# LITTLE WHITE OAK CREEK STREAM RESTORATION

**POLK COUNTY, NORTH CAROLINA**

**CONTRACT # D06027-B**

NORTH CAROLINA PROFESSIONAL SEAL 036254 ENGINEER EMMETT PERDUE 2/20/12

Year 0 - Photo Point 11

Year 4 - Photo Point 11

Prepared For:

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

# ANNUAL MONITORING REPORT (YEAR 4 OF 5)

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## 1.0 Executive Summary

This annual monitoring report details the fourth year monitoring activities and their results for the Little White Oak Creek Stream Restoration Site (LWOC). All of the monitoring activities were conducted and the subsequent results are reported in accordance with the approved mitigation plan (Mulkey Engineers and Consultants, 2008) for LWOC. The content and format of this report were developed in accordance with the contract requirements for the Full Delivery RFP 16-D06027 (NCEEP, 2005). Accordingly, this report includes project background information, project monitoring results, and description of the project monitoring methodology.

Mulkey Engineers and Consultants (Mulkey) submitted LWOC for the Full Delivery RFP 16-D06027 to provide 18,200 Stream Mitigation Units (SMUs). Mulkey was awarded the stream restoration contract and began work on the project on May 16, 2007 The primary goals of LWOC were to improve water quality, to reduce bank erosion, to reestablish a floodplain along each of the stream reaches, and to improve the aquatic and terrestrial wildlife habitat. These goals were met through the following objectives:

- By using natural channel design to restore stable pattern, dimension, and profile for 18,290 linear feet of stream channel
- By establishing a conservation easement, which will protect the streams from cattle intrusion and future development activities
- By establishing a floodplain or reconnecting the stream back to its historic floodplain, or a combination of both, for each project stream reach
- By creating or restoring floodplain features such as vernal pools, off channel ponds, or riparian wetlands
- By increasing the amount of aquatic habitat through the addition of rock and wood structures
- By reestablishing native plant communities throughout the conservation easement, whereby reintroducing shading, cover areas, and travel corridors.

LWOC is located in Polk County, North Carolina near the community of Mill Springs and is situated in the Broad River Basin. Past land use practices, including extensive cattle farming, stream channelization and dredging, and clearing of the riparian buffers resulted in substantial degradation of the stream systems at LWOC. LWOC is comprised of seven stream reaches totaling 18,290 feet of restored stream channel. All of the analyses, design, and restoration at LWOC were accomplished using natural stream channel design methods. In addition to stream channel restoration, the restored stream banks and the riparian and upland buffer areas along LWOC were also replanted with native species vegetation.

The survivability of the planted vegetation at LWOC was monitored at representative vegetation plots as well as project-wide. Stem counts, photo documentation and comparison, and visual assessment were utilized. Bare root stock were planted at a density of 680 stems per acre (8 foot by 8 foot spacing) and live stakes were planted on the stream banks at a density of 1,742 stems per acre (5 foot by 5 foot spacing). A total of 24 representative vegetation plots were installed at LWOC based on the recommendations set forth by EEP regarding the acreage contained in the conservation easement. The survivability of the planted woody vegetation at LWOC was monitored using annual stem counts at each of the plots. In addition to the stem counts, annual photos were taken at each of the plots and also from 14 other permanent photo reference points. The vegetation plot photos were used for photo documentation and comparison of the vegetation growth at each plot. The photo documentation at the reference points were employed to assist in a project-wide visual assessment of the vegetation at LWOC. Survivability will be based on achieving a minimum of 320 stems per acre after Year 3 and 260 stems per acre after Year 5, across the project site. The stem counts were conducted during the latter part of the growing season months (August, September, and October) to insure survival throughout a complete growing season while still allowing for relative ease in identification.

Mulkey relocated portions of the fence surrounding the easement around LWOC during the Spring of 2010. This was performed at the request of NCEEP to ensure the entire easement was protected from cattle and to include the required 50 foot buffer established by the United States Army Corps of Engineers. On February 23, 2011, woody vegetation was planted within the new areas created by fence relocation.

During the middle of October 2011, the vegetation monitoring for Monitoring Year 4 was conducted using the methodologies described above, including stem counts, photo documentation, and visual assessment. The stem counts resulted in the 325 stems being counted in 24 vegetation plots. These plots have a survivability of planted woody stems ranging from 327 to 917 stems per acre. The survival level of the planted woody vegetation at LWOC was maintained from Year 3 to Year 4. The site is on track to meet the success criteria established for Year 5 described above. Visual comparison of the vegetation plot and permanent photos clearly show the significant growth that has taken place over the last 4 years. The project-wide visual assessment also confirmed a sustained growth trend, as no vegetative problem areas were observed.

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored to evaluate the success of stream restoration at LWOC. The limits of the project stream reaches to be monitored at LWOC were determined using the sampling rates outlined by the USACE *et al*. (2003). The monitoring was conducted using annual field surveys, pebble counts, crest gage recordation, visual assessment and photo documentation. Baseline conditions for comparison of the stream parameters to be monitored were established from data gathered immediately after construction through the as-built survey process. Longitudinal profiles and Modified Wolman pebble counts were conducted for all reaches and a total of 13 permanent cross sections were surveyed and photo documented across LWOC. A total of eight crest gages across LWOC were installed for hydrologic monitoring to verify the occurrence of bankfull storm events. Annual photo documentation was used for stream monitoring to complement and validate the other stream monitoring practices from 14 permanent reference photo points. Annual project wide visual assessment was conducted using field observation and pedestrian surveys to identify any specific problem areas. BEHI information was not collected during the current year since it is only required during Monitoring Years 3 and 5. Stream restoration success at LWOC was evaluated by comparison of the annual monitoring results against those same parameters as predicted, specified, and required in the proposed design and as implemented during the construction process represented by the as-built or baseline conditions. Success was achieved when all such comparisons reveal positive trends toward overall stream stability.

During the early months of 2011, repairs were conducted on the floodplain benches and terraces of R1 and R2 following a large flood event in 2010. These repairs were highly successful in improving the benches and terraces throughout these two reaches. Visual assessments of these areas do not show any future areas of concern.

During November 2011, the stream monitoring for Monitoring Year 4 was conducted using the methodologies described above. The stream dimension, pattern, and profile remained consistent with the 3 previous years' data and continue to remain within the tolerances of the design parameters. All reaches have maintained stable C type stream channels throughout the past 4 years of monitoring. Bed materials have also remained stable with only slight fluctuations; however one reach experienced significant coarsening over the last monitoring period. The compilation of four years of monitoring data strongly suggests that the LWOC project is trending toward a restored, stable stream system.

Therefore, based on the positive trends from the Year 4 monitoring data, Mulkey does not propose any actions other than to proceed with the final year of monitoring.

## 2.0 Project Background

### 2.1 Project Location and Setting

The Little White Oak Creek Stream Restoration Site is located in Polk County, North Carolina approximately 2.5 miles east/southeast from the community of Mill Springs along NC Highway 9 South, and approximately 0.5 mile northwest from the intersection of NC Highway 9 South and US Highway 74 (Figure 1). LWOC is situated in the Broad River Basin 8-digit cataloging unit of 03050105 and the 14-digit cataloging unit 03050105030010. Mulkey proposed to provide 18,200 Stream Mitigation Units (SMUs) with LWOC under the Full Delivery RFP 16-D06027 issued by the Ecosystem Enhancement Program Department of Environment and Natural Resources (NCEEP). Mulkey acquired and installed permanent fencing along an easement covering 55.3 acres, which encompasses the restored streams and associated buffers at LWOC.

### 2.2 Project Goals and Objectives

The primary goals of LWOC were to improve water quality, to reduce bank erosion, to reestablish a floodplain along each of the stream reaches, and to improve the aquatic and terrestrial wildlife habitat.

These goals were met through the following objectives:

- By using natural channel design to restore stable pattern, dimension, and profile for 18,290 linear feet of stream channel

- By establishing a conservation easement, which will protect the streams from cattle intrusion and future development activities
- By establishing a floodplain or reconnecting the stream back to its historic floodplain, or a combination of both, for each project stream reach
- By creating or restoring floodplain features such as vernal pools, off channel ponds, or riparian wetlands
- By increasing the amount of aquatic habitat through the addition of rock and wood structures
- By reestablishing native plant communities throughout the conservation easement, whereby reintroducing shading, cover areas, and travel corridors.

### 2.3 Project Restoration Approach and Mitigation Type

LWOC is comprised of three main reaches (R1, R2 Upper and R2 Lower) and four tributaries (R1A, R2A, R2B and R2D). Prior to construction, these seven reaches were identified and proposed for restoration due to their distinct stream characteristics and drainage areas. These seven existing reaches totaled approximately 15,487 linear feet. A total of 18,290 linear feet of stream channel was restored at LWOC within the 55.3 acre conservation easement.

Analyses, design, and restoration of the stream channels at LWOC was accomplished using Natural Stream Channel design methods developed by Rosgen (Rosgen, D. L., 1994, 1996, 1998). The proposed Rosgen channel type for two of the tributaries (R2A and R2B) was a C4 channel. The restoration of these tributaries was implemented using Priority Level I and II methodologies. The proposed stream classification for the majority of the reaches (R1, R1A, R2 Upper, and R2 Lower) was a C5 channel. A combination of Priority Level I and II methods were used to construct these reaches. The remaining reach (R2D) was proposed to be a C6 channel using the same methods previously mentioned.

The most significant stream restoration component at LWOC involved the reconstruction of each of the stream reaches such that stream flows greater than bankfull are allowed to access the restored stream's floodplain. Two different approaches were used to insure such floodplain access. The first approach involved relocating and raising the stream bed such that the historic floodplain is accessed by stream flows greater than bankfull (the sections of the project stream reaches that were restored using Priority Level I methodologies). A second approach was used where site constraints prevented such relocation and raising of the stream bed. Therefore the second approach involved building a floodplain at a level lower than the historic floodplain through the construction of bankfull benches (the sections of the project stream reaches that were restored using Priority Level II methodologies). In-stream structures were installed along each of the stream reaches to provide grade control and stream bank protection, and to increase in-stream habitat diversity. The in-stream structures installed included rock cross vanes, j-hook rock vanes, rock vanes, constructed riffles, and root wads. Stream banks were further stabilized through the installation of coir fiber erosion control matting, temporary and permanent seeding, and the installation of native species vegetation in the form of transplants, live stakes, and bare root stock. All areas of the site that were disturbed during construction activities were stabilized using temporary and permanent seeding. The riparian and upland buffer communities along LWOC were also restored with native species vegetation using a target community which will emulate the Piedmont/Low Mountain Alluvial Forest described by Shafale and Weakley (1990). The conservation easement was fenced to permanently protect the restored stream and buffer areas. Information regarding the restoration approach and mitigation type for each of the seven project stream reaches is detailed in Table 1.

## 2.4 Project History

The existing conditions at LWOC prior to restoration were a result of cattle use for the past 50 years. When Mulkey initially became involved with this project, there were approximately 200 livestock (cattle and horses) utilizing the pastures. The livestock had never been fenced from any of the stream channels within LWOC. This continual livestock access to the streams resulted in substantial erosion along the stream banks, incision of the channels, channel widening in some areas, and heavy siltation throughout LWOC, as well as reduced water quality due to large quantities of fecal matter into the stream system. Based on information gained from the property owner, it was determined that many of the streams at the LWOC, particularly the smaller tributaries, were historically maintained through channelization, dredging, and clearing of the riparian buffer. As a result of these land and water quality issues, Mulkey submitted LWOC for the Full Delivery RFP 16-D06027 to provide 18,200 Stream Mitigation Units (SMUs). Mulkey was awarded the stream restoration contract by the NCEEP and began work on the project on May 16, 2007. The project activity and reporting history are detailed in Table II. Table III lists the contacts for the designer, contractor, relevant suppliers, and monitoring firm for LWOC. Table IV provides a complete listing of project background information.

## 2.5 Project Monitoring Plan View

Mulkey conducted monitoring baseline surveys along the entire length of each of the restored project stream reaches using total station survey equipment. These surveys were conducted to establish and document baseline conditions for the newly restored stream channels for future monitoring activities. As-built drawings were developed using the results of the monitoring baseline surveys. These drawing depicted the post construction condition of LWOC and are included in Appendix A. The as-built drawings consisted of plan sheets that include the following:

- Title sheet
- Legend sheet
- As-built planimetric drawing developed from aerial photography of LWOC after the completion of construction
- As-built planimetric drawings and profiles developed from the baseline monitoring field surveys

The as-built drawings illustrate the location of all major project elements, including, but not limited to the:

- Restored stream channel thalweg, normal edges of water, constructed bankfull channel limits, and the constructed cut slope limits
- Conservation easement boundaries
- Permanent fencing limits
- Topography
- In-stream structures
- Photo points
- Crest gages
- Vegetation plots locations
- Permanent cross sections
- Project survey control
- Monitoring profile survey limits
- Relevant structures and utilities

## 3.0 Project Condition and Monitoring Results

## 3.1 Project Vegetation Monitoring

### 3.1.1 Vegetation Monitoring Methodology

The survivability of the planted vegetation at LWOC, including both woody and herbaceous species, was monitored at representative vegetation plots as well as project-wide. Monitoring at representative vegetation plots focused primarily on planted woody vegetation and was conducted using stem counts and photo documentation. Project-wide monitoring of planted vegetation included both woody and herbaceous species and was accomplished using visual assessment as well as photo documentation.

Major grading and channel construction was completed during the last week of November 2007. Throughout construction, appropriate temporary and permanent seeding was conducted to stabilize areas disturbed during construction. Appropriate existing native species vegetation was also salvaged, where feasible, in the form of transplants and live stakes, throughout the construction process. Immediately following the completion of the major grading and channel construction activities, all remaining plant material was installed during the months of November and December 2007. These remaining plant materials consisted of native species bare root seedlings and live stakes and were installed, as appropriate, to restore the riparian and upland buffer communities along LWOC within the conservation easement area. A complete listing of the planting zones, their corresponding acreages, and the corresponding vegetation species was included in the approved mitigation report (Mulkey Engineers and Consultants, 2008). The bare root stock were planted at a density of 680 stems per acre (8 foot by 8 foot spacing) and the lives stakes were planted on the stream banks at a density of 1,742 stems per acre (5 foot by 5 foot spacing).

An As-Built Survey was initiated immediately following the installation of plant materials. In December 2007, during the as-built survey and after the completion of planting, a total of 24 representative vegetation plots (vegetation plots 1 through 24) were installed randomly across LWOC. An iron pipe was installed at each plot corner for monumentation and a polyvinyl chloride (PVC) pipe, along with a label specifying the plot number, was also installed at one of the corners of each plot. The plot corners were strategically located such that each plot has a total area of approximately 100 square meters. Between January and February 2008, after the establishment of the plots, all stems contained in the plots were identified and tallied by species and plot, then marked with loosely tied survey flagging (on lateral branches) to facilitate future identification. This data was recorded to provide the baseline survivability. The survivability of the planted woody vegetation at LWOC for the various monitoring periods was then calculated using annual stem counts at each of the plots and compared to the baseline data. During each of the annual stem counts, the planted stems were re-flagged as required to ensure that all planted stems were accounted for and considered in the survivability calculations. In addition to the stem counts, photos were taken at each of the plots. Where necessary, the corner of each plot was remarked with PVC pipe and the plot number relabeled. This PVC plot corner was used as the reference point from which the annual vegetation plot photos were taken such that the photos at each plot will have the same orientation. The photos were compared to the photos from the previous years to validate and document vegetation success. In addition to the photo reference points established at each of the vegetation plots, a total of 11 additional permanent photo reference points were installed across LWOC. Subsequently, three additional permanent photo reference points (photo points 2.5Y1, 3.5Y1, and 8.5Y1) were added during the Year 1 monitoring period to ensure adequate photo documentation would be conducted within the monitoring limits of the project stream reaches. These additional permanent photo reference points were monumented using steel rebar and PVC pipe. Photos were taken from each of the 14 permanent photo reference points with the same orientation each applicable year and used for photo documentation and annual comparison of the vegetation growth across LWOC. This exercise helped to further validate and document vegetation success at LWOC. Between January and February 2008, after installation of the described 11 permanent photo reference points, photos were taken from each of the permanent photo reference points to document the baseline conditions at LWOC with regards to planted vegetation. Monitoring Year 1 and Monitoring Year 2 photos were taken from all 14 photo points during the visit in August 2008 and October 2009, respectively. Project-wide visual assessment was also used for vegetation monitoring at LWOC. A visual assessment was conducted using annual field observation and pedestrian surveys to identify any specific vegetation problem areas at LWOC during the monitoring period. Any problem areas where vegetation was lacking or exotic vegetation was present, was identified and categorized as bare bank, bare bench, bare floodplain, or invasive population. Such areas were documented using representative photos and their locations were identified on the Monitoring Plan View.

### 3.1.2 Vegetation Monitoring Success Criteria

Vegetation success at LWOC was determined by stem survivability. Successful survivability is dependent upon achieving at least 320 stems per acre after three years and 260 stems per acre after five years across the project site. Therefore, survivability rates exceeding these requirements in previous years were deemed successful. The stem counts were conducted during the latter part of the growing season months (August, September, and October) to ensure survival throughout a complete growing season while still allowing for relative ease in identification. As described above, photo documentation and visual assessment was used to complement the stem counts as part of the vegetation monitoring protocol at LWOC. If during any given year, the planted species survivability was not anticipated to meet the final criteria established for vegetation; supplemental plantings were considered. In the event this occurred, a remedial planting plan was developed to achieve the survivability goals established for Years 3 and 5.

### 3.1.3 Vegetation Monitoring Results for Year 1 of 5

In late August 2008, the vegetation monitoring for Monitoring Year 1 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section above were used for the vegetation monitoring at LWOC for Monitoring Year 1. Stem counts were conducted at each of the 24 vegetation plots and the results are summarized in Table V. Photos were taken from the photo reference points at each of the 24 vegetation plots. Appendix B compares these photos with the initial baseline photos taken from the photo reference points at each of the 24 vegetation plots. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points and provided the baseline photos for the 3 points installed during the Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas. Table VI summarizes the results of the project-wide vegetation visual assessment. The results of the Monitoring Year 1 stem counts showed that the 24 vegetation plots had successfully achieved the survivability of planted woody vegetation with stem counts ranging from 438 to 1000 stems per acre, with an average survivability of 713 stems per acre. The results indicated the survivability of the planted woody vegetation at LWOC should meet the success criteria defined in Section 3.1.2. During the stem counts, it was noted no significant volunteer woody species were observed at any of the 24 vegetation plots. The comparison of the baseline and Monitoring Year 1 photos at both the 24 vegetation plot photo reference points and the 11 permanent photo reference points strongly complemented this suggestion, as no concerns, problems, or negative trends were documented. The project-wide visual assessment provided further validation, as no vegetation problem areas were observed. Based on the results of the vegetation monitoring for Monitoring Year 1 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring.

### 3.1.4 Vegetation Monitoring Results for Year 2 of 5

In mid-October 2009, the vegetation monitoring for Monitoring Year 2 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section were used for the vegetation monitoring at LWOC for Monitoring Year 2. Stem counts were conducted at each of the 24 vegetation plots. Table V presents the results of these stem counts for each of the plots. This table includes and compares the results of the initial stem counts from the original planting, the previous years, and Monitoring Year 2. Photos were taken from the photo reference points at each of the 24 vegetation plots and are compared to the previously collected photos in Appendix B. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points from Year 0 and the photos from the 14 total permanent photo reference points in Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas and is summarized in Table VI. The results of the Monitoring Year 2 stem counts continued to display successful survivability in all 24 vegetation plots with the counts ranging from 367 to 1000 stems per acre and an average survivability of 670 stems per acre. Therefore survivability of the planted woody vegetation at LWOC should meet the success criteria established in Section 3.1.2. Similar to Monitoring Year 1, no significant volunteer woody species were observed at any of the 24 vegetation plots. The comparison of the Monitoring Year 2 photos to those previously collected at both the 24 vegetation plot photo reference points and the 14 permanent photo reference points suggested the vegetation was growing exceptionally well. Live stake vegetation has exceeded growth expectations and the bare root material is starting to overcome the weedy vegetation. A further review of the vegetation through the project-wide visual assessment validated this positive trend, as no concerns, problems, or negative trends were documented. Based on the results of the vegetation monitoring for Monitoring Year 2 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring.

### 3.1.5 Vegetation Monitoring Results for Year 3 of 5

In early November 2010, the vegetation monitoring for Monitoring Year 3 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section were used for the vegetation monitoring at LWOC for Monitoring Year 3. Stem counts were conducted at each of the 24 vegetation plots. Table V presents the results of these stem counts for each of the plots. This table includes and compares the results of the initial stem counts from the original planting, the previous years, and Monitoring Year 3. Photos were taken from the photo reference points at each of the 24 vegetation plots and are compared to the previously collected photos in Appendix B. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares these photos with the initial baseline photos taken from the original 11 permanent photo reference points from Year 0 and the photos from the 14 total permanent photo reference points in Monitoring Year 1. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas and is summarized in Table VI. The results of the Monitoring Year 3 stem counts continued to display successful survivability in all 24 vegetation plots with the counts ranging from 327 to 917 stems per acre and an average survivability of 557 stems per acre. Therefore survivability of the planted woody vegetation at LWOC meets the success criteria established in Section 3.1.2. for Year 3 and is on track for success in Year 5. Additional uncounted volunteer woody species were observed at all of the 24 vegetation plots. The comparison of the Monitoring Year 2 photos to those previously collected at both the 24 vegetation plot photo reference points and the 14 permanent photo reference points suggested the vegetation was growing exceptionally well. Live stake vegetation has exceeded growth expectations and the bare root material is starting to overcome the weedy vegetation. A further review of the vegetation through the project-wide visual assessment validated this positive trend, as no concerns, problems, or negative trends were documented. Based on the results of the vegetation monitoring for Monitoring Year 3 at LWOC, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring. The only additional plantings that will be utilized are associated with the repair work discussed in Section 3.2.5.

### 3.1.6 Vegetation Monitoring Results for Year 4 of 5

During October 2011, the vegetation monitoring for Monitoring Year 4 was conducted. The methodologies described in the Vegetation Monitoring Methodology Section were used for the vegetation monitoring at LWOC for Monitoring Year 4. Stem counts were conducted at each of the 24 vegetation plots and Table V presents the results for each of the plots. This table includes and compares the results of the initial stem counts from the original planting through 5 years of monitoring. Photos were taken from the photo reference points at each of the 24 vegetation plots and are compared to the previously collected photos in Appendix B. Photos were also taken from each of the 14 permanent photo reference points. Appendix C compares the permanent photo reference points for the current and previous years, showing reachwide views of the woody vegetation growth across the entire site. A project-wide visual assessment was also conducted to identify any specific vegetation problem areas and is summarized in Table VI.

The results of the Monitoring Year 4 stem counts continue to display good survivability in all 24 vegetation plots with the counts ranging from 327 to 917 stems per acre with an average survivability of 553 stems per acre. Therefore survivability of the planted woody vegetation at LWOC is on track to meet the success criteria outlined for Year 5 (Section 3.1.2.). In Year 4, 325 stems were tallied, which represents a 71% survival rate since the site was planted. Additional uncounted volunteer woody species were also observed at all of the 24 vegetation plots. A comparison of the Monitoring Year 4 photos to those previously collected suggests that the vegetation is growing exceptionally well. Live stake vegetation has continued to exceed growth expectations. The bare root material is becoming more dominant within the plant community with some species reaching 10 to 15 feet in height. Briers and grasses still comprise large portions of several vegetation plots, making them difficult to navigate during monitoring. The project-wide visual assessment indicated a positive growth trend and did not find any concerns or problem areas throughout the site.

Based on the results of the vegetation monitoring for Monitoring Year 4 at LWOC, Mulkey does not propose any additional recommendations or actions other than to proceed with the annual vegetation monitoring.

## 3.2 Project Stream Monitoring

### 3.2.1 Stream Monitoring Methodology

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored to evaluate the success of the stream restoration activities at LWOC. The monitoring of stream dimension, pattern, and profile, or morphometric monitoring, along with the monitoring of stream bed material, were conducted using annual field surveys along with visual assessment. The morphometric, stream bed material, and stream bank stability monitoring were conducted along representative sections of the project stream reaches. Hydrologic monitoring consisted of field measurements of bankfull events using crest gages. Project-wide stream monitoring was accomplished using visual assessment as well as photo documentation.

Major grading and channel construction were completed during the last week of November 2007. Immediately following the completion of the major grading and channel construction activities, all remaining plant material was installed during the months of November and December 2007. The as-built survey of all of the stream reaches at LWOC were initiated immediately following the installation of plant materials and were conducted utilizing aerial photography and total station surveys while following the protocols set forth by the 2003 USACE Stream Mitigation guidelines (USACE *et al*., 2003). In addition to documenting the construction of LWOC for comparison to the proposed design, the results of the as-built survey were also used to establish baseline morphology for the proposed monitoring. This information is presented in Table VII. A summary of the restored stream channel lengths are outlined in Table I. A complete set of As-Built Drawings including a monitoring plan view and longitudinal profile for the as-built conditions of the restored channels can be found in Appendix A. After the completion of the as-built survey, the limits and corresponding lengths of the project stream reaches to be monitored at LWOC were determined using the sampling rates outlined by the USACE *et al*. (2003). A total of 5,893 linear feet (32%) of all restored stream channels will be surveyed annually during the monitoring period. Based on these the sampling rates, the limits of the project stream reaches to be surveyed annually for monitoring are as follows:

Reach R1 – 1,974 Linear Feet Total (Stations 14+00-R1- through 33+74-R1-)
Reach R1A – 500 Linear Feet Total (Stations 0+00-R1A- through 5+00-R1A-)
Reach R2 – 2,047 Linear Feet Total (Stations 25+13-R2- through 45+60-R2-)
Reach R2A – 326 Linear Feet Total (Stations 0+00-R2A- through 3+26-R2A-)
Reach R2B – 551 Linear Feet Total (Stations 9+35-R2B- through 14+86-R2B-)
Reach R2D – 495 Linear Feet Total (Stations 2+84-R2D- through 7+79-R2D-)

The upstream and downstream limits of these reaches were monumented in the field using steel rebar/PVC pins. Each pin was also labeled with an aluminum tag identifying the respective reach and the correct descriptor ("begin" or "end").

A total of 13 permanent cross sections, consisting of both riffles and pools, were established across LWOC and surveyed during the as-built survey process. The number of cross sections was determined using the sampling rates outlined by the USACE *et al*. (2003). The left and right ends of each cross section were monumented with a steel rebar pin and PVC pipe. An aluminum tag identifying the cross section number was also installed at the pin on the left side of the channel. In addition to the cross section surveys, photos were taken at each of the 13 cross sections, looking across the stream from left to right, to document the baseline conditions at each respective cross section. Specific stations along each permanent cross section were established during the as-built survey to promote replication and consistency during the subsequent annual cross section surveys. The stationing for each cross section was established to always begin on the left side of the channel, facing downstream, at the left rebar/PVC pin, and to continue across the stream channel to the rebar/PVC pin on the right side. The as-built survey of the 13 cross sections established the baseline conditions with regards to stream dimension. All of the 13 cross sections will be surveyed each year during the five-year monitoring period and the resulting parameters will be compared annually. The parameters to be monitored include bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. Annually, photos will be taken at each of the 13 cross sections looking across the stream from left to right and compared to the photos from the previous years to document stream conditions at each respective cross section.

The pattern for all of the stream reaches was surveyed and baseline conditions were established as part of the as-built survey. Monitoring surveys for stream pattern are limited to the project stream reaches specified above for annual monitoring surveys. The stream pattern parameters resulting from the annual monitoring surveys include sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. These parameters will be compared annually.

The as-built survey included a longitudinal profile survey along the entire length of all restored stream reaches. Longitudinal profiles were surveyed by identifying each stream feature (riffle, run, pool, or glide) and surveying specific points at each feature. These specific locations included top of bank, bankfull, water's edge or surface, and thalweg. The as-built survey was used to establish the baseline conditions with regards to monitoring the longitudinal profile within the project reaches described above. The longitudinal profiles surveys conducted each year are then limited to the project stream reaches specified above. The parameters resulting from these longitudinal profile surveys are compared on an annual basis to those of the baseline and previous years. The parameters to be monitored include bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing.

During the as-built survey, Modified Wolman pebble counts were conducted at each of the project stream reaches to classify the stream bed materials. The pebble counts for the larger project stream reaches (R1 and R2) were conducted at each of the permanent cross sections by performing an equal number of counts at each cross section and then combining the results into a reach-wide count. A minimum of 100 counts were made for each of these larger reaches. Reach-wide pebble counts were conducted along the smaller project stream reaches (R1A, R2A, R2B, and R2D). A minimum of 50 counts were made for each of these smaller reaches. The stream bed materials are monitored at LWOC by repeating the same pebble count procedures on an annual basis. The results of the pebble counts for each specified project stream reach are compared on an annual basis.

BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information served as baseline data for stream bank stability at LWOC. Stream bank stability monitoring using these parameters is required in Monitoring Year 3 and 5. Data collected during these years will be compared with pre-construction conditions to determine the change in bank erosion hazard indices and sediment export rates for each reach assessed. Positive change, namely reduction, in both the stream bank erosion rates and sediment transport rates at LWOC are expected as a result of restoration and will be documented as described to demonstrate success.

A total of eight crest gages, one at each reach and one at the confluence of Reaches R1 and R2, were installed across LWOC during the as-built survey. At the base of each crest gage a permanent vertical datum was installed. The locations of each crest gage along with the elevation of the permanent vertical datum were surveyed during the as-built survey. The crest gages were used for the hydrologic monitoring at LWOC to verify the occurrence of bankfull storm events. Each crest gage was set during its initial installation and baseline photos were taken. The crest gages were checked annually and the flood stage(s) recorded by each gage and measured relative to the permanent vertical datum of the respective gage. The results of these measurements were used to document the occurrence of significant storm events, with the goal of specifically documenting the occurrence of bankfull and larger stream flow events.

Photo documentation and project-wide visual assessment was used for stream monitoring at LWOC to complement the other stream monitoring practices. A total of 14 permanent reference photo points were installed across LWOC (11 during the as-built survey and 3 during the Year 1 monitoring period as described above). These photo points were monumented using steel rebar/PVC pins. Photos were taken at that time to provide photo documentation of baseline stream conditions. Photos were taken from each of the 14 permanent photo reference points with the same orientation each year and were used for photo documentation and annual comparison of the stream conditions across LWOC. This exercise helped to further validate and document stream restoration success at LWOC. The visual assessment was conducted using annual field observations and pedestrian surveys to identify any specific problem areas along the streams at LWOC during the monitoring period. Any such problem areas were identified and organized under appropriate categories. Such areas were documented using representative photos, where applicable, and their locations were mapped on the Monitoring Plan View. The suspected cause and appropriate remedial action for each problem was determined. If during any given year, the streams were not anticipated to meet the final established monitoring criteria, corrective actions were considered. Such modifications were documented and discussed with EEP.

### 3.2.2 Stream Monitoring Success Criteria

Stream dimension, pattern, profile, stream bed material, bank stability, and bankfull hydrology were monitored annually for the project stream reaches as described in detail above. Stream restoration success at LWOC was evaluated by comparison of the annual results against the same parameters as predicted, specified, and required in the proposed design. Success was achieved when all such comparisons reveal positive trends toward overall stream stability. Expectation was the stream monitoring results should confirm the stream channels at LWOC are of the proposed stream channel type (Rosgen 1994).

Stream dimension parameters including bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius were measured and/or calculated for each of the permanent cross sections. The described dimension parameters were expected to remain consistent from year to year and should fall within the ranges established by the original proposed design parameters. It was expected and acceptable that minor adjustments in dimension will occur such as the development of point bars and the subsequent deepening of pools. As vegetation becomes established and the stream banks are stabilized, the anticipation was that the width depth ratios will decrease and the entrenchment ratios will increase slightly, both within the normal ranges for C and E stream channel types (Rosgen, 1994).

Stream pattern parameters including sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio were measured and/or calculated. Stream pattern measurements were expected to remain consistent from year to year and to fall within the originally proposed design parameters. As vegetation becomes established and the stream banks are stabilized, it was anticipated that the sinuosity of the streams will also adjust, likely becoming more sinuous with time.

Stream longitudinal profile parameters including bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing were measured. Longitudinal profiles parameters were expected to remain relatively consistent from year to year. The stream profiles should not show aggrading or degrading conditions during the five-year monitoring period, however, minor profile adjustments such as deepening of pools was expected.

Stream bed material was monitored using the described Modified Wolman pebble counts.
The success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely occur during the early years following construction and several years may be needed to observe a consistent bed material. Bed materials should ultimately reflect the proposed design conditions for each reach at LWOC.

Stream bank stability will be monitored using BEHI and sediment transport estimates during Monitoring Years 3 and 5. Data collected during these years will be compared with pre-construction conditions to determine the change in bank erosion hazard indices and sediment export rates for each reach assessed. Positive change, namely reduction, in both stream bank erosion rates and sediment transport rates at LWOC are expected as a result of restoration and will be documented as described to demonstrate success.

Hydrologic monitoring success was based on the ability to document the occurrence of bankfull storm events at LWOC. A minimum of two bankfull events, each occurring in two separate monitoring years, are required to be documented within the five-year monitoring period. The described crest gauges were used to determine and document the occurrence of these bankfull events.

As described above, photo documentation and visual assessment was used to complement the other stream monitoring practices as part of the stream monitoring protocol at LWOC. If during any given year, the streams were not anticipated to meet the final established monitoring criteria, corrective actions was considered. Such modifications were documented and discussed with EEP.

### 3.2.3 Stream Monitoring Results for Year 1 of 5

In late August 2008, the stream monitoring for Monitoring Year 1 was conducted. The methodologies described in the Section 3.2.1 were used for the stream monitoring at LWOC for Monitoring Year 1. Detailed surveys were conducted along the project stream reaches specified to be surveyed for annual monitoring. The results of these surveys were compared to the baseline data for the morphometric monitoring obtained during the as-built survey.

All of the 13 cross sections were surveyed to measure the bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. The results of the cross section surveys are presented in Table VIII. Appendix D compares photos taken during Monitoring Year 1 with the initial baseline photos at each of the 13 cross sections. Appendix E provides an overlay of the Monitoring Year 1 and baseline conditions along with the raw data for each cross section. The comparison of the baseline and Monitoring Year 1 stream dimension morphometric data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustments including decreasing width to depth ratios, increasing entrenchment ratios, and minor increases in depth. Each of these trends was indicative of movement toward increased stream stability and was attributed to vegetation establishment and natural channel adjustments. The comparison of the Year 1 Monitoring cross section photos to the as-built cross section photos strongly complemented these suggestions, as no concerns, problems, or negative trends were documented.

The pattern for all of the stream reaches was surveyed to measure the parameters of sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. The results of the pattern surveys are presented in Table VIII. The comparison of the baseline and Monitoring Year 1 stream pattern morphometric data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustment attributed to vegetation establishment and natural channel adjustments. This adjustment included slightly increasing radii of curvature, indicative of movement toward increased stream stability. These minor adjustments can be viewed through the overlays included in Appendix A.

Longitudinal profile surveys were conducted along each of the project stream reaches specified for annual monitoring surveys. The surveys were performed to measure the parameters of bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing. The results of the longitudinal profile surveys are presented in Table VIII. The comparison of the baseline and Monitoring Year 1 longitudinal profiles for each of the monitored project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches were experiencing the expected minor adjustment attributed to vegetation establishment and natural channel adjustments. This adjustment included deepening of pools. The comparison of the baseline and Monitoring Year 1 longitudinal profiles did not show excessive aggrading or degrading. Overlays can be found in Appendix E along with the raw data from both the baseline and Monitoring Year 1 conditions.

Modified Wolman pebble counts were repeated at each of the project stream reaches to classify the stream bed materials for comparison to the baseline conditions. The results of the pebble counts are presented in Table VIII while the raw data and overlays of the percent accumulation graphs can be viewed in Appendix E. Fluctuations in bed materials were expected to occur during the early years following construction. This expectation was observed in comparing the results of the baseline and Monitoring Year 1 pebble counts. Specifically, the bed material d50 and d84 for each of the stream reaches decreased. This trend may be observed during the five-year monitoring period. At this time it is believed that the original assumption that the stream bed materials would coarsen after restoration may have been incorrect. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. The monitoring results do suggest, however that on-site sediment supply from LWOC has been reduced as a result of the restoration. As noted earlier, the success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely continue to occur and several years may be needed to observe a consistent bed material.

Stream bank stability monitoring was not conducted, as this monitoring practice is scheduled to be performed using BEHI and sediment transport estimates during Monitoring Years 3 and 5. BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information will serve as baseline data for stream bank stability at LWOC and is presented in Table IX. The raw data for this table can be viewed in Appendix E.

Each of the eight crest gages were checked during the Monitoring Year 1 surveys to monitor hydrology at LWOC. Six of the eight crest gages recorded flood stages in excess of the bankfull stage. The two crest gages that did not record flood stages in excess of the bankfull stage were the crest gages at Reaches R2A and R2D. The crest gage at Reach R2A apparently did not record any evidence of a flood stage event, possibly due to problems with the cork or the gage itself. The crest gage at Reach R2D recorded a flood stage that was 0.26 feet below the bankfull stage. Each of the crest gages was reset after checking stage measurements, in order to record future events. Table X lists the information related to the verification of bankfull events at LWOC for Monitoring Year 1 while the raw data can be found in Appendix E. The evidence recorded by the crest gages indicated a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 1. This documentation of the first bankfull event at LWOC during the monitoring period suggests success with regards to hydrologic monitoring at LWOC.

Photo documentation and project-wide visual assessment were used to complement the other Monitoring Year 1 stream monitoring practices. Photos were taken from each of the original

11 permanent photo reference points. Three additional photo points (photo points 2.5Y1, 3.5Y1, and 8.5Y1) were also added to ensure that adequate photo documentation would be conducted within the monitoring limits of the project stream reaches. Photo point 2.5Y1 was added for Reach R2, photo point 3.5Y1 for Reach R2B, and photo point 8.5Y1 for Reach R1A. After installation, photos were taken at each of the three added photo points. Appendix C includes all of the described photos and provides comparison of the photos with the initial baseline photos taken from the 11 permanent photo reference points. The new photos taken at three additional photo points will serve as supplemental baseline condition photos and subsequent photos at these same locations will be compared in Monitoring Years 2 through 5. No stream problems were documented through the photo comparison process. A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas. Table XI presents the results of the project-wide visual assessment. The project-wide visual assessment revealed 12 specific stream problem areas. Each of these stream problem areas, including their description, location, and suspected cause, are listed in Table XII. The stream problem areas included eight in-stream structure failures and associated stream bank erosion, three areas of floodplain and adjacent stream bank erosion, and one area of stream bank erosion. Mulkey elected to promptly address all of the stream problem areas and conducted construction repairs of each in October 2008. The eight stream problem areas categorized as failures of in-stream structures and were determined to be caused by incorrect construction of the given in-stream structure. The failed in-stream structures included j-hook rock vanes and rock cross vanes. All eight of the structures and the associated areas of stream bank erosion were repaired. Several of the j-hook rock vanes were converted to rock vanes during the repairs to prevent future point bar erosion. The three stream problem areas categorized as floodplain and adjacent stream bank erosion were determined to be attributed to the incorrect installation of floodplain interceptors. All three of the eroded areas were repaired and floodplain interceptors were installed using both rock and log materials. The remaining stream problem area categorized as stream bank erosion was determined to be caused by a minor field adjustment made to the stream alignment in order to save an existing mature tree at the request of the landowner. This area of stream bank erosion was also repaired. The repairs to the all of the areas of eroded stream banks included re-grading, re-seeding with appropriate temporary and permanent seed, and re-installing coir fiber matting. Black willow (*Salix nigra*) and/or silky dogwood (*Cornus amomum*) live stakes were harvested on-site and were installed at the repaired stream banks. Please note that the results shown in Table XI were updated such that the repairs to the stream problem areas described above are included. Based on the results of the stream monitoring for Monitoring Year 1 at LWOC, as well as the subsequent corrective actions taken, Mulkey did not propose any additional recommendations or actions other than to proceed with the annual stream monitoring.

### 3.2.4 Stream Monitoring Results for Year 2 of 5

In mid-October and the beginning of November 2009, the stream monitoring for Monitoring Year 2 was conducted. The methodologies described in the Section 3.2.1 were used for the stream monitoring at LWOC for Monitoring Year 2. Detailed surveys were conducted along the project stream reaches specified to be surveyed for annual monitoring. The results of these surveys were compared to the previous data collected during prior monitoring periods, baseline conditions established through the as-built survey, and to the proposed design parameters calculated prior to construction.

All of the 13 cross sections were surveyed to measure the bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. The results of the cross section surveys are presented in Table VIII. Appendix D compares photos taken during Monitoring Year 2 with the initial baseline photos and the previous monitoring photos taken at each of the 13 cross sections. Appendix E provides an overlay of the Monitoring Year 2, the previous monitoring periods, and baseline conditions along with the raw data for each cross section. The comparison of Monitoring Year 2 to the previous surveys for stream dimension data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. Throughout all the cross sections, the bankfull cross sectional area and entrenchment ratios remained consistent indicating the channels were able to contain and convey all the flows experienced during Monitoring Year 2. However, the main channels R1 and R2 displayed typical signs of adjustment in their channel geometries. Both of these reaches have recently been impacted by beavers and some of these adjustments can be attributed to this recent development. In particular on R1, cross section 11 had a significant increase in the width to depth ratio due to the backwater of a downstream beaver dam causing the pool to experience siltation. On the other end, cross section 12 experienced the reverse because a beaver dam was located directly upstream and the cascading water created scour ultimately decreasing the width to depth ratio. Similarly, cross sections along R2 exhibited localized changes in channel geometries, some attributable to beaver activity and others to natural fluctuations, but all within the acceptable ranges of the design parameters. The one exception was cross section 1, with a width to depth ratio climbing up to 22 and the bankfull cross sectional area remaining consistent, a cursory analysis raised concern. However, the overlay of cross section 1 clearly demonstrated the channel developing opposing inner berms to better accommodate the low flow capacity. This effectively allowed the channel to deepen without creating a change in the cross sectional area causing the width to depth ratio to increase instead of decrease due to the derivation being based on the calculated value of mean depth. The results of the smaller tributaries R1A, R2A, R2B, and R2D consistently exhibited minor natural adjustments typical of stable C type streams. The comparisons of the Monitoring Year 2 overlays and cross sectional photos to the previous year's strongly substantiated these findings, as no concerns, problems, or negative trends were documented.

The pattern for all of the stream reaches was surveyed to measure the parameters of sinuosity, belt width, radii of curvature, meander wavelength, and meander width ratio. The results of the pattern surveys are presented in Table VIII. The comparison of the Year 2 monitoring data to previous year's stream pattern data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. The results showed that all of the reaches remained consistent to the design parameters with minor variations attributed to vegetation establishment, natural channel adjustments, and variance in measuring techniques. These minor variations can be viewed through the overlays included in Appendix A.

Longitudinal profile surveys were conducted along each of the project stream reaches specified for annual monitoring surveys. The surveys were performed to measure the parameters of bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing. The results of the longitudinal profile surveys are presented in Table VIII. In comparing the data collected from Monitoring Year 2 to the previously collected data, the results followed the previous analysis. All reaches showed acceptable minor variations in all parameters monitored. These variations are within the design tolerances and are attributable to vegetation establishment, natural channel adjustments, and variance in measuring techniques. Overall, none of the longitudinal profiles showed excessive aggrading or degrading. Overlays of the longitudinal profiles can be found in Appendix E.

Modified Wolman pebble counts were repeated at each of the project stream reaches to classify the stream bed materials and for comparison to the previous years' conditions. The results of the pebble counts are presented in Table VIII while the raw data and overlays of the percent accumulation graphs can be viewed in Appendix E. Fluctuations in bed materials were expected to occur during the early years following construction. Over time the expectation was for the stream to eventually coarsen, however, Monitoring Year 1 and Year 2 have shown the opposite to be true. Specifically, the bed material d50 and d84 for each of the stream reaches decreased. Therefore it is believed that the original assumption that the stream bed materials would coarsen after restoration may have been incorrect. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur. Nonetheless, the monitoring results do suggest on-site sediment supply from LWOC was reduced as a result of the restoration. As noted earlier, the success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely continue to occur and several years may be needed to observe a consistent bed material.

Stream bank stability monitoring was not conducted, as this monitoring practice is scheduled to be performed using BEHI and sediment transport estimates during Monitoring Years 3 and 5. BEHI information was collected during the existing condition surveys and sediment transport rates were subsequently developed. The resulting information will serve as baseline data for stream bank stability at LWOC and is presented in Table IX. The raw data for this table can be viewed in Appendix E.

Each of the eight crest gages were checked during the Monitoring Year 2 surveys to monitor hydrology at LWOC. Seven of the eight crest gages recorded flood stages in excess of the bankfull stage. The one crest gage that did not record a flood stage in excess of the bankfull stage was at Reach R2D. Although, the region has seen a significant drought, the site has received large quantities of rain this monitoring year. Additionally, the R2D reach has a constant flow of water throughout its course. The crest gage at Reach R2D recorded a flood stage that was 0.10 feet below the bankfull stage this monitoring year. This information coupled with the other seven gauges having recorded a bankfull event during this monitoring year suggested that Mulkey needs to recheck the R2D crest gage in 2010 for elevation discrepancies with regard to its zero elevation. All of the crest gages were reset after checking stage measurements, in order to record future events. Table X lists the information related to the verification of bankfull events at LWOC for Monitoring Year 2 while the raw data can be found in Appendix E. The evidence recorded by the crest gages indicated a storm event producing a stage in excess of the bankfull storm occurred at LWOC during Monitoring Year 2. This documented the second and final required bankfull event at LWOC and therefore demonstrated success with regards to hydrologic monitoring per Section 3.2.2.

Photo documentation and project-wide visual assessment were used to complement the other Monitoring Year 2 stream monitoring practices. Photos were taken from each of the 14 permanent photo reference points. Appendix C includes all of the described photos and provides comparison of the photos between the baseline conditions, Monitoring Year 1 and Monitoring Year 2 photos taken from the 14 permanent photo reference points. No stream problems were documented through the photo comparison process. A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas (Table XI). During the project-wide visual assessment, along with the other Monitoring Year 2 field work activities, Mulkey noticed a significant increase in beaver activity at the site. Specifically, beaver dams have been constructed along Reaches R1, R2 Upper, and R2 Lower in several locations. Please note that Table XI and Table XII have been updated to reflect these observations. Mulkey is currently coordinating with the USDA Wildlife Services under BMAP to have the beavers and beaver dams removed, as well as to have the site monitored for future beaver activity. Mulkey has also observed cattle intrusion into the fenced buffers at LWOC. Mulkey is working with the landowner to prevent future cattle trespass from occurring. Other field observations made during the Monitoring Year 2 include the observation of the apparent restoration of wetland hydrology adjacent to Reach R1A. The restoration of Reach R1A appears to have reconnected the stream to its historic floodplain, as well as raise the groundwater table in the buffer areas adjacent to the reach. These observations are evidenced by the increase of wetland vegetation species and the saturation of the soils in the buffer areas adjacent to Reach R1A. The waste treatment outfall located on R1 reach and emanating from the nearby school appears to be functioning extremely well. Vegetation around the outfall is growing rapidly and helping to create a highly stable secondary treatment area.

Based on the results of the stream monitoring for Monitoring Year 2 at LWOC, as well as the subsequent corrective actions being taken, Mulkey does not propose any additional recommendations or actions other than to proceed with the annual stream monitoring.

NCEEP expressed concerns regarding the fencing of the conservation easement at LWOC to Mulkey in a letter dated May 26, 2009. Mulkey responded to NCEEP in a June 1, 2009 letter, urging NCEEP to consider several key exceptions for this particular case. These exceptions are explained in the referenced June 1, 2009 letter. Mulkey awaits response from NCEEP regarding the July 2009 letter before further addressing the concerns raised by NCEEP.

### 3.2.5 Stream Monitoring Results for Year 3 of 5

In early November 2010, the stream monitoring for Monitoring Year 3 was conducted using the methodologies described above. Despite the site suffering a flood event from the remnants of a tropical storm, the overall stability of the six stream reaches has improved. The stream dimension, pattern, and profile remained consistent with the previous years' data and continue to remain within the tolerances of the design parameters which are explained in detail below. However the visual assessment did reveal areas of scour along the banks, benches, and terraces confined mostly to reach R1. Mulkey intends to repair these areas in early 2011 to ensure ample time for the project to recover. Nonetheless, per the monitoring guidance, the overall stability of LWOC is within acceptable tolerances.

LWOC experienced several storm events over the Year 3 monitoring period, the most extensive occurring from the remnants of a tropical storm occurring in late September of 2010. This event created storm flows well in excess of the bankfull stage evidenced by wrack lines along the terrace slopes. These lines were often above the measurable extent of the crest gages. In fact, the flows destroyed four of the eight crest gages across the site. The four destroyed crest gages existed on reaches which have achieved the two bankfull events in two separate years' hydrological monitoring success criteria. Overall, five of the six reaches on LWOC have achieved the hydrological success criteria for monitoring; therefore Mulkey intends to only continue monitoring R2D.

The visual assessment of LWOC supported the crest gage data with several areas of scour occurring along reach R1, vegetative matts being forced down, wrack lines along the terrace slopes, silt dispersed on the vegetation on the bench, deposition of sand/silt on the benches, and minor washing out of the fence. Most of this evidence can be viewed through the photo logs of the vegetation plots (Appendix B), photo points (Appendix C), and cross sections (Appendix D); however photos of the scour along R1 can be found in Appendix F as no existing photo points could capture the areas of concern. The scour occurred because back eddies were formed from the terrace slopes following the creek. In these areas the back eddies essentially drilled a hole in the bench and deposited the materials downstream. Areas of bank scour were located in the vicinity of these scour holes as heavy flows began re-entering the channel. There are also areas of scour around the structure tie-ins with the bench where unforeseen eddies began to develop downstream of structure arms. Due to the location of this disturbance occurring up on the bench or terraces, the monitoring does not reflect any instability from these areas of concern. Nonetheless, Mulkey perceived these areas of concern as detracting from the overall positive trends developing across LWOC and therefore intends to repair these areas in early 2011. The repairs will consist of a combination of grading and vegetative activities to minimize the effects of future excessive flows.

Contrary to the visual assessment, the comparison of the 13 cross sections to previous monitoring data indicated stability across the site (Appendix E). The cross sections along R2 (1-5) not only show signs of a stable channel, but they depict the expected tightening of the channel due to vegetation taking hold with aggradation along the banks occurring in all but 1 cross section. The cross section on R2A (6) also depicts this phenomenon while the cross sections for R1A (13), R2B (7) and R2D (8) show no significant change in shape or form. The cross sections along R1 (9-12) show slight variation in shape and form that is indicative of a recent excessive storm event. However, upon comparison of all cross sections with past monitoring data and design tolerances, every measured variable is either varying within the design tolerance or migrating back towards an acceptable value. Therefore in terms of channel dimension, LWOC has been determined to be stable and meeting all monitoring success criteria.

Similarly, the stream pattern for all reaches across LWOC portrayed a stable stream network. The meander length, belt width, and radius of curvature measurements for each reach remained within the design tolerances and showed no significant deviations from the previously collected monitoring data.

The longitudinal profiles, found in Appendix E, depicted slight variations in each stream reach. Reaches R1 and R2B were consistent with previously collected data while R2 and R2A displayed degradation and R1A and R2D aggradation. These differences can be attributed to the dynamic nature of the stream system coupled with the system experiencing an intense storm event. Typically, the bed materials would correlate and support stream bed fluctuation with aggrading streams displaying an influx of finer materials and vice versa for degrading streams. This correlation is displayed in R1A and R2D where the finer sediments upstream are being slowed by the vegetation and aggrading the channel. Similarly, R2 is displaying the correlation in reverse with the bed material coarsening while the bed degrades exposing the larger substrate materials. R1 has a consistent longitudinal profile and is beginning to coarsen indicating the reach still moving towards an equilibrium between stream power and sediment transport. R2A with degradation in the longitudinal profile and fining of the bed materials is still trying to accommodate the sediment supply exposed upstream during the construction process. R2B displayed consistent bed slope and bed form thus indicating a balance reached between stream power and sediment transport. Therefore all of the reaches except R2B are still showing the expected signs of stream fluctuation indicative of a system trying to establish equilibrium. None of the described trends are representative of trends toward instability, rather they depict the natural development of a young stream network striking a balance between stream power and sediment transport.

As detailed by the monitoring guidance, data was collected and analyzed for the Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBS) in an effort to quantify the sediment transport rate in tons/year for each reach in LWOC (See Table IX). The results of this process indicated a significant decrease across LWOC. Pre-construction data determined the sediment transport rate to be 1853 tons/year. Data collected in Monitoring Year 3 revealed a sediment transport rate of 342 tons/year or an 82% reduction in sediment in the system. Reach R1, the reach most affected by the storm event, showed a reduction in sediment transport from 455 tons/year to 189 tons/year or a 58% reduction. These individual reach trends and cumulative system wide trends show extremely positive results and are indicative of stream stability across the entire stream network at LWOC.

In the Spring of 2010, Mulkey relocated portions of the fence surrounding the easement around LWOC. This was performed at the request of NCEEP to ensure the entire easement was protected from cattle and to include the required 50 foot buffer established by the United States Army Corps of Engineers. The new fence locations have been incorporated and accurately depicted on the plan sheets found in Appendix B.

In conclusion, Mulkey has determined that all monitoring aspects have met the monitoring success criteria established for LWOC. Mulkey does intend to perform some minor corrections to LWOC in early 2011 so as not to detract from the overall success of the project. These corrections are minor in scope and do not affect the overall stability of LWOC. Given the overall success and the prior fence relocation, Mulkey does not recommend any action except to proceed with the annual stream monitoring.

### 3.2.6 Stream Monitoring Results for Year 4 of 5

During the early months of 2011, repairs were conducted on the floodplain benches and terraces of R1 and R2. These repairs involved reshaping portions of the benches and terraces, installation of live brush mattresses, temporary and permanent reseeding and the installation of erosion control matting. Following these improvements, bare root plants and live stake material were installed in areas impacted by the repair work.

During November 2011, the stream monitoring for Monitoring Year 4 was conducted using the methodologies described above. During initial site investigations, Mulkey noticed that beaver activity had returned to the R1 and R2 reaches. Since Mulkey is currently contracted with the USDA Animal and Plant Health Inspection Service (APHIS) Wildlife Services, it immediately notified them of the activity. Stream surveys of the R1, R2, and R2A reaches was challenging due to the increased water levels. These fluctuations are noticeable throughout the current years' data for these reaches. Immediately following our stream surveys, personnel from APHIS trapped beavers and removed their dams. Mulkey will continue to monitor the site for beaver activity and notify APHIS personnel as necessary.

All of the 13 cross sections were surveyed to measure the bankfull width, floodprone width, bankfull cross sectional area, bankfull mean depth, bankfull max depth, width to depth ratio, entrenchment ratio, wetted perimeter, and hydraulic radius. The results of the cross section surveys are presented in Table VIII. Appendix D compares photos taken during Monitoring Year 4 with all of the previous monitoring years at each of the 13 cross sections. Appendix E provides an overlay of the Monitoring Year 4, the previous monitoring periods, and baseline conditions along with the raw data for each cross section. The comparison of Monitoring Year 4 to the previous surveys for stream dimension data for each of the project stream reaches showed very positive results, all of which were comparable to the originally proposed design parameters. Throughout all the cross sections, the bankfull cross sectional area and entrenchment ratios remained consistent indicating the channels were able to contain and convey all the flows experienced during Monitoring Year 4. However, the main channels R1 and R2 displayed typical signs of adjustment in their channel geometries. Both of these reaches have recently been impacted by beavers and some of these adjustments can be attributed to this recent development. Cross section 12 located on the R1 reach is continuing to recover from scour associated with beaver dams in Year 2. The bankfull maximum depth for Cross Section 12 is continuing to decrease and move closer to the design parameters. Similarly, cross sections along R2 exhibited localized changes in channel geometries, some attributable to beaver activity and others to natural fluctuations, but all within the acceptable ranges of the design parameters. The only exception was Cross Section 1 which has a width to depth ratio of 20.4. After review of the previous years' cross sections, the bankfull width has remained constant but the bankfull maximum depth has fluctuated. The increased bankfull maximum depth is likely related to beaver activity and associated scour from cascading water. Since the site is under management for beaver activity by APHIS, the situation is currently being addressed. The results of the smaller tributaries R1A, R2A, R2B, and R2D consistently exhibited minor natural adjustments typical of stable C type streams. The comparisons of the Monitoring Year 4 overlays and cross sectional photos to the previous year's strongly substantiated these findings. No other concerns, problems, or negative trends were documented except the issues discussed above.

The pattern for all of the stream reaches was surveyed to measure the parameters of sinuosity, belt width, radius of curvature, meander wavelength, and meander width ratio. The results of the pattern surveys are presented in Table VIII. The comparison of the Year 4 monitoring data to previous years showed very little variation in the data, indicating stability. The results showed that all of the reaches remained consistent to the design parameters with minor variations attributed to vegetation establishment, natural channel adjustments, and variance in measuring techniques. These minor variations can be viewed through the overlays included in Appendix A.

Longitudinal profile surveys were conducted along each of the project stream reaches specified for annual monitoring surveys. The surveys were performed to measure the parameters of bankfull slope, riffle length, riffle slope, pool length, and pool to pool spacing. The results of the longitudinal profile surveys are presented in Table VIII. The longitudinal profiles, found in Appendix E, depicted slight variations in each stream reach. Some of these variations are the result of the beaver activity which was present during the November 2011 stream surveys. The beaver activity caused higher water and thalweg elevations between the areas with beaver dams. Beaver activity was confined to R1 and R2 but other reaches were impacted by the backed up water, particularly R2A. Each of these beaver activity areas are detailed in Table XII. In comparing the data collected from Monitoring Year 4 to the previously collected data, the results showed that reaches only experienced minor variations in all parameters monitored. These variations are within the design tolerances and are attributable to vegetation establishment, natural channel adjustments, and variance in measuring techniques. Overall, none of the longitudinal profiles showed excessive aggrading or degrading. Overlays of the longitudinal profiles can be found in Appendix E.

