

Snowbird Creek Tributaries Mitigation Project

Year 2 Monitoring Report - Final

Graham County, North Carolina



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EXECUTIVE SUMMARY

The Snowbird Creek Tributaries site was restored through a full delivery contract with the North Carolina Ecosystem Enhancement Program (NCEEP). This report documents the completion of the project and presents Year 2 monitoring data for the five-year monitoring period. The goals for the restoration project were as follows:

- Promote and recreate geomorphically stable conditions at the Snowbird Creek Tributaries project site;
- The reduction of sediment and nutrient inputs through restoration of riparian areas and stream banks; and
- To improve aquatic and terrestrial habitat along the project corridor.

To accomplish these goals, the following objectives were implemented:

- Restoration of an incised, channelized, and eroding stream by creating a stable channel that has access to its floodplain; enhancement of a previously disturbed stream reach by replanting the riparian corridor with native woody vegetation;
- Improve water quality by establishing buffers for nutrient removal from runoff;
- Improve in-stream habitat by providing a more diverse bedform with riffles and pools, creating deeper pools, developing areas that increase oxygenation, providing woody debris for habitat, and reducing bank erosion; and
- Improve terrestrial habitat by removing invasive species, planting riparian areas with native vegetation and protecting these areas with a permanent conservation easement so that the riparian area will increase storm water runoff filtering capacity, improve bank stability, provide shading to decrease water temperature and improve wildlife habitat.

One vegetation monitoring plot 100 square meters (m²) (10m x 10m) in size was used to predict the survival of the woody vegetation planted on-site. The Year 2 monitoring of vegetation indicated an average survival of 890 stems per acre. The data shows that the Site is on track to meet both the interim stem survival criteria for Year 3 (320 stems per acre) and the final success criteria of 260 trees per acre by the end of Year 5.

The design implemented at the Snowbird Creek Tributaries mitigation project site involved Priority Level 1 Restoration, and Enhancement Level II approaches, as well as Preservation. Channels were built to be consistent with, or evolve to, a stable B3-type channel for Reach 2 of UT3 and a B4-type channel for the section of UT2 that was enhanced. Restoration and enhancement work were completed in accordance with the approved design approach provided in the mitigation plan for the tributaries. Longitudinal profile and cross-section data indicate that the project streams have remained stable since baseline monitoring data were collected in February 2011. At least two bankfull events have now been documented (in two separate years) over the course of the first two monitoring periods thereby satisfying the hydrologic success criteria. During the time of the as-built surveys, vegetation was sparse on a section of UT3-Reach 2; however, by the time Year 1 monitoring activities began in November 2011, a dense layer of herbaceous vegetation covered the site. Photo logs included in this report confirm the herbaceous cover at the project site is flourishing, and in conjunction with other erosion control measures like matting, is promoting bank stability on-site while planted, woody vegetation becomes more established. Based on geomorphic and hydrologic data presented in Appendix D and E, this Site is currently on track to meet the stream and hydrologic success criteria specified in the Snowbird Creek Tributaries Mitigation Plan.

Summary information/data related to potential threats to restoration values, such as encroachment and statistics related to performance of various project and monitoring elements can be found in the tables and figures in the report appendices. The only area of concern observed in Year 2 is a small strip of impacted buffer paralleling the upstream limits of UT3-Reach 2. This buffer impact is approximately 30 feet wide by 130 feet long and is located within the left floodplain; it is caused by local residents encroaching on a portion of the easement in order to gain vehicle access to existing logging roads (trails) that continue on the property further upstream of the project reach/easement limits. Vegetation within this impacted swath of buffer is

sparse from the mowing over and flattening by vehicles to the extent that a defined path has become apparent. Baker is coordinating with the contractor and land owner to correct this situation by relocating the easement encroached portion of the vehicle access to outside of and adjacent to the easement to avoid further encroachment. The impacted buffer within the easement will be reseeded and replanted after construction of the relocated vehicle access. This is scheduled to be completed by the end of 2013 and will be documented within the Year 3 monitoring report. Supplemental information can be found in Appendix F which includes a planview figure, photos, and a summary table.

Narrative background and supporting information formerly found in these reports can be found in the Baseline Monitoring Report (formerly Mitigation Plan) and in the Mitigation Plan (formerly Restoration Plan) documents available on EEP's website. All raw data supporting the tables and figures in the appendices is available from EEP upon request.

1.0 PROJECT BACKGROUND AND ATTRIBUTES

The Snowbird Creek Tributaries mitigation site is located approximately one and a half miles southwest of Robbinsville in Graham County, North Carolina (Figure 1, Appendix A). The project site is situated in the Little Tennessee River Basin, within North Carolina Division of Water Quality (NCDWQ) sub-basin 04-04-04 and United States Geologic Survey (USGS) hydrologic unit 06010204020010. The Snowbird Creek Tributaries mitigation project is located in a watershed that is predominantly forested that also contains a small number of residences near the tributaries and Hooper Branch. The vast majority of the watershed is in forested cover, with less than one percent of land being in agricultural use. Over the past 100 years, various parcels within the project area have been impacted by logging activities as well as residential and agricultural land use within the valley bottom.

Anthropogenic land use alteration and channelization of streams in the Snowbird Creek Tributaries project watersheds have resulted in various stream corridor impairments. Incision, bank erosion, and other ongoing stream processes typical of adjusting streams were found in various reaches of UT3 and other tributaries within the project area. However, it was determined that the benefits of stream and riparian enhancement further upslope in the watershed would not be significant enough to justify further disturbance of the watershed which continues to revert to a more natural state in the absence of intensive logging activities.

In accordance with the approved mitigation plan for the site, construction activities were conducted in August 2010. Project activity on UT2 consisted of improving bank stability and riparian conditions along a small section of UT2 that had been degraded by previous logging activities. An Enhancement II approach was used to stabilize this reach; efforts included replacing native woody vegetation in an area previously disturbed during logging activities and removal of debris from the channel that was contributing to channel disturbance. Re-vegetation of the riparian corridor will improve shading and provide high quality biomass to the stream in addition to other habitat improvements.

A Priority I Restoration approach was used on Reach 2 of UT3 to address prior manipulation and relocation of the reach by restoring a channel with step-pool morphology in the low part of the valley. The restoration of this reach of UT3 eliminated the bank erosion, aggradation of fines, and lack of native riparian vegetation and rootmass that characterized the former location of Reach 2 on UT3. The new channel has improved connectivity to its floodplain and channel bedform was improved by constructing a series of step-pool and riffle-pool sequences using grade control structures. These grade control structures will aid in dissipating streamflow energy, decrease pool-to-pool spacing and improve the quality of in-stream habitat present. Given the steepness of the project area, creating a step-pool channel system was critical in achieving a more stable profile and preventing self-propagating headcuts. A vegetated riparian buffer was also planted which will support streambank stability along the new reach while serving a variety of terrestrial and aquatic habitat functions.

The project involved the restoration of 543 linear feet (LF) of UT3 (Reach 2) and the enhancement of 171 LF of UT2 (Reach 2). In addition, 7,497 LF of UT1, UT2 and UT3 were preserved with conservation easements. The restoration, enhancement, and preservation of 8,211 LF of stream within this project site has generated 2,035 stream mitigation units (SMUs). Other general information about the project is located in Tables 1-4 of Appendix A.

1.1 Location and Setting

The Snowbird Creek Tributaries mitigation site is located approximately one and a half miles southwest of Robbinsville in Graham County, North Carolina. To reach the project site from the intersection of NC Highways 143 and 129, turn south onto N.C. Highway 129. At the first stop light past the Microtel, turn right onto East Main Street, continue for approximately 0.3 miles, and turn left onto Atoah Street. Atoah

Street becomes Snowbird Road (both are NC Highway 143). Snowbird Road (NC 143) will come to parallel Santeetlah Reservoir (an inundated portion of Snowbird Creek). At the intersection of IU Gap Road and Snowbird Road, the property will be situated to the east. The last house on the left before you get to this intersection is the property owner and just before you get to this house there is a gated dirt road that leads to UT1 and UT2. To get to UT3, turn left on IU Gap Rd., go .15 miles, the UT3 property is on the left and the access drive is on the left just past a small rental farm house.

2.0 METHODOLOGY AND RESULTS

The five-year monitoring plan for the Snowbird Creek Tributaries mitigation project includes criteria to evaluate the success of the geomorphic, vegetative and hydrologic components of the project. The specific locations of the cross-sections, sediment sampling location, vegetation plot, crest gauge installation and permanent reference photo stations, are shown on the current condition plan view submitted with this report.

2.1 Stream Assessment

2.1.1 Morphologic Parameters and Channel Stability

Geomorphic monitoring of restored stream reaches is being conducted over a five year period to evaluate the effectiveness of the restoration practices installed. Monitored stream parameters include channel dimension (cross-sections), profile (longitudinal survey), pattern (to a lesser degree for reasons noted below), bed composition, bank stability, bankfull flows, and stability of reference sites documented by photographs. Crest gauges, as well as high flow marks, will be used to document the occurrence of bankfull events. The methods used and any related success criteria are described below for each parameter.

2.1.1.1 Dimension

Four permanent cross-sections were installed in representative riffle and pool reaches on UT3 to help evaluate the success of the mitigation project. Each cross-section was established by installing permanent pins on each bank to establish a consistent and repeatable transect from year-to-year. The cross-sectional surveys capture points at all breaks in slope and includes typical features such as top of bank, bankfull (if different from top of bank), inner berm, edge of water, and thalweg. Cross-sections are provided in Exhibit 3 of Appendix D and are depicted with an orientation looking downstream. Riffle cross-sections are classified using the Rosgen Stream Classification System. The project was built with a larger-than-typical entrenchment ratio for B-type channels, however Baker has determined that the B classification is still most appropriate based on other channel characteristics, namely width-depth ratio, sinuosity, and slope.

From year-to-year, change in cross-section dimensions should typically be limited to steepening of the banks from a gentler side-slope that they are typically constructed at, to a steeper slope that is sustainable once complementary vegetation establishes. This vegetation of the banks and floodplain may promote further bank deposition and channel narrowing based on the resulting increase in roughness that accompanies dense vegetation establishment. These, and any other changes, will be evaluated to determine their root cause and whether they represent movement toward a more unstable condition (e.g., down-cutting or erosion) or movement toward increased stability (e.g., settling, vegetative changes, deposition along the banks, or decrease in width/depth ratio).

2.1.1.1.1 Results

As-built cross-section monitoring data for stream stability was collected in February 2011. The four permanent cross-sections along UT3 were re-surveyed in February 2013 to document stream dimension for Monitoring Year 2. Cross-sectional data is presented in Table 8 (Appendix D) and the location of cross-sections is shown on the plan sheets submitted with this report.

The cross-sections show that there has been little to no adjustment to stream dimension on Reach 2 of UT3 since construction. At this time, cross-sectional measurements do not indicate any streambank or channel stability issues.

2.1.1.2 Pattern and Longitudinal Profile

The longitudinal profile for Year 1 was surveyed during February 2013; a visualization of the profile is provided in Exhibit 4 of Appendix D. A longitudinal profile was conducted for the entire project length on Reach 2 of UT3. This longitudinal profile will be replicated annually during the five year monitoring period.

Measurements taken along the longitudinal profile include thalweg, water surface, and top of left and right bank. The pools should remain relatively deep with flat water surface slopes, and the riffles should remain steeper and shallower than the pools. Bed form observations should be consistent with those observed for channels of the design stream type. Profile data collected should reflect stable channel bedform and a diverse range of riffle and pool complexes.

All measurements were taken at the head of each feature (e.g., riffle, run, pool, glide) and the maximum pool depth. Elevations of grade control structures were also included in the longitudinal profiles surveyed. Surveys were tied to a permanent benchmark. Although pattern adjustments were made on Reach 2 of UT3 for channel alignment considerations, such as following the low point of the valley, pattern adjustments were not made with the intent to greatly increase sinuosity. Unnamed Tributary 3 is an A/B-type stream characterized as having a step-pool morphology. Consequently, pattern information is not provided in Appendix D as the parameters present are generally associated with meandering, riffle-pool channels and not step-pool channels. However, as the site is monitored, reaches will be evaluated for significant changes in pattern. Any changes that occur and warrant repair will be discussed in future monitoring reports.

2.1.1.2.1 Results

The longitudinal profile shows that the bed features are stable; closely-spaced grade control structures continue to help maintain the overall profile desired. As noted in the Stream Reach Morphology Data Tables in Appendix D (Table 9), riffle and pool characteristics do not appear to have changed much since construction; the riffle slope and pool spacing measurements obtained for Year 2 are acceptable when compared to design data provided for Reach 2 of UT3. Bedform diversity, particularly max pool depths and pool spacing features, appears to have improved with the restoration of the channel; grade control structures will help maintain vertical stability in Reach 2 of UT3 as the channel adjusts to a more natural B-type channel.

There was also little to no change in the profile of Reach 2 of UT3 since construction. The piping that was previously observed around the structure near station 0+95 during Monitoring Year 1 appears to have resolved itself; there were no signs of bank or channel instability observed during the Monitoring Year 2 survey. At this time, the structure is not considered to be an area of concern. Baker will continue to monitor this structure and make any

adjustments that are needed. No other stream problem areas were observed during Monitoring Year 2.

2.1.1.3 Substrate and Sediment Transport

Bed material analysis will consist of a pebble count taken in the same constructed riffle during annual geomorphic surveys of the project site. This sample, combined with evidence provided by changes in cross-sectional and profile data will reveal changes in sediment transport and bed gradation that occur over time as the stream adjusts to upstream sediment loads and cross-sections evolve into a more permanent stable dimension. Significant changes in bed load composition will be evaluated with respect to stream stability and watershed changes.

2.1.1.3.1 Results

For this project, a pebble count was collected on UT3. Visual observations of UT3 and a review of pebble count data collected during Year 1 monitoring did not yield any signs that sediment transport functions have been hampered by the mitigation project; specifically, no significant areas of aggradation or degradation within the project area were observed. The pebble count data (Exhibit 5, Appendix D) indicates that the stream is moving fines through the system and larger pebbles are making up a greater percentage of the bed material.

