SOUTH FORK HOPPERS CREEK STREAM AND WETLAND RESTORATION PROJECT

ANNUAL MONITORING REPORT FOR 2008 (YEAR 3)

Project Number: D04006-4

Submitted to:

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SUMMARY

This Annual Report details the monitoring activities during the 2008 growing season on the South Fork Hoppers Creek Wetland and Stream Restoration Site ("Site"). Construction of the Site, including planting of trees, was completed in April 2006. In order to document project success, ten vegetation monitoring plots, sixteen permanent cross-sections, 3,562 linear feet of longitudinal profiles, one rain gauge, one crest gauge and eight hydrologic monitoring gauges (five automated and three manual) were installed and assessed across the Site. The 2008 data represents results from the third year of vegetation and hydrologic monitoring for both wetlands and streams and from the second year of macroinvertebrate data for streams.

Prior to restoration, wetland, stream, and buffer functions on the Site were impaired as a result of agricultural conversion. Streams flowing through the Site had been channelized to reduce flooding and provide drainage for adjacent farm fields. After construction it was determined that 5.6 acres of riverine wetlands and 7,229 linear feet (LF) of stream were restored, and 1.4 acres of riverine wetlands were enhanced.

Weather station data from the Natural Resources Conservation Service (NRCS) National Climate and Water Center (Marion WETS Station in McDowell County – NC 5340) and the US Geological Survey (USGS) Water Data for North Carolina (USGS 03451500 French Broad River at Asheville, NC) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. Rainfall was normal or below normal for more than 70 percent of the 2008 growing season. The monitoring well data shows that seven of the eight hydrologic monitoring gauges had met the 7 percent hydrologic success criteria based on field observations in 2008. Though one well did not meet the project's success criteria, its documented hydroperiods were similar to those documented for the reference monitoring wells.

Ten monitoring plots that are 10 meters by 10 meters or 0.025 of an acre in size were used to assess survivability of the woody vegetation planted on site. They are randomly located to represent the different zones within the project. The vegetation monitoring documented a survivability range of 520 stems per acre to 640 stems per acre with an overall average of 592 stems per acre. Overall, the Site is exceeding the initial vegetation survival criteria of 320 stems per acre surviving after the third growing season.

In general, dimension, pattern, profile and in-stream structures remained stable during the third growing season. Remnant minor scour erosion was noted along the upstream end of a few rootwads at stations 124+50, 126+75, and 133+50. The erosion appears to have taken place before vegetation was fully established. Minor stream dimension aggradation was documented at a few cross-sections and has occurred within the last year. On-site evaluation suggests that this is due to increased sediment supply upstream from the site. Point bar formation along the inside of a meander bend indicates flow velocity vectors occurring as designed. All monitored cross-sections fell within the quantitative parameters defined for "C" type channels. Three bankfull events were observed and documented during the months of January, April, and July.

In summary, the Site is on track to achieve the hydraulic, vegetative, and stream success criteria specified in the Site's Restoration Plan.

1.0 PROJECT BACKGROUND

The South Fork Hoppers Creek Restoration Site is located in McDowell County, North Carolina (Figure 1). The Site lies in the Catawba River Basin within North Carolina Division of Water Quality (NCDWQ) sub-basin 03-08-30 and US Geologic Survey (USGS) hydrologic unit 03050101040020. The Site has a recent history of pasture and general agricultural usage. The streams of the Site were channelized and riparian vegetation was cleared in most locations. Stream and riparian functions on the Site had been severely impacted as a result of agricultural conversion.

The project involved the restoration of 5.6 acres of riverine wetlands, enhancement of 1.4 acres of riverine wetlands, and restoration of 7,229 linear feet (LF) of stream along South Fork Hoppers Creek (the mainstem) and one unnamed tributary (UT 1). A total of 33.8 acres of stream, wetland, and riparian buffer are protected through a permanent conservation easement.

1.1 Project Location

The Site is located approximately 30 miles northwest of the town of Shelby in McDowell County, North Carolina (Figure 1 & 2). From Shelby take NC Highway 226 north towards Dysartsville. Approximately 3 miles past the Rutherford/McDowell County line, turn left onto Walker Road. Take the next right onto Pierce Road. The Site is divided into two separate sections by Pierce Road. Access for the downstream section is northeast of the culvert crossing. The conservation easement gate for the upstream section is southwest of the culvert crossing.

1.2 Mitigation Goals and Objectives

The specific goals for the South Fork Hoppers Creek Restoration Project were as follows:

- Restoration of 7,229 LF of stream channel.
- Restoration of 5.6 acres of riverine wetlands.
- Enhancement of 1.4 acres of existing riverine wetlands.
- Removal of cattle access to the stream channel, wetland and riparian buffer areas.
- Improvement of floodplain functionality by matching floodplain elevations with the bankfull stage.
- Establishment of native wetland and floodplain vegetation within the conservation easement.
- Improvement of wildlife habitat functions of the Site.

1.3 Project Description and Restoration Approach

For assessment and analysis purposes, the on-site streams were divided into five reaches: four along the mainstem, and one on UT 1 that flows into the mainstem downstream of Pierce Road (Figure 3). The following paragraphs describe the Site's pre-construction conditions and the selected restoration approach.

The mainstem entered the Site from the southwest and flowed east through a 48-inch corrugated metal pipe (CMP) culvert. Reach 1 continued east through a pasture for approximately 1,500 LF and then entered a second 48-inch CMP culvert. Reach 2 began 1,000 LF downstream of the second 48-inch culvert, at the confluence of a small tributary, and continued east and north for 578 LF to twin, 72-inch CMP culverts under Pierce Road. Reach 3 began downstream of the twin culverts and continued approximately 1,200 LF north through an abandoned pasture. Reach 4 extended the final 900 LF to the north project boundary and was characterized by a flatter slope, finer bed material, and a lower bank height ratio than the other 3 reaches.

UT 1 entered the Site through a 36-inch culvert under Pierce Road, then flowed east to west, parallel to Pierce Road, and entered Reach 3 approximately 80 LF downstream of the twin, 72-inch culverts. UT 1 had a reach length of 306 LF on the project Site.

For design purposes, the mainstem was divided into two reaches. From the assessment, Reach 1 correlates to Design Reach 1, while Reaches 2, 3, and 4 were combined for Design Reach 2.

It is likely that much of the project area once existed as a wetland ecosystem, as evidenced by hydric soil areas across the bottomland fields of the Site, as well as landowner accounts of wet areas of the Site prior to drainage activities. Wetland areas that once existed on the Site were drained and manipulated to promote agricultural uses. The stream was channelized within the project site to improve surface and subsurface drainage and to decrease flooding. Subsurface drain tiles were also installed in floodplain areas of the project Site, particularly the field downstream of Pierce Road. As a result, wetland functions were impacted within the project area. The channelization of the stream impaired its ability to function naturally, resulting in areas of active bank erosion and an overall poor habitat condition.

Design for the restored stream involved the construction of a new channel meandering through the agricultural fields. The restored mainstem was a Rosgen "C" stream type channel with a low width/depth cross-sectional area approaching typical Rosgen "E" type dimensions. A Rosgen "B" stream type was used for the restored UT 1 channel. Each stream type's design dimensions are based on those of reference parameters. Wetland restoration of the agricultural fields on the Site involved raising the local water table to restore a natural flooding regime. The stream through the Site was restored to a stable dimension, pattern, and profile, such that riverine wetland functions were restored to the adjacent hydric soil areas. Drainage ditches within the restoration areas were filled to decrease surface and subsurface drainage and raise the local water table. Total stream length across the Site was increased from approximately 5,579 LF to 7,229 LF. Total wetland acreage was increased from 2.17 acres to 5.6 acres. Assessment of the restored site determined that 7,229 stream mitigation units (SMU) were provided for the stream restoration and a total of 6.3 wetlands mitigation units (WMU) were achieved for wetland restoration and enhancement.

The design allows stream flows larger than the bankfull to spread onto the floodplain, dissipating flow energies and reducing stress on stream banks. In-stream structures were used to control streambed grade, reduce stress on stream banks, and promote bedform sequences and habitat diversity. The in-stream structures consisted of root-wads, cover logs and log vanes, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles or rock cross vanes were installed to provide long-term stability. Stream banks were stabilized using a combination of erosion control matting, live stakes, bare-root planting, and transplants. Transplants provide living root mass to increase stream bank stability and create holding areas for fish and aquatic biota. Native vegetation was planted across the Site, and the entire restoration site is protected through a permanent conservation easement.

Table 1. Project Mitigation Approach

South Fork Hoppers Creek Restoration Site: Project No. D04006-4								
Existing Segment or Reach ID	**Existing Feet / Acreage**	**Mitigation Type ***	**Approach****	**Footage / Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
UT1	306 LF	R	P1	203 LF	1	203	200+00 - 202+03	Restoration of dimension, pattern, and profile to a "B" stream type.
South Fork Hoppers Reach 1	2,595 LF	R	P1 & P2	3,528 LF	1	3528	110+85 - 146+17	Restoration to a "C" approaching "E" stream type and P2 used to tie into the Pierce Road culvert.
South Fork Hoppers Reach 2	2,678 LF	R	P1 & P2	3,498 LF	1	3498	146+17 - 181+70	Restoration to a "C" approaching "E" stream type and P2 used to tie channel into the Pierce Road culvert.
Wetland Enhancement	2.53 Ac	E	---	1.4 Ac	0.5	0.7	164+50 - 166 + 90 (R) 171+05 - 176+79 (R) 175+91 - 179+52 (L) 178+31 - 179+52 (R)	Planting, and raising water table
Wetland Restoration		R	---	5.6 Ac	1	5.6	135+79 - 139+00 (L) 154+53 - 167+80 (L) 166+89 - 174+25 (R) 175+50 - 177+67 (R) 175+70 - 180+43 (L)	Grading, soil roughing, planting, and raising water table

Total linear feet of channel restored: 7,229 **Total Stream Mitigation Units:** 7,229

Total acres of wetlands restored: 5.6 **Total Wetland Mitigation Units:** 6.3

* R = Restoration
E = Enhancement
S = Stabilization

** P1 = Priority I
P2 = Priority II
P3 = Priority III
EI = Enhancement I
EII = Enhancement II

1.4 Project History and Background

The chronology of the South Fork Hoppers Creek Restoration Project is presented in Table 2. The contact information for all designers, contractors, and relevant suppliers is presented in Table 3. Relevant project background information is presented in Table 4.

Table 2. Project Activity and Reporting History

South Fork Hoppers Creek Restoration Site: Project No. D04006-4		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan Prepared	N/A	Mar-05
Restoration Plan Amended	N/A	Apr-05
Restoration Plan Approved	N/A	
Final Design – (at least 90% complete)	N/A	Aug-05
Construction Begins	N/A	Jun-05
Temporary S&E mix applied to entire project area	N/A	N/A
Permanent seed mix applied to entire project area	N/A	Apr-06
Planting of live stakes	N/A	Apr-06
Planting of bare root trees	N/A	Apr-06
End of Construction	N/A	May-06
Survey of As-built conditions (Year 0 Monitoring-baseline)	Jun-06	Jul-06
Repair work	Oct-06	Oct-06
	Unknown	Unknown
Year 1 Monitoring	Oct-06	Nov-06
Year 2 Monitoring	Oct-07	Nov-07
Year 3 Monitoring	Oct-08	Nov-08
Year 4 Monitoring (Scheduled)	Oct-09	Nov-09
Year 5 Monitoring (Scheduled)	Oct-10	Nov-10

Table 3. Project Contact Table

South Fork Hoppers Creek Restoration Site : Project No.D04006-4	
Full Service Delivery Contractor	
EBX-Neuse I, LLC	909 Capability Drive, Suite 3100 Raleigh, NC 27606 Contact: Norton Webster, Tel. 919-829-9909
Designer	
Michael Baker Engineering, Inc.	1447 S. Tryon Street, Suite 200 Charlotte, NC 28203 Contact: Eng. Chris Yow, Tel 704-334-4454
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Planting Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200 Cary, NC 27518 Contact: Will Pedersen, Tel. 919-459-9001
Seed Mix Sources	Mellow Marsh Farm, 919-742-1200
Nursery Stock Suppliers	International Paper, 1-888-888-7159
Monitoring Performers	
Michael Baker Engineering, Inc.	1447 S. Tryon Street, Suite 200 Charlotte, NC 28203
Stream Monitoring Point of Contact:	Ian Eckardt, Tel.704-334-4454
Wetland Monitoring Point of Contact:	Ian Eckardt, Tel.704-334-4454
Vegetation Monitoring Firm: Wetland and Natural Resource Consultants	3674 Pine Swamp Road Sparta, NC 28675 Chris Hysman, Tel. 336-406-0906

Table 4. Project Background

South Fork Hoppers Creek Restoration Site: Project No. D04006-4	
Project County:	McDowell County, NC
Drainage Area:	
South Fork Hoppers Reach 1	0.93 mi^2
South Fork Hoppers Reach 2	1.38 mi^2
UT1	0.07 mi^2
Estimated Drainage % Impervious Cover:	
Reach: South Fork Hoppers Reach 1	< 5%
Reach: South Fork Hoppers Reach 2	< 5%
Reach: UT1	< 5%
Stream Order:	
South Fork Hoppers Reach 1	2
South Fork Hoppers Reach 2	2
UT1	1
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	
South Fork Hoppers Reach 1	C
South Fork Hoppers Reach 2	C
UT-1	B
Cowardin Classification	Riverine, Upper Perennial, Unconsolidated Bottom, Cobble-Gravel
Dominant Soil Types	
South Fork Hoppers Reach 1	IoA, EwE, HeD, HcC1
South Fork Hoppers Reach 2	IoA, EwE, HeD, HcC2
UT1	IoA
Reference Site ID	Spencer Creek, Craig Creek, Big Branch, Sals Branch
USGS HUC for Project and Reference Sites	03050101040020
NCDWQ Sub-basin for Project and Reference	03-08-30
NCDWQ classification for Project and Reference	C
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
Percent of project easement fenced	50%

1.5 Project Monitoring Plan

Plans depicting the as-built conditions of the major project elements, location of permanent monitoring cross-sections, locations of hydrologic monitoring stations, and locations of permanent vegetation monitoring plots are presented in Appendix C of this report.

2.0 VEGETATION MONITORING

2.1 Soil Data

The soil data for the Site is presented in Table 5.

Table 5. Soil Data for Project

South Fork Hoppers Creek Restoration Site: Project No. D04006-4					
Series	**Max Depth (in)**	**% Clay on Surface**	**K**	**T**	**OM %**
(IaA) - Iotla Sandy Loam, 0 to 3 percent slopes	60	12-18	0.2	5	2-5
(EwE) - Evard-Cowee Complex, 2 to 95 percent slopes	65	5-20	0.24	5	1-5
(HcC2) -Hayesville Clay Loam, 2 to 60 percent slopes	62	10-25	0.24	4	1-3
(HeD) -Hayesville-Evard Complex, 2 to 60 percent slopes	62	5-25	0.24	5	1-5

NRCS, USDA. Official Soil Series Descriptions (http://soils.usda.gov/soils/technical/classification/osd/index.html)

General taxonomy of Site soils:

Iotla:

The Iotla series (IaA) consists of very deep, somewhat poorly-drained soils with moderately rapid permeability on floodplains. They formed in loamy, recent alluvium. Slopes range from 0 to 3 percent.

Evard-Cowee:

The Evard-Cowee complex (EwE) is composed of very deep, well-drained, moderately permeable soils on ridges and side slopes. They formed in residuum affected by soil creep in the upper part and weathered from felsic to mafic, igneous and high-grade metamorphic rocks. Slopes range from 2 to 95 percent.

Hayesville:

The Hayesville Series (HcC2 and HeD) consists of very deep well-drained soils on gently sloping to very steep ridges. They most commonly formed in residuum weathered from igneous and high-grade metamorphic rocks such as granite, granodiorite, mica gneiss and schist; but in some places formed from thickly-bedded metagraywacke and metasandstone. On steeper slopes the upper part of some pedons may have some colluvial influence. Slopes range from 2 to 60 percent.

2.2 Description of Species and Monitoring Protocol

The Site was planted in bottomland hardwood forest species in March and April 2006. The following tree species were planted in the restoration area:

Table 6. Tree Species Planted

South Fork Hoppers Creek Restoration Site : Project No. D04006-4			
ID	**Scientific Name**	**Common Name**	**FAC Status**
1	*Betula nigra*	River Birch	FACW
2	*Fraxinus pennsylvanica*	Green Ash	FACW
3	*Platanus occidentalis*	Sycamore	FACW-
4	*Quercus phellos*	Willow Oak	FACW-
5	*Quercus rubra*	Northern Red Oak	FACU
6	*Quercus michauxii*	Swamp Chestnut Oak	FACW-
7	*Liriodendron tulipifera*	Tulip Poplar	FAC
8	*Celtis laevigata*	Sugarberry	FACW
9	*Diospyrus virginiana*	Persimmon	FAC
10	*Nyssa sylvatica*	Blackgum	FAC

The following monitoring protocol was designed to predict vegetative survivability. Ten plots were established on the South Fork Hoppers Site, to monitor approximately 1.5 percent of the Site. All plots are 0.025 acre in size, or 10 meters by 10 meters. Six plots were established in areas that included both the wetlands and stream buffer. The remaining four plots were located adjacent to the newly constructed streambed to monitor the vegetation in the stream restoration buffer. The plots were randomly located within each zone and randomly oriented within the wetland restoration area.

Plot construction involved using metal fence posts at each of the four corners to clearly and permanently establish the area that was to be sampled. Then ropes were hung connecting all four corners to help in determining if trees close to the plot boundary were inside or outside of the plot. Trees right on the boundary and trees just outside of the boundary that appear to have greater than 50 percent of their canopy inside the boundary were counted inside the plot. A piece of white PVC pipe ten feet tall was placed over the metal post on one corner to facilitate visual location of plot throughout the five-year monitoring period.

All of the planted stems inside the plot were flagged with orange flagging and marked with a three-foot tall piece of half-inch PVC to identify them as the planted stems (vs. any colonizers) and to help in locating them in the future. Each stem was then tagged with a permanent, numbered aluminum tag.

2.3 Vegetation Success Criteria

The interim measure of vegetative success for the South Fork Hoppers Mitigation Plan will be the survival of at least 320, 3-year old planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria will be the survival of 260, 5-year old planted trees per acre at the end of Year 5 of the monitoring period.

Up to 20 percent of the Site species composition may be comprised of invaders. Remedial action may be required should these volunteer species (i.e. Loblolly pine, red maple, sweet gum, etc.) present a problem and exceed 20 percent composition.

2.4 Results of Vegetative Monitoring

The following tables present stem counts for each of the monitoring plots. Each planted tree species is identified down the left column, and each plot is identified across the top row. Trees are flagged in the field on an as-needed basis before the flags degrade. Flags are utilized as opposed to an alternative identification method because they will not interfere with the growth of the tree. Volunteer species are also flagged during this process.

Table 7. Year 3 Stem Counts for Each Species Arranged by Plot

South Fork Hoppers Creek Restoration Site: Project No. D04006-4											Initial Totals	Year 1 Totals	Year 2 Totals	Year 3 Totals	% Survival
	Year 3 Plot Counts														
Tree Species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**					
Betula nigra	1	0	0	0	0	0	0	0	0	0	2	2	2	1	50.0
Fraxinus pennsylvanica	9	1	4	4	0	2	0	0	0	4	24	25	23	24	100.0
Platanus occidentalis	2	0	8	4	5	8	0	0	2	0	30	31	32	29	97.0
Quercus phellos	4	0	3	7	4	1	0	0	6	4	25	32	32	29	116.0
Quercus rubra	0	0	0	0	0	0	0	0	2	0	2	3	2	2	100.0
Quercus michauxii	0	0	0	0	4	0	0	0	0	7	7	10	11	11	158.0
Liriodendron tulipifera	0	7	0	0	0	2	6	5	4	0	0	27	24	24	0.0
Celtis laevigata	0	0	0	0	3	0	0	0	0	0	18	4	3	3	17.0
Diospyros virginiana	0	0	0	0	0	0	5	0	0	0	16	5	5	5	32.0
Nyssa sylvatica	0	6	0	0	0	0	5	9	0	0	10	22	21	20	200.0
Quercus spp.											19	0	0	0	0.0
Unknown											12	0	0	0	0.0
Stems/plot	16	14	15	15	16	13	16	14	14	15	165	161	155	148	90.0
Stems/acre	**640**	**560**	**600**	**600**	**640**	**520**	**640**	**560**	**560**	**600**	**620**	**average**			

Average Stems/Acre for Year 3: 592

Range of Stems/Acre for Year 3: 520-640

Volunteer species will also be monitored throughout the five-year monitoring period. Table 8 depicts the most commonly found woody volunteer species.

Table 8. Volunteers within Wetland Restoration Area

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
ID	**Scientific Name**	**Common Name**	**FAC Status**
A	*Liquidambar styraciflua*	Sweetgum	FAC+
B	*Acer rubrum*	Red Maple	FAC

Few volunteer woody species were observed in any of the vegetation plots, and were deemed too small to tally. If these trees persist into the next growing season, they will be flagged and added to the overall stems per acre assessment of the site. Red Maple (*Acer rubrum*) was the most common volunteer, though Sweetgum (*Liquidambar styraciflua*) was also observed.

2.5 Vegetation Observations

After construction of the Site, a permanent ground cover seed mixture of Virginia wild rye (*Elymus virginicus*), switch grass (*Panicum virgatum*), and fox sedge (*Carex vulpinoidea*) was broadcast on the Site at a rate of 10 pounds per acre. These species were present on the Site. Hydrophytic herbaceous vegetation, including rush (*Juncus effusus*), spike-rush (*Eleocharis obtusa*), boxseed (*Ludwigia* sp.) and sedge (*Carex* sp.) were observed across the Site, particularly in areas of periodic inundation. The presence of these herbaceous wetland plants helps to confirm the presence of wetland hydrology on the Site.

There are weedy species occurring on the site, though currently only the kudzu and lespedeza seem to pose any potential problems. These weedy species should be managed aggressively to prevent any major mortality issues. This threatening weedy vegetation and any others found will be documented and discussed in tri-annual reports.

2.6 Vegetation Conclusions

The site was planted in bottomland hardwood forest species in April and May 2006. There were ten vegetation-monitoring plots established throughout the planting areas. The data reflects that overall the Site has met the minimum success interim criteria of 320 trees per acre by the end of year three and on trajectory to meet the final success criteria of 260 trees per acre by the end of year five. There will need to be a maintenance herbicide application schedule for next year to prevent the invasive kudzu and lespedeza that is observed on the perimeter and throughout the restoration area from spreading and becoming more densely populated. Assuming that preventative methods will be used to maintain the invasive exotics, vegetation survivability should remain excellent on site and vegetative success criteria will easily be met.

2.7 Vegetation Photos

Photos of the project showing the on-site vegetation are included in Appendix A of this report.

3.0 STREAM MONITORING

3.1 Description of Stream Monitoring

To document the stated success criteria, the following monitoring program was instituted following construction completion on the Site:

Bankfull Events: The occurrence of bankfull events within the monitoring period was documented by the use of a crest gauge and photographs. One crest gauge was installed on the floodplain within 10 feet of the restored channel, near As-built Station 176+00. The crest gauge recorded the highest watermark

between Site visits and was checked at each Site visit to determine if a bankfull event had occurred. Photographs were taken to document the occurrence of these bankfull events and are included in Appendix A.

Cross-sections: Two permanent cross-sections were installed per 1,000 LF of stream restoration work, with one located at a riffle cross-section and one located at a pool cross-section. Sixteen total cross sections were established. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. A common benchmark was used for cross-sections and consistently referenced to facilitate comparison of year-to-year data. The annual cross-sectional survey included points measured at all breaks in slope, including top of bank, bankfull, inner berm, edge of water, water surface, and thalweg, if the features are present. Riffle cross-sections were classified using the Rosgen stream classification system (Rosgen, 1994). Permanent cross-sections for 2008 (Year 3) were surveyed in October 2008 and are included in Appendix B.

Longitudinal Profiles: A partial longitudinal profile was surveyed for 2008 (Year 3). The profile was conducted for approximately 3,562 LF of South Fork Hoppers Creek, beginning upstream of the bridge at As-built Station 125+09 and continuing down to As-built Station 160+09 (natural migration of the thalweg accounts for the additional 62 feet surveyed within the As-built Stations). Measurements included thalweg, water surface, bankfull, and top of low bank. Each of these measurements was taken at the head of each feature (e.g., riffle, pool, glide). In addition, maximum pool depth was recorded. All survey was tied to a single permanent benchmark. This data is included in Appendix B of this report.

Bed Material Analysis: Pebble counts were conducted for the permanent cross sections (100 counts per cross section) on the Site. Pebble count data was plotted on a semi-log graph and are included in Appendix B.

Photo Reference Stations: Photographs were used to visually document restoration success. Seventy reference stations were established to document conditions at the constructed grade control structures across the Site. These photos are provided in Appendix A. Additional photo stations were established at each of the sixteen permanent cross-sections and hydrologic monitoring stations. Each streambank was photographed at each permanent cross-section photo station. For each streambank photo, the photo view line followed a survey tape placed across the channel, perpendicular to flow (representing the cross-section line). The photograph was framed so that the survey tape is centered in the photo (appears as a vertical line at the center of the photograph), keeping the channel water surface line horizontal and near the lower edge of the frame. These photos are presented along with the cross-section monitoring data in Appendix B.

The GPS coordinates of each photo station were noted as additional reference to ensure the same photo location was used throughout the monitoring period. These stations are included in the As-built Plan Sheets in Appendix C. Reference photos were taken once per year.

3.2 Stream Restoration Success Criteria

The approved Mitigation Plan requires the following criteria be met to achieve stream restoration success:

- *Bankfull Events*: Two bankfull flow events must be documented within the five-year monitoring period. The two bankfull events must occur in separate years.
- *Cross-sections:* There should be little change in as-built cross-sections. If changes to channel cross-section take place, they should be minor changes representing an increase in stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio).
- *Longitudinal Profiles:* The longitudinal profiles should show that the bedform features are remaining stable (not aggrading or degrading). The pools should remain deep with flat water surface slopes and the riffles should remain steeper and shallower than the pools.

- *Bed Material Analysis:* Pebble counts should indicate maintenance of bed material.
- *Photo Reference Stations*: Photographs will be used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation and effectiveness of erosion control measures. Photos should indicate the absence of developing bars within the channel, no excessive bank erosion or increase in channel depth over time, and maturation of riparian vegetation. These stations are included in the As-built Plan Sheets in Appendix C.

3.3 Bankfull Discharge Monitoring Results

The on-site crest gauge documented the occurrence of three bankfull flow events during the third year (2008) of the post-construction monitoring period (Table 9). Inspection of site conditions following these events revealed visual evidence of out-of-bank flow, confirming the crest gauge reading. The largest stream flow documented by the crest gauge during Year 3 of monitoring was approximately 0.22 feet (2.64 inches) above the bankfull stage.

Crest gauge data was unable to be documented for the last site visit on 10/28/08 due to a recently built beaver dam just downstream of the gauge at approximately Station 176+50. The dam has backed up water and the gauge could not be accurately interpreted. The dam is scheduled for removal to restore normal stream flow conditions.

Photos of these crest gauge readings are contained in Appendix A, including pictures of the beaver dam and the flooded crest gauge from 10/28/08.

Table 9. Verification of Bankfull Events

South Fork Hoppers Creek Restoration Site: Project No. D04006-4			
Date of Data Collection	Date of Occurrence of Bankfull Event	Method of Data Collection	Gage Height (feet)
1/16/2008	Unknown	Crest Gauge	0.16
4/1/2008	Unknown	Crest Gauge	0.17
7/25/2008	Unknown	Crest Gauge	0.22

3.4 Stream Monitoring Data and Photos

A photo log of the project showing each of the 70 permanent photo locations is included in Appendix A of this report. Survey data and photos from each permanent cross-section are included in Appendix B of this report.

3.5 Stream Stability Assessment

Table 10 presents a summary of the results obtained from the visual inspection of in-stream structures performed during Year 3 of post-construction monitoring. The percentages noted are a general overall field evaluation of the how the features were performing at the time of the last photo point survey on October 20, 2008. These percentages are solely based on the field evaluator's visual assessment at the time of the site visit.

Visual observations of the various structures throughout the Year 3 growing season indicated that all structures were functioning as designed and holding their elevation grade. Cover logs placed in meander pool areas allowed scour to keep pools deep and provide cover for fish. Root wads placed on the outside of meander bends provided bank stability and in-stream cover for fish and other aquatic organisms.

Issues discovered during Year 2 monitoring were closely scrutinized during Year 3 investigations. During Year 2 monitoring a few isolated pockets of scour were observed along the upstream end of rootwads located at stations 124+50, 126+75, and 133+50. The scour appeared to have taken place

before vegetation established along the streambanks. These areas of minor scour were still visible during Year 3 monitoring, and do not appear to have changed. Also, a downstream beaver impoundment backed up water onto the site during Year 2 monitoring. Since then that impoundment was either removed or abandoned. A new beaver impoundment was noted at Station 176+50 during monitoring this year. This structure is backing up water into the floodplain and could threaten Vegetation Monitoring Plot #2. It is scheduled for removal.

Table 10. Categorical Stream Feature Visual Stability Assessment

South Fork Hoppers Creek Restoration Site: Project No. D04006-4						
	Performance Percentage					
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%	100%	100%	100%		
Pools	100%	100%	100%	100%		
Thalweg	100%	100%	100%	100%		
Meanders	100%	100%	100%	100%		
Bed General	100%	100%	100%	100%		
Vanes / J Hooks etc.	100%	100%	100%	100%		
Rootwads and Boulders	100%	100%	95%	95%		

3.6 Cross-section, Longitudinal Profile, and Bed Material Analysis Monitoring Results

Cross Sections

Year 3 cross-section monitoring data for stream stability were collected during October 2008 and compared to as-built conditions, Year 1 data (collected October 2006), and Year 2 (collected October - November 2007).

The sixteen permanent cross-sections along the restored channels (eight located across riffles and eight located across pools) were re-surveyed to document stream dimension at the end of monitoring Year 3. Cross-sections are provided in Appendix B, and data from the cross-sections are summarized in Appendix E. The cross-sections show that there has been minor adjustment to stream dimension within the last year.

A few cross-sections have aggraded, including cross-sections 7, 8, and 13. Cross-sections 7 and 8 are located on the small unnamed tributary (UT1) below Pierce Rd. Aggradation in these sections is the result of low flow conditions coupled with well established vegetation in the bed making it difficult for the channel to transport sediment. Cross-section 13 is located across a pool found at the apex of a meander bend. Survey data from this section indicate the aggradation on point bar features on the inside bank of the meander bend. Flow through a meander bend possesses higher conveyance velocity along its boundary with the outer bank of the bend, and lower flow velocity along its boundary with the bend's inner bank. As flow velocity reduces, its sediment transport capacity also reduces, causing flow to drop some of its transported sediment as it slows down. Point bar formation along the inside of a meander bend indicates flow velocity vectors occurring as designed, and is therefore expected. All monitored cross-sections fell within the quantitative parameters defined for "C" type channels.

Longitudinal Profiles

The Year 3 longitudinal profile was conducted during October 2008. A representative 3,561 LF section of the channel was surveyed, beginning at As-built Station 125+09 and ending at As-built Station 160+09. Placement of the rock cross vanes upstream of the bridge as well as natural migration of the thalweg accounts for the 61 LF discrepancy between the surveyed length and the as-built conditions. The representative longitudinal profile along the restored channel was resurveyed to document stream profile at the end of monitoring Year 3. Overall, riffle slopes, pool-to-pool spacing and sinuosity within Reach 1 and Reach 2 of South Fork Hoppers Creek changed very little between the as-built survey and this Year 3 monitoring event.

The longitudinal profile is included in Appendix B. A summary of parameters measured are provided in Appendix E. Please note that this summary represents only the portion of the project that was surveyed.

