Badin Inn
Stream Restoration
Stanly County, North Carolina
Year 4 Monitoring Report

Monitoring Year: 2012
Measurement Year 4
As-Built Date 2009
NCEEP Project Number 92666

January 2013

BADIN INN STREAM RESTORATION
YEAR 4 MONITORING REPORT

CONDUCTED FOR THE NORTH CAROLINA DEPARTMENT
OF
ENVIRONMENT AND NATURAL RESOURCES

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I. EXECUTIVE SUMMARY/PROJECT ABSTRACT

The Badin Inn project consists of 4,174 linear feet of Priority 1 stream restoration located on the golf course of the Badin Inn Golf Resort and Club in the Town of Badin, North Carolina. Construction on the site was completed in April of 2009. The following report provides the Year 4 monitoring information.

The project consists of a portion of an unnamed tributary to Little Mountain Creek (UT to Little Mountain Creek), a tributary to the Yadkin River. It is located entirely on land owned by the Badin Inn Golf Resort and Club and drains into Little Mountain Creek in Stanly County, North Carolina. The watershed area for this project is approximately 0.5 square miles.

UT to Little Mountain Creek is a 2nd order stream, as several small 1st order tributaries flow into it near the top of the watershed. As it passes through the town, the channel has uniform rectangular dimensions and is lined with concrete. As the primary drainage feature in the Town of Badin, it receives discharge from numerous stormwater pipes from houses and townhouse complexes. The channelization of this stream occurred during the development of Badin by ALCOA during the early 1920's, and has since served as the primary stormwater conveyance system for a portion of the town.

Prior to restoration, the stream entered a much larger, concrete-lined channel that traveled straight down the valley until joining with Little Mountain Creek. The Priority 1 restoration involved removal of the concrete channel and adjustment of the stream dimension, pattern, and profile to allow the stream to more fully transport its water and sediment load. A combination of bedform transformations, channel dimension adjustments, pattern alterations, and structure installations were used to accomplish this. The natural meander patterns were restored and rock and log grade control vanes were incorporated for aquatic habitat enhancement and bed and bank stability. The tributary was also restored using a Priority 1 restoration. The riparian area also underwent buffer restoration with plantings and is protected with a permanent easement. Construction of the restored channel and planting of the riparian vegetation was completed in April 2009.

The Year 4 monitoring revealed that the stream has remained stable and riparian vegetation is becoming well established. No problem areas such as stream bank erosion, unstable structures, excessive aggradation or degradation, or changes in channel morphology were identified. Golf course mowing has cut a long, narrow strip of riparian vegetation along both sides of the outer boundary of the easement in the downstream half of the easement. Golf course management personnel have been contacted and informed that this is a violation of the easement and is to cease.

II. PROJECT BACKGROUND

A. Location and Setting

The Badin Inn project site is located in the Town of Badin in northeast Stanly County. (Figure 1). The headwaters of the project originate approximately 0.8 miles to the northeast of the restoration site. From the headwaters, UT to Little Mountain Creek flows for approximately 1.5 miles before emptying into Little Mountain Creek. One tributary enters UT Little Mountain Creek along its project extent.

The watershed of the project stream is approximately 0.5 square miles (346 acres) and is oriented northeast to southwest. The project is located within a conservation easement that occurs on private land owned by Badin Inn Golf Resort and Club. The upper portions of the watershed are comprised of the western slope of a ridgeline in the Uwharrie Mountains chain. Further down, the watershed contains part of the Town of Badin, and includes residential areas, and the Badin Inn Golf Resort and Club, the golf course property on which the project is located. Although the town is small, it possesses a densely developed area of townhouse complexes and houses that were built as residences for the workers of ALCOA, the large aluminum manufacturer that built the Town of Badin in the early part of the twentieth century. Most of this densely developed area lies within the watershed of UT to Little Mountain Creek.

If traveling from the north (Raleigh, Greensboro, Winston-Salem), proceed southwest on NC 49 from Asheboro. After passing over the Yadkin River/Badin Lake, head south on NC 8 until reaching New London, where NC 8 merges with US Highway 52. Shortly after the merger, turn left onto NC 740 towards Badin. In Badin, after passing the ALCOA plant, turn left on Nantahala Street, then turn right on Henderson Street (SR 1720), which becomes Valley Drive. The beginning of the project is on the right, where the road passes through the fairways of the golf course.

If coming from the south (Charlotte), take NC 24/27 towards Albemarle, then in Albemarle proceed north on NC 740 towards Badin. In Badin, turn right on Nantahala Street, then right on Henderson Street (SR 1720), which becomes Valley Drive. The beginning of the project is on the right, where the road passes the fairways of the golf course.

B. Mitigation Structures and Objectives

The Priority 1 restoration involved removal of the concrete lining and construction of a stream with a proper dimension, pattern, and profile to allow the stream to more fully transport its water and sediment load. A combination of bedform transformations, channel dimension and pattern restoration, and structure installations were used to restore the stream. Natural meander patterns were added and rock and log grade control vanes were incorporated for aquatic habitat enhancement and bed and bank stability. The tributary was restored using Priority 1 restoration. The Priority 1 restoration involved converting the concrete-lined channel into a sinuous channel that meanders for a total of 3,994 linear feet of stream as measured along the centerline (Table I). A riparian buffer was planted in April 2009 and is

protected by a Conservation Easement. This monitoring report follows the template of Version 1.2 to keep reporting consistent with the MY1 report (also in Version 1.2).

The project had the goal of accomplishing the following objectives:

1. Restore 3,994 linear feet of UT to Little Mountain Creek and 180 linear feet of a small unnamed tributary to Little Mountain Creek.
2. Provide a stable stream channel that neither aggrades nor degrades while maintaining its dimension, pattern, and profile with the capacity to transport its watershed's water and sediment load.
3. Improve water quality and reduce erosion by stabilizing the stream banks.
4. Reconnect the stream to its floodplain.
5. Improve aquatic habitat with the use of natural material stabilization structures such as root wads, rock vanes, woody debris, and a riparian buffer.
6. Provide aesthetic value, wildlife habitat, and bank stability through the creation or enhancement of a riparian zone.

Table I. Project Restoration Components Badin Inn Stream Restoration - EEP Project No. 92666								
Project Component or Reach ID	**Existing Feet/Acres**	**Type**	**Approach**	**Footage or Acreage**	**Mitigation Ratio**	**Mitigation Units**	**Stationing**	**Comment**
UT to Little Mountain Creek	3,540 feet	R	PI	3,994 feet	1.0	3,994	10+00 - 50+22	Construction started 28 feet from the start of stationing
Tributary	141 feet	R	PI	180 feet	1.0	180	10+00 - 11+80	
Mitigation Unit Summations								
Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment			
4,174	NA	NA	NA	0.0				

R = Restoration
PI = Priority I

C. Project History and Background

The Badin Inn Stream Restoration Project is located in the Town of Badin in Stanly County, North Carolina and is situated entirely within the golf course of the Badin Inn Golf Resort and Club (Figure 1). The project site encompasses a perennial, unnamed tributary to Little Mountain Creek (UT to Little Mountain Creek) and a small, first-order intermittent tributary of UT to Little Mountain Creek (Tributary) and the associated floodplain through which these channels flow. Prior to restoration, the channel of UT to Little Mountain Creek consisted of approximately 3,700 feet of a concrete-lined and straightened perennial stream that had been in its altered state for nearly a century. The Tributary consisted of approximately 141 feet of an intermittent channel routed through a culvert from where it entered the golf course property until it's confluence with UT to Little Mountain Creek.

UT to Little Mountain Creek is a 2nd order stream, as several small 1st order tributaries flow into it near the top of the watershed. As it passes through the town, the channel has uniform rectangular dimensions and is lined with concrete. As the primary drainage feature in the Town of Badin, it receives discharge from numerous stormwater pipes from houses and townhouse complexes. The channelization of this stream occurred during the development of Badin by ALCOA during the early 1920's, and has since served as the primary stormwater conveyance system for a portion of the town. Where the stream enters the Badin Inn Golf Resort and Club golf course, the stream is confined to a narrow, stone-lined channel for roughly 700 feet. It continues in this form until reaching the conservation easement and the upstream end of the project reach, after passing through a 48" culvert under Henderson Street (State Road 1720).

Prior to restoration, the stream entered a much larger, concrete-lined channel at this point, which traveled straight down the valley until joining with Little Mountain Creek. An intermittent tributary that was routed underground through a culvert entered the main channel approximately 500 feet downstream of the beginning of the project. The relict floodplain of the pre-restoration channel was covered by fairways of the Badin Inn Golf Resort and Club golf course, and some modification to the valley had been done to create bunkers, greens and tee boxes. In addition, a network of drains, pipes and irrigation systems had been installed within the valley, and numerous stormwater outfalls discharged into the stream.

The project is located in the Yadkin River Basin 8-digit Catalogue Unit 03040104 and the 14-digit hydrological unit 03040104010010. This watershed was identified by the NC Ecosystem Enhancement Program (EEP) as a Targeted Local Watershed and is also classified by the NC Division of Water Quality (NCDWQ) as a Water Supply Watershed (WSIV). The receiving stream, Little Mountain Creek, is listed on the 303(d) list for biological impairment (NCDENR, 2012).

The project site is located in the Carolina Slate Belt ecoregion (Griffith *et. al*, 2002). The primary adjacent land use throughout the project watershed consists of managed herbaceous areas (which consists mainly of the Badin Inn golf course), developed areas, including much of the residential areas of the Town of Badin, and forested areas on the slopes above the town.

Table II. Project Activity and Reporting History Badin Inn Stream Restoration - EEP Project No. 92666		
Activity or Report	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	9/1/2007	July 2008
Final Design – 90%	July 2008	December 2008
Construction	NA	April 2009
Temporary S&E mix applied to entire project area	NA	4/1/2009
Permanent seed mix applied to entire project area	NA	4/1/2009
Containerized, B&B, and livestake plantings	4/1/2009	4/1/2009
Mitigation Plan / As-built (Year 0 Monitoring – baseline)	July 2009	August 2009
Year 1 Monitoring	January 2010	January 2010
Year 2 Monitoring	February 2011	March 2011
Year 3 Monitoring	November 2011	December 2011
Year 4 Monitoring	December 2012	January 2013
Year 5 Monitoring		
Year 5+ Monitoring		

Figure 1. Vicinity Map

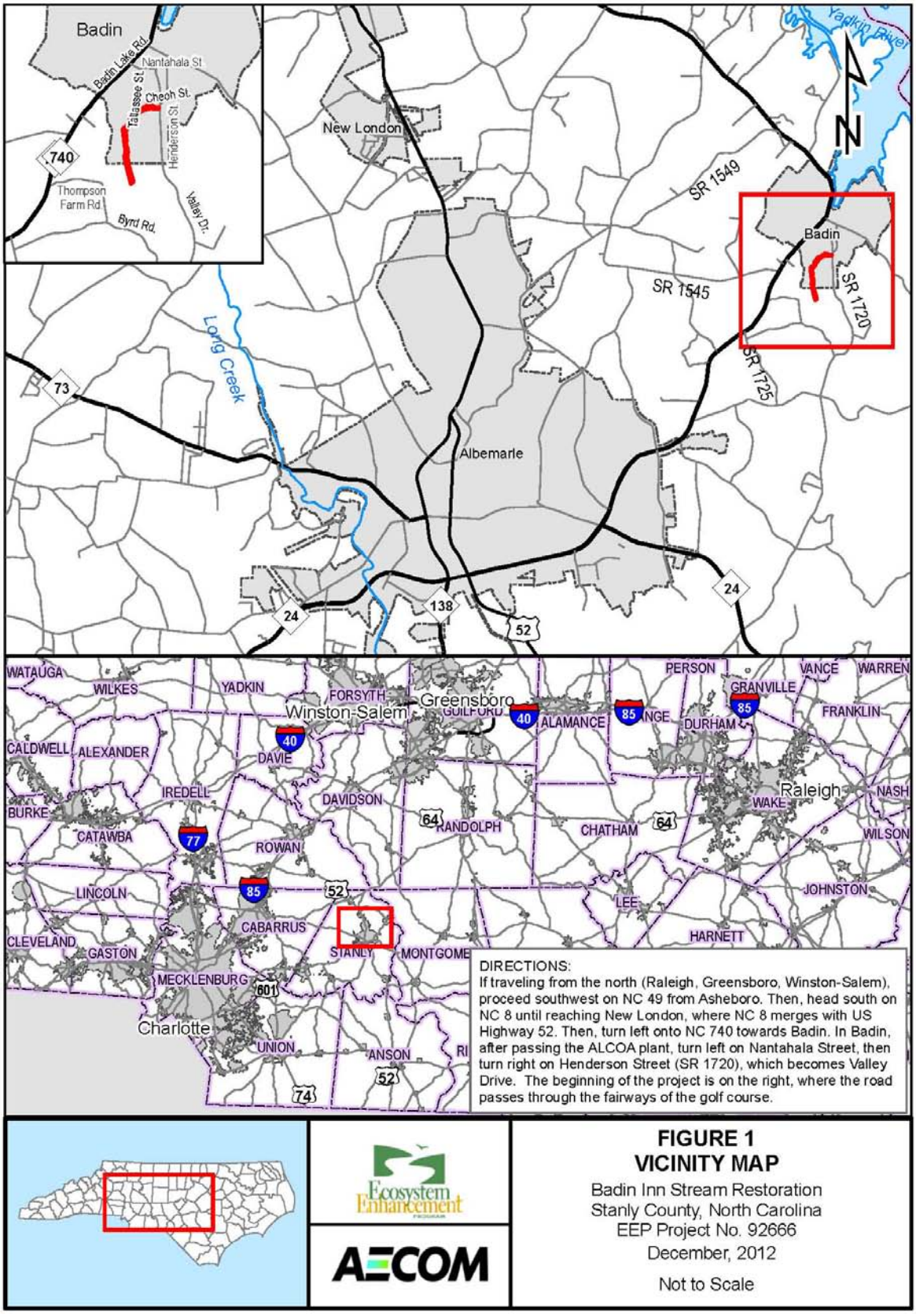


Table III. Project Contacts Table Badin Inn Stream Restoration - EEP Project No. 92666	
Designer	AECOM 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 Phone: (919) 854-6200
Construction Contractor	River Works, Inc. 8000 Regency Parkway, Suite 200 Cary, NC 27511 Phone: (919) 459-9001
Survey Contractor	AECOM 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607 Phone: (919) 854-6200
Planting Contractor	Efird Landscaping, Inc 42759 Greenview Dr. Albemarle, NC 28001 Phone: (704) 985-6559
Seeding Contractor	Efird Landscaping, Inc 42759 Greenview Dr. Albemarle, NC 28001 Phone: (704) 985-6559
Seed Mix Sources	Mellow Marsh Farm, Inc. 1312 Woody Store Rd. Siler City, NC 27344 Phone: (919) 742-1200
Nursery Stock Suppliers	Arborgen LLC 5594 Highway 38 Blenheim, SC 29516 Phone: (843) 528-9669 Carolina Wetland Services 550 E. Westinghouse Blvd. Charlotte, NC 28273 Phone: (704) 527-1177
Monitoring Performers	AECOM 701 Corporate Center Drive, Suite 475 Raleigh, NC 27607
Stream Monitoring	AECOM Phone: (919) 854-6200
Vegetation Monitoring	AECOM Phone: (919) 854-6200

Table IV. Project Background Table Badin Inn Stream Restoration - EEP Project No. 92666		
	UT to Little Mountain Creek	Tributary
Project County	Stanly County	Stanly County
Drainage Area	0.5 sq miles	0.05 sq. miles
Drainage impervious cover estimate (%)	5%	15%
Stream order	2nd	1st
Physiographic Region	Piedmont	Piedmont
Ecoregion	Carolina Slate Belt	Carolina Slate Belt
Rosgen Classification of As-built	C4	C
Cowardin Classification	Riverine	Riverine
Dominant soil types	Oakboro/Kirksey Silt loams	Oakboro/Kirksey Silt loams
Reference site ID	Spencer Creek and UT Meadow Fork	Spencer Creek and UT Meadow Fork
USGS HUC for Project and Reference	03040104 (Project) 03040101 (UT Meadow Fork) 03040103 (Spencer Creek	03040104 (Project) 03040101 (UT Meadow Fork) 03040103 (Spencer Creek
NCDWQ Sub-basin for Project and Reference	03-07-08 (Project)	03-07-08 (Project)
NCDWQ classification for Project and Reference	WS-IV (UT Little Mountain Creek) C (Spencer Creek) B Tr+ (UT Meadow Fork)	WS-IV (UT Little Mountain Creek) C (Spencer Creek) B Tr+ (UT Meadow Fork)
Any portion of any project segment 303(d) listed?	No	No
Any portion of any project upstream of a 303d listed segment	Yes	Yes
Reasons for 303d listing or stressor	Low dissolved oxygen and high conductivity	Low dissolved oxygen and high conductivity
% of project easement fenced	100	100

III. PROJECT CONDITION AND MONITORING RESULTS

A. Vegetation Assessment

Vegetation success is based on the criteria established in the USACE Stream Mitigation Guidelines (2003). Planted stem density minimums of 320 stems/acre through year three, 288 stems/acre in year four, and 260 stems/acre in year five are required. Vegetation monitoring was performed using the CVS-EEP Level 2 protocol.

1. *Vegetative Problem Areas*

One moderate and a few minor vegetation problem areas were noted during Year 4 monitoring. As a whole the vegetation plantings have been very successful though a few areas of concern were noted where survival has been less than optimal, primarily due to golf course maintenance intrusions in the easement. Mowing once again is contributing to

vegetation mortality along the edges of the easement as in previous years, though the extent of the mowing is greater than previously experienced. A narrow strip was mowed in the fall along the outside of the easement boundary in the lower half of the easement. See Table 6 and Photo 1 in Appendix A-1. The mowed strip included an area approximately 3-4 feet wide and 1,900 (north side) and 900 feet (south side) long along the edge of the easement. It was noted that care had been taken to mow or use a weedeater to cut the vegetation cleanly around the metal easement boundary posts. Golf course management personnel have been contacted and informed that this is a violation of the easement and is to cease.

The second circumstance was associated with sparse vegetative growth occurring under large, mature, pre-existing trees in three locations. These areas were replanted in the spring of 2011 to increase the density of vegetation. Due to the shade from the existing trees, survival of the plantings in these areas was less than optimal. This situation is not likely to change unless the large trees were removed which would be counter-productive. Although these areas are not developing a dense undergrowth of shrubby vegetation we are no longer considering them problem areas since the trees in these locations represent an approximate basal area of 116 sq. ft/acre which is within the range of a mature forest. The ground surface is covered with leaf mulch and some herbaceous vegetation is becoming established. No surface erosion is present. The current site conditions of the areas of large pine and oak trees are similar conditions to what one would expect to find under mature oak-pine forest. Additionally, the nutrient reduction qualities and quality as a buffer are equivalent of a mature vegetated hardwood/pine forest. Because these areas have mature trees, are already providing nutrient reduction, and no erosion is occurring, they will no longer be classified as problem areas. These areas will be closely watched during the remainder of the monitoring period to ensure that they remain stable.

Invasive exotic vegetation had been noted in previous reports as occurring within the easement but never in amounts that warrant concern. This is still the case with the largest concentrations occurring down by the confluence of UT Little Mountain Creek with Little Mountain Creek in the vicinity of vegetation monitoring plot VP 1. Chinese privet (*Ligustrum sinense*) is the primary species with small amounts of Japanese honeysuckle (*Lonicera japonica*) also present in the area. The density of these two species is still small and not warranting control at this point. The area surrounding vegetation monitoring plot VP 5 is now being overrun with Bermuda grass (*Cynodon dactylon*) which has spread since last year when it was just entering the plot. This situation has not changed and Bermuda grass was not observed in other areas of the easement and does not seem to be having a negative effect on planted stem survival.

2. *Stem Counts*

Baseline vegetation plots were established in April 2009 after vegetative planting was completed. Nine (9) vegetation survival plots were staked out in the floodplain and terrace along UT Little Mountain Creek within the project area. Each plot measured 10m X 10m with an area of $100m^2$. Stems were flagged and counted to establish baseline and yearly stem counts. Year 4 vegetation monitoring was performed on August 22, 2012.

Year 4 monitoring revealed an average of 373 woody stems per acre. This average exceeds the required Year 4 threshold of 288 stems per acre for the project. This average is below the baseline count of 621 woody stems per acre and the Year 3 count of 472 woody stems per acre. The range of stem densities encountered on the mitigation site varied from 202 to 647 stems per acre. Seven of the nine vegetation monitoring plots contain a density greater than the 288 planted stems per acre for the required interim threshold for Year 4. Vegetation density is low in some individual plots due to shading from large adjacent trees and possible soil compaction. Plot 4 exhibits a density of 202 stems per acre, a drop from last year. Plot 6 fell below the Year 4 threshold and now exhibits a stem density of 243 planted stems per acre as was reported last year. In April 2011 approximately 0.9 acres were replanted with 600 bare root trees and 50 container-sized trees to address low survivability in areas within and adjacent to Plots 4 and 6. These supplemental plantings were not very successful and survival remains low in these areas due to shading and possible soil compaction. There will be no further attempts to replant areas within and adjacent to Plots 4 and 6 since overall stem survival for the project is well above required minimum densities and previous attempts were unsuccessful. As noted above these areas are no longer considered to be a problem area. Species counts of 6 or fewer species now occur in seven of the nine sampling plots (Plots 1, 2, 3, 4, 6, 7, and 9). This is the same as the previous year.