2.1.2 Hydrology

2.1.2.1 Streams

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. A crest gauge was installed on the floodplain of UT3 at the bankfull elevation. The crest gauge will record the highest watermark between site visits and will be checked at each site visit to determine if a bankfull event has occurred. 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 on 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 or we reach the end of the monitoring period. If we reach the end of the monitoring period without two bankfull events occurring, the IRT will decide how to proceed.

2.1.2.1.1 Results

The site was found to have at least one bankfull event over the duration of the Year 2 monitoring period based on crest gauge readings. A cumulative total of at least two bankfull events have now been documented onsite within the first two monitoring periods/years (with at least one event documented per monitoring period). These two bankfull events were documented to have occurred in two separate years (between Spring 2011/Winter 2012 and Winter 2012/Winter 2013 respectively), and thus fulfills the hydrology success criteria for this stream mitigation project site. However, Baker will continue to monitor and report subsequent bankfull events using the crest gauges throughout the course of the remaining monitoring periods through year five. Information on these events is provided in Table E10 (Appendix E).

2.1.3 Photographic Documentation of Site

Photographs will be used to document restoration success visually. Reference sites were photographed during the as-built survey; photographing these sites will be repeated for at least five years following construction. Reference photos are taken once a year, from a height of

approximately five to six feet. Permanent markers will ensure that the same locations (and view) are utilized during each monitoring period. Selected site photographs are shown in Appendix B.

Lateral and structure photographs are used to subjectively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, structure function and stability, and effectiveness of erosion control measures. Lateral photos should not indicate excessive erosion or degradation of the banks. A series of photos over time should indicate successive maturation of riparian vegetation and consistent structure function. Photo documentation of the site during Year 2 monitoring reflects stable site conditions in restored or enhanced areas.

2.1.3.1 Lateral Reference Photos

Reference photos of transects were taken of the right and left banks at each permanent cross-section. A survey tape was shown in most photographs and represents the cross-section line located perpendicular to the channel flow. The water surface was located in the lower edge of the frame in order to document bank and riparian conditions. Photographers will make an effort to consistently maintain the same area in each photo over time.

2.1.3.2 Structure Photos

Photographs of primary grade control structures (i.e. vanes and weirs), along the restored streams are included within the photographs taken at reference photo stations. Photographers will make every effort to consistently maintain the same area in each photo over time.

2.1.4 Stream Stability Assessment

In-stream structures installed within the restored streams consisted of boulder steps. Table 11 in Appendix F provides a comprehensive visual assessment of morphological stability throughout the restored area (Reach 2 of UT3). The Year 2 visual observations of these structures indicate that little or no changes have occurred since the baseline survey was performed; structures are functioning as designed and are holding their elevation and grade. The close spacing of grade control structures on UT3 and favorable bank heights are allowing for both vertical and lateral energy dissipation of the stream during flood events; no structures were found to be in need of repair at this time. No stream problem areas were identified during MY2.

Quantitative reference reach and design data used to determine the restoration approach, as well as the Year 2 data collected during the project's post-construction monitoring period are summarized in Appendix D.

2.2 Vegetation Assessment

2.2.1 Vegetation

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, active planting of preferred canopy species, and volunteer regeneration of the native plant community. The restoration plan for the Snowbird Creek Tributaries Site specifies that the number of vegetation monitoring quadrants required will be based on the species/area curve method, as described in NCEEP monitoring guidance documents. The size of individual quadrants is 100 square meters for woody tree species, and 1 square meter for herbaceous vegetation. Level 1 CVS vegetation monitoring will occur in spring, after leaf-out has occurred, or in the fall prior to leaf fall.

At the end of the first growing season during baseline surveys, species composition, density, and survival were evaluated. Individual quadrant data provided during subsequent monitoring events will include diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual stems were marked to ensure that they can be

found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted stems and the current year's living, planted stems.

Photographs are used to visually document vegetation success in sample plots. Reference photos of tree and herbaceous condition within plots are taken at least once per year. Photos of the plots are included in Appendix B of this report.

The interim measure of vegetative success for the site is the survival of at least 320, 3-year old, planted trees per acre at the end of Year 3 of the monitoring period. The final vegetative success criteria is the survival of 260, 5-year old, planted trees per acre at the end of Year 5 of the monitoring period.

Seeding applied to streambanks beneath the erosion matting sprouted within two weeks of application and has provided excellent ground coverage. Live stakes and bare root trees planted are also flourishing and will increasingly contribute to streambank stability and shading. 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 was completed in late March-early April 2011. Species planted are listed below.

Proposed Bare-Root and Live Stake Species (may also include seed or container species)				
Snowbird Creek Tributaries Mitigation Plan-NCEEP Project #92764				
Common Name	Scientific Name	% Planted by Species	Planting Density	Wetness Tolerance
Riparian Buffer Plantings				
Trees Overstory				
Sycamore	<i>Platanus occidentalis</i>	8	54	FACW-
River Birch	<i>Betula nigra</i>	7	48	FACW
White Oak	<i>Quercus alba</i>	5	34	FACU
Red Maple	<i>Acer rubrum</i>	5	34	FAC
Tulip Poplar	<i>Liriodendron tulipifera</i>	5	34	FAC
Yellow Birch	<i>Betula alleghaniensis (lutea)</i>	5	34	FACU+
Black (Sweet) Birch	<i>Betula lenta</i>	5	34	FACU
Northern Red Oak	<i>Quercus rubra</i>	5	34	FACU
Yellow Buckeye	<i>Aesculus octandra</i>	5	34	N/A
Mockernut Hickory	<i>Carya alba (tomentosa)</i>	3	20	N/A
Scarlet Oak	<i>Quercus coccinea</i>	2	14	N/A
Trees Understory				
Highland Doghobble	<i>Leucothoe fontanesiana (axillaris var. editorum)</i>	5	34	N/A
Mountain Laurel	<i>Kalmia latifolia</i>	5	34	FACU
Flame Azalea	<i>Rhododendron calendulaceum</i>	5	34	N/A
Black Willow	<i>Salix nigra</i>	2	14	OBL
Ironwood	<i>Carpinus caroliniana</i>	3	20	FAC
Witch Hazel	<i>Hamamelis virginiana</i>	2	14	FACU
Sourwood	<i>Oxydendrum arboreum</i>	5	34	FACU

Proposed Bare-Root and Live Stake Species (may also include seed or container species)				
Snowbird Creek Tributaries Mitigation Plan-NCEEP Project #92764				
Common Name	Scientific Name	% Planted by Species	Planting Density	Wetness Tolerance
Flowering Dogwood	<i>Cornus florida</i>	5	34	FACU
Rhododendron	<i>Rhododendron maximum</i>	3	20	FAC-
Tag Alder	<i>Alnus serrulata</i>	5	34	FACW+ or OBL
Redbud	<i>Cercis canadensis</i>	5	34	FACU
Shrubs				
Rivercane (giant cane)	<i>Arundinaria gigantea</i>	15	102	FACW
Spicebush	<i>Lindera benzoin</i>	15	102	FACW
Deerberry	<i>Vaccinium stamineum</i>	15	102	FACU
Eastern Sweetshrub, Sweetshrub	<i>Calycanthus floridus, Calycanthus spp.</i>	10	68	FACU
Sweetpepperbush	<i>Clethra spp.</i>	15	102	N/A
Winterberry	<i>Ilex verticillata</i>	10	68	FACW
Virginia Sweetspire	<i>Itea virginica</i>	15	102	FACW+
Chokeberry	<i>Photinia</i>	5	34	N/A
Alternate Species				
Blight-resistant American Chestnut	<i>Castanea dentata</i>	N/A	N/A	N/A
American Hazelnut	<i>Corylus americana</i>	N/A	N/A	FACU
Blue Ridge Blueberry	<i>Vaccinium pallidum</i>	N/A	N/A	N/A
Riparian Livestake Plantings				
Ninebark	<i>Physocarpus opulifolius</i>	15	102	FAC-
Elderberry	<i>Sambucus canadensis</i>	20	136	FACW-
Buttonbush	<i>Cephalanthus occidentalis</i>	15	102	OBL
Silky Willow	<i>Salix sericea</i>	25	170	OBL
Silky Dogwood	<i>Cornus amomum</i>	25	170	FACW+
Note: Species selection may have changed due to refinement or availability at the time of planting.				

In order to determine if the criteria were achieved, one vegetation monitoring quadrant, 10 by 10 meters in size, was installed on Reach 2 of UT3 in April 2011. This plot includes a 1 square meter sub-quadrant for visually documenting the success of herbaceous vegetation.

2.2.1.1.1 Results

Tables 5 through 7b in Appendix C present information on vegetation success criteria, vegetation metadata, and stem counts for the vegetation monitoring plot. Vegetation data was collected in October 2012. Data from the Year 2 monitoring event indicates that approximately 80% of the stems surveyed were in fair to excellent condition and 84% of the stems in the plot showed no signs of damage. The average density of planted bare root stems, based on data collected from the monitoring plot during Year 2 monitoring, is 890 stems per acre or 22 stems per plot. The site was originally planted with approximately 1,102 bare root stems per acre after construction (as cited in the Baseline Monitoring Document), or 25 stems per plot. Therefore,

between the Baseline and Year 2 monitoring periods, a mortality of three stems have been observed that accounts for this difference or decrease between the original planted stem count (1,012 stems) from Baseline monitoring and the total stem count (890) from Year 2 monitoring. However, an average density of 890 stems per acre is still indicative that the Site is on track for meeting the minimum interim success criteria of 320 trees per acre by the end of Year 3, and the final success criteria of 260 trees per acre by the end of Year 5. The location of the vegetation plot is shown on the Current Condition Plan View.

The area on Reach 2 of UT3 that was identified during as-built surveys as having sparse groundcover was found to have rebounded and is no longer considered to be a vegetation problem area; the groundcover is now dense and appears very healthy. Survival rates of planted woody stems in the vegetation plot indicates that plantings in the restored area of UT3 are of sufficient density to meet regulatory requirements, as well as the site stabilization and habitat enhancement goals originally set forth in the mitigation plan.

Baker had planned to install a smaller vegetation plot on Reach 2 of UT2, an Enhancement II reach to help monitor the stability of the channel and riparian buffer where logging debris was originally removed. The Planting Contractor has re-confirmed that the Enhancement II reach was planted. However, when Baker attempted to establish a plot, it was extremely difficult to distinguish planted stems from volunteers. Rather than establish a smaller vegetation plot as originally planned, 2 additional photograph stations, 3a and 3b, were set out in this section of the Enhancement II reach. Photographs for these stations are displayed in Exhibit 1 of Appendix B and their locations are georeferenced in Figures 2. Photographs will be taken on an annual basis to visually document changes in the riparian corridor over the course of the monitoring period. Based on observations during Monitoring Year 2, woody vegetation is becoming re-established where the riparian area was disturbed, and there are no vegetation concerns at this time.

Only one vegetation problem area was identified during the Year 2 monitoring period. It is a small strip of impacted buffer paralleling the upstream limits of UT3-Reach 2. This buffer impact is approximately 30 feet wide by 130 (from station 0+10 to 1+40) feet long and is located within the left floodplain; it is caused by local residents encroaching on a portion of the easement in order to gain vehicle access to existing logging roads (trails) that continue on the property further upstream of the project reach/easement limits. Vegetation within this impacted swath of buffer is sparse from the mowing over and flattening by vehicles to the extent that a defined path has become apparent. Baker is coordinating with the contractor and land owner to correct this situation by relocating the easement encroached portion of the vehicle access to outside of and adjacent to the easement to avoid further encroachment. The impacted buffer within the easement will be reseeded and replanted after construction of the relocated vehicle access. This is scheduled to be completed by the end of 2013 and will be documented within the Year 3 monitoring report. Supplemental information can be found in Appendix F which includes a planview figure, photos, and a summary table.

2.3 Areas of Concern

The easement encroachment and associated impacts to the vegetated buffer occurring within the left floodplain of UT3-Reach 2 between stations 0+10 and 1+40 is the only area of concern identified for the Year 2 monitoring period. As previously mentioned, Baker is coordinating with the contractor and land owner to create an alternate vehicle access located outside the easement to avoid further encroachment. The impacted buffer within the easement will be reseeded and replanted after construction of the alternate vehicle access. This is scheduled to be completed by the end of 2013 and will be documented within the Year 3 monitoring report.

3.0 REFERENCES

Leopold, L.B., M. Wolman, and J. Miller, 1964. "Fluvial Processes in Geomorphology." W.H. Freeman, San Francisco, CA.