Bed Material Analysis

Year 3 bed material samples were collected at each permanent cross-section during October 2008. Overall, bed material indicated coarser riffles and finer pools. During Year 2, riffles showed a trend towards fining downstream of Pierce Road due to the backwater effects of the downstream beaver dam. Riffle cross-sections 1 and 3 had d50 of 0.15 mm and 0.7 mm, respectively, which corresponds to sand. Since then that beaver dam was removed, releasing the fines that had accumulated behind it and at cross-sections 1 and 3. Year 3 d50 values for cross-section 1 and 3 have coarsened to 30 mm and 36 mm respectively. Upstream of Pierce Road all riffle cross-sections, excluding cross-section 15, have a d50 corresponding to very coarse gravel. Cross-section 15, the most upstream riffle cross-section, had a d50 of 0.9 mm, which corresponds to sand. The change in d50 could be the result of a shift in supply sediments from the contributing watershed. Pools throughout the project site are dominated by sand.

All pebble count data is provided in Appendix B.

4.0 HYDROLOGY MONITORING

Weather station data from the for NRCS National Climate and Water Center (Marion WETS Station in McDowell County – NC 5340) and the USGS Water Data for North Carolina (USGS 03451500 French Broad River at Asheville, NC) were used in conjunction with a manual rain gauge located on the Site to document precipitation amounts. For 2008, rainfall was normal or below normal for more than 70% of the growing season (March 28 – Nov. 4). Please note that the rain gauge stopped functioning between the June and July site visits. Because of the malfunction, no rainfall was recorded for the month of July. A replacement gauge was installed during the July site visit and normal rainfall recordation resumed in August.

The restoration plan for the Site specifies that eight monitoring gauges (five automated and three manual) would be established across the restored Site. These eight monitoring gauges were installed during early-March 2006 to document water table hydrology in all required monitoring locations. The wells were located across the site to document the variability in site hydrology, and the locations of monitoring gauges are shown on the as-built plan sheets. As stated in the Restoration Report, the well monitoring data should show that the site has been saturated within 12 inches of the soil surface for at least 7 percent of the growing season, and that the site has exhibited an increased frequency of flooding.

Hydrologic monitoring results are shown in Tables 11 and 12. Figure 5 compares historic rainfall events to rainfall observed during this monitoring year.

Table 11. Comparison of Historic Rainfall to Observed Rainfall (Inches)

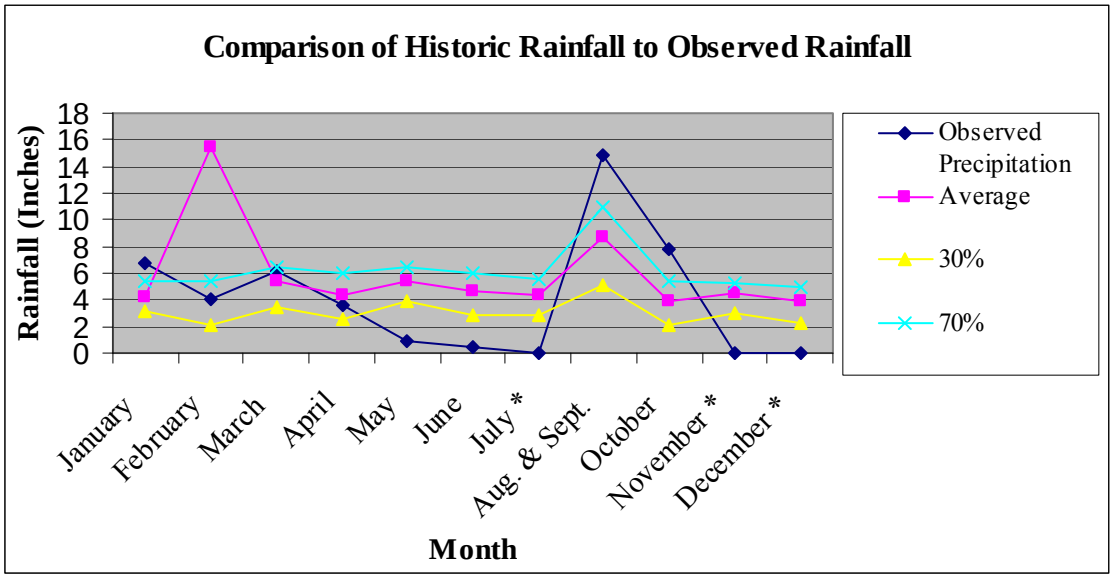
South Fork Hoppers Creek Restoration Site: EEP Contract No. D04006-4				
Month	**Average[A]**	**30%[A]**	**70%[A]**	**Observed 2008 Precipitation**
January	4.23	3.10	5.35	6.75
February	15.46	2.09	5.36	4.01
March	5.43	3.45	6.52	6.12
April	4.41	2.54	6.00	3.54
May	5.40	3.88	6.41	0.92
June	4.70	2.91	5.98	0.49
July	4.28	2.87	5.53	2.08[B]
Aug. & Sept.	8.72	5.10	10.89	14.79
October	3.95	2.17	5.43	7.78
November	4.43	2.96	5.29	-
December	3.96	2.20	5.00	-

(NRCS National Climate and Water Center, 2000 and USGS, 2008)

[A]Data in these columns presented exactly as reported by the NRCS National Climate and Water Center. (Marion WETS Station in McDowell County – NC5340)

[B]Monthly on-site rainfall data unavailable, so total monthly rainfall data was calculated using the nearest USGS rain gauge data (USGS 03451500 FRENCH BROAD RIVER AT ASHEVILLE, NC) to the project site. (USGS, 2008)

Figure 5. Historic Average vs. Observed Rainfall



*Rainfall data is recorded as 0.00 because no rainfall data was observed onsite during the month.

In 2008, seven of the eight wells achieved the success criteria of greater than 7% saturation during the growing season. AW4 did not record a hydroperiod of at least 7% during the 2008 growing season, however, this location did exceed the hydroperiods recorded by the wells at the reference wetland site and did meet success criteria during the 2007 monitoring season. The performance of this well is attributed to the below normal rainfall during the majority of the 2008 growing season. Hydrologic data collected

from the reference site, an existing wetland system, indicate that the reference site experienced hydroperiods considerably less than the hydroperiod recorded by all eight wells at the restoration site.

Table 12. **Comparison of Hydrologic Monitoring Results for Year 3 and Year 2**

South Fork Hoppers Creek Restoration Site: EEP Contract No. D04006-4						
Monitoring Station	Most Consecutive Days Meeting Criteria[1]		Cumulative Days Meeting Criteria[2]		Number of Instances Meeting Criteria[3]	
	Year 3 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 2 Monitoring	Year 3 Monitoring	Year 2 Monitoring
AW1	222 (100%)	222 (100%)	222 (100%)	222 (100%)	1	1
AW2	80 (36%)	222 (100%)	173 (78%)	222 (100%)	7	1
AW3	76 (35%)	133 (60%)	131 (59%)	218 (98%)	6	2
AW4	13 (6%)	33 (15%)	43 (20%)	58 (26%)	10	13
AW5*	166 (75%)	222 (100%)	166 (75%)	222 (100%)	1	1
MW1[4]	222 (100%)	222 (100%)	222 (100%)	222 (100%)	1	1
MW2[5]	80 (36%)	222 (100%)	173 (78%)	222 (100%)	7	1
MW3[4]	222 (100%)	222 (100%)	222 (100%)	222 (100%)	1	1
REF1[6]	7 (4%)	5 (2%)	10 (5%)	26 (12%)	4	8
REF2[6*]	5 (3%)	4 (2%)	10 (5%)	13 (6%)	1	4

[1] Indicates the most consecutive number of days within the monitored growing season with a water table less than 12 inches form the soil surface.

[2] Indicates the cumulative number of days within the monitored growing season with a water table less than 12 inches from the soil surface.

[3] Indicates the number of instances within the monitored growing season when the water table rose to less than 12 inches from the soil surface.

[4] Groundwater gauges MW1 and MW3 are manual gauges. Hydrologic parameters are estimated based on observations and correlation with automated gauge AW1.

[5] Groundwater gauge MW2 is a manual gauge. Hydrologic parameters are estimated based on observations and correlation with automated gauge AW2.

[6] Reference ground water gauges are located on an Unnamed Tributary to Little Silver Creek in Morganton, NC

[*] No data was collected for AW5 from 9/10/08 to the end of the growing season (11/4/08) due to an equipment malfunction.

5.0 BENTHIC MACROINVERTEBRATE MONITORING

5.1 Description of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrate monitoring was conducted in conjunction with the South Fork Hoppers Creek Restoration Project. Because of seasonal fluctuations in populations, macroinvertebrate sampling must be consistently conducted in the same season. Benthic sampling for the Site is conducted during the month of February; therefore this report summarizes the benthic samples collected during the second year post-construction monitoring phase.

The sampling methodology followed the Qual 4 method listed in NCDWQ's Standard Operating Procedures for Benthic Macroinvertebrates (2006). Field sampling was conducted by Christine Miller, Kristi Suggs, and Christopher Tomsic of Baker. Laboratory identification of collected species was conducted by David Lenat, a biologist with Lenat Consulting Services.

Benthic macroinvertebrate samples were collected at Site 2 on the Site on February 6, 2008. Site 3 on the South Fork of Hoppers Creek site and Site 1, the reference site, located upstream of the project were collected on February 21, 2008. Site 1 was located approximately 200 LF upstream of the conservation easement boundary on South Fork Hoppers Creek, Site 2 was located just upstream of Pierce Road, and Site 3 was located upstream of the downstream conservation easement boundary. Figure 1 in Appendix F illustrates the sampling site locations.

Benthic macroinvertebrates were collected to assess quantity and quality of life in the creek. In particular, specimens belonging to the insect orders Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) are useful as an index of water quality. These groups are generally the least tolerant to water pollution and therefore are very useful indicators of water quality. Sampling for these three orders is referred to as EPT sampling.

Habitat assessments using NCDWQ's protocols were also conducted at each site. Physical and chemical measurements including water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity were recorded at each site. The habitat assessment field data sheets are presented in Appendix F. Photographs were taken at Sites 1 through 3 to document stream and bank conditions at the time of sampling. The Photograph Log is also presented in Appendix F.

5.2 Benthic Macroinvertebrate Sampling Results and Discussion

A comparison between the pre- and post-construction monitoring results is presented in Table 13 with complete results presented in Appendix F.

Table 13. Pre-restoration vs. Post-restoration Benthic Macroinvertebrate Sampling Data

South Fork Hoppers Creek Restoration Site: EEP Contract No. D04006-4									
Metric	**Site 1 Reference**			**Site 2 U/S Hoppers**			**Site 3 D/S Hoppers**		
	Pre 1/11/05	**Year 1 1/17/07**	**Year 2 2/21/08**	**Pre 1/11/05**	**Year 1 1/16/07**	**Year 2 2/6/08**	**Pre 1/12/05**	**Year 1 1/16/07**	**Year 2 2/21/07**
Total Taxa Richness	36	50	39	31	43	48	27	40	36
EPT Taxa Richness	23	21	24	21	15	19	14	13	9
Total Biotic Index	3.15	3.47	3.52	3.03	5.58	5.07	3.03	5.53	6.41
EPT Biotic Index	2.62	3.17	3.34	2.56	4.5	4.93	2.33	3.93	5.85
Dominance in Common (%)	n/a	n/a	n/a	74	23	41	58	23	12
Baetidae/EPT Taxa (%)	0	0	8.3	0	13.3	26.3	0	7.7	11.1
Total Shredder/Scraper Index	5/9	8/7	8/5	5/8	7/7	2/8	6/5	2/5	1/3
EPT Shredder/Scraper Index	3/7	4/3	5/3	4/6	1/4	1/3	4/3	1/2	0/1
Habitat Assessment Rating	94	80	92	74	87	87	53	82	79
Water Temperature (˚C)	n/a	7	8.4	n/a	12	11.6	n/a	11.4	7.3
% Dissolved Oxygen (DO)	n/a	54.7	91.3	n/a	35.7	92.6	n/a	29.8	93.9
DO Concentration (mg/l)	n/a	6.61	10.64	n/a	3.87	10.03	n/a	3.25	11.31
pH	n/a	6.2	7.1	n/a	6.3	7.21	n/a	6.03	7.26
Conductivity (µmhos/cm)	n/a	40	40	n/a	40	40	n/a	50	50

At Site 1, the reference site, the post-construction community structure appears similar to that observed during the pre-construction monitoring period. Overall taxa richness decreased and there was a marginal increase in EPT taxa richness between 2007 and 2008. Several of the EPT species that were common or abundant in the pre-construction sample, such as *Tallaperla* spp., *Stenonema pudicum,* and *Diploperla duplicata* (tolerance values of 1.2, 2.0, and 2.7, respectively) were also common or abundant in the post-construction sample. *Remenus bilobatus,* which has a tolerance value of 0.3, was not represented in the pre-construction or first year samples but was common in the second year sample. These indicators show that the communities are stable and water quality is adequate to support intolerant species.

Site 2, which underwent complete restoration, exhibited increased total taxa richness and EPT taxa richness. The EPT biotic index increased from 4.50 to 4.93 from 2007 to 2008. The increase indicates that the existing communities continue to be dominated by more tolerant species. The pre-construction EPT biotic index was 2.56. This suggests that Site 2 hasn't recovered from the major disturbance to habitat caused by the in-stream construction techniques implemented onsite. The percentage of Baetidae

species doubled from 13 percent of the EPT taxa in 2007 to 26 percent in the 2008. The Baetidae are part of the scraper functional feeding group. The riparian buffer is comprised of young saplings and tall grasses that don't provide adequate shade to the channel, allowing maximum light penetration for increased photosynthetic activity, thus producing an abundant food source (periphyton). Periphyton is an excellent food source for scrapers. No Baetidaes were present in the pre-construction sample, which was taken when the sampling site had an adequate forested buffer.

Currently Site 2 has 41 percent Dominance in Common (DIC) compared to the reference site, indicating that 41 percent of the dominant communities at the reference site are dominant at Site 2. In pre-construction conditions, Site 2 had a DIC of 74 percent and 23 percent after Year 1 monitoring. This indicates that post-construction recolonization from refugia upstream (represented at Site 1) has continued but the communities at Site 2 haven't reached pre-construction conditions. It is anticipated that improvements in biotic indices and an increase in DIC will be seen in future monitoring reports as the project and buffer matures and as communities continue to recolonize.

Site 3 also underwent total restoration. The overall taxa richness is greater than the pre-construction conditions but EPT taxa richness has decreased since construction. The EPT biotic index increased from 2.33 to 5.85. The decline in water quality at Site 3 reflects the loss of intolerant Ephemeroptera species. Post-construction shredder taxa remain below pre-construction conditions. These organisms feed on partially decomposed organic matter such as sticks and leaf packs, currently a rare habitat (see Habitat Assessment Results). The decrease in sensitive communities and lack of shredders are common responses after a major disturbance to habitat such as the in-stream construction techniques implemented at Site 3. It is anticipated that, as the project matures, shredder populations will increase as more habitat in the form of snags, logs, and leaf packs become available.

Currently Site 3 has 12 percent DIC with the reference site. In pre-construction conditions, Site 3 had a DIC of 58 percent. This indicates that recolonization post-construction from refugia upstream (represented at Site 1) has not reached pre-construction conditions. It is anticipated that improvements in biotic indices and an increase in Dominance in Common will be seen in future monitoring reports as the project and buffer matures and as communities continue to recolonize.

5.3 Habitat Assessment Results and Discussion

Site 1, the reference site, received a 92 on the Habitat Assessment Field Data Sheet. The site exhibited excellent riffle substrate, habitat diversity and shading. Riffles were mostly gravel and cobbles, moderately embedded with sand and the pool bottoms were sandy. Site 1 had a mature hardwood buffer with minimal breaks. Snags or logs were abundant within this section of the channel.

Site 2 received an 87 on the Habitat Assessment Field Data Sheet. The site exhibited excellent riffle pool sequencing, pattern, stability, and habitat diversity. Riffles were mostly gravel and cobbles, and the pool bottoms were silty. The riparian buffer of Site 2 could be classified as fallow field, with immature hardwood seedlings scattered throughout. Numerous types of instream habitat including rocks, snags, logs, macrophytes, sticks, and root mats were present. However, organic material such as sticks and leafpacks were not common. It is anticipated that as the project and buffer continues to mature, habitat will continue to improve and diversify.

Site 3 received a 79 on the Habitat Assessment Field Data Sheet. The site exhibited excellent riffle pool sequencing, pattern and stability. Riffles were mostly gravel and cobbles, moderately embedded with sand, and the pool bottoms were silty. Riffle embeddedness, at Site 3, increased between Year 1 and Year 2 sampling as a result of backwater conditions caused by an offsite beaver impoundment. Fine sediment had accumulated behind the impoundment including Site 3. Since Year 2 sampling the impoundment has either been removed or abandoned which released the fines that had accumulated at Site 3. Therefore future habitat scores should reflect a decrease in riffle embeddedness with slightly higher overall scores. Like Site 2, the riparian buffer of Site 3 could be classified as fallow field, with

immature hardwood seedlings scattered throughout. The contribution of organics from the young riparian vegetation is low. The lack of organic habitats is likely the cause for the decreased shredder communities from pre-construction monitoring to post-construction monitoring. It is anticipated that as the riparian buffer becomes established, the shredders from the upstream reference site (Site 1) will begin to colonize throughout the restoration reach.

The restoration of pattern and dimension as well as the addition of several root wads, vanes, and armored riffles has enhanced the overall in-stream habitat throughout the restoration sites. The immature riparian vegetation has had minimal effect on in-stream habitat at Sites 2 and 3; however, future contributions from planted riparian vegetation will be evident as the woody plant species mature. Contributions will include in-stream structures such as sticks, leaf packs, and root mats.

The physical and chemical measurements of water temperature, percent dissolved oxygen, dissolved oxygen concentration, pH, and specific conductivity at all sites were within established norms for Piedmont streams.

5.4 Photograph Log

The photograph log is attached as Appendix F. Photos P-1 and P-2 show the stable, well defined riffle pool sequence at Site 1. The riparian buffer is visible in P-1, as well as the coarse substrate. Undercut banks are visible in P-2. Photos P-3 and P-4 shows the bedform diversity at Site 2. Site 2 lacks a mature forested canopy; however, young woody vegetation is present and growing along the banks. Site 3 is shown in P-5 and P-6. Both photos show the stability of the channel as well as the riffle pool sequence. Woody transplants are visible both upstream and downstream in P-5 and P-6, respectively.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Vegetation Monitoring: Vegetation monitoring efforts have calculated the average number of stems per acre on site to be 592, which is a survival rate of greater than 89% based on the initial planting count of 664 stems per acre. There will need to be a maintenance herbicide application schedule for next year to prevent the invasive kudzu and lespedeza that is observed on the perimeter and throughout the restoration area from spreading and becoming more densely populated. Assuming that preventative methods will be used to maintain the invasive exotics, we feel that vegetation survivability should remain excellent on site and vegetative success criteria will easily be met.

Stream Monitoring: The total length of stream channel restored on the Site was 7,229 LF. This entire length was inspected during Year 3 of the monitoring period (2008) to assess stream performance. Based on the data collected and a visual assessment, all riffles, pools, and other constructed features along the restored channel are stable and functioning as designed. Remnant isolated scour, noted in Year 2, along the outer bank of a few pools upstream of Pierce Road showed no change during Year 3. The beaver impoundment downstream of the restored area was removed, restoring normal flow conditions to that section of the channel. However, a new beaver impoundment located at Station 176+50 is backing up water in the floodplain and could threaten Vegetation Monitoring Plot #2. Therefore the dam is scheduled to be removed. The lack of major problem areas along the length of the restored channel after the occurrence of three stream flow events larger than bankfull discharge further supports functionality of the design. It is expected that stability and in-stream habitat of the system will improve in the coming years as permanent vegetation becomes more established, and that the Site will achieve the stream stability success criteria specified in the Restoration Plan.

Hydrologic Monitoring: Data collected during the 2008 growing season by the eight monitoring gauges showed that hydrology varied across the Site. The hydrology of these areas is expected to be more variable throughout the growing season, with the wettest periods during the early spring and late fall. Groundwater levels at 7 of the 8 gauges met hydrologic success criteria. AW4 did not meet the hydrologic success criteria specified in the Restoration Plan but did achieve hydroperiods similar to those

achieved by the reference monitoring wells. Overall, the Site appears to be on track to meet the hydrologic success criteria specified in the Restoration Plan.

7.0 WILDLIFE OBSERVATIONS

Observations of deer and raccoon tracks are common on the Site. Beavers are present and have created a beaver dam within the Site around Station 176+50. During certain times of the year, frogs, turtles, snakes, and fish have also been observed.

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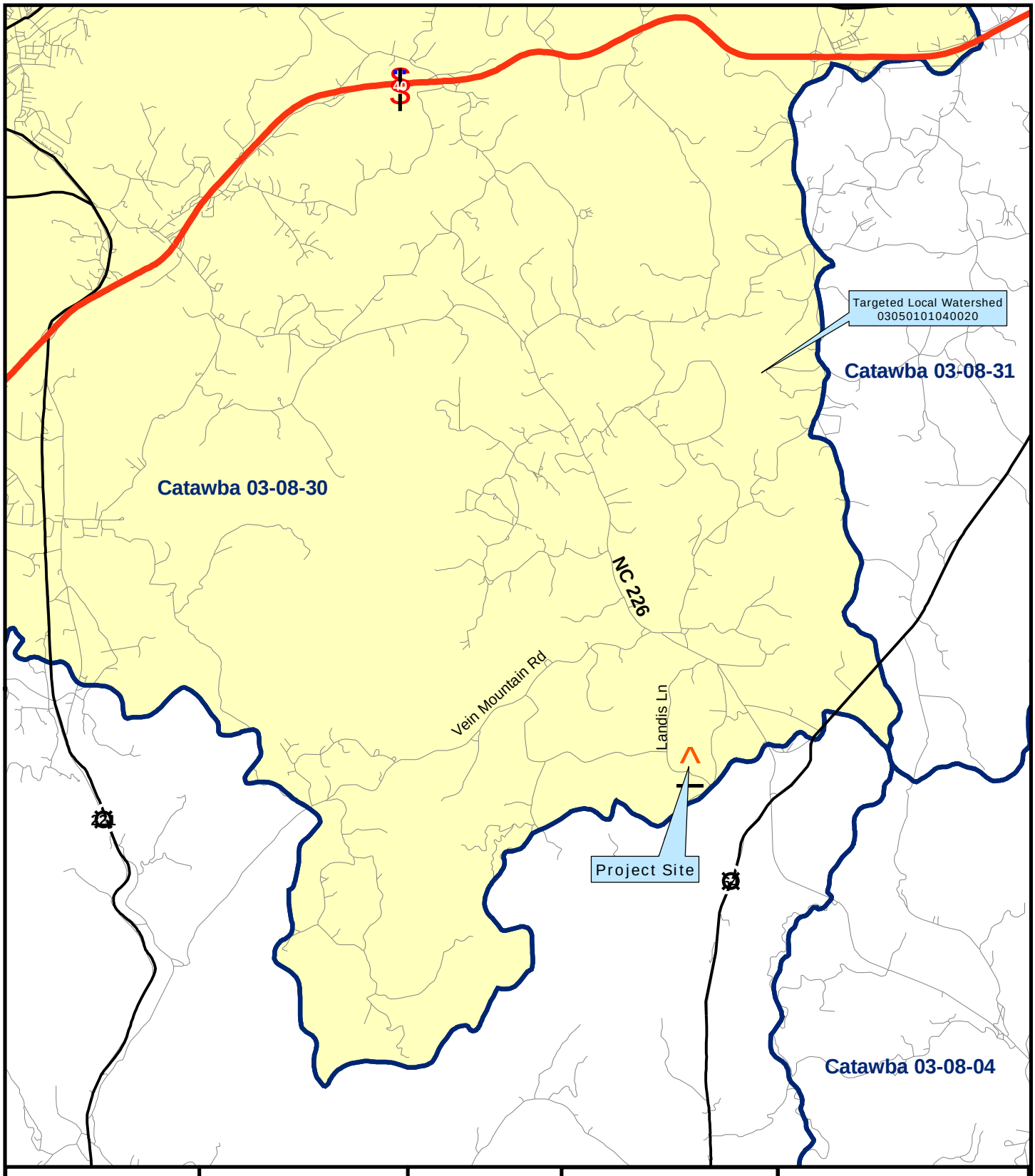
FIGURES



Ecosystem Enhancement Program

Map Inset

McDowell County, NC

Legend

Interstate
US Route
NC Primary Roads
8 Digit HUC

0 0.5 1 2 Miles

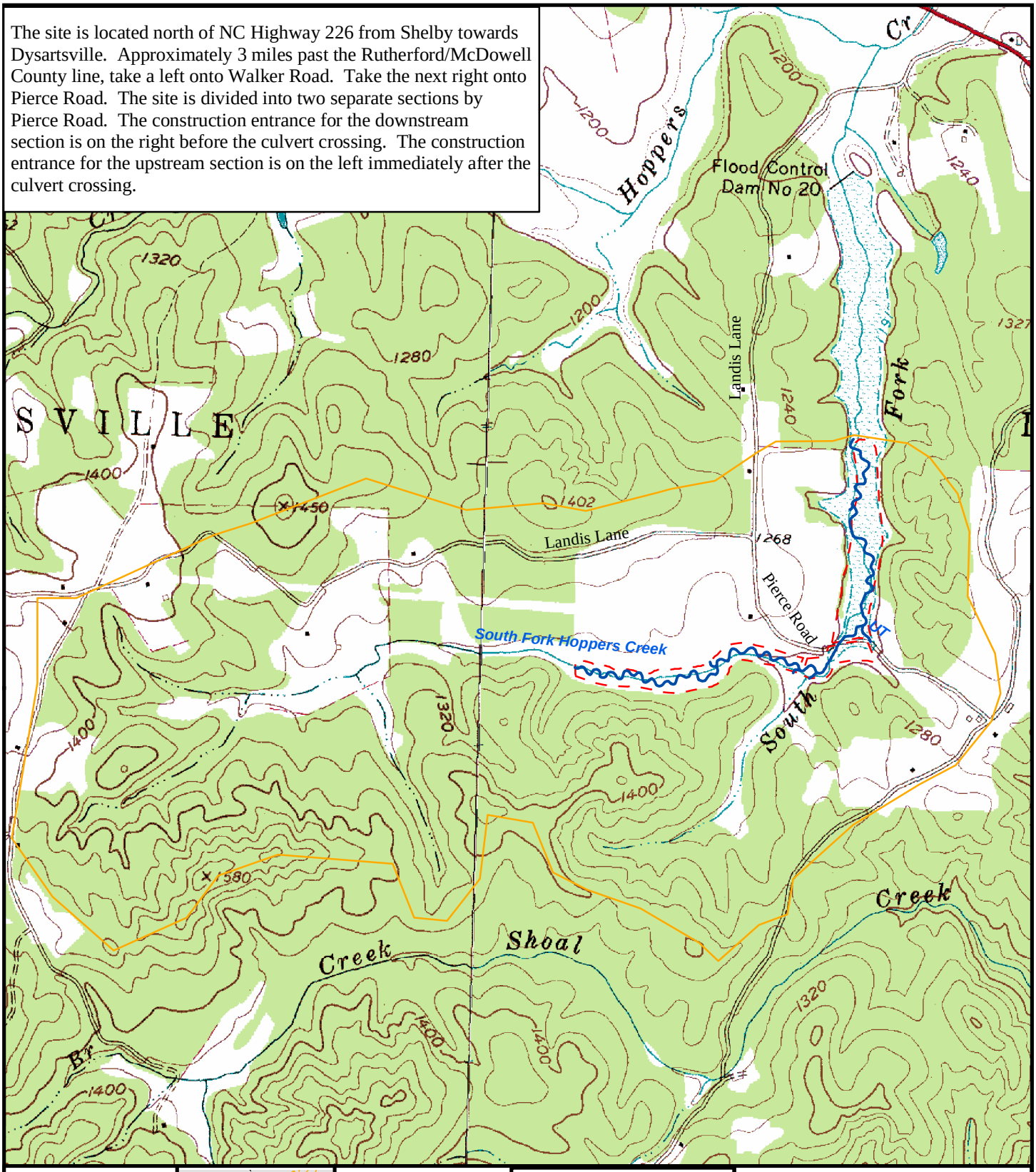
November 2008

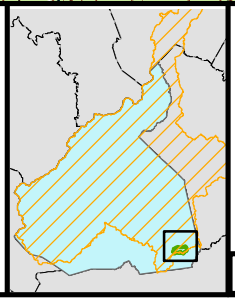
EEP Contract No.: D04006-4

Figure 1. Project Vicinity Map
Restoration Project
South Fork Hoppers Creek

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606

The site is located north of NC Highway 226 from Shelby towards Dysartsville. Approximately 3 miles past the Rutherford/McDowell County line, take a left onto Walker Road. Take the next right onto Pierce Road. The site is divided into two separate sections by Pierce Road. The construction entrance for the downstream section is on the right before the culvert crossing. The construction entrance for the upstream section is on the left immediately after the culvert crossing.





