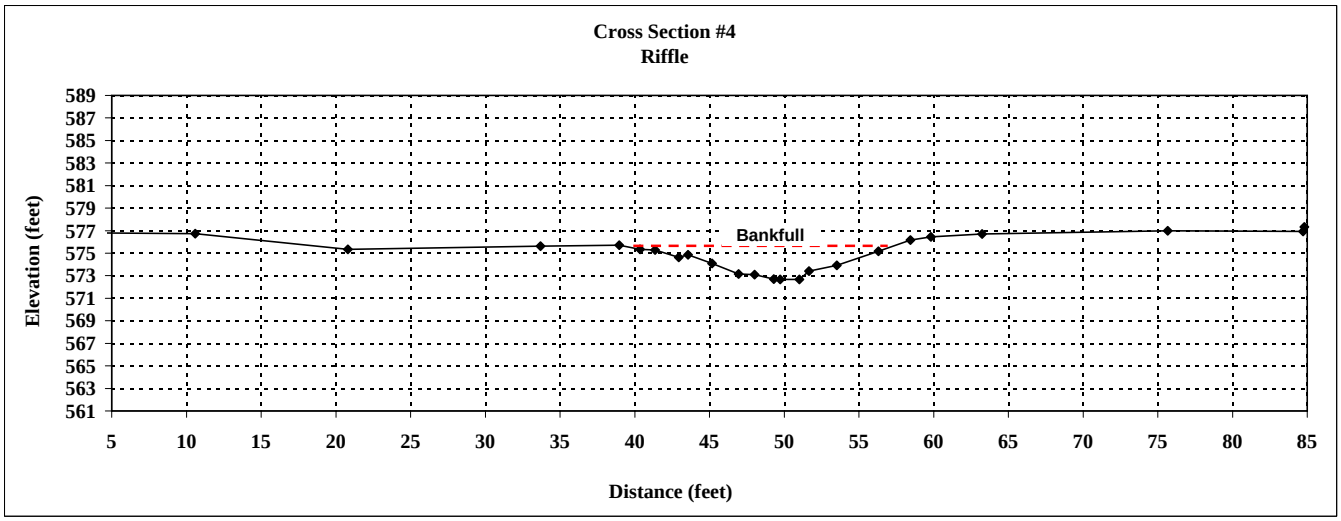
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	1.0	0.3	1.05	0.1
	1.0	0.3	1.00	0.3
	1.6	1.0	1.71	1.0
	0.6	0.8	0.66	0.5
	1.6	1.5	1.79	1.8
	1.8	2.5	2.01	3.5
	1.1	2.5	1.06	2.6
	1.3	2.9	1.35	3.5
	0.4	2.9	0.43	1.3
	1.3	2.9	1.28	3.8
	0.6	2.2	0.97	1.7
	1.9	1.7	1.94	3.6
	2.8	0.4	3.04	2.9
	1.0	0.0	1.05	0.2
TOTALS	17.9		19.3	27.0

SUMMARY DATA (BANKFULL)

A(BKF)	26.99	W(FPA)	85+
W(BKF)	17.90	WP	19.33
Max d	2.94	Hydraulic Radius	0.93
Mean d	1.51	Wetted Perimeter=	WP
W/D	11.87	Area=	A
Bank Height	3.03	Width=	W
Entrenchment	4.75+	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			28.0

Bankfull datum* = 575.61

*Datum reset during Monitoring Year 3.



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Sep-08
Monitoring Year	4

STATION (Feet)	ELEVATION* (Feet)	NOTES
0.00	574.65	
0.04	574.28	
19.31	573.72	
29.95	573.86	
32.97	573.36	
34.91	572.89	
37.07	572.29	
38.95	571.58	
42.67	569.08	
44.71	568.73	
46.26	568.62	
47.52	568.82	
47.95	568.98	
50.47	571.25	
51.58	571.96	
57.05	573.70	
59.35	574.01	
70.77	574.01	
89.22	574.25	
99.71	574.37	
99.71	574.83	

Bankfull/Top of Bank Hydraulic Geometry

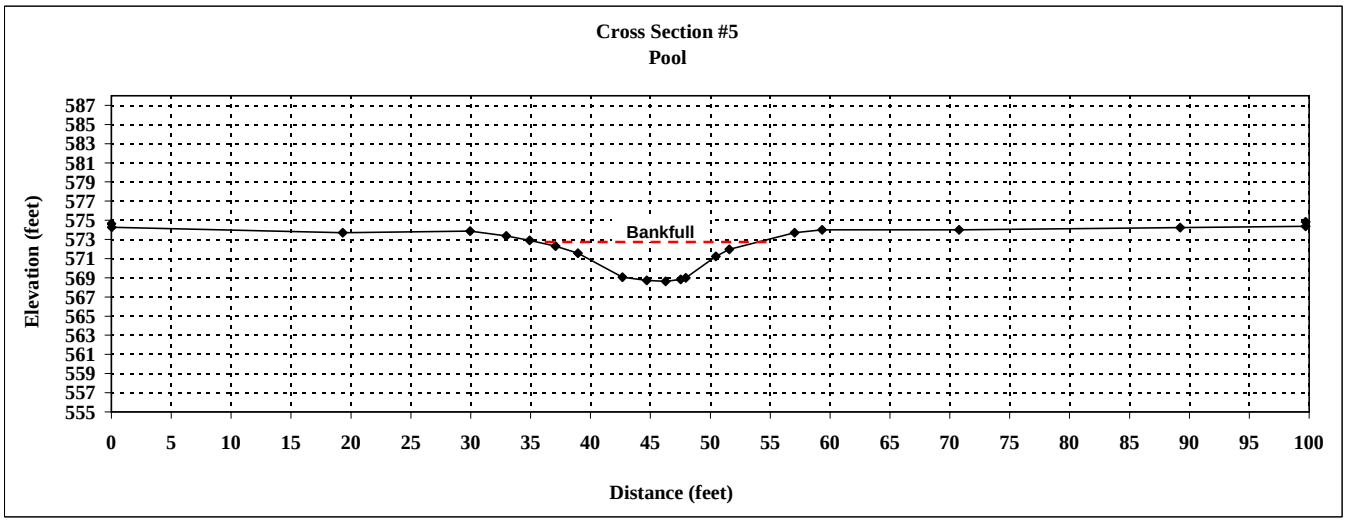
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	1.9	0.5	1.94	0.5
	1.9	1.2	2.01	1.6
	3.7	3.7	4.49	9.2
	2.0	4.1	2.07	8.0
	1.6	4.2	1.55	6.4
	1.3	4.0	1.27	5.2
	0.4	3.8	0.46	1.7
	2.5	1.6	3.39	6.8
	1.1	0.9	1.32	1.3
	2.7	0.0	2.78	1.1
TOTALS	19.0		21.3	41.9

SUMMARY DATA

A(BKF)	41.85
W(BKF)	19.03
Max d	4.19
Mean d	2.20
Wet. P	21.28
Hyd. R	1.97

Bankfull datum* = 572.81

*Datum reset during Monitoring Year 3.



Field Crew:	IPJ and PDB
Stream Reach:	Reedy Branch
Drainage Area:	1.6 mi^2
Date:	Sep-08
Monitoring Year	4.00

STATION (Feet)	ELEVATION* (Feet)	NOTES
-14.30	573.56	
-5.77	572.15	
-4.43	572.73	
2.89	572.31	
6.75	572.52	
7.69	572.22	
8.68	572.21	
10.79	571.78	
15.34	570.88	
17.01	570.17	
17.96	570.07	
18.29	569.45	
19.63	569.05	
21.34	569.05	
22.57	569.36	
23.25	569.68	
23.62	570.42	
24.44	570.71	
28.14	571.61	
30.96	572.63	
31.91	572.76	
40.29	573.45	
45.65	573.35	
45.65	573.90	

Bankfull/Top of Bank Hydraulic Geometry

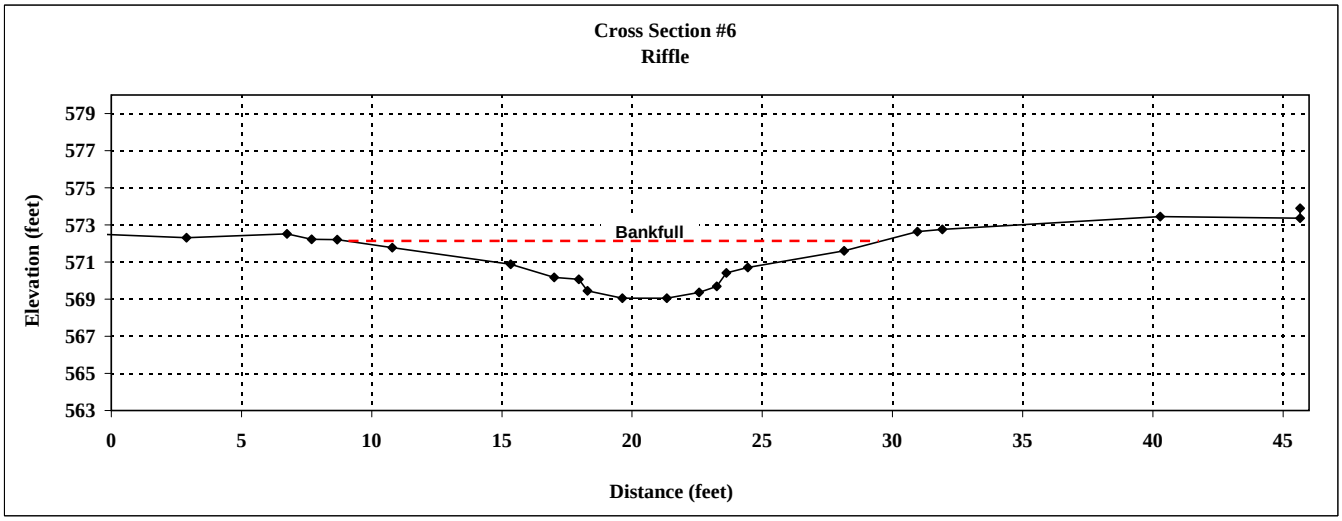
	Width (Feet)	Depth (Feet)	Perimeter (Feet)	Area (Sq. Ft.)
	0.0	0.0	0.00	0.0
	1.7	0.3	1.72	0.3
	4.6	1.2	4.64	3.6
	1.7	1.9	1.82	2.7
	0.9	2.1	0.96	1.9
	0.3	2.7	0.70	0.8
	1.3	3.1	1.40	3.8
	1.7	3.1	1.71	5.3
	1.2	2.8	1.27	3.6
	0.7	2.4	0.75	1.8
	0.4	1.7	0.82	0.8
	0.8	1.4	0.87	1.3
	3.7	0.5	3.81	3.5
	1.4	0.0	1.53	0.4
TOTALS	20.5		22.0	29.6

