Gray Farm Stream Restoration Monitoring Report – Year Four

Contract # D05016-2
EEP Project # 92219

Iredell County, North Carolina

December 2009

Cataloging Unit – Catawba Basin 03050101

Prepared For:

Ecosystem Enhancement PROGRAM

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I. Executive Summary / Project Abstract

The Gray Farm Stream Restoration project consists of two separate stream reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River (Cataloging Unit 03050101). The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC. This restoration was contracted by Restoration Systems LLC (Contract # D05016-2) as a full-delivery project for the North Carolina Ecosystem Enhancement Program (NCEEP). This report summarizes the monitoring efforts for Year 4 (2009) of the Gray Farm Stream Restoration Project.

Restoration construction of Reach 2 began in early March 2006 and was completed in mid-April 2006. Restoration construction of Reach 1 began in mid-April 2006 and was completed in early July 2006. Demobilization and minor contractor punch list items were completed shortly thereafter. Installation of monitoring devices and As-built surveys for both reaches were performed as construction progressed.

Year 4 monitoring of the vegetated buffer was performed by Soil & Environmental Consultants, PA (S&EC) in the fall of 2009. Stem counts were performed within the established vegetation monitoring plots, resulting in an average live stem density of approximately 418 stems per acre.

Physical monitoring of the restored channels for Year 4 was also performed by S&EC and consisted of the collection of cross-section and representative longitudinal profile data, in conjunction with visual stability assessment of the stream. This work was performed in the fall of 2009. Collected data was then compared with As-built, Year 1, Year 2, and Year 3 Monitoring data.

Based on Year 4 Monitoring results, the overall site has met the prescribed success criteria. Detailed analysis of the success of localized areas is discussed within.

Year 5 Monitoring will commence in January of 2010.

II. Project Background

The Gray Farm Stream Restoration project is located in the Catawba River Basin within Hydrologic Cataloging Unit 03050101. The site consists of two separate reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River. The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC.

The restoration project objective was to restore the impaired streams to appropriately sized stream channels that were stable and self-maintaining, and would not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques. Reach 1 restoration was a combination of a Priority I (reconnection of the channel with its historic floodplain) restoration and a Priority II (construction of a new floodplain at a lower elevation) restoration. Reach 2 was a Priority I restoration. Restoring an appropriate sinuosity lengthened both channels, thereby lowering their bankfull slopes.

Restoration construction of Reach 2 began in early March 2006 and was completed in mid-April 2006. Restoration construction of Reach 1 began in mid-April 2006 and was completed in early July 2006. The buffers of both reaches of the restored stream channel were planted with native tree and shrub species and seeded with a native grass seed mix. During construction, site topography and grading allowed for the creation of vernal pools, oxbows, or pocket wetlands within the riparian zone along the restored stream reaches. Planting operations were performed in April 2006. Supplemental planting was performed in December of 2006.

Demobilization and minor contractor punch list items were completed shortly after the completion of construction. Installation of monitoring devices and As-built surveys for both reaches were performed as construction progressed.

1. Project Goals and Objectives

The goals of the Gray Farm Stream Restoration project are:

1) Improve local water quality within the restored channel reaches as well as the downstream watercourses through;

   a. The reduction of current channel and off site sediment loads by restoring appropriately sized channels with stable beds and banks.

   b. The reduction of nutrient loads (both soil enhancement practices and cattle) from adjacent agricultural fields with a restored riparian buffer.

   c. The reduction of water temperatures provided by shading of the channel from canopy species along with the resultant increase in oxygen content.

2) Improve local aquatic and terrestrial habitat and diversity within the restored channels and their vicinity through;

    a. The formation of varying bed form within the channels to provide for fish, amphibian, and benthic species.

    b. The restoration of a suitable riparian buffer corridor which will provide both vertical and horizontal structure and connectivity with adjacent upland areas.

    c. The restoration of understory and canopy species which will provide forage, cover, and nesting for a variety of mammals, reptiles, and birds.

3) Improve local watershed conditions through the restoration of two low order streams (one first order, one second order) and the placement of permanent conservation easements.

Through the restoration process the following objectives were accomplished:

1) Restore approximately 7,610 linear feet of appropriately sized stream channel that is stable and self-maintaining, and will not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques.

2) Develop restored channels with the appropriate morphological characteristics (cross-sectional dimension, pattern, and longitudinal profile) utilizing collected reference reach data as a guide. Allow for no net loss of overall channel length in the process.

3) Create and/or improve bed form diversity (riffles, runs, pools, and glides) and improve aquatic and benthic macroinvertebrate habitat.

4) Construct a floodplain (or local bankfull bench) that is accessible at the proposed bankfull channel elevation.

5) Ensure channel and stream bank stabilization by integrating in-stream structures and native bank vegetation.

6) Establish a native forested and herbaceous riverine buffer plant community within a minimum width of 50 feet from the edge of the restored channel. This new community will be established in conjunction with the eradication of any existing exotic and/or undesirable plant species.

7) Improve water quality within the subject channels and the downstream receiving waters.

8) Supplement the education and conservation efforts for natural resources in Iredell County as indicated in program goals for the local Soil & Water Conservation District and the NC Cooperative Extension Service.

2. Project Structure, Restoration Type, and Approach

The restoration project was intended to restore the impaired streams to appropriately sized stream channels that are stable and self-maintaining, and will not aggrade or degrade over time. Restoration was accomplished with Rosgen-based natural channel design procedures and techniques. Restoring an appropriate sinuosity lengthened both channels, thereby lowering their bankfull slope. A total of 8,004 linear feet of stream channel was restored onsite (8,004 SMU's).

Reach 1

Reach 1 restoration was a combination of a Priority I restoration (reconnection of the channel with its historic floodplain) and a Priority II restoration (construction of a new floodplain at a lower elevation). Reach 1 consists of 5,813 linear feet (5,813 SMU's) of restored Type C4 channel. Approximately 800 linear feet of this length was previously inundated by an existing farm pond that was removed during the channel restoration. The pre-restoration length of this channel segment was approximately 4,340 linear feet.

One additional piped farm road crossing previously existed approximately 700 feet downstream of an existing dam and farm pond near the upper end of Reach 1. This piped crossing was removed and replaced with an at-grade in-stream crossing. Immediately downstream of the dam for a distance of approximately 1,000 feet, severe bank erosion, channel incision, and an over-widening of the stream channel had occurred. This degradation appeared in large part due to previous uncontrolled releases from the existing dam spillway.

The lower two thirds of the reach were characterized by overly steep and undercut banks. Significant localized erosion had occurred along this lower portion. Trees of large diameter lined the banks, many of which were undercut, suspended, or had collapsed into the stream. The channel had down cut and over widened in many locations along the reach allowing no access to its floodplain. The last 200 feet (approximately) of the pre-existing channel was not down cut due to a change in surrounding topography.

Reach 2

Reach 2 was a Priority I restoration. Reach 2 consists of 2,191 linear feet (2,191 SMU's) of restored Type B4 channel. A small impoundment previously existed near the lower end of the reach; however, it was drained and removed a number of years prior to the channel restoration. A piped farm road crossing existed at roughly the same location (the old dam embankment). This was (and remains) the

only existing crossing along the reach. The pre-restoration length of this channel segment was approximately 1,600 linear feet.

Throughout Reach 2, severe bank erosion, channel incision, and an over-widening of the stream channel had occurred. This impairment appeared in large part due to previous uncontrolled grazing operations. The reach was characterized by overly steep, sloughing, and undercut banks.

Significant localized erosion had occurred along the entire reach. Trees of large diameter lined the banks, many of which were undercut, suspended, or collapsed into the stream. The channel had down cut and over widened in many places along the reach allowing no access to its floodplain.

3. Location and Setting

The Gray Farm Stream Restoration project is located in the Catawba River Basin, Cataloguing Unit 03050101. The site consists of two separate reaches (Reach 1 and Reach 2) along unnamed tributaries of Buffalo Shoals Creek, a tributary of the Catawba River. The site is located approximately 10 miles due west of the City of Statesville in western Iredell County, NC.

Reach 1 is located immediately north of Bolick Road (SR 1532). Reach 2 is located immediately west of the intersection of New Sterling Road (SR 1525) and Gray House Road. The watershed areas for Reaches 1 and 2 are estimated at approximately 0.91 square miles (582 acres) and 0.085 square miles (54 acres) respectively. See attached Figure 1.

4. Project History and Background

The following tables summarize the project history and background:

Exhibit Table I. Project Restoration Components
Gray Farm Stream Restoration Site/EEP Project # 92219

Project Segment or Reach ID	Existing Feet/Acres	Type	Approach	Footage or Acreage	Mitigation Ratio	Mitigation Units	Stationing	Comment
Reach I	3,000	R	PI	4,119	1:1	4,119	0+00 to 41+19	
Reach I	1,340	R	PII	1,694	1:1	1,694	41+19 to 58+13	
Reach II	1,600	R	PI	2,191	1:1	2,191	0+00 to 21+91	

Mitigation Unit Summations

Stream (lf)	Riparian Wetland (Ac)	Nonriparian Wetland (Ac)	Total Wetland (Ac)	Buffer (Ac)	Comment
8,004	N/A	N/A	N/A	18.38	

Exhibit Table II. Project Activity and Reporting History
Gray Farm Stream Restoration Site/EEP Project # 92219

Activity or Report	Data Collection Complete	Actual Completion or Delivery
Restoration Plan	Aug-05	Nov-05
Construction	Reach 1	Jul-06
	Reach 2	Apr-06
Temporary S&E mix applied to entire project area	Apr-06	Apr-06
Permanent seed mix applied to reach/segments 1 & 2	Apr-06	Apr-06
Plantings for reach/segments 1 & 2	Apr-06	Apr-06
Mitigation Plan / As-built (Year 0 Monitoring - baseline)	May-06	Jun-06
Year 1 Monitoring	Dec-06	Dec-06
Supplemental Planting	Dec-06	
Year 2 Monitoring	Nov-07	Dec-07
Year 3 Monitoring	Nov-08	Dec-08
Year 4 Monitoring	Nov-09	Dec-09
Year 5 Monitoring		

Exhibit Table III. Project Contact Table Gray Farm Stream Restoration Site/EEP Project # 92219	
Designer Primary Project Design POC	Soil & Environmental Consultants, PA 11010 Raven Ridge Rd Raleigh, NC 27614 Patrick K. Smith, P.E. (919) 846-5900
Construction Contractor Construction Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Planting Contractor Planting Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Seeding Contractor Seeding Contractor POC	North State Environmental 2889 Lowery St. Winston-Salem, NC 27101 Darrell Westmoreland (336) 725-2010
Monitoring Performers	Soil & Environmental Consultants, PA 11010 Raven Ridge Rd. Raleigh, NC 2761
Stream Monitoring POC	David Gainey (919) 846-5900
Vegetation Monitoring POC	David Gainey (919) 846-5900

Exhibit Table IV. Project Background Table Gray Farm Stream Restoration Site/EEP Project # 92219	
Project County	Iredell
Drainage area	Reach 1 - 0.91 square miles (582 acres)
	Reach 2 - 0.085 square miles (54 acres)
Drainage impervious cover estimate (%)	< 20%
Stream Order	Reach 1 - 2nd order
	Reach 2 - 1st order
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont
Rosgen Classification of As-built	Reach 1 - C4
	Reach 2 - B4
Cowardin Classification	N/A
Dominant soil types	Reach 1 - Cw, CxB
	Reach 2 - CsE2
Reference site ID	Reach 1 - Tributary of Turkey Creek
	Reach 2 - Basin Creek
USGS HUC for Project and Reference	3050101
NCDWQ Sub-basin for Project and Reference	Reach 1 - 03-08-32 / 03-04-02
	Reach 2 - 03-08-32 / 03-07-01
NCDWQ classification for Project and Reference	Reach 1 - WS-IV; CA / C;NSW
	Reach 2 - WS-IV; CA / C; Tr; ORW
Any portion of any project segment 303d listed?	No
Any portion of any project segment upstream of a 303d listed segment?	No
Reasons for 303d listing or stressor	N/A
% of project easement fenced	Reach 1 – No Fence, Reach 2 - 100%

5. Monitoring Plan View

Six (6) tree and shrub buffer vegetation plots (four (4) on Reach 1 and two (2) on Reach 2) and four (4) bank vegetation plots (two (2) on Reach 1 and two (2) on Reach 2) were established. All vegetation monitoring occurs within these plots throughout the monitoring period for as long as they continue to be representative of the community.

For all buffer monitoring plots, Level 1 of the Carolina Vegetation Survey-Ecosystem Enhancement Program (CVS-EEP) Protocol for Recording Vegetation was utilized for vegetation sampling in Years 1 and 2. Beginning in Year 3, Level 2 of the CVS-EEP protocol was utilized in order to record and report woody plant volunteers within vegetation monitoring plots along with planted stems. A corner of each vegetation monitoring plot will be used as a permanent photo point for vegetation monitoring photos. Locations of these photo points are shown on the attached Monitoring Plan View.

Benthic macroinvertebrate sampling was performed at a total of five (5) previously established sampling stations. Reach 1, Station 1 is located immediately upstream of the restored Reach 1. Reach 1, Station 2 is located within the restored Reach 1. Reach 1, Station 3 is located immediately downstream of the restored Reach 1. Reach 2, Station 1 is located within the restored Reach 2. Reach 2, station 2 is located immediately downstream of the restored Reach 2. Locations of these benthic macroinvertebrate sampling points for Year 3 are shown in Appendix D.1. Benthic macroinvertebrate sampling was performed during Monitoring Years 1 through 3.

A total of seven (7) nested riffle and pool cross-section pairs was established along Reach 1, and two (2) nested riffle and pool cross-section pairs were established along Reach 2. Each cross-section also serves as a designated photo point that is photographed annually.

The locations of all monitoring devices are shown in Appendix D.1 (Monitoring Plan View, Reaches 1 and 2).

III. Project Condition and Monitoring Results

A. Vegetation Assessment

The success of the adjacent riparian buffer will be based on the combined survival of tree and shrub species for the five-year monitoring period.

In order to be considered successful, survival of woody (tree and shrub) species planted within the restored buffers will be at least 320 stems/acre through year three, 288 stems/acre at year four, and 260 stems/acre at year five. The stem count will be based on an average of the stem counts of the evaluated tree and shrub buffer vegetation plots.

The success of the bank vegetation plots along the restored channels will be based on the survival of live stake (or other) bank plantings for the five-year monitoring period. Survival of bank plantings will be based on a linear average of approximately 50 percent of the planted stems within the restoration reaches.

The approximately 18.4 acre restoration area was planted with various native hardwood tree and shrub species native to the area. Reaches 1 and 2 were planted in April 2006. Supplemental planting was performed in December of 2006.

The following tree species were planted in the Riparian Buffer Area:

- *Alnus serrulata* (Tag Alder)
- *Betula nigra* (River Birch)
- *Carpinus caroliniana* (Ironwood)
- *Fraxinus pennsylvanica* (Green Ash)
- *Ilex opaca* (American Holly)
- *Lindera benzoin* (Spicebush)
- *Liriodendron tulipifera* (Tulip Poplar)
- *Platanus occidentalis* (Sycamore)
- *Quercus michauxii* (Swamp Chestnut Oak)
- *Quercus nigra* (Water Oak)
- *Quercus phellos* (Willow Oak)
- *Viburnum nudum* (Possumhaw)

Stream banks were planted with live stakes in two offset rows. The following shrub species were planted as live stakes:

- *Cornus amomum* (Silky Dogwood)
- *Salix sericea* (Silky Willow)
- *Sambucus canadensis* (Elderberry)

As previously described, a total of six (6) buffer vegetation monitoring plots was established on-site in 2006. The success criteria for the site require a minimum of 288 live stems per acre through the first four (4) years of monitoring. Year 4 vegetation monitoring shows 418 live stems per acre. Year 5 buffer vegetation monitoring data will be compared with previous monitoring data to determine survival rates and stem densities for woody vegetation planted within the riparian buffer. Vegetation monitoring data for buffer plots was collected using Level 2 of the CVS-EEP monitoring protocol and is presented in Appendix A.

NOTE: Level 2 of the CVS-EEP monitoring protocol includes both planted and natural (volunteer) woody stems. For this reason, volunteer specimens are included in the total number of species, as reflected in Tables V-2 through V-4. Table V- 5 (Stem Count by Plot and Species) does not include volunteer/natural woody stem data, only planted stems.

Four (4) bank vegetation plots were also established (two on each reach) to monitor survival of live stake plantings along stream banks. Live stake survival is based on baseline data collected during Year 1 Monitoring in 2006. Future bank vegetation monitoring data will be compared with previous monitoring data to determine survival rates for live stakes planted along stream banks. Live stake survival from Monitoring Year 1 to Monitoring Year 4 for the site overall is approximately 85.9%, an increase from the Year 3 live stake survival percentage. This increase in live stake survival can be attributed to the resprouting of Silky Dogwood in Reach 1 Bank Plot 2.

Live stake counts by species and by plot are presented in the following tables:

2006 - REACH 1					
Common Name	**Species**	**REACH 1**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Dogwood	*Cornus amomum*	12	17	29	39%
Silky Willow	*Salix sericea*	30	16	46	61%
	TOTAL	42	33	75	100%
2007 - REACH 1					
Common Name	**Species**	**REACH 1**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Dogwood	*Cornus amomum*	4	9	13	27%
Silky Willow	*Salix sericea*	27	9	36	73%
	TOTAL	31	18	49	100%
	Live Stake Survival =	73.8%	54.5%	65.3%	
2008 - REACH 1					
Common Name	**Species**	**REACH 1**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Dogwood	*Cornus amomum*	10	9	19	36%
Silky Willow	*Salix sericea*	30	4	34	64%
	TOTAL	40	13	53	100%
	Live Stake Survival =	95.2%	39.4%	70.7%	

2009 - REACH 1					
Common Name	**Species**	**REACH 1**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Dogwood	*Cornus amomum*	10	9	19	32%
Silky Willow	*Salix sericea*	30	10	40	68%
	TOTAL	40	19	59	100%
	Live Stake Survival =	95.2%	57.6%	78.7%	

2006 - REACH 2					
Common Name	**Species**	**REACH 2**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Willow	*Salix sericea*	7	4	11	23%
Silky Dogwood	*Cornus amomum*	9	25	34	72%
Elderberry	*Sambucus canadensis*	0	2	2	4%
	TOTAL	16	31	47	100%
2007 - REACH 2					
Common Name	**Species**	**REACH 2**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Willow	*Salix sericea*	6	4	10	29%
Silky Dogwood	*Cornus amomum*	5	20	25	71%
Elderberry	*Sambucus canadensis*	0	0	0	0%
	TOTAL	11	24	35	100%
	Live Stake Survival =	68.8%	77.4%	74.5%	
2008 - REACH 2					
Common Name	**Species**	**REACH 2**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Willow	*Salix sericea*	7	4	11	24%
Silky Dogwood	*Cornus amomum*	8	25	33	73%
Elderberry	*Sambucus canadensis*	0	1	1	2%
	TOTAL	15	30	45	100%
	Live Stake Survival =	93.8%	96.8%	95.7%	
2009 - REACH 2					
Common Name	**Species**	**REACH 2**		**Species Total**	**% of Total**
		BANK 1	**BANK 2**		
Silky Willow	*Salix sericea*	7	4	11	24%
Silky Dogwood	*Cornus amomum*	8	25	33	73%
Elderberry	*Sambucus canadensis*	0	1	1	2%
	TOTAL	15	30	45	100%
	Live Stake Survival =	93.8%	96.8%	95.7%	

The increase from Year 3 to Year 4 in number of Silky Dogwood counted within Reach 1 Bank Plot 2 is most likely due to the less dense herbaceous vegetation in this area during Year 4, which allowed live stakes to grow or re-

sprout and facilitated observation of these stems. Most surviving live stakes appear healthy and are growing vigorously.

Herbaceous vegetation varies widely throughout the restoration site. The native herbaceous species have become densely established and are dominant throughout the site. Herbaceous species observed along stream banks and in the buffer and wetlands onsite include:

- Jewelweed – *Impatiens capensis*
- Soft Rush – *Juncus effusus*
- Cutgrass – *Leersia oryzoides*
- Monkeyflower – *Mimulus ringens*
- Sedges – *Carex spp.*
- Switchgrass – *Panicum virgatum*
- Duck Potato – *Sagittaria latifolia*
- Goldenrod – *Solidago sp.*
- Dog-fennel – *Eupatorium capillifolium*
- Boneset – *Eupatorium perfoliatum*

1. Problem Areas Plan View (Vegetation)

During field inspections on October 27th-29th and November 5th, 2009, a total of six (6) localized areas of bare bank and floodplain were observed on Reach 1. These areas appear to be due primarily to either surface flows or poor soil conditions. Continued revegetation of previously bare areas was observed during Monitoring Year 4, especially within Reach 2. Vegetation Problem Areas are shown on Sheets 6 through 9 (Reach 1). Photos are included in Appendix A.

During Monitoring Year 2, small amounts of the non-natives Johnsongrass (*Sorghum halepense*) and tall fescue (*Lolium arundinaceum*) were observed at the edges of the buffer restoration areas that border the agricultural fields on both reaches. These populations have not become dominant, nor have they excluded native vegetation.

An area of Kudzu (*Pueraria lobata*) was noted at the site in early June 2007, on the west side of Reach 1 between stations 16+00 to 19+00. Although the majority of the Kudzu was along and in the edge of the woods immediately outside the easement area, some had encroached into the easement area. The area (approximately 0.5 acre) was treated with the herbicide Transline (clopyralid) at a rate of one pint per acre in 2007. A small portion of this area was again treated in 2008. During 2008, a small area (approximately 0.009 acre) of Kudzu was observed immediately east of station 13+00, within the easement area. During 2009, two very small areas of kudzu (totaling approximately 350 sq. feet) was treated with Transline (clopyralid) in the upper part of Reach 1. These areas will be monitored and treated if Kudzu continues to encroach into the easement area.

While we will continue to monitor these areas, based on vegetative success criteria the overall site currently exhibits strong vegetative success.

2. Vegetative Problem Areas Table Summary

Vegetative problem areas observed are described in Table A1 in Appendix A.

3. Vegetative Problem Areas Plan View

Vegetative problem areas are shown on Sheets 6 through 9 for Reach 1 (Problem Area Plan View). No vegetative problem areas were noted on Reach 2.

B. Stream Assessment

A review of available on-line U.S. Geological Survey (USGS) gauge sites was performed to determine if a suitable surrogate gauges was present in the area. No nearby gauge was identified. The closest USGS gauge to the site was on the Lower Little River (near Healing Springs, NC, Gauge Identification Number 02142000) which is approximately 15 miles from the project site. Based on this large distance, significant disparity in watershed sizes, and topographic variation, it is unlikely that a conclusive determination regarding the number of bankfull events experienced on the restoration site could be made.

Based upon recommendations provided by NCEEP a crest gauge was installed on site (at Cross-section 3 on Reach 1). The gauge was installed in June of 2008 and checked during subsequent site visits for evidence of bankfull events. In addition, site observations during visits performed this monitoring year including wrack lines, staining of vegetation, displaced/flattened vegetation, and observable sediment deposition indicate that multiple overbank events have occurred. Photographs documenting overbank conditions during Monitoring Year 4 are attached in Appendix B. The dates of site visits where evidence of bankfull events were observed are listed in the table below.

Exhibit Table V. Verification of Bankfull Events
Gray Farm Stream Restoration Site/EEP Project # 92219

Date of Data Collection	Date of Occurrence	Method	Photo #
10/27/2009	Unknown	Onsite observations (wrack lines, staining of vegetation, displaced/flattened vegetation, and observable sediment deposition and select crest gauge readings)	1
11/11/2009	11/11/2009	Observation of bankfull event – Reach 1	2
11/11/2009	11/11/2009	Observation of bankfull event – Reach 2	3

1. Problem Areas Plan View (Stream)

An assessment of channel stability was performed on October 27th, 2009. Areas of concern that were observed and documented included some minor localized bank scour, buried structures, stressed structures, and a single beaver dam. Detail of scour is evident in cross-section 6 (pool). These problem areas are shown on Sheets 6 through 9 for Reach 1 and Sheets 14 through 16 for Reach 2 (Problem Area Plan View). One stressed log J-hook structure at station 41+50 on Reach 1 will need to be repaired and stabilized to fill a scour area behind the structure. With the exception of this structure, the minimal extent of scour and erosion around structures does not warrant repair at this time.

The beaver dam noted on October 27, 2009 at station 56+40 within Reach 1 had raised the water level in the stream to approximately station 53+00, and structures between these two stations were entirely submerged. In order to preserve the restored physical parameters of Reach 1, beavers and their dams will need to be removed from this area.

The upper portion of Reach 1 has demonstrated pool development since the as-built survey. Significant sediment entered the pools at the upper end of Reach 1 shortly after construction. This sediment came from upstream sources to the north of the restoration site including areas of cattle pasture and areas previously inundated due to the old pond. This sediment was flushed from the system during the first year, causing these pools to deepen to their previously excavated depth. During Monitoring Year 3, sediment from the upstream cattle pasture again entered the upper portion of Reach 1. Based on the Year 4 assessment, this sedimentation has continued and increased during the last year. The area between station 0+00 and station 5+20 contains significant sediment, pools have filled, and structures have been buried. From station 5+20 to station 9+50, sediment is present, but less severe, and the riffle-pool sequence is more easily observed. It is important to note that the cattle pasture north of the restoration site is not under the ownership of the Grays.

The above-mentioned structure will be repaired and beavers removed from Reach 1. Other areas will continue to be monitored to ensure that the site continues to exhibit stable conditions and meet the requirements for physical success based on physical success criteria.

2. Problem Areas Table Summary

Stream problem areas observed are shown in Table B1 in Appendix B.

3. Numbered Issues Photo Section

Representative photos of each category of stream problem area are shown in Appendix B.

4. Fixed Photo Station Photos

Photos from established photo stations (at each cross-section) were collected during the stream survey (October 27-29 and November 5, 2009). These photos are included in Appendix B.

5. Stability Assessment

A visual qualitative assessment was performed to inspect channel facets, meanders, bed, banks, and installed structures. This visual assessment was confirmed and enhanced with a quantitative assessment of the physical stream survey. The goal of this assessment is to provide a percentage of the features listed in Table VII that are in a state of stability. Table VII was compiled from the data in Table B1 in Appendix B of this report.

Table VIIa: Categorical Stream Feature Visual Stability Assessment
Gray Farm Stream and Wetland Restoration Site/EEP Project # 92219
Reach 1

Feature	MY-1 2006	MY-2 2007	MY-3 2008	MY-4 2009	MY-5 2010
A. Riffles	100%	100%	98%	100%	
B. Pools	100%	100%	100%	99%	
C. Thalweg	99%	99%	99%	99%	
D. Meanders	100%	100%	100%	99%	
E. Bed General	96%	99%	99%	99%	
F. Bank Condition	100%	99%	99%	99%	
G. Vanes/ J Hooks, etc.	99%	98%	98%	98%	
H. Wads and Boulders	N/A	N/A	N/A	N/A	

Table VIIb: Categorical Stream Feature Visual Stability Assessment
Gray Farm Stream and Wetland Restoration Site/EEP Project # 92219
Reach 2

Feature	MY-1 2006	MY-2 2007	MY-3 2008	MY-4 2009	MY-5 2010
A. Riffles	100%	100%	100%	100%	
B. Pools	100%	100%	100%	100%	
C. Thalweg	100%	100%	100%	100%	
D. Meanders	99%	98%	98%	97%	
E. Bed General	100%	100%	100%	99%	
F. Bank Condition	100%	100%	99%	100%	
G. Vanes/ J Hooks, etc.	99%	96%	95%	96%	
H. Wads and Boulders	N/A	N/A	N/A	N/A	

6. Quantitative Measures Summary Tables

The following tables (Table VIII and Table IX) summarize the quantitative data collected from the cross-sectional and representative longitudinal stream survey. These data were analyzed and summarized, and then compared with baseline data available for this project.

The Quantitative Morphology Tables illustrate the degree of departure, if any, of the current channel from the baseline data. Tables VIII and IX were compiled from the cross-section and profile raw data and plots located in Appendix B of this report.