Modified Wolman pebble counts were repeated at each of the project stream reaches to classify the stream bed materials and for comparison to the previous years' conditions. The results of the pebble counts are presented in Table VIII while the raw data and overlays of the percent accumulation graphs can be viewed in Appendix E. Fluctuations in bed materials have stabilized and remained consistent on nearly all reaches. Reach R2A coarsened over the last year, which was expected according to the design parameters. The stream systems at LWOC appear to be sand-dominated and therefore coarsening of the bed may not occur on all reaches as expected. Nonetheless, the monitoring results do suggest on-site sediment supply from LWOC was reduced as a result of the restoration. As noted earlier, the success criteria for the bed material will be determined at the end of the five-year monitoring period when data can be reviewed and compared to the proposed channel material types. Fluctuations in bed materials will likely continue to occur and several years may be needed to observe a consistent bed material.

Data for the Bank Erosion Hazard Index (BEHI) and Near Bank Shear Stress (NBS) was not collected in Year 4 per the monitoring guidance. Data is scheduled to be collected again in Year 5. Data previously collected can be seen in Table IX.

Previously, five of the six reaches on LWOC had achieved the hydrological success criteria for monitoring; therefore Mulkey only monitored R2D in Year 4. Table X lists the information related to the verification of bankfull events at LWOC for Monitoring Year 4 while the raw data can be found in Appendix E. At the end of the Year 4 monitoring period, all reaches had achieved at least 2 bankfull events which demonstrates success with regards to hydrologic monitoring per Section 3.2.2.

A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas (Table XI). Photos were taken from each of the 14 permanent photo reference points. Appendix C includes all of these photos and provides comparison of the photos between the baseline conditions and all subsequent years of monitoring. No stream problems were documented through the photo comparison process. A project-wide visual assessment was conducted along each of the project stream reaches to identify any specific stream problem areas (Table XI). During the project-wide visual assessment, along with the other Monitoring Year 4 field work activities, Mulkey noticed a significant increase in beaver activity at the site. Specifically, beaver dams have been constructed along Reaches R1 and R2 Upper (above R1/R2 confluence). Please note that Table XI and Table XII have been updated to reflect these observations. As mentioned previously, Mulkey is currently contracting with APHIS Wildlife Services to monitor and to control the beavers at the site. Following stream surveys in November 2011, beavers were trapped and dams removed by the APHIS personnel.

Other field observations made during the Monitoring Year 4 include numerous whitetail deer bedded within the easement. This is primarily due to the suitable habitat created by the increased vegetation within the easement compared with the surrounding fields and woods. Additionally, during field investigations in March 2011, large quantities of macro-invertebrates were noted in the R2 reach. These macro-invertebrates primarily included caddisflies, stoneflies, and hellgrammites.

In conclusion, Mulkey has determined that all monitoring aspects have met the monitoring success criteria established for LWOC. The stream dimension, pattern, and profile have remained consistent across previous monitoring years. The majority of the data has remained within the design tolerances, which has resulted in stable C type stream channels throughout the past 4 years of monitoring. Based on the current stream monitoring results at LWOC, as well as the recent corrective actions taken, Mulkey does not propose any additional recommendations or actions other than to proceed with the annual stream monitoring.

## 4.0 Project Monitoring Methodology

Success criteria for stream mitigation sites are based on guidelines established by the USACE, US Environmental Protection Agency (USEPA), NC Wildlife Resources Commission (NCWRC) and the NCDWQ (USACE et. al, 2003). These guidelines establish criteria for monitoring both hydrologic conditions and vegetation survival. These same guidelines were used to develop the monitoring methods, frequencies, and success criteria discussed herein for LWOC and further described in detail in the approved mitigation report (Mulkey Engineers and Consultants, 2008). LWOC site conditions will be monitored annually during the latter part of the growing season months (August, September, and October) over the five-year monitoring period. This monitoring period complies with the requirements set forth in the Full Delivery RFP 16-D06027. Monitoring results will be documented on an annual basis, with the associated reports submitted to the NCEEP as evidence that the established project goals and objectives are being achieved. The results of annual monitoring will be used to evaluate the degree of success LWOC has achieved in meeting the said goals and objectives. In the event that goals are not being met, Mulkey will coordinate with the NCEEP to develop a plan for ameliorating the areas of concern.

## 5.0 References

Mulkey Engineers and Consultants. 2008. Little White Oak Creek Stream Restoration Mitigation Report. August 2008.

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

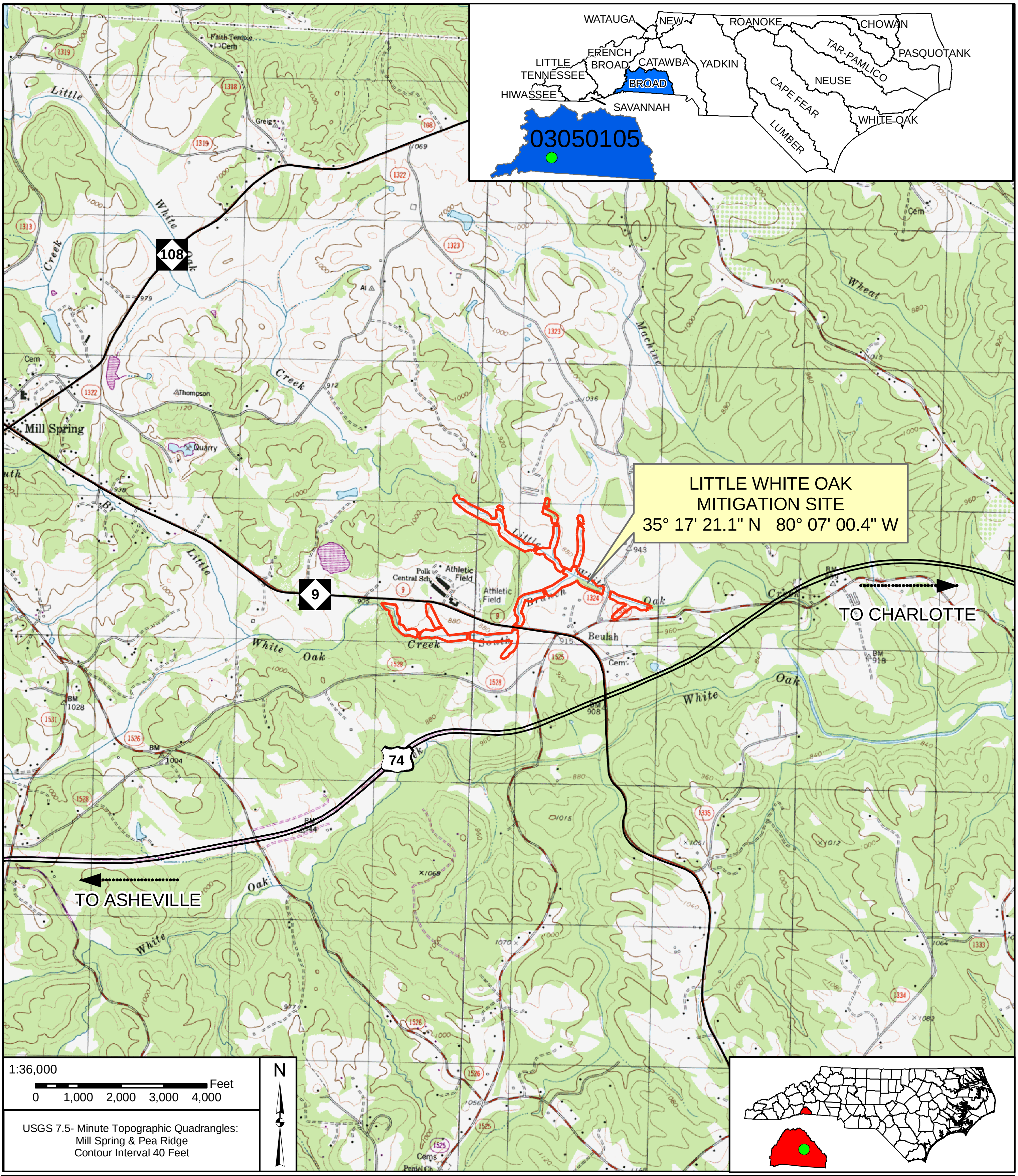
Rosgen, D.L. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

Rosgen, D.L. 1998. The Reference Reach – A Blueprint for Natural Channel Design. From Proceedings of the Wetlands and Restoration Conference, March 1998, Denver CO. Wildland Hydrology, Pagosa Springs, CO.

Schafale, M.P. and A.S. Weakley. 1990. Classification of the Natural Communities of North Carolina, Third Approximation. North Carolina Natural Heritage Program, Division of Parks and Recreation, N.C. Department of Environment, Health and Natural Resources.

USACE, USEPA, NCWRC, and NCDWQ. 2003. Stream Mitigation Guidelines. April 2003.

# Figures




# LOCATION MAP

## LITTLE WHITE OAK STREAM RESTORATION

POLK COUNTY, NORTH CAROLINA

March 20, 2008

Ecosystem Enhancement Program

MULKEY ENGINEERS & CONSULTANTS

PROJECT NO. D06027-B

**Figure**

**1**

# Tables

| Table I. Project Restoration Approach and Mitigation Type<br>Little White Oak Creek Stream Restoration / D06027-B | | | | | |
|---|---|---|---|---|---|
| **Stream Reach ID** | **Restoration Approach** | **Mitigation Type** | **Linear Footage** | **Stationing** | **Comments** |
| R1 | P2 | R | 7,543 | 0+00 – 75+43 | Channel relocation with floodplain excavation |
| R1A | P1/P2 | R | 1,040 | 0+00 – 10+40 | Includes 850 feet of P1 and 190 feet of P2 channel relocation |
| R2 (Upper and Lower) | P2 | R | 7,107 | 0+00 – 71+07 | Channel relocation with floodplain excavation |
| R2A | P2 | R | 336 | 0+00 – 3+36 | Channel relocation with floodplain excavation |
| R2B | P1/P2 | R | 1,474 | 0+00 – 14+74 | Includes 250 feet of P1 and 1224 feet of P2 channel relocation |
| R2D | P1/P2 | R | 790 | 0+00 – 7+90 | Includes 100 feet of P1 and 690 feet of P2 channel relocation |

| | |
|---|---|
| R = Restoration | P1 = Priority I |
| EI = Enhancement I | P2 = Priority II |
| EII = Enhancement II | P3 = Priority III |
| S = Stabilization | SS = Stream Banks Stabilization |

| Table II. Project Activity and Reporting History<br>Little White Oak Creek Stream Restoration / D06027-B | | | |
|---|---|---|---|
| **Activity or Report** | **Scheduled Completion** | **Data Collection Completion** | **Actual Completion or Delivery** |
| Restoration Plan Prepared | Oct-06 | Aug-06 | 12-Feb-07 |
| Restoration Plan Approved | Nov-06 | N/A | 30-Mar-07 |
| Final Design - 90% | Dec-06 | N/A | 16-May-07 |
| Construction | Jun-07 | N/A | 13-Nov-07 |
| Temporary S&E mix applied to entire project area | Jun-07 | N/A | 13-Nov-07 |
| Permanent seed mix applied to entire project area | Jun-07 | N/A | 13-Nov-07 |
| Planting live stakes | Dec-07 | N/A | 11-Jan-08 |
| Planting bare roots | Dec-07 | N/A | 11-Jan-08 |
| End of Construction | Dec-07 | N/A | 11-Jan-08 |
| Survey of As-built conditions (Year 0 Monitoring - Baseline) | Jan-08 | Jan-08 | 9-Jan-08 |
| Monitoring | | | |
| Year 1 - 2008 | Dec-08 | Sep-08 | Dec-08 |
| Year 2 - 2009 | Dec-09 | Oct-09 | Dec-09 |
| Year 3 - 2010 | Dec-10 | Nov-10 | Dec-10 |
| Year 4 - 2011 | Dec-11 | Oct - Nov 11 | Jan-12 |
| Year 5 - 2012 | Dec-12 | N/A | N/A |

Bolded items represent those events or deliverables that are variable. Non-bolded items represent events that are standard components over the course of a typical project.

| Table III. Project Contacts<br>Little White Oak Creek Stream Restoration / D06027-B | |
|---|---|
| **Designer** | |
| Mulkey Engineers<br>and Consultants | 6750 Tryon Road<br>Cary, NC 27518<br>Contact:<br>Emmett Perdue, PE Tel. 919.858.1874 |
| **Construction Contractor** | |
| Vaughan Contracting, LLC | P.O. Box 796<br>Wadesboro, NC 28170<br>Contact:<br>Tommy Vaughan Tel. 704.694.6450 |
| **Planting Coordinator** | |
| Bruton Nurseries and Landscapes | 150 Black Creek Road<br>Fremont, NC 27830<br>Contact:<br>Charles Bruton, Jr. Tel. 919.242.6555 |
| **Seeding Contractor** | |
| Vaughan Contracting, LLC | P.O. Box 796<br>Wadesboro, NC 28170<br>Contact:<br>Tommy Vaughan Tel. 704.694.6450 |
| **Seed Mix Sources** | |
| Evergreen Seed | P.O. Box 669<br>Willow Spring, NC 27592<br>Contact:<br>Wister Heald Tel. 919.567.1333 |
| **Nursery Stock Suppliers** | |
| International Paper<br>South Carolina SuperTree Nursery | 5594 Highway 38 South<br>Blenheim, SC 29516<br>Contact:<br>Geoffrey Hill Tel. 803.528.3203 |
| North Carolina Forestry Service<br>Claridge Nursery | 762 Claridge Nursery Road<br>Goldsboro, NC 27530<br>Contact:<br>James West Tel. 919.731.7988 |
| **Monitoring Performers** | |
| Mulkey Engineers<br>and Consultants | 6750 Tryon Road<br>Cary, NC 27518<br>Contact:<br>Emmett Perdue Tel. 919.858.1874 |

| **Table IV. Project Background<br>Little White Oak Creek Stream Restoration / D06027-B** | |
|---|---|
| Project County | Polk County, North Carolina |
| Drainage Area [sq. mi(acres)] | |
| R1 | 4.46 (2854) |
| R1A | 0.11 (70) |
| R2 | 10.85 (6944) |
| R2A | 0.54 (355) |
| R2B | 0.12 (77) |
| R2D | 0.05 (32) |
| Drainage Impervious cover estimate (%) | |
| R1 | 2 |
| R1A | 2 |
| R2 | 2 |
| R2A | 2 |
| R2B | 2 |
| R2D | 2 |
| Stream Order | |
| R1 | 3 |
| R1A | 1 |
| R2 | 3,4 |
| R2A | 2 |
| R2B | 1 |
| R2D | 1 |
| Physiographic Region | Piedmont |
| Ecoregion | Southern Inner Piedmont |
| Rosgen Classification (As-built) | |
| R1, R1A, R2 | C5 |
| R2A, R2B | C4 |
| R2D | C6 |
| Cowardin Classification | R3UB2* |
| Dominat Soil Types | Riverview-Chewacla-Buncombe |
| Reference Site ID | UT to Ostin Creek |
| USGS HUC for Project and Reference | |
| Project | 03050105 |
| Reference | 03050105 |
| NCDWQ Sub-basin for Project and Reference | |
| Project | 03-08-02 (Broad) |
| Reference | 03-08-03 (Borad) |
| NCDWQ Classification for Project and Reference | |
| Project | C |
| Reference | C,Tr |
| Any portion of any project segement 303d? | No |
| Any portion of any project segement upstream of a 303d listed segment? | No |
| Reasons for 303d listing or stressor | N/A |
| Percent of project easement fenced | 100 |

*(R) Riverine (3) Upper Perennial (UB) Unconsolidated Bottom (2) Sand

**Table V. Stem Counts Monitoring Year 4 for Each Species Arranged by Plot**
**Little White Oak Creek Stream Restoration / D06027-B**

| 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 | 24 | Year 0 Totals | Year 0 Totals (Adjusted) [A] | Year 1 Totals | Year 2 Totals | Year 3 Totals | Year 4 Totals | Survival % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Shrubs** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cephalanthus occidentalis* | | | | | | | | | | | | | | | | 1 | | | 1 | | | | | | 9 | 9 | 8 | 7 | 4 | 2 | 22% |
| *Cornus amomum* | | | | | | | 4 | 2 | | 1 | | 1 | | 3 | | | | | | | | | | | 15 | 18 | 18 | 18 | 12 | 11 | 61% |
| *Sambucus canadensis* | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 2 | 0 | 0 | 0 | 0% |
| **Trees** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Betula nigra* | 1 | 8 | | | | 2 | 5 | 5 | | 1 | | | | 2 | | | | 2 | | 2 | | | 6 | | 41 | 40 | 37 | 35 | 33 | 34 | 85% |
| *Cornus florida* | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | | 2 | 2 | 2 | 2 | 2 | 2 | 100% |
| *Corylus americana* | | | | | | | | | | | | | | 1 | | | | | | | | | | | 17 | 5 | 4 | 3 | 1 | 1 | 20% |
| *Diospyros virginiana* | | | | | | | | | | | 3 | 1 | | | | | 2 | | | | | | | 8 | 19 | 19 | 16 | 17 | 14 | 14 | 74% |
| *Fraxinus pennsylvanica* | | | | | | | | 3 | | 2 | | | 7 | 1 | | | | 4 | 2 | | | 6 | 1 | | 37 | 35 | 35 | 31 | 24 | 26 | 74% |
| *Juglans nigra* | | | 2 | | | | | | | | 1 | | | | | | | | | | 1 | | | 2 | 7 | 7 | 6 | 6 | 6 | 6 | 86% |
| *Pinus echinata* | | | 2 | 1 | 1 | | | | 1 | | | 1 | | | 1 | | 2 | | | | | | | | 28 | 26 | 15 | 11 | 8 | 9 | 35% |
| *Pinus strobus* | | | | | | | | | 2 | | 1 | | | | 4 | | | | | | | | | 2 | 20 | 21 | 18 | 11 | 8 | 9 | 43% |
| *Pinus virginiana* | | | | | 2 | | | | 3 | | | | | | 1 | | | | | | | | | | 12 | 13 | 9 | 8 | 7 | 6 | 46% |
| *Prunus serotina* | | | 1 | | 2 | | | | | | 1 | 1 | | | 1 | | | | | | 1 | | | | 6 | 7 | 7 | 7 | 7 | 7 | 100% |
| *Plantanus occidentalis* | | | | | | | 2 | 2 | | 5 | | 7 | | | | 4 | | 2 | 5 | 16 | | | 1 | | 45 | 45 | 45 | 45 | 44 | 44 | 98% |
| *Quercus alba* | | | 5 | 7 | 3 | | | | 3 | | 1 | 1 | | 1 | 1 | | 9 | | 1 | | 1 | | | 7 | 35 | 43 | 39 | 41 | 38 | 40 | 93% |
| *Quercus falcata* | | | | | | | | | 2 | 1 | 5 | | | | 6 | | 1 | | | | 7 | | | | 41 | 36 | 30 | 28 | 24 | 22 | 61% |
| *Quercus michauxii* | 7 | 2 | | | | | | | | 1 | | | 4 | 2 | | 3 | | 1 | | 4 | | 4 | 3 | | 47 | 46 | 45 | 40 | 30 | 31 | 67% |
| *Quercus nigra* | 8 | | | | 1 | 8 | | | | | | | | | | | | | | | | | | | 34 | 23 | 21 | 21 | 17 | 17 | 74% |
| *Quercus phellos* | 2 | 2 | | | 1 | 5 | | | | | | | | | | | | | | | | | | | 9 | 19 | 19 | 19 | 10 | 10 | 53% |
| *Salix nigra* | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | 1 | 0 | 0 | 0% |
| *Ulmus americana* | | | | | | | | 3 | | 4 | | | | 1 | | 4 | | 3 | 9 | | | 8 | 2 | | 26 | 43 | 42 | 41 | 38 | 34 | 79% |
| Totals | 18 | 12 | 10 | 8 | 10 | 15 | 11 | 15 | 11 | 15 | 12 | 12 | 11 | 11 | 15 | 12 | 14 | 12 | 18 | 22 | 11 | 18 | 13 | 19 | 453 | 460 | 419 | 392 | 327 | 325 | 71% |

| Stems/Acre | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Min | Ave | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year 0 | 996 | 823 | 735 | 653 | 741 | 950 | 748 | 763 | 683 | 694 | 656 | 705 | 795 | 615 | 850 | 868 | 757 | 518 | 854 | 1000 | 645 | 924 | 776 | 939 | 518 | 779 | 1000 |
| Year 1 | 996 | 823 | 571 | 571 | 576 | 826 | 709 | 763 | 562 | 694 | 615 | 581 | 795 | 615 | 729 | 826 | 598 | 438 | 813 | 1000 | 484 | 924 | 776 | 816 | 438 | 713 | 1000 |
| Year 2 | 996 | 823 | 490 | 367 | 535 | 744 | 669 | 643 | 522 | 694 | 615 | 581 | 711 | 615 | 729 | 702 | 558 | 438 | 772 | 1000 | 444 | 843 | 776 | 776 | 367 | 668 | 1000 |
| Year 3 | 747 | 563 | 408 | 327 | 453 | 620 | 433 | 602 | 442 | 612 | 492 | 539 | 460 | 451 | 607 | 537 | 518 | 438 | 732 | 917 | 444 | 723 | 612 | 694 | 327 | 557 | 917 |
| Year 4 | 747 | 519 | 408 | 327 | 412 | 620 | 433 | 602 | 442 | 612 | 492 | 498 | 460 | 451 | 607 | 496 | 558 | 478 | 732 | 917 | 444 | 723 | 531 | 776 | 327 | 553 | 917 |
| Plot Acreage | 0.024 | 0.023 | 0.025 | 0.025 | 0.024 | 0.024 | 0.025 | 0.025 | 0.025 | 0.025 | 0.024 | 0.024 | 0.024 | 0.024 | 0.025 | 0.024 | 0.025 | 0.025 | 0.025 | 0.024 | 0.025 | 0.025 | 0.025 | 0.025 | | | |

Notes: [A] Year 0 Totals (Adjusted) represents the most accurate species occurrence, following corrections for misidentification and other issues during the initial counting process.

| Table VI. Vegetative Problem Areas<br>Little White Oak Creek Stream Restoration / D06027-B | | | |
|---|---|---|---|
| **Feature/Issue** | **Station / Range** | **Probable Cause** | **Photo No. (If Available)** |
| No vegetative problem areas observed (Year 1, 2008) | All project reaches | N/A | N/A |
| No vegetative problem areas observed (Year 2, 2009) | All project reaches | N/A | N/A |
| No vegetative problem areas observed (Year 3, 2010) | All project reaches | N/A | N/A |
| No vegetative problem areas observed (Year 4, 2011) | All project reaches | N/A | N/A |
| | | | |
| | | | |
| | | | |

**Table VII. Baseline Morphology and Hydraulic Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R1 (7543 ft)**

| **PARAMETERS** | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension - Riffle** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | 15 | 43 | 25 | 16.6 | 20.3 | 18.4 | 16.0 | 20.6 | 18.5 | -- | -- | 25.7 | 22.9 | 24.1 | 23.5 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 69.6 | 118.6 | 94.1 | 67.2 | 72.8 | 67.2 | 90.8 | 113.6 | 98.4 | 73.5 | 79.5 | 76.5 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | 30 | 110 | 60 | 52.9 | 69.7 | 61.3 | 27.4 | 33.4 | 30.3 | -- | -- | 52.0 | 39.5 | 49.1 | 44.3 |
| BKF Mean Depth (ft) | -- | -- | -- | 1.5 | 3.8 | 2.5 | 3.20 | 3.43 | 3.32 | 1.57 | 1.72 | 1.64 | -- | -- | 2.02 | 1.6 | 2.1 | 1.89 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 2.37 | 5.00 | 3.69 | 1.54 | 2.36 | 1.90 | 1.90 | 2.91 | 2.34 | 2.8 | 3.0 | 2.89 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 5.2 | 5.9 | 5.6 | 9.3 | 12.7 | 11.3 | -- | -- | 12.7 | 10.7 | 14.7 | 12.7 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 4.2 | 5.8 | 5.0 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | 3.2 | 3.3 | 3.3 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 25.4 | -- | -- | 20.8 | -- | -- | 29.7 | 24.3 | 25.2 | 24.7 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 2.8 | -- | -- | 1.4 | -- | -- | 1.8 | 1.57 | 2.03 | 1.8 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | 22.0 | 61.6 | 39.8 | 36.0 | 150.0 | 67.0 | 77.1 | 208.1 | 92.9 | 40.6 | 135.8 | 87.7 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | 23.4 | 63.8 | 37.7 | 19.0 | 115.0 | 49.0 | 38.5 | 159.5 | 68.0 | 35.5 | 108.4 | 58.1 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | 107.0 | 189.3 | 135.7 | 33.0 | 155.0 | 94.0 | 45.8 | 215.0 | 130.4 | 178.0 | 258.9 | 210.9 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | 1.2 | 3.3 | 2.2 | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 1.7 | 5.8 | 3.7 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 14.3 | 43.1 | 27.5 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | 0.001 | 0.117 | 0.010 | 0.006 | 0.066 | 0.028 | 0.002 | 0.021 | 0.009 | 0.003 | 0.027 | 0.010 |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | 11.4 | 87.9 | 39.3 | 18.3 | 62.9 | 35.1 | 25.4 | 87.2 | 48.7 | 22.4 | 53.7 | 40.7 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | 50.6 | 402.6 | 140.9 | 50.3 | 105.8 | 78.9 | 69.8 | 146.8 | 109.4 | 113.3 | 323.8 | 193.5 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | -- | | | -- | | | 0.22 | | | 3.00 | | | 0.22 | | | 0.5 | | |
| d84 (mm) | -- | | | -- | | | 12.2 | | | 105.54 | | | 12.2 | | | 4.4 | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | -- | | | -- | | | 0.0028 | | | 0.0090 | | | 0.0028 | | | 0.0025 | | |
| Channel Length(ft) | -- | | | -- | | | 6530 | | | 590 | | | 7643 | | | 7543 | | |
| Valley Length (ft) | -- | | | -- | | | 5717 | | | 404 | | | 5717 | | | 5717 | | |
| Sinuosity | -- | | | -- | | | 1.14 | | | 1.46 | | | 1.34 | | | 1.32 | | |
| Rosgen Classification | -- | | | -- | | | Degraded E5 | | | C4/1 | | | C5 | | | C5 | | |

**Table VII. cont. Baseline Morphology and Hydraulic Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R1A (1040 ft)**

| **PARAMETERS** | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | 6 | 21 | 12 | 4.5 | 10.9 | 7.7 | 16.0 | 20.6 | 18.5 | -- | -- | 8.0 | -- | -- | 7.8 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 8.6 | 19.1 | 13.8 | 67.2 | 72.8 | 67.2 | 28.2 | 35.2 | 30.5 | -- | -- | 125.0 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | 9 | 37 | 19 | 1.6 | 5.9 | 3.7 | 27.4 | 33.4 | 30.3 | -- | -- | 5.0 | -- | -- | 3.5 |
| BKF Mean Depth (ft) | -- | -- | -- | 0.9 | 2.1 | 1.6 | 0.36 | 0.54 | 0.45 | 1.57 | 1.72 | 1.64 | -- | -- | 0.63 | -- | -- | 0.45 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 0.54 | 1.18 | 0.86 | 1.54 | 2.36 | 1.90 | 0.59 | 0.90 | 0.73 | -- | -- | 0.79 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 12.5 | 20.2 | 16.4 | 9.3 | 12.7 | 11.3 | -- | -- | 12.7 | -- | -- | 17.2 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 1.7 | 1.9 | 1.8 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | -- | -- | 16.1 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 4.7 | -- | -- | 20.8 | -- | -- | 9.3 | -- | -- | 8.1 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 0.3 | -- | -- | 1.4 | -- | -- | 0.5 | -- | -- | 0.4 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 36.0 | 150.0 | 67.0 | 23.8 | 64.5 | 28.8 | 16.4 | 39.7 | 24.4 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 19.0 | 115.0 | 49.0 | 12.0 | 49.5 | 21.1 | 10.0 | 21.0 | 14.7 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 33.0 | 155.0 | 94.0 | 14.2 | 66.7 | 40.4 | 61.5 | 85.7 | 68.8 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 2.1 | 5.1 | 3.1 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 8.0 | 26.0 | 14.5 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.006 | 0.066 | 0.028 | 0.007 | 0.070 | 0.030 | 0.004 | 0.046 | 0.019 |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 18.3 | 62.9 | 35.1 | 7.9 | 27.1 | 15.1 | 7.5 | 30.7 | 18.5 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 50.3 | 105.8 | 78.9 | 21.6 | 45.5 | 33.9 | 15.0 | 52.3 | 32.0 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | -- | | | -- | | | 0.04 | | | 3 | | | 0.04 | | | 0.28 | | |
| d84 (mm) | -- | | | -- | | | 8.09 | | | 105 | | | 8.09 | | | 1 | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | -- | | | -- | | | 0.0122 | | | 0.0090 | | | 0.0096 | | | 0.0115 | | |
| Channel Length(ft) | -- | | | -- | | | 906 | | | 590 | | | 1225 | | | 1040 | | |
| Valley Length (ft) | -- | | | -- | | | 854 | | | 404 | | | 854 | | | 854 | | |
| Sinuosity | -- | | | -- | | | 1.06 | | | 1.46 | | | 1.43 | | | 1.22 | | |
| Rosgen Classification | -- | | | -- | | | Degraded B6c | | | C4/1 | | | C5 | | | C5 | | |

**Table VII. cont. Baseline Morphology and Hydraulic Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2 (7107 ft)**

| **PARAMETERS** | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | 18 | 50 | 29 | 24.3 | 24.5 | 24.4 | 16.0 | 20.6 | 18.5 | -- | -- | 31.1 | 26.7 | 33.1 | 30.2 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 77.1 | 251.0 | 164.0 | 67.2 | 72.8 | 67.2 | 109.8 | 137.4 | 119.0 | 92.0 | 120.0 | 108.1 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | 40 | 150 | 85 | 76.1 | 76.7 | 76.4 | 27.4 | 33.4 | 30.3 | -- | -- | 76.0 | 61.9 | 73.5 | 66.0 |
| BKF Mean Depth (ft) | -- | -- | -- | 1.8 | 4 | 2.9 | 3.13 | 3.14 | 3.14 | 1.57 | 1.72 | 1.64 | -- | -- | 2.45 | 1.89 | 2.38 | 2.20 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 3.61 | 4.94 | 4.10 | 1.54 | 2.36 | 1.90 | 2.30 | 3.52 | 2.83 | 2.95 | 4.40 | 3.68 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 7.7 | 7.8 | 7.8 | 9.3 | 12.7 | 11.3 | -- | -- | 12.7 | 11.5 | 17.5 | 14.0 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 3.1 | 10.3 | 6.7 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | 2.8 | 4.5 | 3.6 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 28.0 | -- | -- | 20.8 | -- | -- | 35.9 | 28.0 | 34.0 | 31.5 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 2.7 | -- | -- | 1.4 | -- | -- | 2.1 | 1.8 | 2.3 | 2.1 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | 15.2 | 48.7 | 32.8 | 36.0 | 150.0 | 67.0 | 60.4 | 251.6 | 112.4 | 40.6 | 169.2 | 105.1 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | 19.7 | 124.4 | 45.8 | 19.0 | 115.0 | 49.0 | 31.9 | 192.9 | 82.2 | 38.1 | 155.1 | 61.8 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | 85.8 | 165.1 | 118.2 | 33.0 | 155.0 | 94.0 | 55.4 | 260.0 | 157.7 | 179.3 | 296.1 | 248.4 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | 3.5 | 6.8 | 4.9 | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 1.3 | 5.6 | 3.5 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 23.6 | 66.1 | 44.2 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | 0.001 | 0.008 | 0.003 | 0.006 | 0.066 | 0.028 | 0.001 | 0.014 | 0.006 | 0.001 | 0.002 | 0.001 |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | 8.5 | 137.1 | 42.0 | 18.3 | 62.9 | 35.1 | 30.8 | 105.5 | 58.9 | 18.9 | 84.9 | 52.3 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | 38.7 | 442.4 | 205.7 | 50.3 | 105.8 | 78.9 | 84.4 | 177.5 | 132.3 | 132.2 | 264.4 | 183.0 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | -- | | | -- | | | 0.82 | | | 3 | | | 0.82 | | | 0.6 | | |
| d84 (mm) | -- | | | -- | | | 5.44 | | | 105 | | | 5.44 | | | 4.7 | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | -- | | | -- | | | 0.0021 | | | 0.0090 | | | 0.0019 | | | 0.0017 | | |
| Channel Length(ft) | -- | | | -- | | | 5978 | | | 590 | | | 7337 | | | 7107 | | |
| Valley Length (ft) | -- | | | -- | | | 5255 | | | 404 | | | 5255 | | | 5255 | | |
| Sinuosity | -- | | | -- | | | 1.14 | | | 1.46 | | | 1.40 | | | 1.35 | | |
| Rosgen Classification | -- | | | -- | | | Degraded E5 | | | C4/1 | | | C5 | | | C5 | | |

**Table VII. cont. Baseline Morphology and Hydraulic Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2A (336 ft)**

| PARAMETERS | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | 5.5 | 20 | 11 | 11.2 | 11.2 | 11.2 | 16.0 | 20.6 | 18.5 | -- | -- | 11.7 | -- | -- | 13.9 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 16.0 | 19.1 | 17.5 | 67.2 | 72.8 | 67.2 | 42.4 | 51.9 | 44.9 | -- | -- | 40.5 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | 6.5 | 28 | 16 | 10.8 | 16.8 | 13.8 | 27.4 | 33.4 | 30.3 | -- | -- | 11.0 | -- | -- | 15.8 |
| BKF Mean Depth (ft) | -- | -- | -- | 0.65 | 1.9 | 1.3 | 0.97 | 1.50 | 1.24 | 1.57 | 1.72 | 1.64 | -- | -- | 0.94 | -- | -- | 1.14 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 0.95 | 2.23 | 1.48 | 1.54 | 2.36 | 1.90 | 0.88 | 1.35 | 1.09 | -- | -- | 1.80 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 7.5 | 11.5 | 9.5 | 9.3 | 12.7 | 11.3 | -- | -- | 12.5 | -- | -- | 12.2 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 1.4 | 1.7 | 1.6 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.7 | -- | -- | 2.9 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 13.2 | -- | -- | 20.8 | -- | -- | 13.6 | -- | -- | 14.7 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 1.3 | -- | -- | 1.4 | -- | -- | 0.8 | -- | -- | 1.1 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | 20.2 | 20.2 | 20.2 | 36.0 | 150.0 | 67.0 | 22.8 | 95.0 | 42.4 | 32.2 | 49.3 | 40.0 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | 8.8 | 31.4 | 21.1 | 19.0 | 115.0 | 49.0 | 12.0 | 72.8 | 31.0 | 17.6 | 27.2 | 22.9 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | 76.7 | 76.7 | 76.7 | 33.0 | 155.0 | 94.0 | 20.9 | 98.1 | 59.5 | 99.4 | 107.1 | 102.9 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | 1.8 | 1.8 | 1.8 | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 2.3 | 3.6 | 2.9 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5.8 | 46.8 | 23.1 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | 0.004 | 0.024 | 0.011 | 0.006 | 0.066 | 0.028 | 0.006 | 0.066 | 0.029 | 0.011 | 0.131 | 0.046 |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | 17.2 | 65.4 | 31.8 | 18.3 | 62.9 | 35.1 | 11.6 | 39.8 | 22.2 | 16.6 | 42.1 | 29.5 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | 83.1 | 165.7 | 113.2 | 50.3 | 105.8 | 78.9 | 31.8 | 67.0 | 49.9 | 61.7 | 72.9 | 65.7 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | -- | | | -- | | | 5.93 | | | 3 | | | 5.93 | | | 0.5 | | |
| d84 (mm) | -- | | | -- | | | 24.88 | | | 105 | | | 24.88 | | | 27.5 | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | -- | | | -- | | | 0.0107 | | | 0.0090 | | | 0.0091 | | | 0.0150 | | |
| Channel Length(ft) | -- | | | -- | | | 377 | | | 590 | | | 379 | | | 336 | | |
| Valley Length (ft) | -- | | | -- | | | 319 | | | 404 | | | 246 | | | 246 | | |
| Sinuosity | -- | | | -- | | | 1.18 | | | 1.46 | | | 1.54 | | | 1.36 | | |
| Rosgen Classification | -- | | | -- | | | Degraded E4 | | | C4/1 | | | C4 | | | C5 | | |

**Table VII. cont. Baseline Morphology and Hydraulic Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2B (1474 ft)**

| PARAMETERS | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | 3 | 11 | 6 | 4.5 | 6.4 | 5.5 | 16.0 | 20.6 | 18.5 | -- | -- | 8.0 | 8.8 | 8.9 | 8.8 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 5.4 | 195.3 | 100.4 | 67.2 | 72.8 | 67.2 | 28.2 | 35.2 | 30.5 | 26.0 | 75.0 | 49.1 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | 2 | 9 | 4.5 | 5.9 | 8.7 | 7.3 | 27.4 | 33.4 | 30.3 | -- | -- | 5.0 | 4.9 | 8.7 | 6.3 |
| BKF Mean Depth (ft) | -- | -- | -- | 0.45 | 1.2 | 0.8 | 1.31 | 1.35 | 1.33 | 1.57 | 1.72 | 1.64 | -- | -- | 0.63 | 0.56 | 0.98 | 0.72 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 1.70 | 1.80 | 1.75 | 1.54 | 2.36 | 1.90 | 0.59 | 0.90 | 0.73 | 0.93 | 1.48 | 1.13 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 3.4 | 4.8 | 4.1 | 9.3 | 12.7 | 11.3 | -- | -- | 12.7 | 9.0 | 15.7 | 13.0 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 1.2 | 30.3 | 15.8 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | 3.0 | 8.5 | 5.6 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 6.4 | -- | -- | 20.8 | -- | -- | 9.3 | 9.1 | 9.7 | 9.3 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | 0.9 | -- | -- | 1.4 | -- | -- | 0.5 | 0.5 | 0.9 | 0.7 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 36.0 | 150.0 | 67.0 | 15.5 | 64.5 | 28.8 | 8.0 | 37.1 | 22.6 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 19.0 | 115.0 | 49.0 | 8.2 | 49.5 | 21.1 | 7.9 | 31.0 | 15.3 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 33.0 | 155.0 | 94.0 | 14.2 | 66.7 | 40.4 | 56.1 | 70.8 | 63.6 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 0.9 | 4.2 | 2.6 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 5.7 | 17.0 | 10.1 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.006 | 0.066 | 0.028 | 0.008 | 0.083 | 0.036 | -- | -- | -- |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 18.3 | 62.9 | 35.1 | 7.9 | 27.1 | 15.1 | 10.5 | 31.5 | 16.6 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 50.3 | 105.8 | 78.9 | 21.6 | 45.5 | 33.9 | 15.5 | 105.3 | 35.6 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | | -- | | | -- | | | 0.15 | | | 3 | | | 0.15 | | | 0.1 | |
| d84 (mm) | | -- | | | -- | | | 7.72 | | | 105 | | | 7.72 | | | 6.2 | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | | -- | | | -- | | | 0.0145 | | | 0.0090 | | | 0.0113 | | | 0.0139 | |
| Channel Length(ft) | | -- | | | -- | | | 1385 | | | 590 | | | 1654 | | | 1474 | |
| Valley Length (ft) | | -- | | | -- | | | 1264 | | | 404 | | | 1091 | | | 1091 | |
| Sinuosity | | -- | | | -- | | | 1.10 | | | 1.46 | | | 1.52 | | | 1.35 | |
| Rosgen Classification | | -- | | | -- | | | G5c | | | C4/1 | | | C4 | | | C5 | |

| Table VII. cont. Baseline Morphology and Hydraulic Summary<br>Little White Oak Creek Stream Restoration / D06027-B<br>Reach R2D (790 ft) | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PARAMETERS** | USGS Gage Data | | | Regional Curve Interval | | | Pre-Existing Condition | | | Project Reference Stream | | | Design | | | As-built | | |
| **Dimension - Riffle** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| BKF Width (ft) | -- | -- | -- | -- | -- | 3.3 | 3.8 | 7.2 | 5.5 | 16.0 | 20.6 | 18.5 | -- | -- | 8.0 | -- | -- | 8.8 |
| Floodprone Width (ft) | -- | -- | -- | -- | -- | -- | 8.4 | 12.6 | 10.5 | 67.2 | 72.8 | 67.2 | 28.2 | 35.2 | 30.5 | -- | -- | 70.0 |
| BKF Cross Sectional Area (sq. ft.) | -- | -- | -- | -- | -- | 2.7 | 2.7 | 5.8 | 4.3 | 27.4 | 33.4 | 30.3 | -- | -- | 5.0 | -- | -- | 6.0 |
| BKF Mean Depth (ft) | -- | -- | -- | -- | -- | 0.6 | 0.70 | 0.80 | 0.75 | 1.57 | 1.72 | 1.64 | -- | -- | 0.63 | -- | -- | 0.68 |
| BKF Max Depth (ft) | -- | -- | -- | -- | -- | -- | 1.12 | 1.65 | 1.40 | 1.54 | 2.36 | 1.90 | 0.59 | 0.90 | 0.73 | -- | -- | 1.02 |
| Width/Depth Ratio | -- | -- | -- | -- | -- | -- | 5.3 | 8.8 | 7.1 | 9.3 | 12.7 | 11.3 | -- | -- | 12.7 | -- | -- | 13.0 |
| Entrenchment Ratio | -- | -- | -- | -- | -- | -- | 1.8 | 2.2 | 2.0 | 3.5 | 4.4 | 3.8 | 3.5 | 4.4 | 3.8 | -- | -- | 7.9 |
| Wetted Perimeter (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 20.8 | -- | -- | 9.3 | -- | -- | 9.3 |
| Hydraulic Radius (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.4 | -- | -- | 0.5 | -- | -- | 0.7 |
| **Pattern** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 36.0 | 150.0 | 67.0 | 15.5 | 64.5 | 28.8 | 8.6 | 42.0 | 24.8 |
| Radius of Curvature (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 19.0 | 115.0 | 49.0 | 8.2 | 49.5 | 21.1 | 8.2 | 20.1 | 13.3 |
| Meander Wavelength (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 33.0 | 155.0 | 94.0 | 14.2 | 66.7 | 40.4 | 47.7 | 68.6 | 61.8 |
| Meander Width Ratio | -- | -- | -- | -- | -- | -- | -- | -- | -- | 1.9 | 8.1 | 3.6 | 1.9 | 8.1 | 3.6 | 1.0 | 4.8 | 2.8 |
| **Profile** | Min | Max | Med | LL | UL | Eq | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | 6.2 | 26.4 | 13.4 |
| Riffle Slope (ft/ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 0.006 | 0.066 | 0.028 | 0.008 | 0.083 | 0.036 | 0.008 | 0.062 | 0.028 |
| Pool Length (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 18.3 | 62.9 | 35.1 | 7.9 | 27.1 | 15.1 | 10.1 | 23.3 | 15.9 |
| Pool Spacing (ft) | -- | -- | -- | -- | -- | -- | -- | -- | -- | 50.3 | 105.8 | 78.9 | 21.6 | 45.5 | 33.9 | 31.8 | 90.7 | 51.9 |
| **Substrate (Classification)** | | | | | | | | | | | | | | | | | | |
| d50 (mm) | -- | | | -- | | | 0.06 | | | 3 | | | 0.06 | | | 0.32 | | |
| d84 (mm) | -- | | | -- | | | 0.21 | | | 105 | | | 0.21 | | | 0.5 | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | -- | | | -- | | | 0.0111 | | | 0.0090 | | | 0.0079 | | | 0.0105 | | |
| Channel Length(ft) | -- | | | -- | | | 549 | | | 590 | | | 860 | | | 790 | | |
| Valley Length (ft) | -- | | | -- | | | 486 | | | 404 | | | 571 | | | 571 | | |
| Sinuosity | -- | | | -- | | | 1.13 | | | 1.46 | | | 1.51 | | | 1.38 | | |
| Rosgen Classification | -- | | | -- | | | Degraded E6 | | | C4/1 | | | C6 | | | C5 | | |

**Table VIII. Morphology and Hydraulic Monitoring Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R1 (7543 ft)**

| PARAMETERS | Cross Section 9 Pool | | | | | Cross Section 10 Pool | | | | | Cross Section 11 Pool | | | | | Cross Section 12 Riffle | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 23.1 | 23.6 | 19.5 | 19.4 | | 18.9 | 26.0 | 16.7 | 17.5 | | 21.2 | 20.5 | 26.7 | 22.7 | | 22.7 | 23.7 | 23.1 | 22.2 | | | | | | | | | | | |
| Floodprone Width (ft) | 80.3 | 87.7 | 77.3 | 77.8 | | 104.9 | 105.7 | 109.1 | 103.5 | | 129.3 | 83.3 | 87.7 | 81.5 | | 74.9 | 96.5 | 80.3 | 81.9 | | | | | | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 45.9 | 45.1 | 35.4 | 32.6 | | 40.7 | 42.6 | 34.7 | 34.9 | | 61.1 | 44.4 | 60.5 | 41.0 | | 48.9 | 59.2 | 44.0 | 41.9 | | | | | | | | | | | |
| BKF Mean Depth (ft) | 1.99 | 1.91 | 1.82 | 1.68 | | 2.15 | 1.64 | 2.08 | 1.99 | | 2.88 | 2.16 | 2.27 | 1.81 | | 2.16 | 2.50 | 1.91 | 1.89 | | | | | | | | | | | |
| BKF Max Depth (ft) | 3.95 | 4.38 | 3.69 | 3.80 | | 3.70 | 3.48 | 3.94 | 3.27 | | 6.32 | 3.59 | 4.02 | 3.01 | | 3.22 | 5.01 | 4.04 | 3.96 | | | | | | | | | | | |
| Width/Depth Ratio | 11.6 | 12.4 | 10.7 | 11.6 | | 8.8 | 15.9 | 8.0 | 8.8 | | 7.4 | 9.5 | 11.7 | 12.6 | | 10.5 | 9.5 | 12.1 | 11.8 | | | | | | | | | | | |
| Entrenchment Ratio | 3.47 | 3.59 | 3.97 | 4.01 | | 5.55 | 4.06 | 6.53 | 5.90 | | 6.10 | 4.06 | 3.29 | 3.59 | | 3.31 | 4.08 | 3.48 | 3.69 | | | | | | | | | | | |
| Wetted Perimeter (ft) | 25.1 | 26.2 | 22.0 | 22.2 | | 22.5 | 27.9 | 20.5 | 21.5 | | 25.7 | 23.6 | 29.5 | 25.2 | | 25.0 | 27.2 | 25.4 | 24.7 | | | | | | | | | | | |
| Hydraulic Radius (ft) | 1.83 | 1.72 | 1.61 | 1.47 | | 1.81 | 1.53 | 1.69 | 1.63 | | 2.37 | 1.88 | 2.05 | 1.63 | | 1.95 | 2.18 | 1.73 | 1.70 | | | | | | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 50.2 | 134.8 | 95.3 | 38.7 | 121.8 | 90.9 | 50.6 | 133.0 | 95.2 | 44.9 | 131.3 | 94.1 | | | |
| Radius of Curvature (ft) | 44.9 | 73.6 | 54.0 | 37.4 | 87.0 | 55.2 | 38.4 | 74.4 | 53.8 | 38.4 | 74.4 | 54.4 | | | |
| Meander Wavelength (ft) | 186.6 | 240.2 | 210.4 | 189.0 | 240.1 | 209.5 | 190.4 | 238.6 | 210.4 | 190.4 | 238.6 | 210.2 | | | |
| Meander Width Ratio | 2.2 | 6.0 | 4.2 | 1.6 | 5.1 | 3.8 | 2.2 | 5.8 | 4.1 | 2.0 | 5.9 | 4.2 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | 21.8 | 47.5 | 29.3 | 13.1 | 30.0 | 22.5 | 12.3 | 29.1 | 19.7 | 14.3 | 28.6 | 18.0 | | | |
| Riffle Slope (ft/ft) | 0.001 | 0.015 | 0.006 | 0.002 | 0.028 | 0.018 | 0.001 | 0.018 | 0.008 | 0.002 | 0.007 | 0.004 | | | |
| Pool Length (ft) | 25.7 | 85.0 | 43.0 | 37.5 | 88.1 | 54.7 | 14.3 | 69.4 | 33.6 | 26.5 | 55.1 | 37.5 | | | |
| Pool Spacing (ft) | 49.4 | 138.4 | 85.7 | 33.7 | 168.7 | 89.6 | 49.0 | 149.0 | 87.5 | 95.9 | 161.2 | 125.9 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | | 0.23 | | | 0.15 | | | 0.62 | | | 0.21 | | | | |
| d84 (mm) | | 0.73 | | | 0.65 | | | 6.73 | | | 0.86 | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | | 0.0020 | | | 0.0021 | | | 0.0018 | | | 0.0022 | | | | |
| Monitored Channel Length (ft) | | 2022 | | | 2053 | | | 2073 | | | 2071 | | | | |
| Monitored Valley Length (ft) | | 1277 | | | 1414 | | | 1375 | | | 1405 | | | | |
| Sinuosity | | 1.58 | | | 1.45 | | | 1.51 | | | 1.47 | | | | |
| Total Channel Length (ft) | | 7543 | | | 7543 | | | 7543 | | | 7543 | | | | |
| Rosgen Classification | | C5 | | | C5 | | | C5 | | | C5 | | | | |

## Table VIII. Morphology and Hydraulic Monitoring Summary
## Little White Oak Creek Stream Restoration / D06027-B
## Reach R1A (1040 ft)

| PARAMETERS | Cross Section 13 Riffle | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 7.8 | 9.2 | 7.6 | 7.5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Floodprone Width (ft) | 124.2 | 125.0 | 125.0 | 125.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 4.2 | 4.4 | 3.5 | 3.9 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Mean Depth (ft) | 0.54 | 0.48 | 0.46 | 0.52 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Max Depth (ft) | 0.82 | 0.77 | 0.85 | 0.89 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 14.5 | 19.2 | 16.4 | 14.4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 15.85 | 13.54 | 16.56 | 16.71 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 8.1 | 9.8 | 7.8 | 7.7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.52 | 0.45 | 0.45 | 0.50 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 16.7 | 28.1 | 23.4 | 13.7 | 25.5 | 20.3 | 14.9 | 26.2 | 19.6 | 15.5 | 23.7 | 19.4 | | | |
| Radius of Curvature (ft) | 8.1 | 20.1 | 13.8 | 12.9 | 21.2 | 17.0 | 13.4 | 22.1 | 17.8 | 12.3 | 23.7 | 18.5 | | | |
| Meander Wavelength (ft) | 60.6 | 70.0 | 66.1 | 52.6 | 78.9 | 66.3 | 61.0 | 70.0 | 65.8 | 60.8 | 69.3 | 65.5 | | | |
| Meander Width Ratio | 2.1 | 3.6 | 3.0 | 1.5 | 2.8 | 2.2 | 2.0 | 3.5 | 2.6 | 2.1 | 3.2 | 2.6 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | 6.8 | 23.7 | 15.8 | 11.6 | 19.4 | 14.9 | 5.3 | 9.7 | 7.5 | 5.6 | 9.3 | 6.7 | | | |
| Riffle Slope (ft/ft) | 0.012 | 0.050 | 0.023 | 0.013 | 0.033 | 0.022 | 0.008 | 0.052 | 0.033 | 0.012 | 0.046 | 0.023 | | | |
| Pool Length (ft) | 12.1 | 29.1 | 15.9 | 11.1 | 24.7 | 16.6 | 6.8 | 12.6 | 9.4 | 7.4 | 19.0 | 12.0 | | | |
| Pool Spacing (ft) | 32.5 | 55.2 | 43.1 | 25.7 | 73.6 | 50.6 | 20.3 | 52.8 | 34.2 | 19.9 | 45.0 | 33.9 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | 0.14 | | | 0.05 | | | 0.04 | | | 0.05 | | | | | |
| d84 (mm) | 0.44 | | | 0.79 | | | 0.20 | | | 0.13 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | 0.0114 | | | 0.0106 | | | 0.0107 | | | 0.0102 | | | | | |
| Monitored Channel Length (ft) | 501 | | | 499 | | | 500 | | | 502 | | | | | |
| Monitored Valley Length (ft) | 380 | | | 402 | | | 405 | | | 402 | | | | | |
| Sinuosity | 1.32 | | | 1.24 | | | 1.23 | | | 1.25 | | | | | |
| Total Channel Length (ft) | 1040 | | | 1040 | | | 1040 | | | 1040 | | | | | |
| Rosgen Classification | C6 | | | C6 | | | C6 | | | C6 | | | | | |

**Table VIII. Morphology and Hydraulic Monitoring Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2 (7107 ft)**

| PARAMETERS | Cross Section 1 Riffle | | | | | Cross Section 2 Pool | | | | | Cross Section 3 Pool | | | | | Cross Section 4 Riffle | | | | | Cross Section 5 Pool | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 34.0 | 37.5 | 23.5 | 33.6 | | 25.7 | 25.2 | 23.5 | 25.9 | | 27.6 | 26.2 | 25.7 | 26.3 | | 26.1 | 26.0 | 26.1 | 25.4 | | 28.0 | 27.7 | 27.3 | 27.4 | | | | | | |
| Floodprone Width (ft) | 99.7 | 110.0 | 91.3 | 110.0 | | 118.8 | 116.5 | 116.7 | 120.0 | | 150.2 | 155.3 | 164.0 | 164.0 | | 120.4 | 120.0 | 120.0 | 120.0 | | 104.6 | 105.0 | 105.0 | 105.0 | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 64.1 | 64.2 | 44.1 | 55.5 | | 49.7 | 44.2 | 36.7 | 43.9 | | 48.7 | 46.9 | 40.8 | 41.3 | | 52.1 | 55.4 | 51.8 | 52.0 | | 45.4 | 46.2 | 46.8 | 46.1 | | | | | | |
| BKF Mean Depth (ft) | 1.89 | 1.71 | 1.88 | 1.65 | | 1.94 | 1.75 | 1.56 | 1.70 | | 1.77 | 1.79 | 1.59 | 1.57 | | 1.99 | 2.13 | 1.99 | 2.05 | | 1.62 | 1.67 | 1.71 | 1.68 | | | | | | |
| BKF Max Depth (ft) | 3.23 | 3.95 | 3.21 | 3.44 | | 4.23 | 3.48 | 3.51 | 3.49 | | 3.49 | 3.79 | 3.96 | 3.94 | | 3.25 | 3.74 | 3.53 | 3.64 | | 3.11 | 3.09 | 3.22 | 3.31 | | | | | | |
| Width/Depth Ratio | 18.0 | 21.9 | 12.5 | 20.4 | | 13.2 | 14.4 | 15.1 | 15.2 | | 15.6 | 14.6 | 16.2 | 16.7 | | 13.1 | 12.2 | 13.1 | 12.4 | | 17.3 | 16.6 | 16.0 | 16.3 | | | | | | |
| Entrenchment Ratio | 2.94 | 2.93 | 3.89 | 3.27 | | 4.63 | 4.63 | 4.96 | 4.64 | | 5.45 | 5.93 | 6.38 | 6.24 | | 4.61 | 4.62 | 4.61 | 4.73 | | 3.73 | 3.79 | 3.84 | 3.83 | | | | | | |
| Wetted Perimeter (ft) | 34.9 | 39.3 | 25.0 | 35.1 | | 28.6 | 27.1 | 26.3 | 28.5 | | 30.0 | 29.0 | 28.1 | 28.7 | | 27.5 | 27.6 | 27.9 | 28.0 | | 29.4 | 28.9 | 28.8 | 28.8 | | | | | | |
| Hydraulic Radius (ft) | 1.84 | 1.64 | 1.77 | 1.58 | | 1.74 | 1.63 | 1.39 | 1.54 | | 1.62 | 1.62 | 1.45 | 1.44 | | 1.90 | 2.01 | 1.86 | 1.86 | | 1.54 | 1.60 | 1.62 | 1.60 | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 62.5 | 141.1 | 110.6 | 57.5 | 139.1 | 105.8 | 62.3 | 139.0 | 105.2 | 62.6 | 139.0 | 104.4 | | | |
| Radius of Curvature (ft) | 41.9 | 79.3 | 54.7 | 37.3 | 77.6 | 59.4 | 48.0 | 82.1 | 56.4 | 41.9 | 82.1 | 56.7 | | | |
| Meander Wavelength (ft) | 183.6 | 258.7 | 236.1 | 177.2 | 263.4 | 236.7 | 176.1 | 259.7 | 236.5 | 175.7 | 265.7 | 236.4 | | | |
| Meander Width Ratio | 2.1 | 4.7 | 3.7 | 1.8 | 4.4 | 3.3 | 2.5 | 5.6 | 4.2 | 2.1 | 4.7 | 3.5 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | 29.7 | 79.1 | 44.7 | 20.4 | 34.7 | 28.1 | 22.5 | 38.8 | 32.3 | 26.6 | 43.0 | 33.5 | | | |
| Riffle Slope (ft/ft) | 0.002 | 0.013 | 0.005 | 0.002 | 0.006 | 0.004 | 0.003 | 0.012 | 0.006 | 0.001 | 0.009 | 0.004 | | | |
| Pool Length (ft) | 35.6 | 94.9 | 57.7 | 30.6 | 91.9 | 50.3 | 20.4 | 65.3 | 35.2 | 30.7 | 67.6 | 42.2 | | | |
| Pool Spacing (ft) | 108.7 | 264.9 | 176.3 | 79.6 | 228.7 | 147.0 | 61.3 | 200.1 | 129.4 | 55.3 | 208.9 | 133.8 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | 0.25 | | | 0.11 | | | 0.45 | | | 0.52 | | | | | |
| d84 (mm) | 0.76 | | | 0.38 | | | 5.70 | | | 3.33 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | 0.0014 | | | 0.0014 | | | 0.0012 | | | 0.0016 | | | | | |
| Monitored Channel Length (ft) | 2093 | | | 2112 | | | 2103 | | | 2084 | | | | | |
| Monitored Valley Length (ft) | 1392 | | | 1390 | | | 1392 | | | 1380 | | | | | |
| Sinuosity | 1.50 | | | 1.52 | | | 1.51 | | | 1.51 | | | | | |
| Total Channel Length (ft) | 7107 | | | 7107 | | | 7107 | | | 7107 | | | | | |
| Rosgen Classification | C5 | | | C5 | | | C5 | | | C5 | | | | | |