Legend

- Watershed Boundary
- Project Boundary
- Project Reaches

0 500 1,000 Feet

EEP Contract No.: D04006-4

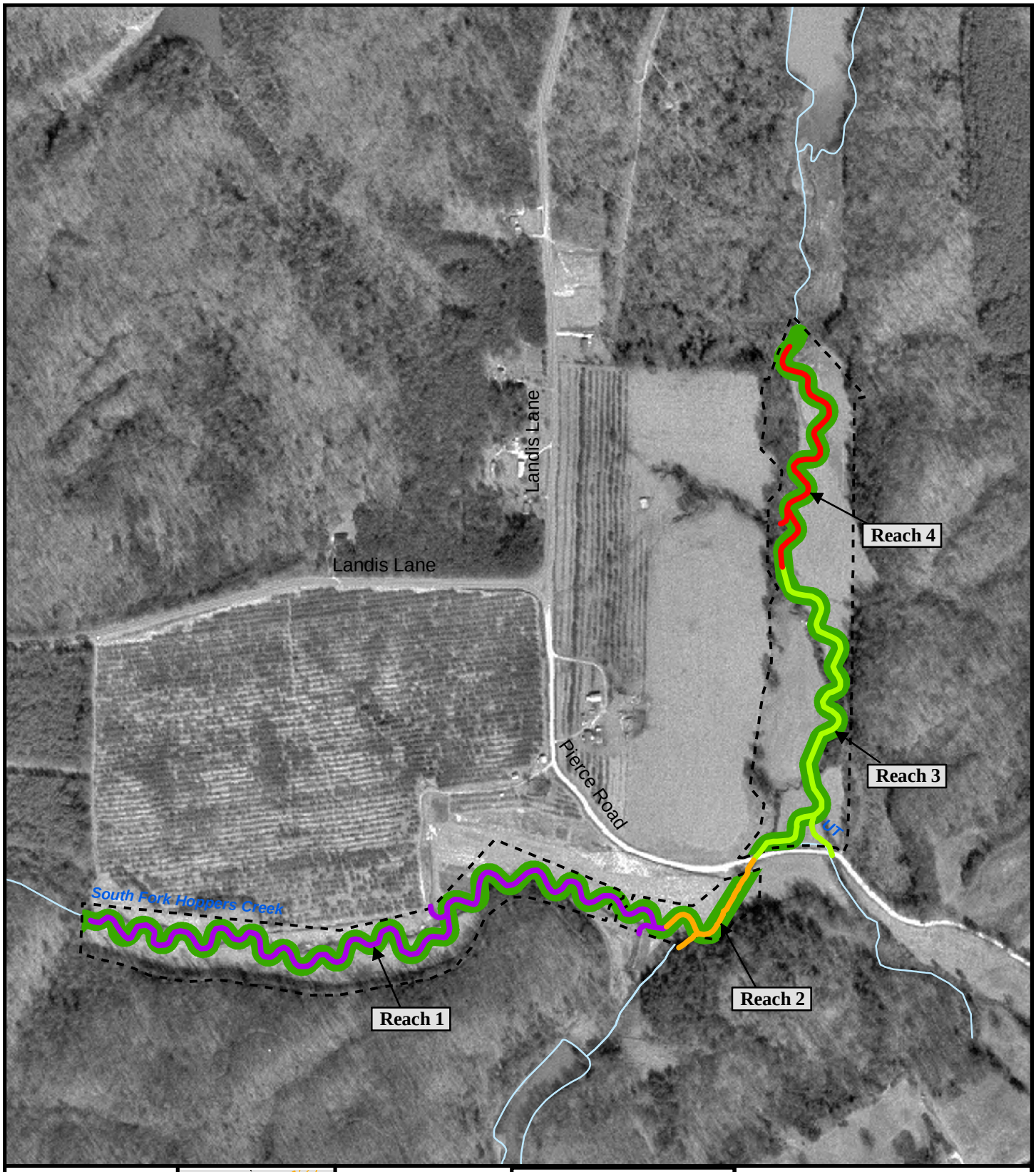
November 2008

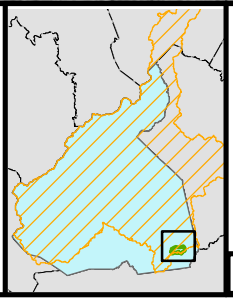
Figure 2. Site Topographic Map
Restoration Project
South Fork Hoppers Creek

Ecosystem Enhancement Program

EBX

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606





Legend

Conservation Easement

30' Stream Buffer

Existing Streams

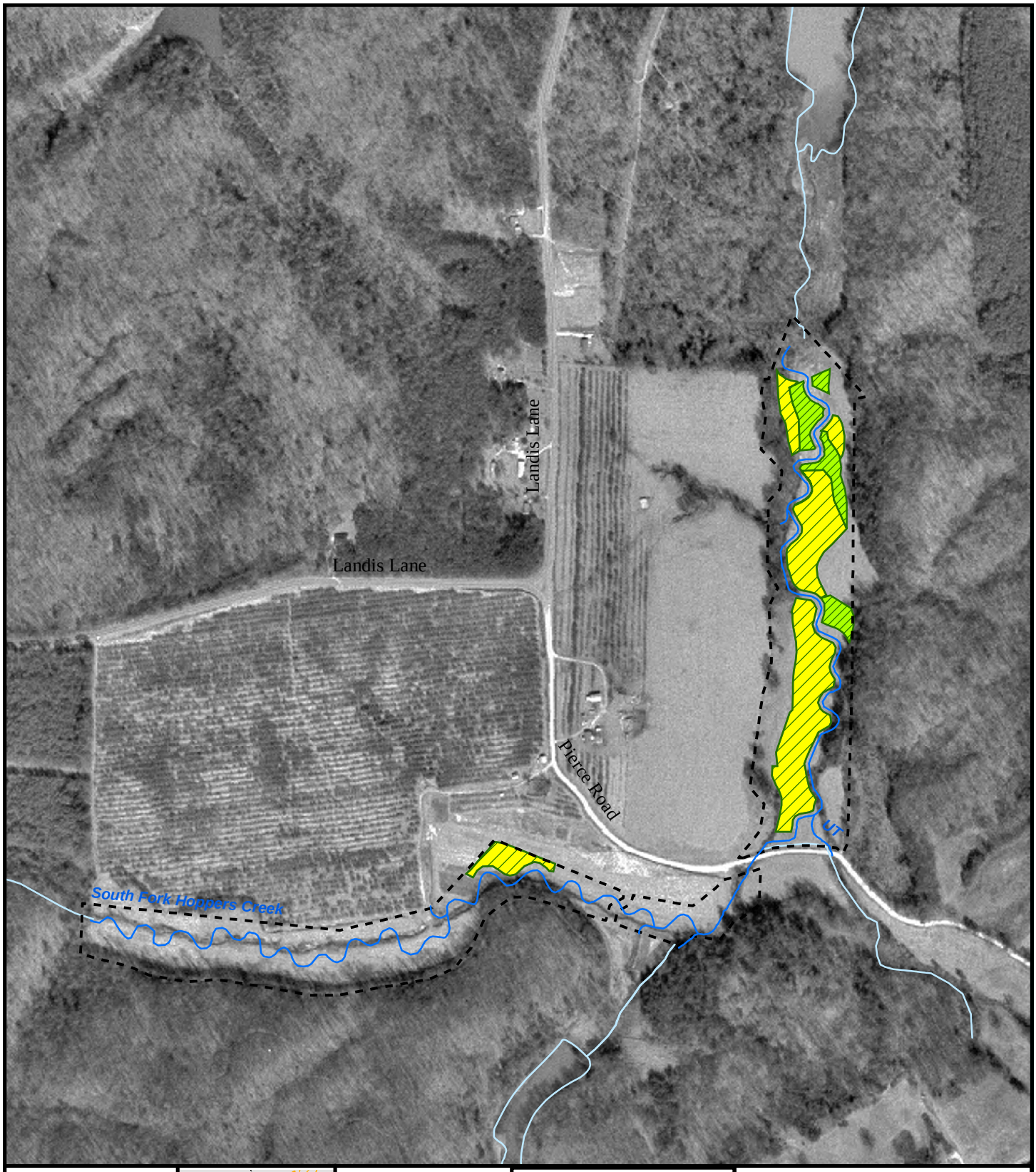
0 400 800 Feet

November 2008

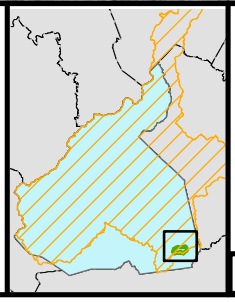
EEP Contract No.: D04006-4

Figure 3. Restoration Summary Map
Restoration Project
South Fork Hoppers Creek

EBX Neuse-I, LLC
Capability Drive
Suite 3100
Raleigh, NC 27606



Ecosystem Enhancement PROGRAM



Legend

- Conservation Easement
- Existing Streams
- Project Reaches
- Enhancement
- Restoration

0 400 800 Feet

November 2008

EEP Contract No.: D04006-4

Figure 4. Wetland Summary Map
Restoration Project
South Fork Hoppers Creek

EBX

EBX Neuse-I, LLC
909 Capability Drive
Suite 3100
Raleigh, NC 27606

APPENDIX A

PHOTO LOG

PHOTO ID LOG

S. Fork Hoppers – PID 1

S. Fork Hoppers – PID 2

S. Fork Hoppers – PID 3

S. Fork Hoppers – PID 4

S. Fork Hoppers – PID 5

S. Fork Hoppers – PID 6

S. Fork Hoppers – PID 7

S. Fork Hoppers – PID 8

S. Fork Hoppers – PID 9

S. Fork Hoppers – PID 10

S. Fork Hoppers – PID 11

S. Fork Hoppers – PID 12

S. Fork Hoppers – PID 13

S. Fork Hoppers – PID 14

S. Fork Hoppers – PID 15

S. Fork Hoppers – PID 16

S. Fork Hoppers – PID 17

S. Fork Hoppers – PID 18

S. Fork Hoppers – PID 19

S. Fork Hoppers – PID 20

S. Fork Hoppers – PID 21

S. Fork Hoppers – PID 22

S. Fork Hoppers – PID 23

S. Fork Hoppers – PID 24

S. Fork Hoppers – PID 25

S. Fork Hoppers – PID 26

S. Fork Hoppers – PID 27

S. Fork Hoppers – PID 28

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S. Fork Hoppers – PID 33

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S. Fork Hoppers – PID 35

S. Fork Hoppers – PID 36

S. Fork Hoppers – PID 37

S. Fork Hoppers – PID 38

S. Fork Hoppers – PID 39

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S. Fork Hoppers – PID 47

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S. Fork Hoppers – PID 49

S. Fork Hoppers – PID 50

S. Fork Hoppers – PID 51

S. Fork Hoppers – PID 52

S. Fork Hoppers – PID 53

S. Fork Hoppers – PID 54

S. Fork Hoppers – PID 55

S. Fork Hoppers – PID 56

S. Fork Hoppers – PID 57

S. Fork Hoppers – PID 58

S. Fork Hoppers – PID 59

S. Fork Hoppers – PID 60

S. Fork Hoppers – PID 61

S. Fork Hoppers – PID 62

S. Fork Hoppers – PID 63

S. Fork Hoppers – PID 64

S. Fork Hoppers – PID 65

S. Fork Hoppers – PID 66

S. Fork Hoppers – PID 67

S. Fork Hoppers – PID 68

S. Fork Hoppers – PID 69

S. Fork Hoppers – PID 70

CREST GAUGE PHOTOS

CREST GAUGE PHOTOS OF BANKFULL

Crest Gauge – 1/16/08

Crest Gauge – 4/1/08

Crest Gauge – 7/25/08

Crest Gauge Underwater – 10/28/08

Beaver dam at Station 176+50

VEG PLOT PHOTOS

Veg Plot #1

Veg Plot #2

Veg Plot #3

Veg Plot #4

Veg Plot #5

Veg Plot #6

Veg Plot #7

Veg Plot #8

Veg Plot #9

Veg Plot #10

APPENDIX B

STREAM MONITORING DATA

PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

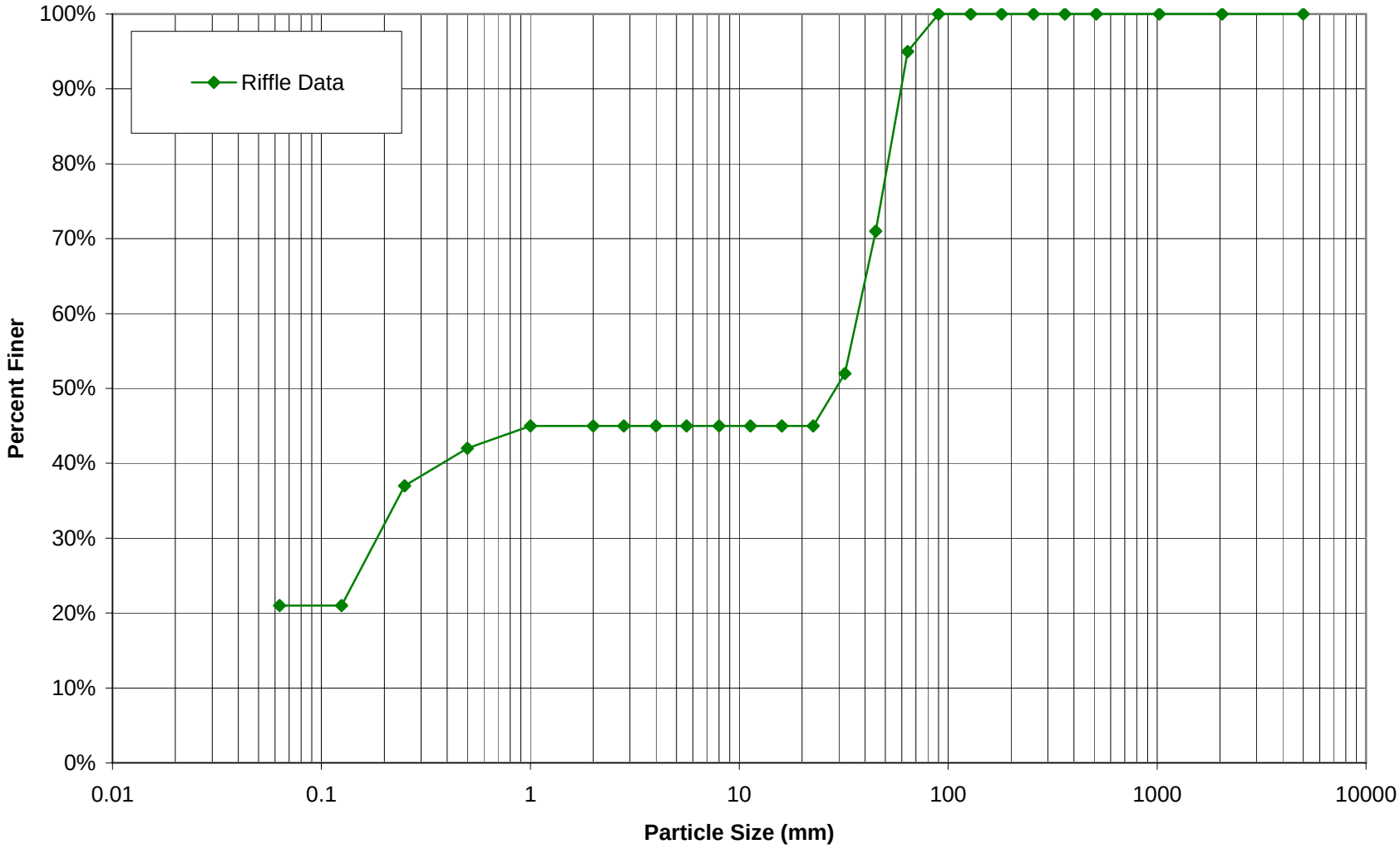
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X1 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	21	21%	21%
SAND	Very Fine	.063 - .125			21%
	Fine	.125 - .25	16	16%	37%
	Medium	.25 - .50	5	5%	42%
	Coarse	.50 - 1.0	3	3%	45%
	Very Coarse	1.0 - 2.0			45%
GRAVEL	Very Fine	2.0 - 2.8			45%
	Very Fine	2.8 - 4.0			45%
	Fine	4.0 - 5.6			45%
	Fine	5.6 - 8.0			45%
	Medium	8.0 - 11.0			45%
	Medium	11.0 - 16.0			45%
	Coarse	16.0 - 22.6			45%
	Coarse	22.6 - 32	7	7%	52%
	Very Coarse	32 - 45	19	19%	71%
	Very Coarse	45 - 64	24	24%	95%
COBBLE	Small	64 - 90	5	5%	100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X1 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

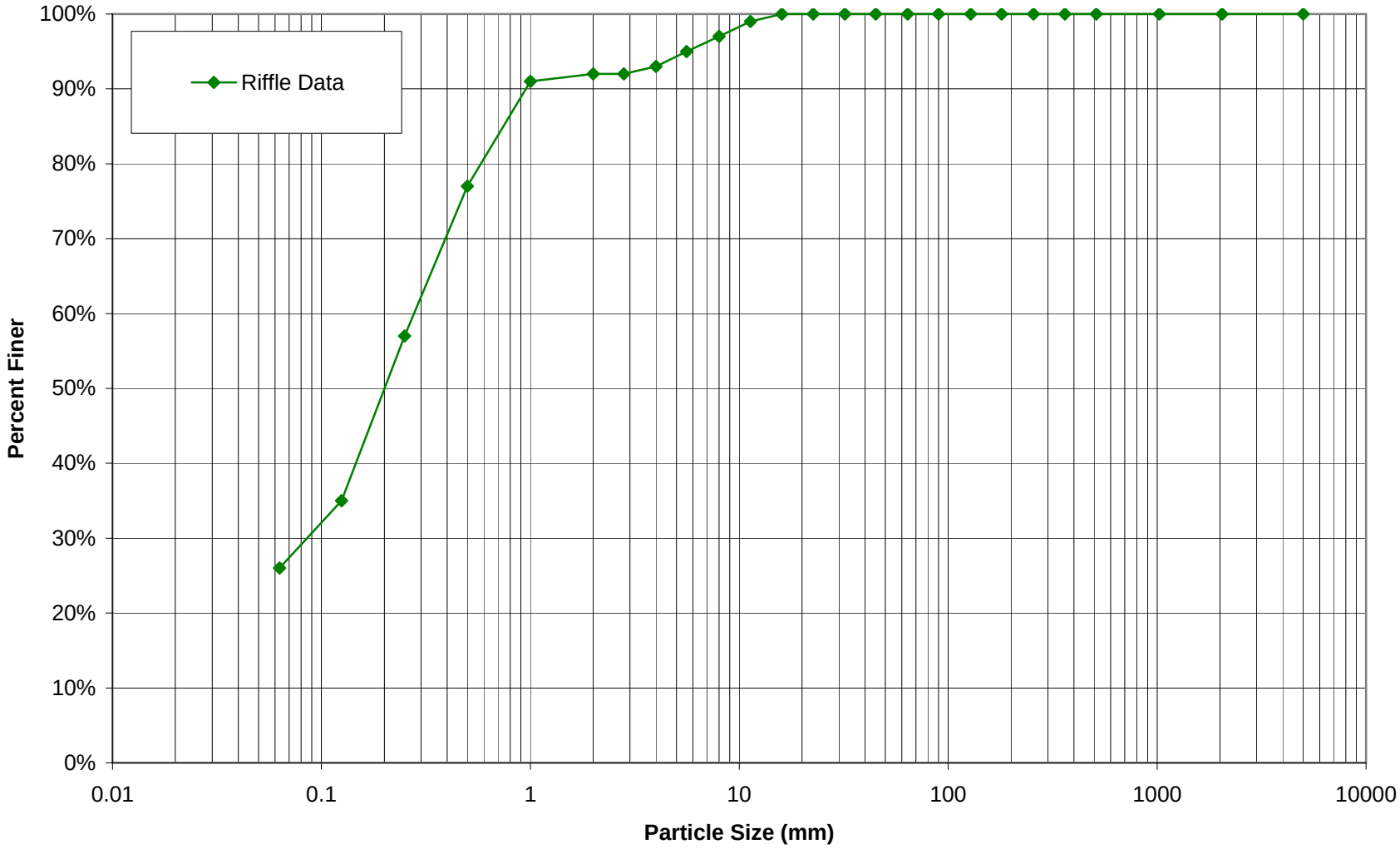
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X2 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	26	26%	26%
SAND	Very Fine	.063 - .125	9	9%	35%
	Fine	.125 - .25	22	22%	57%
	Medium	.25 - .50	20	20%	77%
	Coarse	.50 - 1.0	14	14%	91%
	Very Coarse	1.0 - 2.0	1	1%	92%
GRAVEL	Very Fine	2.0 - 2.8			92%
	Very Fine	2.8 - 4.0	1	1%	93%
	Fine	4.0 - 5.6	2	2%	95%
	Fine	5.6 - 8.0	2	2%	97%
	Medium	8.0 - 11.0	2	2%	99%
	Medium	11.0 - 16.0	1	1%	100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X2 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

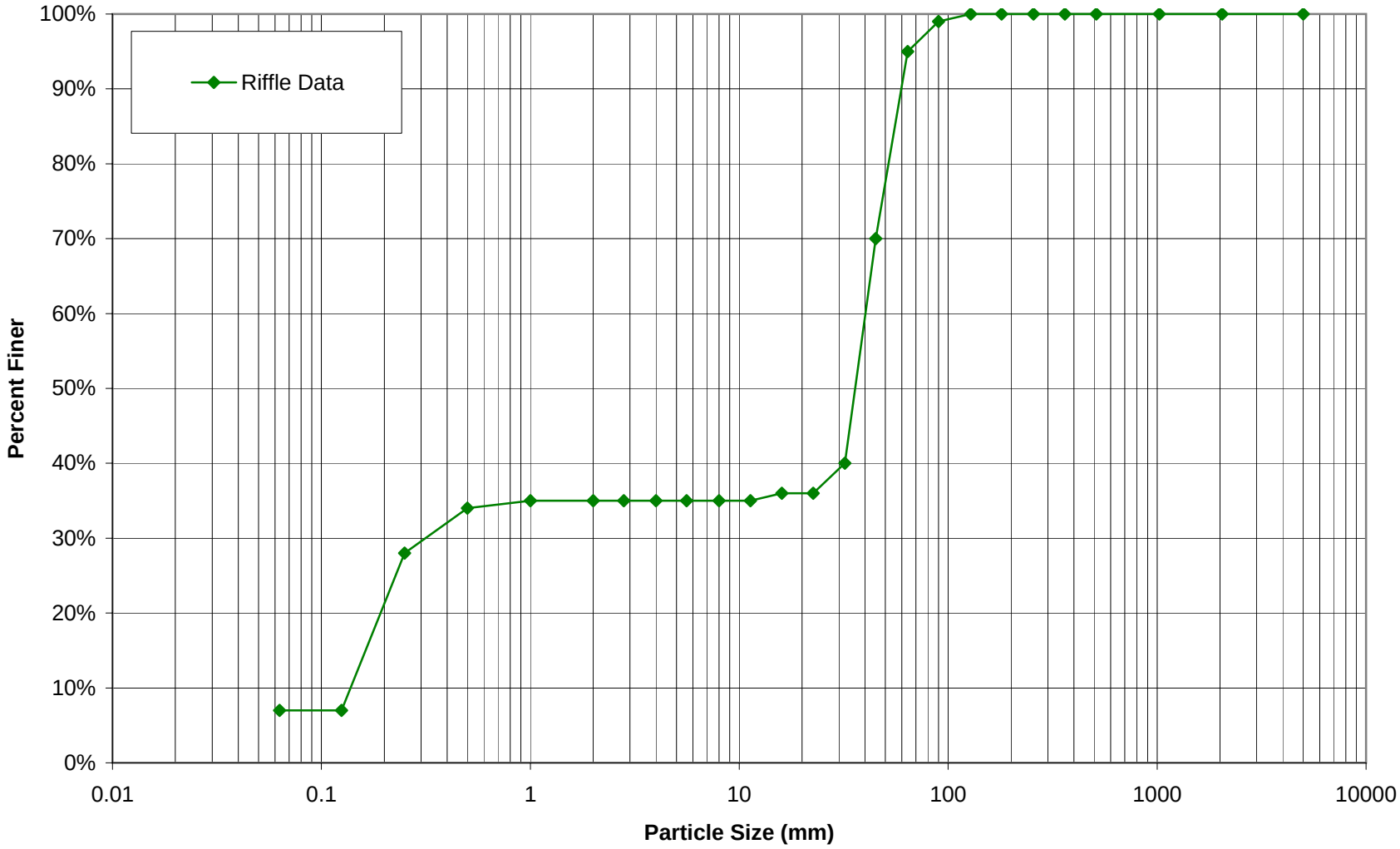
	BUCK PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X3 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	7	7%	7%
SAND	Very Fine	.063 - .125			7%
	Fine	.125 - .25	21	21%	28%
	Medium	.25 - .50	6	6%	34%
	Coarse	.50 - 1.0	1	1%	35%
	Very Coarse	1.0 - 2.0			35%
GRAVEL	Very Fine	2.0 - 2.8			35%
	Very Fine	2.8 - 4.0			35%
	Fine	4.0 - 5.6			35%
	Fine	5.6 - 8.0			35%
	Medium	8.0 - 11.0			35%
	Medium	11.0 - 16.0	1	1%	36%
	Coarse	16.0 - 22.6			36%
	Coarse	22.6 - 32	4	4%	40%
	Very Coarse	32 - 45	30	30%	70%
	Very Coarse	45 - 64	25	25%	95%
COBBLE	Small	64 - 90	4	4%	99%
	Small	90 - 128	1	1%	100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X3 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

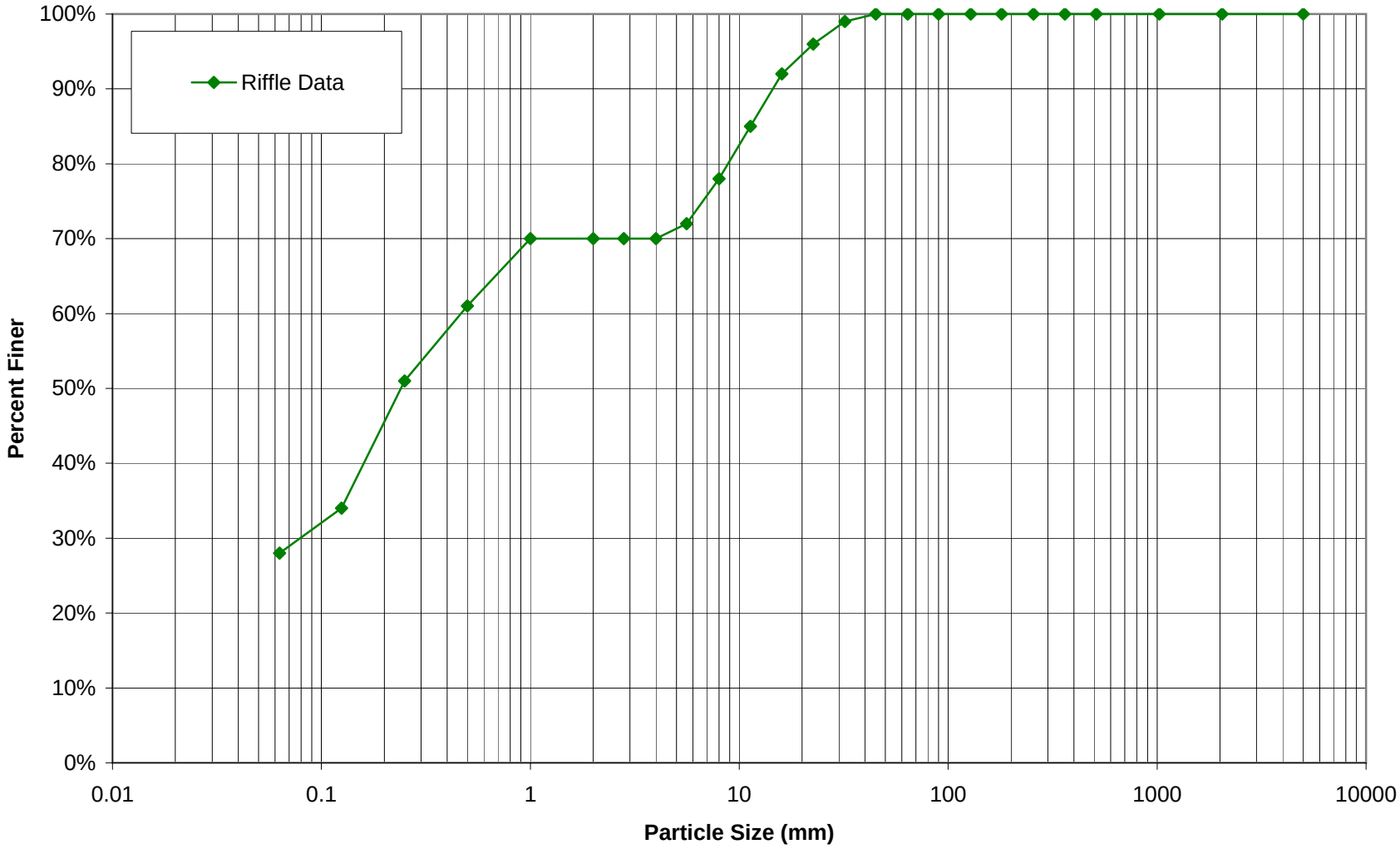
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X4 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	28	28%	28%
SAND	Very Fine	.063 - .125	6	6%	34%
	Fine	.125 - .25	17	17%	51%
	Medium	.25 - .50	10	10%	61%
	Coarse	.50 - 1.0	9	9%	70%
	Very Coarse	1.0 - 2.0			70%
GRAVEL	Very Fine	2.0 - 2.8			70%
	Very Fine	2.8 - 4.0			70%
	Fine	4.0 - 5.6	2	2%	72%
	Fine	5.6 - 8.0	6	6%	78%
	Medium	8.0 - 11.0	7	7%	85%
	Medium	11.0 - 16.0	7	7%	92%
	Coarse	16.0 - 22.6	4	4%	96%
	Coarse	22.6 - 32	3	3%	99%
	Very Coarse	32 - 45	1	1%	100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X4 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

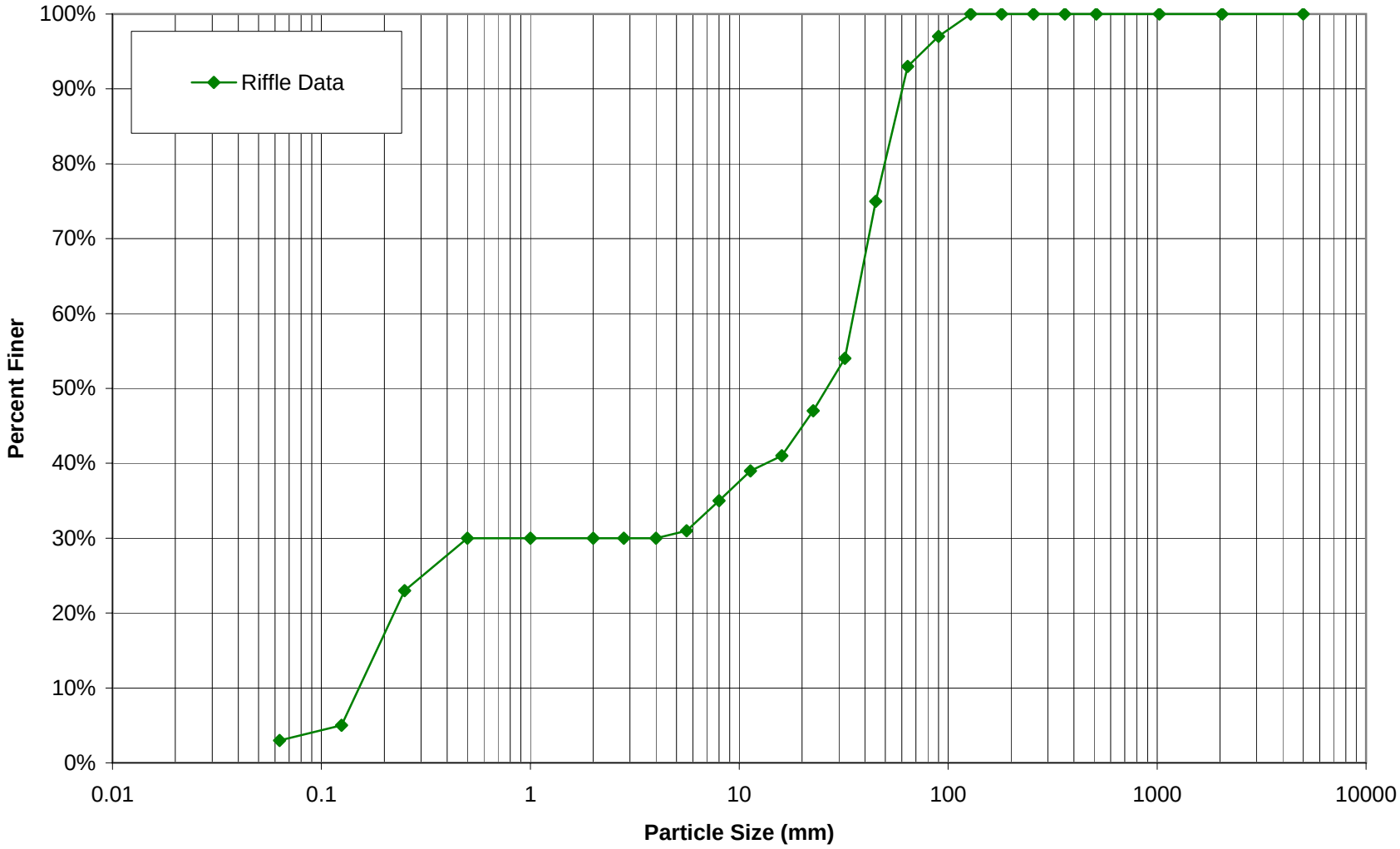
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X5 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	3	3%	3%
SAND	Very Fine	.063 - .125	2	2%	5%
	Fine	.125 - .25	18	18%	23%
	Medium	.25 - .50	7	7%	30%
	Coarse	.50 - 1.0			30%
	Very Coarse	1.0 - 2.0			30%
GRAVEL	Very Fine	2.0 - 2.8			30%
	Very Fine	2.8 - 4.0			30%
	Fine	4.0 - 5.6	1	1%	31%
	Fine	5.6 - 8.0	4	4%	35%
	Medium	8.0 - 11.0	4	4%	39%
	Medium	11.0 - 16.0	2	2%	41%
	Coarse	16.0 - 22.6	6	6%	47%
	Coarse	22.6 - 32	7	7%	54%
	Very Coarse	32 - 45	21	21%	75%
	Very Coarse	45 - 64	18	18%	93%
COBBLE	Small	64 - 90	4	4%	97%
	Small	90 - 128	3	3%	100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X5 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