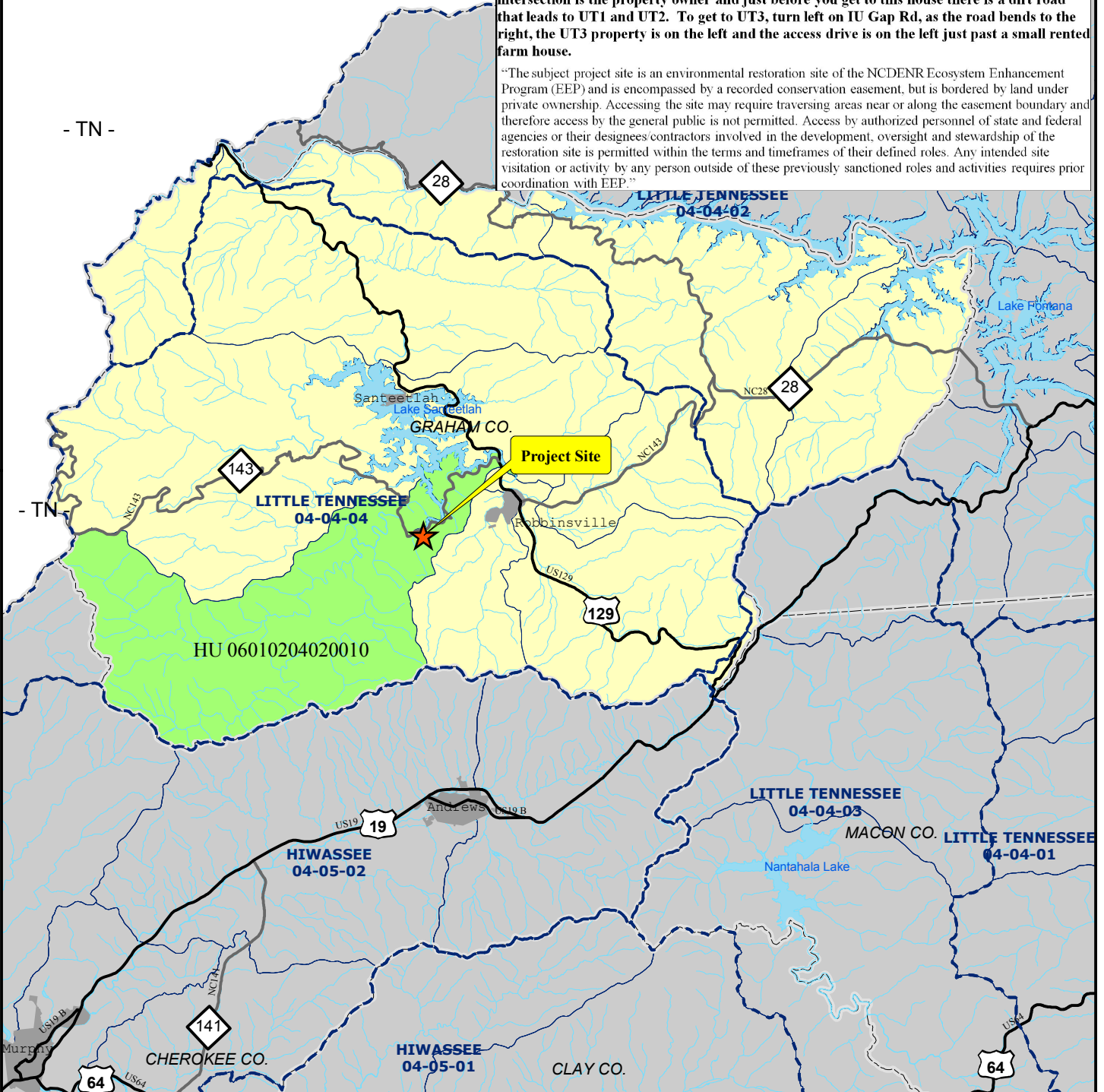
Peet, R.K., T.R. Wentworth and P.S. White. 1998. "A flexible, multipurpose method for recording vegetation composition and structure." *Castanea* 63:262-274.

APPENDIX A
FIGURE & GENERAL TABLES

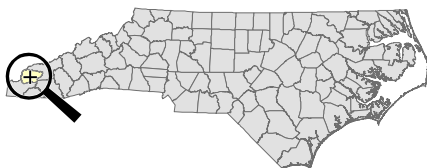
LOCATION MAP
TABLES 1-4

The Snowbird Creek Tributaries mitigation site is located approximately one and a half miles southwest of Robbinsville in Graham County, North Carolina. To reach the project site from the intersection of NC Highways 143 and 129, turn south onto N.C. Highway 129. At the first stop light past the Microtel, turn right onto East Main Street, continue for approximately 0.3 miles, and turn left onto Atoah Street. Atoah Street becomes Snowbird Road (both are NC Highway 143). Snowbird Road (NC 143) will come to parallel Santeetlah Reservoir (an inundated portion of Snowbird Creek). At the intersection of IU Gap Road and Snowbird Road, the property will be situated to the east. The last house on the left before you get to this intersection is the property owner and just before you get to this house there is a dirt road that leads to UT1 and UT2. To get to UT3, turn left on IU Gap Rd, as the road bends to the right, the UT3 property is on the left and the access drive is on the left just past a small rented farm house.

"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."



Map Inset



Graham County, NC

LEGEND:

- NCDWQ Sub-basin
 - Counties
 - USGS Hydrologic Unit
 - Project Hydrologic Unit
 - Graham County
- 0 1 2 4
Miles

Figure 1. Project Vicinity Map

**Snowbird Creek Tributaries Project
Graham County, NC**



Figure 1. Notes

The Snowbird Creek Tributaries mitigation site is located approximately one and a half miles southwest of Robbinsville in Graham County, North Carolina. To reach the project site from the intersection of N.C. Highways 143 and 129 in Robbinsville, turn south onto N.C. Highway 129. At the first stop light past the Microtel, turn right onto East Main Street, continue for approximately .3 miles, and turn left onto Atoah Street. Atoah Street becomes Snowbird Road (both are N.C. Highway 143). Snowbird Road (N.C. Highway 143) will come to parallel Santeetlah Reservoir (an inundated portion of Snowbird Creek). At the intersection of IU Gap Road and Snowbird Road, the property will be situated to the east. The last house on the left before you get to this intersection is the property owner and just before you get to this house there is a dirt road that leads to UT1 and UT2. To get to UT3, turn left on IU Gap Road; as the road bends to the right, the UT3 property is on the left and the access drive is on the left just past a small rented farm house.

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Table 1. Project Components Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764									
Project Segment or Reach ID	Existing Feet/ Acres	Mitigation Type	Approach	Target Stream Type	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
UT1	3,213LF	P	-	-	3,213 LF	5:1	643	-	No channel alteration (preservation).
UT2									
Reach 1	1,033 LF	P	-	-	1,033 LF	5:1	207	-	No channel alteration (preservation).
Reach 2	171 LF	EII	-	B3a	171 LF	2.5:1	68	-	Removal of woody debris; stabilize streambanks; replanting with native vegetation.
Reach 3	675 LF	P	-		675 LF	5:1	135	-	No channel alteration (preservation).
UT3									
Reach 1	2,576LF	P	-	-	2,576LF	5:1	515	-	No channel alteration (preservation).
Reach 2	543 LF	R	PII	Aa+	467 LF	1:1	467	-	Relocate channel in lowest point of the valley; establish a step-pool channel with stable banks and floodplain connectivity.
Mitigation Unit Summations									
Stream (SMUs)	Riparian Wetland (Ac)			Nonriparian Wetland (Ac)			Total Wetland (Ac)	Buffer (Ac)	Comment
2,035	NA			NA			NA	13.1	
Total SMUs	2,035								
Notes:									

Table 2. Project Activity and Reporting History Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764		
Activity or Report	Data Collection Complete	Completion or Delivery
Restoration Plan	-	October 2009
Final Design-90%	-	November 2009
Construction	-	August 2010
Temporary S&E mix applied to entire project area	-	August 2010
Permanent seed mix applied to project site	-	August 2010; February 2011
Containerized and B&B plantings set out	-	March 2011
Installation of crest gauges	-	March 2011
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	April 2011	November 2011 (last of plantings completed in March)
Year 1 Monitoring	January 2012	March 2012
Year 2 Monitoring	February 2013	March 2013
Year 3 Monitoring		
Year 4 Monitoring		
Year 5 Monitoring		

Table 3. Project Contacts Table Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764	
Designer	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201, Asheville, NC 28806 <u>Contact:</u> Micky Clemmons, Tel. 828.350.1408 x2002
Construction Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200, Cary, NC 27511 <u>Contact:</u> Bill Wright, Tel. 919.818.6686
Planting & Seeding Contractor	
River Works, Inc.	8000 Regency Parkway, Suite 200, Cary, NC 27511 <u>Contact:</u> George Morris, Tel. 919.459.9001
Seed Mix Sources	Green Resources
Nursery Stock Suppliers	Arborgen and Hillis Nursery
Monitoring	
Michael Baker Engineering, Inc.	797 Haywood Rd Suite 201, Asheville, NC 28806 <u>Contact:</u> Carmen McIntyre, Tel. 828.350.1408 x2010

Table 4. Project Attribute Table Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764	
Project County	Graham County, NC
Physiographic Region	Blue Ridge
Ecoregion	Blue Ridge Mountains-Southern Metasedimentary Mountains
Project River Basin	Little Tennessee
USGS HUC for Project	06010204020010
NCDWQ Sub-basin for Project	04-04-04
Within extent of EEP Watershed Plan?	No local or targeted watershed plans currently available
WRC Class	Cold
% of Project Easement Fenced or Demarcated	0% (post-construction)
Beaver Activity Observed During Design Phase?	No
Drainage Area (Square Miles)	
	UT1 .13 mi ²
	UT2
	Reach 1 .05 mi ²

**Table 4. Project Attribute Table
Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764**

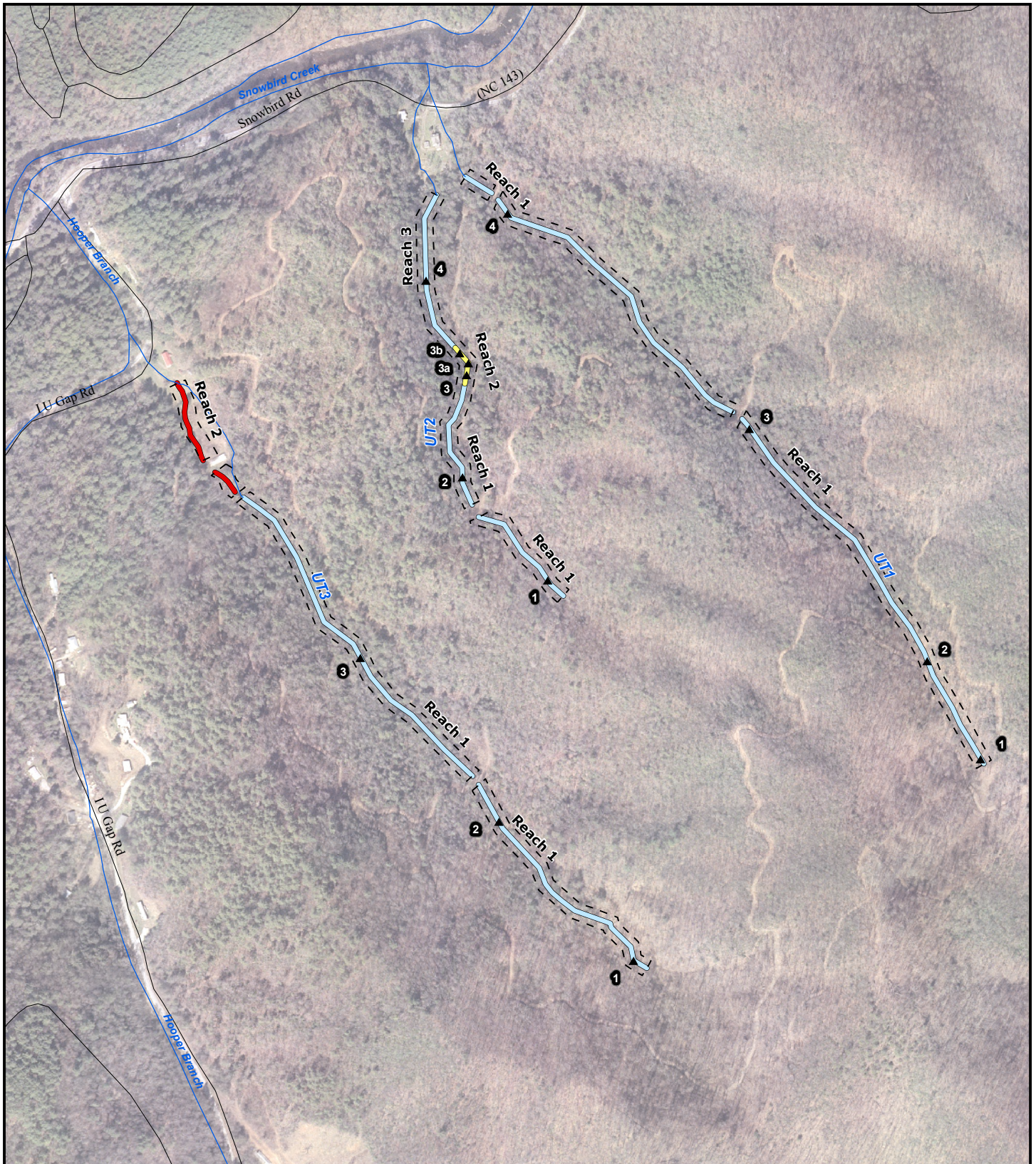
	Reach 2	.06 mi ²
	Reach 3	.08 mi ²
	UT3	
	Reach 1	.15 mi ²
	Reach 2	.18 mi ²
Stream Order		
	UT1	1 st (Perennial)
	UT2	
	Reach 1	1 st (Perennial)
	Reach 2	1 st (Perennial)
	Reach 3	1 st (Perennial)
	UT3	
	Reach 1	1 st (Perennial)
	Reach 2	1 st (Perennial)
Restored Length		
	UT 1	3,212 LF
	UT2	
	Reach 1	1,033 LF
	Reach 2	171 LF
	Reach 3	675 LF
	UT3	
	Reach 1	2,576 LF
	Reach 2	467 LF
Watershed Type		Rural (Predominantly Forested)
Watershed LULC Distribution (Percent area)		
Deciduous Forest		80.15%
Evergreen Forest		8.68%
Mixed Forest		11.16%
Developed Open Space		<1%
Drainage Impervious Cover Estimate (%)		<25%
NCDWQ AU/Index #		2-190-9(15.5)
303d Listed		No
Upstream of 303d Listed Segment		No
Reasons for 303d Listing or Stressor		-

**Table 4. Project Attribute Table
Snowbird Creek Tributaries Mitigation Project-NCEEP Project #92764**

Total Acreage of Easement	13.1			
Total Vegetated Acreage w/in Easement	n/a (Easement vegetated with exception of stream channel)			
Total Planted Acreage within the Easement	~.86 Acres			
Rosgen Classification (Pre-existing)/As-Built				
UT1	Aa ⁺ /Aa ⁺			
UT2				
Reach 1	B3a/ B3a			
Reach 2	B3a/ B3a			
Reach 3	B3a/ B3a			
UT3				
Reach 1	A4a ⁺ /A4a ⁺			
Reach 2	B/B3			
Valley Type	II			
Valley Slope	.094 (UT3)			
Valley Side Slope Range	n/a			
Valley Toe Slope Range	n/a			
Trout Waters Designation	No			
Species of Concern	No			
Dominant Soil Series and Characteristics	Snowbird loam/ Thurmont-Dillard/ Soco-Stecoah/ Spivey-Whiteoak			
	Depth (in.)	% Clay	K Factor	T Factor
UT1	>80"	5-18/ 5-24	.10-.17/ .02-.1	2/3
UT2				
Reach 1	~80/>60"	5-18	.10-.17/.1	5
Reach 2	>80"	5-18	.10-.17	5
Reach 3	>80"	5-18/ 5-24	.10-.17/ .02-.1	5
UT3				
Reach 1	>80"	5-24	.02-.1/ .03-.1	5
Reach 2	>60"	5-25	.17-.24	5

APPENDIX B
PROJECT REACH FIGURE AND
REFERENCE PHOTOGRAPHS

FIGURE 2 PROJECT COMPONENT MAP
EXHIBIT 1-2 REFERENCE STATION AND
VEGETATION PLOT PHOTOLOGS



LEGEND:

Project Components

— Preservation

— Enhancement II

— Restoration (Priority 1)

--- Easement Boundary

— Streams

▲▲ Photo Points (EII & Preservation Reaches)*



* Photo Points for the restored reach, UT3 Reach 2, can be found on the CCPV, Figure 3 of Appendix F.