Table VIII. Baseline Morphology and Hydraulic Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)
REACH 1

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	15.77	15.77	15.77	32.08	32.08	32.08	15.2	15.2	15.2	13.62	19.48	16.02
Floodprone Width (ft)	19.41	52.54	20.39	100			47	90.34	47	37.49	89.67	61.53
BF Cross Sectional Area (ft^2)	17.87	17.87	17.87	79.79	79.79	79.79	17.84	17.84	17.84	11.01	17.92	13.79
BF Mean Depth (ft)	1.13	1.13	1.13	2.49	2.49	2.49	1.17	1.17	1.17	0.7	0.94	0.86
BF Max Depth (ft)	1.49	1.49	1.49	3.61	3.61	3.61	1.71	1.71	1.71	1.36	2.04	1.61
Width/Depth Ratio	13.96	13.96	13.96	12.43	12.43	12.43	12.67	12.67	12.67	18.63	20.07	19.46
Entrenchment Ratio	1.29	1.29	1.29	3.47	3.47	3.47	3.09	3.09	3.09	2.75	4.6	3.84
Wetted Perimeter(ft)	16.52	16.52	16.52	34.8	34.8	34.8	16.01	16.01	16.01	13.26	16.41	15.67
Hydraulic radius (ft)	1.08			2.29			1.11			0.69	0.92	0.83
Pattern												
Channel Beltwidth (ft)	67.62	137.29	98.27	70.8	91.93	84.35	26.1	61.8	40.75	59.32	93.89	72.85
Radius of Curvature (ft)	64.8	121.04	81.58	13.36	36.57	26.56	19.97	37.85	28.23	16.64	40.88	25.73
Meander Wavelength (ft)	716.91	716.91	716.91	148.13	291.09	221.56	77.08	117.13	95.07	77.08	117.13	94.8
Meander Width ratio	4.29	8.71	6.23	2.21	2.87	2.63	1.72	4.07	2.68	3.7	5.86	4.55
Profile												
Riffle length (ft)	N/A	N/A	N/A	32.94	48.35	40.29	19.31	54.86	30.86	25.87	54.2	37.85
Riffle slope (ft/ft)	0.00632	0.00657	0.00647	0.00809	0.01395	0.01074	0.0057			0.00092	0.0187	0.0062
Pool length (ft)	93.8	159.47	119.6	8.96	41.09	26.43	22.9	33.17	29.66	7.41	244.47	23.01
Pool Slope (ft/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0.0009	0.0029	0.0013	0.0007	0.0064	0.0016
Pool spacing (ft)	347.07	525.3	444	44.08	130.73	67.98	51.66	82.92	67.79	12.35	142	70.94
Substrate												
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Additional Reach Parameters												
Valley Length (ft)	4258.3			648.35			4258.3			4258.3		
Channel Length (ft)	4939.628			758.58			5622			5813.3		
Sinuosity	1.16			1.17			1.29			1.36		
Water Surface Slope (ft/ft)	0.00647			0.01074			0.0057			0.00544		
BF slope (ft/ft)	0.00647			0.01074			0.0057			0.00544		
Rosgen Classification	F4			C4			C4			C4		
*Habitat Index	N/A			N/A			N/A			N/A		
*Macrobenthos	N/A			N/A			N/A			N/A		

Table VIII. Baseline Morphology and Hydraulic Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)
REACH 2

Parameter	Pre-Existing Condition			Project Reference Stream			Design			As-built		
Dimension	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.	Min	Max	Avg.
BF Width (ft)	5.34	5.34	5.34	4.86	4.86	4.86	6.9	6.9	6.9	7.38	8.21	7.8
Floodprone Width (ft)	7.04	7.04	7.04	8.73	8.73	8.73	12.4	12.4	12.4	13.96	39.05	26.53
BF Cross Sectional Area (ft^2)	3.88	3.88	3.88	1.94	1.94	1.94	3.96	3.96	3.96	4.14	6.77	5.46
BF Mean Depth (ft)	0.73	0.73	0.73	0.4	0.4	0.4	0.57	0.57	0.57	0.56	0.82	0.69
BF Max Depth (ft)	1.13	1.13	1.13	0.61	0.61	0.61	0.87	0.87	0.87	0.86	1.3	1.08
Width/Depth Ratio	7.32	7.32	7.32	12.15	12.15	12.15	12.11	12.11	12.11	1.01	13.18	11.3
Entrenchment Ratio	1.32	1.32	1.32	1.8	1.8	1.8	1.8	1.8	1.8	1.9	4.7	3.4
Wetted Perimeter(ft)	6.03	6.03	6.03	5.28	5.28	5.28	7.36	7.36	7.36	7.68	8.77	8.23
Hydraulic radius (ft)	0.64			0.37			0.94737	0.94737	0.94737	0.78261	1.11594	0.95652
Pattern												
Channel Beltwidth (ft)	43.58	68.11	54.22	6.97	22.7	13.32	9.49	16.5	12.65	11.83	22.05	16.96
Radius of Curvature (ft)	32.54	52.64	41.25	4.1	8.88	5.93	6.71	9.9	8.05	4.63	9.1	6.43
Meander Wavelength (ft)	209.46	394.66	334.46	22.47	68.78	46.57	31.6	37.12	34.08	27.51	34.72	31.75
Meander Width ratio	8.16	12.75	10.15	1.43	4.67	2.74	1.38	2.39	1.83	1.52	2.83	2.17
Profile												
Riffle length (ft)	N/A	N/A	N/A	5.52	7.6	6.39	4.93	7.24	5.88	3.36	11.6	5.6
Riffle slope (ft/ft)	0.0179	0.03688	0.02444	0.03022	0.05058	0.04025	0.0258			0.0053	0.0555	0.0279
Pool length (ft)	26.27	54.41	40.34	7.56	10.65	8.78	6.25	10.46	8.45	5.2	10.08	7.59
Pool Slope (ft/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0.0017	0.0087	0.003	0.001	0.0092	0.0022
Pool spacing (ft)	125.7	474.65	265.15	20.17	70.04	46.72	15.73	23.84	19.22	9.43	28.94	19.51
Substrate												
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Additional Reach Parameters												
Valley Length (ft)	1872			216.55			1872			1872		
Channel Length (ft)	1965.6			266.36			2114			2191		
Sinuosity	1.05			1.23			1.16			1.2		
Water Surface Slope (ft/ft)	0.0286			0.039			0.0258			0.025		
BF slope (ft/ft)	0.0286			0.039			0.0258			0.025		
Rosgen Classification	G4			B4			B4			B4		
*Habitat Index	N/A			N/A			N/A			N/A		
*Macrobenthos	N/A			N/A			N/A			N/A		

Exhibit Table IX. Morphology and Hydraulic Monitoring Summary
GRAY FARM STREAM RESTORATION SITE (EEP Project #92219)

Parameter	REACH 1																			
	RIFFLE 1					POOL 1					RIFFLE 2					POOL 2				
Dimension	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4
	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009
BF Width (ft)	15.34	11.25	11.58	10.89	8.76	22.32	20.84	24.21	20.82	21.89	13.62	11.33	13.59	14.78	12.48	20.84	20.41	21.64	19.85	20.02
Floodprone Width (ft	54.53	50	50	50	50.86	61.28	62.34	62.25	62.65	63.15	59.9	60.26	60.01	59.8	59.91	57.43	58.07	54.82	57.47	57.93
BF Cross Sectional Area (ft^2)	11.97	5.96	6.46	5.98	4.19	39.71	41.33	35.99	36.03	42.12	11.01	9.18	9.27	9.23	8.5	29.04	26.98	28.27	27.23	27.51
BF Mean Depth (ft)	0.78	0.53	0.56	0.55	0.48	1.78	1.98	1.56	1.73	1.92	0.81	0.68	0.68	0.62	0.68	1.39	1.32	1.31	1.37	1.37
BF Max Depth (ft)	1.39	0.87	1	1.26	1.18	3.29	3.47	3.5	3.58	3.68	1.53	1.25	1.46	1.6	1.79	2.89	2.74	3.5	3.04	3.33
Width/Depth Ratio	19.67	21.23	20.68	19.8	18.25	12.54	10.53	14.79	12.03	11.4	16.81	19.94	19.99	23.84	18.35	14.99	15.46	16.52	14.49	14.61
Entrenchment Ratio	3.56	4.44	4.32	4.59	5.81	2.75	2.99	2.7	3.01	2.88	4.4	4.45	4.41	4.05	4.8	2.76	2.85	2.67	2.89	2.89
Wetted Perimeter(ft)	15.67	11.41	11.77	11.21	9.67	23.83	22.42	24.22	22.41	25.69	13.97	13.82	14.04	15.21	13.52	21.83	21.52	23.58	22.24	23.11
Hydraulic radius (ft)	0.76	0.52	0.55	0.53	0.43	1.67	1.84	1.49	1.61	1.64	0.79	0.66	0.66	0.61	0.63	1.33	1.25	1.2	1.22	0.76
Substrate																				
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Parameter	REACH 1																			
	RIFFLE 3					POOL 3					RIFFLE 4					POOL 4				
Dimension	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4
	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009
BF Width (ft)	12.94	12.1	13.55	12.89	13.37	20.75	21.49	22.08	21.98	21.66	15.7	19	17.9	18.01	18.49	20.28	21.29	20.2	19.85	20.19
Floodprone Width (ft	89.67	89.64	89.86	89.54	89.77	61.38	61.32	61.04	61.15	61.39	66.39	66.2	66.27	66.51	66.39	65.77	65.75	66	65.83	65.92
BF Cross Sectional Area (ft^2)	9.49	9.25	10.46	9.82	10.62	34.09	33.59	32.19	31.82	33.75	11.02	13.49	11.8	11.58	13.39	32.64	38.77	32.03	33.03	33.19
BF Mean Depth (ft)	0.73	0.76	0.77	0.76	0.79	1.64	1.56	1.46	1.45	1.56	0.7	0.71	0.66	0.64	0.72	1.61	1.82	1.59	1.66	1.64
BF Max Depth (ft)	1.41	1.36	1.47	1.44	1.61	3.03	2.83	2.94	2.78	2.99	1.36	1.41	1.3	1.37	1.41	2.79	3.2	2.83	2.83	3.07
Width/Depth Ratio	17.73	15.92	17.6	16.96	16.92	12.65	13.78	15.12	15.16	13.88	22.43	26.76	27.12	28.14	25.68	12.6	11.79	12.7	11.96	12.31
Entrenchment Ratio	6.93	7.41	6.63	6.94	6.71	2.96	2.85	2.76	2.78	2.83	4.23	3.48	3.7	3.69	3.59	3.24	3.09	3.27	3.32	3.27
Wetted Perimeter(ft)	13.26	12.46	13.92	13.27	13.97	21.78	22.45	23.01	22.94	22.79	16.01	19.29	18.22	18.39	19.13	21.59	22.97	21.45	21.21	22.74
Hydraulic radius (ft)	0.72	0.74	0.75	0.74	0.76	1.57	1.5	1.4	1.39	1.48	0.69	0.7	0.65	0.63	0.7	1.51	1.69	1.49	1.56	1.46
Substrate																				
d50 (mm)	0.65	17	1.6	20	19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	4	33	50	60	43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Parameter	REACH 1																			
	RIFFLE 5					POOL 5					RIFFLE 6					POOL 6				
Dimension	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4
	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009
BF Width (ft)	15.63	14.32	16.03	13.84	15.92	26.27	23.03	26.67	24.07	24.14	17.01	14.54	20.16	19.03	16.48	18.59	21.11	19.69	22.85	19.25
Floodprone Width (ft	72.27	64.56	73.17	72.59	72.68	68.23	68.53	68.67	68.48	68.73	50.57	60	60	49.29	48.65	60.15	62.76	63	66.56	67.18
BF Cross Sectional Area (ft^2)	14.76	14.03	15.16	13.33	14.29	37.47	33.39	37.64	35.95	35.15	16	14.61	16.36	12.89	11.82	26.72	27.06	51.7	53	53.19
BF Mean Depth (ft)	0.94	0.98	0.95	0.96	0.9	1.43	1.45	1.41	1.49	1.46	0.94	1.01	0.81	0.68	0.72	1.44	1.28	2.63	2.32	2.76
BF Max Depth (ft)	1.67	2.27	1.92	1.99	1.93	2.75	3.08	3.35	3.23	3.27	1.56	1.49	1.43	1.31	1.24	2.83	3.14	4.82	4.71	4.98
Width/Depth Ratio	16.63	14.61	16.87	14.42	17.69	18.37	15.88	18.91	16.15	16.53	18.1	14.4	24.89	27.99	22.89	12.91	16.49	7.49	9.85	6.97
Entrenchment Ratio	4.62	4.51	4.56	5.24	4.56	2.6	2.98	2.57	2.85	2.85	2.97	4.13	2.98	2.59	2.95	3.24	2.97	3.2	2.91	3.49
Wetted Perimeter(ft)	16.14	15.28	17.15	14.88	17.12	27.26	24.24	28	25.72	26.13	17.42	15	20.56	19.32	17.4	20.27	22.27	23.49	27.89	25.01
Hydraulic radius (ft)	0.91	0.92	0.88	0.9	0.84	1.37	1.38	1.34	1.4	1.35	0.92	0.97	0.8	0.67	0.68	1.32	1.21	2.2	1.9	2.13
Substrate																				
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Parameter	REACH 1									
	RIFFLE 7					POOL 7				
Dimension	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4
	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009
BF Width (ft)	19.48	16.96	22.43	19.14	21.34	22.66	22.31	23.12	22.38	23.96
Floodprone Width (ft	50	50	50	50	50	51.23	55	55	51	47.21
BF Cross Sectional Area (ft^2)	17.92	15.49	16.94	15.82	17.57	42.08	38.22	36.39	35.4	35.15
BF Mean Depth (ft)	0.92	0.91	0.76	0.83	0.82	1.86	1.71	1.57	1.58	1.47
BF Max Depth (ft)	2.04	1.61	1.68	1.76	1.93	3.47	3.06	3.03	2.91	2.76
Width/Depth Ratio	21.17	18.64	29.51	23.06	26.02	12.18	13.03	14.73	14.16	16.3
Entrenchment Ratio	2.57	2.95	2.23	2.61	2.343	2.26	2.46	2.38	2.28	1.97
Wetted Perimeter(ft)	20.08	17.38	22.83	19.59	22.11	23.91	24.11	24.31	23.66	25.89
Hydraulic radius (ft)	0.89	0.89	0.74	0.81	0.79	1.76	1.59	1.5	1.5	1.36
Substrate										
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

REACH 1															
Parameter	As-built (2006)			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)		
Pattern	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Channel Beltwidth (ft	59.32	93.89	72.85	58.48	96.38	71.67	58.96	97.33	72.54	54.62	96.02	72.76	52.64	93.42	69.44
Radius of Curvature (ft)	16.64	40.88	25.73	16.84	39.51	24.43	16.72	40.02	25.69	18.06	41.31	29.62	14.21	38.24	22.46
Meander Wavelength (ft)	77.08	117.13	94.8	76.54	118.26	91.85	75.94	120.96	92.17	81.64	125.68	102.42	86.25	127.4	107.22
Meander Width ratio	3.85	5.86	4.74	3.83	5.91	4.59	3.80	6.05	4.61	4.08	6.28	5.12	4.31	6.37	5.36
Profile															
Riffle length (ft)	25.87	54.2	37.85	19.31	54.86	30.86	22.15	58.62	34.61	17.03	56.21	34.53	20.37	73.65	37.06
Riffle slope (ft/ft)	0.00092	0.0187	0.0062	0.00125	0.01763	0.00883	0.0017	0.025	0.009	0.00115	0.033	0.01196	0.00223	0.03447	0.01102
Pool length (ft)	14.33	32.54	23.01	14.19	31.92	24.11	15.64	34.81	26.84	15.44	56.25	32.43	16.73	52.88	29.44
Pool Slope (ft/ft)	0.0007	0.0064	0.0016	0.0007	0.0029	0.0012	0.0007	0.004	0.0017	0.0007	0.0033	0.0013	0	0.00212	0.00042
Pool spacing (ft)	12.35	142	70.94	13.24	159	74.52	12.46	148	72.69	14.2	172.7	88.45	10.82	125.17	69.28
Additional Reach Parameters															
Valley Length (ft)	4258.3			4258.3			4258.3			4258.3			4258.3		
Channel Length (ft)	5813.3			5813.3			5813.3			5813.3			5813.3		
Sinuosity	1.36			1.36			1.36			1.36			1.36		
Water Surface Slope (ft/ft)	0.00544			0.00544			0.00544			0.00544			0.00544		
BF slope (ft/ft)	0.00544			0.00544			0.00544			0.00544			0.00544		
Rosgen Classificatio	C4			C4			C4			C4			C4		
Habitat Index*	N/A			N/A			N/A			N/A			N/A		
Macrobenthos*	N/A			N/A			N/A			N/A			N/A		

Parameter	**REACH 2**																			
	RIFFLE 1					POOL 1					RIFFLE 2					POOL 2				
Dimension	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4	AS BUILT	MY1	MY2	MY3	MY4
	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009	2006	2006	2007	2008	2009
BF Width (ft)	7.38	7.61	10.66	8.67	11.12	18.44	17.46	22.47	20.95	21.52	8.21	7.6	9.16	8.98	8.85	5.98	6.17	5.56	3.56	5.03
Floodprone Width (ft	23.08	26.25	29.56	25.54	30.39	46.7	46.7	46.7	46.78	46.62	39.05	26.17	26	40.5	41.9	15.65	10.59	10.84	10.93	13.37
BF Cross Sectional Area (ft^2)	4.14	4.65	5.33	4.74	6.02	19.78	18.94	23.35	21.96	21.12	6.77	4.86	7.71	6.71	6.42	6.89	4.93	5.82	3.92	5.79
BF Mean Depth (ft)	0.56	0.61	0.5	0.55	0.54	1.07	1.09	1.04	1.05	0.98	0.82	0.64	0.84	0.75	0.73	1.15	0.8	1.05	1.1	1.15
BF Max Depth (ft)	0.86	0.98	1	0.94	1.11	2.6	2.64	2.63	2.58	2.47	1.3	1.19	1.47	1.23	1.3	1.81	1.49	1.54	1.63	1.66
Width/Depth Ratio	13.18	12.48	13.5	15.76	20.59	17.23	16.02	21.61	19.95	21.96	10.01	11.88	10.9	11.97	12.12	5.2	7.71	5.3	3.24	4.37
Entrenchment Ratio	3.13	1.84	2.77	2.95	2.73	2.53	2.67	2.08	2.23	2.17	4.76	3.44	2.84	4.51	4.73	2.61	1.72	1.97	3.04	2.66
Wetted Perimeter(ft)	7.68	7.92	10.91	8.94	11.44	20.58	19.14	24.19	22.77	23.23	8.77	8.01	9.68	9.36	9.27	7.38	6.99	6.8	5.41	6.54
Hydraulic radius (ft)	0.54	0.59	0.58	0.53	0.53	0.96	0.99	0.97	0.96	0.91	0.77	0.61	0.8	0.72	0.69	0.93	0.71	0.86	0.72	0.89
Substrate																				
d50 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4.8	7	0.12	4	20.5	N/A	N/A	N/A	N/A	N/A
d84 (mm)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	28	42	0.6	66	79	N/A	N/A	N/A	N/A	N/A

REACH 2															
Parameter	As-built (2006)			MY-1 (2006)			MY-2 (2007)			MY-3 (2008)			MY-4 (2009)		
Pattern	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Channel Beltwidth (ft	11.83	22.05	16.96	11.56	23.13	17.05	11.45	24.13	17.55	10.41	25.86	15.91	11.96	21.21	15.94
Radius of Curvature (ft)	4.63	9.1	6.43	4.776	9.84	6.32	4.7	9.7	6.1	3.85	11.5	7.38	4.22	11.02	7.29
Meander Wavelength (ft)	27.51	34.72	31.75	28.61	35.43	32.47	28.42	35.03	31.73	21.56	40.37	30.58	28.77	35.91	31.36
Meander Width ratio	3.44	4.34	3.97	3.58	4.43	4.06	3.55	4.38	3.97	2.70	5.05	3.82	3.60	4.49	3.92
Profile															
Riffle length (ft)	3.36	11.6	5.6	4.93	7.24	5.88	4.95	7.64	6.01	4.2	15.24	8.73	5.7	11.39	8.19
Riffle slope (ft/ft)	0.0053	0.0555	0.0279	0.0045	0.1073	0.0393	0.0049	0.0534	0.0325	0.00231	0.10249	0.037	0.01052	0.05894	0.036
Pool length (ft)	5.2	10.08	7.59	5.17	14.37	8.67	5	15.25	10.125	4.07	12.31	9.59	6.47	16.42	10.3
Pool Slope (ft/ft)	0.001	0.0092	0.0022	0.00087	0.00754	0.00253	0.00084	0.00253	0.00738	0	0.0072	0.00236	0	0.00746	0.00257
Pool spacing (ft)	9.43	28.94	19.51	14.65	35.31	21.98	14.65	36.12	26.95	8.83	33.24	19.04	11.19	31.62	18.34
Additional Reach Parameters															
Valley Length (ft)	1872.37			1872.37			1872.37			1872.37			1872.37		
Channel Length (ft)	2190.67			2190.67			2190.67			2190.67			2190.67		
Sinuosity	1.2			1.2			1.2			1.2			1.2		
Water Surface Slope (ft/ft)	0.025			0.025			0.025			0.025			0.025		
BF slope (ft/ft)	0.025			0.025			0.025			0.025			0.025		
Rosgen Classificatio	B4			B4			B4			B4			B4		
Habitat Index*	N/A			N/A			N/A			N/A			N/A		
Macrobenthos*	N/A			N/A			N/A			N/A			N/A		

7. Benthic Macroinvertebrate Assessment and Interpretation of Data

Year 3 benthic sampling was performed by professionals with the necessary DWQ certification credentials. Samples were preserved in the field in 95% denatured Ethyl alcohol. Following collection, samples were sent to Pennington and Associates, a certified laboratory, for identification.

As stated in the Gray Farm Stream Restoration Mitigation Report (July 2006), biological monitoring will be used as a general indicator of restoration success; however, no specific biological criteria apply to the success of the restoration reaches.

As previously described, benthic sampling was performed at five (5) sampling locations. Where possible, each monitoring station consisted of a riffle-pool sequence. At each station, the Qual-4 sampling method, as described in the NCDENR-DWQ's Standard Operating Procedures for Benthic Macroinvertebrates. The Qual-4 method consists of:

1 Kick Net Sample (from riffle)
1 Sweep Net Sample (from bank)
1 Leaf Pack Sample
1 Visual Observation Sample

Ephemeropteran, Plecopteran, and Tricohopteran (EPT) taxa and abundance and NC Biotic Indices (NCBI), as well as a list of all taxa collected at each sampling point during previous monitoring years, are provided in Appendix C.

The benthic macroinvertebrate assessment presented in this report is based on Year 3 benthic sampling conducted in November 2008.

Benthic data for Year 3 indicate that water quality within Reach 1 is poor in the uppermost portion of the site abutting the cow pasture and upstream degraded channel segment, and increases within the restoration reach and the area downstream of the restoration reach. At all three (3) Reach 1 benthic monitoring stations the abundance, species diversity, EPT taxa, and EPT abundance are similar to or better than the pre-restoration conditions. These data indicate that the restoration of Reach 1 has been successful in improving water quality within the subject channel and the downstream receiving waters.

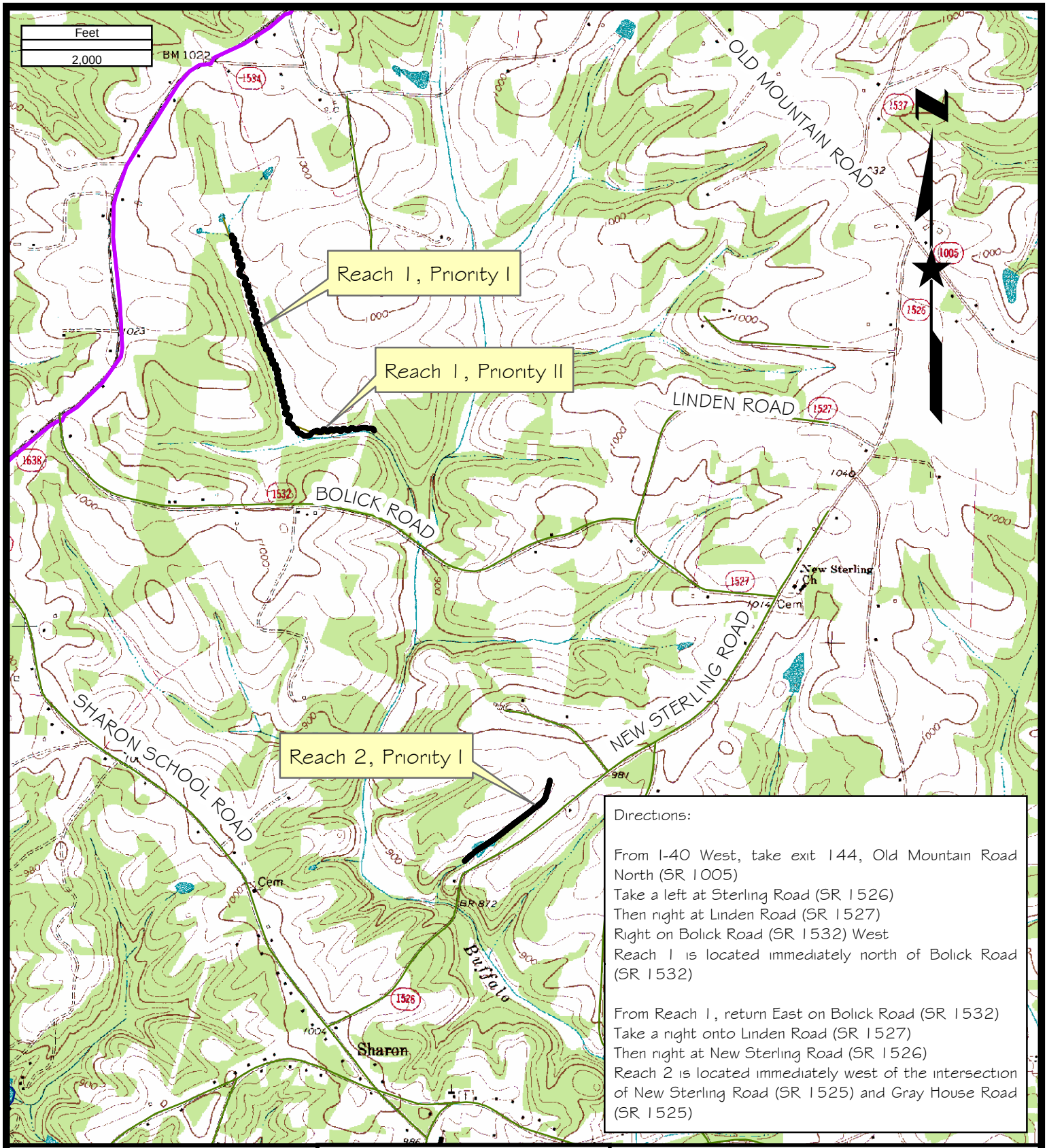
Within Reach 2, the NCBI rating for Year 3 at Station 1, within the restoration reach, is 9.11 indicating many tolerant taxa and relatively poor water quality. No EPT taxa were collected at Station 1; however, EPT taxa, species diversity and abundance increased between Station 1 and Station 2. During Monitoring Year 3, Station 2 received a low NCBI score (5.02), indicating few tolerant taxa and relatively high water quality.

NOTE: In the previously submitted Year 3 Monitoring Report, benthic macroinvertebrate data for Year 2 were entered for actual numbers of

organisms collected. This has been corrected, and the Year 4 Monitoring Report reflects the assigned values for all organisms collected in all monitoring years. For this reason, the data from Year 2 appear differently in this report than in the previously submitted Year 3 Monitoring Report.

IV. Methodology Section

With the exception of the aforementioned use of Level 2 (Planted and Natural Woody Stems) of the CVS-EEP Vegetation Monitoring Protocol, no deviations from initially prescribed methodologies were implemented as a part of Monitoring Year 4 (2009) activities.



Directions:

From I-40 West, take exit 144, Old Mountain Road North (SR 1005)
Take a left at Sterling Road (SR 1526)
Then right at Linden Road (SR 1527)
Right on Bolick Road (SR 1532) West
Reach 1 is located immediately north of Bolick Road (SR 1532)

From Reach 1, return East on Bolick Road (SR 1532)
Take a right onto Linden Road (SR 1527)
Then right at New Sterling Road (SR 1526)
Reach 2 is located immediately west of the intersection of New Sterling Road (SR 1525) and Gray House Road (SR 1525)

Project Number: 9385.D10	Map Title: Figure 1 - Project Location
Project Manager: DG	Gray Farm Stream Restoration Site EEP Job # 92219 Iredell County, NC
Scale: 1" = 2,000'	
Date: DECEMBER 2009	Source: Stony Point Quadrangle

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Ecosystem Enhancement Program

APPENDIX A

VEGETATION RAW DATA

APPENDIX A.1 –

Vegetation Survey Data Tables

Table V-1 – Vegetation Metadata

Report Prepared By	David Cooper
Date Prepared	11/12/2009 14:51
database name	DRAFT_2008-Gray Farm-level2.mdb
database location	\\Sec2\jobs7-9k\9385.D7-D11\YEAR 4 - D10\MONITORING DATA

DESCRIPTION OF WORKSHEETS IN THIS DOCUMENT----------

Metadata	This worksheet, which is a summary of the project and the project data.
Plots	List of plots surveyed.
Vigor	Frequency distribution of vigor classes.
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.
Stem Count by Plot and Spp	Count of living stems of each species for each plot; dead and missing stems are excluded.