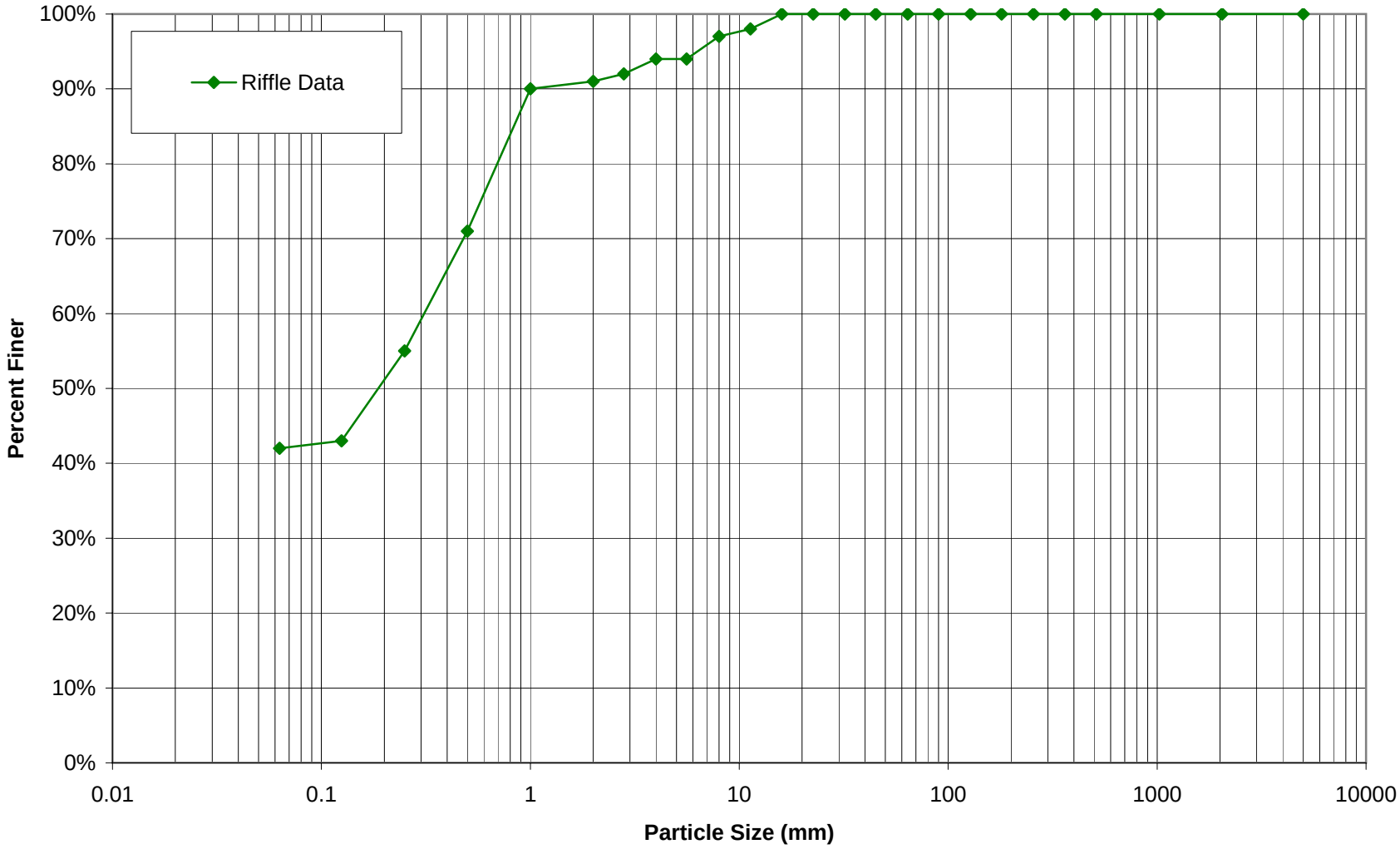
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X6 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	42	42%	42%
SAND	Very Fine	.063 - .125	1	1%	43%
	Fine	.125 - .25	12	12%	55%
	Medium	.25 - .50	16	16%	71%
	Coarse	.50 - 1.0	19	19%	90%
	Very Coarse	1.0 - 2.0	1	1%	91%
GRAVEL	Very Fine	2.0 - 2.8	1	1%	92%
	Very Fine	2.8 - 4.0	2	2%	94%
	Fine	4.0 - 5.6			94%
	Fine	5.6 - 8.0	3	3%	97%
	Medium	8.0 - 11.0	1	1%	98%
	Medium	11.0 - 16.0	2	2%	100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X6 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

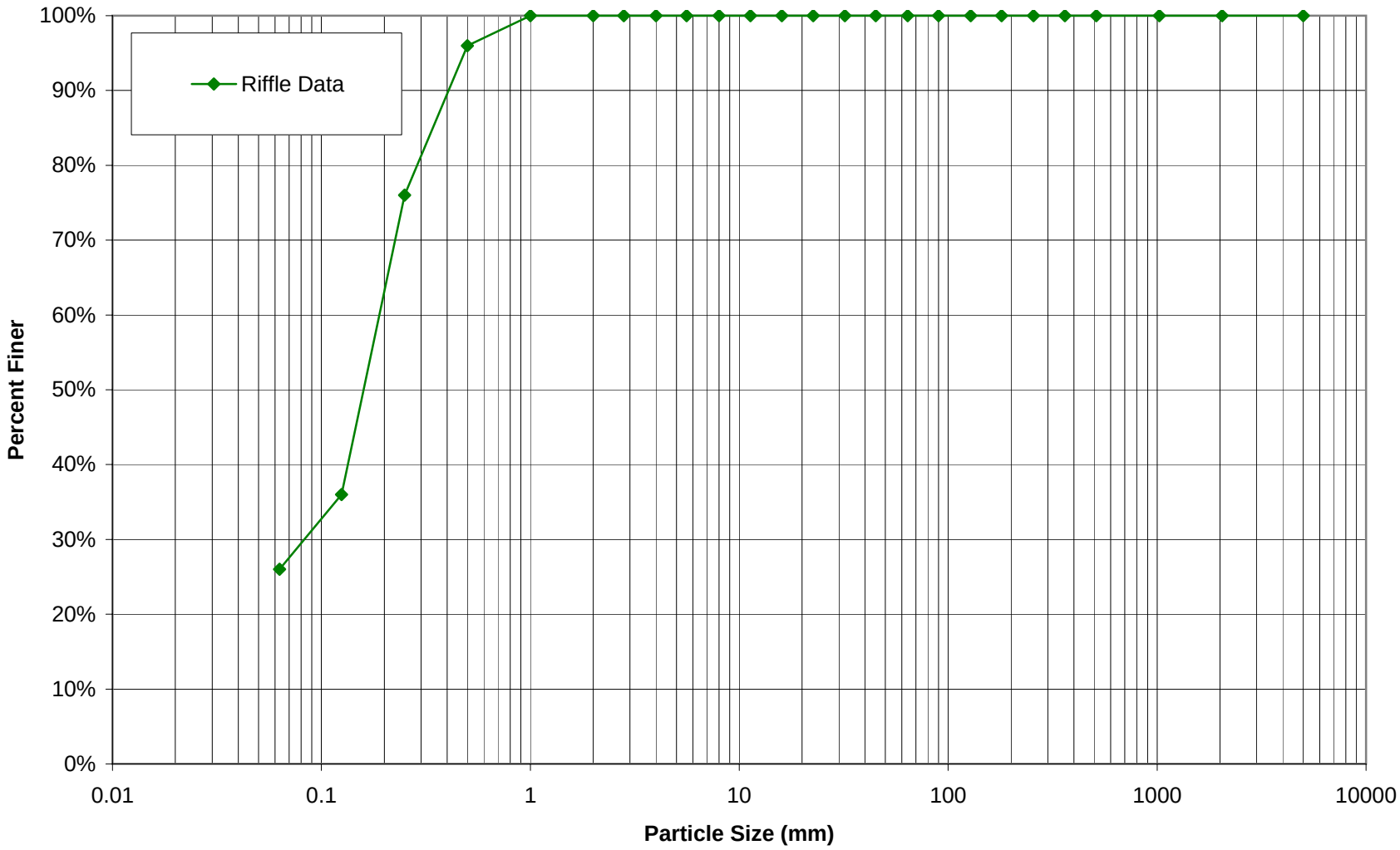
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X7 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	26	26%	26%
SAND	Very Fine	.063 - .125	10	10%	36%
	Fine	.125 - .25	40	40%	76%
	Medium	.25 - .50	20	20%	96%
	Coarse	.50 - 1.0	4	4%	100%
	Very Coarse	1.0 - 2.0			100%
GRAVEL	Very Fine	2.0 - 2.8			100%
	Very Fine	2.8 - 4.0			100%
	Fine	4.0 - 5.6			100%
	Fine	5.6 - 8.0			100%
	Medium	8.0 - 11.0			100%
	Medium	11.0 - 16.0			100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X7 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

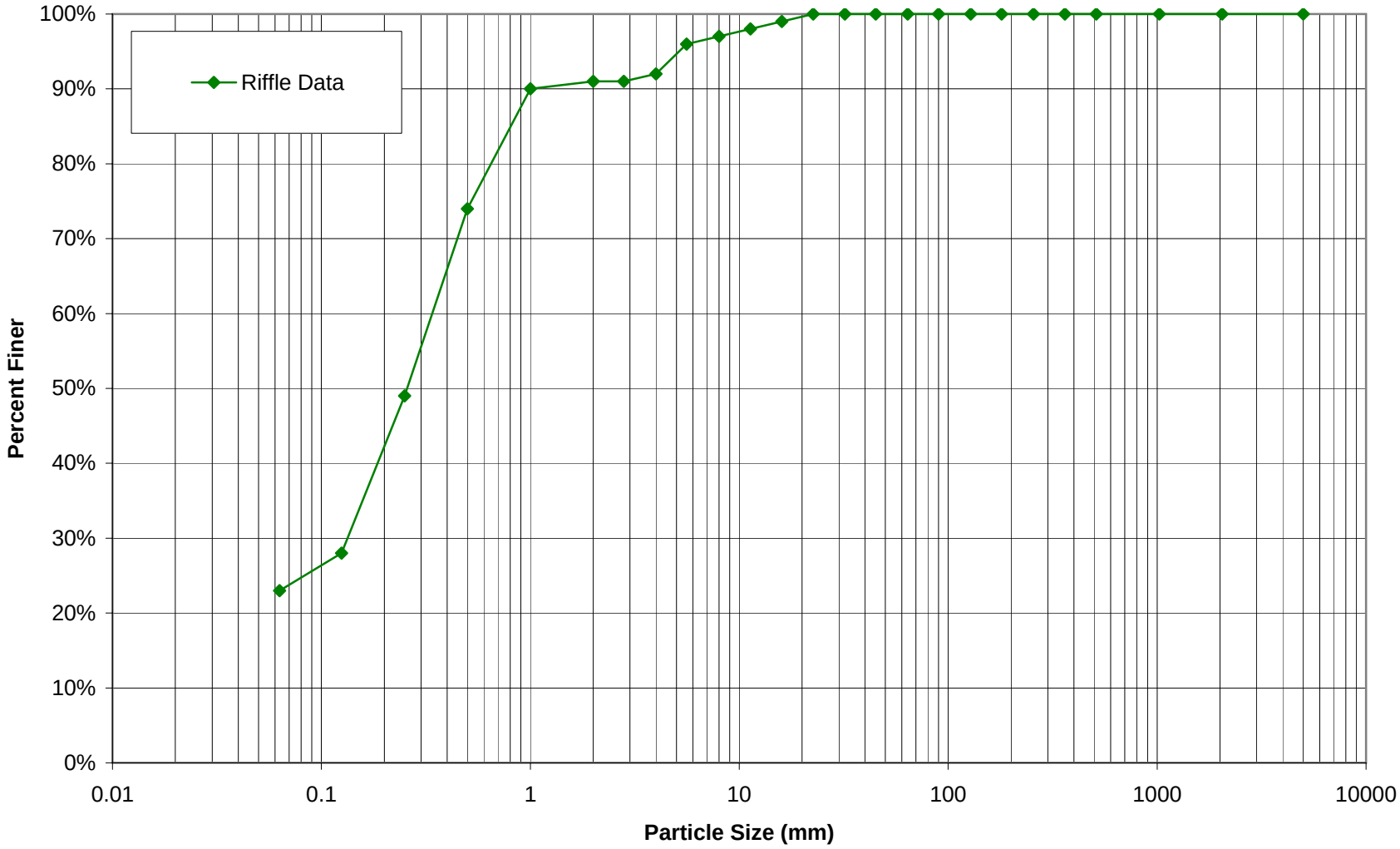
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X8 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	23	23%	23%
SAND	Very Fine	.063 - .125	5	5%	28%
	Fine	.125 - .25	21	21%	49%
	Medium	.25 - .50	25	25%	74%
	Coarse	.50 - 1.0	16	16%	90%
	Very Coarse	1.0 - 2.0	1	1%	91%
GRAVEL	Very Fine	2.0 - 2.8			91%
	Very Fine	2.8 - 4.0	1	1%	92%
	Fine	4.0 - 5.6	4	4%	96%
	Fine	5.6 - 8.0	1	1%	97%
	Medium	8.0 - 11.0	1	1%	98%
	Medium	11.0 - 16.0	1	1%	99%
	Coarse	16.0 - 22.6	1	1%	100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X8 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

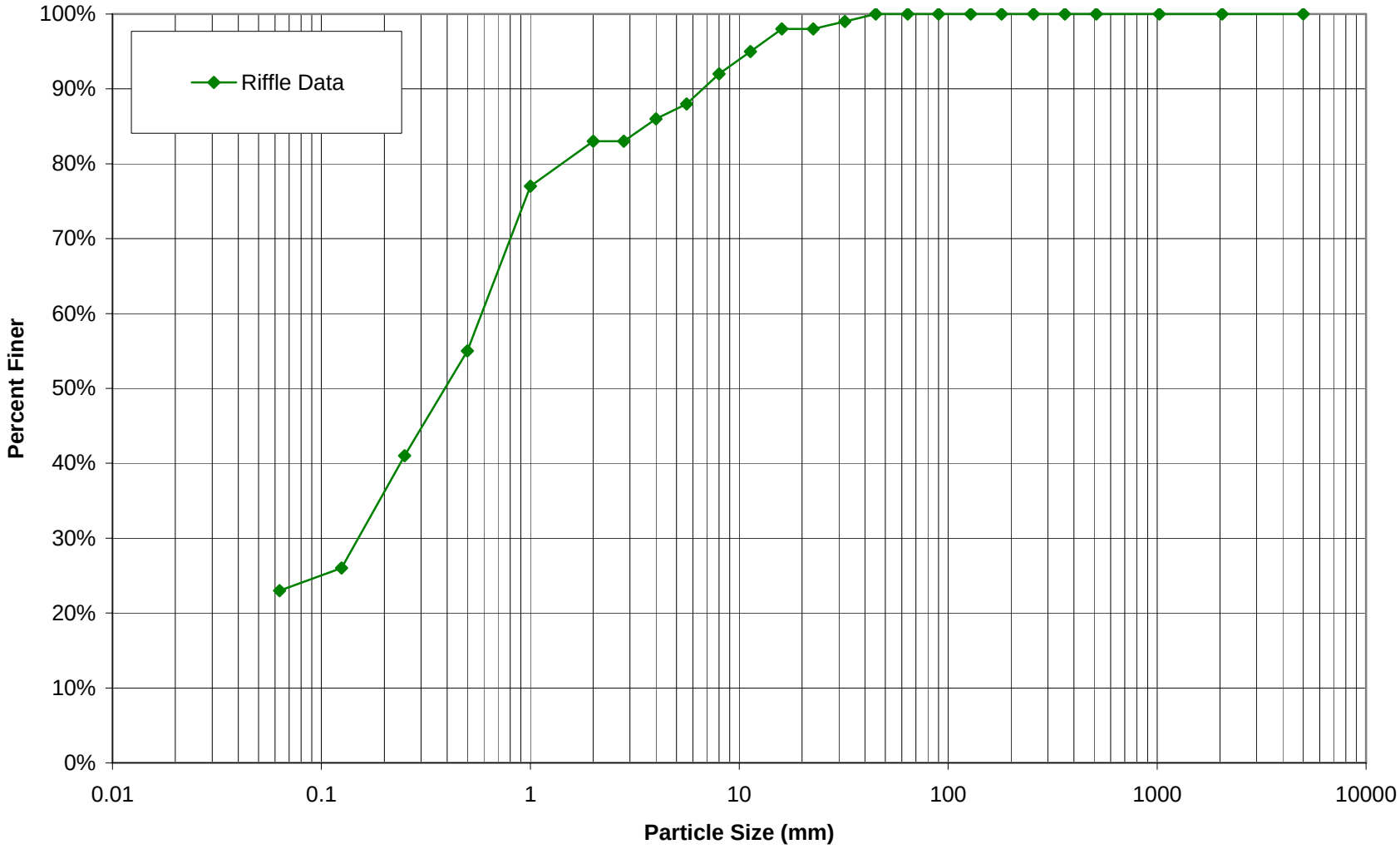
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X9 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	23	23%	23%
SAND	Very Fine	.063 - .125	3	3%	26%
	Fine	.125 - .25	15	15%	41%
	Medium	.25 - .50	14	14%	55%
	Coarse	.50 - 1.0	22	22%	77%
	Very Coarse	1.0 - 2.0	6	6%	83%
GRAVEL	Very Fine	2.0 - 2.8			83%
	Very Fine	2.8 - 4.0	3	3%	86%
	Fine	4.0 - 5.6	2	2%	88%
	Fine	5.6 - 8.0	4	4%	92%
	Medium	8.0 - 11.0	3	3%	95%
	Medium	11.0 - 16.0	3	3%	98%
	Coarse	16.0 - 22.6			98%
	Coarse	22.6 - 32	1	1%	99%
	Very Coarse	32 - 45	1	1%	100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X9 - Pool
Pebble Count Particle Size Distribution



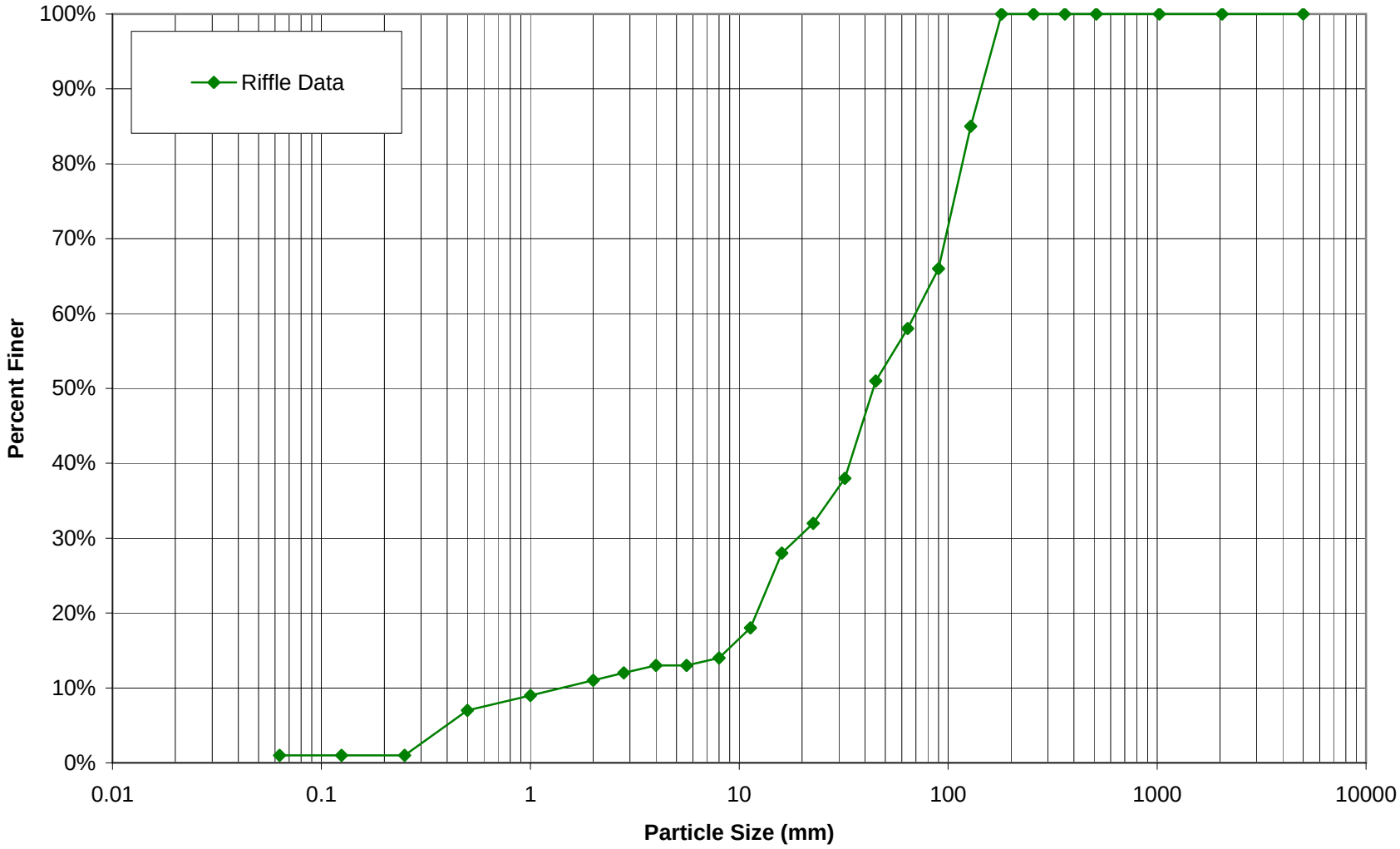
PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X10 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	1	1%	1%
SAND	Very Fine	.063 - .125			1%
	Fine	.125 - .25			1%
	Medium	.25 - .50	6	6%	7%
	Coarse	.50 - 1.0	2	2%	9%
	Very Coarse	1.0 - 2.0	2	2%	11%
GRAVEL	Very Fine	2.0 - 2.8	1	1%	12%
	Very Fine	2.8 - 4.0	1	1%	13%
	Fine	4.0 - 5.6			13%
	Fine	5.6 - 8.0	1	1%	14%
	Medium	8.0 - 11.0	4	4%	18%
	Medium	11.0 - 16.0	10	10%	28%
	Coarse	16.0 - 22.6	4	4%	32%
	Coarse	22.6 - 32	6	6%	38%
	Very Coarse	32 - 45	13	13%	51%
	Very Coarse	45 - 64	7	7%	58%
COBBLE	Small	64 - 90	8	8%	66%
	Small	90 - 128	19	19%	85%
	Large	128 - 180	15	15%	100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

Largest particles: _____ **(riffle)**

South Fork Hoppers Creek
X10 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

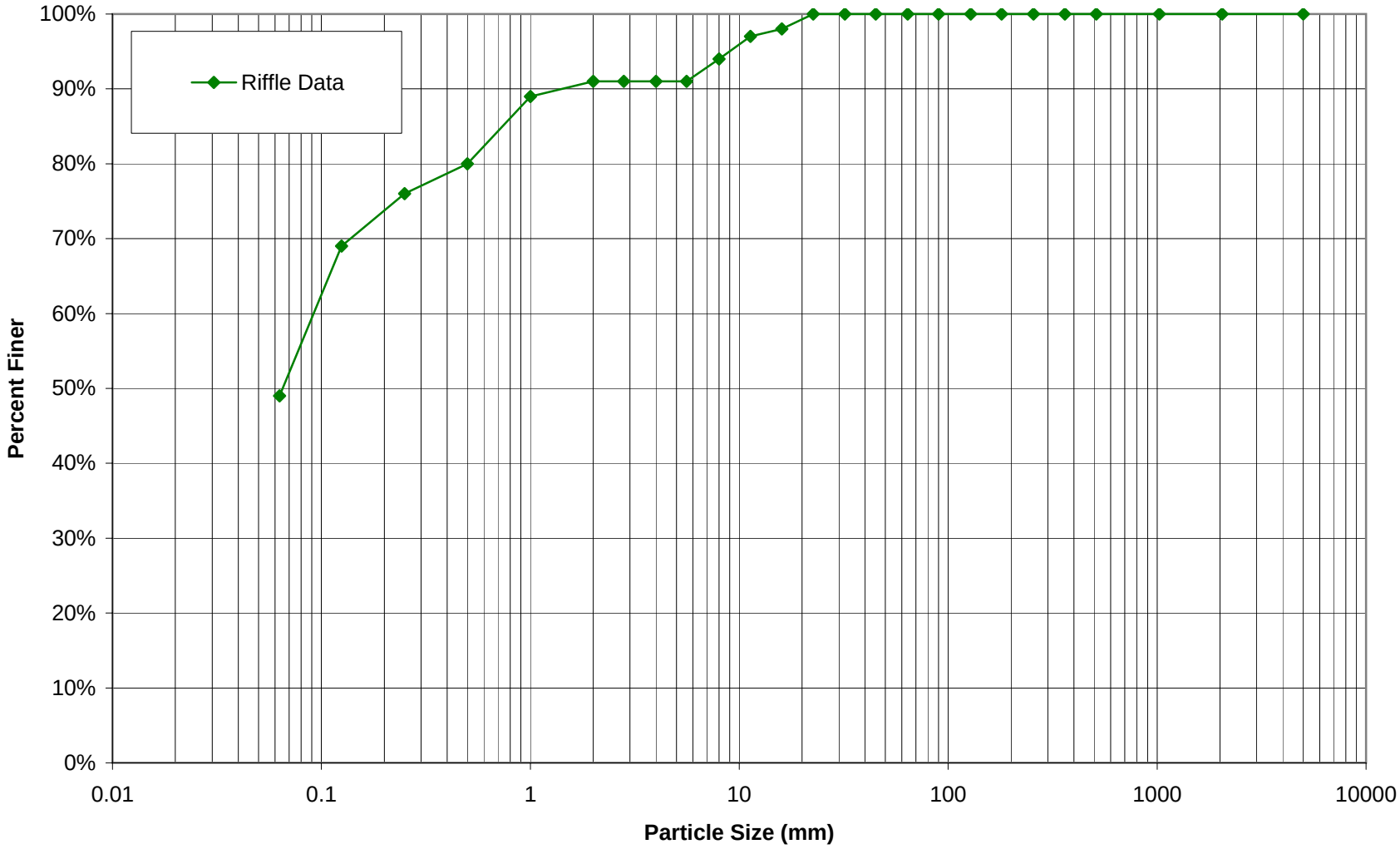
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X11 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	49	49%	49%
SAND	Very Fine	.063 - .125	20	20%	69%
	Fine	.125 - .25	7	7%	76%
	Medium	.25 - .50	4	4%	80%
	Coarse	.50 - 1.0	9	9%	89%
	Very Coarse	1.0 - 2.0	2	2%	91%
GRAVEL	Very Fine	2.0 - 2.8			91%
	Very Fine	2.8 - 4.0			91%
	Fine	4.0 - 5.6			91%
	Fine	5.6 - 8.0	3	3%	94%
	Medium	8.0 - 11.0	3	3%	97%
	Medium	11.0 - 16.0	1	1%	98%
	Coarse	16.0 - 22.6	2	2%	100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X11 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

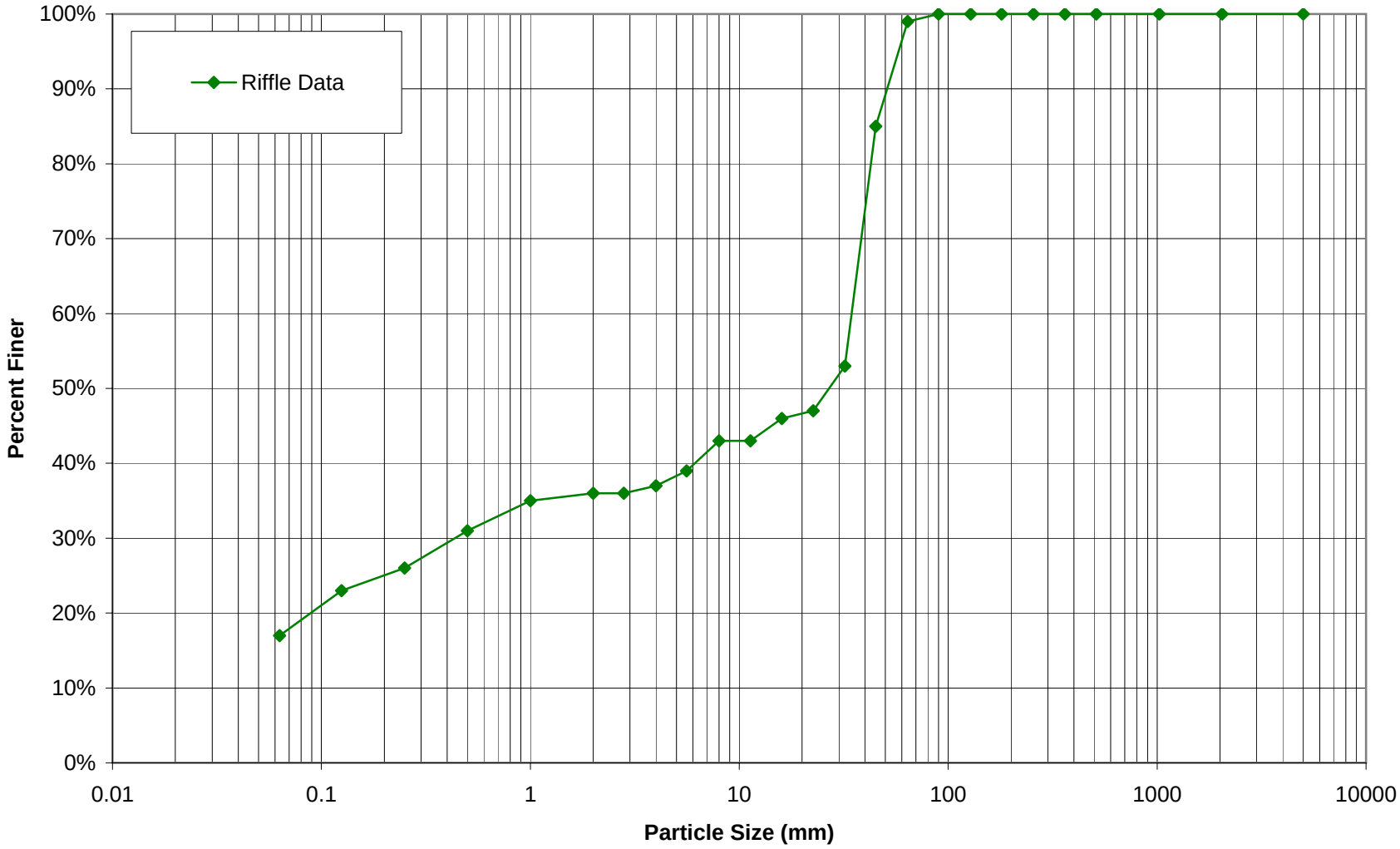
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X12 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	17	17%	17%
SAND	Very Fine	.063 - .125	6	6%	23%
	Fine	.125 - .25	3	3%	26%
	Medium	.25 - .50	5	5%	31%
	Coarse	.50 - 1.0	4	4%	35%
	Very Coarse	1.0 - 2.0	1	1%	36%
GRAVEL	Very Fine	2.0 - 2.8			36%
	Very Fine	2.8 - 4.0	1	1%	37%
	Fine	4.0 - 5.6	2	2%	39%
	Fine	5.6 - 8.0	4	4%	43%
	Medium	8.0 - 11.0			43%
	Medium	11.0 - 16.0	3	3%	46%
	Coarse	16.0 - 22.6	1	1%	47%
	Coarse	22.6 - 32	6	6%	53%
	Very Coarse	32 - 45	32	32%	85%
	Very Coarse	45 - 64	14	14%	99%
COBBLE	Small	64 - 90	1	1%	100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X12 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

