Snow Creek Stream Restoration
2007 Final Monitoring Report
Monitoring Year Three

Ecosystem Enhancement Program Project Number 00344

Submitted to:
NCDENR-Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared by:
URS Corporation – North Carolina
1600 Perimeter Park Drive, Suite 400
Morrisville, NC 27560

Project Designed by:
EcoLogic Associates, P.C.
4321-A S. Elm-Eugene St.
Greensboro, NC 27406

Submitted: February 22, 2008

Ecosystem Enhancement PROGRAM

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.0 EXECUTIVE SUMMARY/PROJECT ABSTRACT

URS Corporation (URS) was retained by the North Carolina Ecosystem Enhancement Program (EEP) to conduct stream monitoring at the Snow Creek stream restoration project, located in the Upper Dan River Watershed of the Upper Roanoke River Basin in Stokes County. The stream monitoring effort conducted by URS in November 2007 represents Monitoring Year 3 for this project. Prior to the 2006 monitoring effort, URS received a digital As-Built drawing for the project site from EEP. In addition, URS received the Snow Creek Stream Restoration Design Report prepared by EcoLogic Associates, P.C. (EcoLogic 2002), and a Year 1 Monitoring Report also produced by EcoLogic Associates, P.C. (EcoLogic 2006).

The North Carolina Ecosystem Enhancement Program (EEP) initiated the restoration of 3,310 linear feet of Snow Creek and 700 feet of an unnamed tributary in 2002. The original condition of Snow Creek included very steep, tall banks, with a single row of mature trees at the top of the banks. Snow Creek was straightened by previous landowners to optimize the floodplain for agricultural fields and pastures.

The goals and objectives of the Snow Creek Stream Restoration were to: improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer; re-establish stable channel dimension, pattern, and profile; restore a functional floodplain; enhance aquatic and terrestrial habitat in the stream corridor; provide a stable ford across the main channel for tractor access; provide two pedestrian bridges across the main channel for access to the temple property and agricultural fields; and enhance habitat in the main channel and tributary for small-anthered bittercress (*Cardamine micranthera*), a federally endangered plant that occurs in the Snow Creek channel.

The morphological restoration included significant increases in belt width accomplished through the construction of new meander bends and bankfull benches. Gently sloping transitions were incorporated between the channel bottom and top of bank. Rock vanes, root wads, and coir matting provide bank protection, and cross vanes provide grade control while promoting pool development.

Riparian corridor restoration included the preservation of as many mature streamside trees as possible, construction of two ford crossings, planting of native herbs and woody plants in the easement area, and fencing the conservation easement to prevent disturbance by livestock.

Although vegetation survival at the site is excellent, and up until the 2007 monitoring period all vegetative problem areas were improving, the presence of beavers is having detrimental effects on the streamside vegetation. Beavers are using livestakes (namely *Salix nigra)* to construct their dams along the mainstem and the Unnamed Tributary. There are two large areas of concentrated 'beaver chews' on the mainstem. The entire length of the Unnamed Tributary has been impacted. As of November 2007, streamside vegetation remains in good condition. However, if beaver are not controlled at the site, the condition will worsen rapidly. Additionally, the site experienced two large storm events between 2006 and 2007 monitoring. The storm events deposited large amounts of sediment both in the project reach and on its floodplain. While the majority of the planted vegetation (livestakes) appears to have faired the sedimentation well, several areas were covered in more than two feet of sand. In these areas, smaller bare root seedlings were buried and many did not survive.

The presence of Japanese stilt grass (*Microstegium vimineum*) and Chinese privet (*Ligustrum sinense)* pose concern for the site. The Japanese stilt grass population has increased since 2006 monitoring. Taxonomy follows 'Flora of the Carolinas, Virginia, Georgia, and surrounding areas' (Weakley 2007).

The Snow Creek Stream Restoration Project is in overall very good condition. There were very few problem areas that will require immediate attention. Several of the cross vanes continue to show signs that a boulder(s) have slipped; however, most continue to hold grade and are beginning to fill behind the vane arms. Beavers are present throughout the site and are influencing the nature of the stream and sediment transport. In general, this project has a notable lack of bank erosion, attributable to extremely

low bank angles and well established streamside vegetation. Pool development is excellent throughout the project reach. However, the beaver dams are influencing the streambed grade, sediment transport, and bed material. Upstream of the beaver dams riffles are submerged, causing the bed to become finer.

2.0 PROJECT BACKGROUND

2.1 PROJECT OBJECTIVES

The objectives of the Snow Creek Stream Restoration per EcoLogic's Stream Restoration Design Report (EcoLogic 2002) were to:

1. Improve water quality by reducing the sediment load generated by eroding banks and by restoring a riparian buffer;
2. Re-establish stable channel dimension, pattern, and profile;
3. Restore a functioning floodplain;
4. Enhance aquatic and terrestrial habitat in the stream corridor;
5. Provide a stable ford across the main channel for tractor access;
6. Provide two pedestrian bridges across the main channel for access to the temple property and agricultural fields, and
7. Enhance habitat in the main channel and tributary for small-anthered bittercress (*Cardamine micranthera*), a federally endangered plant that occurs in the Snow Creek channel.

2.2 PROJECT STRUCTURE, RESTORATION TYPE, AND APPROACH

The original condition of Snow Creek included a thin row of mature trees at the top of the banks and very steep, tall banks. Snow Creek was straightened by previous landowners to optimize the floodplain for use as agricultural fields and pastures. In addition, the previous landowners operated a stone quarry on the property, which was accessed by a road crossing over a culvert in Snow Creek. The combination of the straightening and the undersized culverts accelerated entrenchment of the channel until it reached bedrock. Six agricultural landowners have participated in the Snow Creek Stream Restoration project.

Prior to restoration, the main channel of Snow Creek began as a straight south flowing channel. After a sharp ninety degree bend, the channel turned and flowed to the east. Since much of the riparian buffer had been removed to facilitate channel straightening and to provide more land area, the banks of the channel were actively eroding, allowing for lateral movement of the stream. At the time restoration took place, bank heights were nearing eight feet.

The pre-restoration stream length was 3,310 linear feet of Snow Creek and approximately 700 feet of an unnamed tributary. Based on the Rosgen stream classification system, Snow Creek was an entrenched C4/1, while the unnamed tributary was a F4 stream type.

The morphological restoration included significant increases in belt width accomplished through the construction of new meander bends. Bankfull benches provide flood relief. Cross vanes provide grade control and pool development. Riparian corridor restoration included preservation of as many mature trees as possible, construction of two crossing fords, installation of native herbs and woody plants in the easement area and fencing out the agricultural animals.

2.3 LOCATION AND SETTING

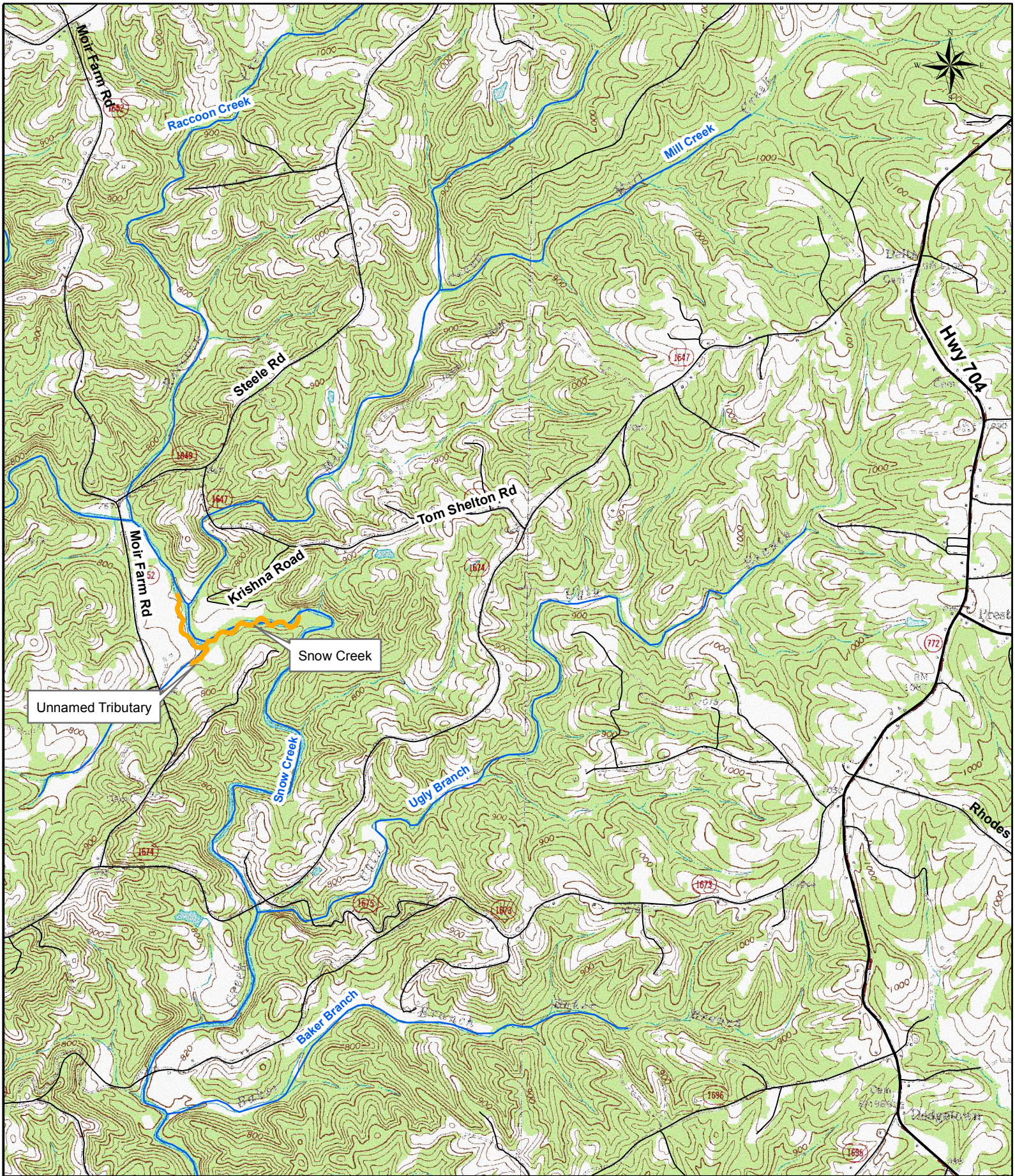
Snow Creek is located in the Upper Dan River Watershed of the Upper Roanoke River Basin in north-central Stokes County. The project reach is located in USGS 8-digit catalog number 03040102-Snow Creek, NC. The NCDWQ classification of the watershed is 0313 Roanoke River Basin, Snow Creek sections 22-20-(0.5) and 22-20-(5.5) (NCDWQ 2005).

The headwaters originate east of the town of Lawsonville, NC, which is just south of the Virginia-North Carolina border. The site's watershed is approximately 28 square miles, and consists primarily of woodland and agriculture. The majority of the upper watershed landscape is cultivated tobacco fields and includes some of the largest and oldest farms in Stokes County.

To reach the site from Raleigh, take I-40 west to exit 210 (NC-68 North) to High Point/Piedmont Triad International Airport. Turn left onto US-158. Continue on Belews Creek Road. Continue on NC-65.

Turn right at US-311. Continue on NC-89, then turn right onto Shepherd Mill Road (SR 1674) and bear left onto Moir Farm Road (SR 1652).

Access to the upstream portion of the site is obtained from Moir Farm Road, northwest of its intersection with Sheppard Mill Road. The project reach begins behind the large white barn on Moir Farm Road. The project reach flows south, then east. The lower portion is accessed from the end of Prahbupada Road. The eastern portion of the project reach is accessed from Krishna Road (Figure 1).



Prepared By:
URS Corporation - North Carolina
1600 Perimeter Park Drive
Suite 400
Morrisville, NC 27560
Phone: 919-461-1100
Fax: 919-461-1415

URS

Prepared For:
NC Ecosystem
Enhancement Program

Ecosystem Enhancement PROGRAM

Project:
Snow Creek
Stream Restoration
Stokes County, NC

Monitoring Year:
3(2007)

Project Number:
00344

Date:
February 2008

Legend
Project Reach

Figure 1
Project Vicinity

0 0.25 0.5
Miles

2.4 PROJECT HISTORY AND BACKGROUND

The tributary to Snow Creek was identified by inventory biologists as a potential restoration project in July 1998. This information was given to representatives of EEP during a field tour of potential restoration sites led by EcoLogic staff in Stokes County in June of 2001. The existing condition survey occurred in late May 2002 at which time a Federally Endangered plant species, small-anthered bittercress was found. Due to this discovery, a Biological Assessment was required with the U.S. Fish and Wildlife Service (USFWS), which started in June 2002. In September 2002, the final Biological Assessment for small-anthered bittercress was submitted to USFWS. In July 2004, construction began and was completed early January 2005. In January-March 2005, live stakes and bare root trees were installed. A heavy rainfall occurred two weeks after construction and caused some damage that required repair, which was accomplished in April 2005. The as-built survey was conducted in February 2005. The as-built morphological survey, installation of reference cross sections, and implementation of vegetation monitoring plots started in July 2005.