Physical damage was much lower in occurrence this year than previous years. One hundred and thirteen (74%) of all stems had no damage visible. Insects caused the majority of damage and in most cases this was minor (10.9%). Deer activity is still occurring in the easement but does not seem to be causing much of a problem. Three stems had damage that appeared to be a result of human trampling. Though this number is low, it is still likely that some of the dead and missing stems are a result of trampling. This is an ongoing problem and golf balls are commonly found in the easement indicating that golfers frequently hit wayward shots and likely spend time searching for their ball. Sturdier fencing was installed this spring and has reduced the golf course maintenance machinery intrusions in the easement but doesn't impede people from searching for missing golf balls in the easement. We do not foresee this being a major problem especially as vegetation gets taller and less likely to be trampled.

The soft rush (*Juncus effuses*) plugs and live stakes remain healthy and the live stakes are exhibiting rapid growth with little evidence of difficulty. A significant number of the shrubs grown from the willow (*Salix sp.)* live stakes have reached heights of over 15 feet tall. Native dog fennel (*Eupatorium capillifolium*), river birch (*Betula nigra*), loblolly pine (*Pinus taeda*), and sweetgum (*Liquidambar styraciflua*) have begun colonizing the easement in large numbers and are reaching significant heights.

Table V. Vegetation Plot Stem Count Summary
Badin Inn Stream Restoration – EEP Project No. 92666

Species		Plots*									MY4 Totals	MY3 Totals	MY2 Totals	MY1 Totals	Baseline Totals
Scientific Name	**Common Name**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**					
Shrubs															
Sambucus canadensis	Elderberry					1					***1***	*1*	*1*	*1*	*5*
Callicarpa americana	American Beautyberry	2	2			2		2	1	7	***16***	*18*	*15*	*15*	*16*
Prunus americana	American plum										***0***	*1*	*3*	*1*	*1*
Viburnum nudum	Possumhaw							1			***1***	*0*	*0*	*0*	*0*
	Total Shrubs	***2***	***2***	***0***	***0***	***3***	***0***	***3***	***1***	***7***	***18***	*20*	*19*	*17*	*22*
Trees															
Cercis canadensis	Redbud		2	1	1		4	3	2		***13***	*11*	*15*	*23*	*22*
Carpinus caroliniana	Ironwood	1									***1***	*2*	*7*	*3*	*4*
Quercus alba	White oak	4		1		1			1		***7***	*7*	*5*	*4*	*4*
Quercus nigra	Water oak										***0***	*0*	*0*	*2*	*2*
Quercus velutina	Black oak			2							***2***	*2*	*2*	*5*	*6*
Nyssa sylvatica	Black gum										***0***	*2*	*5*	*6*	*7*
Asimina triloba	Paw Paw					1				9	***10***	*9*	*11*	*9*	*10*
Quercus phellos	Willow oak			2	1			1			***4***	*4*	*4*	*5*	*3*
Cornus florida	Flowering dogwood					1					***1***	*1*	*3*	*4*	*6*
Castanea pumila	Chinquapin			3		3			2		***8***	*9*	*17*	*34*	*32*
Diospyros virginiana	American persimmon		2	3	3	1	1	1	3		***14***	*17*	*11*	*11*	*11*
Morus rubra	Red mulberry	1	2	1				3			***7***	*10*	*6*	*5*	*5*
Betula nigra	River birch						1		2		***3***	*2*	*4*	*2*	*3*
Fraxinus pennsylvanica	Green ash										***0***	*0*	*1*	*1*	*0*
Robiniana pseudoacacia	Black locust		7								***7***	*7*	*5*	*0*	*0*
Hamamelis virginiana	Witchhazel								1		***1***	*1*	*0*	*2*	*0*
Crataegus	Hawthorn species										***0***	*0*	*1*	*0*	*0*
Ulmus rubra	Slippery elm					1					***1***	*1*	*0*	*2*	*0*
Quercus sp.	Oak species										***0***	*0*	*1*	*0*	*0*
Alnus serrulata	Tag alder	1									***1***	*0*	*0*	*0*	*0*
Acer negundo	Box elder					1					***1***	*0*	*0*	*0*	*0*
	Total Trees	***7***	***13***	***13***	***5***	***9***	***6***	***8***	***11***	***9***	***81***	*85*	*98*	*118*	*116*
TABLE SUMMARY	*Total WoodyStems*	9	15	13	5	12	6	11	12	16	99	*105*	*117*	*134*	*138*
	% Shrubs	22%	13%	0%	0%	25%	0%	27%	8%	44%	***18%***	*19%*	*16%*	*13%*	*16%*
	% Trees	78%	87%	100%	100%	75%	100%	73%	92%	56%	***82%***	*80%*	*84%*	*87%*	*84%*
	Current Density														
	Shrubs per acre	81	81	0	0	121	0	121	40	283	***81***	*90*	*85*	*76*	*99*
	Shrubs per hectare	200	200	0	0	300	0	300	100	700	***200***	*222*	*211*	*189*	*244*
	Trees per acre	283	526	526	202	364	243	324	445	364	***364***	*382*	*441*	*531*	*522*
	Trees per hectare	700	1300	1300	500	900	600	800	1100	900	***900***	*944*	*1089*	*1311*	*1289*
	Total stems per acre	***364***	***607***	***526***	***202***	***486***	***243***	***445***	***486***	***647***	***445***	*472*	*526*	*607*	*621*
	Total stems per hectare	***900***	***1500***	***1300***	***500***	***1200***	***600***	***1100***	***1200***	***1600***	***1100***	*1167*	*1300*	*1500*	*1533*

B. Stream Assessment

The stream remains in excellent condition. No problem areas were noted this year. Overall, the stream is remaining close to as-built morphology and no signs of bank or structure instability were noted. The slight degradation noted in the MY2 report in the left floodplain of the riffle at Cross Section 9 has remained stable since last year. Slight changes from as-built morphology are to be expected as time progresses and ultimate stability is achieved.

1. Morphometric Criteria

Considering the 5 year timeframe of standard mitigation monitoring, restored streams should demonstrate morphologic stability in order to be considered successful. Stability does not equate to an absence of change, but rather to sustainable rates of change or stable patterns of variation. Restored streams often demonstrate some level of initial adjustment in the several months that follow construction and some change/variation subsequent to that is to also be expected. However, the observed change should not indicate a high rate or be unidirectional over time such that a robust trend is evident. If some trend is evident, it should be very modest or indicate migration to another stable form. Examples of the latter include depositional processes resulting in the development of constructive features on the banks and floodplain, such as an inner berm, slight channel narrowing, modest natural levees, and general floodplain deposition. Annual variation is to be expected, but over time this should demonstrate maintenance around some acceptable central tendency while also demonstrating consistency or a reduction in the amplitude of variation. Lastly, all of this must be evaluated in the context of hydrologic events to which the system is exposed over the monitoring period.

For channel dimension, cross-sectional overlays and key parameters such as cross-sectional area and the channel's width to depth ratio should demonstrate modest overall change and patterns of variation that are in keeping with above. For the channels' profile, the reach under assessment should not demonstrate any consistent trends in thalweg aggradation or degradation over any significant continuous portion of its length. Over the monitoring period, the profile should also demonstrate the maintenance or development of bedform (facets) more in keeping with reference level diversity and distributions for the stream type in question. It should also provide a meaningful contrast in terms of bedform diversity against the pre-existing condition. Bedform distributions, riffle/pool lengths and slopes will vary, but should do so with maintenance around design/As-built distributions. This requires that the majority of pools are maintained at greater depths with lower water surface slopes and riffles are shallow with greater water surface slopes. Substrate measurements should indicate the progression towards, or the maintenance of, the known distributions from the design phase.

Cross-section and longitudinal surveys were performed on November 28 – 30 and December 12-13, 2012. Ten cross- sections and approximately 4,022 linear feet of UT Little Mountain Creek and 180 linear feet of the unnamed tributary were surveyed. Pebble counts were performed on November 19 and 30, 2012 and photographs were taken at all permanent photo points.

A monitoring baseline was established in the Year 0 monitoring effort, and was stationed from 10+00 at the culvert under Valley Drive to 50+22 at the end of the constructed portion of the project, in order to facilitate future monitoring efforts by different monitoring groups. The stationing of this baseline is used to identify locations along the restored portion of UT Little Mountain Creek throughout this report. Tributary stationing is the same in the monitoring as the construction documents.

The assessment included the survey of ten cross-sections, as well as the longitudinal profile. Cross-sections are marked with rebar and are located at the following locations:

- Cross-Section #1. UT Little Mountain Creek, Station 47+67, riffle
- Cross-Section #2. UT Little Mountain Creek, Station 43+05, pool
- Cross-Section #3. UT Little Mountain Creek, Station 38+26, riffle
- Cross-Section #4. UT Little Mountain Creek, Station 33+72, riffle
- Cross-Section #5. UT Little Mountain Creek, Station 29+78, pool
- Cross-Section #6. UT Little Mountain Creek, Station 25+39, riffle
- Cross-Section #7. UT Little Mountain Creek, Station 20+45, pool
- Cross-Section #8. UT Little Mountain Creek, Station 16+50, pool
- Cross-Section #9. UT Little Mountain Creek, Station 13+61, riffle
- Cross-Section #10. Tributary, Station 10+85, riffle

2. Hydrologic Criteria

Monitoring requirements state that at least two bankfull events must be documented through the five-year monitoring period. To assist in documenting bankfull events a stream crest gauge was installed on UT Little Mountain Creek. One documented bankfull event occurred on December 25, 2009 following a heavy rainfall event. A second bankfull event occurred in the fall of 2010 and was documented by the observation of wrack deposits and vegetation lying flat as a result of flooding. A third observed bankfull event from the 2011 monitoring year was presumed due to the presence of wrack deposits prior to the 2011 monitoring effort. Evidence of a bankfull event was once again observed on the site during the 2012 monitoring period. Photo 1 shows a wrack deposits and vegetation laying flat as a result of flooding prior to December 13, 2012 during the 2012 monitoring period.

Table VI. Verification of Bankfull Events Badin Inn Stream Restoration - EEP Project No. 92666			
Date of Data Collection	**Date of Occurrence**	**Method**	**Photo # (if applicable)**
2009	12-25-09	Photographed on-site	Photo 1 - MY1 Report
2010	Before 9-30-10	Photographed on-site	Photo 1 - MY2 Report
2011	Before 9-26-11	Photographed on-site	Photo 1 - MY3 Report
2012	Before 12-13-12	Photographed on-site	Photo 1

Photo 1. Photo evidence of bankfull event prior to 12-13-12.

Table VII. Categorical Stream Feature Visual Stability Assessment Badin Inn Stream Restoration – EEP Project No. 92666					
Feature	**Initial**	**MY-01**	**MY-02**	**MY-03**	**MY-04**
A. Riffles	100%	99%	100%	100%	100%
B. Pools	100%	100%	100%	100%	100%
C. Thalweg	100%	100%	100%	100%	100%
D. Meanders	100%	100%	100%	100%	100%
E. Bed General	100%	100%	100%	100%	100%
F. Vanes/J Hooks etc.	100%	100%	100%	100%	100%
G. Wads and Boulders	100%	100%	100%	100%	100%

IV. METHODOLOGY

The survey of the cross-sections and longitudinal profile were performed using RTK survey-grade GPS and/or total station survey equipment to detect thalweg, bankfull, and water

surface elevations of the UT to Little Mountain Creek. A monitoring baseline was established in the Year 0 monitoring effort, and was stationed from the downstream end of the constructed portion of the project upstream to approximately station 10+00, in order to facilitate future monitoring efforts by different monitoring groups. The stationing of this baseline is used to identify locations along the restored portion of UT Little Mountain Creek throughout this report. The entire length of the tributary is surveyed annually as well. Baseline cross sections were established for ten cross sections. During monitoring year 1, it was found that one or more pins were "removed" from cross sections 5 and 8. These missing pins were reset and the monitoring year 1 data is used as the new baseline data for these two cross sections.

Data was entered into the stream morphology applications program, Rivermorph, to obtain the dimensions of the cross sections and parameters applicable to the longitudinal profile. Reports generated by Rivermorph are used in this report to display and summarize stream survey data.

Table VIII. Baseline Stream Data Summary

Badin Inn Stream Restoration - EEP Project No. 92666
Reach I UT to Little Mountain Creek and Tributary(4,174 feet)

Parameter	Gauge	Regional Curve			Pre-Existing Condition			Reference Reach UT to Meadow Fork Creek			Reference Reach Spencer Creek			Design UT to Little Mountain Creek			Design Tributary			As-Built UT to Little Mountain Creek			As-Built Tributary		
Dimension and Substrate - Riffle		Min	Max	Med	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Bankfull Width (ft)	NA			10.2						11.81			12.3			10			5.6	9.4	11.6	10.9			6.29
Floodprone Width (ft)																				44.5	53.4	48.7			46.9
Bankfull Cross Sectional Area (ft^2)	NA			13.1						15.34			10.8			7			3.2	7.2	9	8.0			2.64
Bankfull Mean Depth (ft)	NA			1.3						1.3			0.88			0.7			0.57	0.65	0.8	0.73			0.42
Bankfull Max Depth (ft)	NA									2.11			1.8			1			0.7	1.04	1.25	1.19			0.56
Width/Depth Ratio	NA									9.08			13.98			14.3			9.82	12.17	17.89	14.99			14.98
Entrenchment Ratio	NA									28.11			>2.2			>2.2			>2.2	3.97	5.37	4.49			7.45
Bank Height Ratio	NA							1.03	1.05	1.04			1.1			1			1			1			1
Wetted Perimeter (ft)	NA							NA	NA	NA			NA			NA			NA			NA			NA
Hydraulic Radius (ft)	NA							NA	NA	NA			NA			NA			NA			NA			NA
Pattern																									
Channel Beltwidth (ft)								22	57.1	37.2	24	52	38	18.6	48.3	33.4	10.4	27.1	18.7	18.6	48.3	33.5	10.4	27.1	18.7
Radius of Curvature (ft)								18	42.8	25	5.4	22.1	12.9	22.1	42.3	32.2	12.4	23.7	18.0	22.1	42.3	32.2	12.4	23.7	18.03
Meander Wavelength (ft)								78.5	149.9	107.1	54	196	125	43.9	159.3	101.6	24.6	89.2	56.9	43.9	159.4	101.6	24.6	89.2	56.9
Meander Width Ratio								1.86	4.83	3.15	1.95	4.23	3.09	1.86	4.83	3.35	1.86	4.83	3.35	1.86	4.83	3.35	1.86	4.83	3.35
Profile																									
Riffle Length (ft)								NA	NA	NA	NA	NA	NA	14.3	154.4	49.0	18.9	28.5	24.8	18.2	121.0	54.0	17.2	22.5	20.9
Riffle Slope (ft/ft)								0.011	0.021	0.017	0.02	0.036	0.026	0.012	0.037	0.019	0.022	0.04	0.03	0.0053	0.0205	0.0143	0.0162	0.0505	0.0275
Pool Length (ft)								12.9	20.8	18.0	9.3	23.9	17.8	18.3	31	24.6	10.2	17.3	13.8	14.8	41.8	22.1	10.9	25.7	16.3
Pool Spacing (ft)								79.4	96.9	88.2	13	46.5	24.2	68.4	83.1	75.7	5.9	21.1	13.5	36.3	148.0	66.6	36.6	39.7	38.1
Substrate																									
d50(mm)	NA							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.04	26.7	10.9	NA	NA	28.6
d84 (mm)	NA							NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.83	68.3	38.5	NA	NA	32
Additional Reach Parameters																									
Valley length (ft)					3540			200			235			3820			157								
Channel length (ft)					3540			288			266			3994			180			3994			180		
Sinuosity (ft)					1			1.4			1.1			1.05			1.03			1.05			1.03		
Water Surface Slope (Channel) (ft/ft)	NA				0.0178			0.0122			0.0132			0.0134			0.0147			0.012			0.012		
BF slope (ft/ft)	NA				0.0178			0.0122			0.0132			0.0134			0.0147			0.012			0.012		
Rosgen Classification	NA				NA			E4			C4			C4			C4			C4			C4		
Habitat Index					N/A			N/A			N/A														
Macrobenthos					N/A			N/A			N/A														

NOT APPLICABLE. STREAM IS COMPLETELY MODIFIED

Table IX. Morphology and Hydraulic Monitoring Summary
Badin Inn Stream Restoration/ EEP Project No. 92666
Reach I UT to Little Mountain Creek and Tributary(4,174 feet)

Parameter	Cross Section 1					Cross Section 2					Cross Section 3					Cross Section 4					Cross Section 5				
	Riffle					Pool					Riffle					Riffle					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
BF Width (ft)	11.6	11.8	11.9	12.2		10.4	12.3	8.5	9.3		10.5	9.9	9.9	11.8		9.9	10.1	10.2	9.9		7.6	9.3	10.1	8.9	
Floodprone Width (ft) (approx)	50.0	52.6	52.6	52		40.5	44.8	44.2	44		45.9	53.7	51.5	54.6		44.9	46.8	47.2	47.2		40.3	51.1	51.6	51.6	
BF Cross-Sectional Area (ft^2)	6.5	9.4	8.3	9.2		7.8	8.3	6.6	7.2		5.8	6.0	5.9	7.2		6.7	8.1	8.5	8.4		8.1	9.3	11.8	9.6	
BF Mean Depth (ft)	0.6	0.8	0.7	0.7		0.7	0.7	0.8	0.8		0.6	0.6	0.6	0.6		0.7	0.8	0.8	0.8		1.1	1.0	1.1	1.1	
BF Max Depth (ft)	1.0	1.4	1.4	1.5		1.4	1.5	1.3	1.4		0.9	0.9	0.9	1		1.2	1.2	1.3	1.4		1.9	1.9	1.9	1.9	
Width/Depth Ratio	20.6	14.7	17.1	16.2		13.8	18.4	10.9	12.1		19.0	16.6	16.6	18.0		14.5	12.6	12.1	11.6		7.1	9.2	8.6	8.2	
Entrenchment Ratio	4.3	4.4	4.4	4.3		3.9	3.6	5.2	4.7		4.4	5.4	5.2	4.6		4.5	4.6	4.6	4.7		5.3	5.5	5.1	5.8	
Wetted Perimeter (ft)	11.8	12.2	12.4	12.6		10.9	12.7	9.1	9.8		10.8	10.2	10.2	12.1		10.2	10.6	10.6	10.4		9.4	10.2	10.9	9.8	
Hydraulic radius (ft)	0.55	0.78	0.67	0.73		0.71	0.65	0.73	0.73		0.54	0.59	0.58	0.6		0.66	0.76	0.8	0.81		0.86	0.92	1.08	0.98	
Bank Height Ratio (ft/ft)	1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1	
Substrate																									
d50 (mm)	29.1	22.6	14.8	33.1		9.6	23.5	12.8	48.8		8.7	51.3	8	54.5		1	9.6	17.1	72		0.6	18.2	0.1	0.06	
d84 (mm)	77	128	77	78		34	168	88	128		45	277	45	138		71	139	78	159		16	56	16	27	

Parameter	MY-01 (2009)				MY-02 (2010)				MY-03 (2011)				MY-04 (2012)				MY-05 (2013)				MY+ (2014)			
Pattern	Min	Max	Med		Min	Max	Med		Min	Max	Med		Min	Max	Med		Min	Max	Med		Min	Max	Med	
Channel Beltwidth (ft)	18.6	48.3	33.4		18.6	48.3	33.4		18.6	48.3	33.4		18.6	48.3	33.4									
Radius of Curvature (ft)	22.1	42.3	32.2		22.1	42.3	32.2		22.1	42.3	32.2		22.1	42.3	32.2									
Meander Wavelength (ft)	43.9	159.3	101.6		43.9	159.3	101.6		43.9	159.3	101.6		43.9	159.3	101.6									
Meander Width Ratio	1.86	4.83	3.35		1.86	4.83	3.35		1.86	4.83	3.35		1.86	4.83	3.35									
Profile																								
Riffle Length (ft)	18.2	121.0	54.0		35.2	151.3	92.2		12.5	90.1	41.7		9.5	76.3	40.8									
Riffle Slope (ft/ft)	0.0053	0.0205	0.014		0.0090	0.0359	0.0179		0.0083	0.0263	0.0171		0.007	.0277	0.0177									
Pool length (ft	14.8	41.9	22.1		23.9	47.2	32.2		18.7	61.8	32.7		7.63	46.3	22.9									
Pool spacing (ft)	36.3	148.1	66.6		58.6	151.3	92.2		48.3	115.3	69.4		20.3	125.9	65.9									
Additional Reach Parameters																								
Valley Length (ft)	3820				3820				3820				3820											
Channel Length (ft)	3994				3994				3994				3994											
Sinuosity	1.05				1.05				1.05				1.05											
Water Surface Slope (ft/ft)	0.012				0.012				0.012				0.012											
BF Slope (ft/ft)	0.012				0.012				0.012				0.012											
Rosgen Classification	C4				C4				C4				C4											
Habitat Index	NA				NA				NA				NA											
Macrobenthos	NA				NA				NA				NA											