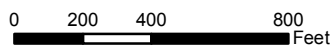


Figure 2. Restoration Summary Map

**Snowbird Creek Tributaries Project
Graham County, NC**



UT3-Restoration Reach Photo Log - Reference Photo Points

Notes: Photos for UT3 were taken October 2012 and February 2013.

1. Photo point locations are shown on the plan views in the actual location the picture was taken.
2. All points are marked with a wooden stake and flagging. For channel points, the stake is set up on an adjacent bank.



Photo Point 1: looking downstream



Photo Point 2: looking downstream



Photo Point 2: looking upstream



Photo Point 3: looking downstream



Photo Point 3: looking upstream



Photo Point 4: looking downstream



Photo Point 4: looking upstream



Photo Point 5: looking downstream



Photo Point 5: looking upstream



Photo Point 6: looking downstream



Photo Point 6: looking upstream

UT1 Reach 1 (Preservation) Photo Log - Reference Photo Points

Notes: Photos were taken February 2013.

1. Photo point locations are shown on the plan sheets in the actual location the picture was taken.
2. All points are marked with flagging tape and recorded with GPS points. For channel points, the flagging is tied on an adjacent bank.



Photo Point 1: looking downstream



Photo Point 1: looking upstream



Photo Point 2: looking downstream



Photo Point 2: looking upstream



Photo Point 3: looking downstream



Photo Point 3: looking upstream



Photo Point 4: looking downstream



Photo Point 4: looking upstream

UT2 (Preservation & Enhancement II) Photo Log - Reference Photo Points

Notes: Photos were taken February 2013.

1. Photo point locations are shown on the plan sheets in the actual location the picture was taken.
2. All points are marked with flagging tape and recorded with GPS points. For channel points, the flagging is tied on an adjacent bank.
3. Photo point 3, 3a, and 3b are located in the Enhancement II Reach.



Photo Point 1: looking downstream



Photo Point 1: looking upstream



Photo Point 2: looking downstream



Photo Point 2: looking upstream



Photo Point 3: looking downstream



Photo Point 3: looking upstream



Photo Point 3a: looking down valley along right bank



Photo Point 3a: looking up valley along right bank



Photo Point 3b: looking down valley along right bank



Photo Point 3b: looking up valley along right bank



Photo Point 4: looking downstream



Photo Point 4: looking upstream

UT3 (Preservation) Photo Log - Reference Photo Points

Notes: Photos were taken February 2013.

1. Photo point locations are shown on the plan sheets in the actual location the picture was taken.
2. All points are marked with flagging tape and recorded with GPS points. For channel points, the flagging is tied on an adjacent bank.



Photo Point 1: looking downstream



Photo Point 1: looking upstream



Photo Point 2: looking downstream



Photo Point 2: looking upstream



Photo Point 3: looking downstream



Photo Point 3: looking upstream

Snowbird Creek Tributaries Mitigation Project

Photo Log - Vegetation Plot Photos

Notes: Photos for Vegetation Plots were taken October 2012.

1. Vegetation plots marked by t-posts at corners; herbaceous plot marked by stake within larger plot.
2. Planted vegetation flagged and tagged for future identification.



Photo 1: Veg Plot 1



Photo 2: Veg Plot 1-Herbaceous Plot

APPENDIX C
VEGETATION SUMMARY DATA
TABLES 5-7

Table 5. Vegetation Plot Criteria Attainment-Year 2	
Snowbird Creek Tributaries Mitigation Project-#92764	
Vegetation Plot ID	Vegetation Survival Threshold Met?
1	Y

Table 6. Vegetation Metadata- Year 1	
Snowbird Creek Tributaries Mitigation Project-#92764	
Report Prepared By	Carmen Horne-McIntyre
Date Prepared	11/21/2012 16:00
database name	cvs-eep-entrytool-v2.3.1.mdb
database location	L:\Monitoring\Monitoring Guidance\Vegetation\2012 Updates_V2.3
computer name	ASHEWCMCINTYR
file size	60428288
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT-----	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
CVS Stem Count Total and Planted by Plot and Species	Displays Plot and Stem Count Metrics as well as Stems Planted Per Acre
PROJECT SUMMARY----- 92764	
Project Code	Snowbird Tributaries
project Name	Restoration: 466 LF, Enhancement II:171 LF, Preservation: 7,497 LF
Description	Little Tennessee
River Basin	466
length(ft)	30
stream-to-edge width (ft)	2597.31
area (sq m)	1
Required Plots (calculated)	1
Sampled Plots	1

Table 7. Stem Count Arranged by Plot-Year 2
Snowbird Creek Tributaries Mitigation Project-#92764

Tree Species	Common Name	Type	Current Data (Yr 2 2012)		Current Mean		Annual Means (Previous Years)										
			Plot 1				AB		MY1		MY3		MY4		MY5		
			P	T	P	T	P	T	P	T	P	T	P	T	P	T	
<i>Acer rubrum</i>	Red Maple	Tree	2	2	2	2	1	1	2	2							
<i>Alnus serrulata</i>	Tag Alder	Tree	3	3	3	3	3	3	3	3							
<i>Betula lenta</i>	Sweet Birch	Tree	4	4	4	4	4	4	4	4							
<i>Betula nigra</i>	River Birch	Tree	0	0	0	0	2	2	2	0							
<i>Carya alba</i>	Mockernut Hickory	Tree	3	3	3	3	3	3	3	3							
<i>Quercus rubra</i>	Red Oak	Tree	2	2	2	2	3	3	2	2							
<i>Platanus occidentalis</i>	Ninebark	Tree	7	7	7	7	7	7	7	6							
Understory/Shrub Species																	
<i>Cercis canadensis</i>	Redbud	Tree	0	0	0	0	1	1	1	0							
<i>Hamamelis virginiana</i>	Witch Hazel	Shrub	1	1	1	1	1	1	1	1							
Volunteers																	
			0	0	0	0											
P=Planted T=Total	Plot Area (acres)		0.025														
	Species Count		9	7	9	7	9	9	9	7							
	Planted Stems/Plot		22	22	22	22	25	25	25	21							
	Stems/Plot		25	21	25	21	25	25	25	21							
	Planted Stems/Acre		890	890	890	890	1012	1012	1012	850							

Table 7b. Stem Count Arranged by Plot
Snowbird Creek Tributaries Mitigation Project-#92764

Scientific Name	Common Name	Species Type	Current Plot Data (MY2 2012)			Annual Means		
			92663-01-0001			MY2 (2012)		
			PnoLS	P-all	T	PnoLS	P-all	T
<i>Acer rubrum</i>	Red Maple	Tree	2	2	2	2	2	2
<i>Alnus serrulata</i>	Tag Alder	Tree	3	3	3	3	3	3
<i>Betula lenta</i>	Sweet Birch	Tree	0	4	4	0	4	4
<i>Betula nigra</i>	River Birch	Tree	0	0	0	0	0	0
<i>Carya alba</i>	Mockernut Hickory	Tree	3	3	3	3	3	3
<i>Platanus occidentalis</i>	Sycamore	Tree	7	7	7	7	7	7
<i>Quercus rubra</i>	Red Oak	Tree	2	2	2	2	2	2
Shrub Species								
<i>Cercis canadensis</i>	Redbud	Tree	0	0	0	0	0	0
<i>Hamamelis virginiana</i>	Witch Hazel	Shrub	1	1	1	1	1	1
	Stem count size (ares)		18	22	22	18	22	22
	size (ACRES)		1			1		
	Species count		0.025			0.025		
	Species count		9	9	9	9	9	9
	Stems per ACRE		728	890	890	728	890	890

APPENDIX D
MORPHOLOGICAL SUMMARY DATA

- EXHIBIT 3-Year 2 CROSS-SECTIONS (WITH ANNUAL OVERLAYS)**
EXHIBIT 4- Year 2 LONGITUDINAL PROFILE (WITH ANNUAL OVERLAY)
EXHIBIT 5 RIFFLE PEBBLE COUNT SIZE CLASS DISTRIBUTION (UT3)
TABLE 8- CROSS-SECTION MORPHOLOGY DATA TABLE
TABLE 9- STREAM REACH MORPHOLOGY DATA TABLE

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B3	4.3	8.15	0.53	0.83	15.34	1	5	2045.23	2045.23

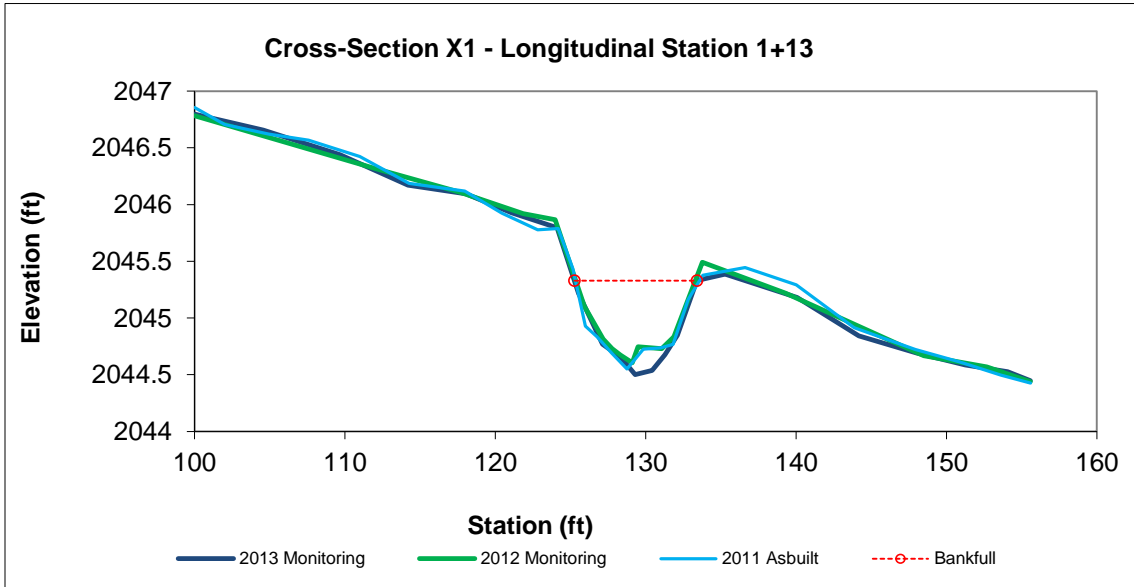


Photo 1: XS-1 facing right bank



Photo 2: XS-1 facing left bank



Photo 3: XS-1 facing upstream



Photo 4: XS-1 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B3	8.7	12.47	0.7	1.29	17.79	0.9	4	2030	2029.81

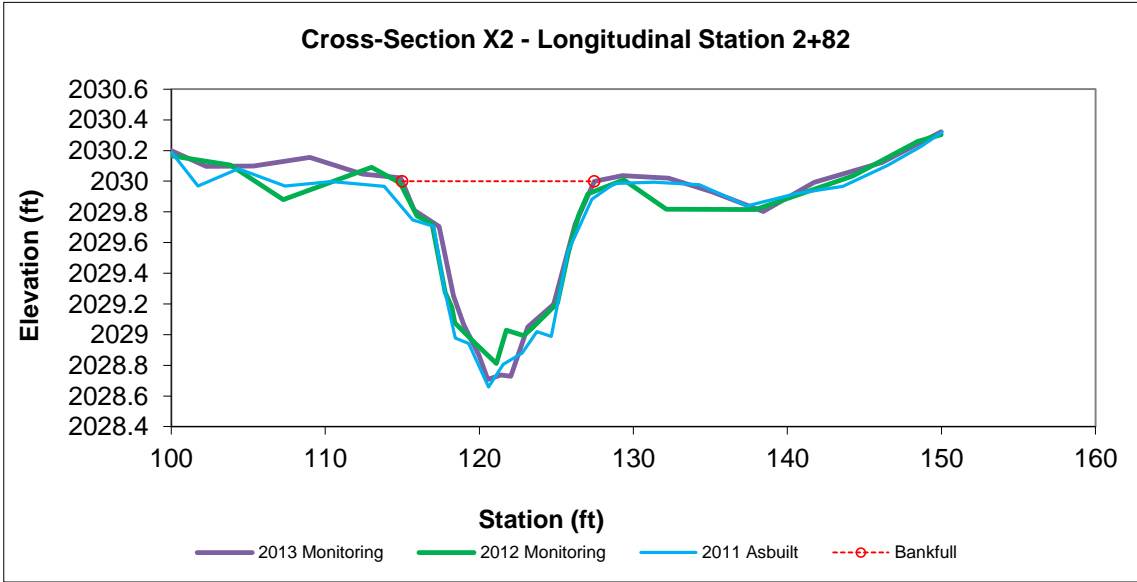


Photo 1: XS-2 facing right bank



Photo 2: XS-2 facing left bank



Photo 3: XS-2 facing upstream



Photo 4: XS-2 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Pool	B3	9.1	10.23	0.89	1.94	11.45	0.9	5.6	2020.94	2020.76

