South Muddy Creek Stream Restoration Project Final Baseline Monitoring Document and As-Built Baseline Report

McDowell County, North Carolina

NCEEP Project Numbers - 737 and 92251

SCO Project No. 050666701

South Muddy Creek

South Fork Hoppers Creek

Submitted to/prepared for:

NCDENR-EEP
1652 Mail Service Center
Raleigh, North Carolina 27699-1652
Phone: 919-715-0476
Fax: 919-715-2219

Data Collection Period: Fall 2010 – Spring 2011

Submission Date: June 30, 2011

South Muddy Creek Stream Restoration Project
Final Baseline Monitoring Document and As-Built Baseline Report

Report Prepared and Submitted by:

Baker

5550 Seventy – Seven Center Dr.
Ste. 320
Charlotte, NC 28217
(704) 665-2200
Fax: (704) 665-2201

Kristi R. Leadman Suggs
Project Manager

William Scott Hunt, III, PE
Project Engineer

Table of Contents

Appendices

1.0 EXECUTIVE SUMMARY

The South Muddy Creek Stream Restoration Project (Project) was restored by the North Carolina Ecosystem Enhancement Program (NCEEP). The Project restored, enhanced, and/or preserved 7,408 linear feet (LF) of stream and 1.56 acres of wetland in the South Muddy Creek Watershed in McDowell County, NC. The Project includes work at two sites: 2,787 LF of South Muddy Creek at Sain Road and 4,621 LF of South Fork Hoppers Creek and three tributaries (UT1, UT2, and UT3) at the Melton Farm. The sites are located within the Muddy Creek Local Watershed Plan (LWP), identified by the Muddy Creek Partnership, (NCDENR, 2003). Wetland activities consisted of the restoration of 1.23 acres and the enhancement of 0.33 acres adjacent to South Fork Hoppers Creek.

Both sites have been used historically for agriculture and South Fork Hoppers is currently being used as pasture for livestock grazing. South Muddy Creek was previously straightened and disconnected from the floodplain by channel incision. Excessive shear stress forces on the bed and banks had caused erosion. The South Fork Hoppers Creek and its tributaries have been impacted by livestock and were incised and eroded. Channel incision along South Fork Hoppers Creek resulted in the lowering of the water table; therefore, dewatering floodplain wetlands.

The Project goals for both sites were to restore each channel to geomorphically stable conditions, restore connectivity to the floodplain, improve water quality in the watershed, improve aquatic and terrestrial habitat, and protect the South Fork Hoppers Creek Watershed from nearby rapid development, and to restore wetlands in a Piedmont/Low Mountain Alluvial forest along South Fork Hoppers Creek. To accomplish these goals the Project objectives are outlined below for each site:

<u>South Muddy Creek</u>

- Excavate a wide floodplain bench and construct a new channel with stable dimension and pattern.
- Restore channel access to the floodplain during bankfull or larger storm events to increase hydrologic connections and alleviate erosive shear stresses.
- Incorporate bedform diversity with varied in-stream structures to provide a variety of aquatic habitats.
- Treat the floodplain for invasive species vegetation.
- Reestablish a native species vegetation riparian buffer to improve terrestrial habitat and eliminate excessive sedimentation from erosion.

<u>South Fork Hoppers Creek</u>

- Stabilize eroding channel banks by implementing a combination of Priority I restoration and Enhancement II.
- Increase floodplain connectivity to restore historic floodplain wetlands.
- Incorporate bedform diversity with varied in-stream structures to provide a variety of aquatic habitats.
- Reestablish a native species vegetation riparian buffer to improve terrestrial habitat and eliminate excessive sedimentation from erosion.
- Restore and enhance existing floodplain wetlands, where feasible.
- Eliminate livestock access to the channel to improve water quality and reduce erosion from hoof shear.

Each site's As-built condition closely mimics that proposed by the design. Differences are outlined below:

- Large storm events, during the construction phase, cause newly established riffles on South Muddy Creek to migrate downstream and fill pool areas. Therefore, at the end of construction, riffles

between Stations 25+25 and 31+50 were regraded to reduce riffle slope and to remove bed material from each pool increase pool depth,

- After the as-built survey was conducted along both South Muddy Creek and South Fork Hoppers Creek, geo-lifts and brush mattresses were installed, on some outer meander bends, to reduce bank erosion,
- After the As-built survey was conducted on South Muddy Creek, diversion ditches were installed along the perimeter of the spoil area to redirect excess flows into areas with erosion control matting, reduce erosion rilling, and promote site stabilization, and
- Bare root plantings of Sugarberry, Blackgum, and Swamp Chestnut Oak were replaced with Cherrybark Oak, American Hornbeam, and Easter Cottonwood due to lack of plant availability (See Section 4.3 – Vegetation Data for changes in planting density of revised list).

Bio-engineering measures, diversion ditches along the perimeter of the spoil area, and wetland gauges at stations 13+95 and 19+60 on South Fork Hoppers Creek were installed after the as-built surveys were conducted. Therefore, these structures are depicted on the record drawings as opposed to the As-built plans. Bioengineering measures need to be geographically located during the Year 1 Monitoring Period and submitted with the Year 1 Monitoring Report. Locations of the wetland gauges installed post-As-built survey were located during installation using a GPS locator to sub-meter accuracy. Location of the diversion ditches are not needed since they are not located within the conservation easement and will not be monitored.

This report documents the completion of the restoration construction and presents As-built monitoring data for the five-year monitoring period. Table 1 summarizes site conditions before and after restoration as well as the conditions predicted in the previously approved site restoration plan and is located in Appendix A.

2.0 PROJECT GOALS, BACKGROUND & ATTRIBUTES

2.1 Project Location and Description

The South Muddy Creek Stream Restoration Project (Project) is located in the Catawba River Basin near Marion, North Carolina. The Project lies within the NCDWQ sub-basin 03-08-30 and hydrologic unit 03050101040-020 (NCDENR, 2004). The Project includes work at two sites: the South Muddy Creek Site and the South Fork Hoppers Creek Site. Directions to these sites are outlined below.

South Muddy Creek Site

The South Muddy Creek Site is located approximately nine miles southeast of Marion in McDowell County, North Carolina, as shown in Figure 1 in Appendix A.

Driving directions to the South Muddy Creek Site are as follows.

- From I-40, take State Route 226 South (I-40 exit 86).
- Continue approximately 10 miles south.
  - Turn left onto Trinity Church Loop.
  - Turn left onto Dysartville Road. Continue approximately 1 mile.
  - Turn left onto Sain Road. Continue approximately 0.5 mile to the bridge at South Muddy Creek.

South Fork Hoppers Creek Site

The South Fork Hoppers Creek Site is located approximately 10 miles southeast of Marion in McDowell County, North Carolina, as shown in Figure 1 in Appendix A.

Driving directions to the South Fork Hoppers Creek Site are as follows.

- From I-40, take State Route 226 South (I-40 exit 86).
- Continue approximately 10 miles south.
  - Turn right onto Landis Lane. Continue approximately 1 mile. Bear right at a fork in the road to stay on Landis Lane. Continue approximately 2 miles.
  - The Melton Farm will be on the left, at sharp curve to the right.

Both South Muddy Creek and South Fork Hoppers Creek are classified by the NCDWQ as Class C waters (DWQ Index No. 11-32-2 and 11-32-2-9-1, respectively). Based on North Carolina's tributary rule, the tributaries would also be considered Class "C" waters (NCDENR, 2007). South Muddy Creek has seen improving water quality in the past monitoring cycle as demonstrated by the benthic macroinvertebrate Use Support rating increase from 'supporting but threatened' in 1998 to 'supporting' in 2004. However, the Catawba River Sub-basin Plan (NCDENR, 2004) continues to identify the Muddy Creek Watershed as impacted by excessive sediment loads and notes that this watershed is a prime candidate for restoration and enhancements. Figure 1 in Appendix A depicts the basin boundary and HUC for the Project sites.

South Muddy Creek and South Fork Hoppers Creek lie within the Piedmont physiographic province, as described by Medina et al. (2004), as "…consist(ing) of generally rolling, well-rounded hills and ridges with a few hundred feet of elevation difference between the hills and valleys." Characteristic of the Inner Piedmont Belt, the sites are comprised mainly of thinly layered mica and biotite gneiss. The geology within the South Muddy Creek is mapped as migmatitic granitoid gneiss that is described as medium- to coarse-grained, gray, thickly layered gneissic biotite granite to quartz diorite. The South Fork Hoppers Creek Site is mostly underlain by migmatitic granitoid gneiss with lesser amounts of schist, quartzite, and inequigranular biotite gneiss mapped along or close to the western edge of the South Fork Hoppers Creek Site in the vicinity of UT2 (Goldsmith, 1988).

Soil types were researched using Natural Resources Conservation Service (NRCS) soil survey data for McDowell County, along with on-site evaluations. The predominant soils within the floodplain area of the South Muddy Creek and South Fork Hoppers Creek sites consist of Hayesville clay loam, Hayesville-Evard Complex, and Iotla sandy loam (NRCS, 2009a and 2009b).

The South Muddy Creek Watershed is predominately forested, supporting some isolated rural residential housing, chicken farms, agricultural lands, nurseries, and several small rural residential developments. In the early 1960's the McDowell County NRCS constructed a flood control structure within South Muddy Creek approximately three miles upstream from the Project area. This structure controls flows from approximately 12.4 square miles of the watershed and is located on privately-owned land and is maintained by the NRCS. Within the Project area, the land surrounding the South Muddy Creek Site has been used predominantly for crop cultivation while South Fork Hoppers Creek Watershed is predominantly agricultural pasture with some forested land located in the upstream extents of UT1, UT2, and UT3.

South Muddy Creek is located in a Zone A of the regulatory FEMA floodplain, as indicated on Panel 1648 of the FEMA Flood Insurance Rate Map (FIRM) for McDowell County, NC - Community Number 370148 (NFIP). Due to potential hydrologic trespass issues, a Rosgen Priority 1 restoration was not feasible (Rosgen, 1994). The reach was too deeply incised to re-connect with its original floodplain without causing flooding upstream of the Project boundary; therefore, a Rosgen Priority 2 restoration approach was implemented along the reach (Rosgen, 1994). A Priority 2 design allowed the channel to remain at its existing elevation while alleviating shear stress through the excavation of bankfull benches. Because additional conveyance area was provided by the excavated benches, a "No-Impact" Certification was obtained for the design reach and was included in the Restoration Report. A Letter of Map Revision (LOMR) was obtained following construction at South Muddy Creek to show changes in the floodplain and non-encroachment area boundary shifts due to alignment changes of the creek. See Appendix C for a copy of the LOMR.

South Fork Hoppers Creek, nor its tributaries, within the Project site are located in a FEMA regulated floodplain and did not require any floodplain regulatory permits prior to construction.

2.2 Restoration Summary

2.2.1 Mitigation Goals and Objectives

The specific goals for the South Muddy Creek Stream Restoration Project were as follows:

- Create geomorphically stable conditions on both the South Muddy Creek Site and the South Fork Hoppers Creek Site,
- Improve and restore hydrologic connections between the streams and their floodplains,
- Improve water quality in the South Muddy and South Fork Hoppers Watersheds,
- Improve aquatic and terrestrial habitat along the Project corridor,
- Protect the South Fork Hoppers Creek Watershed from nearby rapid development, and
- Restore Piedmont/Low Mountain Alluvial forest wetlands along South Fork Hoppers Creek.

To accomplish these goals the Project objectives are outlined below for each site:

<u>South Muddy Creek Site</u>

- Excavate a wide floodplain bench and construct a new channel with stable dimension and pattern.
- Restore channel access the floodplain during bankfull or larger storm events to increase hydrologic connections and alleviate erosive shear stresses.
- Incorporate bedform diversity with varied in-stream structures to provide a variety of aquatic habitats.

- Treat the floodplain for invasive species vegetation.
- Reestablish a native species vegetation riparian buffer to improve terrestrial habitat and eliminate excessive sedimentation from erosion.

South Fork Hoppers Creek Site

- Stabilize eroding channel banks by implementing a combination of Priority I restoration and Enhancement II.
- Increase floodplain connectivity to restore historic floodplain wetlands.
- Incorporate bedform diversity with varied in-stream structures to provide a variety of aquatic habitats.
- Reestablish a native species vegetation riparian buffer to improve terrestrial habitat and eliminate excessive sedimentation from erosion.
- Restore and enhance existing floodplain wetlands, where feasible.
- Eliminate livestock access to the channel to improve water quality and reduce erosion from hoof shear.

The primary goal of the South Muddy Creek Stream Restoration Project was to create natural, geomorphically stable stream types that correlate to the existing valley type. The next goal was to improve and restore hydrologic connections between the streams and their floodplains. The final goals were to improve water quality and aquatic and terrestrial habitat throughout the Project areas. The project goals were achieved by providing stable channels using natural channel design with bankfull floodplain access throughout the Project site where applicable. In-stream habitat was enhanced through the creation of riffle-pool sequences and strategic placement of stream structures. Terrestrial habitat was enhanced through the planting of appropriate native species vegetation along the Project's riparian corridor. Therefore, these hydrologic, geomorphic, and habitat features working in combination will improve flood attenuation, reduce stormwater runoff, alleviate bank stresses and erosion, provide aeration of the water column and result in water quality improvements in the South Muddy Creek Watershed.

2.2.2 Projection Description and Restoration Approach

The Project consists of two location sites: South Muddy Creek Site and South Fork Hoppers Creek Site. The South Muddy Creek Site involved the restoration, solely, of South Muddy Creek, while the South Fork Hoppers Site involved the restoration, enhancement, and preservation of South Fork Hoppers Creek and three unnamed tributaries. In addition, the South Fork Hoppers Creek Site included the restoration and enhancement of a riparian wetland abutting South Fork Hoppers Creek and UT1.

Based on the post-construction As-built survey, restoration consisted of a total of 7,408 linear feet (LF) of stream channel. Restoration consisted of 2,787 LF on South Muddy Creek and 2,293 LF on South Fork Hoppers Creek and one of its unnamed tributaries. Enhancement II was implemented on 1,257 LF of UT1 and UT2, while 1,071 LF of Preservation was implemented on UT1 and UT3. A total of 1.56 acres of riparian wetland was restored and/or enhanced, 1.23 and 0.33 respectively.

Approximately 19.7 acres of associated riparian buffer were restored/enhanced throughout the Project area, while a conservation easement consisting of 27.2 acres will protect and preserve all stream reaches and riparian buffers in perpetuity.

For design purposes, South Muddy Creek, South Fork Hoppers Creek, and three unnamed tributaries to South Fork Hoppers Creek (UT1, UT2, and UT3) were divided into eight reaches (Figures 5 and 6, Appendix A). South Muddy Creek flows from southwest to northeast entering the site approximately 3,000 LF upstream of the bridge at Sain Road. The channel crosses Sain Road and continues for approximately 877 LF before flowing offsite. South Fork Hoppers Creek generally flows from west to east. South Fork Hoppers Creek Reach 1 begins at the western property boundary and ends at the confluence with UT1. South Fork Hoppers

Creek Reach 2 begins where Reach 1 ends and continues to eastern property boundary. UT1flows south to north and enters the site along the southern property boundary. UT1 Reach A begins at the southern property boundary, flows through a mature forested buffer and ends just before the channel enters the existing pasture. UT1 Reach A flows into Reach B and continues north to the confluence with South Fork Hoppers Creek. UT2 flows from northwest to southeast entering the site at the northwest corner. UT2 Reach A begins at the northwest property boundary and ends at the downstream end of the old hog lot. UT2B begins at the bottom of the old hog lot and continues to the confluence with South Fork Hoppers Creek.

A holistic restoration approach was based on the condition of the overall sites and each reach's potential for restoration as determined during the site assessment. Design criteria for the proposed stream concept were selected based on the range of the reference data and the desired performance of the proposed channel. The developed design criteria were then compared to past projects built with similar conditions. Ultimately, these sites provide the best pattern and dimension ratios because they reflect site conditions after construction. While most reference reaches are in mature forests, restoration sites are in floodplains with little or no mature woody vegetation. This lack of mature woody vegetation severely alters floodplain processes and stream bank conditions. If past ratios did not provide adequate stability or bedform diversity, they were not used. Conversely, if past project ratios created stable channels with optimal bedform diversity, they were incorporated into the design.

Following the initial application of design criteria, detailed refinements were made to accommodate the existing valley morphology, to avoid encroachment of the valley wall, and to minimize unnecessary disturbance to the existing riparian forest. The design philosophy employed at both of the Project sites was to use conservative design ratios and to allow the stream to evolve to values exhibited by reference reaches with mature bottomland hardwood forests. This evolution will occur over time with flooding and the establishment of permanent vegetation.

The overall restoration approach for the sites allows stream flows larger than bankfull flows to spread onto the floodplain, dissipating flow energies and reducing stress on streambanks. In-stream structures were used throughout all reaches to control streambed grade, reduce streambank stress, and promote bedform sequences and habitat diversity. The in-stream structures consist of root wads, log vanes, log weirs, cross vanes, j-hook vanes, and constructed riffles, which promote a diversity of habitat features in the restored channel. Where grade control was a consideration, constructed riffles, log weirs, and cross vanes were installed to provide long-term stability. Streambanks were stabilized using a combination of erosion control matting, temporary and permanent seeding, bare-root planting, brush mattresses, and geo-lifts. The sites were planted with native species vegetation as shown in Table 8 (Appendix D) and are protected through a permanent conservation easement. Table 1 and Figures 5 and 6 (Appendix A) provide a summary of the Project components.

2.2.3 Project History, Contacts, and Attribute Data

The South Muddy Creek and South Fork Hoppers Creek Sites were restored by Baker through an on-call design and construction services contract with NCEEP. The chronology of the 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. Tables 3 and 4 are located in Appendix A of this report. As-built stationing is outlined in the Construction Summary, below, and in Table 1 in Appendix A.

2.2.3.1 Construction Summary

In accordance with the approved restoration plan and permits, construction began with site preparation, installation of sediment and erosion control measures, and the establishment of staging areas, haul roads, and stockpile areas. Materials were stockpiled as needed for the initial stages of construction. The construction contractor, Carolina Environmental Contracting (CEC), began

construction activities simultaneously at the South Muddy Creek and South Fork Hoppers Creek Sites.

Construction along South Muddy Creek Site began with floodplain excavation and channel construction to design grades beginning at Station 10+00 and continuing downstream to Station 30+00 at the Sain Road crossing. The offline sections of the channel were the first stream segments to be constructed. After bank grading was complete, pump-around operations were installed as needed and followed by the installation of in-stream structures. Upon completion of work above Sain Road, CEC began floodplain grading and channel construction at Station 38+41 working upstream to Station 30+00. Excavated material was stockpiled in specified areas near existing channel sections that were to be filled. Excess excavated dirt was disposed on-site in designated areas as specified within the plan set. Two clean water ditches were installed on either side of the disposal area to divert runoff around the sediment laden area. Upon completion of stream work within the site, pump around operations, temporary stream crossings, in-stream rock check dams, and sediment and erosion control measures were removed and all disturbed areas were seeded and mulched before leaving the site.

Work along South Fork Hoppers Creek Site began with bank stabilization between Stations 14+00 and 18+00 on UT2 and grading of the wetland areas along South Fork Hoppers Creek. Channel construction began with offline meanders on Reach 1 (Station 10+00 to 17+83) of South Fork Hoppers Creek. After offline channel meanders were complete, pump-around operations were installed, as needed, followed by bank grading and in-stream structure installation along existing channel sections. Construction continued downstream along South Fork Hoppers, Reach 1 (Station 10+00 to 17+83) and Reach 2 (Station 17+83 to 22+44) per the approved design plans. In-stream structures varied slightly from plans in areas where bedrock was encountered. Floodplain excavation continued downstream in conjunction with channel work. Work along Reach 2 was halted at Station 21+20 at which point CEC began the construction of UT1B, working upstream from Station 20+85 to 10+00.

Between the time existing conditions data was collected (2007) and construction commenced (2010) the upper portion of UT2 (Station 10+00 to 13+79) experienced significant degradation that resulted in a steeper channel profile, and an adjoining ephemeral tributary experienced additional erosion issues. The design on UT2 was revised to include log drop structures at the downstream end of reach of the five riffles to hold grade and more efficiently and to dissipate energy, vertically, through the steep system, while a revised stabilization approach was implemented along the ephemeral tributary. The channel was filled and three boulder sills were installed across the fill to help stabilize the fill and to allow grade to drop quickly. Plunge pools armored with rip rap were placed at the base of each boulder sill to dissipate energy and a rip rap channel installed between sills.

Excavated material was stockpiled in specified areas near existing channel sections that were to be filled. Excess excavated dirt was disposed on-site in the old road bed and drainage swale fill areas. Upon completion of stream work within the site, pump around operations, temporary stream crossings, in-stream rock check dams, and sediment and erosion control measures were removed and all disturbed areas were seeded and mulched before leaving the site. CEC demobilized at the end of September 2010 as most construction items were complete except for the installation of geo-lifts, brush mattresses, and riparian and wetland plantings, which were scheduled to be completed during the dormant season.

CEC remobilized to the site in early December 2010 and began the installation of geo-lifts and brush mattresses. Extreme weather conditions and the holidays delayed the completion of the vegetative structure installations and hindered the establishment of vegetative cover upon disturbed areas. Geo-lifts and brush mattress installations and riparian and wetland plantings were complete in March

2011. Lack of established permanent vegetation in stockpile area led to the reinstallation and matting of diversion swales to reduce erosion. Diversion swales installations, stream work repairs, witness post installations, and reseeding of stockpile area were finalized in June of 2011. A final walk through of the site was conducted on June 22, 2011.

All riparian buffer areas within the Project boundaries are a minimum of thirty feet from the top of the stream bank and are protected in perpetuity by a conservation easement that totals 27.2 acres. Three stranded barbed wire was installed along both sides of the South Muddy Creek Site. High tensile smooth wire fencing was installed along both sides of South Fork Hoppers Creek, UT1B, and along the entire left side and most of the right side of UT2B. Fence locations are shown on the As-built plan sheets.

As-built plan sheets depict actual surveyed areas with the Project area while, the record drawing depicts any changes from the construction drawings to what was implemented on-site during construction. Both the As-built plan sheets and the record drawing are located in Appendix E. The As-built results for the Project, including restoration, enhancement, and preservation areas, totaled 7,408 LF of stream length and 1.56 of wetland acreage, are outlined in Table 1 of Appendix A.

3.0 MONITORING PLAN & SUCCESS CRITERIA

Channel stability, vegetation survival, and wetland hydrology will be monitored on the Project site. Post-restoration monitoring will be conducted for five years (geomorphic stream and floodplain vegetation components) to seven years (wetland components) following the completion of construction to document Project success.

3.1 Stream Monitoring

Geomorphic monitoring of restored stream reaches will be conducted for five years to evaluate the effectiveness of the restoration practices. Monitored stream parameters include bankfull flows, stream dimension (cross-sections), profile (longitudinal profile survey), channel stability (visual assessment), and photographic documentation. The methods used and any related success criteria are described below for each parameter. For monitoring stream success criteria, 10 permanent cross-sections, 2 crest gauges, 4 wetland gauges, and 59 photo identification points were established. The specific locations of these monitoring features are represented on either the As-built plan sheets or the record drawings in Appendix E.

3.1.1 Bankfull Events

The occurrence of bankfull events within the monitoring period will be documented by the use of crest gauges and photographs on each Project site. Two crest gauges were installed at top of bank along the restored channels. The bottom of each crest gauge coincides with the top of bank elevation. The crest gauges will record the highest watermark between site visits, and the gauge will be checked at each site visit to determine if a bankfull event has occurred. Rainfall data from the Marion automated weather station will be reviewed to corroborate on-site observations. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits.

Two bankfull flow events must be documented at the crest gauge within the 5-year monitoring period. The two bankfull events must occur in separate years; otherwise, the stream monitoring will continue until two bankfull events have been documented in separate years.

3.1.2 Cross-sections

Ten permanent cross-sections were installed throughout the entire Project area. Each Project reach has at least one riffle cross-section and one pool cross-section. Each cross-section was marked on both banks with permanent pins to establish the exact transect used. A common benchmark will be used for cross-sections and consistently referenced to facilitate comparison of year-to-year data. The annual cross-sectional survey will include points measured at all breaks in slope, including top of bank, bankfull, inner berm, water surface, and thalweg, if the features are present.

There should be little change in As-built cross-sections. If changes do take place, they will be evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio). Riffle cross-sections will be classified using the Rosgen Stream Classification System (Rosgen, 1994), and all monitored cross-sections should fall within the quantitative parameters defined for channels of the design stream type.

3.1.3 Longitudinal Profile

A longitudinal profile will be completed annually during each year of the monitoring period. At least 3,000 feet of channel, per project site, will be surveyed each year for the longitudinal survey. Measurements will include thalweg, water surface, left and right edge of channel, and left and right top of bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, run, pool, glide) and at the maximum pool depth. The survey will be tied to a permanent benchmark.

The longitudinal profiles should show that the bedform features are remaining stable (i.e., they are 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. Bedforms observed should be consistent with those observed for channels of the design stream type.

3.1.4 Bed Material Analysis

Reach-wide pebble counts were collected immediately after construction for stream classification of South Muddy Creek, South Fork Hoppers Creek Reach 1, South Fork Hoppers Creek Reach 2, and UT1 to South Fork Hoppers Creek. The data is provided in Appendix B. Pebble counts will be collected annually during post-restoration monitoring. Counts will be conducted for the permanent riffle cross-sections (100 counts per cross-section) on the project reaches. This data will be compared to known distributions from the existing conditions surveys. Results should indicate either maintenance of seeded bed material or a progression towards previous distributions. Constructed riffles were seeded with Class A, Class B, and Class 1 stone that range in size from 50 to 432 millimeters in diameter. Previous bed material distribution data is located in Table 6 of Appendix B.

3.1.5 Watershed Observations

As part of the post-construction monitoring following construction, any observed activities or changes in the watershed will be noted and connections to onsite observations will be drawn, where appropriate.

3.1.6 Photo Reference Sites

Photographs will be used to document restoration success visually. Reference stations will be photographed after construction and for five years (geomorphic stream and floodplain vegetation components) and seven years (wetland components) following construction. Reference photos will be taken once a year, from a height of approximately five to six feet. To ensure that the same locations are monitored photograph locations were field staked and located during the As-built survey. Efforts will be made to take clear photos by taking photos

on overcast days or during the early or latter portion of the day to minimize shadow and high contrast. Photographs taken at cross sections are provided in Appendix B, while structure photographs are shown in Appendix F. The location of each structure photo point is located on the As-built plan sheets in Appendix E.

3.1.6.1 Lateral Reference Photos

Reference photo transects will be taken at each permanent cross-section. Photographs will be taken of both banks at each cross-section. The survey tape will be centered in the photographs of the bank. The water line will be located in the lower edge of the frame, and as much of the bank as possible will be included in each photo. Photographers will make an effort to consistently document the same view in each photo point over time. Lateral photos should not indicate excessive erosion or continuing degradation of the banks.

3.1.6.2 Structure Photos

Representative photographs of the grade structures and a visual documentation of bank conditions will be conducted annually to evaluate channel stability along all constructed project reaches. All structure photos will be taken looking upstream towards the structure.

3.2 Vegetation Monitoring

Successful restoration of the vegetation on a mitigation site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. In order to determine if the criteria are achieved, a total of twenty-four vegetation monitoring quadrants, twelve at the South Muddy Creek Site and twelve at the South Fork Hoppers Site, were installed as directed by NCEEP monitoring guidance. The total number of quadrants was calculated using the CVS-NCEEP Entry Tool Database version 2.2.7 (CVS-NCEEP, 2007). The size of each quadrant is 100 square meters for woody tree species. Vegetation monitoring will occur in the fall, prior to the loss of leaves. Individual quadrant data will be provided and will include species composition, density, and survivability. Individual seedlings will be marked to ensure that they can be found in subsequent monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first growing season, species composition, diameter, height, density, and survival will be evaluated (Lee, et al., 2007). For each subsequent year, until the final success criteria are met, each site will be evaluated between June and November.

The interim measure of vegetative success for the site will be the survival of at least 320, three-year-old, planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criterion will be the survival of 260, five-year old, planted trees per acre at the end of Year 5 of the monitoring period. While measuring species density is the current accepted methodology for evaluating vegetation success on restoration projects, species density alone may be inadequate for assessing plant community health. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices to assess overall vegetative success.

Herbaceous vegetation, primarily native grasses, were planted at the site shall have at least 80 percent coverage of the seeded/planted area. Evaluation of the herbaceous vegetation will occur annually at the same time as monitoring of the vegetation quadrants is performed. Any herbaceous vegetation not meeting these criteria will be evaluated to determine if replanting or other remediation is necessary and written recommendations will be provided to EEP. At a minimum, at all times ground cover at the Project sites shall be in compliance with the North Carolina Erosion and Sedimentation Control Ordinance (NCDENR, NCSCD, and NCAES, 2006).

3.3 Wetland Monitoring

Groundwater monitoring stations were installed in the wetland restoration area to document hydrologic conditions of the restored site. Four automated groundwater monitoring stations were installed at the South Fork Hoppers Creek site (See Figure 4 for locations). Groundwater monitoring stations will follow the USACE standard methods found in WRP Technical Notes ERDC TN-WRAP-00-02 (July 2000).

In order to determine if the rainfall is normal for the given year, rainfall amounts will be tallied using data obtained from the Marion automated weather station, located approximately 12 miles northwest of the Project site.

The monitoring data should show that the site has been saturated within 12 inches of the soil surface for at least 9% of the growing season as indicated by the DRAINMOD model and that the site has exhibited an increased frequency of flooding. Baker used DRAINMOD (version 5.1) to develop hydrologic simulation models that represented conditions at a variety of locations across the restoration area. DRAINMOD indicated wetland hydrology would occur for approximately 6-12% of the growing season. The mean value of the DRAINMOD outputs, 9% will be used for success criteria. Additional hydrologic modeling information can be found in the Sections 5.4 and 8.2 of the Restoration report.

3.4 Maintenance and Contingency Plan

Maintenance requirements vary from site to site and are generally driven by the following conditions:

- Projects without established, woody floodplain vegetation are more susceptible to erosion from floods than those with a mature, hardwood forest.
- Projects with sandy, non-cohesive soils are more prone to bank erosion than cohesive soils or soils with high gravel and cobble content.
- Alluvial valley channels with access to their floodplain are less vulnerable to erosion than channels that have been disconnected from their floodplain.
- Wet weather during construction can make accurate channel and floodplain excavations difficult.
- Extreme and/or frequent flooding can cause floodplain and channel erosion.
- Extreme hot, cold, wet, or dry weather during and after construction can limit vegetation growth, particularly temporary and permanent seed.
- The presence and aggressiveness of invasive vegetation species can affect the extent to which a native species vegetation buffer can be established.
- The presence of beaver can affect vegetation survivability and stream function.

Maintenance issues and recommended remediation measures will be detailed and documented in the monitoring reports. Factors that may have caused any maintenance needs, including any of the conditions listed above, shall be discussed. NCEEP approval will be obtained prior to any remedial action.

4.0 MONITORING RESULTS – 2010 AS-BUILT DATA

Stream and vegetation components will be monitored for five years post-construction to evaluate success. Wetlands at the South Fork Hoppers site will be monitored for seven years post-construction. The specific locations of vegetation plots, permanent cross-sections, crest gauges, and wetland gauges are shown on the

As-built plan sheets. Photo points, located at each of the structures along the restored stream channel, are also located on the As-built plan sheets in Appendix E.

4.1 Stream Data

For monitoring stream success criteria, 10 permanent cross-sections, 2 crest gauges, and 59 photo identification points were installed throughout the Project area. The permanent cross-sections will be used to monitor channel dimension and bank stability over time. The crest gauges will be used to document the occurrence of bankfull events. In addition, a longitudinal survey was completed for the restored stream channels to provide a base-line for evaluating changes in bed conditions over time. The longitudinal profile included the elevations of all grade control structures. The As-built permanent cross-sections (with photos) and As-built longitudinal data as well as the quantitative pre-construction, reference reach, and design data used to determine restoration approach are provided in Appendix B. The locations of the permanent cross-sections and the crest gauges are shown on the As-built plan sheets in Appendix E. Photographs are provided in Appendix F.

4.1.1 Results and Discussion

Bio-engineering measures were installed after the As-built surveys were conducted. Therefore, these structures are depicted on the record drawings as opposed to the As-built plans. Bioengineering measures need to be geographically located during the Year 1 Monitoring Period and submitted with the Year 1 Monitoring Report.

No results were available at the submittal of this report. As-built data will be compared with first year monitoring data in the Year 1 Monitoring Report, scheduled for submittal to NCEEP during December 2012.

4.2 Hydrology Data

The restoration plan specifies that four monitoring gauges would be established across the restored site. Two gauges were installed in September 2010 and two more in April 2011 document water table hydrology in all required monitoring locations. Since two of the gauges were installed after the As-built surveys were conducted, the locations of these structures were collected with sub-meter accuracy GPS unit and are depicted on the record drawings as opposed to the As-built plans.

4.2.1 Results and Discussion

No results were available at the submittal of this report. As-built data will be compared with first year monitoring data in the Year 1 Monitoring Report, scheduled for submittal to NCEEP during December 2012.

4.3 Vegetation Data

Bare-root trees and shrubs were planted within restoration and enhancement areas of the conservation easement. A minimum 30-foot buffer was established along all stream reaches. In general, bare-root vegetation was planted at a target density of 680 stems per acre, in an 8-foot by 8-foot grid pattern. Planting of bare-root trees and shrubs were completed in March 2011. Species planted are summarized in Tables 8 and 9 in Appendix D.

The restoration plan for the site specifies that the number of quadrants required is based on the CVS-NCEEP monitoring guidance. The total number of quadrants was calculated using the CVS-NCEEP Entry Tool Database version 2.2.7 (CVS-NCEEP, 2007). The sizes of individual quadrants are 100 square meters. A total of 24 vegetation plots, 12 at each site were installed. Each plot measures 10 meters by 10 meters in size. The initial planted density within each of the vegetation monitoring plots is given in Table 9. The average

density of planted bare root stems, based on the data from the 24 monitoring plots, is 690 stems per acre. The locations of the vegetation plots are shown on the As-built plan sheets in Appendix D.

4.3.1 Results and Discussion

No results were available at the submittal of this report. Vegetation survival is to be compared with first year monitoring data in the Year 1 Monitoring Report, scheduled for submittal to NCEEP during December 2012.

4.4 Areas of Concern

Invasive species can quickly affect the survivability of the planted stems. During a September visit to the South Muddy Creek Site tendrils of kudzu were observed in the right floodplain above the Sain Rd. Bridge. The source of the kudzu appears to be offsite. Trumpet creeper vines were also observed in vegetation monitoring plots 4 and 5 of the South Muddy Creek Site. These vines can potentially outcompete the planted stems and should be removed by hand tools. Baker will request CEC treat the kudzu and remove the trumpet creeper vines when they mobilize to replant portions of the project area during the fall of 2011.

Mimosa trees are being grown as part of a tree nursery immediately outside the conservation easement along Sain Rd. The project areas closest to these invasive trees should be monitored in order to keep the invasive species from invading the site.

A few areas of sparse vegetation where noted at both sites. Baker will request CEC replant these areas during the fall of 2011.

5.0 REFERENCES

Carolina Vegetation Survey (CVS) and NC Ecosystem Enhancement Program (NCEEP). 2007. CVS-NCEEP Data Entry Tool v. 2.2.7. University of North Carolina, Raleigh, NC.

Goldsmith, R., Milton, D.J., and Horton, J.W. 1988. Geologic Map of the Charlotte 1° x 2° Quadrangle, North Carolina and South Carolina. USGS Map I-1251-E, 3p.

Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology*. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Lee, M., Peet R., Roberts, S., Wentworth, T. 2007. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1.

Medina, M.A., Reid, J.C., Carpenter, R.H. 2004. Physiography of North Carolina Map. North Carolina Geologic Survey. Raleigh, NC.

National Flood Insurance Program (NFIP). 2007. Flood Insurance Rate Map (FIRM) Panel 1648. NC Federal Emergency Management Agency (FEMA), Raleigh, NC. http://www.ncfloodmaps.com.

NC Department of Environment and Natural Resources (DENR), Division of Water Quality (DWQ). 2007. "Redbook" Surface Waters and Wetlands Standards. NC Administrative Code 15A NCAC 02B .0100, .0200, & .0300. NC Department of Environment and Natural Resources (DENR), Environmental Management Commission, Raleigh, NC. http://portal.ncdenr.org/c/document_library/get_file?folderId=285750&name=DLFE-8513.pdf.

NCDENR, DWQ. 2003. Feasibility Report and Restoration Plan for the Muddy Creek Watershed. NC DENR, Raleigh, NC. http://portal.ncdenr.org/web/eep/rbrps/catawba

NCDENR, DWQ. 2004. Catawba River Basinwide Water Quality Plan. NC DENR, Raleigh, NC.

NC DENR, NC Sediment and Control Division (SCD), and NC Agricultural Extension Service (AES). 2006. Erosion and Sediment Control Planning and Design Manual, Revised March 2009. Raleigh, NC.

Natural Resources Conservation Service (NRCS). 2009a. Soil Survey Geographic (SSURGO) Database for McDowell County, NC. http://soildatamart.nrcs.usda.gov/Report.aspx?Survey=NC111&UseState=NC. Accessed on 4/20/09.

NRCS. 2009b. Web Soil Survey of McDowell County, NC. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed on 4/20/09.

Rosgen, D. L. 1994. A Classification of Natural Rivers. Catena 22:169-199.

US Army Corps of Engineers, WRP, July 2000. Technical Notes ERDC TN-WRAP-00-02.

US Army Corps of Engineers, 2003. Stream Mitigation Guidelines. Prepared with cooperation from US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality. www.saw.usace.army.mil/wetlands/Mitigation/stream_mitigation.html

Appendix A

Figures 1 - 6

Tables 1 - 5

The subject project site is an environmental restoration site of the NCDENR Ecosystem Enhancement Program (EEP) and is encompassed by a recorded conservation easement, but is bordered by land under private ownership. Accessing the site may require traversing areas near or along the easement boundary and therefore access by the general public is not permitted. Access by authorized personnel of state and federal agencies or their designees/contractors involved in the development, oversight and stewardship of the restoration site is permitted within the terms and timeframes of their defined roles. Any intended site visitation or activity by any person outside of these previously sanctioned roles and activities requires prior coordination with EEP.

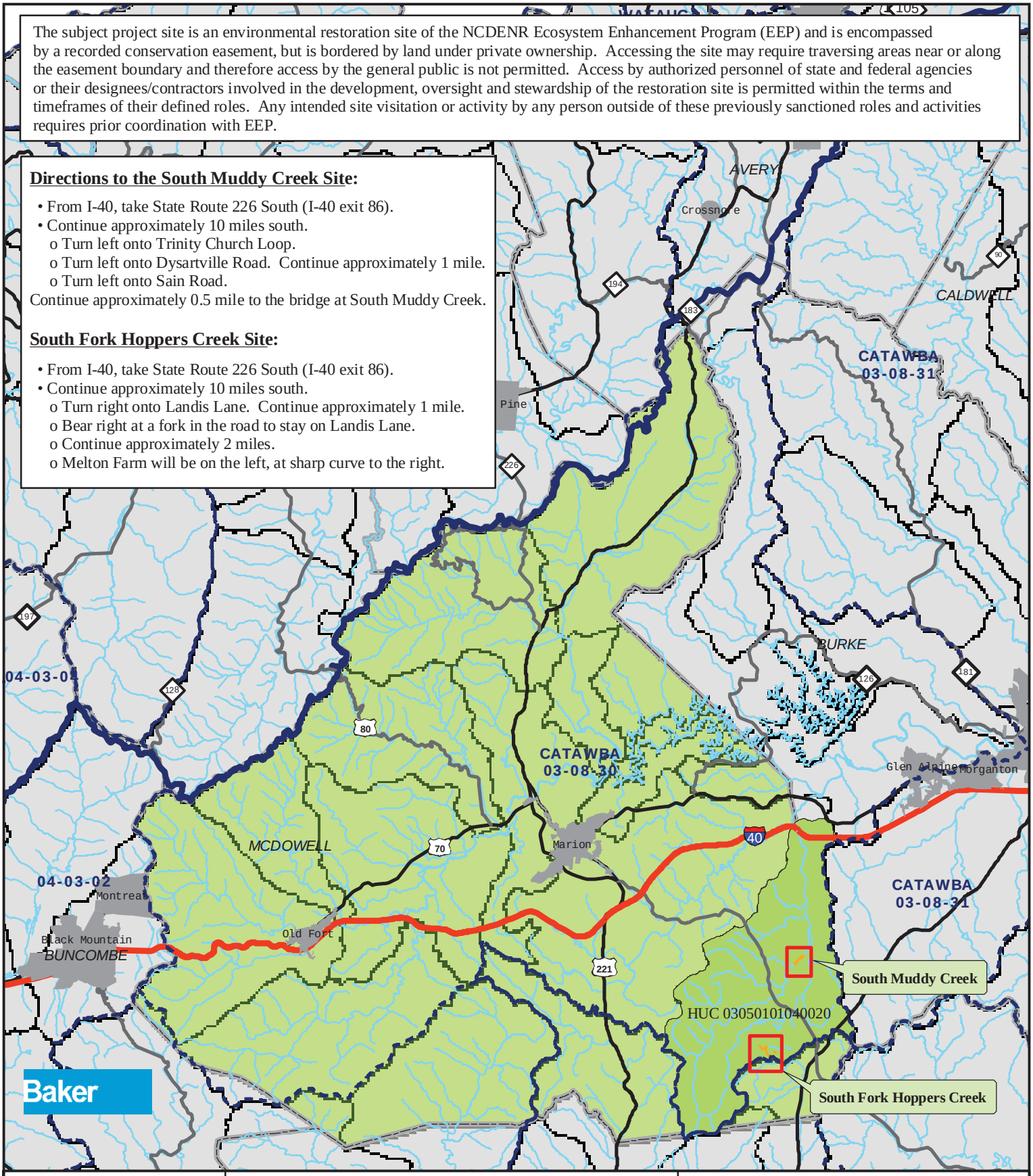
Directions to the South Muddy Creek Site:

- From I-40, take State Route 226 South (I-40 exit 86).
- Continue approximately 10 miles south.
  - o Turn left onto Trinity Church Loop.
  - o Turn left onto Dysartville Road. Continue approximately 1 mile.
  - o Turn left onto Sain Road.

Continue approximately 0.5 mile to the bridge at South Muddy Creek.

South Fork Hoppers Creek Site:

- From I-40, take State Route 226 South (I-40 exit 86).
- Continue approximately 10 miles south.
  - o Turn right onto Landis Lane. Continue approximately 1 mile.
  - o Bear right at a fork in the road to stay on Landis Lane.
  - o Continue approximately 2 miles.
  - o Melton Farm will be on the left, at sharp curve to the right.