PROJECT SUMMARY----------

Project Code	project Name	Description	length(ft)	stream-to-edge width (ft)	area (sq m)	Required Plots (calculated)	Sampled Plots
GF1	Gray Farm Reach 1	Gray Farm stream restoration - Reach 1					4
GF2	Gray Farm Reach 2	Gray Farm stream restoration - Reach 2					2

Table V-2 – Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing
	Alnus serrulata	**2**	**2**				**3**
	Betula nigra	**2**				**1**	**1**
	Cornus amomum		**3**				
	Diospyros virginiana						
	Fraxinus pennsylvanica	**1**	**1**	**1**			**3**
	Liquidambar styraciflua						
	Pinus taeda						
	Pinus virginiana						
	Quercus michauxii		**1**				
	Quercus nigra						**2**
	Quercus phellos	**3**	**8**	**3**	**1**	**1**	**2**
	Salix nigra						
	Sambucus canadensis						
	Viburnum nudum		**1**				**1**
	Viburnum		**1**				
	Viburnum dentatum	**1**					
	Ilex opaca		**2**				**3**
	Betula lenta						
	Carpinus caroliniana	**1**					
	Juniperus virginiana						
	Quercus sp.						**6**
	Quercus rubra	**2**					**1**
	Lindera benzoin						**4**
	Liriodendron tulipifera	**2**	**1**				**3**
	Platanus occidentalis	**10**	**13**				**5**
	Prunus serotina						
	Acer negundo						
	Acer rubrum						
TOT:	**28**	**24**	**33**	**4**	**1**	**2**	**34**

Table V-3 – Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Deer	Insects
	Acer negundo	**2**	**2**		
	Acer rubrum	**6**	**6**		
	Alnus serrulata	**7**	**7**		
	Betula lenta	**1**	**1**		
	Betula nigra	**4**	**4**		
	Carpinus caroliniana	**2**	**2**		
	Cornus amomum	**3**	**2**	**1**	
	Diospyros virginiana	**3**	**3**		
	Fraxinus pennsylvanica	**7**	**6**		**1**
	Ilex opaca	**5**	**5**		
	Juniperus virginiana	**1**	**1**		
	Lindera benzoin	**4**	**4**		
	Liquidambar styraciflua	**2**	**2**		
	Liriodendron tulipifera	**7**	**7**		
	Pinus taeda	**1**	**1**		
	Pinus virginiana	**1**	**1**		
	Platanus occidentalis	**30**	**30**		
	Prunus serotina	**2**	**2**		
	Quercus sp.	**6**	**6**		
	Quercus michauxii	**1**	**1**		
	Quercus nigra	**2**	**2**		
	Quercus phellos	**18**	**18**		
	Quercus rubra	**4**	**4**		
	Salix nigra	**1**	**1**		
	Sambucus canadensis	**2**	**2**		
	Viburnum sp.	**1**	**1**		
	Viburnum dentatum	**1**	**1**		
	Viburnum nudum	**2**	**2**		
TOT:	**28**	**126**	**124**	**1**	**1**

Table V-4 – Vegetation Damage by Plot

	plot	All Damage Categories	(no damage)	Deer	Insects
	GFR1-01-buffer1-year:3	20	20		
	GFR1-01-buffer2-year:3	21	20		1
	GFR1-01-buffer3-year:3	22	22		
	GFR1-01-buffer4-year:3	18	17	1	
	GFR2-01-Buffer1-year:3	28	28		
	GFR2-01-Buffer2-year:3	17	17		
TOT:	6	126	124	1	1

Table V-5 – Stem Count by Plot and Species

	Species	Total Stems	# plots	Avg. # stems	Gray Farm Reach 1, Buffer Plot 1, Year 4	Gray Farm Reach 1, Buffer Plot 2, Year 4	Gray Farm Reach 1, Buffer Plot 3, Year 4	Gray Farm Reach 1, Buffer Plot 4, Year 4	Gray Farm Reach 2, Buffer Plot 1, Year 4	Gray Farm Reach 2, Buffer Plot 2, Year 4
	Alnus serrulata	4	3	1.33	2		1	1		
	Betula nigra	2	2	1			1	1		
	Carpinus caroliniana	1	1	1					1	
	Cornus amomum	3	2	1.5			1	2		
	Fraxinus pennsylvanica	3	3	1	1	1	1			
	Ilex opaca	2	2	1			1		1	
	Liriodendron tulipifera	3	2	1.5		1				2
	Platanus occidentalis	23	6	3.83	2	2	9	7	2	1
	Quercus michauxii	1	1	1		1				
	Quercus phellos	15	4	3.75	2	2			10	1
	Quercus rubra	2	2	1	1					1
	Viburnum	1	1	1		1				
	Viburnum dentatum	1	1	1						1
	Viburnum nudum	1	1	1		1				
TOT:	14	62	14		8	9	14	11	14	6
	Total Plot Density (Stems Per Acre)				324	364	567	445	567	243
	Average Plot Density (Stems Per Acre)				418					

APPENDIX A.2 –

Vegetation Problem Area Tables

Exhibit Table A1 - Vegetative Problem Areas
Gray Farm Stream Restoration Site/EEP Project #92219

Reach 1			
Feature/Issue	**Station # / Range**	**Probable Cause**	**Photo #**
Bare Floodplain	2+00-2+60	Surface Flow / Poor Soil Quality	1-2
	4+50 - 5+75	Surface flow / Poor soil quality	
	6+10 - 6+90	Surface flow / Poor soil quality	
	42+00 - 42+50	Surface flow / Poor soil quality	
	42+75 - 43+30	Surface flow / Poor soil quality	
Bare Bank	40+70 - 41+00	Bank Scour	3

Reach 2			
Feature/Issue	**Station # / Range**	**Probable Cause**	**Photo #**
Vegetative Problem Areas Improved from Last Year	21+00 et.al.	Revegetation of previously bare areas	4

APPENDIX A.3 –

Vegetation Problem Area Photos

Photo 1 – Typical Bare Bench/Floodplain – Reach 1 – Year 4 (2009)

Photo 2 – Typical Bare Bench/Floodplain – Reach 1 – Year 4 (2009)

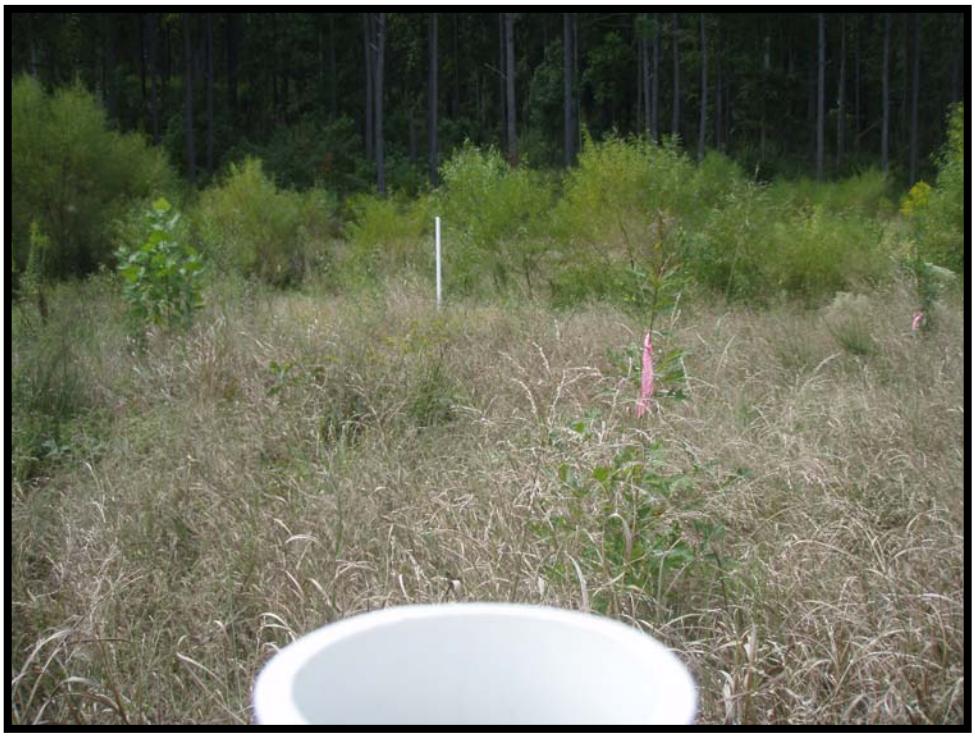
Photo 3 – Typical Bare Bank, Improved from Year 3 – Reach 1 – Year 4 (2009)

Photo 4 – Typical Vegetated Bench/Floodplain, Improved from Year 3 – Reach 2 – Year 4 (2009)

APPENDIX A.4 –

Vegetation Monitoring Plot Photos

Vegetation Monitoring Plot—Reach 1— Buffer 1—Year 4 (2009)



Vegetation Monitoring Plot—Reach 1— Buffer 1—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1—Buffer 1—Year 2 (2007)

Vegetation Monitoring Plot—Reach 1—Buffer 1—Year 1 (2006)

Appendix A **Vegetation Monitoring Plot Photos**

Vegetation Monitoring Plot—Reach 1— Buffer 2—Year 4 (2009)

Vegetation Monitoring Plot—Reach 1— Buffer 2—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1— Buffer 2—Year 2 (2007)

Vegetation Monitoring Plot—Reach 1— Buffer 2—Year 1 (2006)

Vegetation Monitoring Plot—Reach 1— Buffer 3—Year 4 (2009)

Vegetation Monitoring Plot—Reach 1— Buffer 3—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1— Buffer 3—Year 2 (2007)

Vegetation Monitoring Plot—Reach 1— Buffer 3—Year 1 (2006)

Appendix A Vegetation Monitoring Plot Photos

Vegetation Monitoring Plot—Reach 1— Buffer 4—Year 4 (2009)

Vegetation Monitoring Plot—Reach 1— Buffer 4—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1— Buffer 4—Year 2 (2007)

Vegetation Monitoring Plot—Reach 1— Buffer 4—Year 1 (2006)

Vegetation Monitoring Plot—Reach 1— Bank 1—Year 4 (2009)

Vegetation Monitoring Plot—Reach 1— Bank 1—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1— Bank 1—Year 2 (2007)

Vegetation Monitoring Plot—Reach 1— Bank 1—Year 1 (2006)

Vegetation Monitoring Plot—Reach 1— Bank 2—Year 4 (2009)

Vegetation Monitoring Plot—Reach 1— Bank 2—Year 3 (2008)

Vegetation Monitoring Plot—Reach 1— Bank 2—Year 2 (2007)

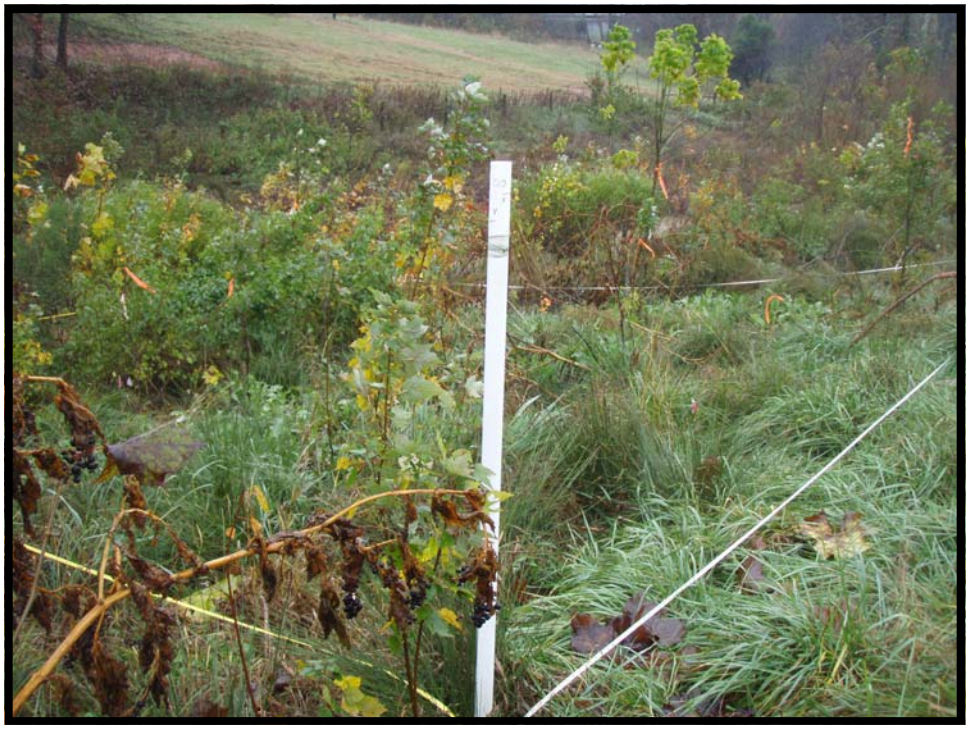
Vegetation Monitoring Plot—Reach 1— Bank 2—Year 1 (2006)

Vegetation Monitoring Plot—Reach 2— Buffer 1—Year 4 (2009)

Vegetation Monitoring Plot—Reach 2— Buffer 1—Year 3 (2008)

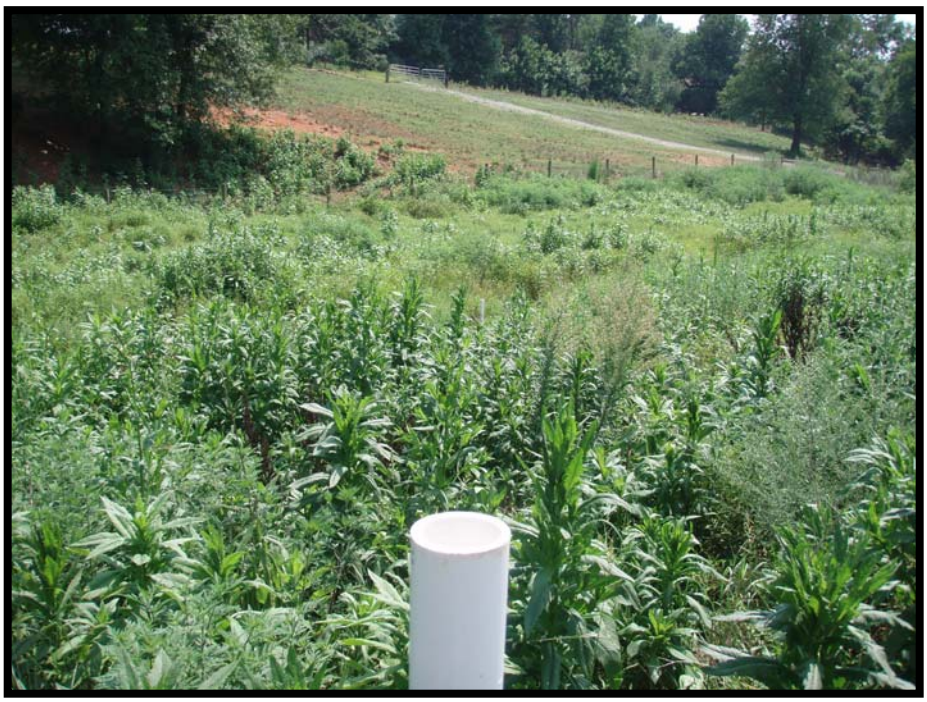
Vegetation Monitoring Plot—Reach 2— Buffer 1—Year 2 (2007)

Vegetation Monitoring Plot—Reach 2— Buffer 1—Year 1 (2006)



Vegetation Monitoring Plot—Reach 2— Buffer 2—Year 4 (2009)

Vegetation Monitoring Plot—Reach 2— Buffer 2—Year 3 (2008)



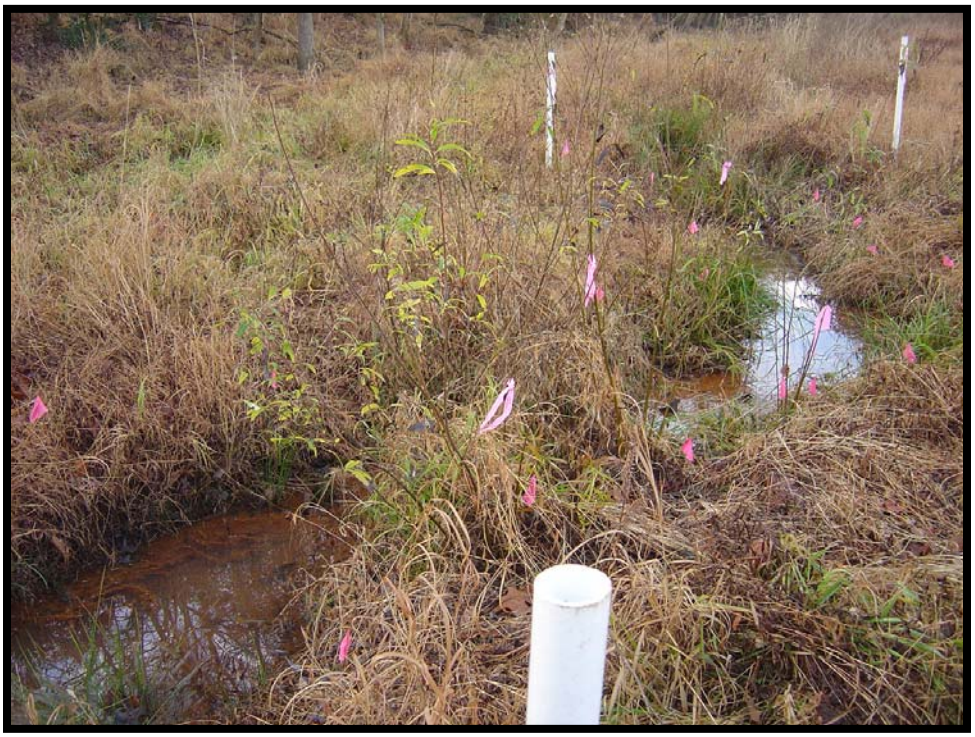
Vegetation Monitoring Plot—Reach 2— Buffer 2—Year 2 (2007)

Vegetation Monitoring Plot—Reach 2— Buffer 2—Year 1 (2006)

Vegetation Monitoring Plot—Reach 2— Bank 1—Year 4 (2009)

Vegetation Monitoring Plot—Reach 2— Bank 1—Year 3 (2008)

Vegetation Monitoring Plot—Reach 2— Bank 1—Year 2 (2007)



Vegetation Monitoring Plot—Reach 2— Bank 1—Year 1 (2006)

Vegetation Monitoring Plot—Reach 2— Bank 2—Year 4 (2009)

Vegetation Monitoring Plot—Reach 2— Bank 2—Year 3 (2008)

Vegetation Monitoring Plot—Reach 2— Bank 2—Year 2 (2007)

Vegetation Monitoring Plot—Reach 2— Bank 2—Year 1 (2006)

APPENDIX B

GEOMORPHOLOGIC RAW DATA

APPENDIX B.1 –

Bankfull Events

Photo 1 – Reach 1 – Wrack Piles near Cross-section 3

Photo 2 – Reach 1 – Overbank Event 11/11/2009

Photo 3 – Reach 2 – Bankfull Event 11/11/2009

APPENDIX B.2 –

Stream Problem Area Table (Table B1)

Exhibit Table B1- Stream Problem Areas
Gray Farm Stream Restoration Site/EEP Project #92219

Reach 1			
Feature Issue	**Station numbers**	**Suspected Cause**	**Photo number**
Bank Scour	24+75	Surface flow	1-2
	30+00	Surface flow	
	32+60	Surface flow	
	41+60	Surface flow	
	43+05	Surface flow - Settling fill	
Undercut Bank	47+00 - 47+50	Increased water velocity from nearby tributary	3
Structures	0+30	Buried Structure - Upstream Sediment	4
	1+50	Buried Structure - Upstream Sediment	
	24+75	Stressed structure - Bank Scour	1-2
	31+60	Stressed structure - Bank Scour	
	41+60	Stressed structure - Bank Scour	
	43+05	Stressed structure - Bank Scour	
Beaver Dam	56+40	Beavers	5

Reach 2			
Feature Issue	**Station numbers**	**Suspected Cause**	**Photo number**
Bank Scour	2+50	Surface Flow	6
	4+80	Surface flow	
	6+00	Surface flow	
	16+60	Surface flow	
	12+70 - 12+80	Surface flow	
Channel Scour	16+10	High Stormwater Flow	7
Structures	2+50	Stressed Structure - Bank Scour	6
	4+80	Stressed structure - Bank Scour	
	6+00	Stressed structure - Bank Scour	
	16+60	Stressed structure - Bank Scour	
	12+70 - 12+80	Stressed structures - Bank Scour	

APPENDIX B.3 –

Stream Problem Area Photos

Photo 1 – Typical Stressed Structure/Bank Scour – Reach 1 – Year 4 (2009)

Photo 2 – Typical Stressed Structure/Bank Scour – Reach 1 – Year 4 (2009)

Photo 3 – Typical Undercut Bank – Reach 1 – Year 4 (2009)

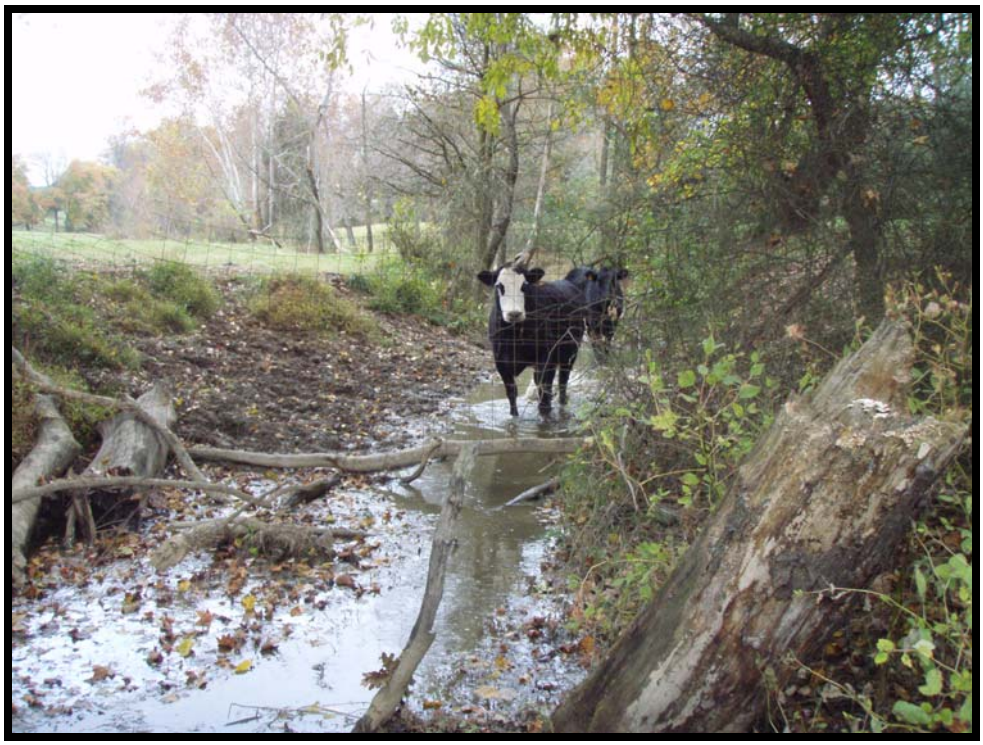


Photo 4 – Sediment from Off-site – Reach 1 near Beginning of Restoration – Year 4 (2009)

Photo 5 – Beaver Dam – Reach 1 near End of Restoration – Year 4 (2009)

Photo 6 – Typical Stressed Structure/Bank Scour – Reach 2 – Year 4 (2009)

Photo 7 – Area of Channel Scour (Station 16+10 in Long Profile Section 2) – Reach 2 – Year 4 (2009)

APPENDIX B.4 –

Stream Photo-Station Photos

Cross-Section 1— Reach 1—Riffle 1—Year 4 (2009)

Cross-Section 1— Reach 1—Riffle 1—Year 3 (2008)

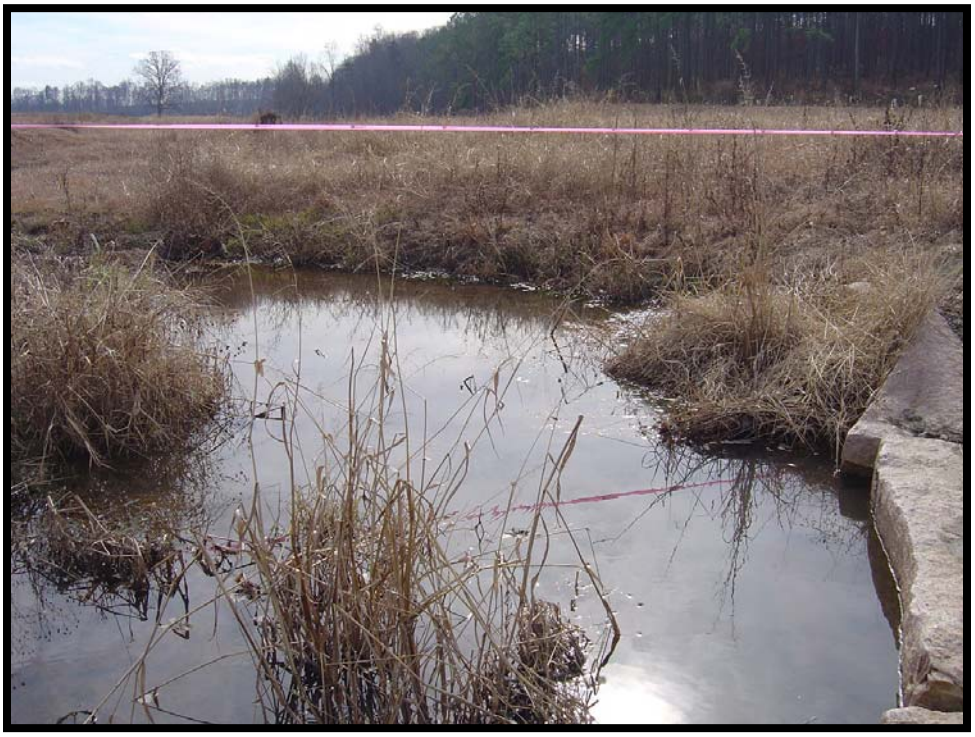
Cross-Section 1— Reach 1—Riffle 1—Year 2 (2007)

Cross-Section 1— Reach 1—Riffle 1—Year 1 (2006)

Cross-Section 1— Reach 1—Pool 1—Year 4 (2009)

Cross-Section 1— Reach 1—Pool 1—Year 3 (2008)

Cross-Section 1— Reach 1—Pool 1—Year 2 (2007)



Cross-Section 1— Reach 1—Pool 1—Year 1 (2006)

Cross-Section 2—Reach 1—Riffle 2—Year 4 (2009)

Cross-Section 2—Reach 1—Riffle 2—Year 3 (2008)

Cross-Section 2—Reach 1—Riffle 2—Year 2 (2007)

Cross-Section 2—Reach 1—Riffle 2—Year 1 (2006)

Cross-Section 2—Reach 1 - Pool 2—Year 4 (2009)

Cross-Section 2—Reach 1 - Pool 2—Year 3 (2008)

Cross-Section 2—Reach 1 - Pool 2—Year 2 (2007)

Cross-Section 2—Reach 1 - Pool 2—Year 1 (2006)

Cross-Section 3—Reach 1—Riffle 3—Year 4 (2009)

Cross-Section 3—Reach 1—Riffle 3—Year 3 (2008)

Cross-Section 3—Reach 1—Riffle 3—Year 2 (2007)

Cross-Section 3—Reach 1—Riffle 3—Year 1 (2006)

Cross-Section 3—Reach 1 - Pool 3—Year 4 (2009)

Cross-Section 3—Reach 1 - Pool 3—Year 3 (2008)

Cross-Section 3—Reach 1 - Pool 3—Year 2 (2007)

Cross-Section 3—Reach 1 - Pool 3—Year 1 (2006)

Cross-Section 4—Reach 1—Riffle 4—Year 4 (2009)

Cross-Section 4—Reach 1—Riffle 4—Year 3 (2008)

Cross-Section 4—Reach 1—Riffle 4—Year 2 (2007)

Cross-Section 4—Reach 1—Riffle 4—Year 1 (2006)

Cross-Section 4—Reach 1—Pool 4—Year 4 (2009)

Cross-Section 4—Reach 1—Pool 4—Year 3 (2008)

Cross-Section 4—Reach 1—Pool 4—Year 2 (2007)

Cross-Section 4—Reach 1—Pool 4—Year 1 (2006)

Cross-Section 5—Reach 1—Riffle 5—Year 4 (2009)

Cross-Section 5—Reach 1—Riffle 5—Year 3 (2008)

Cross-Section 5—Reach 1—Riffle 5—Year 2 (2007)

Cross-Section 5—Reach 1—Riffle 5—Year 1 (2006)

Cross-Section 5—Reach 1—Pool 5—Year 4 (2009)

Cross-Section 5—Reach 1—Pool 5—Year 3 (2008)

Cross-Section 5—Reach 1—Pool 5—Year 2 (2007)

Cross-Section 5—Reach 1—Pool 5—Year 1 (2006)

Cross-Section 6—Reach 1—Riffle 6—Year 4 (2009)

Cross-Section 6—Reach 1—Riffle 6—Year 3 (2008)

Cross-Section 6—Reach 1—Riffle 6—Year 2 (2007)

Cross-Section 6—Reach 1—Riffle 6—Year 1 (2006)

Cross-Section 6—Reach 1—Pool 6—Year 4 (2009)

Cross-Section 6—Reach 1—Pool 6—Year 3 (2008)

Cross-Section 6—Reach 1—Pool 6—Year 2 (2007)

Cross-Section 6—Reach 1—Pool 6—Year 1 (2006)

Cross-Section 7—Reach 1—Riffle 7—Year 4 (2009)

Cross-Section 7—Reach 1—Riffle 7—Year 3 (2008)

Cross-Section 7—Reach 1—Riffle 7—Year 2 (2007)

Cross-Section 7—Reach 1—Riffle 7—Year 1 (2006)

Cross-Section 7—Reach 1—Pool 7—Year 4 (2009)

Cross-Section 7—Reach 1—Pool 7—Year 3 (2008)

Cross-Section 7—Reach 1—Pool 7—Year 2 (2007)

Cross-Section 7—Reach 1—Pool 7—Year 1 (2006)

Cross-Section 1—Reach 2—Riffle 1—Year 4 (2009)

Cross-Section 1—Reach 2—Riffle 1—Year 3 (2008)

Cross-Section 1—Reach 2—Riffle 1—Year 2 (2007)

Cross-Section 1—Reach 2—Riffle 1—Year 1 (2006)

Cross-Section 1—Reach 2—Pool 1—Year 4 (2009)

Cross-Section 1—Reach 2—Pool 1—Year 3 (2008)

Cross-Section 1—Reach 2—Pool 1—Year 2 (2007)