Table I. Project Restoration Components
Snow Creek
EEP Project Number 00344

Project Segment or Reach ID	Existing Feet	Mitigation Type	Approach	Linear Footage	Stationing	Comment
Snow Creek – Reach 1	3,310	R	PII	1,200	0+00 to 12+00	Portion of reach is new channel
Snow Creek – Reach 2		R	PII	2,200	12+00 to 35+59	Modify profile, dimension, pattern
UT to Snow Creek	1,355	R	PII	450	0+00 to 4+50	New pattern, profile, dimension, and structures
UT to Snow Creek		E	EI	855		Cattle exclusion and easement

R= Restoration P1= Priority I EI= Enhancement I PII= Priority II
EII= Enhancement II PIII= Priority III S= Stabilization SS= Stream Bank Stabilization

Table II. Project Activity and Reporting History Snow Creek EEP Project Number 00344			
Activity or Report	**Scheduled Completion**	**Data Collection Complete**	**Actual Completion or Delivery**
Restoration Plan	Unknown	Unknown	September 2002
Final Design 90%	Unknown	Unknown	Unknown
Construction (began July 2004)	Unknown	Unknown	January 2005
Permanent seed mix applied	Unknown	Unknown	July 2004 – January 2005
Live stakes and woody plants	Unknown	Unknown	January 2005 – March 2005
Storm Damage Repairs	Unknown	Unknown	April 2005
Final Walk Through	Unknown	Unknown	July 2005
As-Built Report	Unknown	Unknown	December 2005
Warranty Repairs	2005	Unknown	April 2005
Year 1 Monitoring	2005	July 2005	April 2006
Year 2 Monitoring	2006	October 2006	December 2006
Year 3 Monitoring	2007	November 2007	December 2007
Year 4 Monitoring	2008		
Year 5 Monitoring	2009		
Year + Monitoring	Not Scheduled		

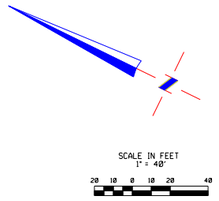
Table III. Project Contact Table Snow Creek EEP Project Number 00344	
Designer Primary project design POC	EcoLogic Associates P.C. 4321-A South Elm-Eugene Street Greensboro, NC 27406 Ken Bridle 336-355-8108
Construction Contractor Construction contractor POC	Shamrock Environmental PO Box 14987 Greensboro, NC 27415 Bill Wright 336-375-1989
Planting Contractor Planting contractor POC	Wheat Swamp Landscaping 4675 Ben Dail Road LaGrange, NC 28551-8038 Charles Hughes 252-566-5030
Seeding Contractor Seeding contractor POC	Shamrock Environmental PO Box 14987 Greensboro, NC 27415 Bill Wright 336-375-1989
Seed Mix Sources	Earnst Seed/Monitor Roller Mill 109 E 4th Street Walnut Cove, NC 27052 336-591-4126

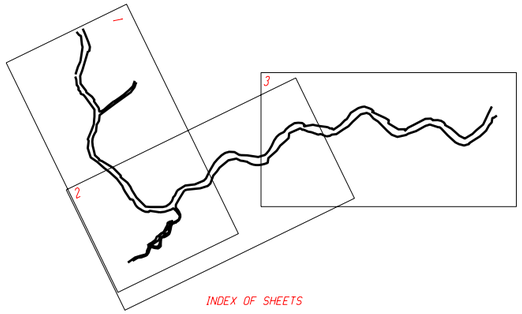
Nursery Stock Suppliers	Wheat Swamp Landscaping 4675 Ben Dail Road LaGrange, NC 28551-8038 252-566-5030
Monitoring Performers – 2005 Monitoring POC – Ken Bridle	EcoLogic Associates P.C. 4321-A South Elm-Eugene Street Greensboro, NC 27406 336-335-1108
Monitoring Performers – 2006 Monitoring POC – Kathleen McKeithan	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 919-461-1597
Monitoring Performers – 2007 Monitoring POC – Kathleen McKeithan	URS Corporation – North Carolina 1600 Perimeter Park Drive, Suite 400 Morrisville, NC 27560 919-461-1597

Table IV. Project Background Table Snow Creek EEP Project Number 00344	
Project County	Stokes
Drainage Area: Snow Creek	28 square miles
Unnamed Tributary	0.9 square miles
Drainage impervious cover estimate (%)	1% or less
Stream Order: Snow Creek	4th order
Unnamed Tributary	2nd order
Physiographic Region	Piedmont
Ecoregion	Northern Inner Piedmont (45e)
Rosgen Classification of As-Built	C4
Dominant soil types	Toccoa and Riverview
Reference site ID	Long Creek in VA
USGS HUC for Project	03010103 – Project
NCDWQ Sub-basin for Project	ROA01 22-20 – Project
NCDWQ classification for Project	C – Project
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	NA
% of project easement fenced	100

2.5 MONITORING PLAN VIEW

See Monitoring Plan View (Figure 2).





INDEX OF SHEETS

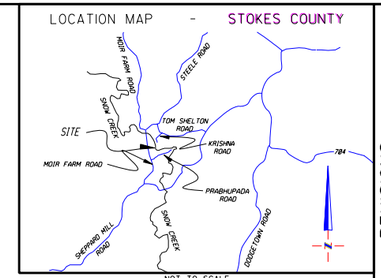
NOTES

1. ALL DISTANCES SHOWN ARE HORIZONTAL.
2. NO NCGS CONTROL MONUMENT FOUND WITHIN 2000 FEET.
3. PROPERTY SUBJECT TO ANY AND ALL EASEMENTS, RIGHTS OF WAYS AND RECORDED OR UNRECORDED ENCUMBRANCES THAT MAY AFFECT SAID SUBJECT TRACT.
4. NORTH BASED ON PLANS PREPARED BY ECOLOGIC ENTITLED "SNOW CREEK STREAM RESTORATION STOKES COUNTY" DATED SEPTEMBER 26, 2003.
5. SURVEY IS AN AS-BUILT SURVEY.

LEGEND

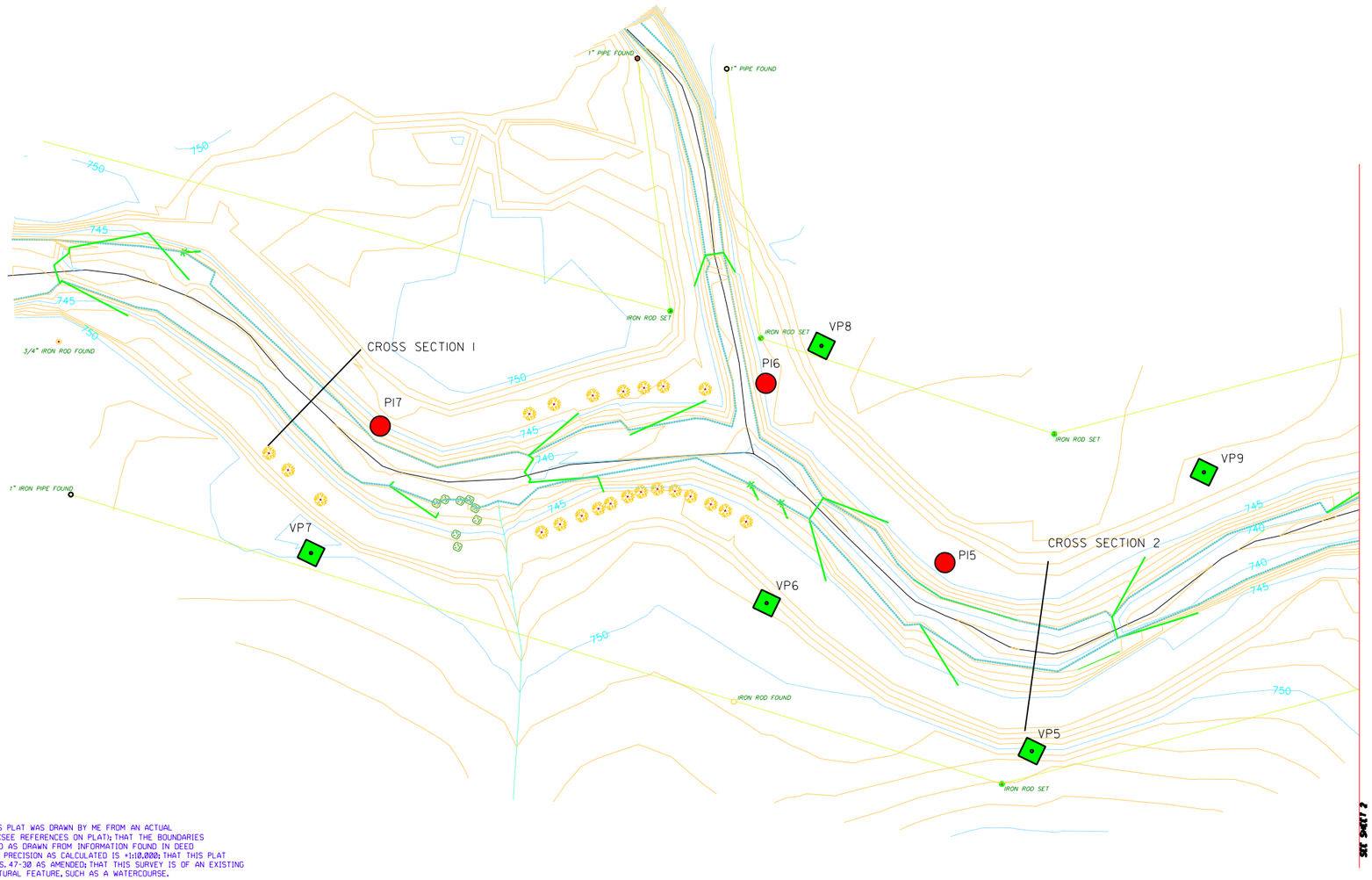
- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- COMPUTED POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- ROOT WAD
- ROCK OR STONE
- ROW OF STONES
- ROCK VANE
- CONTOUR LINE
- VEGETATION PLOTS
- PHOTO POINTS
- THALWEG (2/05)
- TOP OF BANK (2/05)

LOCATION MAP - STOKES COUNTY



NOT TO SCALE

Photo Points			Veg Plots		
ID	Northing	Easting	ID	Northing	Easting
1	987106	1665046	1	986400.3	1663186
2	986990.9	1664930	2	986435.1	1663280
3	987071.6	1664833	3	986561.4	1663373
4	987096.2	1664703	4	986695	1663101
5	987039.3	1664582	5	986881.3	1662913
6	987164.4	1664419	6	987084.5	1662935
7	987043.1	1664212	7	987281	1662828
8	987085.2	1664071	8	987099.7	1663035
9	986935.1	1663889	9	986861.7	1663116
10	986889.5	1663835	10	986674.2	1663331
11	986925	1663712	11	986908.3	1663590
12	986756.8	1663472	12	986950.4	1663730
13	986642.6	1663354	13	987104.2	1664071
14	986665.7	1663210	14	987135.6	1664514
15	986982.5	1662972	15	987109.8	1664612
16	987115.6	1663015	16	987063.2	1664886
17	987291.1	1662893	17	987074.4	1664386
18	986431.9	1663286	18	986851.6	1663921
19	986490.8	1663356	19	986747.7	1663620
20	986553.4	1663394	20	986688.8	1663528
21	986623.6	1663401	21	986382.9	1663269



I, KEITH P. GARRISON, CERTIFY THAT THIS PLAT WAS DRAWN BY ME FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (SEE REFERENCES ON PLAT); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN DEED REFERENCES SHOWN; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED; THAT THIS SURVEY IS OF AN EXISTING BUILDING OR OTHER STRUCTURE, OR NATURAL FEATURE, SUCH AS A WATERCOURSE.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS

DAY OF A.D., 20

KEITH P. GARRISON
NORTH CAROLINA PROFESSIONAL LAND SURVEYOR *L-4434

This document originally issued and sealed by KEITH P. GARRISON, PLS NC Registration No. L-4434 ON MARCH 30, 2005
This media should not be considered a certified document.

40 30 0 40 80
1" = 80'

REVISIONS

NO.	DATE

Prepared by
URS
URS Corporation - North Carolina
1600 Perimeter Park Drive
Morrisville, North Carolina 27560
TELEPHONE (919) 461-1100 FAX (919) 461-1415

PROJECT: SNOW CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2007

TECHNICIAN: EHJ

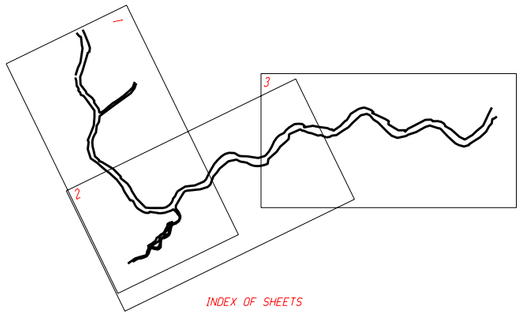
CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00344

SHEET NO. 1

SCALE IN FEET
1" = 40'
20 10 0 10 20 40



INDEX OF SHEETS

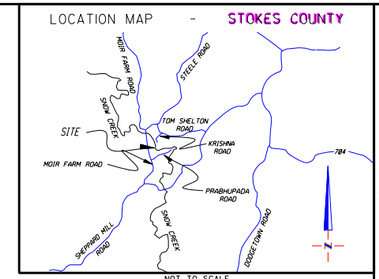
NOTES

1. ALL DISTANCES SHOWN ARE HORIZONTAL.
2. NO NCGS CONTROL MONUMENT FOUND WITHIN 2000 FEET.
3. PROPERTY SUBJECT TO ANY AND ALL EASEMENTS, RIGHTS OF WAYS AND RECORDED OR UNRECORDED ENCUMBRANCES THAT MAY AFFECT SAID SUBJECT TRACT.
4. NORTH BASED ON PLANS PREPARED BY ECOLOGIC ENTITLED "SNOW CREEK STREAM RESTORATION STOKES COUNTY" DATED SEPTEMBER 26, 2003.
5. SURVEY IS AN AS-BUILT SURVEY.

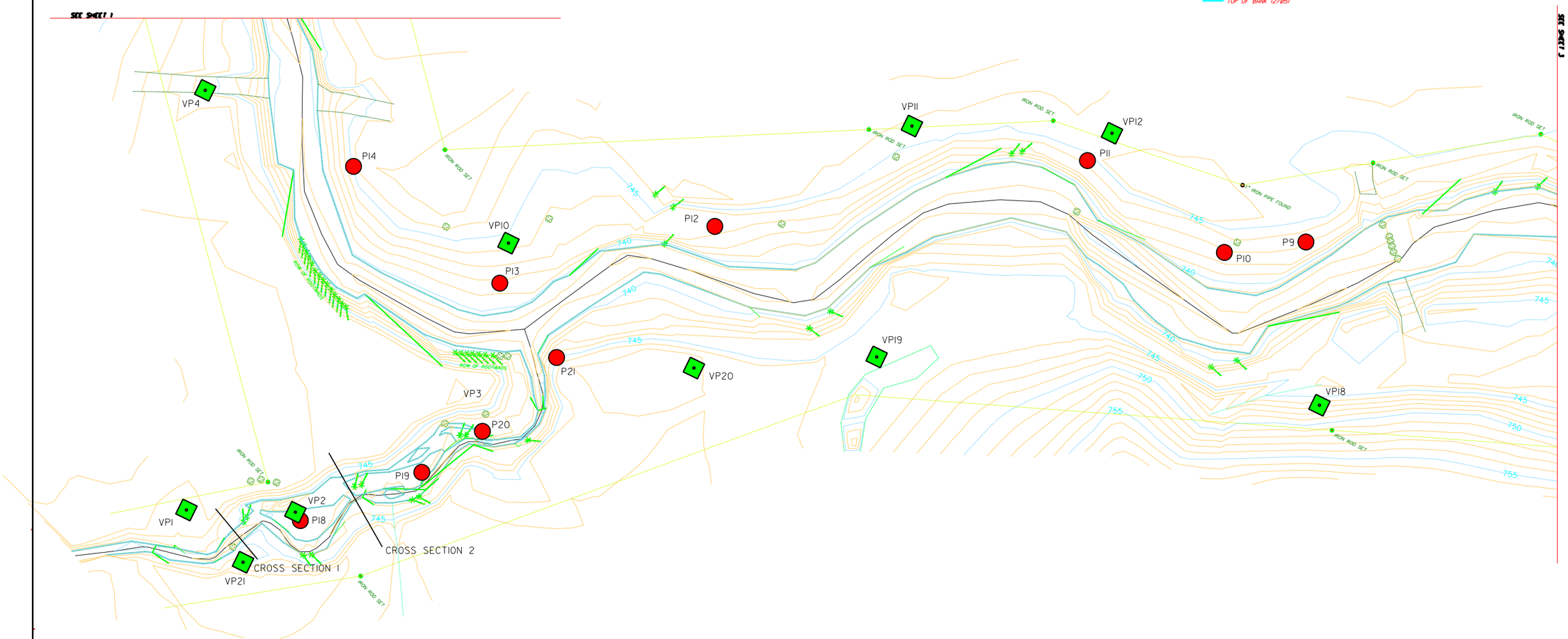
LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- COMPUTED POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- ROOT WAD
- ROCK OR STONE
- ROW OF STONES
- ROCK VANE
- CONTOUR LINE
- VEGETATION PLOTS
- PHOTO POINTS
- THALWEG (2/05)
- TOP OF BANK (2/05)

LOCATION MAP - STOKES COUNTY



NOT TO SCALE



I, KEITH P. GARRISON, CERTIFY THAT THIS PLAT WAS DRAWN BY ME FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (SEE REFERENCES ON PLAT); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN DEED REFERENCES SHOWN; THAT THE RATIO OF PRECISION AS CALCULATED IS 1:10,000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED; THAT THIS SURVEY IS OF AN EXISTING BUILDING OR OTHER STRUCTURE, OR NATURAL FEATURE, SUCH AS A WATERCOURSE.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS

DAY OF A.D., 20

KEITH P. GARRISON
NORTH CAROLINA PROFESSIONAL LAND SURVEYOR *L-4434

This document originally issued and sealed by
KEITH P. GARRISON, PLS
NC Registration No. L-4434
ON MARCH 30, 2005
This media should not be considered a certified document.