Map Vicinity

McDowell County, NC

Figure 1. Vicinity Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

Ecosystem Enhancement Program

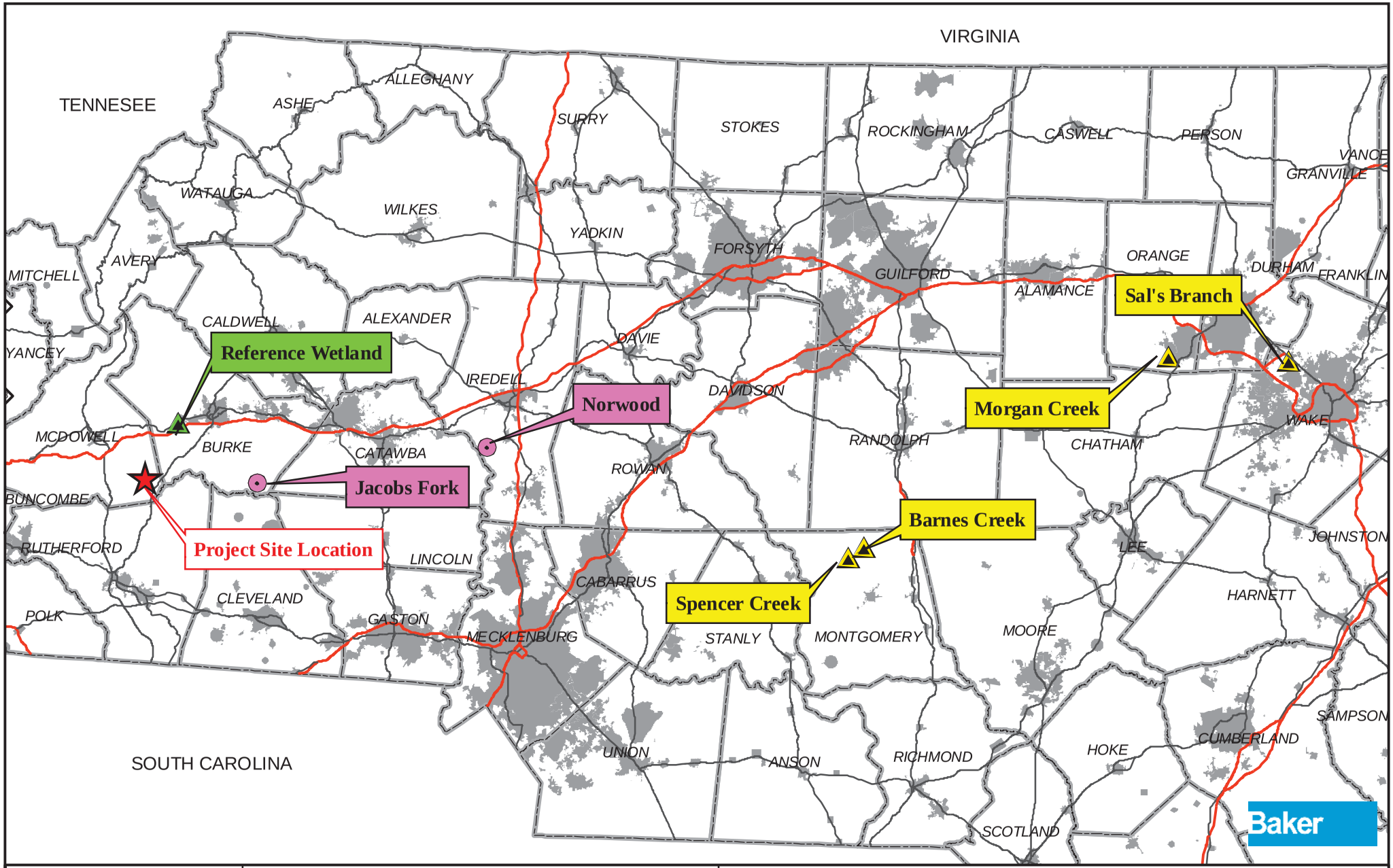
NCEEP Project Nos.: 737 & 92251

June 2011

LEGEND:

- Project Areas
- NCDWQ Sub-basin
- Counties
- USGS Hydrologic Unit

0 2.5 5 Miles



Map Vicinity

McDowell County, NC

Figure 2. Reference Reach & Wetland Location Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

Ecosystem Enhancement Program

NCEEP Project Nos.: 737 & 92251

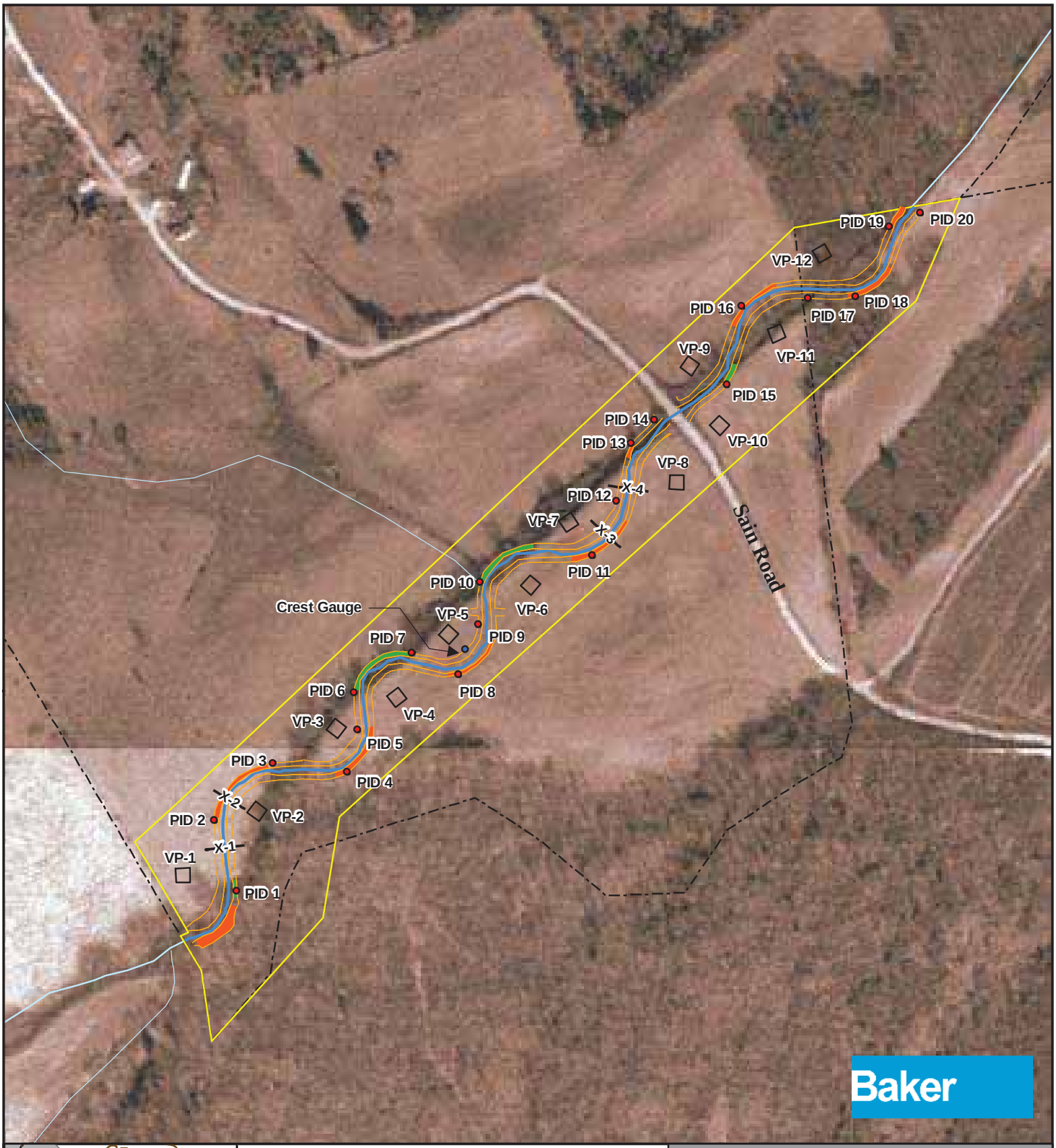
June 2011

LEGEND

- **Bankfull Reference Site Gage Locations**
- **Wetland Reference Sites**
- **Reference Reach Sites**
- **Municipal Boundaries**
- **Counties**
- **Interstate**
- **US Route**

0 20 40 Miles

1 inch = 20 miles



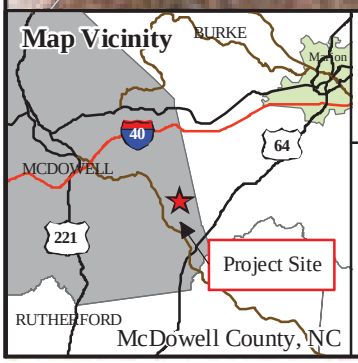


Figure 3. South Muddy As-built Design Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

Ecosystem Enhancement Program

NCEEP Project Nos.: 737 & 92251
June 2011

As-Built Survey: September 2010

0 150 300 Feet

1 inch = 300 feet

LEGEND

- Bank Alignment
- Thalweg
- Brush Mattresses
- Geo-Lifts
- Conservation Easement
- Existing Streams
- Property Boundaries
- As-built X-Section Locations
- Crest Gauge
- Photo ID Point (PID)
- Veg Plot Locations

Ecosystem Enhancement PROGRAM

Figure 4. South Fork Hoppers As-Built Design Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

NCEEP Project Nos.: 737 & 92251
June 2011

As-Built Survey: September 2010

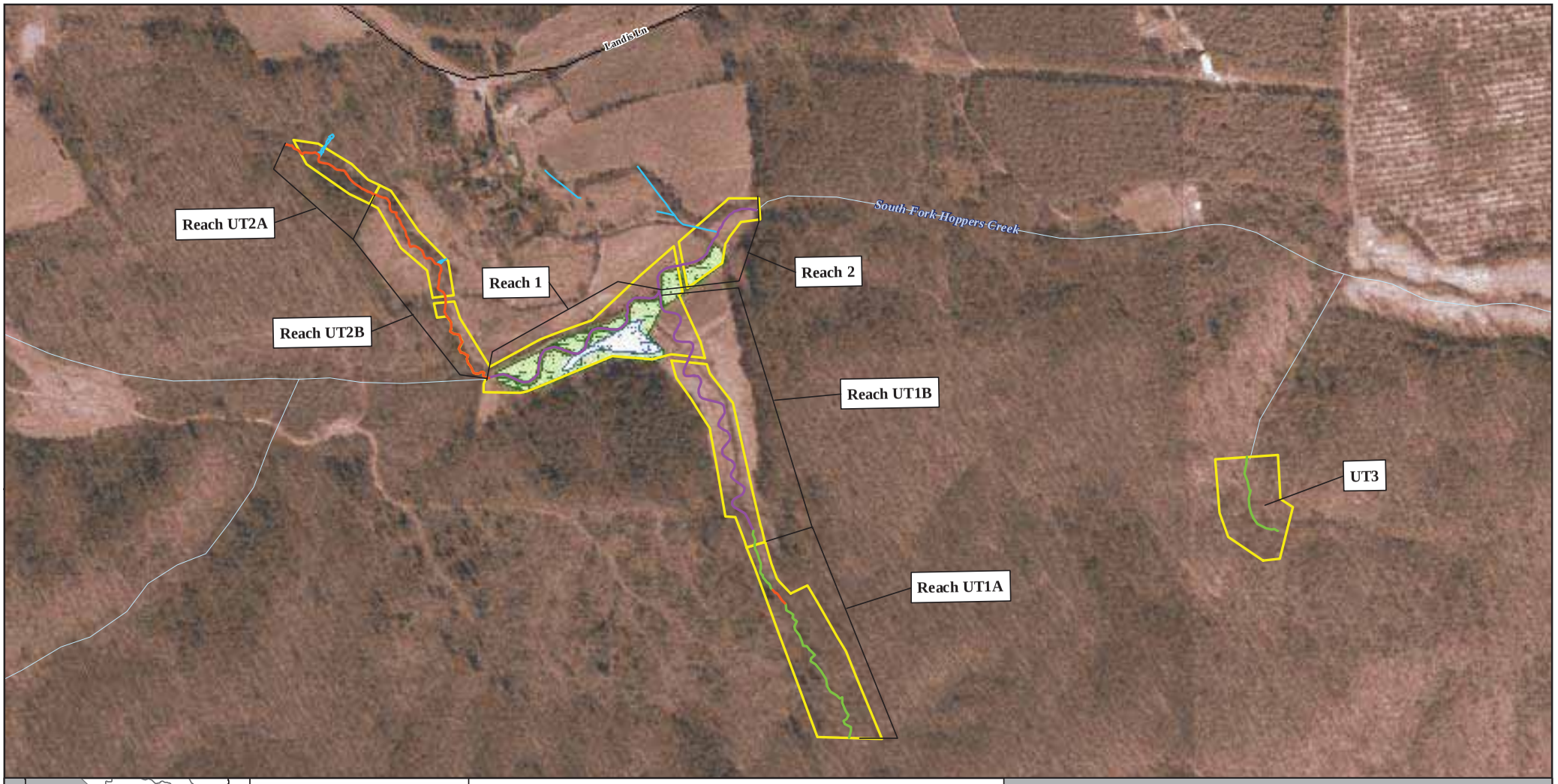
0 100 200 400 Feet

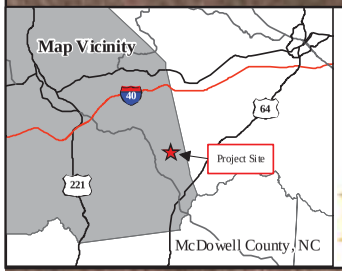
1 inch = 200 feet

Baker

LEGEND

- Existing Streams
- As-built X-Section Locations
- Conservation Easement
- Brush Mattress
- Geo-Lift
- Bank Alignment
- Thalweg
- Wetland Restoration & Enhancement Area
- Roads
- Photo Id Point (PID)
- Crest Gauge
- Wetland Gauges
- Veg Plot Locations





Ecosystem Enhancement PROGRAM

Figure 5. South Fork Hoppers Restoration Component Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

EEP Project No.: 737 and 92251
June 2011

0 150 300 Feet
1 inch = 300 feet

Baker

LEGEND

- Restoration
- Enhancement II
- Preservation
- Wetland Enhancement Area
- Wetland Restoration Area
- Drainge Swale Stabilization Areas
- Conservation Easement
- Streams

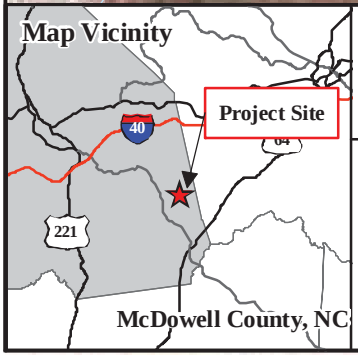


Figure 6. South Muddy Project Components Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

EEP Project No.: 737 & 92251

June 2011

0 200 400 Feet

1 inch = 400 feet

LEGEND

- Restoration
- StockPileArea
- As-built Conservation Easement
- ExistingStreams
- Property Boundaries
- Streets

Table 1. Project Components
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251

Project Segment or Reach ID	Existing Feet/Acres*	Mitigation Type	Approach	Linear Footage or Acreage*	Stationing	Comment
South Muddy Creek	2,593	R	P2	2,787	10+00 - 38+77**	Installed in-stream structures to protect the stream bank from erosion and to provide aquatic habitat. Priority 2 was implemented to connect the channel to a newly evacated floodplain bench.
South Fork Hoppers Creek - Reach 1	1,350	R	P1	783	10+00 - 17+83	Installed in-stream structures to control grade, reduce bank erosion, and provide habitat. Priority I was implemented to reestablish stream pattern and relocate the channel onto the historic floodplain.
South Fork Hoppers Creek - Reach 2		R	P1	445	17+83 - 22+48***	Installed in-stream structures to control grade, reduce bank erosion, and provide habitat. Priority I was implemented to reestablish stream pattern and relocate the channel onto the historic floodplain.
UT1 - Reach A	782	P	-	722	-	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
		EII	P4	60	7+86 - 8+46****	Regraded right bank to create a bankfull bench and implemented riparian plantings to improve stability and reduce erosion.
UT1 - Reach B	970	P	-	51	9+49 - 10+00****	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
		R	P1	1,065	10+00 - 20+85***	Installed in-stream structures to increase habitat diversity. Installed fencing to restrict cattle access. Priority I was implemented to restore dimension, pattern, and profile.
UT2 - Reach A	366	EII	P4	379	10+00 - 13+79	Regraded banks and implemented a step-pool channel where feasible. Implemented fencing to restrict hog access.
UT2 - Reach B	802	EII	P4	818	13+79 - 22+17***	Regraded banks and implemented riparian plantings to improve reach stability and reduce erosion.
UT3	298	P	-	298	-	Preservation. A 30 - 100 foot conservation easement was implemented to on right and left stream banks.
Ephermal drainage in left floodplain of South Fork Hoppers Creek	348	-	-	497	-	Stabilized ephemeral drainage from adjacent pasture by creating a flat bottom swale. Swale was matted and seeded. Not being sought for mitigation credit.
Ephermal drainage near the upstream extend of UT2	80	-	-	80	-	Stabilized ephemeral drainage with boulder sill structures and armored channel bed. Areas outside the channel were mulched and planted. Not being sought for mitigation credit.
Ephemeral drainage at Station 16+75 of UT2	15	-	-	15	-	Stabilized ephemeral drainage by regrading, rematting, and armoring with riprap. Not being sought for mitigation.
Wetland	0.33	E	-	0.33	-	Regraded the wetland boundary to improve hydrologic imputs and maximize surface storage.
		R	-	1.23	-	Restored wetland hydrology to the original stream alignment.

* Existing reach breaks and design reach breaks varied based on initial geomorphic differences and design requirements.

** Stationing includes 20 ft. of farm crossing above Sain Rd. and 70 ft. of Sain Rd. bridge crossing, but is not reflected in the reach length.

*** Stationing includes 20 ft. stream crossing, but is not reflected in the reach length

****During construction enhancement slated to occur between 9+49 and 10+00 of UT1B was shifted upstream into UT1A per conversations with EEP and CEC. The section slated for enhancement at the top of UT1B (9+49 to 10+00) became presevation upon the field change.

Component Summations

Restoration Level	Stream (LF)	Riparian Wetland (Ac)		Non-Ripar (Ac)	Upland (Ac)
		Riverine	Non-Riverine		
Restoration	5,080	1.23	-	-	-
Enhancement		0.33	-	-	-
Enhancement I	-				
Enhancement II	1,257				
Creation		-	-	-	-
Preservation	1,071	-	-	-	-
HQ Preservation	-	-	-	-	-
		1.56	0.00		
Totals	7,408	1.56			

Table 2. Project Activity and Reporting History South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan Prepared	N/A	N/A	Jul-07
Restoration Plan Amended	N/A	N/A	Jan-08
Restoration Plan Approved	N/A	N/A	Aug-08
Final Design – (at least 90% complete)	N/A	N/A	Jun-09
Construction Begins	Jun-10	N/A	Jun-10
Temporary S&E mix applied to entire project area	N/A	N/A	N/A
Permanent seed mix applied to entire project area	Nov-10	N/A	Jan-11
Planting of live stakes	Mar-11	N/A	Mar-11
Planting of bare root trees	Mar-11	N/A	Mar-11
End of Construction	Mar-11	N/A	Jun-11
Survey of As-built conditions (Year 0 Monitoring-baseline)	Nov-10	N/A	Jun-11
Year 1 Monitoring	Dec-12	N/A	N/A
Year 2 Monitoring	Dec-13	N/A	N/A
Year 3 Monitoring	Dec-14	N/A	N/A
Year 4 Monitoring	Dec-15	N/A	N/A
Year 5 Monitoring	Dec-16	N/A	N/A

Table 3. Project Contacts Table South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251	
Designer	
Michael Baker Engineering, Inc.	5550 Seventy-Seven Center Dr., Ste.320 Charlotte, NC 28217 Contact: Scott Hunt, Tel. 919-459-9003
Construction Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Stephen James, Tel. 919-921-1116
Planting Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Stephen James, Tel. 919-921-1116
Seeding Contractor	
Carolina Environmental Contracting, Inc.	150 Pine Ridge Road Mount Airy, NC 27030 Contact: Stephen James, Tel. 919-921-1116
Seed Mix Sources	Green Resources, Tel. 336-855-6363
Nursery Stock Suppliers	Foggy Mountain Nursery, Tel. 336-384-5323
Profession Land Surveyor	
Turner Land Survey, PLLC.	3201 Glenridge Drive Raleigh, NC 27604 Contact:
Profession Land Surveyor	David Turner, Tel. 919-875-1378
As-Built Plan Set Production	Lissa Turner, Tel. 919-875-1378
Monitoring Performers	
Michael Baker Engineering, Inc.	5550 Seventy-Seven Center Dr., Ste.320 Charlotte, NC 28217 Contact:
Stream Monitoring Point of Contact:	Ian Eckardt, Tel. 704-665-2200
Vegetation Monitoring Point of Contact:	Ian Eckardt, Tel. 704-665-2200
Wetland Monitoring Point of Contact:	Ian Eckardt, Tel. 704-665-2200

Table 4. Project Attribute Table
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92551

Project County	McDowell County, NC
Physiographic Region	Piedmont
Ecoregion	Inner Piedmon Belt
Project River Basin	Catawba
USGS HUC for Project and Reference sites	Project: 03050101040020; References: 03040103050 -090 (Spencer Creek), -080 (Barnes Creek); 03030002060 -070 (Morgan Creek); 03020201080 -020 (Sal's Branch)
NCDWQ Sub-basin for Project and Reference	Project: 03-08-30; References: 03-07-09 (Spencer Creek and Barnes Creek); 03-06-06 (Morgan Creek); 03-04-02 (Sal's Branch)
Within extent of EEP Watershed Plan ?	Muddy Creek Local Watershed Plan (LWP), 2003
WRC Class (Warm, Cool, Cold)	Warm
% of project easement fenced or demarcated	100%
Beaver activity observed during design phase ?	None

Restoration Component Attribute Table

	South Muddy	Fork Hoppers - Re	Fork Hoppers - Re	UT1 - Reach A (Preservation)	UT1 - Reach A (Enhancement 2)	UT1 - Reach B (Preservation)	UT1 - Reach B	UT2 - Reach A	UT2 - Reach B	UT3
Drainage area (sq. mi.)	18.8	0.48	0.52	0.06	0.06	0.08	0.08	0.04	0.07	0.02
Stream order	4th	2nd	2nd	1st	1st	1st	1st	0	0	0
Restored length	2,787	783	445	722	60	51	1,065	379	818	298
Perennial or Intermitten	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Perennial	Intermittent
Watershed type (Rural, Urban, Developing etc.)	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural	Rural
Watershed LULC Distribution (e.g.)										
Developed Low-Medium Intensity	3.7	-		-	-	-	-	-	-	-
Ag-Cultivated Crops	0.6	1.5		-	-	-	-	-	-	-
Ag-Pasture/Hay	10.5	15.3		-	-	-	-	-	-	-
Forested	77.4	60.8		-	-	-	-	-	-	-
Other (Open water, Grassland, Etc.)	7.8	22.4		-	-	-	-	-	-	-
Watershed impervious cover (%)	U	U	U	U	U	U	U	U	U	U
NCDWQ AU/Index number	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30	03-08-30
NCDWQ classification	C	C	C	C	C	C	C	C	C	C
303d listed ?	No	No	No	No	No	No	No	No	No	No
Upstream of a 303d listed segment?	No	No	No	No	No	No	No	No	No	No
Reasons for 303d listing or stressor	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total acreage of easement	27.2									
Total planted arceage as part of the restoration	20.5									
Rosgen classification of pre-existing	G4c	G5c	C4/1	-	-	E5	E5	G5	G5c	-
Rosgen classification of As-built	C4	C5	C5	B	B	C5	C5	G5/B5	G5c	B
Valley type	Alluvial	Alluvial	Alluvial	-	-	Alluvial	Alluvial	Alluvial	Alluvial	-
Valley slope	0.0017 ft/ft	0.0115ft/ft	0.0115 ft/ft	-	-	0.023 ft/ft	0.023 ft/ft	0.034 ft/ft	0.023 ft/ft	-
Valley side slope range (e.g. 2-3%)	U	U	U	-	-	U	U	U	U	-
Valley toe slope range (e.g. 2-3%)	U	U	U	-	-	U	U	U	U	-
Cowardin classification	Riverine, Upper Perennial, Unconsolidated Bottom, Cobble-Gravel									
Trout waters designation	No	No	No	No	No	No	No	No	No	No
Species of concern, endangered etc.? (Y?N)	No	No	No	No	No	No	No	No	No	No
Dominant soil series and characteristics										
Series	IoA	IoA	IoA	EwE	EwE	IoA	IoA	HeD	HeD / IoA	EwE
Depth	10	10	10	5	6	10	10	5, 8	5,8 / 10	5
Clay %	18	18	18	25,20	25,20	18	18	25	25 / 18	25,20
K	0.15	0.15	0.15	0.17, 0.10	0.17, 0.10	0.15	0.15	0.24, 0.17	0.24, 0.17 / 0.15	0.17, 0.10
T	5	5	5	3 / 5	3 / 5	5	5	5	5 / 5	3 / 5

Table 5. Visual Morphological Stability Assessment						
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251						
South Muddy Creek (2,787 LF)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%					
Pools	100%					
Thalweg	100%					
Meanders	100%					
Bed General	100%					
Bank Conition	100%					
Vanes / J Hooks etc.	100%					
Wads and Boulders	100%					
South Fork Hoppers Creek Reach 1 (783 LF)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%					
Pools	100%					
Thalweg	100%					
Meanders	100%					
Bed General	100%					
Bank Conition	100%					
Vanes / J Hooks etc.	100%					
Wads and Boulders	100%					
South Fork Hoppers Creek Reach 2 (445 LF)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%					
Pools	100%					
Thalweg	100%					
Meanders	100%					
Bed General	100%					
Bank Condition	100%					
Vanes / J Hooks etc.	100%					
Wads and Boulders	100%					
South Fork Hoppers Creek UT1B (1,065 LF)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%					
Pools	100%					
Thalweg	100%					
Meanders	100%					
Bed General	100%					
Bank Condition	100%					
Vanes / J Hooks etc.	100%					
Wads and Boulders	100%					
South Fork Hoppers Creek UT2 (1,197 LF)						
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**	**MY-05**
Riffles	100%					
Pools	100%					
Thalweg	100%					
Meanders	100%					
Bed General	100%					
Bank Condition	100%					
Vanes / J Hooks etc.	100%					
Wads and Boulders	N/A					

Appendix B

Morphological Summary Data (Tables 6 & 7)

Cross-section Plots

Profile Plots

Pebble Count Data and Plots

Table 6. Baseline Stream Summary
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251

South Muddy Creek (2,787 LF)

Parameter	USGS Gauge	Regional Curve Interval (Harman et al. 1999)[1]			Pre-Existing Condition						Reference Reach(es) Data — Morgan Creek						Reference Reach(es) Data — Barnes Creek						Design						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																		
BF Width (ft)	------	23.0	80.0	42.0	24.1	32.3	-----	51.2	------	5	33.2	------	------	33.5	------	2	60.7	------	------	69	------	2	------	43.2	------	------	------	1	41.4	------	------	42.2	------	2
Floodprone Width (ft)	------	------	------	------	29.6	44.8	-----	72.7	------	5	77.5	------	------	86.8	------	2	219	------	------	220	------	2	------	210+	------	------	------	1	90.7	------	------	93.6	------	2
BF Mean Depth (ft)	------	2.3	5.8	3.8	1.9	2.7	-----	3.0	------	5	2.3	------	------	2.4	------	2	2.9	------	------	3.8	------	2	------	3.0	------	------	------	1	2.7	------	------	2.8	------	2
BF Max Depth (ft)	------	------	------	------	3.3	3.6	-----	4.0	------	5	2.8	------	------	2.9	------	2	3.9	------	------	5.2	------	2	------	4.2	------	------	------	1	4.2	------	------	4.4	------	2
BF Cross-sectional Area (ft²)	------	80.0	300.0	157.6	72.8	83.8	-----	97.2	------	5	75.1	------	------	79.8	------	2	199	------	------	288	------	2	------	128.5	------	------	------	1	110.8	------	------	115.9	------	2
Width/Depth Ratio	------	------	------	------	8.1	12.9	-----	26.9	------	5	14.1	------	------	14.7	------	2	16	------	------	23.8	------	2	------	14.4	------	------	------	1	15.4	------	------	15.5	------	2
Entrenchment Ratio	------	------	------	------	1.1	1.4	-----	1.7	------	5	2.3	------	------	2.6	------	2	3.2	------	------	3.6	------	2	------	4.9+	------	------	------	1	2.2	------	------	2.2	------	2
Bank Height Ratio	------	------	------	------	2.4	2.8	-----	2.8	------	5+	------	1.0	------	------	------	2	------	------	------	------	------	------	------	1.0	------	------	------	1	1.0	------	------	1.0	------	2
d50 (mm)	------	------	------	------	------	4.0	-----	------	------	1	------	3.0	------	------	------	1	------	60	------	------	------	1	------	------	------	------	------	------	------	------	------	------	------	------
Pattern																																		
Channel Belt width (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	128.0	------	------	209.0	------	9	143.0	168.3	164.0	244.0	32.2	8
Radius of Curvature (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	84.0	------	------	138.0	------	9	96.0	121.2	114.0	152.0	18.9	9
Rc:Bankfull width (ft/ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1.9	------	------	3.2	------	9	2.3	2.9	2.7	3.6	0.5	9
Meander Wavelength (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	345.0	------	------	506.0	------	6	387.0	400.8	396.5	418.0	12.9	6
Meander Width Ratio	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	3.0	------	------	4.8	------	9	3.4	4.0	3.9	5.8	0.8	8
Profile																																		
Riffle Length (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	61	80	88	122	23	3
Riffle Slope (ft/ft)	------	------	------	------	0.003	0.004	-----	0.006	------	3	0.01	------	------	0.02	------	2	------	------	------	------	------	------	0.0034	------	------	0.0054	------	7	0.000	0.006	0.005	0.011	0.004	3
Pool Length (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Pool Spacing (ft)	------	------	------	------	80	163	-----	240	------	4	46	------	------	277	------	2	------	------	------	------	------	------	154.0	------	------	327.0	------	10	167	272	257	335	53	3
Pool Max Depth (ft)	------	------	------	------	3.8	4.8	-----	5.8	------	4	------	4.1	------	------	------	1	------	------	------	------	------	------	6.2	------	------	10.3	------	11	------	------	------	------	------	------
Pool Volume (ft³)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Substrate and Transport Parameters																																		
Rf% / Ru% / Pl% / G% / S%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
SC% / Sa% / G% / B% / Be%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
d16 / d35 / d50 / d84 / d95	------	------	------	------			<0.06 / 0.2 / 4 / 25 / 44						N/A / 1.2 /3 / 77 / 800						0.4 / 11 / 60 / 512 / >2048						------	------	------	------	------	------			0.15 / 5 / 52 / 135 / 190			
Reach Shear Stress (competency) lb/f²	------	------	------	------	0.18	------	------	0.3	------	5	------	------	------	------	------	------	------	------	------	------	------	------	------	0.28	------	------	------	------	------	------	------	------	------	------
Max part size (mm) mobilized at bankfull (Rosgen Curve)	------	------	------	------	------	95.0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	90.0	------	------	------	------	------	------	------	------	------	------
Stream Power (transport capacity) W/m²	------	------	------	------	10.8	------	------	24	------	5	------	------	------	------	------	------	------	------	------	------	------	------	------	12.6	------	------	------	------	------	------	------	------	------	------
Additional Reach Parameters																																		
Drainage Area (SM)	------	------	------	------	------	------	------	18.8	------	------	------	------	------	8.4	------	------	------	------	------	23.0	------	------	------	------	------	18.8	------	------	------	------	------	18.8	------	------
Impervious cover estimate (%)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Rosgen Classification	------	------	------	------	------	G4c	------	------	------	------	------	C4	------	------	------	------	------	C4	------	------	------	------	------	C4	------	------	------	------	------	C5	------	------	------	------
BF Velocity (fps)	------	------	------	------	4.1	------	------	5.5	------	5	------	7	------	------	------	------	------	------	------	------	------	------	------	3.1	------	------	------	------	------	3.0	------	------	------	------
BF Discharge (cfs)	------	290.0	2000.0	741.1	------	400	------	------	------	------	------	524.0	------	------	------	------	------	------	------	------	------	------	------	400.0	------	------	------	------	------	340.0	------	------	------	------
Valley Length	------	------	------	------		2446	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	2409	------	------	------	------
Channel length (ft)	------	------	------	------	------	2593	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	2842	------	------	------	------	------	2787	------	------	------	------
Sinuosity	------	------	------	------	------	1.06	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1.20	------	------	------	------	------	1.18	------	------	------	------
Water Surface Slope (Channel) (ft/ft)	------	------	------	------		0.0016	------	------	------	------	------	0.0070	------	------	------	------	------	------	------	------	------	------	------	0.0017	------	------	------	------	------	0.0016	------	------	------	------
BF slope (ft/ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Bankfull Floodplain Area (acres)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
BEHI VL% / L% / M% / H% / VH% / E%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Channel Stability or Habitat Metric	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Biological or Other	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

* Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. Wildland Hydrology. AWRA Symposium Proceedings, D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

South Fork Hoppers Creek Reach 1 (783 LF)

Parameter	USGS Gauge		Regional Curve Interval (Harman et al, 1999)[1]			Pre-Existing Condition						Reference Reach(es) Data — Sal's Branch						Reference Reach(es) Data — Spencer Creek Downstream						Design						As-built					
	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension and Substrate - Riffle																																			
BF Width (ft)	61.3	32	5.0	20.0	8.7	7.4	10.5	-----	14.4	------	3	------	8.7	------	------	------	1	------	10.7	------	------	------	1	------	13.2	------	------	------	1	------	13.1	------	------	------	1
Floodprone Width (ft)	96.3	------	------	------	------	16.8	26.2	-----	33.0	------	3	------	163.0	------	------	------	1	------	60.0	------	------	------	1	------	50+	------	------	------	8	------	62.9	------	------	------	1
BF Mean Depth (ft)	4.7	3.1	0.7	2.0	1.2	1.0	1.2	-----	1.6	------	3	------	1.2	------	------	------	1	------	1.6	------	------	------	1	------	1.0	------	------	------	1	------	1.1	------	------	------	1
BF Max Depth (ft)	5.8	------	------	------	------	1.7	1.9	-----	2.0	------	3	------	2.4	------	------	------	1	------	2.1	------	------	------	1	------	1.3	------	------	------	1	------	1.7	------	------	------	1
BF Cross-sectional Area (ft²)	290.3	99	6.0	26.0	13.0	7.4	12.5	-----	15.6	------	3	------	10.4	------	------	------	1	------	17.8	------	------	------	1	------	13.8	------	------	------	1	------	15.0	------	------	------	1
Width/Depth Ratio	13	10.3	------	------	------	6.1	9.3	-----	14.4	------	3	------	7.3	------	------	------	1	------	5.7	------	------	------	1	------	13.2	------	------	------	1	------	11.5	------	------	------	1
Entrenchment Ratio	1.6	------	------	------	------	2.0	2.6	-----	3.4	------	3	------	18.7	------	------	------	1	------	5.5	------	------	------	1	------	3.8+	------	------	------	8	------	4.8	------	------	------	1
Bank Height Ratio	1.3	------	------	------	------	1.3	2.2	-----	2.6	------	5+	------	1.2	------	------	------	1	------	1.0	------	------	------	1	------	1.0	------	------	------	1	------	1.0	------	------	------	1
d50 (mm)	------	------	------	------	------	------	0.7	-----	------	------	1	------	9.5	------	------	------	------	------	8.8	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Pattern																																			
Channel Belt width (ft)	------	------	------	------	------	------	------	------	------	------	------	10	------	------	16	------	4	38.3	------	------	40.8	------	2	54.0	------	------	78.0	------	8	40.0	62.1	62.0	87.0	14.0	7
Radius of Curvature (ft)	------	------	------	------	------	------	------	------	------	------	------	13.1	------	------	29.6	------	4	10.9	------	------	14.6	------	5	37.0	------	------	53.0	------	8	34.0	39.9	39.0	47.0	5.4	7
Rc:Bankfull width (ft/ft)	------	------	------	------	------	------	------	------	------	------	------	4.4	------	------	5.2	------	3	1.3	------	------	1.4	------	5	2.8	------	------	4.0	------	8	2.6	3.0	3.0	3.6	0.4	7
Meander Wavelength (ft)	------	------	------	------	------	------	------	------	------	------	------	38	------	------	45	------	3	46	------	------	48	------	2	130.0	------	------	177.0	------	6	146.0	162.0	158.0	184.0	15.7	6
Meander Width Ratio	------	------	------	------	------	------	------	------	------	------	------	1.2	------	------	1.8	------	4	3.4	------	------	3.6	------	2	4.1	------	------	5.9	------	8	3.1	4.7	4.7	6.6	1.1	7
Profile																																			
Riffle Length (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	30.0	36.0	37.0	45.0	6.4	6
Riffle Slope (ft/ft)	------	------	------	------	------	0.015	0.025	-----	0.035	------	15	0.03	------	------	0.04	------	4	------	0.013	------	------	------	2	0.013	------	------	0.0305	------	6	0.01	0.02	0.02	0.03	0.01	6
Pool Length (ft)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Pool Spacing (ft)	------	------	------	------	------	27.0	66.0	-----	161.0	------	14	35.5	------	------	47	------	3	------	71	------	------	------	5	82.0	------	------	118.0	------	7	74.0	103.0	100.0	129.0	18.0	7
Pool Max Depth (ft)	------	------	------	------	------	2.1	2.2	-----	2.4	------	3	------	3.1	------	------	------	1	------	3.3	------	------	------	1	------	2.0	------	------	------	9	------	2.4	------	------	------	1
Pool Volume (ft³)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Substrate and Transport Parameters																																			
Rf% / Ru% / Pl% / G% / S%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
SC% / Sa% / G% / B% / Be%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
d16 / d35 / d50 / d84 / d95	------	------	------	------	------			<0.2 / 0.38 / 0.69 /26 / 67						48 / N/A / 9.5/ 30 / N/A						<0.062 / 3 / 8.8 / 42 / 90						------	------	------	------	------	------			33 / 46 / 57 / 100 / 128			
Reach Shear Stress (competency) lb/f²	------	------	------	------	------	0.5	------	------	0.76	------	3	------	------	------	------	------	------	------	------	------	------	------	------	0.4	------	------	------	------	------	------	------	------	------	------
Max part size (mm) mobilized at bankfull (Rosgen Curve)	------	------	------	------	------	------	200.0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	100.0	------	------	------	------	------	------	------	------	------	------
Stream Power (transport capacity) W/m²	------	------	------	------	------	27.9	------	------	48.8	------	3	------	------	------	------	------	------	------	------	------	------	------	------	22.9	------	------	------	------	------	------	------	------	------	------
Additional Reach Parameters																																			
Drainage Area (SM)	25.7	7.2	------	------	------	------	------	------	0.5	------	------	------	------	------	0.2	------	------	------	------	------	1.0	------	------	------	------	------	0.52	------	------	------	------	------	0.52	------	------
Impervious cover estimate (%)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Rosgen Classification	C4	E	------	------	------	------	G5c	------	------	------	------	------	E4	------	------	------	------	------	E4	------	------	------	------	------	C5	------	------	------	------	------	E5/C5	------	------	------
BF Velocity (fps)[2]	3.9	2.6	------	------	------	3.2	------	------	6.8	------	3	------	------	------	------	------	------	------	------	------	------	------	------	5.4	------	------	3.6	------	------	------	------	------	------	------
BF Discharge (cfs)	1140	254	18.0	160.0	52.4	------	50	------	------	------	3	------	------	------	------	------	------	------	97.0	------	------	------	------	50.0	------	------	------	------	------	------	------	------	------	------
Valley Length (ft)	------	------	------	------	------	------	1016.0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	619.0	------	------	------	------
Channel length (ft)	850	------	------	------	------	------	1016.0	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	783.0	------	------	------	------
Sinuosity	1.06	------	------	------	------	------	1.14	------	------	------	------	------	1.19	------	------	------	------	------	2.30	------	------	------	------	1.20	------	------	------	------	------	1.26	------	------	------	------
Water Surface Slope (Channel) (ft/ft)	------	------	------	------	------	------	0.0101	------	------	------	------	------	0.0109	------	------	------	------	------	0.0047	------	------	------	------	0.0077	------	------	------	------	------	------	------	------	------	------
BF slope (ft/ft)	0.0025	0.0008	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Bankfull Floodplain Area (acres)	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
BEHI VL% / L% / M% / H% / VH% / E%	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Channel Stability or Habitat Metric	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Biological or Other	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------

1. The rural region curve by Harman, et.al. 1999 was used for these parameters.

2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

Table 6. Baseline Stream Summary
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251

South Fork Hoppers Creek Reach 2 (445 LF)

Parameter	USGS Gauge		Regional Curve Interval (Harman et al, 1999) [1]			Pre-Existing Condition						Reference Reach(es) Data Sal's Branch						Reference Reach(es) Data Spencer Creek Downstream						Design						As-built					
	Jacob	Norwood	LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension - Riffle																																			
BF Width (ft)	61.3	32	5.3	21.0	9.0	7.4	10.5	-----	14.4	-----	3	-----	8.7	-----	-----	-----	1	-----	10.7	-----	-----	-----	1	-----	14.2	-----	-----	-----	1	-----	13.3	-----	-----	-----	1
Floodprone Width (ft)	96.3	-----	-----	-----	-----	16.8	26.2	-----	33.0	-----	3	-----	163.0	-----	-----	-----	1	-----	60.0	-----	-----	-----	1	-----	50+	-----	-----	-----	2	-----	62.9	-----	-----	-----	1
BF Mean Depth (ft)	4.7	3.1	0.75	2	1.2	1.0	1.2	-----	1.6	-----	3	-----	1.2	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	0.9	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
BF Max Depth (ft)	5.8	-----	-----	-----	-----	1.7	`	-----	2.0	-----	3	-----	2.4	-----	-----	-----	1	-----	2.1	-----	-----	-----	1	-----	1.2	-----	-----	-----	1	-----	1.5	-----	-----	-----	1
BF Cross-sectional Area (ft²)	290.3	99	6.0	27.0	13.7	7.4	12.5	-----	15.6	-----	3	-----	10.4	-----	-----	-----	1	-----	17.8	-----	-----	-----	1	-----	12.7	-----	-----	-----	1	-----	13.5	-----	-----	-----	1
Width/Depth Ratio	13	10.3	-----	-----	-----	6.1	9.3	-----	14.4	-----	3	-----	7.3	-----	-----	-----	1	-----	5.7	-----	-----	-----	1	-----	15.8	-----	-----	-----	1	-----	13.1	-----	-----	-----	1
Entrenchment Ratio	1.6	-----	-----	-----	-----	2.0	2.6	-----	3.4	-----	3	-----	18.7	-----	-----	-----	1	-----	5.5	-----	-----	-----	1	-----	3.8+	-----	-----	-----	1	-----	4.7	-----	-----	-----	1
Bank Height Ratio	1.3	-----	-----	-----	-----	1.3	2.2	-----	2.6	-----	5+	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	-----	0.7	-----	-----	-----	1	-----	9.5	-----	-----	-----	-----	-----	8.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																			
Channel Belt width (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----	-----	16	-----	4	38.3	-----	-----	40.8	-----	2	62.0	-----	-----	62.0	-----	3	62.0	62.5	62.5	63.0	-----	2
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.1	-----	-----	29.6	-----	4	10.9	-----	-----	14.6	-----	5	45.0	-----	-----	87.0	-----	3	36.0	55.7	62.0	69.0	17..39	3
Rc:Bankfull Width (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4.4	-----	-----	5.2	-----	3	1.3	-----	-----	1.4	-----	5	3.2	-----	-----	6.1	-----	3	2.5	3.9	4.4	4.9	1.2	3
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38	-----	-----	45	-----	3	46	-----	-----	48	-----	2	179.0	-----	-----	313.0	-----	2	178.0	246.5	246.5	315.0	-----	2
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.8	-----	4	3.4	-----	-----	3.6	-----	2	4.4	-----	-----	4.4	-----	3	4.4	4.4	4.4	4.4	-----	2
Profile																																			
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	31	37	37	43	6	3
Riffle Slope (ft/ft)	-----	-----	-----	-----	-----	0.015	0.025	-----	0.035	-----	15	0.03	-----	-----	0.04	-----	4	-----	0.013	-----	-----	-----	2	0.0275	-----	-----	0.0330	-----	3	0.024	0.029	0.028	0.032	0.004	3
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	-----	27.0	66.0	-----	161.0	-----	14	35.5	-----	-----	47	-----	3	-----	71	-----	-----	-----	5	138.0	-----	-----	176.0	-----	2	92	155	155	218	-----	2
Pool Max Depth (ft)	-----	-----	-----	-----	-----	2.1	2.2	-----	2.4	-----	3	-----	3.1	-----	-----	-----	1	-----	3.3	-----	-----	-----	1	2.5	-----	-----	2.7	-----	3	-----	2.1	-----	-----	-----	2
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																			
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	-----	-----	<0.2 / 0.38 / 0.69 /26 / 67	-----	-----	-----	-----	-----	48 / N/A / 9.5/ 30 / N/A	-----	-----	-----	-----	-----	<0.062 / 3 / 8.8 / 42 / 90	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7 / 22.6 / 36 / 60 / 90	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	-----	0.5	-----	-----	0.76	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max part size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	-----	200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	175.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	-----	27.9	-----	-----	48.8	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	44	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																			
Drainage Area (SM)	25.7	7.2	-----	-----	-----	-----	-----	-----	0.5	-----	-----	-----	-----	-----	0.2	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	0.52	-----	-----	-----	-----	-----	0.52	-----	-----
Impervious cover estimate (%)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	C4	E	-----	-----	-----	-----	G5c	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----
BF Velocity (fps)²	3.9	2.6	-----	-----	-----	3.2	-----	-----	6.8	-----	3	-----	-----	-----	-----	-----	-----	-----	5.4	-----	-----	-----	-----	-----	3.9	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	1140	254	19.0	175.0	55.5	-----	50	-----	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	97.0	-----	-----	-----	-----	-----	50.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length (ft)	-----	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	405	-----	-----	-----
Channel length (ft)	850	-----	-----	-----	-----	-----	1016.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	415	-----	-----	-----
Sinuosity	1.06	-----	-----	-----	-----	-----	1.14	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	1.10	-----	-----	-----	-----	-----	1.02	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	-----	0.0101	-----	-----	-----	-----	-----	0.0109	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----	-----	0.0016	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF Slope (ft/ft)	0.0025	0.0008	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Banfull Floodplain Area (Acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

1. The rural region curve by Harman, etal. 1999 was used for these parameters.
2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

UT1B (1,065 LF)

Parameter	USGS Gauge	Regional Curve Interval			Pre-Existing Condition						Reference Reach(es) Data Sal's Branch						Reference Reach(es) Data Spencer Creek Downstream						Design						As-built					
		LL	UL	Eq.	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n	Min	Mean	Med	Max	SD	n
Dimension - Riffle																																			
BF Width (ft)	-----	-----	-----	-----	3.4	4.6	-----	5.7	-----	2.0	-----	8.7	-----	-----	-----	1	-----	10.7	-----	-----	-----	1	-----	7.0	-----	-----	-----	1	-----	7.0	-----	-----	-----	1
Floodprone Width (ft)	-----	-----	-----	-----	9.8	51.1	-----	92.5	-----	2.0	-----	163.0	-----	-----	-----	1	-----	60.0	-----	-----	-----	1	-----	30+	-----	-----	-----	16	-----	51.0	-----	-----	-----	1
BF Mean Depth (ft)	-----	-----	-----	-----	0.6	0.8	-----	1.0	-----	2.0	-----	1.2	-----	-----	-----	1	-----	1.6	-----	-----	-----	1	-----	0.5	-----	-----	-----	1	-----	0.5	-----	-----	-----	1
BF Max Depth (ft)	-----	-----	-----	-----	1.3	1.4	-----	1.6	-----	2.0	-----	2.4	-----	-----	-----	1	-----	2.1	-----	-----	-----	1	-----	0.8	-----	-----	-----	1	-----	1.1	-----	-----	-----	1
BF Cross-sectional Area (ft²)	-----	-----	-----	-----	3.4	3.5	-----	3.5	-----	2.0	-----	10.4	-----	-----	-----	1	-----	17.8	-----	-----	-----	1	-----	3.6	-----	-----	-----	1	-----	3.7	-----	-----	-----	1
Width/Depth Ratio	-----	-----	-----	-----	3.4	6.5	-----	9.5	-----	2.0	-----	7.3	-----	-----	-----	1	-----	5.7	-----	-----	-----	1	-----	13.8	-----	-----	-----	1	-----	13.3	-----	-----	-----	1
Entrenchment Ratio	-----	-----	-----	-----	2.9	9.5	-----	16.2	-----	2.0	-----	18.7	-----	-----	-----	1	-----	5.5	-----	-----	-----	1	-----	4.3+	-----	-----	-----	1	-----	7.3	-----	-----	-----	1
Bank Height Ratio	-----	-----	-----	-----	1.1	2.0	-----	4.5	-----	5+	-----	1.2	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1	-----	1.0	-----	-----	-----	1
d50 (mm)	-----	-----	-----	-----	-----	0.46	-----	-----	-----	-----	-----	9.5	-----	-----	-----	-----	-----	8.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pattern																																			
Channel Belt width (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	10	-----	-----	16	-----	4	38.3	-----	-----	40.8	-----	2	32.0	-----	-----	59.0	-----	16	28.0	43.5	41.5	57.0	8.9	14
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	13.1	-----	-----	29.6	-----	4	10.9	-----	-----	14.6	-----	5	14.0	-----	-----	24.0	-----	16	12.0	19.4	19.0	27.0	4.0	15
Rc:Bankfull Width (ft/ft)	-----	-----	-----	-----		-----	-----	-----	-----	-----	4.4	-----	-----	5.2	-----	3	1.3	-----	-----	1.4	-----	5	2.0	-----	-----	3.4	-----	16	1.7	2.8	2.7	3.9	0.6	15
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	38	-----	-----	45	-----	3	46	-----	-----	48	-----	2	58.0	-----	-----	134.0	-----	13	76.0	97.9	94.0	120.0	14.1	13
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.2	-----	-----	1.8	-----	4	3.4	-----	-----	3.6	-----	2	4.6	-----	-----	8.4	-----	16	4.0	6.2	5.9	8.1	1.3	14
Profile																																			
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	17.0	27.0	30.0	47.0	8.0	11
Riffle Slope (ft/ft)	-----	-----	-----	-----	0.033	0.127	-----	0.564	-----	19	0.03	-----	-----	0.04	-----	4	-----	0.013	-----	-----	-----	2	0.0198	-----	-----	0.0371	-----	12	0.010	0.030	0.020	0.040	0.009	11
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Pool Spacing (ft)	-----	-----	-----	-----	14.0	52.0	-----	110.0	-----	9	35.5	-----	-----	47	-----	3	-----	71	-----	-----	-----	5	42.0	-----	-----	105.0	-----	15	49	63	69	106	20	14
Pool Max Depth (ft)	-----	-----	-----	-----	1.3	1.5	-----	1.6	-----	2	-----	3.1	-----	-----	-----	1	-----	3.3	-----	-----	-----	1	1.0	-----	-----	2.0	-----	16	-----	1.6	-----	-----	-----	1
Pool Volume (ft³)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Substrate and Transport Parameters																																			
Ri% / Ru% / P% / G% / S%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
SC% / Sa% / G% / B% / Be%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
d16 / d35 / d50 / d84 / d95	-----	-----	-----	-----	-----	0.17 / 0.33 / 0.46 / 22 / 56	-----	-----	-----	-----	-----	-----	-----	48 / N/A / 9.5/ 30 / N/A	-----	-----	-----	-----	-----	<0.062 / 3 / 8.8 / 42 / 90	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1.25 / 35 / 49 / 80 / 90	-----	-----
Reach Shear Stress (competency) lb/f²	-----	-----	-----	-----	0.61	-----	-----	0.77	-----	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	0.4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Max Part Size (mm) mobilized at bankfull (Rosgen Curve)	-----	-----	-----	-----	-----	200.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	20.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Stream Power (transport capacity) W/m²	-----	-----	-----	-----	34.5	-----	-----	45.5	-----	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	22.8	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Additional Reach Parameters																																			
Drainage Area (SM)	-----	-----	-----	-----	-----	-----	-----	0.1	-----	-----	-----	-----	-----	0.2	-----	-----	-----	-----	-----	1.0	-----	-----	-----	-----	-----	0.08	-----	-----	-----	-----	-----	0.08	-----	-----
Impervious cover estimate (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Rosgen Classification	-----	-----	-----	-----	-----	E5	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	E4	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----	-----	C5	-----	-----	-----	-----
Bankfull Velocity (fps)²	-----	-----	-----	-----	4	-----	-----	4.1	-----	2	-----	-----	-----	-----	-----	-----	-----	5.4	-----	-----	-----	-----	-----	4.2	-----	-----	-----	1.0	-----	-----	-----	-----	-----	-----
BF Discharge (cfs)	-----	-----	-----	-----	-----	14	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	97.0	-----	-----	-----	-----	-----	14.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Valley Length (ft)	-----	-----	-----	-----	-----	822	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	816.0	-----	-----	-----	-----
Channel length (ft)	-----	-----	-----	-----	-----	970	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1035	-----	-----	-----	-----
Sinuosity	-----	-----	-----	-----	-----	1.18	-----	-----	-----	-----	-----	1.19	-----	-----	-----	-----	-----	2.30	-----	-----	-----	-----	-----	1.60	-----	-----	-----	-----	-----	1.27	-----	-----	-----	-----
Water Surface Slope (Channel) (ft/ft)	-----	-----	-----	-----	-----	0.0193	-----	-----	-----	-----	-----	0.0109	-----	-----	-----	-----	-----	0.0047	-----	-----	-----	-----	-----	0.0144	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Bankfull Floodplain Area (acres)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
BEHI VL% / L% / M% / H% / VH% / E%	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Channel Stability or Habitat Metric	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Biological or Other	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

2. An insufficent amount of water surface data was collected along this reach which resulted in not being able to accurately calculate water surface and bankfull velocity.