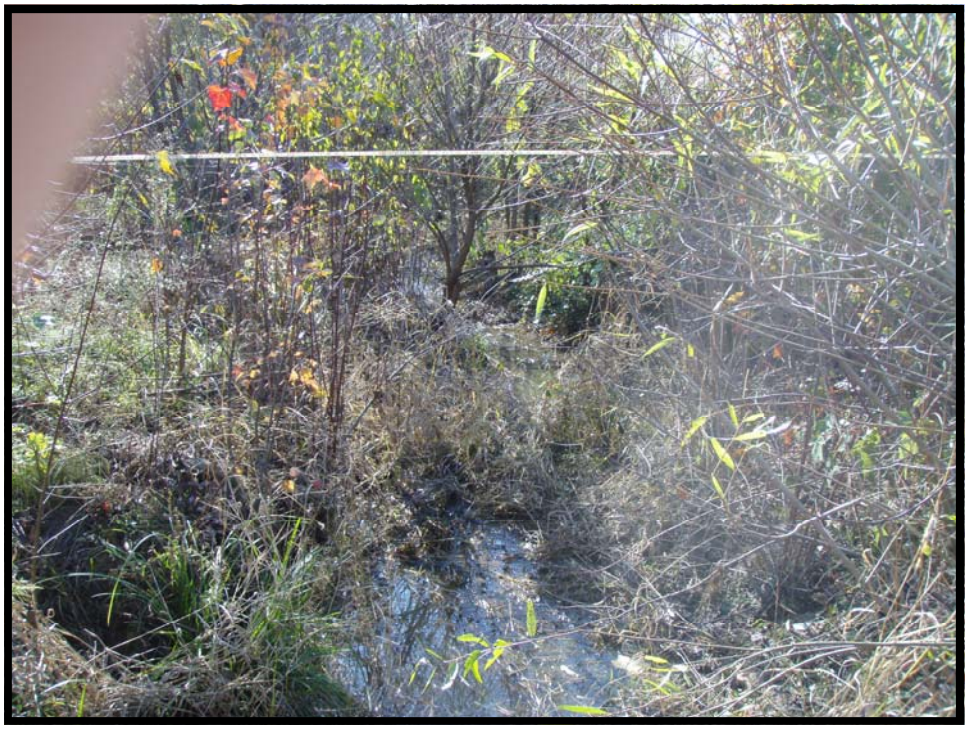
Cross-Section 1—Reach 2—Pool 1—Year 1 (2006)

Cross-Section 2—Reach 2—Riffle 2—Year 4 (2009)

Cross-Section 2—Reach 2—Riffle 2—Year 3 (2008)

Cross-Section 2—Reach 2—Riffle 2—Year 2 (2007)

Cross-Section 2—Reach 2—Riffle 2—Year 1 (2006)



Cross-Section 2—Reach 2—Pool 2—Year 4 (2009)

Cross-Section 2—Reach 2—Pool 2—Year 3 (2008)

Cross-Section 2—Reach 2—Pool 2—Year 2 (2007)

Cross-Section 2—Reach 2—Pool 2—Year 1 (2006)

APPENDIX B.5 –

Exhibit Table B2 - Qualitative Visual Stability Assessment

Table B2 - Qualitative Visual Stability Assessment
Date: NOVEMBER 2009 Project # 9385.D10
GRAY FARM STREAM RESTORATION - REACH 1

Feature Category	Metric (per As-built and reference baselines	(# stable) Number performing as intended	Total number per As-built	Total Number / feet in unstable state	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	34	34	NA	100%	
	2. Armor stable (e.g. no displacement)?	34	34	NA	100%	
	3. Facet grade appears stable?	33	34	NA	97%	
	4. Stable interval grade?	34	34	NA	100%	
	5. Feature spacing appropriate?	34	34	NA	100%	
	6. Minimal evidence of embedding/fining?	34	34	NA	100%	
	7. Depth appears appropriate for current discharge?	34	34	NA	100%	
	8. Length appropriate?	34	34	NA	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	48	49	NA	98%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6)	48	49	NA	98%	
	3. Thalweg located outer bend?	49	49	NA	100%	
	4. Spacing appropriate?	49	49	NA	100%	
	5. Non-aggrading (not filling)?	48	49	NA	98%	
	6. Length appropriate?	49	49	NA	100%	**99%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	34	34	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	33	34	NA	97%	**99%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	48	49	NA	98%	
	2. Of those eroding, # w/ concomitant point bar formation?	N/A	49	NA	N/A	
	3. Apparent Rc within spec?	49	49	NA	100%	
	4. Sufficient floodplain access and relief?	49	49	NA	100%	**99%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	75	98%	**99%**
G. Banks	1. Apparent scour points from channel processes	NA	NA	35	99%	
	2. Apparent cut points from overland flow	NA	NA	150	96%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	0	100%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	0	100%	
	6. Collapse/slumping	NA	NA	0	100%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	0	100%	**99%**
H. Vanes	1. Free of back or arm scour?	27	28	N/A	96%	
	2. Height appropriate?	28	28	N/A	100%	
	3. Angle and geometry appear appropriate?	27	28	N/A	96%	
	4. Free of piping or other structural failures?	28	28	N/A	100%	**98%**
I. Wads/Boulders	1. Free of scour?	0	0	N/A	N/A	
	2. Footing stable?	0	0	N/A	N/A	**N/A**

Notes:

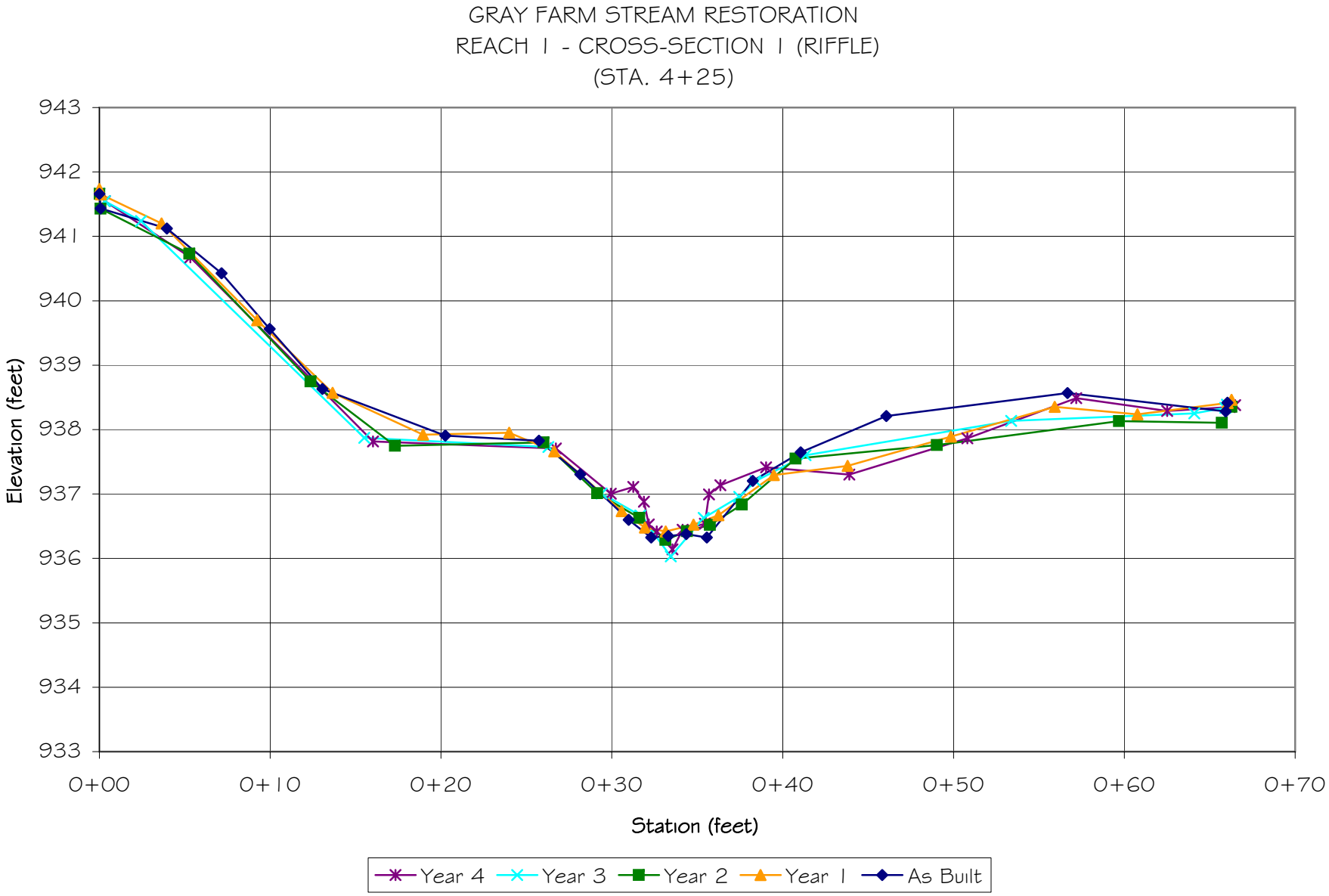
Table B2 - Qualitative Visual Stability Assessment
Date: NOVEMBER 2009 Project # 9385.D10
GRAY FARM STREAM RESTORATION - REACH 2

Feature Category	Metric (per As-built and reference baselines	(# stable) Number performing as intended	Total number per As-built	Total Number / feet in unstable state	% perfor. in stable condition	Feature Perform. Mean or Total
A. Riffles	1. Present?	51	51	NA	100%	
	2. Armor stable (e.g. no displacement)?	51	51	NA	100%	
	3. Facet grade appears stable?	51	51	NA	100%	
	4. Stable interval grade?	51	51	NA	100%	
	5. Feature spacing appropriate?	51	51	NA	100%	
	6. Minimal evidence of embedding/fining?	51	51	NA	100%	
	7. Depth appears appropriate for current discharge?	51	51	NA	100%	
	8. Length appropriate?	51	51	NA	100%	**100%**
B. Pools	1. Present? (e.g. not subject to severe aggradation?)	52	52	NA	100%	
	2. Sufficiently deep (Max Pool D:Mean Bkf>1.6)	52	52	NA	100%	
	3. Thalweg located outer bend?	52	52	NA	100%	
	4. Spacing appropriate?	52	52	NA	N/A	
	5. Non-aggrading (not filling)?	52	52	NA	100%	
	6. Length appropriate?	52	52	NA	N/A	**100%**
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	51	51	NA	100%	
	2. Downstream of meander (glide/inflection) centering?	51	51	NA	100%	**100%**
D. Meanders	1. Outer bend in state of limited/controlled erosion?	49	52	NA	94%	
	2. Of those eroding, # w/ concomitant point bar formation?	N/A	N/A	NA	N/A	
	3. Apparent Rc within spec?	52	52	NA	100%	
	4. Sufficient floodplain access and relief?	52	52	NA	100%	**97%**
E. Bed General	1. General channel bed aggradation areas (bar formation)	NA	NA	0	100%	
	2. Channel bed degradation - areas of increasing down cutting or head cutting?	NA	NA	15	99%	**99%**
G. Banks	1. Apparent scour points from channel processes	NA	NA	25	98%	
	2. Apparent cut points from overland flow	NA	NA	0	100%	
	3. Apparent cut or scour from flood water re-entry to channel (e.g. inadequate floodplain access?)	NA	NA	0	100%	
	4. Tension cracks	NA	NA	0	100%	
	5. Bank gradient in excess of 40%?	NA	NA	0	100%	
	6. Collapse/slumping	NA	NA	0	100%	
	7. Ratio of bank height: bankfull height elevated	NA	NA	0	100%	**100%**
H. Vanes	1. Free of back or arm scour?	50	53	NA	94%	
	2. Height appropriate?	53	53	NA	100%	
	3. Angle and geometry appear appropriate?	51	53	NA	96%	
	4. Free of piping or other structural failures?	50	53	NA	94%	**96%**
I. Wads/Boulders	1. Free of scour?	0	0	NA	N/A	
	2. Footing stable?	0	0	NA	N/A	**N/A**

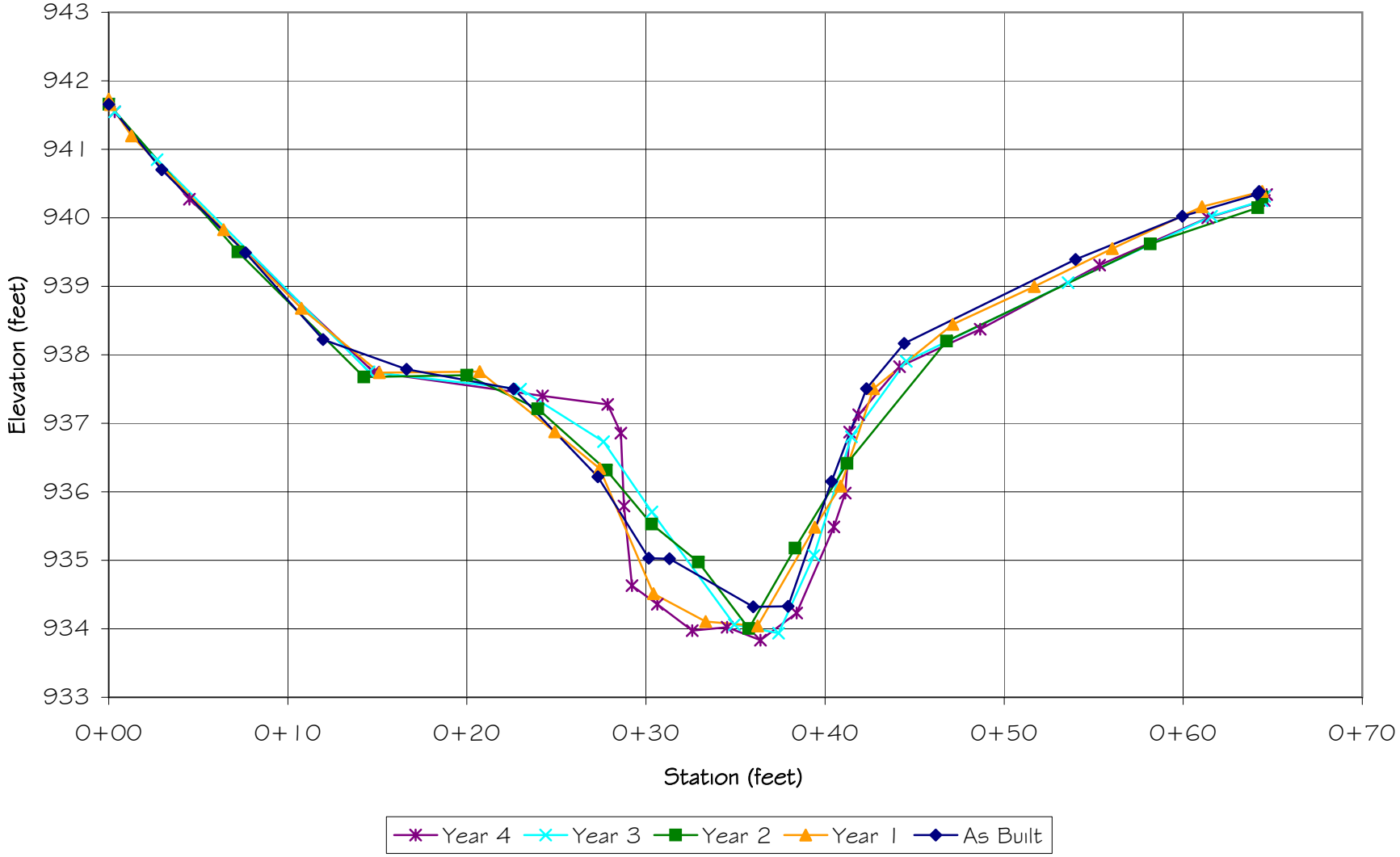
Notes:

APPENDIX B.6 –

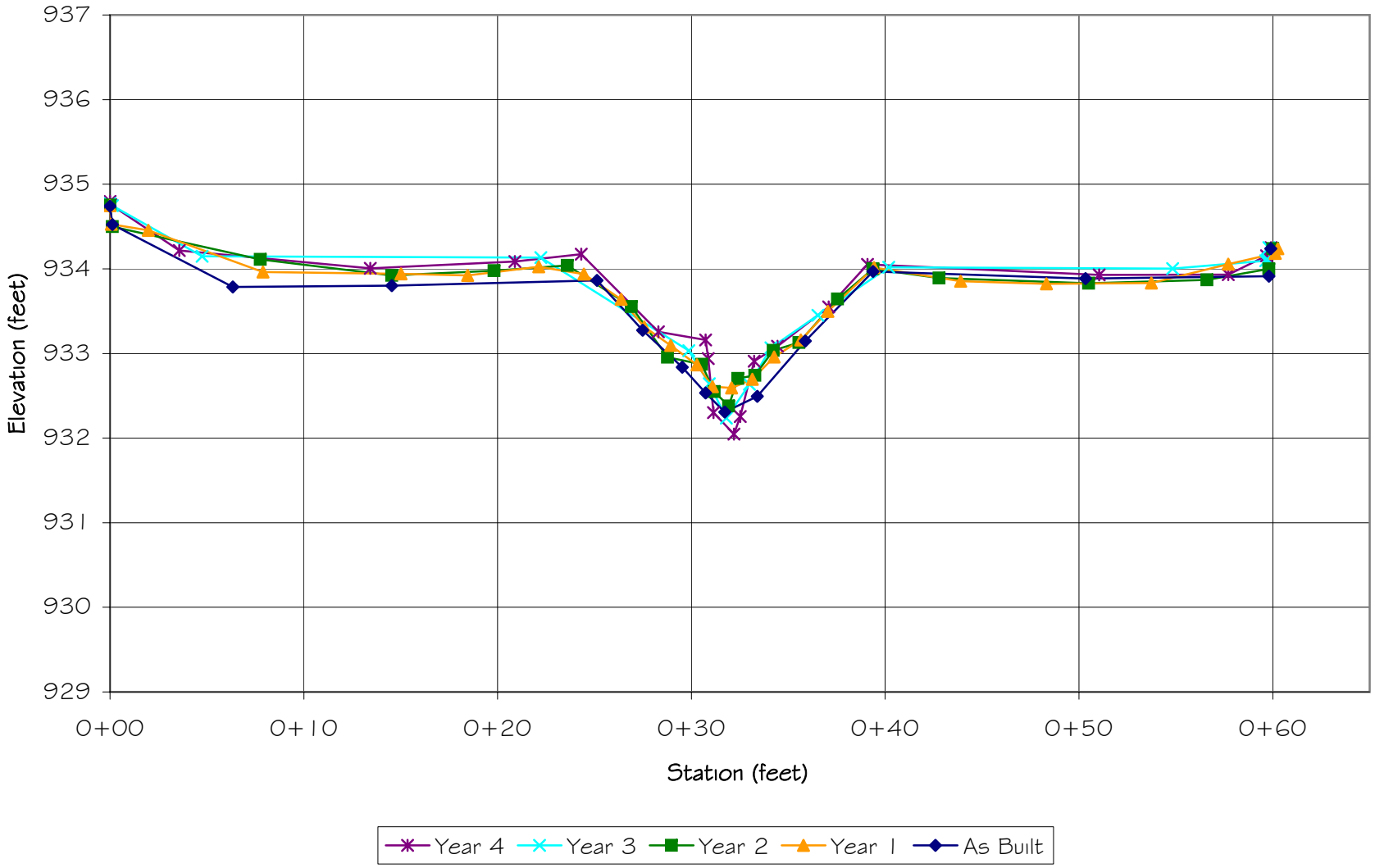
Annual Overlays of Cross Section Plots


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 1 (RIFFLE)
(STA. 4+25)
Elevation (feet)
943
942
941
940
939
938
937
936
935
934
933
0+00
0+10
0+20
0+30
0+40
0+50
0+60
0+70
Station (feet)
Year 4
Year 3
Year 2
Year 1
As Built

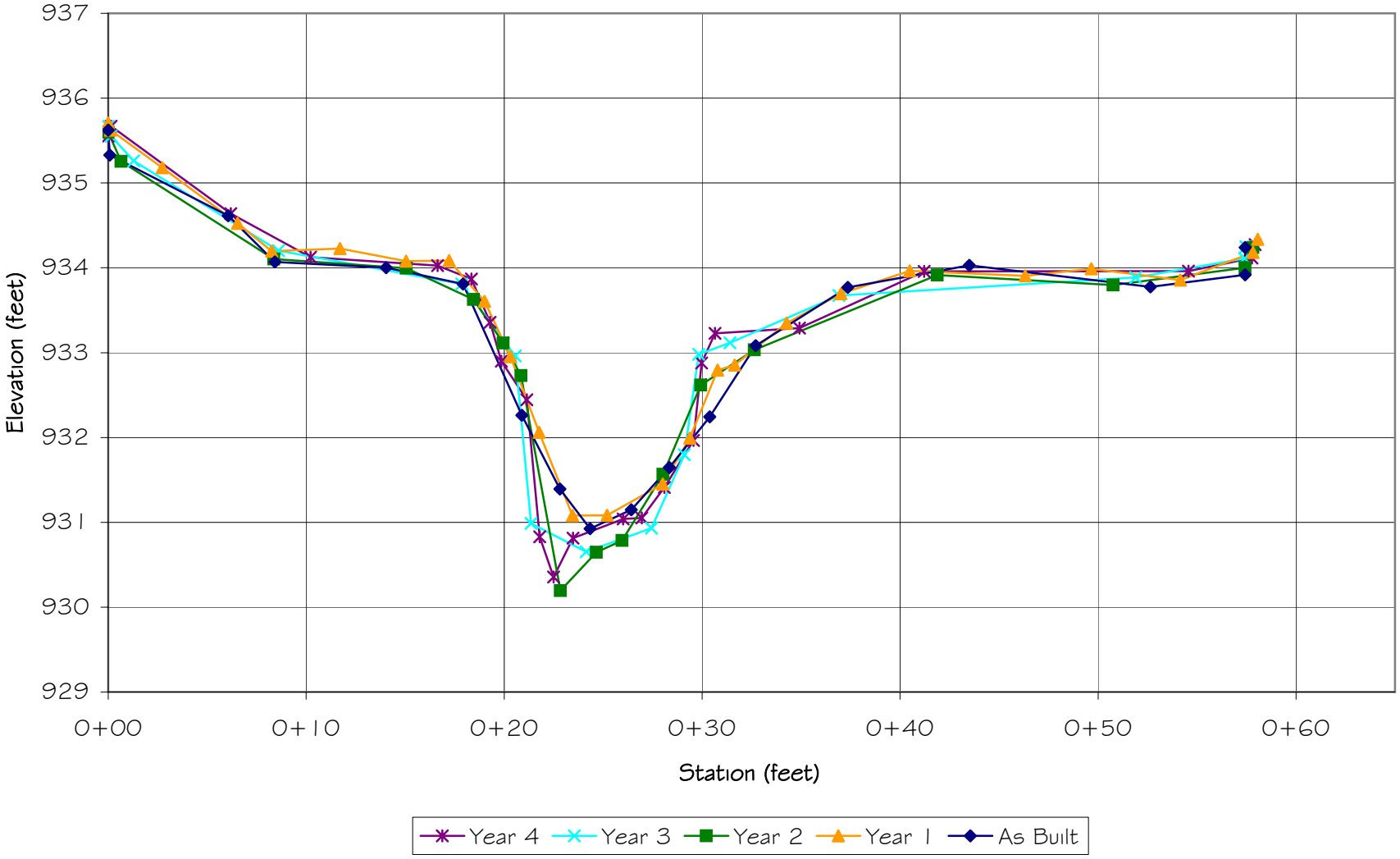
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 1 (POOL)
(STA. 4+65)



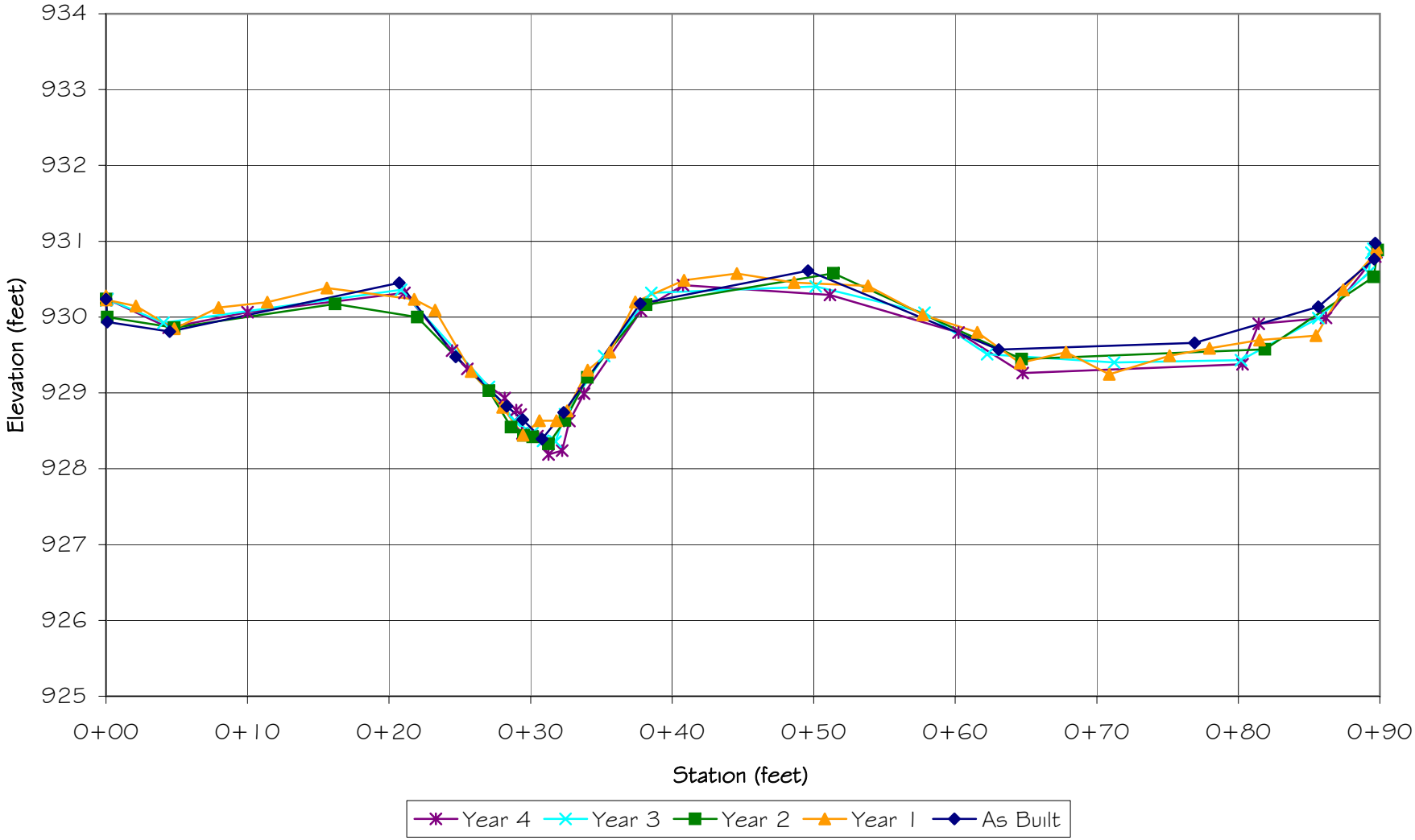
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 2 (RIFFLE)
(STA. 13+55)



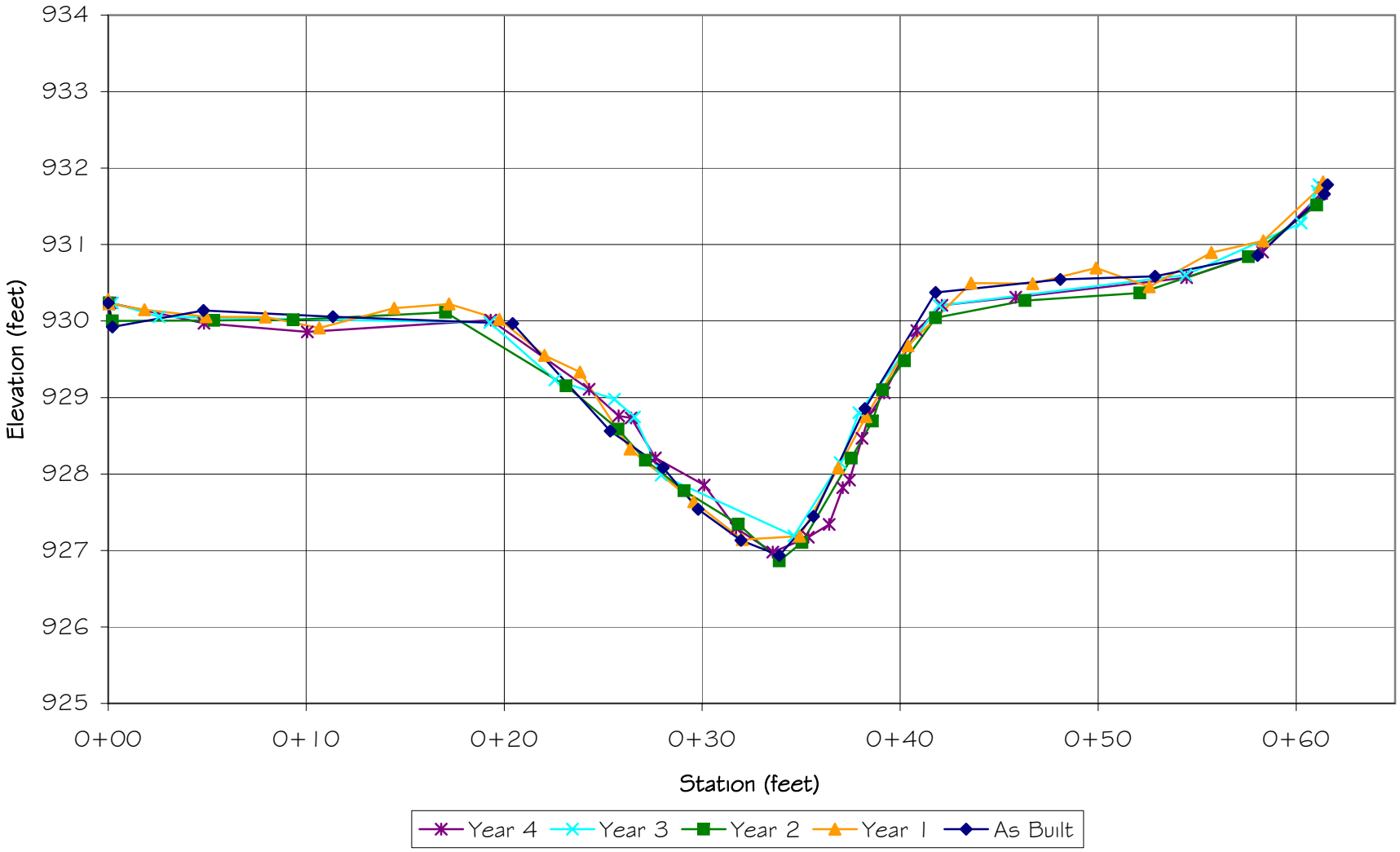
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 2 (POOL)
(STA. 13+90)