SUMMARY DATA (BANKFULL)

A(BKF)	29.61	W(FPA)	60+
W(BKF)	20.48	WP	21.99
Max d	3.07	Hydraulic Radius	0.93
Mean d	1.45	Wetted Perimeter=	WP
W/D	14.17	Area=	A
Bank Height	3.17	Width=	W
Entrenchment	2.9+	Depth=	D
Stream Type	C	Bankfull=	BKF
Area from Rural Regional Curve			28.0

Bankfull datum* = 572.12 (post adjust)

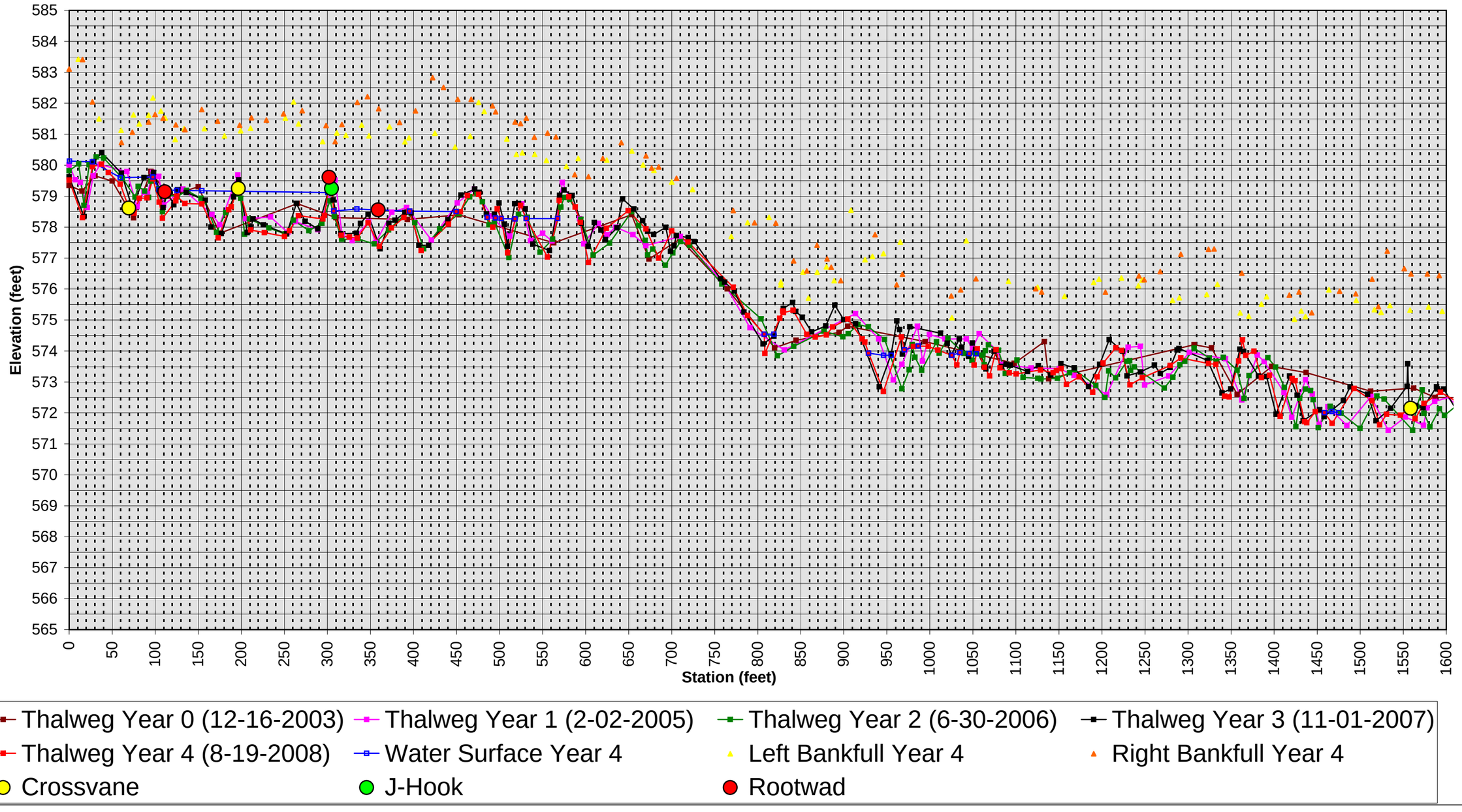
*Datum reset during Monitoring Year 3.