**Table VIII. Morphology and Hydraulic Monitoring Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2A (336 ft)**

| PARAMETERS | Cross Section 6 Riffle | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 16.1 | 16.1 | 13.4 | 12.6 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Floodprone Width (ft) | 40.4 | 40.6 | 41.6 | 41.5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 16.2 | 15.1 | 9.4 | 10.2 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Mean Depth (ft) | 1.01 | 0.94 | 0.70 | 0.81 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Max Depth (ft) | 1.89 | 1.90 | 2.09 | 2.08 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 15.9 | 17.1 | 19.2 | 15.6 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 2.51 | 2.52 | 3.10 | 3.29 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 16.7 | 16.9 | 15.1 | 13.8 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.97 | 0.90 | 0.62 | 0.74 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 33.9 | 47.2 | 39.4 | 35.0 | 48.3 | 40.5 | 34.9 | 48.2 | 40.1 | 33.2 | 41.4 | 36.0 | | | |
| Radius of Curvature (ft) | 21.3 | 26.8 | 23.7 | 20.1 | 27.1 | 22.9 | 19.1 | 28.5 | 23.4 | 19.1 | 22.8 | 21.2 | | | |
| Meander Wavelength (ft) | 98.3 | 105.2 | 100.6 | 99.6 | 103.3 | 101.0 | 98.4 | 108.1 | 101.8 | 96.7 | 106.5 | 100.6 | | | |
| Meander Width Ratio | 2.1 | 2.9 | 2.4 | 2.2 | 3.0 | 2.5 | 2.6 | 3.6 | 3.0 | 2.6 | 3.3 | 2.9 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | 19.2 | 24.6 | 22.0 | 18.2 | 26.3 | 21.4 | 6.6 | 12.4 | 9.2 | 12.0 | 12.8 | 12.4 | | | |
| Riffle Slope (ft/ft) | 0.007 | 0.020 | 0.013 | 0.005 | 0.020 | 0.012 | 0.005 | 0.025 | 0.013 | 0.010 | 0.017 | 0.013 | | | |
| Pool Length (ft) | 18.3 | 45.0 | 31.7 | 13.2 | 22.1 | 18.3 | 7.8 | 20.2 | 13.8 | 18.6 | 22.1 | 20.4 | | | |
| Pool Spacing (ft) | 71.8 | 133.0 | 102.4 | 47.7 | 93.0 | 72.7 | 46.5 | 90.3 | 67.3 | 56.5 | 78.6 | 69.7 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | 0.24 | | | 0.68 | | | 0.05 | | | 4.00 | | | | | |
| d84 (mm) | 11.30 | | | 11.30 | | | 11.30 | | | 13.18 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | 0.0108 | | | 0.0115 | | | 0.0143 | | | 0.0109 | | | | | |
| Monitored Channel Length (ft) | 320 | | | 321 | | | 319 | | | 209 | | | | | |
| Monitored Valley Length (ft) | 246 | | | 248 | | | 244 | | | 159 | | | | | |
| Sinuosity | 1.30 | | | 1.30 | | | 1.30 | | | 1.32 | | | | | |
| Total Channel Length (ft) | 336 | | | 336 | | | 336 | | | 336 | | | | | |
| Rosgen Classification | C5 | | | C5 | | | C6 | | | C4 | | | | | |

**Table VIII. Morphology and Hydraulic Monitoring Summary**
**Little White Oak Creek Stream Restoration / D06027-B**
**Reach R2B (1474 ft)**

| PARAMETERS | Cross Section 7 Riffle | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 8.7 | 8.3 | 8.5 | 8.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Floodprone Width (ft) | 25.5 | 24.9 | 25.1 | 26.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 4.5 | 4.2 | 4.4 | 4.5 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Mean Depth (ft) | 0.52 | 0.51 | 0.51 | 0.56 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Max Depth (ft) | 0.89 | 0.85 | 0.84 | 0.96 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 16.7 | 16.2 | 16.6 | 14.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 2.93 | 3.01 | 2.96 | 3.29 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 9.0 | 8.5 | 8.9 | 8.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.50 | 0.50 | 0.49 | 0.54 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 16.9 | 31.6 | 22.8 | 15.1 | 28.7 | 21.1 | 16.4 | 29.1 | 21.5 | 17.8 | 29.6 | 22.2 | | | |
| Radius of Curvature (ft) | 9.4 | 22.2 | 16.7 | 11.5 | 23.1 | 18.0 | 9.5 | 22.6 | 16.9 | 9.5 | 23.6 | 16.5 | | | |
| Meander Wavelength (ft) | 59.4 | 68.7 | 64.2 | 60.1 | 69.8 | 64.6 | 58.5 | 79.1 | 65.5 | 58.3 | 81.0 | 65.6 | | | |
| Meander Width Ratio | 1.9 | 3.6 | 2.6 | 1.8 | 3.5 | 2.6 | 1.9 | 3.4 | 2.5 | 2.2 | 3.7 | 2.8 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | -- | -- | -- | 5.1 | 10.7 | 7.8 | 5.1 | 10.7 | 7.8 | 7.2 | 10.4 | 8.7 | | | |
| Riffle Slope (ft/ft) | -- | -- | -- | 0.013 | 0.048 | 0.035 | 0.013 | 0.048 | 0.035 | 0.022 | 0.037 | 0.028 | | | |
| Pool Length (ft) | 9.6 | 18.6 | 15.0 | 13.5 | 23.6 | 17.5 | 13.5 | 23.6 | 17.5 | 15.6 | 21.5 | 18.3 | | | |
| Pool Spacing (ft) | 24.8 | 60.2 | 44.0 | 30.4 | 55.1 | 42.2 | 30.4 | 55.1 | 42.2 | 39.1 | 64.5 | 51.9 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | 0.04 | | | 0.03 | | | 0.03 | | | 0.04 | | | | | |
| d84 (mm) | 0.38 | | | 0.06 | | | 0.05 | | | 0.08 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | 0.0165 | | | 0.0164 | | | 0.0163 | | | 0.0159 | | | | | |
| Monitored Channel Length (ft) | 528 | | | 553 | | | 517 | | | 538 | | | | | |
| Monitored Valley Length (ft) | 387 | | | 433 | | | 405 | | | 420 | | | | | |
| Sinuosity | 1.36 | | | 1.28 | | | 1.28 | | | 1.28 | | | | | |
| Total Channel Length (ft) | 1474 | | | 1474 | | | 1474 | | | 1474 | | | | | |
| Rosgen Classification | C6 | | | C6 | | | C6 | | | C6 | | | | | |

## Table VIII. Morphology and Hydraulic Monitoring Summary
## Little White Oak Creek Stream Restoration / D06027-B
## Reach R2D (790 ft)

| PARAMETERS | Cross Section 8 Riffle | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dimension** | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 | MY1 | MY2 | MY3 | MY4 | MY5 |
| BKF Width (ft) | 11.7 | 10.9 | 11.1 | 11.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Floodprone Width (ft) | 69.6 | 70.0 | 70.0 | 70.0 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Cross Sectional Area (sq. ft.) | 6.7 | 7.1 | 6.5 | 7.3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Mean Depth (ft) | 0.57 | 0.65 | 0.59 | 0.66 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BKF Max Depth (ft) | 1.04 | 1.05 | 1.03 | 1.06 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width/Depth Ratio | 20.6 | 16.8 | 18.8 | 16.7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Entrenchment Ratio | 5.94 | 6.40 | 6.31 | 6.34 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wetted Perimeter (ft) | 12.1 | 11.3 | 11.5 | 11.4 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hydraulic Radius (ft) | 0.55 | 0.63 | 0.57 | 0.64 | | | | | | | | | | | | | | | | | | | | | | | | | | |

| PARAMETERS | MY-01 (2008) | | | MY-02 (2009) | | | MY-03 (2010) | | | MY-04 (2011) | | | MY-05 (2012) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pattern** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Channel Beltwidth (ft) | 12.0 | 30.9 | 23.7 | 6.7 | 28.7 | 21.4 | 11.7 | 27.8 | 21.8 | 12.3 | 27.8 | 22.7 | | | |
| Radius of Curvature (ft) | 12.4 | 20.4 | 15.1 | 10.8 | 23.8 | 15.7 | 12.0 | 20.2 | 15.8 | 12.0 | 20.2 | 15.8 | | | |
| Meander Wavelength (ft) | 49.7 | 67.7 | 61.6 | 50.1 | 69.4 | 61.5 | 49.5 | 67.8 | 61.7 | 48.7 | 67.2 | 61.4 | | | |
| Meander Width Ratio | 1.0 | 2.6 | 2.0 | 0.6 | 2.6 | 2.0 | 1.1 | 2.5 | 2.0 | 1.1 | 2.5 | 2.1 | | | |
| **Profile** | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med | Min | Max | Med |
| Riffle Length (ft) | 7.0 | 14.9 | 11.4 | 5.8 | 12.2 | 8.1 | 5.8 | 15.7 | 10.5 | 7.0 | 11.6 | 9.3 | | | |
| Riffle Slope (ft/ft) | -- | -- | -- | 0.011 | 0.044 | 0.025 | 0.002 | 0.095 | 0.027 | 0.007 | 0.023 | 0.014 | | | |
| Pool Length (ft) | 12.2 | 19.7 | 16.3 | 8.1 | 24.4 | 16.8 | 7.0 | 20.9 | 13.6 | 10.0 | 16.7 | 12.3 | | | |
| Pool Spacing (ft) | 42.2 | 51.1 | 44.6 | 27.9 | 66.3 | 49.4 | 27.3 | 54.1 | 42.3 | 26.7 | 60.1 | 40.6 | | | |
| **Substrate** | | | | | | | | | | | | | | | |
| d50 (mm) | 0.14 | | | 0.16 | | | 0.03 | | | 0.08 | | | | | |
| d84 (mm) | 0.41 | | | 0.42 | | | 0.06 | | | 0.20 | | | | | |
| **Additional Reach Parameters** | | | | | | | | | | | | | | | |
| Bankfull Slope (ft/ft) | 0.0124 | | | 0.0125 | | | 0.0138 | | | 0.0132 | | | | | |
| Monitored Channel Length (ft) | 463 | | | 464 | | | 466 | | | 457 | | | | | |
| Monitored Valley Length (ft) | 346 | | | 345 | | | 346 | | | 342 | | | | | |
| Sinuosity | 1.34 | | | 1.35 | | | 1.35 | | | 1.33 | | | | | |
| Total Channel Length (ft) | 790 | | | 790 | | | 790 | | | 790 | | | | | |
| Rosgen Classification | C5 | | | C5 | | | C6 | | | C5 | | | | | |

| Exhibit Table IX. BEHI and Sediment Export Estimates<br>Little White Oak Creek Stream Restoration / D06027-B | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time Point** | **Segment / Reach** | **Linear Footage or Acreage** | **Extreme** | | **Very High** | | **High** | | **Moderate** | | **Low** | | **Very Low** | | **Sediment Export** |
| | | | ft | % | ft | % | ft | % | ft | % | ft | % | ft | % | tons/yr |
| Preconstruction 2006 | R1 | 6530 | | | 5877 | 90 | | | | | | | | | 455 |
| | R1A | 906 | 906 | 100 | | | | | | | | | | | 229 |
| | R2 | 5979 | 5381 | 90 | | | | | | | | | | | 767 |
| | R2A | 625 | | | 625 | 100 | | | | | | | | | 32 |
| | R2B | 1713 | | | | | 1713 | 100 | | | | | | | 120 |
| | R2D | 526 | 526 | 100 | | | | | | | | | | | 250 |
| | TOTAL | 16279 | 6813 | 42 | 6502 | 40 | 1713 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 1853 |
| Monitoring Y3 2010 | R1 | 7543 | | | | | | | 5280 | 70 | 2263 | 30 | | | 189 |
| | R1A | 1040 | | | | | | | | | 1040 | 100 | | | 1 |
| | R2 | 7107 | | | | | | | 7107 | 100 | | | | | 123 |
| | R2A | 336 | | | | | | | | | 336 | 100 | | | 3 |
| | R2B | 1474 | | | | | | | | | 1474 | 100 | | | 4 |
| | R2D | 790 | | | | | | | | | 790 | 100 | | | 22 |
| | TOTAL | 18290 | 0 | 0 | 0 | 0 | 0 | 0 | 12387 | 68 | 5903 | 32 | 0 | 0 | 342 |
| Monitoring Y5 2012 | R1 | 7543 | | | | | | | | | | | | | |
| | R1A | 1040 | | | | | | | | | | | | | |
| | R2 | 7107 | | | | | | | | | | | | | |
| | R2A | 336 | | | | | | | | | | | | | |
| | R2B | 1474 | | | | | | | | | | | | | |
| | R2D | 790 | | | | | | | | | | | | | |
| | TOTAL | 18290 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| Exhibit Table X. Verification of Bankfull Events<br>Little White Oak Creek Stream Restoration / D06027-B | | | |
|---|---|---|---|
| **Date of Data Collection** | **Date of Occurrence** | **Method** | **Photo No. (If Available)** |
| 8/25/08-8/27/08 | Unknown | Crest Guage | N/A |
| 10/13/09 - 10/14/09 | Unknown | Crest Guage | N/A |
| 11/01/10 - 11/03/10 | Unknown | Crest Guage | N/A |
| 11/14/11 - 11/15/11 | Unknown | Visual Assessment | N/A |
| | | | |

| Table XI. Categorical Stream Feature Visual Stability Assessment<br>Little White Oak Creek Stream Restoration / D06027-B | | | | | | |
|---|---|---|---|---|---|---|
| **Reach R1 (7543ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02 [A]** | **MY-03 [B]** | **MY-04 [C]** | **MY-05** |
| Riffles | 100% | 100% | 100% | 91% | 90% | |
| Pools | 100% | 100% | 100% | 84% | 90% | |
| Thalwegs | 100% | 100% | 100% | 100% | 90% | |
| Meanders | 100% | 100% | 95% | 95% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 95% | 88% | 100% | |
| Rootwads | 100% | 100% | 95% | 98% | 100% | |
| **Reach R1A (1040ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02** | **MY-03** | **MY-04** | **MY-05** |
| Riffles | 100% | 100% | 100% | 100% | 100% | |
| Pools | 100% | 100% | 100% | 100% | 100% | |
| Thalwegs | 100% | 100% | 100% | 100% | 100% | |
| Meanders | 100% | 100% | 100% | 100% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 100% | 100% | 100% | |
| Rootwads | 100% | 100% | 100% | 100% | 100% | |
| **Reach R2 (7107ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02 [A]** | **MY-03** | **MY-04 [C]** | **MY-05** |
| Riffles | 100% | 100% | 100% | 100% | 95% | |
| Pools | 100% | 100% | 100% | 100% | 95% | |
| Thalwegs | 100% | 100% | 100% | 100% | 95% | |
| Meanders | 100% | 100% | 95% | 95% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 95% | 95% | 100% | |
| Rootwads | 100% | 100% | 95% | 95% | 100% | |
| **Reach R2A (336ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02** | **MY-03** | **MY-04 [C]** | **MY-05** |
| Riffles | 100% | 100% | 100% | 100% | 95% | |
| Pools | 100% | 100% | 100% | 100% | 95% | |
| Thalwegs | 100% | 100% | 100% | 100% | 95% | |
| Meanders | 100% | 100% | 100% | 100% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 100% | 100% | 100% | |
| Rootwads | 100% | 100% | 100% | 100% | 100% | |
| **Reach R2B (1474ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02** | **MY-03** | **MY-04** | **MY-05** |
| Riffles | 100% | 100% | 100% | 100% | 100% | |
| Pools | 100% | 100% | 100% | 100% | 100% | |
| Thalwegs | 100% | 100% | 100% | 100% | 100% | |
| Meanders | 100% | 100% | 100% | 100% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 100% | 100% | 100% | |
| Rootwads | 100% | 100% | 100% | 100% | 100% | |
| **Reach R2D (790ft)** | | | | | | |
| **Feature** | **Initial** | **MY-01** | **MY-02** | **MY-03** | **MY-04** | **MY-05** |
| Riffles | 100% | 100% | 100% | 100% | 100% | |
| Pools | 100% | 100% | 100% | 100% | 100% | |
| Thalwegs | 100% | 100% | 100% | 100% | 100% | |
| Meanders | 100% | 100% | 100% | 100% | 100% | |
| Bed General | 100% | 100% | 100% | 100% | 100% | |
| Structures | 100% | 100% | 100% | 100% | 100% | |
| Rootwads | 100% | 100% | 100% | 100% | 100% | |

Notes:

[A]The results shown above as less than 100% percent, reflect the construction of beaver dams on the respective reaches during MY-02 (2009).

[B]The entire project suffered a flood event during MY-03 (2010) causing damage along R1.

[C]The results shown above as less than 100% percent, reflect the construction of beaver dams on the respective reaches during MY-04 (2011). Beavers in these reaches were trapped and the beaver dams destroyed shortly after the stream surveys were conducted.

| Table XII. Stream Problem Areas (Year 4 of 5)<br>Little White Oak Creek Stream Restoration / D06027-B | | | |
|---|---|---|---|
| **Feature/Issue** | **Station / Range** | **Probable Cause** | **Photo No. (If Available)** |
| Beaver dams constructed | Reach -R1- scattered reachwide | Beavers | N/A |
| Beaver dams constructed | Reach -R2- scattered in upper portions of reach (above R1/R2 confluence) | Beavers | N/A |

Note: Beavers were trapped in both reaches R1 and R2 during November 2011. Beaver dams were manually removed in December 2011.

# Appendix A

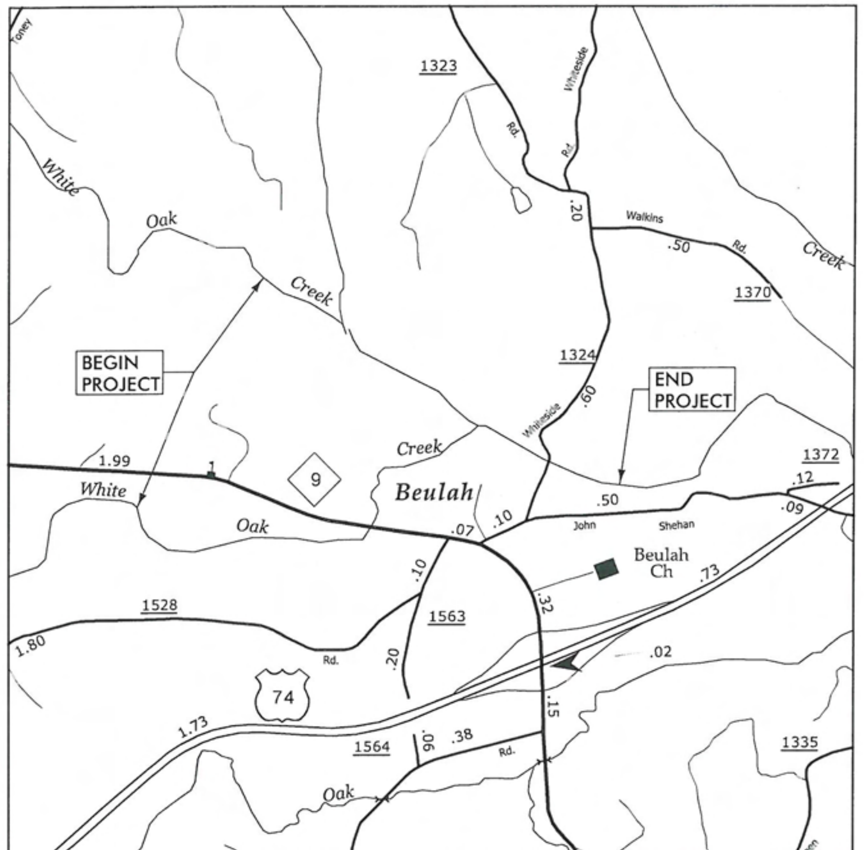
SCO ID NO. D06027-B

# POLK COUNTY

## LITTLE WHITE OAK CREEK STREAM RESTORATION SITE

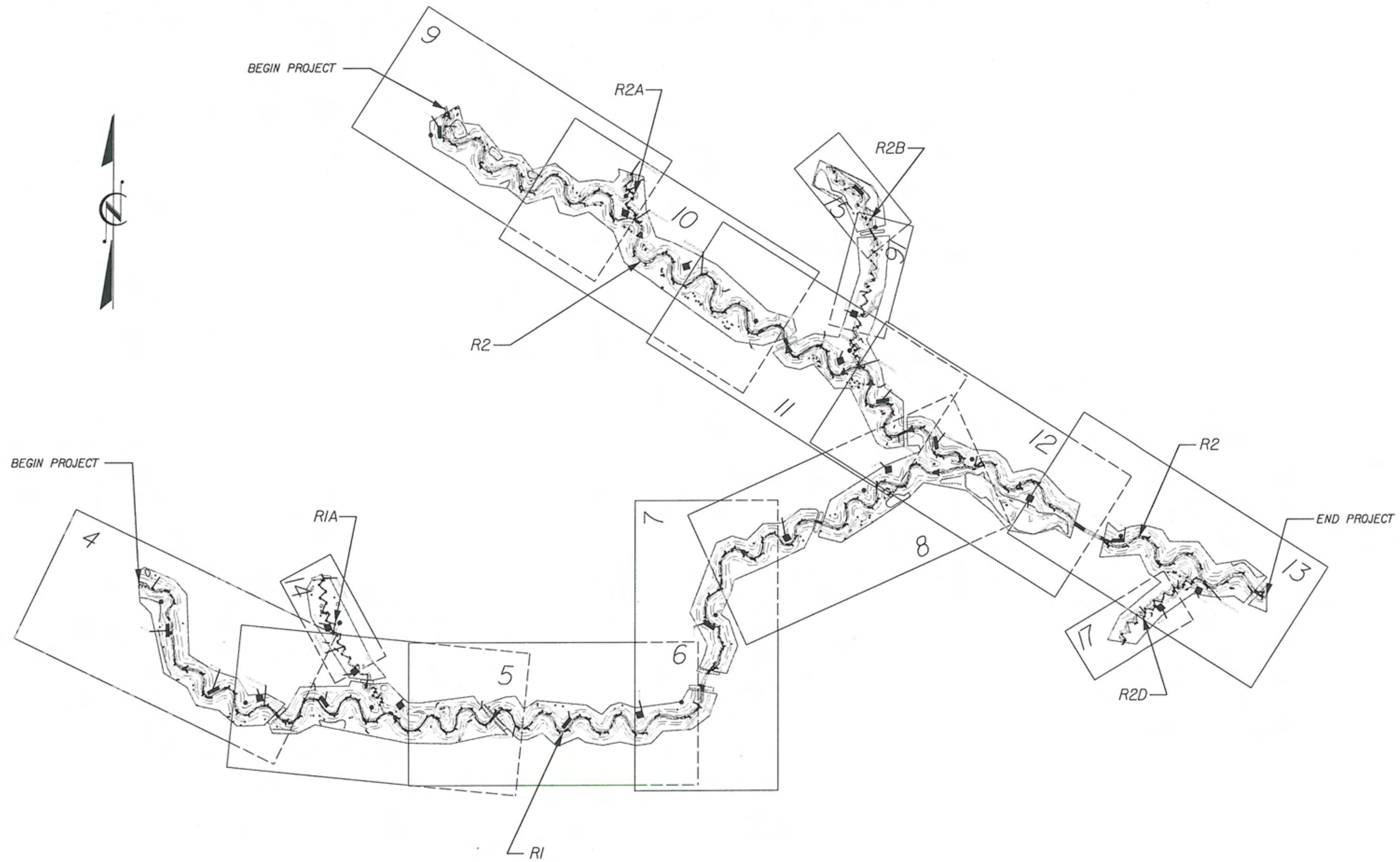
LOCATION: NORTHEAST OF THE INTERSECTION OF NC 9 AND US 74 (EXIT 167)

# YEAR 4 MONITORING




VICINITY MAP

NOT TO SCALE




NOT TO SCALE

INDEX OF SHEETS

| SHEET NUMBER | SHEET |
|---|---|
| 1 | TITLE SHEET |
| 2 | LEGEND |
| 3 | PROJECT OVERVIEW |
| 4 - 19 | YEAR 0-4 MONITORING OVERLAY |

REVISIONS

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

SCALE AS SHOWN

| | |
|---|---|
| DATE: | 1/10/12 |
| DESIGNED: | WSH |
| DRAWN: | MLM |
| CHECKED: | EMP |
| APPROVED: | EMP |

MULKEY PROJECT NUMBER
2006237.00

PLANS PREPARED BY:

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WENDEE B. SMITH

MULKEY ENGINEER
EMMETT PERDUE, PE

MULKEY SENIOR SCIENTIST
THOMAS BARRETT, RF

PROJECT ENGINEER

TITLE SHEET

SHEET 1 OF 19

**NOTE: NOT TO SCALE**
**Not all symbols used in plans**

# LEGEND

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 3/14/08 | JTL | AS-BUILT DRAWINGS |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 2 |

*LEGEND*

MULKEY
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PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM

## *BOUNDARIES AND PROPERTY:*

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin (EIP)
- Property Corner
- Property Monument (ECM)
- Existing Fence
- Temporary Fence
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Tree Protection Fence
- Wetland Boundary
- Proposed Oxbow Wetland Boundary (WLB)
- Conservation Easement
- Construction Limits
- Limits Of Disturbance
- Proposed Gate
- Bench Mark
- Control Point

## *BUILDINGS AND OTHER CULTURE:*

- Sign
- Foundation
- Area Outline
- Building
- School
- Church

## *HYDROLOGY:*

- Hydro, Pool or Reservoir
- River Basin Buffer (RBB)
- Flow Arrow
- Disappearing Stream
- Spring
- Thalweg
- Top Of Bank
- Swamp Marsh
- Proposed Lateral, Tail, Head Ditch (FLOW)
- Bedrock

## *RAILROADS:*

- Standard Guage (CSX TRANSPORTATION)
- RR Signal Milepost (MILEPOST 35)
- Switch (SWITCH)
- RR Abandoned

## *ROADS AND RELATED FEATURES:*

- Existing Edge of Pavement
- Existing Curb
- Existing Soil Road
- Existing Metal Guardrail
- Existing Cable Guiderail

## *VEGETATION:*

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard (Vineyard)

## *EXISTING STRUCTURES:*

MAJOR:

- Bridge, Tunnel or Box Culvert (CONC)
- Bridge Wing Wall, Head Wall and End Wall (CONC WW)

MINOR:

- Head and End Wall (CONC HW)
- Pipe Culvert
- Footbridge
- Drainage Box: Catch Basin, DI or JB (CB)
- Paved Ditch Gutter
- Storm Sewer Manhole
- Storm Sewer (S)

## *UTILITIES:*

POWER:

- Existing Power Pole
- Existing Joint Use Pole
- Power Manhole
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole
- H-Frame Pole
- Recorded U/G Power Line (P)

GAS:

- Gas Meter
- Recorded U/G Gas Line (G)
- Above Ground Gas Line (A/G Gas)

TELEPHONE:

- Existing Telephone Pole
- Telephone Manhole
- Telephone Booth
- Telephone Pedestal
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole
- Recorded U/G Telephone Cable (T)
- Recorded U/G Telephone Conduit (TC)
- Recorded U/G Fiber Optics Cable (T FO)

WATER:

- Water Manhole
- Water Valve
- Water Hydrant
- Recorded U/G Water Line
- Above Ground Water Line (A/G Water)

TV:

- TV Satellite Dish
- TV Pedestal
- TV Tower
- U/G TV Cable Hand Hole
- Recorded U/G TV Cable (TV)
- Recorded U/G Fiber Optic Cable (TV FO)

MISCELLANEOUS:

- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box
- Utility Unknown U/G Line (?UTL)
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

SANITARY SEWER:

- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line (SS)
- Above Ground Sanitary Sewer (A/G Sanitary Sewer)
- Recorded SS Forced Main Line (FSS)

## *PROPOSED STREAM WORK:*

STREAM STRUCTURES:

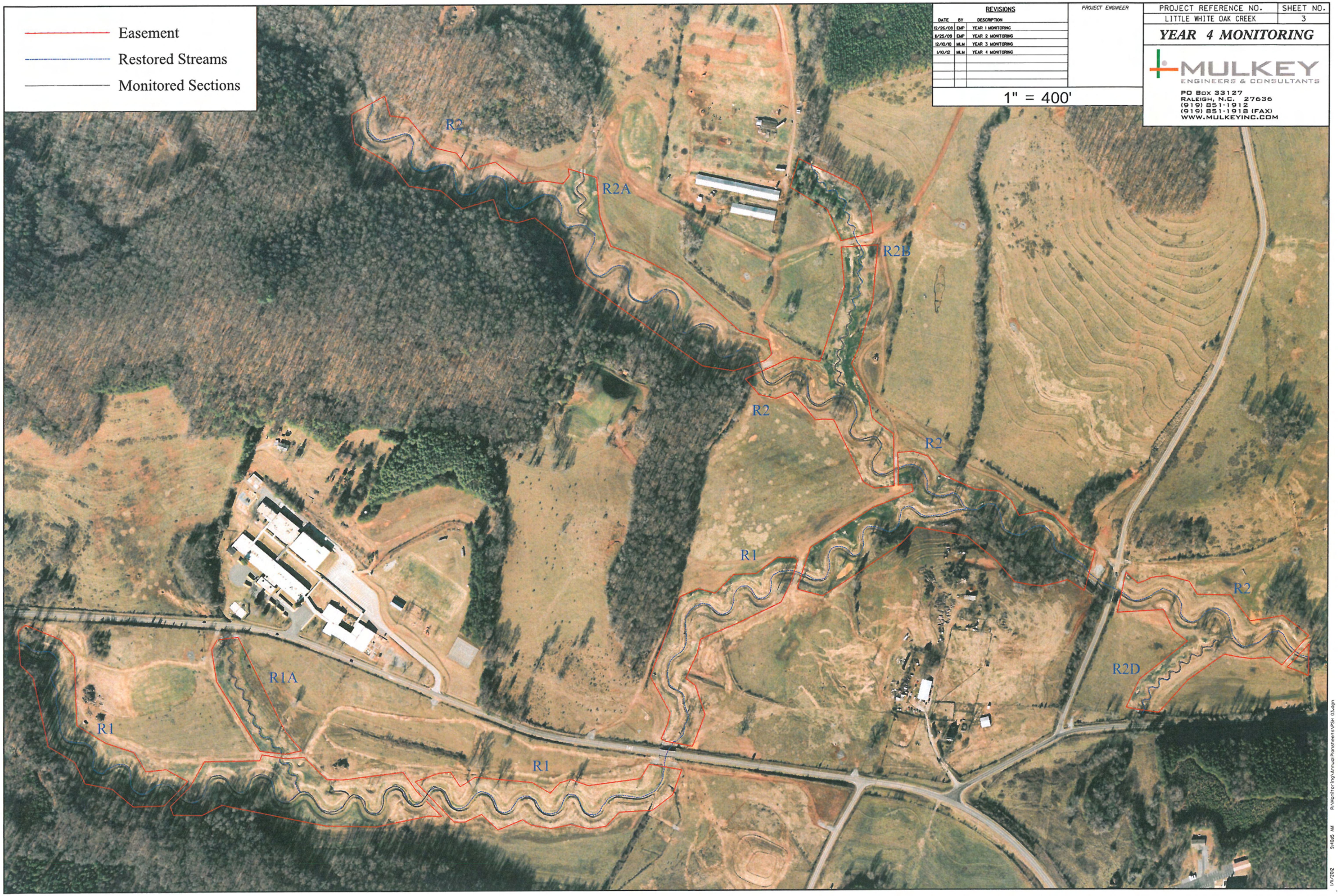
- Rock Crossvane
- Rock Vane
- J Hook Rock Vane
- Flood Plane Interceptor
- Constructed Riffle
- Root Wad
- Structure Number
- Constructed Flood Plane Interceptor

STREAM FEATURES:

- Constructed Bankfull/Top Of Bank
- Old Top Of Bank
- Constructed Thalweg
- Proposed Thalweg
- Waters Edge
- Old Waters Edge
- Vernal Pool
- Surface Water
- Staging Area
- Impervious Dike
- Permanent Improved Gravel Road
- Temporary Gravel Road
- Stone Outlet Sediment Trap
- Impervious Stream Channel Plug
- Fill Existing Stream Channel
- Vegetation Plot

## *MISCELLANEOUS:*

- Photo Point (PP #1)
- Cross Section
- Crest Gauge




| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

1" = 400'

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 3 |

**YEAR 4 MONITORING**

MULKEY
ENGINEERS & CONSULTANTS
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RALEIGH, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
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| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 4 |

# YEAR 4 MONITORING

PROJECT ENGINEER

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ENGINEERS & CONSULTANTS
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RALEIGH, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
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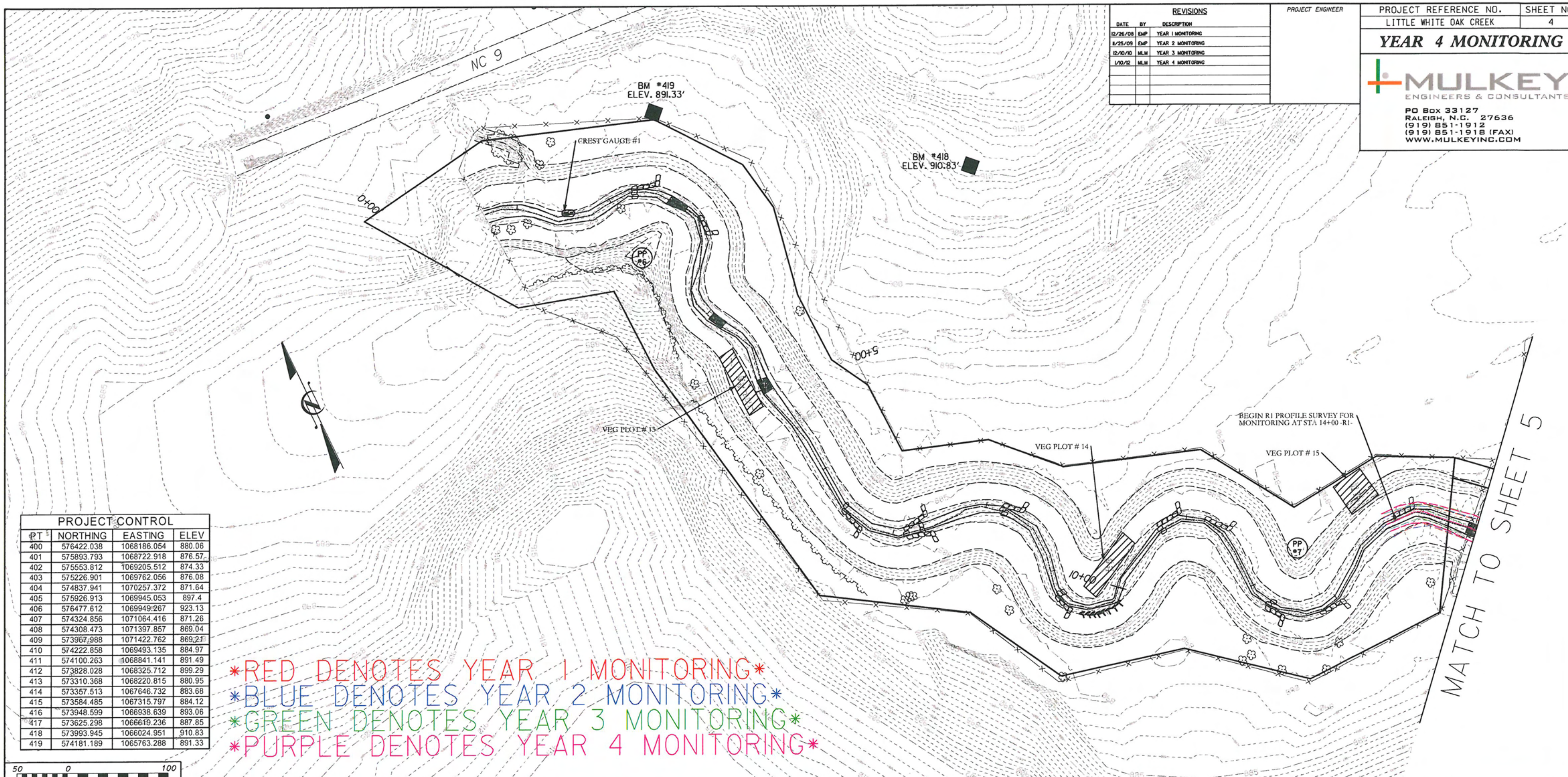
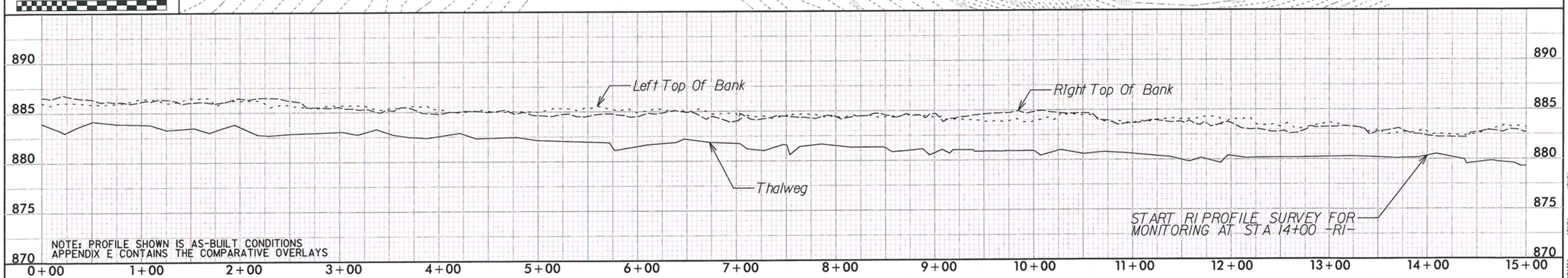
REVISIONS

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |




PROJECT CONTROL

| PT | NORTHING | EASTING | ELEV |
|---|---|---|---|
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |




NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 5 |

## YEAR 4 MONITORING

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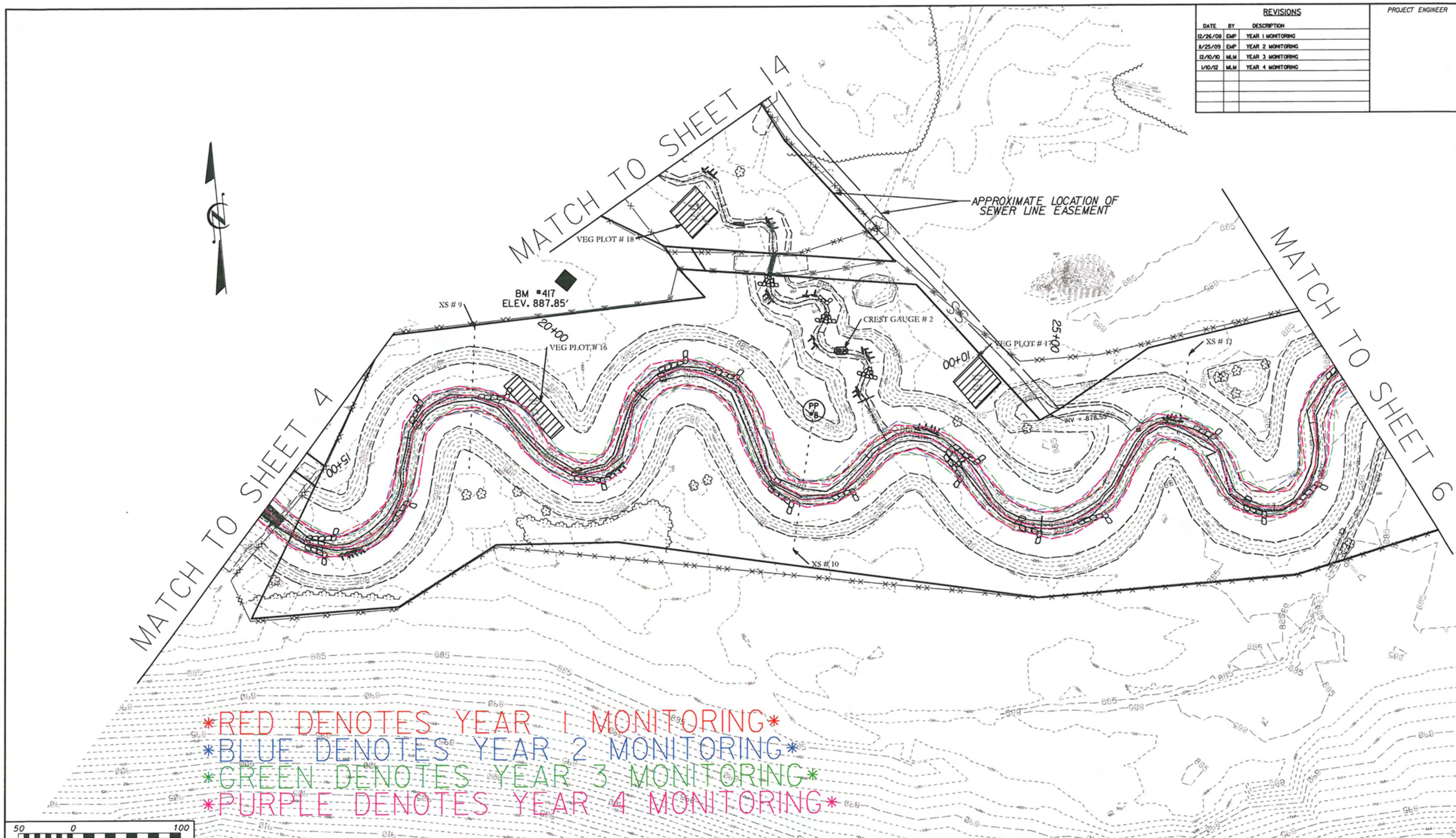
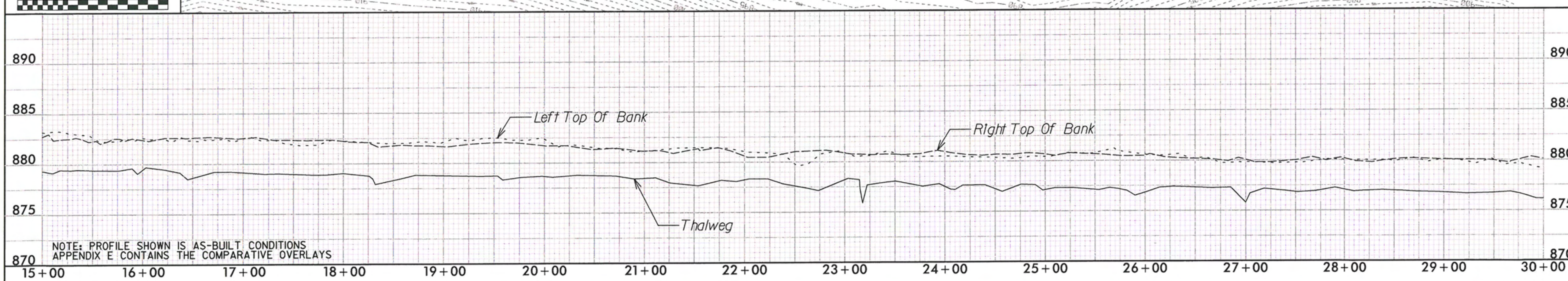
| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |



| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 6 |

# YEAR 4 MONITORING

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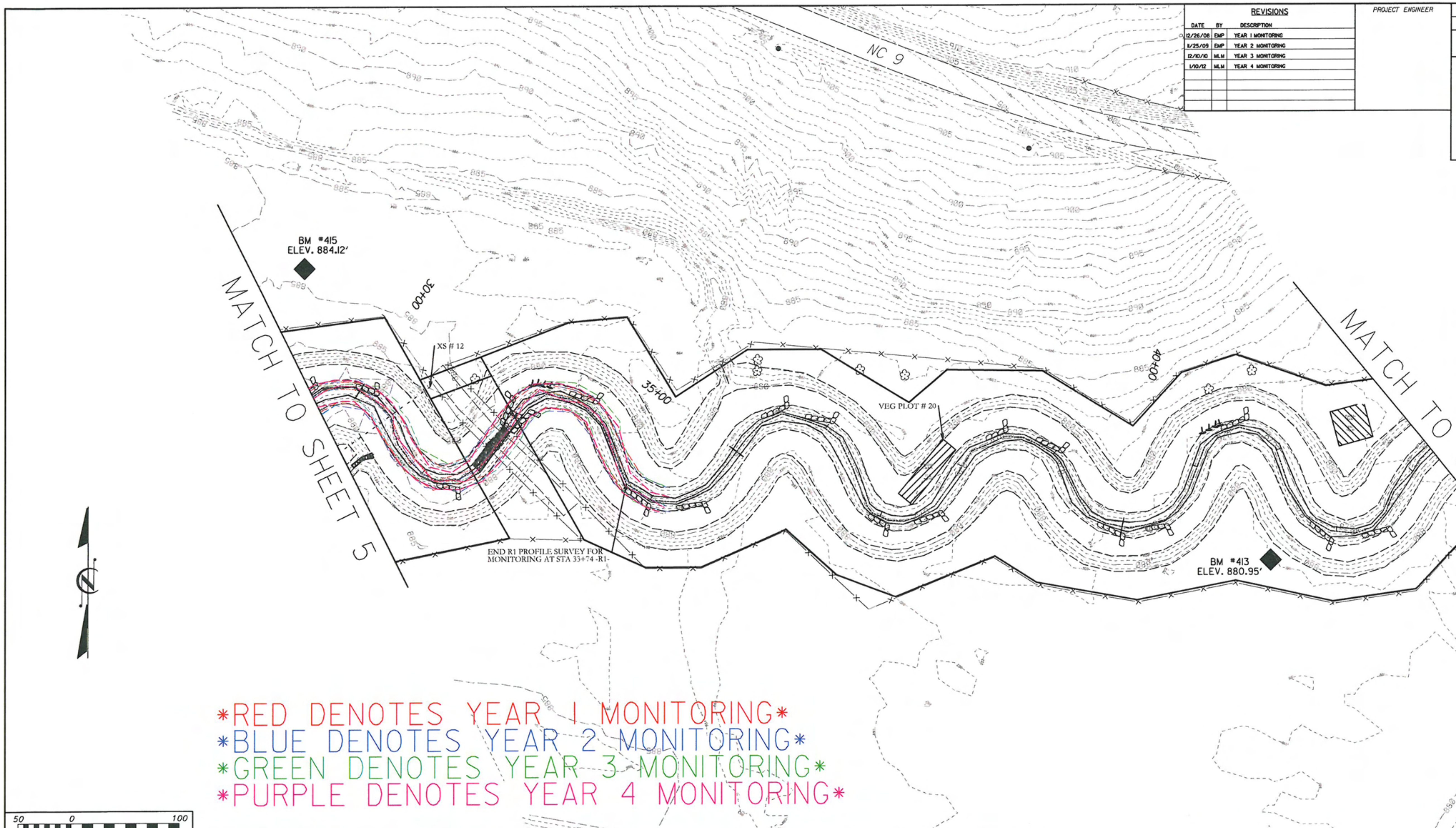
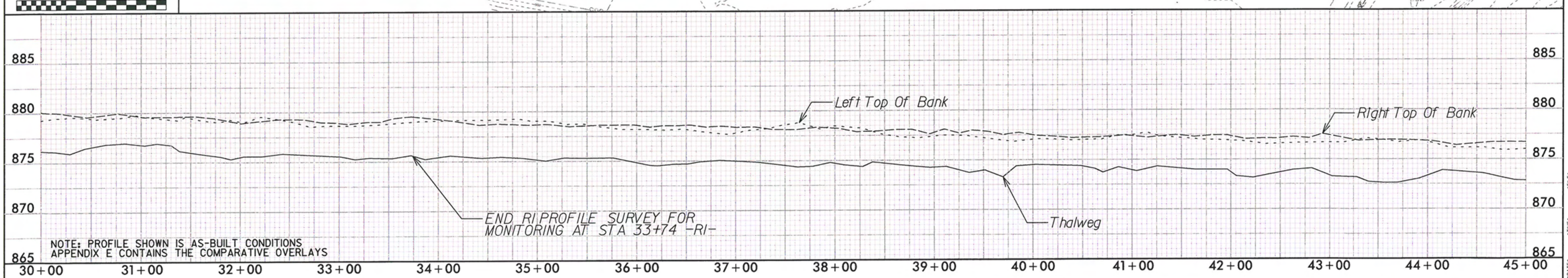
| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |



| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 7 |

**YEAR 4 MONITORING**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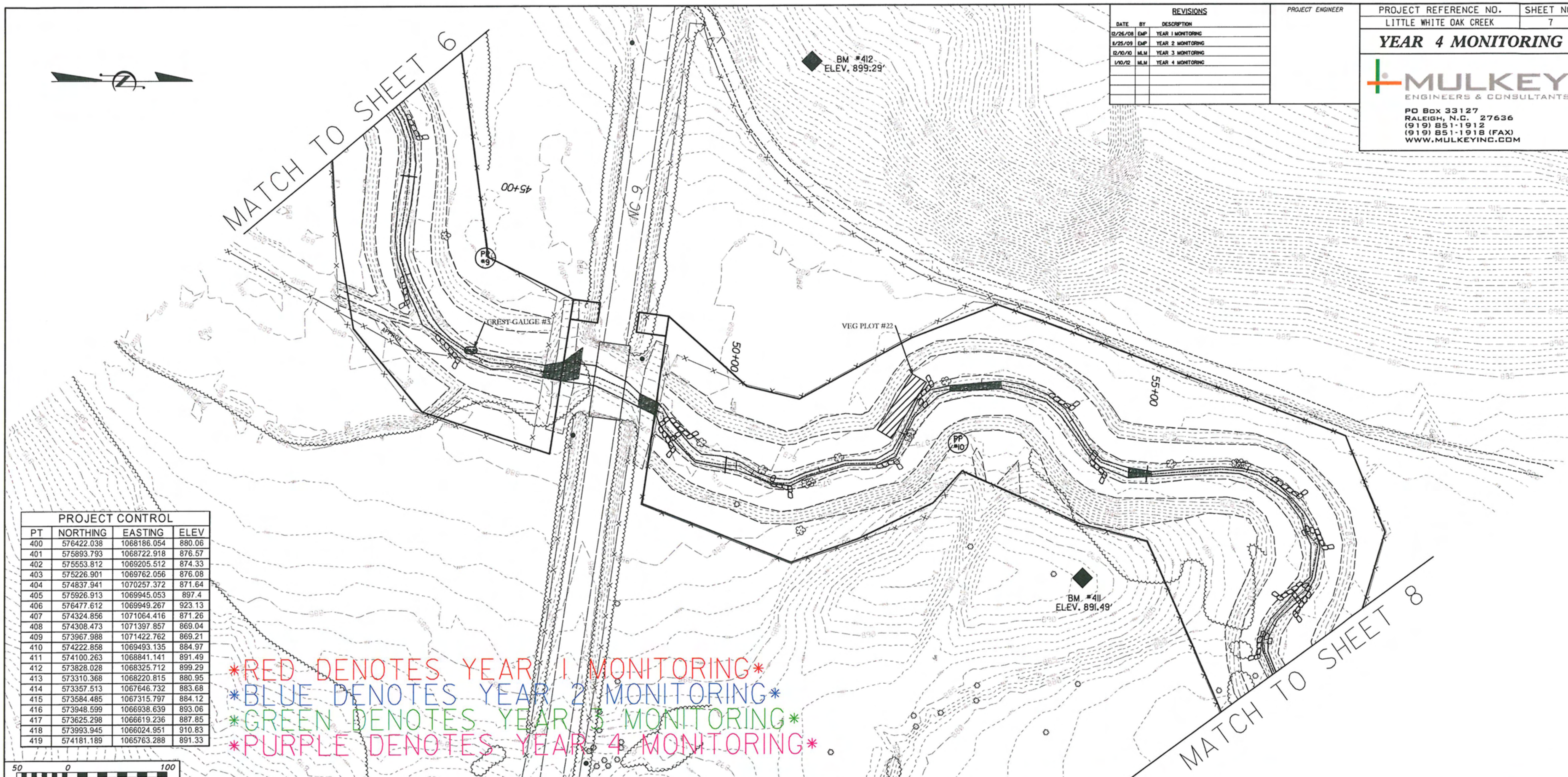
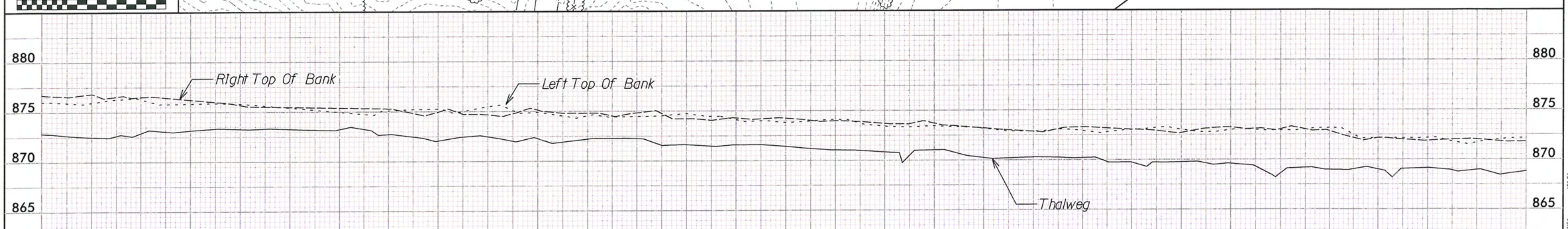



| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |




NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 8/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 8 |

# YEAR 4 MONITORING

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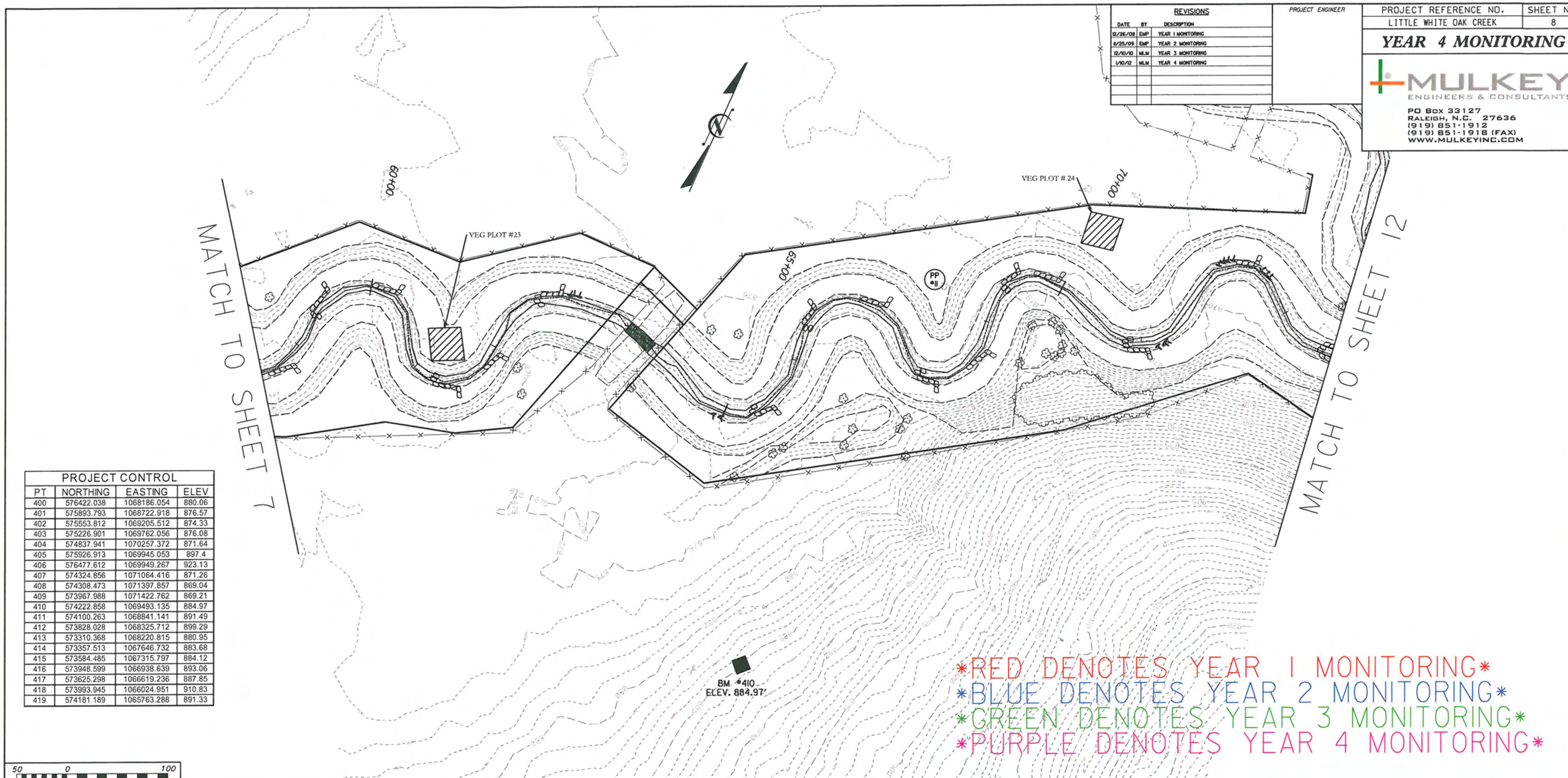
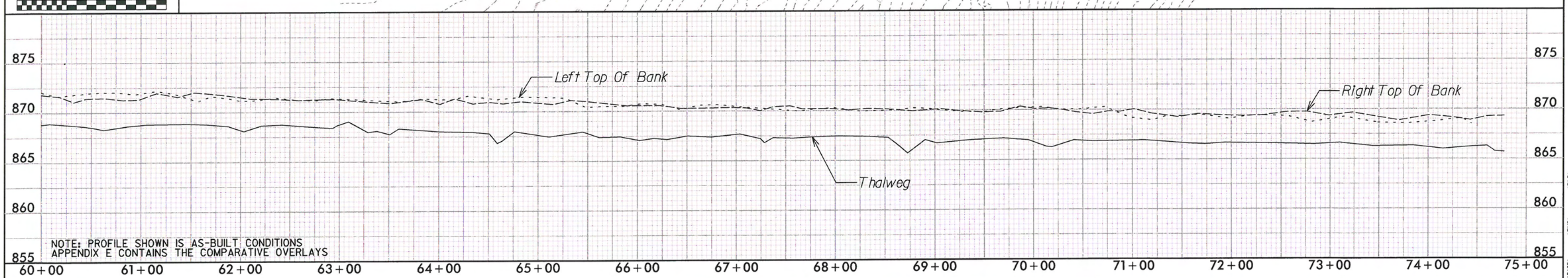



| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |



*RED DENOTES YEAR 1 MONITORING*
*BLUE DENOTES YEAR 2 MONITORING*
*GREEN DENOTES YEAR 3 MONITORING*
*PURPLE DENOTES YEAR 4 MONITORING*

| REVISIONS | | |
| --- | --- | --- |
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| LITTLE WHITE OAK CREEK | 9 |