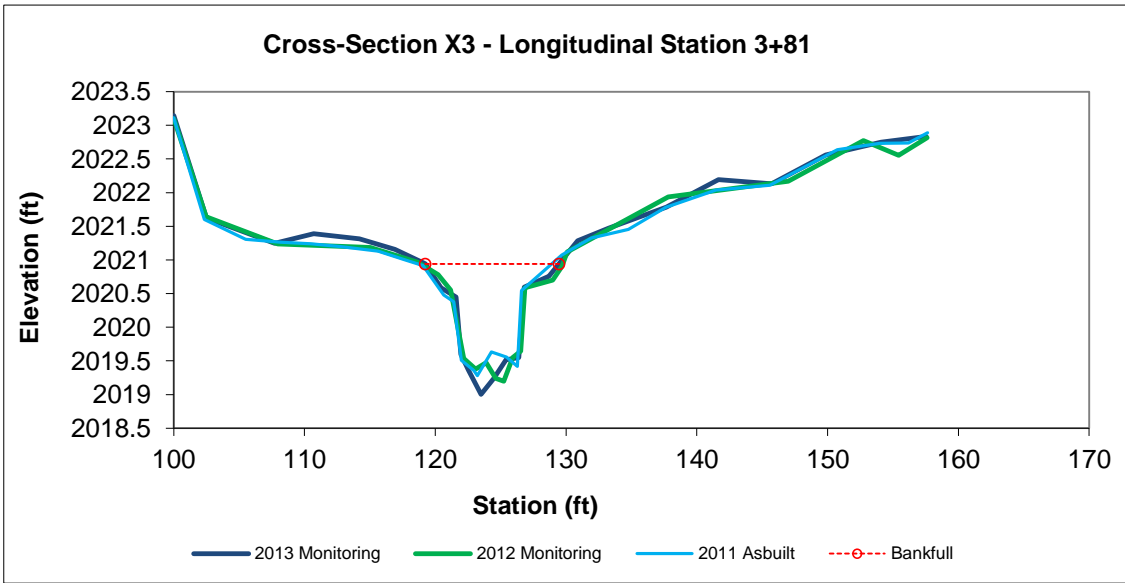


Photo 1: XS-3 facing right bank



Photo 2: XS-3 facing left bank



Photo 3: XS-3 facing upstream



Photo 4: XS-3 facing downstream

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	B3	9.5	12.22	0.77	1.21	15.79	1	4.6	2015.06	2015.06