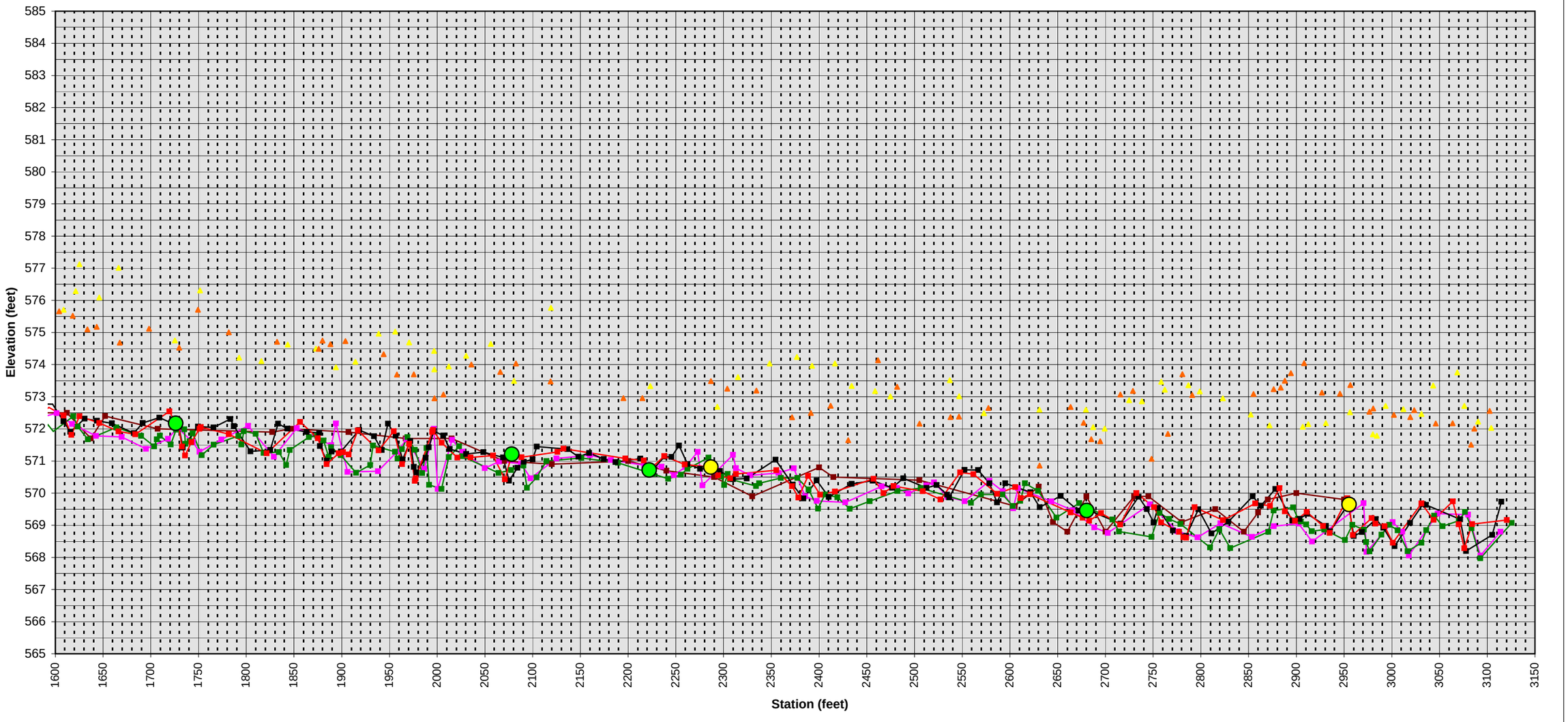
APPENDIX B5

STREAM LONGITUDINAL PROFILE

Longitudinal Profile Overlay Page 1 of 2
Reedy Branch



Longitudinal Profile Overlay Page 2 of 2
Reedy Branch



APPENDIX B6

STREAM PEBBLE COUNTS

Reedy Branch
Stream Monitoring
Year 4: 2008
Alamance County, NC

PEBBLE COUNT

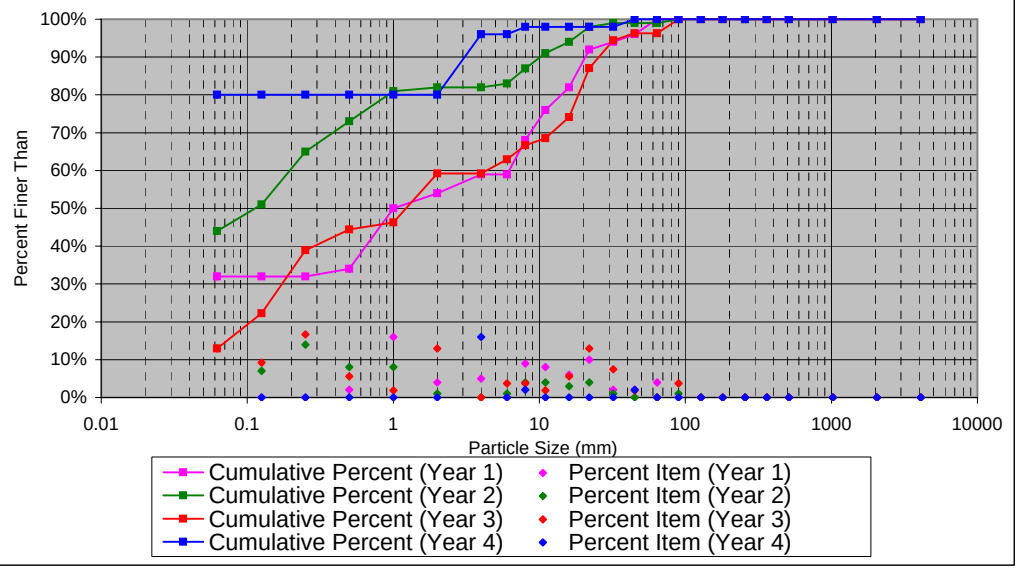
Site: Reedy Branch

Party: PDB and KD

Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 1 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	40	40	80%	80%
	Very Fine	.062-.125	SAND		0	0%	80%
	Fine	.125-.25			0	0%	80%
	Medium	.25-.50			0	0%	80%
	Coarse	.50-1.0			0	0%	80%
.04-.08	Very Coarse	1.0-2			0	0%	80%
.08-.16	Very Fine	2.0-4.0	GRAVEL	8	8	16%	96%
.16-.22	Fine	4-5.7			0	0%	96%
.22-.31	Fine	5.7-8		1	1	2%	98%
.31-.44	Medium	8-11.3			0	0%	98%
.44-.63	Medium	11.3-16			0	0%	98%
.63-.89	Coarse	16-22.6			0	0%	98%
.89-1.26	Coarse	22.6-32			0	0%	98%
1.26-1.77	Very Coarse	32-45		1	1	2%	100%
1.77-2.5	Very Coarse	45-64			0	0%	100%
2.5-3.5	Small	64-90	COBBLE		0	0%	100%
3.5-5.0	Small	90-128			0	0%	100%
5.0-7.1	Large	128-180			0	0%	100%
7.1-10.1	Large	180-256			0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512			0	0%	100%
20-40	Medium	512-1024			0	0%	100%
40-80	Large	1024-2048			0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					50	**100%**	**100%**

Riffle Pebble Count, Cross Section #1



Reedy Branch
Stream Monitoring
Year 4: 2008
Alamance County, NC

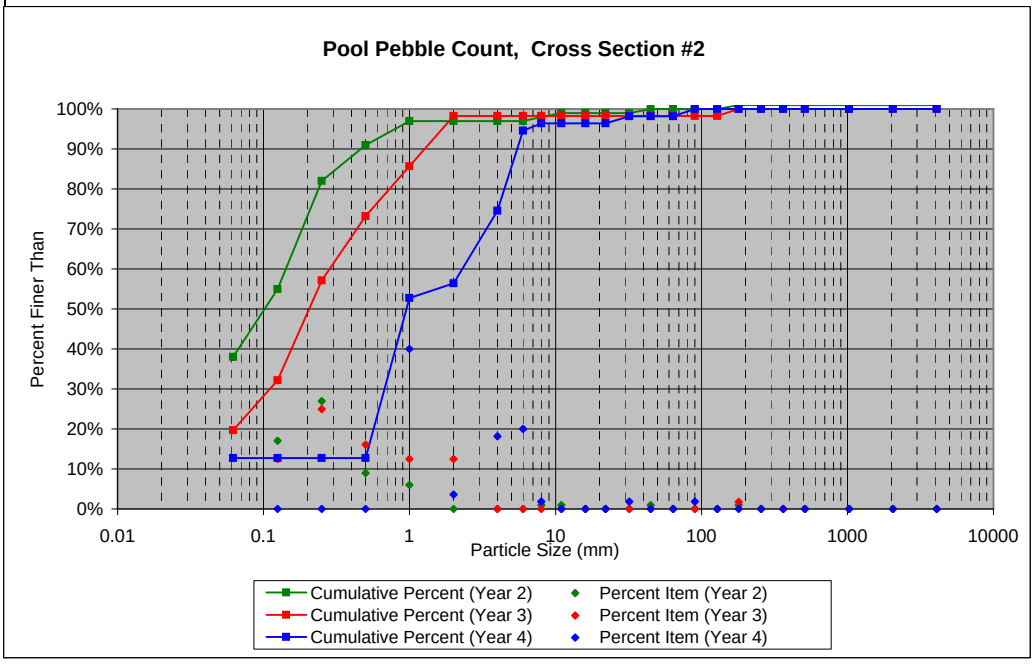
PEBBLE COUNT

Site: Reedy Branch

Party: PDB and KD

Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 2 (Pool)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	7	7	13%	13%
	Very Fine	.062-.125	SAND		0	0%	13%
	Fine	.125-.25			0	0%	13%
	Medium	.25-.50			0	0%	13%
	Coarse	.50-1.0		22	22	40%	53%
.04-.08	Very Coarse	1.0-2		2	2	4%	56%
.08-.16	Very Fine	2.0-4.0	GRAVEL	10	10	18%	75%
.16-.22	Fine	4-5.7		11	11	20%	95%
.22-.31	Fine	5.7-8		1	1	2%	96%
.31-.44	Medium	8-11.3			0	0%	96%
.44-.63	Medium	11.3-16			0	0%	96%
.63-.89	Coarse	16-22.6			0	0%	96%
.89-1.26	Coarse	22.6-32		1	1	2%	98%
1.26-1.77	Very Coarse	32-45			0	0%	98%
1.77-2.5	Very Coarse	45-64			0	0%	98%
2.5-3.5	Small	64-90	COBBLE	1	1	2%	100%
3.5-5.0	Small	90-128			0	0%	100%
5.0-7.1	Large	128-180			0	0%	100%
7.1-10.1	Large	180-256			0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512			0	0%	100%
20-40	Medium	512-1024			0	0%	100%
40-80	Large	1024-2048			0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					55	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 4: 2004
Alamance County, NC

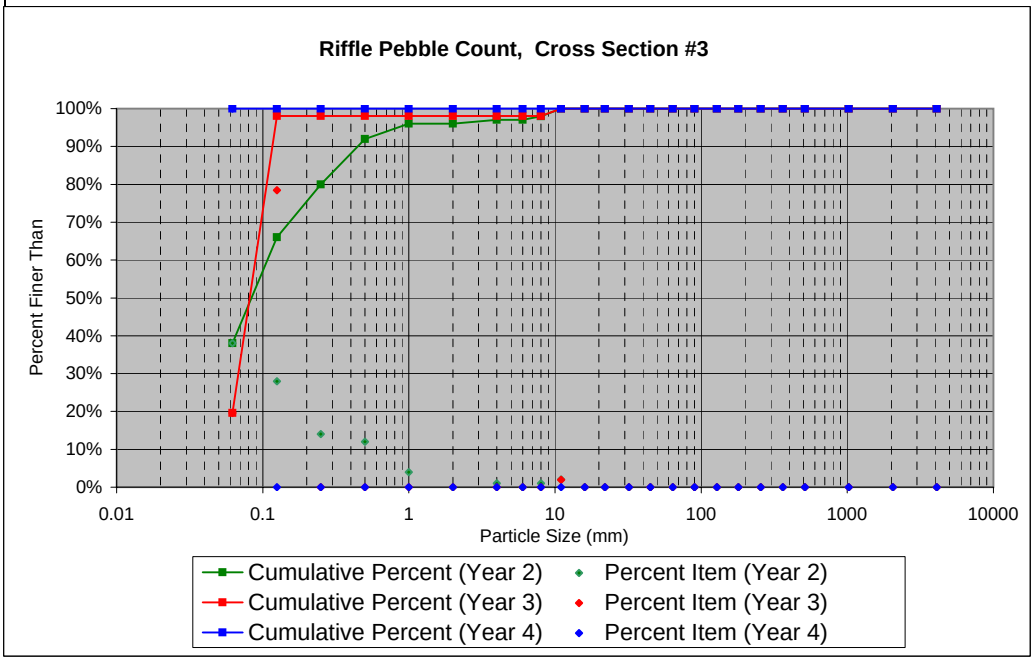
PEBBLE COUNT

Site: Reedy Branch

Party: PDB and KD

Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 3 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	50	50	100%	100%
	Very Fine	.062-.125	SAND		0	0%	100%
	Fine	.125-.25			0	0%	100%
	Medium	.25-.50			0	0%	100%
	Coarse	.50-1.0			0	0%	100%
.04-.08	Very Coarse	1.0-2			0	0%	100%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	100%
.16-.22	Fine	4-5.7			0	0%	100%
.22-.31	Fine	5.7-8			0	0%	100%
.31-.44	Medium	8-11.3			0	0%	100%
.44-.63	Medium	11.3-16			0	0%	100%
.63-.89	Coarse	16-22.6			0	0%	100%
.89-1.26	Coarse	22.6-32			0	0%	100%
1.26-1.77	Very Coarse	32-45			0	0%	100%
1.77-2.5	Very Coarse	45-64			0	0%	100%
2.5-3.5	Small	64-90	COBBLE		0	0%	100%
3.5-5.0	Small	90-128			0	0%	100%
5.0-7.1	Large	128-180			0	0%	100%
7.1-10.1	Large	180-256			0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512			0	0%	100%
20-40	Medium	512-1024			0	0%	100%
40-80	Large	1024-2048			0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					50	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 4: 2008
Alamance County, NC