Table IX. Morphology and Hydraulic Monitoring Summary
Badin Inn Stream Restoration/ EEP Project No. 92666
Reach I UT to Little Mountain Creek and Tributary(4,174 feet)

Parameter	Cross Section 6					Cross Section 7					Cross Section 8					Cross Section 9					Cross Section10				
	Riffle					Pool					Pool					Riffle					Tributary - 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
BF Width (ft)	10.5	9.9	9.9	9.5		16.4	14.4	12.1	11.4		8.9	13.9	8.5	8.8		10.1	11.1	9.8	10.0		5.8	8.3	7.1	5.9	
Floodprone Width (ft) (approx)	39.5	52.5	53.0	53.0		40.0	40.5	40.5	40.5		49.3	60.0	62.5	62.5		39.7	47.3	48.8	48.8		46.9	47.9	48.0	48.0	
BF Cross-Sectional Area (ft^2)	7.6	7.6	7.6	7.1		20.0	18.5	16.0	15.8		5.5	14.6	12.3	12.2		8.9	9.6	8.4	10.1		1.9	3.3	3.1	2.2	
BF Mean Depth (ft)	0.7	0.8	0.8	0.8		1.2	1.3	1.3	1.4		0.6	1.1	1.4	1.4		0.9	0.9	0.9	1.0		0.3	0.4	0.4	0.4	
BF Max Depth (ft)	1.1	1.1	1.1	1.1		2.5	2.5	2.5	2.4		1.9	2.3	2.7	2.5		1.3	1.5	1.5	1.6		0.6	0.7	0.7	0.5	
Width/Depth Ratio	14.6	13.1	12.9	12.6		13.4	11.2	9.1	8.2		15.3	13.2	5.9	6.4		11.5	11.3	11.4	9.9		16.9	20.7	16.1	15.9	
Entrenchment Ratio	3.7	5.3	5.3	5.6		2.4	1.6	3.4	3.6		5.6	4.3	7.3	7.1		3.9	4.3	5.0	4.9		8.1	5.8	6.8	8.1	
Wetted Perimeter (ft)	11.0	10.3	10.3	9.9		17.3	15.7	13.5	12.9		10.2	14.9	10.3	10.4		10.7	11.9	10.4	10.8		6.0	8.5	7.3	6.1	
Hydraulic radius (ft)	0.69	0.74	0.74	0.72		1.15	1.18	1.19	1.22		0.51	0.97	1.19	1.17		0.83	0.81	0.81	0.93		0.33	0.39	0.42	0.36	
Bank Height Ratio (ft/ft)	1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1		1	1	1	1	
Substrate																									
d50 (mm)	31.4	40.4	20.9	58.6		0.06	0.04	8.8	10.2		0.05	0.05	0 .06	0.05		38.5	0.04	26.9	12.5		13.2	92.7	25.3	33.6	
d84 (mm)	62	7	44	127		19	19	32	42		6	48	16	43		81	19	83	103		34	168	52	96	

APPENDIX A

1. Vegetation Data Tables

   Table 1. Vegetation Metadata
   Table 2. Vegetation Vigor by Species
   Table 3. Vegetation Damage by Species
   Table 4. Vegetation Damage by Plot
   Table 5. Stem Count by Plot and Species
   Table 6. Vegetation Problem Areas Tables

2. Vegetation Monitoring Plot Photos

Table 1. Vegetation Metadata
Badin Inn Stream Restoration/ EEP No. 92666
Appendix A

Report Prepared By	Kevin Lapp
Date Prepared	12/19/2012 14:25
database name	AECOM-2008-0.mdb
database location	Q:\99255\Monitoring\Vegetation
computer name	USRAL3LT064
file size	45568000
DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------	
Metadata	Description of database file, the report worksheets, and a summary of project(s) and project data.
Proj, planted	Each project is listed with its PLANTED stems per acre, for each year. This excludes live stakes.
Proj, total stems	Each project is listed with its TOTAL stems per acre, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems.
Plots	List of plots surveyed with location and summary data (live stems, dead stems, missing, etc.).
Vigor	Frequency distribution of vigor classes for stems for all plots.
Vigor by Spp	Frequency distribution of vigor classes listed by species.
Damage	List of most frequent damage classes with number of occurrences and percent of total stems impacted by each.
Damage by Spp	Damage values tallied by type for each species.
Damage by Plot	Damage values tallied by type for each plot.
ALL Stems by Plot and spp	A matrix of the count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.
PROJECT SUMMARY----------	
Project Code	92666
project Name	Badin Inn
Description	
River Basin	Yadkin-Pee Dee
length(ft)	4174
stream-to-edge width (ft)	42
area (sq m)	32570
Required Plots (calculated)	9
Sampled Plots	0

Table 2. Vegetation Vigor by Species Badin Inn Stream Restoration/ EEP No. 92666 Appendix A								
	Species	**4**	**3**	**2**	**1**	**0**	**Missing**	**Unknown**
	Alnus serrulata	1						
	Asimina triloba	8	1		1		3	
	Betula nigra	3					1	
	Callicarpa americana	10	4	2			3	
	Castanea pumila	4	3		1	3	14	
	Cornus florida	1					1	
	Diospyros virginiana	8	3	3			4	
	Fraxinus pennsylvanica							
	Nyssa sylvatica						6	
	Prunus americana						2	
	Quercus alba	6	1					
	Quercus nigra						1	
	Quercus phellos	4						
	Quercus velutina		1	1			1	
	Robinia pseudoacacia	4	1	2			1	
	Sambucus canadensis	1						
	Ulmus rubra		1					
	Viburnum nudum			1				
	Morus rubra	2	3	2			6	
	Carpinus caroliniana		1				4	
	Cercis canadensis	3	5	5		1	8	
	Hamamelis virginiana		1					
	Crataegus sp.						1	
	Prunus serotina						1	
	Acer negundo	1						
TOT:	**25**	**56**	**25**	**16**	**2**	**4**	**57**	

Table 3. Vegetation Damage by Species
Badin In Stream Restoration/EEP No. 92666
Appendix A

	SPECIES	All Damage Categories	No Damage	Other damage	Deer	Insects	Unknown
	Acer negundo	1	1				
	Alnus serrulata	1	1				
	Asimina triloba	13	4		4	5	
	Betula nigra	5	4			1	
	Callicarpa americana	19	9		5	5	
	Carpinus caroliniana	5	5				
	Castanea pumila	25	21		2	1	1
	Cercis canadensis	22	14	1	4	3	
	Cornus florida	3	3				
	Crataegus	1	1				
	Diospyros virginiana	20	13		1	6	
	Fraxinus pennsylvanica	1	1				
	Hamamelis virginiana	1			1		
	Morus rubra	14	10		4		
	Nyssa sylvatica	6	6				
	Prunus americana	2	2				
	Prunus serotina	1	1				
	Quercus alba	7	5		1	1	
	Quercus nigra	1	1				
	Quercus phellos	4	4				
	Quercus velutina	3	3				
	Robinia pseudoacacia	8	4		3	1	
	Sambucus canadensis	1	1				
	Ulmus rubra	1	1				
	Viburnum nudum	1			1		
TOT:	**25**	**166**	**115**	**1**	**26**	**23**	**1**

Table 4. Vegetation Damage by Plot
Badin Inn Stream Restoration/EEP No. 92666
Appendix A

	PLOT	All Damage Categories	No Damage	Other Damage	Deer	Insects	Unknown
	92666-01-0001-year:4	16	16				
	92666-01-0002-year:4	26	20		5	1	
	92666-01-0003-year:4	21	18			3	
	92666-01-0004-year:4	12	8		2	2	
	92666-01-0005-year:4	17	13		4		
	92666-01-0006-year:4	16	14	1		1	
	92666-01-0007-year:4	25	18		6	1	
	92666-01-0008-year:4	15	5		3	6	1
	92666-01-0009-year:4	18	3		6	9	
TOT:	**9**	**166**	**115**	**1**	**26**	**23**	**1**

Table 5. Stem Count by Plot and Species
Badin Inn Stream Restoration/ EEP No. 92666
Appendix A

	Species	Total Planted Stems	# plots	Avg# stems	Plot 92666-01-0001-year:4	Plot 92666-01-0002-year:4	Plot 92666-01-0003-year:4	Plot 92666-01-0004-year:4	Plot 92666-01-0005-year:4	Plot 92666-01-0006-year:4	Plot 92666-01-0007-year:4	Plot 92666-01-0008-year:4	Plot 92666-01-0009-year:4
	Alnus serrulata	5	1	5	5								
	Asimina triloba	10	2	5					1				9
	Betula nigra	366	3	122					9	355		2	
	Callicarpa americana	16	6	2.67	2	2			2		2	1	7
	Castanea pumila	11	4	2.75			5		3		1	2	
	Cornus florida	1	1	1					1				
	Diospyros virginiana	14	7	2		2	3	3	1	1	1	3	
	Fraxinus pennsylvanica	34	6	5.67	8		4	2		2	4		14
	Ligustrum sinense	6	1	6	6								
	Liquidambar styraciflua	67	7	9.57	32	3			2	3	8	4	15
	Pinus taeda	584	9	64.89	2	53	250	24	7	8	110	53	77
	Quercus alba	7	4	1.75	4		1		1			1	
	Quercus phellos	12	3	4			2	5			5		
	Quercus velutina	2	1	2			2						
	Robinia pseudoacacia	7	1	7		7							
	Salix nigra	7	3	2.33			2	1		4			
	Sambucus canadensis	1	1	1					1				
	Ulmus rubra	10	4	2.5				7	1	1	1		
	Viburnum nudum	1	1	1							1		
	Morus rubra	7	4	1.75	1	2	1				3		
	Carpinus caroliniana	1	1	1	1								
	Cercis canadensis	14	6	2.33		2	2	1		4	3	2	
	Hamamelis virginiana	1	1	1								1	
	Liriodendron tulipifera	10	1	10	10								
	Platanus occidentalis	4	3	1.33	2		1			1			
	Prunus serotina	4	1	4					4				
	Acer negundo	1	1	1					1				
	Acer rubrum	1	1	1							1		
TOT:	**28**	**1204**	**28**		**73**	**71**	**273**	**43**	**34**	**379**	**140**	**69**	**122**

Table 6. Vegetation Problem Areas Badin Inn Stream Restoration/ EEP No. 92666 Appendix A			
Feature/Issue	Station#/Range	Probable Cause	Photo #
Mechanical cutting	N/A	Golf course maintenance crews cutting within posted boundary of easement	1

Photo 1. Mechanical encroachment along easement boundary


Vegetation Plot 1 facing 210˚.


Vegetation Plot 2 facing 150˚.


Vegetation Plot 3 facing 210˚.


Vegetation Plot 4 facing 160˚.


Vegetation Plot 5 facing 180˚.


Vegetation Plot 6 facing 260˚.

Vegetation Plot 7 facing 260˚.

Vegetation Plot 8 facing 310˚.

Vegetation Plot 9 facing 340˚.

APPENDIX B

1. Stream Problem Areas Plan View (not included, incorporated into Appendix C)

2. Table B.1. Stream Problem Areas Table

3. Representative Stream Problem Area Photos

4. Stream Photo Station Photos

5. Table B.2. Visual Morphological Stability Assessment

6. Annual Overlays of Cross Section Plots

7. Annual Overlays of Longitudinal Plots

8. Annual Overlays of Pebble Count Frequency Distribution Plots

B-1 Stream Problem Areas Plan View has been incorporated into Appendix C (Integrated Plan View)

Table B.1. Stream Problem Areas Badin Inn Stream Restoration/ EEP No. 92666 Appendix B			
Feature/Issue	**Station#/Range**	**Probable Cause**	**Photo #**
None Observed			

Badin Inn Stream Restoration Site
Mitigation Report
Appendix B-3
Stream Problem Area Photos

None Taken

Badin Inn Stream Restoration Site
Mitigation Report
Appendix B-4
Stream Photo-Station Photos


Photo Point 1. Upstream From Cross Section 1.


Photo Point 1. Downstream from Cross Section 1.


Photo Point 2. Upstream from Cross Section 2.


Photo Point 2. Downstream from Cross Section 2.


Photo Point 3. Upstream from Cross Section 3.


Photo Point 3. Downstream from Cross Section 3.

Badin Inn Stream Restoration Site
Mitigation Report
Appendix B-4
Stream Photo-Station Photos

Photo Point 4. Upstream from Cross Section 4.

Photo Point 4. Downstream from Cross Section 4.

Photo Point 5. Upstream from Cross Section 5.

Photo Point 5. Downstream from Cross Section 5.

Photo Point 6. Upstream from Cross Section 6.

Photo Point 6. Downstream from Cross Section 6.

Photo Point 7. Upstream from Cross Section 7.

Photo Point 7. Downstream from Cross Section 7.

Photo Point 8. Upstream from Cross Section 8.

Photo Point 8. Downstream from Cross Section 8.

Photo Point 9. Upstream from Cross Section 9.

Photo Point 9. Downstream from Cross Section 9.

Badin Inn Stream Restoration Site
Mitigation Report
Appendix B-4
Stream Photo-Station Photos

Photo Point 10. Upstream from Cross Section 10 (Tributary).

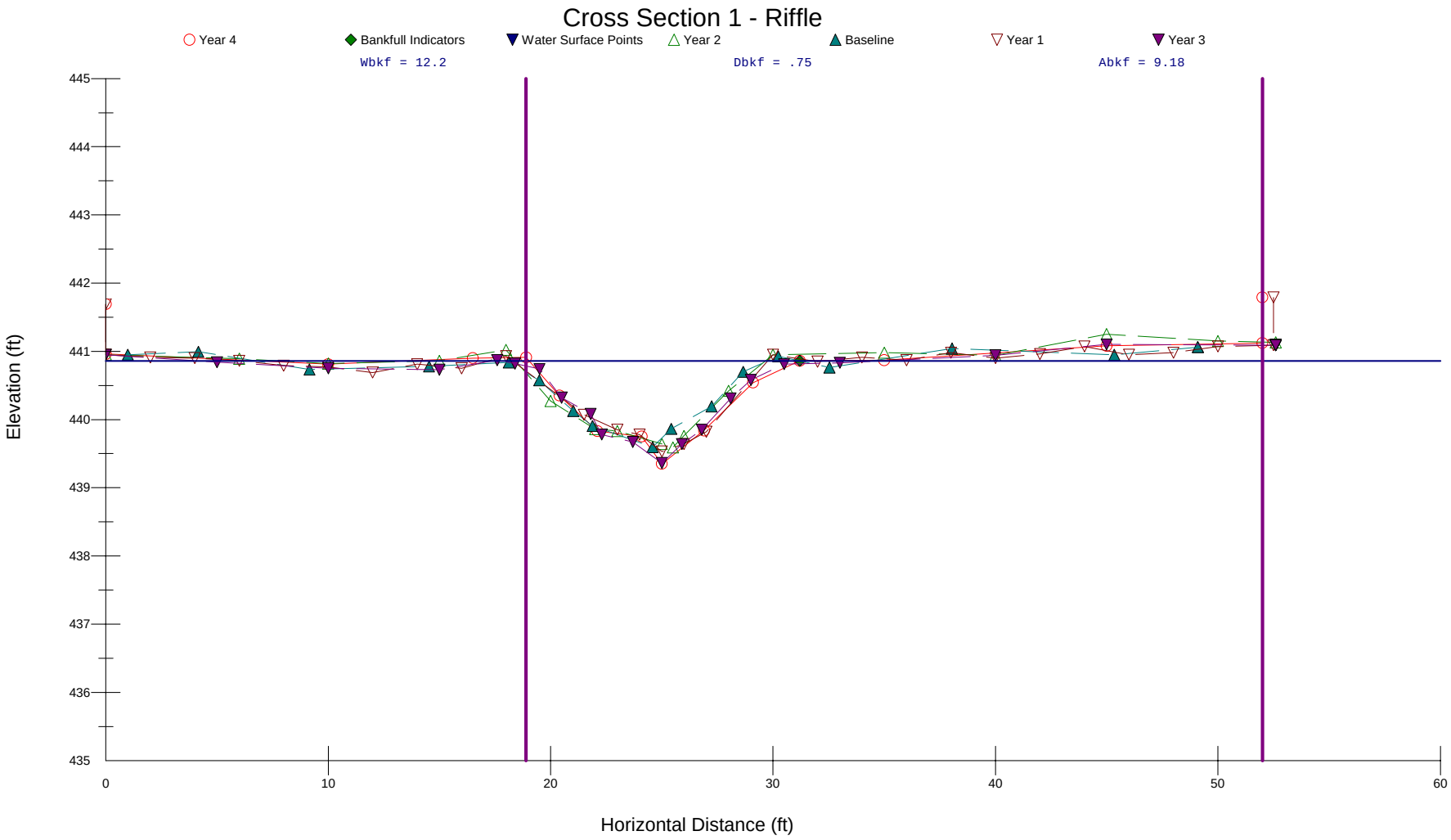
Photo Point 10. Downstream from Cross Section 10 (Tributary).

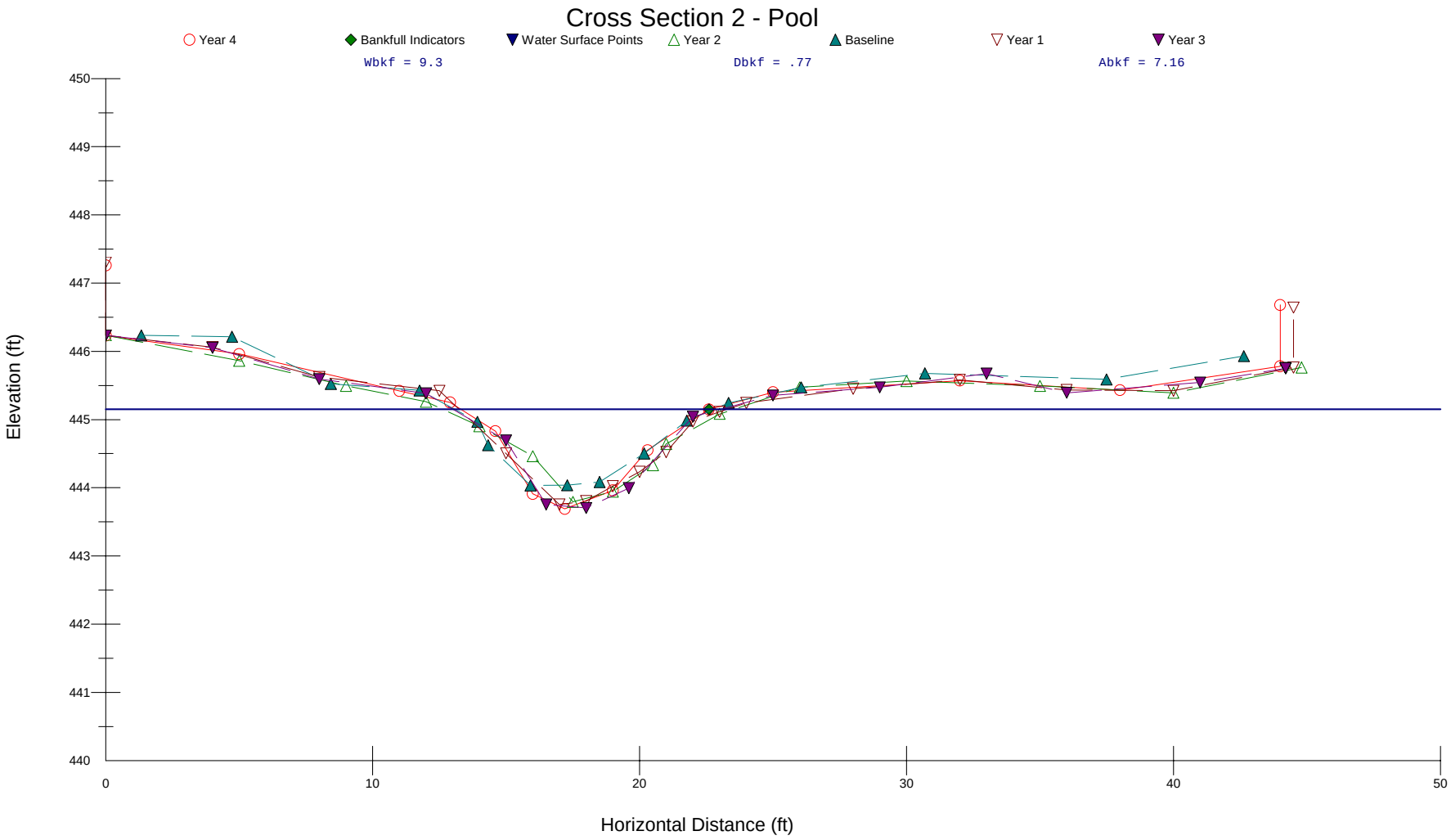
Table B2. Visual Morphological Stability Assessment
Badin Inn Stream Restoration/ EEP Number 92666
UT Little Mountain Creek/ 4,022 feet