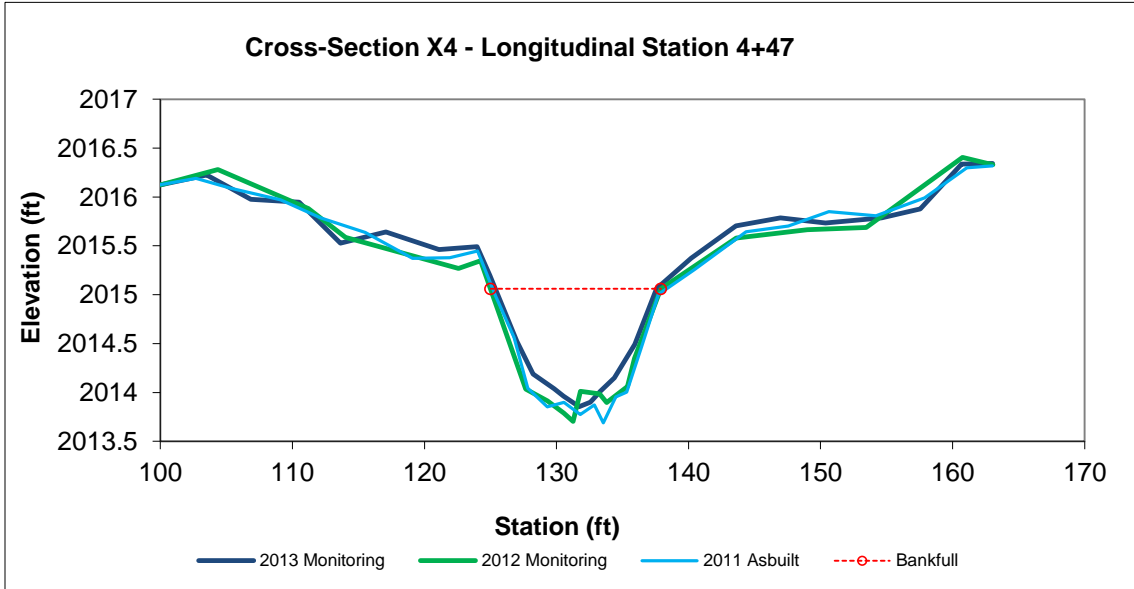


Photo 1: XS-4 facing right bank



Photo 2: XS-4 facing left bank

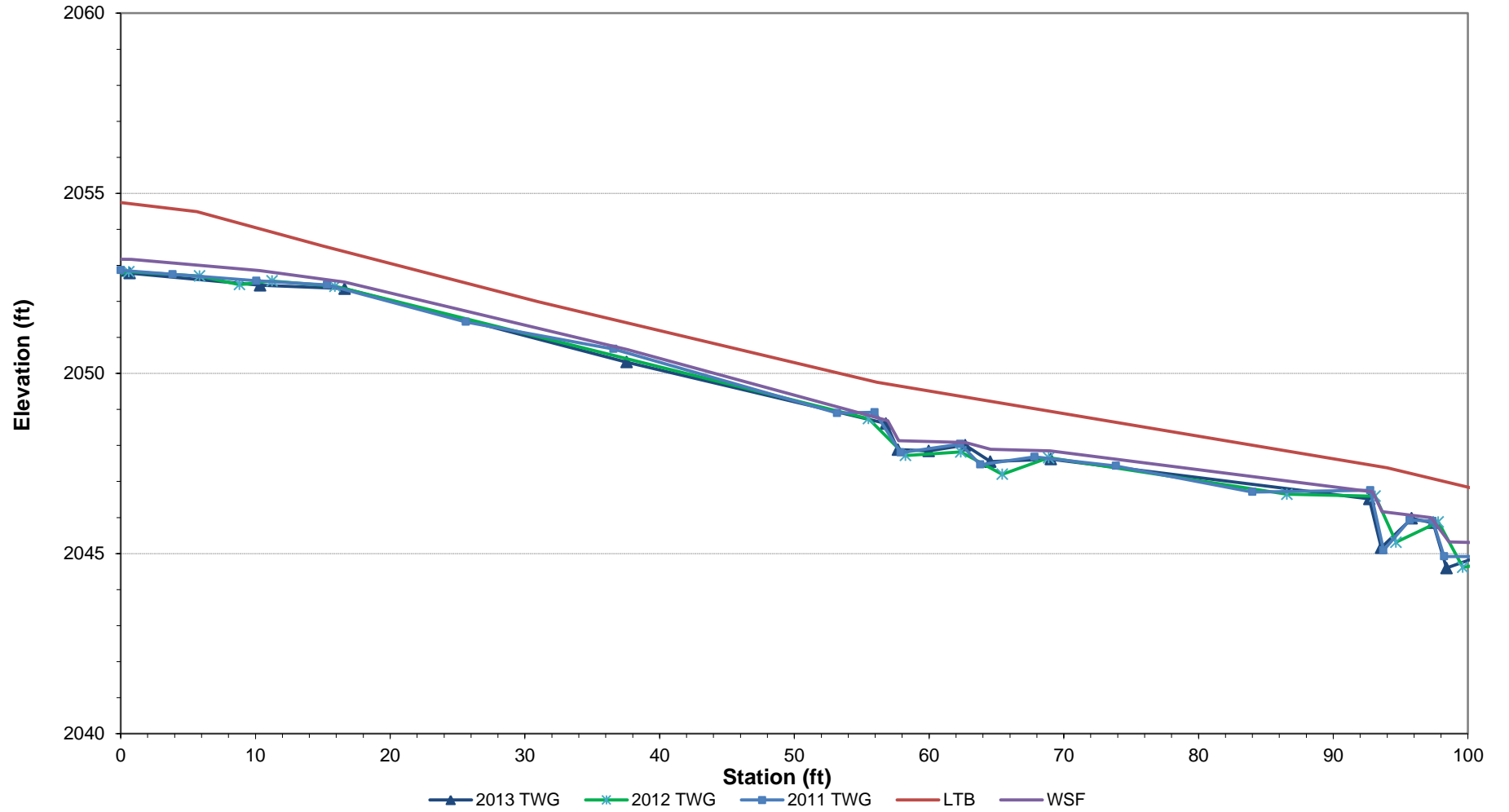


Photo 3: XS-4 facing upstream

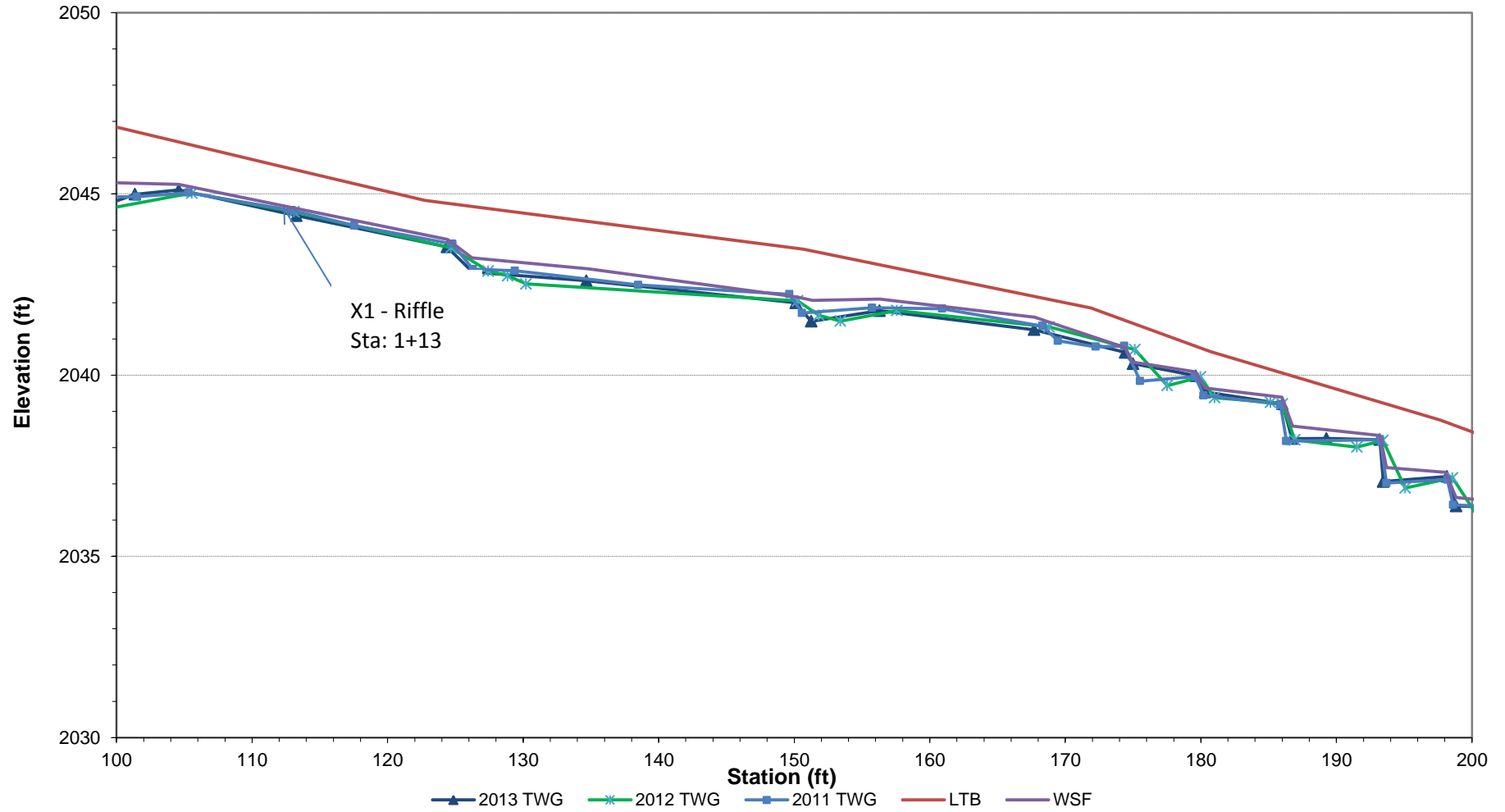


Photo 4: XS-4 facing downstream

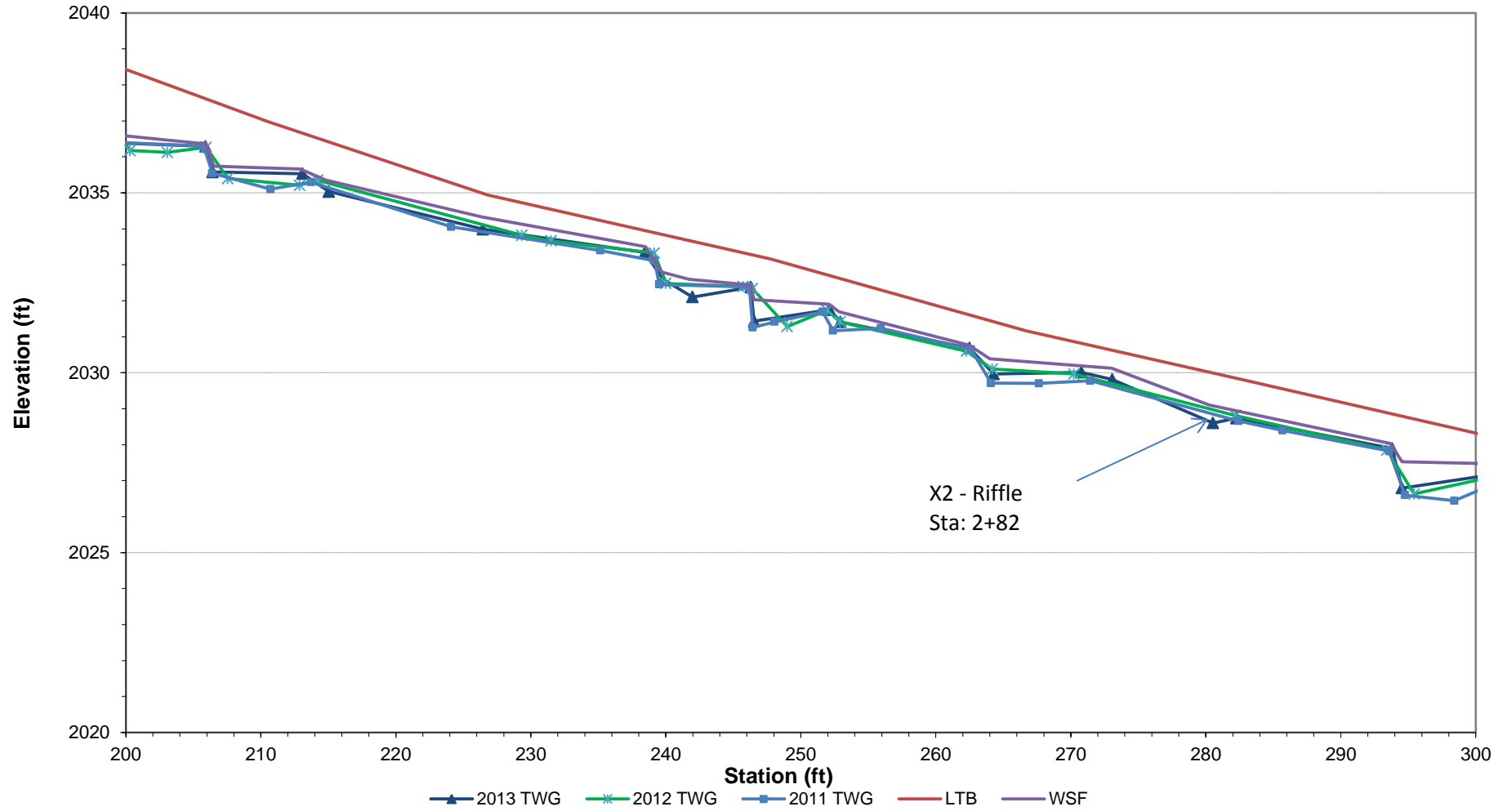
Longitudinal Profile - UT3 (Reach 2)
Sta: 0+00 - 1+00



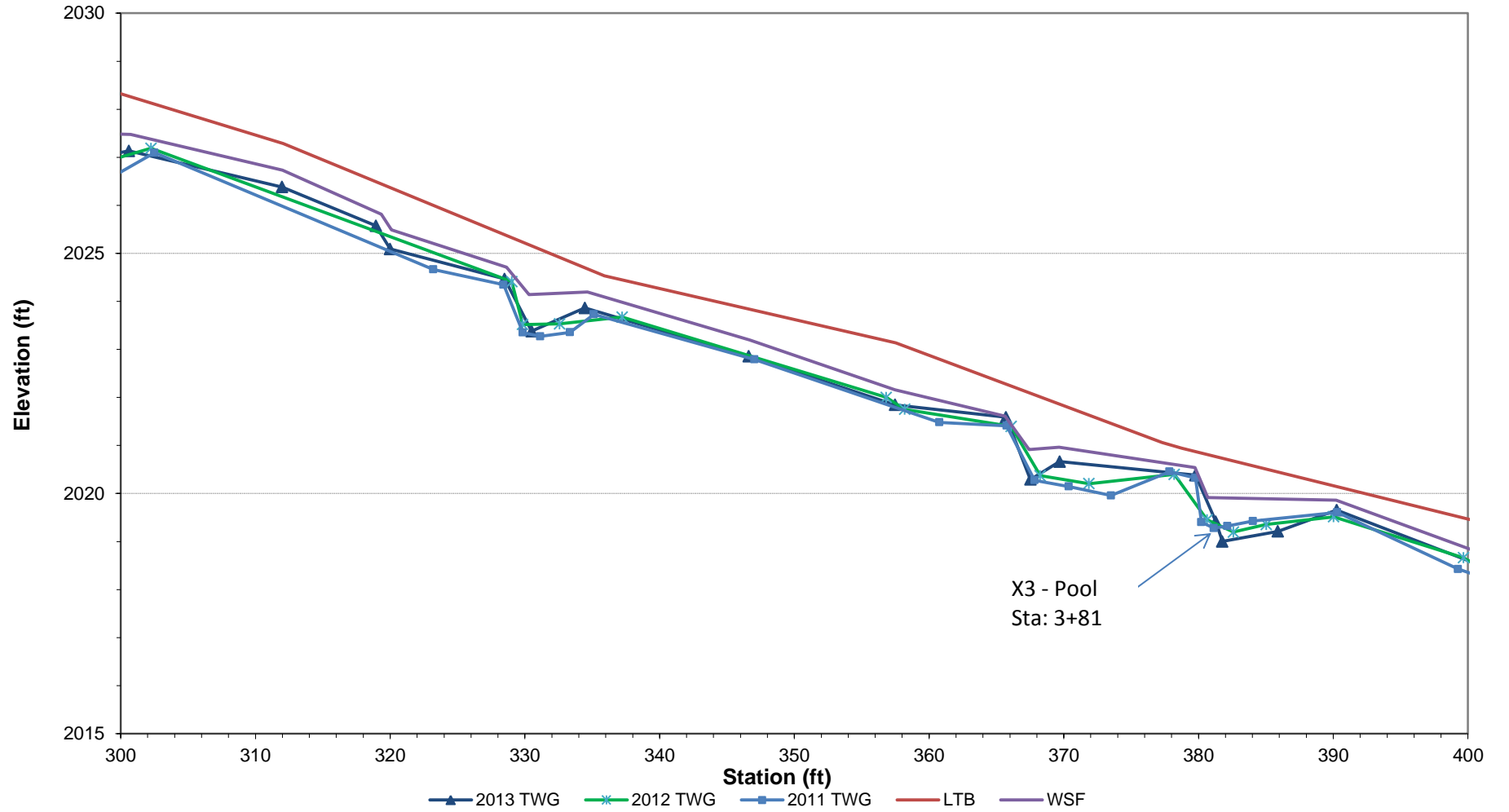
Longitudinal Profile - UT3 (Reach 2)
Sta: 1+00 - 2+00



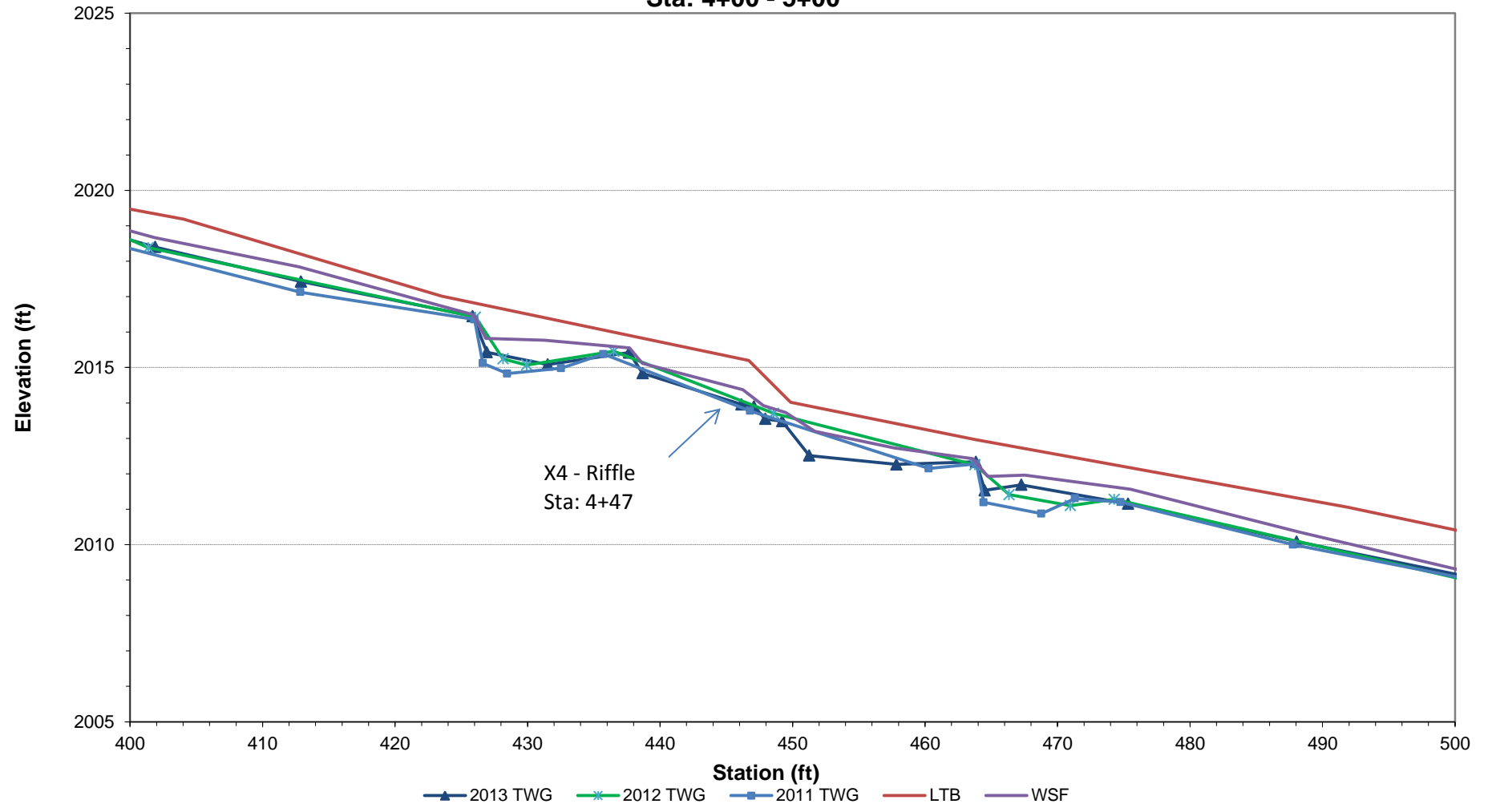
Longitudinal Profile - UT3 (Reach 2)
Sta: 2+00 - 3+00



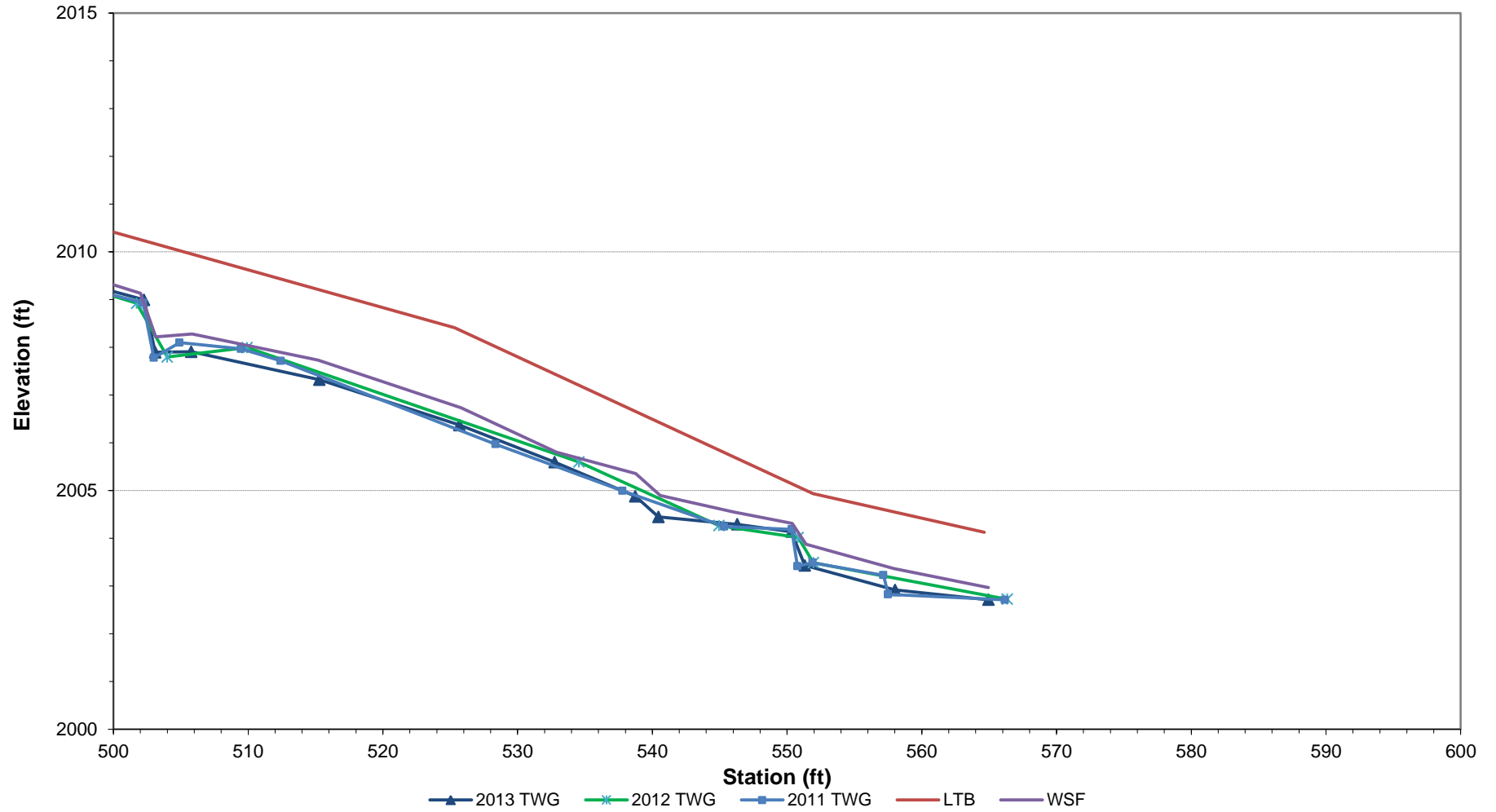
Longitudinal Profile - UT3 (Reach 2)
Sta: 3+00 - 4+00