PEBBLE COUNT

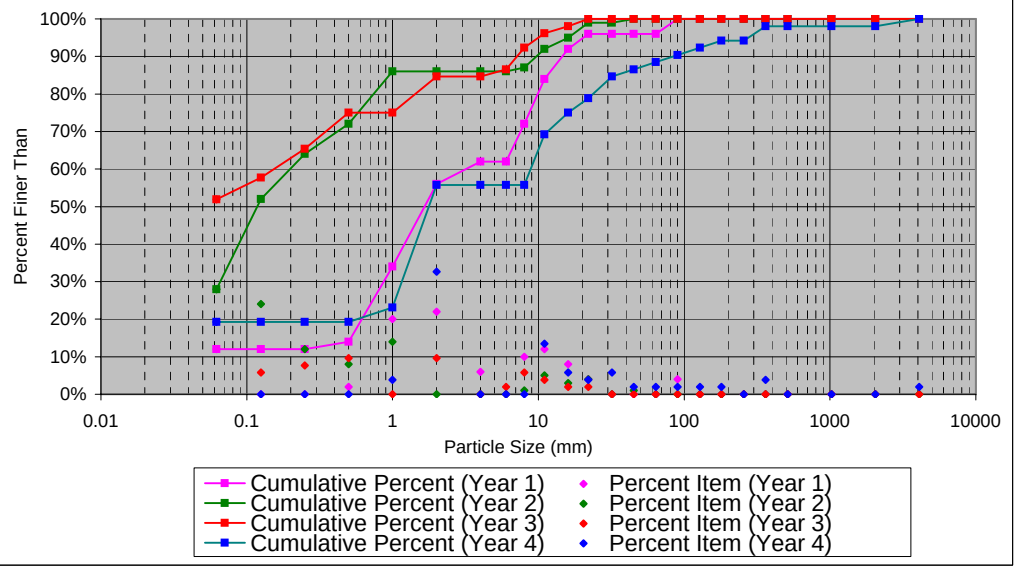
Site: Reedy Branch

Party: PDB and KD

Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 4 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	10	10	19%	19%
	Very Fine	.062-.125	SAND		0	0%	19%
	Fine	.125-.25			0	0%	19%
	Medium	.25-.50			0	0%	19%
	Coarse	.50-1.0		2	2	4%	23%
.04-.08	Very Coarse	1.0-2		17	17	33%	56%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	56%
.16-.22	Fine	4-5.7			0	0%	56%
.22-.31	Fine	5.7-8			0	0%	56%
.31-.44	Medium	8-11.3		7	7	13%	69%
.44-.63	Medium	11.3-16		3	3	6%	75%
.63-.89	Coarse	16-22.6		2	2	4%	79%
.89-1.26	Coarse	22.6-32		3	3	6%	85%
1.26-1.77	Very Coarse	32-45		1	1	2%	87%
1.77-2.5	Very Coarse	45-64		1	1	2%	88%
2.5-3.5	Small	64-90	COBBLE	1	1	2%	90%
3.5-5.0	Small	90-128		1	1	2%	92%
5.0-7.1	Large	128-180		1	1	2%	94%
7.1-10.1	Large	180-256			0	0%	94%
10.1-14.3	Small	256-362	BOULDER	2	2	4%	98%
14.3-20	Small	362-512			0	0%	98%
20-40	Medium	512-1024			0	0%	98%
40-80	Large	1024-2048			0	0%	98%
	Bedrock		**BDRK**	1	1	2%	100%
					52	**100%**	**100%**

Riffle Pebble Count, Cross Section #4



Reedy Branch
Stream Monitoring
Year 4: 2008
Alamance County, NC

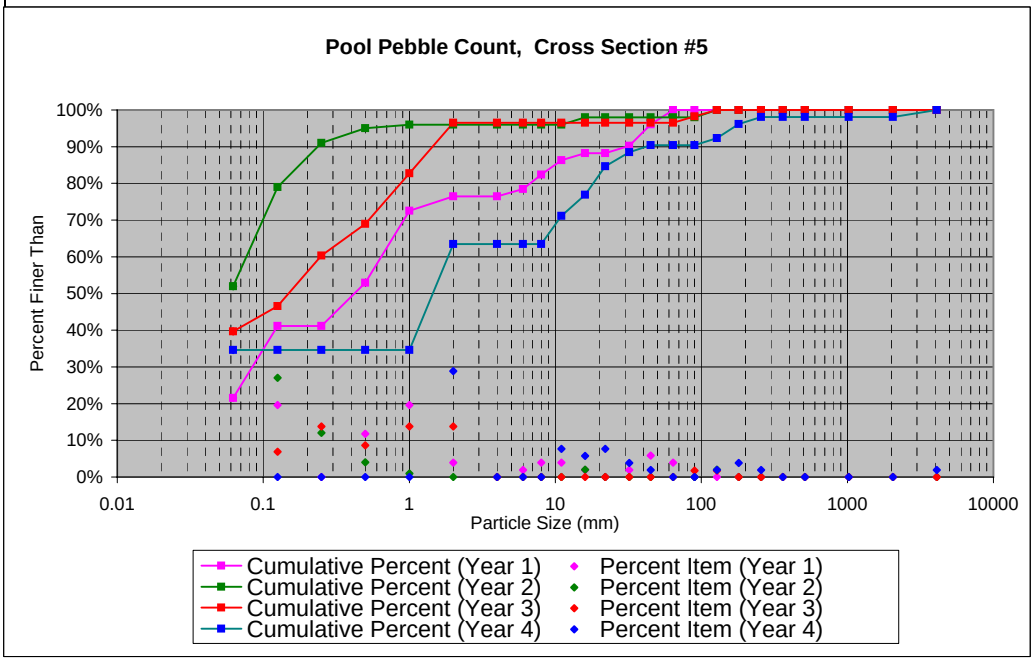
PEBBLE COUNT

Site: Reedy Branch

Party: PDB and KD

Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 5 (Pool)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	18	18	35%	35%
	Very Fine	.062-.125	SAND		0	0%	35%
	Fine	.125-.25	SAND		0	0%	35%
	Medium	.25-.50	SAND		0	0%	35%
	Coarse	.50-1.0	SAND		0	0%	35%
.04-.08	Very Coarse	1.0-2	SAND	15	15	29%	63%
.08-.16	Very Fine	2.0-4.0	GRAVEL		0	0%	63%
.16-.22	Fine	4-5.7	GRAVEL		0	0%	63%
.22-.31	Fine	5.7-8	GRAVEL		0	0%	63%
.31-.44	Medium	8-11.3	GRAVEL	4	4	8%	71%
.44-.63	Medium	11.3-16	GRAVEL	3	3	6%	77%
.63-.89	Coarse	16-22.6	GRAVEL	4	4	8%	85%
.89-1.26	Coarse	22.6-32	GRAVEL	2	2	4%	88%
1.26-1.77	Very Coarse	32-45	GRAVEL	1	1	2%	90%
1.77-2.5	Very Coarse	45-64	GRAVEL		0	0%	90%
2.5-3.5	Small	64-90			0	0%	90%
3.5-5.0	Small	90-128	COBBLE	1	1	2%	92%
5.0-7.1	Large	128-180	COBBLE	2	2	4%	96%
7.1-10.1	Large	180-256	COBBLE	1	1	2%	98%
10.1-14.3	Small	256-362			0	0%	98%
14.3-20	Small	362-512	BOULDER		0	0%	98%
20-40	Medium	512-1024	BOULDER		0	0%	98%
40-80	Large	1024-2048	BOULDER		0	0%	98%
	Bedrock		**BDRK**	1	1	2%	100%
					52	**100%**	**100%**