**YEAR 4 MONITORING**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| PROJECT CONTROL | | | |
| --- | --- | --- | --- |
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

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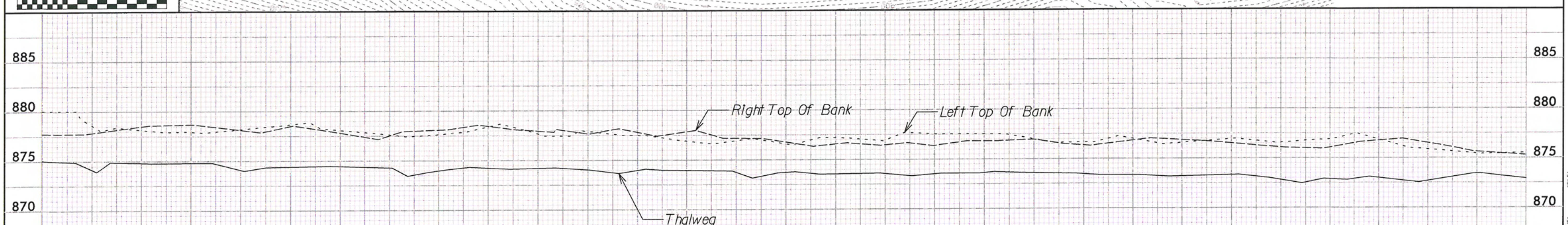


NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 10 |

# YEAR 4 MONITORING

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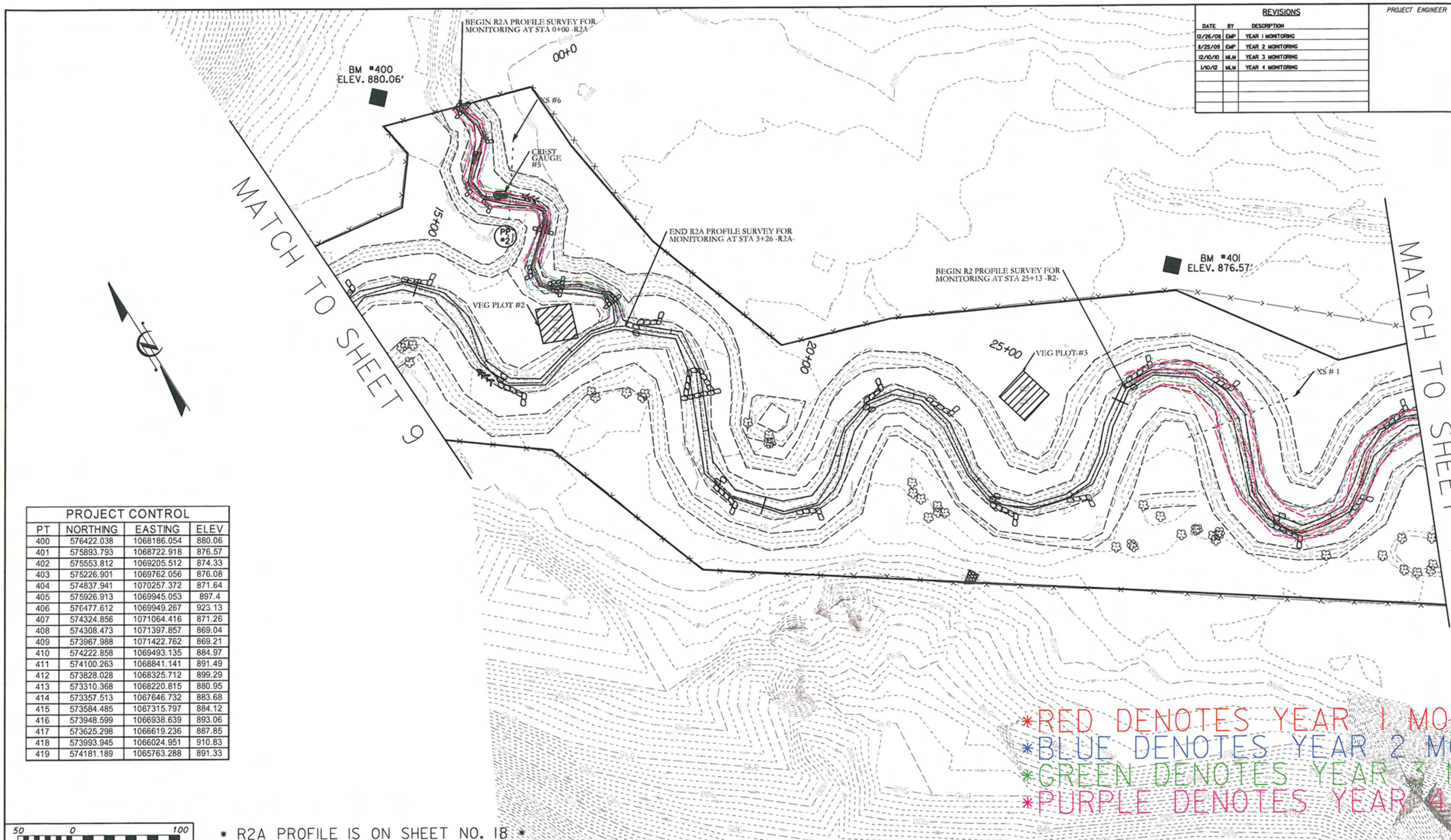
PROJECT ENGINEER

REVISIONS

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 8/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

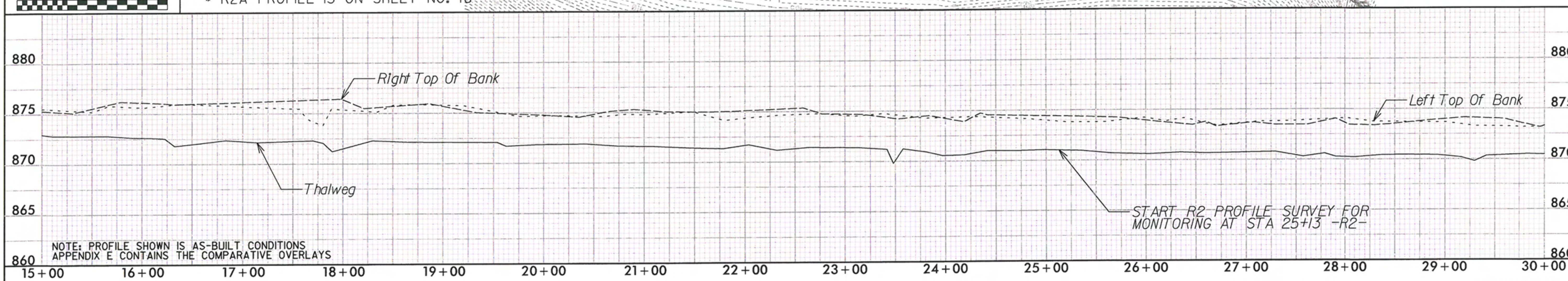



| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

*RED DENOTES YEAR 1 MONITORING*
*BLUE DENOTES YEAR 2 MONITORING*
*GREEN DENOTES YEAR 3 MONITORING*
*PURPLE DENOTES YEAR 4 MONITORING*

50 0 100

* R2A PROFILE IS ON SHEET NO. 18 *




NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 11 |

**YEAR 4 MONITORING**

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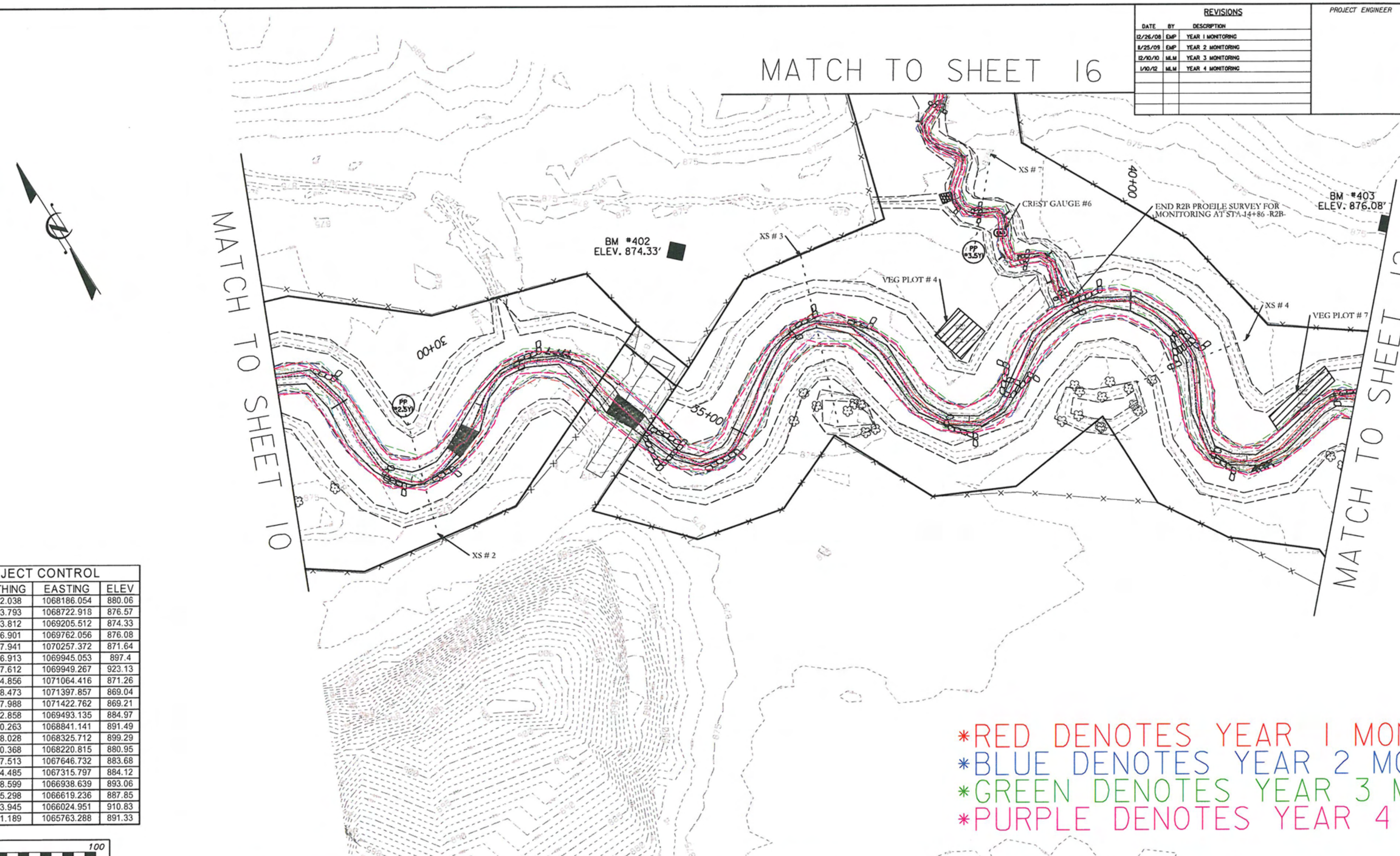


| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
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| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

50 0 100


NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
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| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

REVISIONS

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 12 |

# YEAR 4 MONITORING

MULKEY
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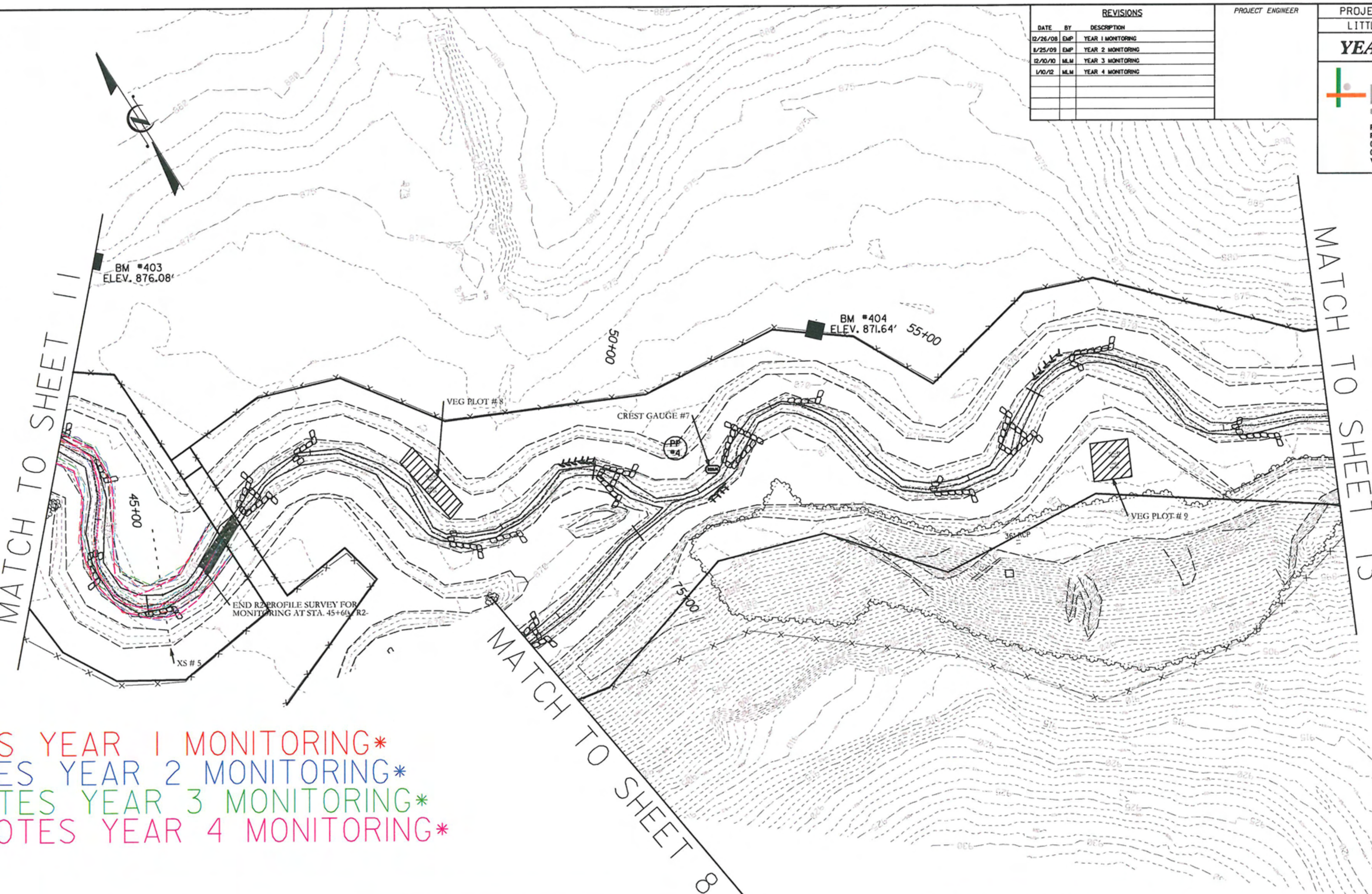
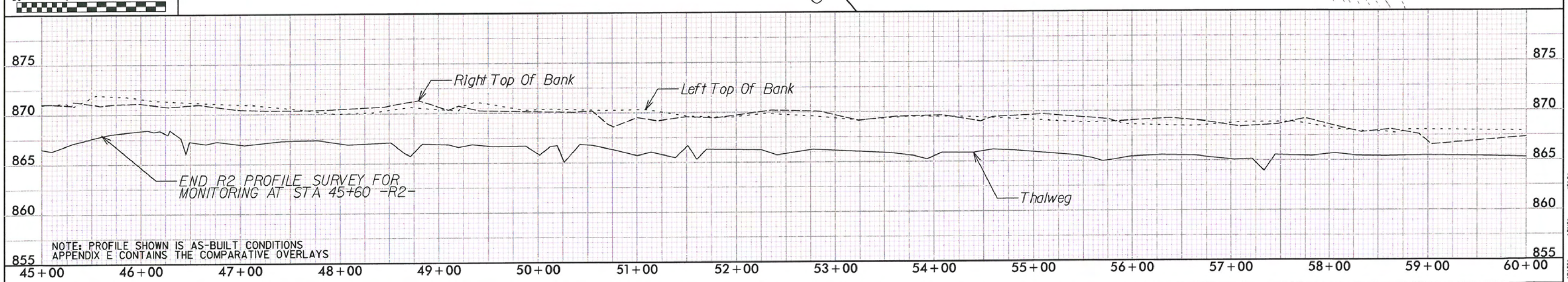
PO Box 33127
Raleigh, N.C. 27636
(919) 851-1912
(919) 851-1918 (FAX)
WWW.MULKEYINC.COM




*RED DENOTES YEAR 1 MONITORING*
*BLUE DENOTES YEAR 2 MONITORING*
*GREEN DENOTES YEAR 3 MONITORING*
*PURPLE DENOTES YEAR 4 MONITORING*




NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

**REVISIONS**

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 13 |

**YEAR 4 MONITORING**


MULKEY
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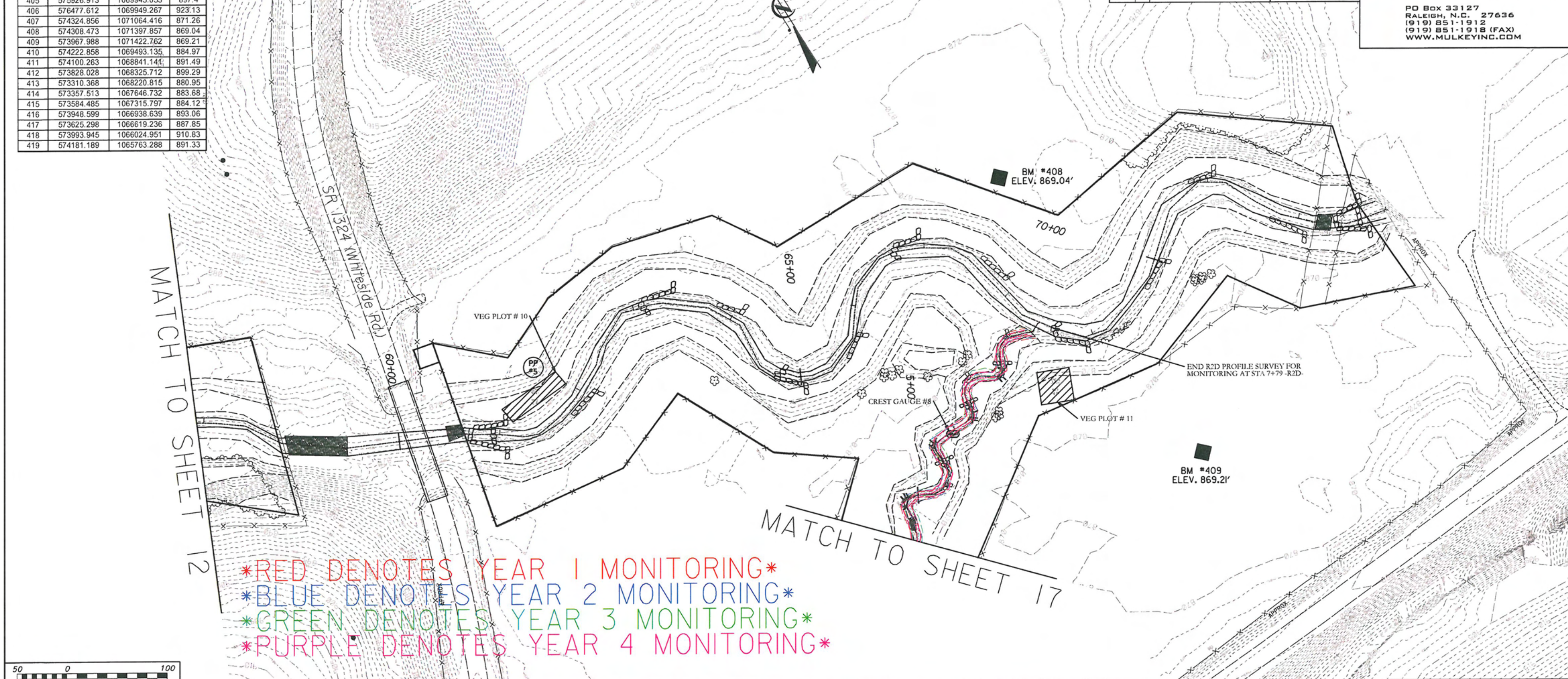


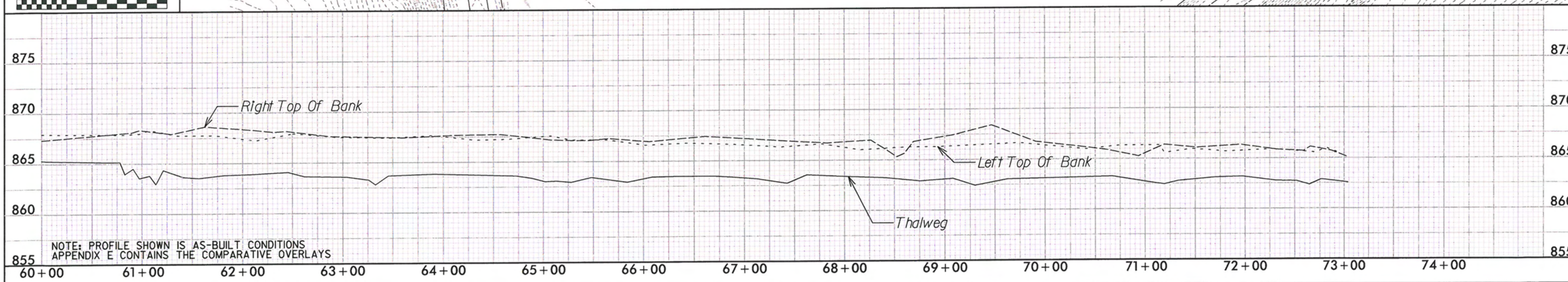

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 14 |

## YEAR 4 MONITORING

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

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PO Box 33127
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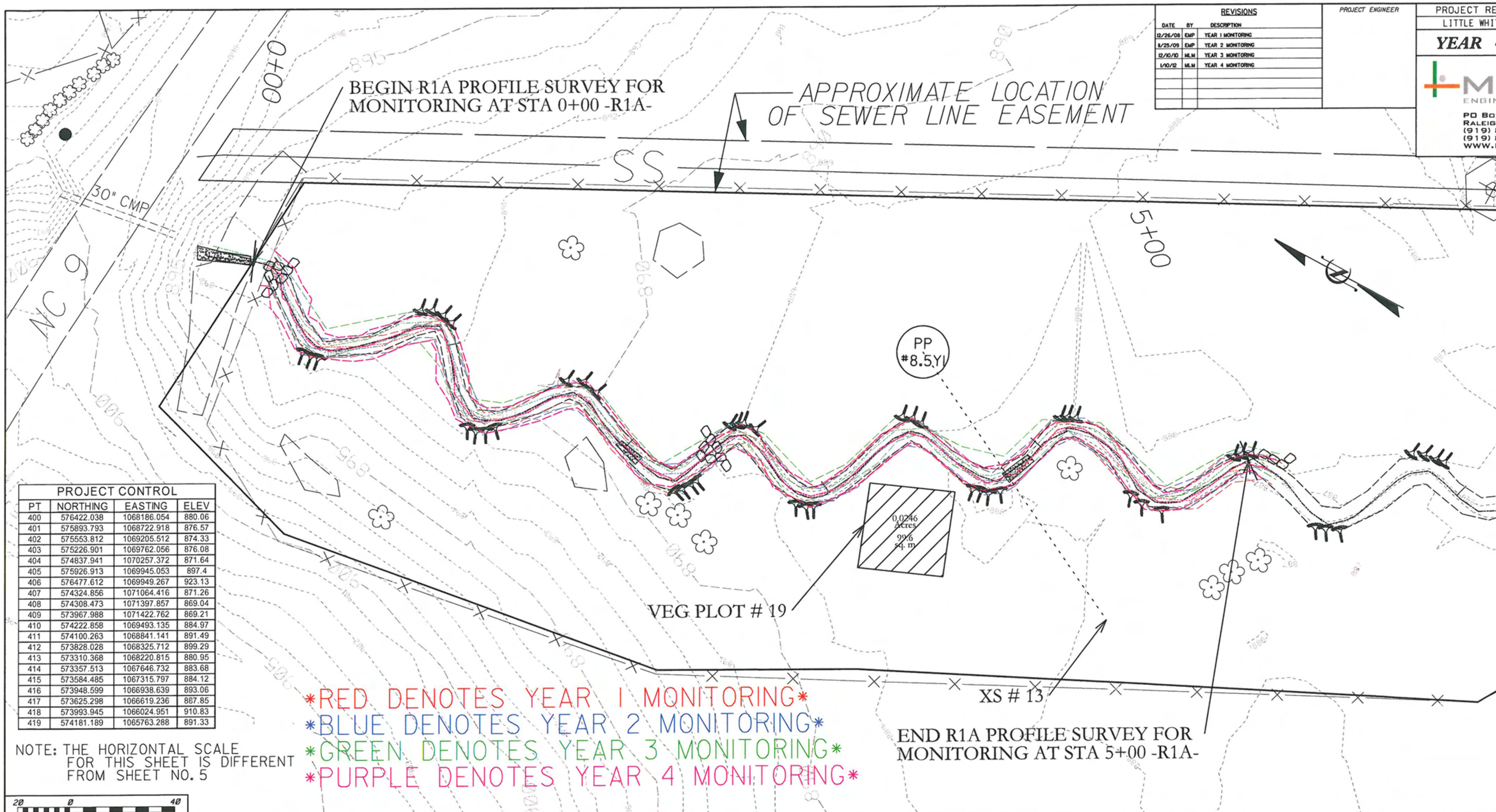


| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 5

SEE SHEET NO. 18 FOR -R1A- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 15 |

**YEAR 4 MONITORING**

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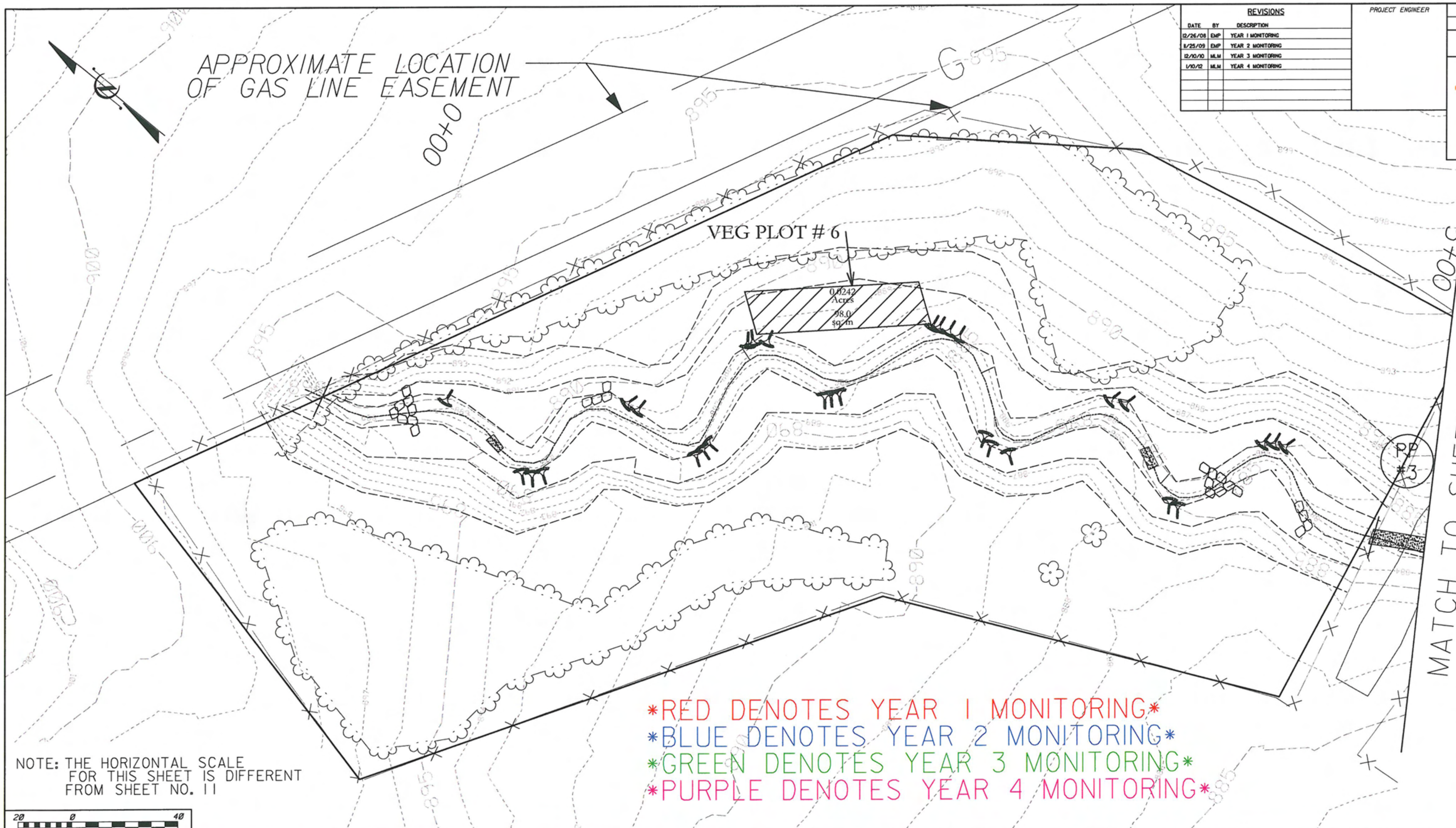


| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

SEE SHEET NO. 19 FOR -R2B- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

REVISIONS

| DATE | BY | DESCRIPTION |
|---|---|---|
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 16 |

**YEAR 4 MONITORING**


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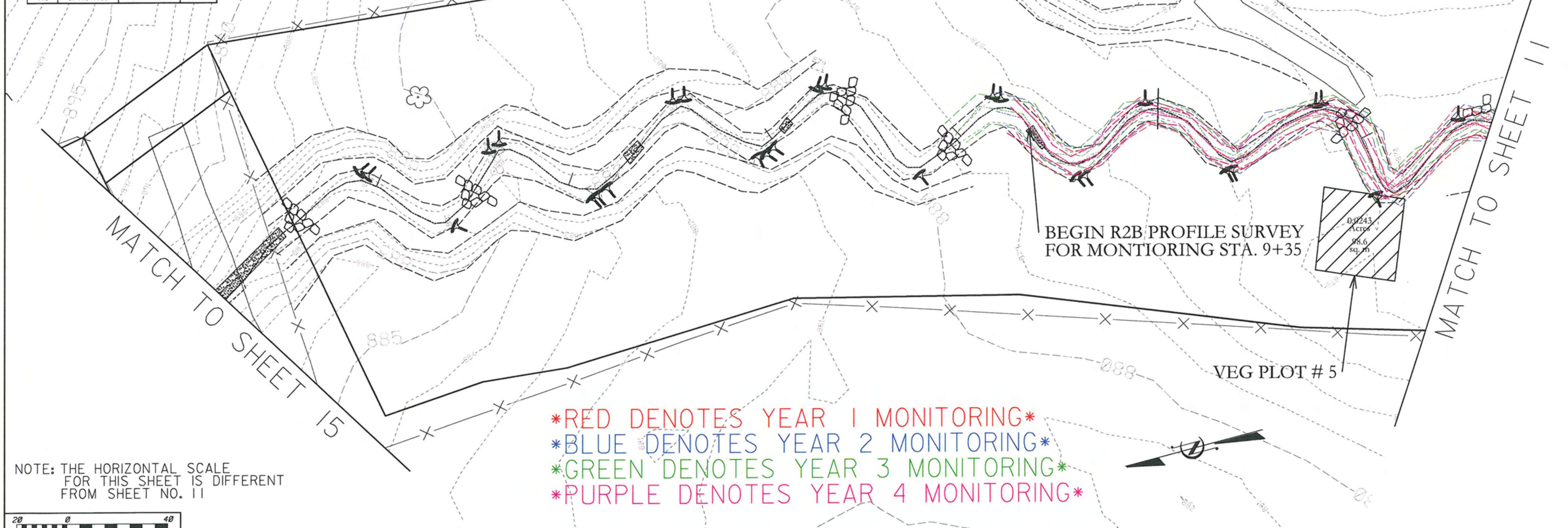


*RED DENOTES YEAR 1 MONITORING*
*BLUE DENOTES YEAR 2 MONITORING*
*GREEN DENOTES YEAR 3 MONITORING*
*PURPLE DENOTES YEAR 4 MONITORING*

NOTE: THE HORIZONTAL SCALE FOR THIS SHEET IS DIFFERENT FROM SHEET NO. 11

SEE SHEET NO. 19 FOR -R2B- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

| PROJECT CONTROL | | | |
|---|---|---|---|
| PT | NORTHING | EASTING | ELEV |
| 400 | 576422.038 | 1068186.054 | 880.06 |
| 401 | 575893.793 | 1068722.918 | 876.57 |
| 402 | 575553.812 | 1069205.512 | 874.33 |
| 403 | 575226.901 | 1069762.056 | 876.08 |
| 404 | 574837.941 | 1070257.372 | 871.64 |
| 405 | 575926.913 | 1069945.053 | 897.4 |
| 406 | 576477.612 | 1069949.267 | 923.13 |
| 407 | 574324.856 | 1071064.416 | 871.26 |
| 408 | 574308.473 | 1071397.857 | 869.04 |
| 409 | 573967.988 | 1071422.762 | 869.21 |
| 410 | 574222.858 | 1069493.135 | 884.97 |
| 411 | 574100.263 | 1068841.141 | 891.49 |
| 412 | 573828.028 | 1068325.712 | 899.29 |
| 413 | 573310.368 | 1068220.815 | 880.95 |
| 414 | 573357.513 | 1067646.732 | 883.68 |
| 415 | 573584.485 | 1067315.797 | 884.12 |
| 416 | 573948.599 | 1066938.639 | 893.06 |
| 417 | 573625.298 | 1066619.236 | 887.85 |
| 418 | 573993.945 | 1066024.951 | 910.83 |
| 419 | 574181.189 | 1065763.288 | 891.33 |

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 17 |

***YEAR 4 MONITORING***


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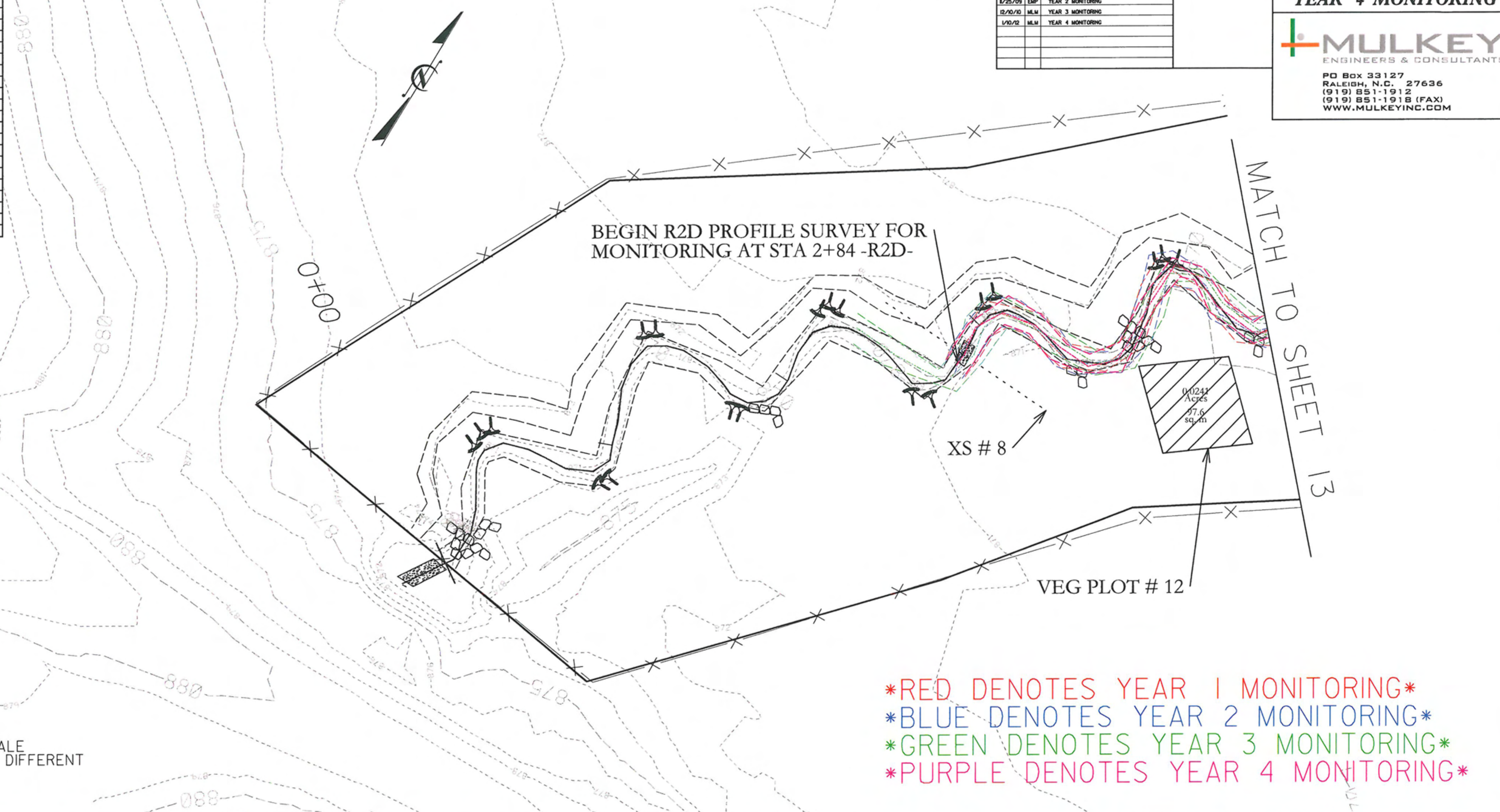



NOTE: THE HORIZONTAL SCALE
FOR THIS SHEET IS DIFFERENT
FROM SHEET NO. 13

20 0 40

SEE SHEET NO. 19 FOR -R2D- PROFILE

NOTE: PROFILE SHOWN IS AS-BUILT CONDITIONS
APPENDIX E CONTAINS THE COMPARATIVE OVERLAYS

# AS-BUILT PROFILES

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

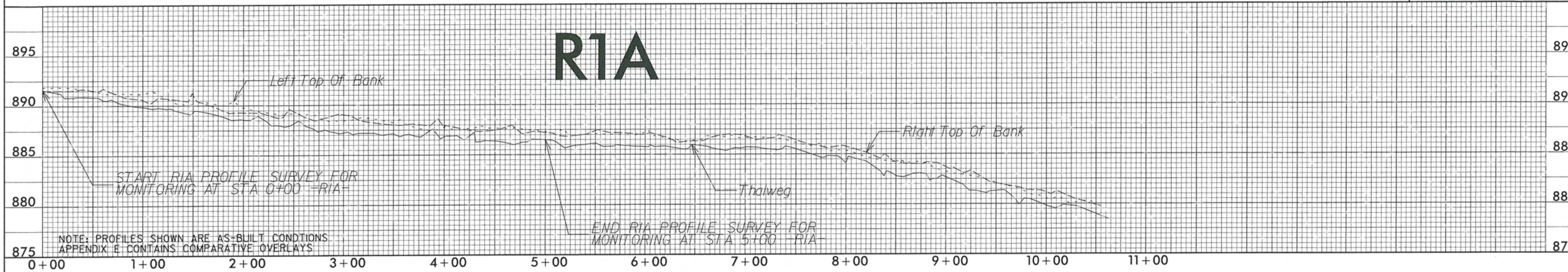
| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 18 |

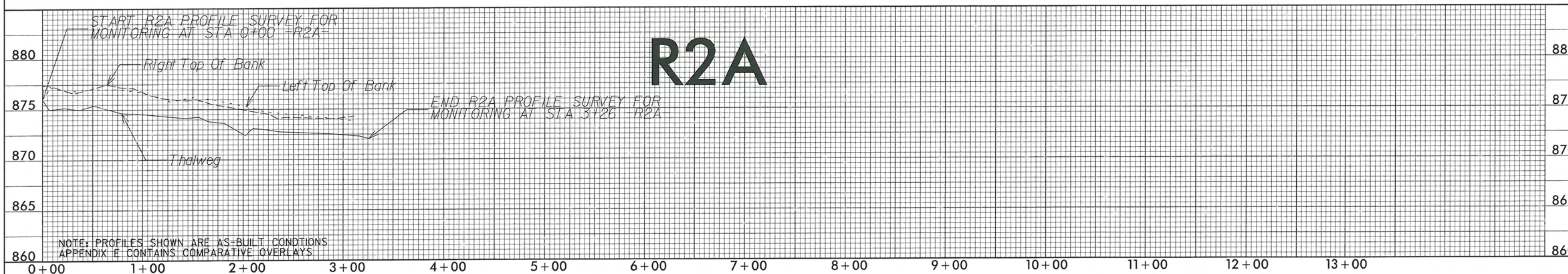
*YEAR 4 MONITORING*

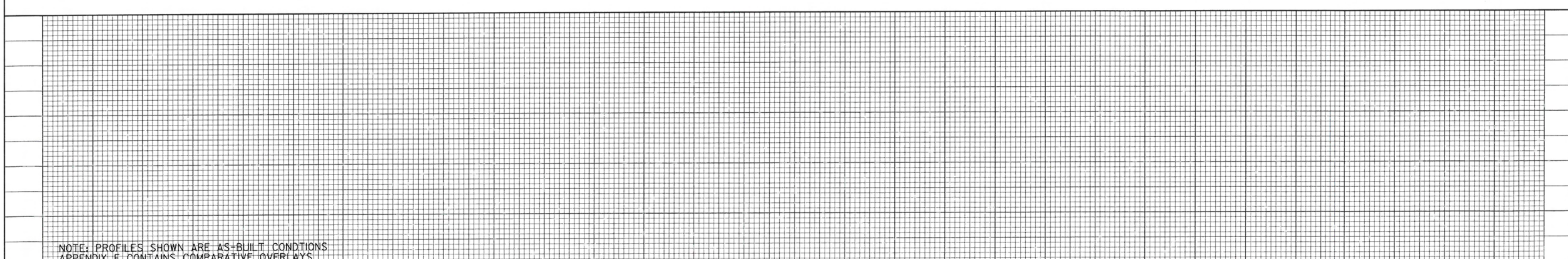
MULKEY ENGINEERS & CONSULTANTS

HORIZONTAL SCALE 50 0 100

VERTICAL SCALE 5 0 10



# AS-BUILT PROFILES

| REVISIONS | | |
|---|---|---|
| DATE | BY | DESCRIPTION |
| 12/26/08 | EMP | YEAR 1 MONITORING |
| 11/25/09 | EMP | YEAR 2 MONITORING |
| 12/10/10 | MLM | YEAR 3 MONITORING |
| 1/10/12 | MLM | YEAR 4 MONITORING |

PROJECT ENGINEER

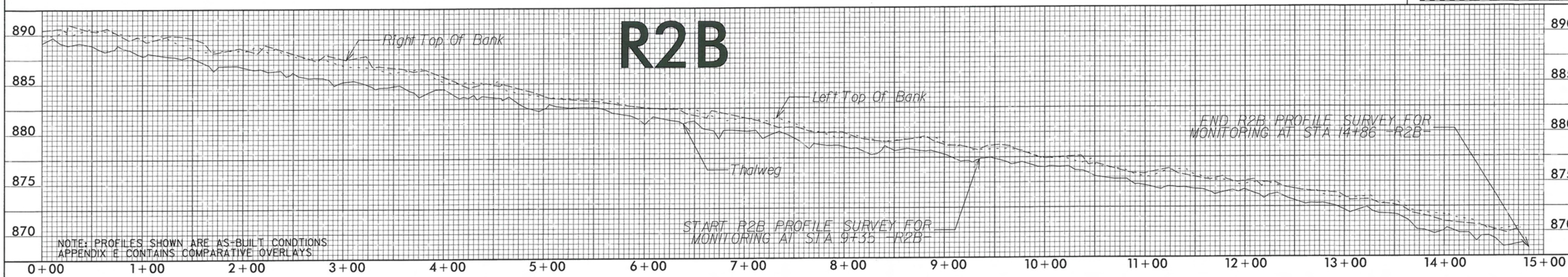
| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| LITTLE WHITE OAK CREEK | 19 |

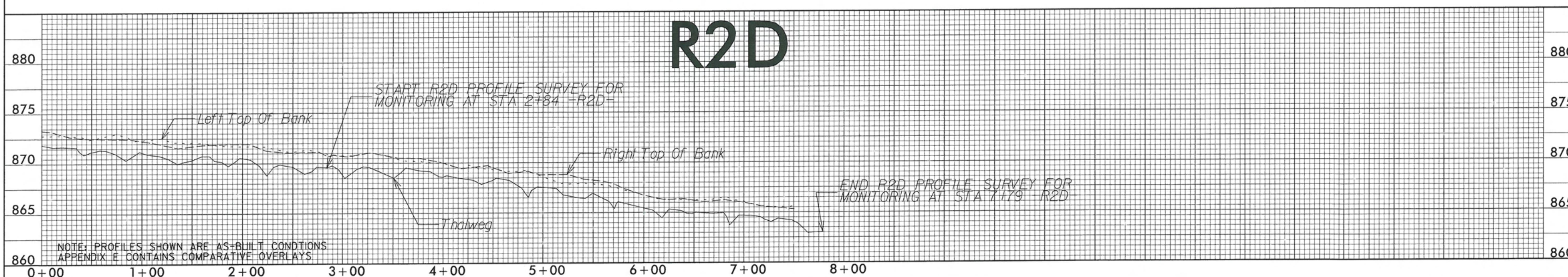
**YEAR 4 MONITORING**

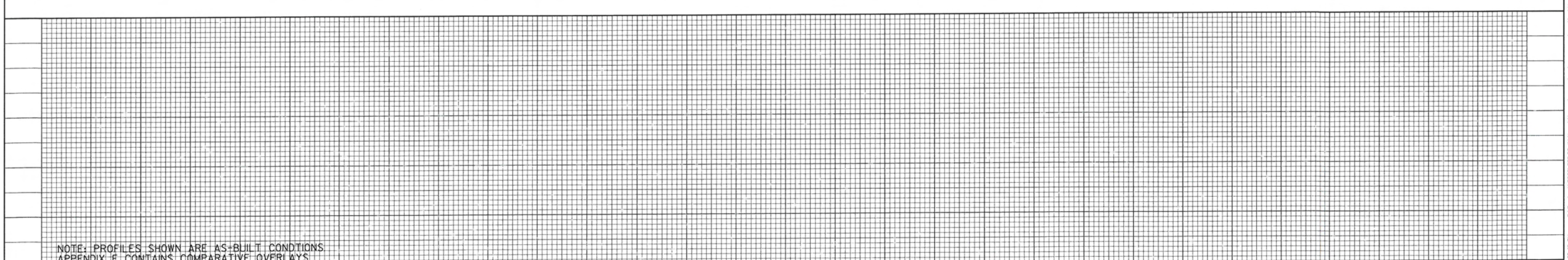
MULKEY
ENGINEERS & CONSULTANTS

HORIZONTAL SCALE 50 0 100

VERTICAL SCALE 5 0 10



# Appendix B

Vegetation Plot 1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 3


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 4


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 5


As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Vegetation Plot 6


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 7


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 8


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 9


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 10


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 11


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 12


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 13


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

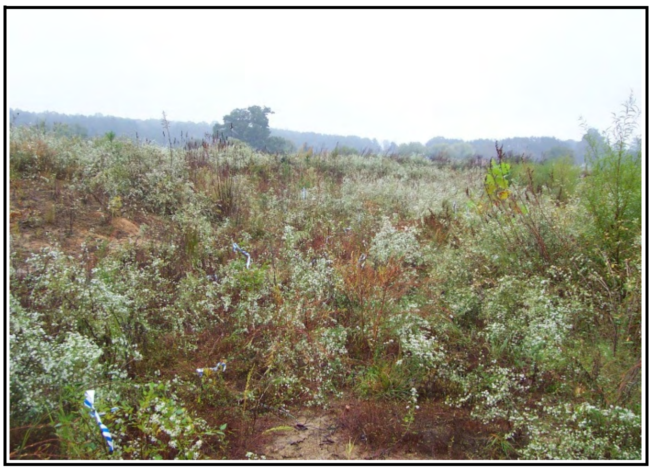
Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegeation Plot 14


As-built Survey: January 2008

Year 1 Monitoring: September 2008



Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 15


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 16


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 17


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 18


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

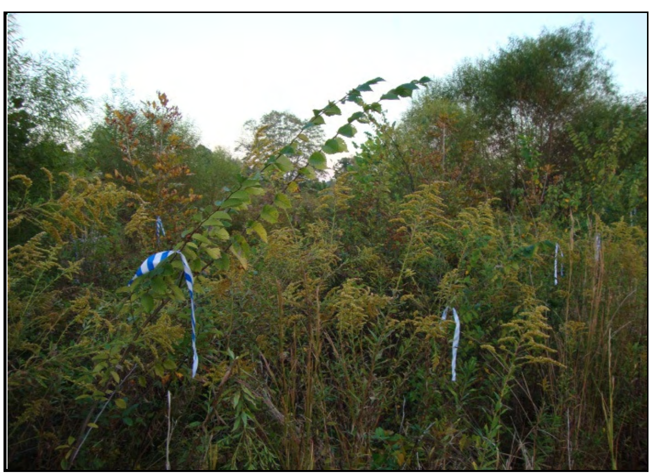
Vegetation Plot 19


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010



Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 20

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 21

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 22

As-built Survey:  January 2008

Year 1 Monitoring: September 2008

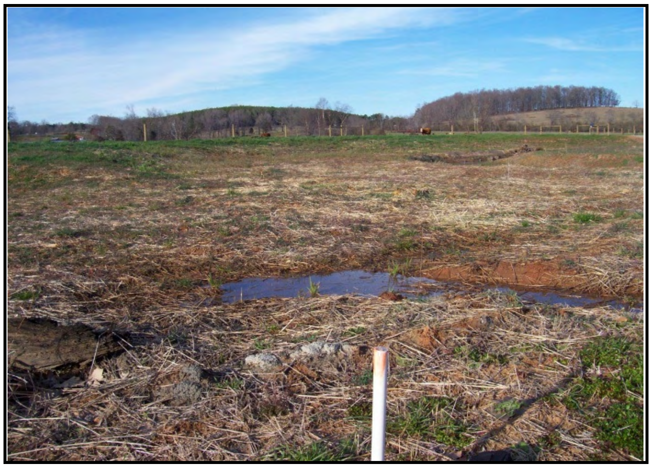
Year 2 Monitoring: October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Vegetation Plot 23



As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Vegetation Plot 24

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

# Appendix C

Photo Point 1; Looking Downstream on Reach R2


As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 2; Looking Downstream on Reach R2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 2; Looking Upstream on Reach R2


As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 2; Looking upstream on Reach R2A


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 2.5Y1; Looking Downstream Along R2

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 2.5Y1; Looking Upstream Along Reach R2

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 3; Looking Downstream Along Reach R2B


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 3; Looking Upstream Along Reach R2B


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Downstream Along R2&R2B

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Upstream Along R2

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 3.5Y1; Looking Upstream Along R2B

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 4; Looking Downstream Along R2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 4; Looking Upstream at Confluence of R1&R2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 5; Looking Downstream Along R2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 5; Looking Upstream Along R2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 6; Looking Downstream Along Reach R1


As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 6; Looking Upstream Along Reach R1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 7; Looking Downstream Along R1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 7; Looking Upstream Along R1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 8; Looking Downstream Along R1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 8; Looking Upstream Along R1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 8; Looking Upstream Along R1A


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 8.5Y1; Looking Downstream Along R1A

*Not Applicable*

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 8.5Y1; Looking Upstream Along R1A

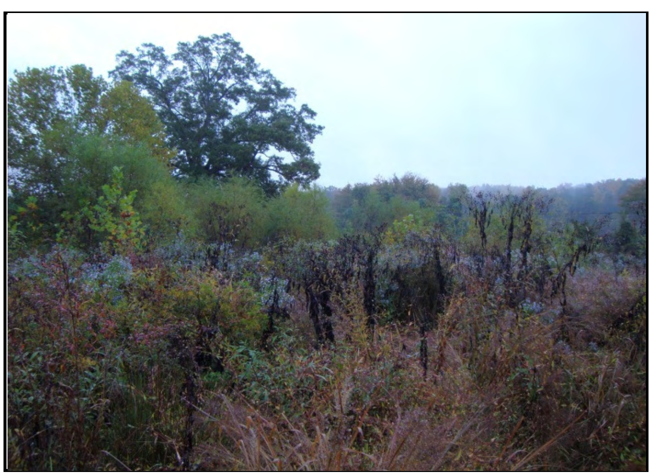
*Not Applicable*

As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010



Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 9; Looking Across Reach R1

As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 9; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 9; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 10; Looking Across Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 10; Looking Downstream Along Reach R1

As-built Survey:  January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring:  October 2009


Year 3 Monitoring:  November 2010

Year 4 Monitoring:  November 2011

Year 5 Monitoring:

Photo Point 10; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

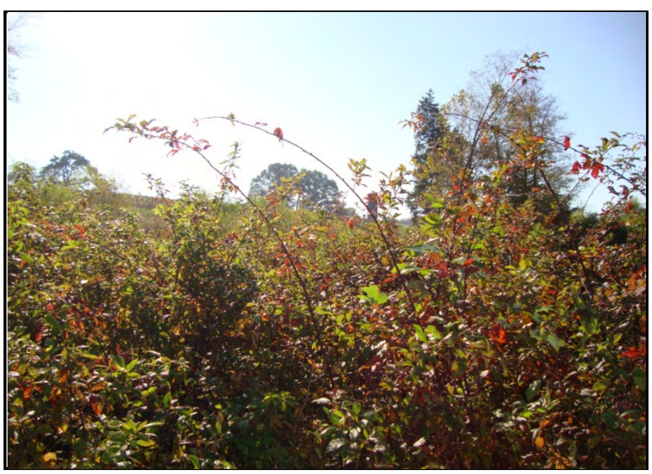
Photo Point 11; Looking Across Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010



Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 11; Looking Downstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Photo Point 11; Looking Upstream Along Reach R1

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

# Appendix D

Permanent Cross Section 1


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 2


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 3


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 4


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 5


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 6

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 7


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 8


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 9


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 10


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 11

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 12

As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: November 2009


Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

Permanent Cross Section 13


As-built Survey: January 2008

Year 1 Monitoring: September 2008

Year 2 Monitoring: October 2009

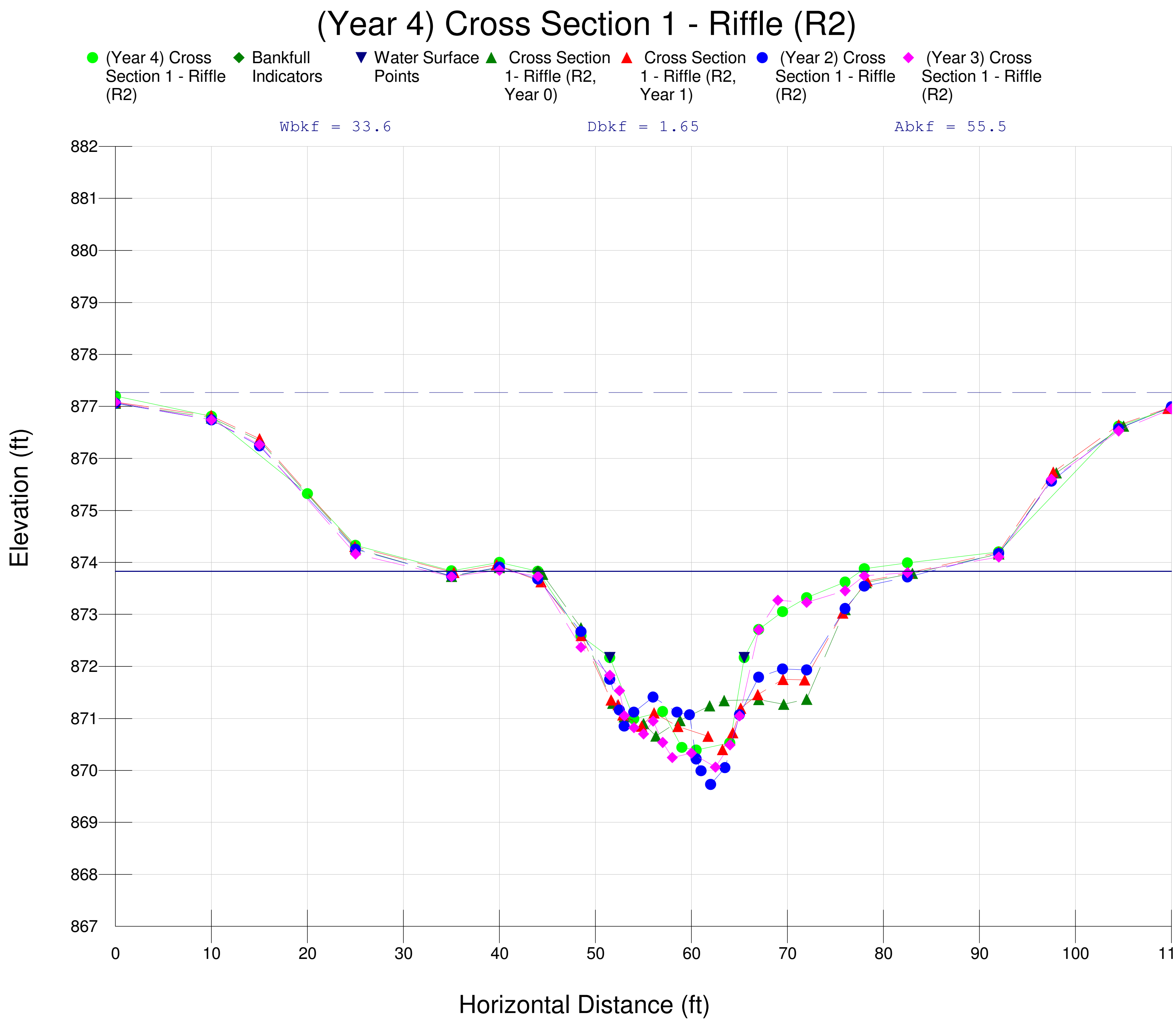

Year 3 Monitoring: November 2010

Year 4 Monitoring: November 2011

Year 5 Monitoring:

# Appendix E

# Cross Sections



(Year 4) Cross Section 1 - Riffle (R2)
(Year 4) Cross Section 1 - Riffle (R2)
Bankfull Indicators
Water Surface Points
Cross Section 1- Riffle (R2, Year 0)
Cross Section 1 - Riffle (R2, Year 1)
(Year 2) Cross Section 1 - Riffle (R2)
(Year 3) Cross Section 1 - Riffle (R2)
Wbkf = 33.6
Dbkf = 1.65
Abkf = 55.5
Elevation (ft)
882
881
880
879
878
877
876
875
874
873
872
871
870
869
868
867
0
10
20
30
40
50
60
70
80
90
100
110
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Cross Section Name: (Year 4) Cross Section 1 - Riffle (R2)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 877.2 | GS |
| 10 | 0 | 876.81 | GS |
| 20 | 0 | 875.32 | GS |
| 25 | 0 | 874.33 | GS |
| 35 | 0 | 873.84 | GS |
| 40 | 0 | 874 | GS |
| 44 | 0 | 873.83 | BKF |
| 48.5 | 0 | 872.59 | GS |
| 51.5 | 0 | 872.17 | LEW |
| 54 | 0 | 870.99 | GS |
| 57 | 0 | 871.13 | GS |
| 59 | 0 | 870.44 | GS |
| 60.5 | 0 | 870.39 | TW |
| 64 | 0 | 870.53 | GS |
| 65.5 | 0 | 872.17 | REW |
| 67 | 0 | 872.71 | GS |
| 69.5 | 0 | 873.05 | GS |
| 72 | 0 | 873.32 | GS |
| 76 | 0 | 873.62 | RB |
| 78 | 0 | 873.88 | GS |
| 82.5 | 0 | 873.99 | GS |
| 92 | 0 | 874.2 | GS |
| 104.5 | 0 | 876.62 | GS |
| 110 | 0 | 876.97 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 877.27 | 877.27 | 877.27 |
| Bankfull Elevation (ft) | 873.83 | 873.83 | 873.83 |
| Floodprone Width (ft) | 110 | ----- | ----- |
| Bankfull Width (ft) | 33.62 | 14.59 | 19.03 |
| Entrenchment Ratio | 3.27 | ----- | ----- |
| Mean Depth (ft) | 1.65 | 1.77 | 1.56 |
| Maximum Depth (ft) | 3.44 | 3.25 | 3.44 |
| Width/Depth Ratio | 20.38 | 8.24 | 12.2 |
| Bankfull Area (sq ft) | 55.48 | 25.8 | 29.68 |
| Wetted Perimeter (ft) | 35.08 | 18.4 | 23.18 |
| Hydraulic Radius (ft) | 1.58 | 1.4 | 1.28 |
| Begin BKF Station | 44 | 44 | 58.59 |
| End BKF Station | 77.62 | 58.59 | 77.62 |

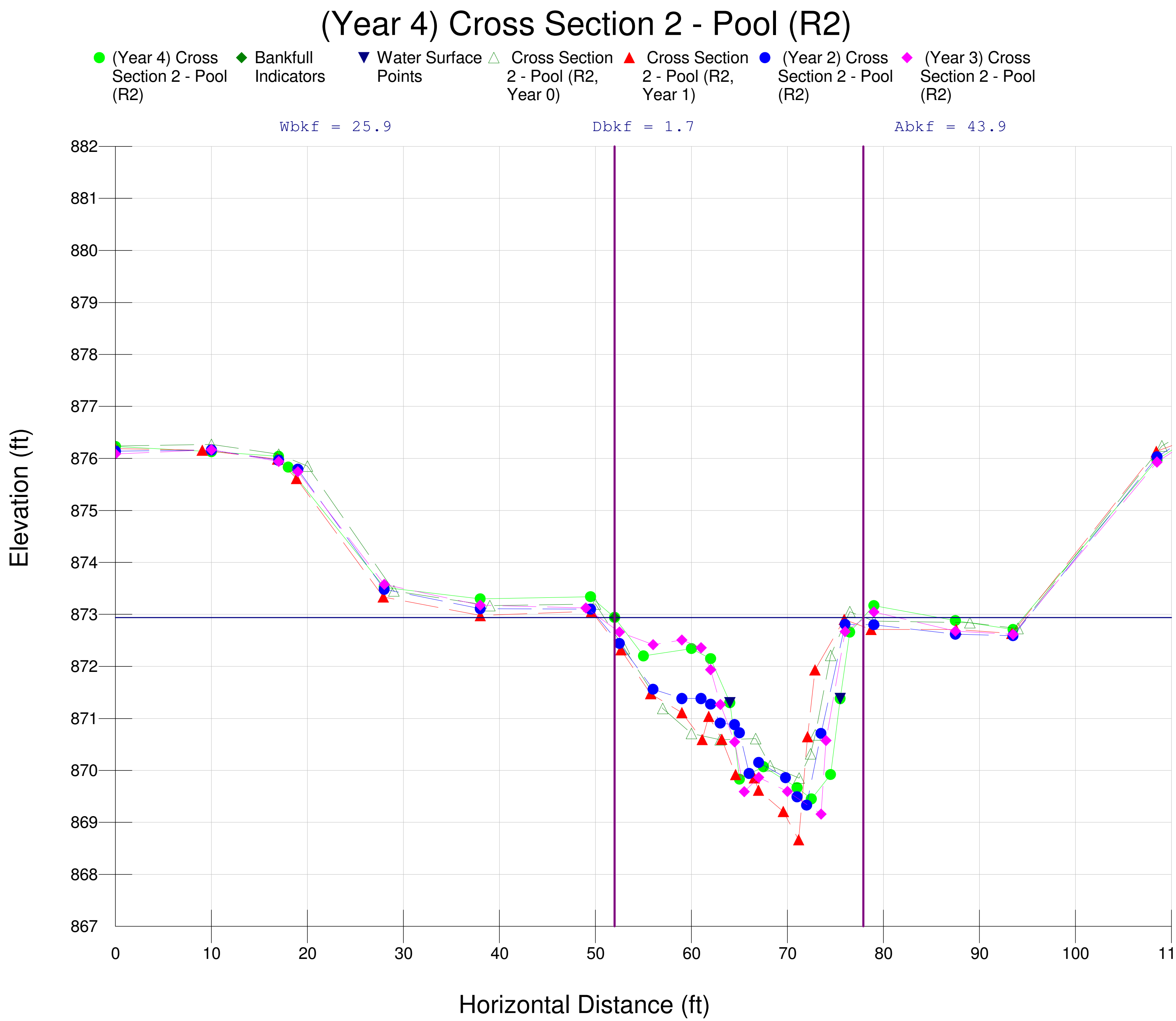
---

## Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |


(Year 4) Cross Section 2 - Pool (R2)
(Year 4) Cross Section 2 - Pool (R2)
Bankfull Indicators
Water Surface Points
Cross Section 2 - Pool (R2, Year 0)
Cross Section 2 - Pool (R2, Year 1)
(Year 2) Cross Section 2 - Pool (R2)
(Year 3) Cross Section 2 - Pool (R2)
Wbkf = 25.9
Dbkf = 1.7
Abkf = 43.9
Elevation (ft)
882
881
880
879
878
877
876
875
874
873
872
871
870
869
868
867
0
10
20
30
40
50
60
70
80
90
100
110
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Cross Section Name: (Year 4) Cross Section 2 - Pool (R2)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 876.23 | GS |
| 10 | 0 | 876.13 | GS |
| 17 | 0 | 876.04 | GS |
| 18 | 0 | 875.83 | GS |
| 28 | 0 | 873.52 | GS |
| 38 | 0 | 873.3 | GS |
| 49.5 | 0 | 873.34 | GS |
| 52 | 0 | 872.94 | BKF |
| 55 | 0 | 872.2 | GS |
| 60 | 0 | 872.34 | GS |
| 62 | 0 | 872.15 | GS |
| 64 | 0 | 871.3 | LEW |
| 65 | 0 | 869.83 | GS |
| 67.5 | 0 | 870.07 | GS |
| 71 | 0 | 869.67 | GS |
| 72.5 | 0 | 869.45 | TW |
| 74.5 | 0 | 869.92 | GS |
| 75.5 | 0 | 871.38 | REW |
| 76.5 | 0 | 872.66 | GS |
| 79 | 0 | 873.17 | RB |
| 87.5 | 0 | 872.88 | GS |
| 93.5 | 0 | 872.71 | GS |
| 108.5 | 0 | 875.97 | GS |
| 112 | 0 | 876.4 | GS |
| 120 | 0 | 876.1 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 876.43 | 876.43 | 876.43 |
| Bankfull Elevation (ft) | 872.94 | 872.94 | 872.94 |
| Floodprone Width (ft) | 120 | ----- | ----- |
| Bankfull Width (ft) | 25.87 | 17.34 | 8.53 |
| Entrenchment Ratio | 4.64 | ----- | ----- |
| Mean Depth (ft) | 1.7 | 1.36 | 2.37 |
| Maximum Depth (ft) | 3.49 | 3.11 | 3.49 |
| Width/Depth Ratio | 15.22 | 12.75 | 3.6 |
| Bankfull Area (sq ft) | 43.86 | 23.6 | 20.25 |
| Wetted Perimeter (ft) | 28.45 | 21.5 | 13.11 |
| Hydraulic Radius (ft) | 1.54 | 1.1 | 1.54 |
| Begin BKF Station | 52 | 52 | 69.34 |
| End BKF Station | 77.87 | 69.34 | 77.87 |

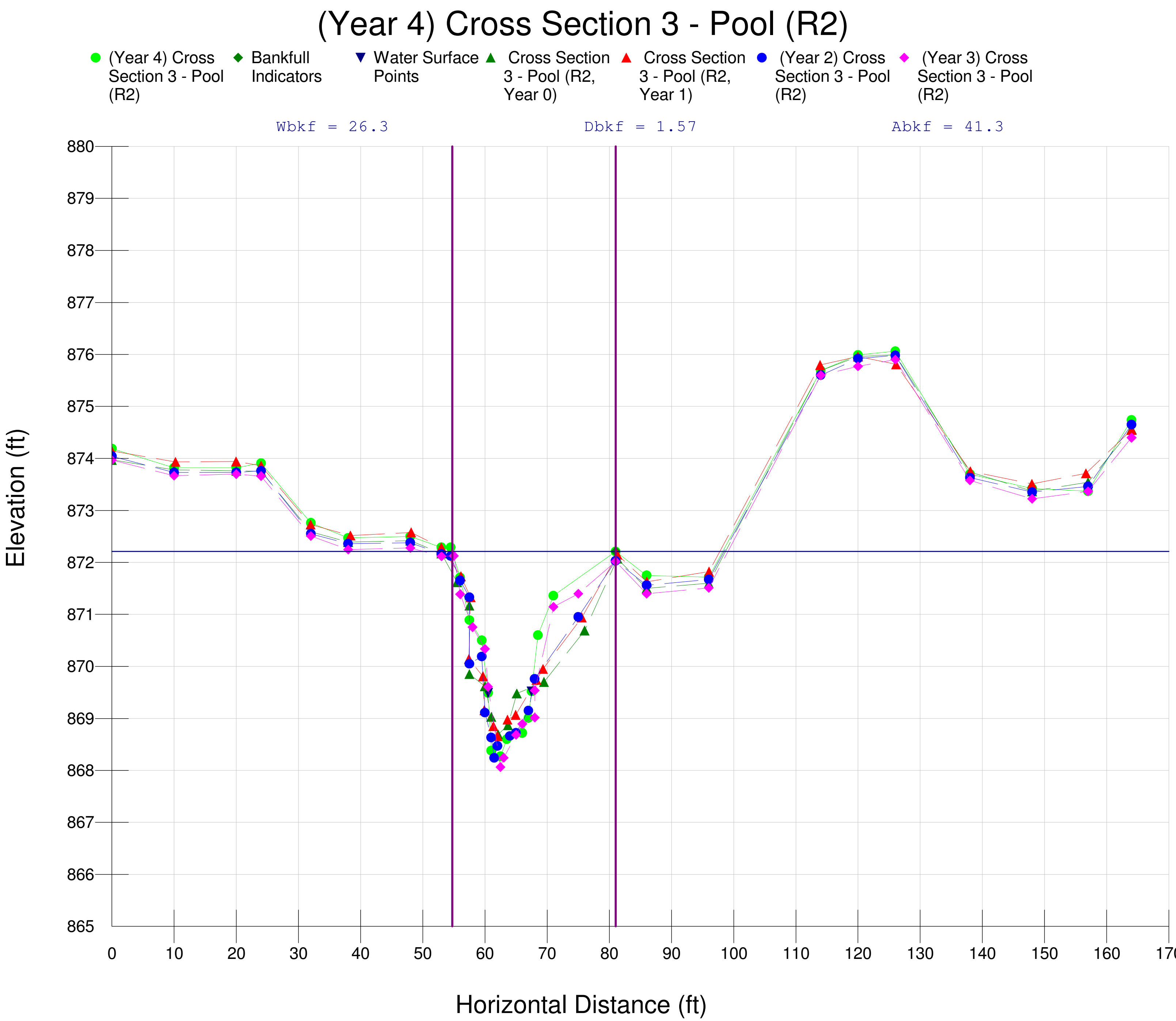
---

## Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 3 - Pool (R2)
(Year 4) Cross Section 3 - Pool (R2)
Bankfull Indicators
Water Surface Points
Cross Section 3 - Pool (R2, Year 0)
Cross Section 3 - Pool (R2, Year 1)
(Year 2) Cross Section 3 - Pool (R2)
(Year 3) Cross Section 3 - Pool (R2)
Wbkf = 26.3
Dbkf = 1.57
Abkf = 41.3
Elevation (ft)
Horizontal Distance (ft)
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Cross Section Name: (Year 4) Cross Section 3 - Pool (R2)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 874.19 | GS |
| 10 | 0 | 873.82 | GS |
| 20 | 0 | 873.82 | GS |
| 24 | 0 | 873.91 | GS |
| 32 | 0 | 872.76 | GS |
| 38 | 0 | 872.47 | GS |
| 48 | 0 | 872.5 | GS |
| 53 | 0 | 872.29 | GS |
| 54.5 | 0 | 872.29 | GS |
| 56 | 0 | 871.71 | LB |
| 57.5 | 0 | 870.89 | GS |
| 59.5 | 0 | 870.5 | GS |
| 60.5 | 0 | 869.49 | LEW |
| 61 | 0 | 868.38 | GS |
| 62.5 | 0 | 868.27 | TW |
| 63.5 | 0 | 868.6 | GS |
| 66 | 0 | 868.72 | GS |
| 67 | 0 | 869.01 | GS |
| 67.5 | 0 | 869.52 | REW |
| 68.5 | 0 | 870.6 | GS |
| 71 | 0 | 871.36 | GS |
| 81 | 0 | 872.21 | BKF |
| 86 | 0 | 871.75 | GS |
| 96 | 0 | 871.72 | GS |
| 114 | 0 | 875.69 | GS |
| 120 | 0 | 875.99 | GS |
| 126 | 0 | 876.06 | GS |
| 138 | 0 | 873.7 | GS |
| 148 | 0 | 873.42 | GS |
| 157 | 0 | 873.37 | GS |
| 164 | 0 | 874.74 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 876.15 | 876.15 | 876.15 |
| Bankfull Elevation (ft) | 872.21 | 872.21 | 872.21 |
| Floodprone Width (ft) | 164 | ----- | ----- |
| Bankfull Width (ft) | 26.27 | 21.81 | 4.46 |
| Entrenchment Ratio | 6.24 | ----- | ----- |
| Mean Depth (ft) | 1.57 | 1.86 | 0.19 |
| Maximum Depth (ft) | 3.94 | 3.94 | 0.38 |
| Width/Depth Ratio | 16.73 | 11.73 | 23.47 |
| Bankfull Area (sq ft) | 41.34 | 40.5 | 0.85 |
| Wetted Perimeter (ft) | 28.69 | 24.6 | 4.86 |
| Hydraulic Radius (ft) | 1.44 | 1.65 | 0.17 |

| | | | |
|---|---|---|---|
| Begin BKF Station | 54.73 | 54.73 | 76.54 |
| End BKF Station | 81 | 76.54 | 81 |

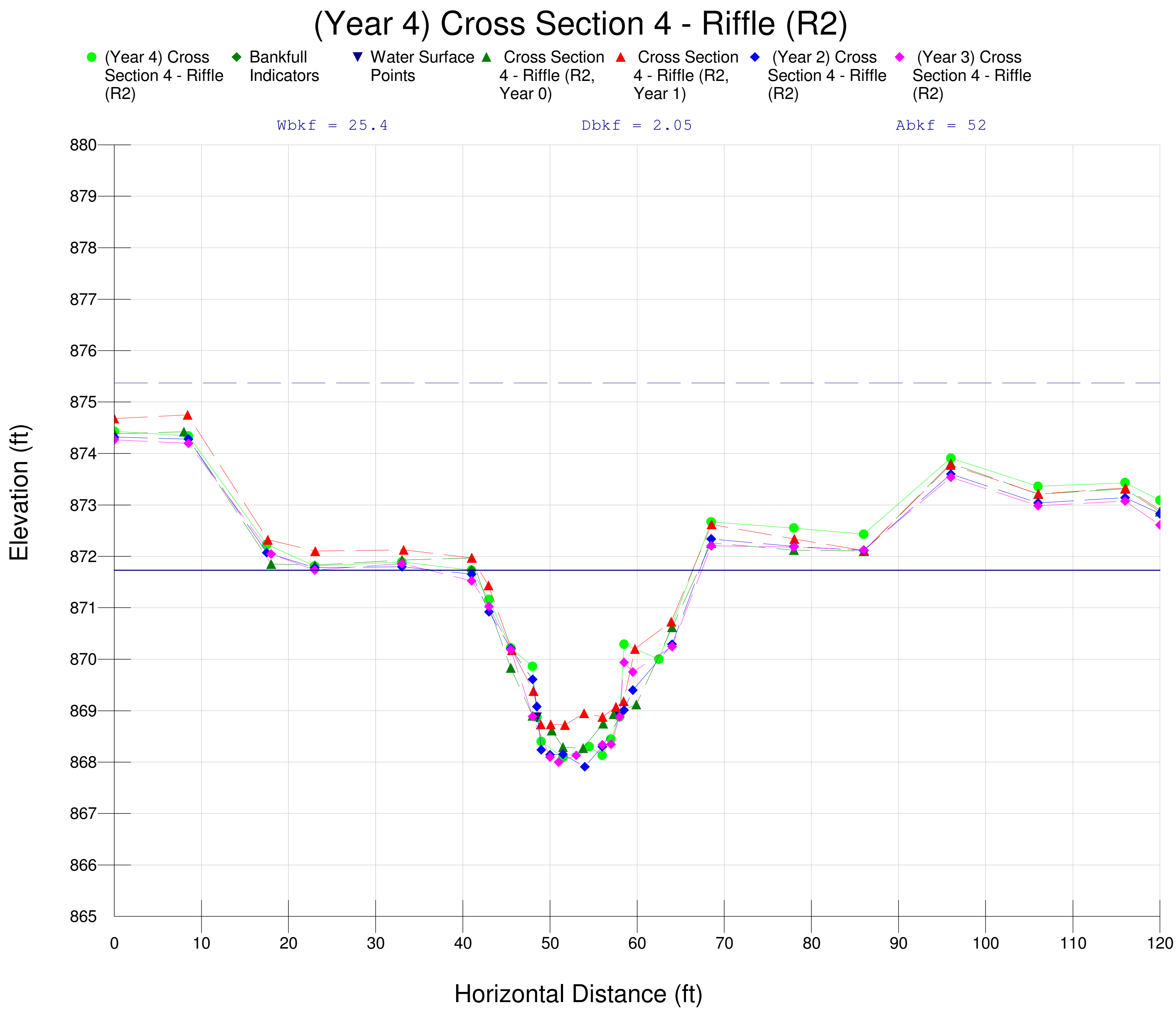
---

Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 4 - Riffle (R2)
(Year 4) Cross Section 4 - Riffle (R2)
Bankfull Indicators
Water Surface Points
Cross Section 4 - Riffle (R2, Year 0)
Cross Section 4 - Riffle (R2, Year 1)
(Year 2) Cross Section 4 - Riffle (R2)
(Year 3) Cross Section 4 - Riffle (R2)
Wbkf = 25.4
Dbkf = 2.05
Abkf = 52
Elevation (ft)
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
0
10
20
30
40
50
60
70
80
90
100
110
120
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Cross Section Name: (Year 4) Cross Section 4 - Riffle (R2)
Survey Date: 11/15/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 874.43 | GS |
| 8.5 | 0 | 874.34 | GS |
| 17.5 | 0 | 872.23 | GS |
| 23 | 0 | 871.81 | GS |
| 33 | 0 | 871.89 | GS |
| 41 | 0 | 871.73 | BKF |
| 43 | 0 | 871.16 | GS |
| 45.5 | 0 | 870.22 | GS |
| 48 | 0 | 869.86 | GS |
| 48.5 | 0 | 868.87 | LEW |
| 49 | 0 | 868.4 | GS |
| 51.5 | 0 | 868.09 | TW |
| 54.5 | 0 | 868.3 | GS |
| 56 | 0 | 868.13 | GS |
| 57 | 0 | 868.45 | GS |
| 58 | 0 | 868.88 | REW |
| 58.5 | 0 | 870.29 | GS |
| 62.5 | 0 | 870 | GS |
| 68.5 | 0 | 872.67 | RB |
| 78 | 0 | 872.55 | GS |
| 86 | 0 | 872.43 | GS |
| 96 | 0 | 873.91 | GS |
| 106 | 0 | 873.36 | GS |
| 116 | 0 | 873.43 | GS |
| 120 | 0 | 873.09 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 875.37 | 875.37 | 875.37 |
| Bankfull Elevation (ft) | 871.73 | 871.73 | 871.73 |
| Floodprone Width (ft) | 120 | ----- | ----- |
| Bankfull Width (ft) | 25.39 | 12.69 | 12.7 |
| Entrenchment Ratio | 4.73 | ----- | ----- |
| Mean Depth (ft) | 2.05 | 2.1 | 2 |
| Maximum Depth (ft) | 3.64 | 3.64 | 3.6 |
| Width/Depth Ratio | 12.39 | 6.04 | 6.35 |
| Bankfull Area (sq ft) | 52 | 26.64 | 25.35 |
| Wetted Perimeter (ft) | 28.01 | 17.27 | 17.71 |
| Hydraulic Radius (ft) | 1.86 | 1.54 | 1.43 |
| Begin BKF Station | 41 | 41 | 53.69 |
| End BKF Station | 66.39 | 53.69 | 66.39 |

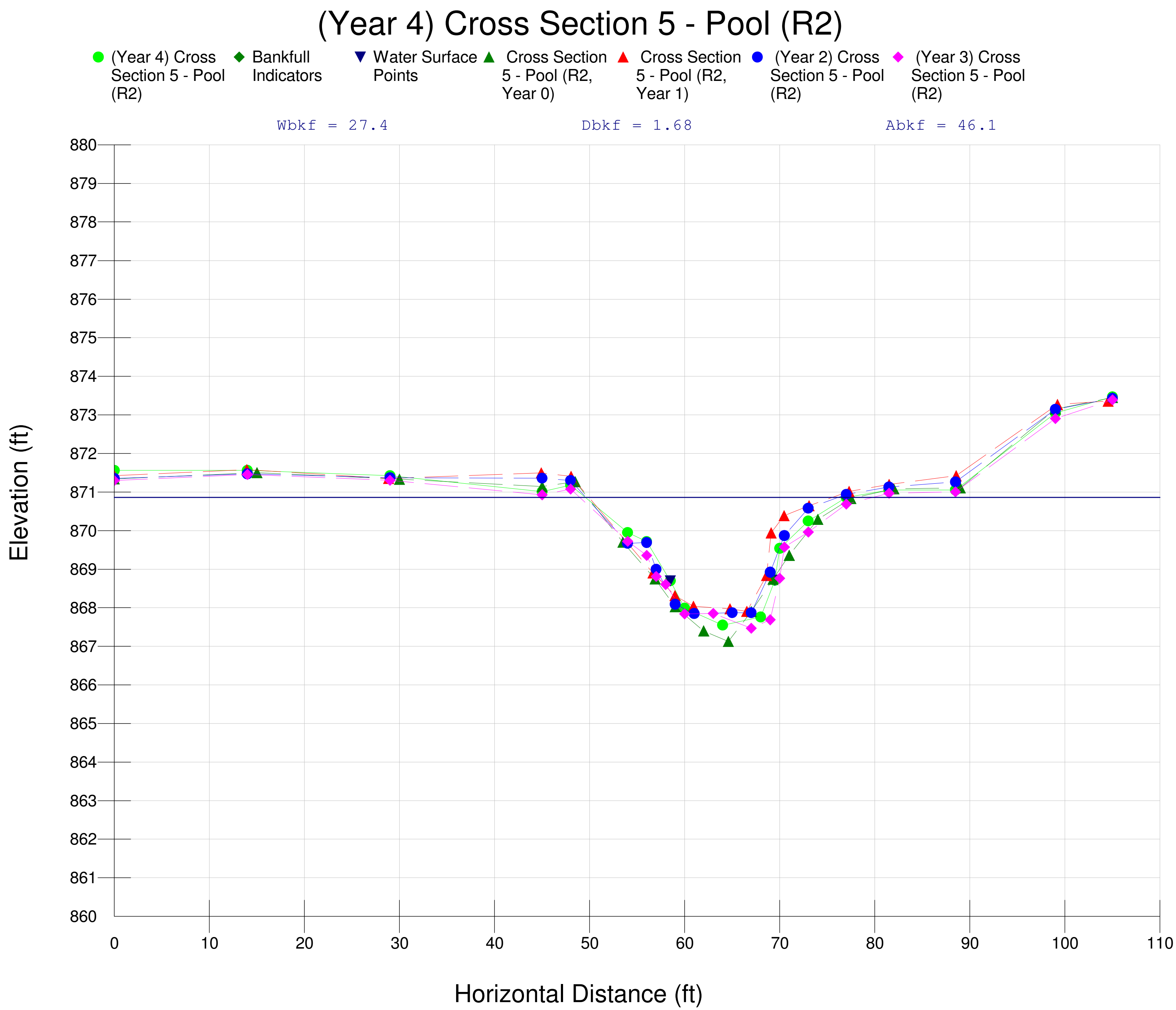
---

## Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |


(Year 4) Cross Section 5 - Pool (R2)
(Year 4) Cross Section 5 - Pool (R2)
Bankfull Indicators
Water Surface Points
Cross Section 5 - Pool (R2, Year 0)
Cross Section 5 - Pool (R2, Year 1)
(Year 2) Cross Section 5 - Pool (R2)
(Year 3) Cross Section 5 - Pool (R2)
Wbkf = 27.4
Dbkf = 1.68
Abkf = 46.1
Elevation (ft)
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
864
863
862
861
860
0
10
20
30
40
50
60
70
80
90
100
110
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Cross Section Name: (Year 4) Cross Section 5 - Pool (R2)
Survey Date: 11/15/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 871.56 | GS |
| 14 | 0 | 871.56 | GS |
| 29 | 0 | 871.42 | GS |
| 45 | 0 | 871.01 | GS |
| 48 | 0 | 871.18 | LB |
| 54 | 0 | 869.95 | GS |
| 56 | 0 | 869.72 | GS |
| 58.5 | 0 | 868.7 | LEW |
| 60 | 0 | 867.99 | GS |
| 64 | 0 | 867.55 | TW |
| 68 | 0 | 867.76 | GS |
| 69.5 | 0 | 868.71 | REW |
| 70 | 0 | 869.54 | GS |
| 73 | 0 | 870.25 | GS |
| 77 | 0 | 870.86 | BKF |
| 81.5 | 0 | 871.05 | GS |
| 88.5 | 0 | 871.05 | GS |
| 99 | 0 | 873.05 | GS |
| 105 | 0 | 873.47 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 874.17 | 874.17 | 874.17 |
| Bankfull Elevation (ft) | 870.86 | 870.86 | 870.86 |
| Floodprone Width (ft) | 105 | ----- | ----- |
| Bankfull Width (ft) | 27.44 | 13.72 | 13.72 |
| Entrenchment Ratio | 3.83 | ----- | ----- |
| Mean Depth (ft) | 1.68 | 1.6 | 1.76 |
| Maximum Depth (ft) | 3.31 | 3.23 | 3.31 |
| Width/Depth Ratio | 16.33 | 8.57 | 7.8 |
| Bankfull Area (sq ft) | 46.07 | 21.97 | 24.09 |
| Wetted Perimeter (ft) | 28.81 | 17.43 | 17.83 |
| Hydraulic Radius (ft) | 1.6 | 1.26 | 1.35 |
| Begin BKF Station | 49.56 | 49.56 | 63.28 |
| End BKF Station | 77 | 63.28 | 77 |

---

## Entrainment Calculations

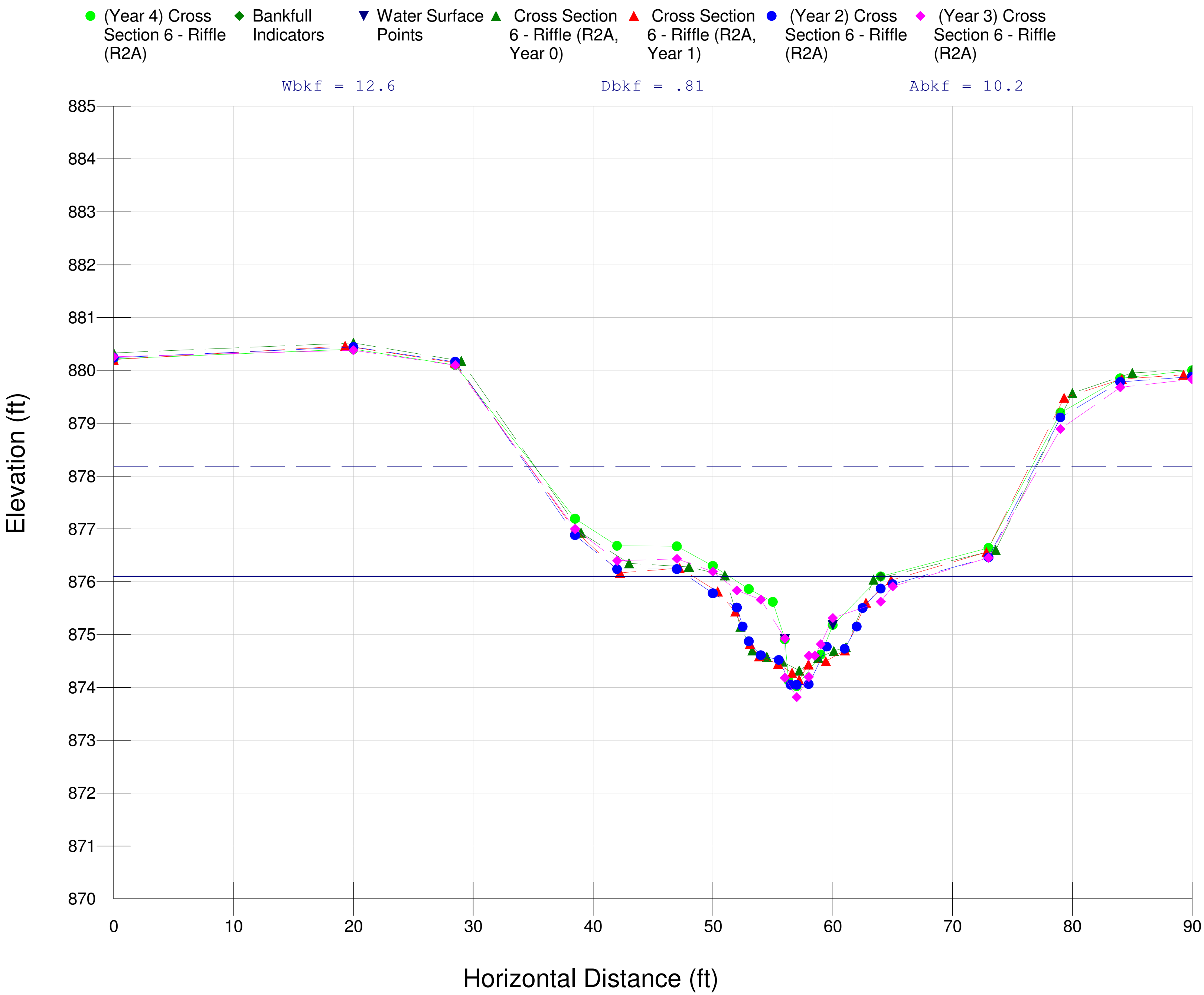
---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |

Movable Particle (mm)

# (Year 4) Cross Section 6 - Riffle (R2A)



# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2A
Cross Section Name: (Year 4) Cross Section 6 - Riffle (R2A)
Survey Date: 11/15/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 880.22 | GS |
| 20 | 0 | 880.4 | GS |
| 28.5 | 0 | 880.1 | GS |
| 38.5 | 0 | 877.19 | GS |
| 42 | 0 | 876.68 | GS |
| 47 | 0 | 876.67 | GS |
| 50 | 0 | 876.3 | LB |
| 53 | 0 | 875.86 | GS |
| 55 | 0 | 875.62 | GS |
| 56 | 0 | 874.91 | LEW |
| 56.3 | 0 | 874.13 | GS |
| 57 | 0 | 874.02 | TW |
| 59 | 0 | 874.62 | GS |
| 60 | 0 | 875.18 | REW |
| 64 | 0 | 876.1 | BKF |
| 73 | 0 | 876.64 | GS |
| 79 | 0 | 879.2 | GS |
| 84 | 0 | 879.85 | GS |
| 90 | 0 | 880 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 878.18 | 878.18 | 878.18 |
| Bankfull Elevation (ft) | 876.1 | 876.1 | 876.1 |
| Floodprone Width (ft) | 41.51 | ----- | ----- |
| Bankfull Width (ft) | 12.64 | 6.32 | 6.32 |
| Entrenchment Ratio | 3.29 | ----- | ----- |
| Mean Depth (ft) | 0.81 | 0.79 | 0.83 |
| Maximum Depth (ft) | 2.08 | 2.08 | 1.88 |
| Width/Depth Ratio | 15.6 | 8 | 7.61 |
| Bankfull Area (sq ft) | 10.24 | 4.99 | 5.25 |
| Wetted Perimeter (ft) | 13.78 | 9.02 | 8.5 |
| Hydraulic Radius (ft) | 0.74 | 0.55 | 0.62 |
| Begin BKF Station | 51.36 | 51.36 | 57.68 |
| End BKF Station | 64 | 57.68 | 64 |

---

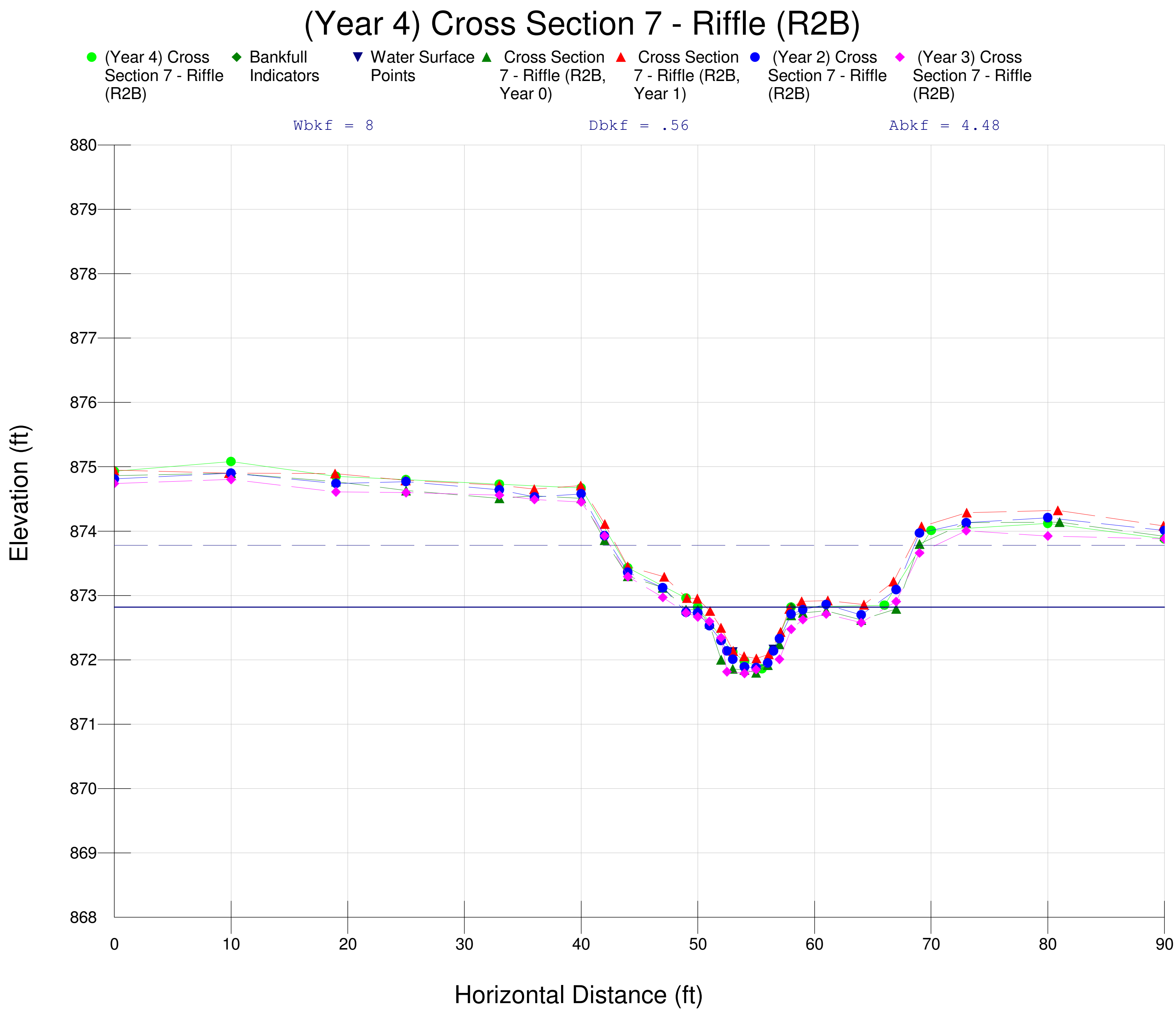
## Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |

Movable Particle (mm)



(Year 4) Cross Section 7 - Riffle (R2B)
(Year 4) Cross Section 7 - Riffle (R2B)
Bankfull Indicators
Water Surface Points
Cross Section 7 - Riffle (R2B, Year 0)
Cross Section 7 - Riffle (R2B, Year 1)
(Year 2) Cross Section 7 - Riffle (R2B)
(Year 3) Cross Section 7 - Riffle (R2B)
Wbkf = 8
Dbkf = .56
Abkf = 4.48
880
879
878
877
876
875
874
873
872
871
870
869
868
0
10
20
30
40
50
60
70
80
90
Elevation (ft)
Horizontal Distance (ft)

RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2B
Cross Section Name: (Year 4) Cross Section 7 - Riffle (R2B)
Survey Date: 11/15/2011

---

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 874.93 | GS |
| 10 | 0 | 875.08 | GS |
| 19 | 0 | 874.85 | GS |
| 25 | 0 | 874.8 | GS |
| 33 | 0 | 874.73 | GS |
| 40 | 0 | 874.67 | GS |
| 44 | 0 | 873.43 | GS |
| 49 | 0 | 872.96 | GS |
| 50 | 0 | 872.82 | LB |
| 53 | 0 | 872.12 | LEW |
| 54 | 0 | 871.98 | GS |
| 55.5 | 0 | 871.86 | TW |
| 56.5 | 0 | 872.16 | REW |
| 58 | 0 | 872.82 | BKF |
| 66 | 0 | 872.85 | GS |
| 70 | 0 | 874.01 | GS |
| 80 | 0 | 874.12 | GS |
| 90 | 0 | 873.88 | GS |

---

Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 873.78 | 873.78 | 873.78 |
| Bankfull Elevation (ft) | 872.82 | 872.82 | 872.82 |
| Floodprone Width (ft) | 26.34 | ----- | ----- |
| Bankfull Width (ft) | 8 | 4 | 4 |
| Entrenchment Ratio | 3.29 | ----- | ----- |
| Mean Depth (ft) | 0.56 | 0.46 | 0.66 |
| Maximum Depth (ft) | 0.96 | 0.84 | 0.96 |
| Width/Depth Ratio | 14.29 | 8.7 | 6.06 |
| Bankfull Area (sq ft) | 4.48 | 1.82 | 2.66 |
| Wetted Perimeter (ft) | 8.28 | 4.93 | 5.03 |
| Hydraulic Radius (ft) | 0.54 | 0.37 | 0.53 |
| Begin BKF Station | 50 | 50 | 54 |
| End BKF Station | 58 | 54 | 58 |

---

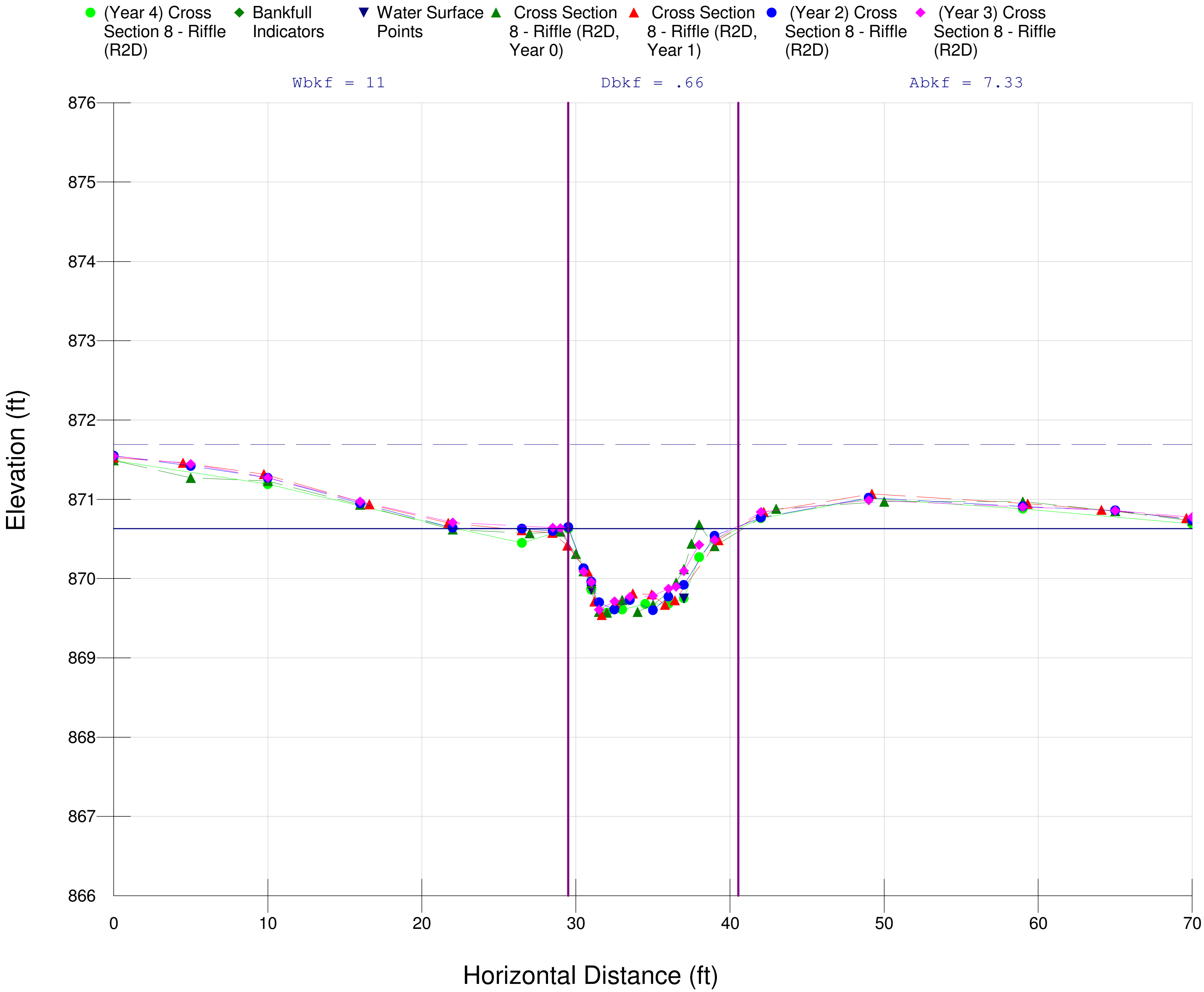
Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |

# (Year 4) Cross Section 8 - Riffle (R2D)



# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2D
Cross Section Name: (Year 4) Cross Section 8 - Riffle (R2D)
Survey Date: 11/15/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 871.49 | GS |
| 10 | 0 | 871.19 | GS |
| 22 | 0 | 870.64 | GS |
| 26.5 | 0 | 870.45 | GS |
| 29.5 | 0 | 870.63 | BKF |
| 31 | 0 | 869.86 | LEW |
| 32 | 0 | 869.57 | GS |
| 33 | 0 | 869.61 | GS |
| 34.5 | 0 | 869.68 | TW |
| 36 | 0 | 869.68 | GS |
| 37 | 0 | 869.75 | REW |
| 38 | 0 | 870.27 | GS |
| 39 | 0 | 870.49 | RB |
| 42 | 0 | 870.76 | GS |
| 49 | 0 | 871.01 | GS |
| 59 | 0 | 870.88 | GS |
| 70 | 0 | 870.69 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 871.69 | 871.69 | 871.69 |
| Bankfull Elevation (ft) | 870.63 | 870.63 | 870.63 |
| Floodprone Width (ft) | 70 | ----- | ----- |
| Bankfull Width (ft) | 11.04 | 5.52 | 5.52 |
| Entrenchment Ratio | 6.34 | ----- | ----- |
| Mean Depth (ft) | 0.66 | 0.82 | 0.51 |
| Maximum Depth (ft) | 1.06 | 1.06 | 0.95 |
| Width/Depth Ratio | 16.73 | 6.73 | 10.82 |
| Bankfull Area (sq ft) | 7.33 | 4.5 | 2.82 |
| Wetted Perimeter (ft) | 11.43 | 6.7 | 6.63 |
| Hydraulic Radius (ft) | 0.64 | 0.67 | 0.43 |
| Begin BKF Station | 29.5 | 29.5 | 35.02 |
| End BKF Station | 40.54 | 35.02 | 40.54 |

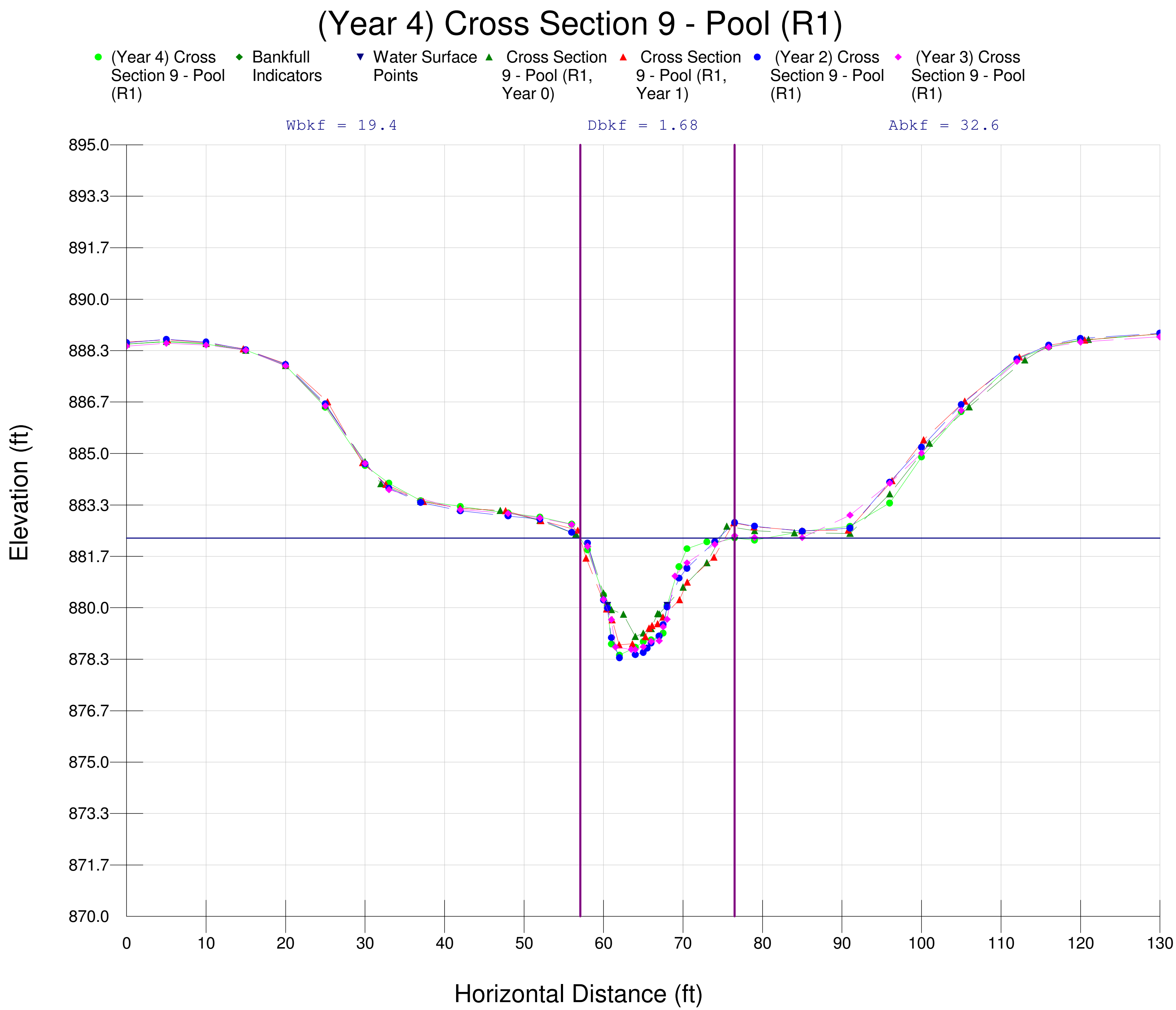
---

## Entrainment Calculations

---

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 9 - Pool (R1)
(Year 4) Cross Section 9 - Pool (R1)
Bankfull Indicators
Water Surface Points
Cross Section 9 - Pool (R1, Year 0)
Cross Section 9 - Pool (R1, Year 1)
(Year 2) Cross Section 9 - Pool (R1)
(Year 3) Cross Section 9 - Pool (R1)
Wbkf = 19.4
Dbkf = 1.68
Abkf = 32.6
895.0
893.3
891.7
890.0
888.3
886.7
885.0
883.3
881.7
880.0
878.3
876.7
875.0
873.3
871.7
870.0
Elevation (ft)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Cross Section Name: (Year 4) Cross Section 9 - Pool (R1)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 888.5413 | GS |
| 5 | 0 | 888.6185 | GS |
| 10 | 0 | 888.5389 | GS |
| 15 | 0 | 888.344 | GS |
| 20 | 0 | 887.8469 | GS |
| 25 | 0 | 886.4981 | GS |
| 30 | 0 | 884.6068 | GS |
| 33 | 0 | 884.0379 | GS |
| 37 | 0 | 883.4719 | GS |
| 42 | 0 | 883.2812 | GS |
| 48 | 0 | 883.0651 | GS |
| 52 | 0 | 882.9403 | GS |
| 56 | 0 | 882.7071 | LB |
| 58 | 0 | 881.8772 | GS |
| 60 | 0 | 880.4105 | GS |
| 60.5 | 0 | 880.0753 | LEW |
| 61 | 0 | 878.8247 | GS |
| 62 | 0 | 878.4645 | TW |
| 64 | 0 | 878.7184 | GS |
| 65 | 0 | 878.9013 | GS |
| 66 | 0 | 878.953 | GS |
| 67 | 0 | 879.077 | GS |
| 67.5 | 0 | 879.1761 | GS |
| 68 | 0 | 880.0751 | REW |
| 69.5 | 0 | 881.3271 | GS |
| 70.5 | 0 | 881.9133 | GS |
| 73 | 0 | 882.1361 | GS |
| 74 | 0 | 882.1056 | GS |
| 76.5 | 0 | 882.2615 | BKF |
| 79 | 0 | 882.1902 | GS |
| 85 | 0 | 882.4773 | GS |
| 91 | 0 | 882.6397 | GS |
| 96 | 0 | 883.3926 | GS |
| 100 | 0 | 884.8813 | GS |
| 105 | 0 | 886.3531 | GS |
| 112 | 0 | 888.0522 | GS |
| 116 | 0 | 888.4478 | GS |
| 120 | 0 | 888.6651 | GS |
| 130 | 0 | 888.8689 | GS |

---

## Cross Sectional Geometry

---

| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 886.06 | 886.06 | 886.06 |
| Bankfull Elevation (ft) | 882.26 | 882.26 | 882.26 |
| Floodprone Width (ft) | 77.82 | ----- | ----- |

| | | | |
|---|---|---|---|
| Bankfull Width (ft) | 19.4 | 8.87 | 10.53 |
| Entrenchment Ratio | 4.01 | ----- | ----- |
| Mean Depth (ft) | 1.68 | 2.52 | 0.97 |
| Maximum Depth (ft) | 3.8 | 3.8 | 3.31 |
| Width/Depth Ratio | 11.55 | 3.52 | 10.86 |
| Bankfull Area (sq ft) | 32.58 | 22.39 | 10.19 |
| Wetted Perimeter (ft) | 22.17 | 13.78 | 15.01 |
| Hydraulic Radius (ft) | 1.47 | 1.62 | 0.68 |
| Begin BKF Station | 57.08 | 57.08 | 65.95 |
| End BKF Station | 76.48 | 65.95 | 76.48 |

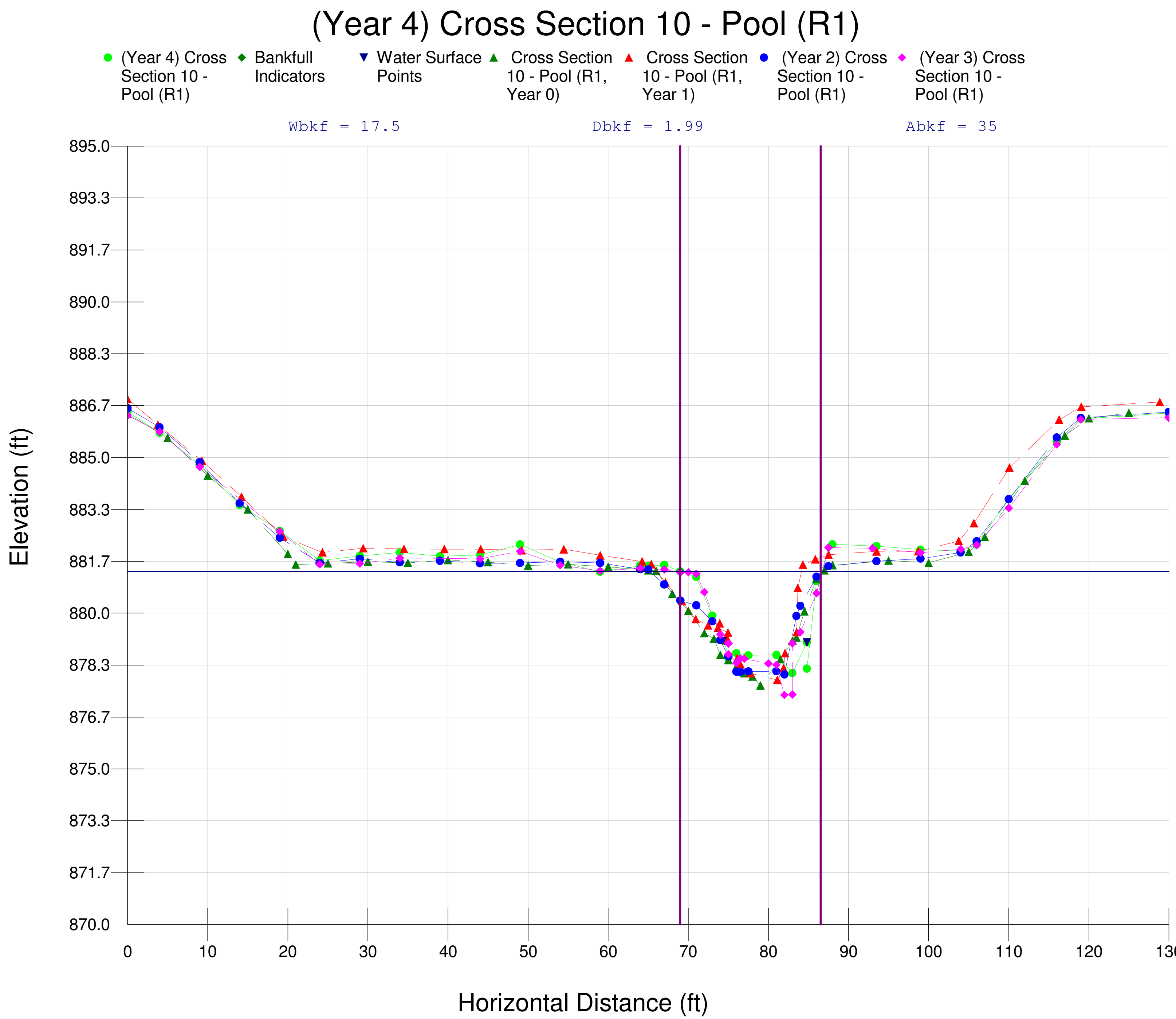
----------------------------------------------------------------------