Table 7. Morphology and Hydraulic Monitoring Summary

South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251

South Muddy Creek (2,787 LF)

	Cross-section 1 (Riffle)						Cross-section 2 (Pool)						Cross-section 3 (Pool)						Cross-section 4 (Riffle)					
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																								
BF Width (ft)	41.4						42.1						44.2						42.2					
BF Mean Depth (ft)	2.7						2.8						2.9						2.8					
Width/Depth Ratio	15.5						15.3						15.4						15.4					
BF Cross-sectional Area (ft^2)	110.8						115.8						126.5						115.9					
BF Max Depth (ft)	4.4						5.1						4.5						4.2					
Width of Floodprone Area (ft)	90.7						85.6						95.3						93.6					
Entrenchment Ratio	2.2						N/A						N/A						2.2					
Bank Height Ratio	1.0						1.0						1.0						1.0					
Wetted Perimeter (ft)	46.8						47.6						49.9						47.7					
Hydraulic Radius (ft)	2.4						2.4						2.5						2.4					
Based on current/developing bankfull feature																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Cross Sectional Area between end pins (ft^2)	-						-																	
d50 (mm)	-						-																	
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Based on current/developing bankfull feature																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Cross Sectional Area between end pins (ft^2)																								
d50 (mm)																								

Table 7. Morphology and Hydraulic Monitoring Summary

South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251

South Fork Hoppers Creek Reach 1 (783 LF)

	Cross-section 5 (Riffle)						Cross-section 6 (Pool)																	
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																								
BF Width (ft)	13.1						14.6																	
BF Mean Depth (ft)	1.1						1.2																	
Width/Depth Ratio	11.5						11.8																	
BF Cross-sectional Area (ft^2)	15.0						18.0																	
BF Max Depth (ft)	1.7						2.4																	
Width of Floodprone Area (ft)	62.9						65.9																	
Entrenchment Ratio	4.8						N/A																	
Bank Height Ratio	1.0						1.0																	
Wetted Perimeter (ft)	15.4						17.1																	
Hydraulic Radius (ft)	1.0						1.1																	
Based on current/developing bankfull feature																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Cross Sectional Area between end pins (ft^2)	-						-						-						-					
d50 (mm)	-						-						-						-					
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Based on current/developing bankfull feature																								
BF Width (ft)																								
BF Mean Depth (ft)																								
Width/Depth Ratio																								
BF Cross-sectional Area (ft^2)																								
BF Max Depth (ft)																								
Width of Floodprone Area (ft)																								
Entrenchment Ratio																								
Bank Height Ratio																								
Wetted Perimeter (ft)																								
Hydraulic Radius (ft)																								
Cross Sectional Area between end pins (ft^2)	-																							
d50 (mm)	-																							

Table 7. Morphology and Hydraulic Monitoring Summary																							
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251																							
South Fork Hoppers Creek Reach 2 (445 LF)																							
	Cross-section 7 (Riffle)						Cross-section 8 (Pool)																
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																							
BF Width (ft)	13.3						17.5																
BF Mean Depth (ft)	1.0						0.9																
Width/Depth Ratio	13.1						19.0																
BF Cross-sectional Area (ft²)	13.5						16.0																
BF Max Depth (ft)	1.5						2.1																
Width of Floodprone Area (ft)	62.9						71.0																
Entrenchment Ratio	4.7						N/A																
Bank Height Ratio	1.0						1.0																
Wetted Perimeter (ft)	15.4						19.3																
Hydraulic Radius (ft)	0.9						0.8																
Based on current/developing bankfull feature																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Cross Sectional Area between end pins (ft²)	-						-						-						-				
d50 (mm)	-						-						-						-				
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Based on current/developing bankfull feature																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Cross Sectional Area between end pins (ft²)																							
d50 (mm)																							

Table 7. Morphology and Hydraulic Monitoring Summary																							
South Muddy Creek Mitigation Plan: EEP Project Nos. 737 and 92251																							
UT1B (1,065 LF)																							
	Cross-section 9 (Riffle)						Cross-section 10 (Pool)																
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																							
BF Width (ft)	7.0						10.2																
BF Mean Depth (ft)	0.5						0.8																
Width/Depth Ratio	13.3						13.3																
BF Cross-sectional Area (ft²)	3.7						7.9																
BF Max Depth (ft)	1.1						1.6																
Width of Floodprone Area (ft)	51.0						62.0																
Entrenchment Ratio	7.3						N/A																
Bank Height Ratio	1.0						1.0																
Wetted Perimeter (ft)	8.1						11.8																
Hydraulic Radius (ft)	0.5						0.7																
Based on current/developing bankfull feature																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Cross Sectional Area between end pins (ft²)	-						-																
d50 (mm)	-						-																
Dimension and substrate	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5	Base	MY1	MY2	MY3	MY4	MY5
Based on fixed baseline bankfull elevation																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Based on current/developing bankfull feature																							
BF Width (ft)																							
BF Mean Depth (ft)																							
Width/Depth Ratio																							
BF Cross-sectional Area (ft²)																							
BF Max Depth (ft)																							
Width of Floodprone Area (ft)																							
Entrenchment Ratio																							
Bank Height Ratio																							
Wetted Perimeter (ft)																							
Hydraulic Radius (ft)																							
Cross Sectional Area between end pins (ft²)																							
d50 (mm)																							

South Muddy Creek

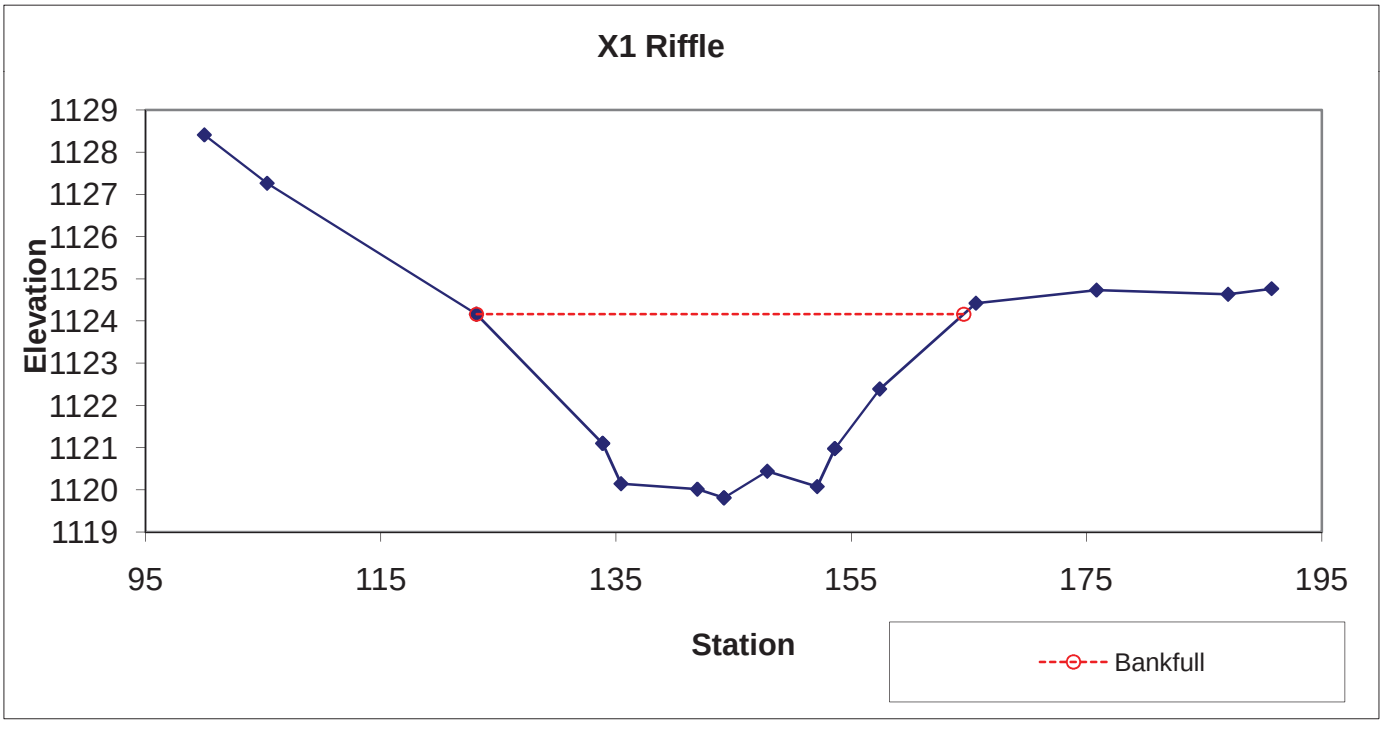
Permanent Cross Section X1

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	110.8	41.43	2.68	4.36	15.49	1	2.2	1124.16	1124.16



South Muddy Creek

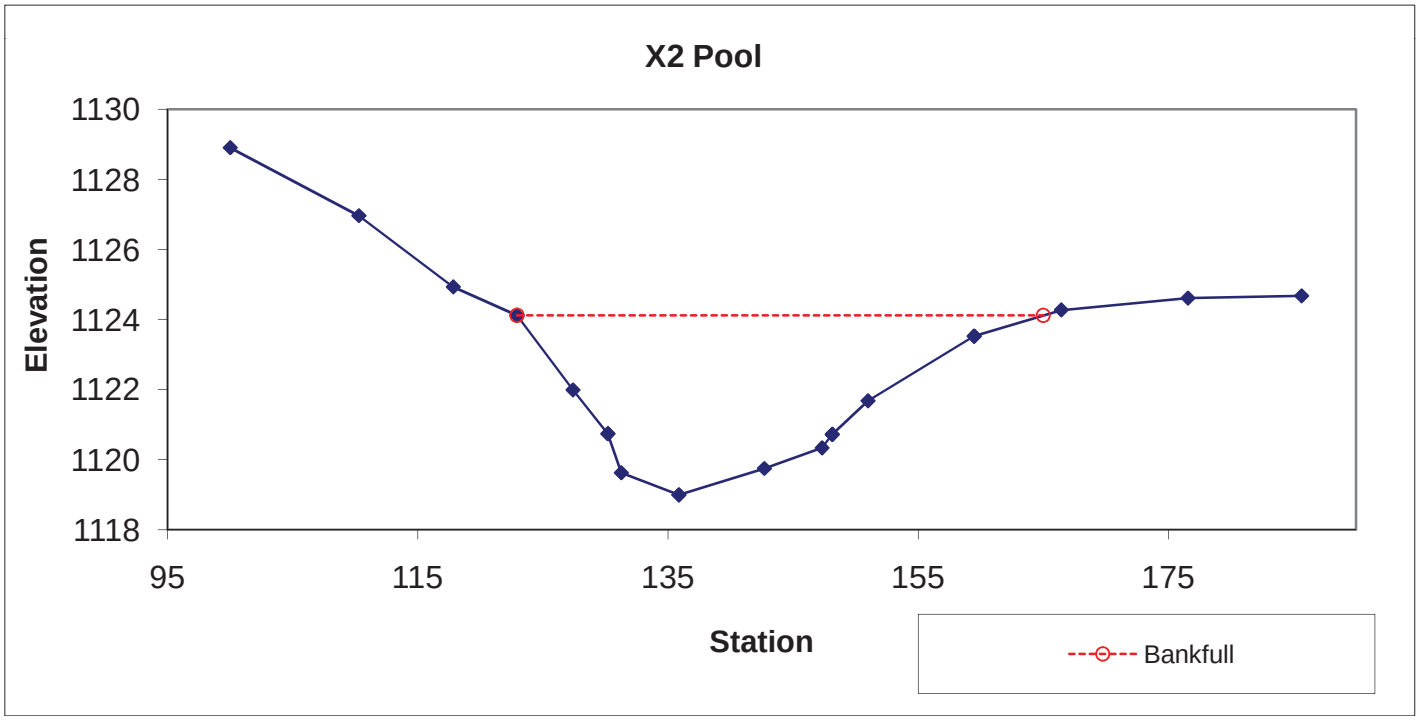
Permanent Cross Section X2

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		115.8	42.06	2.75	5.13	15.28	1		1124.12	1124.12



South Muddy Creek

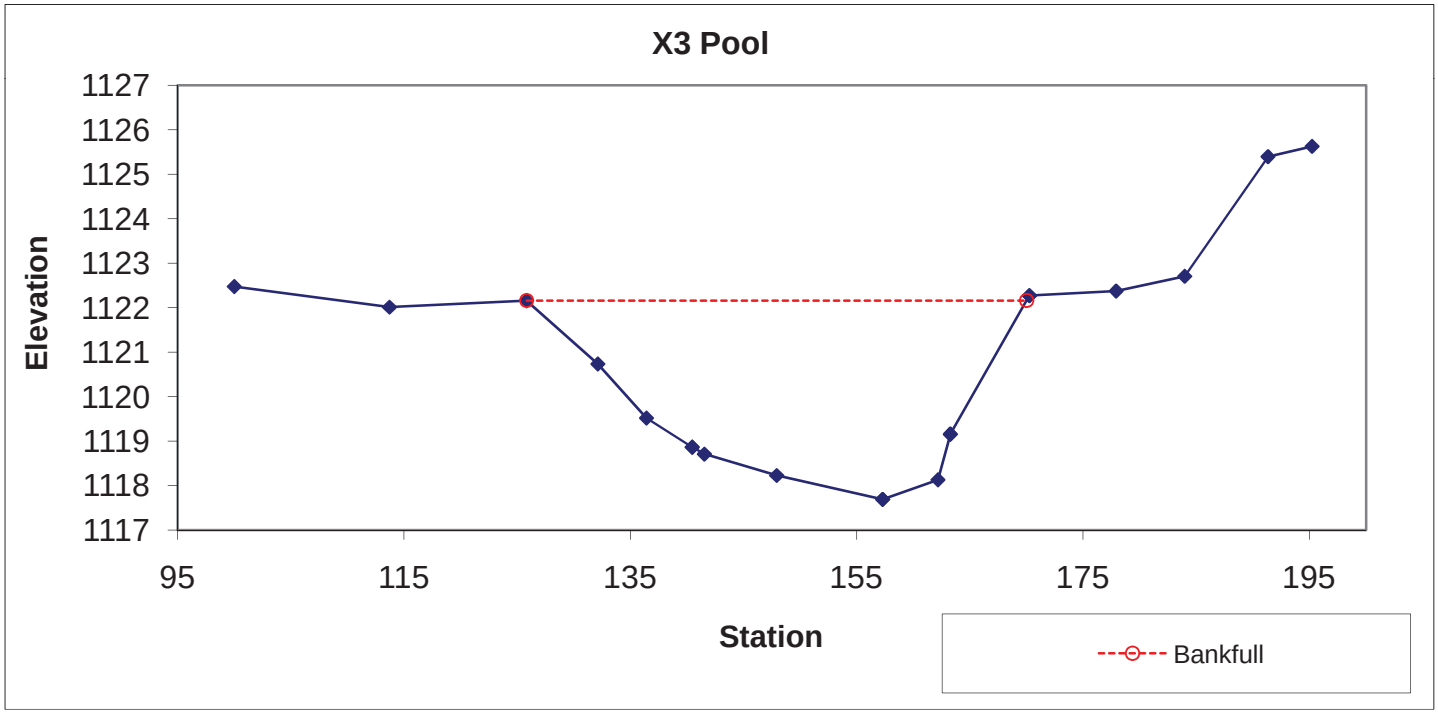
Permanent Cross Section X3

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		126.5	44.18	2.86	4.47	15.42	1		1122.2	1122.16



South Muddy Creek

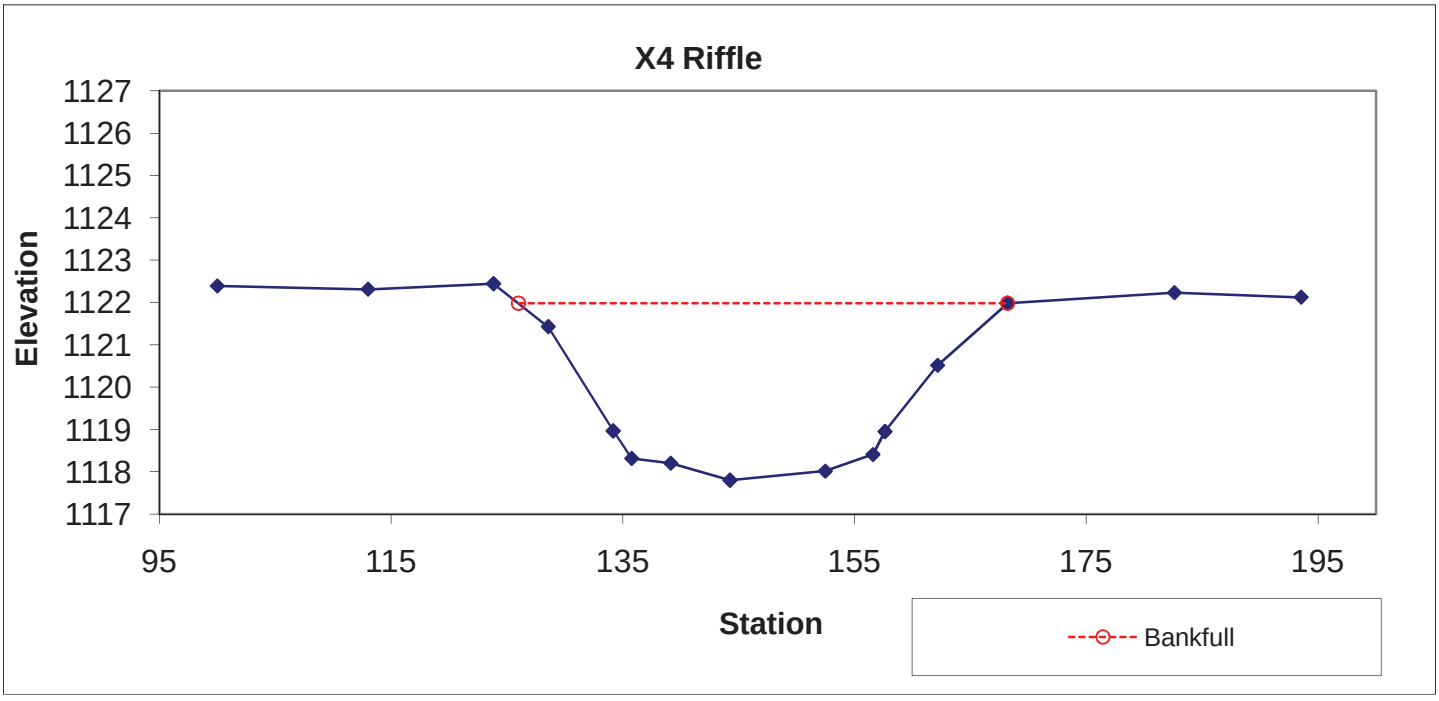
Permanent Cross Section X4

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	115.9	42.22	2.75	4.18	15.38	1	2.2	1121.98	1121.98



South Fork Hoppers Creek

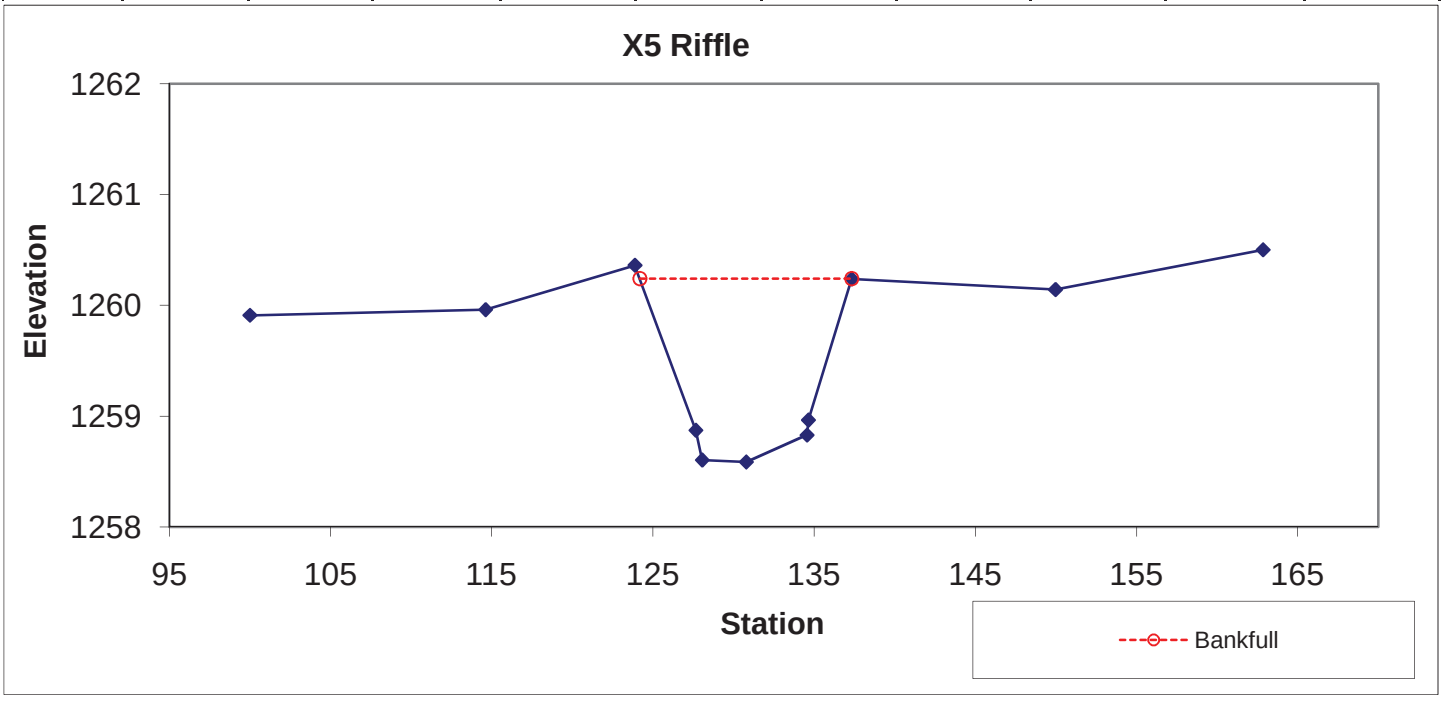
Permanent Cross Section X5

(As-built Data - collected September 2010)

LEFT BANK

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	15	13.14	1.14	1.65	11.49	1	4.8	1260.24	1260.24



South Fork Hoppers Creek

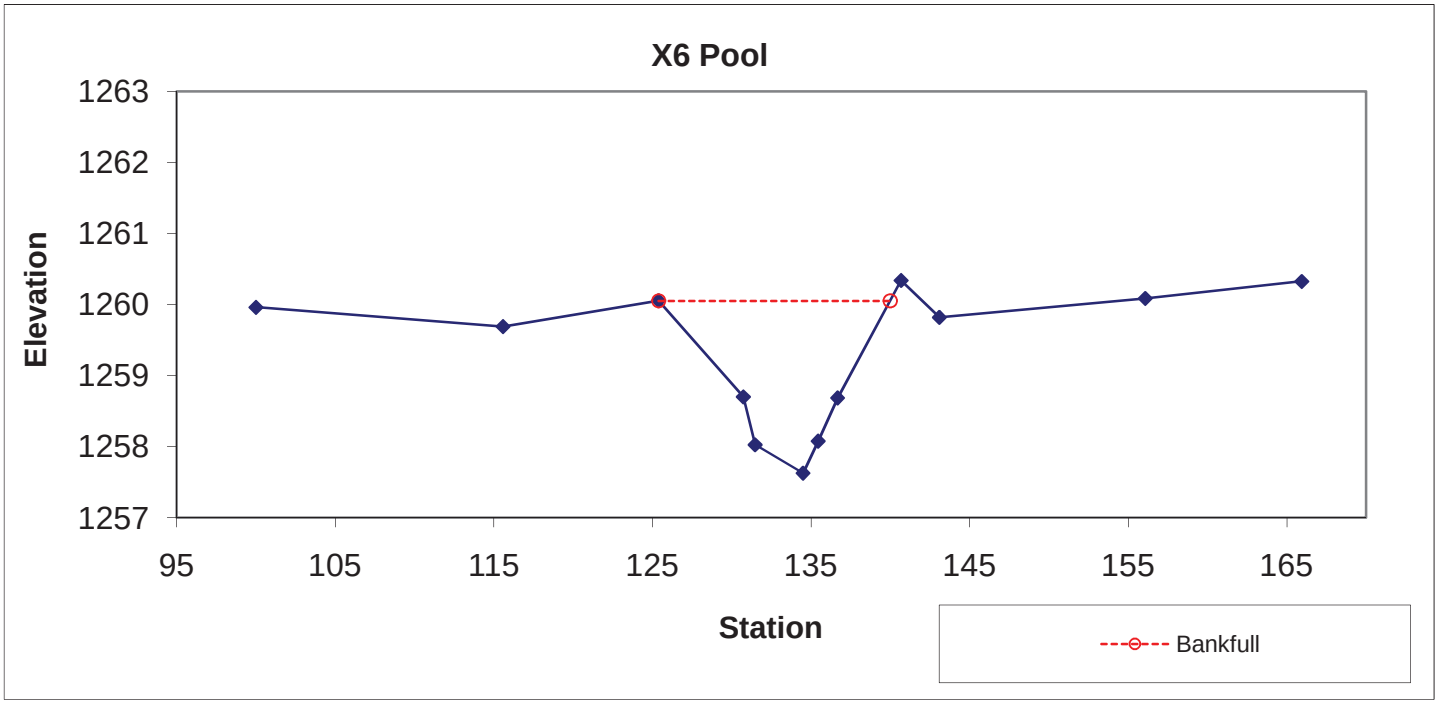
Permanent Cross Section X6

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		18	14.6	1.23	2.43	11.83	1		1260.05	1260.05



South Fork Hoppers Creek

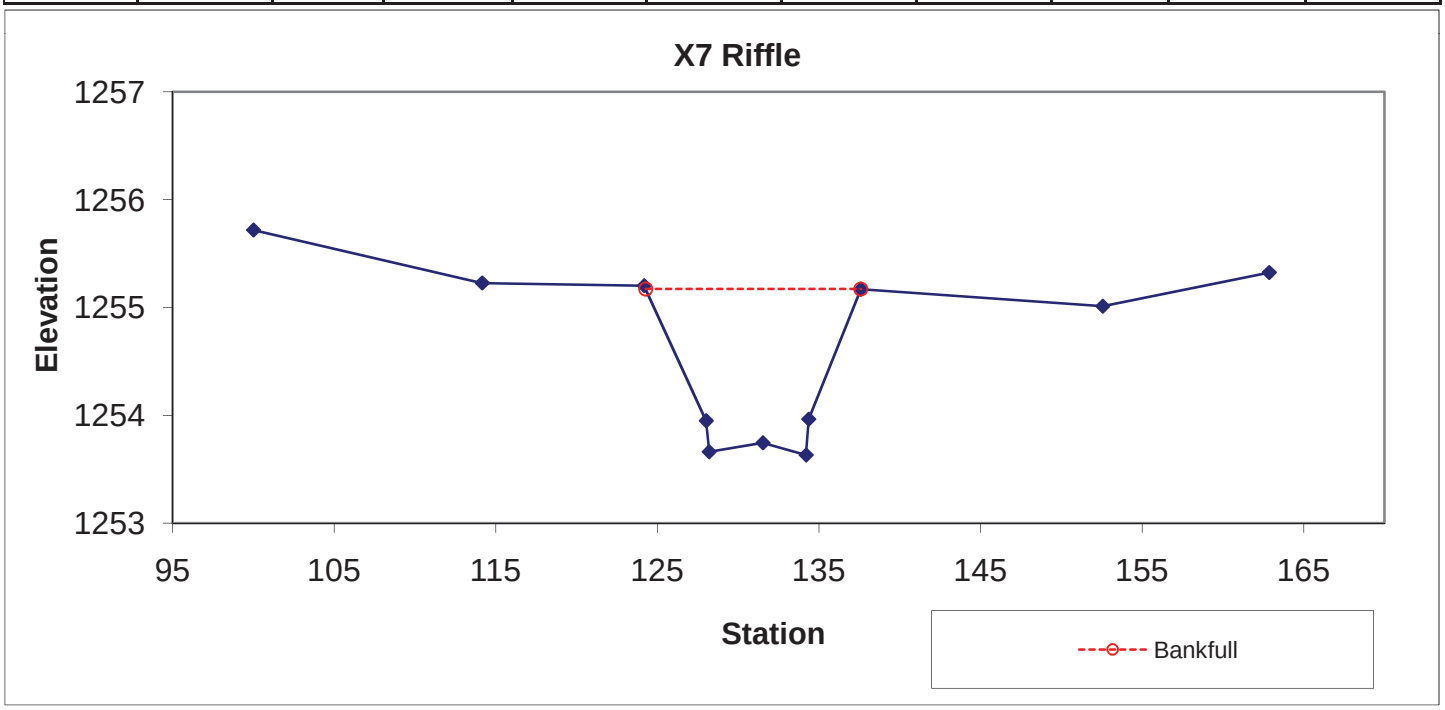
Permanent Cross Section X7

(As-built Data - collected September 2010)

LEFT BANK

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	13.5	13.31	1.02	1.54	13.1	1	4.7	1255.17	1255.17



South Fork Hoppers Creek

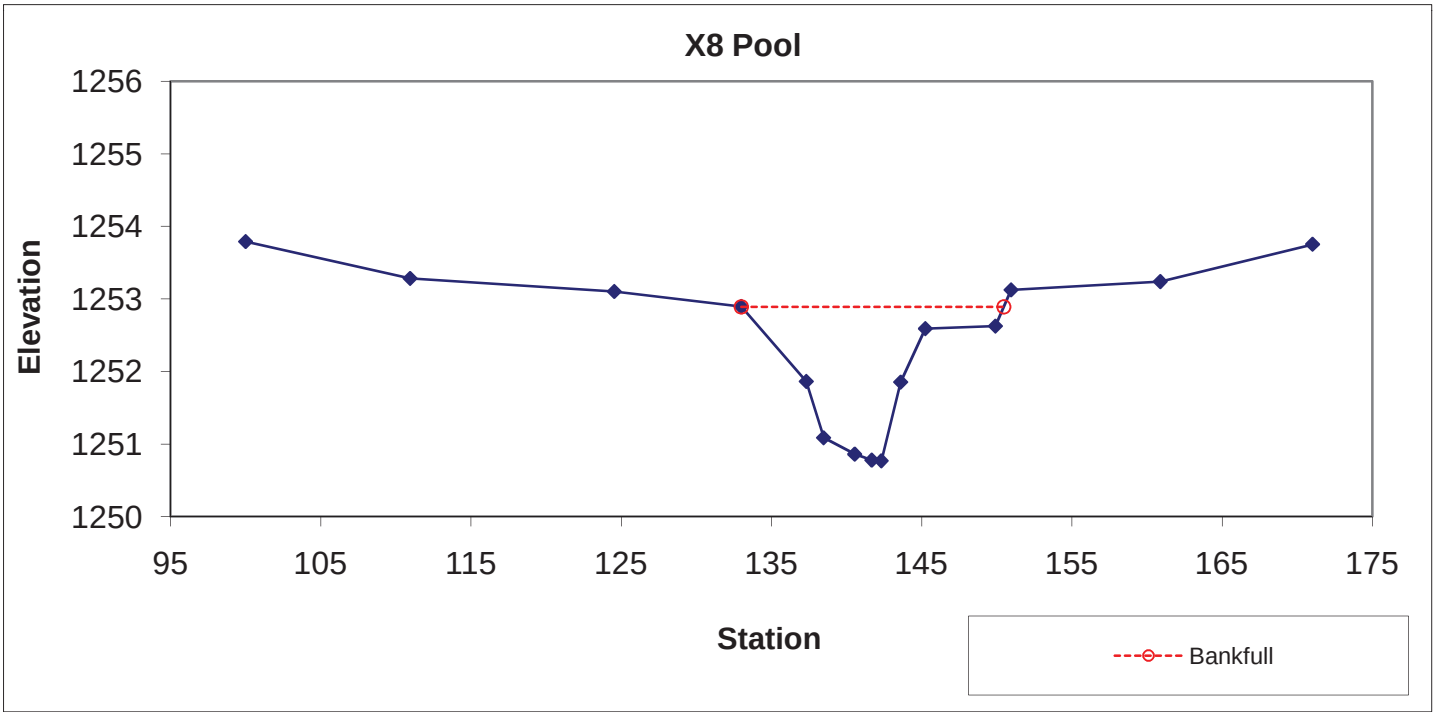
Permanent Cross Section X8

(As-built Data - collected September 2010)

LEFT BANK

RIGHT BANK

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		16	17.46	0.92	2.12	19.04	1		1252.89	1252.89



UT1

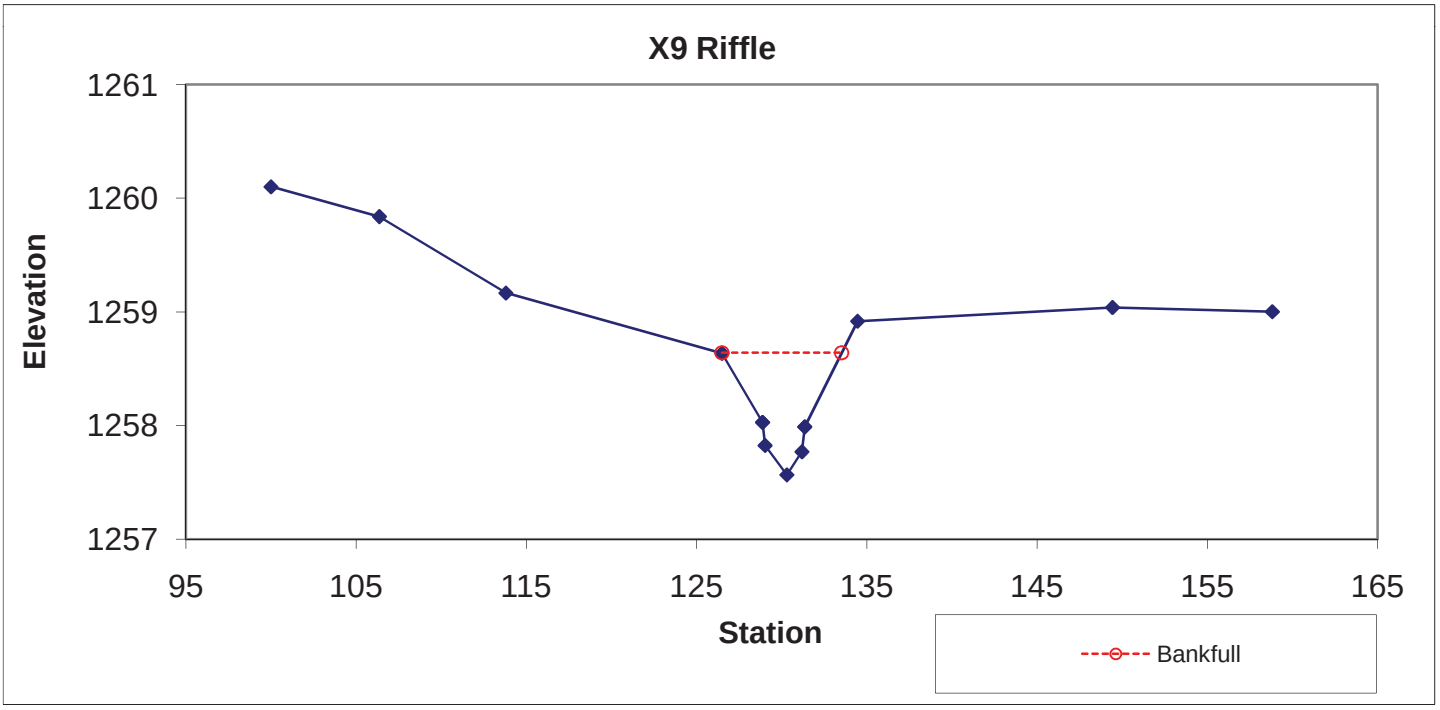
Permanent Cross Section X9

(As-built Data - collected September 2010)

LEFT BANK

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	3.7	7.02	0.53	1.07	13.28	1	7.3	1258.64	1258.64



UT1

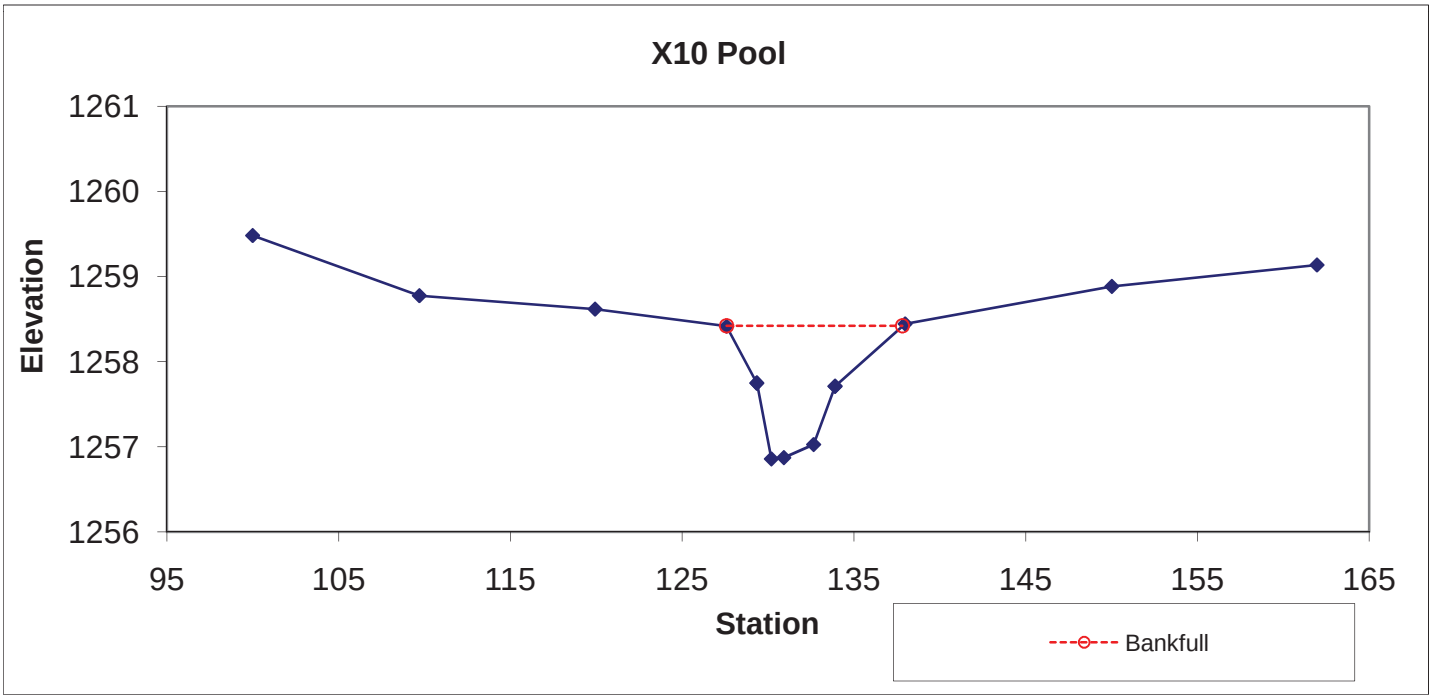
Permanent Cross Section X10

(As-built Data - collected September 2010)

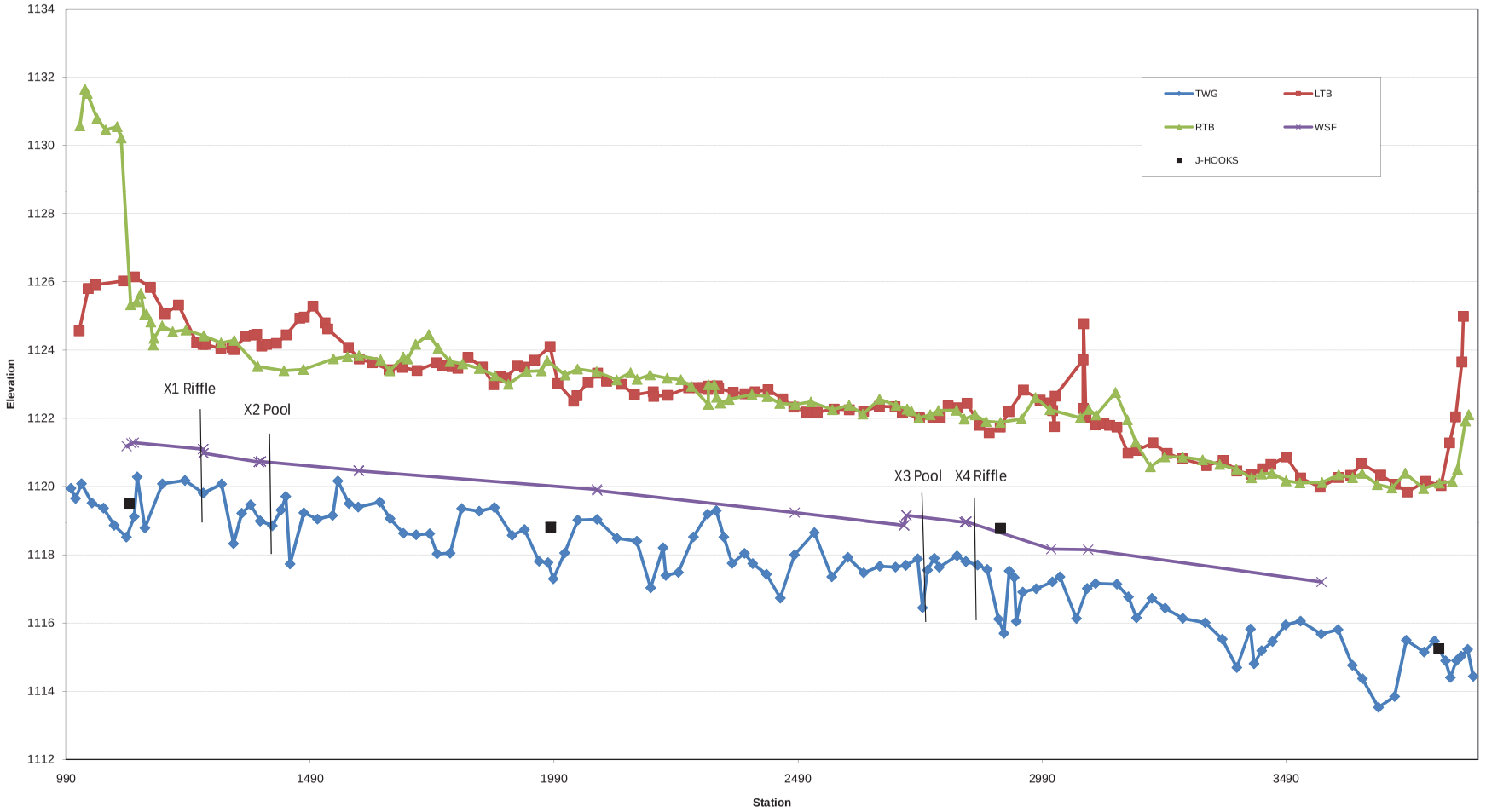
LEFT BANK

RIGHT BANK

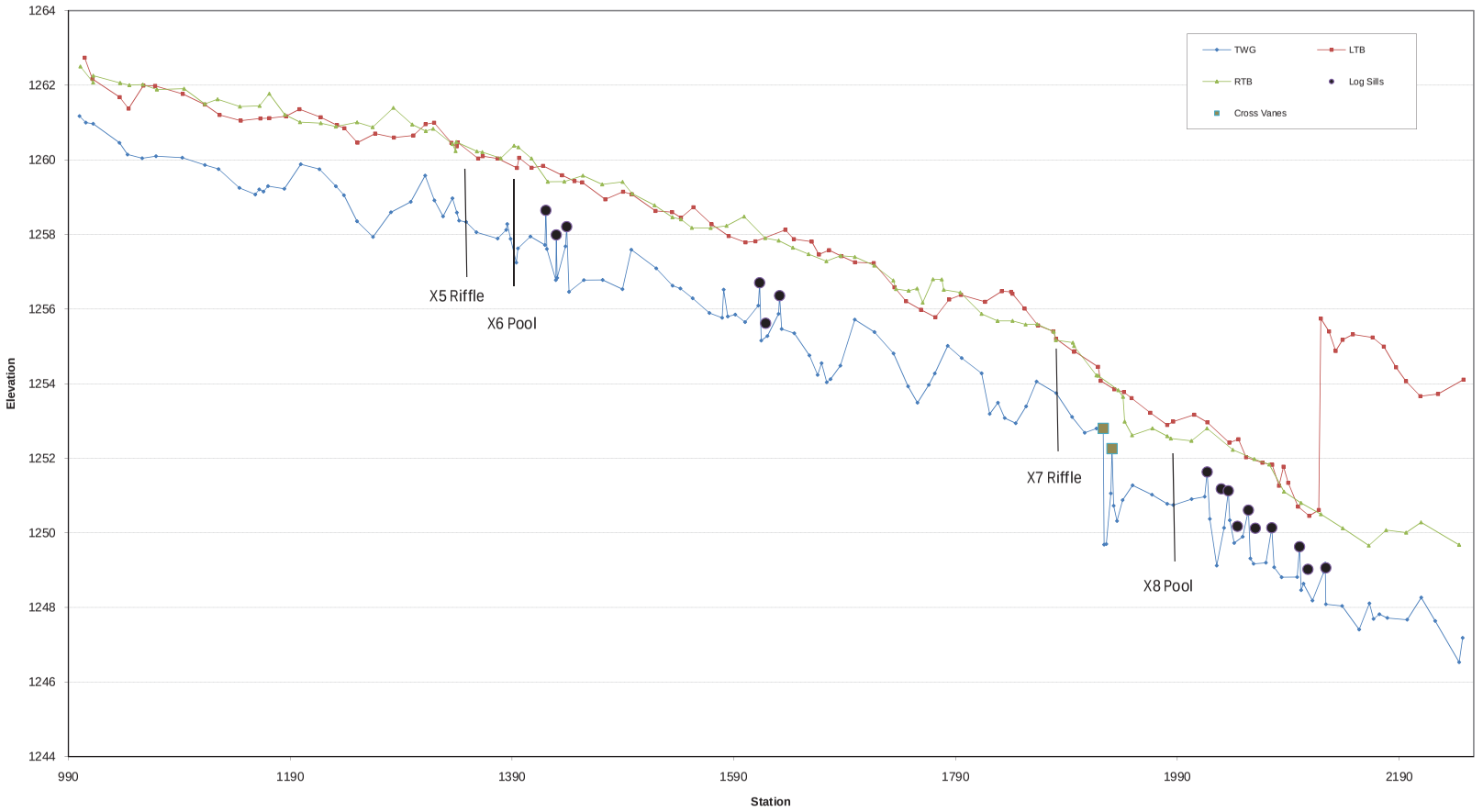
Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool		7.9	10.24	0.77	1.56	13.29	1		1258.42	1258.42