Reedy Branch
Stream Monitoring
Year 4: 2008
Alamance County, NC

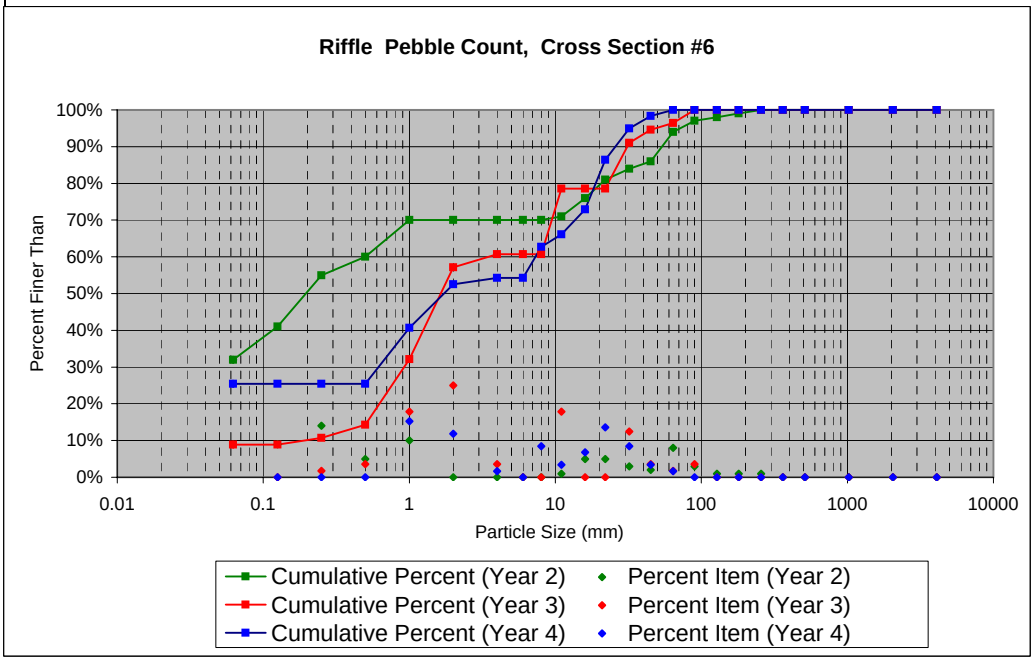
PEBBLE COUNT

Site: Reedy Branch

Party: PDB and KD

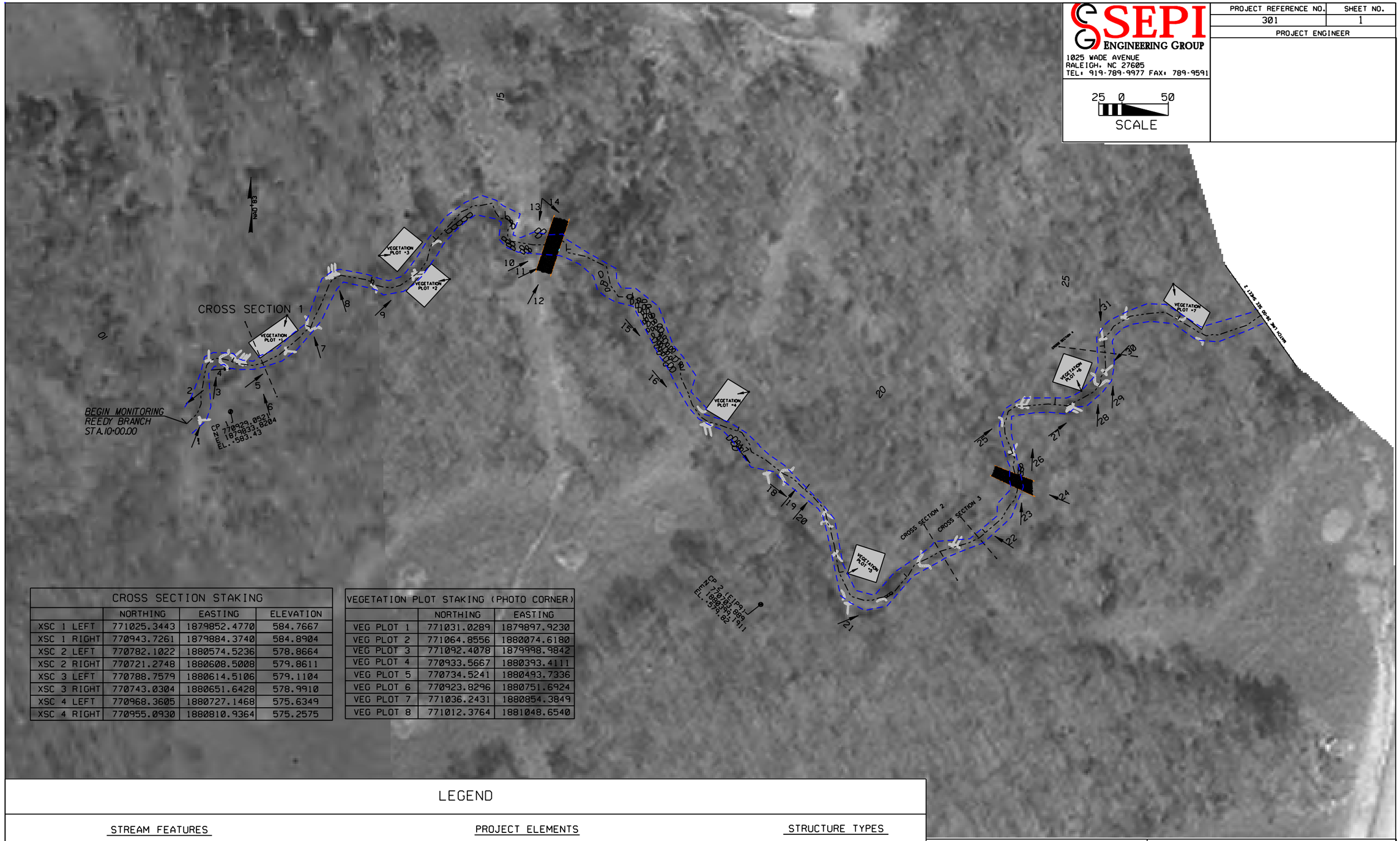
Date: 11/6/2008

Inches	Particle	Millimeters		Cross-Section 6 (Riffle)	TOT#	ITEM %	% CUM
	Silt/Clay	< 0.062	**S/C**	15	15	25%	25%
	Very Fine	.062-.125	SAND		0	0%	25%
	Fine	.125-.25			0	0%	25%
	Medium	.25-.50			0	0%	25%
	Coarse	.50-1.0		9	9	15%	41%
.04-.08	Very Coarse	1.0-2		7	7	12%	53%
.08-.16	Very Fine	2.0-4.0	GRAVEL	1	1	2%	54%
.16-.22	Fine	4-5.7			0	0%	54%
.22-.31	Fine	5.7-8		5	5	8%	63%
.31-.44	Medium	8-11.3		2	2	3%	66%
.44-.63	Medium	11.3-16		4	4	7%	73%
.63-.89	Coarse	16-22.6		8	8	14%	86%
.89-1.26	Coarse	22.6-32		5	5	8%	95%
1.26-1.77	Very Coarse	32-45		2	2	3%	98%
1.77-2.5	Very Coarse	45-64		1	1	2%	100%
2.5-3.5	Small	64-90	COBBLE		0	0%	100%
3.5-5.0	Small	90-128			0	0%	100%
5.0-7.1	Large	128-180			0	0%	100%
7.1-10.1	Large	180-256			0	0%	100%
10.1-14.3	Small	256-362	BOULDER		0	0%	100%
14.3-20	Small	362-512			0	0%	100%
20-40	Medium	512-1024			0	0%	100%
40-80	Large	1024-2048			0	0%	100%
	Bedrock		**BDRK**		0	0%	100%
					59	**100%**	**100%**



APPENDIX C

PLAN VIEW SHEETS



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 1 LEFT	771025.3443	1879852.4770	584.7667
XSC 1 RIGHT	770943.7261	1879884.3740	584.8904
XSC 2 LEFT	770782.1022	1880574.5236	578.8664
XSC 2 RIGHT	770721.2748	1880608.5008	579.8611
XSC 3 LEFT	770788.7579	1880614.5106	579.1104
XSC 3 RIGHT	770743.0304	1880651.6428	578.9910
XSC 4 LEFT	770968.3605	1880727.1468	575.6349
XSC 4 RIGHT	770955.0930	1880810.9364	575.2575

VEGETATION PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 1	771031.0289	1879897.9230
VEG PLOT 2	771064.8556	1880074.6180
VEG PLOT 3	771092.4078	1879998.9842
VEG PLOT 4	770933.5667	1880393.4111
VEG PLOT 5	770734.5241	1880493.7336
VEG PLOT 6	770923.8296	1880751.6924
VEG PLOT 7	771036.2431	1880854.3849
VEG PLOT 8	771012.3764	1881048.6540

LEGEND

STREAM FEATURES

- THALWEG 2008
- BANKFULL 2008

PROJECT ELEMENTS

- CROSS-SECTIONS
- PHOTO POINT
- VEGETATION PLOT WITH PHOTO CORNER ARROW
- FENCED CATTLE CROSSING (FORD)
- CONTROL POINT (CP)

STRUCTURE TYPES

- ROCK CROSS VANE
- J-HOOK VANE
- ROCK VANE
- ROOTWAD
- BEDROCK

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
301	1
PROJECT ENGINEER	

Ecosystem Enhancement PROGRAM

LOCATION: REEDY BRANCH MONITORING PLAN VIEW MONITORING YEAR 4

PROJ #: 301 COUNTY: ALAMANCE

PREPARED BY: IPJ

CHECKED BY: PDB DATE: 2/2/2009

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

25 0 50
SCALE

PROJECT REFERENCE NO.	SHEET NO.
301	2
PROJECT ENGINEER	

CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 5 LEFT	771655.7440	1881190.6814	572.4095
XSC 5 RIGHT	771596.7893	1881270.3239	572.6393
XSC 6 LEFT	771737.2562	1881187.0696	570.5211
XSC 6 RIGHT	771773.7453	1881214.5737	571.7398