40 30 0 40 80
1" = 80'

REVISIONS

NO.	DATE

Prepared by
URS
URS Corporation - North Carolina
1600 Perimeter Park Drive
Morrisville, North Carolina 27560
TELEPHONE (919) 461-1100 FAX (919) 461-1415

PROJECT: SNOW CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES

Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2007

TECHNICIAN: EHJ

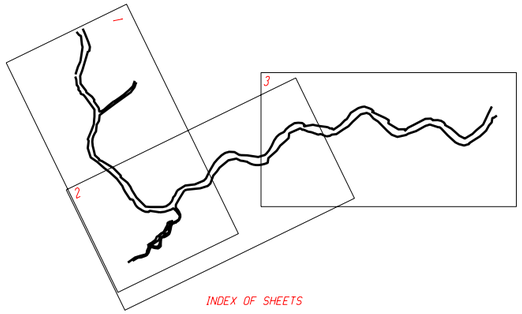
CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00344

SHEET NO. 2

SCALE IN FEET
1" = 40'
20 10 0 10 20 40



INDEX OF SHEETS

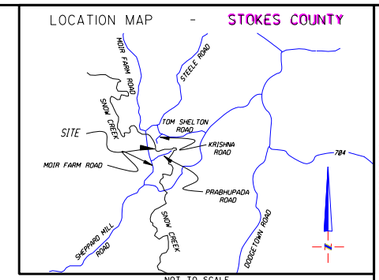
NOTES

1. ALL DISTANCES SHOWN ARE HORIZONTAL.
2. NO NCGS CONTROL MONUMENT FOUND WITHIN 2000 FEET.
3. PROPERTY SUBJECT TO ANY AND ALL EASEMENTS, RIGHTS OF WAYS AND RECORDED OR UNRECORDED ENCUMBRANCES THAT MAY AFFECT SAID SUBJECT TRACT.
4. NORTH BASED ON PLANS PREPARED BY ECOLOGIC ENTITLED "SNOW CREEK STREAM RESTORATION STOKES COUNTY" DATED SEPTEMBER 26, 2003.
5. SURVEY IS AN AS-BUILT SURVEY.

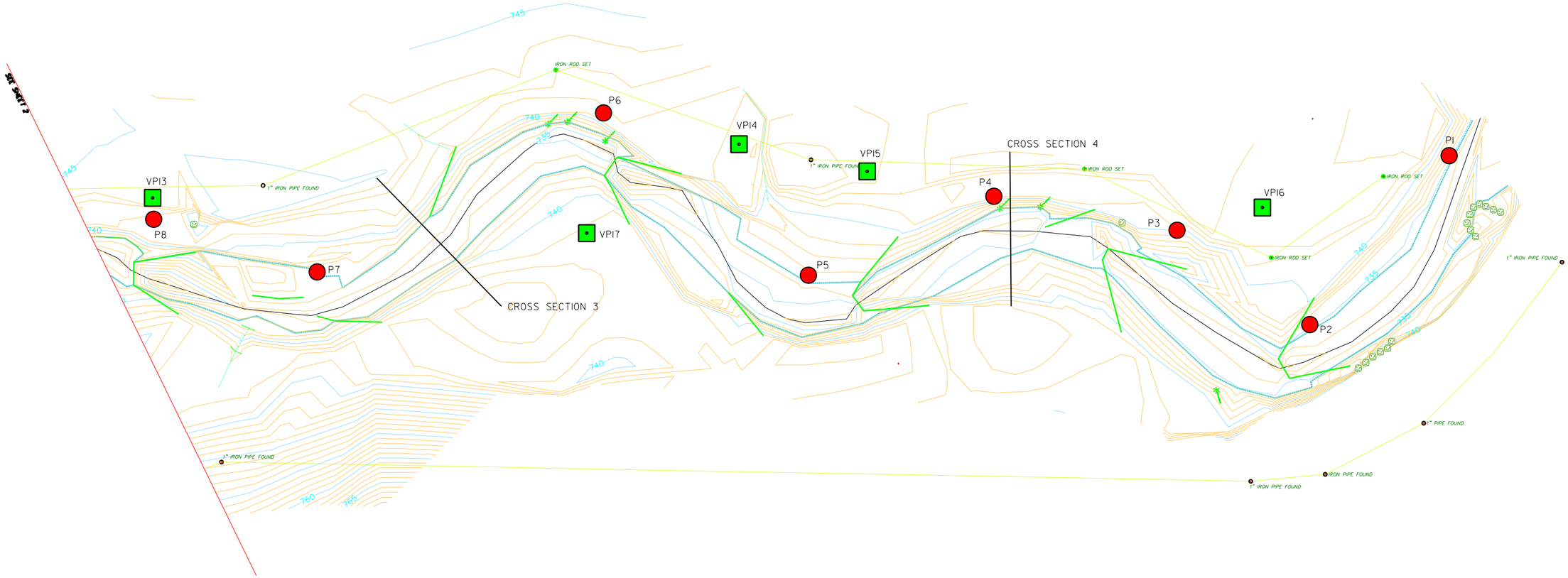
LEGEND

- IRON MARKER FOUND
- IRON MARKER SET
- STONE FOUND
- PK NAIL FOUND
- COMPUTED POINT
- PK NAIL SET
- CONCRETE NAIL SET
- MAG NAIL SET
- CONC. MONUMENT FOUND
- ROOT WAD
- ROCK OR STONE
- ROW OF STONES
- ROCK VANE
- CONTOUR LINE
- VEGETATION PLOTS
- PHOTO POINTS
- THALWEG (2/05)
- TOP OF BANK (2/05)

LOCATION MAP - STOKES COUNTY



NOT TO SCALE



I, KEITH P. GARRISON, CERTIFY THAT THIS PLAT WAS DRAWN BY ME FROM AN ACTUAL SURVEY MADE UNDER MY SUPERVISION (SEE REFERENCES ON PLAT); THAT THE BOUNDARIES NOT SURVEYED ARE CLEARLY INDICATED AS DRAWN FROM INFORMATION FOUND IN DEED REFERENCES SHOWN; THAT THE RATIO OF PRECISION AS CALCULATED IS +1:10,000; THAT THIS PLAT WAS PREPARED IN ACCORDANCE WITH G.S. 47-30 AS AMENDED; THAT THIS SURVEY IS OF AN EXISTING BUILDING OR OTHER STRUCTURE, OR NATURAL FEATURE, SUCH AS A WATERCOURSE.

WITNESS MY ORIGINAL SIGNATURE, REGISTRATION NUMBER AND SEAL THIS

DAY OF A.D., 20 .

KEITH P. GARRISON, PLS
L-4434
MARCH 30, 2006

KEITH P. GARRISON
NORTH CAROLINA PROFESSIONAL LAND SURVEYOR *L-4434

40 30 0 40 80
1" = 80'

REVISIONS

NO.	DATE

Prepared by
URS
URS Corporation - North Carolina
1600 Perimeter Park Drive
Morrisville, North Carolina 27560
TELEPHONE (919) 461-1100 FAX (919) 461-1415

PROJECT: SNOW CREEK STREAM RESTORATION 2006 MONITORING REPORT

TITLE: MONITORING PLAN VIEW

CLIENT: NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Ecosystem Enhancement Program

FIGURE 2

DATE: DEC 2007

TECHNICIAN: EHJ

CHECKED BY: KM

MONITORING YEAR 3

EEP PROJECT NO. 00344

SHEET NO. 3

3.0 PROJECT CONDITION AND MONITORING RESULTS

3.1 VEGETATION ASSESSMENT

3.1.1 Vegetative Problem Areas

Although vegetation survival at the site is excellent, and up until the 2007 monitoring period all vegetative problem areas were improving, the presence of beavers is having detrimental effects on the streamside vegetation. Beavers are using livestakes (namely *Salix nigra)* to construct their dams along the mainstem and the Unnamed Tributary. There are two large areas of concentrated 'beaver chews' on the mainstem. The entire length of the Unnamed Tributary has been impacted. In addition, Japanese stilt grass (*Microstegium vimineum*) and Chinese privet (*Ligustrum sinense)* have begun populating the project buffer. While the current infestation is not severe, Japanese stilt grass is known to be an aggressive plant and prolific seed producer and will likely expand rapidly throughout the project site. As with other invasive species, eradication is far less expensive and more successful if conducted at early stages, before the plant is allowed to take over a large area. Therefore, eradication of the Japanese stilt grass is recommended.

Vegetative Problem Area data tables are located in Appendix A-I. Vegetative Problem Area Photos are located in Appendix A-II.

3.1.2 Vegetative Problem Areas Plan View

The Vegetative Problem Areas Plan View is located in Appendix A-III.

3.2 STREAM ASSESSMENT

3.2.1 Procedural Items

3.2.1.1 Morphometric Criteria

Dimension and profile were sampled at a rate as per the USACE Stream Mitigation Guidelines (USACE 2003) and the 2005 Monitoring Report (EcoLogic 2006) as follows:

Dimension: Four cross sections are located on Snow Creek for a total of three riffles and one pool. Two cross sections, a riffle and a pool, are located on the Unnamed Tributary. The cross sections are to include points at all breaks in slope.

Profile: The longitudinal survey includes 4,182 linear feet of Snow Creek and 482 linear feet of the unnamed tributary, for a total survey length of 4,664 linear feet. Measurements include thalweg, water surface, bankfull, and top of low bank.

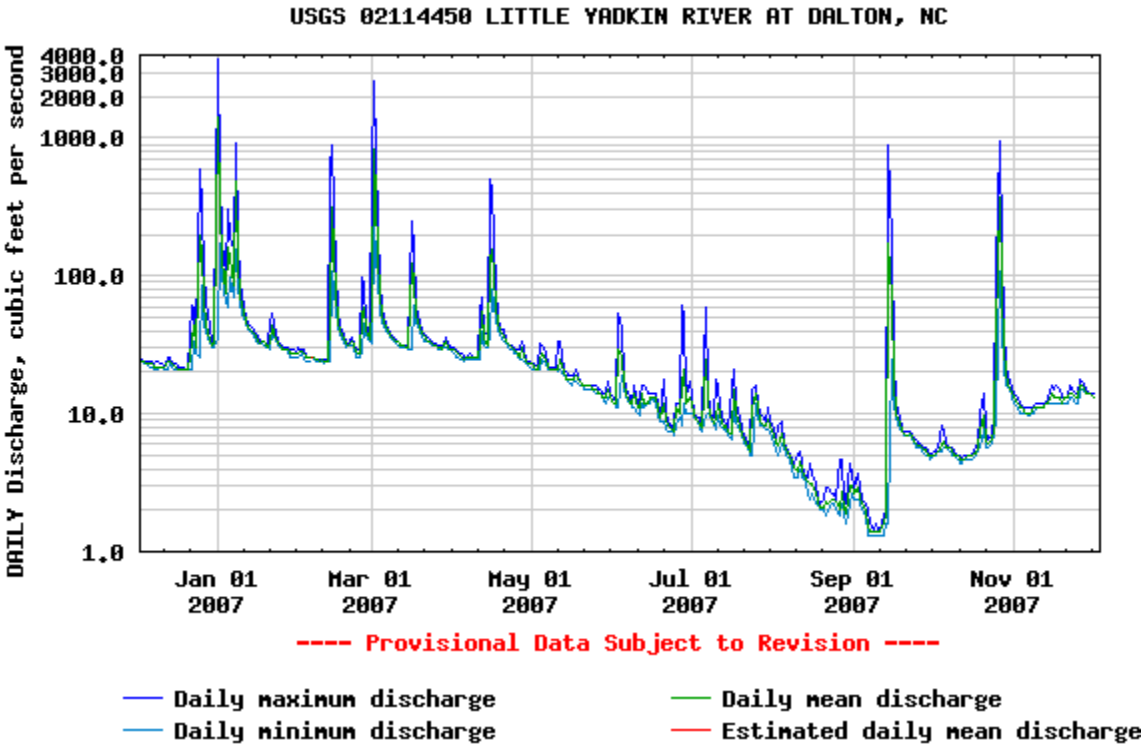
3.2.1.2 Hydrologic Criteria

No crest gages are installed at this site to document bankfull events. Therefore, potential occurrence was extrapolated based on USGS stream gage discharge data for the Little Yadkin River at Dalton, NC (USGS 2007). The USGS gage plot is shown below (Figure 4). The gage is located about 25 miles from the project site and has a drainage area of 43 square miles. An estimate of the number of bankfull events in 2007 was made by comparing the stream discharges from the USGS data in cubic feet per second (cfs) against the bankfull discharge estimated from the drainage area on the Rural Piedmont Regional Curve. According to the regional curve, a bankfull event occurs on a stream with a 43-square mile drainage area when the discharge is about 1,300 cfs. This discharge was exceeded in January and March of 2007, indicating that the Little Yadkin River has had two bankfull events this year (as of November 30, 2007). Snow Creek is in proximity to the Little Yadkin River, and it is likely that the project site also experienced two bankfull events during 2007.

Table V. Verification of Bankfull Events
Snow Creek
EEP Project Number 00344

Date of Data Collection	Date of Occurrence	Method
11/2/2006	Mid-January 2006	Proximal USGS Gage Resource
11/30/07	January and March 2007	Proximal USGS Gage Resource

Figure 4. USGS Stream Gage Discharge Data



3.2.2 Stream Current Condition Plan View

Overall, the Snow Creek Stream Restoration Project is in very good condition. Up until the 2007 monitoring event, the problem areas listed in the initial monitoring reports (Monitoring Year 1) were improving. However, the large storm events that occurred in January and March of 2007 coupled with the large beaver population have caused damage to the site.

During the 2005 monitoring period, EcoLogic identified 14 problem areas on Snow Creek, and seven on the Unnamed Tributary. During 2006, nine of the previous problem areas on Snow Creek had been repaired or had naturally stabilized and three new problem areas were identified. On the Unnamed Tributary, six of the seven problem areas had been repaired or had stabilized, one was still present, and two new problem areas were identified.

Real-Time Water Data provided by the USGS showed that a significant rain event occurred in early January as recorded on the Little Yadkin River in Dalton, NC. The Little Yadkin River gauging station recorded a discharge of approximately 4,000 cubic feet per second that month. Average daily mean discharge at the Little Yadkin River gauging station for January is approximately 100 cubic feet per second. According to Log Pearson III estimates, this event produced more than a 2-year rain event. A 2-year storm produces 3,240 cubic feet per second of discharge and a 5-year storm produces 5,400 cubic feet per second of discharge.

The significant rain event shown by the gauging station was evident during the initial assessment and project status conducted by URS in March of 2007. Sand deposition on the floodplain ranged from six inches to four feet. Large wrack lines, approximately five feet high, were also noted. All vegetation plots have been buried with (up to four feet of) sediment. An increase in beaver activity was noted throughout the entire project reach.