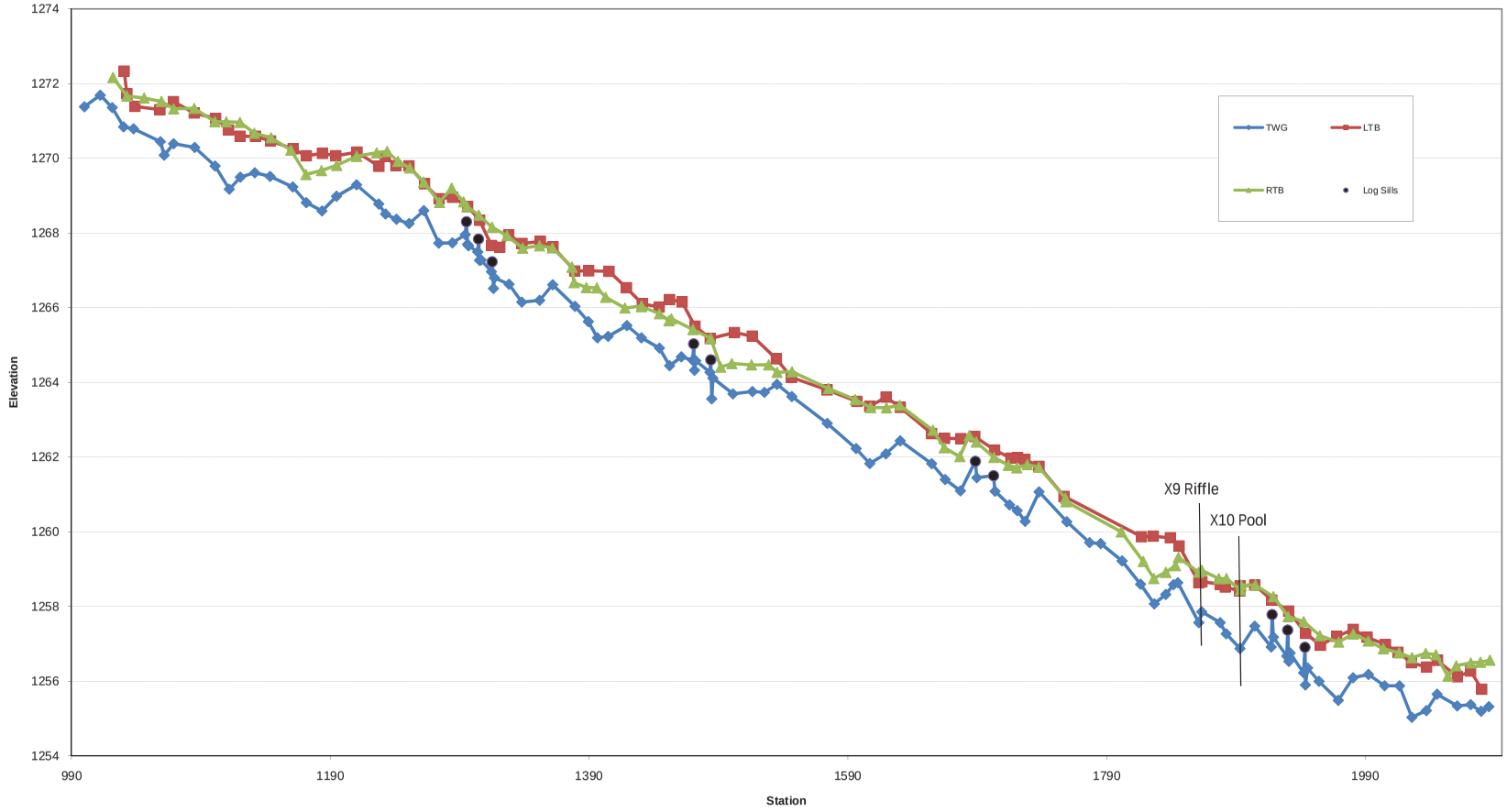
South Muddy Creek
Profile Chart
As-Built Survey - September 2010



South Fork Hoppers Creek
Profile Chart
As-Built Survey - September 2010



South Fork Hoppers Creek - UT1B
Profile Chart
As-Built Survey - September 2010



PEBBLE COUNT DATA SHEET: REACH-WIDE COUNT

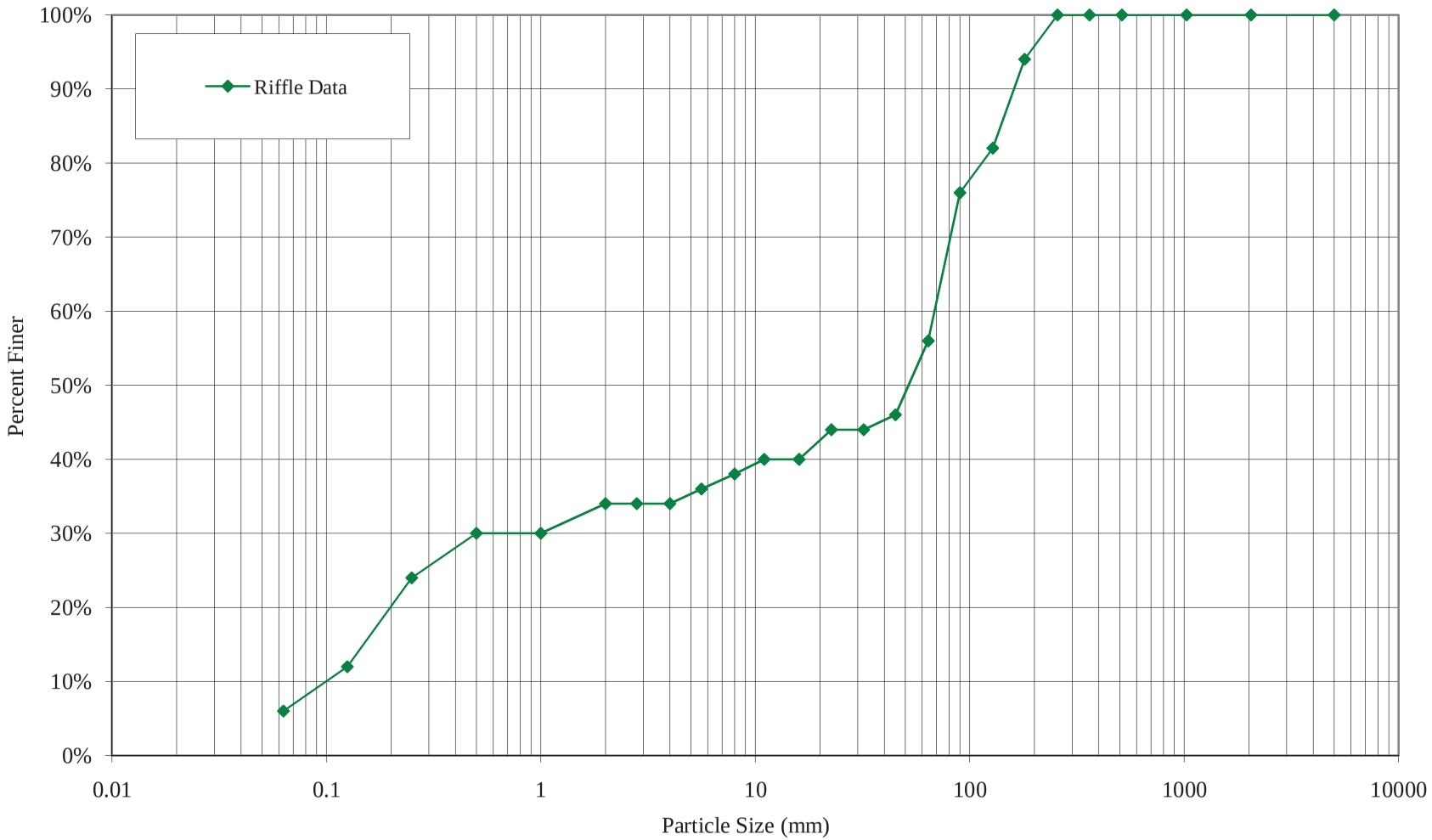
	BAKER PROJECT NO. 110650
SITE OR PROJECT:	South Muddy Creek Stream Restoration - Mitigation Plan
REACH/LOCATION:	South Muddy / Reachwide
DATE COLLECTED:	10/1/2010
FIELD COLLECTION BY:	P. Lynch & C. Tomsic
DATA ENTRY BY:	K. Suggs

			PARTICLE CLASS WEIGHT (g)			Reach Summary		Riffle Summary		Pool Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Pool	Total	Class %	% Cum	Class %	% Cum	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	3		3	6%	6%	6%	6%		
SAND	Very Fine	.063 - .125	3		3	6%	12%	6%	12%		
	Fine	.125 - .25	6		6	12%	24%	12%	24%		
	Medium	.25 - .50	3		3	6%	30%	6%	30%		
	Coarse	.50 - 1.0					30%		30%		
	Very Coarse	1.0 - 2.0	2		2	4%	34%	4%	34%		
GRAVEL	Very Fine	2.0 - 2.8					34%		34%		
	Very Fine	2.8 - 4.0					34%		34%		
	Fine	4.0 - 5.6	1		1	2%	36%	2%	36%		
	Fine	5.6 - 8.0	1		1	2%	38%	2%	38%		
	Medium	8.0 - 11.0	1		1	2%	40%	2%	40%		
	Medium	11.0 - 16.0					40%		40%		
	Coarse	16.0 - 22.6	2		2	4%	44%	4%	44%		
	Coarse	22.6 - 32					44%		44%		
	Very Coarse	32 - 45	1		1	2%	46%	2%	46%		
	Very Coarse	45 - 64	5		5	10%	56%	10%	56%		
COBBLE	Small	64 - 90	10		10	20%	76%	20%	76%		
	Small	90 - 128	3		3	6%	82%	6%	82%		
	Large	128 - 180	6		6	12%	94%	12%	94%		
	Large	180 - 256	3		3	6%	100%	6%	100%		
BOULDER	Small	256 - 362					100%		100%		
	Small	362 - 512					100%		100%		
	Medium	512 - 1024					100%		100%		
	Large-Very Large	1024 - 2048					100%		100%		
BEDROCK	Bedrock	> 2048					100%		100%		
		Total	50		50	100%	100%	100%	100%	0%	0%

Largest particles: 230 (riffle) _____ (pool) **mm**

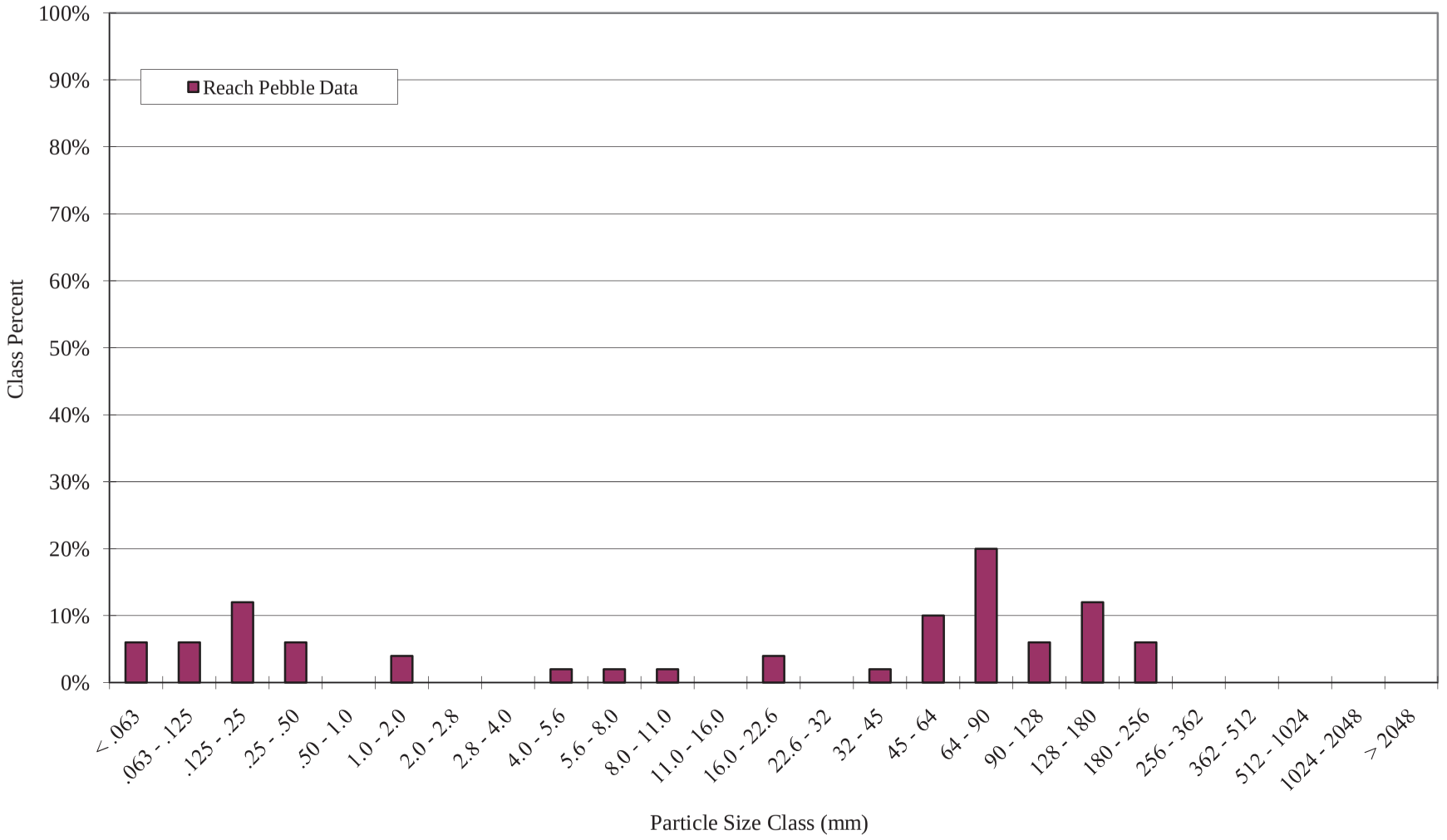
South Muddy - Mainstem

Pebble Count Particle Size Distributions



South Muddy - Mainstem

Reach Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: REACH-WIDE COUNT

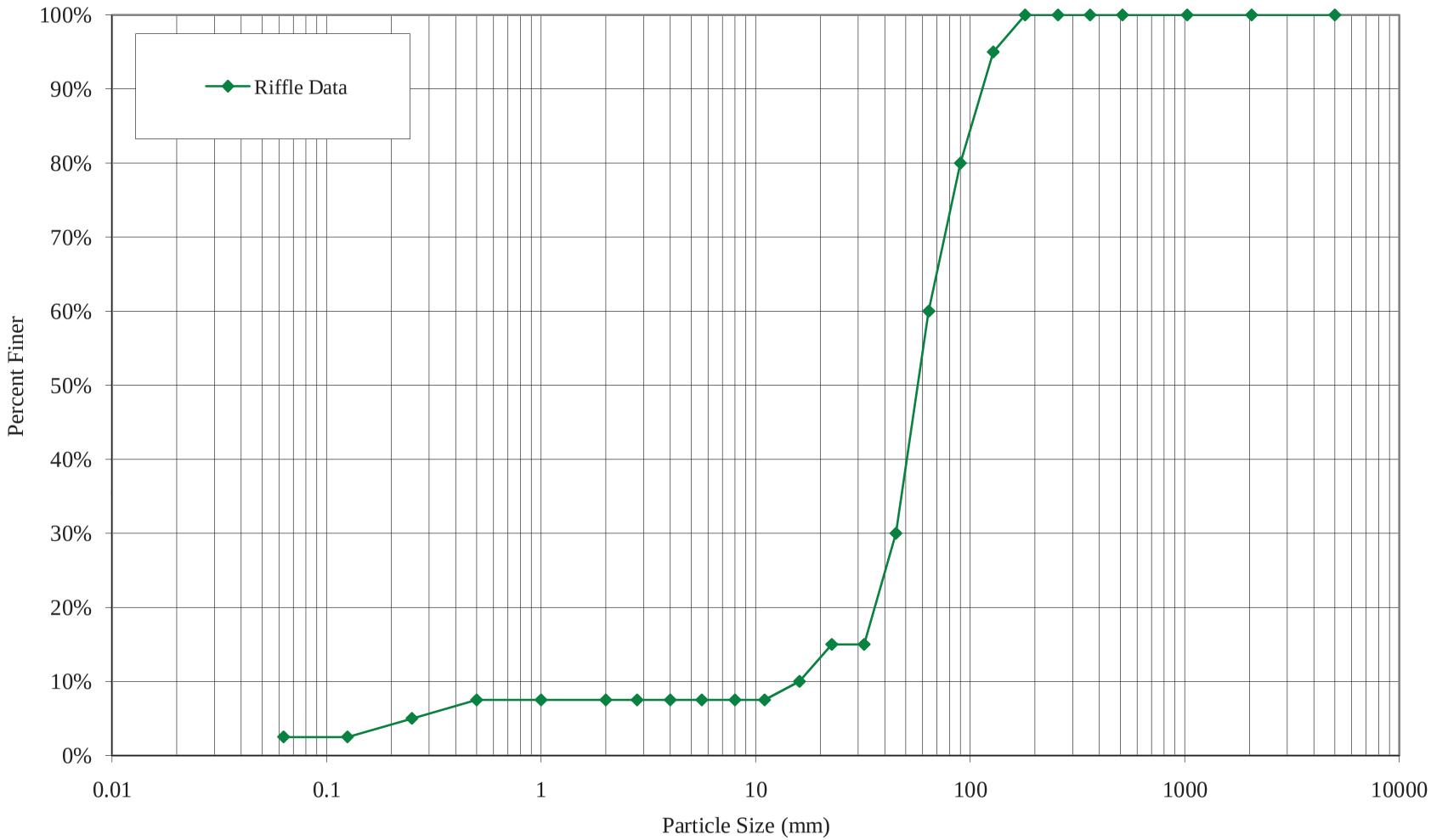
	BAKER PROJECT NO. 110650
SITE OR PROJECT:	South Muddy Creek Stream Restoration - Mitigation Plan
REACH/LOCATION:	South Fork Hoppers Reach 1 / Reachwide
DATE COLLECTED:	10/1/2010
FIELD COLLECTION BY:	P. Lynch & C. Tomsic
DATA ENTRY BY:	K. Suggs

			PARTICLE CLASS WEIGHT (g)			Reach Summary		Riffle Summary		Pool Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Pool	Total	Class %	% Cum	Class %	% Cum	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	1		1	3%	3%	3%	3%		
SAND	Very Fine	.063 - .125					3%		3%		
	Fine	.125 - .25	1		1	3%	5%	3%	5%		
	Medium	.25 - .50	1		1	3%	8%	3%	8%		
	Coarse	.50 - 1.0					8%		8%		
	Very Coarse	1.0 - 2.0					8%		8%		
GRAVEL	Very Fine	2.0 - 2.8					8%		8%		
	Very Fine	2.8 - 4.0					8%		8%		
	Fine	4.0 - 5.6					8%		8%		
	Fine	5.6 - 8.0					8%		8%		
	Medium	8.0 - 11.0					8%		8%		
	Medium	11.0 - 16.0	1		1	3%	10%	3%	10%		
	Coarse	16.0 - 22.6	2		2	5%	15%	5%	15%		
	Coarse	22.6 - 32					15%		15%		
	Very Coarse	32 - 45	6		6	15%	30%	15%	30%		
	Very Coarse	45 - 64	12		12	30%	60%	30%	60%		
COBBLE	Small	64 - 90	8		8	20%	80%	20%	80%		
	Small	90 - 128	6		6	15%	95%	15%	95%		
	Large	128 - 180	2		2	5%	100%	5%	100%		
	Large	180 - 256					100%		100%		
BOULDER	Small	256 - 362					100%		100%		
	Small	362 - 512					100%		100%		
	Medium	512 - 1024					100%		100%		
	Large-Very Large	1024 - 2048					100%		100%		
BEDROCK	Bedrock	> 2048					100%		100%		
		Total	40		40	100%	100%	100%	100%		

Largest particles: _____ (riffle) _____ (pool) **mm**

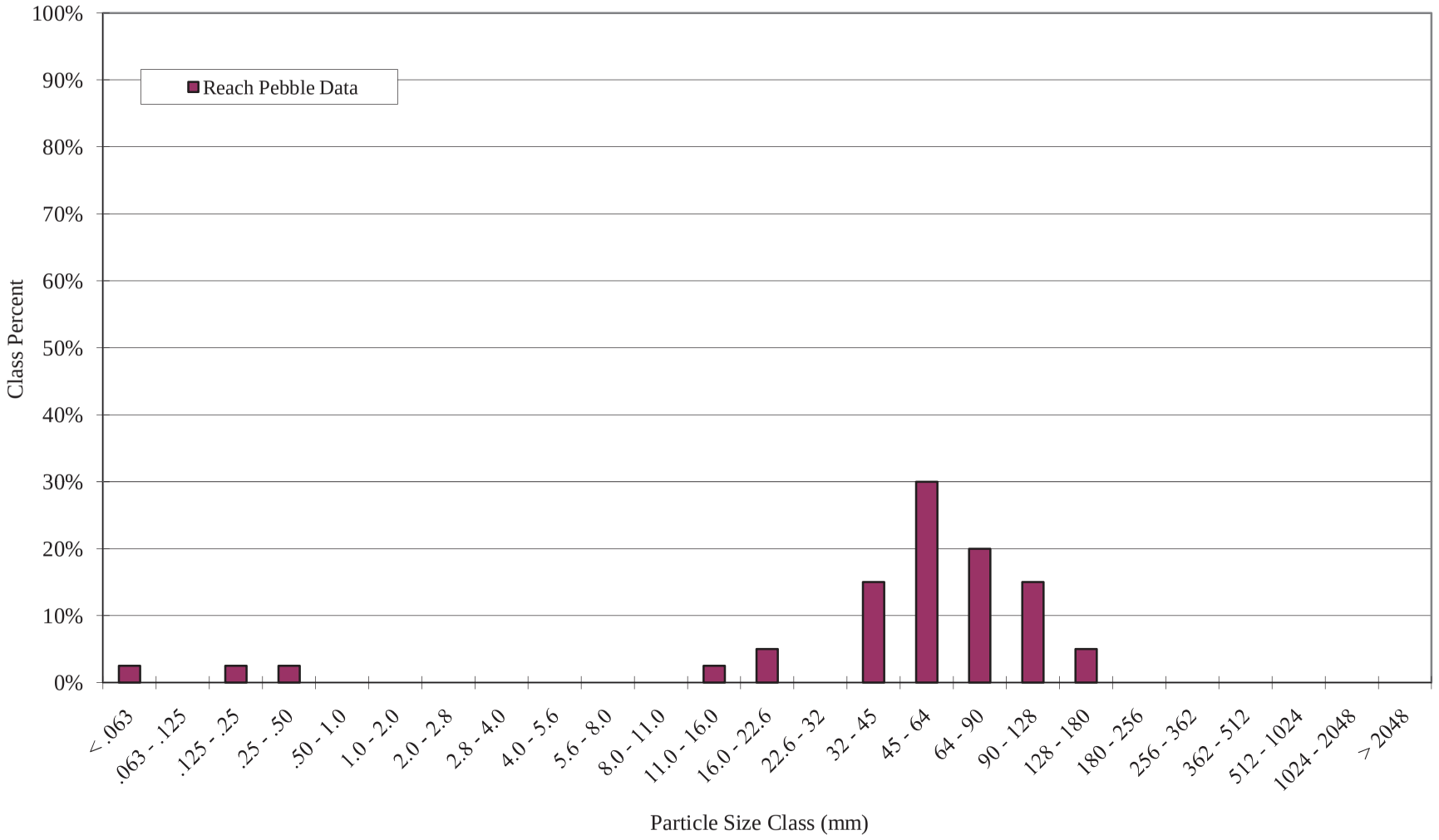
South Fork Hoppers - Reach1

Pebble Count Particle Size Distributions



South Fork Hoppers - Reach 1

Reach Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: REACH-WIDE COUNT

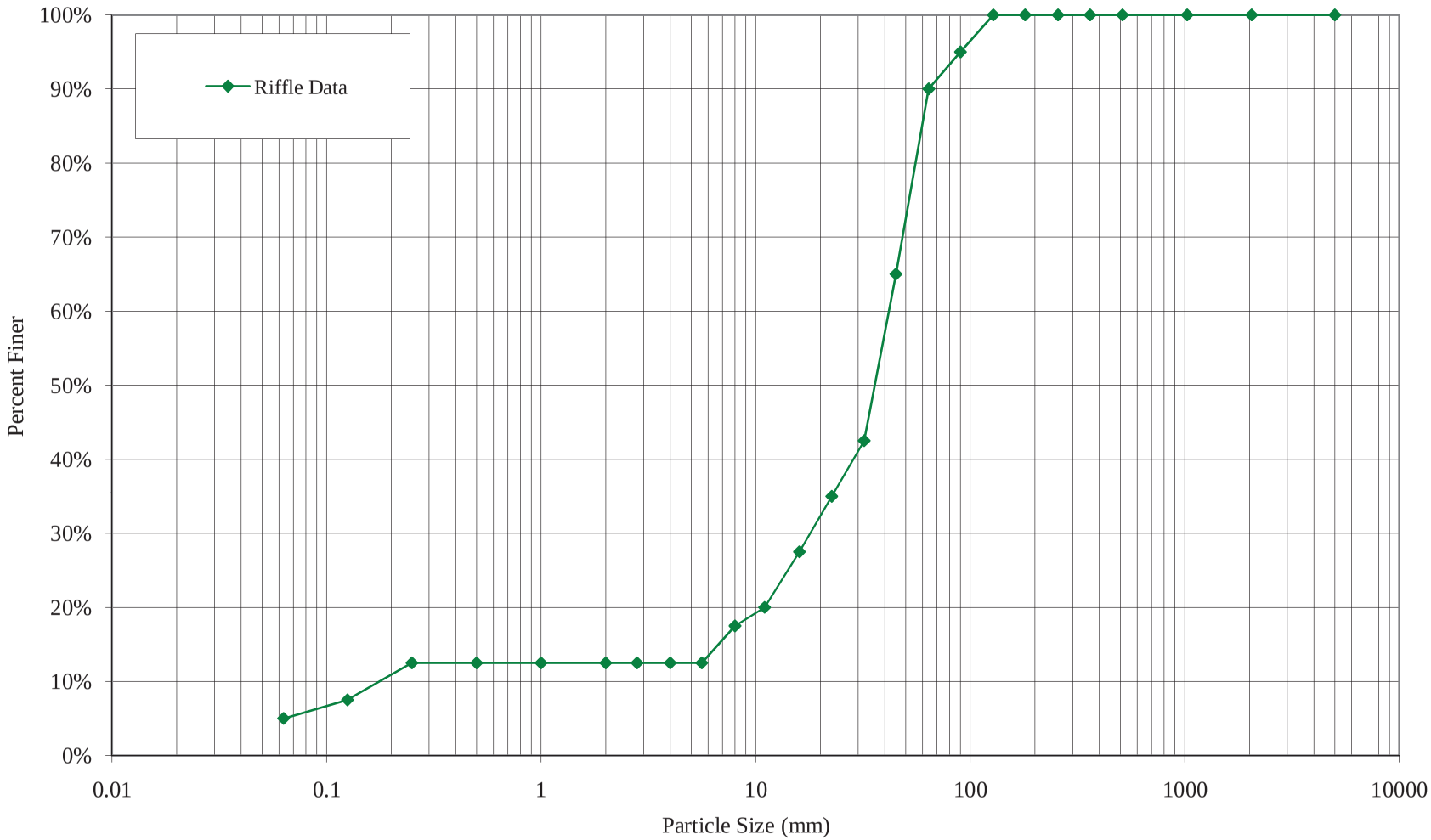
	BAKER PROJECT NO. 110650
SITE OR PROJECT:	South Muddy Creek Stream Restoration - Mitigation Plan
REACH/LOCATION:	South Fork Hoppers Reach 2 / Reachwide
DATE COLLECTED:	10/1/2010
FIELD COLLECTION BY:	P. Lynch & C. Tomsic
DATA ENTRY BY:	K. Suggs

			PARTICLE CLASS WEIGHT (g)			Reach Summary		Riffle Summary		Pool Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Pool	Total	Class %	% Cum	Class %	% Cum	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	2		2	5%	5%	5%	5%		
SAND	Very Fine	.063 - .125	1		1	3%	8%	3%	8%		
	Fine	.125 - .25	2		2	5%	13%	5%	13%		
	Medium	.25 - .50					13%		13%		
	Coarse	.50 - 1.0					13%		13%		
	Very Coarse	1.0 - 2.0					13%		13%		
GRAVEL	Very Fine	2.0 - 2.8					13%		13%		
	Very Fine	2.8 - 4.0					13%		13%		
	Fine	4.0 - 5.6					13%		13%		
	Fine	5.6 - 8.0	2		2	5%	18%	5%	18%		
	Medium	8.0 - 11.0	1		1	3%	20%	3%	20%		
	Medium	11.0 - 16.0	3		3	8%	28%	8%	28%		
	Coarse	16.0 - 22.6	3		3	8%	35%	8%	35%		
	Coarse	22.6 - 32	3		3	8%	43%	8%	43%		
	Very Coarse	32 - 45	9		9	23%	65%	23%	65%		
	Very Coarse	45 - 64	10		10	25%	90%	25%	90%		
COBBLE	Small	64 - 90	2		2	5%	95%	5%	95%		
	Small	90 - 128	2		2	5%	100%	5%	100%		
	Large	128 - 180					100%		100%		
	Large	180 - 256					100%		100%		
BOULDER	Small	256 - 362					100%		100%		
	Small	362 - 512					100%		100%		
	Medium	512 - 1024					100%		100%		
	Large-Very Large	1024 - 2048					100%		100%		
BEDROCK	Bedrock	> 2048					100%		100%		
		Total	**40**		**40**	**100%**	**100%**	**100%**	**100%**		

Largest particles: ____ (riffle) ____ (pool) **mm**

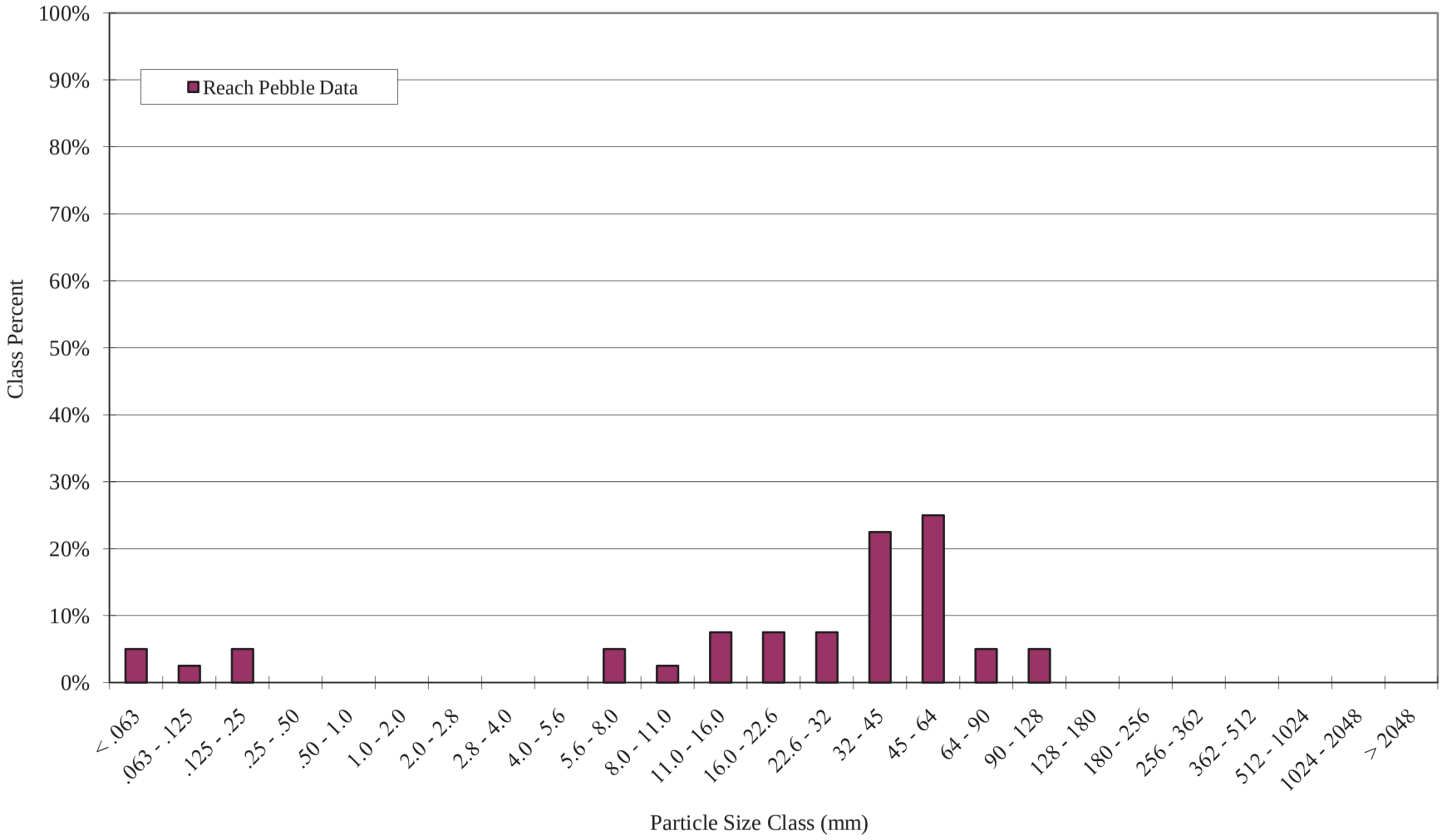
South Fork Hoppers - Reach 2

Pebble Count Particle Size Distributions



South Fork Hoppers - Reach 2

Reach Pebble Count Size Class Distribution



PEBBLE COUNT DATA SHEET: REACH-WIDE COUNT

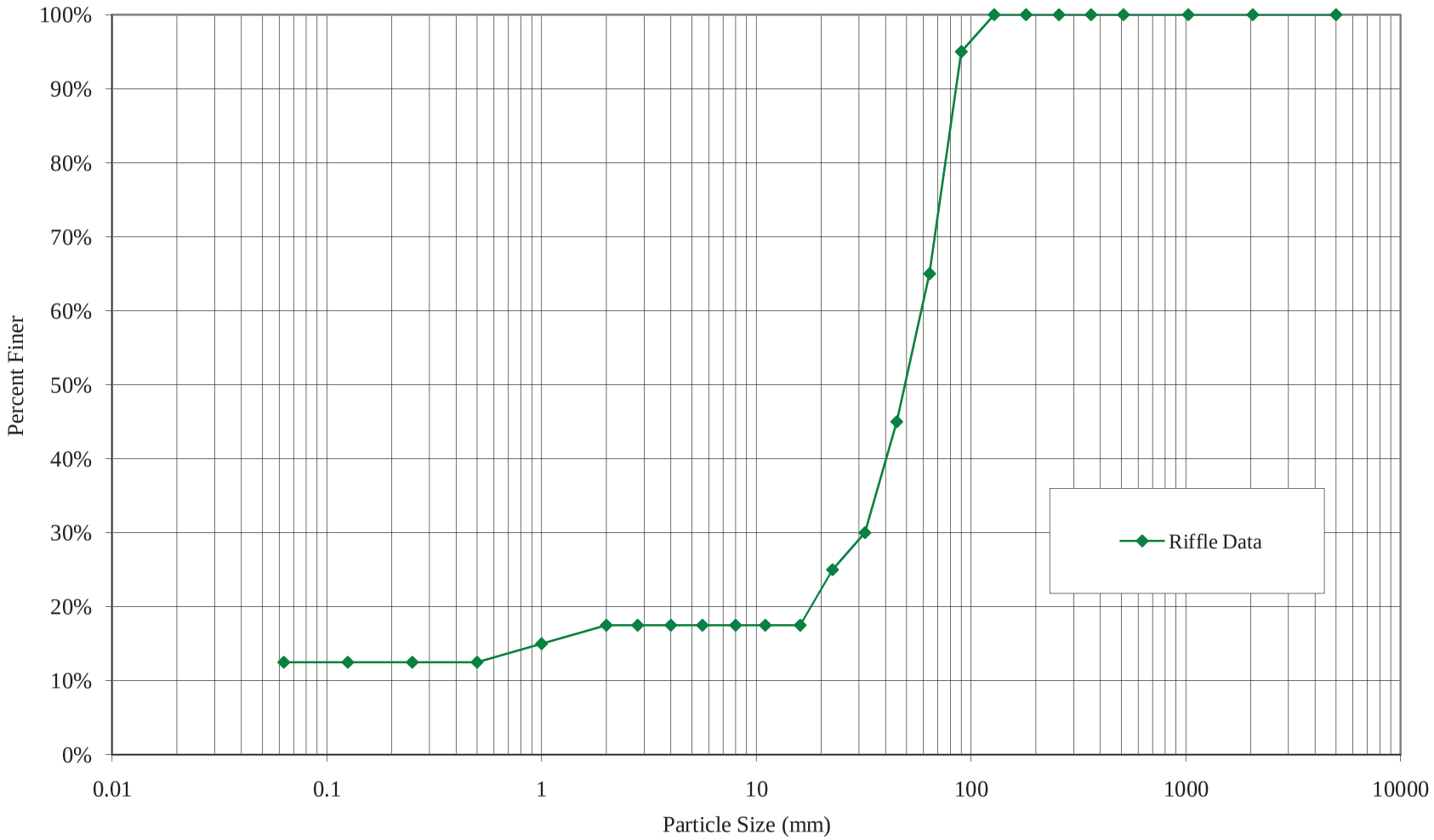
	BAKER PROJECT NO. 110650
SITE OR PROJECT:	South Muddy Creek Stream Restoration - Mitigation Plan
REACH/LOCATION:	South Fork Hoppers UT1B / Reachwide
DATE COLLECTED:	10/1/2010
FIELD COLLECTION BY:	P. Lynch & C. Tomsic
DATA ENTRY BY:	K. Suggs

			PARTICLE CLASS WEIGHT (g)			Reach Summary		Riffle Summary		Pool Summary	
MATERIAL	PARTICLE	SIZE (mm)	Riffle	Pool	Total	Class %	% Cum	Class %	% Cum	Class %	% Cum
SILT/CLAY	Silt / Clay	< .063	5		5	13%	13%	13%	13%		
SAND	Very Fine	.063 - .125					13%		13%		
	Fine	.125 - .25					13%		13%		
	Medium	.25 - .50					13%		13%		
	Coarse	.50 - 1.0	1		1	3%	15%	3%	15%		
	Very Coarse	1.0 - 2.0	1		1	3%	18%	3%	18%		
GRAVEL	Very Fine	2.0 - 2.8					18%		18%		
	Very Fine	2.8 - 4.0					18%		18%		
	Fine	4.0 - 5.6					18%		18%		
	Fine	5.6 - 8.0					18%		18%		
	Medium	8.0 - 11.0					18%		18%		
	Medium	11.0 - 16.0					18%		18%		
	Coarse	16.0 - 22.6	3		3	8%	25%	8%	25%		
	Coarse	22.6 - 32	2		2	5%	30%	5%	30%		
	Very Coarse	32 - 45	6		6	15%	45%	15%	45%		
	Very Coarse	45 - 64	8		8	20%	65%	20%	65%		
COBBLE	Small	64 - 90	12		12	30%	95%	30%	95%		
	Small	90 - 128	2		2	5%	100%	5%	100%		
	Large	128 - 180					100%		100%		
	Large	180 - 256					100%		100%		
BOULDER	Small	256 - 362					100%		100%		
	Small	362 - 512					100%		100%		
	Medium	512 - 1024					100%		100%		
	Large-Very Large	1024 - 2048					100%		100%		
BEDROCK	Bedrock	> 2048					100%		100%		
		Total	**40**	**0**	**40**	**100%**	**100%**	**100%**	**100%**		

Largest particles: _____ (riffle) _____ (pool) **mm**

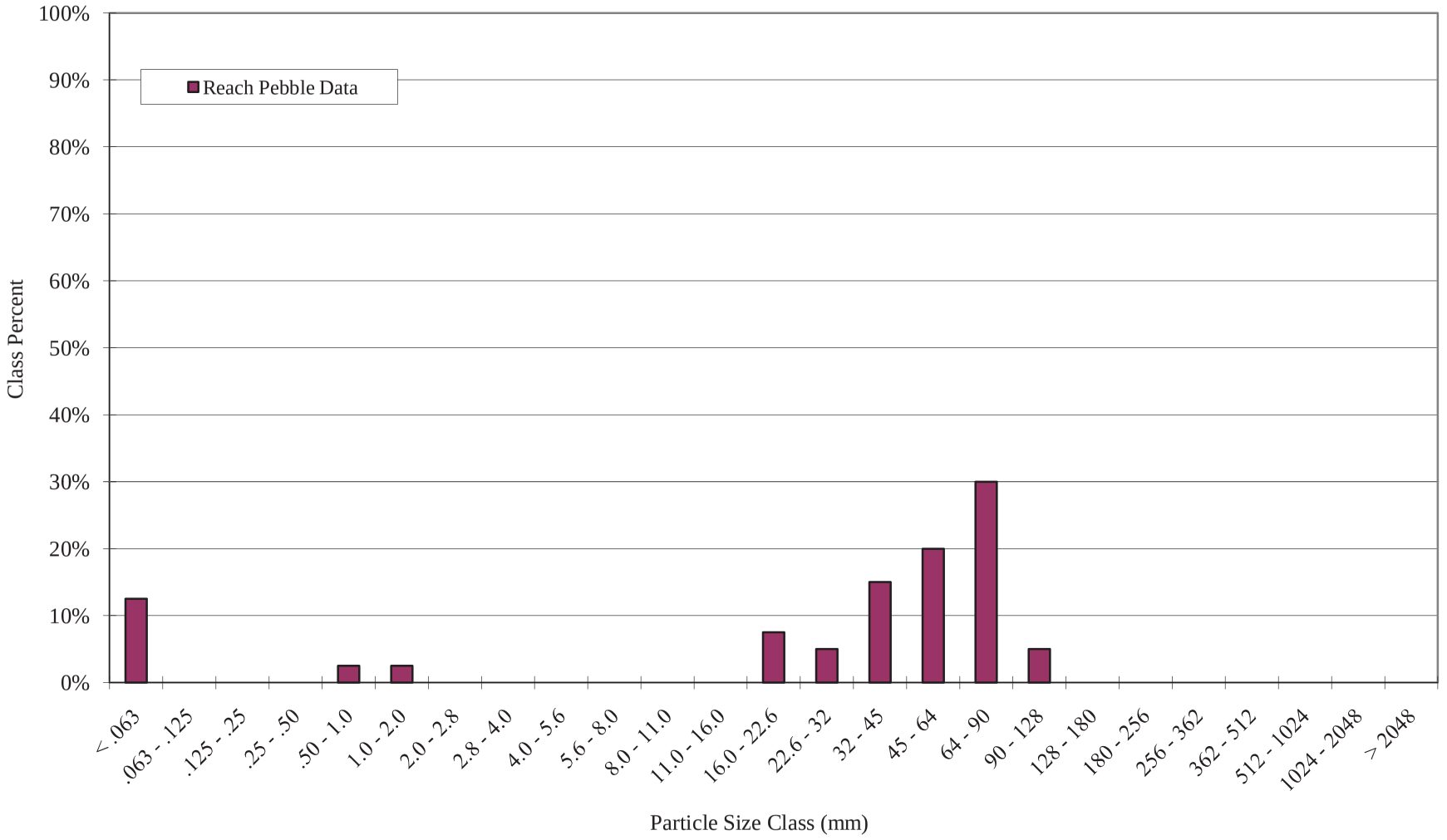
South Fork Hoppers - UT1B

Pebble Count Particle Size Distributions



South Fork Hoppers - UT1B

Reach Pebble Count Size Class Distribution



Appendix C

LOMR

South Muddy Creek Stream Restoration

McDowell County, North Carolina

Application for:

Letter of Map Revision (LOMR)

Prepared For:

N.C. Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared By:

Michael Baker Engineering, Inc.
1447 South Tryon Street
Suite 200
Charlotte, NC 28203
Phone: 704.334.4454
Fax: 704.334.4492

March 9, 2011

Table of Contents

Letter of Map Revision
South Muddy Creek Stream Restoration

1447 South Tryon Street
Suite 200
Charlotte, North Carolina

Phone: 704-334-4454
Fax: 704-334-4492

March 9, 2011

Jerry Silvers, Chief Building Inspector
McDowell County Administration Bldg.
60 East Court Street
Marion, NC 28752

RE: Application Package for FEMA Letter of Map Revision (LOMR)
South Muddy Creek Stream Restoration Project

Dear Mr. Silvers:

Michael Baker Engineering, Inc. (Baker) has been contracted by the NC Ecosystem Enhancement Program (NC EEP) to prepare a Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR) package for the South Muddy Creek Stream Restoration Project in McDowell County, NC. The project encompasses approximately 2,800 linear feet of South Muddy Creek from approximately 850 feet downstream of Sain Road to approximately 2,600 feet upstream of Sain Road.

This LOMR application is the follow up to a No-rise certification and hydraulic analysis report dated April 10, 2009. This LOMR application is based on the post construction as-built conditions from the stream restoration project. Construction along the South Muddy Creek reach was completed in late February 2011.

As the floodplain administrator for McDowell County, we ask that you review the contents, sign the Community Acknowledgement portion of Section D of the "Overview and Concurrence Form", and return this package to us for submittal to FEMA.

If you have any questions regarding this submittal, please contact me at (704) 319-7894 or by email at khiggins@mbakercorp.com.