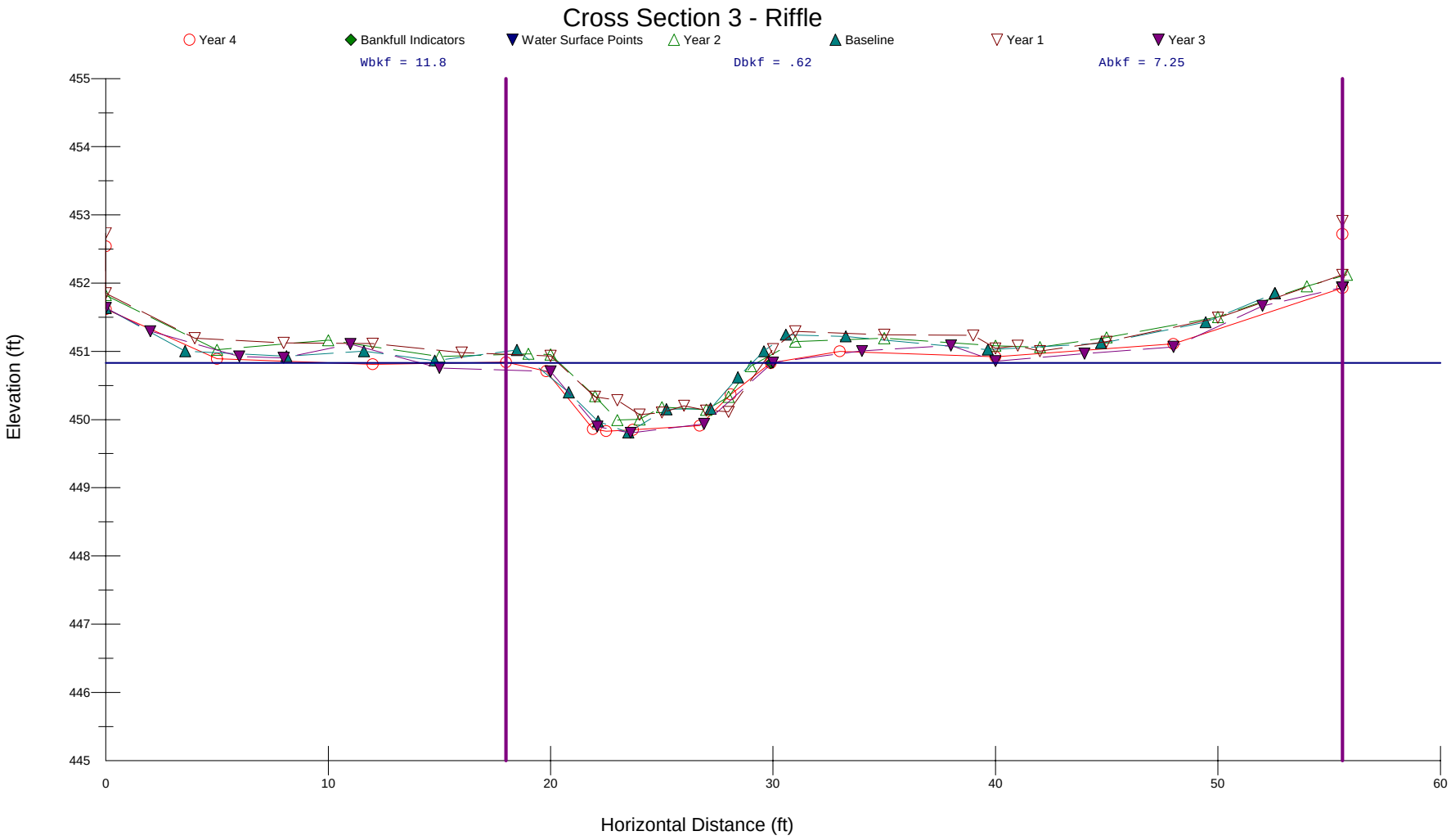
Feature Category	Metric (Per As-built and reference baselines)	# Stable Number Perform. as Intended	Total No. per As-built	Total Number/ feet in unstable state	% Perform. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	58	58	0	100	100
	2. Armor stable (e.g. no displacement)	58	58	0	100	100
	3. Facet grade appears stable	58	58	0	100	100
	4. Minimal evidence of embedding/fining	58	58	0	100	100
	5. Length appropriate	58	58	0	100	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	58	58	0	100	100
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?	NA	NA	NA	NA	NA
	3. Length appropriate?	58	58	0	100	100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	NA	NA	NA	NA	NA
	2. Downstream of meander (glide/inflection) centering?	NA	NA	NA	NA	NA
D. Meanders	1. Outer bend in state of limited/controlled erosion?	44	44	0	100	100
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	NA	NA	NA
	3. Apparent Rc within spec?	44	44	0	100	100
	4. Sufficient floodplain access and relief?	44	44	0	100	100
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100	100
	2. Channel bed degradation - areas of increasing down-cutting or headcutting	NA	NA	0	100	100
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100	100
G. Vanes	1. Free of back or arm scour?	17	17	0	100	100
	2. Height appropriate?	17	17	0	100	100
	3. Angle and geometry appear appropriate?	17	17	0	100	100
	4. Free of piping or other structural failures?	17	17	0	100	100
H. Wads/ Boulders	1. Free of scour?	NA	NA	NA	NA	NA
	2. Footing stable?	NA	NA	NA	NA	NA

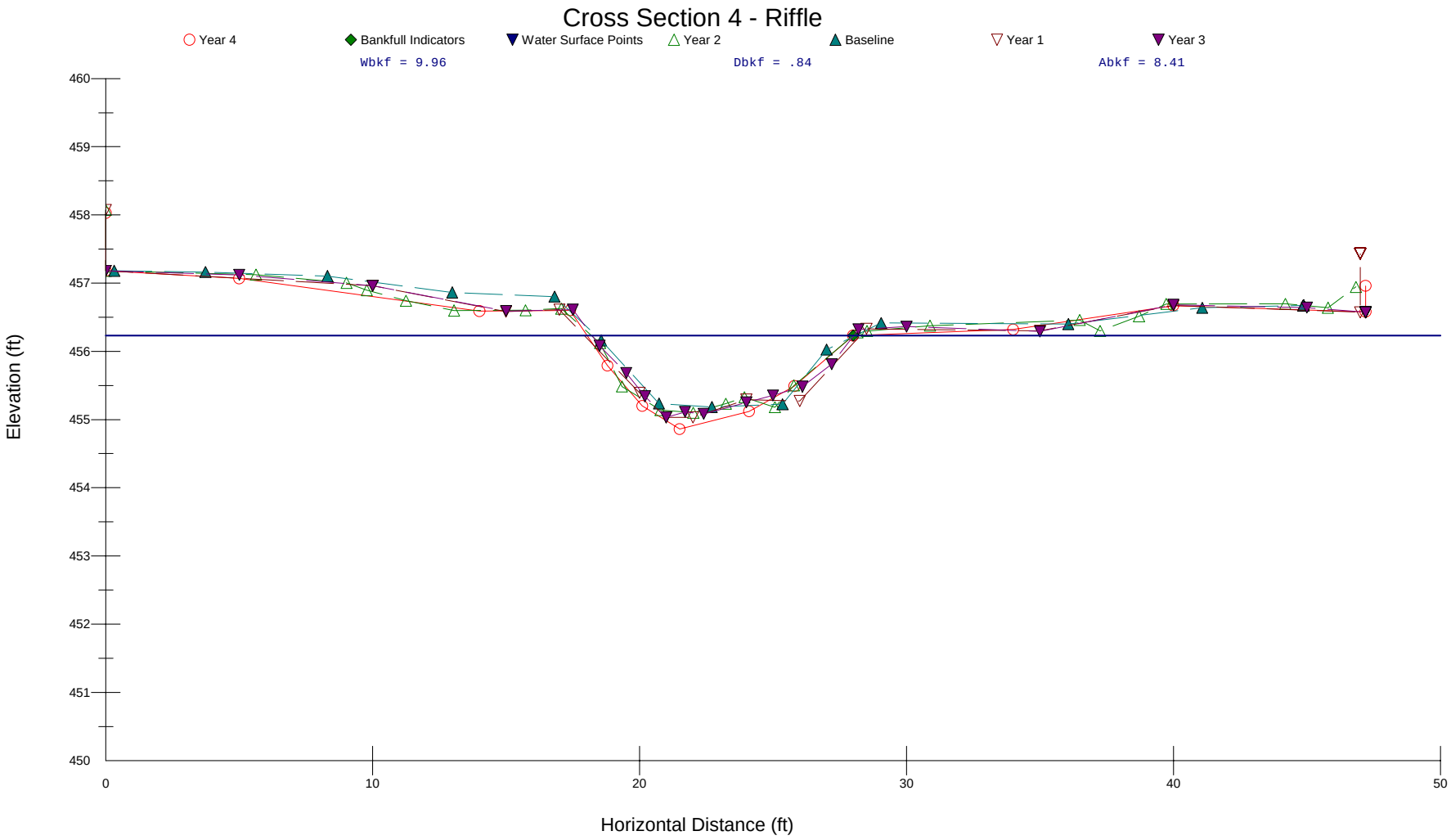
Table B2. Visual Morphological Stability Assessment
Badin Inn Stream Restoration/ EEP Number 92666
Tributary/ 180 feet

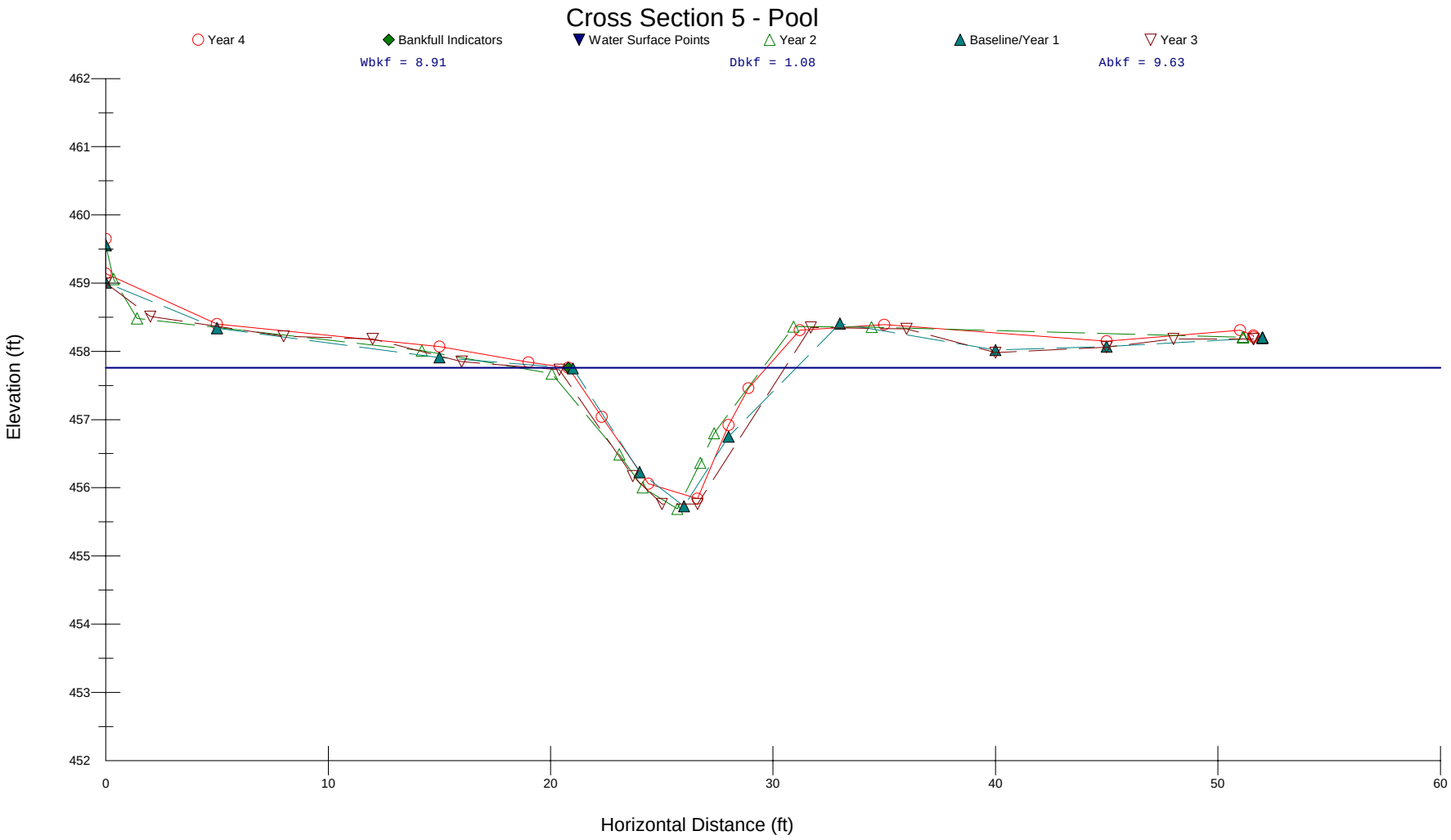
Feature Category	Metric (Per As-built and reference baselines)	# Stable Number Perform. as Intended	Total No. per As-built	Total Number/ feet in unstable state	% Perform. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	4	4	0	100	100
	2. Armor stable (e.g. no displacement)	4	4	0	100	100
	3. Facet grade appears stable	4	4	0	100	100
	4. Minimal evidence of embedding/fining	4	4	0	100	100
	5. Length appropriate	4	4	0	100	100
B. Pools	1. Present? (e.g. not subject to severe aggrad. Or migrat.?)	4	4	0	100	100
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6?	NA	NA	NA	NA	NA
	3. Length appropriate?	4	4	0	100	100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	NA	NA	NA	NA	NA
	2. Downstream of meander (glide/inflection) centering?	NA	NA	NA	NA	NA
D. Meanders	1. Outer bend in state of limited/controlled erosion?	4	4	0	100	100
	2. Of those eroding, # w/concomitant point bar formation?	NA	NA	NA	NA	NA
	3. Apparent Rc within spec?	4	4	0	100	100
	4. Sufficient floodplain access and relief?	4	4	0	100	100
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100	100
	2. Channel bed degradation - areas of increasing down-cutting or headcutting	NA	NA	0	100	100
F. Bank	1. Actively eroding, wasting, or slumping bank	NA	NA	0	100	100
G. Vanes	1. Free of back or arm scour?	NA	NA	NA	NA	NA
	2. Height appropriate?	NA	NA	NA	NA	NA
	3. Angle and geometry appear appropriate?	NA	NA	NA	NA	NA
	4. Free of piping or other structural failures?	NA	NA	NA	NA	NA
H. Wads/ Boulders	1. Free of scour?	NA	NA	NA	NA	NA
	2. Footing stable?	NA	NA	NA	NA	NA

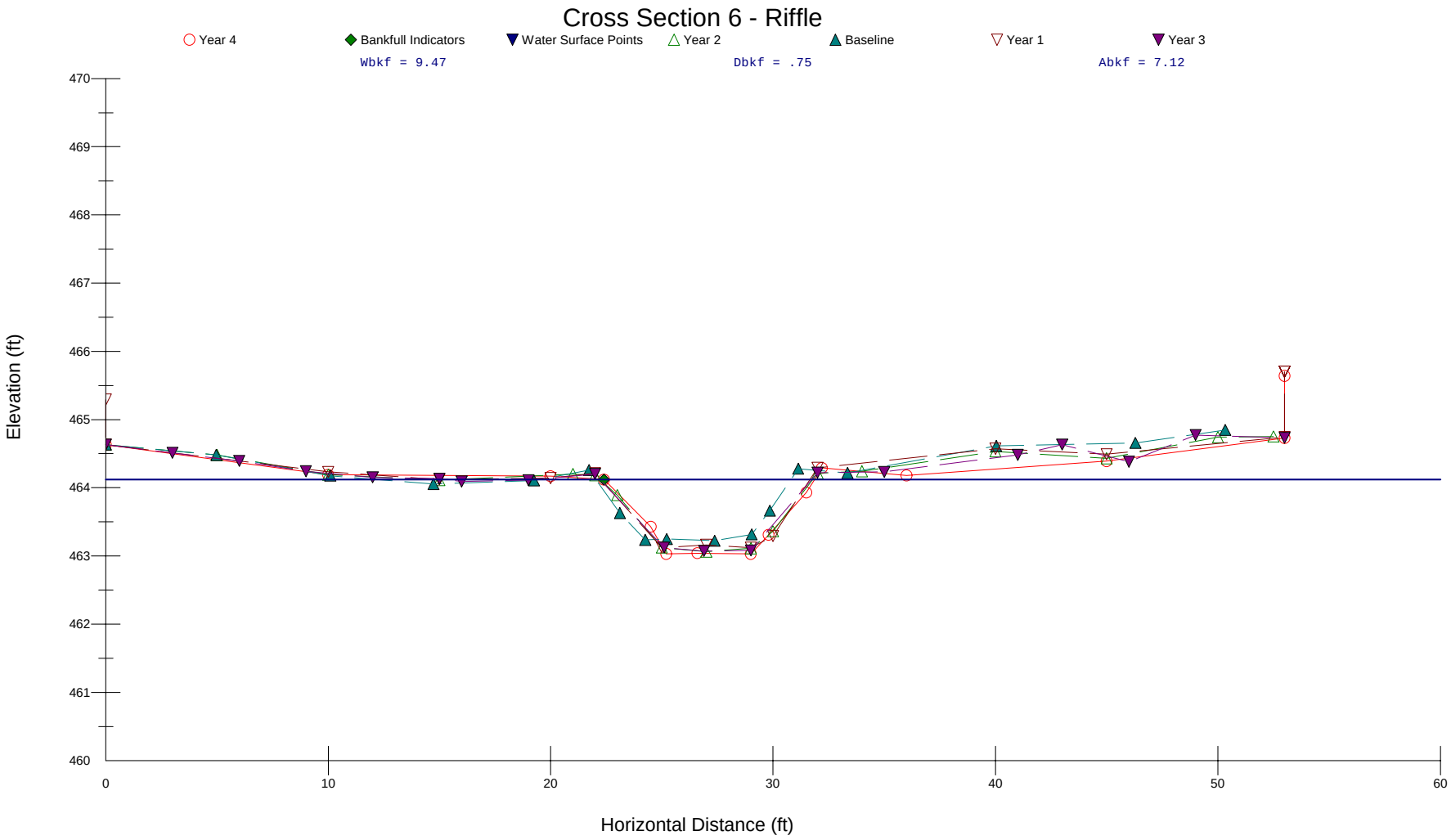

Cross Section 1 - Riffle
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 12.2
Dbkf = .75
Abkf = 9.18
Elevation (ft)
445
444
443
442
441
440
439
438
437
436
435
0
10
20
30
40
50
60
Horizontal Distance (ft)