Thirteen problem areas were identified on Snow Creek and one on the Unnamed Tributary during 2007 monitoring. Stream Problem Area data tables are located in Appendix B-II. A number of the failing structures identified during 2006 are now submerged due to downstream beaver dams. Sedimentation within the Unnamed Tributary remains.

The Stream Current Condition Plan View is located in Appendix B-I. Stream Current Condition Photos are located in Appendix B-III.

3.2.3 Fixed Photo Station Photos

Fixed Photo Station Photos are Located in Appendix B-III.

3.2.4 Stability Assessment

Table VIa. Categorical Stream Feature Visual Stability Assessment – Snow Creek
Snow Creek
EEP Project Number 00344

Feature	Initial*	MY-01**	MY-02	MY-03	MY-04	MY-05
A. Riffle	100	N/A	88	49		
B. Pool	100	N/A	90	100		
C. Thalweg	100	N/A	100	100		
D. Meanders	100	N/A	100	100		
E. Bed General	100	N/A	98	80.5		
F. Bank Condition	100	N/A	100	100		
G. Vanes / J Hooks	100	N/A	91	98		
H. Wads and Boulders	100	N/A	100	100		

* It is assumed that all were 100 percent functional upon completion of construction.
**No stability data are presented in the previous report.

Table VIb. Categorical Stream Feature Visual Stability Assessment – Unnamed Tributary
Snow Creek
EEP Project Number 00344

Feature	Initial*	MY-01**	MY-02	MY-03	MY-04	MY-05
A. Riffle	100	N/A	80	80		
B. Pool	100	N/A	100	93		
C. Thalweg	100	N/A	100	100		
D. Meanders	100	N/A	100	97		
E. Bed General	100	N/A	95	86		
F. Bank Condition	100	N/A	100	100		
G. Vanes / J Hooks	100	N/A	100	100		
H. Wads and Boulders	100	N/A	100	29		

* It is assumed that all were 100 percent functional upon completion of construction.
**No stability data are presented in the previous report.

3.2.5 Quantitative Measures Tables (Morphology and Hydrology)

Exhibit Table VIIa. Baseline Morphology and Hydraulic Summary – Snow Creek Snow Creek EEP Project Number 00344																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	--	--	66	26	90	50	66	85	68	13.5	15.2	14.4	52	68	55	55	70	65
Floodprone Width (ft)	--	--	126	--	--	--	120	800+	535	25	125	94	80	800+	535	100	250	132
BF Cross Sectional Area (ft^2)	--	--	358	100	350	175	250	325	294	15.9	19	17.6	--	--	204	186	238	205
BF Mean Depth (ft)	--	--	5.4	2.5	6	4	4.2	5.5	4.3	1.1	1.4	1.2	--	--	3.7	2.7	3.7	3.5
BF Max Depth (ft)	--	--	6.4	--	--	--	5.7	8.1	6.2	1.5	1.9	1.7	--	--	5.4	5.1	7.5	5.5
Width/Depth Ratio	--	--	12.4	--	--	--	12	20	15.9	9.6	13.2	11.8	--	--	14.9	19	25	22
Bank Height Ratio	--	--	--	--	--	--	--	--	1.4	1.0	1.5	1.18	--	--	1.0	--	--	1.0
Entrenchment Ratio	--	--	1.9	--	--	--	6.6	8	7.8	6.6	7	6.6	--	--	9.7	1.4	1.9	1.6
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic radius (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Pattern																		
Channel Beltwidth (ft)	--	--	230	--	--	--	75	150	120	--	--	42	--	--	175	100	250	170
Radius of Curvature (ft)	--	--	155	--	--	--	75	125	100	--	--	25	--	--	127	85	168	130
Meander Wavelength (ft)	--	--	420	--	--	--	320	450	360	--	--	97	--	--	385	320	400	360
Meander Width Ratio	--	--	6.3	--	--	--	--	--	1.75	--	--	2.9	--	--	3.2	--	--	6.4

Exhibit Table VIIa. Baseline Morphology and Hydraulic Summary – Snow Creek Snow Creek EEP Project Number 00344																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Profile																		
Riffle Length (ft)	--	--	95	--	--	--	5	65	42	20	109	53	25	100	50	27	77	45
Riffle Slope (ft/ft)	--	--	0.004	--	--	--	--	--	0.020	--	--	0.017	--	--	0.005	0.002	0.056	0.005
Pool Length (ft)	--	--	200	--	--	--	25	145	93	10	28	18.7	--	--	72	64	262	129
Pool Spacing (ft)	--	--	444	--	--	--	210	630	397	50	88	69	55	231	155	23	271	149
Substrate																		
d50 (mm)	--	--	13.3	--	--	--	--	--	9.4	--	--	18.4	--	--	9.4	--	--	--
d84 (mm)	--	--	69	--	--	--	--	--	54	--	--	73	--	--	54	--	--	--
Additional Reach Parameters																		
Valley Length (ft)	--	--	575	--	--	--	--	--	2200	--	--	895	--	--	2200	--	--	2200
Channel Length (ft)	--	--	745	--	--	--	--	--	3000	--	--	1074	--	--	3400	--	--	3404
Sinuosity	--	--	1.3	--	--	--	--	--	1.4	--	--	1.2	--	--	1.5	--	--	1.54
Water Surface Slope (ft/ft)	--	--	0.003	--	--	--	--	--	0	--	--	0.012	--	--	0.002	--	--	0.012
BF Slope (ft/ft)	--	--	0.003	--	--	--	--	--	0	--	--	0.012	--	--	0.002	--	--	
Rosgen Classification	--	--	B4	--	--	--	--	--	C4/1	--	--	C4	--	--	C4/1	--	--	C4/1

Exhibit Table VIIb. Baseline Morphology and Hydraulic Summary – Unnamed Tributary Snow Creek EEP Project Number 00344																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
BF Width (ft)	--	--	66	6.5	25	13	66	85	68	13.5	15.2	14.4	9	15	12	7.8	13	8.5
Floodprone Width (ft)	--	--	126	--	--	--	120	800+	535	25	125	94	25	45	30	25	75	35
BF Cross Sectional Area (ft^2)	--	--	358	8.5	35	17	250	325	294	15.9	19	17.6	--	--	9.6	7.8	11	8
BF Mean Depth (ft)	--	--	5.4	0.8	2.2	1.4	4.2	5.5	4.3	1.1	1.4	1.2	--	--	0.8	0.5	1	0.6
BF Max Depth (ft)	--	--	6.4	--	--	--	5.7	8.1	6.2	1.5	1.9	1.7	--	--	1.2	0.8	1.2	1
Width/Depth Ratio	--	--	12.4	--	--	--	12	20	15.9	9.6	13.2	11.8	--	--	15	10.2	19.3	13.24
Entrenchment Ratio	--	--	1.9	--	--	--	6.6	8	7.8	6.6	7	6.6	--	--	2.5	4.5	8	5.2
Bank Height Ratio	--	--	--	--	--	--	1.8	4.1	2.2	1.0	1.5	1.18	--	--	1.0	--	--	1.0
Wetted Perimeter (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8
Hydraulic radius (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Pattern																		
Channel Beltwidth (ft)	--	--	230	--	--	--	75	150	120	--	--	42	35	55	40	40	65	45
Radius of Curvature (ft)	--	--	155	--	--	--	75	125	100	--	--	25	25	35	28	15	35	20
Meander Wavelength (ft)	--	--	420	--	--	--	320	450	360	--	--	97	76	94	84	65	95	87

Exhibit Table VIIb. Baseline Morphology and Hydraulic Summary – Unnamed Tributary Snow Creek EEP Project Number 00344																		
Parameter	**USGS Gage Data**			**Regional Curve Interval**			**Pre-Existing Condition**			**Project Reference Stream**			**Design**			**As-built**		
Dimension	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Meander Width Ratio	--	--	6.3	--	--	--	--	--	1.75	--	--	2.9	--	--	7	--	--	10.8
Profile																		
Riffle Length (ft)	--	--	95	--	--	--	5	65	42	20	109	53	12	25	18	8	22	16
Riffle Slope (ft/ft)	--	--	0	--	--	--	--	--	0.020	--	--	0.017	--	--	0	0.015	0.040	0.030
Pool Length (ft)	--	--	200	--	--	--	25	145	93	10	28	18.7	--	--	16	9.2	38.1	17
Pool Spacing (ft)	--	--	444	--	--	--	210	630	397	50	88	69	35	65	52	12	68	42
Substrate																		
d50 (mm)	--	--	13.3	--	--	--	--	--	9.4	--	--	18.4	--	--	11	--	--	1.6
d84 (mm)	--	--	69	--	--	--	--	--	54	--	--	73	--	--	68	--	--	6.6
Additional Reach Parameters																		
Valley Length (ft)	--	--	575	--	--	--	--	--	382	--	--	895	--	--	382	--	--	382
Channel Length (ft)	--	--	745	--	--	--	--	--	700	--	--	1074	--	--	450	--	--	454
Sinuosity	--	--	1.3	--	--	--	--	--	1.8	--	--	1.2	--	--	1.2	--	--	1.2
Water Surface Slope (ft/ft)	--	--	0.003	--	--	--	--	--	0.002	--	--	0.012	--	--	0	--	--	0.010
BF Slope (ft/ft)	--	--	0.003	--	--	--	--	--	0.002	--	--	0.012	--	--	0	--	--	0.010
Rosgen Classification	--	--	B4	--	--	--	--	--	C5	--	--	C4	--	--	C4	--	--	C4

Exhibit Table VIIIa. Morphology and Hydraulic Monitoring Summary Snow Creek – Reach 1 Snow Creek EEP Project Number 00344												
Parameter	**Cross Section 1 Riffle**						**Cross Section 2 Pool**					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	68	52.9	55.9				75.6	61.5	75.0			
Floodprone Width (ft)	132	>133	>133				151	>132	>150			
BF Cross Sectional Area (ft^2)	186	169.9	161.1				249	237.2	220.4			
BF Mean Depth	2.7	3.2	2.9				3.3	3.9	2.9			
BF Max Depth	5.1	5.1	5.2				7.5	8.1	6.9			
Width/Depth Ratio	25	16.5	19.4				22.9	15.9	25.5			
Entrenchment Ratio	1.9	>2.5	>2.4				2	>2.1	>2.0			
Bank Height Ratio	--	1.0	1.0				--	1.0	1.0			
Wetted Perimeter (ft)	69.7	55.8	58.6				77.6	64.1	77.7			
Hydraulic radius (ft)	2.7	3.0	2.7				3.2	3.7	2.8			
Substrate												
d50 (mm)	37.6	37	8.5				4.85	37	0.4			
d84 (mm)	102.7	94	29				24.2	94	3.8			

Exhibit Table VIIIb. Morphology and Hydraulic Monitoring Summary Snow Creek – Reach 2 Snow Creek EEP Project Number 00344												
Parameter	**Cross Section 3 Glide***						**Cross Section 4 Pool***					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	63	46.9	48.1				67	63.3	64.7			
Floodprone Width (ft)	107	>97.7	>100				100	>98.7	>100			
BF Cross Sectional Area (ft^2)	205	125.9	145.9				238	238.8	238.3			
BF Mean Depth	3.2	2.7	3.0				3.5	3.8	3.7			
BF Max Depth	4.7	4.0	4.8				5.6	5.6	5.7			
Width/Depth Ratio	19.7	17.5	15.8				19.2	16.8	17.6			
Entrenchment Ratio	1.7	>2.1	>2.1				1.48	>1.6	>1.5			
Bank Height Ratio	--	1.0	1.0				--	1.0	1.0			
Wetted Perimeter (ft)	65.2	48.7	50.2				69	68.8	69.5			
Hydraulic radius (ft)	3.2	2.6	2.9				3.5	3.5	3.4			
Substrate												
d50 (mm)	10.4	8	0.8				12.1	21	0.6			
d84 (mm)	40.4	47	4.3				36.3	56	21			

* Cross Sections 3 and 4 were identified as riffles in the Monitoring Year One Report. They have transitioned.

Exhibit TableVIIIc. Morphology and Hydraulic Monitoring Summary – Snow Creek Snow Creek EEP Project Number 00344																		
Parameter	**MY1**			**MY2**			**MY3**			**MY4**			**MY5**			**MY+**		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	100	250	170	--	--	--	50	250	133									
Radius of Curvature (ft)	85	168	130	--	--	--	120	185	135									
Meander Wavelength (ft)	320	400	360	--	--	--	325	510	389									
Meander Width Ratio	1.5	3.7	2.5	--	--	--	0.9	4.5	2.4									
Profile																		
Riffle Length (ft)	27.7	77.1	45.4	15.0	110.0	63	24	118	71									
Riffle Slope (ft/ft)	0.0056	0.015	0.010	0.0004	0.009	0.004	0.004	0.014	0.009									
Pool Length (ft)	64.7	262	129	27.0	239.0	65.0	27	96	70									
Pool Spacing (ft)	23	271	149	35	287	138	53	300	168									
Additional Reach Parameters																		
Valley Length (ft)	--	--	2200	--	--	2200	--	--	2129									
Channel Length (ft)	--	--	3404	--	--	3559	--	--	4182									
Sinuosity	--	--	1.5	--	--	1.6	--	--	20									
Water Surface Slope (ft/ft)	--	--	0.002	--	--	0.003	--	--	0.003									
BF Slope (ft/ft)	--	--	0.003	--	--	0.002	--	--	0.001									
Rosgen Classification	--	--	C	--	--	C4	--	--	C4									

Exhibit Table VIIId. Morphology and Hydraulic Monitoring Summary – Unnamed Tributary Snow Creek EEP Project Number 00344												
Parameter	**Cross Section 1 Pool**						**Cross Section 2 Riffle**					
Dimension	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**	**MY1**	**MY2**	**MY3**	**MY4**	**MY5**	**MY+**
BF Width (ft)	10.9	14.4	13.8				7.8	12.3	14.1			
Floodprone Width (ft)	59	66.5	45.8				41	48.3	45.9			
BF Cross Sectional Area (ft^2)	11	15.4	17.1				4.7	8.1	10.7			
BF Mean Depth	1	1.1	1.2				0.6	0.7	0.8			
BF Max Depth	2	2.3	2.6				1	1.8	1.9			
Width/Depth Ratio	10.8	13.5	11.1				13.2	18.7	18.6			
Bank Height Ratio	--	1.0	1.0				--	1.0	1.0			
Entrenchment Ratio	5.4	4.6	3.3				5.2	3.9	3.3			
Wetted Perimeter (ft)	11.8	16.1	14.8				8.2	13.5	15.3			
Hydraulic radius (ft)	0.9	1.0	1.2				0.57	0.6	0.7			
Substrate												
d50 (mm)	0.56	0.43	0.29				1.64	16	2.4			
d84 (mm)	4.0	4.9	2.8				6.58	38	11			

Exhibit Table VIIIe. Morphology and Hydraulic Monitoring Summary – Unnamed Tributary Snow Creek EEP Project Number 00344																		
Parameter	**MY1**			**MY2**			**MY3**			**MY4**			**MY5**			**MY+**		
Pattern	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**	**Min**	**Max**	**Med**
Channel Beltwidth (ft)	40	65	45	--	--	--	18	40	26									
Radius of Curvature (ft)	15	35	20	--	--	--	15	40	30									
Meander Wavelength (ft)	65	95	87	--	--	--	65	100	78									
Meander Width Ratio	5.9	8.7	10.8	--	--	--	2	2.8	1.9									
Profile																		
Riffle Length (ft)	6.1	12.3	8.8	11	33	19	9	30	18									
Riffle Slope (ft/ft)	0.015	0.043	0.031	0.008	0.028	0.014	0.000	0.030	0.014									
Pool Length (ft)	9.2	38.1	16.9	12	41	22	11	45	24									
Pool Spacing (ft)	11.83	67.8	42.4	14	74	32	18	79	35									
Additional Reach Parameters																		
Valley Length (ft)	--	--	382	--	--	382	--	--	382									
Channel Length (ft)	--	--	464	--	--	454	--	--	482									
Sinuosity	--	--	1.2	--	--	1.2	--	--	1.3									
Water Surface Slope (ft/ft)	--	--	0.013	--	--	0.014	--	--	0.017									
BF Slope (ft/ft)	--	--	0.011	--	--	0.013	--	--	0.0167									
Rosgen Classification	--	--	C	--	--	C5	--	--	C4									

4.0 METHODOLOGY SECTION

All monitoring methodologies follow the 2006 templates and guidelines provided by EEP (EEP 2006). Photographs were taken at high resolution using an Olympus Stylus 4.0 megapixel digital camera. GPS location information was collected in 2006 using a Trimble Geo XT handheld mapping grade GPS unit. GPS locations were collected on both banks of each cross section and on all four corners of each vegetation plot. Stream and vegetation problem areas were noted in the field on As-Built Plan Sheets. Permanent photo station photographs were taken from locations marked in the Year One Monitoring Report, prepared by EcoLogic Associates.