Sincerely,

Kevin Higgins

Kevin Higgins, PE, CFM
Water Resources Engineer

Enclosures

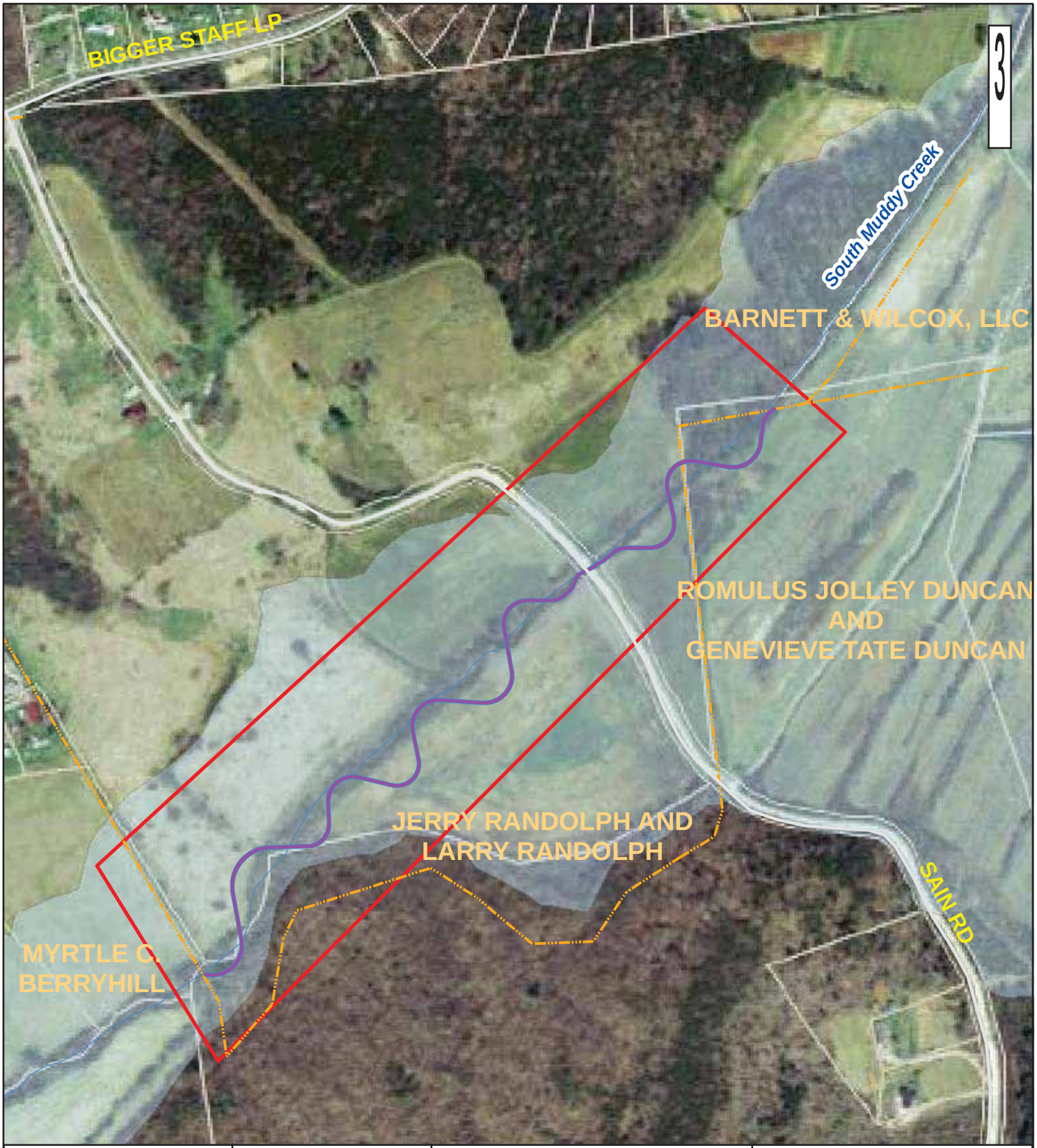
I. PROJECT NARRATIVE

Overview

The North Carolina Ecosystem Enhancement Program (NC EEP) is requesting to revise the 1% annual chance floodplain for a section of South Muddy Creek based on the as-built survey from a recently completed stream restoration project. The project reach extends along South Muddy Creek from approximately 850 feet downstream of Sain Road to approximately 2,600 feet upstream of Sain Road. A study area map is provided in Figure 1. This stream restoration project generally entailed restoring the natural channel dimension and pattern to the portion of South Muddy Creek that lies within the study area. These project objectives were achieved primarily through a Rosgen Priority Level II restoration approach which involves constructing a new meandering channel within an excavated floodplain at the existing channel invert elevation. This restoration approach re-establishes natural channel dimension and pattern to the stream, while connecting the channel to a newly excavated floodplain, allowing for a natural cycle of sediment degradation and aggradation during high flow events. A hardcopy of the "as-built" drawings are provided in Appendix A.

A no-impact study, and accompanying Floodplain Development Permit application for this stream restoration project was submitted to McDowell County on April 10, 2009. Final project approval was obtained from McDowell County in September 2009.

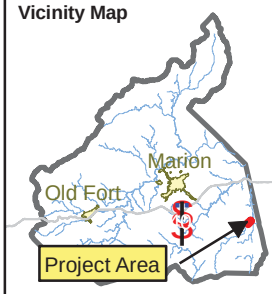
South Muddy Creek is a Federal Emergency Management Agency (FEMA) / North Carolina Floodplain Mapping Program (NCFMP) regulated stream, referenced on Flood Insurance Rate Map (FIRM) 3710164800K (Effective 10/2/2008). The project area is located within a mapped AE Zone that was established through the creation of a Limited Detail Study. Therefore the project area has published base flood elevations (BFEs) and a "non-encroachment zone". The annotated FIRM panel is located in Appendix B.



Baker

400 200 0 Feet

Vicinity Map



McDowell County, NC

Legend

- Study Stream
- FEMA Streams
- PropertyLines
- Project Area

FLOODZONE

- AE
- SHADED X

Figure 1.
Project Area Map

South Muddy Creek
Stream Restoration Project
McDowell County, NC

March 2011

II. HYDRAULIC MODELING SUMMARY

Below is a description of the hydraulic models used / developed for preparation of this LOMR application. A summary of the model development process is provided in table below, followed by more detailed descriptions in the text. In addition, all models and supporting information are included in digital format on the enclosed CD.

Model	Changes Made during Model Development
Effective	HEC-RAS model obtained from the North Carolina Floodplain Mapping Program
Duplicate Effective	Created by running the Effective HEC-RAS model on local computers using HEC-RAS (ver. 4.0)
Corrected Effective	Created by incorporating detailed pre-project survey data into the Duplicate Effective model and adding three (3) supplemental cross sections.
Existing (Post-Project)	HEC-RAS model created by modifying a Corrected Effective model that was created to represent conditions along the reach prior to this stream maintenance project. Cross sections were modified where necessary to reflect existing conditions based on the "as-built" field survey.

Effective Hydraulic Model / Duplicate Effective Model

The Effective Model for South Muddy Creek is a HEC-RAS model that was developed to produce the published Flood Insurance Study (FIS) and FIRM maps (dated 10/2/2008). The model and FIS report were obtained from the North Carolina Floodplain Mapping Program. The FIRM panel was obtained from the FEMA Map Service Center. The project reach is located between effective cross sections 27963.25 and 31563.25. The effective data were run in HEC-RAS (ver. 4.0) without any modifications by Baker to create the Duplicate Effective Model.

Corrected Effective Model

The Corrected Effective Model is the model that is developed to correct any errors in the Duplicate Effective Model, and/or to incorporate more detailed topographic information or additional hydraulic cross sections into the analysis in order to more accurately define the terrain under pre- and post-project conditions. The Existing Model is the model that is developed to incorporate any man-made modifications that have occurred in the floodplain since the date of the Effective Model into the Corrected Effective Model. No known man-made changes have been made since the issuance of the Effective maps/models, therefore the Corrective Effective Model and the Existing Model were combined as one model (hereafter referred to as the Corrected Effective Model).

A detailed survey of the stream channel and immediate overbanks was conducted for this project. The Existing model incorporated this detailed survey data into the Duplicate Effective cross sections within the project limits. In addition, three (3) supplemental cross sections (30521.38, 29299, and 28383) were added within the project limits in order to more accurately define the

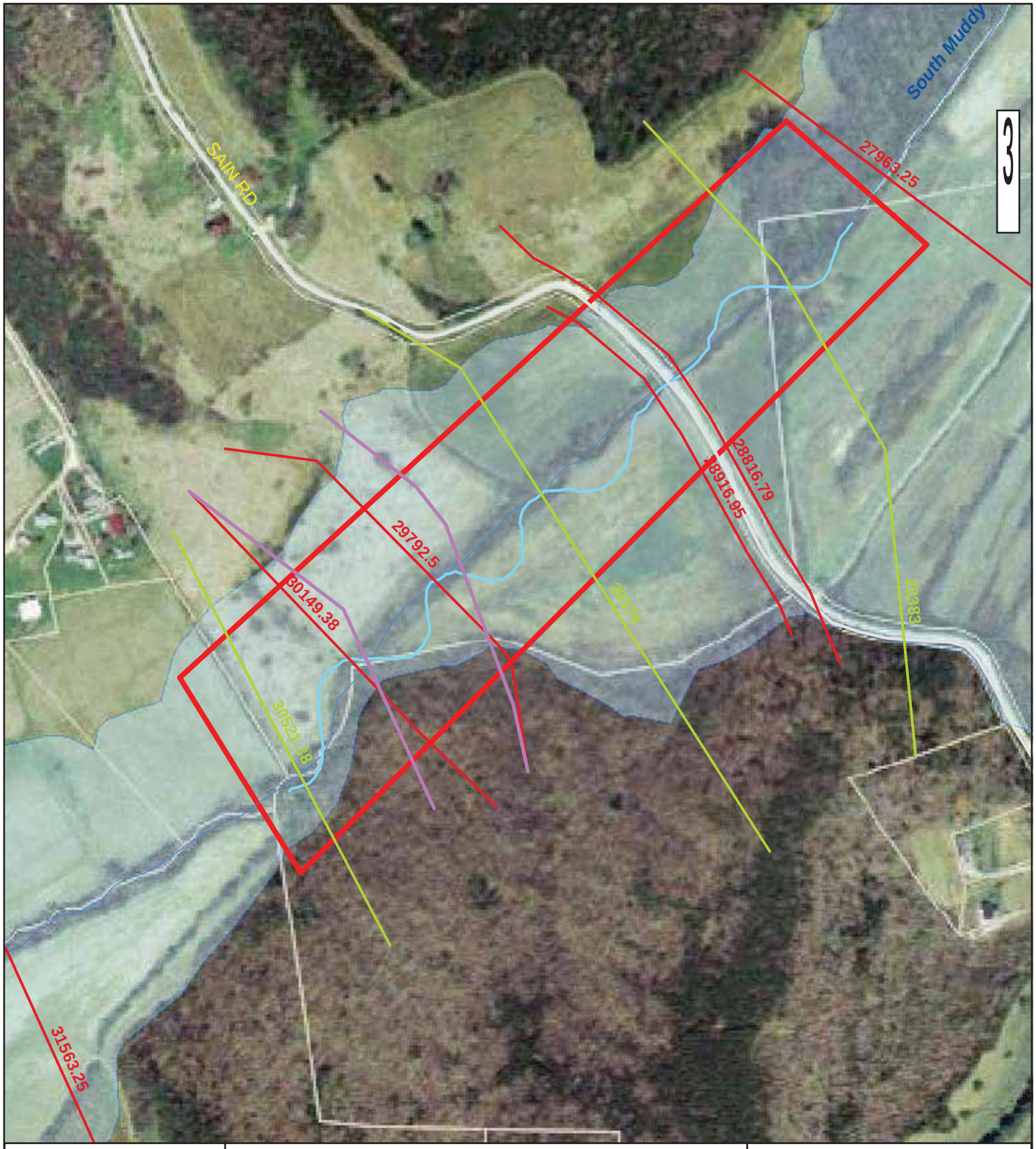
stream channel, complement the existing cross section locations in the Duplicate Effective Model, and to account for the proposed stream restoration improvements in the Post-Project Model. The added cross sections were based on a combination of field survey (channel plus approximately 100' off top of banks), and 5-foot contours obtained from the NC DOT GIS website (www.ncdot.org/IT/gis) for the overbank areas beyond the survey limits. Supplemental cross section hydraulic parameters (i.e. Manning's n values, contraction/expansion coefficients, etc.) were not changed for modified cross section, and were set to be consistent with those in the Effective Model. In addition, floodway encroachment stations were added to the supplemental cross sections in HEC-RAS so as to maintain the original width and spacing from stream centerline of the Effective Model. Encroachment stations were adjusted on cross sections 30149.25 and 30521.38 so that they are located inside the floodplain. Figure 2 shows the locations of the added/replaced cross sections in the Corrected Effective Model (with station/alignment scale).

Existing (Post Project) Model

The Existing Model for the project area was created by modifying the Corrected Effective model that was created in support of a No-Impact certification prior to construction beginning on this project (referenced previously). The corrected effective model incorporated modification of the geometry of four (4) existing cross sections and the addition of three (3) supplemental cross sections. Cross section geometry in the pre-project model was based on a detailed field survey of the existing channel and overbank areas. Downstream reach lengths were also modified where necessary to account for the additional stream length created by the stream restoration project. Manning's roughness coefficients were verified in the pre-project model and not changed from the Duplicate Effective Model.

An "As-Built" survey was conducted following completion of construction of the stream restoration project. The Post-Project Model cross sections were based on a combination of the "as-built" survey and 5 foot contour data from the North Carolina Floodplain mapping Program. Cross section changes made between the Pre-Project and Post-Project Models are summarized in the table below.

Station	Description	Cross Section Modifications from Pre-Project to Post-Project Model
27963.25	Effective	None
28383	Added (Pre-project)	Cross section geometry modified based on survey
28816.79	Effective	None
28916.95	Effective	None
29379	Added (Pre-project)	Cross section geometry modified based on survey
29688	Modified Effective	Cross section geometry modified based on survey
30115	Modified Effective	Cross section geometry modified based on survey
30521.38	Added (Pre-project)	Cross section geometry modified based on survey
31563.25	Duplicate Effective	None



Baker

400 200 0 Feet

Legend

Study Cross Sections (w/ Stations)

- Added
- Effective
- Modified Effective

- SMuddy_AsbuiltCL
- FEMA Streams
- Project Area

NCFMP Floodplain

- AE

Figure 2. Model Summary Map

South Muddy Creek Stream Restoration Project

McDowell County, NC

March 2011

III. HYDRAULIC ANALYSIS RESULTS AND CONCLUSIONS

Comparison of the effective and existing hydraulic model results indicates increases and decreases in BFEs along the project reach. Increases in BFEs range from 0.01 to 0.17 feet, with the maximum increase occurring at cross section 29792.5. Decreases in BFEs range from -0.13 to -0.85 feet, with the maximum decrease occurring at cross section 30149.38. The increase at cross section 29792.5 is primarily due to the more detailed topographic data as there is actually a decrease in the BFE from the Corrected Effective to the Post Project at this location.

Note that there is no rise in water surface elevation between the Proposed Model and the Corrected Effective Model. A floodplain development permit was obtained from McDowell County prior to project construction based on this condition.

Table 1 below shows the comparison of the water surface elevations (WSEs) for all the cross sections along South Muddy Creek that lie within the project limits. The complete HEC-RAS models and results are provided in the enclosed CD.

TABLE 1. 100-year Water Surface Elevation Comparison Summary

Station	Duplicate Effective (DUP)	Corrected Effective/Existing Model (EXST)	Proposed Model (PRP)	Post Project Model (POST)	Change (POST - DUP)
31563.25	1135.8	1135.64	1135.41	1135.67	-0.13
30521.38	N/A	1132.23	1132.21	1132.15	N/A
30149.38	1131.99	1131.34	1131.16	1131.14	-0.85
29792.5	1130.07	1130.48	1130.25	1130.24	0.17
29379	N/A	1129.46	1129.21	1129.26	N/A
28916.95	1128.7	1128.94	1128.83	1128.71	0.01
28816.79	1128.08	1128.45	1128.21	1128.1	0.02
28383	N/A	1127.58	1127.37	1127.46	N/A
27963.25	1127.03	1127.03	1127.03	1127.03	0.00

IV. MT-2 FORMS

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hour per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☒ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301	City of Katy	TX	480301	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
370148	McDowell County	NC	37101C	1648K	10/02/08

2. a. Flooding Source: South Muddy Creek

   b. Types of Flooding: ☒ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: South Muddy Creek Stream Restoration Project

4. FEMA zone designations affected: AE (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ☒ Physical Change ☐ Improved Methodology/Data ☐ Regulatory Floodway Revision ☒ Base Map Changes
   ☐ Coastal Analysis ☒ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ☒ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

   b. The area of revision encompasses the following structures (check all that apply)

   Structures: ☐ Channelization ☐ Levee/Floodwall ☐ Bridge/Culvert
   ☐ Dam ☐ Fill ☐ Other (Attach Description)

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☒ Yes Fee amount: $5000

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: Mr. Jeff Jurek	Company: NC Ecosystem Enhancement Program	
Mailing Address: 1652 Mail Service Center Raleigh, NC 27699-1652	Daytime Telephone No.: 919-715-1157	Fax No.: 919-715-2219
	E-Mail Address: Jeff.Jurek@ncdenr.gov	
Signature of Requester (required):	Date: 5-5-11	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirement that no fill be placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Mr. Jerry Silvers, Chief Building Inspector	Community Name: McDowell County	
Mailing Address: 60 East Court Street Marion, NC 28752	Daytime Telephone No.: 828-652-7030	Fax No.:
	E-Mail Address: buildinginspections@mcdowellgov.com	
Community Official's Signature (required):	Date: April 28, 2011	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting data. All documents submitted in support of this request are correct to the best of my knowledge. All analyses have been performed correctly and in accordance with sound engineering practices. All project works are designed in accordance with sound engineering practices to provide protection from the 1% annual chance flood. If "as-built" conditions data/plan provided, then the structure(s) has been built according to the plans being certified, is in place, and is fully functioning. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: Kevin P. Higgins, PE, CFM	License No.: 035700	Expiration Date: 12/31/2011
Company Name: Michael Baker Engineering, Inc.	Telephone No.: 704-665-2216	Fax No.: 704-665-2201
Signature: Kevin P. Higgins		Date: 5/3/2011

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	Required if ...
☒ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
☒ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 3.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: South Muddy Creek
Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

☒ Not revised (skip to section B) ☐ No existing analysis ☐ Improved data
☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

☐ Statistical Analysis of Gage Records ☐ Precipitation/Runoff Model
☐ Regional Regression Equations ☐ Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters) and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Was sediment transport considered? ☐ Yes ☐ No If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered.

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.)	
			Effective	Proposed/Revised
Downstream Limit	approx. 850 feet D/S of Sain Rd.	27963.25	1127.03	1127.03
Upstream Limit	approx. 2600 feet U/S of Sain Rd.	31563.25	1135.8	1135.67

2. Hydraulic Method/Model Used

HEC-RAS ver. 4.0

B. HYDRAULICS (CONTINUED)

3. Pre-Submittal Review of Hydraulic Models

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. These review programs may help verify that the hydraulic estimates and assumptions in the model data are in accordance with NFIP requirements, and that the data are comparable with the assumptions and limitations of HEC-2/HEC-RAS. CHECK-2 and CHECK-RAS identify areas of potential error or concern. **These tools do not replace engineering judgment.** CHECK-2 and CHECK-RAS can be downloaded from http://www.fema.gov/plan/prevent/fhm/frm_soft.shtm. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS. Review of your submittal and resolution of valid modeling discrepancies may result in reduced review time.

4. Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name: SouthMuddyCr.prj	Plan Name: Duplicate Effective	File Name: same	Plan Name: same	NAD83
Corrected Effective Model*	File Name: SouthMuddyCr.prj	Plan Name: Corrected Effective	File Name: same	Plan Name: same	NAD83
Existing or Pre-Project Conditions Model	File Name:	Plan Name:	File Name:	Plan Name:	_____
Revised or Post-Project Conditions Model	File Name: SouthMuddyCr.prj	Plan Name: Post Project	File Name: same	Plan Name: same	NAD83
Other - (attach description)	File Name:	Plan Name:	File Name:	Plan Name:	_____

* For details, refer to the corresponding section of the instructions.

☒ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☒ Digital Mapping (GIS/CADD) Data Submitted

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM,** annotated to show the boundaries of the revised 1%- and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%- and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area of revision.

☒ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☒ Yes ☐ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:
      - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot.
      - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot.

   b. For LOMR requests, does this request require property owner notification and acceptance of BFE increases? ☒ Yes ☐ No
      If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notification can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☒ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(a)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☒ Yes ☐ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being added. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For LOMR/CLOMR requests, does this request have the potential to impact an endangered species? ☐ Yes ☐ No

   If Yes, please submit documentation to the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA). Section 9 of the ESA prohibits anyone from "taking" or harming an endangered species. If an action might harm an endangered species, a permit is required from U.S. Fish and Wildlife Service or National Marine Fisheries Service under Section 10 of the ESA.

   For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

U.S. DEPARTMENT OF HOMELAND SECURITY - FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE STRUCTURES FORM

O.M.B No. 1660-0016
Expires: 12/31/2010

PAPERWORK REDUCTION ACT

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, U.S. Department of Homeland Security, Federal Emergency Management Agency, 500 C Street, SW, Washington DC 20472, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

Flooding Source: South Muddy Creek
Note: Fill out one form for each flooding source studied

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:

Channelization.....complete Section B
Bridge/Culvert.....complete Section C
Dam/Basin.....complete Section D
Levee/Floodwall.....complete Section E
Sediment Transport.....complete Section F (if required)

Description Of Structure

1. Name of Structure:

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

2. Name of Structure:

Type (check one): ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

3. Name of Structure:

Type (check one) ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam/Basin

Location of Structure:

Downstream Limit/Cross Section:

Upstream Limit/Cross Section:

NOTE: For more structures, attach additional pages as needed.

B. CHANNELIZATION

Flooding Source: South Muddy Creek

Name of Structure:

1. Accessory Structures

The channelization includes (check one):

- ☐ Levees [Attach Section E (Levee/Floodwall)]
- ☐ Superelevated sections
- ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)]
- ☒ Other (Describe): Rosgen Priority II stream restoration with floodplain bench
- ☐ Drop structures
- ☐ Transitions in cross sectional geometry
- ☐ Energy dissipator

2. Drawing Checklist

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Hydraulic Considerations

The channel was designed to carry 400 (cfs) and/or the 1.0-year flood.

The design elevation in the channel is based on (check one):

☒ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions
☐ Other locations (specify):

4. Sediment Transport Considerations

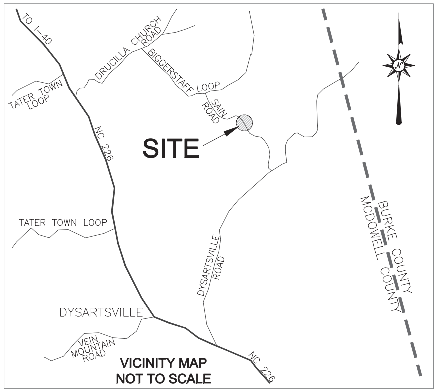
Was sediment transport considered? ☐ Yes ☒ No If Yes, then fill out Section F (Sediment Transport).
If No, then attach your explanation for why sediment transport was not considered.

Existing Channel Stability

South Muddy Creek Stream Restoration

One of the main purposes of this project is to reverse the affects of channelization along the project stretch of South Muddy Creek that is located upstream and downstream of Sain Rd. The intent of the design for this project was to restore the channel's dimension and pattern to their natural (i.e. "pre-development") state. Results from the hydraulic analysis indicate that post project channel velocities for the 1% annual chance flood are very similar to effective channel velocities. The design incorporated appropriate natural channel lining materials that, once established, should withstand velocities associated with the 1% annual chance flood.

APPENDIX A –
STREAM RESTORATION AS-BUILT SURVEY SHEETS



AS-BUILT SURVEY OF
SOUTH MUDDY CREEK STREAM RESTORATION
SCO# 05-06667-01

REFERENCES:

OWNER:
NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27099-1652
(919)715-0476
EEP PROJ. MGR.: PAUL WIESNER
EEP REVIEW COORDINATOR: LIN XU

CONTRACTOR:
CAROLINA ENVIRONMENTAL CONTRACTING, INC.
MT. AIRY, NC
(336)320-3849

DESIGNER:
MICHAEL BAKER ENGINEERING, INC.
CHARLOTTE, NC
(704)334-4454
EXISITNG CONDITIONS & BOUNDARY INFORMATION PROVIDED BY DESIGNER

GENERAL NOTES

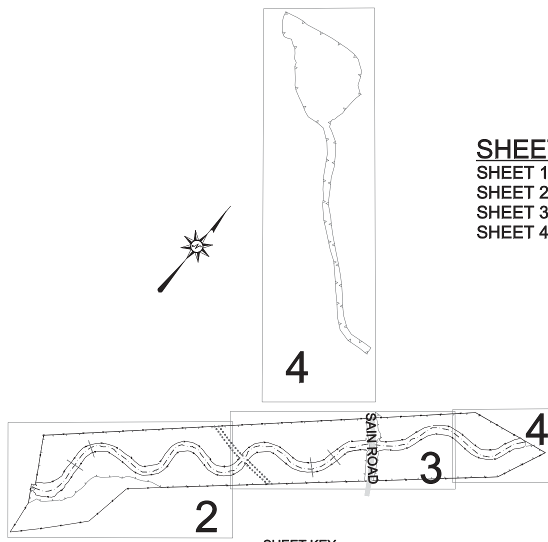
1. ALL DISTANCES ARE HORIZONTAL UNLESS OTHERWISE NOTED.
2. THE VERTICAL DATUM IS NAVD 88.
3. THE BASIS OF BEARINGS IS NCGS STATE PLANE GRID COORDINATES NAD83 DATUM.
4. THIS MAP IS NOT FOR RECORDATION, SALES, OR CONVEYANCES AND DOES NOT COMPLY WITH G.S. 47-30 MAPPING REQUIREMENTS.
5. PERMANENT CROSS-SECTIONS ARE PRESENTED ON SHEET 4. ALL CROSS-SECTIONS ARE FROM LEFT BANK TO RIGHT BANK (FACING DOWNSTREAM).
6. CONTROL DATA SHOWN TAKEN FROM EXISTING CONDITIONS SURVEY PROVIDED BY DESIGNER & VERIFIED DURING CONSTRUCTION & AS-BUILT SURVEYS.

SOUTH MUDDY CREEK SITE

I, ELISABETH G. TURNER, CERTIFY THAT THESE PLANS WERE DRAWN UNDER MY SUPERVISION FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION AND THAT THE RATIO OF PRECISION AS CALCULATED IS 1: 10,000 +. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 4th DAY OF DECEMBER, 2010.

ELISABETH G. TURNER, P.L.S. #L-4440

PRELIMINARY



SHEET KEY
NOT TO SCALE

SHEET INDEX

SHEET 1 - TITLE, VICINITY MAP, SHEET KEY, GENERAL NOTES
SHEET 2 - PLAN VIEW & PROFILE - SOUTH MUDDY CREEK
SHEET 3 - PLAN VIEW & PROFILE - SOUTH MUDDY CREEK
SHEET 4 - PLAN VIEW & PROFILE - SOUTH MUDDY CREEK, PERMANENT CROSS-SECTIONS 1-4 AND PLAN VIEW - GRADED STOCKPILE AREA

I, ELISABETH G. TURNER, AS A DULY REGISTERED PROFESSIONAL LAND SURVEYOR IN THE STATE OF NORTH CAROLINA, HEREBY CERTIFY THAT THE DATA SHOWN ON THIS DRAWING, WAS OBTAINED UNDER MY SUPERVISION, IS AN ACCURATE AND COMPLETE REPRESENTATION OF WHAT WAS CONSTRUCTED IN THE FIELD, AND THAT THE PHYSICAL DIMENSIONS OR ELEVATIONS SHOWN THUS ARE AS-BUILT CONDITIONS EXCEPT WHERE OTHERWISE NOTED HEREON. WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER, AND SEAL THIS 4th DAY OF DECEMBER, 2010.

ELISABETH G. TURNER, P.L.S. #L-4440

PROJECT DATA:

STREAM RESTORATION LENGTH (S. MUDDY CREEK AS-BUILT LENGTH)	2,876 LF
TOTAL DISTURBED AREA	18.5 AC
TOTAL CONSERVATION EASEMENT AREA	17.1 AC

STRUCTURE DATA:

CONSTRUCTED RIFFLES	8
LOG VANES	5
LOG J-HOOK	2
ROCK J-HOOK	2
ROOT WADS	9

MONITORING DATA:

PERMANENT CROSS-SECTIONS	4
PHOTO POINTS	20
VEGETATION PLOTS	12

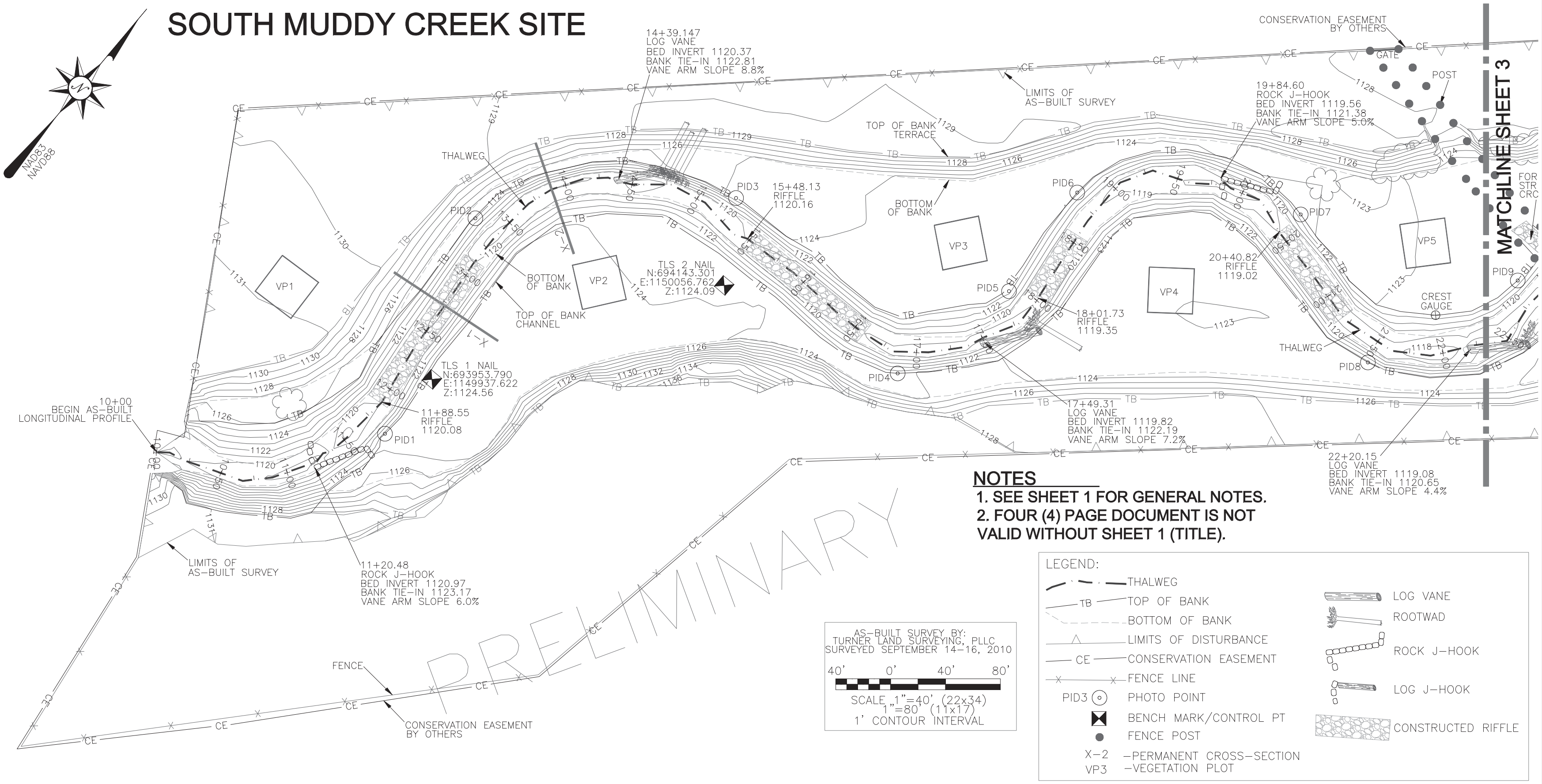
REVISIONS, DATE AND INITIAL:

TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 -- (919)875-1378
Lturner921@nc.rr.com -- Dturner119@nc.rr.com
www.TURNERLANDSURVEYING.com

TITLE
AS-BUILT SURVEY OF
SOUTH MUDDY CREEK STREAM RESTORATION
SCO# 05-0667-01
DYSARTSVILLE MCDOWELL COUNTY NORTH CAROLINA

DATE:	10/04/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-10-007
FILE:	SOUTH MUDDY CREEK _348_AB_TLS_D
SCALE:	NO SCALE
SHEET	1 of 4

SOUTH MUDDY CREEK SITE



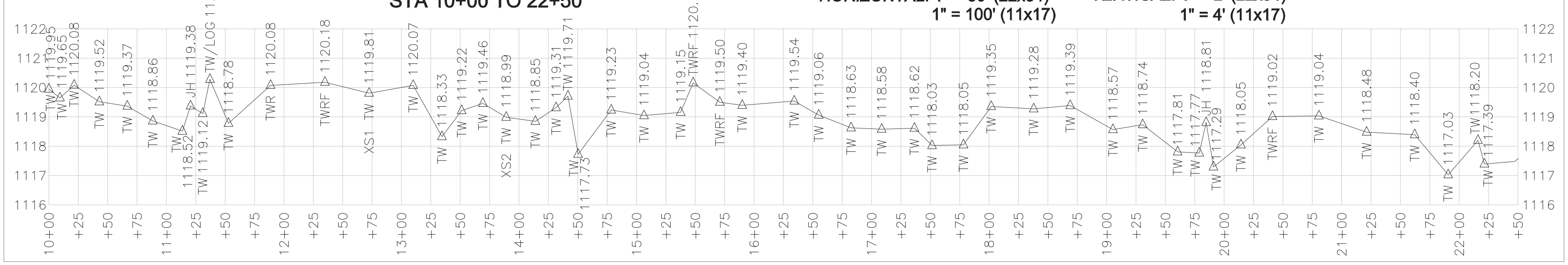
NAD83
NAVD88
MATCHLINE SHEET 3
CONSERVATION EASEMENT BY OTHERS
LIMITS OF AS-BUILT SURVEY
10+00 BEGIN AS-BUILT LONGITUDINAL PROFILE
THALWEG
BOTTOM OF BANK
TOP OF BANK CHANNEL
TOP OF BANK TERRACE
14+39.147 LOG VANE BED INVERT 1120.37 BANK TIE-IN 1122.81 VANE ARM SLOPE 8.8%
11+20.48 ROCK J-HOOK BED INVERT 1120.97 BANK TIE-IN 1123.17 VANE ARM SLOPE 6.0%
11+88.55 RIFFLE 1120.08
TLS 1 NAIL N:693953.790 E:1149937.622 Z:1124.56
TLS 2 NAIL N:694143.301 E:1150056.762 Z:1124.09
15+48.13 RIFFLE 1120.16
17+49.31 LOG VANE BED INVERT 1119.82 BANK TIE-IN 1122.19 VANE ARM SLOPE 7.2%
18+01.73 RIFFLE 1119.35
19+84.60 ROCK J-HOOK BED INVERT 1119.56 BANK TIE-IN 1121.38 VANE ARM SLOPE 5.0%
20+40.82 RIFFLE 1119.02
22+20.15 LOG VANE BED INVERT 1119.08 BANK TIE-IN 1120.65 VANE ARM SLOPE 4.4%
CREST GAUGE
GATE
POST
FENCE
VP1 VP2 VP3 VP4 VP5
PID1 PID2 PID3 PID4 PID5 PID6 PID7 PID8 PID9
X-1 X-2
PRELIMINARY
AS-BUILT SURVEY BY: TURNER LAND SURVEYING, PLLC SURVEYED SEPTEMBER 14-16, 2010
40' 0' 40' 80'
SCALE 1"=40' (22x34) 1"=80' (11x17)
1' CONTOUR INTERVAL
LEGEND:
THALWEG
TB TOP OF BANK
BOTTOM OF BANK
LIMITS OF DISTURBANCE
CE CONSERVATION EASEMENT
FENCE LINE
PID3 PHOTO POINT
BENCH MARK/CONTROL PT
FENCE POST
X-2 —PERMANENT CROSS-SECTION
VP3 —VEGETATION PLOT
LOG VANE
ROOTWAD
ROCK J-HOOK
LOG J-HOOK
CONSTRUCTED RIFFLE

NOTES

1. SEE SHEET 1 FOR GENERAL NOTES.
2. FOUR (4) PAGE DOCUMENT IS NOT VALID WITHOUT SHEET 1 (TITLE).

AS-BUILT LONGITUDINAL PROFILE STA 10+00 TO 22+50

PROFILE SCALE:
HORIZONTAL: 1" = 50' (22x34) 1" = 100' (11x17)
VERTICAL: 1" = 2' (22x34) 1" = 4' (11x17)



1116 1117 1118 1119 1120 1121 1122
10+00 +25 +50 +75 11+00 +25 +50 +75 12+00 +25 +50 +75 13+00 +25 +50 +75 14+00 +25 +50 +75 15+00 +25 +50 +75 16+00 +25 +50 +75 17+00 +25 +50 +75 18+00 +25 +50 +75 19+00 +25 +50 +75 20+00 +25 +50 +75 21+00 +25 +50 +75 22+00 +25 +50
TW 1119.95
TW 1119.65
TW 1120.08
TW 1119.52
TW 1119.37
TW 1118.86
TW 1118.52
JH 1119.38
TW 1119.12
TW/LOG 1120.28
TW 1118.78
TWR 1120.08
TWRF 1120.18
XS1 TW 1119.81
TW 1120.07
TW 1118.33
TW 1119.22
TW 1119.46
XS2 TW 1118.99
TW 1118.85
TW 1119.31
TW 1119.71
TW 1117.73
TW 1119.23
TW 1119.04
TW 1119.15
TWRF 1120.16
TWRF 1119.50
TW 1119.40
TW 1119.54
TW 1119.06
TW 1118.63
TW 1118.58
TW 1118.62
TW 1118.03
TW 1118.05
TW 1119.35
TW 1119.28
TW 1119.39
TW 1118.57
TW 1118.74
TW 1117.81
TW 1117.77
JH 1118.81
TW 1117.29
TW 1118.05
TWRF 1119.02
TW 1119.04
TW 1118.48
TW 1118.40
TW 1117.03
TW 1118.20
TW 1117.39

REVISIONS, DATE AND INITIAL:

TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 – (919)875-1378
Lturner921@nc.rr.com – Dturner119@nc.rr.com
www.TURNERLANDSURVEYING.com

PLAN VIEW & PROFILE STA 10+00 TO 22+50

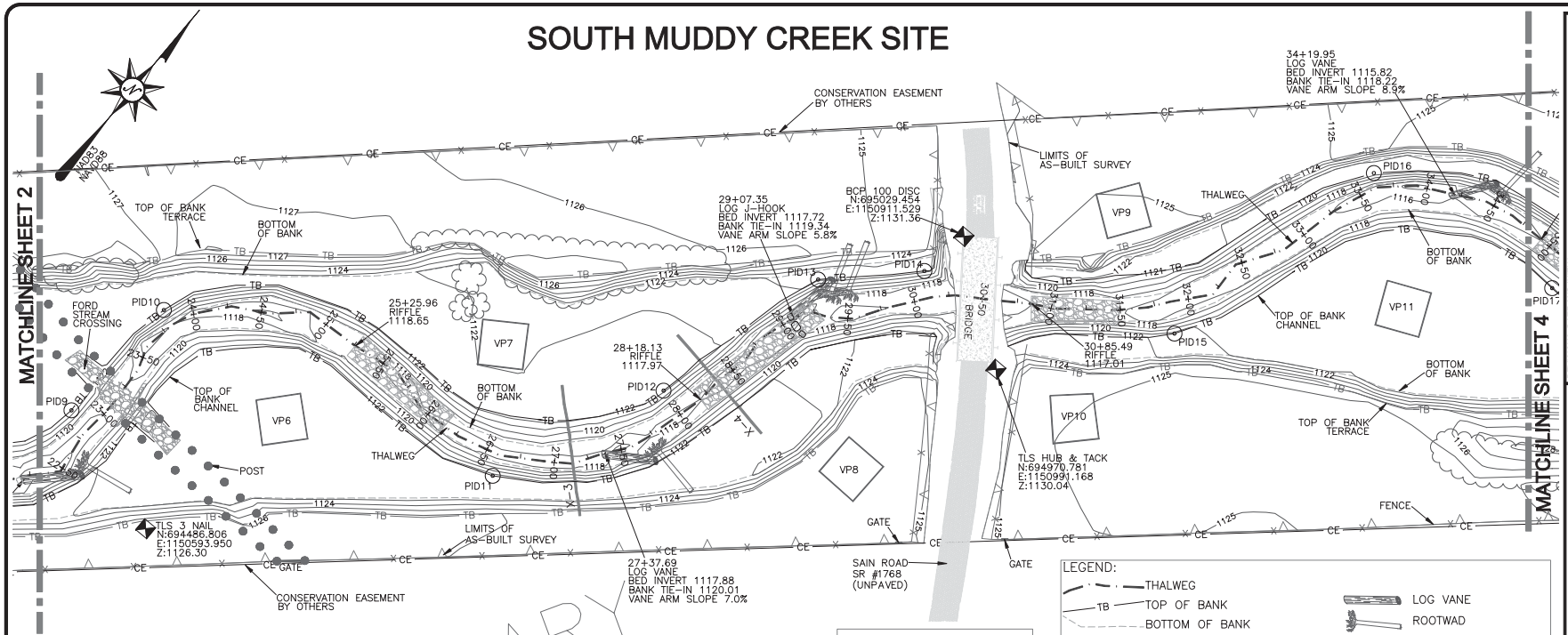
AS-BUILT SURVEY OF SOUTH MUDDY CREEK STREAM RESTORATION

SCO# 05-0667-01

DYSARTSVILLE | MCDOWELL COUNTY | NORTH CAROLINA

DATE:	10/04/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-10-007
FILE:	SOUTH MUDDY CREEK _348_AB_TLS_D
SCALE:	1" = 40' (22x34) 1" = 80' (11x17)
SHEET	2 of 4

SOUTH MUDDY CREEK SITE



PRELIMINARY

NOTES

1. SEE SHEET 1 FOR GENERAL NOTES.
2. FOUR (4) PAGE DOCUMENT IS NOT VALID WITHOUT SHEET 1 (TITLE).

AS-BUILT SURVEY BY:
TURNER LAND SURVEYING, PLLC
SURVEYED SEPTEMBER 14-16, 2010

40' 0' 40' 80'

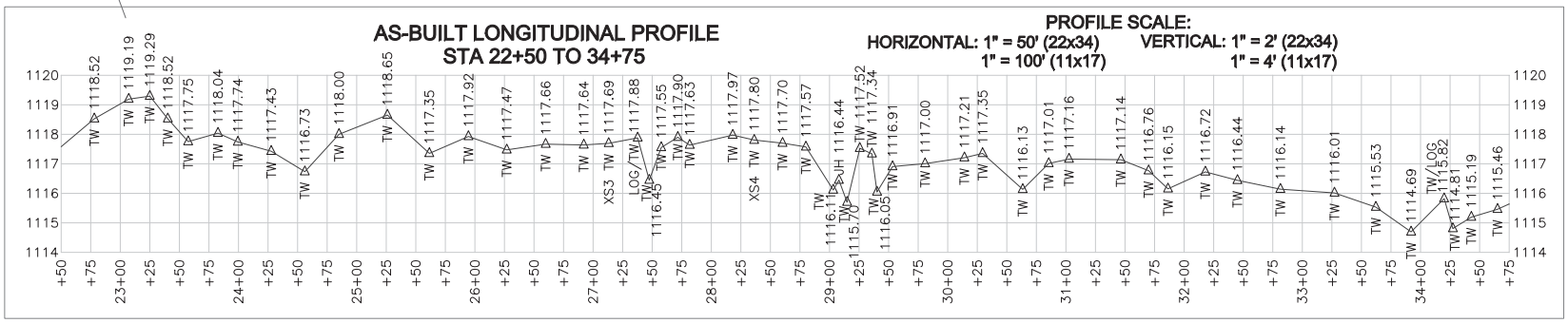
SCALE 1"=40' (22x34)
1"=80' (11x17)
1' CONTOUR INTERVAL

LEGEND:

- THALWEG
- TB — TOP OF BANK
- BOTTOM OF BANK
- LIMITS OF DISTURBANCE
- CE — CONSERVATION EASEMENT
- FENCE LINE
- PID3 — PHOTO POINT
- BENCH MARK/CONTROL PT
- FENCE POST
- X-2 — PERMANENT CROSS-SECTION
- VP3 — VEGETATION PLOT
- LOG VANE
- ROOTWAD
- ROCK J-HOOK
- LOG J-HOOK
- CONSTRUCTED RIFFLE

AS-BUILT LONGITUDINAL PROFILE
STA 22+50 TO 34+75

PROFILE SCALE:
HORIZONTAL: 1" = 50' (22x34) 1" = 100' (11x17)
VERTICAL: 1" = 2' (22x34) 1" = 4' (11x17)



TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 – (919)875-1378
Lturner2@nc.rr.com
www.TURNERLANDSURVEYING.com

REVISIONS, DATE AND INITIAL:

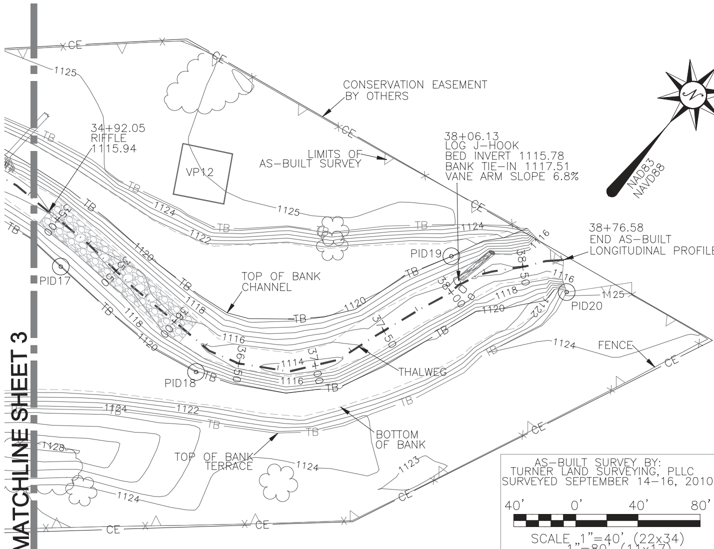
PLAN VIEW & PROFILE STA 22+50 TO 34+75
AS-BUILT SURVEY OF
SOUTH MUDDY CREEK STREAM RESTORATION
SCO# 05-0667-01
MCDOWELL COUNTY NORTH CAROLINA
DYSARTSVILLE

DATE:	10/04/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-10-007
FILE:	SOUTH MUDDY CREEK _348_AB_TLS_D
SCALE:	1" = 40' (22x34) 1" = 80' (11x17)

SHEET 3 of 4

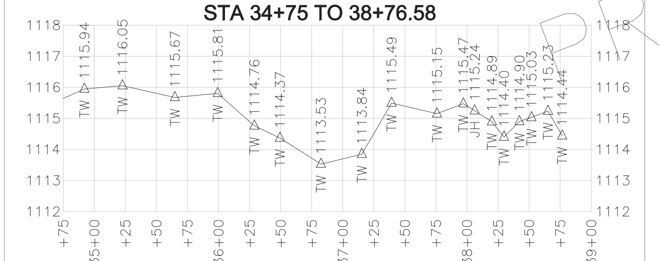
SOUTH MUDDY CREEK SITE

NOTES
1. SEE SHEET 1 FOR GENERAL NOTES.
2. FOUR (4) PAGE DOCUMENT IS NOT VALID WITHOUT SHEET 1 (TITLE).