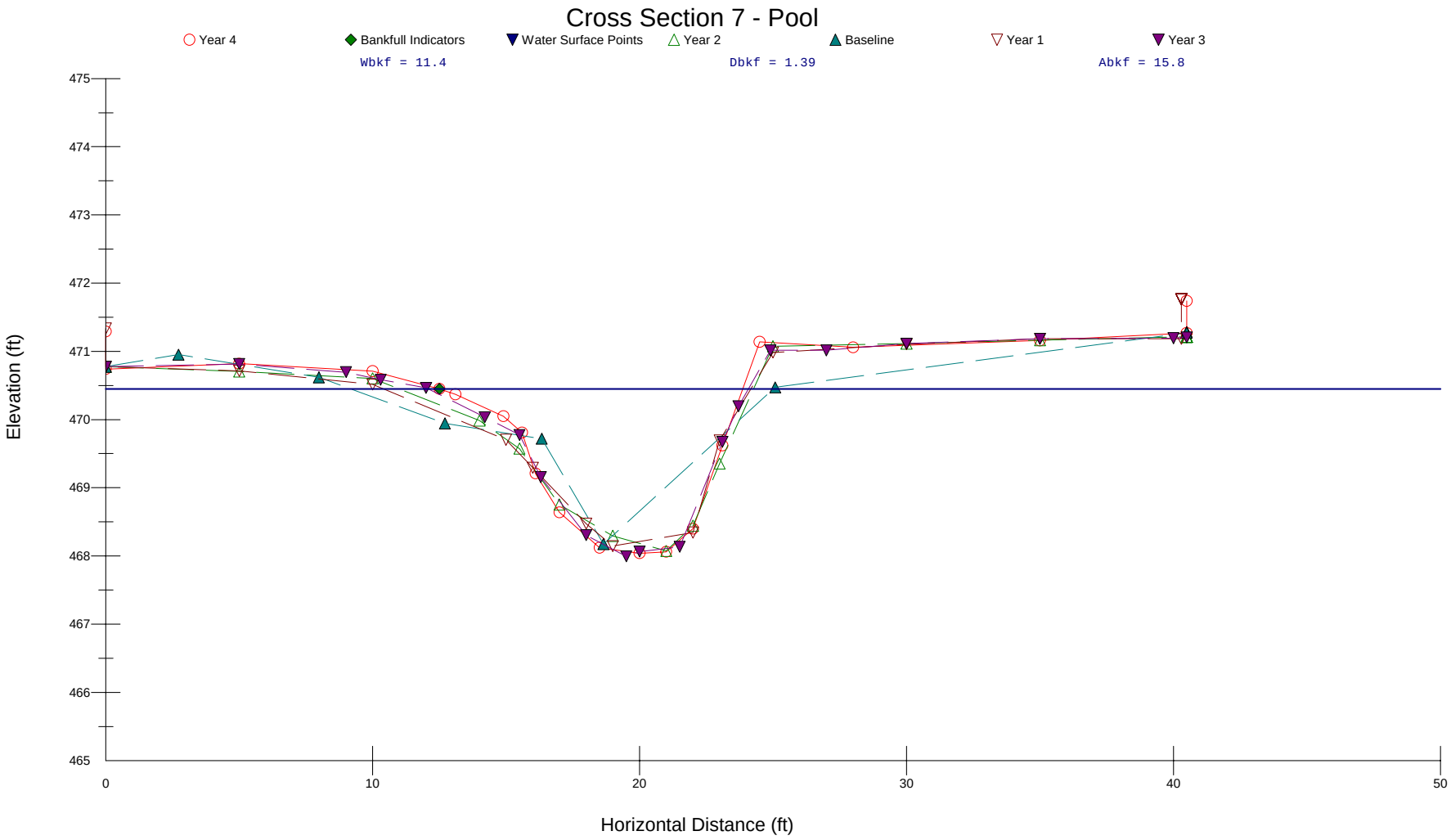

Cross Section 2 - Pool
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 9.3
Dbkf = .77
Abkf = 7.16
Elevation (ft)
450
449
448
447
446
445
444
443
442
441
440
0
10
20
30
40
50
Horizontal Distance (ft)

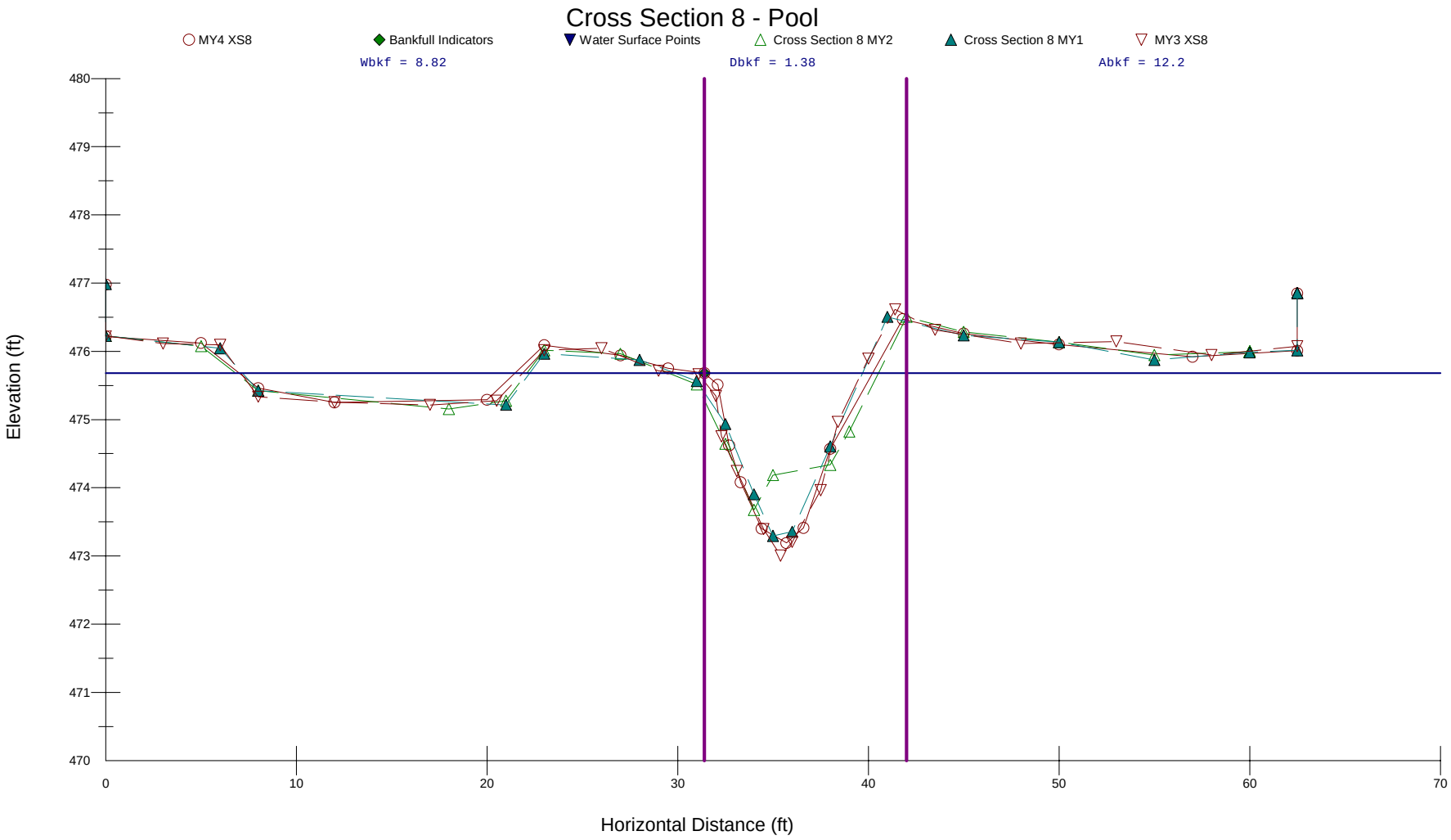

Cross Section 3 - Riffle
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 11.8
Dbkf = .62
Abkf = 7.25
Elevation (ft)
455
454
453
452
451
450
449
448
447
446
445
0
10
20
30
40
50
60
Horizontal Distance (ft)

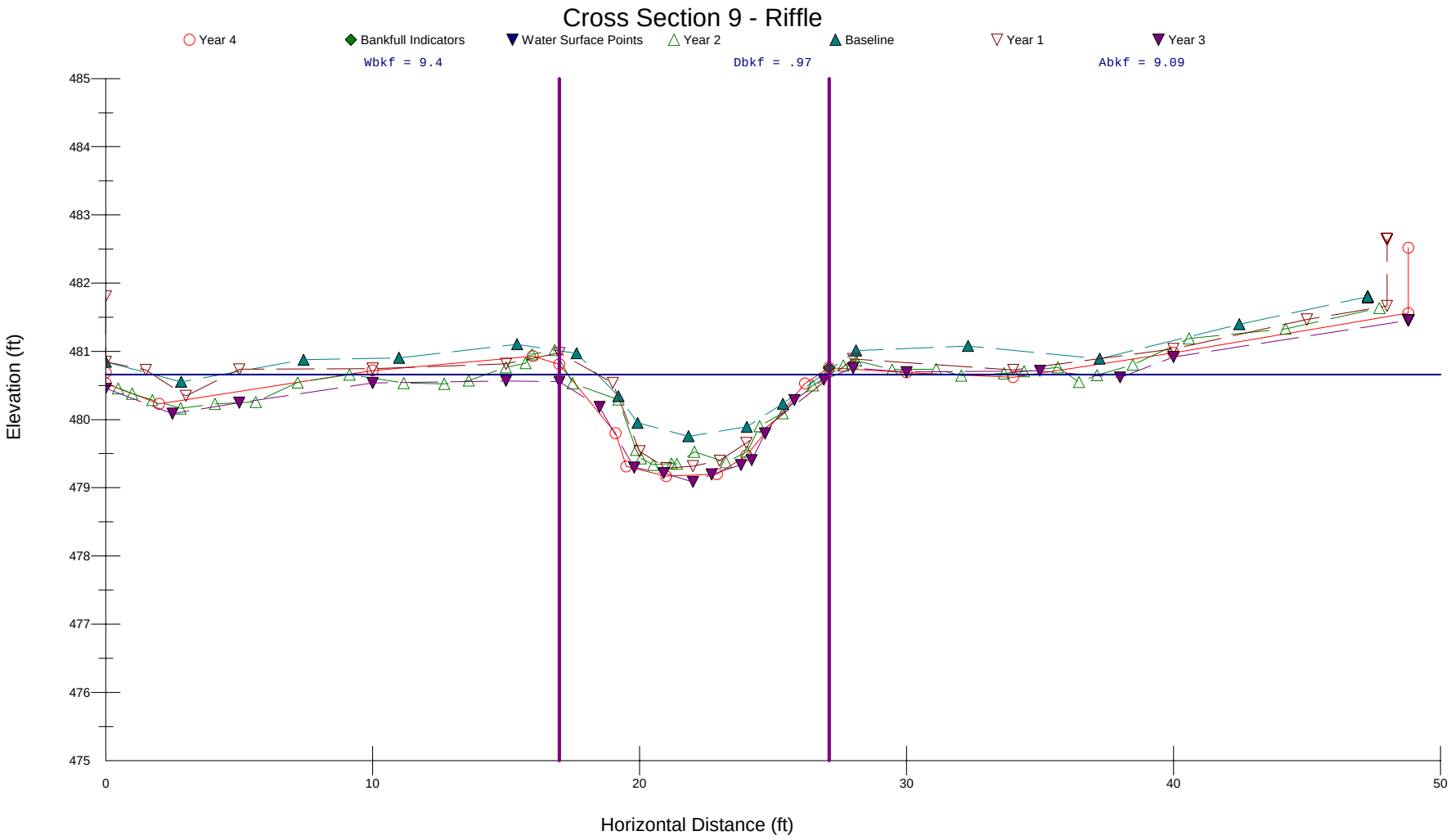

Cross Section 4 - Riffle
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 9.96
Dbkf = .84
Abkf = 8.41
Elevation (ft)
460
459
458
457
456
455
454
453
452
451
450
0
10
20
30
40
50
Horizontal Distance (ft)

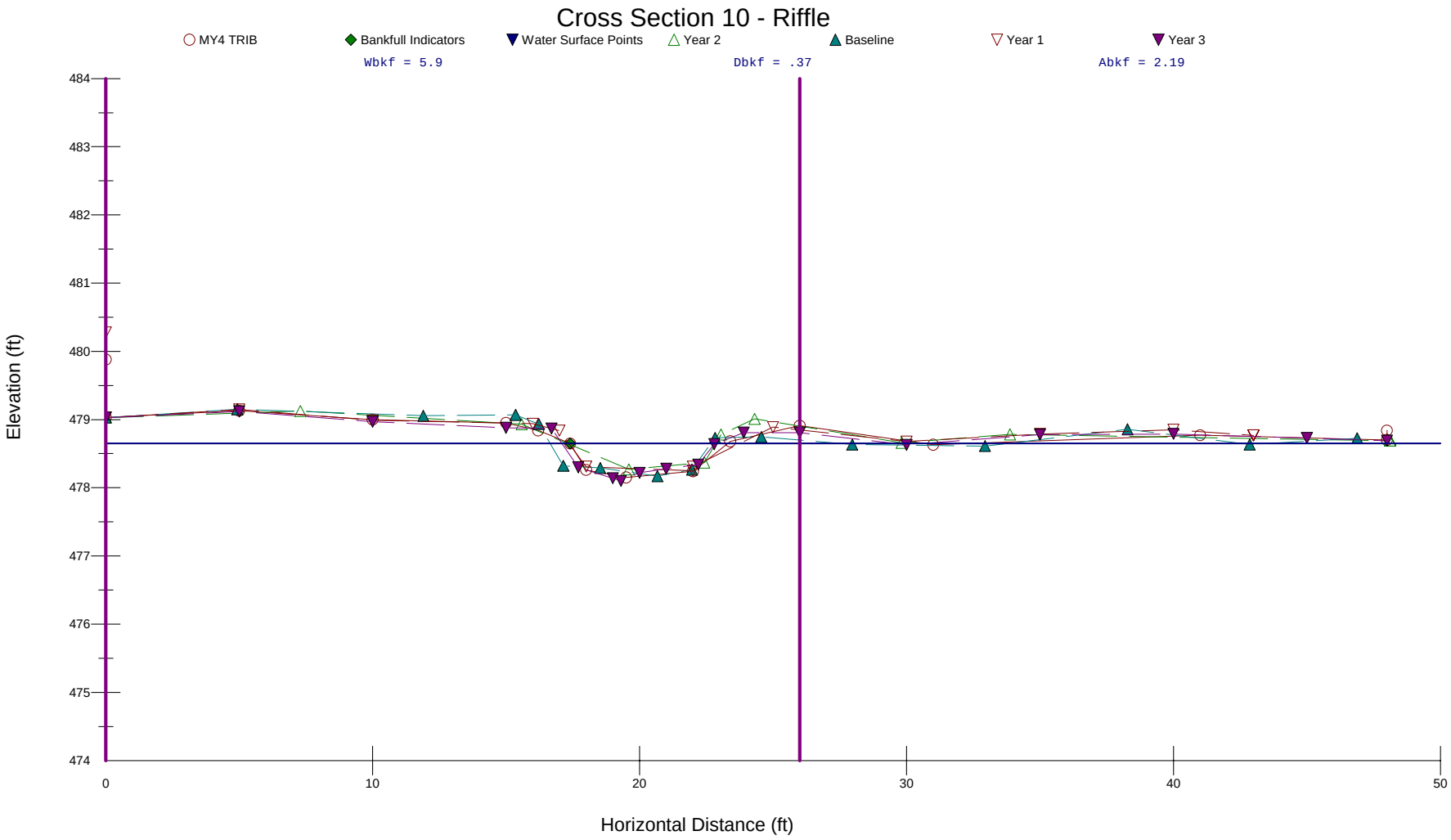

Cross Section 5 - Pool
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline/Year 1
Year 3
Wbkf = 8.91
Dbkf = 1.08
Abkf = 9.63
Elevation (ft)
462
461
460
459
458
457
456
455
454
453
452
0
10
20
30
40
50
60
Horizontal Distance (ft)


Cross Section 6 - Riffle
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 9.47
Dbkf = .75
Abkf = 7.12
Elevation (ft)
470
469
468
467
466
465
464
463
462
461
460
0
10
20
30
40
50
60
Horizontal Distance (ft)

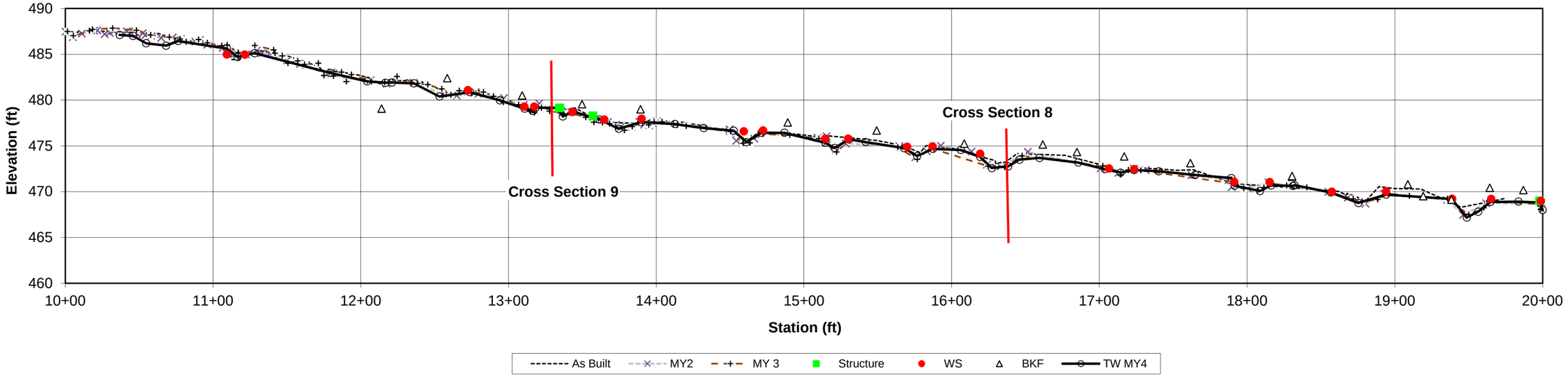

Cross Section 7 - Pool
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 11.4
Dbkf = 1.39
Abkf = 15.8
Elevation (ft)
475
474
473
472
471
470
469
468
467
466
465
0
10
20
30
40
50
Horizontal Distance (ft)


Cross Section 8 - Pool
MY4 XS8
Bankfull Indicators
Water Surface Points
Cross Section 8 MY2
Cross Section 8 MY1
MY3 XS8
Wbkf = 8.82
Dbkf = 1.38
Abkf = 12.2
Elevation (ft)
480
479
478
477
476
475
474
473
472
471
470
0
10
20
30
40
50
60
70
Horizontal Distance (ft)


Cross Section 9 - Riffle
Year 4
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 9.4
Dbkf = .97
Abkf = 9.09
Elevation (ft)
485
484
483
482
481
480
479
478
477
476
475
0
10
20
30
40
50
Horizontal Distance (ft)

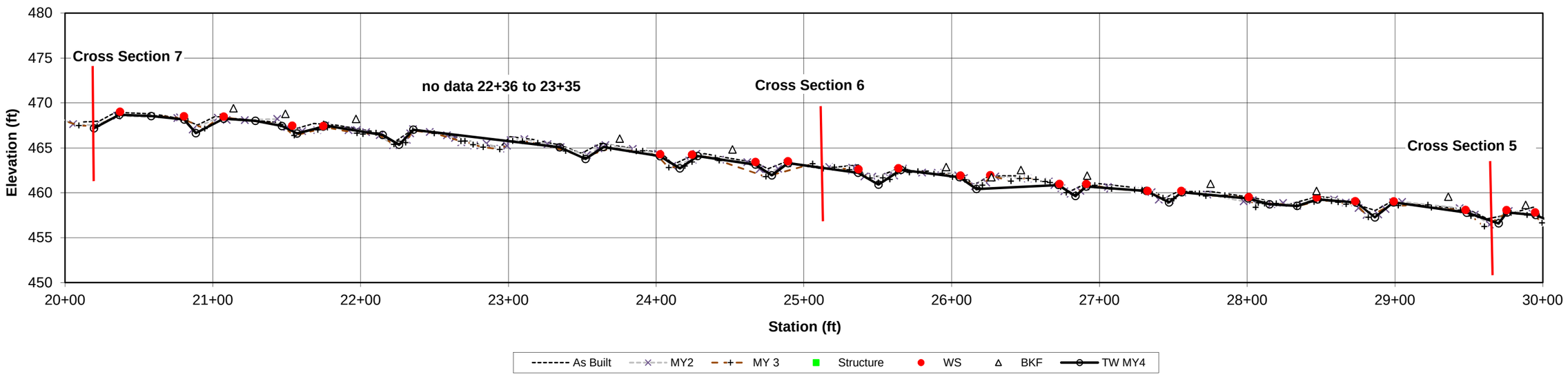

Cross Section 10 - Riffle
MY4 TRIB
Bankfull Indicators
Water Surface Points
Year 2
Baseline
Year 1
Year 3
Wbkf = 5.9
Dbkf = .37
Abkf = 2.19
Elevation (ft)
484
483
482
481
480
479
478
477
476
475
474
0
10
20
30
40
50
Horizontal Distance (ft)

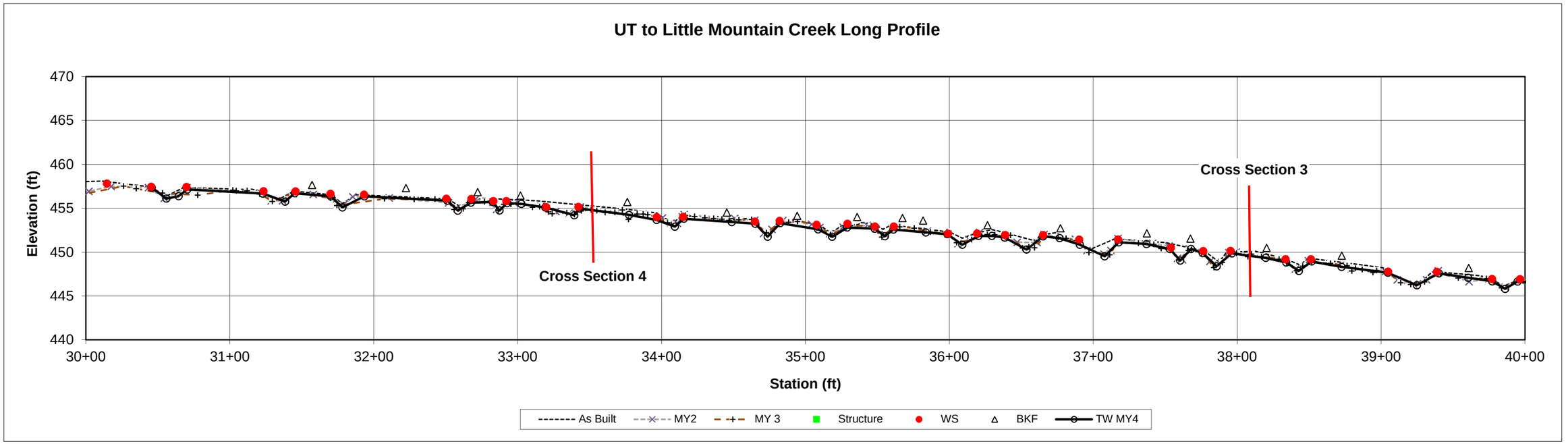
UT to Little Mountain Creek Long Profile