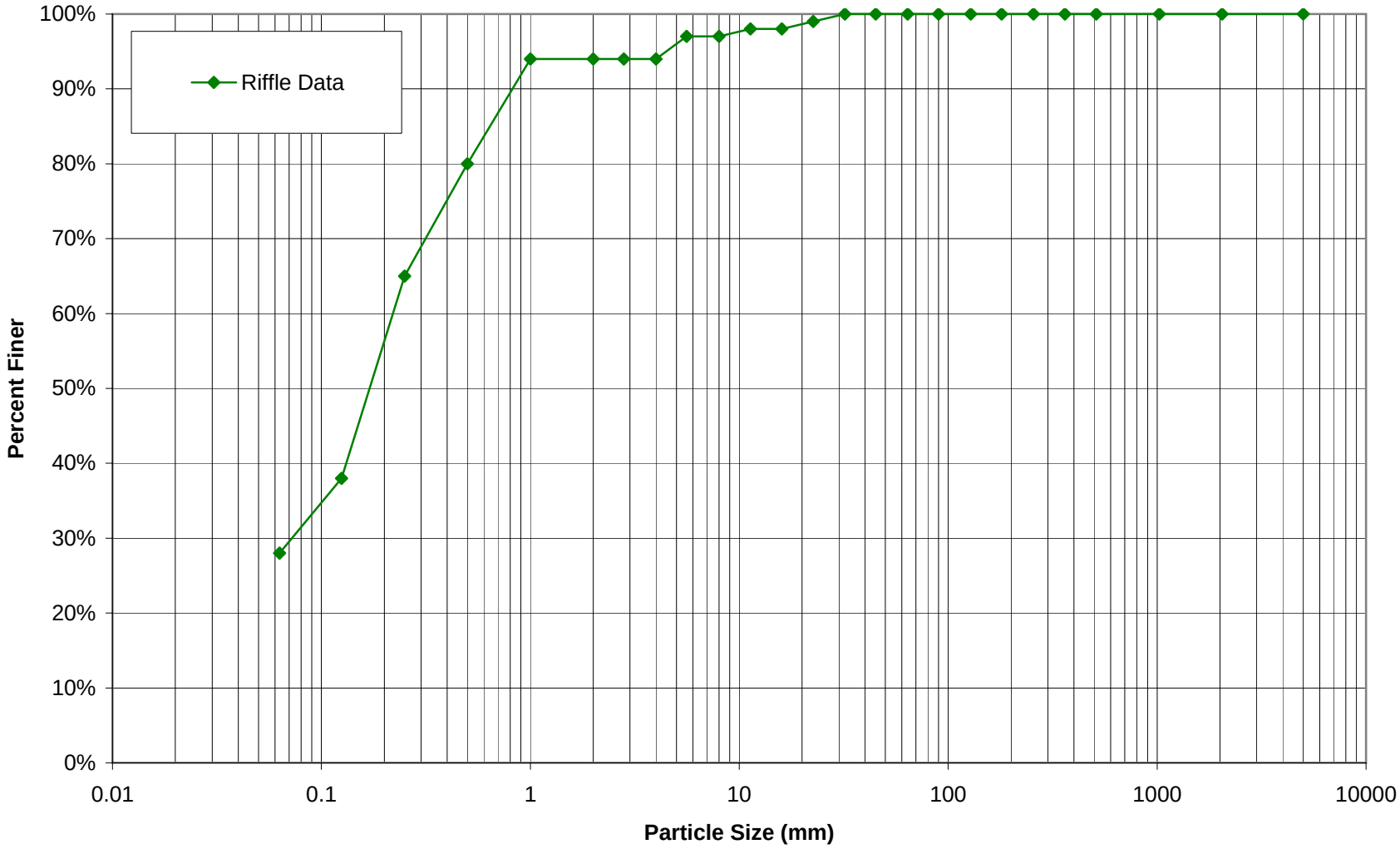
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X13 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	28	28%	28%
SAND	Very Fine	.063 - .125	10	10%	38%
	Fine	.125 - .25	27	27%	65%
	Medium	.25 - .50	15	15%	80%
	Coarse	.50 - 1.0	14	14%	94%
	Very Coarse	1.0 - 2.0			94%
GRAVEL	Very Fine	2.0 - 2.8			94%
	Very Fine	2.8 - 4.0			94%
	Fine	4.0 - 5.6	3	3%	97%
	Fine	5.6 - 8.0			97%
	Medium	8.0 - 11.0	1	1%	98%
	Medium	11.0 - 16.0			98%
	Coarse	16.0 - 22.6	1	1%	99%
	Coarse	22.6 - 32	1	1%	100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(pool)

South Fork Hoppers Creek
X13 - Pool
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

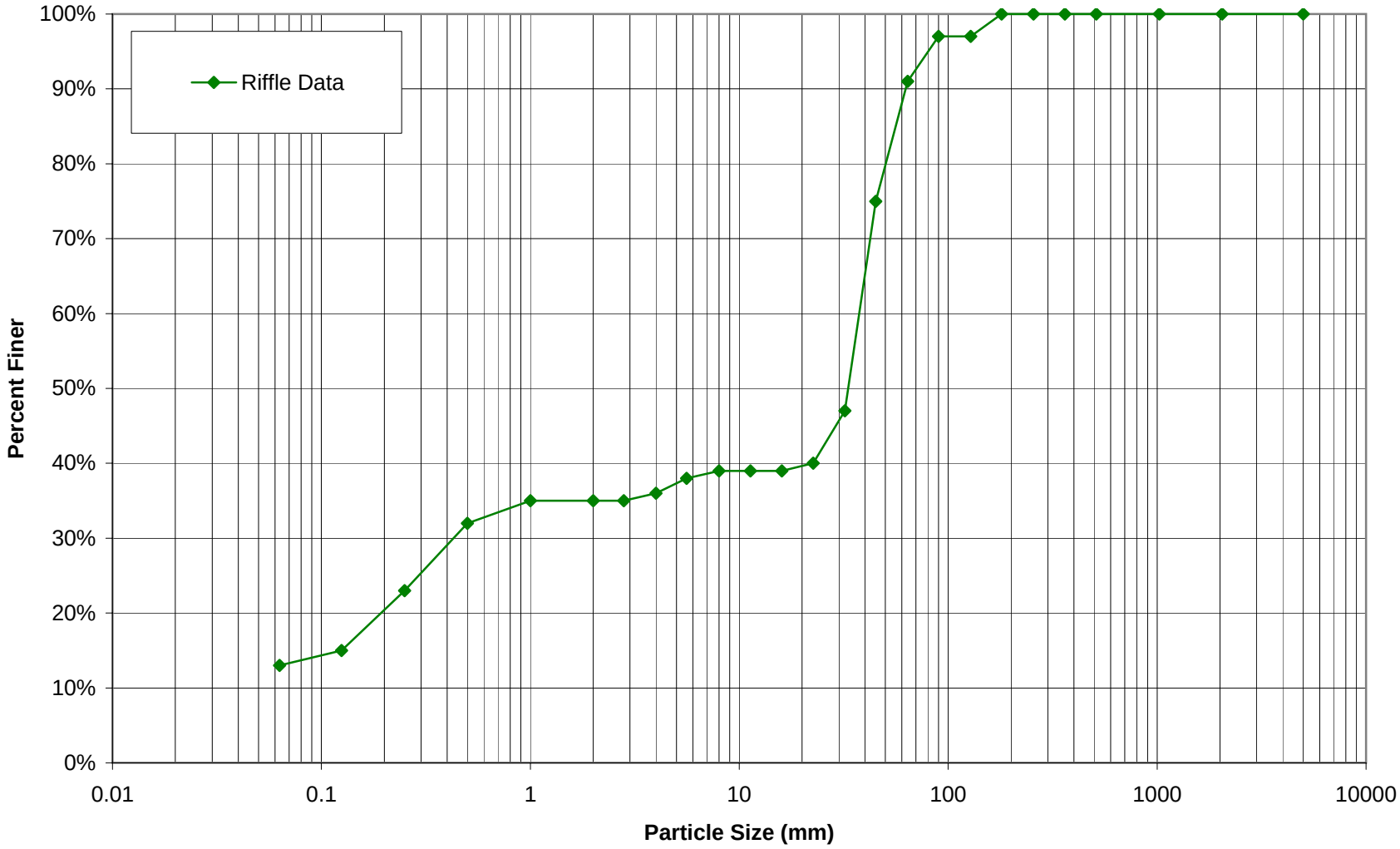
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X14 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	13	13%	13%
SAND	Very Fine	.063 - .125	2	2%	15%
	Fine	.125 - .25	8	8%	23%
	Medium	.25 - .50	9	9%	32%
	Coarse	.50 - 1.0	3	3%	35%
	Very Coarse	1.0 - 2.0			35%
GRAVEL	Very Fine	2.0 - 2.8			35%
	Very Fine	2.8 - 4.0	1	1%	36%
	Fine	4.0 - 5.6	2	2%	38%
	Fine	5.6 - 8.0	1	1%	39%
	Medium	8.0 - 11.0			39%
	Medium	11.0 - 16.0			39%
	Coarse	16.0 - 22.6	1	1%	40%
	Coarse	22.6 - 32	7	7%	47%
	Very Coarse	32 - 45	28	28%	75%
	Very Coarse	45 - 64	16	16%	91%
COBBLE	Small	64 - 90	6	6%	97%
	Small	90 - 128			97%
	Large	128 - 180	3	3%	100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	**100**	**100%**	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X14 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: RIFFLE 100-COUNT

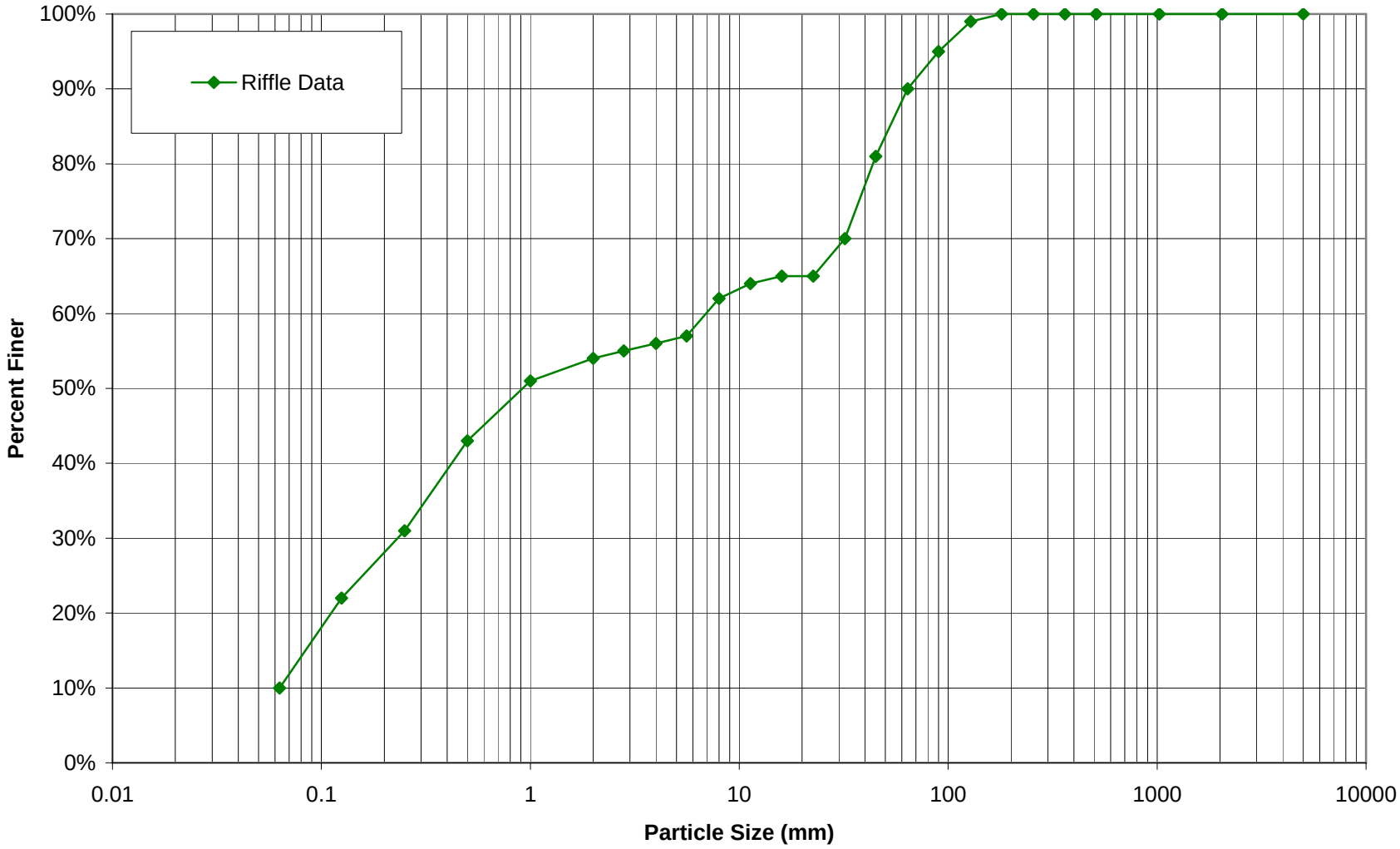
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X15 Riffle
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	10	10%	10%
SAND	Very Fine	.063 - .125	12	12%	22%
	Fine	.125 - .25	9	9%	31%
	Medium	.25 - .50	12	12%	43%
	Coarse	.50 - 1.0	8	8%	51%
	Very Coarse	1.0 - 2.0	3	3%	54%
GRAVEL	Very Fine	2.0 - 2.8	1	1%	55%
	Very Fine	2.8 - 4.0	1	1%	56%
	Fine	4.0 - 5.6	1	1%	57%
	Fine	5.6 - 8.0	5	5%	62%
	Medium	8.0 - 11.0	2	2%	64%
	Medium	11.0 - 16.0	1	1%	65%
	Coarse	16.0 - 22.6			65%
	Coarse	22.6 - 32	5	5%	70%
	Very Coarse	32 - 45	11	11%	81%
	Very Coarse	45 - 64	9	9%	90%
COBBLE	Small	64 - 90	5	5%	95%
	Small	90 - 128	4	4%	99%
	Large	128 - 180	1	1%	100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

Largest particles: _____

(riffle)

South Fork Hoppers Creek
X15 - Riffle
Pebble Count Particle Size Distribution



PEBBLE COUNT DATA SHEET: POOL 100-COUNT

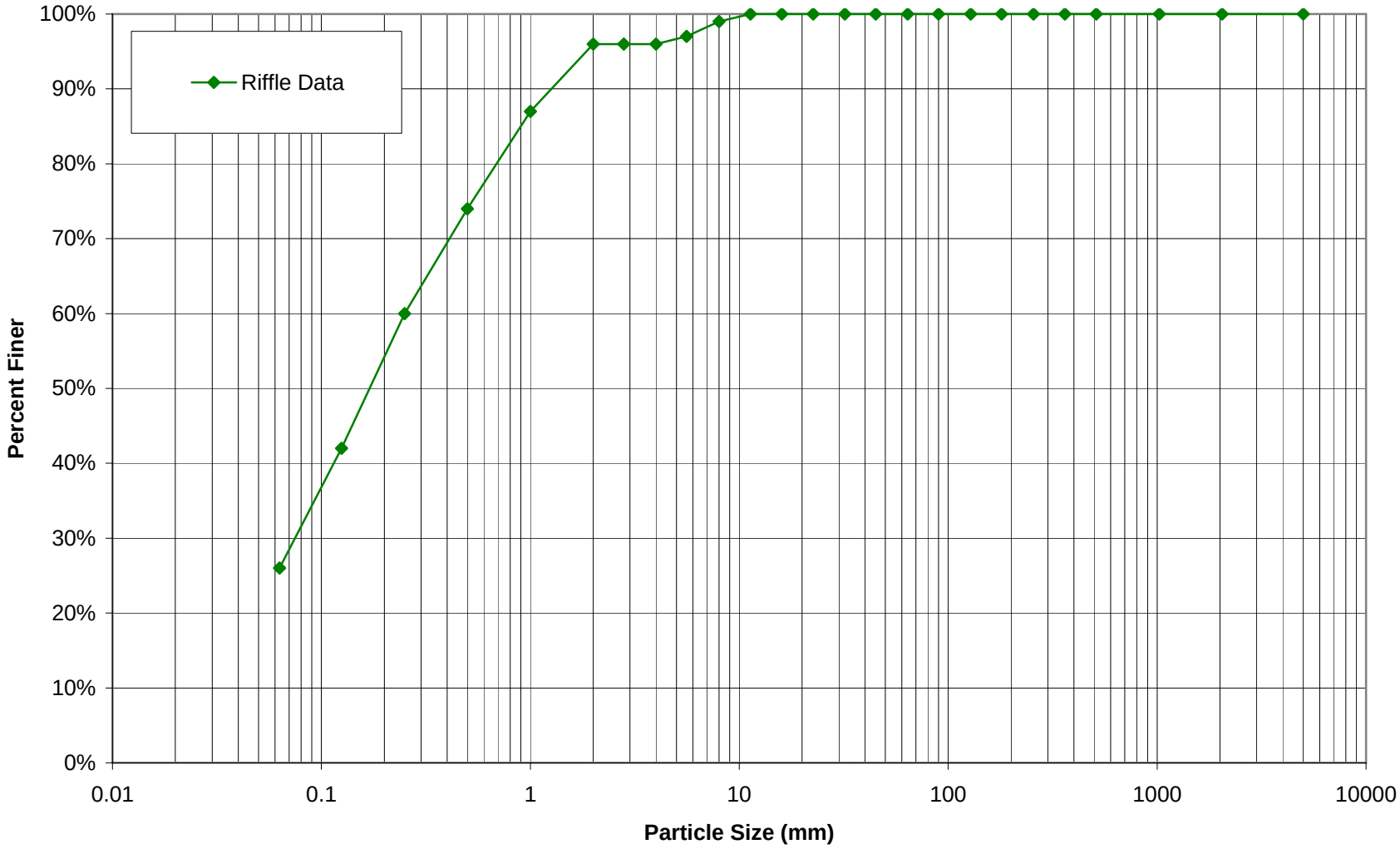
	BAKER PROJECT NO. 108410
SITE OR PROJECT:	South Fork Hoppers Creek - Year 3 Monitoring
REACH/LOCATION:	X16 Pool
DATE COLLECTED:	10/20/2008
FIELD COLLECTION BY:	IE/CM
DATA ENTRY BY:	IE

			PARTICLE CLASS COUNT	Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	26	26%	26%
SAND	Very Fine	.063 - .125	16	16%	42%
	Fine	.125 - .25	18	18%	60%
	Medium	.25 - .50	14	14%	74%
	Coarse	.50 - 1.0	13	13%	87%
	Very Coarse	1.0 - 2.0	9	9%	96%
GRAVEL	Very Fine	2.0 - 2.8			96%
	Very Fine	2.8 - 4.0			96%
	Fine	4.0 - 5.6	1	1%	97%
	Fine	5.6 - 8.0	2	2%	99%
	Medium	8.0 - 11.0	1	1%	100%
	Medium	11.0 - 16.0			100%
	Coarse	16.0 - 22.6			100%
	Coarse	22.6 - 32			100%
	Very Coarse	32 - 45			100%
	Very Coarse	45 - 64			100%
COBBLE	Small	64 - 90			100%
	Small	90 - 128			100%
	Large	128 - 180			100%
	Large	180 - 256			100%
BOULDER	Small	256 - 362			100%
	Small	362 - 512			100%
	Medium	512 - 1024			100%
	Large-Very Large	1024 - 2048			100%
BEDROCK	Bedrock	> 2048			100%
		Total	100	100%	

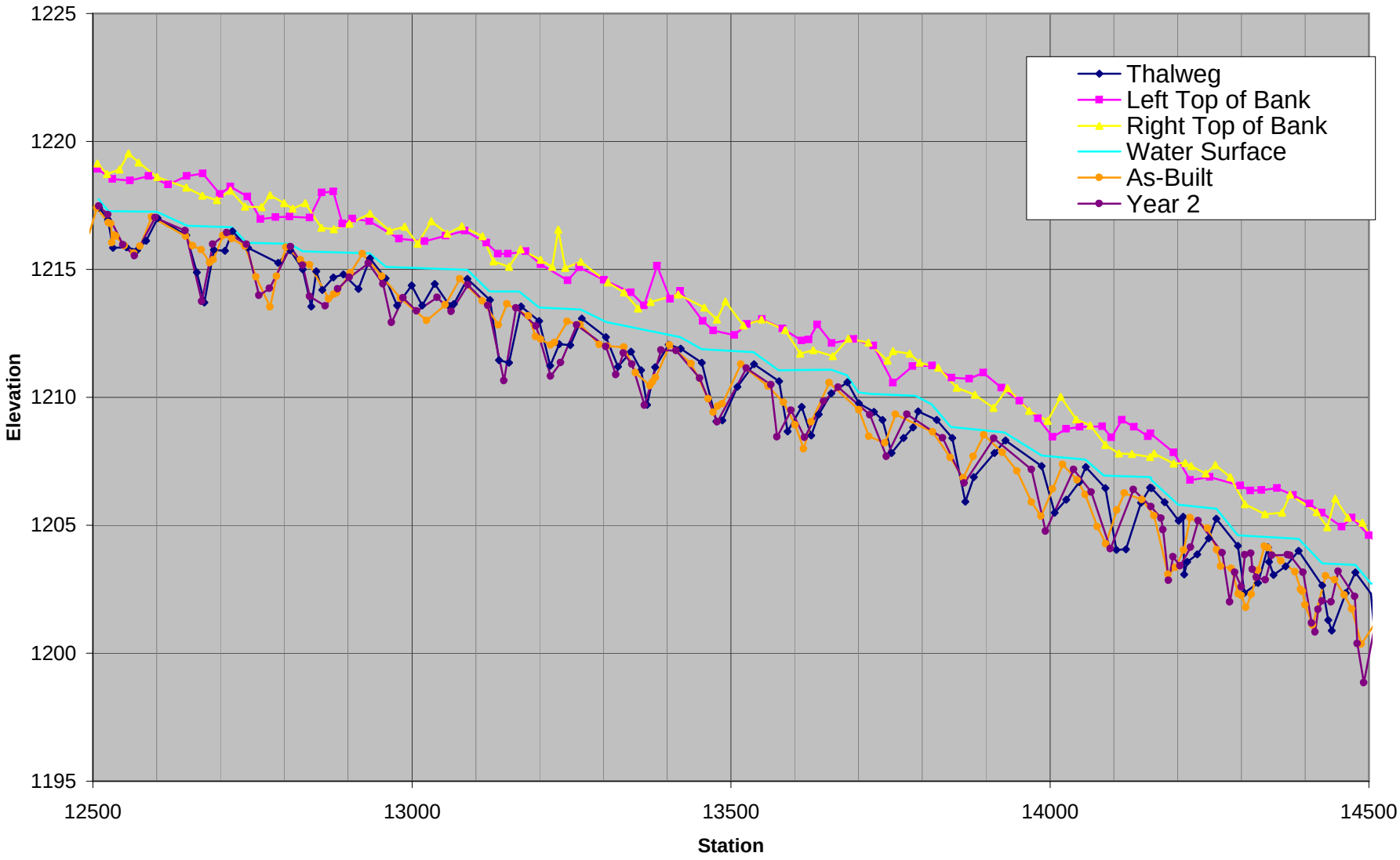
Largest particles: _____

(pool)

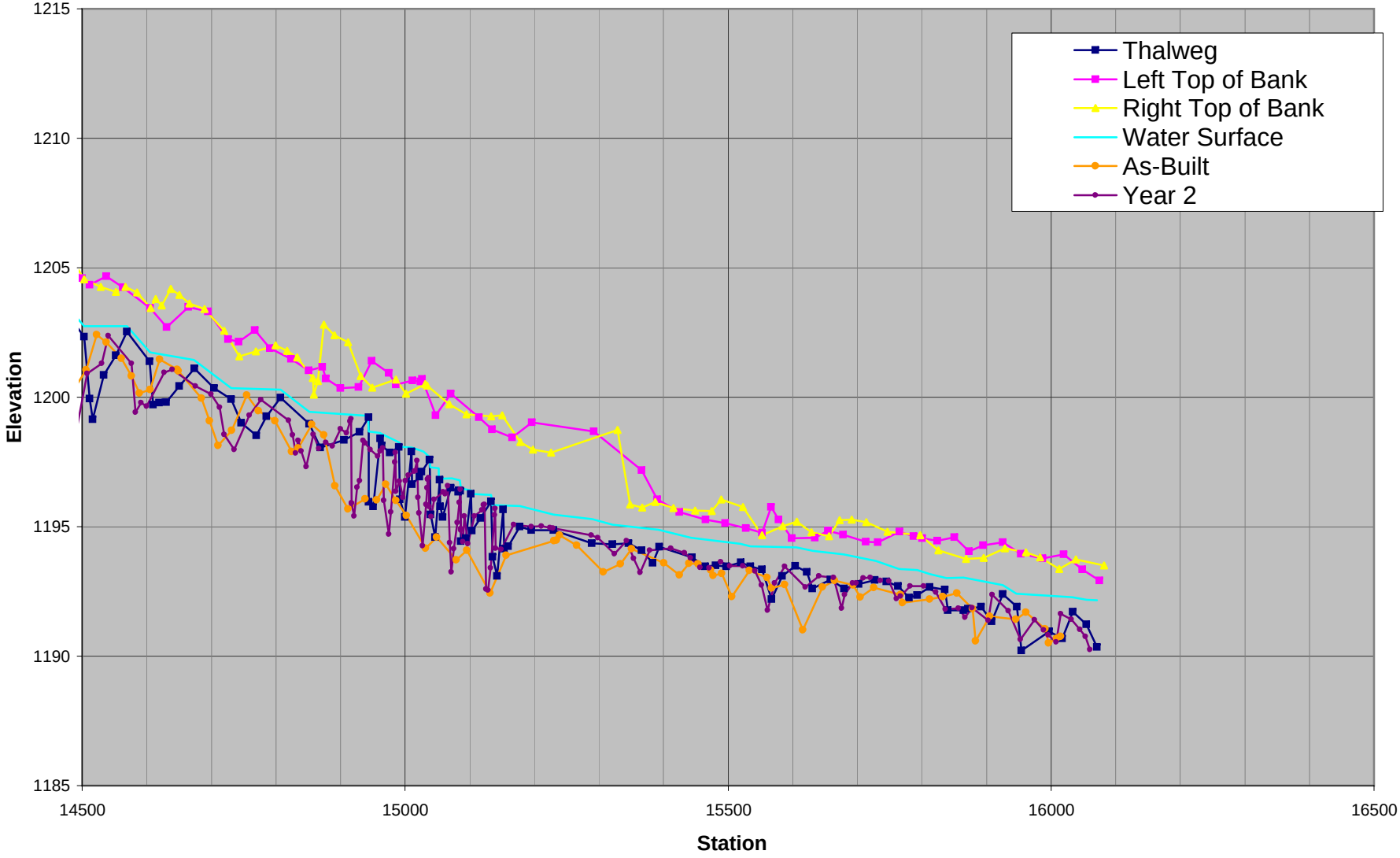
South Fork Hoppers Creek
X16 - Pool
Pebble Count Particle Size Distribution



South Fork Hoppers Creek - Year 3 (2008) Monitoring Profile



South Fork Hoppers Creek - Year 3 (2008) Monitoring Profile



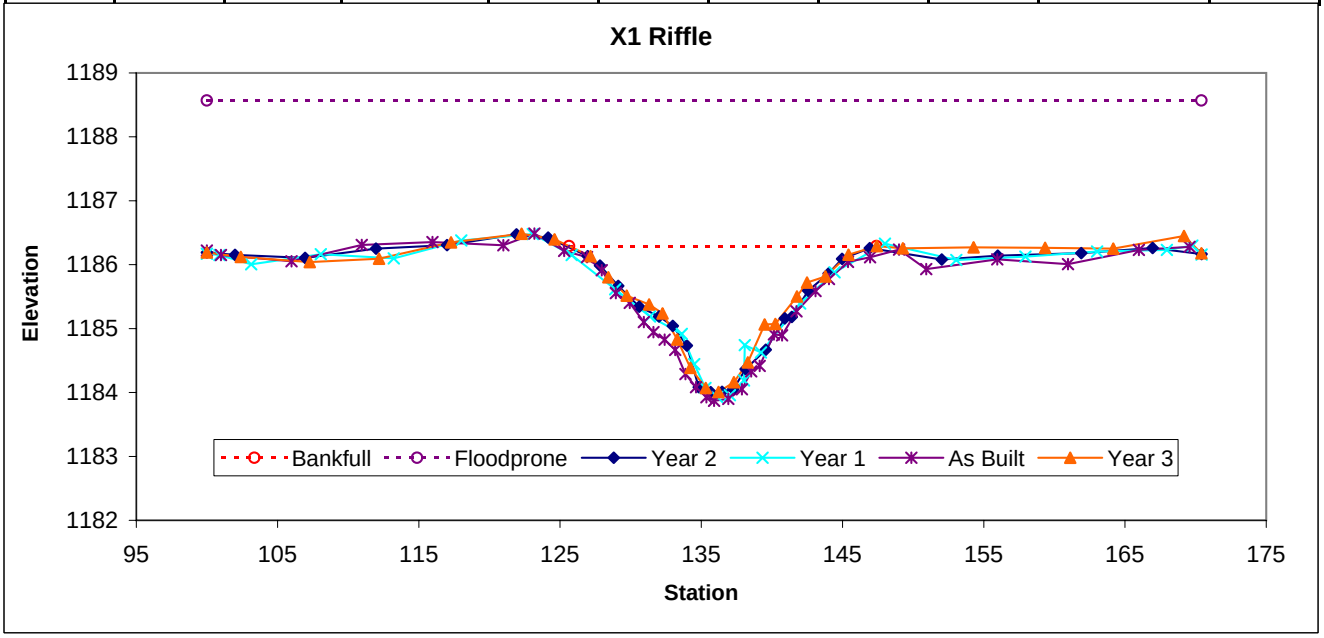
Permanent Cross Section X1

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	21.2	21.76	0.97	2.28	22.35	1	3.2	1186.29	1186.29



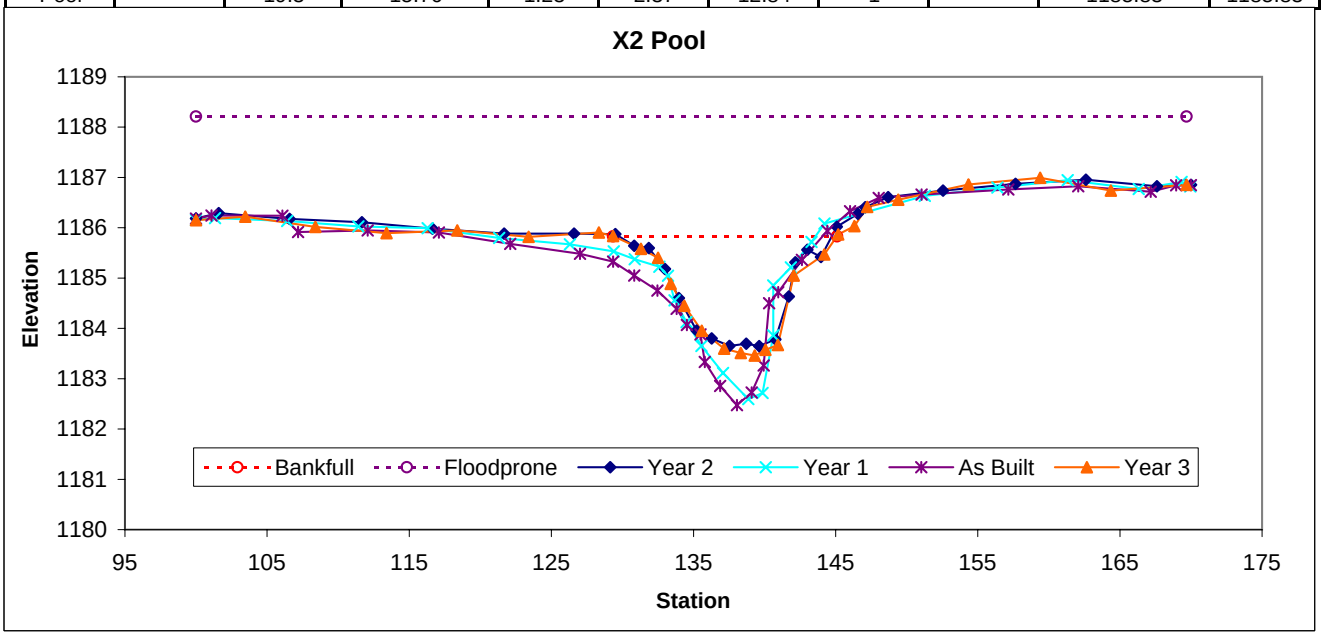
Permanent Cross Section X2

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		19.3	15.76	1.23	2.37	12.84	1		1185.83	1185.83