MATCHLINE SHEET 3
CONSERVATION EASEMENT BY OTHERS
LIMITS OF AS-BUILT SURVEY
34+92.05 RIFFLE 1115.94
38+06.13 LOG J-HOOK BED INVERT 1115.78 BANK TIE-IN 1117.51 VANE ARM SLOPE 6.8%
38+76.58 END AS-BUILT LONGITUDINAL PROFILE
TOP OF BANK CHANNEL
THALWEG
BOTTOM OF BANK
TOP OF BANK TERRACE
FENCE
VP12
PID17
PID18
PID19
PID20
NAD83 NAVD88
AS-BUILT SURVEY BY: TURNER LAND SURVEYING, PLLC SURVEYED SEPTEMBER 14-16, 2010
SCALE 1"=40' (22x34) 1"=80' (11x17)
1' CONTOUR INTERVAL

AS-BUILT LONGITUDINAL PROFILE
STA 34+75 TO 38+76.58



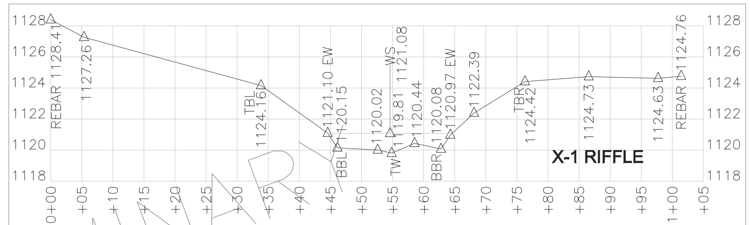
PROFILE SCALE:
HORIZONTAL: 1" = 50' (22x34) VERTICAL: 1" = 2' (22x34)
1" = 100' (11x17) 1" = 4' (11x17)

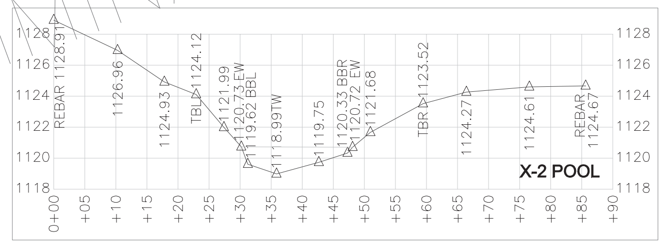
LEGEND:

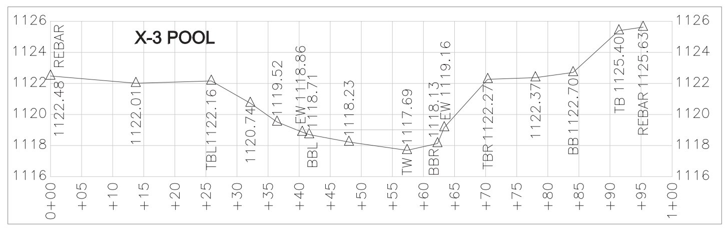
- THALWEG
- TB — TOP OF BANK
- BOTTOM OF BANK
- LIMITS OF DISTURBANCE
- CE — CONSERVATION EASEMENT
- FENCE LINE
- PID3 — PHOTO POINT
- BENCH MARK/CONTROL PT
- FENCE POST
- X-2 — PERMANENT CROSS-SECTION
- VP3 — VEGETATION PLOT
- LOG VANE
- ROOTWAD
- ROCK J-HOOK
- LOG J-HOOK
- CONSTRUCTED RIFFLE

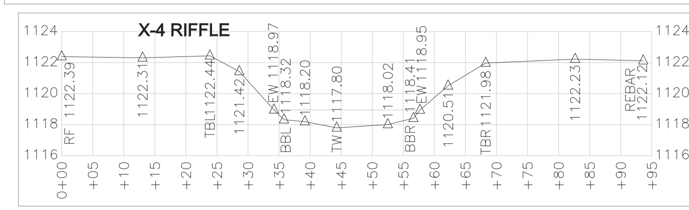
SOUTH MUDDY CREEK CROSS-SECTIONS 1-4
CROSS-SECTION SCALE:
HORIZONTAL: 1" = 10' (22x34) VERTICAL: 1" = 4' (22x34)
1" = 20' (11x17) 1" = 8' (11x17)

TBL-TOP OF LEFT BANK
BBL-BOTTOM LEFT BANK
TBR-TOP OF RIGHT BANK
BBR-BOTTOM RIGHT BANK
EW-EDGE OF WATER
TW-THALWEG
WS-WATER SURFACE









REVISIONS, DATE AND INITIAL:

TURNER LAND SURVEYING, PLLC
3201 Glenridge Drive, Raleigh, NC 27604 – (919)875-1378
Ltumer921@nc.rr.com – Dturner119@nc.rr.com
www.TURNERLANDSURVEYING.com

PLAN VIEW & PROFILE STA 34+75 TO 38+76.58
AND PERMANENT CROSS-SECTION 1-4

AS-BUILT SURVEY OF
SOUTH MUDDY CREEK STREAM RESTORATION
SCO# 05-0667-01
DYSARTSVILLE MCDOWELL COUNTY NORTH CAROLINA

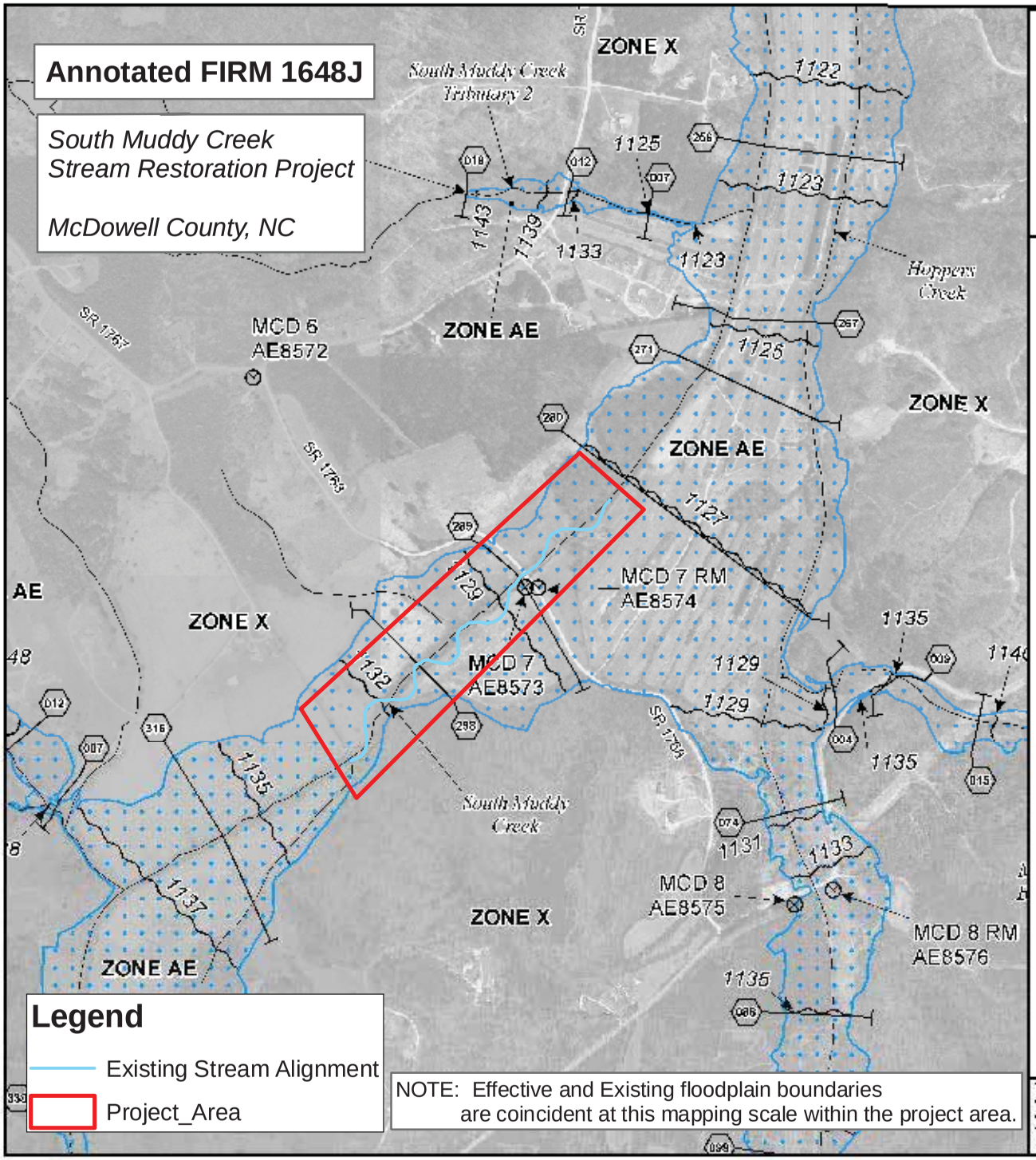
DATE:	10/04/2010
SURVEYED BY:	DST/EGT
DRAWN BY:	DST/EGT
REVIEWED BY:	DST/EGT
PROJECT:	TLS-10-007
FILE:	SOUTH MUDDY CREEK _348_AB_TLS_D
SCALE:	AS SHOWN

APPENDIX B –
ANNOTATED FIRMs and
WORK MAP

Annotated FIRM 1648J

South Muddy Creek
Stream Restoration Project

McDowell County, NC



Legend

- Existing Stream Alignment
- Project_Area

NOTE: Effective and Existing floodplain boundaries are coincident at this mapping scale within the project area.

GRID NORTH

MAP SCALE 1" = 1000' (1 : 12,000)

500 0 1000 2000 FEET

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1648K

FIRM

FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 1648

(SEE INDEX DIAGRAM OR MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	CID No.	PANEL	SUFFIX
BURKE COUNTY	370338	1648	K
MCDOWELL COUNTY	370148	1648	K

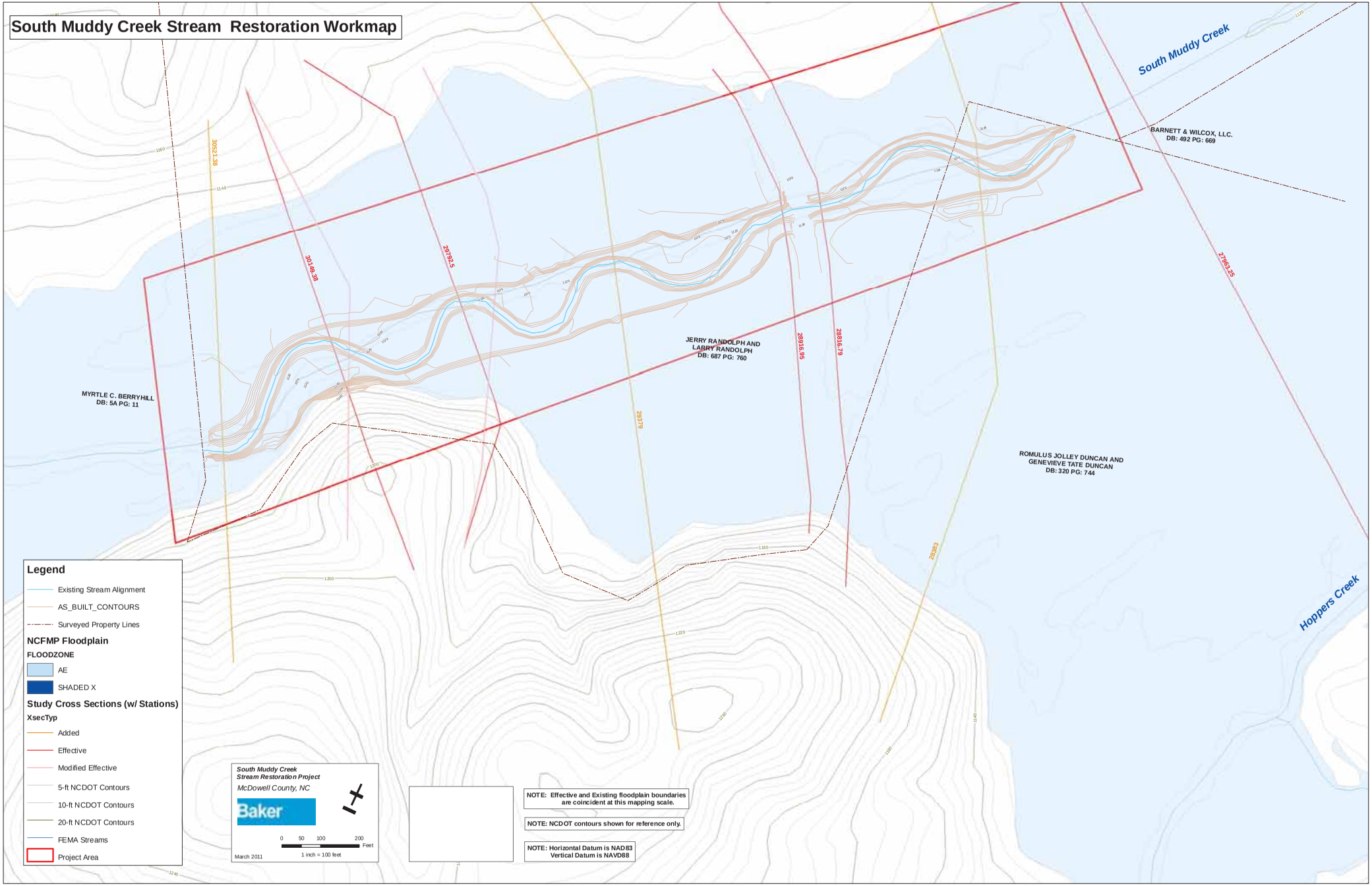
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP REVISED
OCTOBER 2, 2008

MAP NUMBER
3710164800K

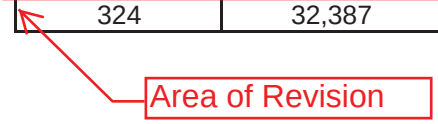
State of North Carolina
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov


South Muddy Creek Stream Restoration Workmap
South Muddy Creek
Hoppers Creek
BARNETT & WILCOX, LLC.
DB: 492 PG: 669
JERRY RANDOLPH AND
LARRY RANDOLPH
DB: 687 PG: 760
MYRTLE C. BERRYHILL
DB: 5A PG: 11
ROMULUS JOLLEY DUNCAN AND
GENEVIEVE TATE DUNCAN
DB: 320 PG: 744
30149.38
29792.5
29379
28916.95
28816.79
27963.25
26383
36521.38
Legend
Existing Stream Alignment
AS_BUILT_CONTOURS
Surveyed Property Lines
NCFMP Floodplain
FLOODZONE
AE
SHADED X
Study Cross Sections (w/ Stations)
XsecTyp
Added
Effective
Modified Effective
5-ft NCDOT Contours
10-ft NCDOT Contours
20-ft NCDOT Contours
FEMA Streams
Project Area
South Muddy Creek
Stream Restoration Project
McDowell County, NC
Baker
0 50 100 200
Feet
1 inch = 100 feet
March 2011
NOTE: Effective and Existing floodplain boundaries are coincident at this mapping scale.
NOTE: NCDOT contours shown for reference only.
NOTE: Horizontal Datum is NAD83
Vertical Datum is NAVD88

APPENDIX C-
REVISED FLOOD HAZARD DATA TABLE

Cross Section[1]	Stream Station[2]	Flood Discharge (cfs)	1% Annual Chance Water-Surface Elevation (feet NAVD 88)	Non-Encroachment Width[3] (feet)
South Muddy Creek				
148	14,763	8,990	1,103.5	549 / 167
165	16,526	8,990	1,105.4	379 / 105
184	18,363	8,190	1,108.1	752 / 462
190	19,004	8,190	1,108.8	564 / 97
191	19,107	8,190	1,111.4	551 / 101
196	19,563	8,190	1,112.1	333 / 117
208	20,763	8,190	1,114.8	362 / 330
227	22,677	8,190	1,117.9	83 / 71
241	24,140	8,190	1,120.9	206 / 614
256	25,563	8,190	1,122.5	148 / 380
266	26,576	8,190	1,124.3	211 / 546
267	26,697	8,190	1,124.8	120 / 575
271	27,070	8,190	1,125.7	42 / 410
280	27,963	8,190	1,127.0	319 / 739
288	28,817	5,770	1,128.1	85 / 803
289	28,917	5,770	1,128.7	85 / 774
298	29,793	5,770	1,130.2	355 / 183
301	30,149	5,770	1,131.1	421 / 73
316	31,563	5,770	1,135.7	350 / 404
324	32,387	5,550	1,137.5	33 / 824



APPENDIX D –
PUBLIC NOTIFICATION

McDowell County

60 East Court Street • Marion, North Carolina 28752
Telephone: (828) 652-7121 • Fax: (828) 659-3484
Website: www.mcdowellgov.com

April 27, 2011

Romulus and Genevieve Duncan
1441 Dysartsville Road
Nebo, NC 28761

Re: Notification of 1% (100-year) annual chance water-surface elevation increases and widening of the 1% annual chance floodplain

Dear Romulus and Genevieve Duncan:

The Flood Insurance Rate Map (FIRM) for a community depicts land which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Michael Baker Engineering, Inc. is applying for a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (DHS-FEMA) on behalf of the North Carolina Ecosystem Enhancement Program (EEP) to revise FIRM panel 371064800K for McDowell County, NC along South Muddy Creek. The EEP conducted this stream restoration project to restore the natural channel dimension and pattern along South Muddy Creek.

The Letter of Map Revision will result in:

1. Increases and decreases in the 1% annual chance water-surface elevations with a maximum increase of 0.17 feet at a point approximately 900 feet upstream of the Sain Rd. crossing and a maximum decrease in the 1% annual chance water-surface elevation of -0.85 feet at a point approximately 1230 feet upstream of the Sain Rd. crossing.

2. No changes will occur to the width of the 1% annual chance floodplain as a result of this Letter of Map Revision.

This letter is to inform you of revision of the 1% annual chance water-surface elevation on your property at 1441 Dysartsville Rd.

If you have any questions or concerns about the proposed changes to the FIRM or its effect on your property, you may contact Kevin Higgins, PE, CFM of Michael Baker Engineering, Inc. by email at khiggins@mbakercorp.com or by phone at 704-665-2216.

Sincerely,

Jerry Silvers
Floodplain Administrator
McDowell County Building Inspections

McDowell County

60 East Court Street • Marion, North Carolina 28752
Telephone: (828) 652-7121 • Fax: (828) 659-3484
Website: www.mcdowellgov.com

April 27, 2011

Ms. Myrtle C. Berryhill
1952 N. Main St.
Marion, NC 28752

Re: Notification of 1% (100-year) annual chance water-surface elevation increases and widening of the 1% annual chance floodplain

Dear Ms. Berryhill:

The Flood Insurance Rate Map (FIRM) for a community depicts land which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Michael Baker Engineering, Inc. is applying for a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (DHS-FEMA) on behalf of the North Carolina Ecosystem Enhancement Program (EEP) to revise FIRM panel 371064800K for McDowell County, NC along South Muddy Creek. The EEP conducted this stream restoration project to restore the natural channel dimension and pattern along South Muddy Creek.

The Letter of Map Revision will result in:

1. Increases and decreases in the 1% annual chance water-surface elevations with a maximum increase of 0.17 feet at a point approximately 900 feet upstream of the Sain Rd. crossing and a maximum decrease in the 1% annual chance water-surface elevation of -0.85 feet at a point approximately 1230 feet upstream of the Sain Rd. crossing.

2. No changes will occur to the width of the 1% annual chance floodplain as a result of this Letter of Map Revision.

This letter is to inform you of revision of the 1% annual chance water-surface elevation on your property near Berryhill Farm Drive in Dysartsville.

If you have any questions or concerns about the proposed changes to the FIRM or its effect on your property, you may contact Kevin Higgins, PE, CFM of Michael Baker Engineering, Inc. by email at khiggins@mbakercorp.com or by phone at 704-665-2216.

Sincerely,

Jerry Silvers
Floodplain Administrator
McDowell County Building Inspections

McDowell County

60 East Court Street • Marion, North Carolina 28752
Telephone: (828) 652-7121 • Fax: (828) 659-3484
Website: www.mcdowellgov.com

April 27, 2011

Mr. Larry Randolph
205 Sain Road
Nebo, NC 28761

Re: Notification of 1% (100-year) annual chance water-surface elevation increases and widening of the 1% annual chance floodplain

Dear Mr. Randolph:

The Flood Insurance Rate Map (FIRM) for a community depicts land which has been determined to be subject to a 1% (100-year) or greater chance of flooding in any given year. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

Michael Baker Engineering, Inc. is applying for a Letter of Map Revision (LOMR) from the Federal Emergency Management Agency (DHS-FEMA) on behalf of the North Carolina Ecosystem Enhancement Program (EEP) to revise FIRM panel 371064800K for McDowell County, NC along South Muddy Creek. The EEP conducted this stream restoration project to restore the natural channel dimension and pattern along South Muddy Creek.

The Letter of Map Revision will result in:

1. Increases and decreases in the 1% annual chance water-surface elevations with a maximum increase of 0.17 feet at a point approximately 900 feet upstream of the Sain Rd. crossing and a maximum decrease in the 1% annual chance water-surface elevation of -0.85 feet at a point approximately 1230 feet upstream of the Sain Rd. crossing.

2. No changes will occur to the width of the 1% annual chance floodplain as a result of this Letter of Map Revision.

This letter is to inform you of revision of the 1% annual chance water-surface elevation on your property at 205 Sain Rd.

If you have any questions or concerns about the proposed changes to the FIRM or its effect on your property, you may contact Kevin Higgins, PE, CFM of Michael Baker Engineering, Inc. by email at khiggins@mbakercorp.com or by phone at 704-665-2216.

Sincerely,

Jerry Silvers
Floodplain Administrator
McDowell County Building Inspections

APPENDIX E –
DIGITAL SUBMITTAL ON CD INCLUDING: HEC-RAS MODELS, STREAM MAINTENANCE "AS-BUILT" SURVEY SHEETS, MODEL COMPARISON SPREADSHEETS, AND DIGITAL LOMR REPORT

Appendix D

Vegetation Data (Tables 8 & 9)

Vegetation Plot Photo Log

Raw Vegetation Data

Table 8. Vegetation Species Planted Across the Restoration Site
South Muddy Creek Stream Restoration (Contract No. D06054-D)

Scientific Name	Common Name	Percent Planted by Species	Total Number of Stems
Upland Planting Zone Bare Root Trees Species			
Celtis laevigata	Sugarberry	15%	1010
Diospyros virginiana	Persimmon	15%	1010
Fraxinus pennsylvanica	Green Ash	20%	1346
Liriodendron tulipifera	Tulip Poplar	15%	1010
Platanus occidentalis	Sycamore	10%	673
Quercus palustris	Pin Oak	10%	673
Quercus rubra	Southern Red Oak	15%	1010
Floodplain Planting Zone Bare Root Trees Species			
Betula nigra	River Birch	10%	558
Celtis laevigata	Sugarberry	5%	279
Diospyros virginiana	Persimmon	10%	558
Fraxinus pennsylvanica	Green Ash	15%	836
Juglans nigra	Black Walnut	5%	279
Liriodendron tulipifera	Tulip Poplar	15%	836
Nyssa sylvatica	Blackgum	5%	279
Platanus occidentalis	Sycamore	20%	1115
Quercus lyrata	Overcup Oak	8%	446
Quercus phellos	Willow Oak	7%	390
Wetland Planting Zone Bare Root Trees Species			
Betula nigra	River Birch	15%	159
Diospyros virginiana	Persimmon	10%	106
Fraxinus pennsylvanica	Green Ash	17%	180
Juglans nigra	Black Walnut	13%	138
Nyssa sylvatica	Blackgum	10%	106
Platanus occidentalis	Sycamore	20%	212
Quercus phellos	Willow Oak	10%	106
Salix nigra	Black Willow	5%	53
Stream Bank Planting Zone Live Stake Species			
Silky dogwood	*Cornus amomum*	40%	-
Ninebark	*Physocarpus opulifolius*	15%	-
Silky willow	*Salix sericea*	30%	-
Elderberry	*Sambucus canadensis*	15%	-

Table 9 Stem Count for Each Species Arranged by Plot
South Muddy Creek Stream Restoration (Contract No. D06054-D)

Tree Species	Plots																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	WP-1
Betula nigra	1	2		5	5	1	5	2			3			2	2	4	3	1	1	2	4	4	3	2
Celtis laevigata	3	1	4		2		1	1					1		1				1					
Diospyros virginiana															1									
Fraxinus pennsylvanica		4	2	1	2		1	1	4	5		2		1	2	6	5	1	3	2	4	5		1
Juglans nigra					1	2	2				1			3	1	1				3				2
Liriodendron tulipifera	4	6	5	5	2	3			3		1	4	6			1	1	2	4		1	5	2	
Nyssa sylvatica				1											2		2					1		
Platanus occidentalis	1	4	7	3	2		2	4	1	4	4	9			3	1		2	1	2	4		2	6
Quercus palustris	3		2	2	2	3	1	3	2	1	1	3	3	5	2		8	2			10	2	7	1
Quercus phellos							1		1		1		4	10		3	1	6	2	2	3	4	5	
Quercus rubra		3		1		3		6		7			4				2			2	7	2	6	2
Salix sericea																				1				
Sambucus canadensis																				1				
Unknown																								2
Stems/plot	12	20	20	18	16	12	13	17	11	17	11	18	18	21	14	16	22	14	12	15	33	23	25	16
Stems/acre	480	800	800	720	640	480	520	680	440	680	440	720	720	840	560	640	880	560	480	600	1320	920	1000	640
Total Stems/ Acre for Year 0 As-Built (Baseline Data)	**690**																							

South Muddy Creek Restoration Project
South Muddy Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

Notes:
1. Herbaceous plot located in foreground of each photo.

4/15/2011 - Photo 1: Veg Plot 1

4/15/2011 - Photo 2: Veg Plot 1: Herbaceous Plot

4/15/2011 - Photo 3: Veg Plot 2

4/15/2011 - Photo 4: Veg Plot 2: Herbaceous Plot

4/15/2011 - Photo 5: Veg Plot 3

4/15/2011 - Photo 6: Veg Plot 3: Herbaceous Plot

South Muddy Creek Restoration Project
South Muddy Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo 7: Veg Plot 4

4/15/2011 - Photo 8: Veg Plot 4: Herbaceous Plot

4/15/2011 - Photo 9: Veg Plot 5

4/15/2011 - Photo 10: Veg Plot 5: Herbaceous Plot

4/15/2011 - Photo Point 11: Veg Plot 6

4/15/2011 - Photo Point 12: Veg Plot 6: Herbaceous Plot

South Muddy Creek Restoration Project
South Muddy Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo Point 13: Veg Plot 7

4/15/2011 - Photo Point 14: Veg Plot 7: Herbaceous Plot

4/15/2011 - Photo Point 15: Veg Plot 8

4/15/2011 - Photo Point 16: Veg Plot 8: Herbaceous Plot

4/15/2011 - Photo Point 17: Veg Plot 9

4/15/2011 - Photo Point 18: Veg Plot 9: Herbaceous Plot

South Muddy Creek Restoration Project
South Muddy Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo Point 19: Veg Plot 10

4/15/2011 - Photo Point 20: Veg Plot 10: Herbaceous Plot

4/15/2011 - Photo Point 21: Veg Plot 11

4/15/2011 - Photo Point 22: Veg Plot 11: Herbaceous Plot

4/15/2011 - Photo Point 23: Veg Plot 12

4/15/2011 - Photo Point 24: Veg Plot 12: Herbaceous Plot

South Muddy Creek Restoration Project
South Fork Hoppers Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo 1: Veg Plot 13

4/15/2011 - Photo 2: Veg Plot 13: Herbaceous Plot

4/15/2011 - Photo 3: Veg Plot 14

4/15/2011 - Photo 4: Veg Plot 14: Herbaceous Plot

4/15/2011 - Photo 5: Veg Plot 15

4/15/2011 - Photo 6: Veg Plot 15: Herbaceous Plot

South Muddy Creek Restoration Project
South Fork Hoppers Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo 7: Veg Plot 16

4/15/2011 - Photo 8: Veg Plot 16: Herbaceous Plot

4/15/2011 - Photo 9: Veg Plot 17

4/15/2011 - Photo 10: Veg Plot 17: Herbaceous Plot

4/15/2011 - Photo Point 11: Veg Plot 18

4/15/2011 - Photo Point 12: Veg Plot 18: Herbaceous Plot

South Muddy Creek Restoration Project
South Fork Hoppers Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo 13: Veg Plot 19

4/15/2011 - Photo 14: Veg Plot 19: Herbaceous Plot

4/15/2011 - Photo 15: Veg Plot 20

4/15/2011 - Photo 16: Veg Plot 20: Herbaceous Plot

4/15/2011 - Photo Point 17: Veg Plot 21

4/15/2011 - Photo Point 18: Veg Plot 21: Herbaceous Plot

South Muddy Creek Restoration Project
South Fork Hoppers Creek Project Area
Mitigation Plan - Vegetation Plot Photo Log

4/15/2011 - Photo Point 19: Veg Plot 22

4/15/2011 - Photo Point 20: Veg Plot 22: Herbaceous Plot

4/15/2011 - Photo Point 21: Veg Plot 23

4/15/2011 - Photo Point 22: Veg Plot 23: Herbaceous Plot

4/15/2011 - Photo Point 23: Veg Plot WLP1

4/15/2011 - Photo Point 24: Veg Plot WLP1: Herbaceous Plot

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 110650 Team: CKM/MR Plot: 1 Date: 4 / 12 / 11 Page 1 of 1

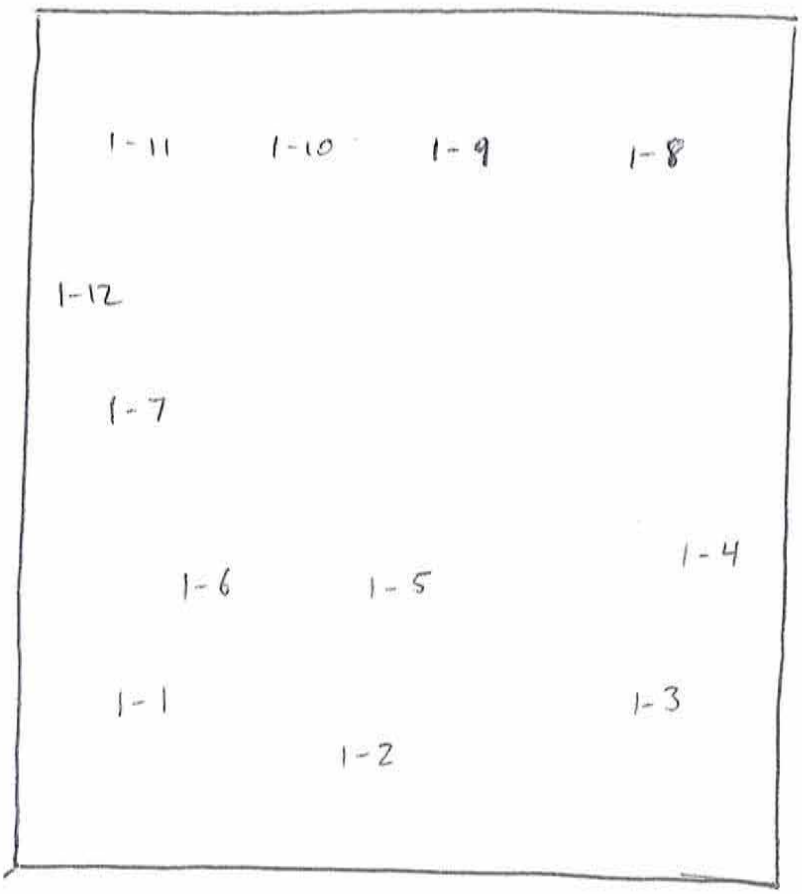
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
LT		1-1					4	
Bn		1-2					4	
Cl sugarberry		1-3					3	
Qp pin oak		1-4					4	
LT		1-5					4	
Cl sugarberry		1-6					3	
LT		1-7					4	
LT		1-8					4	
Po		1-9					4	
Qp pin oak		1-10					4	
Qp		1-11					4	
Cl sugarberry		1-12					4	
		1-13						
		1-14						
		1-15						
		1-16						
		1-17						
		1-18						
		1-19						
		1-20						
		1-21						
		1-22						
		1-23						
		1-24						
		1-25						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing. ↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3



Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 110650 Team: CHM/MR Plot: 2 Date: 4 / 11 / 11 Page 1 of 1

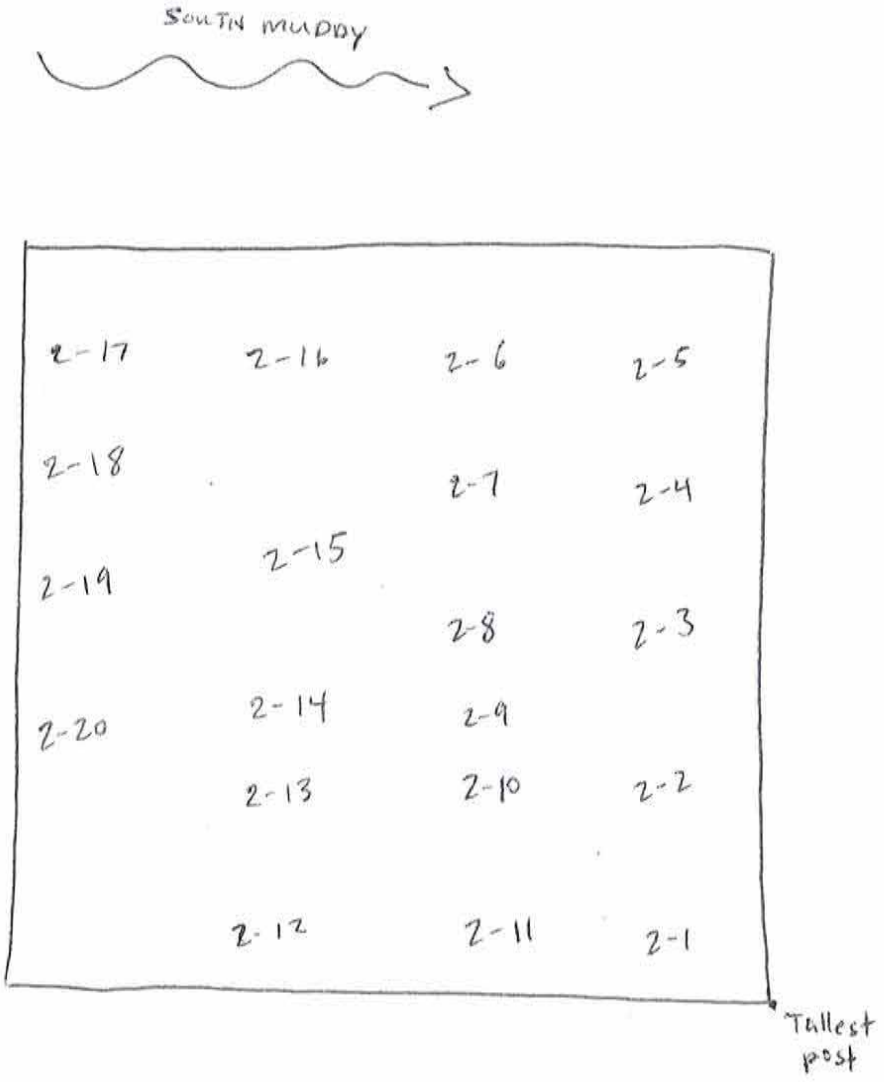
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Lt		2-1					4	
Lt		2-2					4	
Lt		2-3					3	
Bn		2-4					3	
Cl sugarberry		2-5					2	
Fp		2-6					4	
Po		2-7					4	
Fp		2-8					4	
Po		2-9					4	
Fp		2-10					3	
Lt		2-11					4	
Qr		2-12					2	
Fp		2-13					4	
Lt		2-14					2	
Qr		2-15					3	
Bn		2-16					4	
Lt		2-17					4	
Po		2-18					2	
Qr		2-19					4	
Po		2-20					4	

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


SOUTH MUDDY
2-17
2-16
2-6
2-5
2-18
2-7
2-4
2-15
2-19
2-8
2-3
2-20
2-14
2-9
2-13
2-10
2-2
2-12
2-11
2-1
Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10650 Team: CHM/MR Plot: 3 Date: 4 / 12 / 11 Page 1 of 1

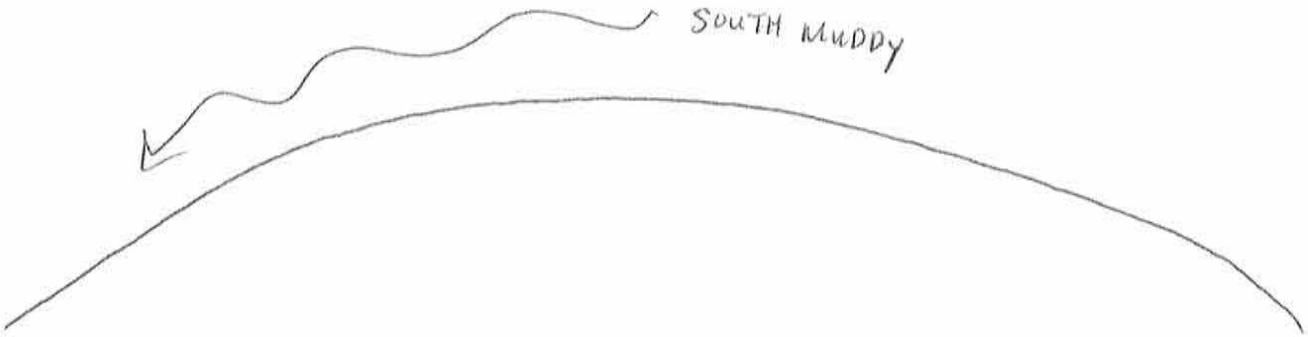
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Lt		3-1					3	
Po		3-2					3	
Cl sugar berry		3-3					3	
Qe Pin oak		3-4					4	
Lt		3-5					4	
Lt		3-6					4	
Po		3-7					4	
Po		3-8					4	
Po		3-9					4	
Cl sugar berry		3-10					3	
Po		3-11					4	
Lt		3-12					4	
Po		3-13					3	
Lt		3-14					4	
Cl		3-15					4	
Pe		3-16					3	
Fp		3-17					4	
Cl		3-18					3	
Qp Pin oak		3-19					4	
Fp		3-20					3	
		3-21						
		3-22						
		3-23						
		3-24						
		3-25						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3



	3-19	3-18	3-17	
3-20				3-16
3-11	3-12	3-13	3-14	3-15
3-10	3-9	3-8	3-7	3-6
3-1	3-2	3-3	3-4	3-5

Tallest post

* Several woody vines (Trumpet Creeper) were misidentified as Fraxinus Pennsylvanica (FP). The tags were removed and stem count revised during September 2011 site visit.

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10650 Team: CM/MR Plot: 4 Date: 4 / 11 / 11 Page 1 of 1

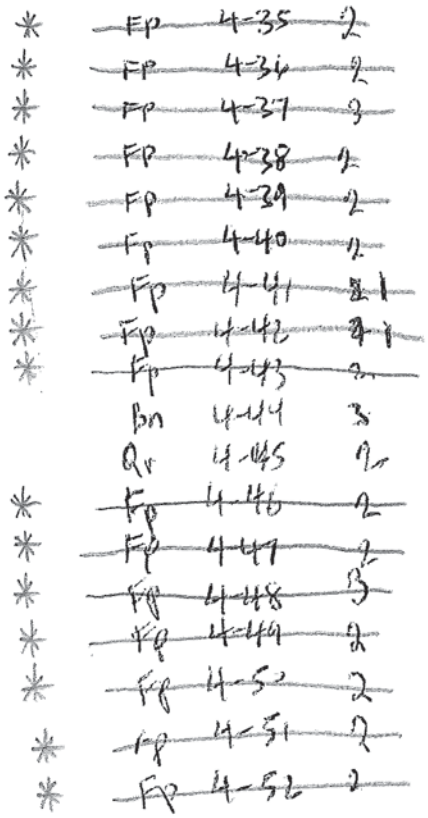
	Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
	LT		4-1					4	
	BM		4-2					4	
*	FP		4-3					3	
*	FP		4-4					1	tiny
*	FP		4-5					1	tiny
	PO		4-6					4	
*	FP		4-7					1	weak looking
	LT		4-8					4	
*	FP		4-9					3	
	NS		4-10					4	
	LT		4-11					4	
	FP		4-12					3	
	LT		4-13					4	
	BM		4-14					4	
*	FP		4-15					3	
*	FP		4-16					3	
*	FP		4-17					3	
	FP PO		4-18					4	
*	FP		4-19					3	
*	FP		4-20					3	
*	FP		4-21					3	
*	FP		4-22					2	
*	FP		4-23					2	
*	FP		4-24					2	
	QP Pin OAK		4-25					3	
	BM		4-26					4	
	LT		4-27					4	
	QP Pin OAK		4-28					4	
*	FP		4-29					2	
*	FP		4-30					2	
*	FP		4-31					2	
*	FP		4-32					2	
*	FP		4-33					2	
*	FP		4-34					2	

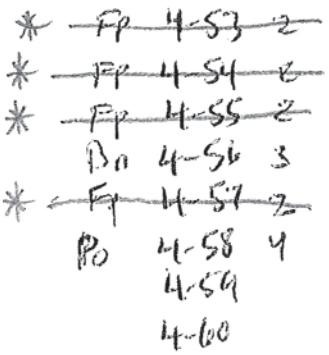
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

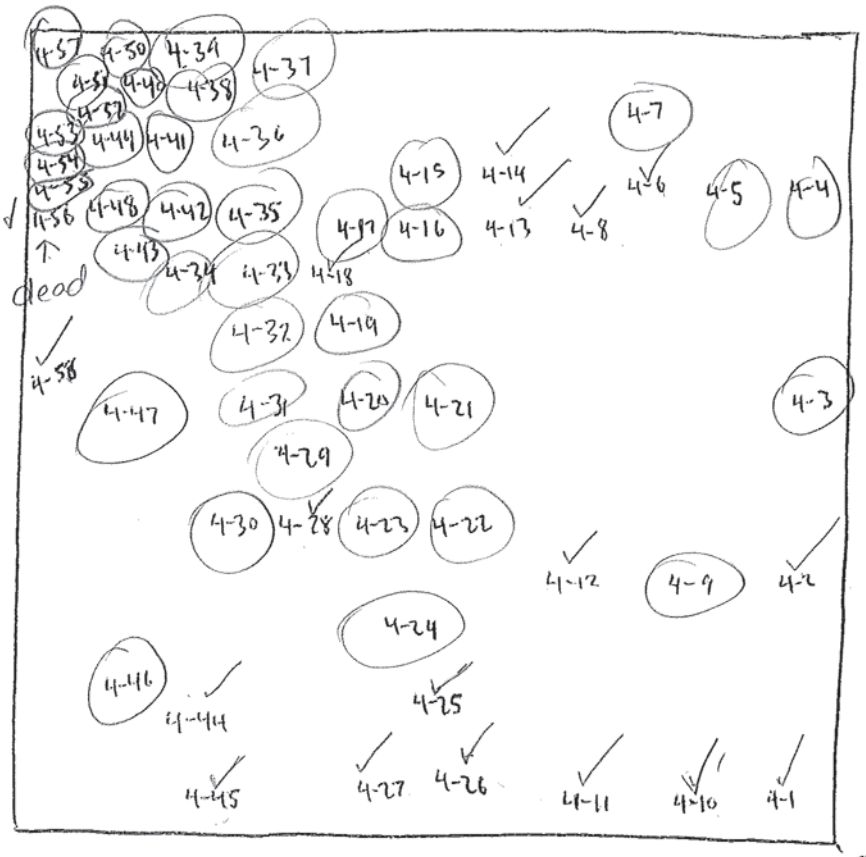
Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


Fp 4-35 2
Fp 4-36 2
Fp 4-37 2
Fp 4-38 2
Fp 4-39 2
Fp 4-40 2
Fp 4-41 2
Fp 4-42 2
Fp 4-43 2
Bn 4-44 3
Qv 4-45 2
Fp 4-46 2
Fp 4-47 2
Fp 4-48 3
Fp 4-49 2
Fp 4-50 2
Fp 4-51 2
Fp 4-52 2


Fp 4-53 2
Fp 4-54 2
Fp 4-55 2
Bn 4-56 3
Fp 4-57 2
Bo 4-58 4
4-59
4-60

South Muddy



Unusual cluster of stems in this corner →

Perhaps due to reconstruction of meander → replanting?

↑ dead

Tallest post

INVASIVE

* Several woody vines (Trumpet Creeper) were misidentified as Fraxinus Pennsylvanica (FP) or Juglans Nigra (JN). The tags were removed and stem counts revised during September 2011 site visit.

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10050 Team: CHM/MR Plot: 5 Date: 9/12/11 Page 1 of 1

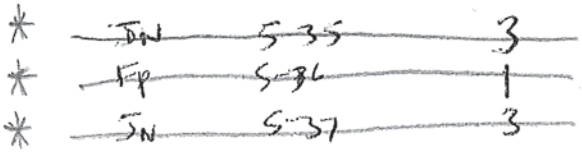
	Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
*	Fp		5-1					2	tmg
*	Fp		5-2					2	
	Fp		5-3					4	
*	Fp		5-4					2	
*	Fp		5-5					2	
*	Fp		5-6					2	
*	Fp		5-7					2	
	Lt		5-8					4	
*	Fp		5-9					2	
*	Fp		5-10					2	
*	Fp		5-11					2	
*	Fp		5-12					2	
*	Fp		5-13					2	
	Lt		5-14					3	
*	Fp		5-15					2	
	Bn		6-16					3	
*	Po		5-17					1	
*	Po		5-18					1	
*	Hp		5-19					3	
	Qp pin oak		5-20					3	
*	Fp		5-21					1	
	Bn		5-22					4	
	Jn		5-23					4	
*	Jn		5-24					4	
	Bn		5-25					4	
	Bn		5-26					4	
	Bn		5-27					4	
	Cl sugarberry		5-28					4	
	Fp		5-29					4	
	Cl sugarberry		5-30					4	
	Po		5-31					3	
	Po		5-32					4	
	Qp pin oak		5-33					4	
*	Fp		5-34					2	

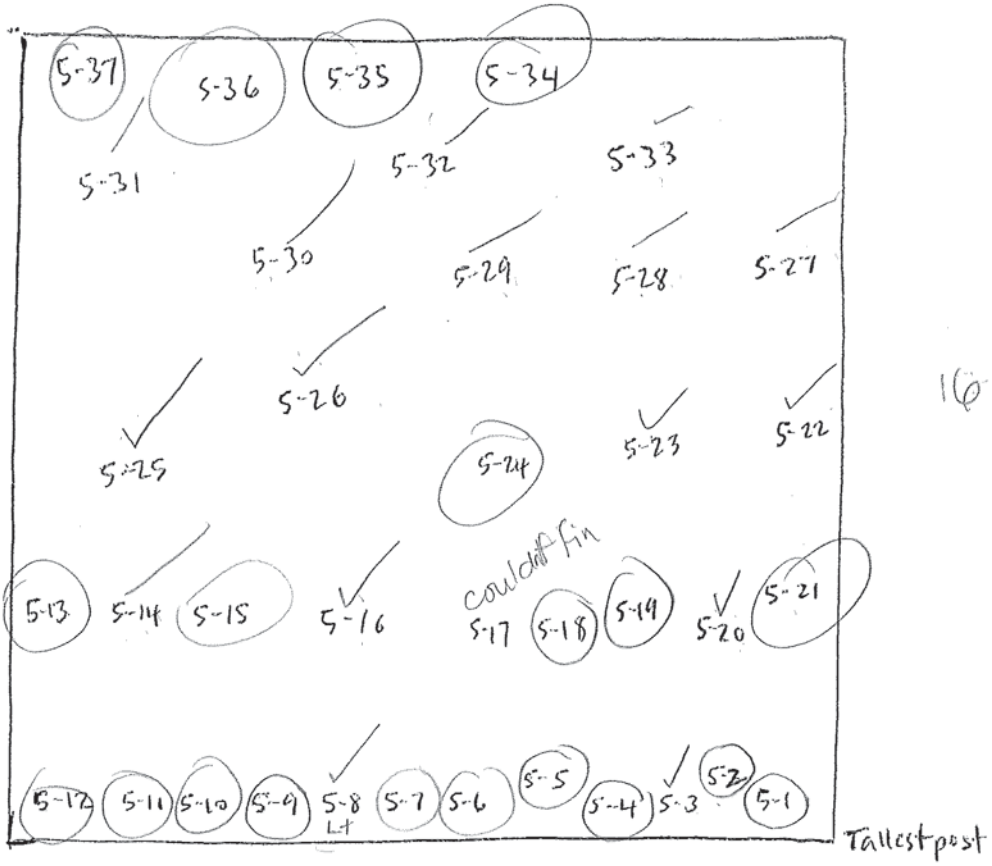
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.