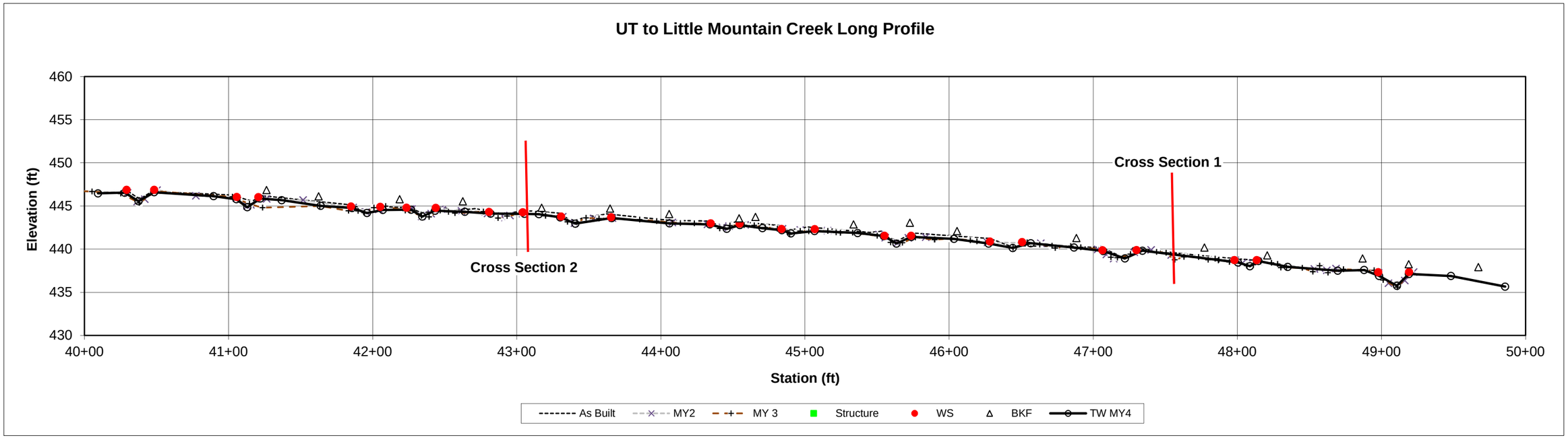


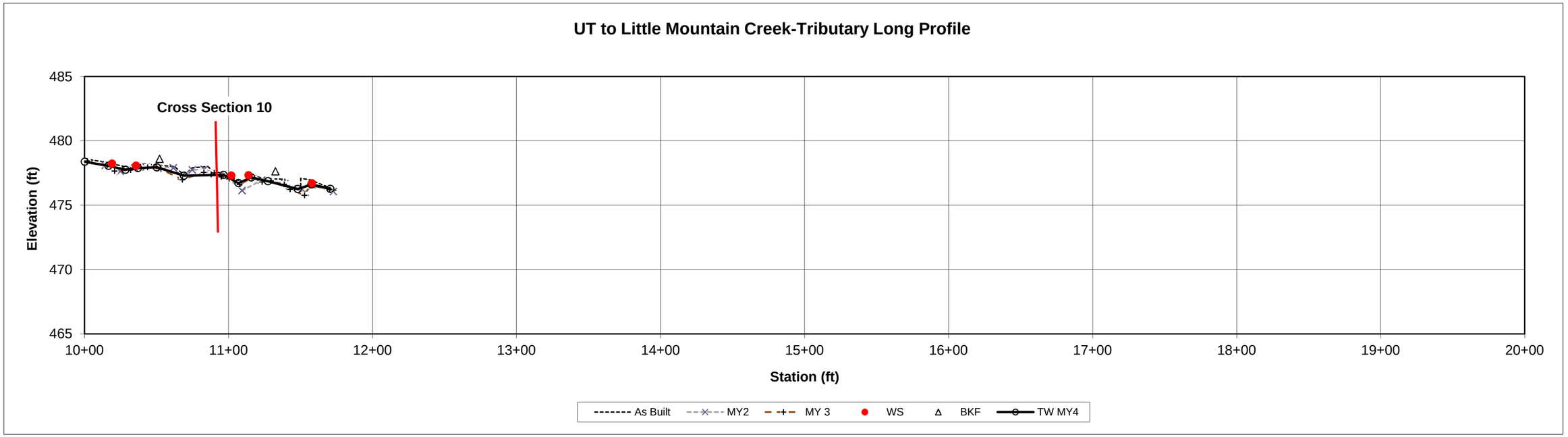
Cross Section 6

UT to Little Mountain Creek Long Profile




UT to Little Mountain Creek Long Profile
Elevation (ft)
470
465
460
455
450
445
440
30+00
31+00
32+00
33+00
34+00
35+00
36+00
37+00
38+00
39+00
40+00
Station (ft)
Cross Section 4
Cross Section 3
As Built
MY2
MY 3
Structure
WS
BKF
TW MY4


UT to Little Mountain Creek Long Profile
Elevation (ft)
460
455
450
445
440
435
430
40+00
41+00
42+00
43+00
44+00
45+00
46+00
47+00
48+00
49+00
50+00
Station (ft)
Cross Section 2
Cross Section 1
As Built
MY2
MY 3
Structure
WS
BKF
TW MY4

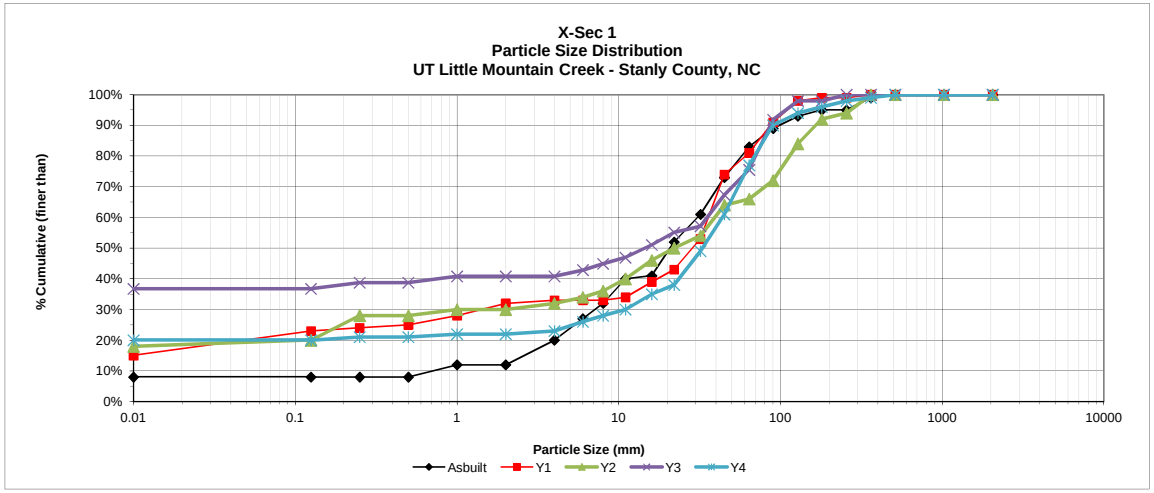

UT to Little Mountain Creek-Tributary Long Profile
Cross Section 10
Elevation (ft)
485
480
475
470
465
10+00
11+00
12+00
13+00
14+00
15+00
16+00
17+00
18+00
19+00
20+00
Station (ft)
As Built
MY2
MY 3
WS
BKF
TW MY4

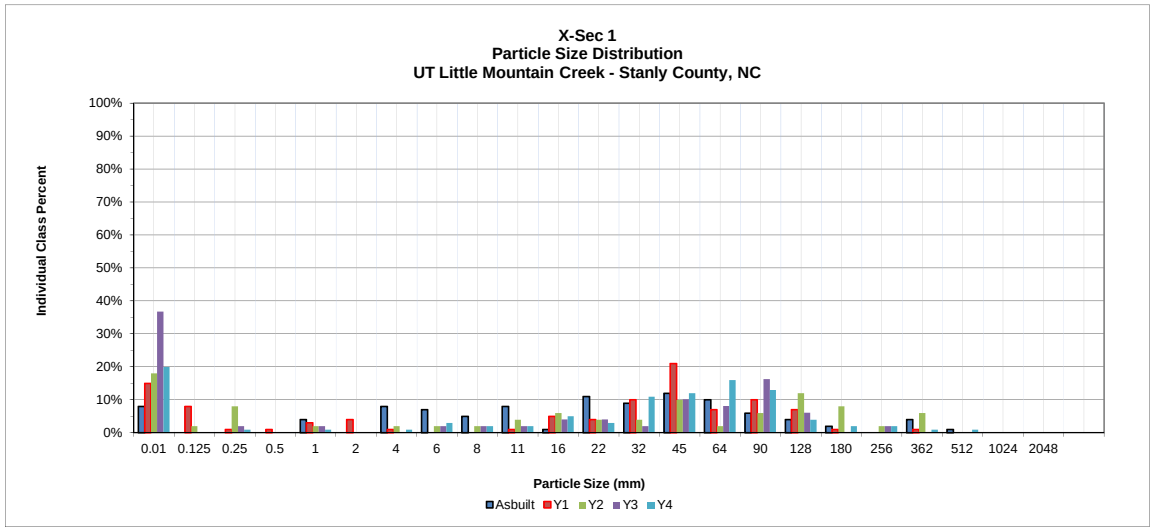
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 1
Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	20	20%	20%
S	Very Fine	.062 - .125	0	0%	20%
A	Fine	.125 - .25	1	1%	21%
N	Medium	.25 - .50	0	0%	21%
D	Coarse	.50 - 1.0	1	1%	22%
S	Very Coarse	1.0 - 2.0	0	0%	22%
	Very Fine	2.0 - 4.0	1	1%	23%
G	Fine	4.0 - 5.7	3	3%	26%
R	Fine	5.7 - 8.0	2	2%	28%
A	Medium	8.0 - 11.3	2	2%	30%
V	Medium	11.3 - 16.0	5	5%	35%
E	Coarse	16.0 - 22.6	3	3%	38%
L	Coarse	22.6 - 32.0	11	11%	49%
S	Very Coarse	32.0 - 45.0	12	12%	61%
	Very Coarse	45.0 - 64.0	16	16%	77%
C	Small	64 - 90	13	13%	90%
O	Small	90 - 128	4	4%	94%
B	Large	128 - 180	2	2%	96%
L	Large	180 - 256	2	2%	98%
B	Small	256 - 362	1	1%	99%
L	Small	362 - 512	1	1%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			100	100%	

Summary Data	
D50	33.08
D84	78
D95	154



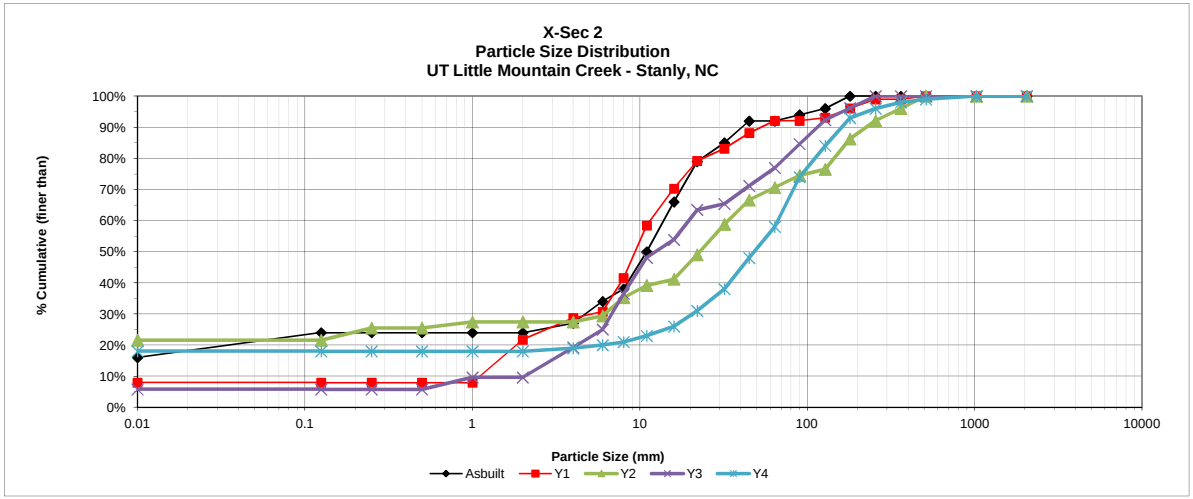


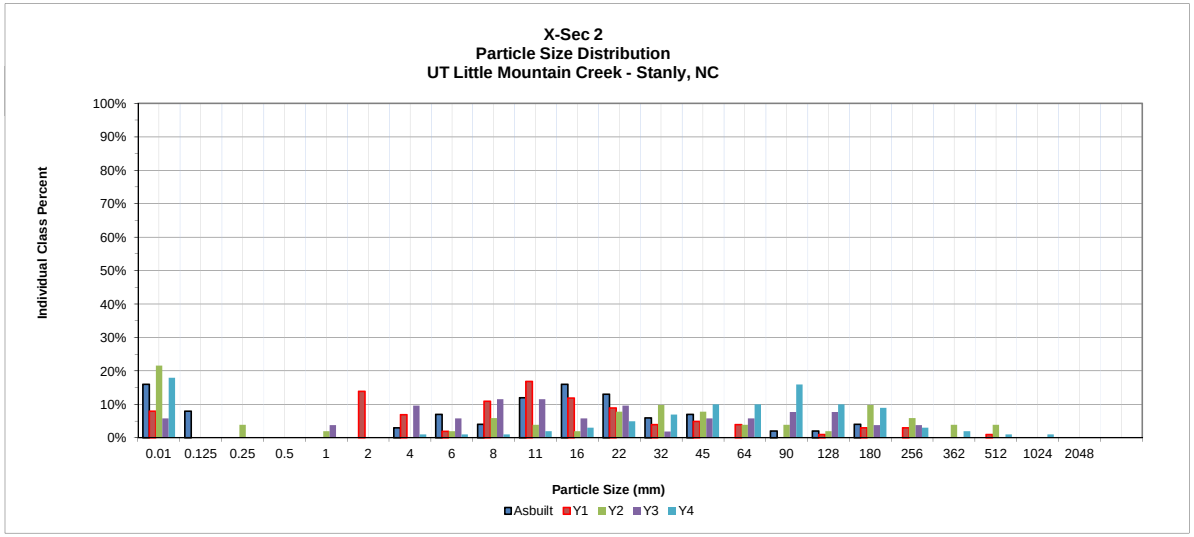
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 2
Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	18	18%	18%
S	Very Fine	.062 - .125	0	0%	18%
A	Fine	.125 - .25	0	0%	18%
N	Medium	.25 - .50	0	0%	18%
D	Coarse	.50 - 1.0	0	0%	18%
S	Very Coarse	1.0 - 2.0	0	0%	18%
	Very Fine	2.0 - 4.0	1	1%	19%
G	Fine	4.0 - 5.7	1	1%	20%
R	Fine	5.7 - 8.0	1	1%	21%
A	Medium	8.0 - 11.3	2	2%	23%
V	Medium	11.3 - 16.0	3	3%	26%
E	Coarse	16.0 - 22.6	5	5%	31%
L	Coarse	22.6 - 32.0	7	7%	38%
S	Very Coarse	32.0 - 45.0	10	10%	48%
	Very Coarse	45.0 - 64.0	10	10%	58%
C	Small	64 - 90	16	16%	74%
O	Small	90 - 128	10	10%	84%
B	Large	128 - 180	9	9%	93%
L	Large	180 - 256	3	3%	96%
B	Small	256 - 362	2	2%	98%
L	Small	362 - 512	1	1%	99%
D	Medium	512 - 1024	1	1%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			100	100%	

Summary Data	
D50	48.8
D84	128
D95	130



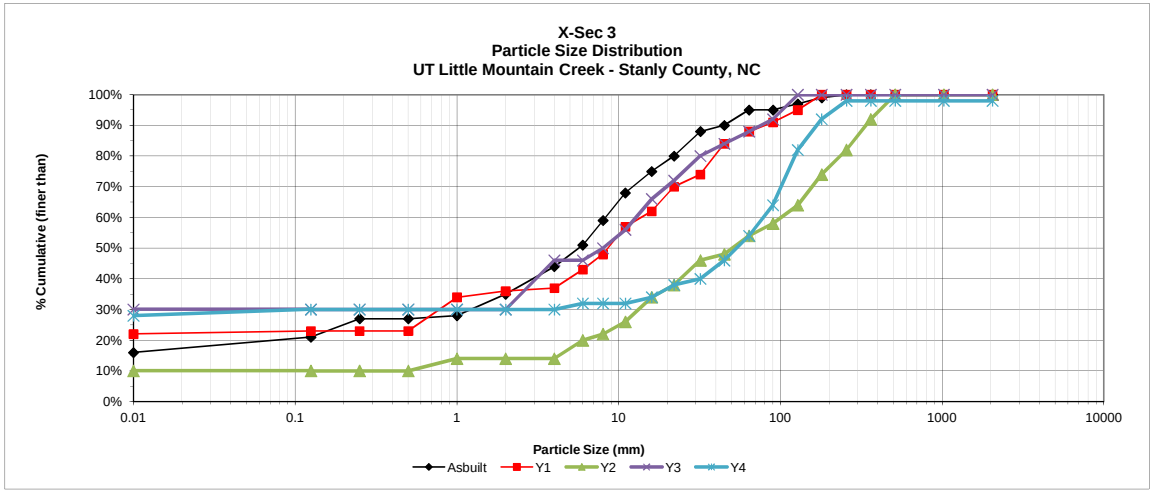


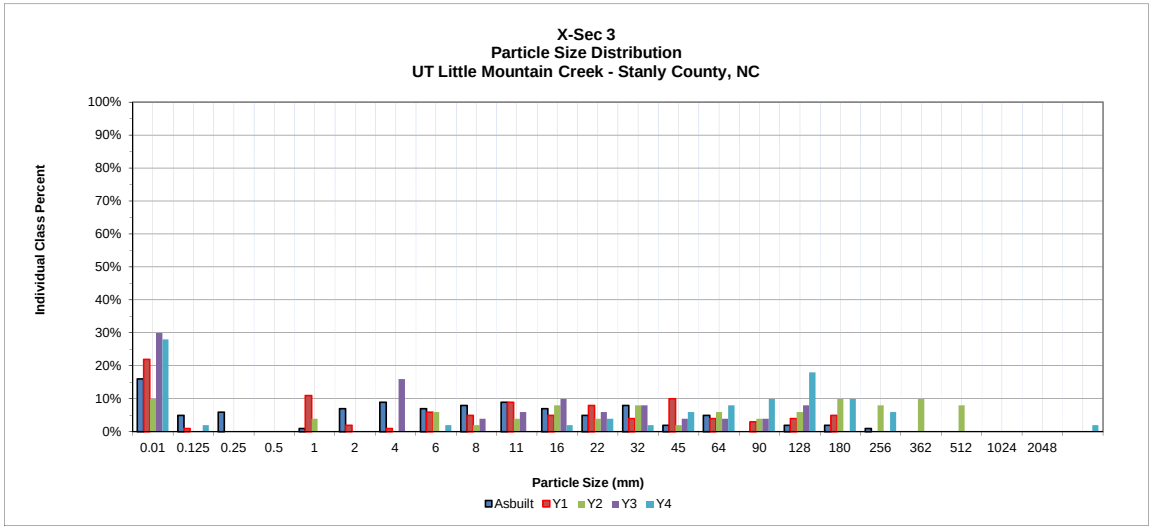
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 3
Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	14	28%	28%
S	Very Fine	.062 - .125	1	2%	30%
A	Fine	.125 - .25	0	0%	30%
N	Medium	.25 - .50	0	0%	30%
D	Coarse	.50 - 1.0	0	0%	30%
S	Very Coarse	1.0 - 2.0	0	0%	30%
	Very Fine	2.0 - 4.0	0	0%	30%
G	Fine	4.0 - 5.7	1	2%	32%
R	Fine	5.7 - 8.0	0	0%	32%
A	Medium	8.0 - 11.3	0	0%	32%
V	Medium	11.3 - 16.0	1	2%	34%
E	Coarse	16.0 - 22.6	2	4%	38%
L	Coarse	22.6 - 32.0	1	2%	40%
S	Very Coarse	32.0 - 45.0	3	6%	46%
	Very Coarse	45.0 - 64.0	4	8%	54%
C	Small	64 - 90	5	10%	64%
O	Small	90 - 128	9	18%	82%
B	Large	128 - 180	5	10%	92%
L	Large	180 - 256	3	6%	98%
B	Small	256 - 362	0	0%	98%
L	Small	362 - 512	0	0%	98%
D	Medium	512 - 1024	0	0%	98%
R	Lrg- Very Lrg	1024 - 2048	0	0%	98%
BDRK	Bedrock		1	2%	100%
Totals			50	100%	