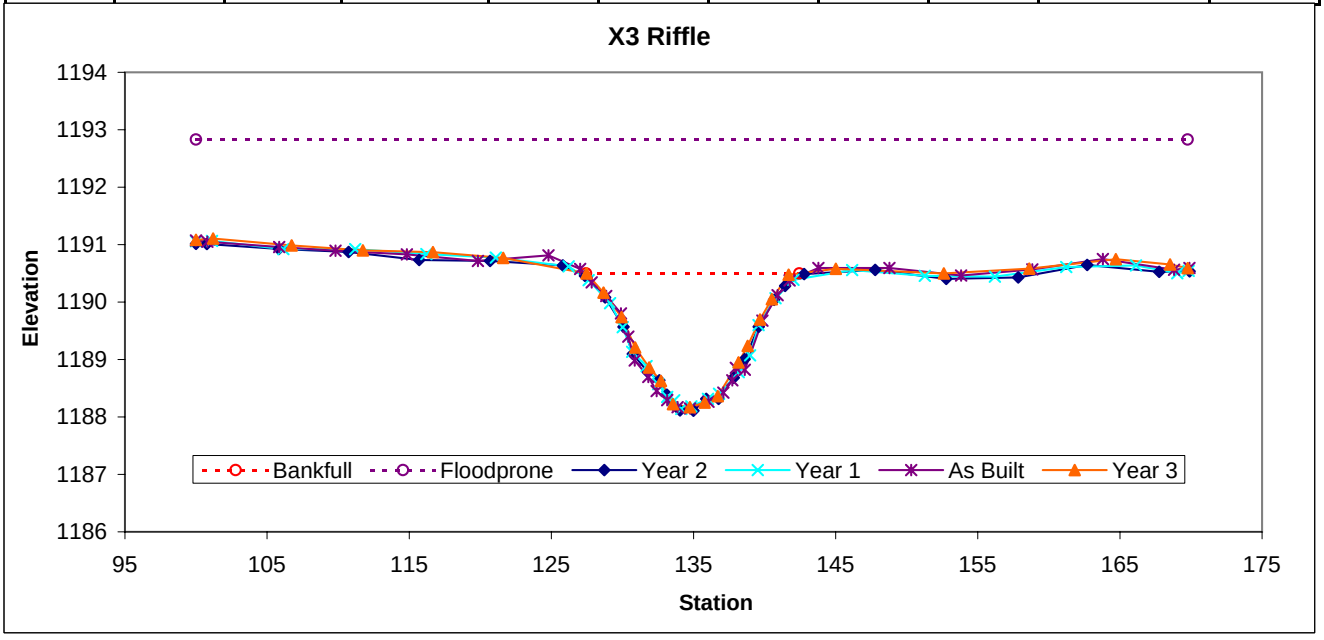
Permanent Cross Section X3

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

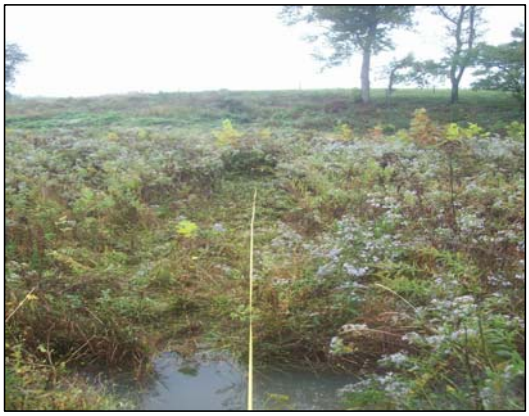
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	19	15.01	1.26	2.33	11.88	1	4.6	1190.5	1190.48



Permanent Cross Section X4

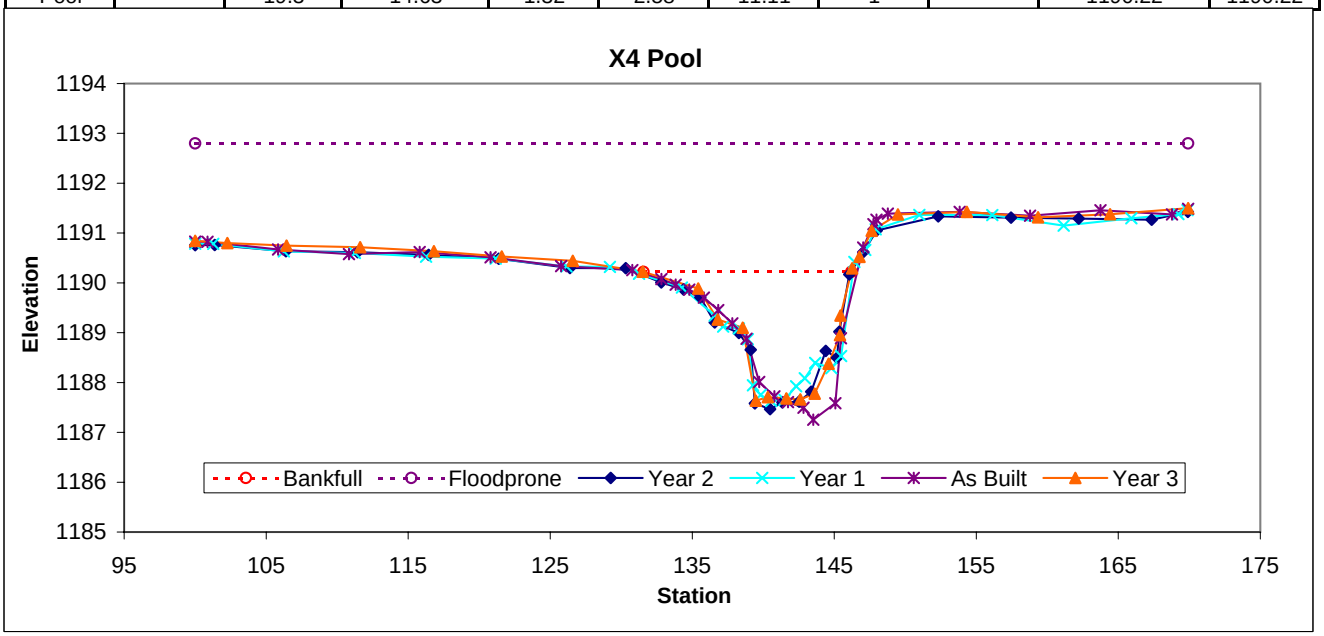
(Year 3 Monitoring Data - collected October 2008)



Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		19.3	14.63	1.32	2.58	11.11	1		1190.22	1190.22



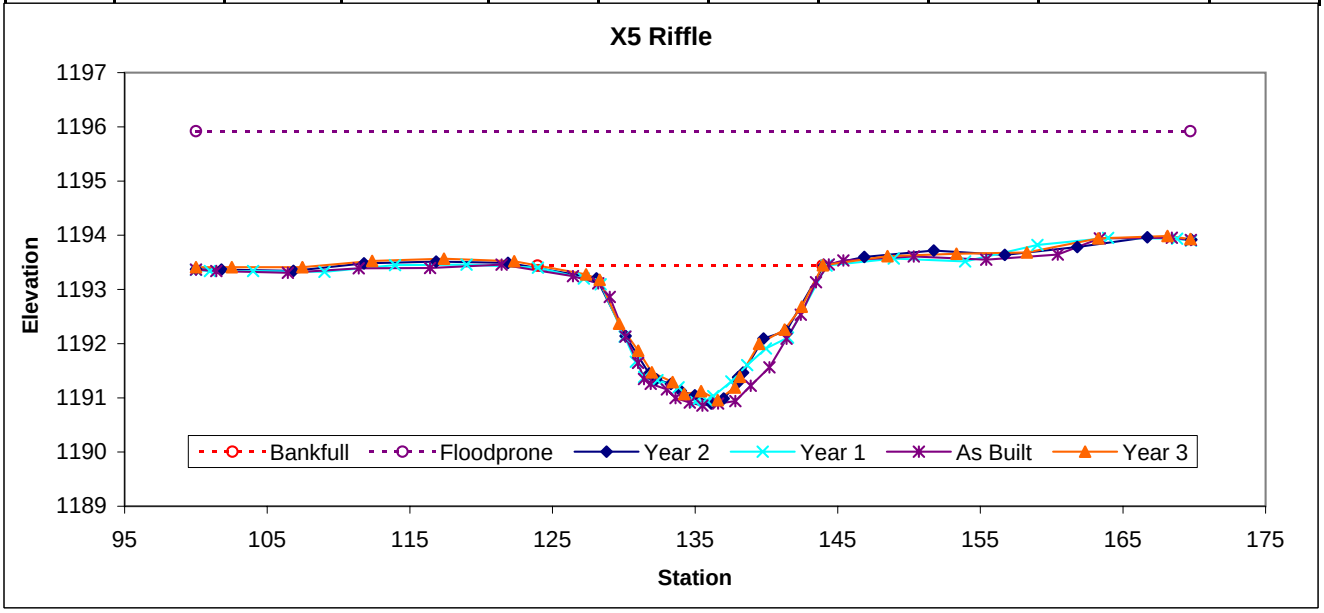
Permanent Cross Section X5

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	25.3	19.99	1.26	2.48	15.81	1	3.5	1193.44	1193.45



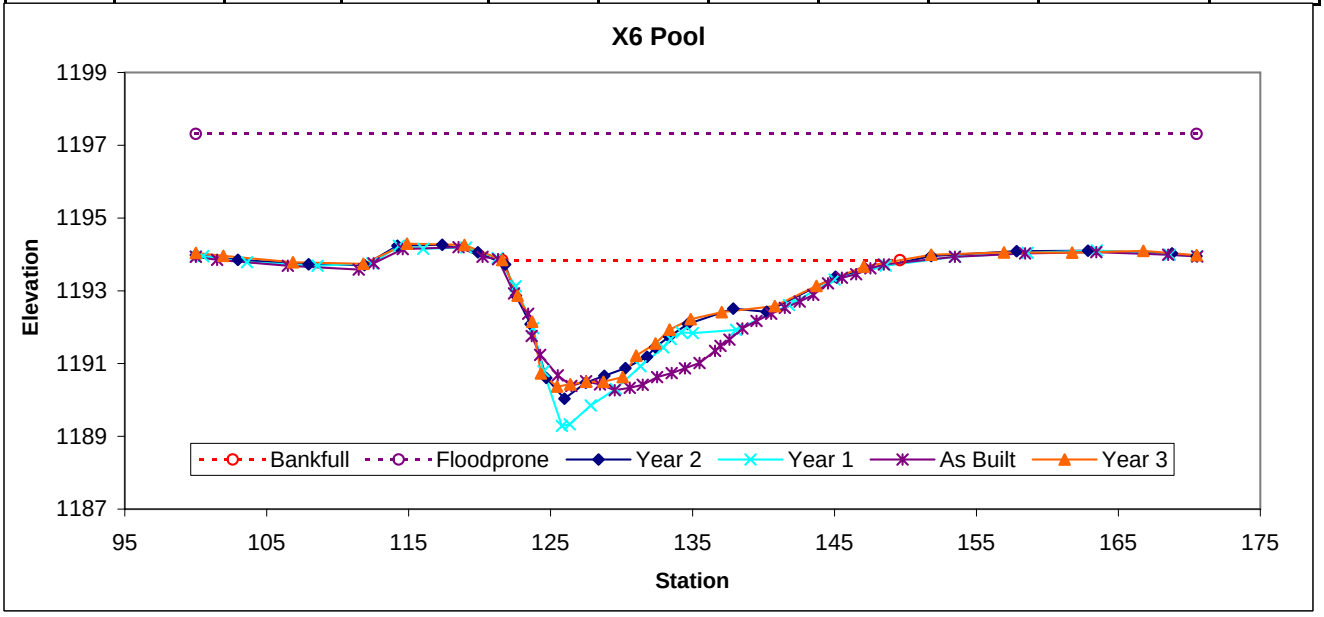
Permanent Cross Section X6

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		46.4	28.01	1.66	3.47	16.92	1		1193.84	1193.85



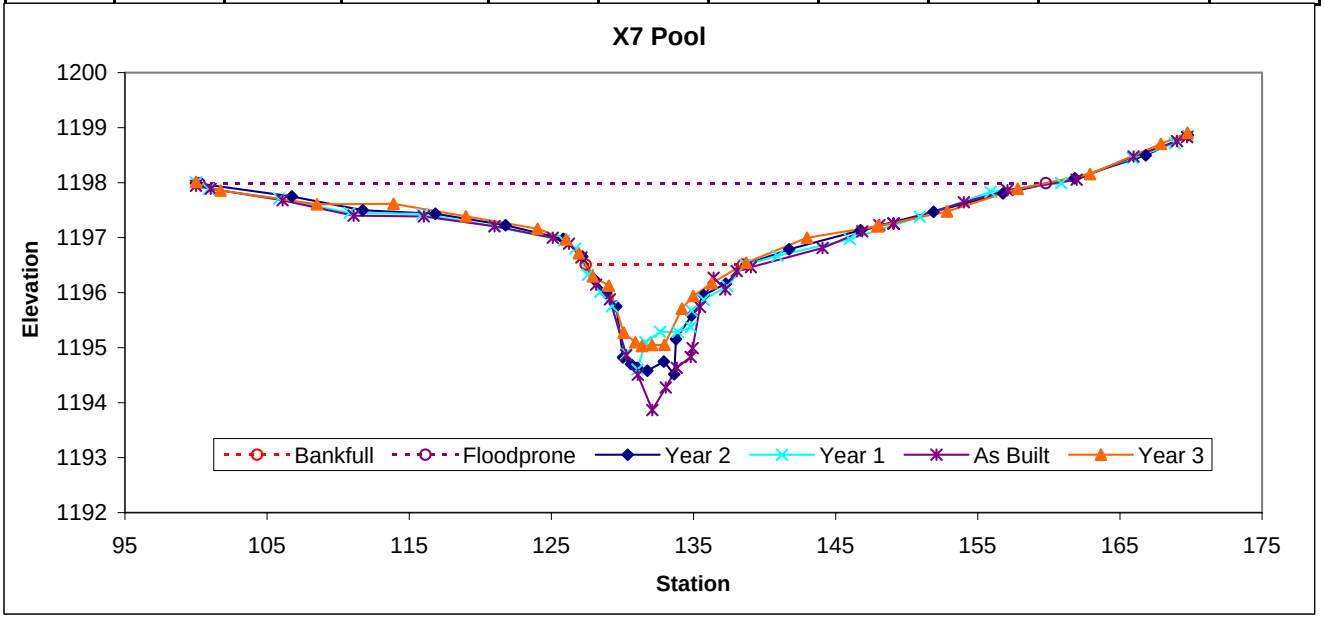
Permanent Cross Section X7

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		8.2	11.07	0.74	1.48	14.9	1		1196.51	1196.54



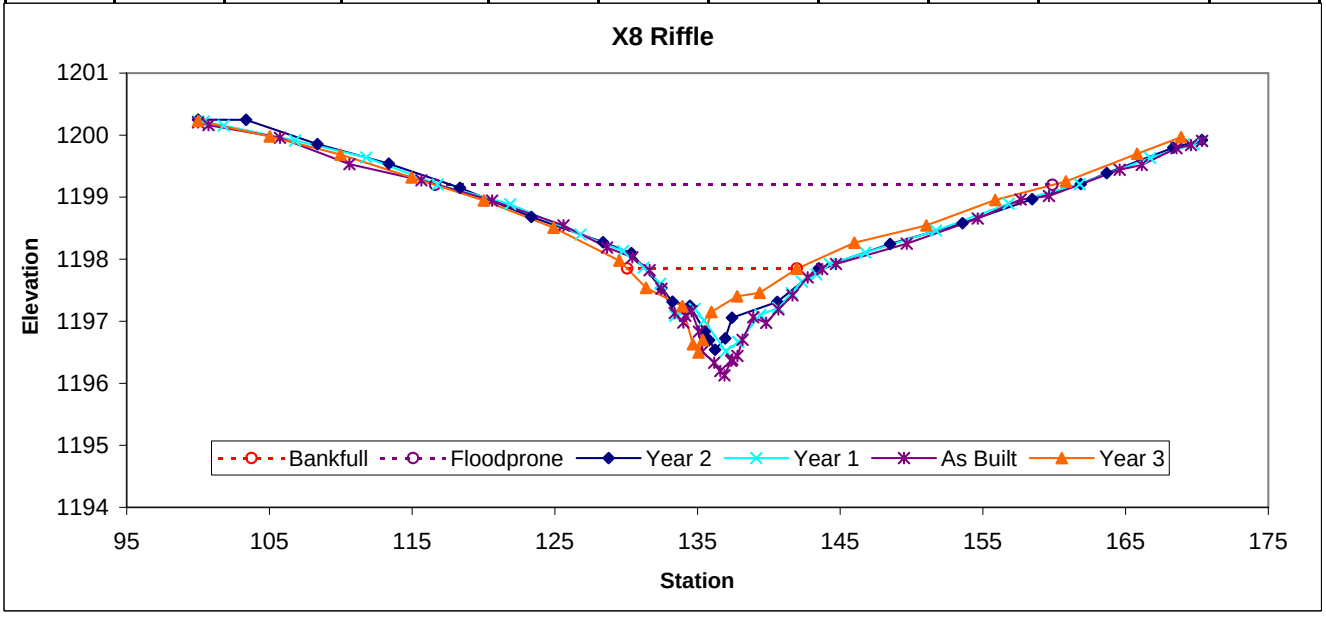
Permanent Cross Section X8

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

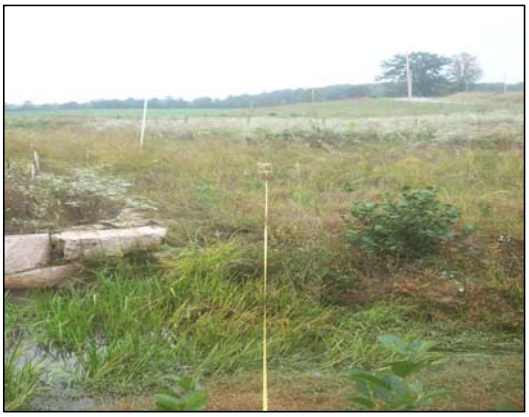
Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	5.7	11.89	0.48	1.35	24.94	1	3.6	1197.85	1197.85



Permanent Cross Section X9

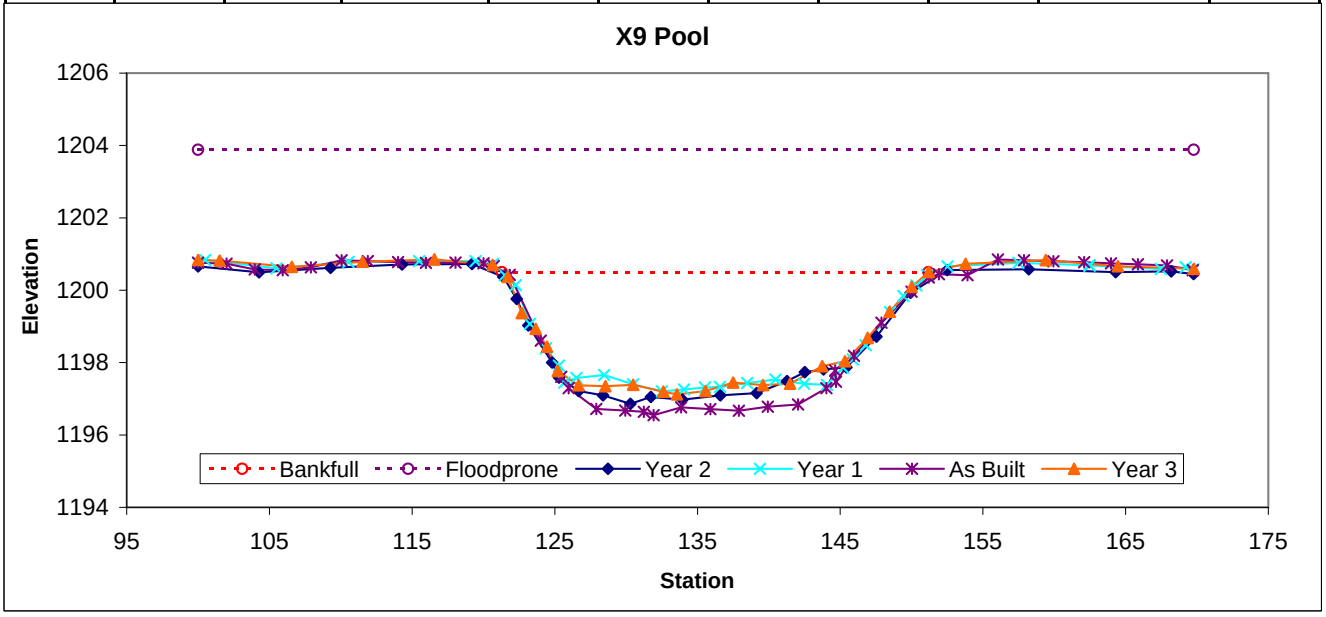
(Year 3 Monitoring Data - collected October 2008)



Looking at the Left Bank

Looking at the Right Bank

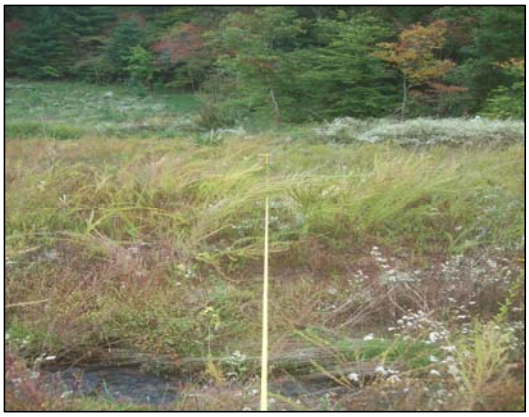
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		74.1	29.9	2.48	3.38	12.07	1		1200.5	1200.51



Permanent Cross Section X10

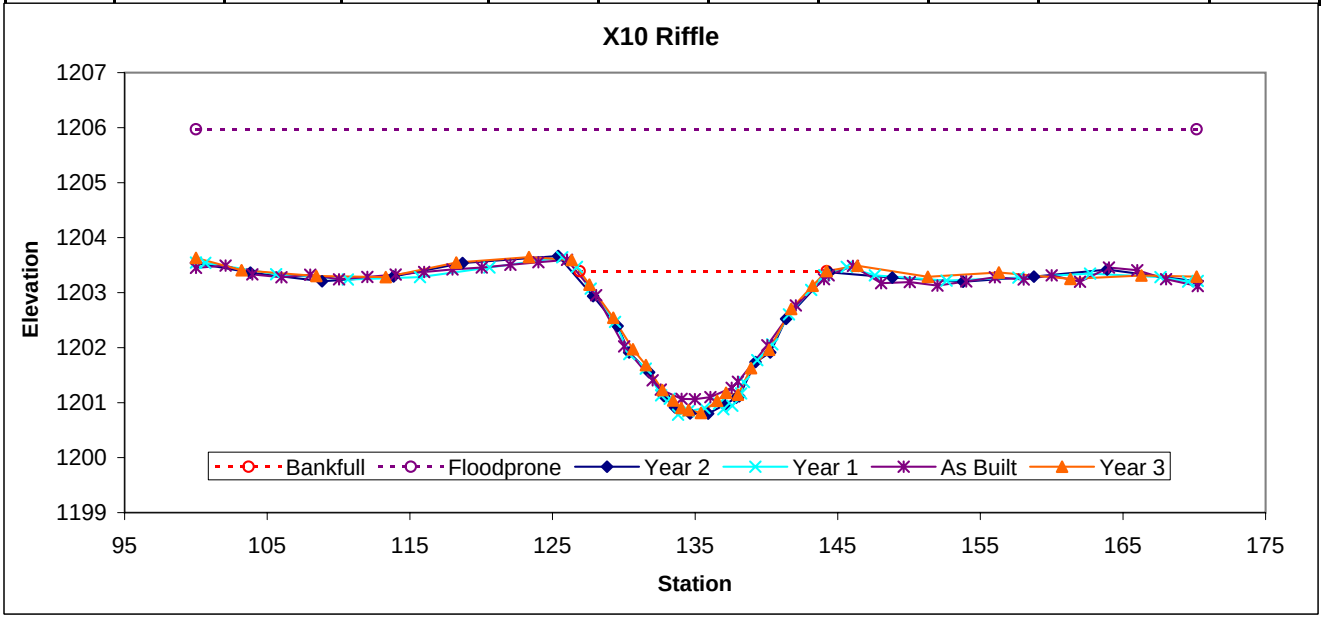
(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	25.2	17.32	1.46	2.58	11.88	1	4.1	1203.39	1203.39



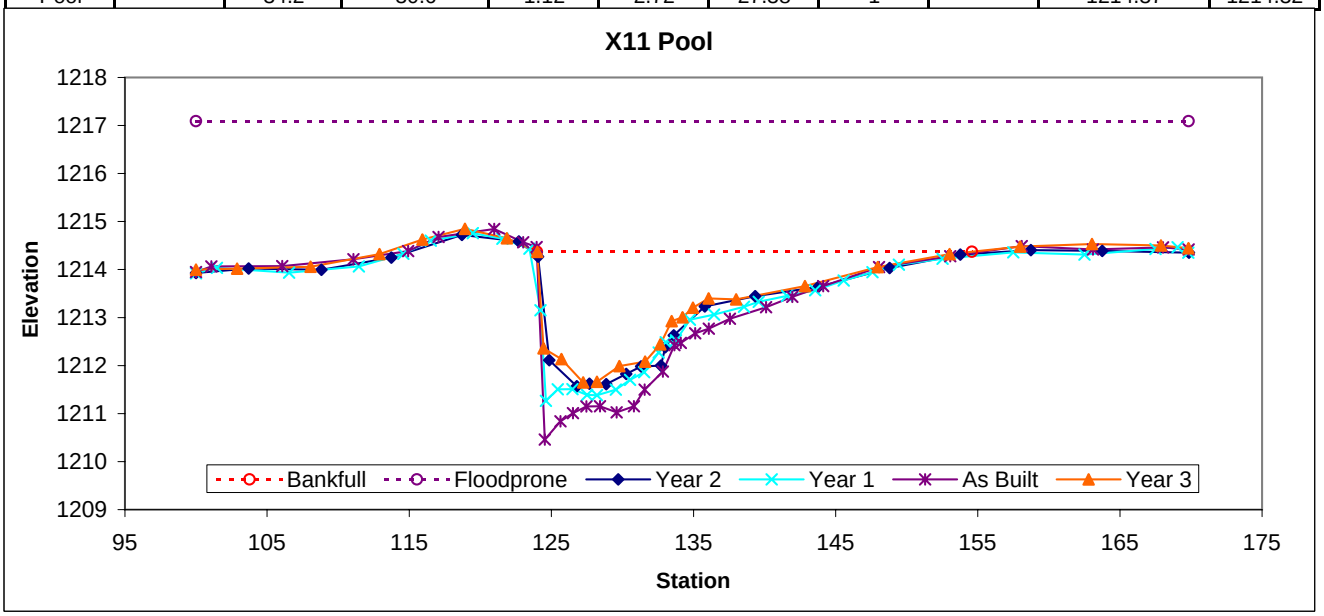
Permanent Cross Section X11

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		34.2	30.6	1.12	2.72	27.38	1		1214.37	1214.32



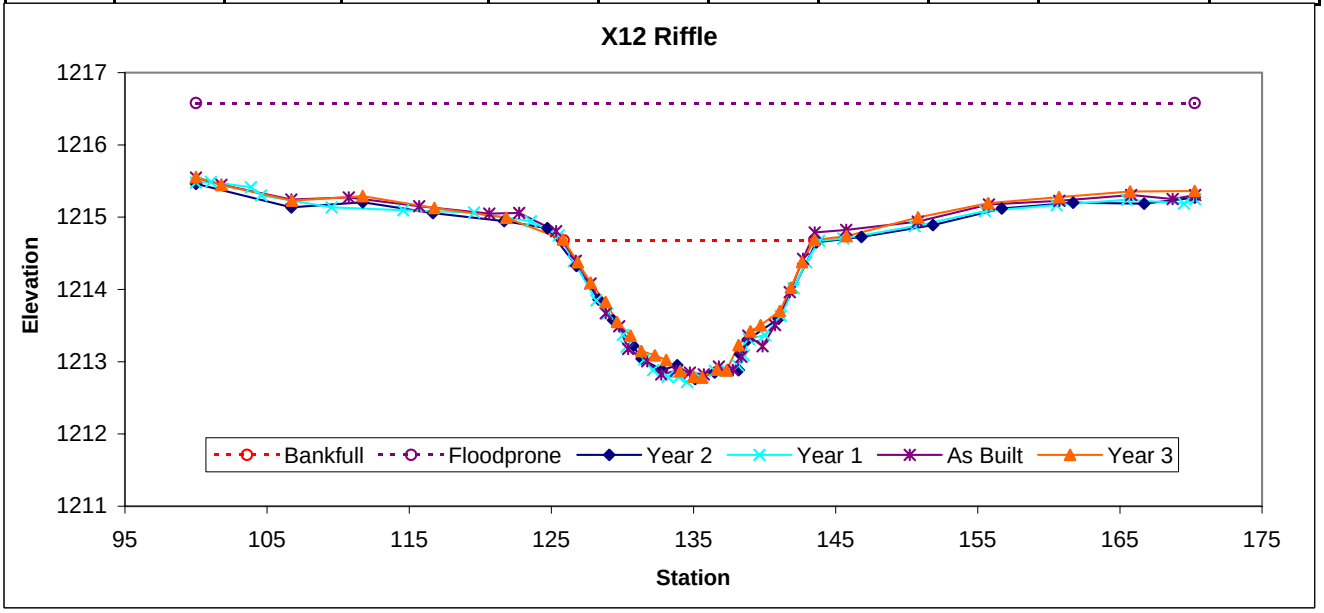
Permanent Cross Section X12

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

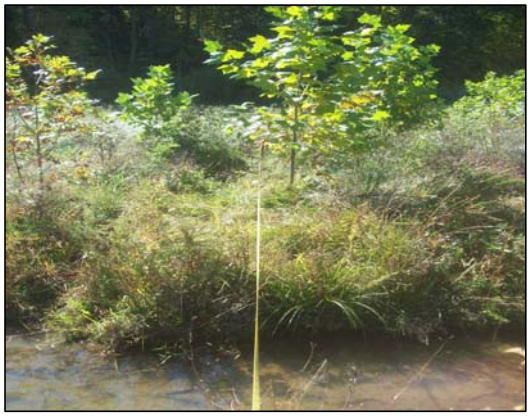
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	20.8	17.63	1.18	1.9	14.92	1	4	1214.68	1214.69