VEG PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 8	771012.3764	1881048.6540
VEG PLOT 9	771292.8400	1881051.7913
VEG PLOT 10	771421.1759	1881033.7591
VEG PLOT 11	771495.3763	1881180.2835
VEG PLOT 12	771707.8736	1881201.8622

LEGEND

STREAM FEATURES

- THALWEG 2008
- BANKFULL 2008

PROJECT ELEMENTS

- CROSS-SECTIONS
- PHOTO POINT
- VEGETATION PLOT WITH PHOTO CORNER ARROW
- FENCED CATTLE CROSSING (FORD)
- CONTROL POINT (CP)

STRUCTURE TYPES

- ROCK CROSS VANE
- J-HOOK VANE
- ROCK VANE
- ROOTWAD
- BEDROCK

Ecosystem Enhancement PROGRAM

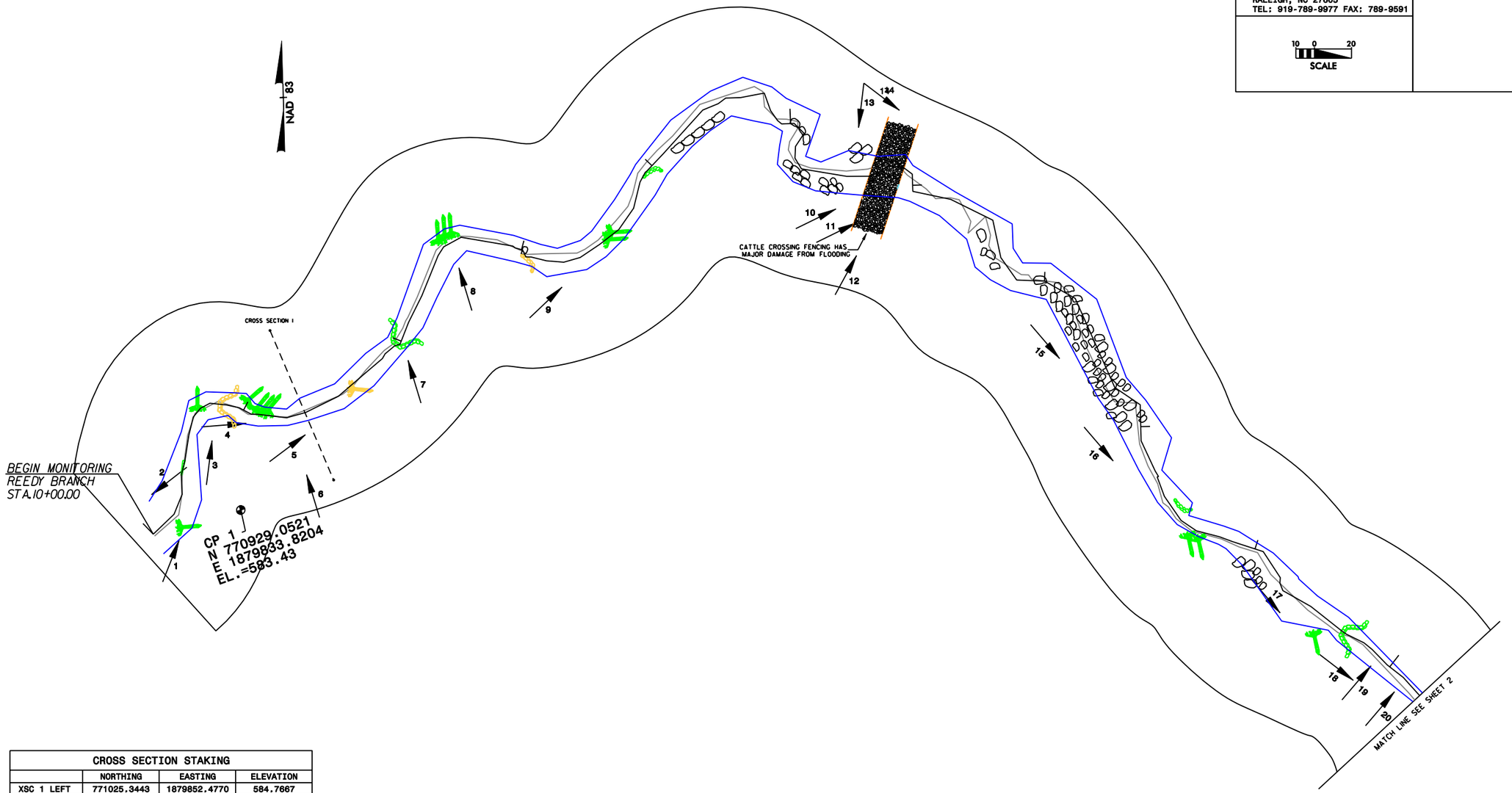
LOCATION: REEDY BRANCH MONITORING PLAN VIEW MONITORING YEAR 4

PROJ #:	COUNTY:
301	ALAMANCE
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 2/2/2009

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
301	1
PROJECT ENGINEER	

10 0 20
SCALE



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 1 LEFT	771025.3443	1879852.4770	584.7667
XSC 1 RIGHT	770943.7261	1879884.3740	584.8904

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- PHOTO POINT

- BANK EROSION
- SEVERE BANK EROSION
- AGGRADATION (GRASSES)
- UNDERCUT BANKS

STRUCTURE TYPES

ROCK CROSS VANE, J-HOOK VANE, ROCK VANE, ROOTWAD, BEDROCK

COLOR CODE FOR STRUCTURES

- GOOD STRUCTURE
- STRUCTURE WITH POTENTIAL PROBLEM
- FAILING STRUCTURE

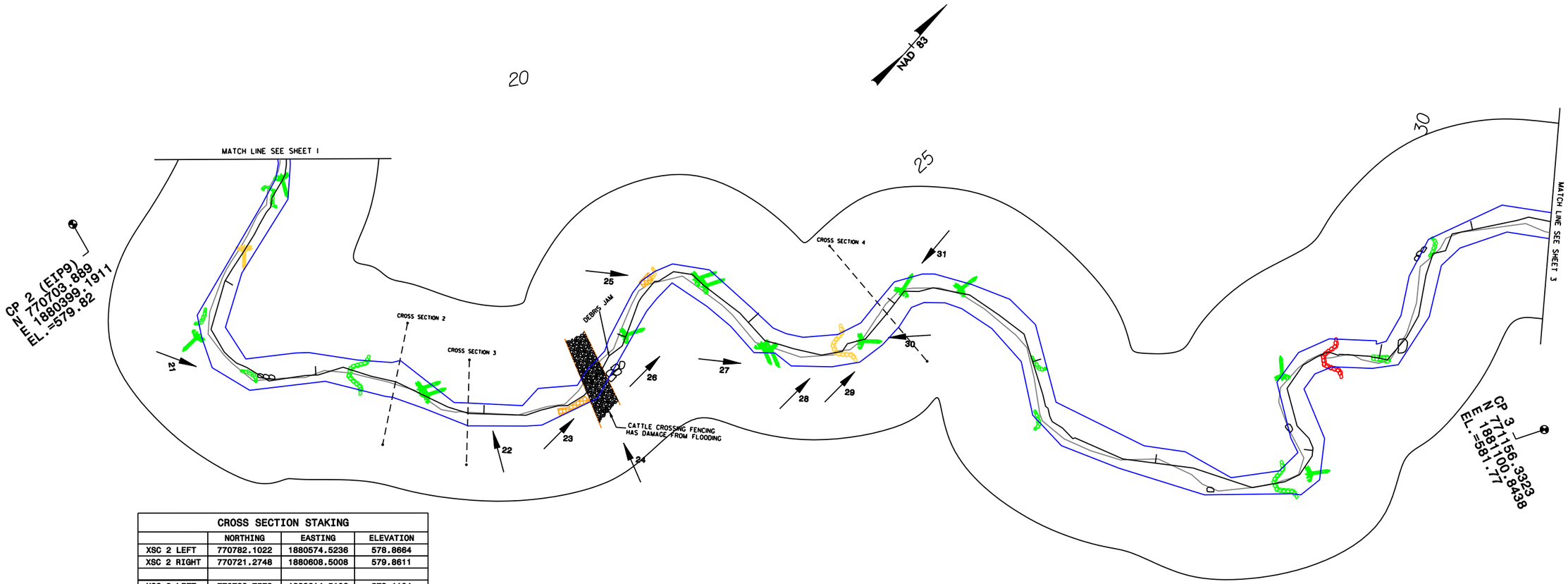
Ecosystem Enhancement PROGRAM

LOCATION:	REEDY BRANCH CURRENT CONDITIONS PLAN VIEW STREAM MONITORING - YEAR 4
PROJ #:	301
COUNTY:	ALAMANCE
PREPARED BY:	IPJ
CHECKED BY:	PDB
DATE:	10/1/2008

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
301	2
PROJECT ENGINEER	

10 0 20
SCALE



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 2 LEFT	770782.1022	1880574.5236	578.8664
XSC 2 RIGHT	770721.2748	1880608.5008	579.8611
XSC 3 LEFT	770788.7579	1880614.5106	579.1104
XSC 3 RIGHT	770743.0304	1880651.6428	578.9910
XSC 4 LEFT	770968.3605	1880727.1468	575.6349
XSC 4 RIGHT	770955.0930	1880810.9364	575.2575