Longitudinal Profile - UT3 (Reach 2)
Sta: 4+00 - 5+00



Longitudinal Profile - UT3 (Reach 2)
Sta: 5+00 - 5+66



**Exhibit 5. Cross-Section Pebble Count (UT3 to Hooper Branch)
Snowbird Creek Tributaries Mitigation Project, EEP# 92764**

SITE OR PROJECT:	Snowbird Creek Tributaries Project
REACH/LOCATION:	UT3 to Hooper Branch (Reach 2)
FEATURE:	Riffle

MY 2 (2012)					
MATERIAL	PARTICLE	SIZE (mm)	Total	Class %	% Cum
Silt/Clay	Silt / Clay	< .063	10	10.00	10.00
Sand	Very Fine	.063 - .125			10.00
	Fine	.125 - .25			10.00
	Medium	.25 - .50	2	2.00	12.00
	Coarse	.50 - 1.0	2	2.00	14.00
	Very Coarse	1.0 - 2.0			14.00
Gravel	Very Fine	2.0 - 2.8			14.00
	Very Fine	2.8 - 4.0			14.00
	Fine	4.0 - 5.6			14.00
	Fine	5.6 - 8.0	4	4.00	18.00
	Medium	8.0 - 11.0	4	4.00	22.00
	Medium	11.0 - 16.0			22.00
	Coarse	16 - 22.6	2	2.00	24.00
	Coarse	22.6 - 32	2	2.00	26.00
	Very Coarse	32 - 45	10	10.00	36.00
	Very Coarse	45 - 64	14	14.00	50.00
	Cobble	Small	64 - 90	12	12.00
Small		90 - 128	18	18.00	80.00
Large		128 - 180	12	12.00	92.00
Large		180 - 256	2	2.00	94.00
Boulder	Small	256 - 362	6	6.00	100.00
	Small	362 - 512			100.00
	Medium	512 - 1024			100.00
	Large-Very Large	1024 - 2048			100.00
Bedrock	Bedrock	> 2048			100.00
Total % of whole count			100	100	100%

Summary Data	
Channel materials	
D ₅₀ =	64.00
D ₈₄ =	143.40
D ₉₅ =	271.22

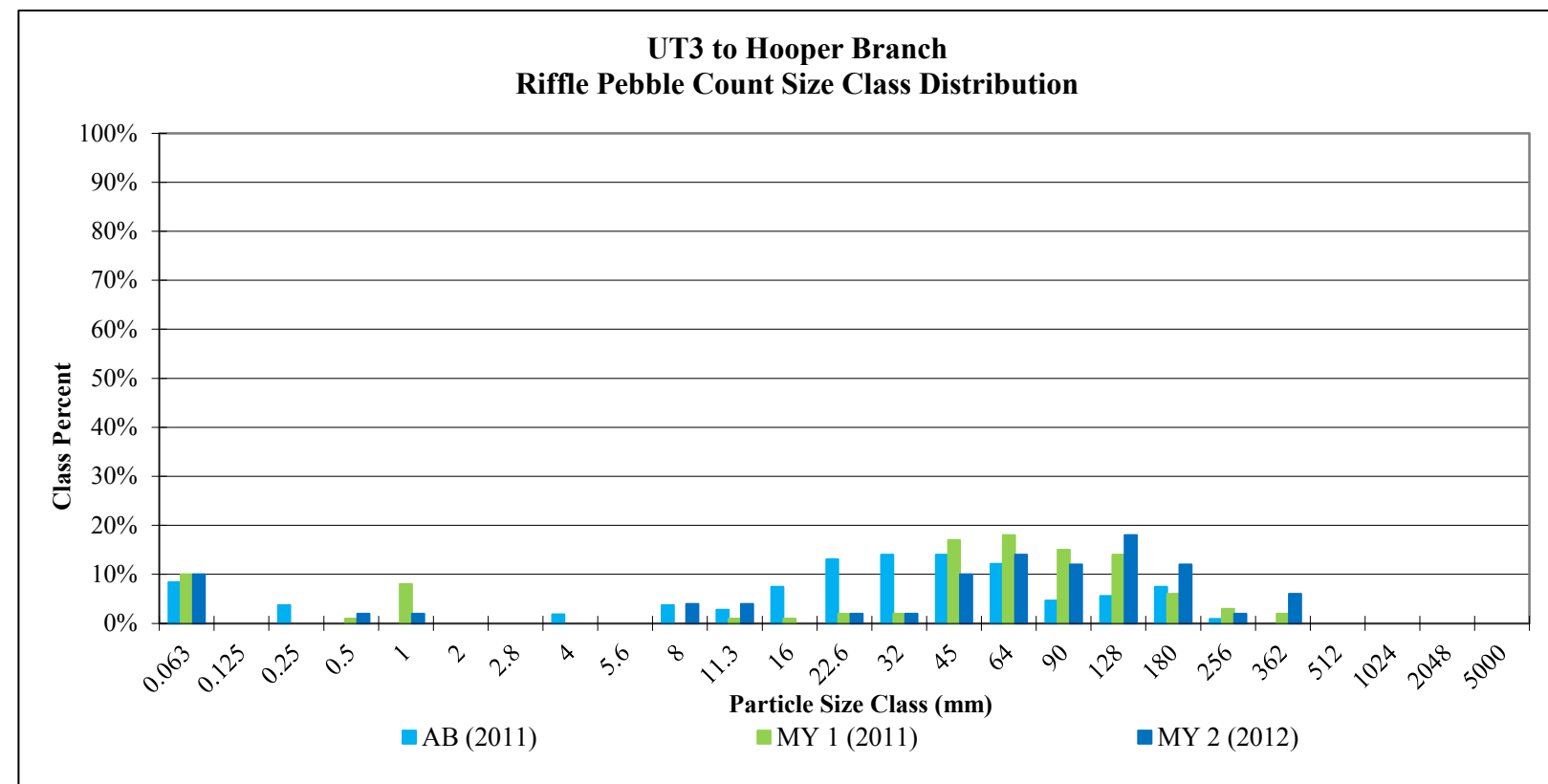
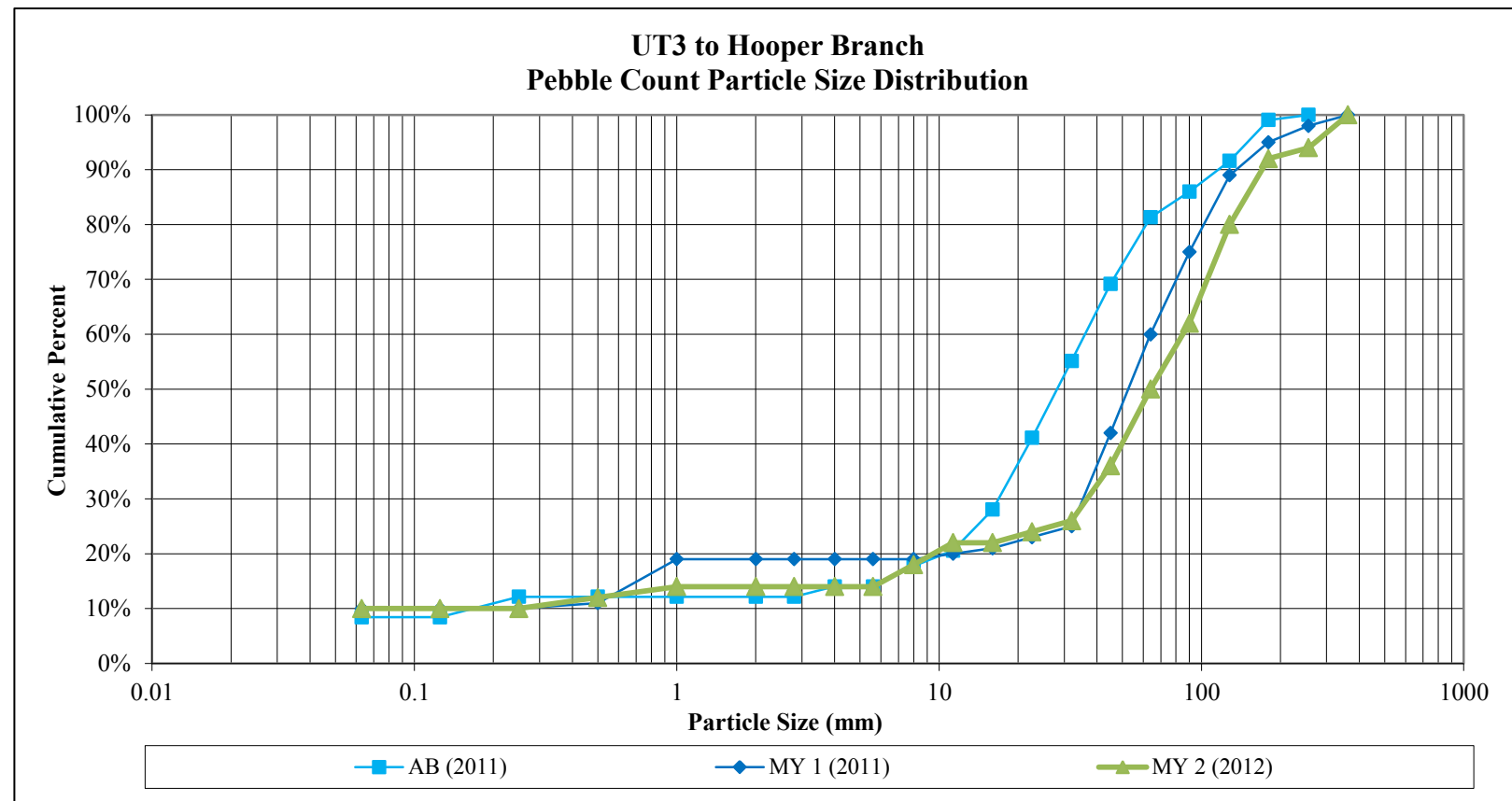


Table 8. Cross-Section Morphology Data Table

Snowbird Creek Tributaries Mitigation Project #92764

UT3																								
Parameter	Cross Section 1 Riffle						Cross Section 2 Riffle						Cross Section 3 Pool						Cross Section 4 Riffle					
	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5	AB	MY1	MY2	MY3	MY4	MY5
Dimension																								
BF Width (ft)	8.5	8.8	8.2				9.5	11.8	12.5				9.7	10.5	10.2				12.4	12.9	12.2			
Floodprone Width (ft)	41.5	45.1	40.7				50.0	50.0	50.0				49.1	50.4	57.2				62.5	63.1	56.7			
BF Cross Sectional Area (ft ²)	4.5	5.1	4.3				6.3	7.7	8.7				8.1	8.5	9.1				10.7	11.2	9.5			
BF Mean Depth (ft)	0.53	0.58	0.53				0.66	0.65	0.70				0.84	0.81	0.89				0.87	0.87	0.77			
BF Max Depth (ft)	0.83	0.89	0.83				1.05	1.11	1.29				1.64	1.71	1.94				1.31	1.35	1.21			
Width/Depth Ratio	16.3	15.4	15.3				14.3	18.1	17.8				11.6	12.9	11.5				14.3	14.8	15.8			
Entrenchment Ratio	4.9	5.1	5.0				5.3	4.2	4.0				5.1	4.8	5.6				5.1	4.9	4.6			
Wetted Perimeter (ft)	9.6	10.0	9.2				10.8	13.1	13.9				11.4	12.1	12.0				14.1	14.6	13.8			
Hydraulic Radius (ft)	0.5	0.5	0.5				0.6	0.6	0.6				0.7	0.7	0.8				0.8	0.8	0.7			
Substrate																								
d50 (mm)																								
d84 (mm)																								
Parameter	AB (2010)			MY-1 (2011)			MY-2 (2012)			MY-3 (2013)			MY-4 (2014)			MY-5 (2015)								
	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med	Min	Max	Med						
Pattern																								
Channel Beltwidth (ft)	-	-	-	-	-	-	-	-	-															
Radius of Curvature (ft)	-	-	-	-	-	-	-	-	-															
Meander Wavelength (ft)	-	-	-	-	-	-	-	-	-															
Meander Width Ratio	-	-	-	-	-	-	-	-	-															
Profile																								
Riffle length (ft)	24	33	26	23	27	27	23	28	26															
Riffle Slope (ft/ft)	0.058	0.102	0.072	0.044	0.120	0.104	0.047	0.118	0.092															
Pool Length (ft)	3	6	4	3	7	7	4	10	4															
Pool Spacing (ft)	8	41	35	8	47	29	8	55	34															
Substrate																								
d50 (mm)		28			53			64																
d84 (mm)		78			113			143																
Additional Reach Parameters																								
Valley Length (ft)		445			445			445																
Channel Length (ft)		467			467			467																
Sinuosity		1.05			1.07			1.05																
Water Surface Slope (ft/ft)		0.089			0.087			0.088																
BF Slope (ft/ft)		0.090			0.088			0.092																
Rosgen Classification		B3a			B3a			B3a																

Notes:

Table 9. Stream Reach Morphology Data Table
 Snowbird Creek Tributaries Mitigation Project #92764