4.1 STREAM METHODOLOGY

The methods used to generate the data in this report are standard fluvial geomorphology techniques as described in *Applied River Morphology* (Rosgen 1996) and related publications from US Forest Service and the interagency Stream Mitigation Guidelines (USACE 2003). URS' field morphology survey was conducted using a Nikon DTM-420 Total Station and the data were analyzed and displayed using the Reference Reach Spreadsheet, Version 4.1T (Mecklenburg 2004). Pebble counts were conducted by sampling a total of 100 pebbles from the feature of the cross section (the entire riffle or pool). According to the most recent guidance issued in Rosgen courses, the pebble count was concentrated within the wetted perimeter of the channel and did not include the banks.

Photographs were taken at each cross section. A photo was taken from the left bank towards the right bank, and from the right bank towards the left bank.

4.2 VEGETATION METHODOLOGY

Twenty-three vegetation plots were established by EcoLogic in 2005. The plots are 10-meter by 10-meter in size. These 23 plots were evaluated for Year 1 monitoring in 2005.

According to the new CVS-EEP Protocol for Recording Vegetation (Lee *et al.* 2006), the Snow Creek Stream Restoration Project requires monitoring of 12 vegetation plots. The new CVS-EEP Protocol for Recording Vegetation was used to inventory 12 (3, 5, 7, 8, 10, 11, 13, 15, 16, 17, 18, and 21) of the 23 vegetation plots previously established by EcoLogic.

Ecologic used rebar to mark all four corners of the vegetation plots and the upstream, outside corner was marked with a 4-foot PVC pipe flagged with orange. The remaining three corners were marked with blue flagging. Planted stems were marked with white flagging. A reference photograph was taken from the outside, upstream corner of each plot.

The new protocol was used to inventory the plots for the Year 2 stem counts. All planted stems were marked with white flagging. If flagging from the previous year was present, the old flagging was not removed. New flags were hung adjacent to old flags. Natural regeneration stems were marked with red flagging and recorded. Reference photographs and GPS coordinates were taken at the southwest corner, facing the northeast corner, for each plot. Due to the large quantity of livestakes present in the vegetation plots, a sampling method was devised for planted stem counts based on the sub-sample methodology described in the CVS-EEP Protocol. The sub-sample method was only used for silky dogwood (*Cornus amomum*) and black willow (*Salix nigra*). Over 200 stems of these species were observed in several vegetation plots (URS 2007). Monitoring taxonomy follows 'Manual of the Vascular Flora of the Carolinas' (Radford *et. al* 1968).

The sand deposition experienced at Snow Creek was first noted during the March 2007 initial site assessment. URS reported that: "As a result of the sand deposition, it will be extremely difficult to measure the diameter at decimeter height of the planted stems and/or accurately count the number of stems. The majority of the vegetation plots are buried in more than two feet of sand, leaving many live stakes and the majority of the small volunteer species that were counted in 2006 inaccessible. In addition,

many of the flags hung during 2006 to identify counted, planted stems are also buried, making it difficult to discern between planted and volunteer stems. The methodologies used to inventory vegetation plots during 2007 will need to be altered from the current protocol in order to conduct sampling. Since diameter at decimeter height measurements will not be possible for many stems, and the true height of the stem may not be measurable, it may be preferable to simply count and identify stems in each plot."

URS met with EEP staff onsite in June of 2007 to discuss how to monitor vegetation at Snow Creek during Year 3 monitoring. It was decided that due to the amount of deposition and the number of livestakes present onsite, that Year 3 vegetation monitoring would consist of a presence/absence (stem count) assessment and that ddh (diameter at decimeter height) and dbh (diameter at breast height) measurements would not be taken. Planted stems were not re-flagged during Year 3 monitoring.

Vegetation survey data tables are located in Appendix A-I. Vegetation Plot Photos are located in Appendix A-IV.

5.0 REFERENCES

Ecologic Associates, P.C. 2002. Snow Creek Stream Restoration Design Report. Prepared for NC Ecosystem Enhancement Program. September 2002.

Ecologic Associates, P.C. 2006. Snow Creek Stream Restoration 2005 Monitoring Report. Monitoring Year One. Prepared for NC Ecosystem Enhancement Program. April 2006.

Mecklenburg, Dan. 2004. The Reference Reach Spreadsheet for Channel Survey Data Management. Version 4.1T. Ohio Department of Natural Resources.

EEP. 2006. Content, Format, and Data Requirements for EEP Monitoring Reports. Version 1.2 (11/16/06). NCDENR, NCEEP. 17pp.

Lee, Michael T., Peek, Robert K., Roberts, Steven D., Wentworth, Thomas R. 2006. CVS-EEP Protocol for Recording Vegetation. Version 4.0. (http://cvs.bio.unc.edu/methods.htm)

NCDWQ. 2005. Basinwide Assessment Report. Roanoke River Basin. North Carolina Division of Water Quality. Raleigh, NC.

Radford, A.E., Ahles, H.E., and C.R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press. Chapel Hill, NC.

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

URS. 2007. Snow Creek Stream Restoration. 2006 Monitoring Report. Monitoring Year Two. Ecosystem Enhancement Project Number 00344. January 2007.

USACE, Wilmington District, US Environmental Protection Agency, NC Wildlife Resources Commission, and NC Division of Water Quality. 2003. Stream Mitigation Guidelines. April 2003. 26 pp.

USGS. 2007. Little Yadkin River at Dalton, NC streamflow gage. USGS Real-Time Water Data. Gage 02114450. http://waterdata.usgs.gov.

Weakley, A.S. 2007. Flora of the Carolinas, Virginia, Georgia, and surrounding Areas. Working Draft as of 11 January 2007. UNC Herbarium. North Carolina Botanical Garden. UNC at Chapel Hill.

APPENDIX A

VEGETATION RAW DATA

Table A1. Vegetation Metadata

Report Prepared By	Susan Shelingoski
Date Prepared	12/4/2007 11:36
database name	CVS_EEP_EntryTool_v220NEW.mdb
database location	P:\Jobs3\31825348_Monitoring\Veg
computer name	RDUXPL129

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

Metadata	This worksheet, which is a summary of the project and the project data.
Proj, planted	Each project is listed with its PLANTED stems, for each year. This excludes live stakes and lists stems per acre.
Proj, total stems	Each project is listed with its TOTAL stems, for each year. This includes live stakes, all planted stems, and all natural/volunteer stems. Listed in stems per acre.
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.
ALL Stems by Plot and spp	Count of total living stems of each species (planted and natural volunteers combined) for each plot; dead and missing stems are excluded.

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

Project Code	344
project Name	Snow Creek
Description	Stream Restoration
River Basin	
length(ft)	
stream-to-edge width (ft)	
area (sq m)	
Required Plots (calculated)	
Sampled Plots	12

Table A2. Vegetation Vigor by Species

	Species	4	3	2	1	0	Missing
	Alnus serrulata	1	4	1			2
	Aronia arbutifolia		4	1	1		2
	Cornus amomum	29	297	4			16
	Cornus florida	3	13				
	Nyssa sylvatica	1		2		1	1
	Quercus velutina		1				
	Salix nigra	19	141	3	26	2	6
	Sambucus canadensis	1	7	2			
	Alnus				1		
	Cercis canadensis		1				1
	Quercus rubra		2				
	Platanus occidentalis	3	2				
	Crataegus		2	1		1	2
	Prunus serotina	1					
	Unknown					1	1
TOT:	**15**	**58**	**474**	**14**	**28**	**5**	**31**

Table A3. Vegetation Damage by Species

	Species	All Damage Categories	(no damage)	Enter other damage	Beaver	Storm
	Alnus	1			1	
	Alnus serrulata	8	8			
	Aronia arbutifolia	8	6	1	1	
	Cercis canadensis	2	2			
	Cornus amomum	346	346			
	Cornus florida	16	16			
	Crataegus	6	6			
	Nyssa sylvatica	5	3	2		
	Platanus occidentalis	5	5			
	Prunus serotina	1	1			
	Quercus rubra	2	2			
	Quercus velutina	1	1			
	Salix nigra	197	169		26	2
	Sambucus canadensis	10	10			
	Unknown	2	2			
TOT:	**15**	**610**	**577**	**3**	**28**	**2**

Table A4. Vegetation Damage by Plot

	Plot	All Damage Categories	No Damage	Enter other damage	Beaver	Storm
	344-01-0003-year:3	71	67		4	
	344-01-0005-year:3	13	10		3	
	344-01-0007-year:3	34	27		7	
	344-01-0008-year:3	39	34	3		2
	344-01-0010-year:3	22	21		1	
	344-01-0011-year:3	120	120			
	344-01-0013-year:3	67	63		4	
	344-01-0015-year:3	20	18		2	
	344-01-0016-year:3	45	45			
	344-01-0017-year:3	27	27			
	344-01-0018-year:3	85	85			
	344-01-0021-year:3	67	60		7	
TOT:	**12**	**610**	**577**	**3**	**28**	**2**

Table A5. Stem Count by Plot and Species

	Species	Total Planted Stems	# plots	avg# stems	plot 344-01-0003-year:3	plot 344-01-0005-year:3	plot 344-01-0007-year:3	plot 344-01-0008-year:3	plot 344-01-0010-year:3	plot 344-01-0011-year:3	plot 344-01-0013-year:3	plot 344-01-0015-year:3	plot 344-01-0016-year:3	plot 344-01-0017-year:3	plot 344-01-0018-year:3	plot 344-01-0021-year:3
	Alnus	1	1	1												1
	Alnus serrulata	6	5	1.2		1						1	2	1		1
	Aronia arbutifolia	6	4	1.5		1	1	2							2	
	Cercis canadensis	1	1	1			1									
	Cornus amomum	330	11	30	66	1	17	3		71	59	14	20	14	27	38
	Cornus florida	16	1	16											16	
	Crataegus	3	1	3				3								
	Nyssa sylvatica	3	1	3				3								
	Platanus occidentalis	5	2	2.5											2	3
	Prunus serotina	1	1	1											1	
	Quercus rubra	2	2	1				1					1			
	Quercus velutina	1	1	1	1											
	Salix nigra	189	12	15.75	4	10	10	20	21	47	8	2	15	9	22	21
	Sambucus canadensis	10	4	2.5			2					3			2	3
TOT:	**14**	**574**	**14**		**71**	**13**	**31**	**32**	**21**	**118**	**67**	**20**	**38**	**24**	**72**	**67**

Table A6a. Vegetative Problem Areas – Snow Creek Snow Creek EEP Project Number 00344			
Feature/Issue	**Station #/Range**	**Probable Cause**	**Photo #**
Bare slope	7+60	Dry slope	VPA2
Scour of floodplain	5+60	Storm Flows	NVPA1
Poor survival	12+80	Beaver activity	NVPA2
Invasive population	19+90 to 20+40	*Microstegium vimeneum*	NVPA3
Poor survival	21+40 to 25+50	Beaver activity	NVPA4

Table A6b. Vegetative Problem Areas – Unnamed Tributary Snow Creek EEP Project Number 00344			
Feature/Issue	**Station #/Range**	**Probable Cause**	**Photo #**
Invasive population	0+00 to 4+50	*Microstegium vimineum* *Ligustrum sinense*	UTVPA1

SNOW CREEK


VPA2 on right bank, facing downstream


NVPA1 on left bank, facing downstream


NVPA2 on left bank, facing downstream

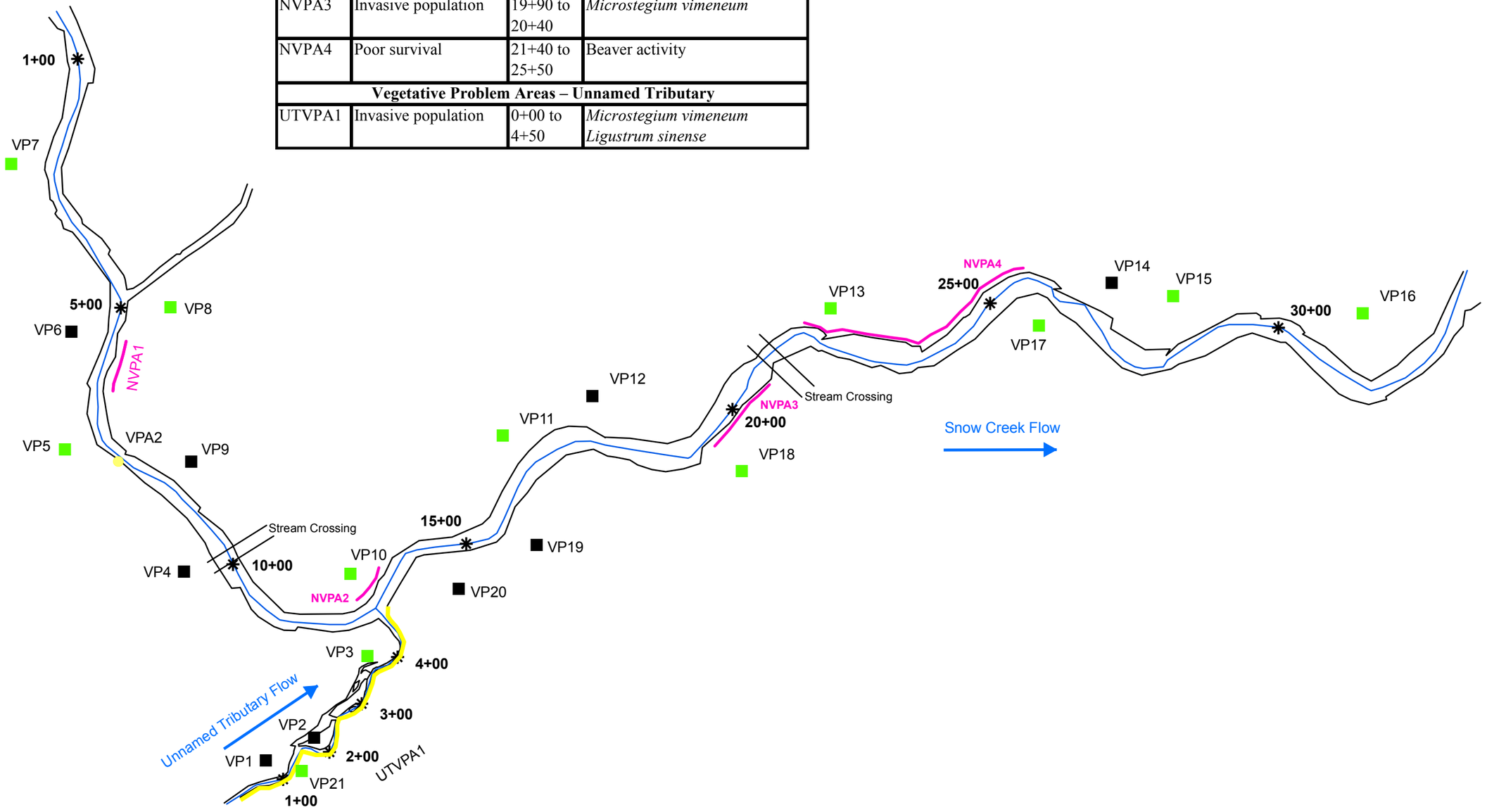

NVPA3 on right bank, facing downstream


NVPA4 on left bank, facing downstream

UNNAMED TRIBUTARY

UTVPA1 on right bank, facing downstream

Vegetative Problem Areas – Snow Creek			
Feature #	**Feature Issue**	**Station # / Range**	**Probable Cause**
VPA2	Bare Slope	7+60	Dry Slope
NVPA1	Scour of floodplain	5+60	Storm Flows
NVPA2	Poor survival	12+80	Beaver activity
NVPA3	Invasive population	19+90 to 20+40	*Microstegium vimeneum*
NVPA4	Poor survival	21+40 to 25+50	Beaver activity
Vegetative Problem Areas – Unnamed Tributary			
UTVPA1	Invasive population	0+00 to 4+50	*Microstegium vimeneum* *Ligustrum sinense*