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- PHOTO POINT

- BANK EROSION
- SEVERE BANK EROSION
- AGGRADATION (GRASSES)
- UNDERCUT BANKS

STRUCTURE TYPES

ROCK CROSS VANE | J-HOOK VANE | ROCK VANE | ROOTWAD | BEDROCK

COLOR CODE FOR STRUCTURES

- GOOD STRUCTURE
- STRUCTURE WITH POTENTIAL PROBLEM
- FAILING STRUCTURE

Ecosystem Enhancement PROGRAM

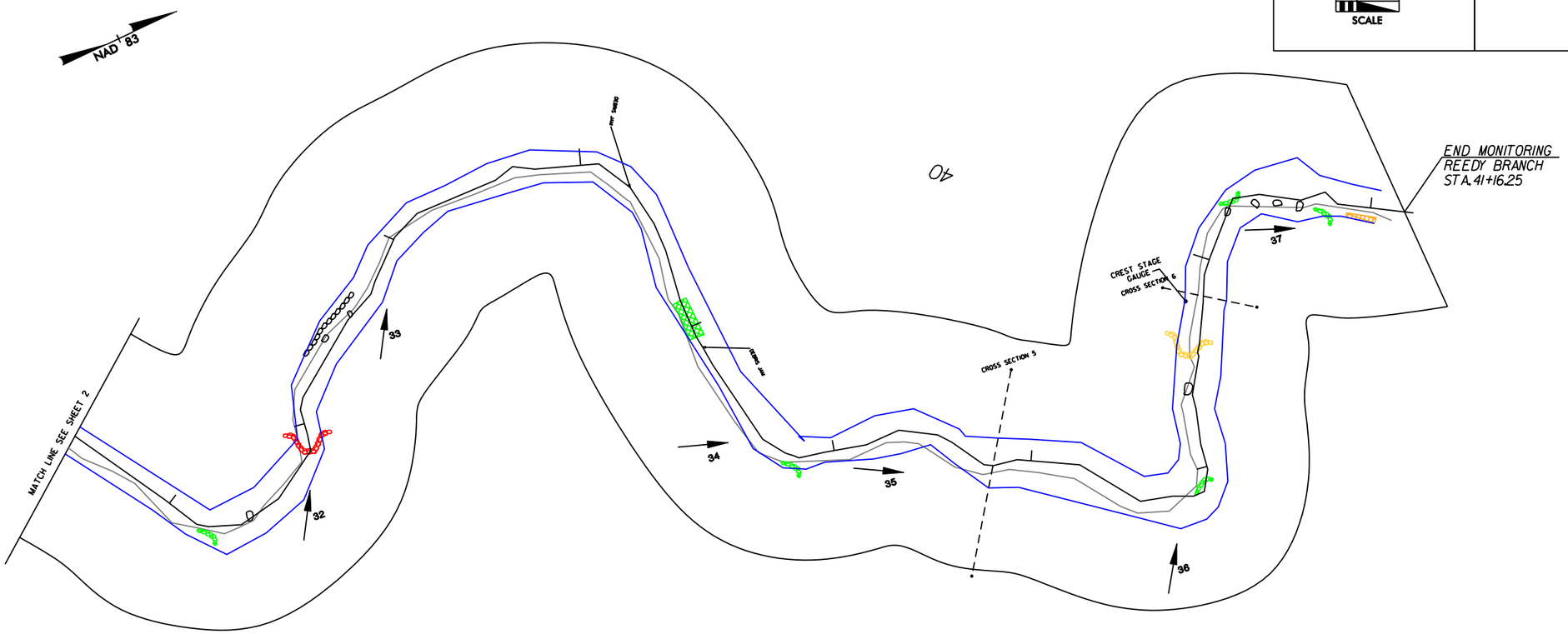
LOCATION: REEDY BRANCH
CURRENT CONDITIONS PLAN VIEW
STREAM MONITORING - YEAR 4

PROJ #:	COUNTY:
301	ALAMANCE
PREPARED BY:	
IPJ	
CHECKED BY:	DATE:
PDB	10/1/2008

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
301	3
PROJECT ENGINEER	

10 0 20
SCALE



CROSS SECTION STAKING			
	NORTHING	EASTING	ELEVATION
XSC 5 LEFT	771655.7440	1881190.6814	572.4095
XSC 5 RIGHT	771596.7893	1881270.3239	572.6393
XSC 6 LEFT	771737.2562	1881187.0696	570.5211
XSC 6 RIGHT	771773.7453	1881214.5737	571.7398

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- PHOTO POINT

- BANK EROSION
- SEVERE BANK EROSION
- AGGRADATION (GRASSES)
- UNDERCUT BANKS

STRUCTURE TYPES

ROCK CROSS VANE, J-HOOK VANE, ROCK VANE, ROOTWAD, BEDROCK

COLOR CODE FOR STRUCTURES

- GOOD STRUCTURE
- STRUCTURE WITH POTENTIAL PROBLEM
- FAILING STRUCTURE

Ecosystem Enhancement PROGRAM

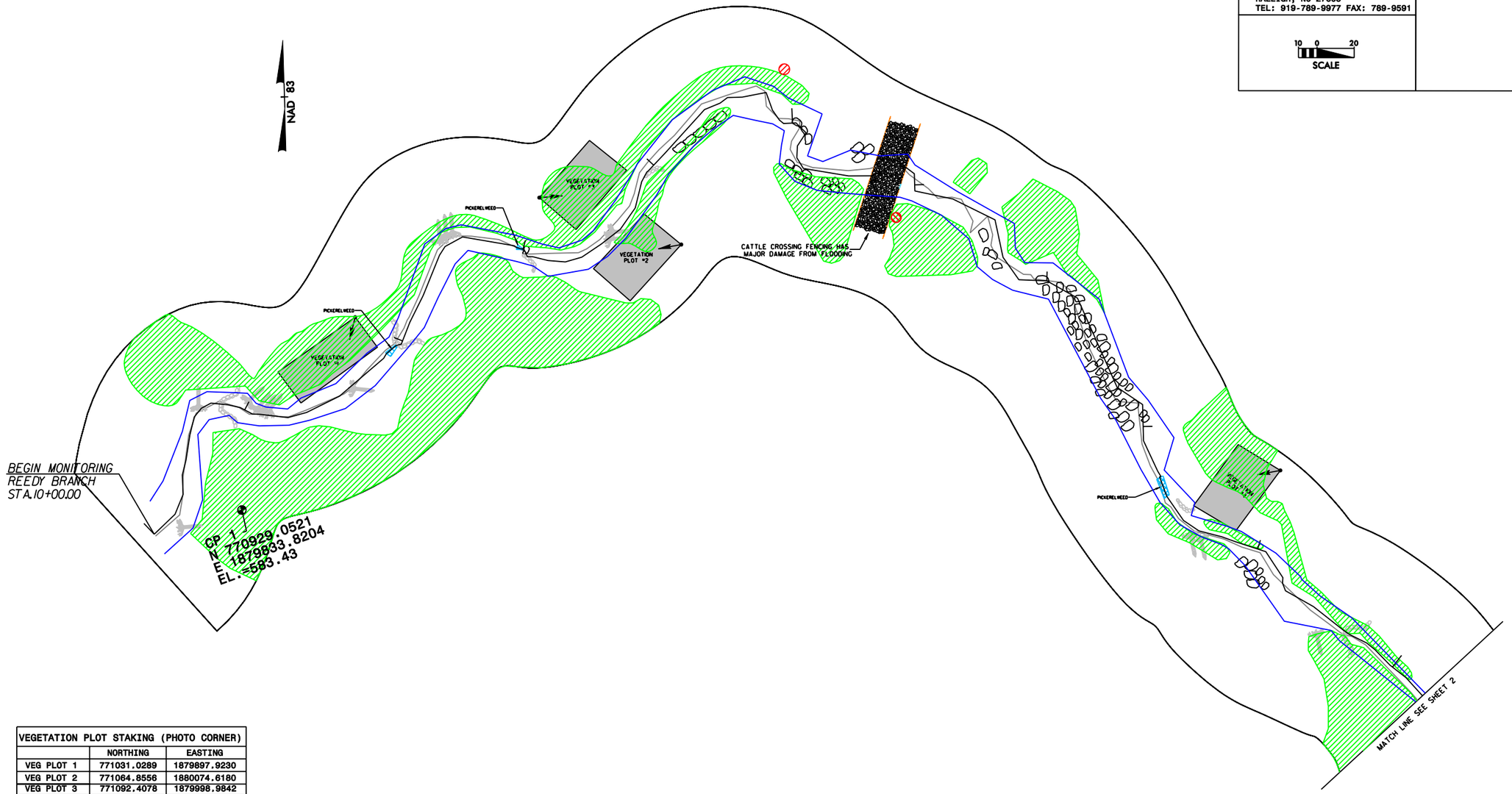
LOCATION: REEDY BRANCH
CURRENT CONDITIONS PLAN VIEW
STREAM MONITORING - YEAR 4

PROJ #:	COUNTY:
301	ALAMANCE
PREPARED BY: IPJ	
CHECKED BY: PDB	DATE: 10/1/2008

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
301	1
PROJECT ENGINEER	

10 0 20
SCALE



VEGETATION PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 1	771031.0289	1879897.9230
VEG PLOT 2	771064.8556	1880074.6180
VEG PLOT 3	771092.4078	1879998.9842
VEG PLOT 4	770933.5667	1880393.4111

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- VEGETATION PLOT WITH PHOTO CORNER
- VEGETATION PLOT NOT MEETING SUCCESS REQUIREMENTS