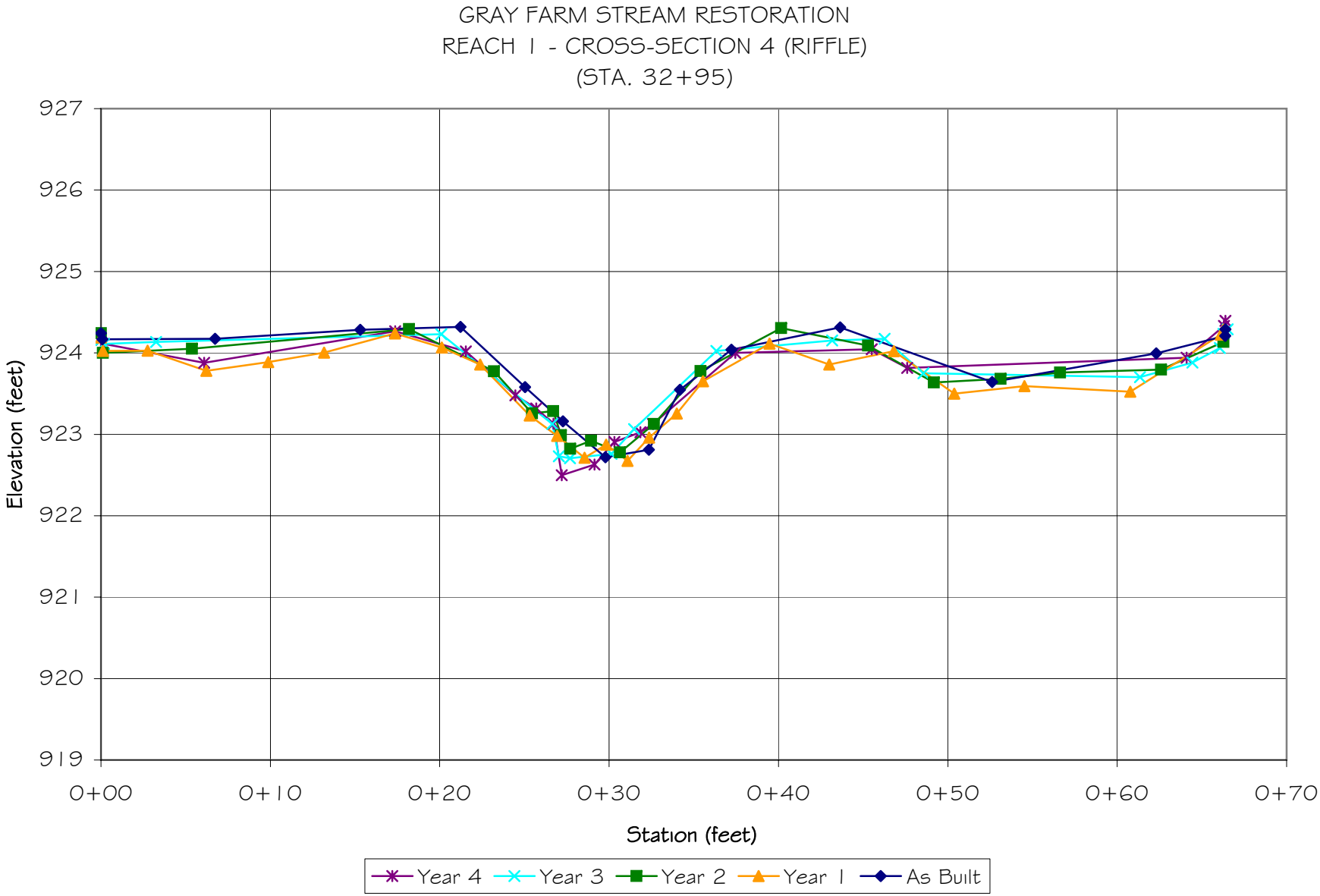


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 3 (RIFFLE)
(STA. 23+40)

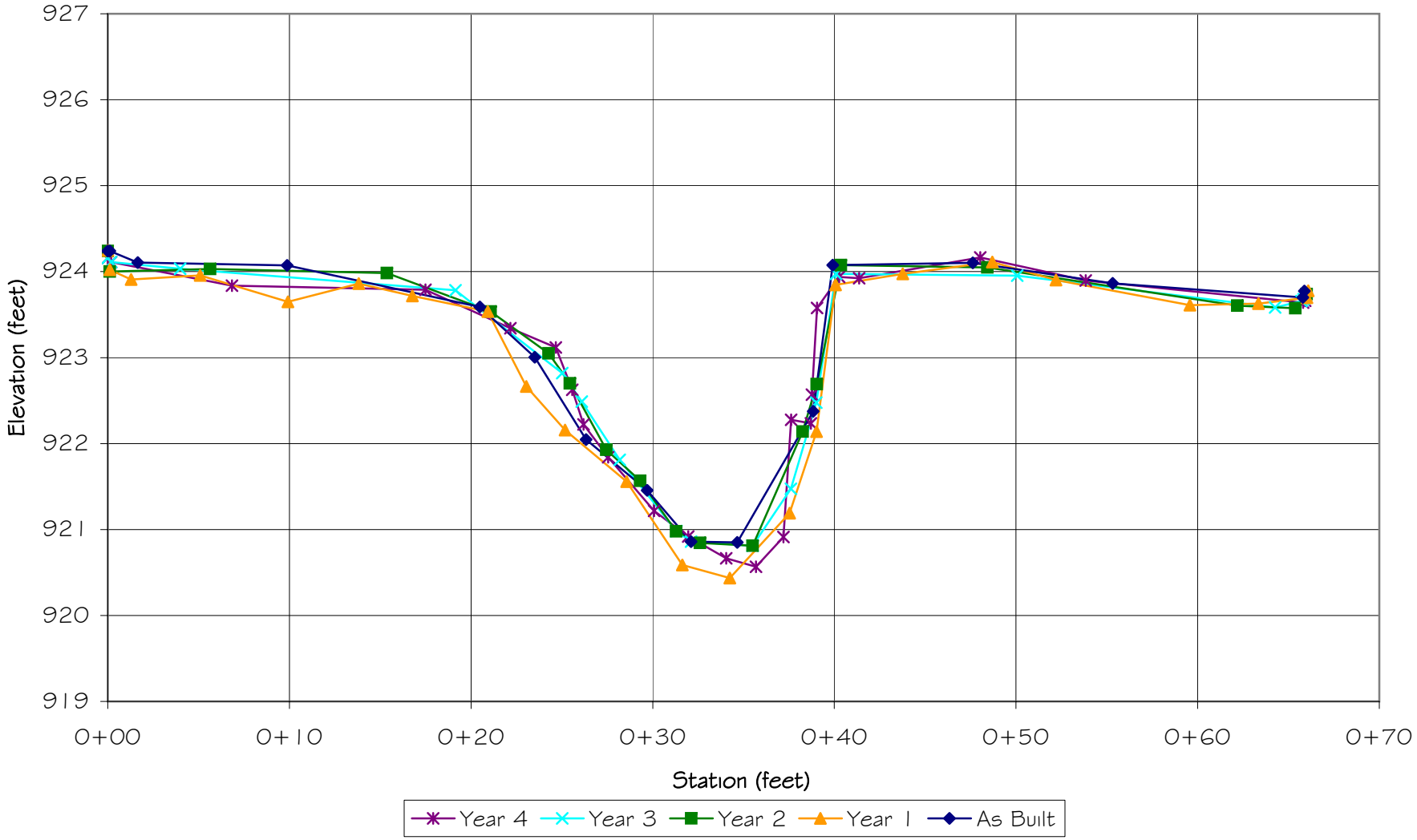


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 3 (POOL)
(STA. 23+20)

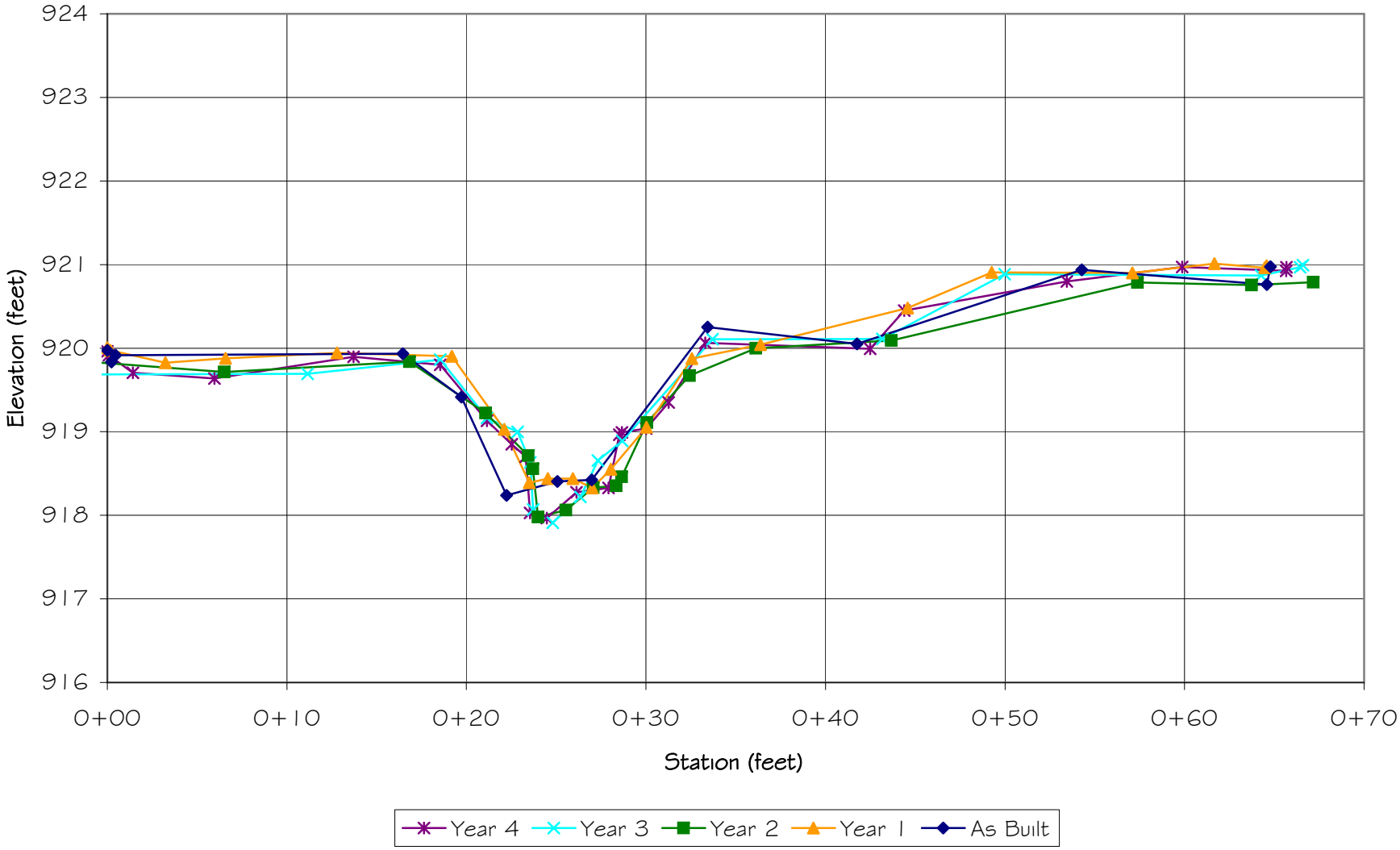


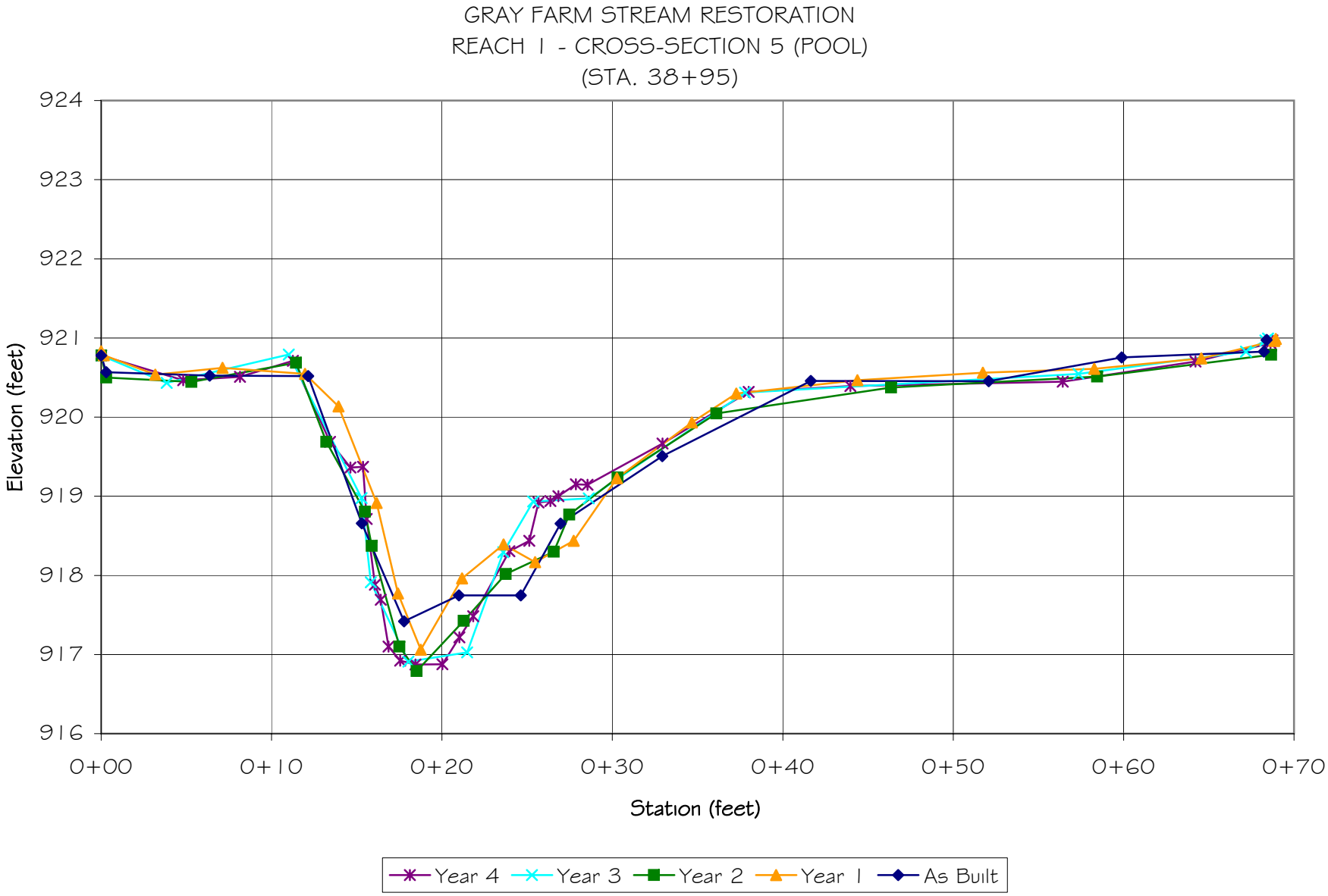

GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 4 (RIFFLE)
(STA. 32+95)
927
926
925
924
923
922
921
920
919
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
0+50
0+60
0+70
Station (feet)
Year 4
Year 3
Year 2
Year 1
As Built

GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 4 (POOL)
(STA. 33+30)

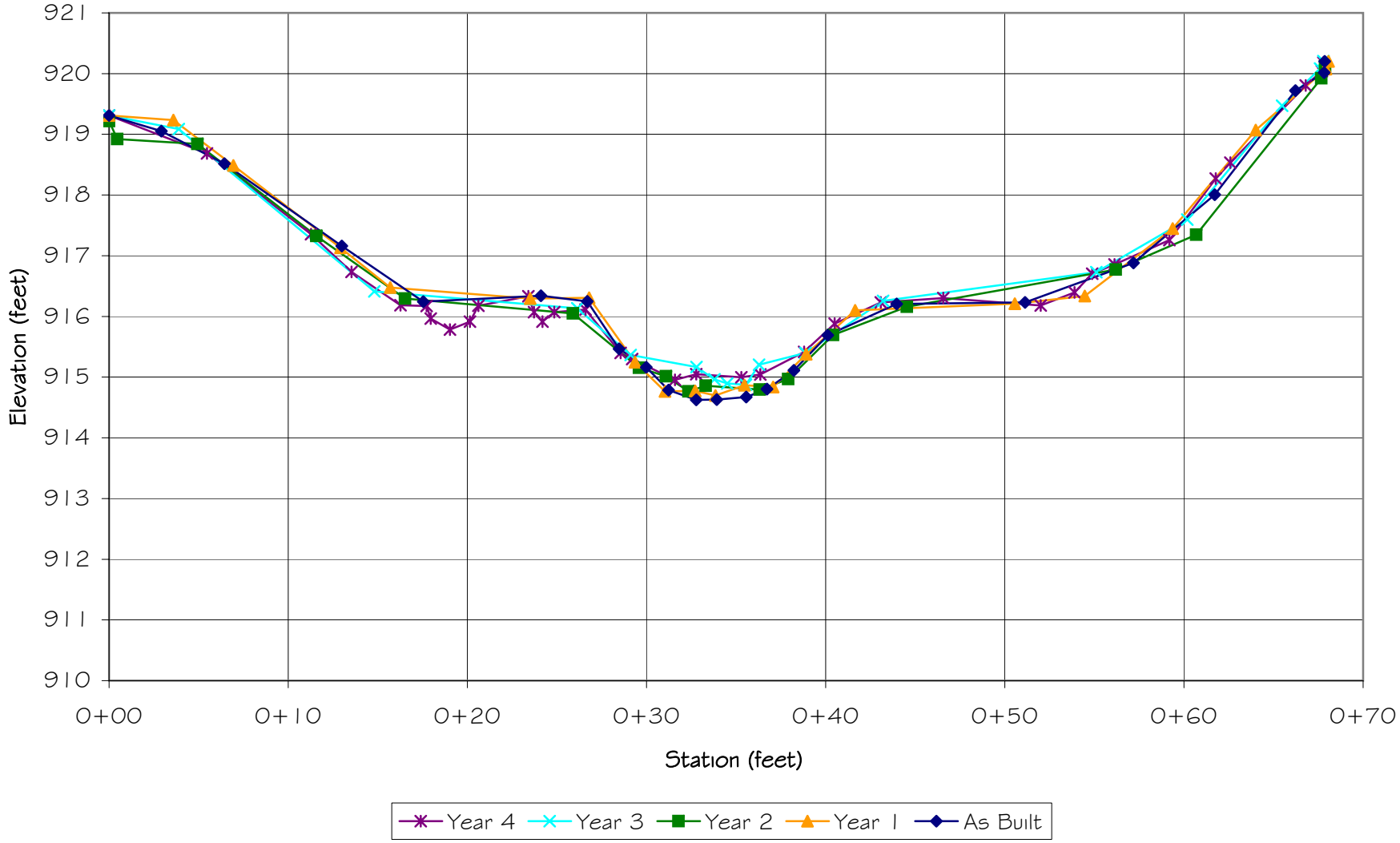


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 5 (RIFFLE)
(STA. 39+30)

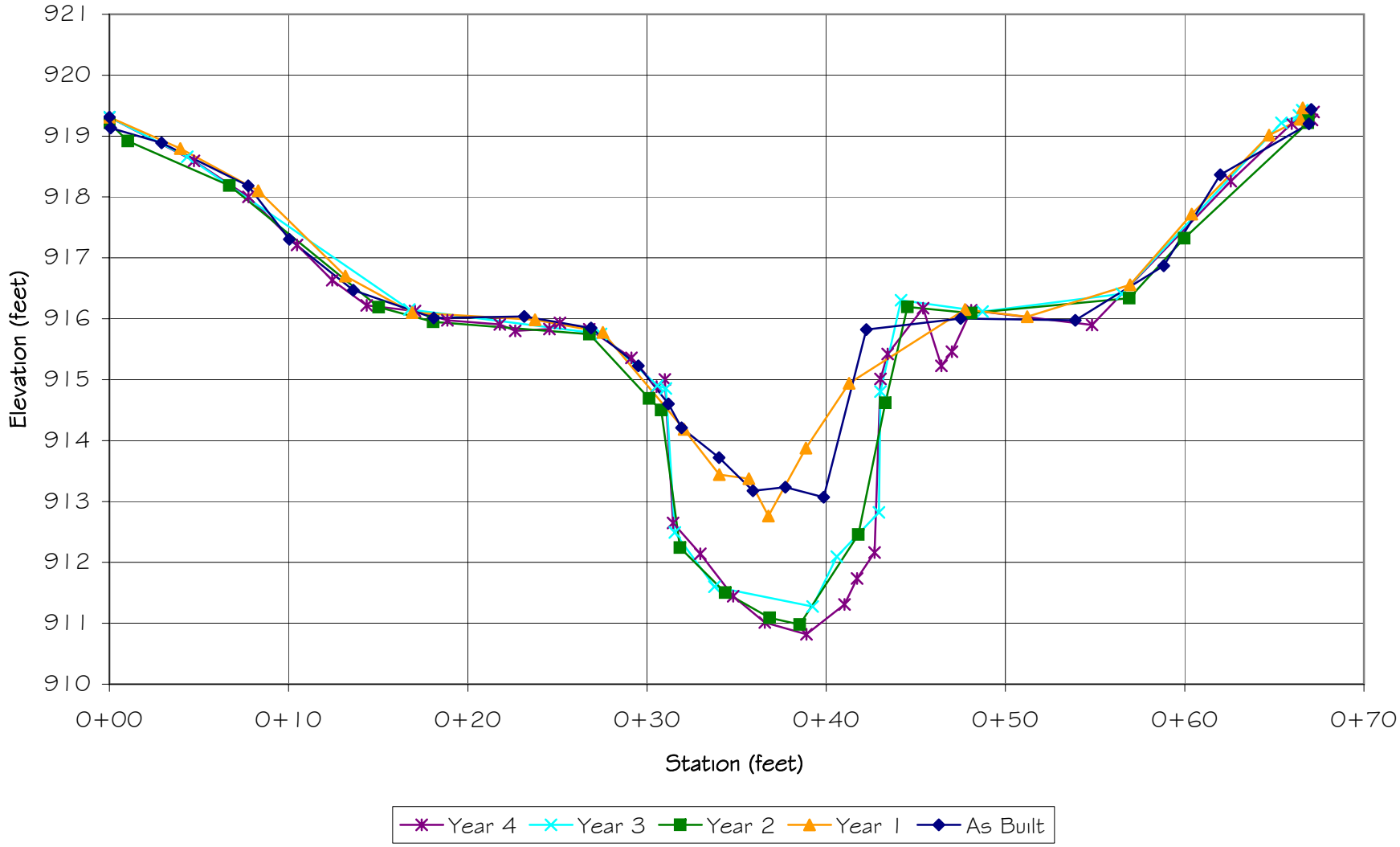



GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 5 (POOL)
(STA. 38+95)
924
923
922
921
920
919
918
917
916
Elevation (feet)
0+00
0+10
0+20
0+30
0+40
0+50
0+60
0+70
Station (feet)
Year 4
Year 3
Year 2
Year 1
As Built

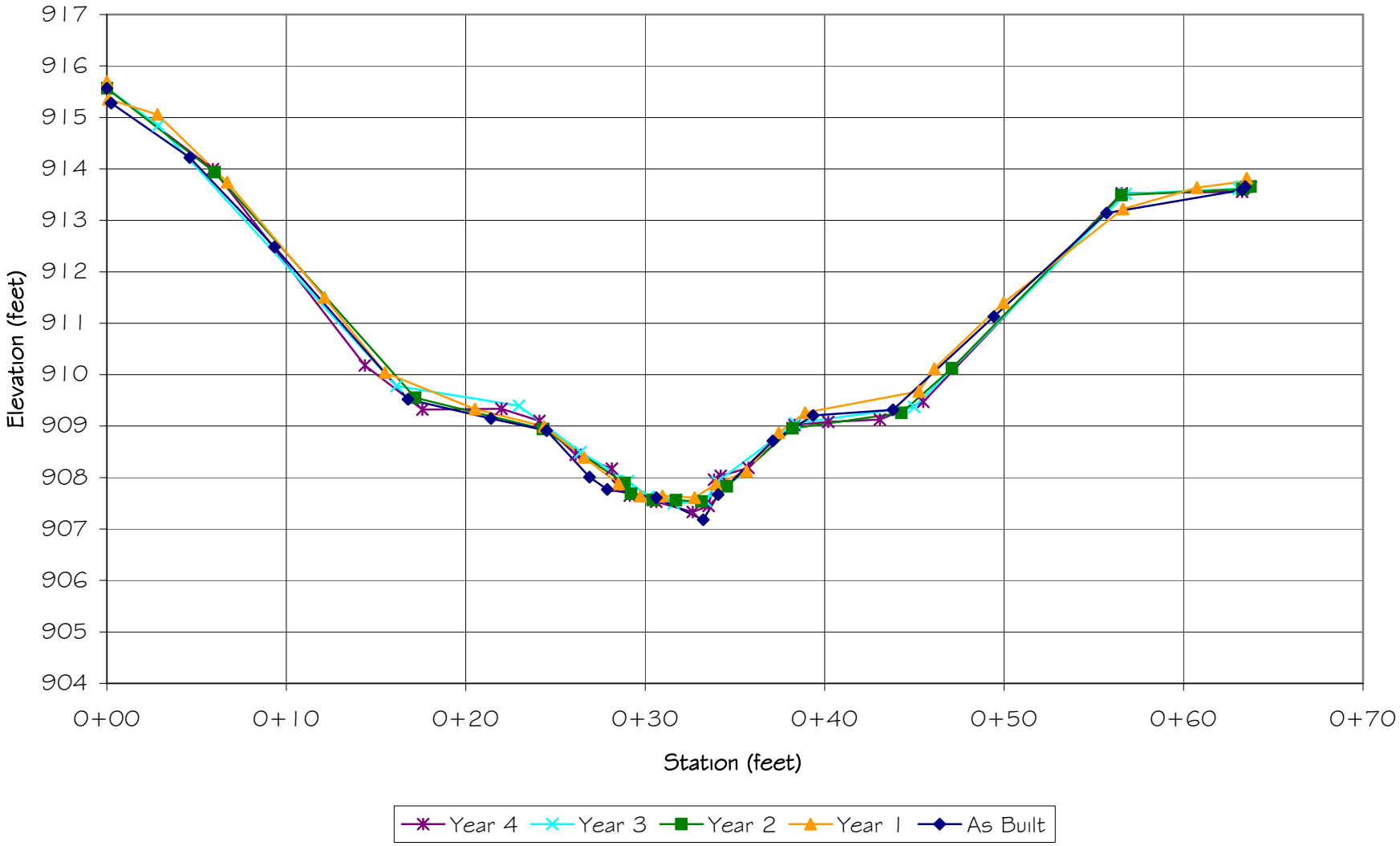
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 6 (RIFFLE)
(STA. 42+80)



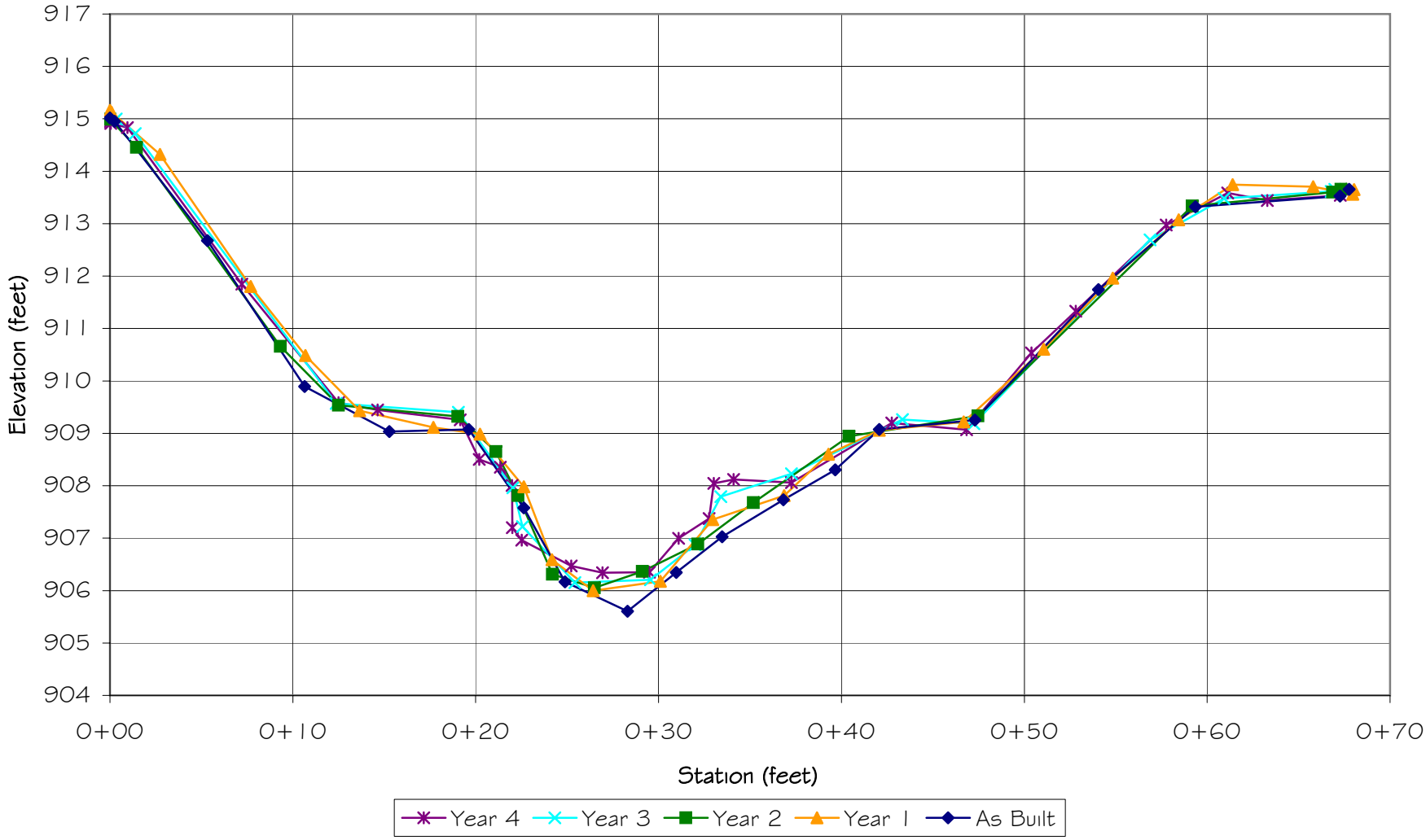
GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 6 (POOL)
(STA. 43+10)