Stream Reach Data Summary																									
UT3																									
Parameter	Regional Curve Equation	Reference Reach(es) Data			Design			(As-Built)			Yr 1			Yr 2			Yr 3			Yr 4			Yr 5		
		Eq.	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max		
Dimension - Riffle																									
Bankfull Width (ft)	10.1	7.4	17.5	27.6	-----	9.9	-----	8.5	10.1	12.4	8.8	11.2	12.9	8.2	10.9	12.5									
Floodprone Width (ft)	-----	12.2	25.4	38.6	20.0	35.0	50.0	41.5	51.4	62.5	45.1	52.7	63.1	40.7	49.1	56.7									
Bankfull Mean Depth (ft)	0.65	0.87	0.99	1.10	-----	0.66	-----	0.53	0.69	0.87	0.58	0.70	0.87	0.53	0.67	0.77									
Bankfull Max Depth (ft)	-----	1.09	1.35	1.60	-----	0.90	-----	0.83	1.06	1.31	0.9	1.12	1.4	0.83	1.11	1.29									
Bankfull Cross Sectional Area (ft ²)	6.7	7.0	20.0	33.0	-----	6.5	-----	4.5	7.1	10.7	5.1	8.0	11.2	4.3	7.5	9.5									
Width/Depth Ratio	-----	7.6	17.3	27.0	-----	15.1	-----	14.3	14.9	16.3	14.8	16.1	18.1	15.3	16.3	17.8									
Entrenchment Ratio	-----	1.3	1.6	2.0	2.0	3.5	5.0	4.9	5.1	5.3	4.2	4.7	5.1	4.0	4.5	5.0									
Bank Height Ratio	-----	1.1	1.1	1.2	-----	1.0	-----	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0									
Bankfull Velocity (fps)	-----	-----	-----	-----	-----	4.6	-----	-----	3.4	-----	-----	3.0	-----	-----	3.2	-----									
Pattern																									
Channel Beltwidth (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Radius of Curvature (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Meander Wavelength (ft)	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Meander Width Ratio	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Profile																									
Riffle Length (ft)	-----	-----	-----	-----	-----	-----	-----	24	27	33	23	26	27	23	26	28									
Riffle Slope (ft/ft)	-----	0.136	0.152	0.167	0.048	0.101	0.153	0.058	0.075	0.102	0.044	0.094	0.120	0.0467	0.0864	0.1177									
Pool Length (ft)	-----	-----	-----	-----	-----	-----	-----	3	4	6	3	7	7	4	6	10									
Pool Spacing (ft)	-----	42	99	157	5	27	48	8	27	41	8	26	47	8	29	55									
Substrate and Transport Parameters																									
d16 / d35 / d50 / d84 / d95	-----	5.6/9.5/11/100/200			-----	6.8/19/28/78/150			-----	.7/39/53/113/180			-----	6.7/43/64/143/271			-----	-----			-----	-----			
Reach Shear Stress (competency) lb/ft ²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Stream Power (transport capacity) W/m ²	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----									
Additional Reach Parameters																									
Channel length (ft)	-----	-----	-----	-----	-----	466	-----	-----	467	-----	-----	467	-----	-----	467	-----									
Drainage Area (SM)	-----	0.13	0.87	1.60	-----	0.18	-----	-----	0.18	-----	-----	0.18	-----	-----	0.18	-----									
Rosgen Classification	-----	-----	B4a	-----	-----	B3	-----	-----	B3	-----	-----	B3	-----	-----	B3	-----									
Bankfull Discharge (cfs)	27	-----	-----	-----	20	30	40	-----	24	-----	-----	24	-----	-----	24	-----									
Sinuosity	-----	-----	1.10	-----	-----	1.10	-----	-----	1.05	-----	-----	1.07	-----	-----	1.05	-----									
BF slope (ft/ft)	-----	-----	-----	-----	-----	-----	-----	-----	0.090	-----	-----	0.088	-----	-----	0.092	-----									

APPENDIX E

TABLE 10-VERIFICATION OF BANKFULL EVENTS

Table E10. Verification of Bankfull or Greater than Bankfull Events
 Snowbird Creek Tributaries Mitigation Project-#92764

Date of Data Collection	Date of Event	Method of Data Collection	Gauge Watermark Height (feet above bankfull)
			UT3 (Reach 2)
MY 1 (January 6 th , 2012)	April 8 th , 2011 (crest gauge installation for asbuilt) January 6 th , 2012	Gauge measurement	0.15
MY 2 (February 6 th , 2013)	January 6 th , 2012 – February 6 th , 2013	Gauge measurement	0.22






APPENDIX F
PROJECT PROBLEM AREAS

FIGURE 3 – PROBLEM AREAS CCPV

TABLE 11 – VISUAL MORPHOLOGICAL STABILITY ASSESSMENT

TABLE 12 – VEGETATION PROBLEM AREAS

EXHIBIT 6 – VEGETATION PROBLEM AREAS PHOTOLOG

LEGEND	
	CONSERVATION EASEMENT
	DESIGNED CENTERLINE
	DESIGNED STREAM BANK
	CROSS SECTION
	PHOTO POINT





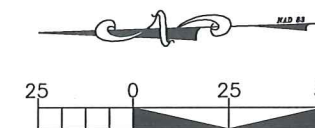
PROJECT CONDITION	
	VEG PLOT CRITERIA MET
	VEG PLOT CRITERIA UNMET (NO PLOTS CURRENTLY MEETING THIS CRITERIA)
	VEGETATION PROBLEM AREA (VPA) (BARE FLOOD PLAIN)
	STREAM PROBLEM AREAS (NO STREAM PROBLEM AREAS)



IMAGE SOURCE: NC STATEWIDE ORTHOIMAGERY, 2010

SNOWBIRD UT3 REACH 2
CURRENT CONDITION
PLAN VIEW
YEAR 2 MONITORING



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Baker

SNOWBIRD CREEK TRIBUTARIES PROJECT
GRAHAM COUNTY, NORTH CAROLINA
FIGURE 3
PROBLEM AREAS



Prepared for:
Ecosystem Enhancement Program
2728 Capitol Blvd, Suite 1H 103
Raleigh, NC 27604
Phone: 919-715-0476
Fax: 919-715-2219

EEP Project No.
92764

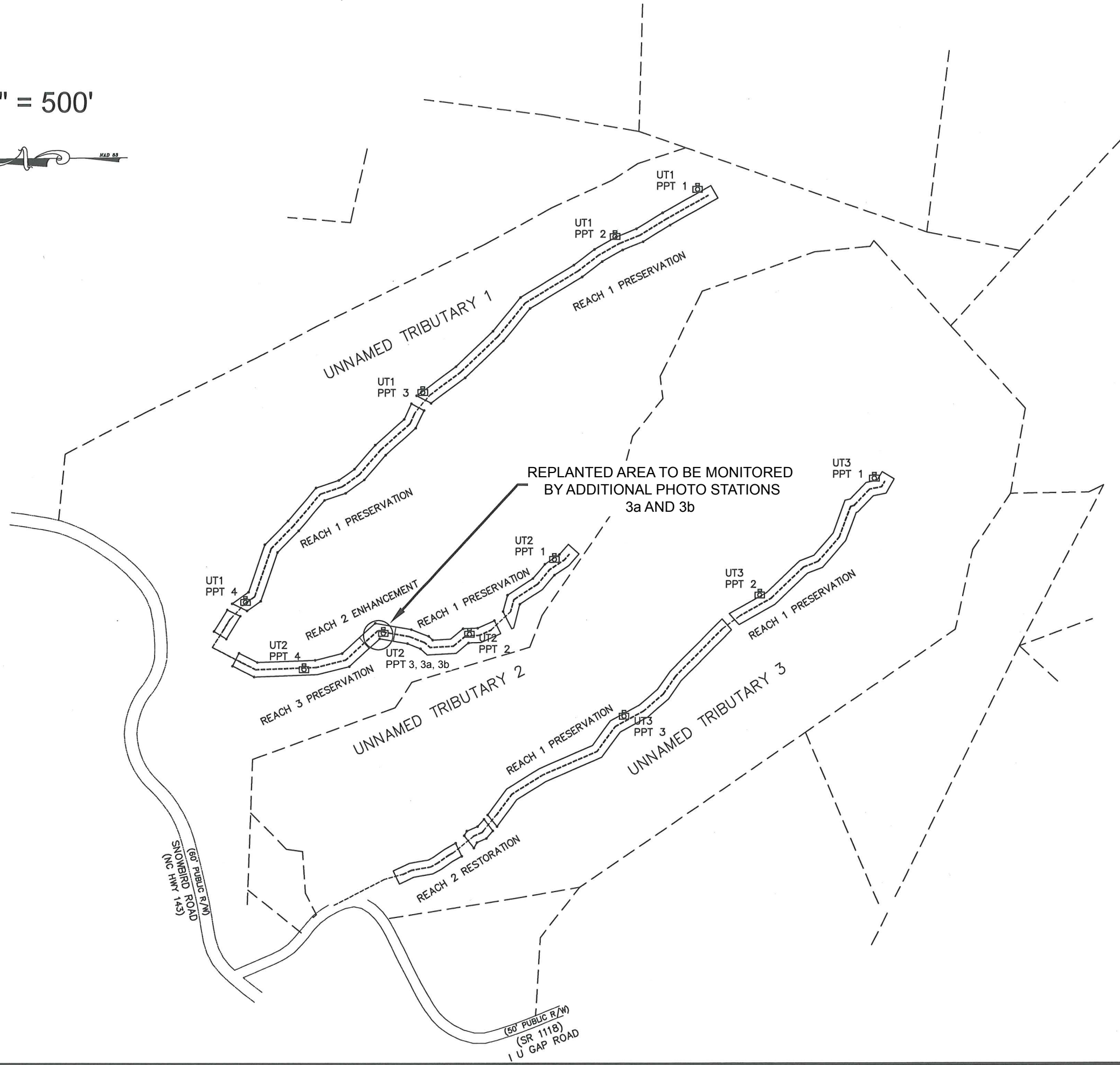
Baker Project No.
113112

Date:
3/26/2013

DESIGNED: JPM
DRAWN: MDR
APPROVED: MMC

Monitoring Year:
2 of 5

1" = 500'



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Baker

SNOWBIRD CREEK TRIBUTARIES PROJECT
 GRAHAM COUNTY, NORTH CAROLINA

FIGURE 3
 PROBLEM AREAS



Prepared for:
 Ecosystem Enhancement Program
 2728 Capitol Blvd., Suite 1103
 Raleigh, NC 27604
 Phone: 919-715-0476
 Fax: 919-715-2219

EPP Project No.
92764

Baker Project No.
113112

Date:
3/26/2013

DESIGNED: JPM
 DRAWN: MDR
 APPROVED: MMC

Monitoring Year:
2 of 5

Table 11. Visual Morphological Stability Assessment
Snowbird Creek Tributaries Mitigation Project: Project No. 92764

UT3 Reach 2 (467 LF)

Feature Category	Metric (per As-Built and reference baselines)	(# Stable) Number Performing as Intended	Total number per As-Built	Total Number / feet in unstable state	% Performing in Stable Condition	Feature Performance Mean or Total
A. Riffles	1. Present?	14	14	N/A	100	
	2. Armor stable (e.g. no displacement)?	14	14	N/A	100	
	3. Facet grades appears stable?	14	14	N/A	100	
	4. Minimal evidence of embedding/fining?	14	14	N/A	100	
	5. Length appropriate?	14	14	N/A	100	100%
B. Pools	1. Present? (e.g. not subject to severe aggradation or migration?)	24	24	N/A	100	
	2. Sufficiently deep (Max Pool D:Mean Bkf >1.6?)	24	24	N/A	100	
	3. Length appropriate?	24	24	N/A	100	100%
C. Thalweg ¹	1. Upstream of pool (structure) centering?	36	36	N/A	100	
	2. Downstream of pool (structure) centering?	36	36	N/A	100	100%
D. Meanders	1. Outer bend in state of limited/controlled erosion?	N/A	N/A	N/A	N/A	
	2. Of those eroding, # w/concomitant point bar formation?	N/A	N/A	N/A	N/A	
	3. Apparent Rc within spec?	N/A	N/A	N/A	N/A	
	4. Sufficient floodplain access and relief?	N/A	N/A	N/A	N/A	N/A
E. Bed General	1. General channel bed aggradation areas (bar formation)	N/A	N/A	0/0	100	
	2. Channel bed degradation - areas of increasing down-cutting or head cutting?	N/A	N/A	0/0	100	100%
F. Bank	1. Actively eroding, wasting, or slumping bank	N/A	N/A	0/0	100	100%
G. Rock/Log Drop Structures ²	1. Free of back or arm scour?	24	24	N/A	100	
	2. Height appropriate?	24	24	N/A	100	
	3. Angle and geometry appear appropriate?	24	24	N/A	100	
	4. Free of piping or other structural failures?	24	24	N/A	100	100%
H. Wads/Boulders	1. Free of scour?	N/A	N/A	N/A	N/A	
	2. Footing stable?	N/A	N/A	N/A	N/A	N/A

¹ Thalweg feature is scored according to the centering of the thalweg over inverts of drop structures above pools and through the constructed riffle below pools since this reach is a step-pool channel without meander bends.

² Vane feature category was replaced with rock/log drop structures since there are no vanes present on this reach.

**Table 12. Vegetation Problem Areas
Snowbird Creek Tributaries Mitigation Project: Project No. 92764**

UT2 Reach 2 (171 LF)

Feature Issue	Station No.	Suspected Cause	Photo Number
Bare Floodplain	0+10 to 1+40 (left floodplain)	Easement encroachment by vehicles accessing existing forest road located further upstream of project reach limits. Baker is coordinating with the contractor and land owner to create an alternate vehicle access located outside the easement to avoid further encroachment. The impacted buffer within the easement will be reseeded and replanted during construction of the alternate vehicle access.	VPA1

EXHIBIT 6 – Vegetation Problem Area (VPA) Photos



VPA1 – Easement encroachment/buffer impact from access road paralleling the upstream limits of UT3-Reach 2 (looking downstream from left floodplain)



VPA1 – Easement encroachment/buffer impact from access road paralleling the upstream limits of UT3-Reach 2 (looking downstream from left floodplain)