Entrainment Calculations

----------------------------------------------------------------------

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 10 - Pool (R1)
(Year 4) Cross Section 10 - Pool (R1)
Bankfull Indicators
Water Surface Points
Cross Section 10 - Pool (R1, Year 0)
Cross Section 10 - Pool (R1, Year 1)
(Year 2) Cross Section 10 - Pool (R1)
(Year 3) Cross Section 10 - Pool (R1)
Wbkf = 17.5
Dbkf = 1.99
Abkf = 35
Elevation (ft)
895.0
893.3
891.7
890.0
888.3
886.7
885.0
883.3
881.7
880.0
878.3
876.7
875.0
873.3
871.7
870.0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Cross Section Name: (Year 4) Cross Section 10 - Pool (R1)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 886.4706 | GS |
| 4 | 0 | 885.7921 | GS |
| 9 | 0 | 884.7667 | GS |
| 14 | 0 | 883.4731 | GS |
| 19 | 0 | 882.646 | GS |
| 24 | 0 | 881.6876 | GS |
| 29 | 0 | 881.8367 | GS |
| 34 | 0 | 881.9515 | GS |
| 39 | 0 | 881.8282 | GS |
| 44 | 0 | 881.8688 | GS |
| 49 | 0 | 882.2073 | GS |
| 54 | 0 | 881.6426 | GS |
| 59 | 0 | 881.3271 | GS |
| 64 | 0 | 881.529 | GS |
| 65 | 0 | 881.5229 | GS |
| 67 | 0 | 881.5501 | GS |
| 69 | 0 | 881.3409 | BKF |
| 71 | 0 | 881.1601 | GS |
| 73 | 0 | 879.9178 | GS |
| 74.5 | 0 | 879.1055 | LEW |
| 75 | 0 | 878.5721 | GS |
| 76 | 0 | 878.7167 | GS |
| 77.5 | 0 | 878.6432 | GS |
| 81 | 0 | 878.6591 | GS |
| 83 | 0 | 878.0734 | TW |
| 84.8 | 0 | 879.0663 | REW |
| 84.8 | 0 | 878.2151 | GS |
| 86 | 0 | 881.0233 | GS |
| 88 | 0 | 882.2127 | RB |
| 93.5 | 0 | 882.1508 | GS |
| 99 | 0 | 882.0425 | GS |
| 104 | 0 | 881.994 | GS |
| 106 | 0 | 882.2076 | GS |
| 110 | 0 | 883.655 | GS |
| 116 | 0 | 885.509 | GS |
| 119 | 0 | 886.2372 | GS |
| 130 | 0 | 886.4358 | GS |

---

## Cross Sectional Geometry

---

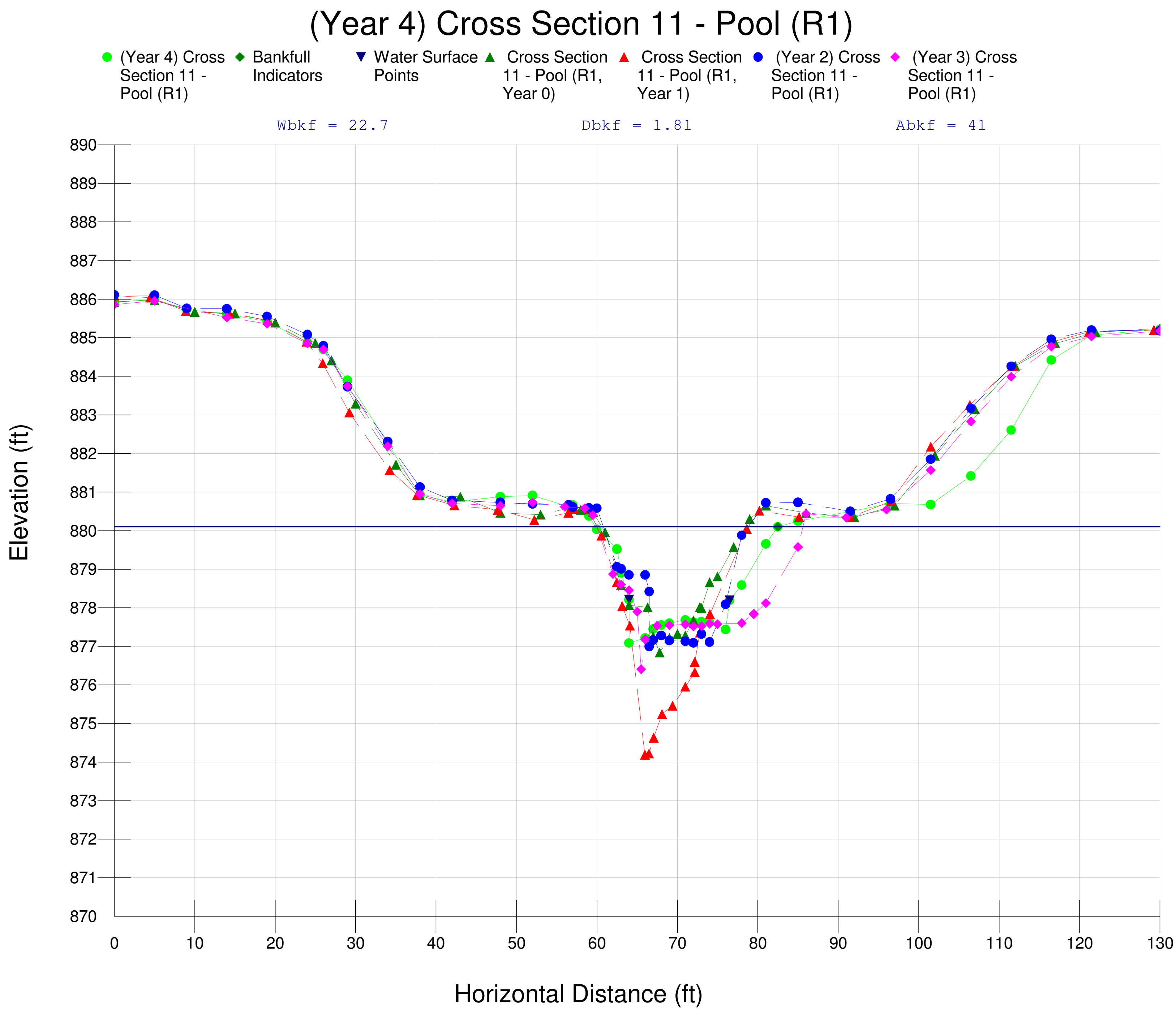
| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 884.61 | 884.61 | 884.61 |
| Bankfull Elevation (ft) | 881.34 | 881.34 | 881.34 |
| Floodprone Width (ft) | 103.46 | ----- | ----- |
| Bankfull Width (ft) | 17.52 | 8.76 | 8.76 |
| Entrenchment Ratio | 5.9 | ----- | ----- |

| | | | |
|---|---|---|---|
| Mean Depth (ft) | 1.99 | 1.51 | 2.48 |
| Maximum Depth (ft) | 3.27 | 2.77 | 3.27 |
| Width/Depth Ratio | 8.8 | 5.8 | 3.53 |
| Bankfull Area (sq ft) | 34.95 | 13.19 | 21.77 |
| Wetted Perimeter (ft) | 21.47 | 12.27 | 14.59 |
| Hydraulic Radius (ft) | 1.63 | 1.08 | 1.49 |
| Begin BKF Station | 69.01 | 69.01 | 77.77 |
| End BKF Station | 86.53 | 77.77 | 86.53 |

---------------------------------------------------------------------
Entrainment Calculations
---------------------------------------------------------------------

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 11 - Pool (R1)
(Year 4) Cross Section 11 - Pool (R1)
Bankfull Indicators
Water Surface Points
Cross Section 11 - Pool (R1, Year 0)
Cross Section 11 - Pool (R1, Year 1)
(Year 2) Cross Section 11 - Pool (R1)
(Year 3) Cross Section 11 - Pool (R1)
Wbkf = 22.7
Dbkf = 1.81
Abkf = 41
Elevation (ft)
Horizontal Distance (ft)
890
889
888
887
886
885
884
883
882
881
880
879
878
877
876
875
874
873
872
871
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130

# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Cross Section Name: (Year 4) Cross Section 11 - Pool (R1)
Survey Date: 11/14/2011

---

Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 885.9182 | GS |
| 5 | 0 | 885.9921 | GS |
| 9 | 0 | 885.7356 | GS |
| 14 | 0 | 885.609 | GS |
| 19 | 0 | 885.4228 | GS |
| 24 | 0 | 884.8807 | GS |
| 26 | 0 | 884.6986 | GS |
| 29 | 0 | 883.8964 | GS |
| 34 | 0 | 882.2653 | GS |
| 38 | 0 | 880.9251 | GS |
| 42 | 0 | 880.7398 | GS |
| 48 | 0 | 880.8799 | GS |
| 52 | 0 | 880.9106 | GS |
| 56.5 | 0 | 880.6225 | GS |
| 57 | 0 | 880.6587 | GS |
| 59 | 0 | 880.3766 | LB |
| 60 | 0 | 880.0311 | GS |
| 62.5 | 0 | 879.5195 | GS |
| 63 | 0 | 878.9044 | GS |
| 64 | 0 | 878.2105 | LEW |
| 64 | 0 | 877.085 | GS |
| 66 | 0 | 877.213 | TW |
| 67 | 0 | 877.4489 | GS |
| 68 | 0 | 877.5524 | GS |
| 69 | 0 | 877.599 | GS |
| 71 | 0 | 877.6833 | GS |
| 72 | 0 | 877.6256 | GS |
| 73 | 0 | 877.6398 | GS |
| 74 | 0 | 877.6273 | GS |
| 76 | 0 | 877.439 | GS |
| 76.5 | 0 | 878.1919 | REW |
| 78 | 0 | 878.5884 | GS |
| 81 | 0 | 879.655 | GS |
| 82.5 | 0 | 880.0989 | BKF |
| 85 | 0 | 880.245 | GS |
| 91.5 | 0 | 880.495 | GS |
| 96.5 | 0 | 880.7063 | GS |
| 101.5 | 0 | 880.6754 | GS |
| 106.5 | 0 | 881.4182 | GS |
| 111.5 | 0 | 882.6066 | GS |
| 116.5 | 0 | 884.4198 | GS |
| 121.5 | 0 | 885.0695 | GS |
| 130 | 0 | 885.2149 | GS |

---

Cross Sectional Geometry

---

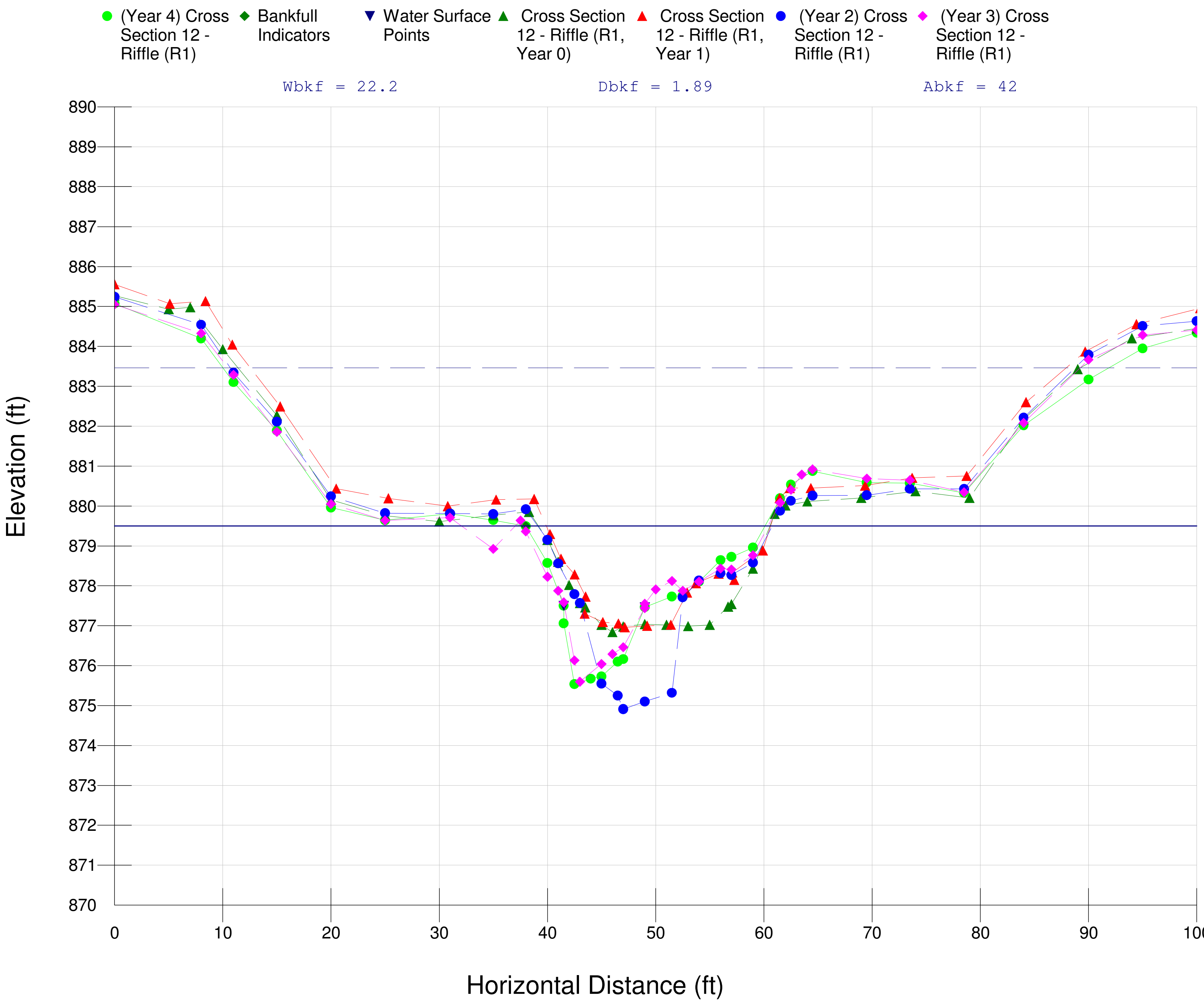
| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 883.12 | 883.12 | 883.12 |
| Bankfull Elevation (ft) | 880.1 | 880.1 | 880.1 |
| Floodprone Width (ft) | 81.51 | ----- | ----- |
| Bankfull Width (ft) | 22.72 | 11.36 | 11.36 |
| Entrenchment Ratio | 3.59 | ----- | ----- |
| Mean Depth (ft) | 1.81 | 1.93 | 1.68 |
| Maximum Depth (ft) | 3.01 | 3.01 | 2.66 |
| Width/Depth Ratio | 12.55 | 5.89 | 6.76 |
| Bankfull Area (sq ft) | 41.01 | 21.91 | 19.1 |
| Wetted Perimeter (ft) | 25.17 | 15.52 | 14.5 |
| Hydraulic Radius (ft) | 1.63 | 1.41 | 1.32 |
| Begin BKF Station | 59.8 | 59.8 | 71.16 |
| End BKF Station | 82.52 | 71.16 | 82.52 |

----------------------------------------------------------------------
Entrainment Calculations
----------------------------------------------------------------------

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |

# (Year 4) Cross Section 12 - Riffle (R1)



# RIVERMORPH CROSS SECTION SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Cross Section Name: (Year 4) Cross Section 12 - Riffle (R1)
Survey Date: 11/14/2011

---

## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 885.0723 | GS |
| 8 | 0 | 884.1964 | GS |
| 11 | 0 | 883.1008 | GS |
| 15 | 0 | 881.8882 | GS |
| 20 | 0 | 879.9582 | GS |
| 25 | 0 | 879.642 | GS |
| 31 | 0 | 879.8082 | GS |
| 35 | 0 | 879.6464 | GS |
| 38 | 0 | 879.4952 | BKF |
| 40 | 0 | 878.5748 | GS |
| 41.5 | 0 | 877.5017 | LEW |
| 41.5 | 0 | 877.0603 | GS |
| 42.5 | 0 | 875.538 | TW |
| 44 | 0 | 875.672 | GS |
| 45 | 0 | 875.7289 | GS |
| 46.5 | 0 | 876.0992 | GS |
| 47 | 0 | 876.1654 | GS |
| 49 | 0 | 877.4647 | REW |
| 51.5 | 0 | 877.7312 | GS |
| 52.5 | 0 | 877.7497 | GS |
| 54 | 0 | 878.1057 | GS |
| 56 | 0 | 878.6436 | GS |
| 57 | 0 | 878.7227 | GS |
| 59 | 0 | 878.9583 | GS |
| 61.5 | 0 | 880.1896 | GS |
| 62.5 | 0 | 880.5345 | RB |
| 64.5 | 0 | 880.8761 | GS |
| 69.5 | 0 | 880.5869 | GS |
| 73.5 | 0 | 880.5719 | GS |
| 78.5 | 0 | 880.3291 | GS |
| 84 | 0 | 882.0204 | GS |
| 90 | 0 | 883.17 | GS |
| 95 | 0 | 883.948 | GS |
| 100 | 0 | 884.3407 | GS |

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## Cross Sectional Geometry

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| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 883.46 | 883.46 | 883.46 |
| Bankfull Elevation (ft) | 879.5 | 879.5 | 879.5 |
| Floodprone Width (ft) | 81.87 | ----- | ----- |
| Bankfull Width (ft) | 22.2 | 11.1 | 11.1 |
| Entrenchment Ratio | 3.69 | ----- | ----- |
| Mean Depth (ft) | 1.89 | 2.56 | 1.22 |
| Maximum Depth (ft) | 3.96 | 3.96 | 2.04 |
| Width/Depth Ratio | 11.75 | 4.34 | 9.1 |

| | | | |
|---|---|---|---|
| Bankfull Area (sq ft) | 41.96 | 28.4 | 13.56 |
| Wetted Perimeter (ft) | 24.72 | 15.38 | 13.41 |
| Hydraulic Radius (ft) | 1.7 | 1.85 | 1.01 |
| Begin BKF Station | 37.9 | 37.9 | 49 |
| End BKF Station | 60.1 | 49 | 60.1 |

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Entrainment Calculations

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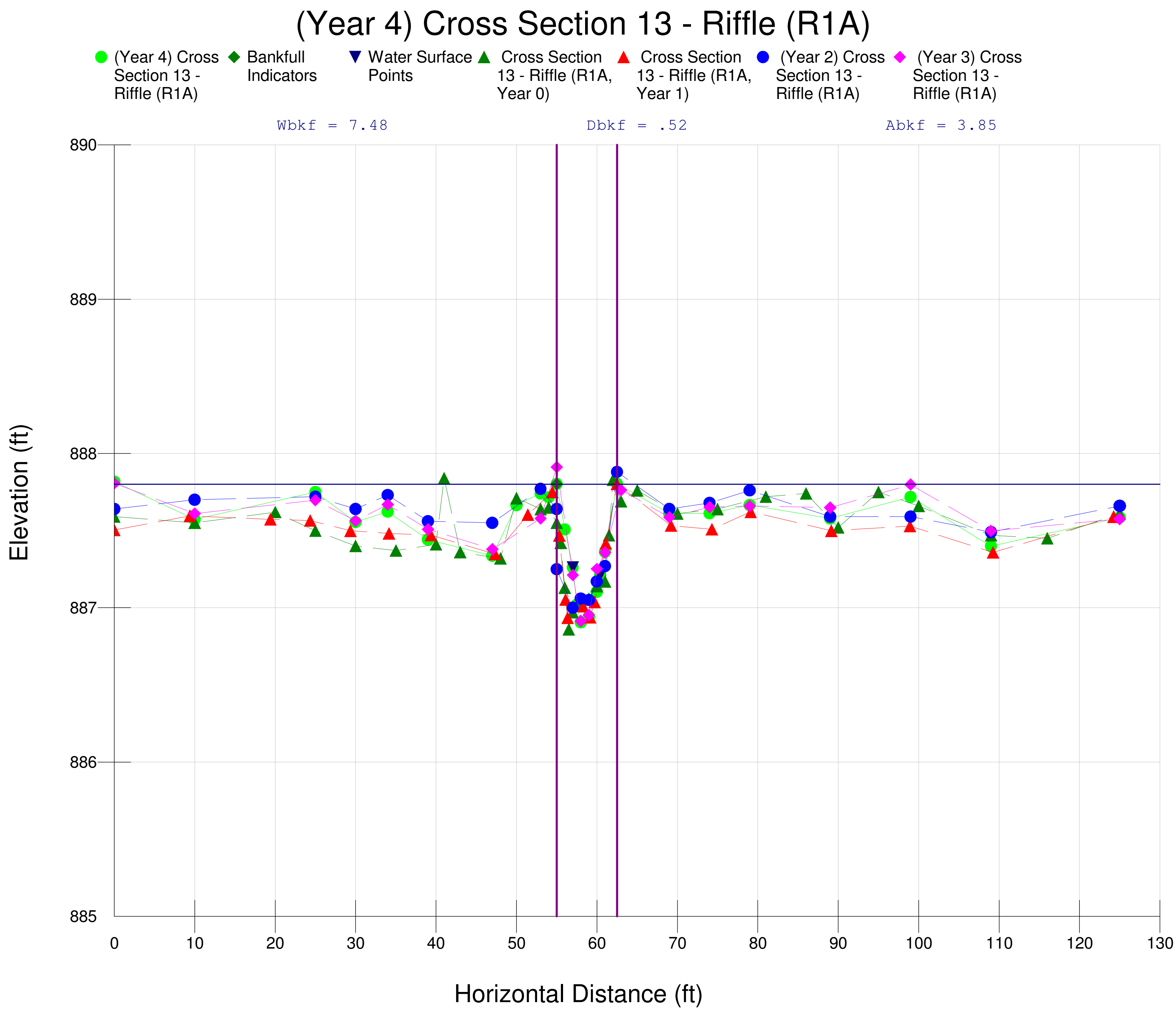
Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |



(Year 4) Cross Section 13 - Riffle (R1A)
(Year 4) Cross Section 13 - Riffle (R1A)
Bankfull Indicators
Water Surface Points
Cross Section 13 - Riffle (R1A, Year 0)
Cross Section 13 - Riffle (R1A, Year 1)
(Year 2) Cross Section 13 - Riffle (R1A)
(Year 3) Cross Section 13 - Riffle (R1A)
Wbkf = 7.48
Dbkf = .52
Abkf = 3.85
Elevation (ft)
890
889
888
887
886
885
0
10
20
30
40
50
60
70
80
90
100
110
120
130
Horizontal Distance (ft)

# RIVERMORPH CROSS SECTION SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R1A
Cross Section Name: (Year 4) Cross Section 13 - Riffle (R1A)
Survey Date: 11/14/2011

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## Cross Section Data Entry

BM Elevation: 0 ft
Backsight Rod Reading: 0 ft

| TAPE | FS | ELEV | NOTE |
|---|---|---|---|
| 0 | 0 | 887.8178 | GS |
| 10 | 0 | 887.5721 | GS |
| 25 | 0 | 887.75 | GS |
| 30 | 0 | 887.5553 | GS |
| 34 | 0 | 887.6232 | GS |
| 39 | 0 | 887.4413 | GS |
| 47 | 0 | 887.3365 | GS |
| 50 | 0 | 887.6649 | GS |
| 53 | 0 | 887.7402 | GS |
| 54 | 0 | 887.7162 | GS |
| 55 | 0 | 887.8021 | BKF |
| 56 | 0 | 887.5072 | GS |
| 57 | 0 | 887.2611 | LEW |
| 57.5 | 0 | 887.0197 | GS |
| 58 | 0 | 886.9054 | TW |
| 59 | 0 | 886.9422 | GS |
| 60 | 0 | 887.1036 | GS |
| 60.4 | 0 | 887.2127 | REW |
| 61 | 0 | 887.3622 | GS |
| 62.5 | 0 | 887.8034 | RB |
| 69 | 0 | 887.6107 | GS |
| 74 | 0 | 887.6118 | GS |
| 79 | 0 | 887.6653 | GS |
| 89 | 0 | 887.5785 | GS |
| 99 | 0 | 887.718 | GS |
| 109 | 0 | 887.3988 | GS |
| 125 | 0 | 887.5852 | GS |

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## Cross Sectional Geometry

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| | Channel | Left | Right |
|---|---|---|---|
| Floodprone Elevation (ft) | 888.69 | 888.69 | 888.69 |
| Bankfull Elevation (ft) | 887.8 | 887.8 | 887.8 |
| Floodprone Width (ft) | 125 | ----- | ----- |
| Bankfull Width (ft) | 7.48 | 4.84 | 2.64 |
| Entrenchment Ratio | 16.71 | ----- | ----- |
| Mean Depth (ft) | 0.52 | 0.59 | 0.38 |
| Maximum Depth (ft) | 0.89 | 0.89 | 0.72 |
| Width/Depth Ratio | 14.38 | 8.2 | 6.95 |
| Bankfull Area (sq ft) | 3.85 | 2.86 | 1 |
| Wetted Perimeter (ft) | 7.73 | 5.72 | 3.46 |
| Hydraulic Radius (ft) | 0.5 | 0.5 | 0.29 |
| Begin BKF Station | 55.01 | 55.01 | 59.85 |
| End BKF Station | 62.49 | 59.85 | 62.49 |

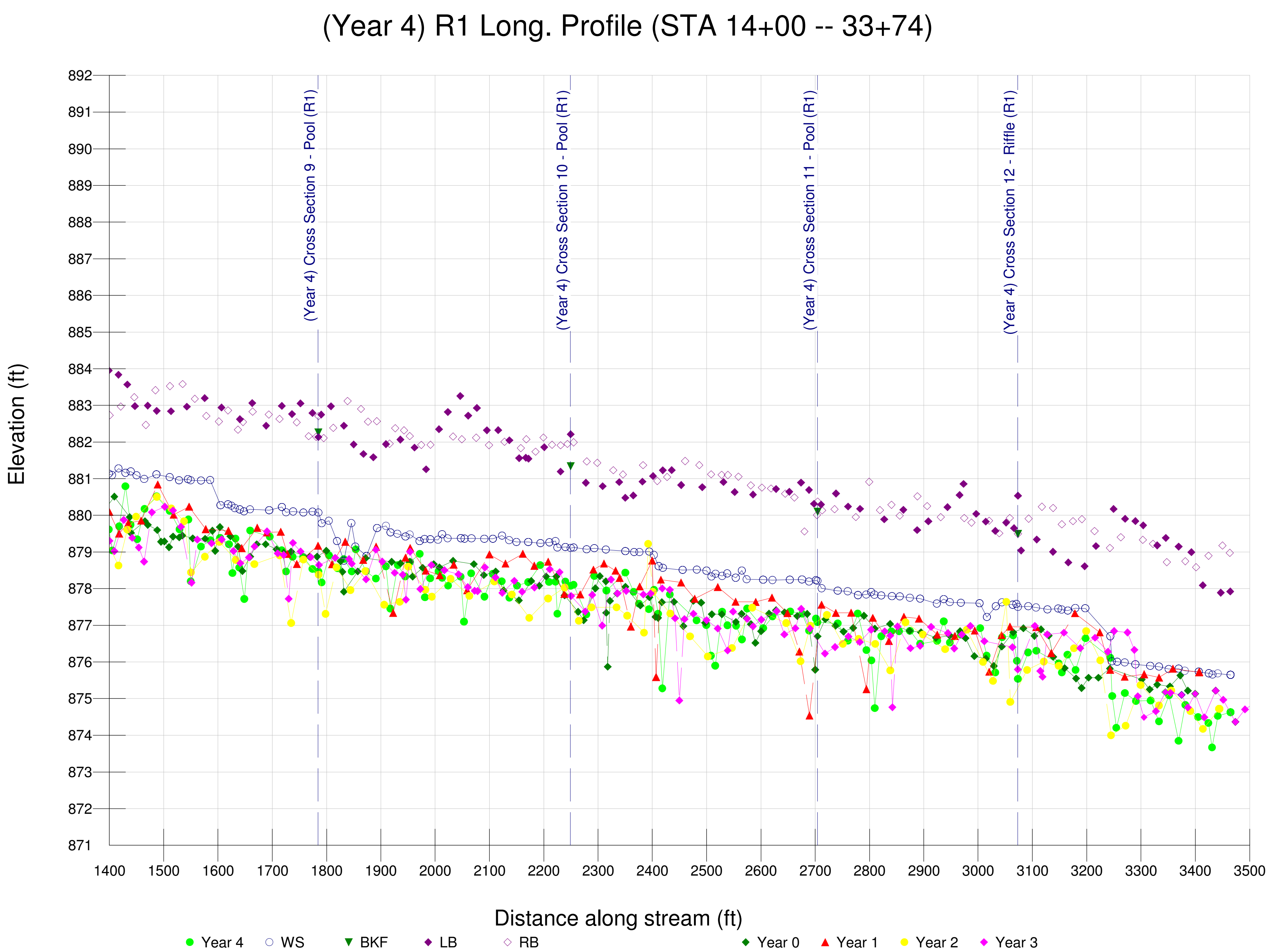
---

Entrainment Calculations
-----------------------------------------------------------------------

Entrainment Formula: Rosgen Modified Shields Curve

| | Channel | Left Side | Right Side |
|---|---|---|---|
| Slope | 0 | 0 | 0 |
| Shear Stress (lb/sq ft) | | | |
| Movable Particle (mm) | | | |

# Longitudinal Profiles



(Year 4) R1 Long. Profile (STA 14+00 -- 33+74)
Elevation (ft)
Distance along stream (ft)
(Year 4) Cross Section 9 - Pool (R1)
(Year 4) Cross Section 10 - Pool (R1)
(Year 4) Cross Section 11 - Pool (R1)
(Year 4) Cross Section 12 - Riffle (R1)
Year 4
WS
BKF
LB
RB
Year 0
Year 1
Year 2
Year 3

RIVERMORPH PROFILE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Profile Name: (Year 4) R1 Long. Profile (14+00 -- 33+74)
Survey Date: 11/15/2011

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Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 1399.0387 | 879.613 | | | | |
| 1399.0387 | | | | 883.951 | |
| 1399.0387 | | 881.135 | | | |
| 1400.6137 | | | | | 882.73 |
| 1405.0587 | | 881.097 | | | |
| 1405.5177 | 879.04 | | | | |
| 1416.6397 | | | | 883.836 | |
| 1417.0697 | | 881.277 | | | |
| 1418.1017 | 879.698 | | | | |
| 1420.9317 | | | | | 882.97 |
| 1429.4907 | 880.791 | | | | |
| 1429.6727 | | 881.159 | | | |
| 1433.1367 | | | | 883.569 | |
| 1439.1867 | 879.742 | | | | |
| 1439.3737 | | 881.197 | | | |
| 1445.9537 | | | | | 883.222 |
| 1446.9977 | | | | 882.98 | |
| 1450.1477 | | 881.092 | | | |
| 1451.2227 | 879.35 | | | | |
| 1464.2327 | | 880.989 | | | |
| 1464.8447 | 880.173 | | | | |
| 1467.1657 | | | | | 882.467 |
| 1470.5297 | | | | 882.995 | |
| 1484.7587 | | | | | 883.413 |
| 1486.6067 | | 881.115 | | | |
| 1487.0877 | | | | 882.85 | |
| 1487.0877 | 880.517 | | | | |
| 1511.0477 | | 881.042 | | | |
| 1511.0687 | 880.121 | | | | |
| 1511.5687 | | | | | 883.525 |
| 1513.4177 | | | | 882.84 | |
| 1528.3107 | | 880.957 | | | |
| 1529.1587 | 879.618 | | | | |
| 1534.8687 | | | | | 883.58 |
| 1542.6127 | | | | 882.965 | |
| 1544.9987 | | 880.985 | | | |
| 1545.6837 | 879.884 | | | | |
| 1549.8907 | | 880.955 | | | |
| 1549.9797 | 878.199 | | | | |
| 1557.3387 | | | | | 883.177 |
| 1568.9487 | 879.149 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 1568.9667 | | 880.948 | | | |
| 1575.5567 | | | | 883.197 | |
| 1578.4667 | | | | | 882.71 |
| 1585.5087 | | 880.962 | | | |
| 1586.0717 | 879.318 | | | | |
| 1601.5747 | | | | | 882.559 |
| 1603.9537 | 879.385 | | | | |
| 1604.8487 | | 880.275 | | | |
| 1606.4607 | | | | 882.943 | |
| 1618.4507 | | | | | 882.862 |
| 1618.6507 | | 880.299 | | | |
| 1620.3277 | 879.211 | | | | |
| 1624.8547 | | 880.26 | | | |
| 1626.7787 | 878.424 | | | | |
| 1631.1627 | | 880.197 | | | |
| 1632.3717 | 879.365 | | | | |
| 1636.6847 | | | | | 882.336 |
| 1639.4927 | 878.575 | | | | |
| 1640.3437 | | 880.159 | | | |
| 1640.4207 | | | | 882.621 | |
| 1646.1017 | | | | | 882.546 |
| 1647.8147 | | 880.106 | | | |
| 1648.4667 | 877.718 | | | | |
| 1659.0027 | | 880.166 | | | |
| 1659.2877 | 879.587 | | | | |
| 1663.1037 | | | | 883.063 | |
| 1663.7007 | | | | | 882.829 |
| 1688.7187 | | | | 882.445 | |
| 1693.5627 | | | | | 882.748 |
| 1694.4107 | | 880.141 | | | |
| 1695.5017 | 879.417 | | | | |
| 1713.3537 | | | | | 882.631 |
| 1717.5357 | | | | 882.985 | |
| 1717.5357 | 879.043 | | | | |
| 1717.8947 | | 880.227 | | | |
| 1725.4237 | 878.467 | | | | |
| 1725.4657 | | 880.082 | | | |
| 1736.5067 | | | | 882.763 | |
| 1737.6197 | 878.867 | | | | |
| 1738.4947 | | 880.105 | | | |
| 1745.0397 | | | | | 882.535 |
| 1752.0177 | | | | 883.055 | |
| 1756.8567 | 878.866 | | | | |
| 1757.3827 | | 880.074 | | | |
| 1766.9987 | | | | | 882.16 |
| 1774.0767 | 878.537 | | | | |
| 1774.0767 | | | | 882.792 | |
| 1774.3477 | | 880.099 | | | |
| 1781.0497 | | | | | 882.142 |
| 1784.8897 | 878.465 | 880.075 | 882.262 | 882.136 | 882.707 |
| 1790.0917 | | | | 882.747 | |
| 1791.0827 | 878.167 | | | | |
| 1791.3057 | | 879.782 | | | |
| 1794.6887 | | | | | 882.108 |
| 1804.2607 | | 879.849 | | | |
| 1804.5627 | 878.906 | | | | |
| 1808.0397 | | | | 882.973 | |

| | | | | |
|---|---|---|---|---|
| 1812.3357 | | | | 882.385 |
| 1819.3087 | | 879.295 | | |
| 1820.2617 | 878.553 | | | |
| 1831.9537 | | | 882.444 | |
| 1831.9537 | 878.804 | | | |
| 1832.0017 | | 878.762 | | |
| 1838.5577 | | | | 883.12 |
| 1845.5437 | | 879.786 | | |
| 1846.4577 | 878.471 | | | |
| 1849.9637 | | | 881.934 | |
| 1852.9957 | | 879.148 | | |
| 1853.8127 | 879.069 | | | |
| 1863.4297 | | | | 882.903 |
| 1867.9467 | | | 881.672 | |
| 1872.7207 | 878.474 | | | |
| 1873.4617 | | 878.891 | | |
| 1876.2397 | | | | 882.555 |
| 1886.0587 | | | 881.582 | |
| 1890.9517 | 878.273 | | | |
| 1892.5567 | | | | 882.568 |
| 1893.1247 | | 879.654 | | |
| 1909.2677 | | 879.713 | | |
| 1909.2677 | 878.609 | | | |
| 1909.5377 | | | 881.942 | |
| 1916.0857 | | | | 881.955 |
| 1917.4757 | 877.455 | | | |
| 1917.8477 | | 879.537 | | |
| 1926.3207 | | | | 882.377 |
| 1930.4637 | | 879.5 | | |
| 1931.2757 | 878.642 | | | |
| 1935.9787 | | | 882.067 | |
| 1942.7067 | | | | 882.318 |
| 1944.9887 | 878.327 | | | |
| 1945.3827 | | 879.422 | | |
| 1953.1907 | | 879.478 | | |
| 1953.2497 | | | | 882.164 |
| 1953.7407 | 878.725 | | | |
| 1961.9767 | | | 881.847 | |
| 1971.5157 | | 879.298 | | |
| 1971.6517 | 878.95 | | | |
| 1974.5127 | | | | 881.92 |
| 1980.5387 | | 879.354 | | |
| 1981.3247 | 877.763 | | | |
| 1983.2347 | | | 881.258 | |
| 1990.9117 | 878.278 | | | |
| 1991.0247 | | 879.344 | | |
| 1991.4227 | | | | 881.927 |
| 2005.3477 | | 879.331 | | |
| 2006.2937 | 878.474 | | | |
| 2007.0837 | | | 882.351 | |
| 2012.8697 | | 879.482 | | |
| 2013.0557 | 878.292 | | | |
| 2022.8477 | | 879.374 | | |
| 2023.3027 | | | 882.82 | |
| 2023.8407 | 878.079 | | | |
| 2032.8387 | | | | 882.151 |
| 2046.2447 | | | 883.253 | |

| | | | | | |
|---|---|---|---|---|---|
| 2047.0677 | 878.325 | | | | |
| 2047.3837 | | 879.376 | | | |
| 2049.0767 | | | | | 882.076 |
| 2053.2547 | 877.097 | | | | |
| 2054.2167 | | 879.364 | | | |
| 2060.8277 | | | | 882.719 | |
| 2066.6527 | 878.416 | | | | |
| 2067.0177 | | 879.371 | | | |
| 2075.5237 | | | | | 882.117 |
| 2076.8867 | | | | 882.93 | |
| 2090.6667 | | 879.359 | | | |
| 2090.7947 | 877.78 | | | | |
| 2095.2327 | | | | 882.319 | |
| 2099.1237 | | | | | 881.915 |
| 2106.1817 | 878.401 | | | | |
| 2106.5117 | | 879.362 | | | |
| 2116.1367 | | | | 882.325 | |
| 2122.6767 | 878.199 | | | | |
| 2123.1917 | | 879.447 | | | |
| 2127.5057 | | | | | 882.006 |
| 2136.5347 | | 879.322 | | | |
| 2136.7567 | 877.749 | | | | |
| 2136.7567 | | | | 882.048 | |
| 2149.7047 | | 879.274 | | | |
| 2150.8587 | 878.08 | | | | |
| 2154.6897 | | | | 881.561 | |
| 2157.7877 | | | | | 881.834 |
| 2166.9897 | | | | 881.571 | |
| 2167.9897 | | | | | 882.076 |
| 2171.5027 | 878.176 | | | | |
| 2171.5837 | | 879.274 | | | |
| 2171.8857 | | | | 881.543 | |
| 2185.0227 | | | | | 881.735 |
| 2193.4247 | 878.64 | | | | |
| 2193.9977 | | 879.24 | | | |
| 2199.4167 | | | | | 882.122 |
| 2200.8467 | | | | 881.858 | |
| 2209.8647 | 878.181 | | | | |
| 2210.6497 | | 879.263 | | | |
| 2215.1647 | | | | | 881.925 |
| 2221.5367 | | 879.3 | | | |
| 2221.5367 | 878.188 | | | | |
| 2225.1927 | 877.315 | | | | |
| 2225.2377 | | 879.122 | | | |
| 2230.8287 | | | | 881.195 | |
| 2231.1677 | | | | | 881.911 |
| 2239.9487 | 878.195 | | | | |
| 2239.9637 | | 879.136 | | | |
| 2243.8677 | | | | | 881.948 |
| 2249.6377 | 878.073 | 879.106 | 881.341 | 882.213 | |
| 2255.0977 | | | | | 881.992 |
| 2255.0977 | 878.104 | | | | |
| 2255.2077 | | 879.125 | | | |
| 2277.4407 | | | | 880.888 | |
| 2278.8137 | 877.294 | | | | |
| 2279.1717 | | 879.073 | | | |
| 2279.2747 | | | | | 881.473 |

| | | | | |
|---|---|---|---|---|
| 2293.2627 | 878.343 | | | |
| 2293.2627 | | 879.103 | | |
| 2298.6247 | | | | 881.431 |
| 2308.6457 | | | 880.795 | |
| 2314.6877 | | 879.065 | | |
| 2315.6077 | 877.947 | | | |
| 2328.2257 | | | | 881.233 |
| 2338.8747 | | | 880.908 | |
| 2345.9577 | | | | 881.114 |
| 2350.2827 | | | 880.481 | |
| 2350.2827 | 878.436 | | | |
| 2350.3837 | | 879.022 | | |
| 2364.9527 | | | 880.539 | |
| 2365.5877 | 877.912 | | | |
| 2366.3817 | | 879 | | |
| 2375.5697 | 877.589 | | | |
| 2376.2407 | | 878.998 | | |
| 2381.7777 | | | 880.919 | |
| 2382.9597 | | | | 881.368 |
| 2393.4887 | 877.438 | | | |
| 2394.3767 | | 879.012 | | |
| 2401.3147 | | | 881.073 | |
| 2402.7537 | | 878.917 | | |
| 2403.0107 | 877.968 | | | |
| 2409.1647 | | | | 880.938 |
| 2410.6037 | 877.316 | | | |
| 2411.5107 | | 878.614 | | |
| 2418.6247 | 875.28 | | | |
| 2419.2537 | | | 881.228 | |
| 2419.2907 | | 878.565 | | |
| 2427.3357 | | | | 881.048 |
| 2432.3527 | 877.842 | | | |
| 2435.6467 | | | 881.234 | |
| 2453.0697 | | | 880.826 | |
| 2455.7307 | | 878.511 | | |
| 2460.4887 | | | | 881.479 |
| 2481.4127 | 877.134 | | | |
| 2482.0727 | | 878.521 | | |
| 2486.6117 | | | | 881.372 |
| 2491.9907 | | | 880.767 | |
| 2499.5747 | 877.006 | | | |
| 2499.9067 | | 878.488 | | |
| 2508.1897 | 876.171 | | | |
| 2508.2737 | | | | 881.119 |
| 2508.8517 | | 878.33 | | |
| 2515.9497 | 875.897 | | | |
| 2516.3427 | | 878.408 | | |
| 2527.7447 | | | | 881.105 |
| 2528.6297 | | 878.347 | | |
| 2528.7027 | 877.371 | | | |
| 2531.0967 | | | 880.909 | |
| 2537.8707 | | 878.414 | | |
| 2538.3307 | 876.997 | | | |
| 2539.0647 | | | | 881.101 |
| 2551.6377 | | | 880.635 | |
| 2553.7577 | | 878.297 | | |
| 2554.4007 | 876.989 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 2558.5857 | | | | | 881.053 |
| 2564.7997 | | 878.496 | | | |
| 2565.0317 | 876.614 | | | | |
| 2573.8497 | | 878.255 | | | |
| 2574.8087 | 877.456 | | | | |
| 2581.4057 | | | | | 880.817 |
| 2585.4277 | | | | 880.567 | |
| 2601.5657 | | | | | 880.758 |
| 2604.2037 | 876.92 | | | | |
| 2604.2037 | | 878.246 | | | |
| 2618.4357 | | | | | 880.733 |
| 2621.3247 | | 878.235 | | | |
| 2621.5977 | 877.24 | | | | |
| 2627.7687 | | | | 880.717 | |
| 2644.7007 | | | | | 880.591 |
| 2652.2597 | | | | 880.644 | |
| 2653.3387 | | 878.246 | | | |
| 2654.0457 | 877.379 | | | | |
| 2661.6417 | | | | | 880.488 |
| 2673.8367 | | | | 880.892 | |
| 2675.7837 | | 878.248 | | | |
| 2676.1797 | 877.312 | | | | |
| 2680.1037 | | | | | 879.562 |
| 2688.5137 | | 878.196 | | | |
| 2688.6787 | 876.854 | | | | |
| 2688.6787 | | | | 880.691 | |
| 2697.6227 | | | | 880.314 | |
| 2701.2767 | 877.184 | | | | |
| 2701.3117 | | 878.227 | | | |
| 2703.2557 | | | | | 880.007 |
| 2704.3927 | 877.085 | 878.211 | 880.099 | | 880.377 |
| 2710.6117 | | | | 880.295 | |
| 2711.6857 | | 878.01 | | | |
| 2712.7057 | | | | | 880.135 |
| 2735.4807 | | | | | 880.168 |
| 2738.3287 | | | | 880.597 | |
| 2741.5217 | | 877.945 | | | |
| 2741.6697 | 877.053 | | | | |
| 2760.0247 | | 877.929 | | | |
| 2760.5157 | 876.579 | | | | |
| 2760.5157 | | | | 880.239 | |
| 2774.5557 | | | | | 879.952 |
| 2778.5597 | 877.32 | | | | |
| 2778.7127 | | 877.822 | | | |
| 2782.6377 | | | | 880.179 | |
| 2794.1677 | | 877.84 | | | |
| 2794.3087 | 876.325 | | | | |
| 2799.4347 | | | | | 880.913 |
| 2803.3017 | | 877.906 | | | |
| 2803.5107 | 876.04 | | | | |
| 2809.2147 | | 877.834 | | | |
| 2809.7177 | 874.741 | | | | |
| 2819.3487 | | | | | 880.143 |
| 2821.6977 | 876.701 | | | | |
| 2821.9647 | | 877.812 | | | |
| 2827.1257 | | | | 879.889 | |
| 2840.3127 | | | | | 880.288 |

| | | | | | |
|---|---|---|---|---|---|
| 2840.3127 | 876.835 | | | | |
| 2841.4677 | | 877.794 | | | |
| 2854.6687 | 876.837 | | | | |
| 2855.4677 | | | | | 879.991 |
| 2855.6287 | | 877.787 | | | |
| 2862.2857 | | | | 880.151 | |
| 2874.3237 | | 877.752 | | | |
| 2874.4947 | 876.848 | | | | |
| 2887.6867 | | | | 879.598 | |
| 2888.2897 | | | | | 880.52 |
| 2893.1587 | 876.495 | | | | |
| 2893.1587 | | 877.728 | | | |
| 2906.1757 | | | | | 880.254 |
| 2908.2557 | | | | 879.835 | |
| 2924.2867 | | 877.593 | | | |
| 2924.5977 | 876.577 | | | | |
| 2931.1897 | | | | | 879.949 |
| 2936.7247 | 877.106 | | | | |
| 2936.8587 | | 877.714 | | | |
| 2943.6367 | | | | 880.223 | |
| 2947.8837 | | 877.632 | | | |
| 2948.1777 | 876.529 | | | | |
| 2966.0017 | | | | 880.553 | |
| 2968.5367 | | 877.615 | | | |
| 2968.5877 | 876.741 | | | | |
| 2973.0677 | | | | 880.856 | |
| 2974.4827 | | | | | 879.925 |
| 2987.6957 | | | | | 879.803 |
| 2996.6287 | | | | 880.04 | |
| 3002.8317 | | 877.601 | | | |
| 3003.9407 | 876.924 | | | | |
| 3014.0967 | | | | 879.827 | |
| 3015.8137 | 876.175 | | | | |
| 3016.2927 | | 877.224 | | | |
| 3020.2227 | | | | | 879.853 |
| 3031.6757 | 875.713 | | | | |
| 3031.6757 | | | | 879.576 | |
| 3032.6647 | | 877.519 | | | |
| 3039.0597 | | | | | 879.511 |
| 3044.0667 | | 877.624 | | | |
| 3044.3767 | 876.674 | | | | |
| 3051.5787 | | | | 879.799 | |
| 3058.2677 | | | | | 879.929 |
| 3064.0347 | | 877.56 | | | |
| 3064.7027 | 876.724 | | | | |
| 3066.0507 | | | | 879.648 | |
| 3070.5747 | | 877.584 | | | |
| 3071.6577 | 876.031 | | | | |
| 3073.3897 | 875.538 | 877.502 | 879.495 | 880.535 | 879.495 |
| 3079.1647 | | | | 879.041 | |
| 3092.2427 | 876.26 | | | | |
| 3092.4687 | | 877.519 | | | |
| 3093.0467 | | | | | 879.909 |
| 3106.8857 | | 877.485 | | | |
| 3107.4287 | 876.305 | | | | |
| 3108.0387 | | | | 879.341 | |
| 3117.3927 | | | | | 880.234 |

| | | | | |
|---|---|---|---|---|
| 3127.7767 | | 877.434 | | |
| 3137.9957 | | | 879.005 | |
| 3138.1617 | | | | 880.2 |
| 3147.6137 | | 877.457 | | |
| 3148.5927 | 875.961 | | | |
| 3153.9127 | | 877.431 | | |
| 3154.2987 | | | | 879.756 |
| 3154.4127 | 875.711 | | | |
| 3164.7567 | 876.199 | | | |
| 3165.1957 | | 877.401 | | |
| 3166.2327 | | | 878.715 | |
| 3174.8237 | | | | 879.839 |
| 3179.1577 | | 877.468 | | |
| 3179.5367 | 875.779 | | | |
| 3191.1567 | | | | 879.895 |
| 3196.1907 | | | 878.612 | |
| 3197.4057 | | 877.461 | | |
| 3197.9997 | 876.65 | | | |
| 3214.3207 | | | | 879.572 |
| 3216.9917 | | | 879.162 | |
| 3242.9387 | | | | 879.11 |
| 3243.4317 | | 876.702 | | |
| 3243.4487 | 876.114 | | | |
| 3246.5907 | | 876.018 | | |
| 3247.0597 | 875.07 | | | |
| 3249.6887 | | | 880.173 | |
| 3254.5647 | 874.204 | | | |
| 3256.1887 | | 876.004 | | |
| 3262.8257 | | | | 879.404 |
| 3270.2467 | | 875.987 | | |
| 3270.4387 | 875.151 | | | |
| 3270.6937 | | | 879.905 | |
| 3289.4537 | | | 879.843 | |
| 3289.9107 | | 875.935 | | |
| 3290.8687 | 874.936 | | | |
| 3303.5027 | | | | 879.332 |
| 3304.1877 | | | 879.725 | |
| 3317.1807 | | 875.895 | | |
| 3317.9477 | 874.948 | | | |
| 3321.9897 | | | | 879.22 |
| 3329.8837 | | | 879.18 | |
| 3333.0437 | | 875.874 | | |
| 3333.3877 | 874.378 | | | |
| 3345.6617 | | | 879.384 | |
| 3347.4207 | | | | 878.724 |
| 3351.1387 | | 875.806 | | |
| 3351.6817 | 875.091 | | | |
| 3369.3267 | 873.846 | | | |
| 3369.3267 | | | 879.145 | |
| 3369.4887 | | 875.816 | | |
| 3380.6167 | | 875.76 | | |
| 3381.5367 | | | | 878.749 |
| 3381.5367 | 874.826 | | | |
| 3392.8957 | | | 878.994 | |
| 3401.5657 | | | | 878.584 |
| 3405.3247 | 874.495 | | | |
| 3406.3647 | | 875.737 | | |

| | | | | | |
|---|---|---|---|---|---|
| 3413.7437 | | | | 878.09 | |
| 3424.2167 | 874.333 | | | | |
| 3424.2167 | | | | | 878.9 |
| 3425.0237 | | 875.69 | | | |
| 3430.8477 | 873.668 | | | | |
| 3431.7707 | | 875.658 | | | |
| 3441.4807 | | 875.687 | | | |
| 3441.6417 | 874.526 | | | | |
| 3446.9577 | | | | 877.889 | |
| 3450.0967 | | | | | 879.177 |
| 3463.3467 | | | | | 878.977 |
| 3464.2377 | | | | 877.924 | |
| 3465.1087 | | 875.648 | | | |
| 3465.1087 | 874.627 | | | | |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|
| (Year 4) Cross Section 9 - Pool (R1) | Pool XS | 1784 |
| (Year 4) Cross Section 10 - Pool (R1) | Pool XS | 2249 |
| (Year 4) Cross Section 11 - Pool (R1) | Pool XS | 2704 |
| (Year 4) Cross Section 12 - Riffle (R1) | Riffle XS | 3073 |

Measurements from Graph

Bankfull Slope: 0.00216

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.00187 | 0.00414 | 0.00746 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 95.89 | 125.88 | 161.18 |
| Pool length | 26.52 | 37.54 | 55.09 |
| Riffle length | 14.28 | 17.95 | 28.56 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

Notes

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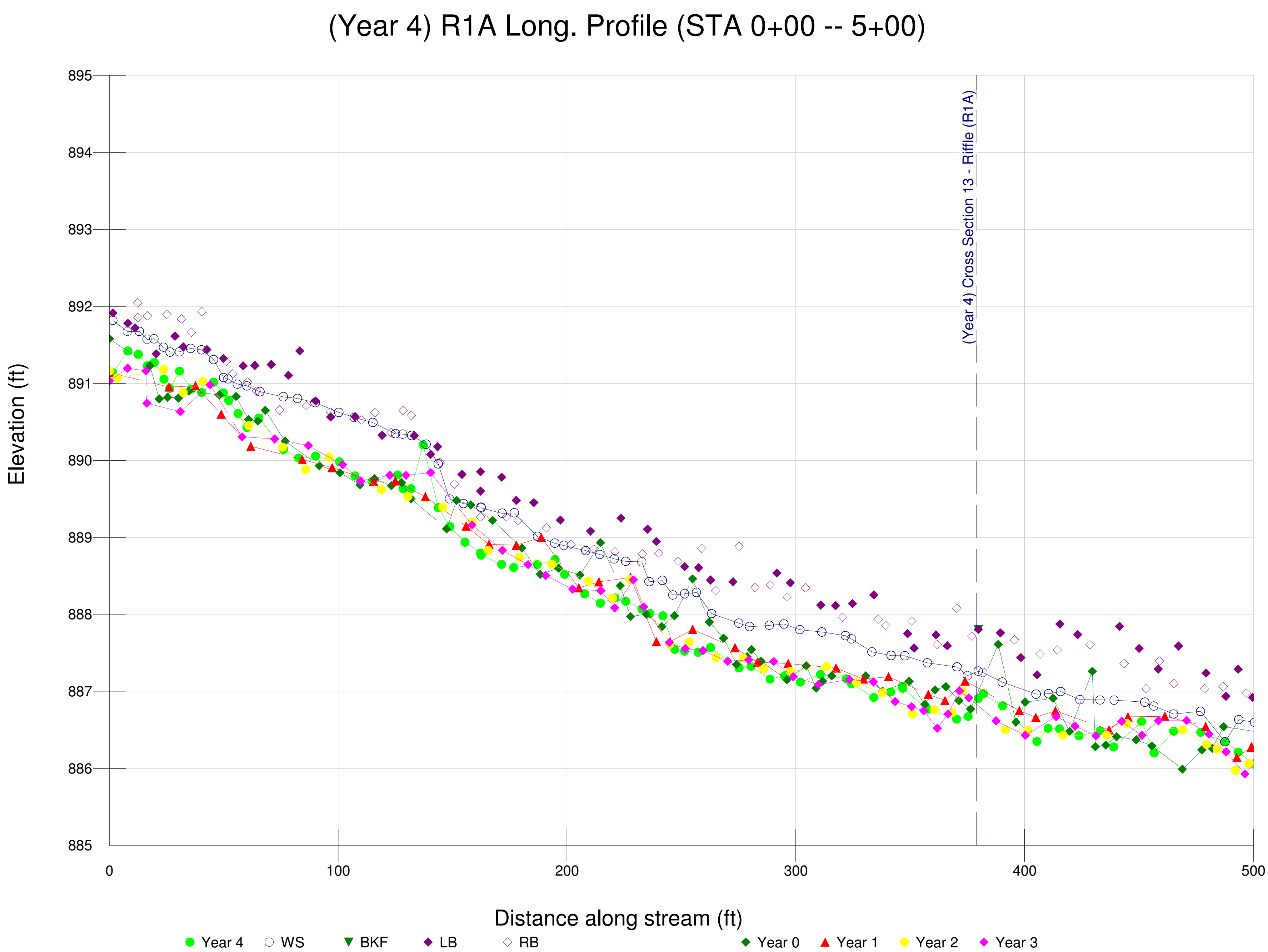
River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Profile Name: (Year 4) R1 Long. Profile (14+00 -- 33+74)
Survey Date: 11/15/2011

| DIST | Note |
|---|---|
| 1399.0387 | LEW |
| 1405.0587 | LEW |
| 1417.0697 | LEW |
| 1429.6727 | LEW |
| 1439.3737 | LEW |
| 1450.1477 | LEW |
| 1464.2327 | LEW |
| 1486.6067 | LEW |
| 1511.0477 | LEW |
| 1528.3107 | LEW |
| 1544.9987 | LEW |
| 1549.8907 | LEW |
| 1568.9667 | LEW |
| 1585.5087 | LEW |
| 1604.8487 | LEW |
| 1618.6507 | LEW |
| 1624.8547 | LEW |
| 1631.1627 | LEW |
| 1640.3437 | LEW |
| 1647.8147 | LEW |
| 1659.0027 | LEW |
| 1694.4107 | LEW |
| 1717.8947 | LEW |
| 1725.4657 | LEW |
| 1738.4947 | LEW |
| 1757.3827 | LEW |
| 1774.3477 | LEW |
| 1784.8897 | XS9 - TW Intersect @ station 1784 |
| 1791.3057 | LEW |
| 1804.2607 | LEW |
| 1819.3087 | LEW |
| 1832.0017 | LEW |
| 1845.5437 | LEW |
| 1852.9957 | LEW |
| 1873.4617 | LEW |
| 1893.1247 | LEW |
| 1909.2677 | LEW |
| 1917.8477 | LEW |
| 1930.4637 | LEW |
| 1945.3827 | LEW |
| 1953.1907 | LEW |
| 1971.5157 | LEW |
| 1980.5387 | LEW |

| | |
|---|---|
| 1991.0247 | LEW |
| 2005.3477 | LEW |
| 2012.8697 | LEW |
| 2022.8477 | LEW |
| 2047.3837 | LEW |
| 2054.2167 | LEW |
| 2067.0177 | LEW |
| 2090.6667 | LEW |
| 2106.5117 | LEW |
| 2123.1917 | LEW |
| 2136.5347 | LEW |
| 2149.7047 | LEW |
| 2171.5837 | LEW |
| 2193.9977 | LEW |
| 2210.6497 | LEW |
| 2221.5367 | LEW |
| 2225.2377 | LEW |
| 2239.9637 | LEW |
| 2249.6377 | XS10 - TW Intersect @ station 2249 |
| 2255.2077 | LEW |
| 2279.1717 | LEW |
| 2293.2627 | LEW |
| 2314.6877 | LEW |
| 2350.3837 | LEW |
| 2366.3817 | LEW |
| 2376.2407 | LEW |
| 2394.3767 | LEW |
| 2402.7537 | LEW |
| 2411.5107 | LEW |
| 2419.2907 | LEW |
| 2455.7307 | LEW |
| 2482.0727 | LEW |
| 2499.9067 | LEW |
| 2508.8517 | LEW |
| 2516.3427 | LEW |
| 2528.6297 | LEW |
| 2537.8707 | LEW |
| 2553.7577 | LEW |
| 2564.7997 | LEW |
| 2573.8497 | LEW |
| 2604.2037 | LEW |
| 2621.3247 | LEW |
| 2653.3387 | LEW |
| 2675.7837 | LEW |
| 2688.5137 | LEW |
| 2701.3117 | LEW |
| 2704.3927 | XS11 - TW Intersect @ station 2704 |
| 2711.6857 | LEW |
| 2741.5217 | LEW |
| 2760.0247 | LEW |
| 2778.7127 | LEW |
| 2794.1677 | LEW |
| 2803.3017 | LEW |
| 2809.2147 | LEW |
| 2821.9647 | LEW |
| 2841.4677 | LEW |
| 2855.6287 | LEW |