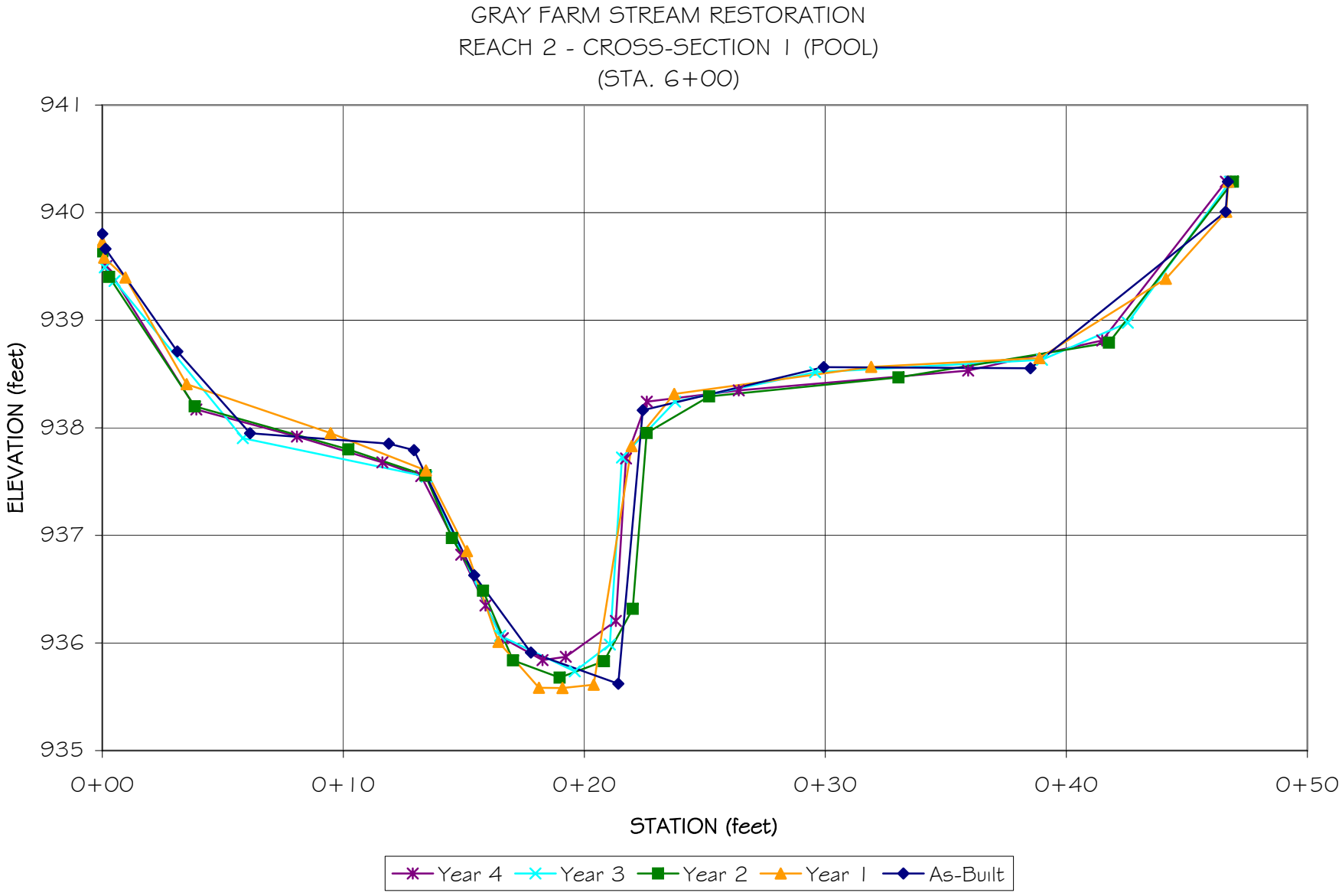


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 7 (RIFFLE)
(STA. 54+05)

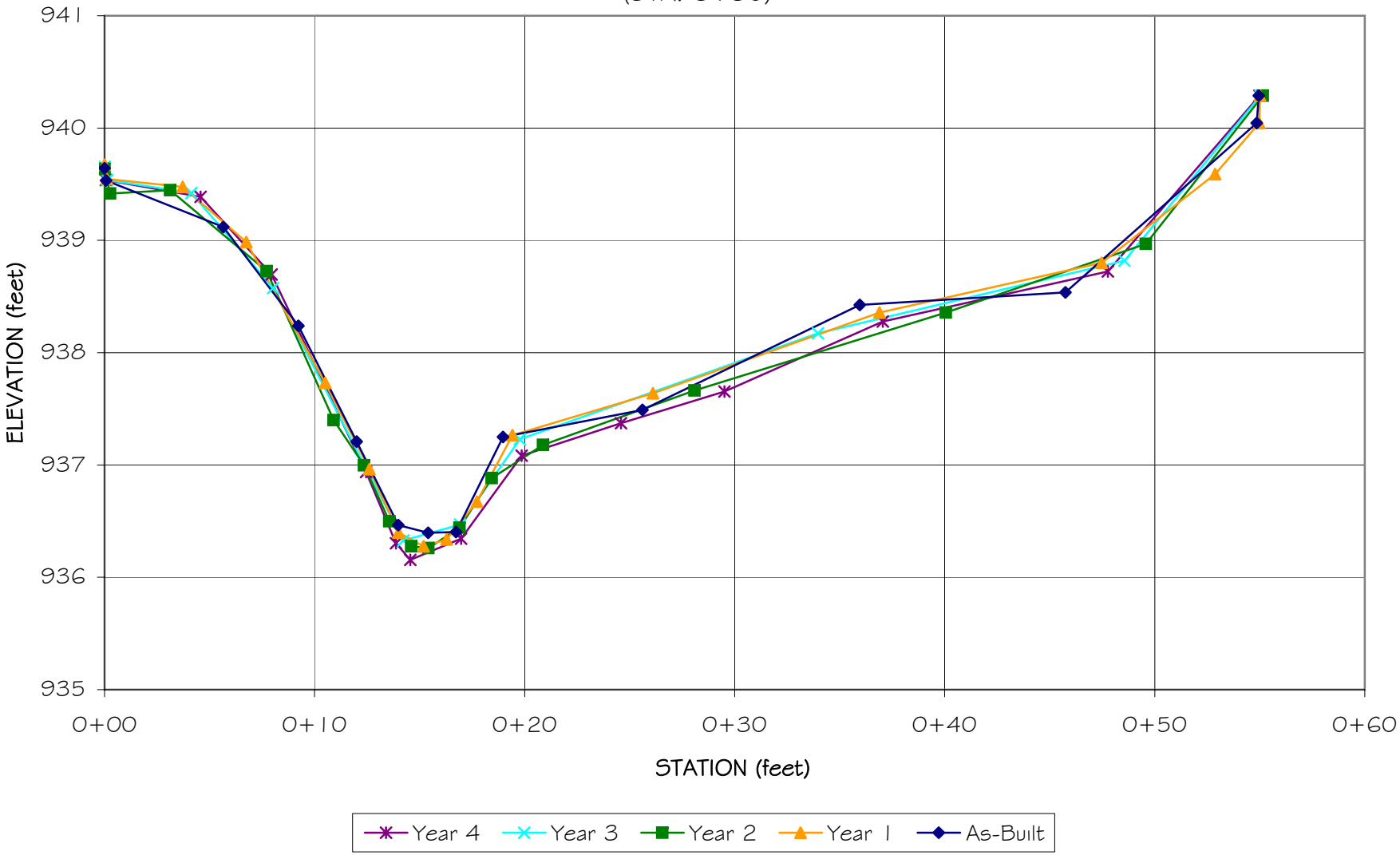


GRAY FARM STREAM RESTORATION
REACH 1 - CROSS-SECTION 7 (POOL)
(STA. 54+45)

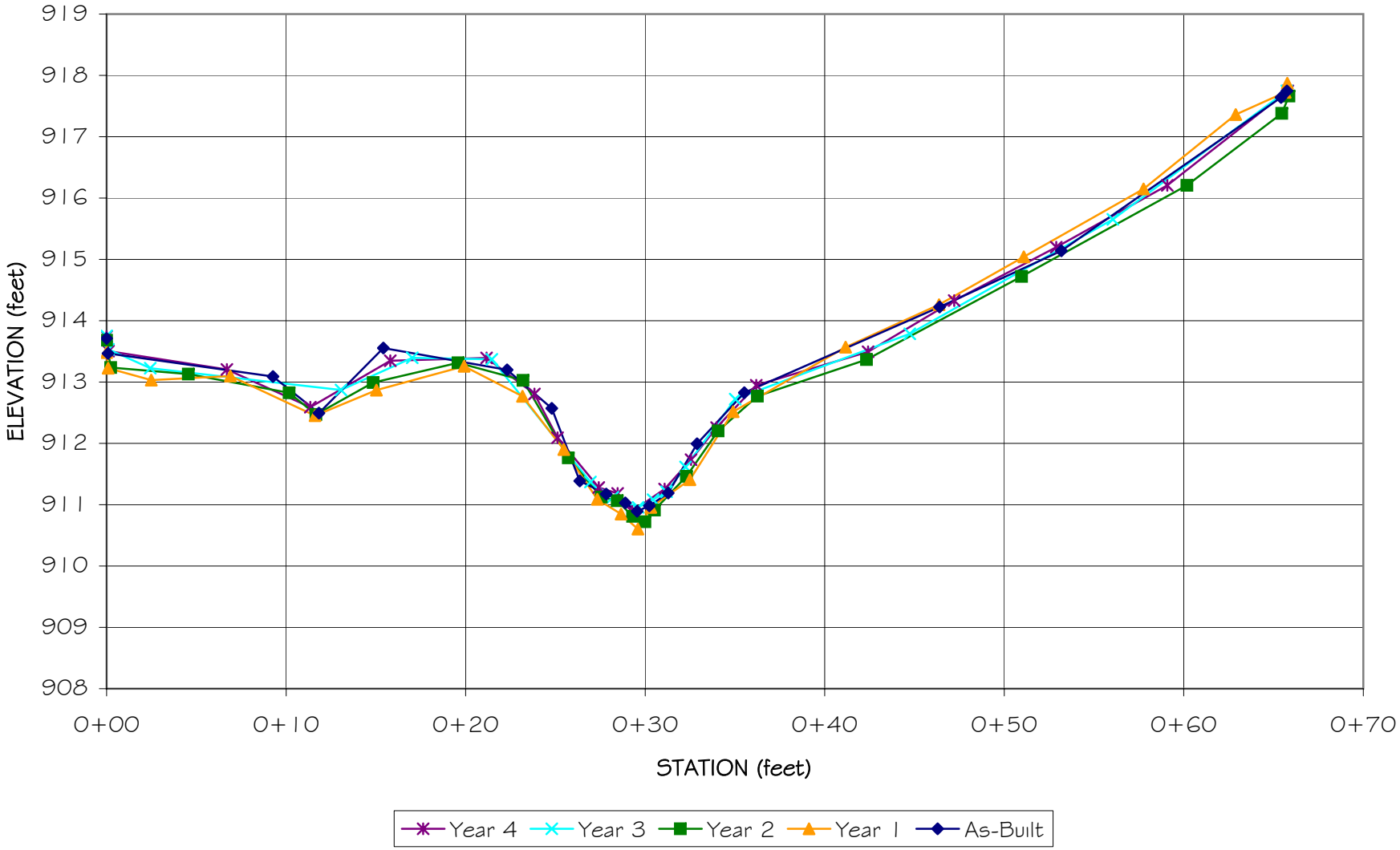



GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 1 (POOL)
(STA. 6+00)
941
940
939
938
937
936
935
ELEVATION (feet)
0+00
0+10
0+20
0+30
0+40
0+50
STATION (feet)
Year 4
Year 3
Year 2
Year 1
As-Built

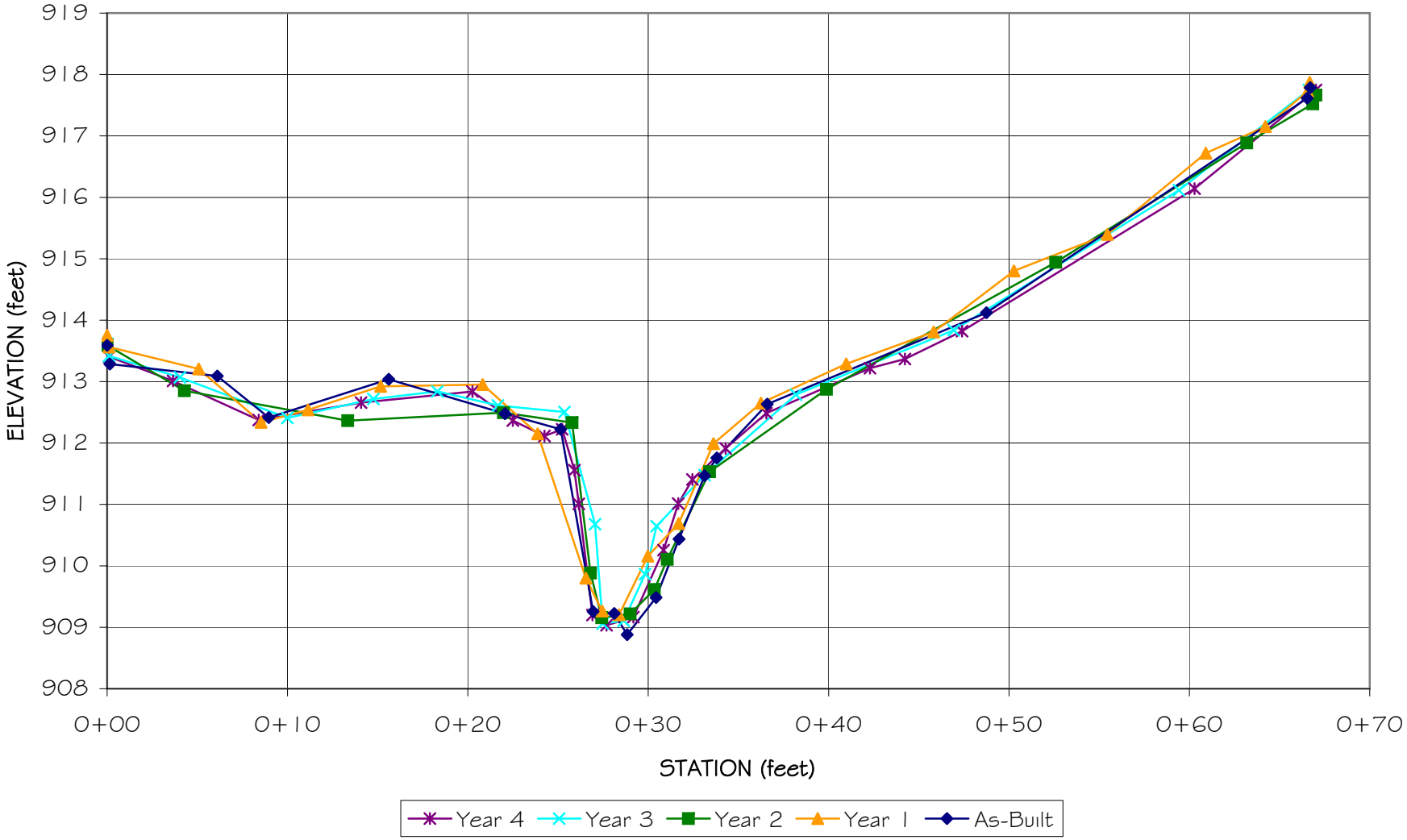
GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 1 (RIFFLE)
(STA. 6+30)



GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 2 (RIFFLE)
(STA. 19+30)



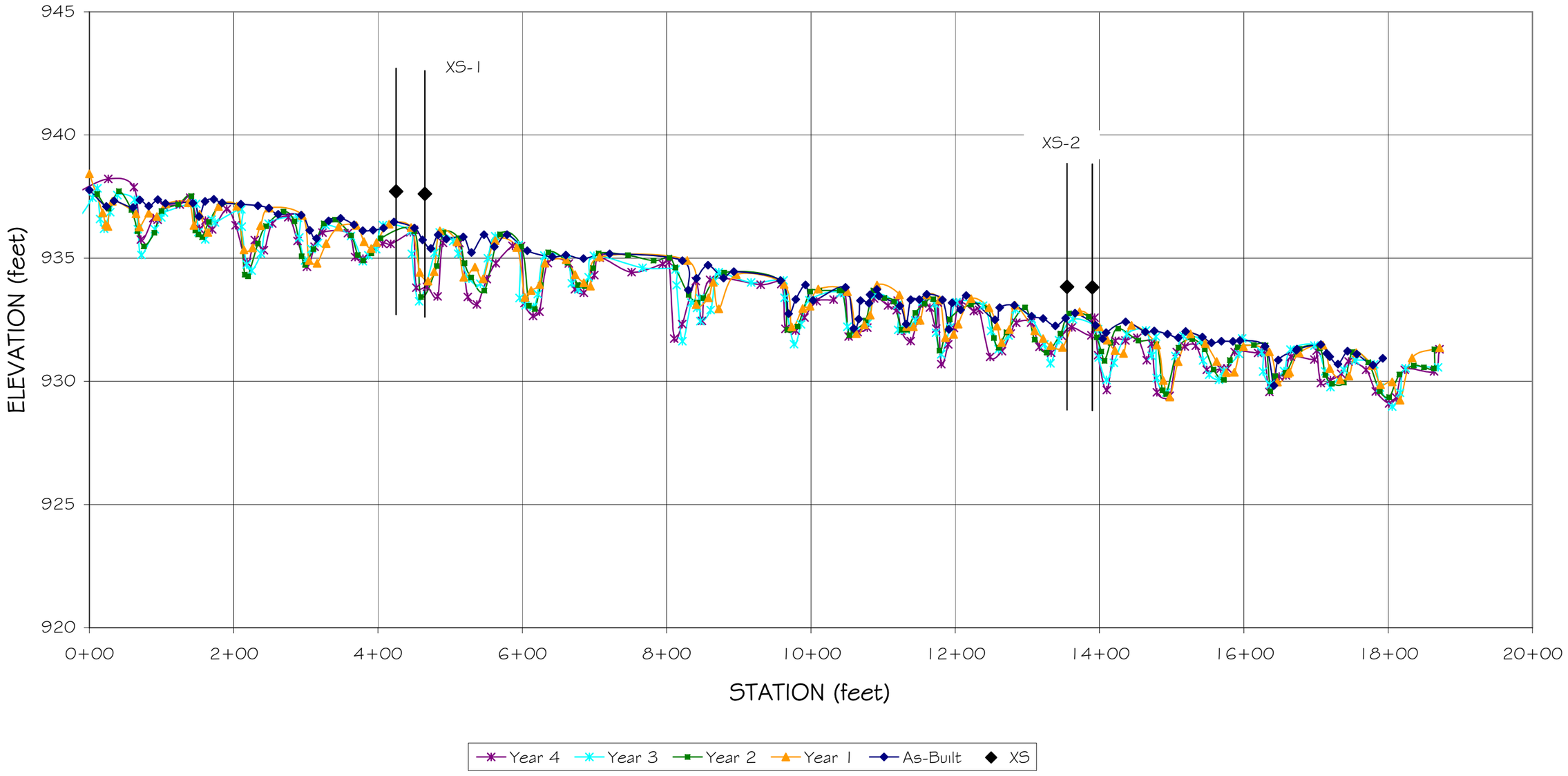
GRAY FARM STREAM RESTORATION
REACH 2 - CROSS-SECTION 2 (POOL)
(STA. 19+45)



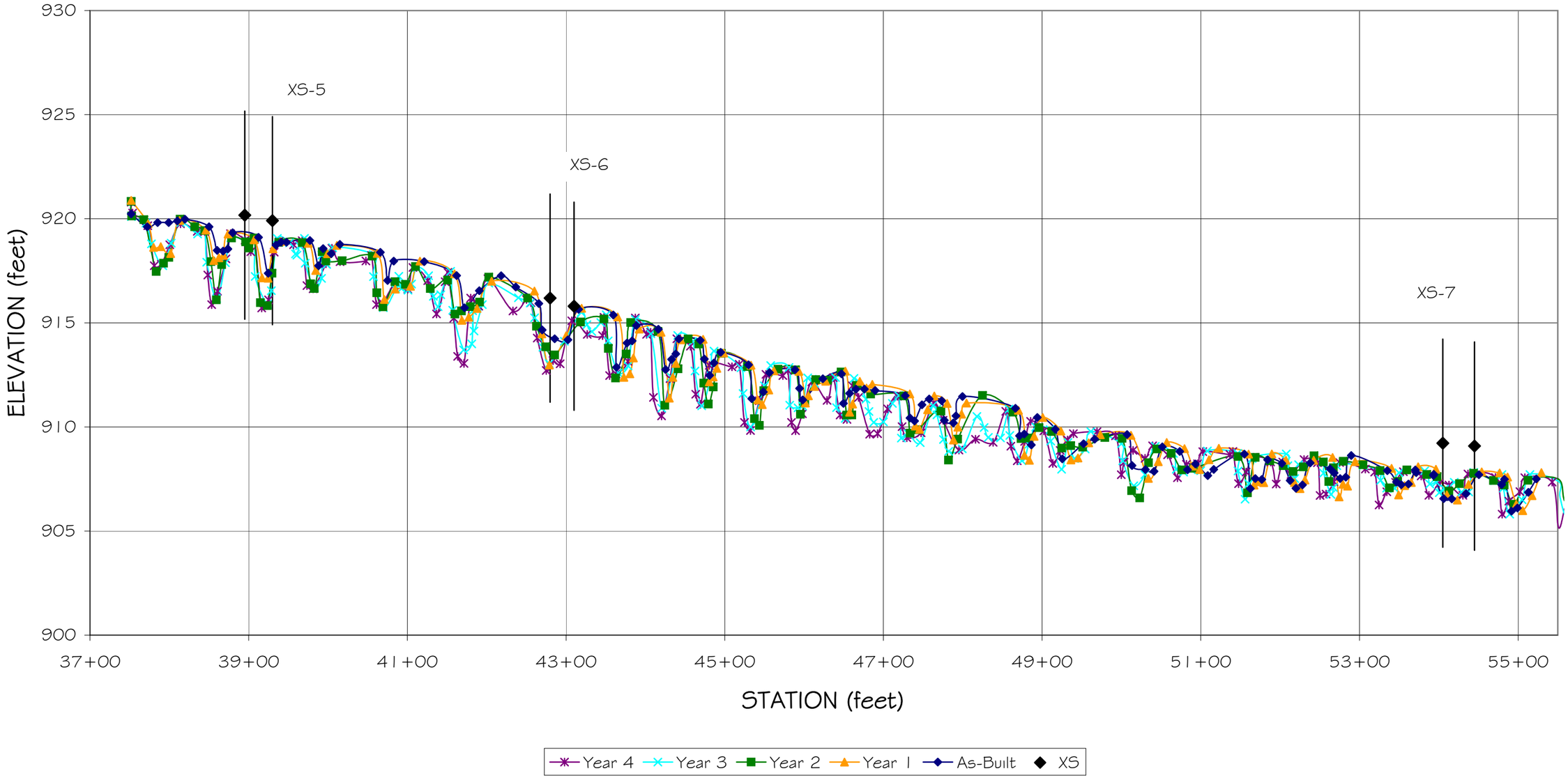
APPENDIX B.7 –

Annual Overlays of Longitudinal Plots

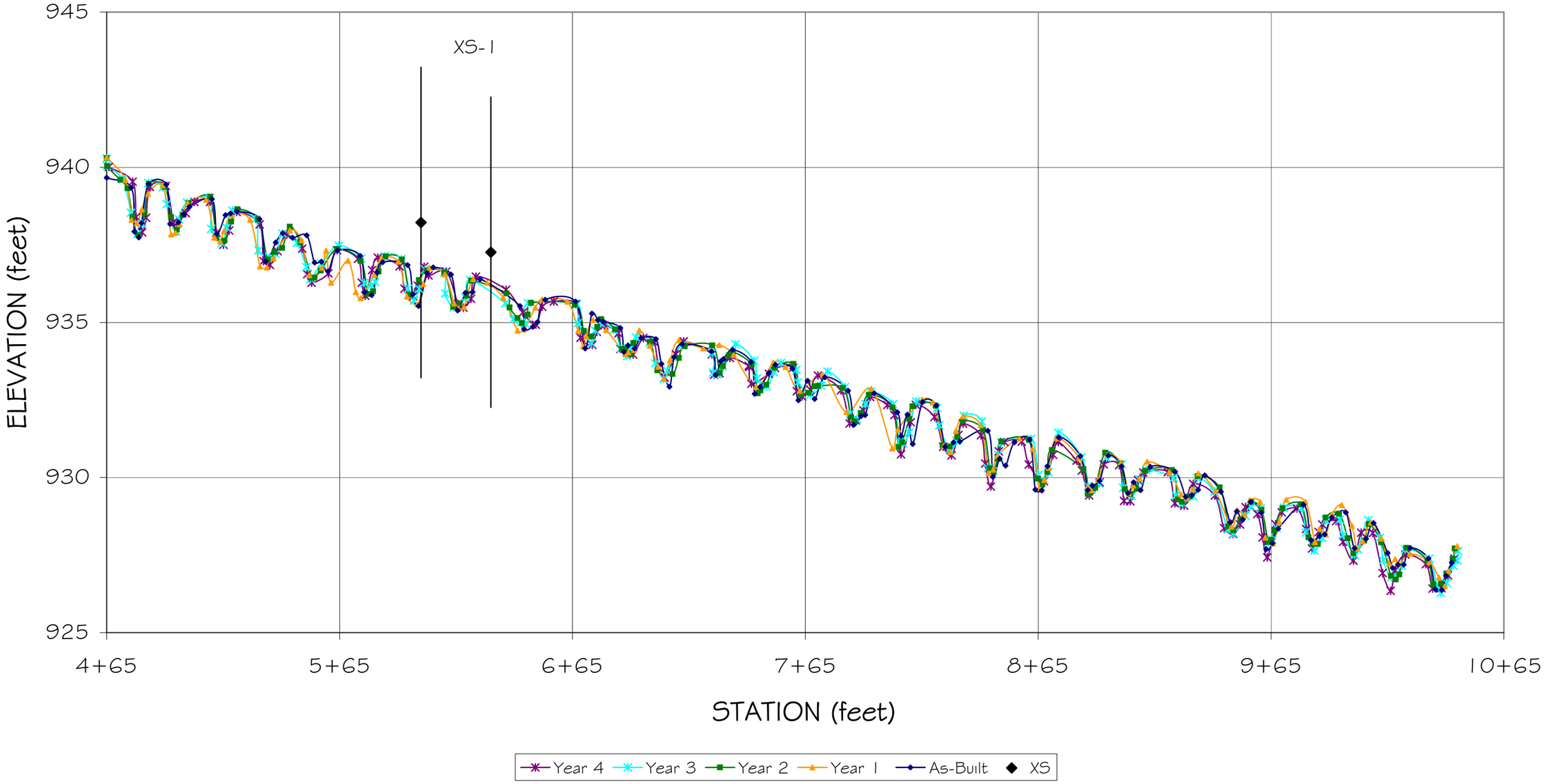
GRAY FARM STREAM RESTORATION
REACH 1 - LONGITUDINAL PROFILE
(STA. 0+00 TO 18+70)