Permanent Cross Section X13

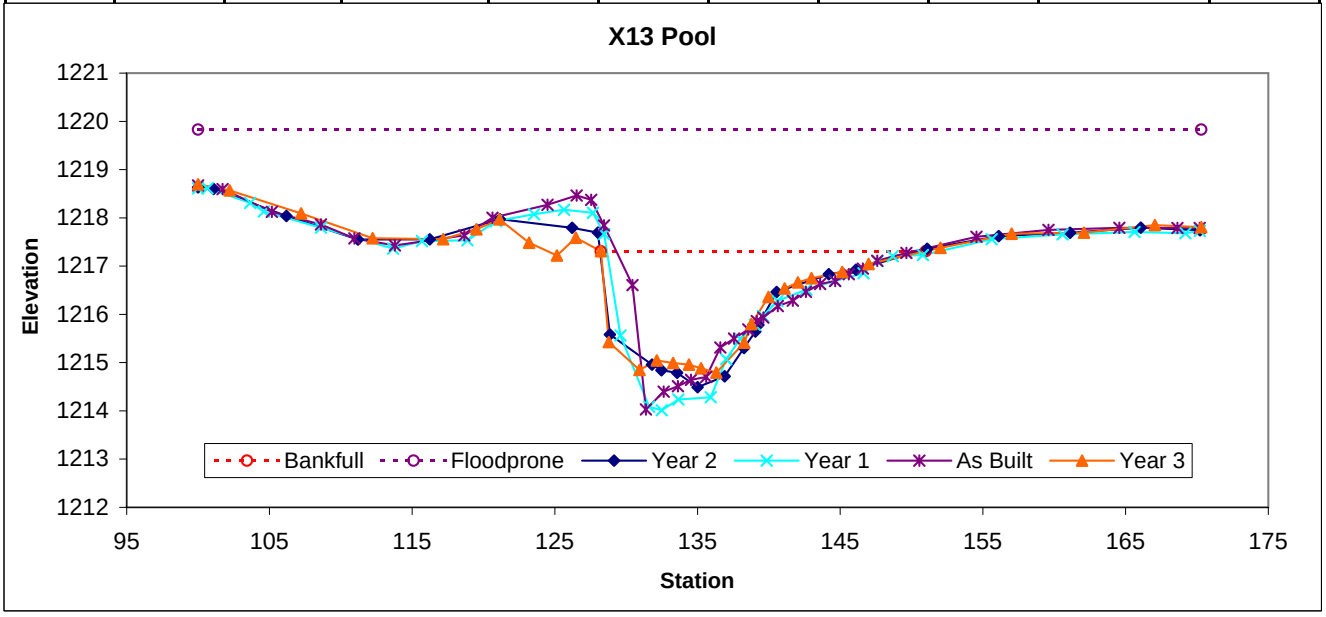
(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank



Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		29	22.78	1.27	2.52	17.87	1		1217.31	1217.31



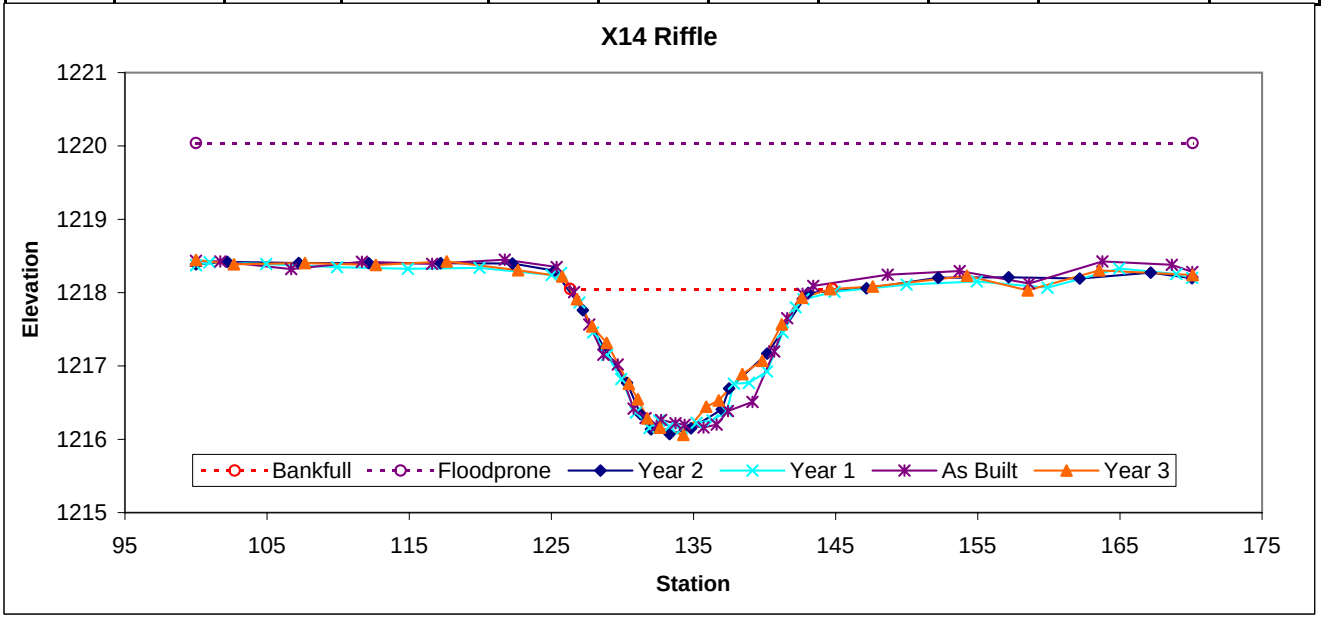
Permanent Cross Section X14

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	18.9	18.44	1.03	1.99	17.95	1	3.8	1218.05	1218.05



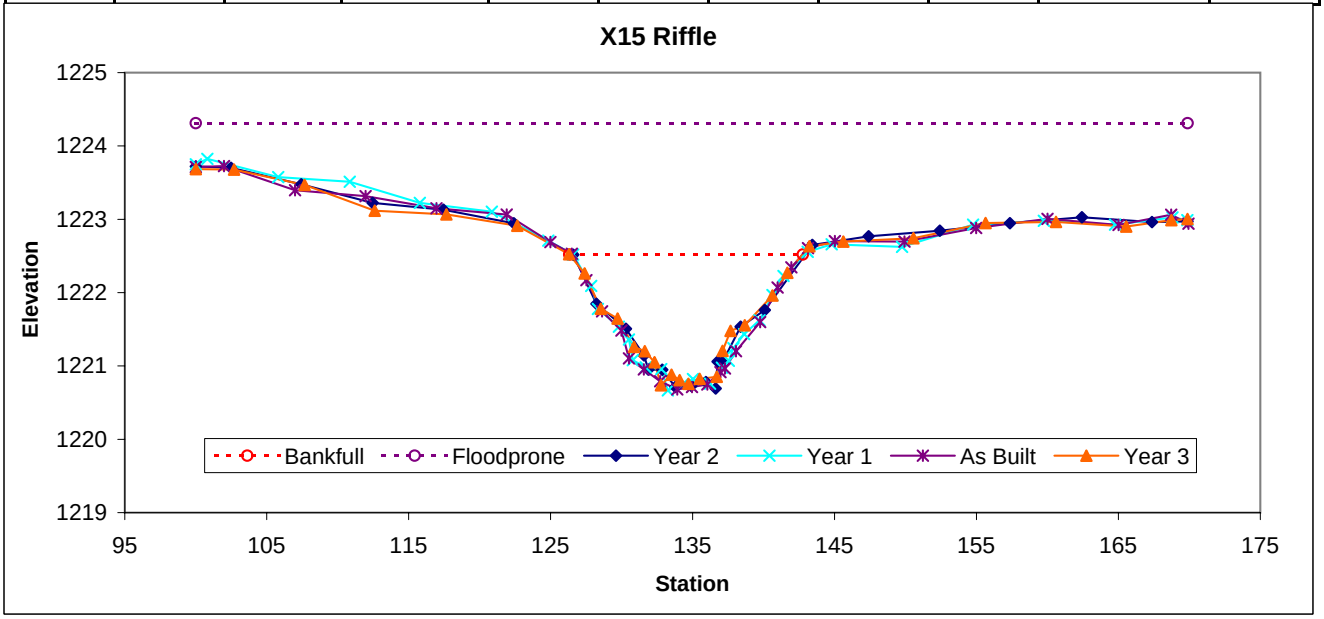
Permanent Cross Section X15

(Year 3 Monitroing Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	16.7	16.46	1.01	1.79	16.26	1	4.2	1222.52	1222.52



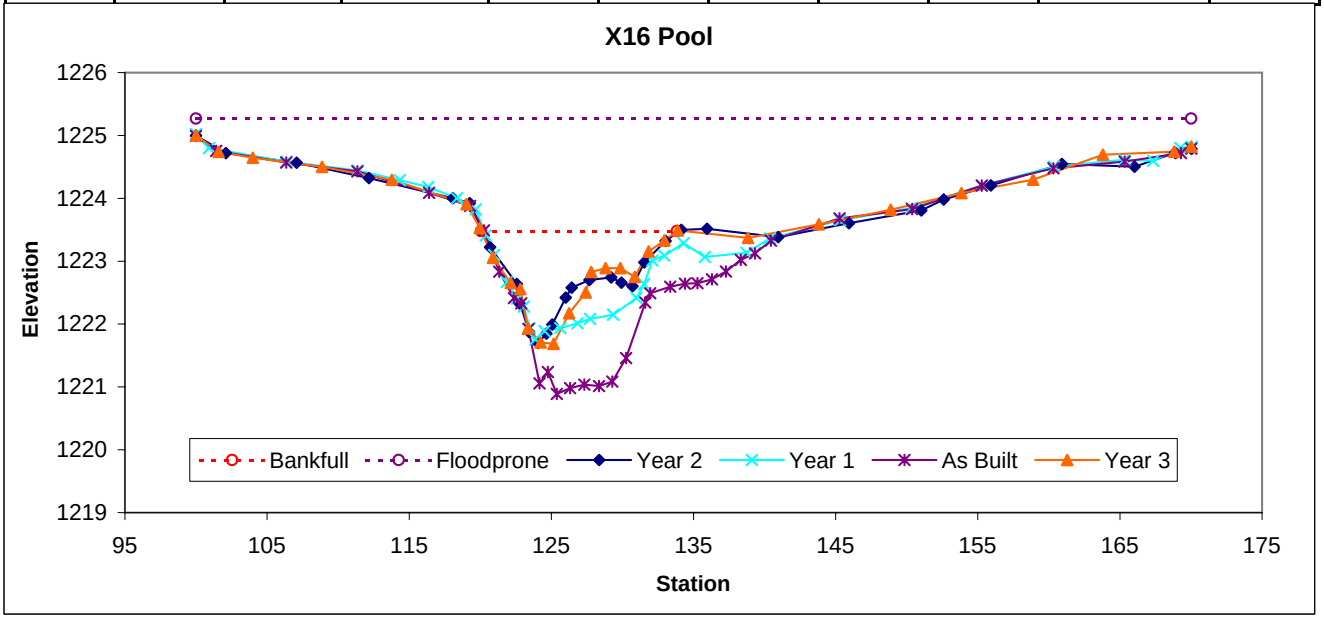
Permanent Cross Section X16

(Year 3 Monitoring Data - collected October 2008)

Looking at the Left Bank

Looking at the Right Bank

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Run		11.4	13.78	0.83	1.79	16.6	1		1223.48	1223.49



APPENDIX C

AS-BUILT PLAN SHEETS

PROJECT REFERENCE NO.	SHEET NO.
0224C	T1

PROJECT ENGINEER
CLY

APPROVED BY
EGR

DATE
06/30/2006

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Charlotte, NC 28203
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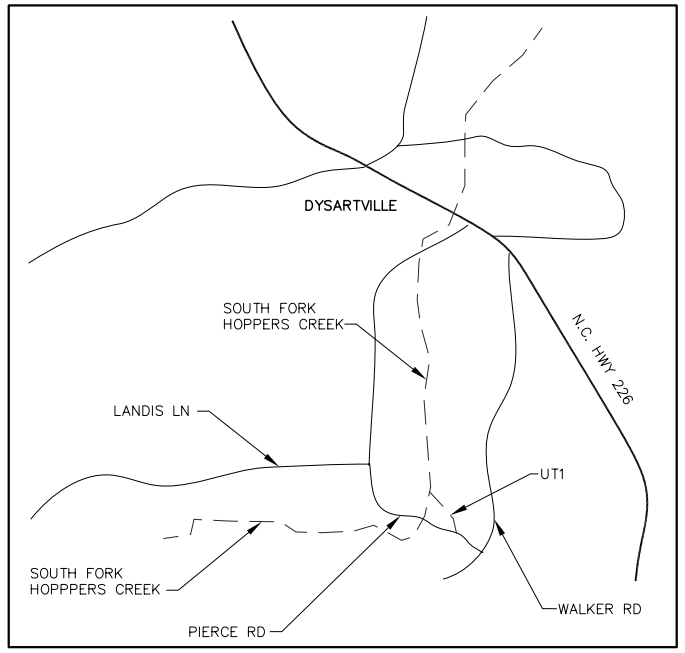


VICINITY MAP – NTS

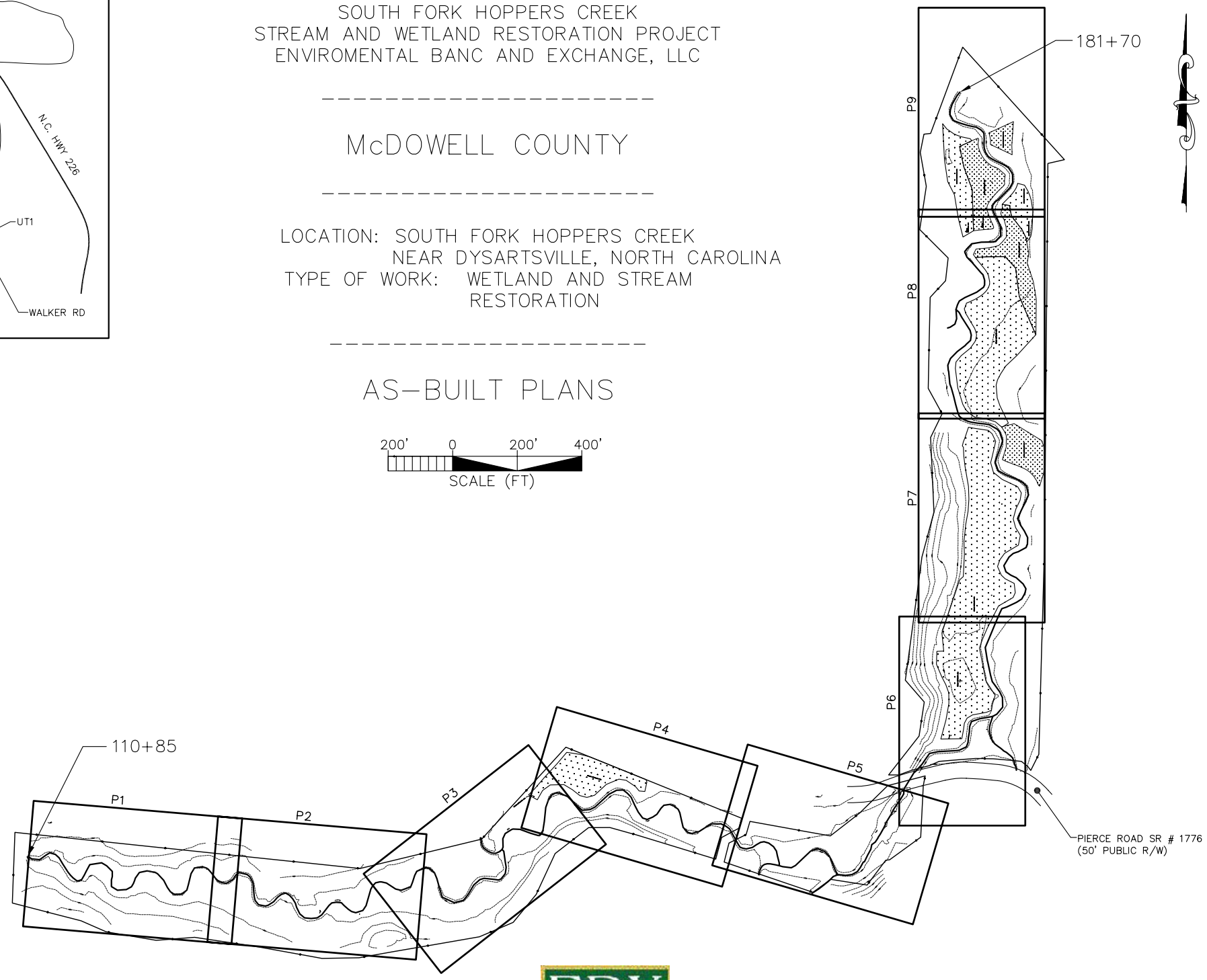
SOUTH FORK HOPPERS CREEK
STREAM AND WETLAND RESTORATION PROJECT
ENVIROMENTAL BANC AND EXCHANGE, LLC

McDOWELL COUNTY

LOCATION: SOUTH FORK HOPPERS CREEK
NEAR DYSARTSVILLE, NORTH CAROLINA
TYPE OF WORK: WETLAND AND STREAM
RESTORATION

AS–BUILT PLANS

200' 0 200' 400'
SCALE (FT)



INDEX OF SHEETS

NOTE:

1. PHOTO ID POINTS AND VEGETATION PLOTS LOCATED USING GPS
2. THESE PLANS WERE ORGINIIALLY SEALED ON 06/30/06 AND ARE PROVIDED WITH THIS MONITORING REPORT FOR REFERENCE ONLY.

EBX

PREPARED FOR THE OFFICE OF:
ENVIROMENTAL BANC AND EXCHANGE, LLC
2530 MERIDIAN PARKWAY, SUITE 200
DURHAM, NC 27713

EBX CONTACT:
THOMAS RINKER
PROJECT MANAGER

SOUTH FORK
HOPPERS AS–BUILT

TITLE SHEET

L:\Projects\0224C\Design\LD-0224-ASBUILT\dwg\PLANSHEETS.dwg Nov 12, 2007

PROJECT REFERENCE NO.	SHEET NO.
0224C	S1

PROJECT ENGINEER
CLY

APPROVED BY
EGR

DATE
06/30/2006

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LEGEND

110+00 — AS-BUILT THALWEG (STA 100+85 TO 181+70)

10+00 — DESIGN THALWEG ALIGNMENT (STA 10+85 TO 82+00)

900 — MAJOR (INDEX) CONTOUR

MINOR CONTOUR

CE — CONSERVATION EASEMENT

CONSERVATION EASEMENT FENCE

BAMBOO BARRIER

X12 CROSS SECTION — CROSS SECTION

ROOTWAD

CONSTRUCTED RIFFLE

PHOTO ID POINT

SURVEY CONTROL POINT

CROSS VANE

LOG VANE

VEGETATION TRANSPLANT

COVER LOG

BAMBOO TREATMENT AREA

VEGETATION PLOT

FORD STREAM CROSSING

WETLAND RESTORATION

WETLAND ENHANCEMENT

SOUTH FORK
HOPPERS AS-BUILT

SYMBOL SHEET

SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P2 – 119+50

BCP #220L
REBAR/CAP
N 673316.00
E 1146814.90
ELEV= 1230.97

VEG PLOT #10

PHOTO ID
POINT #64

LOG VANE

PHOTO ID
POINT #66

PHOTO ID
POINT #68

LOG VANE

BEGIN CONSTRUCTION
110+85

PHOTO ID
POINT #70

PHOTO ID
POINT #65

PHOTO ID
POINT #67

PHOTO ID
POINT #69

PHOTO ID
POINT #63

COVER LOG

COVER LOG

X15 CROSS SECTION

X16 CROSS SECTION

1240
1235
1230
1225
1220
1215
1210
1205
1200

19+00
18+00
17+00
16+00
15+00
14+00
13+00
12+00
11+00
11+85
110+85
119+00

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PROJECT ENGINEER	
CLY	
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EGR	
DATE	
06/30/2006	
SHEET NO.	PROJECT REFERENCE NO.
P1	0224C

PROJECT REFERENCE NO.	SHEET NO.
0224C	P2

PROJECT ENGINEER
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06/30/2006

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MATCHLINE – P1 – 119+50

MATCHLINE – P3 – 128+00

CONSERVATION EASEMENT FENCE

PHOTO ID POINT #61

PHOTO ID POINT #62

PHOTO ID POINT #59

PHOTO ID POINT #60

PHOTO ID POINT #57

PHOTO ID POINT #58

PHOTO ID POINT #55

PHOTO ID POINT #54

PHOTO ID POINT #56

COVER LOG

COVER LOG

COVER LOG

COVER LOG

X14 CROSS SECTION

VEG PLOT #9

BAMBOO TREATMENT AREA

BCP #2900
REBAR/CAP
N 677253.99
E 1147190.52
ELEV.= 1223.87

1225

1220

1225

120+00

121+00

122+00

123+00

124+00

125+00

126+00

127+00

128+00

21+00

22+00

23+00

24+00

26+00

27+00

28+00

30

30

30

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

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SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P4 – 135+75

MATCHLINE – P2 – 128+00

PHOTO ID
POINT #46

PHOTO ID
POINT #47

PHOTO ID
POINT #48

PHOTO ID
POINT #49

PHOTO ID
POINT #50

PHOTO ID
POINT #51

PHOTO ID
POINT #52

PHOTO ID
POINT #53

X11 CROSS SECTION

X12 CROSS SECTION

X13 CROSS SECTION

COVER LOG

LOG VANE

WETLAND RESTORATION AREA

BCP #2207
REBAR/CAP
N 677611.09
E 1147689.06
ELEV= 1216.11

BSP #2211
REBAR/CAP
N 677356.73
E 1147632.36
ELEV= 1218.48

1225
1220
1215

135+00
134+00
133+00
132+00
131+00
130+00
129+00
128+00
37+00
35+00
33+00
31+00
29+00

PROJECT REFERENCE NO.	022-4C
SHEET NO.	P3

PROJECT ENGINEER
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Fax: 704.334.4492

SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P5 – 143+50

MATCHLINE – P3 – 135+75

BAMBOO BARRIER

FORD STREAM CROSSING

ARCHEOLOGICAL
NON-DISTURBANCE AREA

PHOTO ID
POINT #41

PHOTO ID
POINT #43

PHOTO ID
POINT #45

PHOTO ID
POINT #44

PHOTO ID
POINT #42

PHOTO ID
POINT #40

COVER LOG

LOG VANE

VEG PLOT #7

VEG PLOT #8

AUTOMATIC WELL #5

WETLAND RESTORATION AREA

CONSERVATION EASEMENT FENCE

1220
1215
1210

142+00
42+00
141+00
41+00
140+00
40+00
139+00
38+00
138+00
37+00
137+00
36+00

BCP #2209
REBAR/CAP
N 677622.79
E 1148096.72
ELEV= 1213.05

PROJECT REFERENCE NO.	SHEET NO.
0224C	P4

PROJECT ENGINEER
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DATE
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PROJECT REFERENCE NO.	SHEET NO.
0224C	P5

PROJECT ENGINEER
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MATCHLINE – P6 – 151+80

MATCHLINE – P4 – 143+50

PIERCE ROAD SR # 1776
(50' PUBLIC R/W)

ARCHAEOLOGICAL
NON-DISTURBANCE AREA

FORD STREAM CROSSING

PHOTO ID
POINT #38

PHOTO ID
POINT #39

PHOTO ID
POINT #36

PHOTO ID
POINT #37

PHOTO ID
POINT #33

PHOTO ID
POINT #34

PHOTO ID
POINT #35

COVER LOG

COVER LOG

X10 CROSS SECTION

X9 CROSS SECTION

VEG PLOT #6

BCP #5963
REBAR/CAP
N 677453.68
E 1148706.25
ELEV.= 1206.05

BAMBOO BARRIER

BAMBOO BARRIER

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

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SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P7 – 159+20

MATCHLINE – P5 – 151+80

PIERCE ROAD SR # 1776
(50' PUBLIC R/W)

EXISTING 24" CMP

RAIN GAUGE

LOG VANE

BCP #2102
REBAR/CAP
N 6781777.31
E 1149316.15
ELEV.= 1199.02

MAIN TRIB: 54+92.30
END OF TRIB: 202+02.79

X8 CROSS SECTION

X7 CROSS SECTION

PHOTO ID
POINT #22

PHOTO ID
POINT #23

PHOTO ID
POINT #24

PHOTO ID
POINT #25

PHOTO ID
POINT #26

PHOTO ID
POINT #27

PHOTO ID
POINT #28

PHOTO ID
POINT #29

PHOTO ID
POINT #30

PHOTO ID
POINT #31

PHOTO ID
POINT #32

VEG PLOT #5

WETLAND RESTORATION AREA

1194.5

1197.0

PROJECT REFERENCE NO.	SHEET NO.
0224C	P6
PROJECT ENGINEER	
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APPROVED BY	
ECR	
DATE	
06/30/2006	

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PROJECT REFERENCE NO.	SHEET NO.
0224C	P7

PROJECT ENGINEER
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MATCHLINE – P6 – 159+20

MATCHLINE – P8 – 168+15

1215
1210
1205
1200
1195

1193.2

WETLAND RESTORATION AREA

AUTOMATIC WELL #4

1194.5

60+00

X6 CROSS SECTION

PHOTO ID POINT #20

62+00

LOG VANE

LOG VANE

160+00

61+00

161+00

PHOTO ID POINT #21

X5 CROSS SECTION

162+00

PHOTO ID POINT #19

LOG VANE

LOG VANE

VEG PLOT #4

1193.4

1192.8

64+00

PHOTO ID POINT #18

163+00

164+00

65+00

PHOTO ID POINT #17

165+00

64+00

PHOTO ID POINT #16

166+00

67+00

BCP #33
REBAR/CAP
N 678848.23
E 1149[illegible].83
ELEV.= 1190.89

PHOTO ID POINT #14

168+00

X3 CROSS SECTION

X4 CROSS SECTION

COVER LOG

COVER LOG

162+00

PHOTO ID POINT #15

WETLAND ENHANCEMENT AREA

30

30

SOUTH FORK
HOPPERS AS-BUILT

20' 0 20' 40'
SCALE (FT)

L:\Projects\0224C\Design\LD-0224-ASBUILT\dwg\PLANSHEETS.dwg Nov 12, 2007

SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P9 – 176+60

MATCHLINE – P7 – 168+15

WETLAND RESTORATION AREA
WETLAND ENHANCEMENT AREA
MONITORING WELL #1
CREST GAUGE
PHOTO ID POINT #7
VEG PLOT #2
AUTOMATIC WELL #2
MONITORING WELL #2
PHOTO ID POINT #8
PHOTO ID POINT #9
PHOTO ID POINT #10
PHOTO ID POINT #11
PHOTO ID POINT #12
PHOTO ID POINT #13
VEG PLOT #3
LOG VANE
1187.15
176+00
175+00
174+00
173+00
172+00
171+00
170+00
169+00
168+00
76+00
75+00
74+00
73+00
72+00
71+00
70+00
69+00
1190
1195
0611

PROJECT REFERENCE NO.	0224C
SHEET NO.	P8

PROJECT ENGINEER
CLY
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DATE
06/30/2006

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SOUTH FORK
HOPPERS AS-BUILT

SCALE (FT)
20' 0 20' 40'

MATCHLINE – P8 – 176+60

WETLAND RESTORATION AREA
WETLAND ENHANCEMENT AREA
WETLAND ENHANCEMENT AREA
WETLAND RESTORATION AREA
VEG PLOT #1
MONITORING WELL #3
AUTOMATIC WELL #1
PHOTO ID POINT #3
PHOTO ID POINT #4
PHOTO ID POINT #5
PHOTO ID POINT #6
PHOTO ID POINT #1
PHOTO ID POINT #2
BOP #2100 REBAR/CAP N 679762.49 E 1492818.06 ELEV= 1185.65
END CONSTRUCTION 181+70
X1 CROSS SECTION
X2 CROSS SECTION
176+00
177+00
178+00
179+00
180+00
180+60
181+00
181+70.04
80+00
82+00
84+00
1185
1186.3
1186.4
1185.4
1184.8

PROJECT ENGINEER	
CLY	
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EGR	
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06/30/2006	

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PROJECT REFERENCE NO.	SHEET NO.
0224C	P9

APPENDIX D

BASELINE STREAM SUMMARY FOR RESTORATION REACHES

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 1

Parameter	USGS Gauge		Regional Curve Interval			Pre-Construction Condition			Reference Reach(es) Data								
									Big Branch, NCDOT			Sals Branch, Clinton			Spencer Creek, Buck Eng.		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	7.0	26.0	24.4	-----	11.3	-----	19.3	-----	21.5	-----	8.7	-----	10.7	-----	11.2
Floodprone Width (ft)	96.3	-----	-----	-----	-----	-----	119+	-----	-----	130	-----	-----	N/A	-----	60	-----	114+
Bankfull Mean Depth (ft)	4.7	3.1	0.9	2.3	1.5	-----	2.0	-----	1.8	----	2.1	-----	1.2	-----	1.6	-----	1.8
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	-----	3.2	-----	2.5	----	2.7	-----	2.4	-----	2.1	-----	2.6
Bankfull Cross Sectional Area (ft2)	290.0	99.0	10.0	38.0	20.4	-----	22.2	-----	36.9	----	39.9	-----	10.4	-----	17.8	-----	19.7
Width/Depth Ratio	13.0	10.3	-----	-----	-----	-----	5.7	-----	----	10.6	----	-----	7.3	-----	5.8	-----	7.1
Entrenchment Ratio	1.6	-----	-----	-----	-----	-----	10.6	-----	----	6.4	----	-----	----	-----	5.5	-----	10.2
Bank Height Ratio	1.3	-----	-----	-----	-----	-----	1.4	-----	----	----	----	-----	----	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	----	----	----	-----	5.2	-----	4.9	-----	5.9
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	30.5	-----	44	10	-----	16	38.3	-----	40.8
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	42.3	-----	63.1	13.1	-----	29.6	10.9	-----	14.6
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	185	-----	260	-----	-----	-----	46	-----	48
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	----	1.83	----	-----	-----	-----	3.4	-----	3.6
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.015	-----	0.019	-----	0.0833	-----	-----	0.013	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	97.5	-----	179.8	35.5	-----	47	-----	77	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	<0.063 / 0.2 / 0.75 / 15 / 45			0.13 / 0.3 / 1.9 / 50 / 100			4.8 / N/A / 9.5 / 30 / N/A			<0.062 / 3 / 8.8 / 42 / 90		
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	-----	0.84	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	-----	2531	-----	-----	-----	-----	-----	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	0.74	-----	0.93	-----	-----	1.9	-----	-----	0.2	-----	-----	0.96
Rosgen Classification	C4	E	-----	-----	-----	-----	E4/5	-----	----	E4	----	-----	E4	----	-----	E4	-----
Bankfull Discharge (cfs)	1140	254	30	235	84	-----	102	-----	----	-----	----	-----	53.6	----	-----	97	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.0	-----	----	1.1	----	----	1.1	----	-----	2.3	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	0.009	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 1

Parameter	Design			As-built			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)		
Dimension - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	-----	16.0	-----	16.3	18.0	19.7	15.9	17.3	18.9	16.3	17.3	18.2	16.5	17.5	18.4
Floodprone Width (ft)	-----	35.2+	-----	69.9	70.1	70.3	69.9	70.1	70.3	69.9	70.1	70.3	69.9	70.1	70.3
Bankfull Mean Depth (ft)	-----	1.4	-----	1.1	1.3	1.4	1.1	1.2	1.5	1.1	1.3	1.5	1.0	1.2	1.5
Bankfull Max Depth (ft)	-----	2.0	-----	1.9	2.1	2.4	1.8	2.1	2.7	1.8	2.2	2.6	1.8	2.2	2.6
Bankfull Cross Sectional Area (ft2)	-----	22.0	-----	18.6	22.7	26.8	17.7	21.6	27.7	17.1	21.7	26.3	16.7	21.0	25.3
Width/Depth Ratio	10.0	-----	12.0	13.6	14.0	14.5	12.9	14.1	15.0	12.3	13.9	15.5	11.9	14.9	18.0
Entrenchment Ratio	-----	>2.2	-----	3.6	3.9	4.3	3.7	4.1	4.4	3.9	4.1	4.3	3.8	4.0	4.2
Bank Height Ratio	-----	1.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bankfull Velocity (fps)	-----	3.8	-----	-----	3.5	-----	-----	3.6	-----	-----	3.6	-----	-----	3.9	-----
Pattern															
Channel Beltwidth (ft)	56	-----	96	56	-----	96	56	-----	96	----	-----	-----	----	-----	-----
Radius of Curvature (ft)	32	-----	54.5	32	-----	55	32	-----	54.5	----	-----	-----	----	-----	-----
Meander Wavelength (ft)	112	-----	176	112	-----	176	112	-----	176	----	-----	-----	----	-----	-----
Meander Width Ratio	3.5	-----	6	3.5	-----	6.0	3.5	-----	6	----	-----	-----	----	-----	-----
Profile															
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	0.01	0.015	0.02	0.01	0.015	0.02	0.01	0.015	0.02	0.01	0.02	0.03	0.01	0.02	0.03
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	64	88	112	64	88	112	64	88	112	60	91	122	52	94	135
Substrate and Transport Parameters															
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.1-23 / 17-35 / 34-40 / 54-80 / 65-130			<0.063-9.5 / 0.32-27 / 0.9-44 / 44-125 / 58-160		
Reach Shear Stress (competency) lb/f2	-----	0.52	-----	-----	0.52	-----	-----	0.52	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters															
Channel length (ft)	-----	3665	-----	-----	3725	-----	-----	3725	-----	-----	2130	-----	-----	2164	-----
Drainage Area (SM)	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93	0.74	-----	0.93
Rosgen Classification	-----	C4	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----
Bankfull Discharge (cfs)	80	100	120	80	100	120	80	100	120	-----	-----	-----	-----	-----	-----
Sinuosity	-----	>1.2	-----	-----	1.5	-----	-----	1.5	-----	-----	1.4	-----	-----	1.4	-----
BF slope (ft/ft)	-----	0.005	-----	-----	0.005	-----	-----	0.005	-----	-----	0.008	-----	-----	0.008	-----