Summary Data	
D50	54.5
D84	138
D95	218



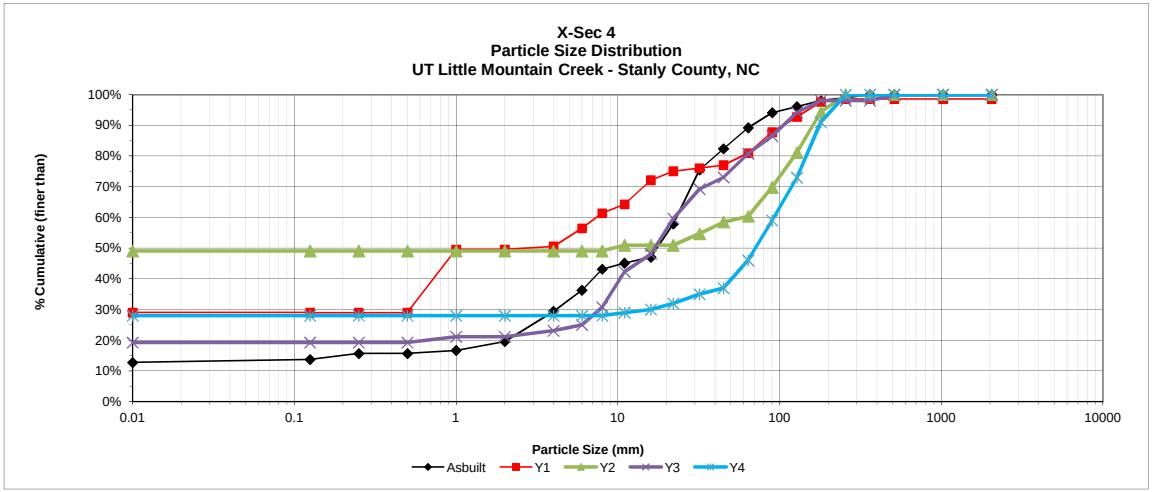


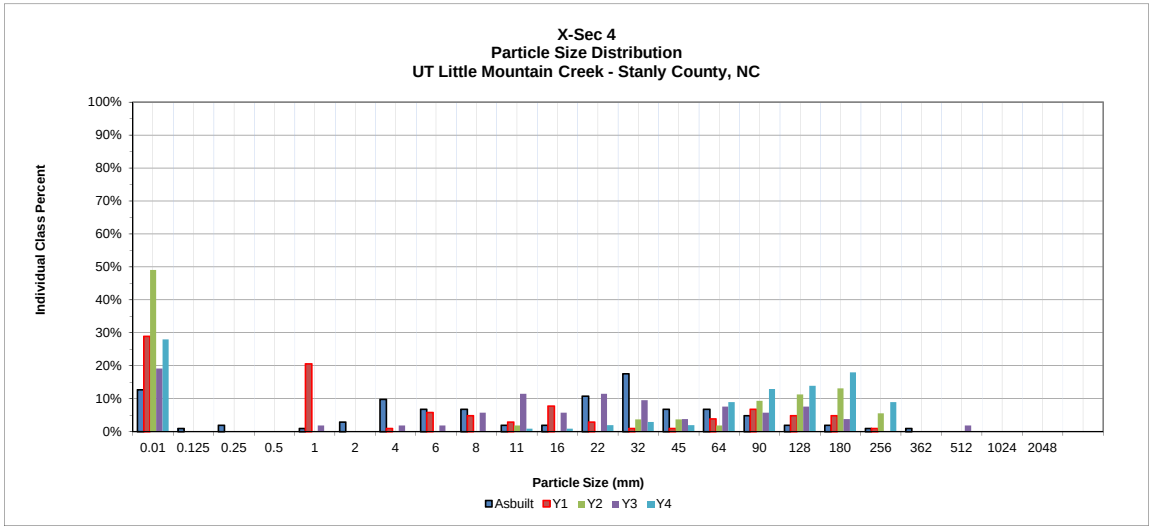
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 4
Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	28	28%	28%
S	Very Fine	.062 - .125	0	0%	28%
A	Fine	.125 - .25	0	0%	28%
N	Medium	.25 - .50	0	0%	28%
D	Coarse	.50 - 1.0	0	0%	28%
S	Very Coarse	1.0 - 2.0	0	0%	28%
	Very Fine	2.0 - 4.0	0	0%	28%
G	Fine	4.0 - 5.7	0	0%	28%
R	Fine	5.7 - 8.0	0	0%	28%
A	Medium	8.0 - 11.3	1	1%	29%
V	Medium	11.3 - 16.0	1	1%	30%
E	Coarse	16.0 - 22.6	2	2%	32%
L	Coarse	22.6 - 32.0	3	3%	35%
S	Very Coarse	32.0 - 45.0	2	2%	37%
	Very Coarse	45.0 - 64.0	9	9%	46%
C	Small	64 - 90	13	13%	59%
O	Small	90 - 128	14	14%	73%
B	Large	128 - 180	18	18%	91%
L	Large	180 - 256	9	9%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			100	100%	

Summary Data	
D50	72
D84	159
D95	213



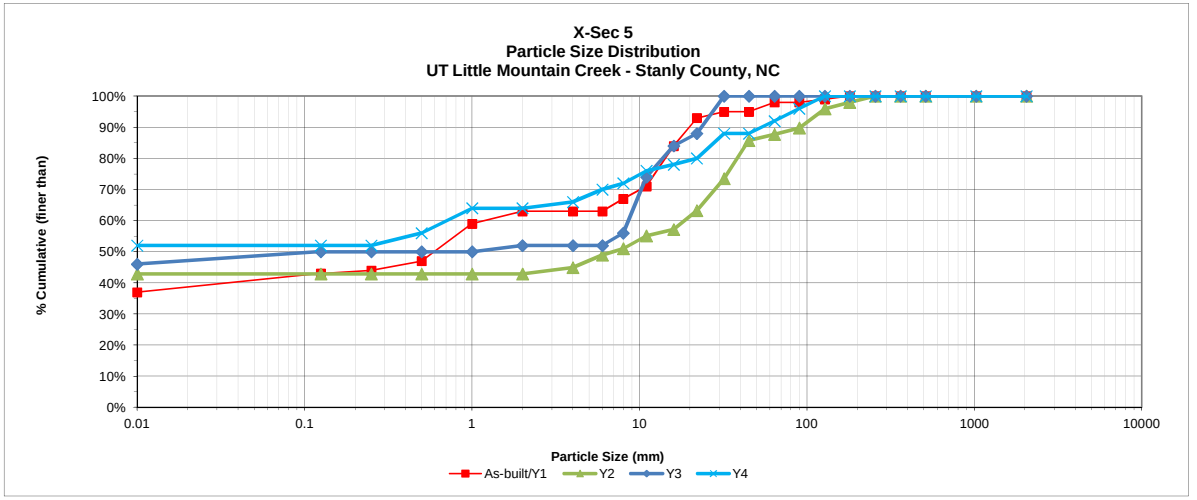


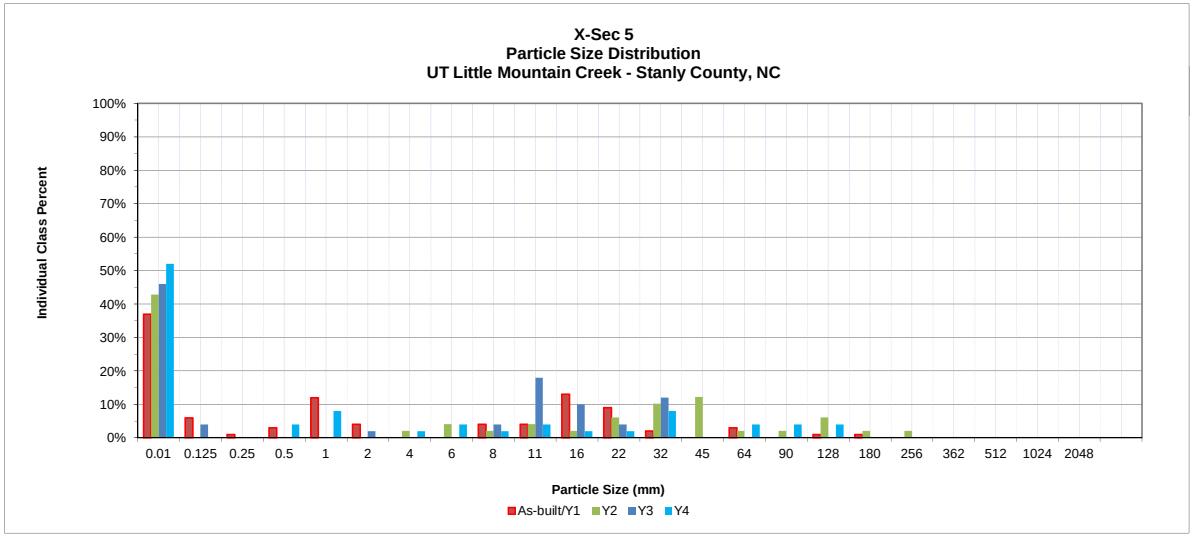
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 5
Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	26	52%	52%
S	Very Fine	.062 - .125	0	0%	52%
A	Fine	.125 - .25	0	0%	52%
N	Medium	.25 - .50	2	4%	56%
D	Coarse	.50 - 1.0	4	8%	64%
S	Very Coarse	1.0 - 2.0	0	0%	64%
	Very Fine	2.0 - 4.0	1	2%	66%
G	Fine	4.0 - 5.7	2	4%	70%
R	Fine	5.7 - 8.0	1	2%	72%
A	Medium	8.0 - 11.3	2	4%	76%
V	Medium	11.3 - 16.0	1	2%	78%
E	Coarse	16.0 - 22.6	1	2%	80%
L	Coarse	22.6 - 32.0	4	8%	88%
S	Very Coarse	32.0 - 45.0	0	0%	88%
	Very Coarse	45.0 - 64.0	2	4%	92%
C	Small	64 - 90	2	4%	96%
O	Small	90 - 128	2	4%	100%
B	Large	128 - 180	0	0%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			50	100%	

Summary Data	
D50	0.06
D84	27
D95	83



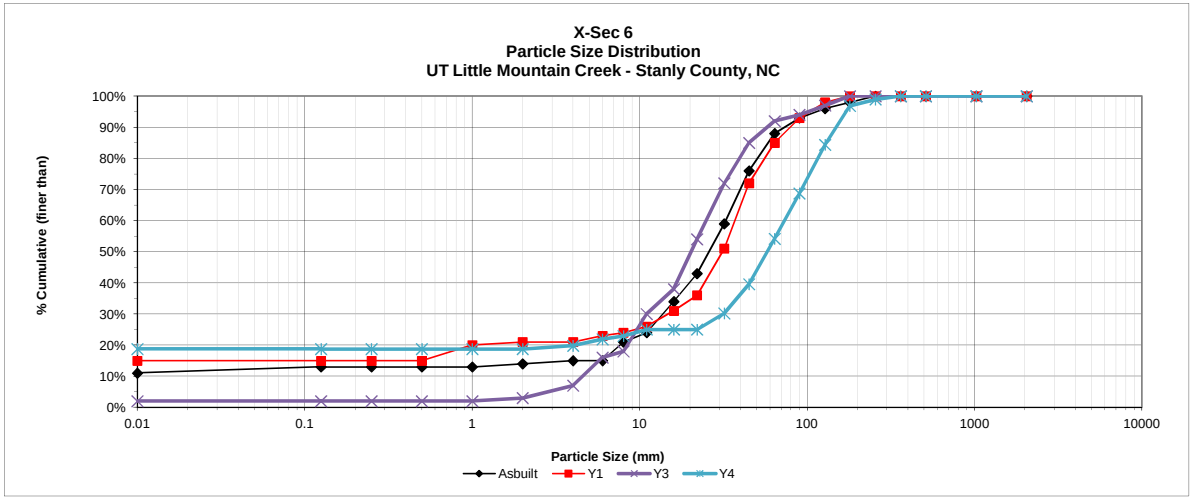


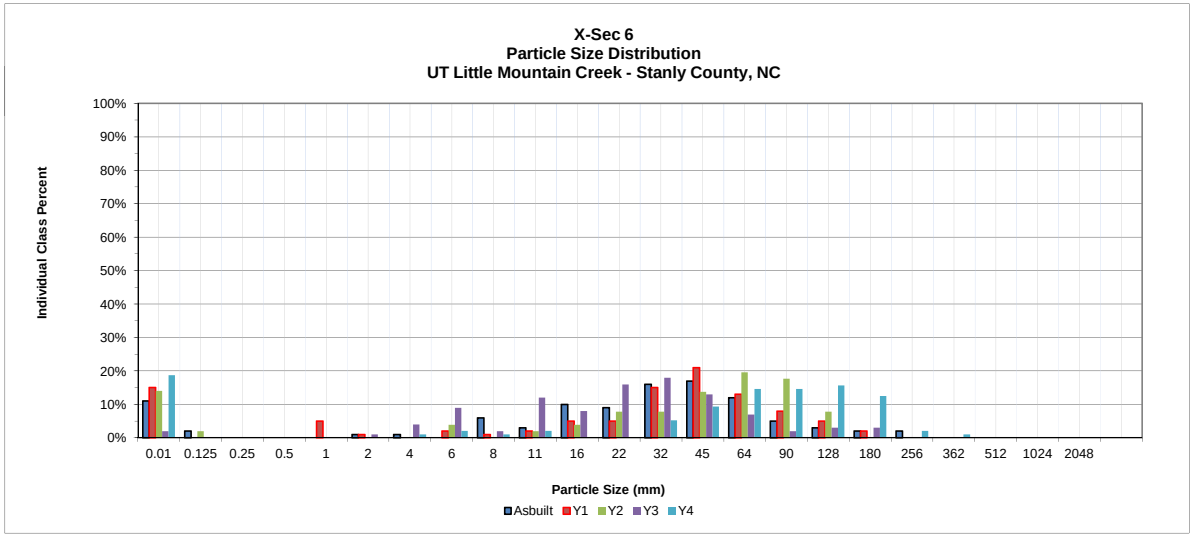
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 6
Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	18	19%	19%
S	Very Fine	.062 - .125	0	0%	19%
A	Fine	.125 - .25	0	0%	19%
N	Medium	.25 - .50	0	0%	19%
D	Coarse	.50 - 1.0	0	0%	19%
S	Very Coarse	1.0 - 2.0	0	0%	19%
	Very Fine	2.0 - 4.0	1	1%	20%
G	Fine	4.0 - 5.7	2	2%	22%
R	Fine	5.7 - 8.0	1	1%	23%
A	Medium	8.0 - 11.3	2	2%	25%
V	Medium	11.3 - 16.0	0	0%	25%
E	Coarse	16.0 - 22.6	0	0%	25%
L	Coarse	22.6 - 32.0	5	5%	30%
S	Very Coarse	32.0 - 45.0	9	9%	40%
	Very Coarse	45.0 - 64.0	14	15%	54%
C	Small	64 - 90	14	15%	69%
O	Small	90 - 128	15	16%	84%
B	Large	128 - 180	12	13%	97%
L	Large	180 - 256	2	2%	99%
B	Small	256 - 362	1	1%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			96	100%	

Summary Data	
D50	58.57
D84	127
D95	172



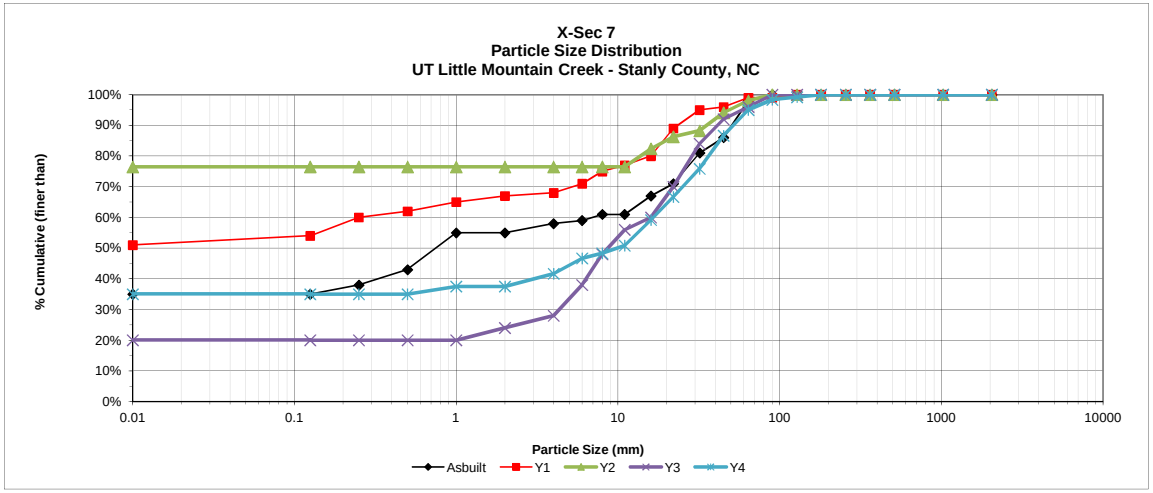


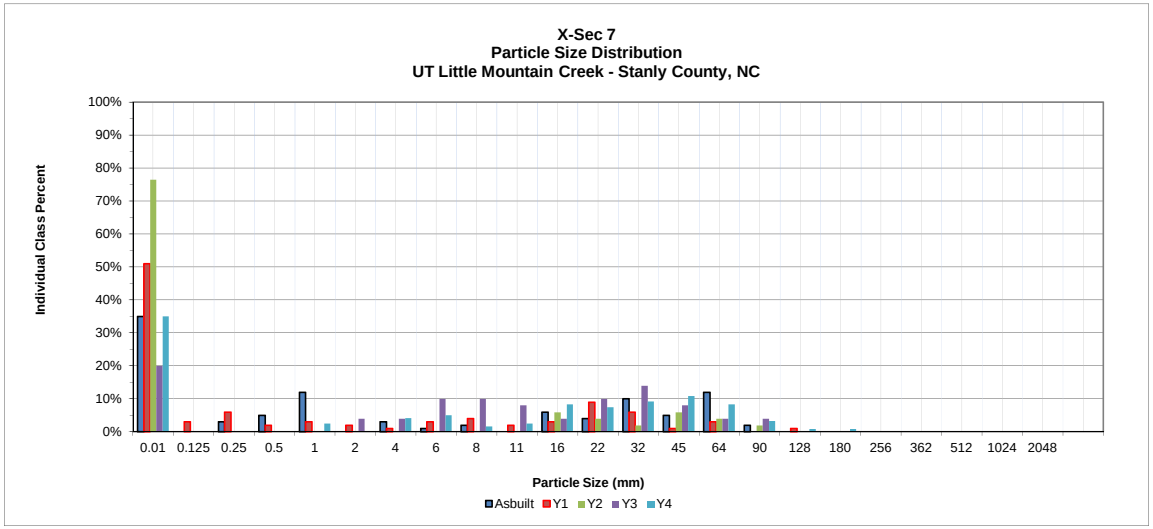
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 7
Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	42	35%	35%
S	Very Fine	.062 - .125	0	0%	35%
A	Fine	.125 - .25	0	0%	35%
N	Medium	.25 - .50	0	0%	35%
D	Coarse	.50 - 1.0	3	3%	38%
S	Very Coarse	1.0 - 2.0	0	0%	38%
	Very Fine	2.0 - 4.0	5	4%	42%
G	Fine	4.0 - 5.7	6	5%	47%
R	Fine	5.7 - 8.0	2	2%	48%
A	Medium	8.0 - 11.3	3	3%	51%
V	Medium	11.3 - 16.0	10	8%	59%
E	Coarse	16.0 - 22.6	9	8%	67%
L	Coarse	22.6 - 32.0	11	9%	76%
S	Very Coarse	32.0 - 45.0	13	11%	87%
	Very Coarse	45.0 - 64.0	10	8%	95%
C	Small	64 - 90	4	3%	98%
O	Small	90 - 128	1	1%	99%
B	Large	128 - 180	1	1%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			120	100%	