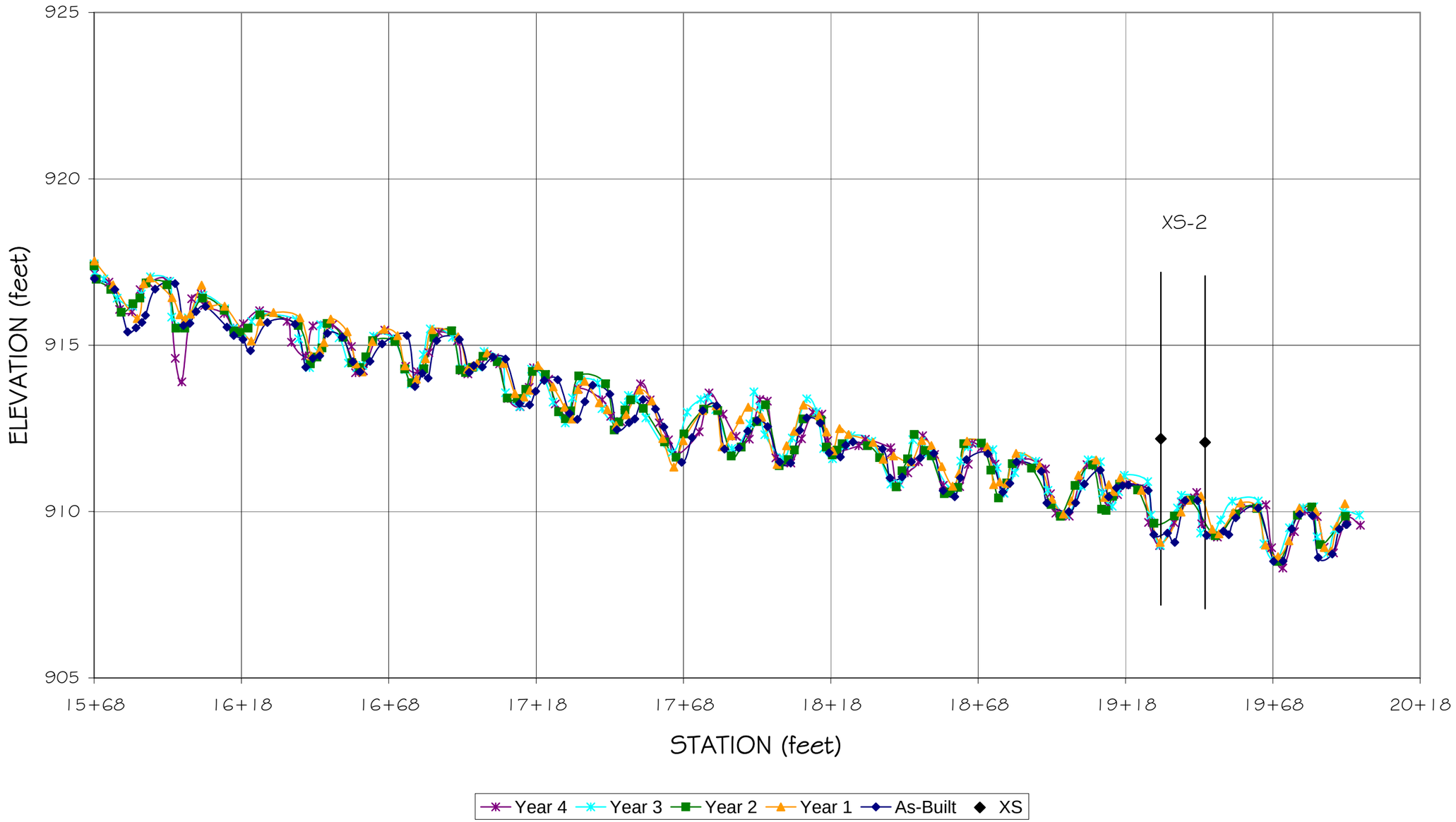
GRAY FARM STREAM RESTORATION
REACH 1 - LONGITUDINAL PROFILE
(STA. 37+50 TO 55+50)



GRAY FARM STREAM RESTORATION
REACH 2 - LONGITUDINAL PROFILE
(STA. 4+65 TO 10+65)

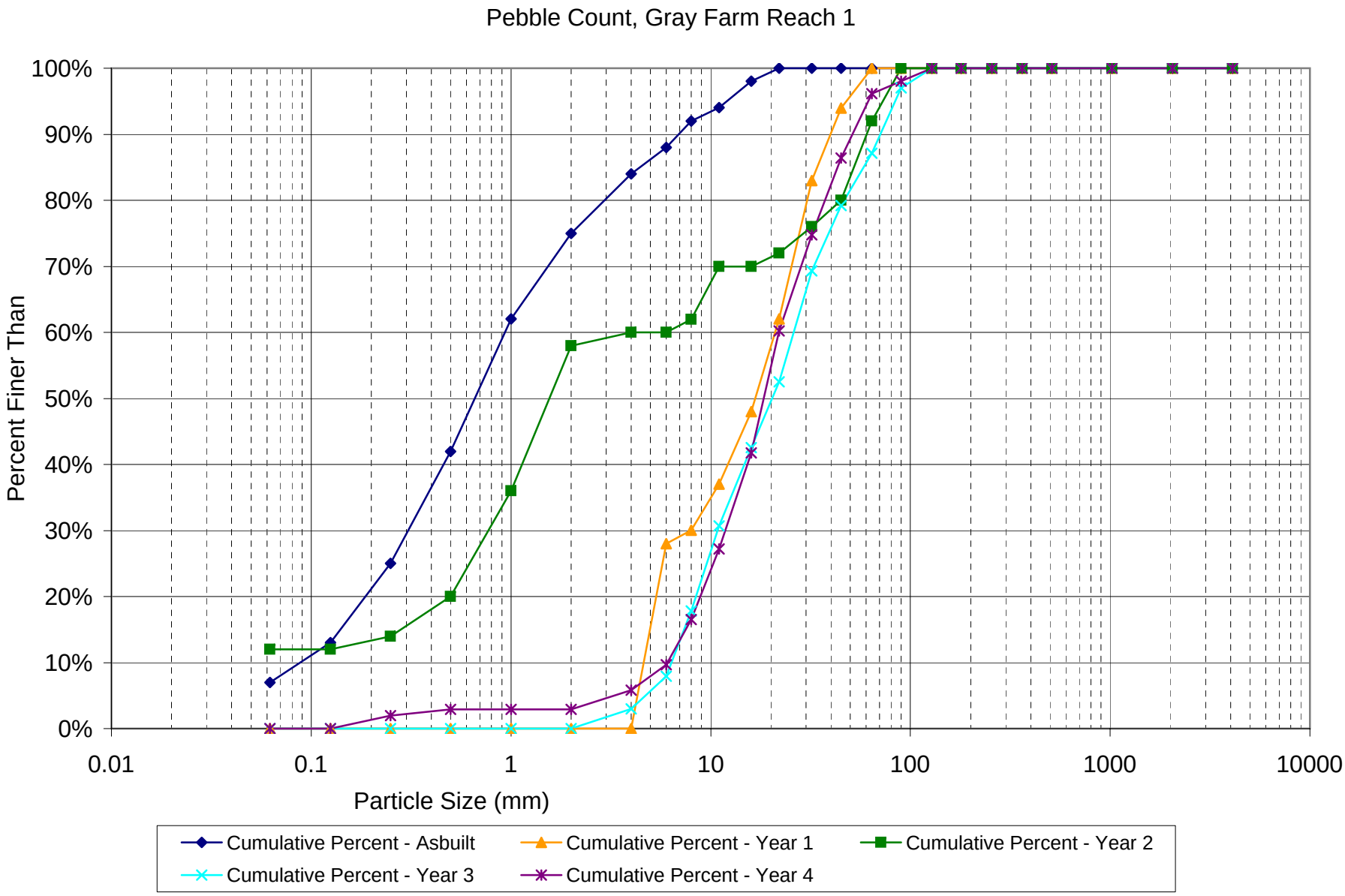


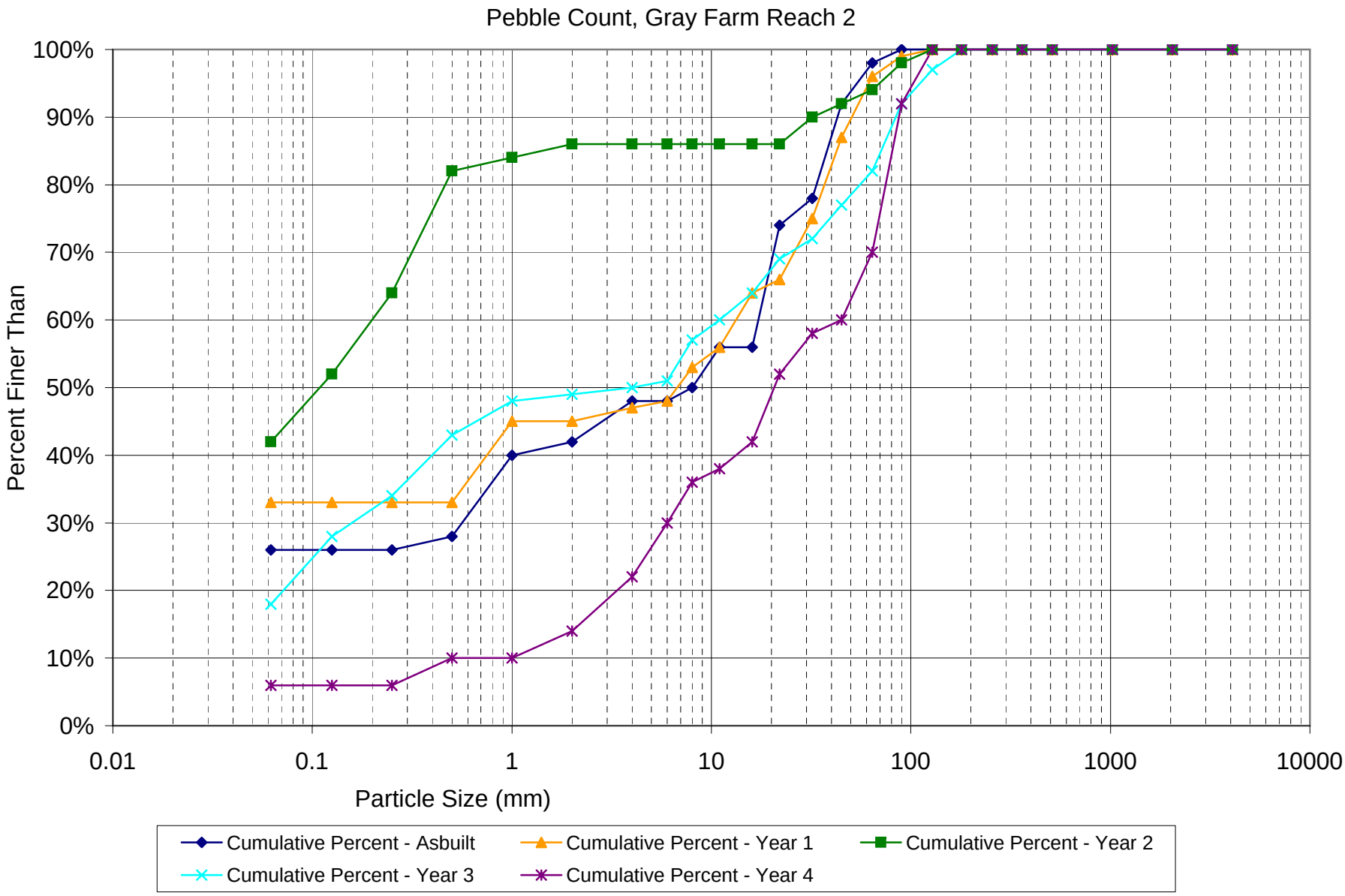
GRAY FARM STREAM RESTORATION
REACH 2 - LONGITUDINAL PROFILE
(STA. 15+68 TO 20+18)



APPENDIX B.8 –

Annual Overlays of Pebble Count Frequency Distribution Plots

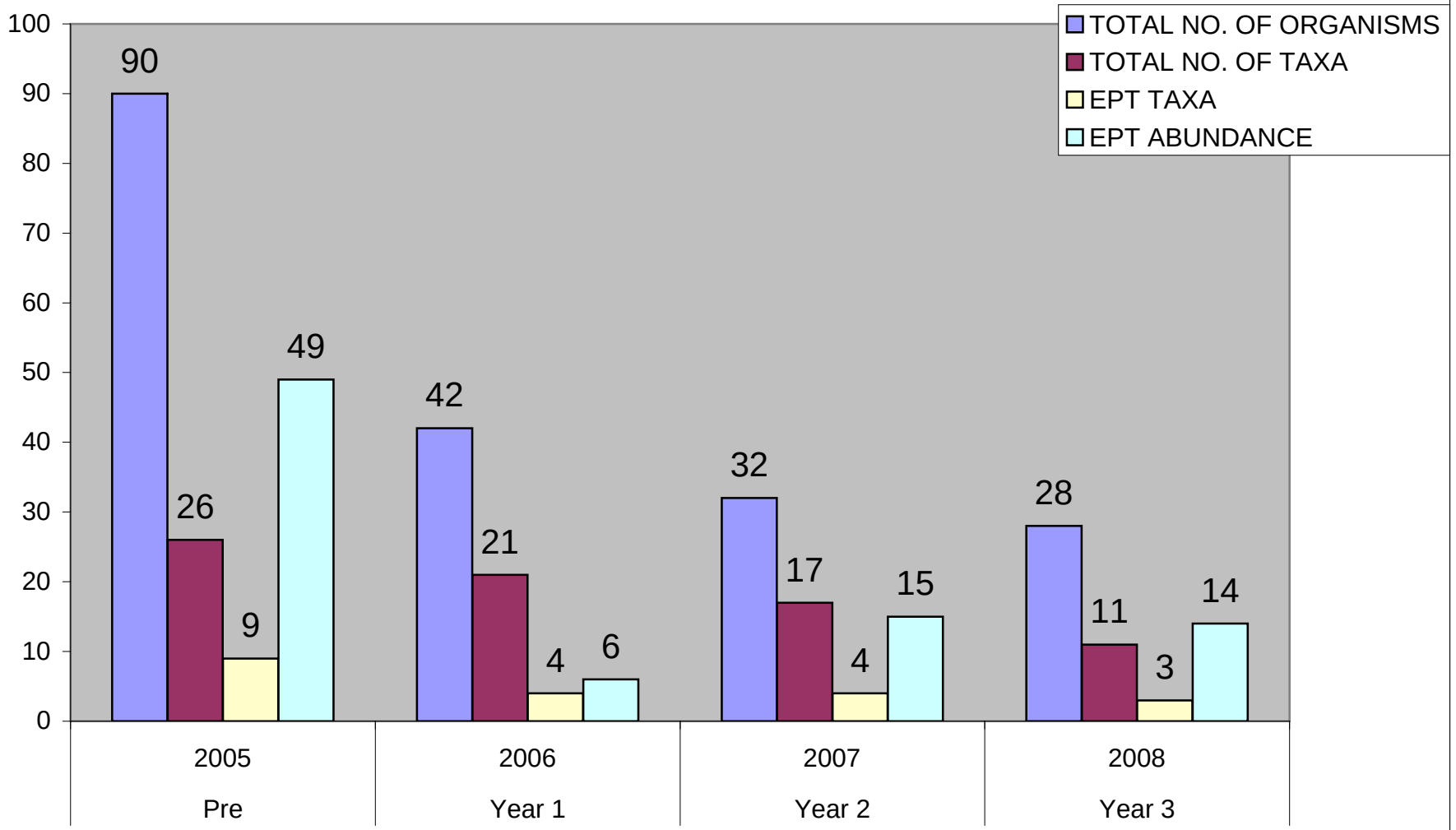

Pebble Count, Gray Farm Reach 1
Percent Finer Than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Cumulative Percent - Asbuilt
Cumulative Percent - Year 1
Cumulative Percent - Year 2
Cumulative Percent - Year 3
Cumulative Percent - Year 4

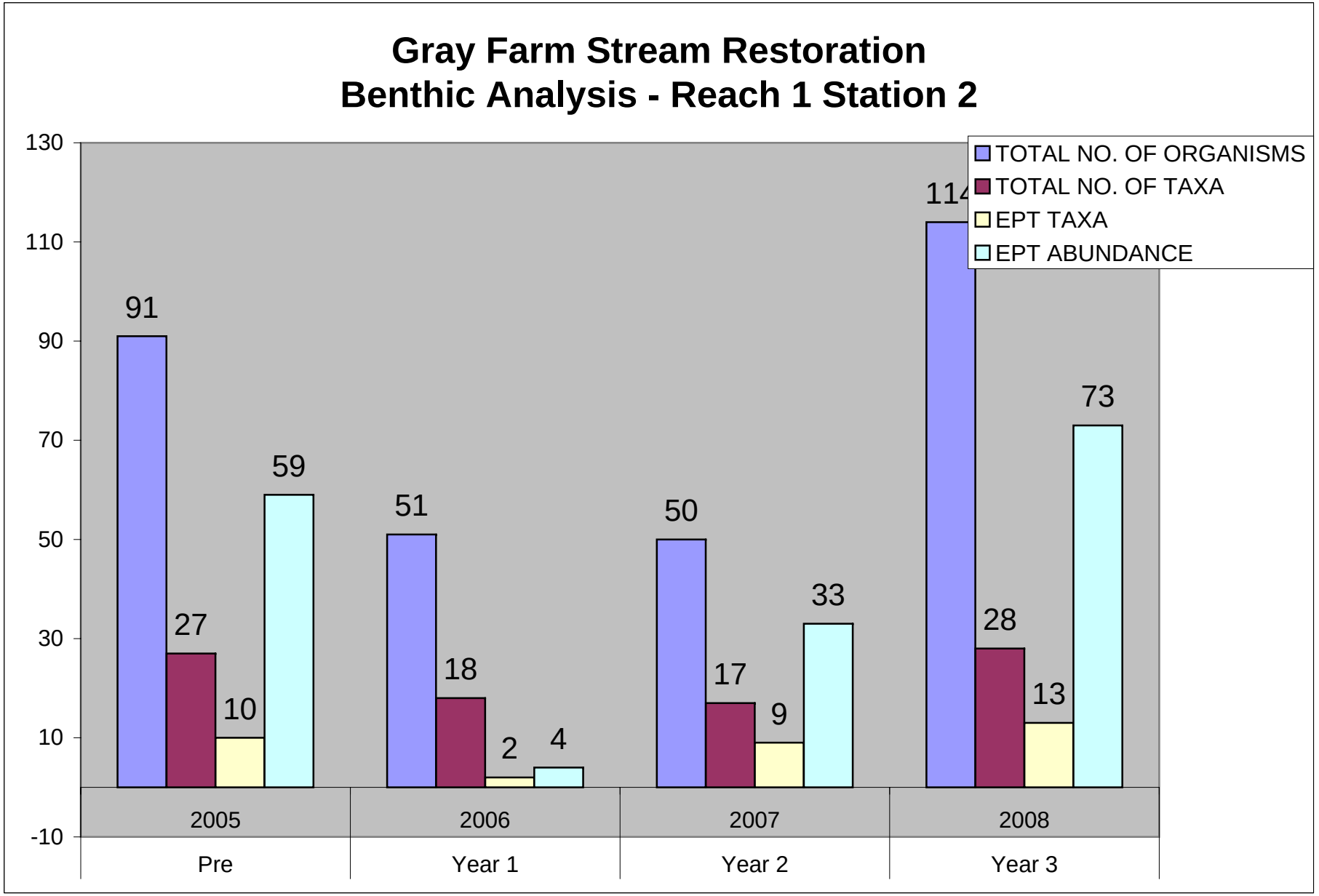

Pebble Count, Gray Farm Reach 2
Percent Finer Than
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0.01
0.1
1
10
100
1000
10000
Particle Size (mm)
Cumulative Percent - Asbuilt
Cumulative Percent - Year 1
Cumulative Percent - Year 2
Cumulative Percent - Year 3
Cumulative Percent - Year 4

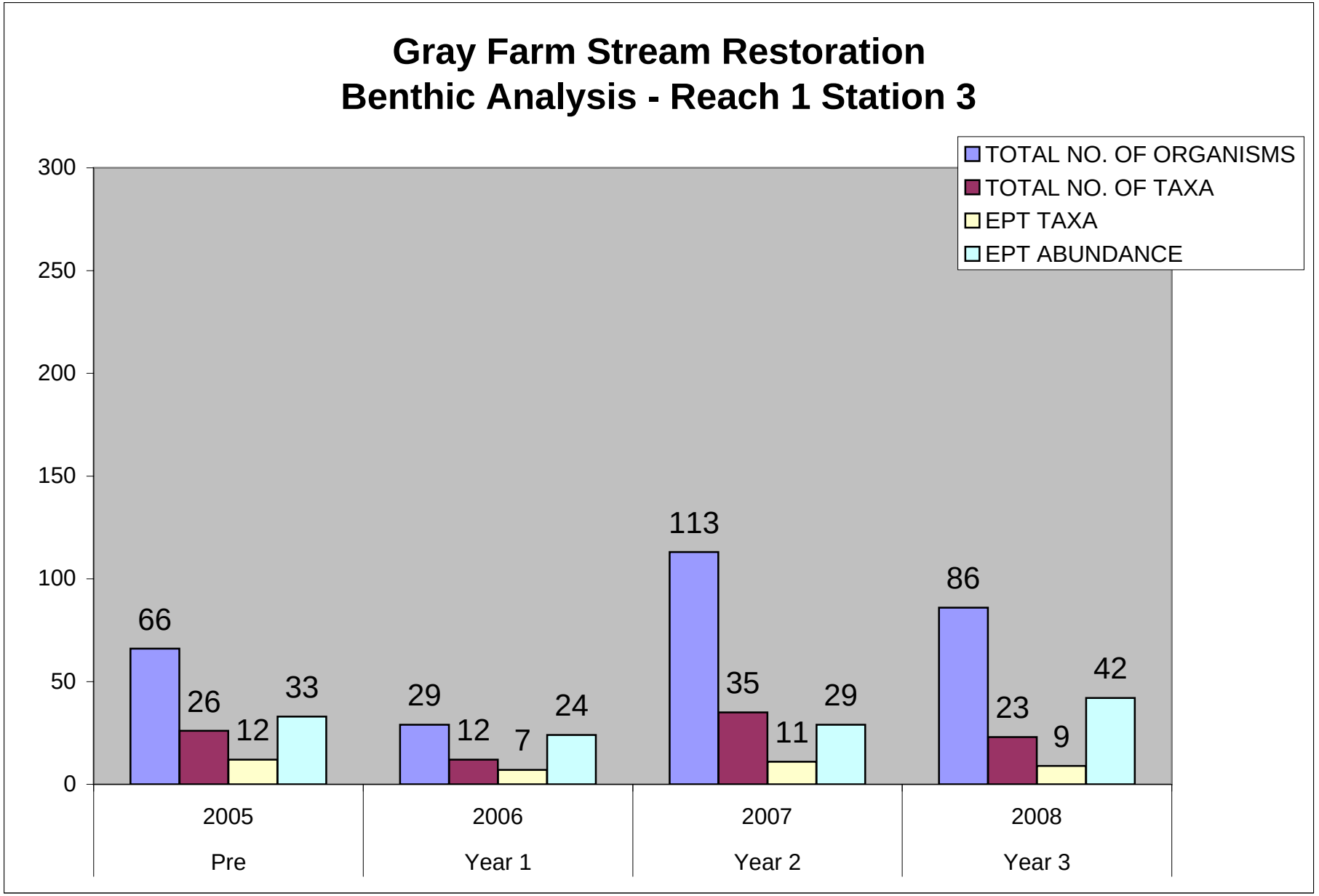
APPENDIX C

BENTHIC MACROINVERTEBRATE ASSESSMENT DATA

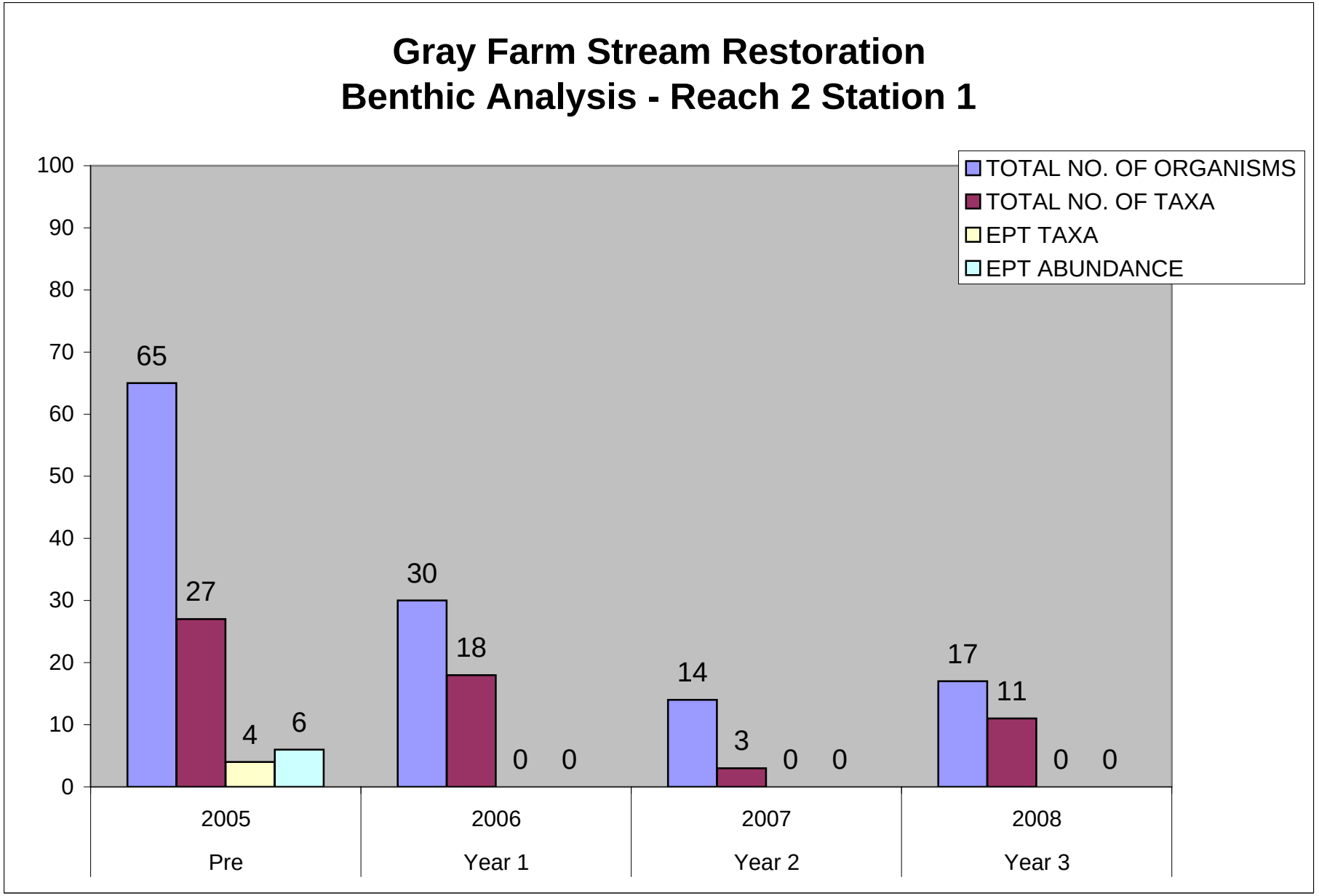
Gray Farm Stream Restoration
Benthic Analysis - Reach 2 Station 2



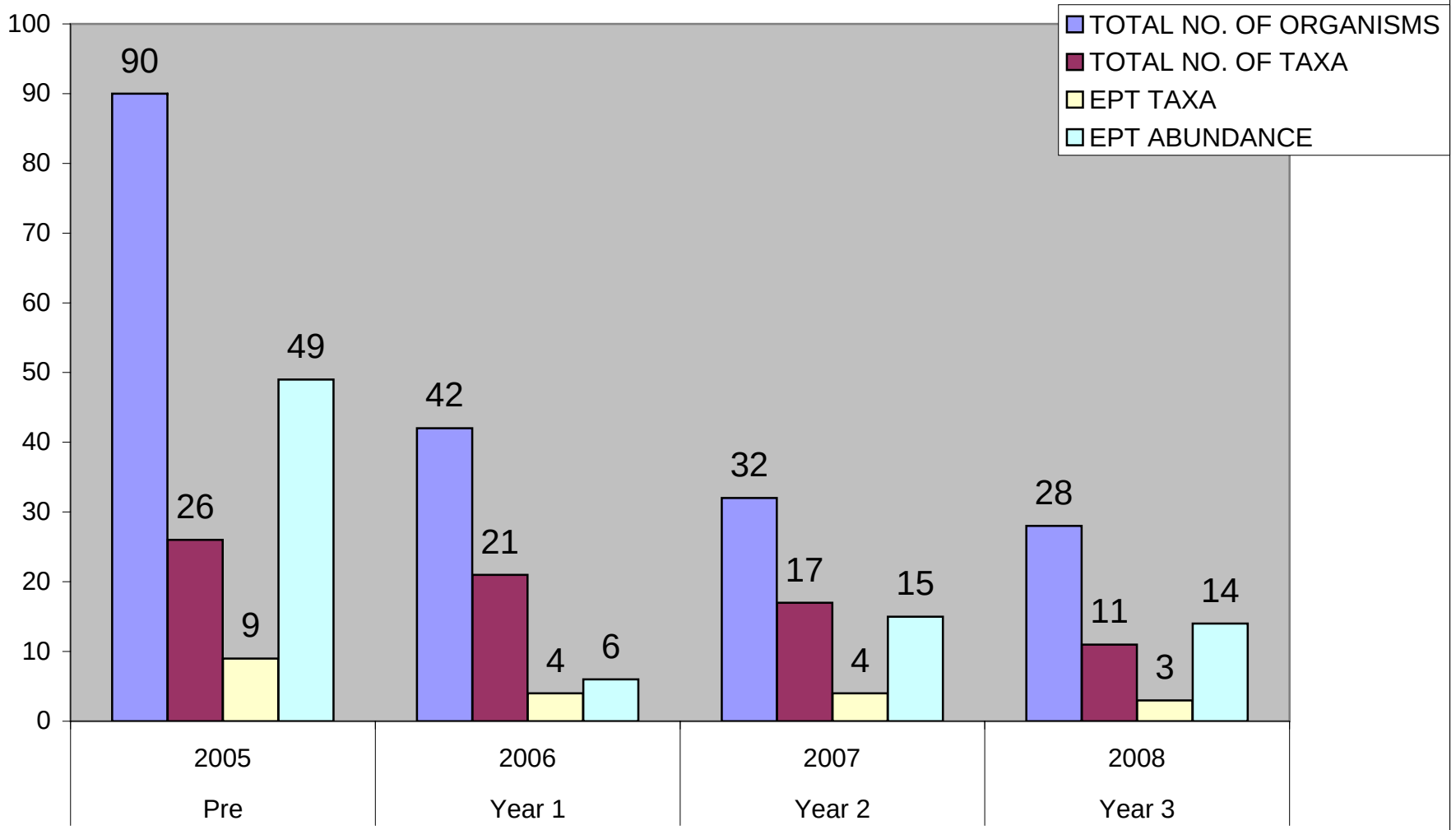

Gray Farm Stream Restoration
Benthic Analysis - Reach 1 Station 2
TOTAL NO. OF ORGANISMS
TOTAL NO. OF TAXA
EPT TAXA
EPT ABUNDANCE
130
110
90
70
50
30
10
-10
91
27
10
59
51
18
2
4
50
17
9
33
114
28
13
73
2005
2006
2007
2008
Pre
Year 1
Year 2
Year 3