* The 2007 Initial Site Assessment revealed that Snow Creek has experienced excessive sedimentation since the 2006 monitoring was conducted. The entire project reach has been impacted by sediment (sand) ranging from 6 inches to 4 feet deep. Several vegetation plots have been buried under more than 3 feet of sand. The entire project reach is a Problem Area Concern.

Prepared By:
URS Corporation - North Carolina
1600 Perimeter Park Drive
Suite 400
Morrisville, NC 27560
Phone: 919-461-1100
Fax: 919-461-1415

Prepared For:
NC Ecosystem Enhancement Program

Project:
Snow Creek
Stream Restoration
Stokes County, NC

Monitoring Year:
3 (2007)

Project Number:
00344

Date:
February 2008

Legend
- Inventoried
- Not Inventoried
- 2006 Problem Area Concern
- 2006 Problem Area Concern
- 2007 Problem Area High Concern
- Stations
- As-Built Centerline
- As-Built Streambank

Vegetative Problem Areas Plan View


VP3


VP5


VP7


VP8


VP10


VP11


VP13


VP15


VP16


VP17

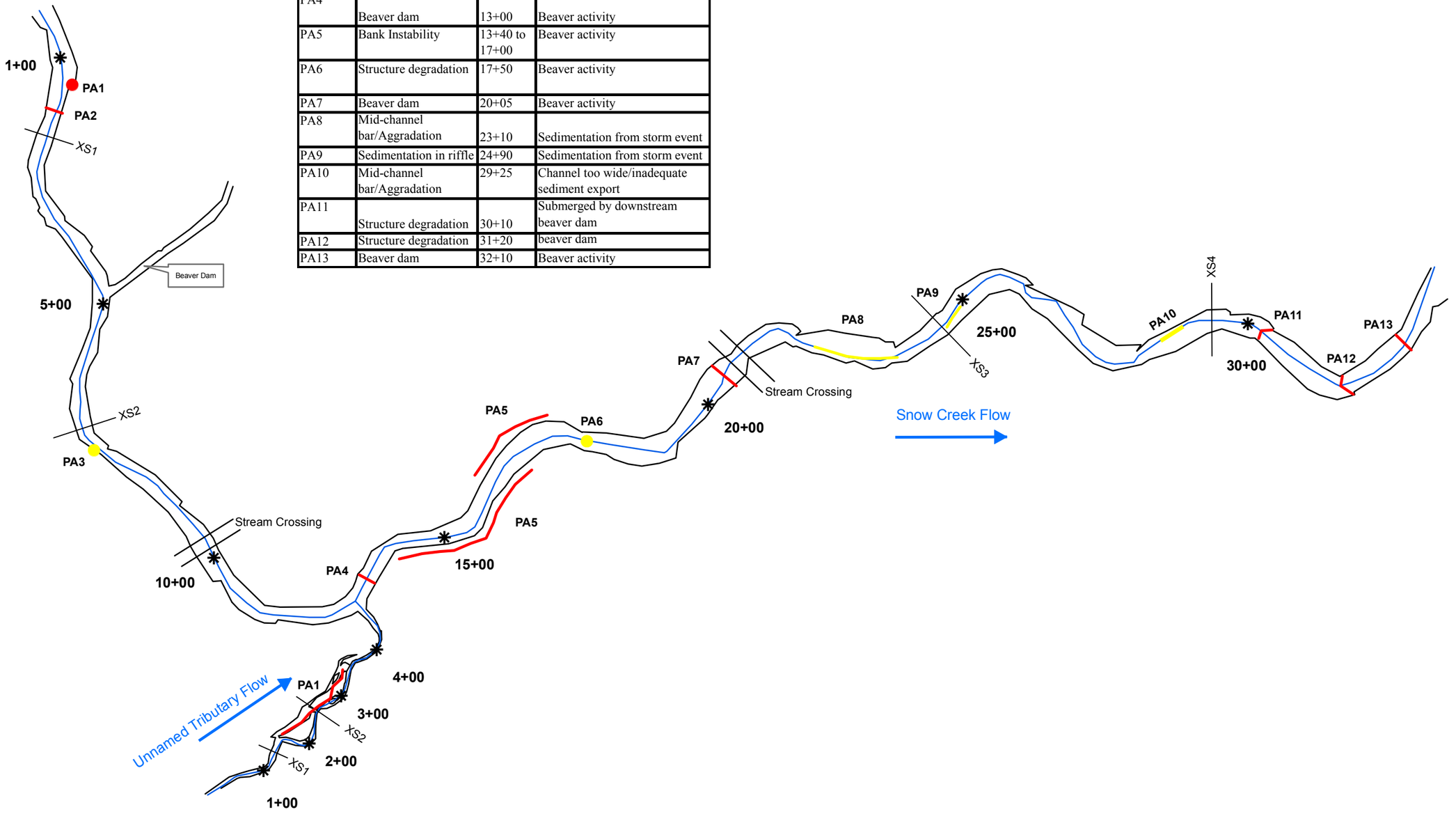

VP18


VP21

APPENDIX B

GEOMORPHIC RAW DATA

Stream Problem Areas – Snow Creek			
Feature #	**Feature Issue**	**Station # / Range**	**Probable Cause**
PA1	Structure degradation	1+05	Submerged by downstream beaver dam
PA2	Beaver dam	1+40	Beaver activity
PA3	Structure degradation	7+60	Sedimentation from storm event
PA4	Beaver dam	13+00	Beaver activity
PA5	Bank Instability	13+40 to 17+00	Beaver activity
PA6	Structure degradation	17+50	Beaver activity
PA7	Beaver dam	20+05	Beaver activity
PA8	Mid-channel bar/Aggradation	23+10	Sedimentation from storm event
PA9	Sedimentation in riffle	24+90	Sedimentation from storm event
PA10	Mid-channel bar/Aggradation	29+25	Channel too wide/inadequate sediment export
PA11	Structure degradation	30+10	Submerged by downstream beaver dam
PA12	Structure degradation	31+20	beaver dam
PA13	Beaver dam	32+10	Beaver activity



* The 2007 Initial Site Assessment revealed that Snow Creek has experienced excessive sedimentation since the 2006 monitoring was conducted. The entire project reach has been impacted by sediment (sand) ranging from 6 inches to 4 feet deep. The Unnamed Tributary and several riffles have been filled. The entire project reach is a Problem Area Concern.

Stream Problem Areas – Unnamed Tributary			
Feature #	**Feature Issue**	**Station # / Range**	**Probable Cause**
PA1	Bank instability	1+50 to 3+40	Beaver activity

0 100 200 400 Feet

Prepared By:
URS Corporation - North Carolina
1600 Perimeter Park Drive
Suite 400
Morrisville, NC 27560
Phone: 919-461-1100
Fax: 919-461-1415

Prepared For:
NC Ecosystem Enhancement Program

Project:
Snow Creek
Stream Restoration
Stokes County, NC

Monitoring Year:
3 (2007)

Project Number:
00344

Date:
February 2008

Legend
- Stations
- Problem Area Concern
- Problem Area High Concern
- Problem Area Concern
- Problem Area High Concern
- Cross Section
- As-Built Centerline
- As-Built Streambank

Stream Current Condition Plan View

Table B1a. Stream Problem Areas – Snow Creek Snow Creek 00344			
Feature Issue	**Station**	**Suspected Cause**	**Photo #**
Structure degradation	1+05	Submerged by downstream beaver dam	PA1
Beaver dam	1+40	Beaver activity	PA2
Structure degradation	7+60	Sedimentation from storm event	PA3
Beaver dam	13+00	Beaver activity	PA4
Bank Instability	13+40 to 17+00	Beaver activity	PA5
Structure degradation	17+50	Beaver activity	PA6
Beaver dam	20+05	Beaver activity	PA7
Mid-channel bar/Aggradation	23+10	Sedimentation from storm event	PA8
Sedimentation in riffle	24+90	Sedimentation from storm event	PA9
Mid-channel bar/Aggradation	29+25	Channel too wide/inadequate sediment export	PA10
Structure degradation	30+10	Submerged by downstream beaver dam	PA11
Structure degradation	31+20	Submerged by downstream beaver dam	PA12
Beaver dam	32+10	Beaver activity	PA13

Table B1b. Stream Problem Areas – Unnamed Tributary Snow Creek 00344			
Feature Issue	**Station**	**Suspected Cause**	**Photo #**
Bank instability	1+50 to 3+40	Beaver activity	PA1

SNOW CREEK


PA1


PA2


PA3


PA4


PA5


PA6


PA7


PA8


PA9


PA10


PA11


PA12

PA13

UNNAMED TRIBUTARY

PA1

SNOW CREEK


PS1


PS2


PS3


PS4


PS5


PS6


PS7


PS8


PS9


PS10


PS11


PS12


PS13


PS14


PS15


PS16


PS17

UNNAMED TRIBUTARY


PS18


PS19


PS20


PS21

Exhibit Table B1a. Visual Morphological Stability Assessment – Snow Creek Snow Creek 00344						
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**	**% perform in stable condition**	**Feature perform. Mean or total**
A. Riffles	1. Present?	7	16	9	44	
	2. Armor stable (no displacement)?	10	16	6	38	
	3. Facet grade appears stable?	10	16	6	38	
	4. Minimal evidence of embedding/fining?	6	16	10	63	
	5. Length appropriate?	6	16	10	63	
						49
B. Pools*	1. Present (not subject to severe aggrad. or migration)?	22	19	0	100	
	2. Sufficiently deep (max pool D:mean Bkf >1.6)	20	19	0	100	
	3. Length appropriate?	19	19	0	100	
						100
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	4182	4182	0	100	
	2. Downstream of meander (glide/inflection) centering?	4182	4182	0	100	
						100
D. Meanders	1. Outer bend in state of limited/controlled erosion?	19	19	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	19	19	0	100	
	3. Apparent Rc within spec?	19	19	0	100	
	4. Sufficient floodplain access and relief?	19	19	0	100	
						100
E. Bed General	1. General channel bed aggradation areas (bar formation)	2570	4182	1612	61	
	2. Channel bed degradation–areas of increasing downcutting/headcutting?	4182	4182	0	100	
						80.5
F. Bank	1. Actively eroding, wasting, or skumping banks	4182	4182	0	100	
						100
G. Vanes**	1. Free of back or arm scour?	22	23	1	96	
	2. Height appropriate?	24	23	0	100	
	3. Angle and geometry appear appropriate?	24	23	0	100	
	4. Free of piping or other structural failures?	22	23	1	96	
						98
H. Wads/ Boulders	1. Free of scour?	1	1	0	100	
	2. Footing stable?	1	1	0	100	
						100

* 19 pools were reported in the As-Built. Twenty-two were observed during 2006 monitoring.

** 23 vanes were reported in the As-Built. Twenty-four were observed during 2006 monitoring.

Table B1b. Visual Morphological Stability Assessment – Unnamed Tributary Snow Creek 00344						
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**	**% perform in stable condition**	**Feature perform. Mean or total**
A. Riffles	1. Present?	4	6	2	67	
	2. Armor stable (no displacement)?	6	6	0	100	
	3. Facet grade appears stable?	6	6	0	100	
	4. Minimal evidence of embedding/fining?	4	6	2	67	
	5. Length appropriate?	4	6	2	67	
						80
B. Pools	1. Present (not subject to severe aggrad. or migration)?	9	9	0	100	
	2. Sufficiently deep (max pool D:mean Bkf >1.6)	9	9	0	100	
	3. Length appropriate?	7	9	2	78	
						93
C. Thalweg	1. Upstream of meander bend (run/inflection) centering?	482	N/A	0	100	
	2. Downstream of meander (glide/inflection) centering?	482	N/A	0	100	
						100
D. Meanders	1. Outer bend in state of limited/controlled erosion?	8	8	0	100	
	2. Of those eroding, # w/concomitant point bar formation?	8	8	0	100	
	3. Apparent Rc within spec?	7	8	1	88	
	4. Sufficient floodplain access and relief?	8	8	0	100	
						97
E. Bed General	1. General channel bed aggradation areas (bar formation)	346	482	136	72	
	2. Channel bed degradation–areas of increasing downcutting/headcutting?	482	482	0	100	
						86
F. Bank	1. Actively eroding, wasting, or slumping banks	482	482	0	100	
						100
G. Vanes	1. Free of back or arm scour?	7	7	0	100	
	2. Height appropriate?	7	7	0	100	
	3. Angle and geometry appear appropriate?	7	7	0	100	
	4. Free of piping or other structural failures?	7	7	0	100	
						100
H. Wads/ Boulders	1. Free of scour?	2	7	5	29	
	2. Footing stable?	2	7	5	29	
						29

Elevation data were not provided to URS. However, elevation data were used by EcoLogic in plotting Year 1 cross section data. URS was unable to locate benchmarks in the field to establish elevations for the 2006 and 2007 cross sections. Cross section data were hand manipulated to negate elevation data used in Year 1 cross sections.

In 2006, cross section pins were located for all plots with the exception of cross section 2 on the UT to Snow Creek, where the left bank pin was not found. URS re-established the left bank pin in the field. Data from this cross section from 2006 and 2007 are not comparable to Year 1 data. The re-establishment of pins effectively relocates the cross sections.