Summary Data	
D50	10.2
D84	42
D95	64



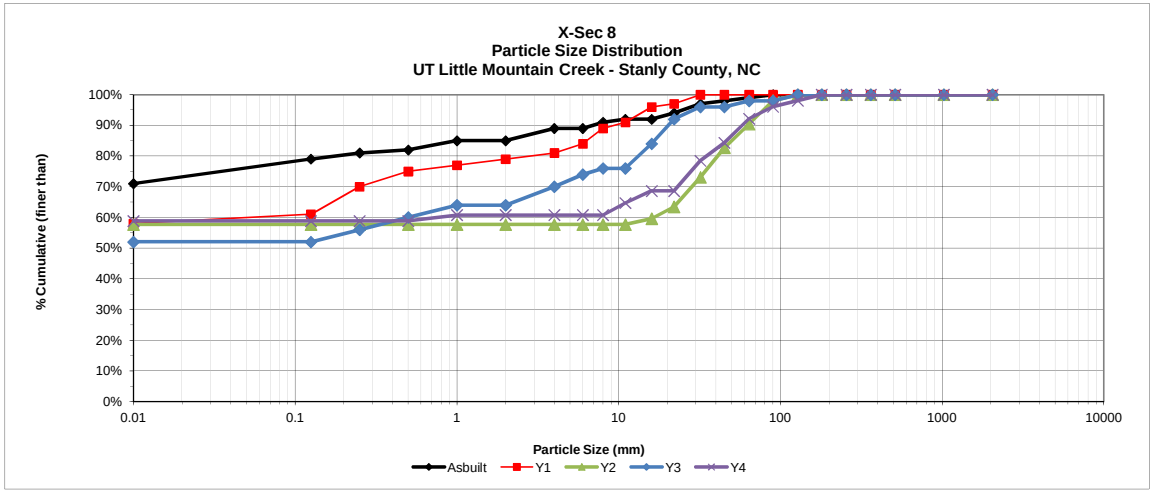


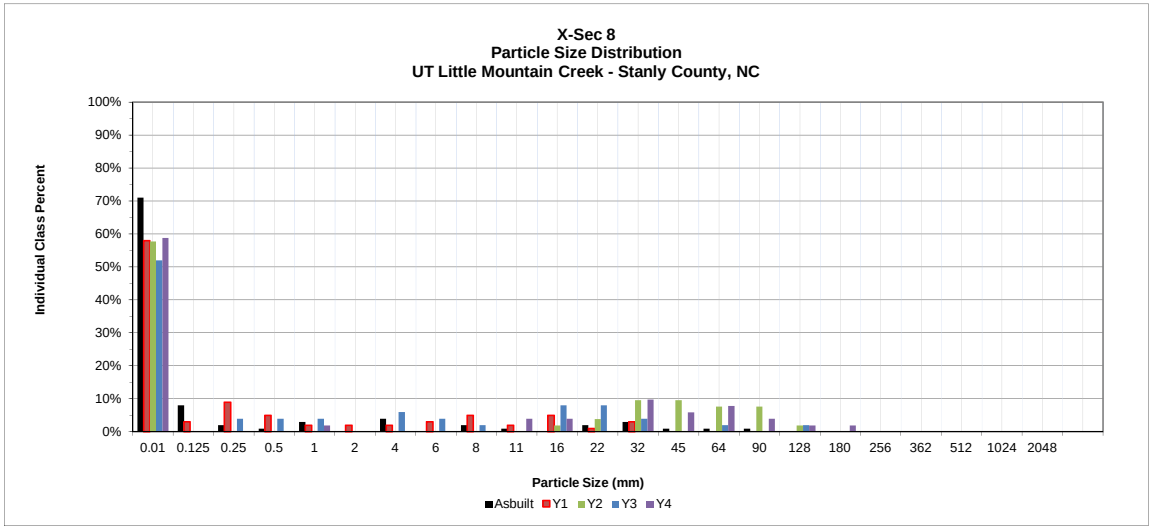
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 8
Feature: Pool

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	30	59%	59%
S	Very Fine	.062 - .125	0	0%	59%
A	Fine	.125 - .25	0	0%	59%
N	Medium	.25 - .50	0	0%	59%
D	Coarse	.50 - 1.0	1	2%	61%
S	Very Coarse	1.0 - 2.0	0	0%	61%
	Very Fine	2.0 - 4.0	0	0%	61%
G	Fine	4.0 - 5.7	0	0%	61%
R	Fine	5.7 - 8.0	0	0%	61%
A	Medium	8.0 - 11.3	2	4%	65%
V	Medium	11.3 - 16.0	2	4%	69%
E	Coarse	16.0 - 22.6	0	0%	69%
L	Coarse	22.6 - 32.0	5	10%	78%
S	Very Coarse	32.0 - 45.0	3	6%	84%
	Very Coarse	45.0 - 64.0	4	8%	92%
C	Small	64 - 90	2	4%	96%
O	Small	90 - 128	1	2%	98%
B	Large	128 - 180	1	2%	100%
L	Large	180 - 256	0	0%	100%
B	Small	256 - 362	0	0%	100%
L	Small	362 - 512	0	0%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			51	100%	

Summary Data	
D50	0.05
D84	43
D95	81



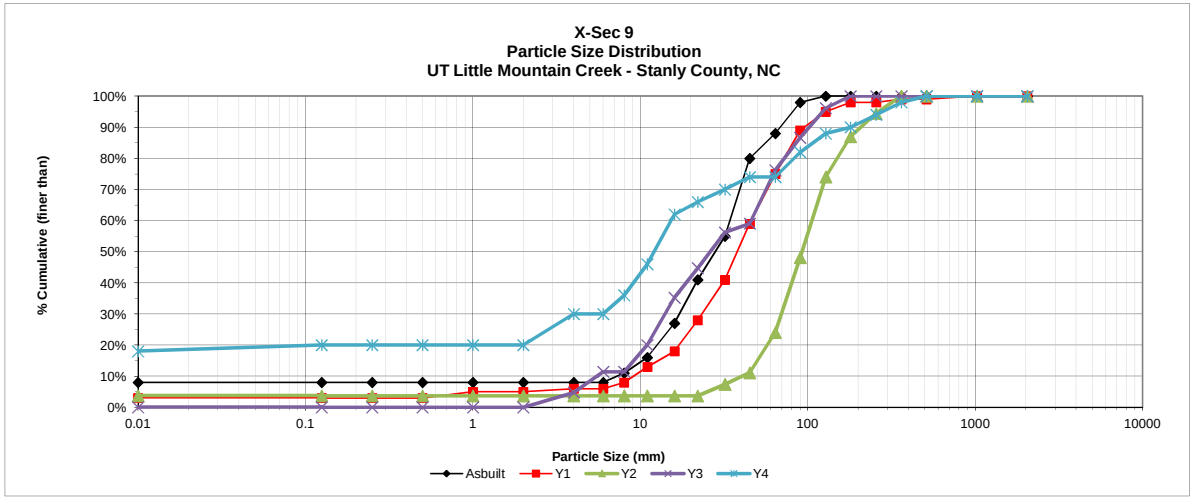


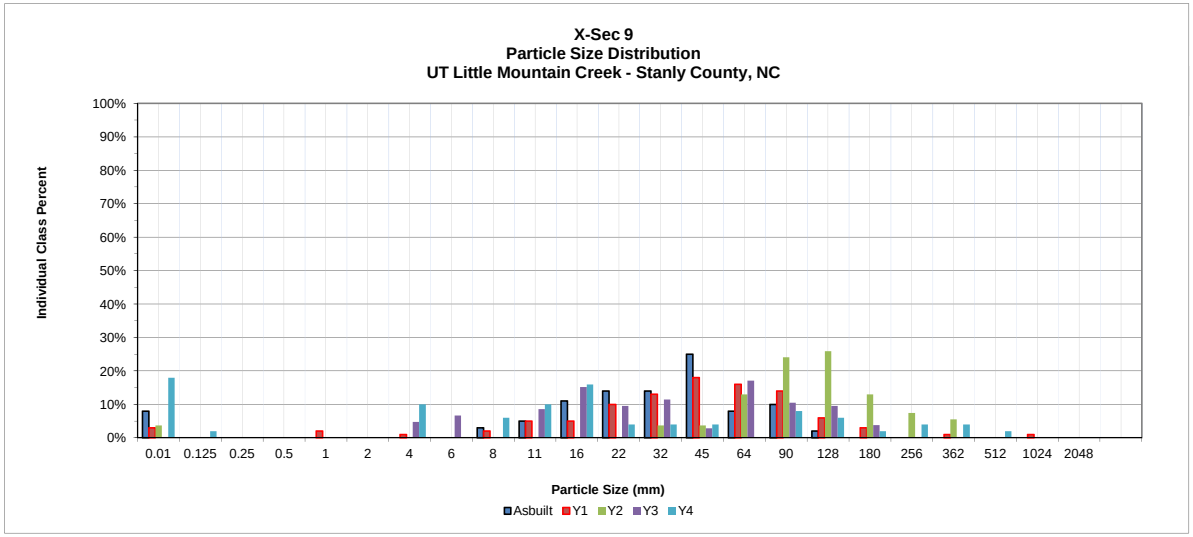
Cross - Section Pebble Count

Project Name : Badin Inn
Cross Section: 9
Feature: Riffle

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	9	18%	18%
S	Very Fine	.062 - .125	1	2%	20%
A	Fine	.125 - .25	0	0%	20%
N	Medium	.25 - .50	0	0%	20%
D	Coarse	.50 - 1.0	0	0%	20%
S	Very Coarse	1.0 - 2.0	0	0%	20%
	Very Fine	2.0 - 4.0	5	10%	30%
G	Fine	4.0 - 5.7	0	0%	30%
R	Fine	5.7 - 8.0	3	6%	36%
A	Medium	8.0 - 11.3	5	10%	46%
V	Medium	11.3 - 16.0	8	16%	62%
E	Coarse	16.0 - 22.6	2	4%	66%
L	Coarse	22.6 - 32.0	2	4%	70%
S	Very Coarse	32.0 - 45.0	2	4%	74%
	Very Coarse	45.0 - 64.0	0	0%	74%
C	Small	64 - 90	4	8%	82%
O	Small	90 - 128	3	6%	88%
B	Large	128 - 180	1	2%	90%
L	Large	180 - 256	2	4%	94%
B	Small	256 - 362	2	4%	98%
L	Small	362 - 512	1	2%	100%
D	Medium	512 - 1024	0	0%	100%
R	Lrg- Very Lrg	1024 - 2048	0	0%	100%
BDRK	Bedrock		0	0%	100%
Totals			50	100%	

Summary Data	
D50	12.48
D84	103
D95	282



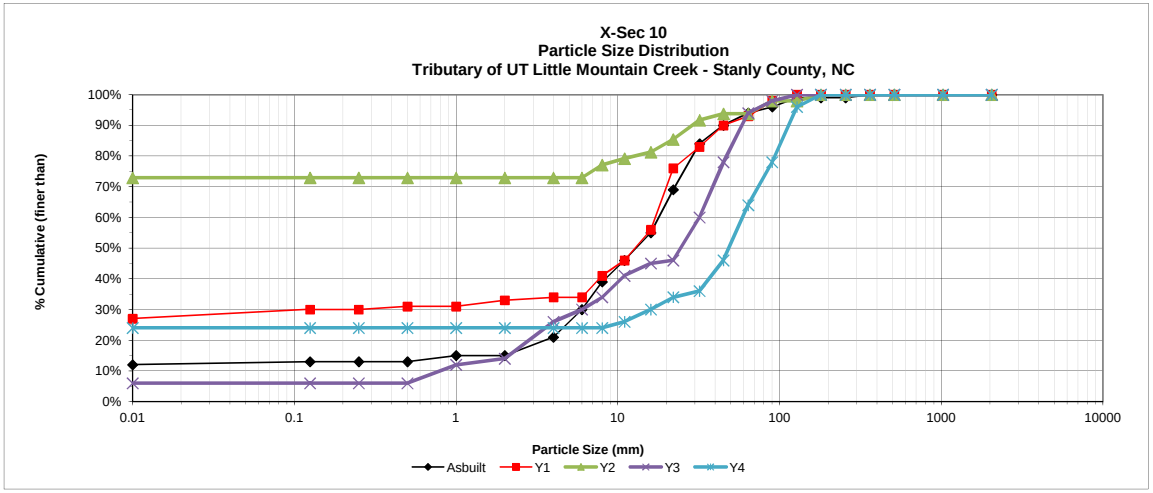


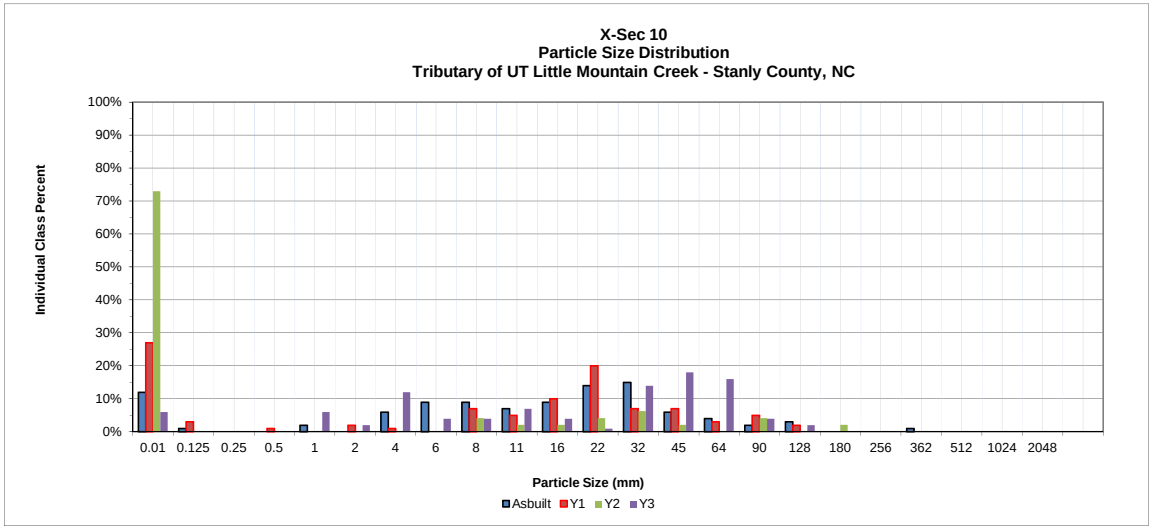
Cross - Section Pebble Count

Project Name : **Badin Inn**
Cross Section: **Tributary**
Feature: **Riffle**

Description	Particle	Millimeter	Total #	Item %	Cum %
S/C	Silt/Clay	< 0.062	22	44%	44%
S	Very Fine	.062 - .125	0	0%	44%
A	Fine	.125 - .25	0	0%	44%
N	Medium	.25 - .50	0	0%	44%
D	Coarse	.50 - 1.0	0	0%	44%
S	Very Coarse	1.0 - 2.0	0	0%	44%
	Very Fine	2.0 - 4.0	0	0%	44%
G	Fine	4.0 - 5.7	0	0%	44%
R	Fine	5.7 - 8.0	0	0%	44%
A	Medium	8.0 - 11.3	0	0%	44%
V	Medium	11.3 - 16.0	4	8%	52%
E	Coarse	16.0 - 22.6	1	2%	54%
L	Coarse	22.6 - 32.0	0	0%	54%
S	Very Coarse	32.0 - 45.0	4	8%	62%
	Very Coarse	45.0 - 64.0	8	16%	78%
C	Small	64 - 90	6	12%	90%
O	Small	90 - 128	8	16%	106%
B	Large	128 - 180	2	4%	110%
L	Large	180 - 256	0	0%	110%
B	Small	256 - 362	0	0%	110%
L	Small	362 - 512	0	0%	110%
D	Medium	512 - 1024	0	0%	110%
R	Lrg- Very Lrg	1024 - 2048	0	0%	110%
BDRK	Bedrock		0	0%	110%
Totals			55	110%	

Summary Data	
D50	33.6
D84	96
D95	124





APPENDIX C

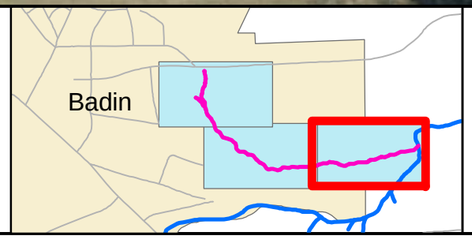
1. Integrated Plan View

N

0 100 200 Feet

Legend

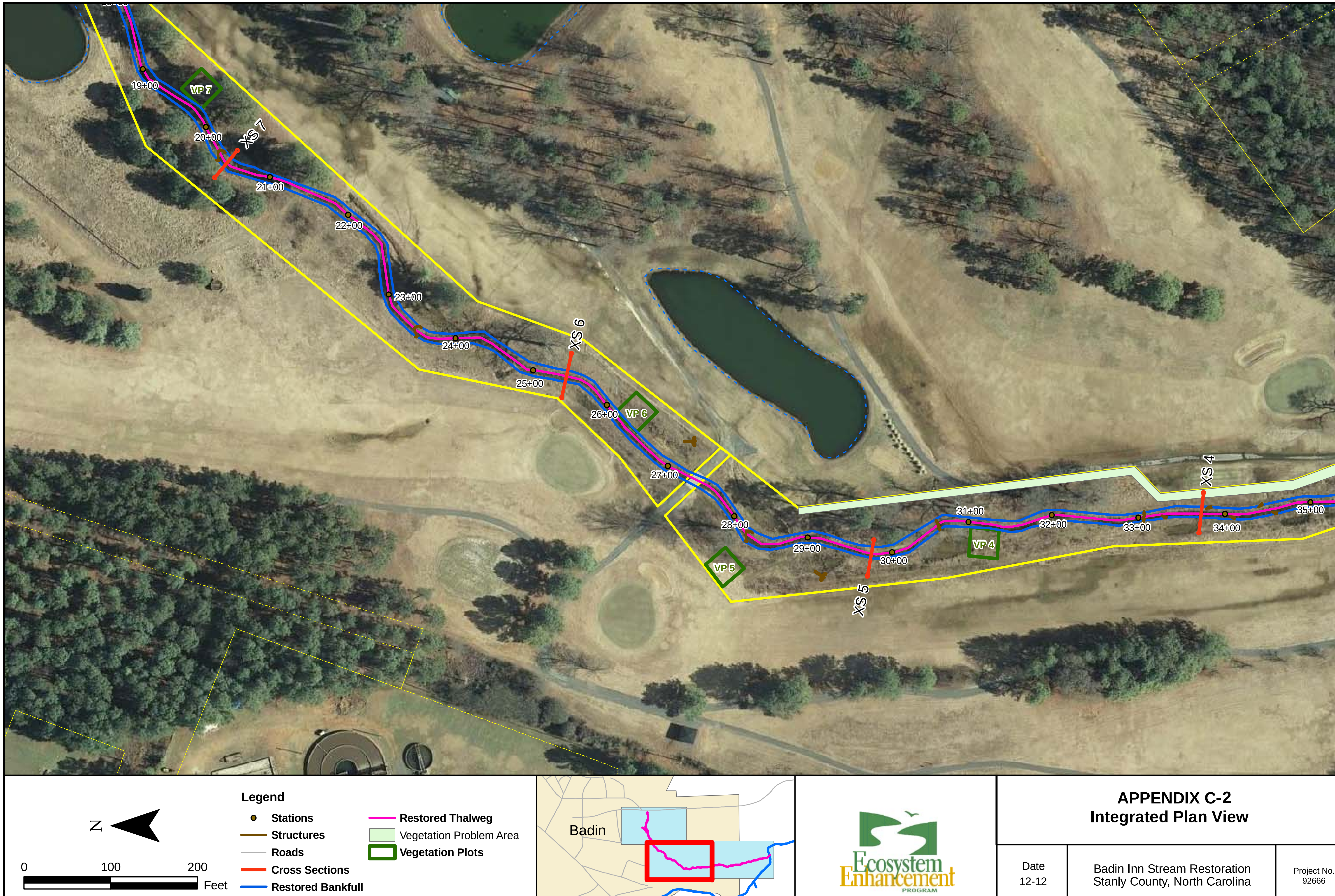
- Stations
- Structures
- Roads
- Cross Sections
- Restored Bankfull
- Restored Thalweg
- Vegetation Problem Area
- Vegetation Plots



Ecosystem Enhancement Program

APPENDIX C-1
Integrated Plan View

Date		Project No.
12-12	Badin Inn Stream Restoration Stanly County, North Carolina	92666



Ecosystem Enhancement PROGRAM

APPENDIX C-2
Integrated Plan View

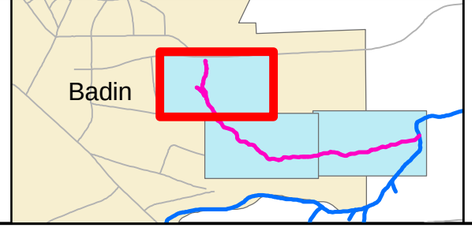
Date	Badin Inn Stream Restoration Stanly County, North Carolina	Project No. 92666
12-12		

N

0 100 200 Feet

Legend

- Stations
- Structures
- Roads
- Cross Sections
- Restored Bankfull
- Restored Thalweg
- Vegetation Problem Area
- Vegetation Plots



Ecosystem Enhancement Program

APPENDIX C-3
Integrated Plan View

Date		Project No.
12-12	Badin Inn Stream Restoration Stanly County, North Carolina	92666