2874.3237  LEW
2893.1587  LEW
2924.2867  LEW
2936.8587  LEW
2947.8837  LEW
2968.5367  LEW
3002.8317  LEW
3016.2927  LEW
3032.6647  LEW
3044.0667  LEW
3064.0347  LEW
3070.5747  LEW
3073.3897  XS12 - TW Intersect @ station 3073
3092.4687  LEW
3106.8857  LEW
3127.7767  LEW
3147.6137  LEW
3153.9127  LEW
3165.1957  LEW
3179.1577  LEW
3197.4057  LEW
3243.4317  LEW
3246.5907  LEW
3256.1887  LEW
3270.2467  LEW
3289.9107  LEW
3317.1807  LEW
3333.0437  LEW
3351.1387  LEW
3369.4887  LEW
3380.6167  LEW
3406.3647  LEW
3425.0237  LEW
3431.7707  LEW
3441.4807  LEW
3465.1087  LEW



(Year 4) R1A Long. Profile (STA 0+00 -- 5+00)
Elevation (ft)
895
894
893
892
891
890
889
888
887
886
885
0
100
200
300
400
500
Distance along stream (ft)
(Year 4) Cross Section 13 - Riffle (R1A)
Year 4
WS
BKF
LB
RB
Year 0
Year 1
Year 2
Year 3

RIVERMORPH PROFILE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R1A
Profile Name: (Year 4) R1A Long. Profile (STA 0+00 -- 5+00)
Survey Date: 11/14/2011

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Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 1.5268 | 891.138 | | | | |
| 1.5268 | | | | 891.915 | |
| 1.5268 | | 891.817 | | | |
| 7.9068 | | 891.675 | | | |
| 8.0708 | 891.42 | | | | |
| 8.0708 | | | | 891.78 | |
| 11.2498 | | | | 891.72 | |
| 12.3858 | | | | | 892.046 |
| 12.4678 | | | | | 891.855 |
| 12.6908 | 891.376 | | | | |
| 13.0158 | | 891.675 | | | |
| 16.5188 | | 891.572 | | | |
| 16.6038 | | | | | 891.877 |
| 16.6038 | 891.227 | | | | |
| 19.5318 | | 891.579 | | | |
| 19.7158 | 891.271 | | | | |
| 20.4458 | | | | 891.384 | |
| 23.6378 | | 891.469 | | | |
| 23.9068 | 891.054 | | | | |
| 25.0898 | | | | | 891.897 |
| 26.4218 | 890.934 | | | | |
| 26.5028 | | 891.407 | | | |
| 28.6868 | | | | 891.613 | |
| 30.6428 | | 891.408 | | | |
| 30.6888 | 891.158 | | | | |
| 31.4608 | | | | | 891.836 |
| 32.2598 | | | | 891.474 | |
| 35.5798 | | 891.454 | | | |
| 35.8058 | | | | | 891.662 |
| 35.8058 | 890.925 | | | | |
| 40.2568 | | 891.436 | | | |
| 40.3488 | 890.88 | | | | |
| 40.4238 | | | | | 891.931 |
| 42.6198 | | | | 891.439 | |
| 45.5738 | | 891.307 | | | |
| 45.5918 | 891.014 | | | | |
| 49.8288 | 890.874 | | | | |
| 49.8288 | | | | 891.323 | |
| 49.9568 | | 891.074 | | | |
| 51.0738 | | | | | 891.285 |
| 51.8688 | | 891.056 | | | |
| 52.1548 | 890.777 | | | | |
| 53.9708 | | | | | 891.125 |
| 55.9718 | | 890.989 | | | |
| 56.2488 | 890.607 | | | | |
| 58.4608 | | | | 891.226 | |
| 60.0798 | | 890.966 | | | |
| 60.1718 | 890.426 | | | | |
| 60.3968 | | | | | 891.019 |
| 63.5698 | | | | 891.232 | |

| | | | | | |
|---|---|---|---|---|---|
| 64.2408 | | | | | 890.898 |
| 65.3308 | 890.548 | | | | |
| 65.8718 | | 890.891 | | | |
| 70.7288 | | | | 891.244 | |
| 74.3898 | | | | | 890.655 |
| 76.0308 | | 890.825 | | | |
| 76.2378 | 890.141 | | | | |
| 78.2548 | | | | 891.106 | |
| 82.2178 | | 890.804 | | | |
| 82.7158 | 890.028 | | | | |
| 83.1818 | | | | 891.421 | |
| 86.1308 | | | | | 890.711 |
| 89.8918 | | 890.75 | | | |
| 90.1498 | 890.054 | | | | |
| 90.1498 | | | | 890.772 | |
| 96.6718 | | | | 890.563 | |
| 96.6858 | | | | | 890.625 |
| 100.3028 | | 890.623 | | | |
| 100.6098 | 889.981 | | | | |
| 107.0228 | | 890.557 | | | |
| 107.3648 | | | | 890.568 | |
| 107.3648 | 889.798 | | | | |
| 110.1138 | | | | | 890.525 |
| 114.8908 | 889.724 | | | | |
| 115.1518 | | 890.491 | | | |
| 116.0028 | | | | | 890.619 |
| 119.1748 | | | | 890.325 | |
| 123.1358 | | | | | 890.361 |
| 125.1078 | | 890.345 | | | |
| 125.9898 | 889.811 | | | | |
| 128.1628 | | 890.341 | | | |
| 128.3568 | 889.63 | | | | |
| 128.3568 | | | | | 890.647 |
| 131.8908 | 889.63 | | | | |
| 131.8908 | | | | | 890.585 |
| 132.1868 | | 890.324 | | | |
| 133.2808 | | | | 890.321 | |
| 137.1838 | 890.201 | | | | |
| 138.4998 | | 890.208 | | | |
| 140.4008 | | | | 890.077 | |
| 143.4238 | | | | 890.177 | |
| 143.7148 | 889.385 | | | | |
| 143.7508 | | 889.954 | | | |
| 144.5298 | | | | | 889.974 |
| 148.6678 | | 889.499 | | | |
| 148.8498 | 889.139 | | | | |
| 150.8048 | | | | | 889.691 |
| 154.0808 | | | | 889.818 | |
| 154.7638 | | 889.438 | | | |
| 155.4318 | 888.937 | | | | |
| 162.2068 | | | | | 889.265 |
| 162.2068 | | | | 889.601 | |
| 162.2068 | 888.794 | | | | |
| 162.2068 | | | | 889.852 | |
| 162.4468 | | 889.392 | | | |
| 162.4808 | | 889.382 | | | |
| 162.5518 | 888.768 | | | | |
| 171.4338 | 888.647 | | | | |
| 171.4338 | | | | 889.781 | |
| 171.7178 | | 889.312 | | | |
| 173.5078 | | | | | 889.267 |
| 176.7248 | 888.607 | | | | |
| 177.0038 | | 889.318 | | | |
| 177.7948 | | | | 889.48 | |
| 178.5668 | | | | | 889.214 |
| 185.5228 | | | | 889.452 | |

| | | | | |
|---|---|---|---|---|
| 187.0888 | | 889.012 | | |
| 187.0888 | 888.646 | | | |
| 191.0348 | | | | 889.125 |
| 194.6568 | | 888.924 | | |
| 194.7958 | 888.711 | | | |
| 197.1188 | | | 889.224 | |
| 198.6508 | | 888.894 | | |
| 198.9848 | 888.518 | | | |
| 201.6748 | | | | 888.905 |
| 207.7698 | 888.264 | | | |
| 207.7698 | | | | 888.837 |
| 208.2608 | | 888.826 | | |
| 210.2858 | | | 889.081 | |
| 211.8188 | | | | 888.849 |
| 214.3768 | | 888.777 | | |
| 214.6048 | 888.144 | | | |
| 220.6698 | | 888.72 | | |
| 220.9268 | | | | 888.812 |
| 221.0468 | 888.213 | | | |
| 223.6018 | | | 889.248 | |
| 225.6518 | 888.168 | | | |
| 225.7148 | | 888.688 | | |
| 232.6708 | | 888.681 | | |
| 232.7978 | 888.068 | | | |
| 232.9038 | | | | 888.784 |
| 235.1858 | | | 889.106 | |
| 235.9238 | | 888.424 | | |
| 236.2228 | 888.011 | | | |
| 239.0238 | | | 888.946 | |
| 240.1238 | | | | 888.793 |
| 241.6848 | | 888.439 | | |
| 241.9528 | 887.979 | | | |
| 246.3108 | | 888.251 | | |
| 247.1268 | 887.543 | | | |
| 248.5368 | | | | 888.69 |
| 251.4098 | | 888.266 | | |
| 251.4108 | | | 888.62 | |
| 251.4108 | 887.521 | | | |
| 256.6338 | | 888.284 | | |
| 257.3478 | 887.507 | | | |
| 257.5358 | | | 888.606 | |
| 258.8648 | | | | 888.857 |
| 262.7608 | 887.566 | | | |
| 262.7628 | | | 888.445 | |
| 263.2328 | | 888.008 | | |
| 264.9448 | | | | 888.308 |
| 272.5468 | | | 888.423 | |
| 275.0808 | | 887.885 | | |
| 275.2278 | 887.303 | | | |
| 275.2278 | | | | 888.884 |
| 279.8848 | | 887.84 | | |
| 280.4768 | 887.323 | | | |
| 282.1638 | | | | 888.351 |
| 288.4748 | | 887.857 | | |
| 288.8018 | | | | 888.381 |
| 288.8018 | 887.157 | | | |
| 291.7068 | | | 888.537 | |
| 294.7698 | | 887.874 | | |
| 295.0758 | 887.2 | | | |
| 296.2008 | | | | 888.226 |
| 297.6278 | | | 888.408 | |
| 301.8108 | | 887.801 | | |
| 302.0088 | 887.119 | | | |
| 304.2118 | | | | 888.344 |
| 310.7178 | 887.218 | | | |
| 310.8938 | | | 888.12 | |

| | | | | | |
|---|---|---|---|---|---|
| 311.3488 | | 887.77 | | | |
| 317.3428 | | | | 888.111 | |
| 320.4088 | | | | | 887.96 |
| 321.6738 | | 887.723 | | | |
| 322.0928 | 887.162 | | | | |
| 324.3288 | | 887.68 | | | |
| 324.4058 | 887.099 | | | | |
| 324.7638 | | | | 888.139 | |
| 333.2918 | | 887.511 | | | |
| 334.1128 | | | | 888.253 | |
| 334.1128 | 886.919 | | | | |
| 335.9718 | | | | | 887.937 |
| 339.2458 | | | | | 887.856 |
| 341.5378 | 886.99 | | | | |
| 341.6678 | | 887.465 | | | |
| 346.5578 | 887.065 | | | | |
| 346.7338 | 887.039 | | | | |
| 347.6698 | | 887.461 | | | |
| 348.8718 | | | | 887.749 | |
| 350.7388 | | | | | 887.912 |
| 351.6778 | | | | 887.56 | |
| 357.5318 | | 887.369 | | | |
| 357.6668 | 886.765 | | | | |
| 361.2778 | | | | 887.733 | |
| 361.8748 | | | | | 887.607 |
| 366.2028 | | | | 887.591 | |
| 370.3428 | 886.637 | | | | |
| 370.3428 | | | | | 888.079 |
| 370.4768 | | 887.317 | | | |
| 375.0498 | | 887.203 | | | |
| 375.4018 | 886.673 | | | | |
| 376.9418 | | | | | 887.718 |
| 379.7968 | 886.905 | 887.261 | 887.802 | 887.803 | |
| 381.7508 | | 887.245 | | | |
| 381.9978 | 886.968 | | | | |
| 389.4178 | | | | 887.758 | |
| 390.2388 | | 887.12 | | | |
| 390.4188 | 886.81 | | | | |
| 395.5728 | | | | | 887.669 |
| 398.3788 | | | | 887.438 | |
| 405.0608 | | 886.963 | | | |
| 405.3858 | 886.346 | | | | |
| 405.4758 | | | | 887.214 | |
| 406.7288 | | | | | 887.484 |
| 410.2458 | 886.52 | | | | |
| 410.5048 | | 886.969 | | | |
| 414.2478 | | | | | 887.537 |
| 415.2528 | 886.512 | | | | |
| 415.4158 | | | | 887.873 | |
| 415.7718 | | 886.996 | | | |
| 423.1988 | | | | 887.737 | |
| 423.7908 | 886.422 | | | | |
| 424.2078 | | 886.892 | | | |
| 428.6108 | | | | | 887.604 |
| 433.0268 | | 886.887 | | | |
| 433.0808 | 886.486 | | | | |
| 438.9728 | 886.275 | | | | |
| 439.1498 | | 886.885 | | | |
| 441.4798 | | | | 887.843 | |
| 443.5288 | | | | | 887.361 |
| 450.0468 | | | | 887.556 | |
| 451.1878 | 886.606 | | | | |
| 452.5358 | | 886.858 | | | |
| 453.1098 | | | | | 887.033 |
| 456.4758 | | 886.808 | | | |
| 456.6308 | 886.2 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 458.4548 | | | | 887.289 | |
| 458.9558 | | | | | 887.395 |
| 465.1178 | | 886.704 | | | |
| 465.1928 | 886.481 | | | | |
| 465.1928 | | | | | 887.1 |
| 467.2758 | | | | 887.588 | |
| 476.9178 | | 886.739 | | | |
| 476.9768 | 886.466 | | | | |
| 478.6678 | | | | | 887.035 |
| 479.2938 | | | | 887.236 | |
| 486.7648 | | | | | 887.061 |
| 487.5978 | | 886.343 | | | |
| 487.6428 | 886.348 | | | | |
| 487.9888 | | | | 886.936 | |
| 493.3568 | | | | 887.286 | |
| 493.3568 | 886.208 | | | | |
| 493.6438 | | 886.633 | | | |
| 496.8098 | | | | | 886.977 |
| 499.6568 | | | | 886.922 | |
| 500.2958 | 886.054 | | | | |
| 500.5128 | | 886.597 | | | |
| 502.1178 | | | | | 886.919 |
| 503.0268 | 885.994 | 886.661 | | 886.838 | |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|
| (Year 4) Cross Section 13 - Riffle (R1A) | Riffle XS | 379 |

Measurements from Graph

Bankfull Slope: 0.01018

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.01177 | 0.0233 | 0.04578 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 19.94 | 33.94 | 44.99 |
| Pool length | 7.42 | 12.01 | 19.02 |
| Riffle length | 5.57 | 6.73 | 9.28 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.

♀

RIVERMORPH PROFILE SUMMARY

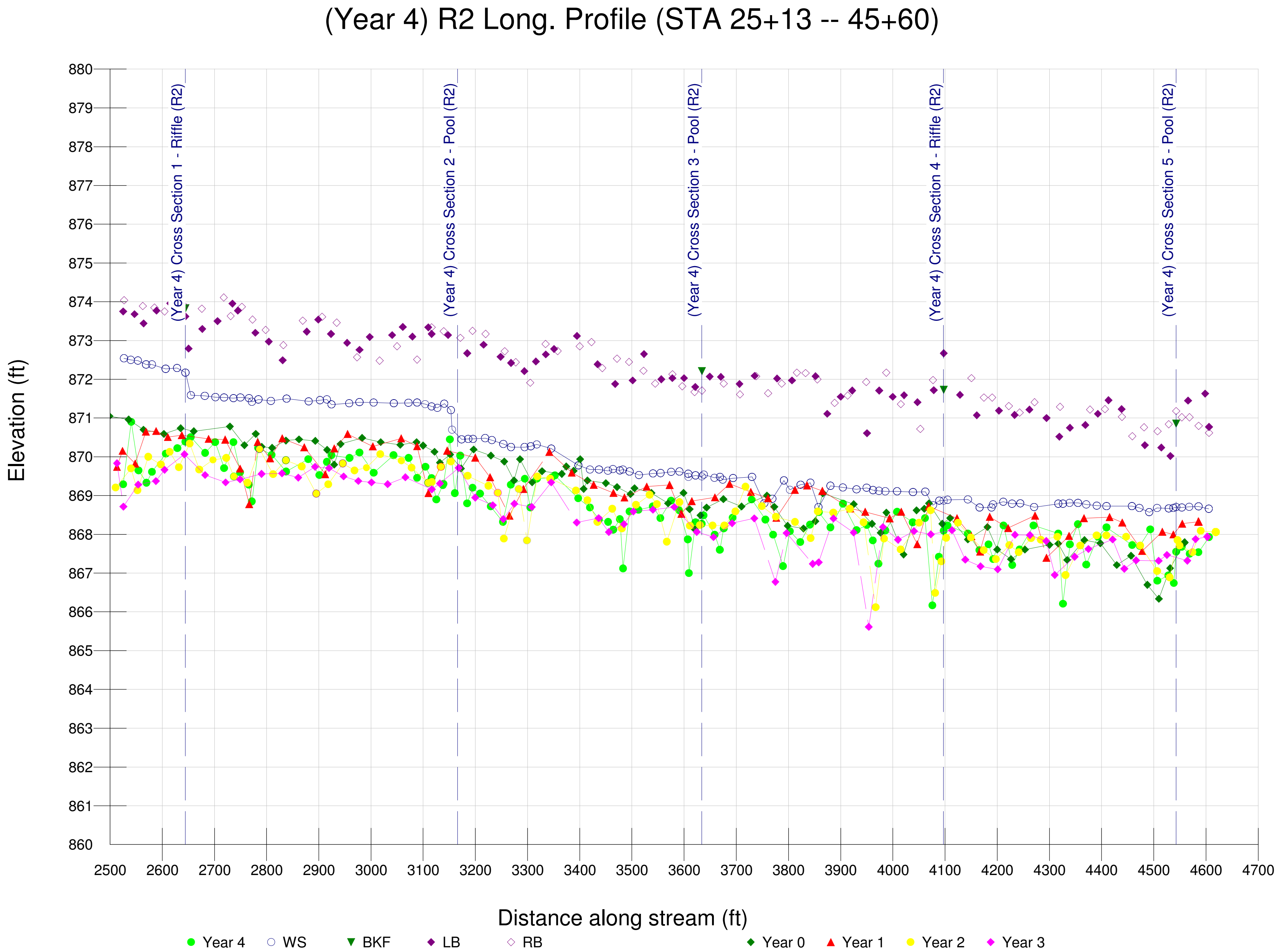
Notes

River Name: Little White Oak Creek (Year 4)
Reach Name: R1A
Profile Name: (Year 4) R1A Long. Profile (STA 0+00 -- 5+00)
Survey Date: 11/14/2011

| DIST | Note |
|---|---|
| 1.5268 | LEW |
| 7.9068 | LEW |

| | |
|---|---|
| 13.0158 | LEW |
| 16.5188 | LEW |
| 19.5318 | LEW |
| 23.6378 | LEW |
| 26.5028 | LEW |
| 30.6428 | LEW |
| 35.5798 | LEW |
| 40.2568 | LEW |
| 45.5738 | LEW |
| 49.9568 | LEW |
| 51.8688 | LEW |
| 55.9718 | LEW |
| 60.0798 | LEW |
| 65.8718 | LEW |
| 76.0308 | LEW |
| 82.2178 | LEW |
| 89.8918 | LEW |
| 100.3028 | LEW |
| 107.0228 | LEW |
| 115.1518 | LEW |
| 125.1078 | LEW |
| 128.1628 | LEW |
| 132.1868 | LEW |
| 138.4998 | LEW |
| 143.7508 | LEW |
| 148.6678 | LEW |
| 154.7638 | LEW |
| 162.4468 | LEW |
| 162.4808 | LEW |
| 171.7178 | LEW |
| 177.0038 | LEW |
| 187.0888 | LEW |
| 194.6568 | LEW |
| 198.6508 | LEW |
| 208.2608 | LEW |
| 214.3768 | LEW |
| 220.6698 | LEW |
| 225.7148 | LEW |
| 232.6708 | LEW |
| 235.9238 | LEW |
| 241.6848 | LEW |
| 246.3108 | LEW |
| 251.4098 | LEW |
| 256.6338 | LEW |
| 263.2328 | LEW |
| 275.0808 | LEW |
| 279.8848 | LEW |
| 288.4748 | LEW |
| 294.7698 | LEW |
| 301.8108 | LEW |
| 311.3488 | LEW |
| 321.6738 | LEW |
| 324.3288 | LEW |
| 333.2918 | LEW |
| 341.6678 | LEW |
| 347.6698 | LEW |
| 357.5318 | LEW |
| 370.4768 | LEW |
| 375.0498 | LEW |
| 379.7968 | XS13 - TW Intersect @ station 379 |
| 381.7508 | LEW |
| 390.2388 | LEW |
| 405.0608 | LEW |
| 410.5048 | LEW |
| 415.7718 | LEW |
| 424.2078 | LEW |

| | |
|---|---|
| 433.0268 | LEW |
| 439.1498 | LEW |
| 452.5358 | LEW |
| 456.4758 | LEW |
| 465.1178 | LEW |
| 476.9178 | LEW |
| 487.5978 | LEW |
| 493.6438 | LEW |
| 500.5128 | LEW |



(Year 4) R2 Long. Profile (STA 25+13 -- 45+60)
Elevation (ft)
Distance along stream (ft)
(Year 4) Cross Section 1 - Riffle (R2)
(Year 4) Cross Section 2 - Pool (R2)
(Year 4) Cross Section 3 - Pool (R2)
(Year 4) Cross Section 4 - Riffle (R2)
(Year 4) Cross Section 5 - Pool (R2)
880
879
878
877
876
875
874
873
872
871
870
869
868
867
866
865
864
863
862
861
860
2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700
Year 4
WS
BKF
LB
RB
Year 0
Year 1
Year 2
Year 3

RIVERMORPH PROFILE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Profile Name: (Year 4) R2 Long. Profile (STA 25+13 -- 45+60)
Survey Date: 11/15/2011

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Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 2525.05 | 869.29 | | | | |
| 2525.05 | | | | 873.75 | |
| 2526.591 | | 872.54 | | | |
| 2526.792 | | | | | 874.04 |
| 2539.722 | | 872.5 | | | |
| 2540.476 | 870.9 | | | | |
| 2546.674 | | | | 873.68 | |
| 2553.364 | | 872.48 | | | |
| 2554.592 | 869.65 | | | | |
| 2562.629 | | | | | 873.89 |
| 2564.229 | | | | 873.44 | |
| 2568.977 | | 872.38 | | | |
| 2569.76 | 869.33 | | | | |
| 2580.097 | | 872.38 | | | |
| 2580.211 | 869.61 | | | | |
| 2585.006 | | | | | 873.85 |
| 2588.762 | | | | 873.77 | |
| 2604.392 | | | | | 873.75 |
| 2606.5 | | 872.27 | | | |
| 2606.794 | 870.08 | | | | |
| 2615.419 | | | | 873.96 | |
| 2623.824 | | | | | 873.69 |
| 2628.216 | | 872.29 | | | |
| 2628.909 | 870.22 | | | | |
| 2631.71 | | | | 873.93 | |
| 2642.925 | | | | | 873.89 |
| 2644.266 | 870.39 | 872.17 | 873.83 | 873.62 | |
| 2650.329 | | | | 872.79 | |
| 2654.681 | 870.51 | | | | |
| 2654.721 | | 871.59 | | | |
| 2675.585 | | | | | 873.82 |
| 2676.388 | | | | 873.3 | |
| 2681.529 | | 871.57 | | | |
| 2681.921 | 870.1 | | | | |
| 2701.265 | 870.38 | | | | |
| 2701.856 | | 871.54 | | | |
| 2705.723 | | | | 873.5 | |
| 2717.678 | | | | | 874.11 |
| 2718.445 | 869.71 | | | | |
| 2718.445 | | 871.53 | | | |
| 2730.993 | | | | | 873.63 |
| 2734.385 | | | | 873.95 | |
| 2736.23 | 870.38 | | | | |
| 2736.481 | | 871.51 | | | |
| 2744.826 | | | | 873.77 | |
| 2749.277 | 869.6 | | | | |
| 2749.726 | | 871.53 | | | |
| 2752.513 | | | | | 873.87 |
| 2765.982 | 869.28 | | | | |
| 2766.274 | | 871.51 | | | |

| | | | | |
|---|---|---|---|---|
| 2771.788 | 868.85 | | | |
| 2771.86 | | 871.42 | | |
| 2772.894 | | | | 873.54 |
| 2778.289 | | | 873.2 | |
| 2783.994 | 870.23 | | | |
| 2784.237 | | 871.48 | | |
| 2797.923 | | | | 873.27 |
| 2803.989 | | | 872.97 | |
| 2808.2 | | 871.44 | | |
| 2809.817 | 870.05 | | | |
| 2830.599 | | | 872.49 | |
| 2832.031 | | | | 872.88 |
| 2837.194 | 869.62 | | | |
| 2838.396 | | 871.5 | | |
| 2869.056 | | | | 873.51 |
| 2876.895 | | | 873.23 | |
| 2879.768 | 869.94 | | | |
| 2880.688 | | 871.43 | | |
| 2898.667 | | | 873.54 | |
| 2901.179 | 869.53 | | | |
| 2902.246 | | 871.46 | | |
| 2906.181 | | | | 873.61 |
| 2915.479 | | 871.48 | | |
| 2915.479 | 869.87 | | | |
| 2923.304 | | | 873.17 | |
| 2924.293 | 870.04 | | | |
| 2924.322 | | 871.35 | | |
| 2934.107 | | | | 873.46 |
| 2954.212 | | | 872.94 | |
| 2958.315 | | 871.38 | | |
| 2958.724 | 869.97 | | | |
| 2973.188 | | | | 872.57 |
| 2977.944 | | | 872.76 | |
| 2977.944 | | 871.41 | | |
| 2977.944 | 870.11 | | | |
| 2997.562 | | | 873.09 | |
| 3004.965 | | 871.4 | | |
| 3005.15 | 869.59 | | | |
| 3016.405 | | | | 872.48 |
| 3040.414 | | | 873.14 | |
| 3043.145 | 870.04 | | | |
| 3043.989 | | 871.38 | | |
| 3049.891 | | | | 872.85 |
| 3060.919 | | | 873.35 | |
| 3071.877 | | 871.39 | | |
| 3072.092 | 869.97 | | | |
| 3079.114 | | | 873.1 | |
| 3088.162 | | | | 872.51 |
| 3088.411 | 869.46 | | | |
| 3088.553 | | 871.4 | | |
| 3103.889 | | 871.36 | | |
| 3104.355 | 869.74 | | | |
| 3109.503 | | | 873.34 | |
| 3116.099 | 869.45 | 871.3 | 873.17 | 873.34 |
| 3125.262 | 868.9 | | | |
| 3127.149 | | 871.26 | | |
| 3137.765 | 869.27 | | | |
| 3138.944 | 869.3 | | | |
| 3139.296 | | | | 873.24 |
| 3140.556 | | 871.37 | | |
| 3147.589 | | | 873.14 | |
| 3151.224 | 870.45 | | | |
| 3153.111 | | 871.2 | | |
| 3155.516 | | 870.7 | | |
| 3160.746 | 869.06 | | | |
| 3171.078 | 870.03 | | | |

| | | | | |
|---|---|---|---|---|
| 3171.078 | | | | 873.07 |
| 3173.672 | | 870.45 | | |
| 3184.285 | | | 872.67 | |
| 3184.285 | 868.8 | | | |
| 3186.41 | | 870.46 | | |
| 3194.509 | 869.2 | | | |
| 3194.509 | | | | 873.25 |
| 3195.534 | | 870.46 | | |
| 3208.959 | 869.05 | | | |
| 3215.606 | | | 872.89 | |
| 3218.844 | | 870.48 | | |
| 3219.391 | | | | 873.17 |
| 3229.372 | 868.72 | | | |
| 3231.729 | | 870.43 | | |
| 3248.429 | | | 872.58 | |
| 3252.878 | 868.32 | | | |
| 3253.732 | | 870.33 | | |
| 3256.172 | | | | 872.72 |
| 3268.055 | 869.28 | | | |
| 3268.246 | | | 872.42 | |
| 3268.298 | | 870.25 | | |
| 3277.337 | | | | 872.44 |
| 3293.942 | | | 872.21 | |
| 3294.318 | | 870.25 | | |
| 3294.833 | 869.43 | | | |
| 3304.948 | | | | 871.91 |
| 3305.215 | 868.69 | | | |
| 3306.188 | | 870.27 | | |
| 3316.054 | | | 872.46 | |
| 3317.578 | | 870.32 | | |
| 3317.863 | 869.43 | | | |
| 3334.408 | | | | 872.91 |
| 3335.015 | | | 872.64 | |
| 3345.624 | | 870.21 | | |
| 3346.64 | 869.47 | | | |
| 3350.791 | | | 872.78 | |
| 3352.529 | 869.52 | | | |
| 3357.529 | | | | 872.73 |
| 3394.506 | | | 873.12 | |
| 3396.962 | 868.93 | | | |
| 3397.609 | | 869.78 | | |
| 3399.871 | | | | 872.85 |
| 3419.399 | | 869.67 | | |
| 3419.523 | 868.69 | | | |
| 3422.511 | | | | 872.96 |
| 3434.174 | | | 872.39 | |
| 3436.988 | 868.38 | | | |
| 3437.061 | | 869.67 | | |
| 3443.129 | | | | 872.29 |
| 3454.153 | | 869.64 | | |
| 3454.455 | 868.32 | | | |
| 3463.785 | | 869.68 | | |
| 3464.266 | 868.12 | | | |
| 3467.906 | | | 871.88 | |
| 3471.387 | | | | 872.53 |
| 3476.978 | | 869.65 | | |
| 3477.091 | 868.39 | | | |
| 3482.844 | | 869.67 | | |
| 3482.992 | 867.12 | | | |
| 3494.458 | | | | 872.45 |
| 3495.487 | 868.59 | | | |
| 3495.487 | | 869.62 | | |
| 3501.354 | | | 871.97 | |
| 3512.688 | 868.63 | | | |
| 3513.693 | | 869.53 | | |
| 3522.049 | | | | 872.22 |

| | | | | | |
|---|---|---|---|---|---|
| 3523.023 | | | | 872.65 | |
| 3540.11 | 868.72 | | | | |
| 3540.597 | | 869.57 | | | |
| 3544.663 | | | | | 871.89 |
| 3554.327 | 868.42 | | | | |
| 3554.949 | | 869.58 | | | |
| 3556.297 | | | | 872 | |
| 3575.125 | 868.87 | | | | |
| 3575.452 | | 869.61 | | | |
| 3577.387 | | | | 872.03 | |
| 3577.646 | | | | | 872.13 |
| 3590.748 | 868.62 | | | | |
| 3591.18 | | 869.62 | | | |
| 3596.553 | | | | | 871.82 |
| 3599.9 | | | | 872.03 | |
| 3607.158 | 867.87 | | | | |
| 3607.974 | | 869.56 | | | |
| 3608.385 | | 869.48 | | | |
| 3609.392 | 867 | | | | |
| 3620.019 | | | | | 871.67 |
| 3621.178 | | | | 871.8 | |
| 3621.868 | 868.31 | | | | |
| 3622.042 | | 869.52 | | | |
| 3634.169 | 868.27 | 869.49 | 872.21 | | 871.71 |
| 3637.587 | 868.49 | | | | |
| 3637.774 | | 869.54 | | | |
| 3649.188 | | | | 872.07 | |
| 3658.36 | | 869.46 | | | |
| 3658.679 | 867.99 | | | | |
| 3668.5 | 867.6 | | | | |
| 3668.579 | | 869.48 | | | |
| 3670.38 | | | | 872.06 | |
| 3674.314 | | 869.41 | | | |
| 3675.878 | 868.15 | | | | |
| 3675.878 | | | | | 871.89 |
| 3692.934 | 868.43 | | | | |
| 3693.994 | | 869.45 | | | |
| 3706.229 | | | | 871.88 | |
| 3707.001 | | | | | 871.61 |
| 3729.428 | 868.9 | | | | |
| 3730.218 | | 869.48 | | | |
| 3735.118 | | | | 872.09 | |
| 3737.886 | | | | | 872.08 |
| 3753.536 | | 868.8 | | | |
| 3755.902 | 868.38 | | | | |
| 3761.081 | | | | | 871.64 |
| 3769.333 | | 868.92 | | | |
| 3770.882 | 867.99 | | | | |
| 3778.163 | | | | 872.02 | |
| 3787.029 | | | | | 871.89 |
| 3789.752 | 867.18 | | | | |
| 3791.45 | | 869.39 | | | |
| 3802.738 | | 869.15 | | | |
| 3802.918 | 868.08 | | | | |
| 3806.667 | | | | 871.97 | |
| 3816.249 | | | | | 872.17 |
| 3822.783 | 867.8 | | | | |
| 3823.325 | | 869.28 | | | |
| 3832.722 | | | | | 872.16 |
| 3841.016 | 868.25 | | | | |
| 3842.24 | | 869.33 | | | |
| 3851.907 | | | | 872.08 | |
| 3855.398 | | | | | 872 |
| 3857.687 | | 868.7 | | | |
| 3858.443 | 868.57 | | | | |
| 3874.423 | | | | 871.11 | |

| | | | | | |
|---|---|---|---|---|---|
| 3880.298 | 868.18 | | | | |
| 3880.312 | | 869.25 | | | |
| 3888.571 | | | | | 871.39 |
| 3900.059 | | | | 871.55 | |
| 3904.318 | | 869.21 | | | |
| 3904.426 | 868.79 | | | | |
| 3913.437 | | | | | 871.58 |
| 3922.11 | | | | 871.71 | |
| 3930.502 | | 869.16 | | | |
| 3930.581 | 868.11 | | | | |
| 3949.005 | | | | | 871.93 |
| 3949.934 | | 869.2 | | | |
| 3950.295 | 868.24 | | | | |
| 3950.514 | | | | 870.61 | |
| 3961.951 | 867.84 | | | | |
| 3962.198 | | 869.14 | | | |
| 3972.656 | 867.24 | | | | |
| 3973.547 | | 869.12 | | | |
| 3973.815 | | | | 871.71 | |
| 3985.616 | | 869.11 | | | |
| 3985.806 | 868.1 | | | | |
| 3987.279 | | | | | 872.17 |
| 3999.687 | | | | 871.55 | |
| 4008.234 | | 869.11 | | | |
| 4008.389 | 868.58 | | | | |
| 4015.254 | | | | | 871.36 |
| 4021.481 | | | | 871.59 | |
| 4038.184 | 868.31 | | | | |
| 4038.781 | | 869.09 | | | |
| 4047.134 | | | | 871.41 | |
| 4052.54 | | | | | 870.72 |
| 4061.87 | 868.42 | | | | |
| 4062.343 | | 869.1 | | | |
| 4075.791 | 866.17 | | | | |
| 4076.811 | | 868.75 | | | |
| 4077.079 | | | | | 871.98 |
| 4078.302 | | | | 871.72 | |
| 4088.355 | 867.42 | | | | |
| 4089.262 | | 868.87 | | | |
| 4097.649 | 868.09 | 868.87 | 871.73 | 872.67 | |
| 4104.941 | 868.23 | | | | |
| 4105.097 | | 868.89 | | | |
| 4128.666 | | | | 871.6 | |
| 4143.831 | | 868.9 | | | |
| 4143.899 | 868.02 | | | | |
| 4150.519 | | | | | 872.03 |
| 4160.847 | | | | 871.07 | |
| 4165.797 | 867.59 | | | | |
| 4166.261 | | 868.69 | | | |
| 4174.541 | | | | | 871.53 |
| 4183.578 | 867.74 | | | | |
| 4189.173 | | 868.69 | | | |
| 4190.444 | | | | | 871.53 |
| 4192.194 | | 868.77 | | | |
| 4192.519 | 867.36 | | | | |
| 4203.34 | | | | 871.19 | |
| 4211.692 | | 868.84 | | | |
| 4212.232 | 868.23 | | | | |
| 4222.187 | | | | | 871.31 |
| 4228.568 | | 868.79 | | | |
| 4228.995 | 867.21 | | | | |
| 4233.423 | | | | 871.08 | |
| 4243.128 | 867.61 | | | | |
| 4243.128 | | | | | 871.14 |
| 4244.412 | | 868.8 | | | |
| 4261.924 | | | | 871.22 | |

| | | | | | |
|---|---|---|---|---|---|
| 4269.606 | 868.23 | | | | |
| 4271.065 | | 868.7 | | | |
| 4271.638 | | | | | 871.41 |
| 4294.405 | | | | 871 | |
| 4316.983 | 868.02 | | | | |
| 4317.411 | | 868.79 | | | |
| 4319.176 | | | | 870.52 | |
| 4320.359 | | | | | 871.29 |
| 4326.176 | | 868.79 | | | |
| 4326.176 | 866.21 | | | | |
| 4338.7 | | 868.81 | | | |
| 4339.368 | 867.74 | | | | |
| 4339.368 | | | | 870.75 | |
| 4354.7 | 868.26 | | | | |
| 4355.027 | | 868.81 | | | |
| 4368.735 | | | | 870.82 | |
| 4370.805 | | 868.77 | | | |
| 4370.96 | 867.22 | | | | |
| 4377.931 | | | | | 871.22 |
| 4391.003 | | 868.74 | | | |
| 4392.843 | 867.94 | | | | |
| 4392.843 | | | | 871.11 | |
| 4406.466 | | | | | 871.23 |
| 4409.616 | | 868.73 | | | |
| 4409.616 | 868.18 | | | | |
| 4413.252 | | | | 871.46 | |
| 4438.599 | | | | 871.23 | |
| 4438.991 | | | | | 871.03 |
| 4458.227 | | 868.73 | | | |
| 4458.787 | | | | | 870.53 |
| 4458.787 | 867.72 | | | | |
| 4472.69 | | 868.68 | | | |
| 4473.502 | 867.7 | | | | |
| 4481.543 | | | | | 870.76 |
| 4482.947 | | | | 870.3 | |
| 4491.603 | | 868.57 | | | |
| 4493.478 | 868.13 | | | | |
| 4506.399 | | 868.68 | | | |
| 4507.017 | 866.8 | | | | |
| 4507.246 | | | | | 870.66 |
| 4514.394 | | | | 870.24 | |
| 4527.832 | 866.94 | | | | |
| 4528.769 | | 868.67 | | | |
| 4528.793 | | | | | 870.84 |
| 4531.908 | | | | 870.02 | |
| 4537.539 | | 868.68 | | | |
| 4538.624 | 866.74 | | | | |
| 4543.094 | 867.55 | 868.7 | 870.86 | | 871.18 |
| 4553.712 | | | | | 871.02 |
| 4553.762 | 867.68 | | | | |
| 4553.977 | | 868.69 | | | |
| 4565.823 | | | | 871.45 | |
| 4568.054 | | 868.71 | | | |
| 4568.581 | | | | | 871.02 |
| 4568.914 | 867.5 | | | | |
| 4585.777 | 867.54 | | | | |
| 4586.06 | | 868.72 | | | |
| 4586.118 | | | | | 870.8 |
| 4598.615 | | | | 871.63 | |
| 4605.405 | | 868.66 | | | |
| 4605.901 | 867.93 | | | 870.77 | 870.62 |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|

| | | |
|---|---|---|
| (Year 4) Cross Section 1 - Riffle | (R2)Riffle XS | 2644 |
| (Year 4) Cross Section 2 - Pool | (R2)Riffle XS | 3166 |
| (Year 4) Cross Section 3 - Pool | (R2)Pool XS | 3634 |
| (Year 4) Cross Section 4 - Riffle | (R2)Riffle XS | 4097 |
| (Year 4) Cross Section 5 - Pool | (R2)Pool XS | 4543 |

Measurements from Graph

Bankfull Slope: 0.00156

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.00059 | 0.00379 | 0.00933 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 55.29 | 133.80 | 208.89 |
| Pool length | 30.72 | 42.24 | 67.58 |
| Riffle length | 26.62 | 33.45 | 43.01 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.

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RIVERMORPH PROFILE SUMMARY

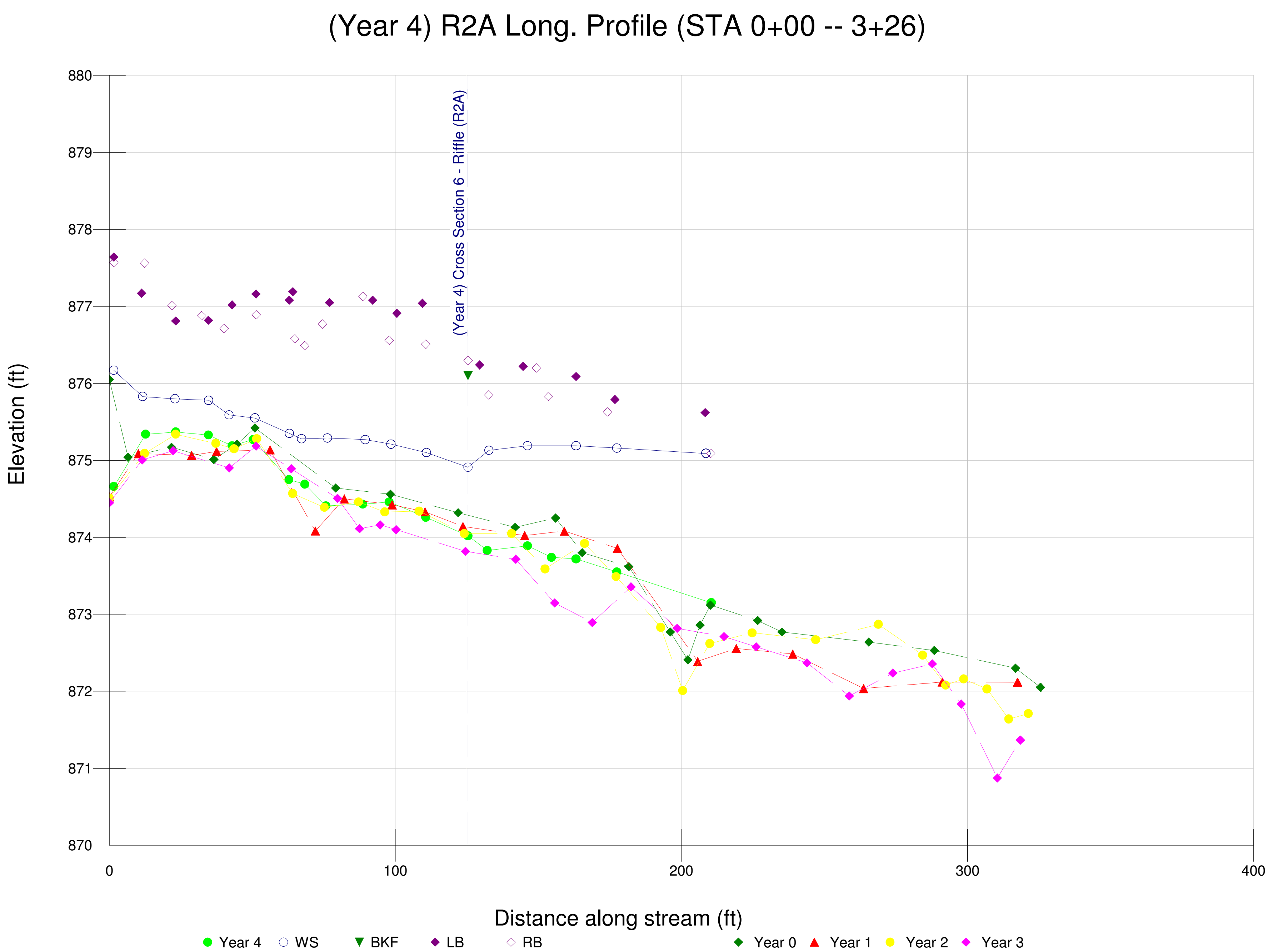
Notes

River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Profile Name: (Year 4) R2 Long. Profile (STA 25+13 -- 45+60)
Survey Date: 11/15/2011

| DIST | Note |
|---|---|
| 2526.591 | LEW |
| 2539.722 | LEW |
| 2553.364 | LEW |
| 2568.977 | LEW |
| 2580.097 | LEW |
| 2606.5 | LEW |
| 2628.216 | LEW |
| 2644.266 | XS1 - TW Intersect @ station 2644 |
| 2654.721 | LEW |
| 2681.529 | LEW |
| 2701.856 | LEW |
| 2718.445 | LEW |
| 2736.481 | LEW |
| 2749.726 | LEW |
| 2766.274 | LEW |
| 2771.86 | LEW |
| 2784.237 | LEW |
| 2808.2 | LEW |
| 2838.396 | LEW |
| 2880.688 | LEW |
| 2902.246 | LEW |
| 2915.479 | LEW |
| 2924.322 | LEW |
| 2958.315 | LEW |
| 2977.944 | LEW |
| 3004.965 | LEW |

| | |
|---|---|
| 3043.989 | LEW |
| 3071.877 | LEW |
| 3088.553 | LEW |
| 3103.889 | LEW |
| 3116.099 | XS2 - TW Intersect @ station 3116 |
| 3127.149 | LEW |
| 3140.556 | LEW |
| 3153.111 | LEW |
| 3155.516 | LEW |
| 3173.672 | LEW |
| 3186.41 | LEW |
| 3195.534 | LEW |
| 3218.844 | LEW |
| 3231.729 | LEW |
| 3253.732 | LEW |
| 3268.298 | LEW |
| 3294.318 | LEW |
| 3306.188 | LEW |
| 3317.578 | LEW |
| 3345.624 | LEW |
| 3397.609 | LEW |
| 3419.399 | LEW |
| 3437.061 | LEW |
| 3454.153 | LEW |
| 3463.785 | LEW |
| 3476.978 | LEW |
| 3482.844 | LEW |
| 3495.487 | LEW |
| 3513.693 | LEW |
| 3540.597 | LEW |
| 3554.949 | LEW |
| 3575.452 | LEW |
| 3591.18 | LEW |
| 3607.974 | LEW |
| 3608.385 | LEW |
| 3622.042 | LEW |
| 3634.169 | XS3 - TW Intersect @ station 3634 |
| 3637.774 | LEW |
| 3658.36 | LEW |
| 3668.579 | LEW |
| 3674.314 | LEW |
| 3693.994 | LEW |
| 3730.218 | LEW |
| 3753.536 | LEW |
| 3769.333 | LEW |
| 3791.45 | LEW |
| 3802.738 | LEW |
| 3823.325 | LEW |
| 3842.24 | LEW |
| 3857.687 | LEW |
| 3880.312 | LEW |
| 3904.318 | LEW |
| 3930.502 | LEW |
| 3949.934 | LEW |
| 3962.198 | LEW |
| 3973.547 | LEW |
| 3985.616 | LEW |
| 4008.234 | LEW |
| 4038.781 | LEW |
| 4062.343 | LEW |
| 4076.811 | LEW |
| 4089.262 | LEW |
| 4097.649 | XS4 - TW Intersect @ station 4097 |
| 4105.097 | LEW |
| 4143.831 | LEW |
| 4166.261 | LEW |

| | |
|---|---|
| 4189.173 | LEW |
| 4192.194 | LEW |
| 4211.692 | LEW |
| 4228.568 | LEW |
| 4244.412 | LEW |
| 4271.065 | LEW |
| 4317.411 | LEW |
| 4326.176 | LEW |
| 4338.7 | LEW |
| 4355.027 | LEW |
| 4370.805 | LEW |
| 4391.003 | LEW |
| 4409.616 | LEW |
| 4458.227 | LEW |
| 4472.69 | LEW |
| 4491.603 | LEW |
| 4506.399 | LEW |
| 4528.769 | LEW |
| 4537.539 | LEW |
| 4543.094 | XS5 - TW Intersect @ station 4543 |
| 4553.977 | LEW |
| 4568.054 | LEW |
| 4586.06 | LEW |
| 4605.405 | LEW |



(Year 4) R2A Long. Profile (STA 0+00 -- 3+26)
Elevation (ft)
880
879
878
877
876
875
874
873
872
871
870
0
100
200
300
400
Distance along stream (ft)
(Year 4) Cross Section 6 - Riffle (R2A)
Year 4
WS
BKF
LB
RB
Year 0
Year 1
Year 2
Year 3

RIVERMORPH PROFILE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R2A
Profile Name: (Year 4) R2A Long. Profile (STA 0+00 -- 3+26)
Survey Date: 11/14/2011

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Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 1.549 | 874.66 | | | | |
| 1.549 | | | | 877.64 | |
| 1.549 | | 876.17 | | | |
| 1.549 | | | | | 877.57 |
| 11.282 | | | | 877.17 | |
| 11.65 | | 875.83 | | | |
| 12.293 | | | | | 877.56 |
| 12.661 | 875.34 | | | | |
| 21.86 | | | | | 877.01 |
| 22.933 | | 875.8 | | | |
| 23.205 | | | | 876.81 | |
| 23.205 | 875.37 | | | | |
| 32.225 | | | | | 876.88 |
| 34.626 | | | | 876.82 | |
| 34.626 | 875.33 | | | | |
| 34.719 | | 875.78 | | | |
| 40.101 | | | | | 876.71 |
| 41.855 | | 875.59 | | | |
| 42.916 | 875.19 | | | | |
| 42.916 | | | | 877.02 | |
| 50.251 | 875.27 | | | | |
| 50.882 | | 875.55 | | | |
| 51.234 | | | | 877.16 | |
| 51.356 | | | | | 876.89 |
| 62.767 | 874.75 | | | | |
| 62.898 | | | | 877.08 | |
| 62.944 | | 875.35 | | | |
| 64.149 | | | | 877.19 | |
| 64.814 | | | | | 876.58 |
| 67.187 | | 875.28 | | | |
| 68.334 | 874.69 | | | | |
| 68.334 | | | | | 876.49 |
| 74.481 | | | | | 876.77 |
| 75.723 | 874.41 | | | | |
| 76.255 | | 875.29 | | | |
| 76.986 | | | | 877.05 | |
| 88.617 | 874.43 | | | | |
| 88.621 | | | | | 877.13 |
| 89.454 | | 875.27 | | | |
| 92.033 | | | | 877.08 | |
| 97.818 | | | | | 876.56 |
| 97.818 | 874.46 | | | | |
| 98.48 | | 875.21 | | | |
| 100.536 | | | | 876.91 | |
| 109.442 | | | | 877.04 | |
| 110.622 | 874.26 | | | | |
| 110.622 | | | | | 876.51 |
| 110.861 | | 875.1 | | | |
| 125.388 | 874.02 | 874.91 | 876.1 | | 876.3 |
| 129.436 | | | | 876.24 | |

| | | | | |
|---|---|---|---|---|
| 132.131 | 873.83 | | | |
| 132.665 | | | | 875.85 |
| 132.702 | | 875.13 | | |
| 144.643 | | | 876.22 | |
| 146.203 | | 875.19 | | |
| 146.203 | 873.89 | | | |
| 149.283 | | | | 876.2 |
| 153.509 | | | | 875.83 |
| 154.573 | 873.74 | | | |
| 163.162 | | | 876.09 | |
| 163.162 | 873.72 | | | |
| 163.162 | | 875.19 | | |
| 174.186 | | | | 875.63 |
| 176.775 | | | 875.79 | |
| 177.413 | | 875.159 | | |
| 177.414 | 873.55 | | | |
| 208.336 | | | 875.62 | |
| 208.604 | | 875.09 | | |
| 210.244 | | | | 875.09 |
| 210.408 | 873.15 | | | |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|
| (Year 4) Cross Section 6 - Riffle (R2A) | Riffle XS | 125 |

Measurements from Graph

Bankfull Slope: 0.01094

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.00951 | 0.01320 | 0.01688 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 56.54 | 69.70 | 78.61 |
| Pool length | 18.59 | 20.39 | 22.07 |
| Riffle length | 12.00 | 12.39 | 12.78 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.