URS has plotted these data on the same graph for reference only. The data and/or graph should not be used to interpret channel change for cross section 2.

SNOW CREEK

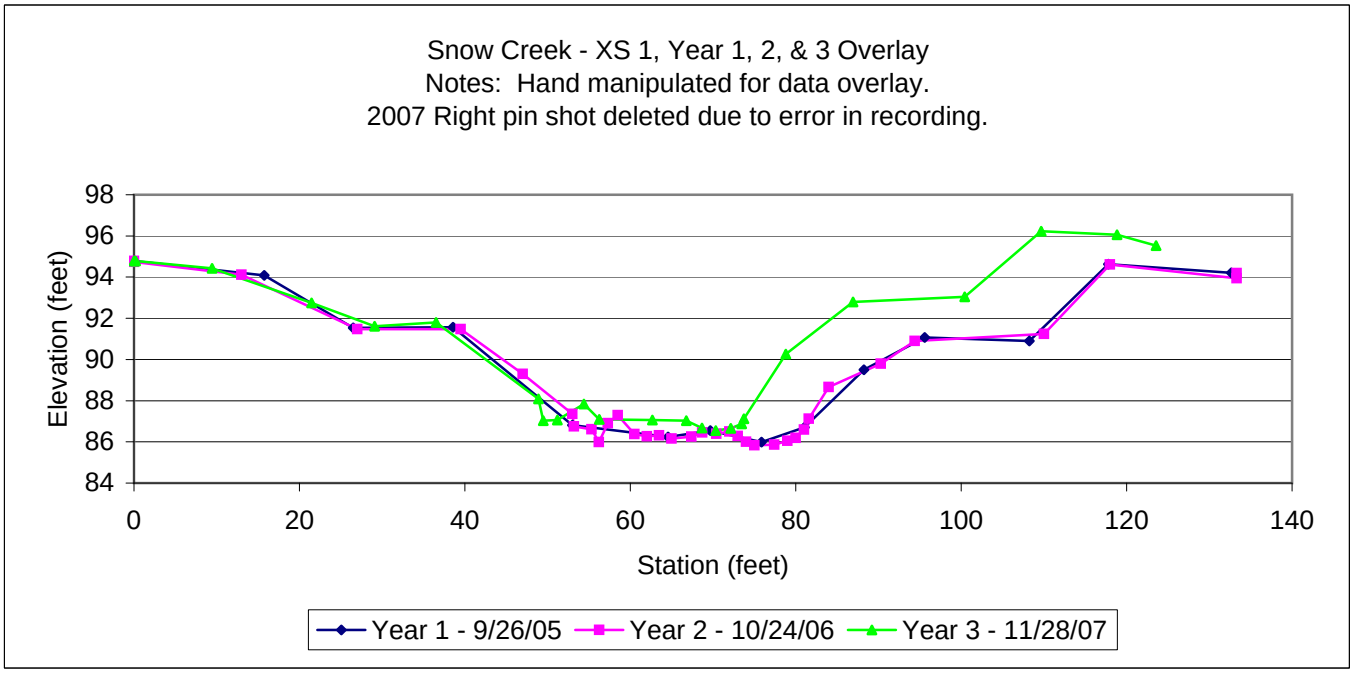
REACH 1

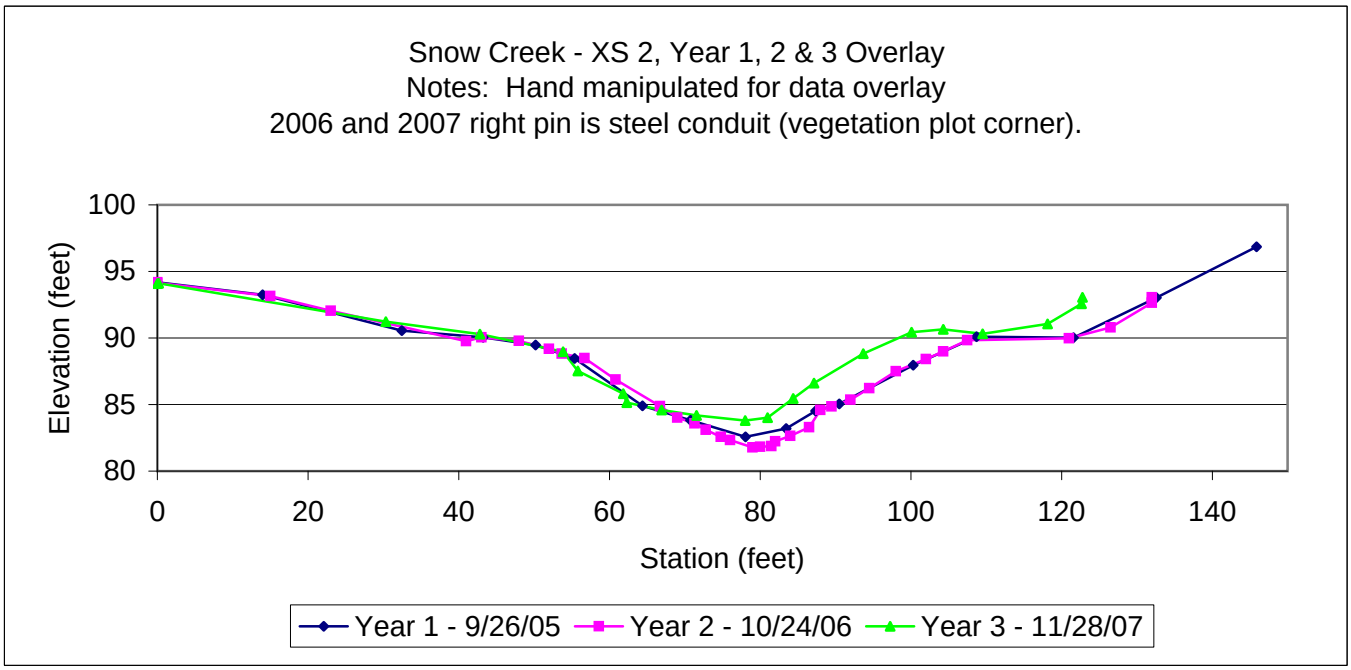

XS1 facing right bank (11/28/07)


XS1 facing left bank (11/28/07)


XS2 facing right bank (11/28/07)


XS2 facing left bank (11/28/07)


Snow Creek - XS 1, Year 1, 2, & 3 Overlay
Notes: Hand manipulated for data overlay.
2007 Right pin shot deleted due to error in recording.
Elevation (feet)
98
96
94
92
90
88
86
84
0
20
40
60
80
100
120
140
Station (feet)
Year 1 - 9/26/05
Year 2 - 10/24/06
Year 3 - 11/28/07


Snow Creek - XS 2, Year 1, 2 & 3 Overlay
Notes: Hand manipulated for data overlay
2006 and 2007 right pin is steel conduit (vegetation plot corner).
Elevation (feet)
100
95
90
85
80
0
20
40
60
80
100
120
140
Station (feet)
Year 1 - 9/26/05
Year 2 - 10/24/06
Year 3 - 11/28/07

SNOW CREEK

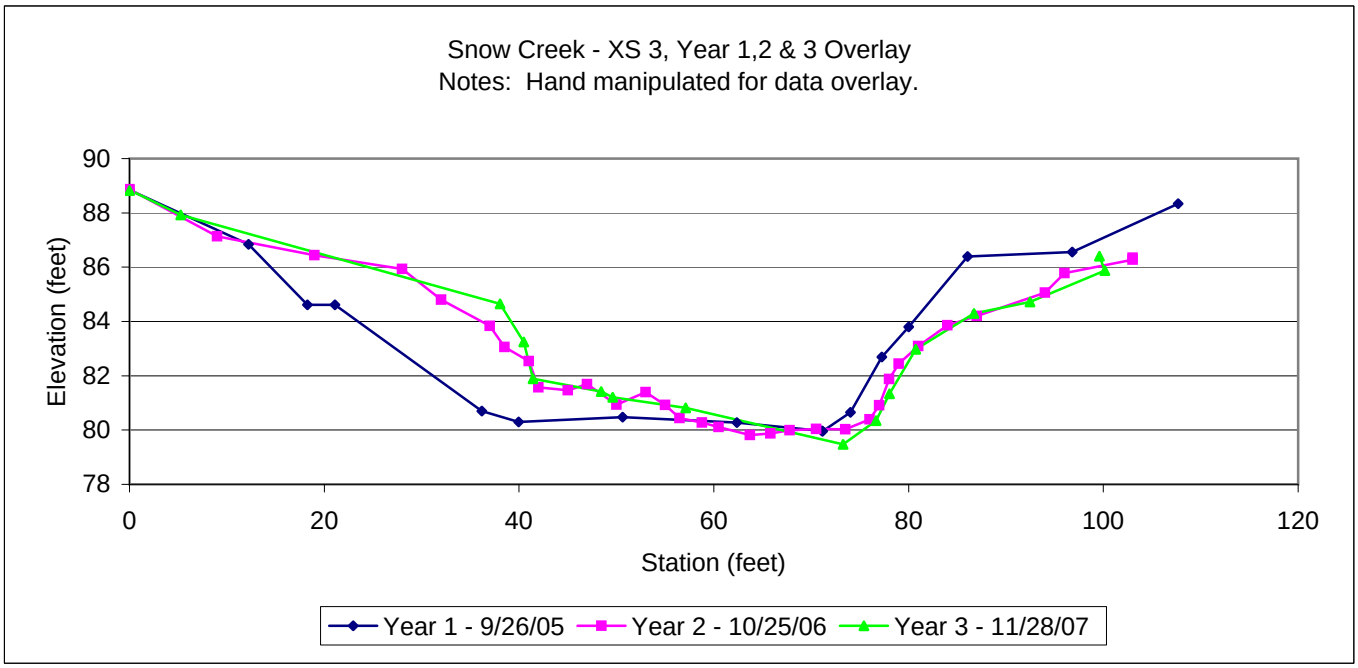
REACH 2

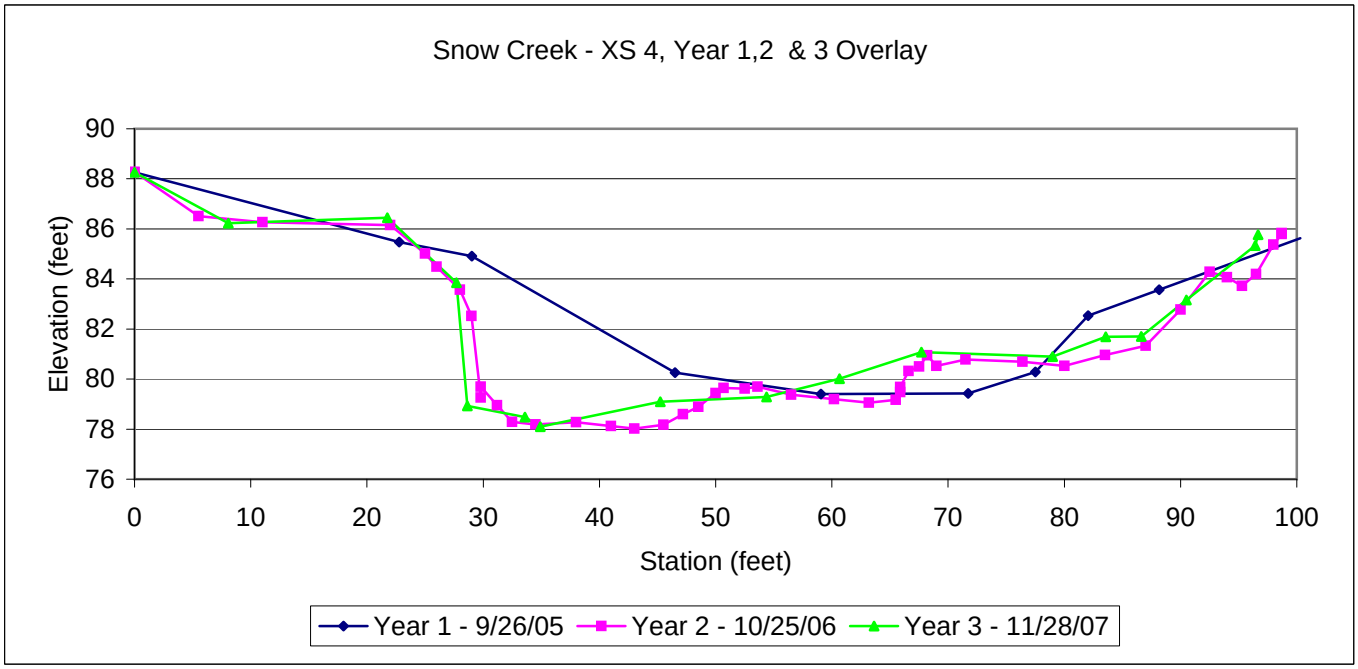

XS3 facing right bank (11/28/07)


XS3 facing left bank (11/28/07)


XS4 facing right bank (11/29/07)


XS4 facing left bank (11/29/07)


Snow Creek - XS 3, Year 1,2 & 3 Overlay
Notes: Hand manipulated for data overlay.
Elevation (feet)
90
88
86
84
82
80
78
0
20
40
60
80
100
120
Station (feet)
Year 1 - 9/26/05
Year 2 - 10/25/06
Year 3 - 11/28/07


Snow Creek - XS 4, Year 1,2 & 3 Overlay
Elevation (feet)
90
88
86
84
82
80
78
76
0
10
20
30
40
50
60
70
80
90
100
Station (feet)
Year 1 - 9/26/05
Year 2 - 10/25/06
Year 3 - 11/28/07