Gray Farm Stream Restoration
Benthic Analysis - Reach 1 Station 3
TOTAL NO. OF ORGANISMS
TOTAL NO. OF TAXA
EPT TAXA
EPT ABUNDANCE
300
250
200
150
100
50
0
66
26
12
33
29
12
7
24
113
35
11
29
86
23
9
42
2005
Pre
2006
Year 1
2007
Year 2
2008
Year 3

Gray Farm Stream Restoration
Benthic Analysis - Reach 2 Station 1



Gray Farm Stream Restoration
Benthic Analysis - Reach 2 Station 2



SPECIES	FFG	REACH 1 STATION 1 UPSTREAM OF REACH 1				REACH 1 STATION 2 WITHIN RESTORATION REACH				REACH 1 STATION 3 DOWNSTREAM OF REST. REACH				REACH 2 STATION 1 WITHIN RESTORATION REACH				REACH 2 STATION 2 DOWNSTREAM OF REST. REACH			
		Pre 2005	Year 1 2006	Year 2 2007	Year 3 2008	Pre 2005	Year 1 2006	Year 2 2007	Year 3 2008	Pre 2005	Year 1 2006	Year 2 2007	Year 3 2008	Pre 2005	Year 1 2006	Year 2 2007	Year 3 2008	Pre 2005	Year 1 2006	Year 2 2007	Year 3 2008
PLATYHELMINTHES		0			1	0				0				0				0			
Turbellaria		0				0				0				0				0			
Tricladida		0				0				0				0				0			
Planariidae		0				0				0				0				0			
Cura foremanii		0				0			10	0				0				1			
MOLLUSCA		0				0				0				0				0			
Bivalvia		0				0				0				0				0			
Veneroida		0				0				0				0				0			
Sphaeriidae	FC	0				0				0				0				0			
Pisidium sp.	FC	3	3		10	0				0				1				0			
Gastropoda																					
Basommatophora																					
Physidae																					
Physa sp.							3														
Physella sp.					3							1									
Planorbidae																					
Micromenetus dilatatus							1														
Ancylidae																					
Lymnaeidae																					
Fossaria sp.				1																	
ANNELIDA		0				0				0				0				0			
Oligochaeta	CG	0				0				0				0				0			
Chaetogaster sp.															1						
Tubificidae		0				0				0				0				0			
Tubificidae w.h.c.					10																
Quistadrilus multisetosus				1																	
Lumbriculida																					
Lumbriculidae					1			1												1	
Naididae	CG	0				0			1	0				0				0			
Nais sp.									1												
Pristina leidyi	CG	0				0				0				1				0			
W/O Cap Setae																			1		
Limnodrilus hoffmeisteri					3																
ARTHROPODA		0				0				0				0				0			
Arachnoidea		0				0				0				0				0			
Acariformes		0				0			1	0				0				0			
Lebertiidae		0				0				0				0				0			
Lebertia sp.		0				1				0				0				0			
Crustacea																					
Asellidae																					
Caecidotea communis			3																		
Copepoda																1					
Cyclopoida																	1				3
Isopoda																					
Asellidae																					
Caecidotea sp.				3	3																1
Amphipoda																					
Crangonyctidae																					
Crangonyx sp.												1									
Hyalella sp.			3																		
Decapoda																					
Cambaridae																					
Cambarus sp.																	1				
Insecta		0				0				0				0				0			
Ephemeroptera		0				0				0				0				0			
Baetidae	CG	0				0				3				0				1			
Baetis sp.	CG	0				1				0		1		0				0			
Baetis flavistriga									1			1									
Baetis pluto									3												
Baetis tricaudatis									1												
Centroptilum sp.								3				1									
Baetiscidae	CG	0				0				0				0				0			
Baetisca carolina		0				1		1		3				0				0			
Caenidae																					
Caenis sp.							1														
Ephemerellidae	SC	0				0				0			3	0				0			
Ephemerella sp.	SC	0	1			10		1	10	1				0				0			
Eurylophella sp.												1									
Heptageniidae	SC	0				0				0				0				0			
Maccaffertium (Stenonema) sp.	SC	0				10		10	10	3		10		1				10		1	
Maccaffertium (Stenonema) modestum	SC	0				10				10	10		10	0				3			
Stenonema carlsoni																			1		
Stenacron interpunctatum	SC	0				0				1	1	1	1	0				0			
Stenacron pallidum		0				0				1				0				0			
Isonychiidae																					
Isonychia sp.									10												
Leptophlebiidae	CG	0				0				0				0				0	1		
Leptophlebia sp.	CG	0				0				1				3				1			3
Paraleptophlebia sp.																				1	
Odonata		0				0				0				0				0			
Aeshnidae	P	0				0				0				0				0			
Boyeria vinosa	P	0				1				0				0				0			
Calopterygidae	P	0				0				0				0				0			
Calopteryx sp.	P	3				0				0				3				0			
Coenagrionidae																					
Ischnura sp.							1					1					3				
Gomphidae	P	0				0				0		1		0				0			
Lanthus sp.	P	0				0				1				0				0			
Ophiogomphus sp.	P	0				1		1	1	0				0				0			
Libellulidae																					
Plathemis lydia															3		3				
Plecoptera		0				0				0				0				0			
Capniidae	SH	0				10				0		10		1				10			
Allocapnia sp.	SH	0	3	1		0		3	10	0	3		10	0				1	3	10	10
Perlidae	P	0				0				0				0				0			
Eccoptura xanthenes	P	0				1		1	1	0				0				0			
Perlodidae	P	0	1			0			1	0			1	0				3			
Isoperla sp.	P	0				3				0				0				0			
Taeniopterygidae												1									
Hemiptera		0				0				0				0				0			
Corixidae		0				0	1			0				0				0			3
Sigara sp.		0				0				0				0				1	1		
Veliidae	P																				
Microvelia sp.	P																				
Megaloptera		0				0				0				0				0			
Corydalidae	P	0				0				0				0				0			
Chauliodes rastricornis																	1				
Corydalus cornutus									1												
Nigronia fasciatus	P	0				0				0				0				1			
Nigronia serricornis													1								
Trichoptera		0				0				0				0				0			
Hydropsychidae	FC	0				0				0				0				0			
Cheumatopsyche sp.	FC	0			1	10		3	3	3	3	1	3	0				0			
Diplectrona modesta	FC	0				0				0				1				10			
Hydropsyche betteni gp.	FC	0				0	3	10	10	3	3		3	0				0			
Hydropsyche sp.									3				1								
Limnephilidae																					
Pycnopsyche sp.																			1	3	
Philopotamidae	FC	0				0				0				0				0			
Chimarra aterrima	FC	0				3		1	10	3	3	1	10	0				10			
Dolophilodes sp.	FC	0				0				1				0				0			
Psychomyiidae																					
Lype diversa											1										
Rhyacophilidae																					
Rhyacophila sp.												1									
Uenoidae																					
Neophylax sp.																					1
Coleoptera		0				0				0				0				0			
Dryopidae		0				0				0				0				0			
Helichus sp.																			1		
Helichus fastigiatus	SC	0				0				0				1				0			
Dytiscidae	P	3				0				0				0				1			

Acilius sp.																			1					
Agabus sp.	**P**	0			1	0				0					3	3			1	0				
Hydroporus sp.	**PI**	0				0				0					0					1				
Neoporus sp.				1															3				1	1
Elmidae	**CG**	0				0				0					0					0				
Oulimnius latiusculus	**CG**	0				1				0			1		0					0				
Helophoridae		0				0				0					0					0				
Helophorus linearis		0				0				0					1					0				
Hydrophilidae		0				0				0					3					0				
Psephenidae	**SC**	0				0				0					0					0				
Ectopria sp.	**SC**	0				0				10	1				0					0				
Ptilodactylidae	**SH**	0				0				0					0					0				
Anchytarsus bicolor	**SH**	0				0				0	1				1					1	1	1		
Scirtidae	**SC**	0				0				0					3					0				
Diptera		0				0				0					0					0				
Ceratopogonidae	**P**	0				1			1	0					0					0				
Bezzia/Palpomyia sp.	**P**	0				0				0					0	1				3				
Chaboridae																								
Chaborus punctipennis																			1					
Chironomidae		0				0				0		3			0					0				
Brillia flavifrons	**SH**	0				0				1			1		0					0				
Chaetocladius sp.	**CG**	0				1				0					0					0				
Chironomus sp.	**CG**	1		1	3	0				0					0				1	0				
Clinotanypus sp.							1																	
Conchapelopia sp.	**P**	0		1		0			1	1		1	1		3					0		1		
Corynoneura sp.	**CG**	3				10				3		10	10		3					10		1		
Cricotopus sp.	**CG**	0				1		10		3		10			1					1				
Cricotopus bicinctus								1																
Diamesa sp.								1				1												
Diplocladius sp.			3																		1			
Diplocladius cultriger	**CG**	0		1		1		1	3	0		10	10		0					1		3		
Endochironomus sp.																						1		
Eukiefferiella claripennis gp.	**CG**	0				3		1		0					0					0				
Heterotrissocladius marcidus gr.																					3			
Kiefferulus sp.																			1					
Microtendipes pedellus gp.	**CG**	0				0	3			1		1			0					1	5			
Natarsia sp.																1					3			
Odontomesa sp.			1																					
Orthocladius sp.								1				1												
Parachaetocladius sp.												1										1		
Paracladopelma sp.	**CG**	0				1				0					0					0				
Parametriocnemus sp.	**CG**	3	1	1		0	1		10	0	1	10	3		10	3				0				
Paraphaenocladius sp.																3								
Paratendipes sp.	**CG**	1				0				0					0					0				
Pentaneurini																1								
Polypedilum aviceps													1											
Polypedilum fallax gr.			1																					
Polypedilum flavum (convictum)	**SH**	3				3				3		1			0					10				
Polypedilum halterale	**SH**	1				0				0					1					0				
Polypedilum illinoense												1	1											
Polypedilum sp.							10																	
Polypedilum tritum																1								
Procladius sp.				1												1								
Psectrotanypus sp.					3											1								
Rheocricotopus robacki	**CG**	0				1				1					0					0				
Rheotanytarsus exiguus gr.			1				10					3												
Rheotanytarsus sp.	**FC**	1				0				0					0					0				
Stilocladius clinopecten		0				1				0					0					0				
Stictochironomus devinctus	**CG**	0		3		0				1					0					0				
Stictochironomus sp.			3																		1			
Tanytarsus sp.	**FC**	3		3		0	1			0		3	3		3	1				0				
Thienemanniella sp.							1																	
Thienemanniella xena	**CG**	1				3			3	3		10	3		1					1				
Thienemannimyia gr. sp.			10				10									3					1			
Tribelos jucundum		0	1			0				0		1			1					0	10			1
Tvetenia bavarica gp.	**CG**	0				1	1			0					0					0				
Tvetenia paucunca												1	3											
Zavrelimyia sp.	**P**	1		1		0				0					1	1				1	1		3	
Culicidae	**FC**	0				0				1					0		10	1		0				
Aedes sp.																1								
Dixidae	**CG**	0				0				0					0					0				
Dixa sp.	**CG**	0		1		0				3					1					3				
Dixella sp.																							1	3
Empididae																								
Hemerodromia sp.			1				1																	
Ptychopteridae		1				0				0					0					0				
Bittacomorpha clavipes		1				0				0					10					0				
Bittacomorpha sp.				6	1							1				1								
Ptychoptera sp.			1				1																	
Simuliidae	**FC**	0				0				0		10			0					0				
Simulium sp.	**FC**	0	1			0	1		3	0	1	1	3		0					1				
Syrphidae																	3							
Tabanidae	**PI**	0				0				0					0					0	1			
Chrysops sp.	**PI**	0	1			0				0					1					0				
Tipulidae	**SH**	0				0				0					0					0				
Antocha sp.									1															
Dicranota sp.																					1	1		
Ormosia sp.																					1	1	1	
Pseudolimnophila sp.	**P**	1	3	1		0				0					3	3				0	3			
Tipula sp.	**SH**	0	3	1		1		1	3	1	1		3		3					3	1	1	1	
TOTAL NO. OF ORGANISMS		30	45	28	40	91	51	50	114	66	29	113	86		65	30	14	17		90	42	32	28	
TOTAL NO. OF TAXA		16	20	17	12	0 27	18	17	28	26	12	35	23		27	18	3	11		26	21	17	11	
EPT TAXA		0	3	1	1	0 10	2	9	13	0 12	7	11	9	0	4	0	0	0	0	9	4	4	3	
EPT ABUNDANCE		0	5	1	1	0 59	4	33	73	0 33	24	29	42	0	6	0	0	0	0	49	6	15	14	
NC BIOTIC INDEX		**6.64**	**6.7**	**7.06**	**7.87**	**4.95**	**6.8**	**6.1**	**4.64**	**5.07**	**5.2**	**5.94**	**5.24**		**6.88**	**8.8**	**N/A**	**9.11**		**4.62**	**6.1**	**4.49**	**5.02**	

APPENDIX D

INTEGRATED PROBLEM AREA PLAN VIEW

APPENDIX D.1 –

Monitoring and Problem Area Plan View, Reach 1

\\Sec2\jobs7-9k\9385.D7-D11\YEAR 4 - D10\Drawings\REACH 1 - Gray Farm Mont.and PAPV - Year 4.dwg

REACH 1 - RESTORATION SITE LAYOUT & KEYSHEET

DRAWINGS PRINTED AT HALF- SCALE

RESTORED STREAM CHANNEL

EXISTING CONTOURS

EXISTING NCDENR STREAMS

EXISTING DOT ROADS

PERMANENT ACCESS EASEMENT

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

BENTHIC SAMPLING POINT

BEGIN UPPER LONG PROFILE

A

EXISTING TREELINE

END UPPER LONG PROFILE

BANKFULL GAUGE LOCATION

PEBBLE COUNT LOCATION

B

PERMANENT CONSERVATION EASEMENT

BEGIN LOWER LONG PROFILE

END LOWER LONG PROFILE

BENTHIC SAMPLING POINT

C

D

BENTHIC SAMPLING POINT

KEY SHEET INDEX

NORTH

SCALE 1" = 200'

200 100 0 200

CONTOUR INTERVAL = 2'

BOLICK ROAD (SR 1532)

VEGETATION PLOT COORDINATES - REACH 1		
	NORTHING	EASTING
BUFFER 1	1385846.18	754364.36
BUFFER 2	1386151.38	753549.82
BUFFER 3	1386517.37	752569.75
BUFFER 4	1386971.65	752535.59
BANK 1	1385719.13	754523.63
BANK 2	1386297.12	752693.45

CROSS SECTION COORDINATES		
	NORTHING	EASTING
CROSS SECTION 1	1385544.83	755250.67
RIFFLE 1	1385494.08	755292.77
POOL 1	1385487.56	755221.71
CROSS SECTION 2	1385714.11	754599.75
RIFFLE 2	1385729.62	754657.41
POOL 2	1385770.59	754609.35
CROSS SECTION 3	1385927.02	753997.26
RIFFLE 3	1385893.90	753914.02
POOL 3	1385874.14	753966.36
CROSS SECTION 4	1386175.52	753301.89
RIFFLE 4	1386120.46	753338.88
POOL 4	1386121.44	753264.47
CROSS SECTION 5	1386236.38	752913.75
RIFFLE 5	1386293.26	752869.42
POOL 5	1386303.28	752926.82
CROSS SECTION 6	1386408.7	752648.11
RIFFLE 6	1386341.17	752644.43
POOL 6	1386369.35	752594.7
CROSS SECTION 7	1387272.28	752583.14
RIFFLE 7	1387227.69	752627.95
POOL 7	1387286.91	752648.36

REVISIONS

REV.	DESCRIPTION	DATE	APP.

S&EC
Soil & Environmental Consultants, PA
11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467
www.SandEC.com

Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING

Project No.: 9385.D10

Proj. Mgr.: DG

Drawn: DGC

Location: IREDELL CO., NC

Client: NC ECOSYSTEM ENHANCEMENT PROGRAM

Scale: 1" = 200'

Sheet Title: REACH 1 RESTORATION SITE LAYOUT & KEYSHEET

Sheet No.: 1 OF 16

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

DRAWINGS PRINTED AT HALF- SCALE

PERMANENT ACCESS EASEMENT

UPPER LIMITS OF RESTORATION

BENTHIC SAMPLING POINT

BEGIN UPPER LONG PROFILE

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00 15+00

XS 1

XS 2

EXISTING TREELINE

PERMANENT CONSERVATION EASEMENT BOUNDARY

BANK 1

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS 1)
- BENTHIC SAMPLING POINT

REACH 1 - MONITORING PLAN VIEW - A

A

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

S&EC

Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING		Project No.: 9385.D10
		Proj. Mgr.: DG / Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'
Sheet Title: REACH 1 - MONITORING PLAN VIEW - A		Sheet No.: 2 OF 16

REACH 1 - MONITORING PLAN VIEW - B

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS1)

BANK 1
BUFFER 1
BUFFER 2
XS 2
XS 3
XS 4
END UPPER LONG PROFILE
EXISTING TREELINE
PERMANENT LOW-WATER CROSSING
PEBBLE COUNT LOCATION
BANKFULL GAUGE LOCATION
RESTORED CHANNEL ALIGNMENT
PERMANENT CONSERVATION EASEMENT BOUNDARY

DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

B

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467
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Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING		Project No.: 9385.D10	
		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'	
Sheet Title: REACH 1 - MONITORING PLAN VIEW - B		Sheet No.: 3 OF 16	

\\Sec2\jobs7-9k\9385.D7-D10\YEAR 4 - D10\Drawings\REACH 1 - Gray Farm Mont.and PAPV - Year 4.dwg

DRAWINGS PRINTED AT HALF- SCALE

NOTES:

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3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

BEGIN LOWER LONG PROFILE

PERMANENT CONSERVATION EASEMENT BOUNDARY

BANK 2

BUFFER 3

BENTHIC SAMPLING POINT

EXISTING TREELINE

NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION
- BENTHIC SAMPLING POINT

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

C

REACH 1 - MONITORING PLAN VIEW - C

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING		Project No.: 9385.D10	
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Proj. Mgr.: DG	Drawn: DGC
Sheet Title: REACH 1 - MONITORING PLAN VIEW - C		Scale: 1" = 50'	
		Sheet No.: 4 OF 16	

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REACH 1 - MONITORING PLAN VIEW - D

NOTES:

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NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

DRAWINGS PRINTED AT HALF- SCALE

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS1)
- BENTHIC SAMPLING POINT

PERMANENT CONSERVATION EASEMENT BOUNDARY

50+00

51+00

52+00

53+00

54+00

XS 7

55+00

56+00

57+00

58+00

58+13

BUFFER 4

DOWNSTREAM LIMIT OF RESTORATION

END LOWER LONG PROFILE

BENTHIC SAMPLING POINT

EXISTING TREELINE

D

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		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'	
Sheet Title: REACH 1 - MONITORING PLAN VIEW - D		Sheet No.: 5 OF 16	

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

DRAWINGS PRINTED AT HALF- SCALE

PERMANENT ACCESS EASEMENT

UPPER LIMITS OF RESTORATION

BEGIN UPPER LONG PROFILE

BURIED STRUCTURES

BARE FLOODPLAIN #1

BARE FLOODPLAIN #2

BARE FLOODPLAIN #3

EXISTING TREELINE

PERMANENT CONSERVATION EASEMENT BOUNDARY

0+00 1+00 2+00 3+00 4+00 5+00 6+00 7+00 8+00 9+00 10+00 11+00 12+00 13+00 14+00

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE
- SEDIMENT FROM UPSTREAM, HEAVY DEPOSITION
- SEDIMENT FROM UPSTREAM, MODERATE DEPOSITION

A

REACH 1 - PROBLEM AREA PLAN VIEW - A

REVISIONS

REV.	DESCRIPTION	DATE	APP.

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		Proj. Mgr.: DG / Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'
Sheet Title: REACH 1-PROBLEM AREA PLAN VIEW - A		Sheet No.: 6 OF 16

REACH 1 - PROBLEM AREA PLAN VIEW - B

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
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PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

END UPPER LONG PROFILE

EXISTING TREELINE

PERMANENT LOW-WATER CROSSING

STRESSED STRUCTURE # 1 / BANK SCOUR # 1

BANK SCOUR #2

STRESSED STRUCTURE #2

PERMANENT CONSERVATION EASEMENT BOUNDARY

DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

B

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'
Sheet Title: REACH 1 -PROBLEM AREA PLAN VIEW - B		Sheet No.: 7 OF 16

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REACH 1 - PROBLEM AREA PLAN VIEW - C

DRAWINGS PRINTED AT HALF- SCALE

NOTES:

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BEGIN LOWER LONG PROFILE

BARE BANK #1

STRESSED STRUCTURE #3
BANK SCOUR #3

STRESSED STRUCTURE #4
BANK SCOUR #4

BANK 2

BUFFER 3

XS 5

XS 6

BARE FLOODPLAIN #4

PERMANENT CONSERVATION EASEMENT BOUNDARY

BARE FLOODPLAIN #5

UNDERCUT BANK
CHANNEL SCOUR

EXISTING TREELINE

NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

C

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

REVISIONS			
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Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'	
Sheet Title: REACH 1-PROBLEM AREA PLAN VIEW - C		Sheet No.: 8 OF 16	

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NORTH

SCALE 1" = 50'

50 25 0 50

CONTOUR INTERVAL = 2'

DRAWINGS PRINTED AT HALF- SCALE

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PERMANENT CONSERVATION EASEMENT BOUNDARY

RECENT BEAVER DAM

XS 7

DOWNSTREAM LIMIT OF RESTORATION

END LOWER LONG PROFILE

EXISTING TREELINE

REACH 1 - PROBLEM AREA PLAN VIEW - D

D

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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		Proj. Mgr.: DG / Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 50'
Sheet Title: REACH 1-PROBLEM AREA PLAN VIEW - D		Sheet No.: 9 OF 16

APPENDIX D.2 –

Monitoring and Problem Area Plan View, Reach 2

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NOTES:

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DRAWINGS PRINTED AT HALF- SCALE

MONITORING FEATURES COORDINATES - REACH 2		
	NORTHING	EASTING
CROSS SECTION 1	1390081.29	746853.93
RIFFLE 1	1390079.60	746799.51
POOL 1	1390109.67	746817.05
CROSS SECTION 2	1389209.56	746215.22
RIFFLE 2	1389254.69	746167.91
POOL 2	1389238.99	746155.98
BUFFER 1	1389961.86	746771.34
BUFFER 2	1389300.47	746281.07
BANK 1	1389733.94	746553.76
BANK 2	1389408.61	746305.49

RESTORED STREAM CHANNEL

EXISTING CONTOURS

EXISTING NCDENR STREAMS

EXISTING DOT ROADS

BEGIN UPPER LONG PROFILE

END UPPER LONG PROFILE

BEGIN LOWER LONG PROFILE

END LOWER LONG PROFILE

EXISTING TREELINE

PERMANENT ACCESS EASEMENT

BENTHIC SAMPLING POINT

PERMANENT CONSERVATION EASEMENT & FENCELINE

PEBBLE COUNT LOCATION

BENTHIC SAMPLING POINT

KEY SHEET INDEX

NEW STERLING ROAD (SR 1526)

E

F

G

NORTH

SCALE 1" = 100'

100 50 0 100

CONTOUR INTERVAL = 2'

REACH 2 - RESTORATION SITE LAYOUT & KEYSHEET

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.

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		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 100'	
Sheet Title: REACH 2 - RESTORATION SITE LAYOUT & KEYSHEET		Sheet No.: 10 OF 16	

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NOTES:

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DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS1)

UPSTREAM LIMIT OF RESTORATION

0+00

1+00

2+00

3+00

4+00

5+00

6+00

7+00

8+00

9+00

XS 1

BUFFER 1

EXISTING TREELINE

BEGIN UPPER LONG PROFILE

PERMANENT CONSERVATION EASEMENT & FENCELINE

PL

REACH 2 - MONITORING PLAN VIEW - E

E

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 30'	
Sheet Title: REACH 2 - MONITORING PLAN VIEW - E		Sheet No.: 11 OF 16	

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DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS1)

END UPPER LONG PROFILE

10+00

11+00

BANK 1

12+00

13+00

14+00

EXISTING TREELINE

15+00

PERMANENT CONSERVATION EASEMENT & FENCELINE

16+00

BEGIN LOWER LONG PROFILE

BANK 2

17+00

REACH 2 - MONITORING PLAN VIEW - F

F

REVISIONS			
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		Proj. Mgr.: DG / Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 30'
Sheet Title: REACH 2 - MONITORING PLAN VIEW - F		Sheet No.: 12 OF 16

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NOTES:

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DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

LEGEND FOR MONITORING FEATURES

- BUFFER VEGETATION PLOT
- BANK VEGETATION PLOT
- PERMANENT PHOTO POINT
- CROSS-SECTION LOCATION (XS1)

BENTHIC SAMPLING POINT

BUFFER 2

18+00

XS 2

19+00

PEBBLE COUNT LOCATION

END LOWER LONG PROFILE

20+34.14

20+00

20+34.14

PERMANENT ACCESS EASEMENT

EXISTING CULVERT TO REMAIN

21+00

EXISTING TREELINE

21+90.67

CC

DOWNSTREAM LIMIT OF RESTORATION

IPF

PERMANENT CONSERVATION EASEMENT & FENCELINE

IPS

BENTHIC SAMPLING POINT

REACH 2 - MONITORING PLAN VIEW - G

RL

RL

CC

G

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

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Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM
Proj. Mgr.: DG	Drawn: DGC
Scale: 1" = 30'	
Sheet Title: REACH 2 - MONITORING PLAN VIEW - G	Sheet No.: 13 OF 16

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NOTES:

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DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

UPSTREAM LIMIT OF RESTORATION

0+00

1+00

2+00

3+00

4+00

5+00

6+00

7+00

8+00

9+00

BARE FLOODPLAIN # 1

STRESSED STRUCTURE #1
BANK SCOUR #1

STRESSED STRUCTURE #2
BANK SCOUR #2

STRESSED STRUCTURE #3
BANK SCOUR #3

XS 1

EXISTING TREELINE

BEGIN UPPER LONG PROFILE

BUFFER 1

PERMANENT CONSERVATION EASEMENT & FENCELINE

PL

REACH 2 - PROBLEM AREA PLAN VIEW - E

E

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.

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		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 30'	
Sheet Title: REACH 2-PROBLEM AREA PLAN VIEW - E		Sheet No.: 14 OF 16	

\\Sec2\jobs7-9k\9385.D7-D10\YEAR 4 - D10\Drawings\REACH2-GrayFarmMontandPAPV_Year4.dwg

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

END UPPER LONG PROFILE

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

STRESSED STRUCTURES #4 and #5, DOWNCUT RIFFLE

EXISTING TREELINE

BED SCOUR

PERMANENT CONSERVATION EASEMENT & FENCELINE

BEGIN LOWER LONG PROFILE

STRESSED STRUCTURE #6 BANK SCOUR #4

F

REACH 2 - PROBLEM AREA PLAN VIEW - F

REVISIONS			
REV.	DESCRIPTION	DATE	APP.

S&EC

Soil & Environmental Consultants, PA

11010 Raven Ridge Road • Raleigh, North Carolina 27614 • Phone: (919) 846-5900 • Fax: (919) 846-9467

www.SandEC.com

Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING		Project No.: 9385.D10	
		Proj. Mgr.: DG	Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 30'	
Sheet Title: REACH 2-PROBLEM AREA PLAN VIEW - F		Sheet No.: 15 OF 16	

\\Sec2\jobs7-9k\9385.D7-D11\YEAR 4 - D10\Drawings\REACH2-GrayFarmMontandPAPV_Year4.dwg

NOTES:

1. SITE DATA AS DETERMINED BY LIMITED ENGINEERING SURVEY PERFORMED BY S&EC. (NCDENR STREAMS, LIDAR CONTOURS, AND NCDOT ROADS TAKEN FROM REFERENCE GIS LAYERS)
2. ALL LOCATIONS, ELEVATIONS, AND DIMENSIONS ARE APPROXIMATE.
3. ELEVATIONS ARE APPROXIMATE AND BASED ON AN ASSUMED ELEVATION OF 100' ADJUSTED TO MATCH 2 FOOT CONTOURS.

DRAWINGS PRINTED AT HALF- SCALE

NORTH

SCALE 1" = 30'

30 15 0 30

CONTOUR INTERVAL = 2'

LEGEND FOR ASBUILT FEATURES

- RESTORED STREAM CHANNEL
- LOG J-HOOK (LJH)
- ROCK J-HOOK (RJH)
- CROSS ROCK VANE (CRV)
- CREATED/RESTORED WETLANDS
- EXISTING STREAMS

PAPV LEGEND

- STREAM PROBLEM AREAS-STRESSED
- VEGETATION PROBLEM AREAS-MODERATE

END LOWER LONG PROFILE

18+00

19+00

20+00

20+34.14

20+34.14

PERMANENT ACCESS EASEMENT

21+00

21+90.67

CC

EXISTING TREELINE

DOWNSTREAM LIMIT OF RESTORATION

IPF

IPS

PERMANENT CONSERVATION EASEMENT & FENCELINE

RL

CC

RL

G

REACH 2 - PROBLEM AREA PLAN VIEW - G

REVISIONS			
REV.	DESCRIPTION	DATE	APPR.

S&EC
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Project: GRAY FARM STREAM RESTORATION YEAR 4 MONITORING		Project No.: 9385.D10
		Proj. Mgr.: DG / Drawn: DGC
Location: IREDELL CO., NC	Client: NC ECOSYSTEM ENHANCEMENT PROGRAM	Scale: 1" = 30'
Sheet Title: REACH 2-PROBLEM AREA PLAN VIEW - G		Sheet No.: 16 OF 16