STRUCTURE TYPES

- ROCK CROSS VANE
- J-HOOK VANE
- ROCK VANE
- ROOTWAD
- BEDROCK

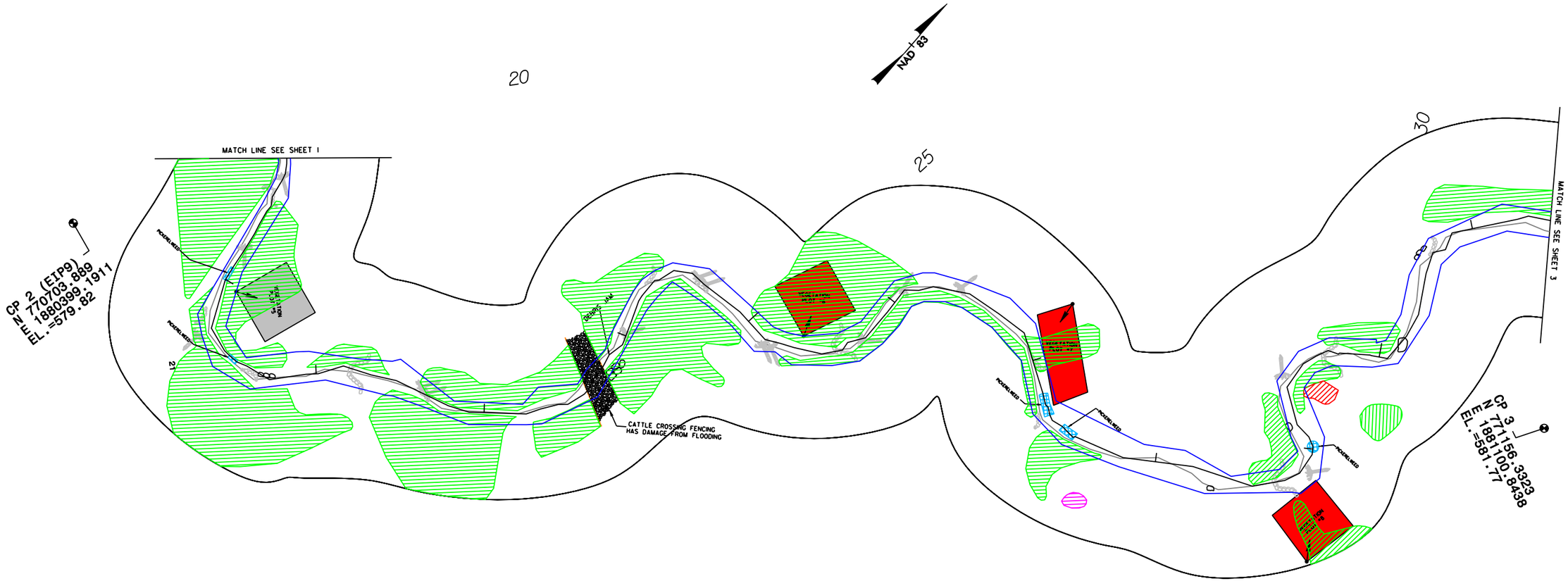
- *PONTEDERIA CORDATA* GROWTH
- *MICROSTEGIUM VIRMINEUM* PRESENT
- *ROSA MULTIFLORA* PRESENT
- *AILANTHUS ALTISSIMA* PRESENT

Ecosystem Enhancement PROGRAM

LOCATION:	REEDY BRANCH CURRENT CONDITIONS PLAN VIEW VEGETATION ASSESSMENT - YEAR 4
PROJ #: 301	COUNTY: ALAMANCE
MONITORED BY: IPJ	
CHECKED BY: PDB	DATE: 10/1/08

SEPI ENGINEERING GROUP	PROJECT REFERENCE NO.	SHEET NO.
1025 WADE AVENUE RALEIGH, NC 27605 TEL: 919-789-9977 FAX: 789-9591	301	2
	PROJECT ENGINEER	

10 0 20
SCALE



VEGETATION PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 5	770734.5241	1880493.7336
VEG PLOT 6	770923.8296	1880751.6924
VEG PLOT 7	771036.2431	1880854.3849
VEG PLOT 8	771012.3764	1881048.6540

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- VEGETATION PLOT WITH PHOTO CORNER
- VEGETATION PLOT NOT MEETING SUCCESS REQUIREMENTS

STRUCTURE TYPES

- ROCK CROSS VANE
- J-HOOK VANE
- ROCK VANE
- ROOTWAD
- BEDROCK

- *PONTEDERIA CORDATA* GROWTH
- *MICROSTEGIUM VIMINEUM* PRESENT
- *ROSA MULTIFLORA* PRESENT
- *AILANTHUS ALTISSIMA* PRESENT

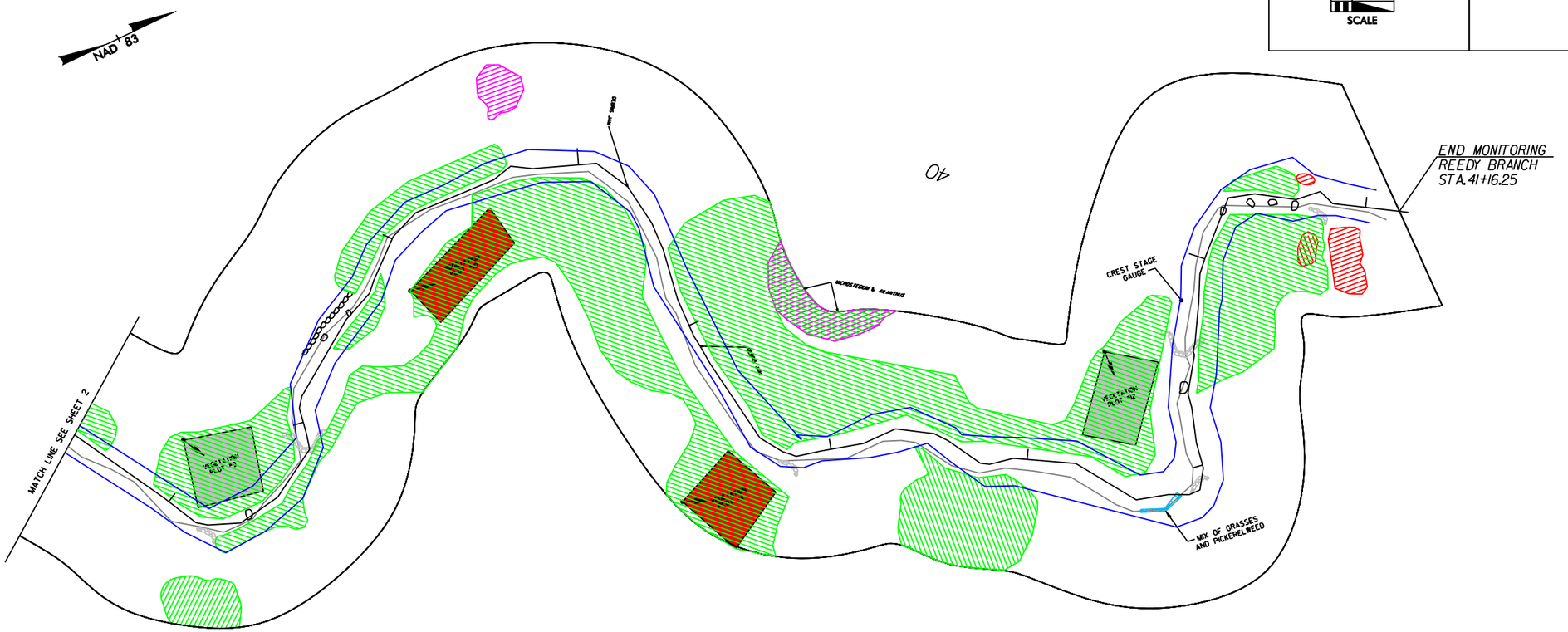
Ecosystem Enhancement PROGRAM

LOCATION:	REEDY BRANCH CURRENT CONDITIONS PLAN VIEW VEGETATION ASSESSMENT - YEAR 4
PROJ #: 301	COUNTY: ALAMANCE
MONITORED BY: IPJ	
CHECKED BY: PDB	DATE: 10/1/08

SEPI ENGINEERING GROUP
1025 WADE AVENUE
RALEIGH, NC 27605
TEL: 919-789-9977 FAX: 789-9591

PROJECT REFERENCE NO.	SHEET NO.
301	3
PROJECT ENGINEER	

10 0 20
SCALE



VEG PLOT STAKING (PHOTO CORNER)		
	NORTHING	EASTING
VEG PLOT 9	771292.8400	1881051.7913
VEG PLOT 10	771421.1759	1881033.7591
VEG PLOT 11	771495.3763	1881180.2835
VEG PLOT 12	771707.8736	1881201.8622

LEGEND

- THALWEG 2007
- THALWEG 2008
- BANKFULL 2008
- TOP OF BANK 2008
- CROSS-SECTIONS
- VEGETATION PLOT WITH PHOTO CORNER
- VEGETATION PLOT NOT MEETING SUCCESS REQUIREMENTS

STRUCTURE TYPES

ROCK CROSS VANE, J-HOOK VANE, ROCK VANE, ROOTWAD, BEDROCK

- *PONTEDERIA CORDATA* GROWTH
- *MICROSTEGIUM VIMINEUM* PRESENT
- *ROSA MULTIFLORA* PRESENT
- *AILANTHUS ALTISSIMA* PRESENT

Ecosystem Enhancement PROGRAM

LOCATION:	REEDY BRANCH CURRENT CONDITIONS PLAN VIEW VEGETATION ASSESSMENT - YEAR 4
PROJ #: 301	COUNTY: ALAMANCE
MONITORED BY:	IPJ
CHECKED BY: PDB	DATE: 10/1/08