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## RIVERMORPH PROFILE SUMMARY

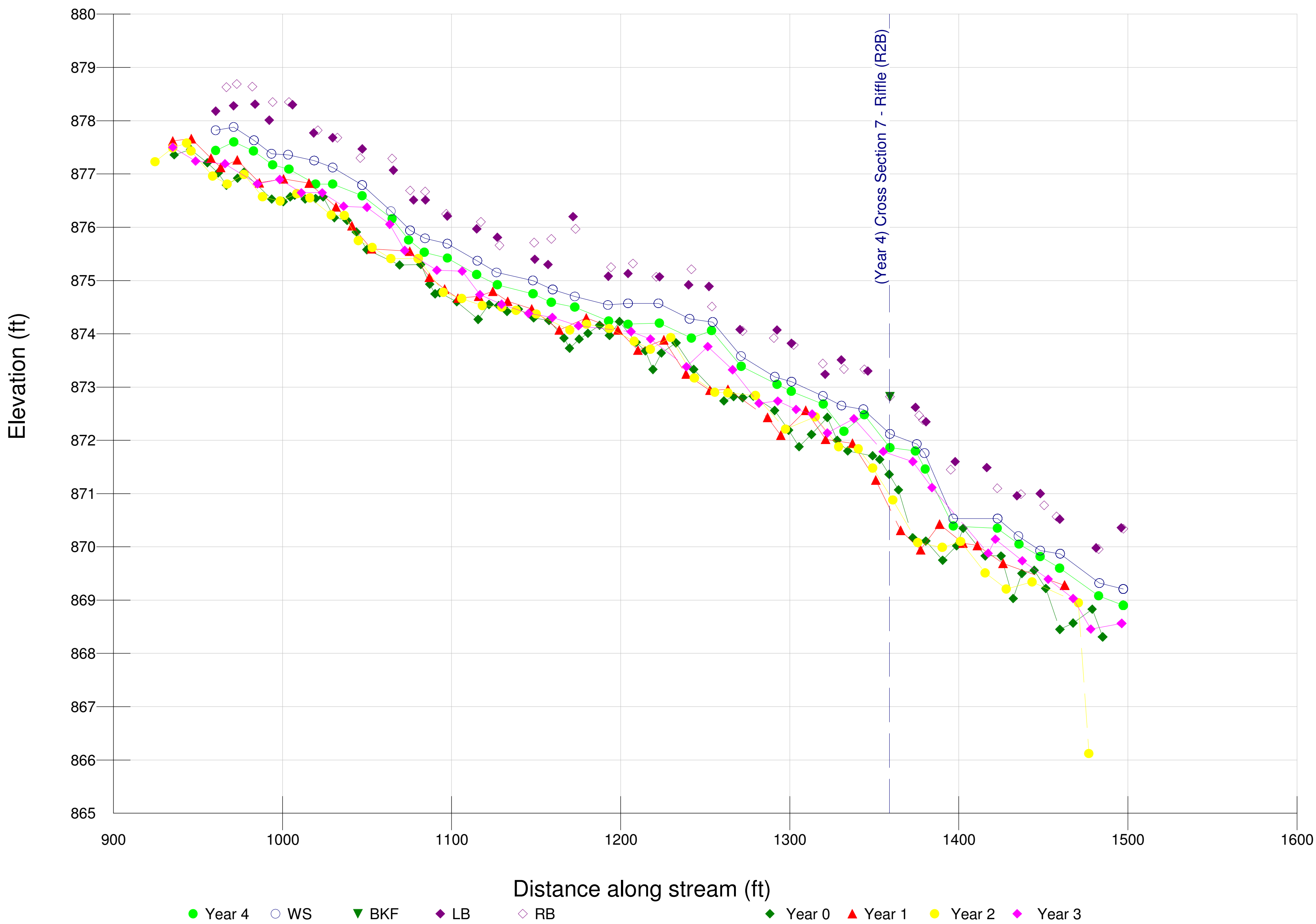
### Notes

River Name: Little White Oak Creek (Year 4)
Reach Name: R2A
Profile Name: (Year 4) R2A Long. Profile (STA 0+00 -- 3+26)
Survey Date: 11/14/2011

| DIST | Note |
|---|---|
| 1.549 | LEW |
| 11.65 | LEW |
| 22.933 | LEW |
| 34.719 | LEW |
| 41.855 | LEW |

| | |
|---|---|
| 50.882 | LEW |
| 62.944 | LEW |
| 67.187 | LEW |
| 76.255 | LEW |
| 89.454 | LEW |
| 98.48 | LEW |
| 110.861 | LEW |
| 125.388 | XS6 - TW Intersect @ station 125 |
| 132.702 | LEW |
| 146.203 | LEW |
| 163.162 | LEW |
| 177.413 | LEW |
| 208.604 | LEW |

## (Year 4) R2B Long. Profile (STA 9+35 -- 14+86)



RIVERMORPH PROFILE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R2B
Profile Name: (Year 4) R2B Long. Profile (STA 9+35 -- 14+86)
Survey Date: 01/05/2012

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Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 960.4373 | 877.440 | | | | |
| 960.4373 | | | | 878.180 | |
| 960.4373 | | 877.820 | | | |
| 966.8053 | | | | | 878.630 |
| 970.9873 | | | | 878.280 | |
| 971.0583 | | 877.880 | | | |
| 971.1843 | 877.600 | | | | |
| 972.8593 | | | | | 878.690 |
| 982.0813 | | | | | 878.640 |
| 982.8473 | 877.430 | | | | |
| 983.0943 | | 877.630 | | | |
| 983.6633 | | | | 878.310 | |
| 992.1353 | | | | 878.010 | |
| 993.4733 | | 877.380 | | | |
| 994.1143 | | | | | 878.350 |
| 994.1143 | 877.170 | | | | |
| 1003.3213 | | 877.360 | | | |
| 1003.7903 | 877.090 | | | | |
| 1003.7903 | | | | | 878.350 |
| 1005.8783 | | | | 878.300 | |
| 1018.4093 | | | | 877.770 | |
| 1018.7283 | | 877.250 | | | |
| 1019.5433 | 876.810 | | | | |
| 1020.8503 | | | | | 877.820 |
| 1029.6453 | | 877.120 | | | |
| 1029.6453 | | | | 877.680 | |
| 1029.6453 | 876.810 | | | | |
| 1032.4063 | | | | | 877.680 |
| 1045.9933 | | | | | 877.300 |
| 1047.0803 | 876.590 | | | | |
| 1047.0803 | | | | 877.470 | |
| 1047.0803 | | 876.790 | | | |
| 1064.0763 | | 876.300 | | | |
| 1064.7933 | 876.160 | | | | |
| 1064.7933 | | | | | 877.290 |
| 1065.5683 | | | | 877.070 | |
| 1074.5853 | 875.760 | | | | |
| 1075.4233 | | | | | 876.690 |
| 1075.4793 | | 875.940 | | | |
| 1077.4803 | | | | 876.510 | |
| 1083.8683 | 875.530 | | | | |
| 1084.2963 | | 875.790 | | | |
| 1084.2963 | | | | | 876.670 |
| 1084.4563 | | | | 876.510 | |
| 1096.7943 | | | | | 876.250 |
| 1097.4793 | | | | 876.210 | |
| 1097.4923 | | 875.690 | | | |
| 1097.4923 | 875.420 | | | | |
| 1114.8053 | 875.110 | | | | |
| 1114.8053 | | | | 875.970 | |

| | | | | | |
|---|---|---|---|---|---|
| 1115.2363 | | 875.370 | | | |
| 1117.2523 | | | | | 876.100 |
| 1126.5633 | | 875.150 | | | |
| 1127.0773 | | | | 875.810 | |
| 1127.0773 | 874.920 | | | | |
| 1128.3093 | | | | | 875.660 |
| 1148.0753 | | 875.000 | | | |
| 1148.1723 | 874.750 | | | | |
| 1148.8523 | | | | | 875.710 |
| 1149.1773 | | | | 875.400 | |
| 1157.0173 | | | | 875.300 | |
| 1158.9923 | 874.590 | | | | |
| 1158.9923 | | | | | 875.780 |
| 1159.8373 | | 874.830 | | | |
| 1171.8283 | | | | 876.200 | |
| 1172.8623 | | 874.700 | | | |
| 1172.8633 | 874.500 | | | | |
| 1173.2793 | | | | | 875.970 |
| 1192.4213 | | 874.540 | | | |
| 1192.7473 | | | | 875.080 | |
| 1192.9033 | 874.240 | | | | |
| 1194.2883 | | | | | 875.250 |
| 1204.3953 | | | | 875.130 | |
| 1204.3953 | | 874.570 | | | |
| 1204.3953 | 874.180 | | | | |
| 1207.2363 | | | | | 875.320 |
| 1221.0623 | | | | | 875.070 |
| 1222.3763 | | 874.570 | | | |
| 1222.9463 | 874.200 | | | | |
| 1222.9463 | | | | 875.070 | |
| 1240.1483 | | | | 874.920 | |
| 1240.7363 | | 874.280 | | | |
| 1241.8143 | 873.920 | | | | |
| 1241.8143 | | | | | 875.210 |
| 1252.2773 | | | | 874.890 | |
| 1253.7653 | 874.060 | | | | |
| 1253.9203 | | | | | 874.510 |
| 1254.4703 | | 874.220 | | | |
| 1270.6233 | | | | 874.080 | |
| 1271.1343 | | 873.580 | | | |
| 1271.3353 | 873.390 | | | | |
| 1272.1303 | | | | | 874.050 |
| 1290.5483 | | | | | 873.920 |
| 1291.1893 | | 873.190 | | | |
| 1292.4833 | 873.050 | | | | |
| 1292.4833 | | | | 874.070 | |
| 1300.9713 | 872.920 | | | | |
| 1300.9773 | | | | 873.820 | |
| 1301.0593 | | 873.100 | | | |
| 1302.3153 | | | | | 873.790 |
| 1319.5903 | | | | | 873.440 |
| 1319.6703 | | 872.830 | | | |
| 1319.8613 | 872.680 | | | | |
| 1320.8893 | | | | 873.240 | |
| 1330.5293 | | | | 873.510 | |
| 1330.6543 | | 872.650 | | | |
| 1332.0583 | 872.170 | | | | |
| 1332.0583 | | | | | 873.340 |
| 1343.5773 | | 872.580 | | | |
| 1344.1463 | | | | | 873.330 |
| 1344.1463 | 872.480 | | | | |
| 1346.1923 | | | | 873.300 | |
| 1359.2433 | 871.860 | 872.120 | 872.820 | | 872.820 |
| 1374.3543 | | | | 872.620 | |
| 1374.3543 | 871.800 | | | | |
| 1375.1903 | | 871.930 | | | |

| | | | | |
|---|---|---|---|---|
| 1376.5373 | | | | 872.470 |
| 1378.9063 | | | | 872.380 |
| 1379.7363 | | 871.760 | | |
| 1380.1723 | 871.460 | | | |
| 1380.6303 | | | 872.350 | |
| 1395.2223 | | | | 871.450 |
| 1396.6953 | | 870.530 | | |
| 1396.7773 | 870.390 | | | |
| 1397.8863 | | | 871.600 | |
| 1416.5573 | | | 871.490 | |
| 1422.8113 | 870.350 | | | |
| 1422.8113 | | | | 871.100 |
| 1422.9903 | | 870.530 | | |
| 1434.4553 | | | 870.960 | |
| 1435.3063 | | 870.200 | | |
| 1435.6493 | 870.050 | | | |
| 1436.8043 | | | | 870.990 |
| 1448.2013 | | 869.930 | | |
| 1448.2013 | | | 871.000 | |
| 1448.2013 | 869.820 | | | |
| 1450.5133 | | | | 870.780 |
| 1457.8383 | | | | 870.570 |
| 1459.6963 | | | 870.520 | |
| 1459.6963 | 869.600 | | | |
| 1460.0013 | | 869.870 | | |
| 1481.2523 | | | 869.980 | |
| 1482.7453 | | | | 869.960 |
| 1482.7493 | 869.080 | | | |
| 1483.1793 | | 869.320 | | |
| 1496.0873 | | | 870.360 | |
| 1497.3323 | | | | 870.340 |
| 1497.3323 | | 869.210 | | |
| 1497.3323 | 868.900 | | | |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|
| (Year 4) Cross Section 7 - Riffle (R2B) | Riffle XS | 1359 |

Measurements from Graph

Bankfull Slope: 0.01586

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.02151 | 0.02809 | 0.03733 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 39.10 | 51.97 | 64.51 |
| Pool length | 15.64 | 18.25 | 21.50 |
| Riffle length | 7.17 | 8.73 | 10.43 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.

RIVERMORPH PROFILE SUMMARY

Notes

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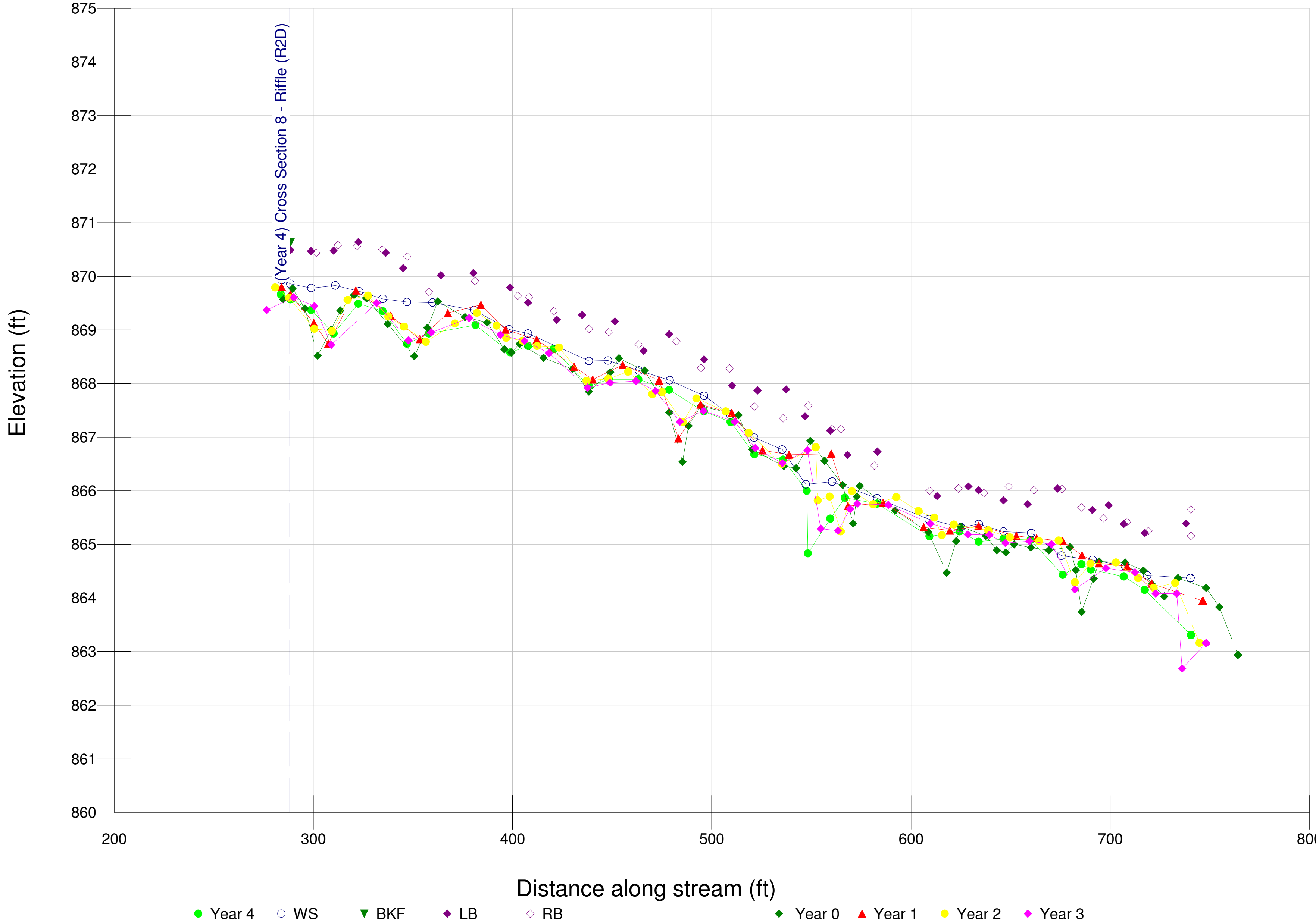
River Name:   Little White Oak Creek (Year 4)
Reach Name:   R2B
Profile Name: (Year 4) R2B Long. Profile (STA 9+35 -- 14+86)
Survey Date:  01/05/2012

| DIST | Note |
|---|---|
| 960.4373 | LEW |
| 971.0583 | LEW |
| 983.0943 | LEW |
| 993.4733 | LEW |
| 1003.3213 | LEW |
| 1018.7283 | LEW |
| 1029.6453 | LEW |
| 1047.0803 | LEW |
| 1064.0763 | LEW |
| 1075.4793 | LEW |
| 1084.2963 | LEW |
| 1097.4923 | LEW |
| 1115.2363 | LEW |
| 1126.5633 | LEW |
| 1148.0753 | LEW |
| 1159.8373 | LEW |
| 1172.8623 | LEW |
| 1192.4213 | LEW |
| 1204.3953 | LEW |
| 1222.3763 | LEW |
| 1240.7363 | LEW |
| 1254.4703 | LEW |
| 1271.1343 | LEW |
| 1291.1893 | LEW |
| 1301.0593 | LEW |
| 1319.6703 | LEW |
| 1330.6543 | LEW |
| 1343.5773 | LEW |
| 1359.2433 | XS7 - TW Intersect @ station 1359 |
| 1375.1903 | LEW |
| 1379.7363 | LEW |
| 1396.6953 | LEW |
| 1422.9903 | LEW |
| 1435.3063 | LEW |
| 1448.2013 | LEW |
| 1460.0013 | LEW |
| 1483.1793 | LEW |
| 1497.3323 | LEW |

# (Year 4) R2D Long. Profile (STA 2+84 -- 7+79)



RIVERMORPH PROFILE SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R2D
Profile Name: (Year 4) R2D Long. Profile (STA 2+84 -- 7+79)
Survey Date: 11/15/2011

---

Survey Data

| DIST | CH | WS | BKF | LB | RB |
|---|---|---|---|---|---|
| 283.705 | 869.66 | | | | 870.69 |
| 283.947 | | | | 870.55 | |
| 284.178 | | 869.93 | | | |
| 288.425 | 869.57 | 869.86 | 870.63 | 870.49 | |
| 298.76 | | | | 870.47 | |
| 298.918 | 869.37 | | | | |
| 298.918 | | 869.78 | | | |
| 301.44 | | | | | 870.44 |
| 310.103 | 868.93 | | | | |
| 310.103 | | | | 870.48 | |
| 310.99 | | 869.83 | | | |
| 312.244 | | | | | 870.58 |
| 321.859 | | | | | 870.56 |
| 322.593 | | | | 870.64 | |
| 322.593 | 869.49 | | | | |
| 322.966 | | 869.72 | | | |
| 334.508 | | | | | 870.5 |
| 334.776 | 869.35 | | | | |
| 334.874 | | 869.58 | | | |
| 336.271 | | | | 870.44 | |
| 345.033 | | | | 870.15 | |
| 346.981 | | 869.52 | | | |
| 346.981 | 868.74 | | | | |
| 346.981 | | | | | 870.37 |
| 357.976 | 868.93 | | | | |
| 357.976 | | | | | 869.71 |
| 359.832 | | 869.51 | | | |
| 364.01 | | | | 870.02 | |
| 380.317 | | | | 870.06 | |
| 380.722 | | 869.37 | | | |
| 381.191 | | | | | 869.91 |
| 381.372 | 869.09 | | | | |
| 398.255 | | 869.01 | | | |
| 398.706 | 868.58 | | | | |
| 398.706 | | | | 869.79 | |
| 402.572 | | | | | 869.64 |
| 407.7 | | 868.93 | | | |
| 407.789 | | | | 869.51 | |
| 407.888 | 868.7 | | | | |
| 408.295 | | | | | 869.61 |
| 420.654 | | | | | 869.35 |
| 420.654 | 868.64 | | | | |
| 422.149 | | | | 869.19 | |
| 434.914 | | | | 869.28 | |
| 438.392 | 867.95 | | | | |
| 438.392 | | 868.42 | | | |
| 438.392 | | | | | 869.02 |
| 447.887 | | 868.43 | | | |
| 448.26 | | | | | 868.96 |
| 448.26 | 868.08 | | | | |

| | | | | |
|---|---|---|---|---|
| 451.317 | | | 869.16 | |
| 463.126 | 868.08 | | | |
| 463.385 | | | | 868.73 |
| 463.433 | | 868.24 | | |
| 465.79 | | | 868.61 | |
| 478.577 | 867.88 | | | |
| 478.577 | | | 868.92 | |
| 478.896 | | 868.06 | | |
| 482.185 | | | | 868.79 |
| 494.573 | | | | 868.29 |
| 496.134 | 867.48 | | | |
| 496.134 | | | 868.45 | |
| 496.156 | | 867.77 | | |
| 508.91 | | | | 868.28 |
| 509.306 | | 867.42 | | |
| 509.498 | 867.28 | | | |
| 510.222 | | | 867.96 | |
| 521.224 | | 866.99 | | |
| 521.358 | | | | 867.57 |
| 521.358 | 866.68 | | | |
| 522.923 | | | 867.87 | |
| 535.364 | | 866.77 | | |
| 535.791 | 866.58 | | | |
| 535.791 | | | | 867.35 |
| 537.295 | | | 867.89 | |
| 546.794 | | | 867.39 | |
| 547.177 | | 866.12 | | |
| 547.682 | 866 | | | |
| 548.274 | 864.83 | | | |
| 548.394 | | | | 867.59 |
| 559.504 | 865.48 | | | |
| 559.504 | | | 867.12 | |
| 560.279 | | | | 867.15 |
| 560.42 | | 866.17 | | |
| 564.814 | | | | 867.15 |
| 566.805 | 865.87 | | | |
| 568.125 | | | 866.67 | |
| 581.531 | | | | 866.47 |
| 582.97 | 865.76 | | | |
| 582.97 | | 865.86 | | |
| 583.134 | | | 866.73 | |
| 608.929 | | 865.47 | | |
| 609.322 | | | | 866 |
| 609.322 | 865.15 | | | |
| 613.082 | | | 865.9 | |
| 623.799 | | | | 866.04 |
| 624.416 | 865.24 | | | |
| 625.081 | | 865.32 | | |
| 628.878 | | | 866.08 | |
| 634.012 | 865.05 | | | |
| 634.012 | | | 866.01 | |
| 634.083 | | 865.38 | | |
| 636.752 | | | | 865.96 |
| 646.456 | | | 865.82 | |
| 646.456 | 865.1 | | | |
| 646.456 | | 865.24 | | |
| 649.168 | | | | 866.08 |
| 658.573 | | | 865.75 | |
| 660.065 | 865.08 | | | |
| 660.42 | | 865.21 | | |
| 661.703 | | | | 866.01 |
| 673.555 | | | 866.04 | |
| 675.574 | | 864.79 | | |
| 675.791 | | | | 866.03 |
| 676.157 | 864.43 | | | |
| 685.587 | 864.63 | | | |

| | | | | | |
|---|---|---|---|---|---|
| 685.587 | | | | | 865.69 |
| 690.295 | 864.53 | | | | |
| 691.065 | | | | 865.64 | |
| 691.356 | | 864.71 | | | |
| 696.677 | | | | | 865.49 |
| 699.201 | | | | 865.73 | |
| 706.849 | 864.4 | | | | |
| 706.849 | | | | 865.38 | |
| 707.563 | | 864.59 | | | |
| 708.451 | | | | | 865.42 |
| 717.384 | 864.15 | | | | |
| 717.384 | | | | 865.21 | |
| 718.564 | | 864.42 | | | |
| 719.246 | | | | | 865.25 |
| 738.108 | | | | 865.39 | |
| 740.313 | | 864.37 | | | |
| 740.595 | | | | | 865.65 |
| 740.595 | | | | | 865.16 |
| 740.595 | 863.31 | | | | |

Cross Section / Bank Profile Locations

| Name | Type | Profile Station |
|---|---|---|
| (Year 4) Cross Section 8 - Riffle (R2D) | Riffle XS | 288 |

Measurements from Graph

Bankfull Slope: 0.01319

| Variable | Min | Avg | Max |
|---|---|---|---|
| S riffle | 0.00728 | 0.01442 | 0.02268 |
| S pool | 0 | 0 | 0 |
| S run | 0 | 0 | 0 |
| S glide | 0 | 0 | 0 |
| P - P | 26.72 | 40.55 | 60.11 |
| Pool length | 10.02 | 12.34 | 16.7 |
| Riffle length | 6.97 | 9.3 | 11.62 |
| Dmax riffle | 0 | 0 | 0 |
| Dmax pool | 0 | 0 | 0 |
| Dmax run | 0 | 0 | 0 |
| Dmax glide | 0 | 0 | 0 |
| Low bank ht | 0 | 0 | 0 |

Length and depth measurements in feet, slopes in ft/ft.
♀
RIVERMORPH PROFILE SUMMARY

Notes

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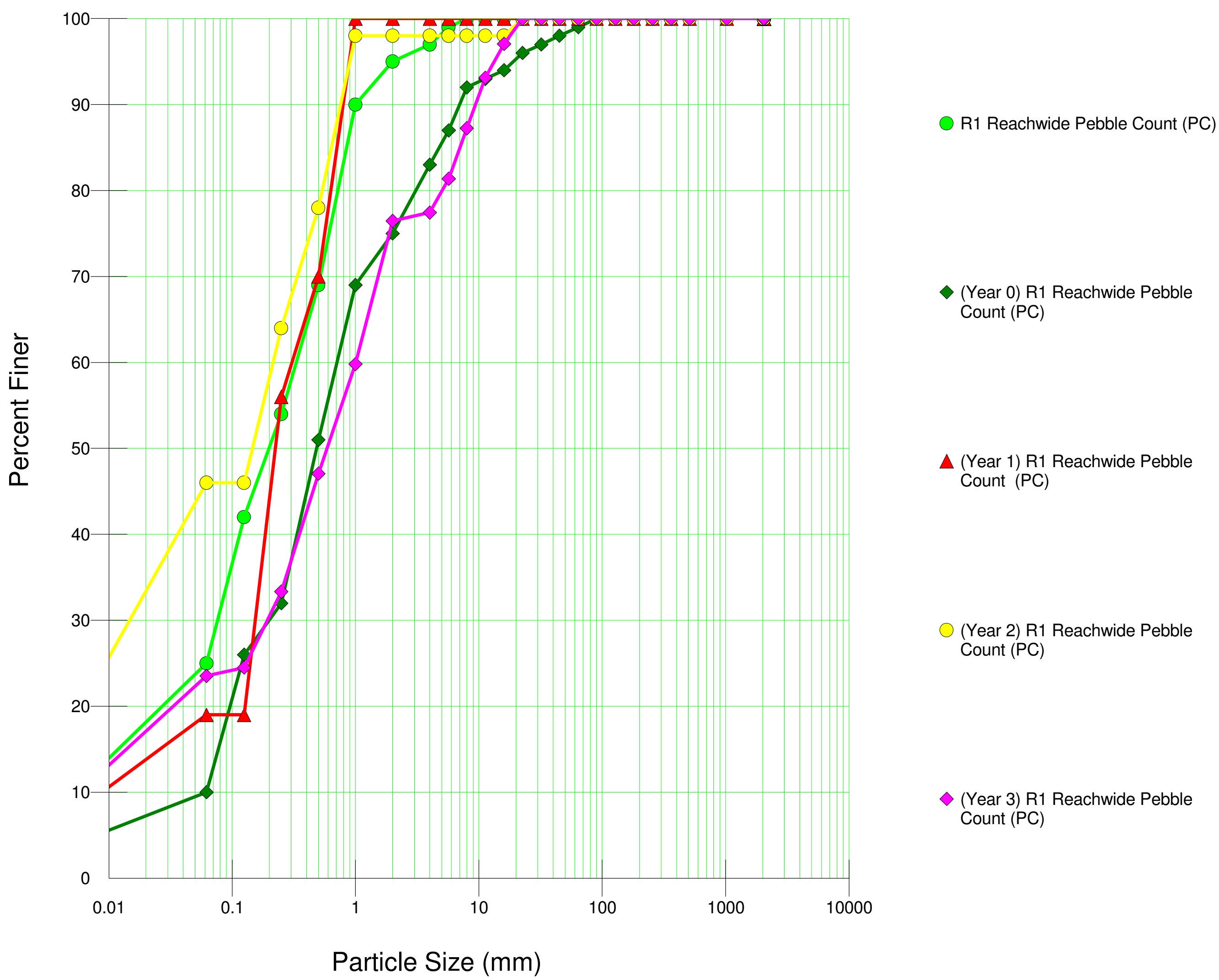
River Name: Little White Oak Creek (Year 4)
Reach Name: R2D
Profile Name: (Year 4) R2D Long. Profile (STA 2+84 -- 7+79)
Survey Date: 11/15/2011

| DIST | Note |
|---|---|
| 284.178 | LEW |
| 288.425 | XS8 - TW Intersect @ station 288 |
| 298.918 | LEW |
| 310.99 | LEW |
| 322.966 | LEW |
| 334.874 | LEW |

| | |
|---|---|
| 346.981 | LEW |
| 359.832 | LEW |
| 380.722 | LEW |
| 398.255 | LEW |
| 407.7 | LEW |
| 438.392 | LEW |
| 447.887 | LEW |
| 463.433 | LEW |
| 478.896 | LEW |
| 496.156 | LEW |
| 509.306 | LEW |
| 521.224 | LEW |
| 535.364 | LEW |
| 547.177 | LEW |
| 560.42 | LEW |
| 582.97 | LEW |
| 608.929 | LEW |
| 625.081 | LEW |
| 634.083 | LEW |
| 646.456 | LEW |
| 660.42 | LEW |
| 675.574 | LEW |
| 691.356 | LEW |
| 707.563 | LEW |
| 718.564 | LEW |
| 740.313 | LEW |

# Modified Wolman Pebble Counts

# (Year 4) R1 Reachwide Pebble Count



# RIVERMORPH PARTICLE SUMMARY

---

River Name: Little White Oak Creek (Year 4)
Reach Name: R1
Sample Name: R1 Reachwide Pebble Count
Survey Date: 10/19/2011

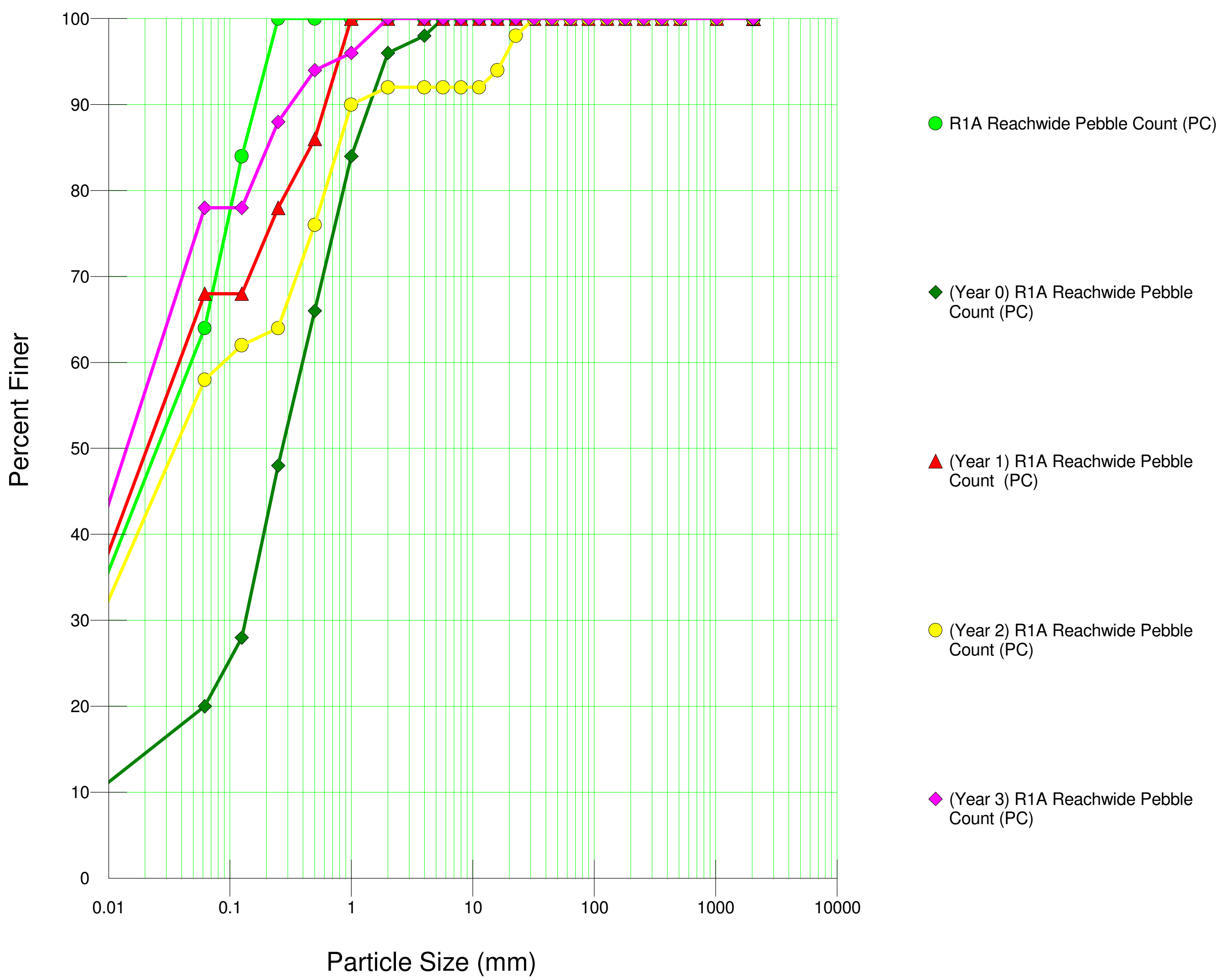
---

| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 25 | 25.00 | 25.00 |
| 0.062 - 0.125 | 17 | 17.00 | 42.00 |
| 0.125 - 0.25 | 12 | 12.00 | 54.00 |
| 0.25 - 0.50 | 15 | 15.00 | 69.00 |
| 0.50 - 1.0 | 21 | 21.00 | 90.00 |
| 1.0 - 2.0 | 5 | 5.00 | 95.00 |
| 2.0 - 4.0 | 2 | 2.00 | 97.00 |
| 4.0 - 5.7 | 2 | 2.00 | 99.00 |
| 5.7 - 8.0 | 1 | 1.00 | 100.00 |
| 8.0 - 11.3 | 0 | 0.00 | 100.00 |
| 11.3 - 16.0 | 0 | 0.00 | 100.00 |
| 16.0 - 22.6 | 0 | 0.00 | 100.00 |
| 22.6 - 32.0 | 0 | 0.00 | 100.00 |
| 32 - 45 | 0 | 0.00 | 100.00 |
| 45 - 64 | 0 | 0.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.04 |
| D35 (mm) | 0.1 |
| D50 (mm) | 0.21 |
| D84 (mm) | 0.86 |
| D95 (mm) | 2 |
| D100 (mm) | 8 |
| Silt/Clay (%) | 25 |
| Sand (%) | 70 |
| Gravel (%) | 5 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 100.

# (Year 4) R1A Reachwide Pebble Count



RIVERMORPH PARTICLE SUMMARY

---

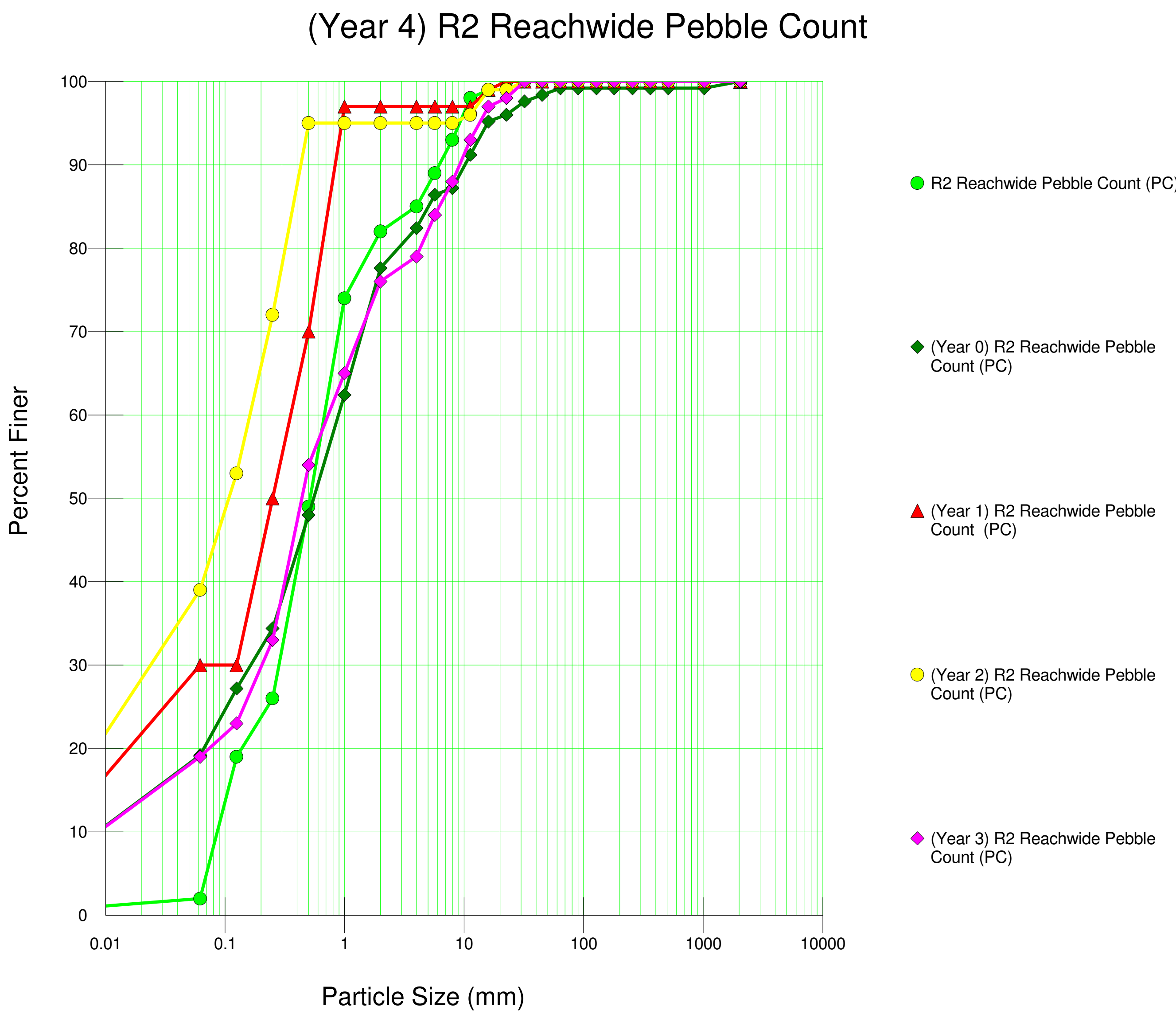
| | |
|---|---|
| River Name: | Little White Oak Creek (Year 4) |
| Reach Name: | R1A |
| Sample Name: | R1A Reachwide Pebble Count |
| Survey Date: | 10/19/2011 |

---

| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 32 | 64.00 | 64.00 |
| 0.062 - 0.125 | 10 | 20.00 | 84.00 |
| 0.125 - 0.25 | 8 | 16.00 | 100.00 |
| 0.25 - 0.50 | 0 | 0.00 | 100.00 |
| 0.50 - 1.0 | 0 | 0.00 | 100.00 |
| 1.0 - 2.0 | 0 | 0.00 | 100.00 |
| 2.0 - 4.0 | 0 | 0.00 | 100.00 |
| 4.0 - 5.7 | 0 | 0.00 | 100.00 |
| 5.7 - 8.0 | 0 | 0.00 | 100.00 |
| 8.0 - 11.3 | 0 | 0.00 | 100.00 |
| 11.3 - 16.0 | 0 | 0.00 | 100.00 |
| 16.0 - 22.6 | 0 | 0.00 | 100.00 |
| 22.6 - 32.0 | 0 | 0.00 | 100.00 |
| 32 - 45 | 0 | 0.00 | 100.00 |
| 45 - 64 | 0 | 0.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.02 |
| D35 (mm) | 0.03 |
| D50 (mm) | 0.05 |
| D84 (mm) | 0.13 |
| D95 (mm) | 0.21 |
| D100 (mm) | 0.25 |
| Silt/Clay (%) | 64 |
| Sand (%) | 36 |
| Gravel (%) | 0 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 50 (need at least 60).



(Year 4) R2 Reachwide Pebble Count
Percent Finer
Particle Size (mm)
0
10
20
30
40
50
60
70
80
90
100
0.01
0.1
1
10
100
1000
10000
R2 Reachwide Pebble Count (PC)
(Year 0) R2 Reachwide Pebble Count (PC)
(Year 1) R2 Reachwide Pebble Count (PC)
(Year 2) R2 Reachwide Pebble Count (PC)
(Year 3) R2 Reachwide Pebble Count (PC)

# RIVERMORPH PARTICLE SUMMARY

---

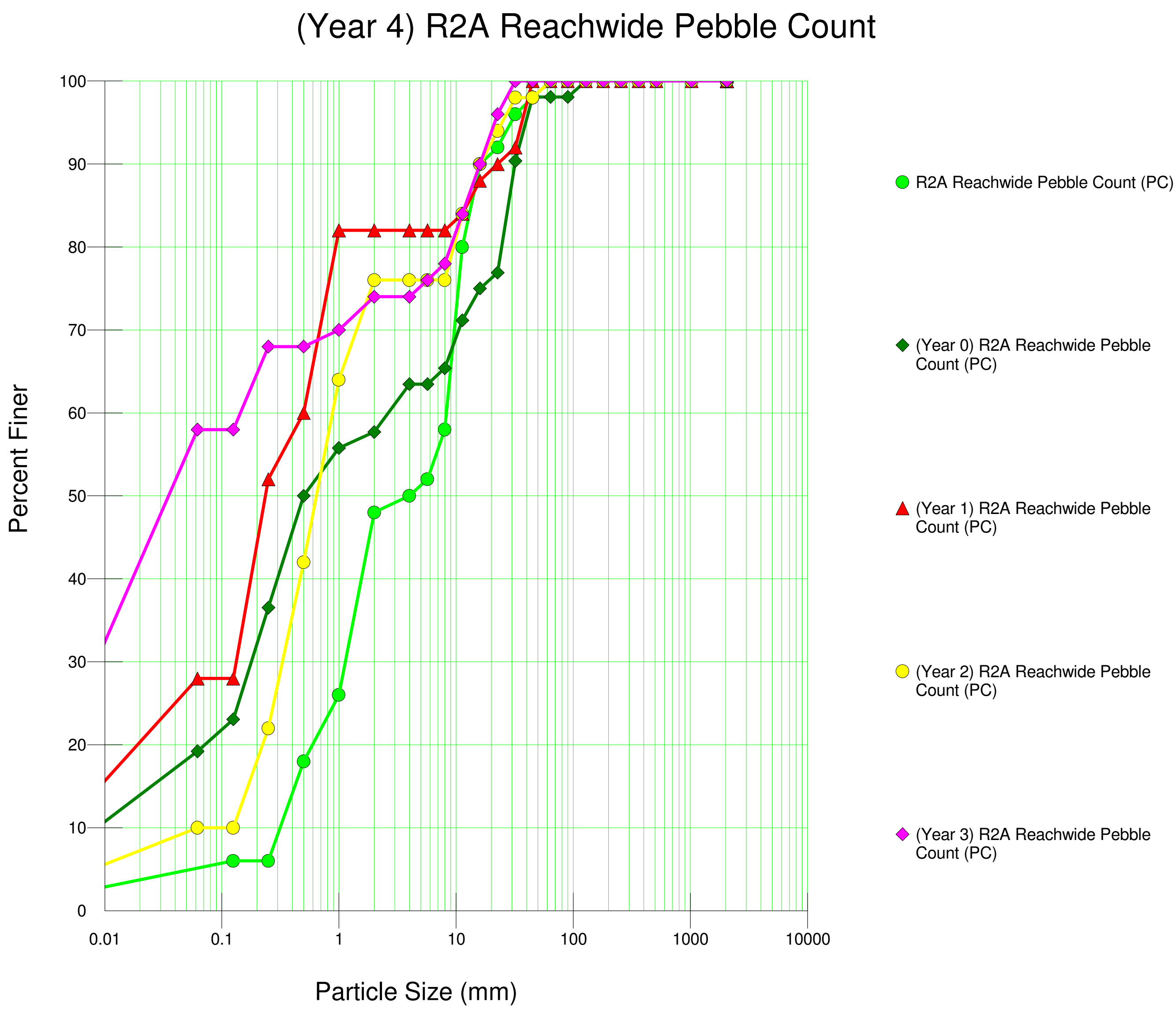
River Name: Little White Oak Creek (Year 4)
Reach Name: R2
Sample Name: R2 Reachwide Pebble Count
Survey Date: 10/19/2011

---

| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 2 | 2.00 | 2.00 |
| 0.062 - 0.125 | 17 | 17.00 | 19.00 |
| 0.125 - 0.25 | 7 | 7.00 | 26.00 |
| 0.25 - 0.50 | 23 | 23.00 | 49.00 |
| 0.50 - 1.0 | 25 | 25.00 | 74.00 |
| 1.0 - 2.0 | 8 | 8.00 | 82.00 |
| 2.0 - 4.0 | 3 | 3.00 | 85.00 |
| 4.0 - 5.7 | 4 | 4.00 | 89.00 |
| 5.7 - 8.0 | 4 | 4.00 | 93.00 |
| 8.0 - 11.3 | 5 | 5.00 | 98.00 |
| 11.3 - 16.0 | 1 | 1.00 | 99.00 |
| 16.0 - 22.6 | 1 | 1.00 | 100.00 |
| 22.6 - 32.0 | 0 | 0.00 | 100.00 |
| 32 - 45 | 0 | 0.00 | 100.00 |
| 45 - 64 | 0 | 0.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.11 |
| D35 (mm) | 0.35 |
| D50 (mm) | 0.52 |
| D84 (mm) | 3.33 |
| D95 (mm) | 9.32 |
| D100 (mm) | 22.6 |
| Silt/Clay (%) | 2 |
| Sand (%) | 80 |
| Gravel (%) | 18 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 100.



(Year 4) R2A Reachwide Pebble Count
Percent Finer
Particle Size (mm)
0
10
20
30
40
50
60
70
80
90
100
0.01
0.1
1
10
100
1000
10000
R2A Reachwide Pebble Count (PC)
(Year 0) R2A Reachwide Pebble Count (PC)
(Year 1) R2A Reachwide Pebble Count (PC)
(Year 2) R2A Reachwide Pebble Count (PC)
(Year 3) R2A Reachwide Pebble Count (PC)

# RIVERMORPH PARTICLE SUMMARY

---

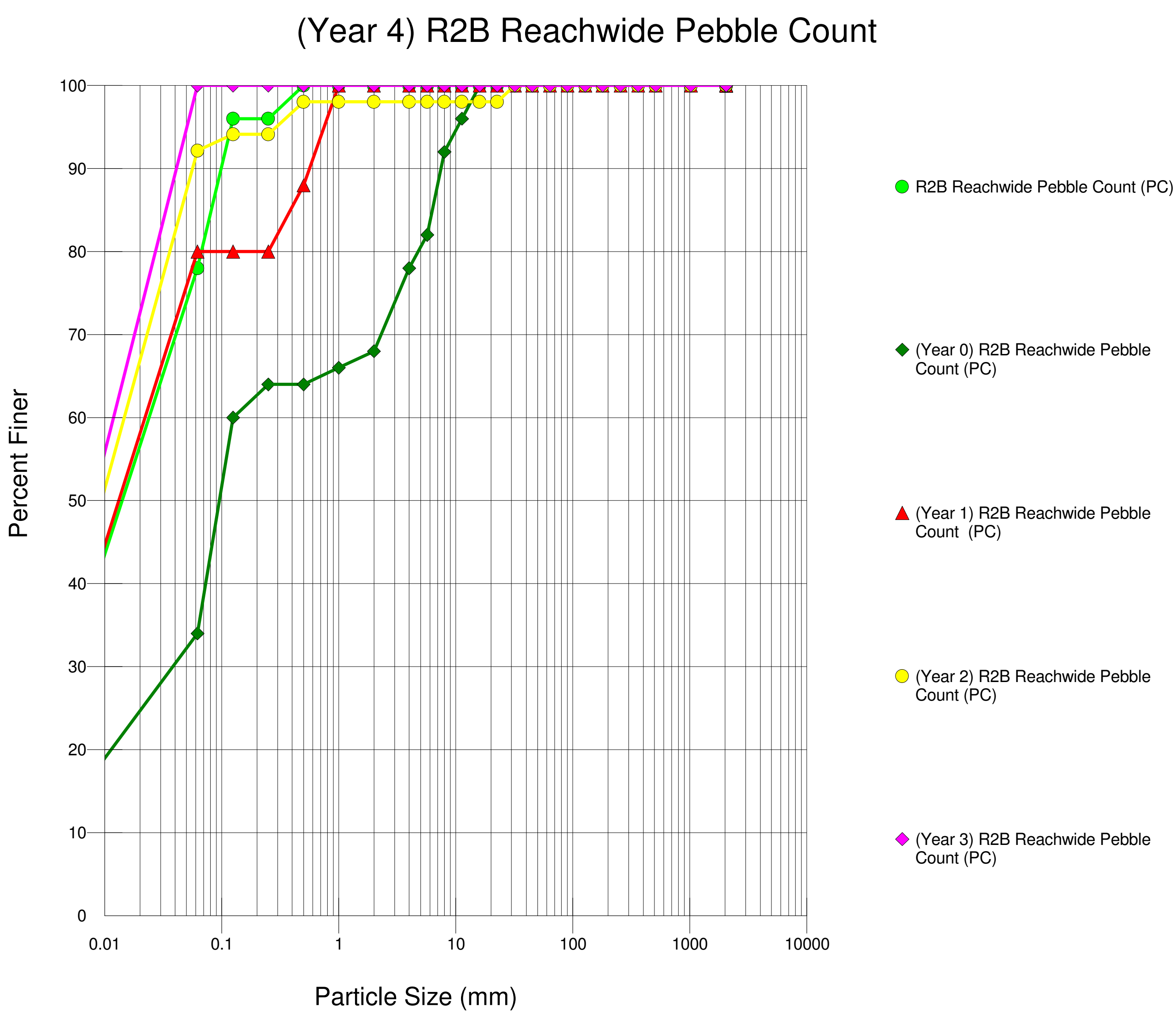
River Name: Little White Oak Creek (Year 4)
Reach Name: R2A
Sample Name: R2A Reachwide Pebble Count
Survey Date: 10/19/2011

---

| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 0 | 0.00 | 0.00 |
| 0.062 - 0.125 | 3 | 6.00 | 6.00 |
| 0.125 - 0.25 | 0 | 0.00 | 6.00 |
| 0.25 - 0.50 | 6 | 12.00 | 18.00 |
| 0.50 - 1.0 | 4 | 8.00 | 26.00 |
| 1.0 - 2.0 | 11 | 22.00 | 48.00 |
| 2.0 - 4.0 | 1 | 2.00 | 50.00 |
| 4.0 - 5.7 | 1 | 2.00 | 52.00 |
| 5.7 - 8.0 | 3 | 6.00 | 58.00 |
| 8.0 - 11.3 | 11 | 22.00 | 80.00 |
| 11.3 - 16.0 | 5 | 10.00 | 90.00 |
| 16.0 - 22.6 | 1 | 2.00 | 92.00 |
| 22.6 - 32.0 | 2 | 4.00 | 96.00 |
| 32 - 45 | 1 | 2.00 | 98.00 |
| 45 - 64 | 1 | 2.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.46 |
| D35 (mm) | 1.41 |
| D50 (mm) | 4 |
| D84 (mm) | 13.18 |
| D95 (mm) | 29.65 |
| D100 (mm) | 64 |
| Silt/Clay (%) | 0 |
| Sand (%) | 48 |
| Gravel (%) | 52 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 50 (need at least 60).


(Year 4) R2B Reachwide Pebble Count
Percent Finer
Particle Size (mm)
0
10
20
30
40
50
60
70
80
90
100
0.01
0.1
1
10
100
1000
10000
R2B Reachwide Pebble Count (PC)
(Year 0) R2B Reachwide Pebble Count (PC)
(Year 1) R2B Reachwide Pebble Count (PC)
(Year 2) R2B Reachwide Pebble Count (PC)
(Year 3) R2B Reachwide Pebble Count (PC)

# RIVERMORPH PARTICLE SUMMARY

---

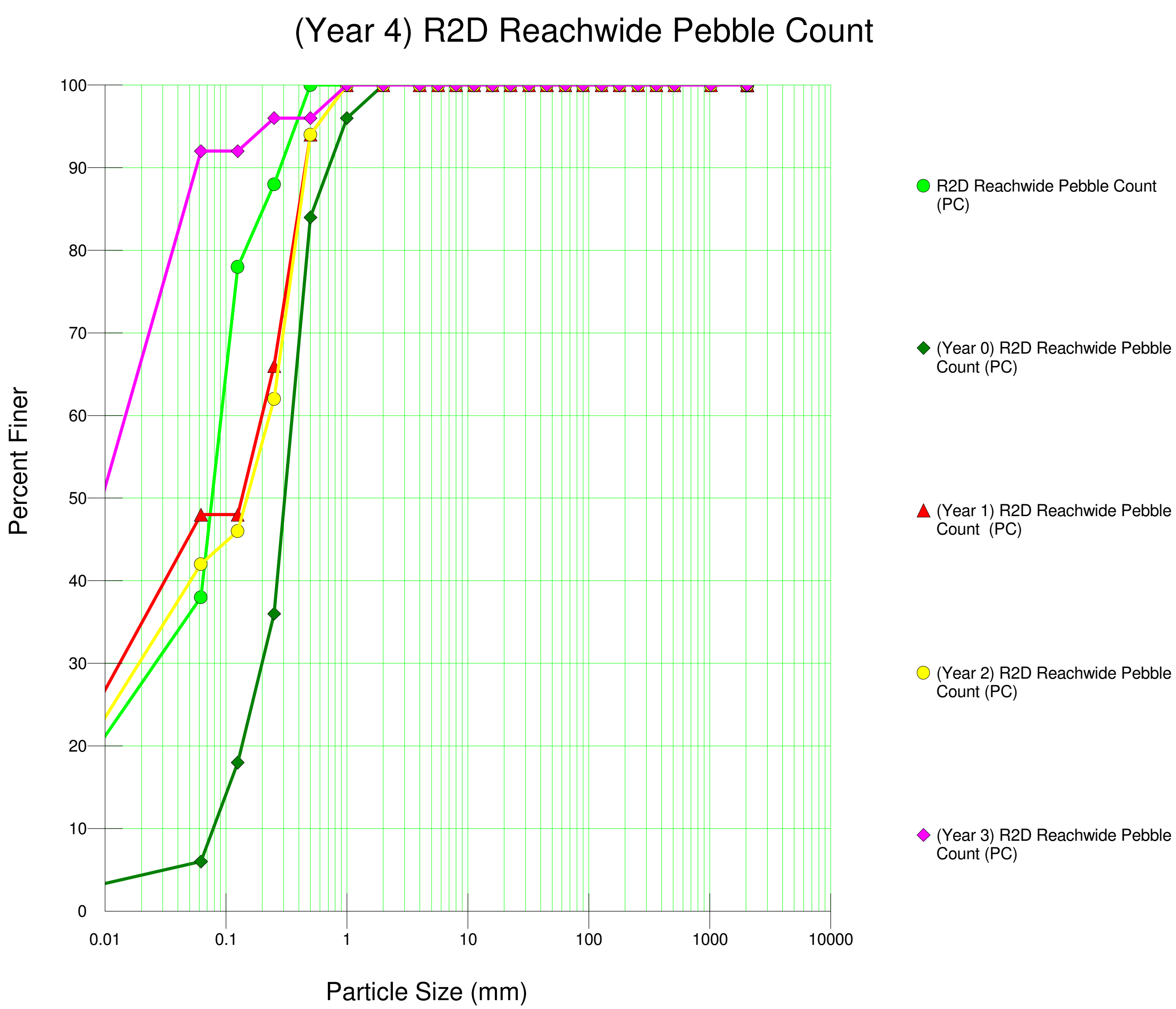
River Name: Little White Oak Creek (Year 4)
Reach Name: R2B
Sample Name: R2B Reachwide Pebble Count
Survey Date: 10/19/2011

---

| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 39 | 78.00 | 78.00 |
| 0.062 - 0.125 | 9 | 18.00 | 96.00 |
| 0.125 - 0.25 | 0 | 0.00 | 96.00 |
| 0.25 - 0.50 | 2 | 4.00 | 100.00 |
| 0.50 - 1.0 | 0 | 0.00 | 100.00 |
| 1.0 - 2.0 | 0 | 0.00 | 100.00 |
| 2.0 - 4.0 | 0 | 0.00 | 100.00 |
| 4.0 - 5.7 | 0 | 0.00 | 100.00 |
| 5.7 - 8.0 | 0 | 0.00 | 100.00 |
| 8.0 - 11.3 | 0 | 0.00 | 100.00 |
| 11.3 - 16.0 | 0 | 0.00 | 100.00 |
| 16.0 - 22.6 | 0 | 0.00 | 100.00 |
| 22.6 - 32.0 | 0 | 0.00 | 100.00 |
| 32 - 45 | 0 | 0.00 | 100.00 |
| 45 - 64 | 0 | 0.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.01 |
| D35 (mm) | 0.03 |
| D50 (mm) | 0.04 |
| D84 (mm) | 0.08 |
| D95 (mm) | 0.12 |
| D100 (mm) | 0.5 |
| Silt/Clay (%) | 78 |
| Sand (%) | 22 |
| Gravel (%) | 0 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 50 (need at least 60).



(Year 4) R2D Reachwide Pebble Count
Percent Finer
Particle Size (mm)
0
10
20
30
40
50
60
70
80
90
100
0.01
0.1
1
10
100
1000
10000
R2D Reachwide Pebble Count (PC)
(Year 0) R2D Reachwide Pebble Count (PC)
(Year 1) R2D Reachwide Pebble Count (PC)
(Year 2) R2D Reachwide Pebble Count (PC)
(Year 3) R2D Reachwide Pebble Count (PC)

# RIVERMORPH PARTICLE SUMMARY

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River Name: Little White Oak Creek (Year 4)
Reach Name: R2D
Sample Name: R2D Reachwide Pebble Count
Survey Date: 10/19/2011

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| Size (mm) | TOT # | ITEM % | CUM % |
|---|---|---|---|
| 0 - 0.062 | 19 | 38.00 | 38.00 |
| 0.062 - 0.125 | 20 | 40.00 | 78.00 |
| 0.125 - 0.25 | 5 | 10.00 | 88.00 |
| 0.25 - 0.50 | 6 | 12.00 | 100.00 |
| 0.50 - 1.0 | 0 | 0.00 | 100.00 |
| 1.0 - 2.0 | 0 | 0.00 | 100.00 |
| 2.0 - 4.0 | 0 | 0.00 | 100.00 |
| 4.0 - 5.7 | 0 | 0.00 | 100.00 |
| 5.7 - 8.0 | 0 | 0.00 | 100.00 |
| 8.0 - 11.3 | 0 | 0.00 | 100.00 |
| 11.3 - 16.0 | 0 | 0.00 | 100.00 |
| 16.0 - 22.6 | 0 | 0.00 | 100.00 |
| 22.6 - 32.0 | 0 | 0.00 | 100.00 |
| 32 - 45 | 0 | 0.00 | 100.00 |
| 45 - 64 | 0 | 0.00 | 100.00 |
| 64 - 90 | 0 | 0.00 | 100.00 |
| 90 - 128 | 0 | 0.00 | 100.00 |
| 128 - 180 | 0 | 0.00 | 100.00 |
| 180 - 256 | 0 | 0.00 | 100.00 |
| 256 - 362 | 0 | 0.00 | 100.00 |
| 362 - 512 | 0 | 0.00 | 100.00 |
| 512 - 1024 | 0 | 0.00 | 100.00 |
| 1024 - 2048 | 0 | 0.00 | 100.00 |
| Bedrock | 0 | 0.00 | 100.00 |

| | |
|---|---|
| D16 (mm) | 0.03 |
| D35 (mm) | 0.06 |
| D50 (mm) | 0.08 |
| D84 (mm) | 0.2 |
| D95 (mm) | 0.4 |
| D100 (mm) | 0.5 |
| Silt/Clay (%) | 38 |
| Sand (%) | 62 |
| Gravel (%) | 0 |
| Cobble (%) | 0 |
| Boulder (%) | 0 |
| Bedrock (%) | 0 |

Total Particles = 50 (need at least 60).

# Crest Gauge

**Project Name:** Little White Oak Creek **Installation Date:** 12/4/2007

**County, State:** Polk County, North Carolina

| Crest Gauge Information | | | Year of Sampling 2008 | 2008 | 2009 | 2010 | 2011 | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Gauge ID** | **Bankfull Elevation (ft)** | **Zero Elevation (ft)** | **Year 0** | **Year 1** | **Year 2** | **Year 3 [a]** | **Year 4** | **Year 5** | **Total Exceedance by Gauge** | **Reach** |
| 1 [bc] | 886.12 | 885.87 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R1 (U/S End) |
| 2 [c] | 882.04 | 882.04 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R1A (D/S End) |
| 3 [bc] | 875.80 | 875.30 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R1 (U/S NC 9) |
| 4 [bc] | 878.10 | 877.96 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R2 (U/S End) |
| 5 [c] | 876.30 | 876.26 | N/A | 0 | 1 | 1 | 1 | 0 | 3 | R2A (Middle) |
| 6 [c] | 871.70 | 871.51 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R2B (D/S End) |
| 7 [bc] | 869.90 | 869.14 | N/A | 1 | 1 | 1 | 1 | 0 | 4 | R2 (Confluence) |
| 8 [d] | 866.93 | 866.67 | N/A | 0 | 0 | 1 | 1 | 0 | 2 | R2D (D/S End) |

[a] A bankfull occurrence is documented for each gauge location during Year 3 due to evidence of extreme flooding at the Site. Evidence of flooding indicated that crest gauges were completed submerged by flood waters.

[b] Gauge was either damaged or missing following Year 3 flood event. These gauge locations will not be replaced or monitored in future years as they have already met the minimum requirement of two bankful occurrences over the 5-year monitoring period.

[c] These gauge locations were not monitored since they have already met the minimum requirement of two bankful occurrences over the 5-year monitoring However, field investigations noted debris wracklines well above the bankfull elevation on the crest gauge indicating a bankfull event during the past year.

[d] This gauge location was not sampled during Year 4. However, field investigations noted debris wracklines well above the bankfull elevation on the crest gauge indicating a bankfull event during the past year.