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 2, 3, & 4

Parameter	USGS Gauge		Regional Curve Interval			Pre-Construction Condition			Reference Reach(es) Data								
									Big Branch, NCDOT			Sals Branch, Clinton			Spencer Creek, Buck Eng.		
Dimension - Riffle	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	61.3	32.0	8.0	29.0	13.7	12.5	16.9	21.2	19.3	-----	21.5	-----	8.7	-----	10.7	-----	11.2
Floodprone Width (ft)	96.3	-----	-----	-----	-----	18.0	-----	150+	-----	130	-----	-----	N/A	-----	60	-----	114+
Bankfull Mean Depth (ft)	4.7	3.1	1.1	2.7	1.7	1.1	1.5	1.8	1.8	----	2.1	-----	1.2	-----	1.6	-----	1.8
Bankfull Max Depth (ft)	5.8	-----	-----	-----	-----	2.3	2.4	2.4	2.5	----	2.7	-----	2.4	-----	2.1	-----	2.6
Bankfull Cross Sectional Area (ft2)	290.0	99.0	14.0	52.0	26.7	20.4	23.1	25.7	36.9	----	39.9	-----	10.4	-----	17.8	-----	19.7
Width/Depth Ratio	13.0	10.3	-----	-----	-----	7.5	13.9	20.3	----	10.6	----	-----	7.3	-----	5.8	-----	7.1
Entrenchment Ratio	1.6	-----	-----	-----	-----	1.2	-----	>2.2	----	6.4	----	-----	----	-----	5.5	-----	10.2
Bank Height Ratio	1.3	-----	-----	-----	-----	1.0	1.6	2.2	----	----	----	-----	----	-----	-----	1.0	-----
Bankfull Velocity (fps)	3.9	2.6	-----	-----	-----	-----	-----	-----	----	----	----	-----	5.2	-----	4.9	-----	5.9
Pattern																	
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	30.5	-----	44	10	-----	16	38.3	-----	40.8
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	42.3	-----	63.1	13.1	-----	29.6	10.9	-----	14.6
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	185	-----	260	-----	-----	-----	46	-----	48
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	----	1.83	----	-----	-----	-----	3.4	-----	3.6
Profile																	
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.015	-----	0.019	-----	0.0833	-----	-----	0.013	-----
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	-----	-----	-----	97.5	-----	179.8	35.5	-----	47	-----	77	-----
Substrate and Transport Parameters																	
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	<0.063/0.17-3.5/0.36-5/10-40/17-128			0.13 / 0.3 / 1.9 / 50 / 100			4.8 / N/A / 9.5 / 30 / N/A			<0.062 / 3 / 8.8 / 42 / 90		
Reach Shear Stress (competency) lb/f2	-----	-----	-----	-----	-----	0.14	-----	0.94	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																	
Channel length (ft)	850	-----	-----	-----	-----	-----	-----	2742	-----	-----	-----	-----	-----	-----	-----	-----	-----
Drainage Area (SM)	25.7	7.2	-----	-----	-----	0.93	-----	1.38	-----	-----	1.9	-----	-----	0.2	-----	-----	0.96
Rosgen Classification	C4	E	-----	-----	-----	E4/5, G4/5c, C4			----	E4	----	-----	E4	----	-----	E4	-----
Bankfull Discharge (cfs)	1140	254	38	300	112.4	35	-----	118	----	-----	----	-----	53.6	----	-----	97	-----
Sinuosity	1.06	-----	-----	-----	-----	1.03	1.34	1.65	----	1.1	----	----	1.1	----	-----	2.3	-----
BF slope (ft/ft)	0.0025	0.0008	-----	-----	-----	0.0024	0.007	0.012	-----	-----	-----	-----	-----	-----	-----	-----	-----

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

South Fork Hoppers Creek Restoration Site - Mainstem Reach 2, 3, & 4

Parameter	Design			As-built			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)		
Dimension - Riffle	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Bankfull Width (ft)	-----	18.0	-----	16.6	17.3	18.1	14.4	19.4	23.7	15.6	18.3	21	15	18.4	21.8
Floodprone Width (ft)	----	39.6+	-----	69.6	69.7	69.9	69.8	70.0	70.4	69.8	70.1	70.4	69.7	70.1	70.4
Bankfull Mean Depth (ft)	-----	1.5	-----	1.1	1.2	1.3	1.0	1.2	1.3	1.0	1.2	1.3	1.0	1.1	1.3
Bankfull Max Depth (ft)	-----	2.3	-----	2.2	2.4	2.6	2.3	2.4	2.5	2.2	2.4	2.5	2.3	2.4	2.5
Bankfull Cross Sectional Area (ft2)	-----	27.0	-----	20.3	24.9	29.5	18.4	22.9	26.1	19.9	22.6	25.2	19.0	22.1	25.3
Width/Depth Ratio	-----	12.0	-----	12.7	15.2	17.7	11.3	16.7	23.1	12.2	16.4	20.6	11.9	17.1	22.4
Entrenchment Ratio	-----	>2.2	-----	3.1	3.6	4.2	3.0	3.8	4.8	3.4	3.9	4.5	3.2	3.9	4.7
Bank Height Ratio	-----	1.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Bankfull Velocity (fps)	-----	2.9	-----	-----	3.1	-----	-----	2.6	-----	-----	2.6	-----	-----	2.5	-----
Pattern															
Channel Beltwidth (ft)	63	-----	108	63	-----	108	63	-----	108	----	-----	----	----	-----	----
Radius of Curvature (ft)	36	-----	61.2	36	-----	61	36	-----	61	----	-----	----	----	-----	----
Meander Wavelength (ft)	126	-----	198	126	-----	198	126	-----	198	----	-----	----	----	-----	----
Meander Width Ratio	3.5	-----	6	3.5	-----	6.0	3.5	-----	6.0	----	-----	----	----	-----	----
Profile															
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Riffle Slope (ft/ft)	0.0045	0.00675	0.009	0.0045	0.00675	0.009	0.0045	0.00675	0.009	0.003	0.0065	0.010	0.006	0.008	0.010
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	72	99	126	72	99	126	72	99	126	58	93	128	63	96	128
Substrate and Transport Parameters															
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	-----	-----	<0.063-0.12 / 0.063-1.5 / 0.16-7.5 / 30-35 / 45-50			<0.063-0.18 / 0.22-8 / 27-36 / 53-55 / 64-80		
Reach Shear Stress (competency) lb/f2	0.25	-----	0.57	0.25	-----	0.57	0.25	-----	0.57	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters															
Channel length (ft)	-----	3,340	-----	-----	3,301	-----	-----	3,301	-----	-----	1,432	-----	-----	1,396	-----
Drainage Area (SM)	0.93	1.155	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38	0.93	-----	1.38
Rosgen Classification	-----	C4	-----	-----	C	-----	-----	C	-----	-----	C	-----	-----	C	-----
Bankfull Discharge (cfs)	80	100	120	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Sinuosity	-----	1.4	-----	-----	1.4	-----	-----	1.4	-----	-----	1.3	-----	-----	1.3	-----
BF slope (ft/ft)	-----	0.004	-----	0.003	-----	0.004	0.003	-----	0.004	----	0.007	----	----	0.004	----

APPENDIX E

MORPHOLOGY AND HYDRAULIC MONITORING SUMMARY – YEAR 3

South Fork Hoppers Creek Restoration Site : Project No. D04006-4																				
Reach: South Fork Hoppers Reach 1																				
I. Cross-Section Parameters	Cross Section 10 Riffle					Cross Section 11 Pool					Cross Section 12 Riffle					Cross Section 13 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	18.93	18.01	17.32			25.8	29.89	30.6			18.1	18.15	17.63			19.98	22.93	22.78		
Floodprone Width (ft)	70.24	70.22	70.17			69.81	69.85	69.83			70.29	70.26	70.26			70.2	70.22	70.3		
BF Cross Sectional Area (ft2)	27.68	26.27	25.25			38.8	35.29	34.2			22.71	21.75	20.84			30.69	31.55	29.05		
BF Mean Depth (ft)	1.46	1.46	1.46			1.29	1.18	1.12			1.25	1.20	1.18			1.54	1.38	1.27		
BF Max Depth (ft)	2.69	2.57	2.58			2.84	2.74	2.72			1.95	1.89	1.9			3.19	2.87	2.52		
Width/Depth Ratio	12.94	12.34	11.88			20.06	25.24	27.38			14.43	15.14	14.92			13	16.67	17.87		
Entrenchment Ratio	3.71	3.9	4.05			2.71	2.34	2.28			3.88	3.87	3.98			3.51	3.06	3.09		
Wetted Perimeter (ft)	21.85	20.93	20.24			28.38	32.25	32.84			20.6	20.55	19.99			23.06	25.69	25.32		
Hydraulic Radius (ft)	1.27	1.26	1.25			1.37	1.09	1.04			1.10	1.06	1.04			1.33	1.23	1.15		
Substrate																				
d50 (mm)	-	34	44			-	0.27	0.07			-	36	27			-	0.3	0.17		
d84 (mm)	-	80	125			-	0.9	0.7			-	55	44			-	0.52	0.65		

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	56	96	-	-	-	-	-	-	-						
Radius of Curvature (ft)	32	54.4	-	-	-	-	-	-	-						
Meander Wavelength (ft)	112	176	-	-	-	-	-	-	-						
Meander Width Ratio	3.5	6	-	-	-	-	-	-	-						
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-						
Riffle Slope (ft/ft)	0.01	0.02	0.015	0.01	0.03	0.02	0.01	0.03	0.02						
Pool Length (ft)	-	-	-	-	-	-	-	-	-						
Pool Spacing (ft)	64	112	88	60	122	91	52	135	94						
Additional Reach Parameters															
Valley Length (ft)	-	-	2527	-	-	1508			1508						
Channel Length (ft)	-	-	3725	-	-	2130			2164						
Sinuosity	-	-	1.47	-	-	1.4			1.4						
Water Surface Slope (ft/ft)	-	-	0.0068	-	-	0.0076			0.0076						
BF Slope (ft/ft)	-	-	0.005	-	-	0.0078			0.008						
Rosgen Classification	-	-	C	-	-	C			C						

South Fork Hoppers Creek Restoration Site : Project No. D04006-4																
Reach: South Fork Hoppers Reach 1 (Cont'd)																
I. Cross-Section Parameters	Cross Section 14 Riffle					Cross Section 15 Riffle					Cross Section 16 Pool					
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	
Dimension																
BF Width (ft)	15.92	16.71	18.44			16.33	16.29	16.46			13.68	14.01	13.78			
Floodprone Width (ft)	70.08	70.07	70.11			69.86	69.88	69.88			69.01	70.03	70.01			
BF Cross Sectional Area (ft2)	18.18	18.91	18.94			17.74	17.13	16.67			12.16	11.35	11.43			
BF Mean Depth (ft)	1.14	1.13	1.03			1.09	1.05	1.01			0.89	0.81	0.83			
BD Max Depth (ft)	1.76	1.93	1.99			1.85	1.82	1.79			1.53	1.8	1.79			
Width/Depth Ratio	13.94	14.77	17.95			15.03	15.49	16.26			15.39	17.29	16.6			
Entrenchment Ratio	4.4	4.19	3.8			4.28	4.29	4.24			5.04	5	5.08			
Wetted Perimeter (ft)	18.2	18.97	20.5			18.51	18.39	18.48			15.46	15.63	15.44			
Hydraulic Radius (ft)	1.00	1.00	0.92			0.96	0.93	0.90			0.79	0.73	0.74			
Substrate																
d50 (mm)	-	35	33			-	40	0.9			-	0.52	0.18			
d84 (mm)	-	54	54			-	60	52			-	7.5	0.85			

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

Reach: South Fork Hoppers Reach 2

I. Cross-Section Parameters	Cross Section 1 Riffle					Cross Section 2 Pool					Cross Section 3 Riffle					Cross Section 4 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension																				
BF Width (ft)	23.7	21	21.76			13.38	15.3	15.76			14.43	15.56	15.01			15.05	16.02	14.63		
Floodprone Width (ft)	70.42	70.42	70.41			69.95	70	69.69			69.83	69.9	69.77			69.88	69.9	69.92		
BF Cross Sectional Area (ft2)	24.2	21.46	21.19			17.17	18.68	19.34			18.41	19.9	18.98			19.07	21.2	19.27		
BF Mean Depth (ft)	1.0	1.02	0.97			1.28	1.22	1.23			1.28	1.28	1.26			1.27	1.32	1.32		
BF Max Depth (ft)	2.4	2.24	2.28			2.94	2.23	2.37			2.25	2.37	2.33			2.55	2.83	2.58		
Width/Depth Ratio	23.1	20.55	22.35			10.42	12.52	12.84			11.31	12.16	11.88			11.87	12.1	11.11		
Entrenchment Ratio	3.0	3.35	3.24			5.23	4.58	4.42			4.84	4.49	4.65			4.64	4.36	4.78		
Wetted Perimeter (ft)	25.71	23.04	23.7			15.94	17.74	18.22			16.99	18.12	17.53			17.59	18.66	17.27		
Hydraulic Radius (ft)	0.94	0.93	0.89			1.08	1.05	1.06			1.08	1.10	1.08			1.08	1.14	1.12		
Substrate																				
d50 (mm)	-	0.16	30			-	0.095	0.2			-	0.7	36			-	0.19	0.24		
d84 (mm)	-	0.35	54			-	0.35	0.75			-	34	55			-	15	11		

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (2010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	63	108	-	-	-	-	-	-	-						
Radius of Curvature (ft)	36	61.2	-	-	-	-	-	-	-						
Meander Wavelength (ft)	126	198	-	-	-	-	-	-	-						
Meander Width Ratio	3.5	6	-	-	-	-	-	-	-						
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-						
Riffle Slope (ft/ft)	0.005	0.009	0.007	0.003	0.02	0.011	0.006	0.01	0.008						
Pool Length (ft)	-	-	-	-	-	-	-	-	-						
Pool Spacing (ft)	72	126	90	58	128	93	63	128	96						
Additional Reach Parameters															
Valley Length (ft)	-	-	2447	-	-	1150	-	-	1150						
Channel Length (ft)	-	-	3301	-	-	1432	-	-	1396						
Sinuosity	-	-	1.35	-	-	1.25	-	-	1.2						
Water Surface Slope (ft/ft)	-	-	0.0047	-	-	0.0067	-	-	0.004						
BF Slope (ft/ft)	-	-	0.0035	-	-	0.0073	-	-	0.008						
Rosgen Classification	-	-	C	-	-	C	-	-	C						

Reach: South Fork Hoppers Reach 2 (cont'd)

I. Cross-Section Parameters	Cross Section 5 Riffle					Cross Section 6 Pool					Cross Section 9 Pool				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension															
BF Width (ft)	15.14	20.09	19.99			22.76	31.33	28.01			29.6	30.33	29.9		
Floodprone Width (ft)	69.77	69.8	69.73			70.52	70.5	70.51			69.71	69.76	69.78		
BF Cross Sectional Area (ft2)	26.1	25.2	25.28			50.2	51.22	46.36			74.07	75.57	74.07		
BF Mean Depth (ft)	1.37	1.25	1.26			1.79	1.63	1.66			2.42	2.49	2.48		
BF Max Depth (ft)	2.17	2.5	2.48			4.02	3.92	3.47			3.21	3.51	3.38		
Width/Depth Ratio	11.03	16.01	15.81			12.72	19.16	16.92			12.25	12.18	12.07		
Entrenchment Ratio	4.61	3.48	3.49			3.1	2.25	2.52			2.35	2.3	2.33		
Wetted Perimeter (ft)	17.88	22.59	22.51			26.34	34.59	31.33			34.44	35.31	34.86		
Hydraulic Radius (ft)	1.4597	1.1155	1.123			1.91	1.481	1.48			2.15	2.14	2.12		
Substrate															
d50 (mm)	-	7.5	27			-	0.15	0.2			-	0.32	0.38		
d84 (mm)	-	30	53			-	2	0.8			-	12	3		

South Fork Hoppers Creek Restoration Site : Project No. D04006-4

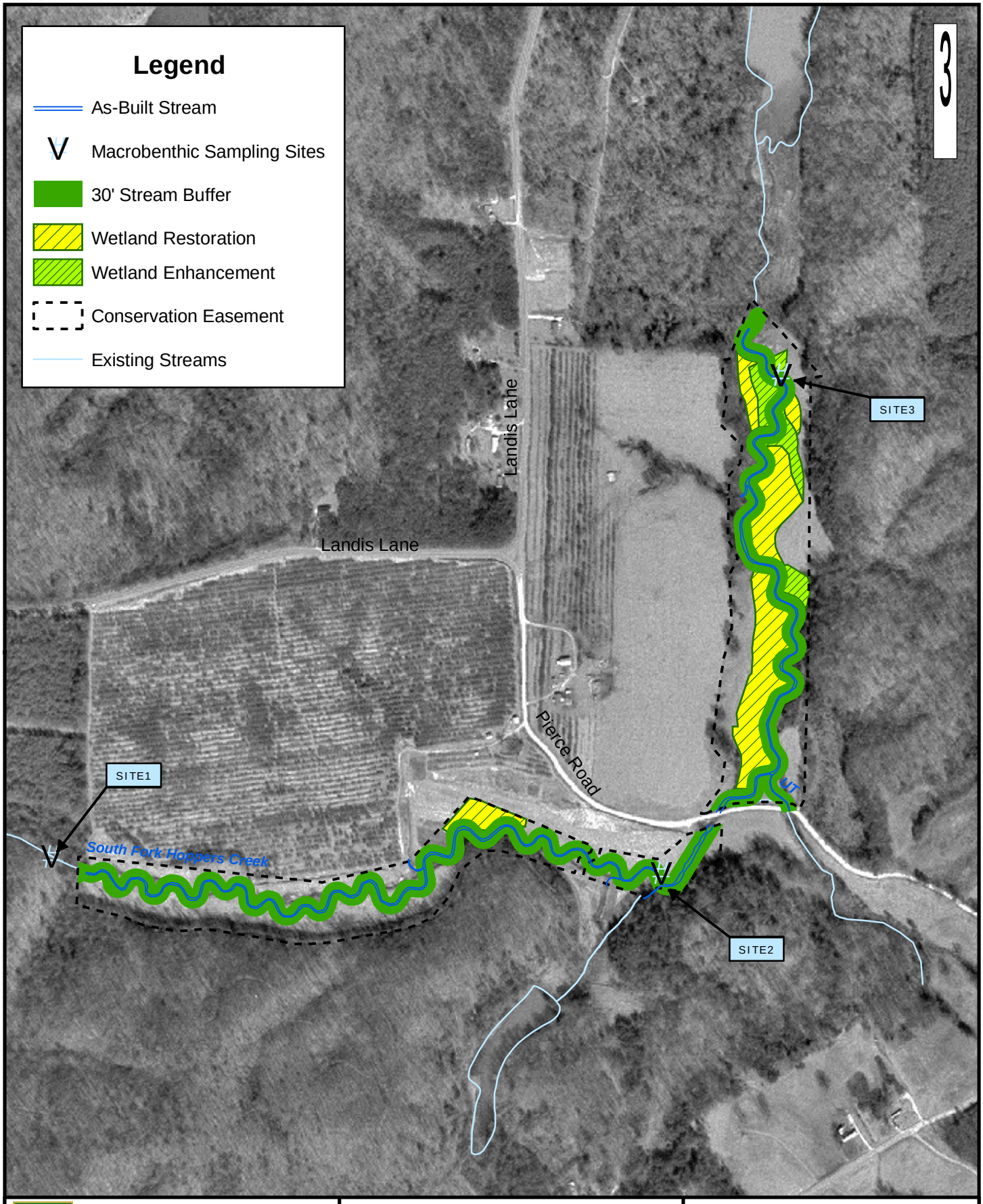
Reach: Unnamed Tributary 1 (UT1)

I. Cross-Section Parameters	Cross Section 7 Pool					Cross Section 8 Riffle				
	MY1	MY2	MY3	MY4	MY5	MY1	MY2	MY3	MY4	MY5
Dimension										
BF Width (ft)	11.4	11.3	11.1			13.4	12.2	11.9		
Floodprone Width (ft)	65.5	66.9	59.6			47.9	43.0	43.3		
BF Cross Sectional Area (ft2)	10.1	11.2	8.2			9.1	7.1	5.7		
BF Mean Depth (ft)	0.9	1.0	0.7			0.7	0.6	0.5		
BF Max Depth (ft)	1.9	2.0	1.5			1.4	1.3	1.4		
Width/Depth Ratio	13.0	11.3	14.9			19.6	20.9	24.9		
Entrenchment Ratio	5.7	6.0	5.4			3.6	3.5	3.6		
Wetted Perimeter (ft)	13.2	13.2	12.6			14.7	13.4	12.9		
Hydraulic Radius (ft)	0.8	0.8	0.7			0.6	0.5	0.4		
Substrate										
d50 (mm)	-	0.25	0.16			-	0.19	0.26		
d84 (mm)	-	0.9	0.33			-	0.8	0.8		

II. Reachwide Parameters	MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)			MY-5 (20010)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Pattern															
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-						
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-						
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-						
Meander Width Ratio	-	-	-	-	-	-	-	-	-						
Profile															
Riffle length (ft)	-	-	-	-	-	-	-	-	-						
Riffle Slope (ft/ft)	-	-	-	-	-	-	-	-	-						
Pool Length (ft)	8	15	12	-	-	-	-	-	-						
Pool Spacing (ft)	10	20	15	-	-	-	-	-	-						
Additional Reach Parameters															
Valley Length (ft)	-	-	179.3	-	-	-	-	-	-						
Channel Length (ft)	-	-	203	-	-	-	-	-	-						
Sinuosity	-	-	1.13	-	-	-	-	-	-						
Water Surface Slope (ft/ft)	-	-	0.0314	-	-	-	-	-	-						
BF Slope (ft/ft)	-	-	0.03	-	-	-	-	-	-						
Rosgen Classification	-	-	B	-	-	-	-	-	-						

APPENDIX F

BENTHIC MACROINVERTEBRATE MONITORING DATA



EBX Neuse-I, LLC
909 Capability Drive
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0 400 800 Feet

Figure 1. Benthic Macroinvertebrate Sampling Sites

South Fork Hoppers Creek

Year 2 - Benthos Data for South Fork Hoppers Creek Collected on February 21, 2008

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Reference 2/21/08	Site 2 U/S Hoppers 2/21/08	Site 3 D/S Hoppers 2/21/08
ANNELIDA					
Oligchaeta					
Lumbriculidae	**7.0**	**GC**			**R**
Naididae					
Slavinia appendiculata	**7.1**	**GC**			**R**
Stylaria lacustris	**9.4**	**GC**			**R**
Vejdovskyella comata	**N/A**	**GC**			**C**
Tubificidae					
Limnodrilus spp.	**9.5**	**GC**			**R**
Insecta					
Coleoptera					
Elmidae					
Optioservus spp.	**2.4**	**SC**	**A**	**R**	
Promoresia tardella	**0.0**	**SC**		**R**	
Ptilodactylidae					
Anchytarsus bicolor	**3.6**	**SH**	**R**		
Diptera					
Ceratopogonidae					
Palpomyia complex	**6.9**	**PR**	**R**		
Chironomidae					
Ablabesmyia mallochi	**7.2**	**OM**			**C**
Brillia spp.	**5.2**	**SH**	**R**		
Conchapelopia grp	**8.4**	**PR**			
Corynoneura spp.	**6.0**	**GC**	**R**	**C**	
Cricotopus bicinctus	**8.5**	**SH**		**R**	**C**
Eukiefferiella brehmi	**2.7**	**GC**	**R**		
Eukiefferiella brevicalar	**2.2**	**GC**		**A**	
Eukiefferiella claripennis	**5.6**	**GC**		**C**	
Euorthocladius spp.	**6.3**	**GC**		**R**	
Nanocladius spp.	**7.1**	**GC**		**R**	
Orthocladius nigritus	**0.4**	**GC**			**C**
Orthocladius obumbratus	**8.5**	**N/A**		**C**	**A**
Orthocladius rubicundus	**N/A**	**N/A**		**R**	**R**
Parametriocnemus lundbecki	**3.7**	**GC**	**A**		
Procladius spp.	**9.1**	**PR**			**C**
Potthastia longimana	**6.5**	**GC**	**R**		
Psectrocladius spp.	**3.6**	**GC**		**R**	**R**
Rheotanytarsus spp.	**5.9**	**FC**		**C**	
Synorthocladius spp.	**4.4**	**GC**			**R**
Paratanytarsus spp.	**8.5**	**GC**		**R**	
Tanytarsus spp.	**6.8**	**FC**			**R**
Micropsectra spp.	**1.5**	**GC**			**R**
Thienemanniella spp.	**5.9**	**GC**		**C**	

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Reference 2/21/08	Site 2 U/S Hoppers 2/21/08	Site 3 D/S Hoppers 2/21/08
Tvetenia bavarica gr.	**3.7**	**GC**		**C**	
Dixidae					
Dixa spp.	**2.6**	**GC**	**A**		
Simulidae					
Cnephia mutata	**4.0**	**N/A**		**R**	
Prosimulium spp.	**6.0**	**FC**	**R**	**A**	
Simulium spp.	**6.0**	**FC**		**C**	
Tipulidae					
Antocha spp.	**4.3**	**GC**		**C**	
Dicranota spp.	**0.0**	**PR**			**R**
Tipula spp.	**7.3**	**SH**	**C**		
Ephemeroptera					
Baetidae					
Acentrella spp.	**4.0**	**GC**	**C**	**C**	
Acentrella ampla	**3.6**	**N/A**		**C**	
Baetis flavistriga	**7.0**	**GC**		**C**	
Baetis hageni	**N/A**	**N/A**	**R**		
Baetis pluto	**4.3**	**N/A**		**C**	
Cloeon spp.	**6.6**	**OM**		**C**	**A**
Ephemerellidae					
Drunella walkeri	**1.0**	**N/A**	**R**		
Ephemerella dorothea	**6.0**	**N/A**	**VA**	**VA**	**R**
Ephemerella invaria	**2.4**	**N/A**		**A**	**R**
Serratella deficiens	**2.8**	**N/A**	**R**	**R**	
Heptageniidae					
Epeorus spp.	**1.3**	**SC**	**C**	**R**	
Stenacron spp.	**N/A**	**SC**	**R**		
Stenonema modestum	**5.5**	**SC**	**C**	**A**	**VA**
Stenonema pudicum	**2.0**	**N/A**	**A**	**C**	
Leptophlebiidae					
Leptophlebia spp.	**6.2**	**GC**			**C**
Paraleptophelbia spp.	**0.9**	**GC**	**R**		
Megaloptera					
Corydalidae					
Corydalus cornutus	**5.2**	**PR**		**C**	
Odonata					
Aeshnidae					
Boyeria vinosa	**5.9**	**PR**		**C**	**R**
Calopterygidae					
Calopteryx spp.	**7.8**	**PR**			**C**
Coenagrionidae					
Argia spp.	**8.2**	**PR**		**R**	**C**
Cordulegastridae					
Cordulegaster spp.	**5.7**	**PR**	**R**		**R**
Enallagma spp.	**8.9**	**PR**			**R**
Gomphidae					
Gomphus spp.	**5.8**	**PR**			**R**

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Reference 2/21/08	Site 2 U/S Hoppers 2/21/08	Site 3 D/S Hoppers 2/21/08
Hagenius brevistylus	**4.0**	**PR**			**R**
Ophiogomphus spp.	**5.5**	**PR**	**C**	**A**	
Macromiidae					
Macromia spp.	**6.2**	**PR**			**R**
Plecoptera					
Chloroperlidae					
Haploperla spp.	**N/A**	**N/A**	**R**		
Leuctridae					
Leuctra spp.	**2.5**	**SH**	**R**		
Nemouridae					
Amphinemura spp.	**3.3**	**SH**	**C**		
Prostoia spp.	**5.8**	**SH**		**R**	
Peltoperlidae					
Tallaperla spp.	**1.2**	**N/A**	**C**		
Perlidae					
Acroneuria abnormis	**2.1**	**PR**		**R**	
Eccoptura xanthenes	**3.7**	**N/A**	**R**		
Perlodidae					
Clioperla clio	**4.7**	**N/A**		**R**	**R**
Diploperla duplicata	**2.7**	**N/A**	**R**		
Isoperla bilineata	**5.4**	**N/A**	**C**		
Isoperla namata	**2.0**	**N/A**	**C**		
Isoperla simills	**0.2**	**N/A**	**R**		
Remenus bilobatus	**0.3**	**N/A**	**C**		
Pteronarcyidae					
Pteronarcys spp.	**1.7**	**SH**	**R**		
Trichoptera					
Glossosomatidae					
Glossosoma nigrior	**1.6**	**SC**		**C**	
Hydropsychidae					
Cheumatopsyche spp.	**6.2**	**FC**	**C**	**C**	**C**
Hydropsyche betteni	**7.8**	**FC**		**VA**	**R**
Symphitopsyche sparna	**2.7**	**N/A**		**C**	
Hydatophylax argus	**2.3**	**SH**	**R**		
Pycnopsyche spp.	**2.5**	**SH**	**R**		
Uenoidae					
Neophylax oligius	**2.2**	**N/A**		**R**	**R**
MOLLUSCA					
Gastropoda					
Lymnaeidae					
Pseudosuccinea columella	**7.7**	**SC**		**C**	
Physidae					
Physella spp.	**8.8**	**SC**		**C**	**R**
Pisidiidae					
Pisidium spp.	**6.8**	**FC**		**R**	
Pleuroceridae					
Elimia spp.	**2.5**	**SC**	**A**	**A**	**R**

SPECIES	Tolerance Values	Functional Feeding Group	Site 1 Reference 2/21/08	Site 2 U/S Hoppers 2/21/08	Site 3 D/S Hoppers 2/21/08
Total Taxa Richness			**39**	**48**	**36**
EPT Taxa Richness			**24**	**19**	**9**
Total Biotic Index			**3.91**	**5.56**	**6.91**
EPT Biotic Index			**3.31**	**4.93**	**5.85**
Dominant in Common Taxa				**41%**	**12%**

Notes: Tolerance Values: ranges from 0 (least tolerant to pollution) to 10 (most tolerant to pollution).
Functional Feeding Group: CG = Collector-Gatherer, FC = Filterer-Collector, OM = Omnivore, PR = Predator, SC = Scraper, SH = Shredder.
Abundance: R = Rare (1-2 individuals); C = Common (3-9 individuals); A = Abundant (10-30); VA = Very Abundant (>30).

P-1 Site 1 – reference site - looking upstream

P-2 Site 1 – reference site - looking downstream

P-3 Site 2 – looking upstream

P-4 Site 2 – looking downstream

P-5 Site 3 – looking upstream

P-6 Site 3 – looking downstream