5-37
5-36
5-35
5-34
5-31
5-32
5-33
5-30
5-29
5-28
5-27
5-26
5-25
5-24
5-23
5-22
5-13
5-14
5-15
5-16
couldn't fin
5-17
5-18
5-19
5-20
5-21
5-12
5-11
5-10
5-9
5-8
L4
5-7
5-6
5-5
5-4
5-3
5-2
5-1
Tallest post
SOUTH MUDDY

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11045 Team: CHM/MR Plot: 6 Date: 4 / 11 / 11 Page 1 of 1

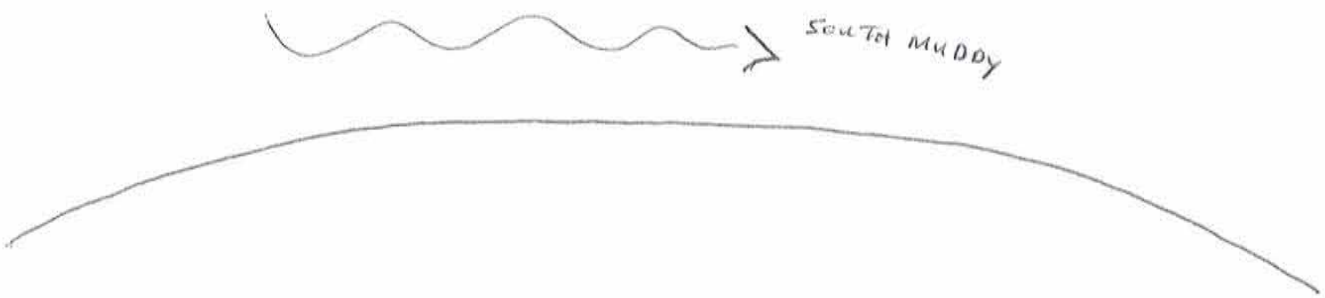
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qp pin oak		6-1					4	
Qv		6-2					2	
Qp pin oak		6-3					3	
Qv		6-4					3	
Jn WALNUT		6-5					1	Snapped-damaged
Jn		6-6					4	
Lt		6-7					4	
Qp pin oak		6-8					4	
Lt		6-9					2	
Lt		6-10					4	
Qv		6-11					3	
Bn		6-12					2	
		6-13						
		6-14						
		6-15						
		6-16						
		6-17						
		6-18						
		6-19						
		6-20						

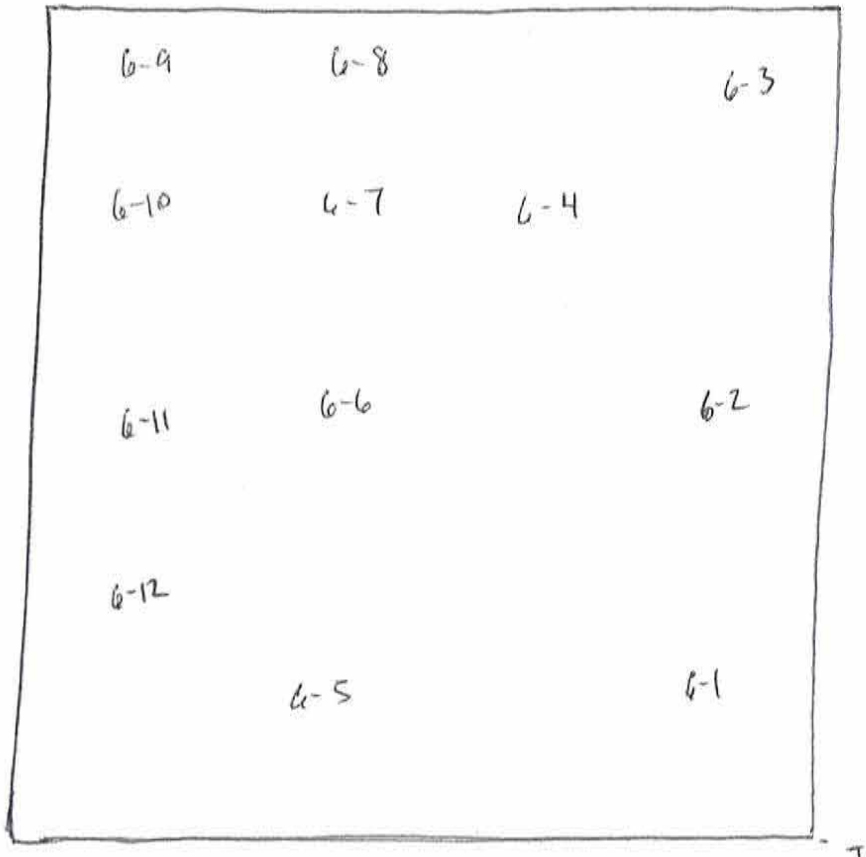
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


SOUTH MUDDY


6-9
6-8
6-3
6-10
6-7
6-4
6-11
6-6
6-2
6-12
6-5
6-1
Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: CM/MR Plot: 7 Date: 9 / 12 / 11 Page 1 of 1

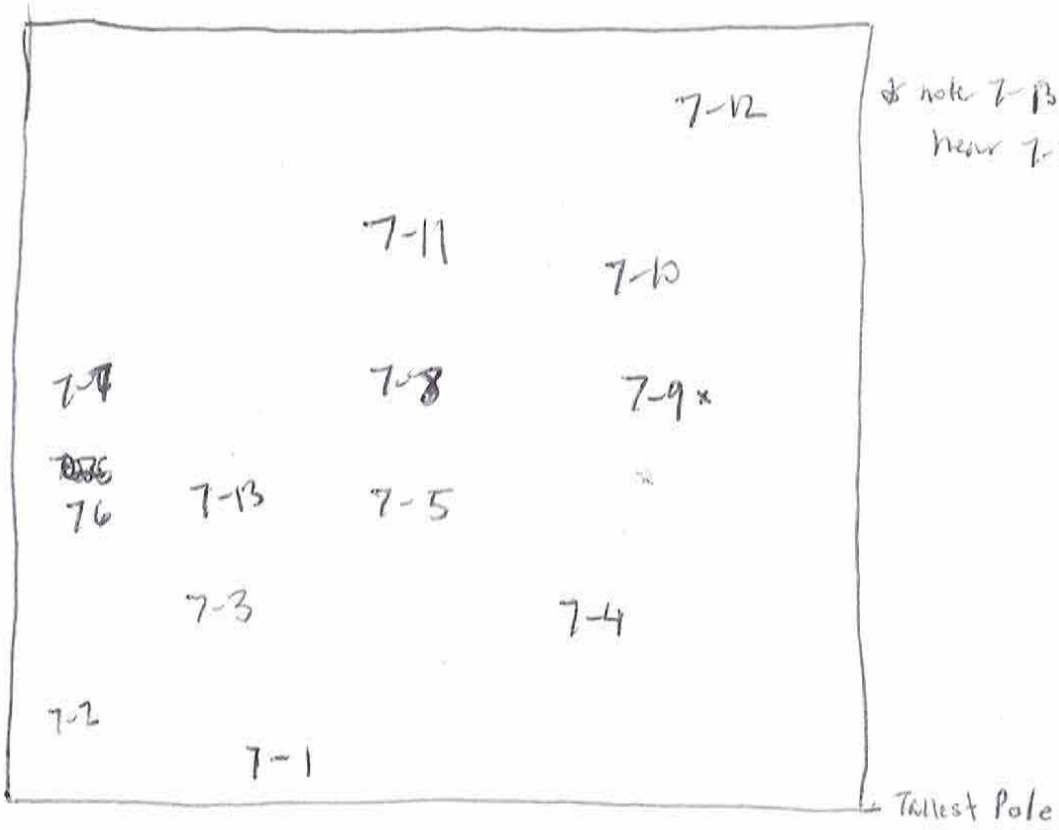
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Bn		7-1					4	
Jn		7-2					4	
Po		7-3					4	
Bn		7-4					4	
Jn		7-5					4	
Po		7-6					4	
Fp		7-7					4	
Bn		7-8					4	
Bn		7-9					4	
Bn		7-10					4	
Qp willow oak		7-11					3	
Qp pin oak		7-12					4	
Cl sourberry		7-13					3	
		7-14						
		7-15						
		7-16						
		7-17						
		7-18						
		7-19						
		7-20						
		7-21						
		7-22						
		7-23						
		7-24						
		7-25						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


7-12
* note 7-13 near 7-3 *
7-11
7-10
7-8
7-9 x
7-6
7-13
7-5
7-3
7-4
7-2
7-1
Tallest Pole
South Muddy

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: CTM/MR Plot: 8 Date: 4 / M / 11 Page 1 of 1

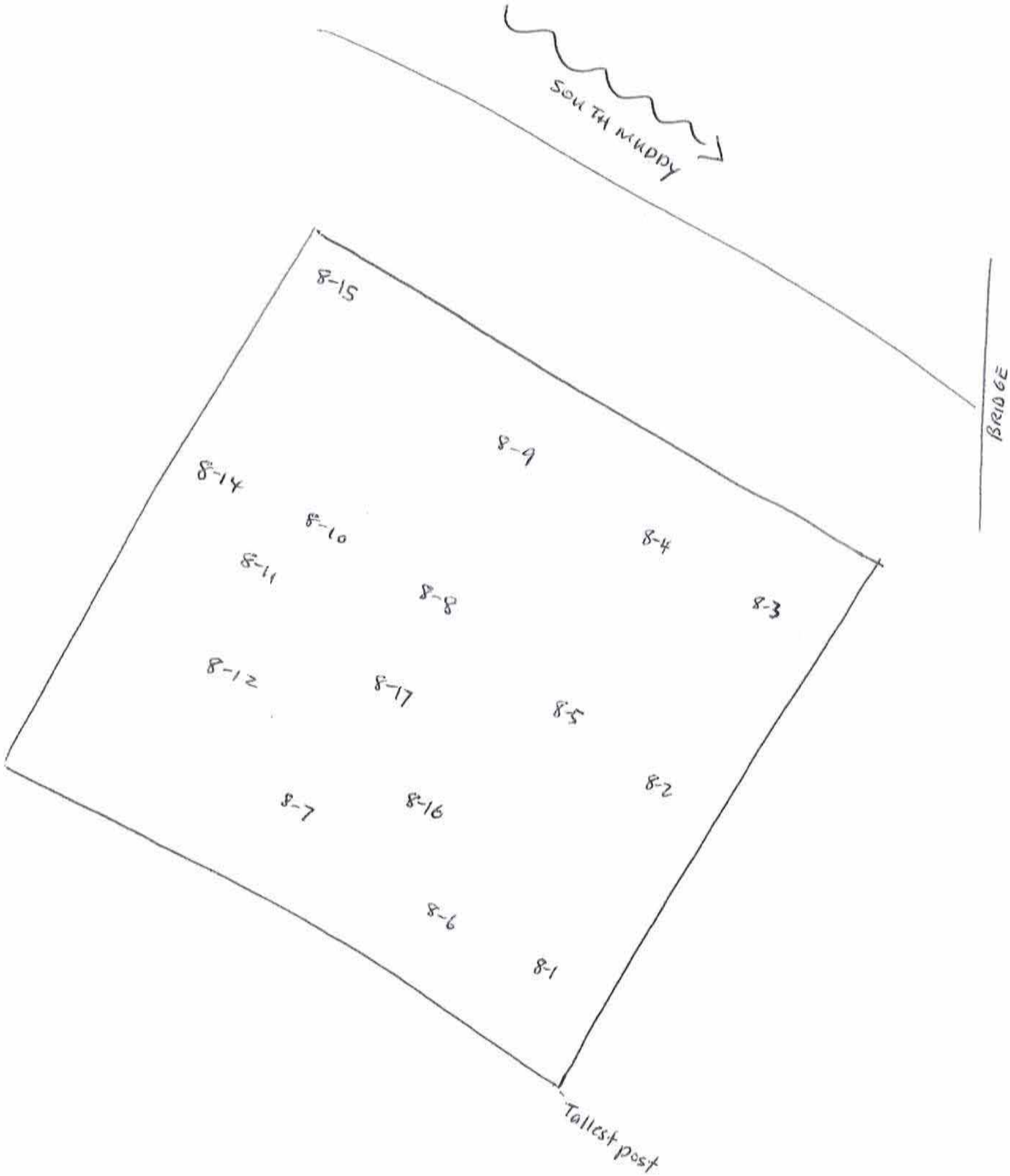
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
~~Qp~~ Qv pin oak/swamp white oak		8-1					4	
Qp pin oak		8-2					4	
Pd		8-3					4	
Pd		8-4					3	
Bn		8-5					4	
Qr redoak		8-6					4	
Pd		8-7					4	
Fp		8-8					1	
Qv swamp white oak		8-9					2	
Qr red oak		8-10					4	
Pd		8-11					4	
Qp pin oak		8-12					3	
~~Cf~~ Qr ~~sweetgum~~ oak		8-13					~~2~~ 4	
Cl sugarberry		8-14					4	
Qr redoak		8-15					3	
Bn		8-16					4	
Qp		8-17					3	
		8-18						
		8-19						
		8-20						
		8-21						
		8-22						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3



SOUTH MUDDY
BRIDGE
8-15
8-9
8-14
8-10
8-4
8-11
8-8
8-3
8-12
8-17
8-5
8-2
8-7
8-16
8-6
8-1
Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: CKM/MR Plot: 9 Date: 4 / 12 / 11 Page 1 of 1

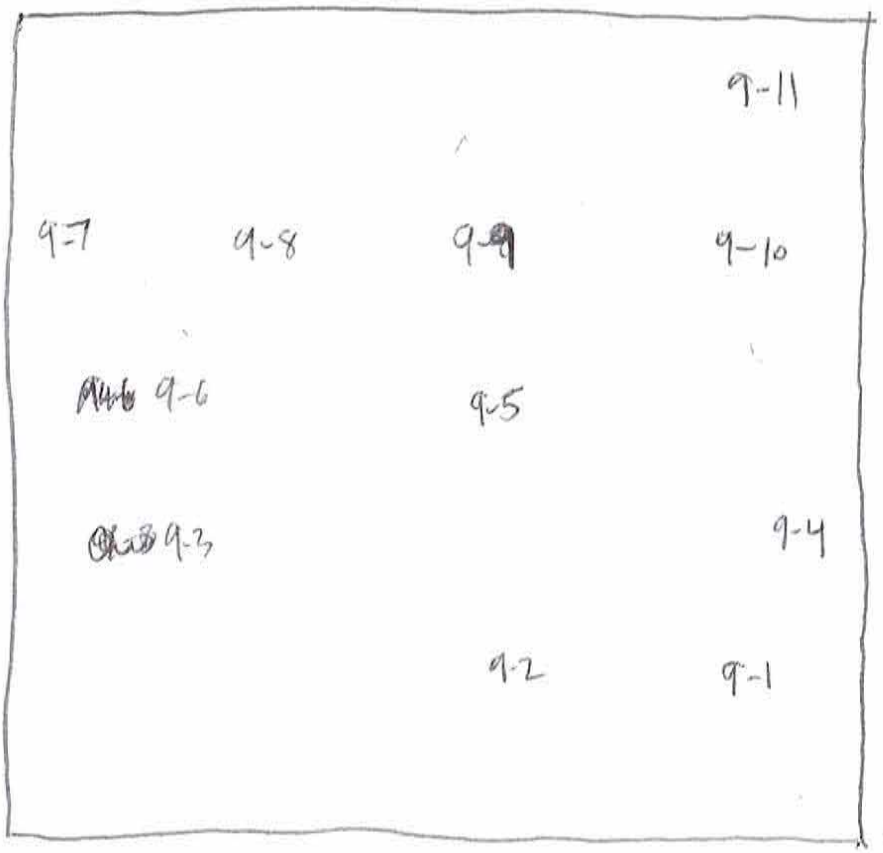
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Po		9-1					3	
Qp willow oak		9-2					4	
Fp		9-3					3	
Fp		9-4					3	
Lt		9-5					4	
Fp		9-6					4	
Qp pin oak		9-7					4	
Lt		9-8					3	
Qp pinoak		9-9					3	really small
Fp		9-10					4	
Lt		9-11					4	
		9-12						
		9-13						
		9-14						
		9-15						
		9-16						
		9-17						
		9-18						
		9-19						
		9-20						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


9-11
9-7
9-8
9-9
9-10
9-6
9-5
9-3
9-4
9-2
9-1
Tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10650 Team: CHM/MK Plot: 10 Date: 4/12/11 Page 1 of 1

Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Po		10-1					4	standing water
Qp pin oak		10-2					4	standing water
Qr red oak		10-3					4	" "
Fp		10-4					4	
Qr red oak		10-5					3	
Fp		10-6					4	standing water
Fg		10-7					4	" "
Qr red oak		10-8					4	
Fp		10-9					4	
Qr red oak		10-10					4	
Po		10-11					4	
Po		10-12					4	
Fp		10-13					4	
Po		10-14					4	
Qr red oak		10-15					4	
Qr		10-16					4	
Qr		10-17					4	
		10-18						
		10-19						
		10-20						

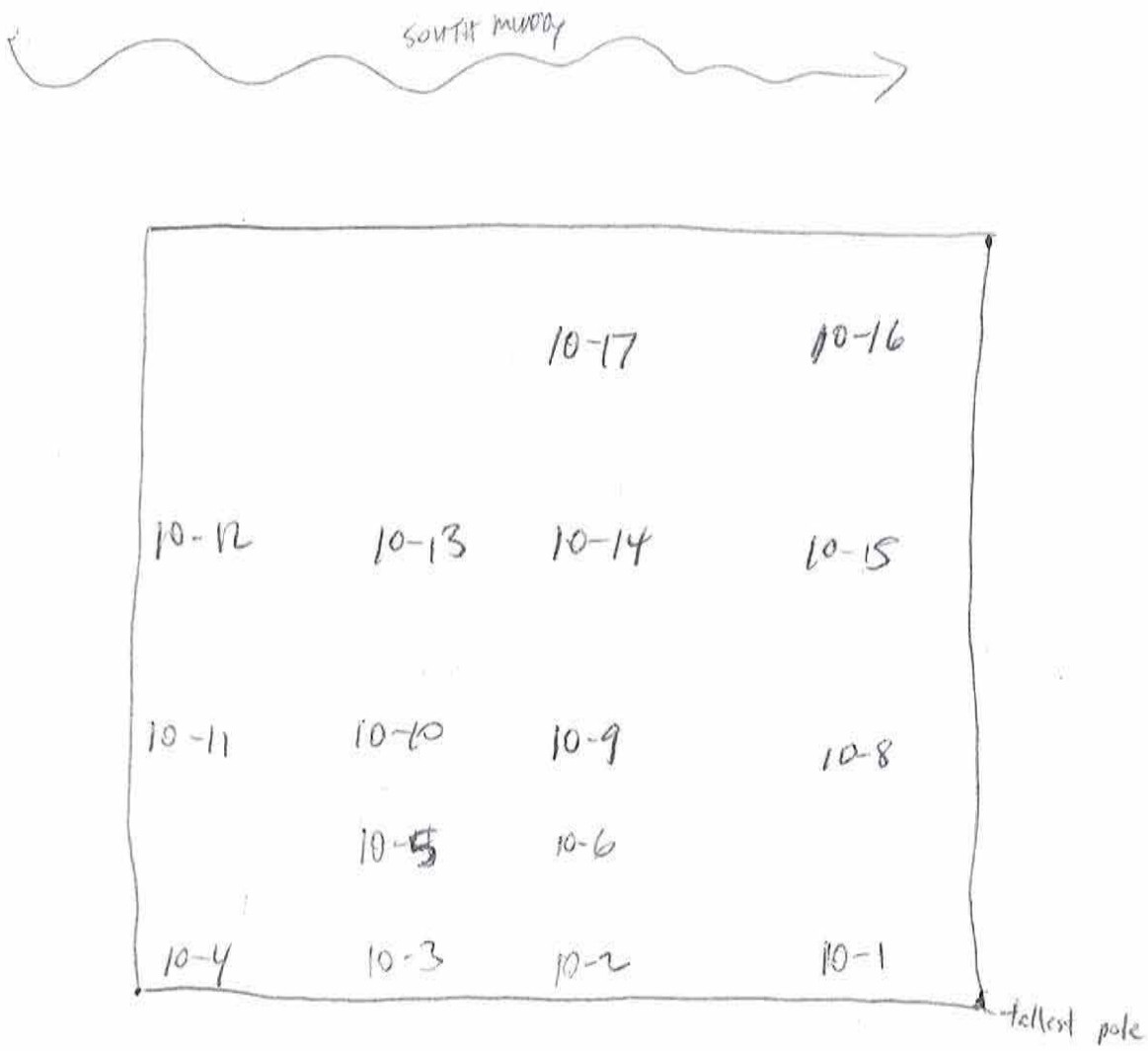
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3

Standing water in 1/3 of the plot. Tadpoles


SOUTH MUDDY
bridge
10-17
10-16
10-12
10-13
10-14
10-15
10-11
10-10
10-9
10-8
10-5
10-6
10-4
10-3
10-2
10-1
tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: ______ **Project:** 110650 **Team:** LHM/MR **Plot:** 11 **Date:** 4 / 12 / 11 Page 1 of 1

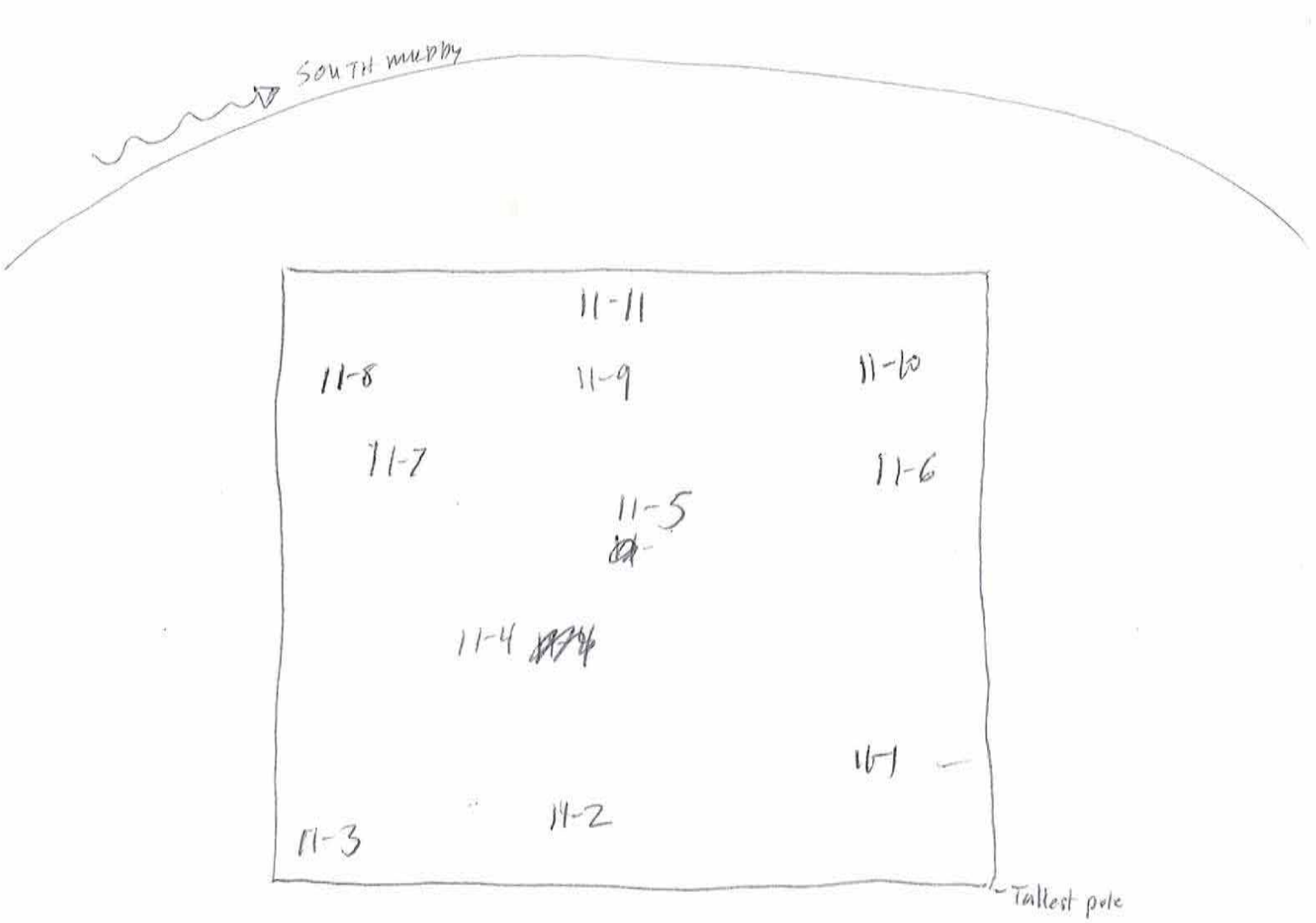
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Bn		11-1					4	
Bn		11-2					4	
Po		11-3					4	
Bn		11-4					4	
Lt		11-5					4	
Po		11-6					4	
Po		11-7					4	
* Qp, pin oak		11-8					4	
Qp willow oak		11-9					4	
Po		11-10					4 [illegible]	
Jn		11-11					4	
		11-12						
		11-13						
		11-14						
		11-15						
		11-16						
		11-17						
		11-18						
		11-19						
		11-20						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing. ↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


SOUTH muddy
11-11
11-8
11-9
11-10
11-7
11-6
11-5
11-4
16-1
11-3
11-2
Tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10450 Team: CKM/MR Plot: 12 Date: 4 / 12 / 11 Page 1 of 1

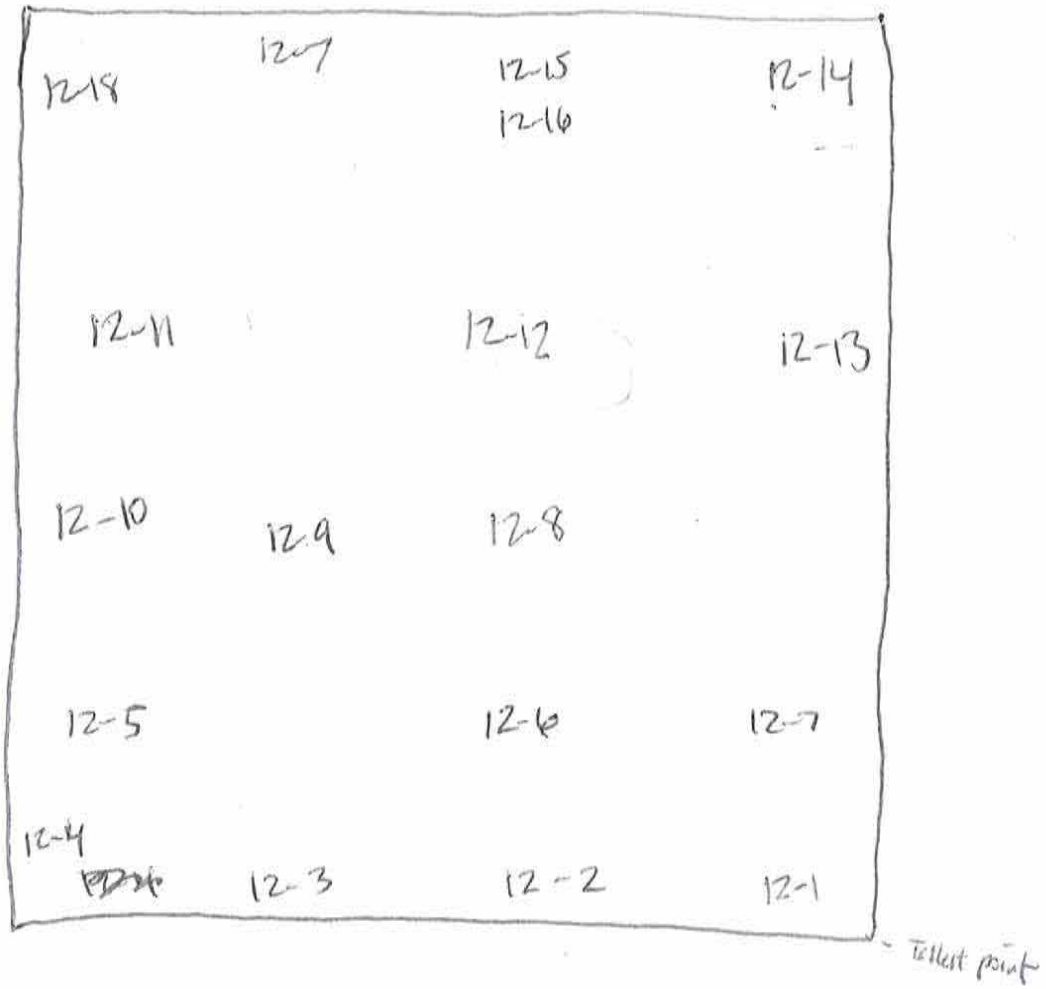
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Lt		12-1					4	
Po		12-2					3	
Po		12-3					3	
Po		12-4					3	
Qp willow oak		12-5					3	
Fp		12-6					3	
Lt		12-7					4	
Po		12-8					4	
Po		12-9					4	
Po		12-10					4	
Po		12-11					3	
Fp		12-12					4	
Lt		12-13					4	
Po		12-14					4	
Lt		12-15					3	
Qp pin oak		12-16					3	really small
Po		12-17					4	
Qp pin oak		12-18					3	really small
		12-19						
		12-20						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


12-18
12-7
12-15
12-16
12-14
12-11
12-12
12-13
12-10
12-9
12-8
12-5
12-6
12-7
12-4
12-3
12-2
12-1
Tallest point
South Wing

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10650 Team: MR/CM Plot: 13 Date: 4 / 15 / 11 Page 1 of 1

	Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Dead	~~Qv~~		~~13-1~~					2	
Dead	~~Qv~~		~~13-2~~					3	
Dead	~~Qv~~		~~13-3~~					2	
Dead	~~Qp~~	pin oak	~~13-4~~					4	
(volunteer)	Cl		13-5					4	
	Cl		13-6					3	
	Qp	willow oak	13-7					4	
(volunteer)	Qp	pin oak	13-8					3	
(volunteer)	Qp	pin oak	13-9					3	
	Qv		13-10					3	
	Qp	pin oak	13-11					4	
	Lt		13-12					4	
	Qv		13-13					4	
(volunteer)	Cl		13-14					3	
	Qp	willow oak	13-15					4	
(volunteer)	Cl		13-16					4	
	Qp	pin oak	13-17					4	
(Dead)	~~Qv~~		~~13-18~~					2	
	Lt		13-19					4	
(volunteer)	Qp	pin oak	13-20					4	
(volunteer)	Qp	pin oak	13-21					4	
Dead	~~Qp~~	pin oak	~~13-22~~					2	
Dead	~~Vnk~~		~~13-23~~					4	
	Qv		13-24					2	small, blkknots + mostly shrubby
(volunteer)	Vnk		13-25					2	diseased
	Lt		13-26					4	
Dead	~~Bm~~		~~13-27~~					2	
Dead	~~Qp~~	pin oak	~~13-28~~					4	
	Qv		13-29					2	
Dead	~~Qp~~	pin oak	~~13-30~~					2	
	Lt		13-31					4	
(volunteer)	Vnk		13-32					2	diseased
	Lt		13-33					3	
	Lt		13-34					1	

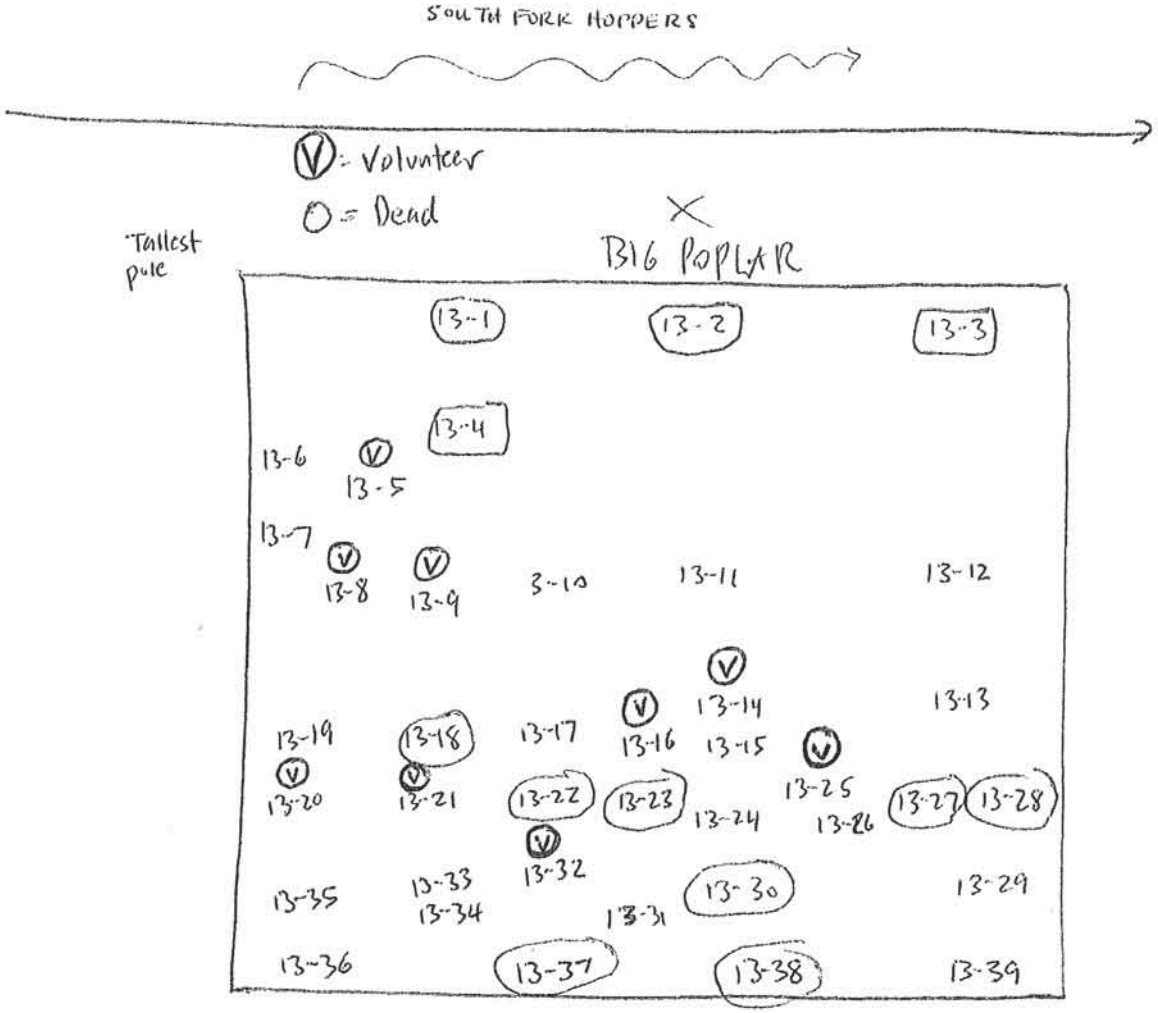
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.

	Qp	willow oak	13	35	3
	Qp	willow oak	13	36	3
Dead	~~Qr~~	~~red oak~~	~~13~~	~~37~~	~~2~~
Dead	~~Qr~~	~~red oak~~	~~13~~	~~38~~	~~3~~
	Qp	pin oak	13	39	2
			13	40	


SOUTH FORK HOPPERS
Ⓥ: Volunteer
O = Dead
X
BIG POPLAR
Tallest pole
13-1
13-2
13-3
13-4
13-6
Ⓥ
13-5
13-7
Ⓥ
13-8
Ⓥ
13-9
3-10
13-11
13-12
Ⓥ
13-14
13-13
13-19
13-18
13-17
Ⓥ
13-16
13-15
Ⓥ
13-25
Ⓥ
13-20
Ⓥ
13-21
13-22
13-23
13-24
13-26
13-27
13-28
Ⓥ
13-32
13-35
13-33
13-34
13-30
13-31
13-29
13-36
13-37
13-38
13-39

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10165 Team: CH/MB Plot: 14 Date: 4 / 14 / 11 Page 1 of 1

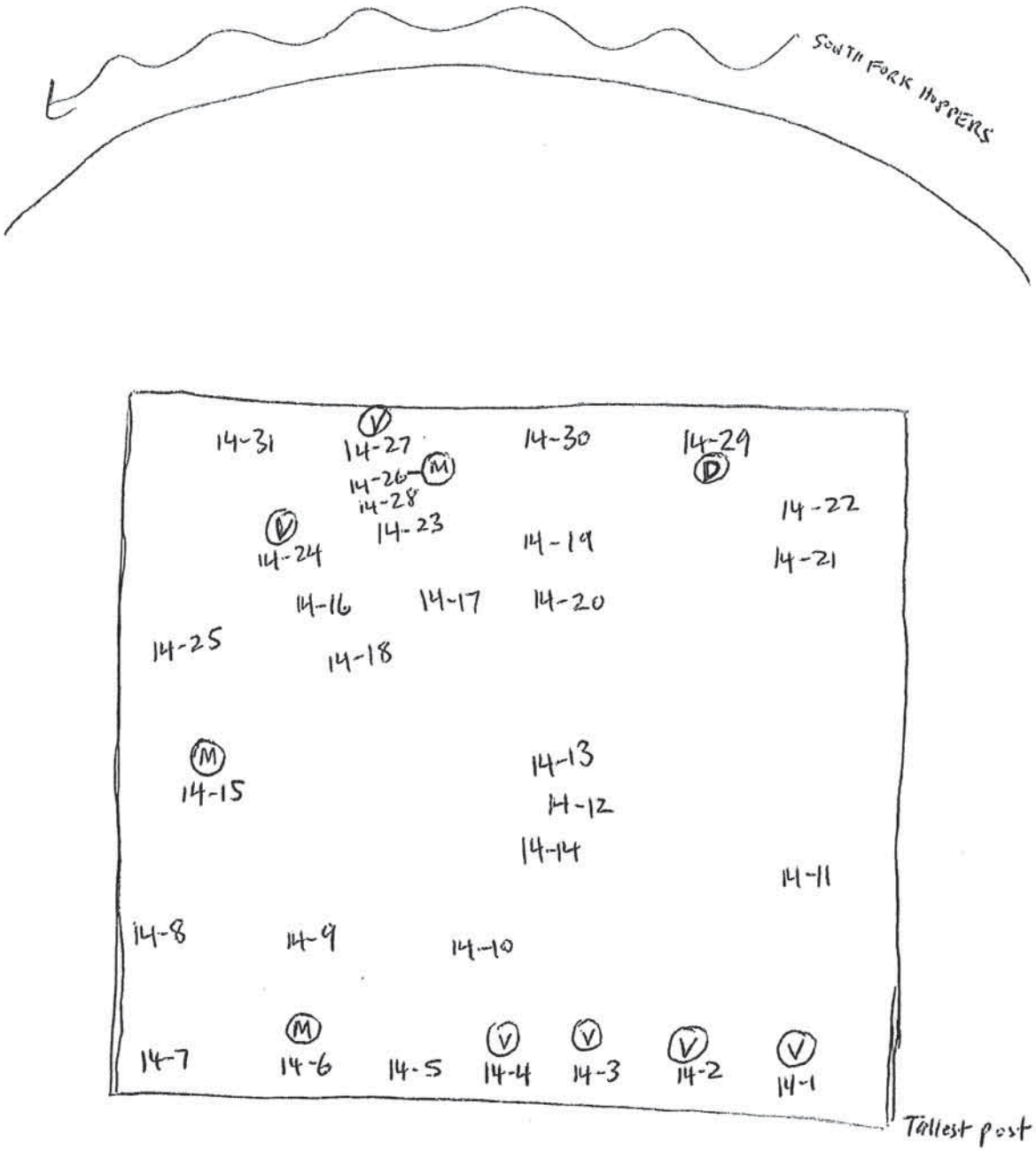
	Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
	willow oak								
(Volunteer)	Qp		14-1					4	
(Volunteer)	Qp	willow oak	14-2	(2) - somewhat spindly-type				4	
(Volunteer)	Qp	" "	14-3	(3)				4	
(Volunteer)	Qp	" "	14-4	(3)				4	
	Jn		14-5					4	
(Dead)	~~Jn~~		14-6					~~4~~	
	Fp		14-7					4	
	Bn	birch	14-8					4	
	Qp	willow oak	14-9					4	
	Jn		14-10					4	
	Qp	~~willow~~ pin oak	14-11					2	broken
	Qp	willow oak	14-12	(2)				4	
	Qp	~~willow~~ pin oak	14-13					3	
	Qp	willow oak	14-14					4	
(Dead)	~~Jn~~		14-15					1	broken
	Qp	willow oak	14-16	(3)				3	
	Qp	willow oak	14-17	(3)				3	
	Qp	" "	14-18					3	
	Qp	~~willow oak~~ pin	14-19					2	
	Qp	willow oak	14-20	(3)				3	
	Bn	birch	14-21					2	
	Qp	willow oak	14-22	(2)				3	
	Qp	~~willow oak~~ pin	14-23					2	
(Volunteer)	Qp	willow oak	14-24	(3)				4	
	Qp	" "	14-25					3	
(Dead)	~~Qp~~	" "	14-26	(2)				~~4~~	
(Volunteer)	Qp	" "	14-27	(3)				3	
	Qp	" "	14-28					3	
(Dead)	~~Qp~~	pin oak	14-29					~~2~~	
	Qp	pin oak	14-30					3	
	Jn		14-31					4	

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.



O = Dead

(V) = Volunteer

~~Dead~~

(M) = Missing

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11045 Team: MR/LM Plot: 15 Date: 4 / 14 / 11 Page 1 of 1

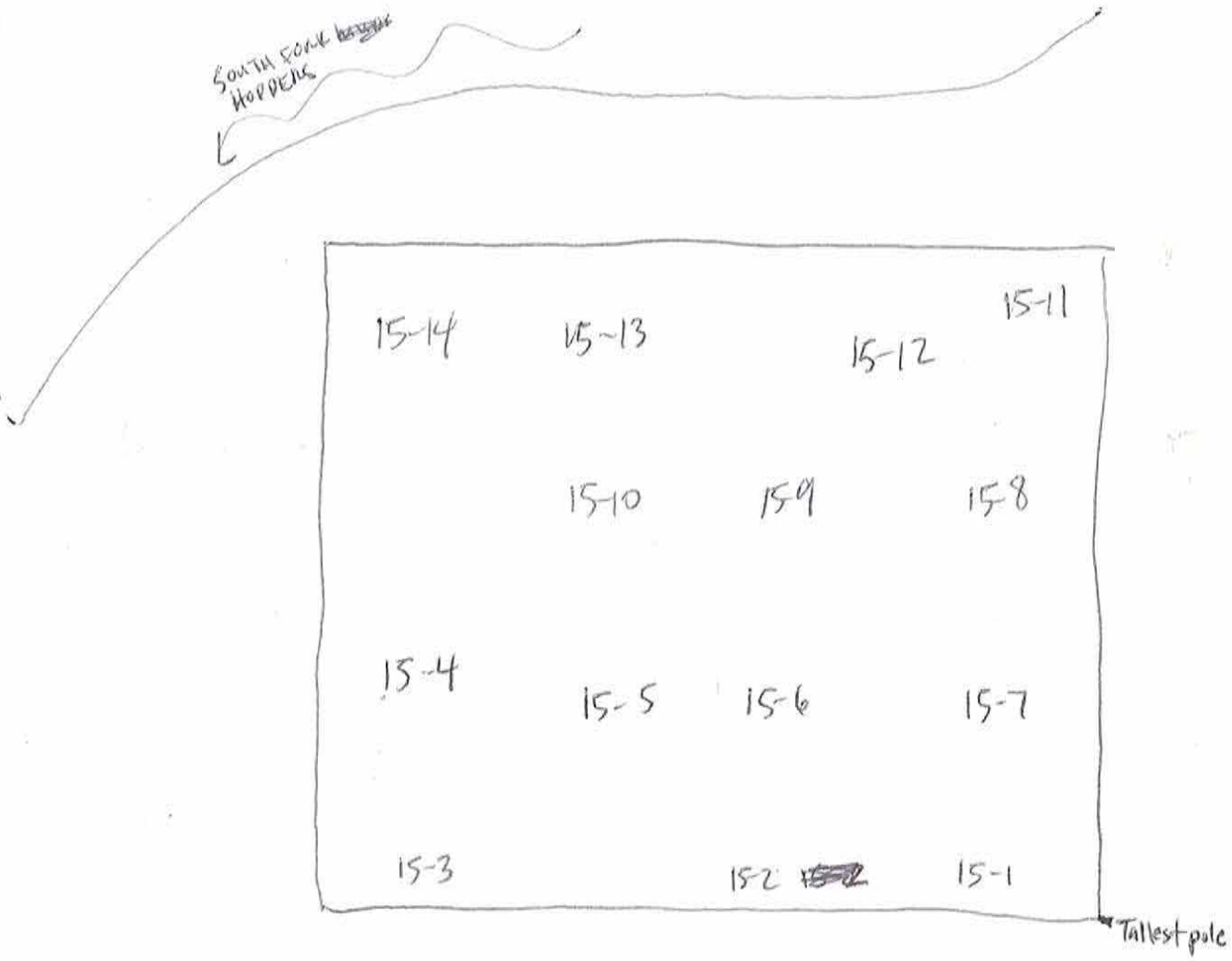
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Bn birch		15-1					4	
Po		15-2					4	
Cl sugarberry		15-3					4	
Fp		15-4					4	
Bn birch		15-5					4	
Ns blackgum		15-6					4	
Qp pin oak		15-7					4	
Ns		15-8					4	
Po		15-9					4	
Po		15-10					4	
Qp pin oak		15-11					3	
Fp		15-12					4	
Jn		15-13					4	
Dv persimmon		15-14					4	really small - hard to tell for sure
		15-15						
		15-16						
		15-17						
		15-18						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


SOUTH FORK HOPPERS
15-14
15-13
15-12
15-11
15-10
15-9
15-8
15-4
15-5
15-6
15-7
15-3
15-2
15-1
Tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: CM/MR Plot: 16 Date: 4 / 14 / 11 Page 1 of 1

Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Fp		16-1					4	
Qp willow oak		16-2					4	standing water
Bn birch		16-3					4	
Po		16-4					4	
Lt		16-5					4	
Fp		16-6					4	
Fp		16-7					4	
Jn		16-8					4	
Qp willow oak		16-9					4	
Fp		16-10					4	
Fp		16-11					4	
Fp		16-12					4	
Bn birch		16-13					1	
Qp willow oak		16-14					34	
Bn birch		16-15					43	
Bn " "		16-16					3	
		16-17						
		16-18						
		16-19						
		16-20						

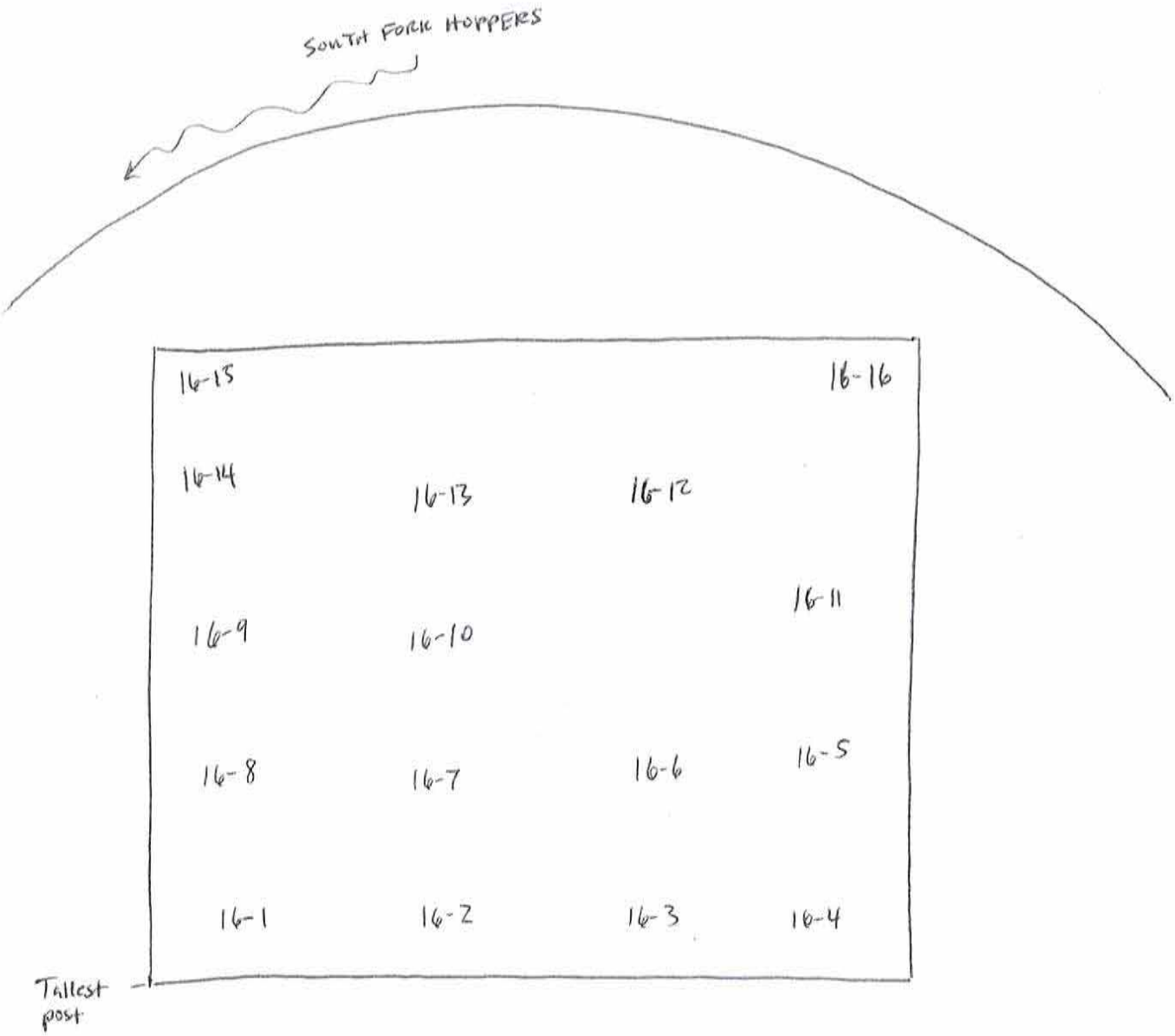
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing. ↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3

Standing water - entire plot


SOUTH FORK HOPPERS
16-15
16-16
16-14
16-13
16-12
16-11
16-9
16-10
16-8
16-7
16-6
16-5
16-1
16-2
16-3
16-4
Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: UNC/MR Plot: 17 Date: 4/14/11 Page 1 of 1

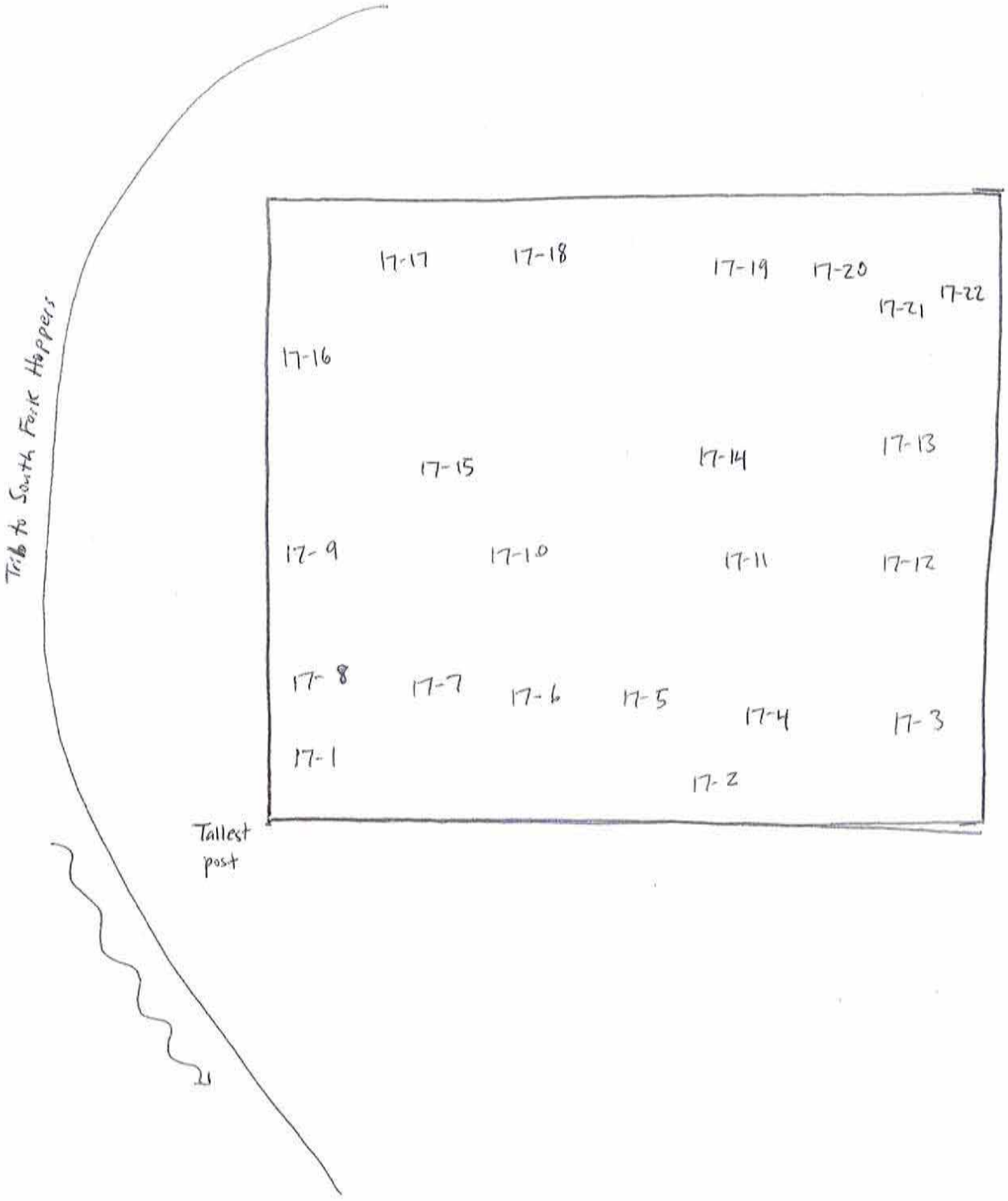
Species Name		Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qp	pin oak		1-17	17-1				4	
Bn	birch		2-17	17-2				4	
Qp	willow oak		3-17	17-3				3	
Ns	black gum		4-17	17-4				4	
Fp			5-17	17-5				4	
Qp	pin oak		6-17	17-6				2	
Fp			7-17	17-7				4	
Fp			8-17	17-8				4	
Qp	pin oak		9-17	17-9				4	
Bn	~~red maple~~		10-17	17-10				4	
Qp	pin oak		11-17	17-11				2	
Bn			12-17	17-12				4	
Fp			13-17	17-13				4	
Ns			14-17	17-14				4	
Qr	red oak		15-17	17-15				4	
Lt			16-17	17-16				4	
Qp	pin oak		17-17	17-17				2	
Qp	pin oak		18-17	17-18				4	
Qp	pin oak		19-17	17-19				4	
Qr			20-17	17-20				3	
Qp	pin oak		21-17	17-21				4	
Fp			22-17	17-22				4	
			23-17	17-23					
			24-17	17-24					

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


Trib to South Fork Hoppers
17-17
17-18
17-19
17-20
17-21
17-22
17-16
17-15
17-14
17-13
17-9
17-10
17-11
17-12
17-8
17-7
17-6
17-5
17-4
17-3
17-1
17-2
Tallest post

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11005 Team: MR/[illegible] Plot: 18 Date: 4 / 14 / 11 Page 1 of 1

Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qp willow oak		18-1					3	small, standing water
Qp pin oak		18-2					4	small " "
Qp willow oak		18-3					3	" "
Qp " "		18-4					4	damp
~~18~~ Qp " "		18-5					3	
~~Rep~~ Lt		18-6					~~3~~	
Fp		18-7					4	standing water
Qp willow oak		18-8					2	small - standing water
Qp pin oak		18-9					2	standing water / emptions beside little buds ov stem to sob
Bn birch		18-10					4	
Qp willow oak		18-11					4	
Po		18-12					3	
Po		18-13					3	
Lt		18-14					4	
		18-15						
		18-16						
		18-17						
		18-18						
		18-19						
		18-20						

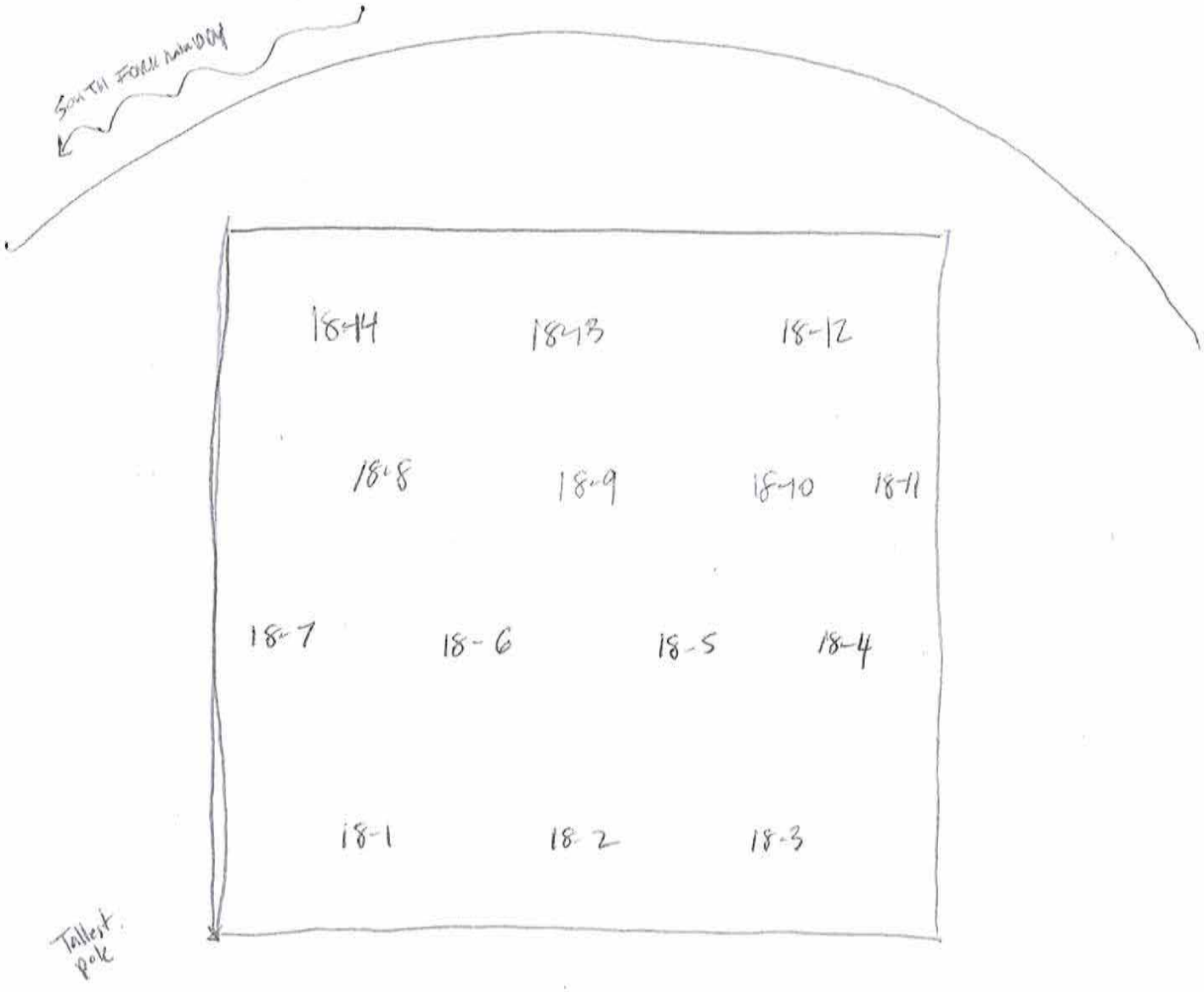
Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.

standing water in most of plot


South Fork Animal Camp
18-14
18-13
18-12
18-8
18-9
18-10
18-11
18-7
18-6
18-5
18-4
18-1
18-2
18-3
Tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: ______ **Project:** 110650 **Team:** MR/CM **Plot:** 19 **Date:** 4 / 14 / 11 Page 1 of 1

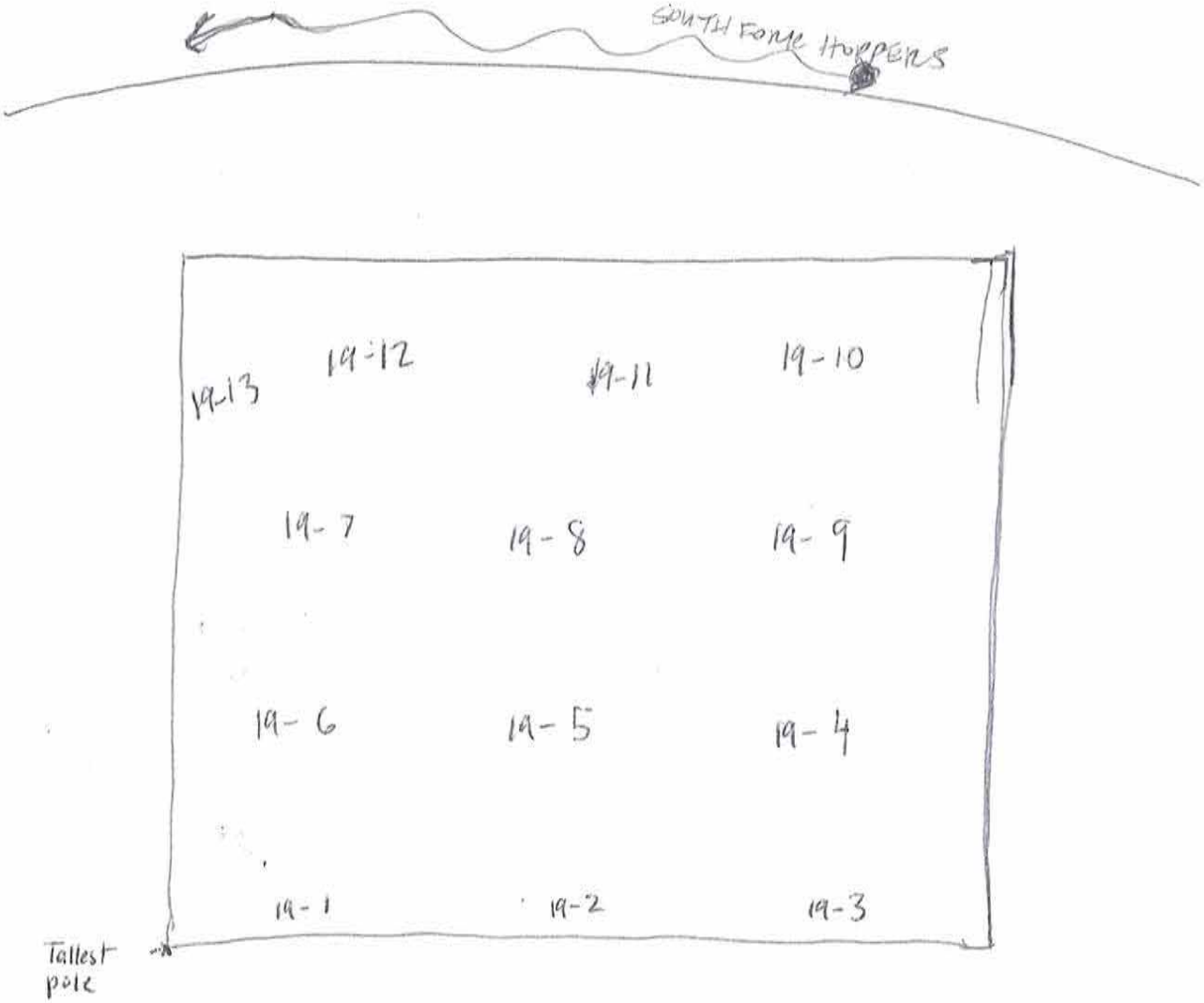
Species Name		Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Bn	birch		19-1					4	
Qp	~~sugarberry~~ willow oak		19-2					4	
Po			19-3					4	
Lt	poplar		19-4					3	
Cl	sugarberry		19-5					4	
Lt			19-6					4	
Qp	willow oak		19-7					4	
Po			19-8					0	
Lt			19-9					4	
Fp			19-10					4	
Lt			19-11					4	
Fp			19-12					4	
Fp			19-13					4	
			19-14						
			19-15						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m. EntryTool2.2.6 Form PWS12, ver 8.3


SOUTH FORK HOPPERS
19-13
19-12
19-11
19-10
19-7
19-8
19-9
19-6
19-5
19-4
19-1
19-2
19-3
Tallest pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10690 Team: MR/CM Plot: 20 Date: 4 / 15 / 11 Page 1 of 1

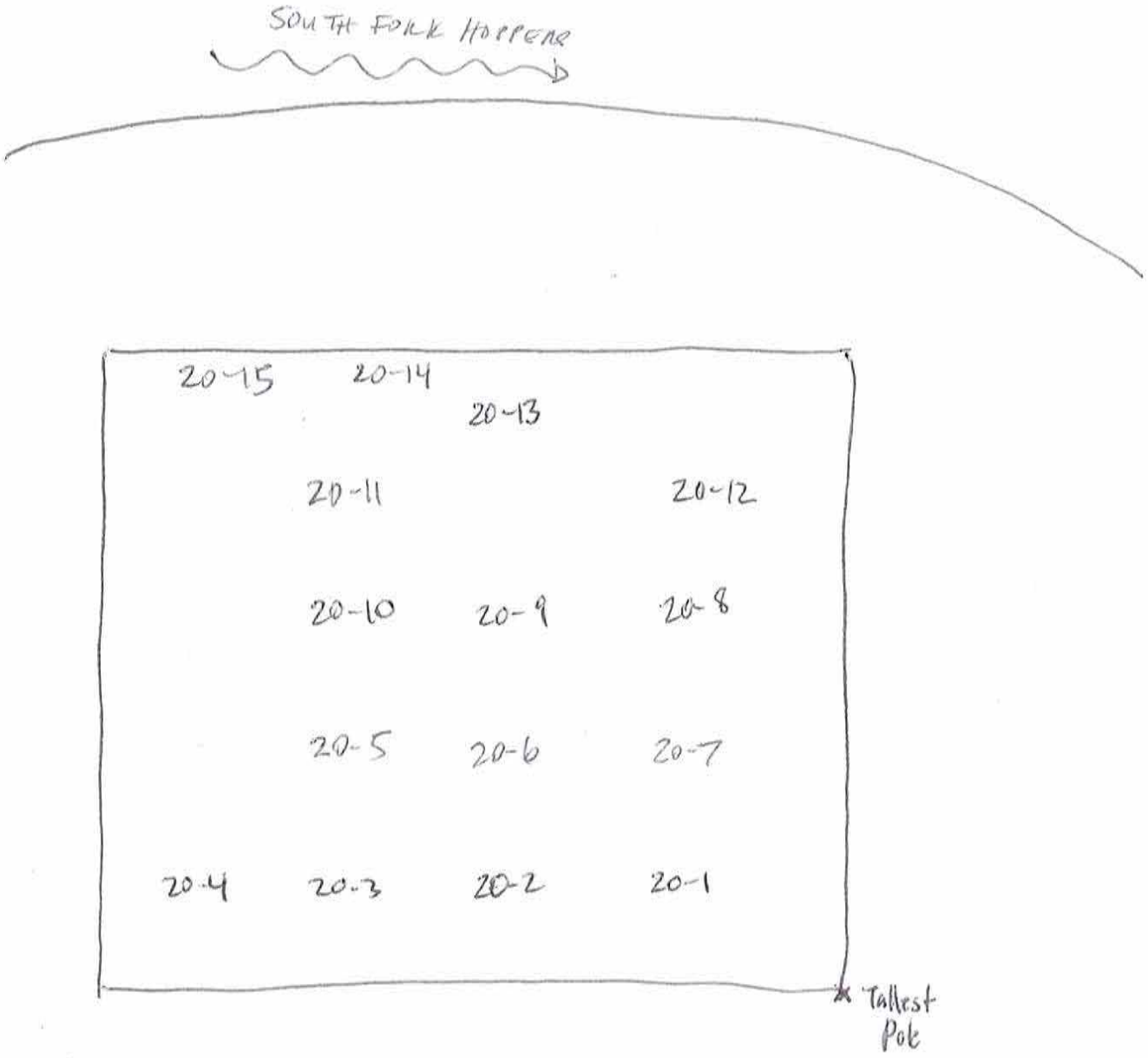
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Br red oak		20-1					3	
Jn		20-2					4	
Rv		20-3					4	
Fp		20-4					4	
Qp willow oak		20-5					4	
Po		20-6					4	
Jn		20-7					4	
Qp willow oak		20-8					4	
Pp		20-9					4	
Bn		20-10					4	
Jn		20-11					4	
Bn		20-12					4	
Fp		20-13					4	
Se elderberry		20-14					4	
Ss sky willow		20-15					4	
		20-16						
		20-17						
		20-18						
		20-19						
		20-20						
		20-21						
		20-22						
		20-23						
		20-24						
		20-25						
		20-26						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing. ↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


SOUTH FORK HOPPER
20-15
20-14
20-13
20-11
20-12
20-10
20-9
20-8
20-5
20-6
20-7
20-4
20-3
20-2
20-1
Tallest Pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 11065 Team: CATM/MC Plot: 21 Date: 4/15/11 Page 1 of 1

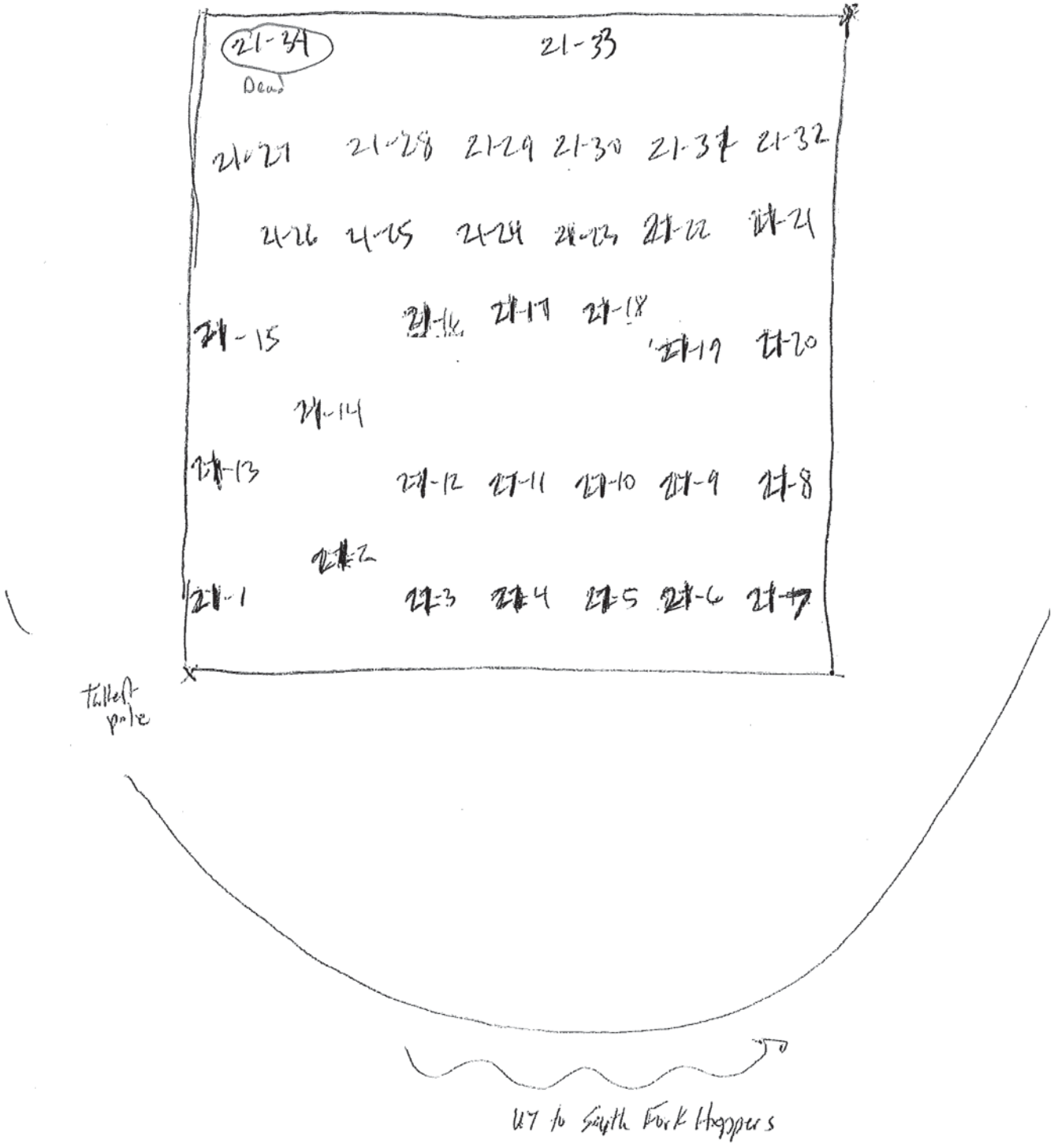
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qp pin oak		21-1					4	
Qv		21-2					4	
Qp willow oak		21-3					4	
Qp red		21-4					2	
Qv redoak		21-5					3	
Qv redoak		21-6					2	
Qp pin oak		21-7					4	
Qp " "		21-8					4	small
Qp " "		21-9					4	
Bn		21-10					4	
Qv		21-11					2	
Fp		21-12					3	
Qp Fp pin oak		21-13					4	
Qp Fp ~~pin oak~~		21-14					4	
Fp		21-15					4	
Bn		21-16					4	
Qp pin oak		21-17					4	
Qv red oak		21-18					3	
Bn		21-19					4	
Qp pin oak		21-20					3	
Qp pin oak		21-21					4	
Lt		21-22					4	
Bn		21-23					4	
Po		21-24					4	
Fp		21-25					3	
Qp pin oak		21-26					4	
Po		21-27					4	
Qp pin oak		21-28					4	
Qp willow oak		21-29					2	
Po		21-30					4	
Qv redoak		21-31					2	
Qp willow oak		21-32					3	
Po		21-33					4	
Fp Dead		21-34					4	

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing. ↓

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


21-34
Dead
21-33
21-27
21-28
21-29
21-30
21-31
21-32
21-26
21-25
21-24
21-23
21-22
21-21
21-15
21-16
21-17
21-18
21-19
21-20
21-14
21-13
21-12
21-11
21-10
21-9
21-8
21-2
21-1
21-3
21-4
21-5
21-6
21-7
Tallest pole
47 to South Fork Hoppers

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10050 Team: MN/CM Plot: 22 Date: 4 / 15 / 11 Page 1 of 1

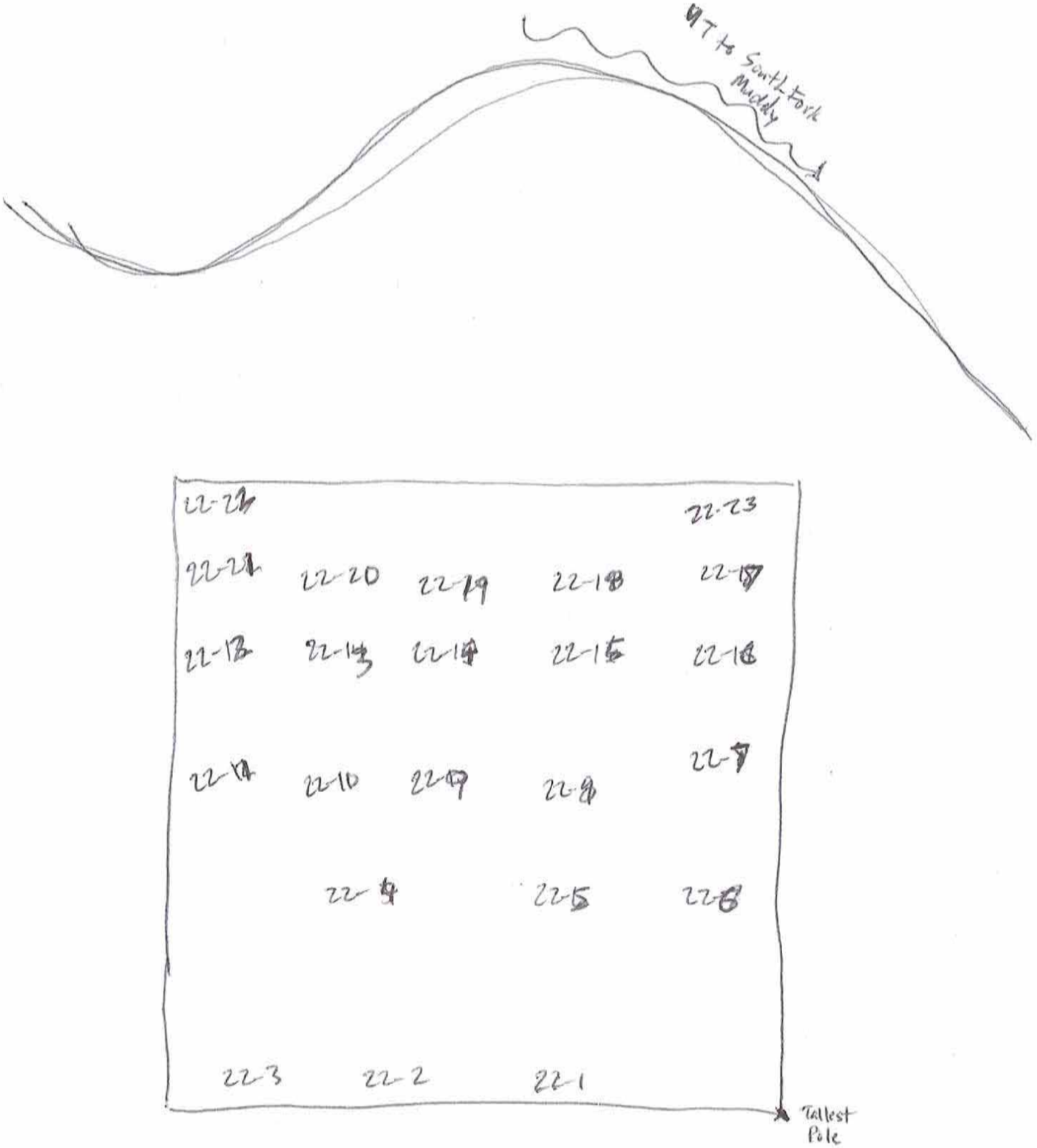
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Ns blackgum		22-1					4	
Bn		22-2					4	
Qp pin oak		22-3					4	
Fp		22-4					4	
Qp willow oak		22-5					4	
Fp		22-6					4	
Fp		22-7					4	
Bn		22-8					4	
Fp		22-9					4	
Qp pin oak		22-10					4	
Fp		22-11					4	
Lt		22-12					4	
Lt		22-13					4	
Qp willow oak		22-14					4	
Bn		22-15					4	
Bn		22-16					4	
Qp willow oak		22-17					4	
Lt		22-18					4	
Lt		22-19					4	
Lt		22-20					4	
Qp willow oak		22-21					4	
Qv		22-22					3	
Qs		22-23					3	
		22-24						
		22-25						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


4T to South Fork Muddy
22-23
22-21
22-20
22-19
22-18
22-17
22-13
22-14
22-15
22-16
22-12
22-10
22-9
22-8
22-7
22-4
22-5
22-6
22-3
22-2
22-1
Tallest Pole

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10650 Team: CHM/MR Plot: 23 Date: 4 / 15 / 11 Page 1 of 1

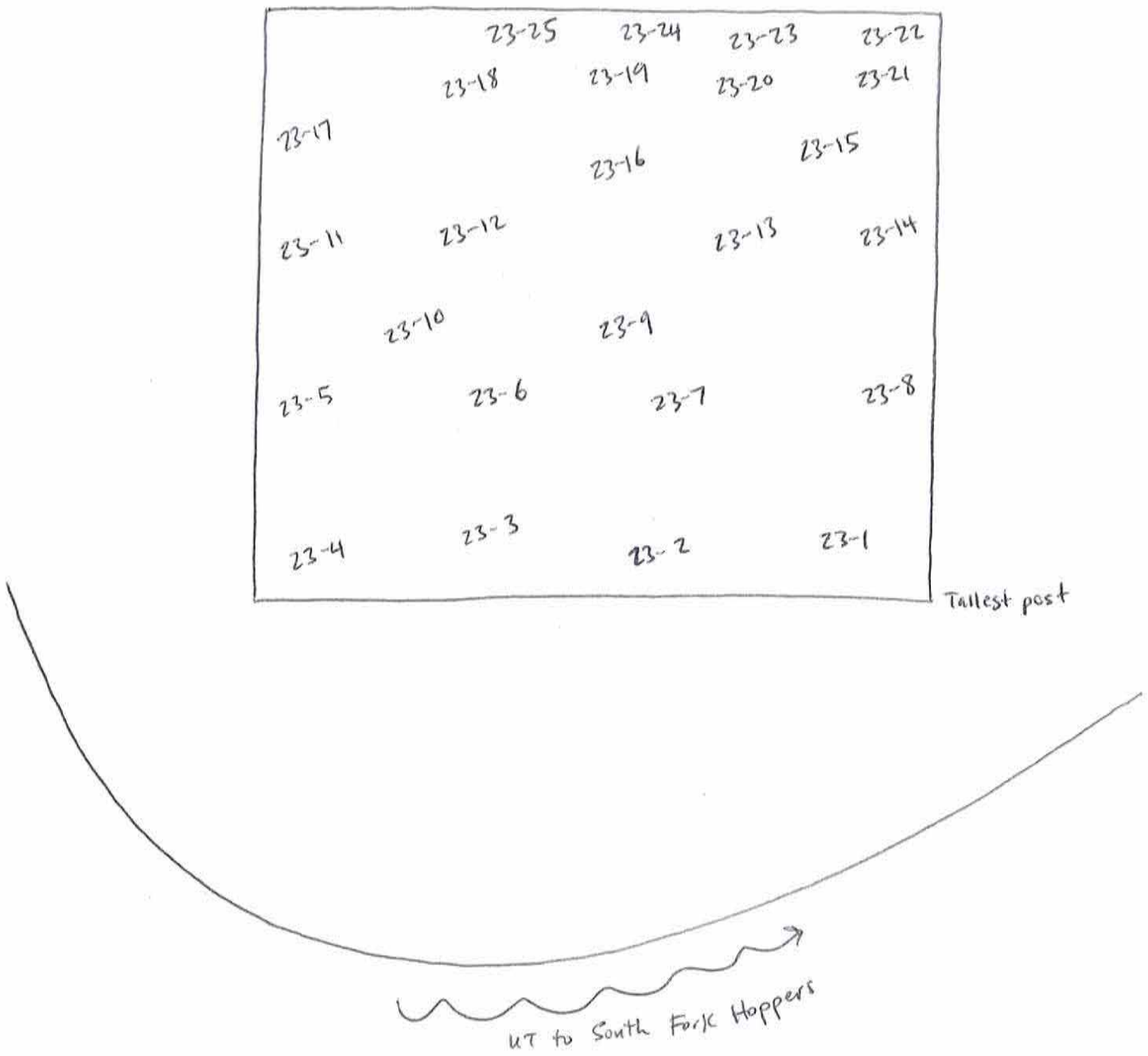
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qp willow oak		23-1					4	
Bn		23-2					4	
Bn		23-3					4	
Qp willow oak		23-4					4	
Qv		23-5					2	
Po		23-6					4	
Qp willow oak		23-7					4	
Qp pin oak		23-8					4	
Qr		23-9					2	
Qp pin oak		23-10					4	
Qp pin oak		23-11					4	
Qp willow oak		23-12					4	
Qp pin oak		23-13					4	
Po		23-14					4	
Lt		23-15					4	
Qr		23-16					3	
Qp pin oak		23-17					3	
Qr		23-18					3	
Qp willow oak		23-19					4	
Qr		23-20					4	
Qp pin oak		23-21					4	
Bn		23-22					4	
Lt		23-23					4	
Qp pin oak		23-24					3	
Qr		23-25					4	

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


23-25
23-24
23-23
23-22
23-18
23-19
23-20
23-21
23-17
23-16
23-15
23-11
23-12
23-13
23-14
23-10
23-9
23-5
23-6
23-7
23-8
23-4
23-3
23-2
23-1
Tallest post
UT to South Fork Hoppers

Planted Woody Stem Data: CVS Level 1

Leader: _____ Project: 10660 Team: MR/EM Plot: WLP1 Date: 4 / 15 / 11 Page 1 of 1

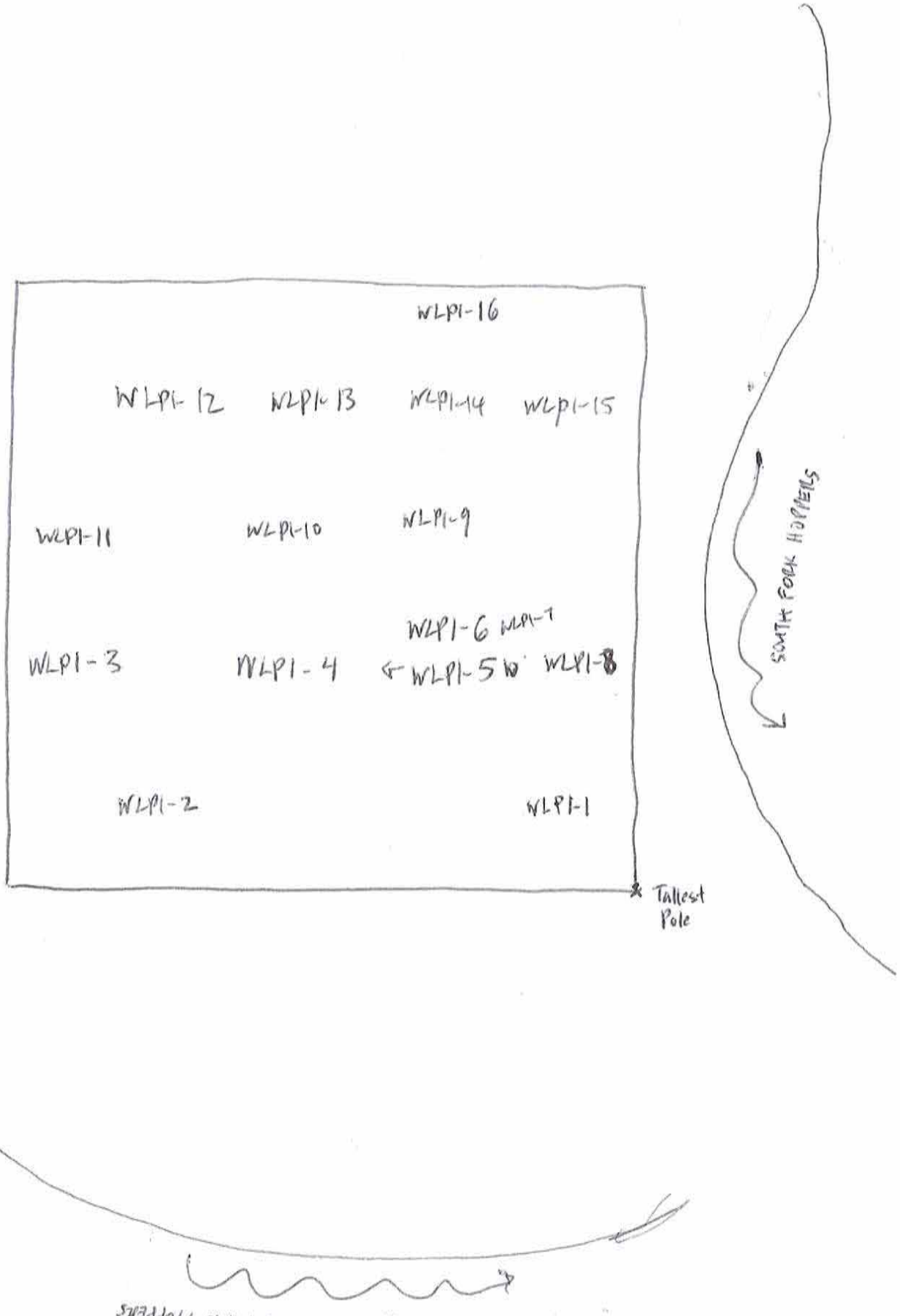
Species Name	Source	Coordinates X (0.1 m)	Coordinates Y (0.1 m)	ddh (1 mm)	Height (1* cm)	DBH (1 cm)	Vigor	Damage
Qv oak		WLP1-1					4	
Qv oak		WLP1-2					4	
Po		WLP1-3					4	
Cl sassafras		WLP1-4					4	
Po		WLP1-5					4	
Bm		WLP1-6					4	
Bm		WLP1-7					2	
Po		WLP1-8					4	
Qp pin oak		WLP1-9					3#	
Jn		WLP1-10					4	
Jn		WLP1-11					4	
Fp		WLP1-12					4	
Unk		WLP1-13					3	doesn't appear to be on list
Po		WLP1-14					4	
Po		WLP1-15					4	
Po		WLP1-16					4	
		WLP1-17						
		WLP1-18						
		WLP1-19						
		WLP1-20						
		WLP1-21						
		WLP1-22						
		WLP1-23						

Source: Transplant, Live stake, Ball and burlap, Pot, Tubling, Bare Root, Mechanically planted, Unknown

Vigor: 4=excellent, 3=good, 2=fair, 1=unlikely to survive year, 0=Dead, Missing.

Damage: Removal, Cut, Mowing, Beaver, Deer, Rodents, Insects, Game, Livestock, Other/Unknown Animal, Human Trampled, Site Too Wet, Site Too Dry, Flood, Drought, Storm, Hurricane, Diseased, Vine Strangulation, Unknown, specify other.

*Height precision drops to 10cm if >2.5m and 50cm if >4m.


WLP1-16
WLP1-12
WLP1-13
WLP1-14
WLP1-15
WLP1-11
WLP1-10
WLP1-9
WLP1-6
WLP1-7
WLP1-3
WLP1-4
WLP1-5
WLP1-8
WLP1-2
WLP1-1
Tallest Pole
SOUTH FORK HOPPERS
UT to South Fork Hoppers

Appendix E (see attached As-Built Plans)

Appendix F:
Photo ID Log

South Muddy Creek Photos

South Muddy Creek PID 1 – J-Hook near upstream end of project

South Muddy Creek PID 2 –Constructed Riffle,

South Muddy Creek PID 3 – Log Vane in Meander

South Muddy Creek PID 4 – Constructed Riffle

South Muddy Creek PID 5 – Log Vane in Meander

South Muddy Creek PID 6 – Constructed Riffle

South Muddy Creek PID 7 – J-Hook in Meander

South Muddy Creek PID 8 – Constructed Riffle

South Muddy Creek PID 9 – Log Vane in Meander

South Muddy Creek PID 10 – Stream Crossing

South Muddy Creek PID 11 – Constructed Riffle

South Muddy Creek PID 12 – Log Vane and Root Wad in Meander

South Muddy Creek PID 13 – Constructed Riffle

South Muddy Creek PID 14 – Immediately upstream of Sain Road crossing

South Muddy Creek PID 15 – Constructed Riffle downstream of Sain Road crossing

South Muddy Creek PID 16

South Muddy Creek PID 17 – Log Vane in Meander

South Muddy Creek PID 18 – Constructed Riffle

South Muddy Creek PID 19

South Muddy Creek PID 20 – J-Hook near downstream end of project

South Fork Hoppers Creek (SFHC) Photos

SFHC P1D 1– Constructed Riffle

SFHC PID 2 – Constructed Riffle

SFHC PID 3 – Log vane in constructed pool

SFHC PID 4 – Constructed Riffle

SFHC PID 5 – Constructed Riffle

SFHC PID 6 – Log Sills and Root Wad

SFHC PID 7 – Constructed Riffle

SHFC PID 8 – Log Sills & Root Wad

SFHC PID 9 – Constructed Riffle

SFHC PID 10 – Confluence of UT1

SFHC PID 11 – Constructed Riffle

SFHC PID 12 – Double Drop Cross Vane below crossing

SFHC PID 13 – Log Sills & Root Wad

SFHC PID 14 – Log Sills & Root Wad

SFHC PID 15 – Log Sills & Root Wads

SFHC PID 16 – Log Vane & Matted Bank

SFHC PID 17 – Constructed Riffle at downstream terminus of project

UT1 to South Fork Hoppers Creek Photos

UT1 P1D 1– Constructed Riffle

UT1 PID 2 – Constructed Riffle

UT1 PID 3 – Constructed Riffle

UT1 PID 4 – Constructed Riffle

UT1 PID 5 – Constructed Riffle

UT1 PID 6 – Log Sills

UT1 PID 7 – Constructed Riffle

UT1 PID 8 – Constructed Riffle

UT1 PID 9 – Ephemeral Pool in Right Floodplain

UT1 PID 10 – Log Sills

UT1 PID 11 – Constructed Riffle

UT1 PID 12 – Ephemeral Pool in Right Floodplain

UT1 PID 13 – Constructed Riffle

UT1 PID 14 – Log Sill

UT1 PID 15 – Constructed Riffle below stream crossing

UT1 PID 16 – Constructed Riffle

UT1 PID 17 – Log Sills

UT1 PID 18 – Constructed Riffle

UT1 PID 19 – Constructed Riffle

UT2 to South Fork Hoppers Creek Photos

UT2 PID 1 – Constructed Riffle & Log Sill

UT2 PID 2 – Constructed Riffles & Log Sills

UT2 PID 3 – Stream crossing