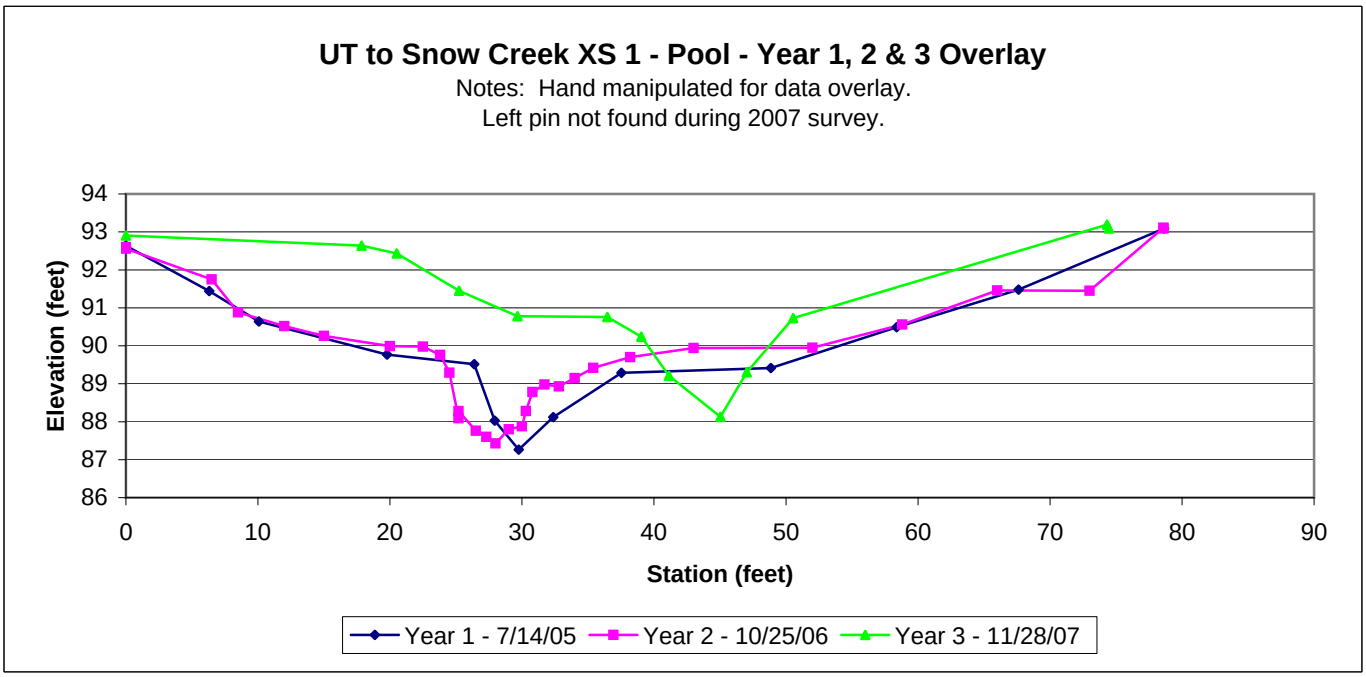
UNNAMED TRIBUTARY

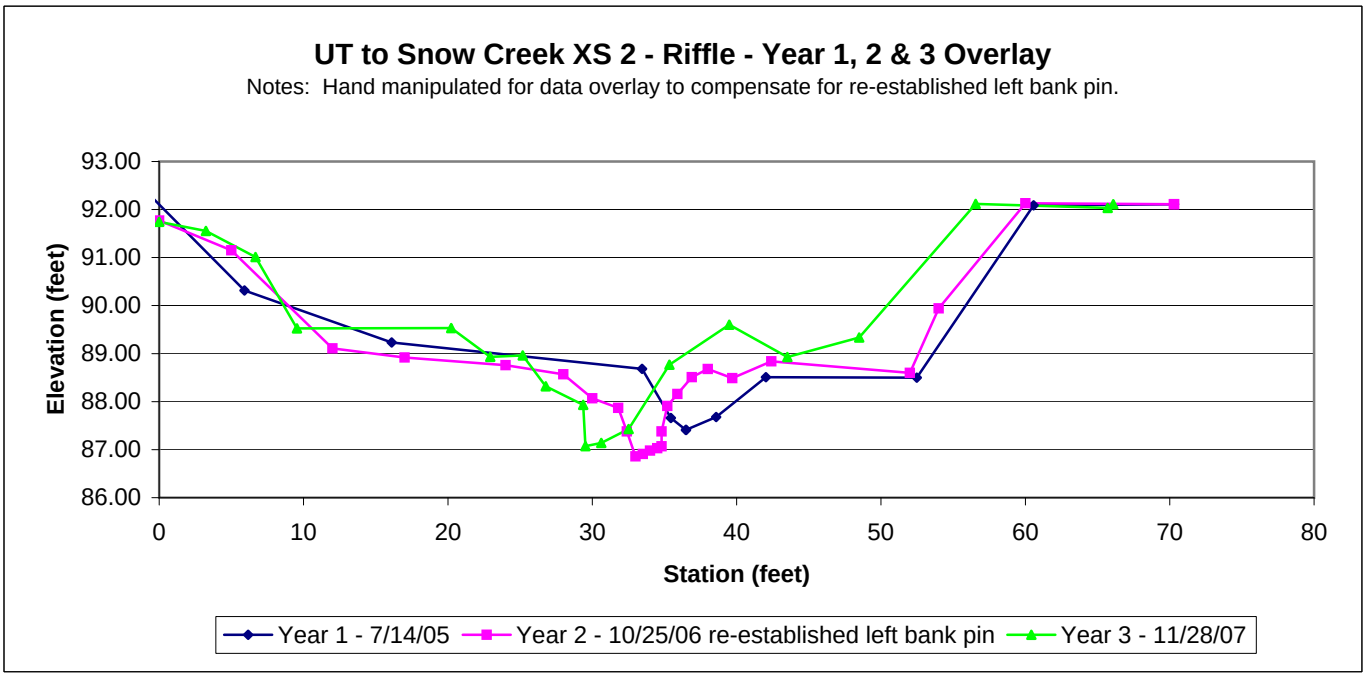

UTXS1 facing right bank (11/29/07)


UTXS1 facing left bank (11/29/07)


UTXS2 facing right bank (11/29/07)


UTXS2 facing left bank (11/29/07)


UT to Snow Creek XS 1 - Pool - Year 1, 2 & 3 Overlay
Notes: Hand manipulated for data overlay.
Left pin not found during 2007 survey.
Elevation (feet)
94
93
92
91
90
89
88
87
86
0
10
20
30
40
50
60
70
80
90
Station (feet)
Year 1 - 7/14/05
Year 2 - 10/25/06
Year 3 - 11/28/07

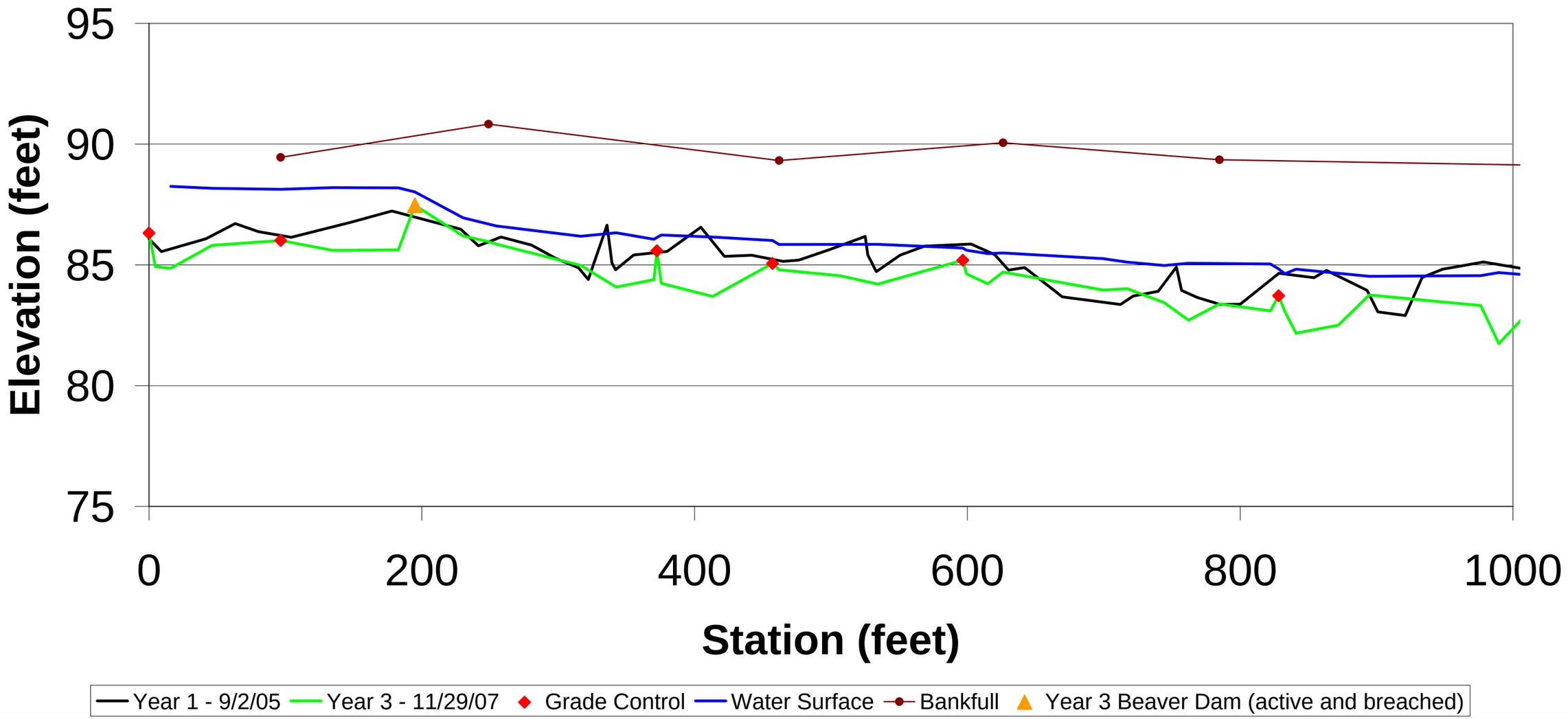

UT to Snow Creek XS 2 - Riffle - Year 1, 2 & 3 Overlay
Notes: Hand manipulated for data overlay to compensate for re-established left bank pin.
Elevation (feet)
93.00
92.00
91.00
90.00
89.00
88.00
87.00
86.00
0
10
20
30
40
50
60
70
80
Station (feet)
Year 1 - 7/14/05
Year 2 - 10/25/06 re-established left bank pin
Year 3 - 11/28/07

SNOW CREEK

REACH 1 AND REACH 2

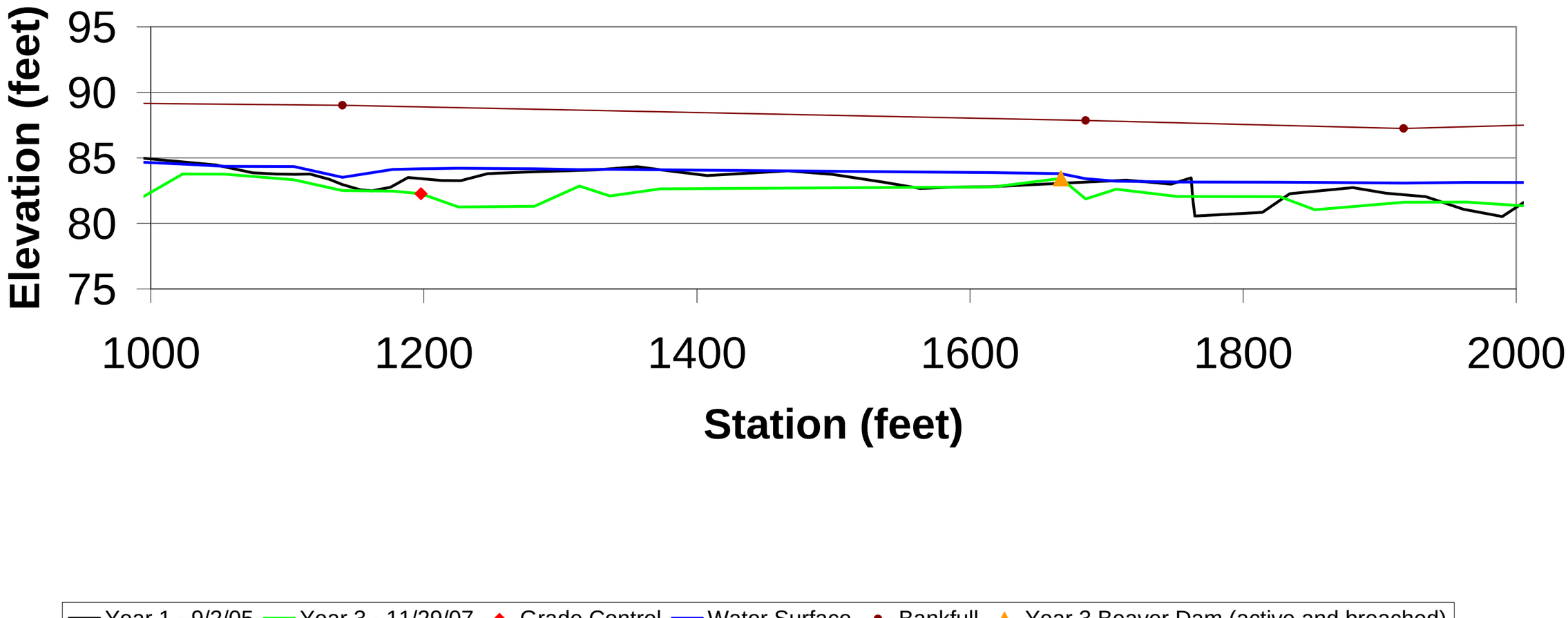
Snow Creek - Year 1 and Year 3 Overlay (0-1000lf)

Notes: Hand manipulated for data overlay.



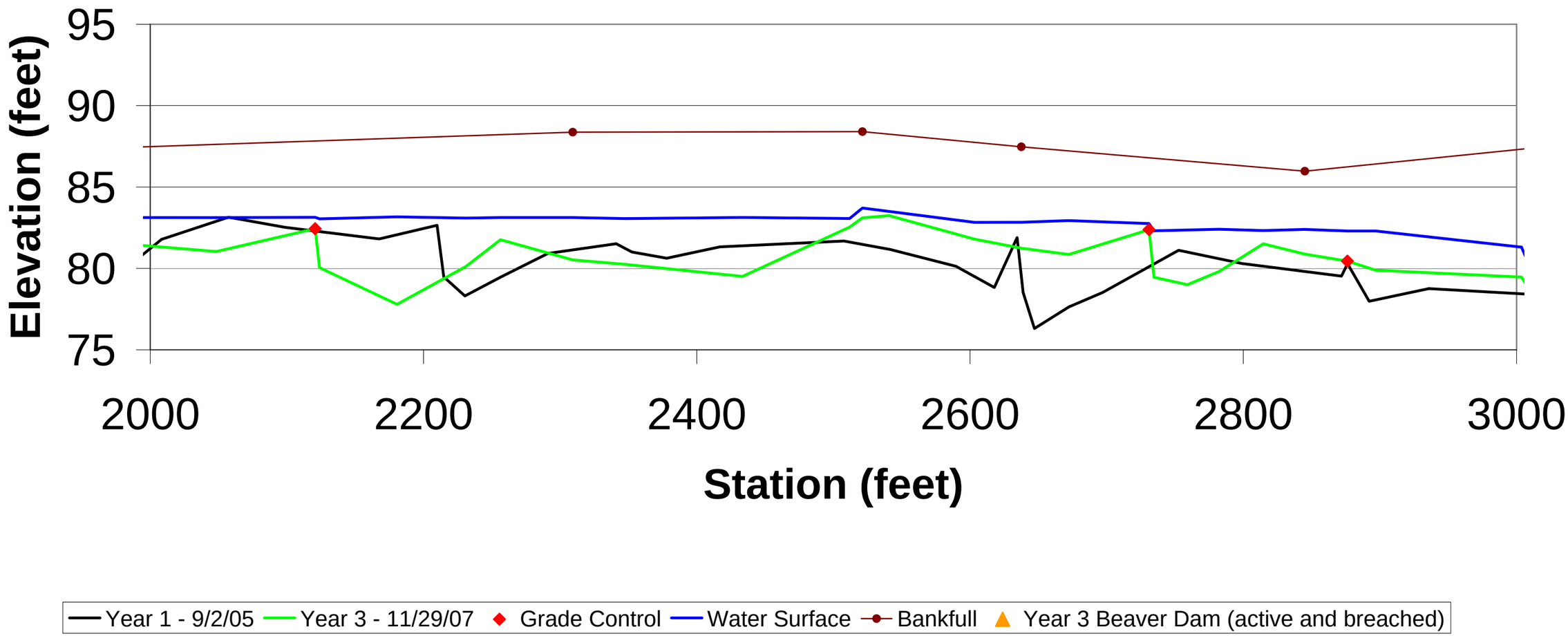
Snow Creek - Year 1 and Year 3 Overlay (1000-2000)

Notes: Hand manipulated for data overlay.



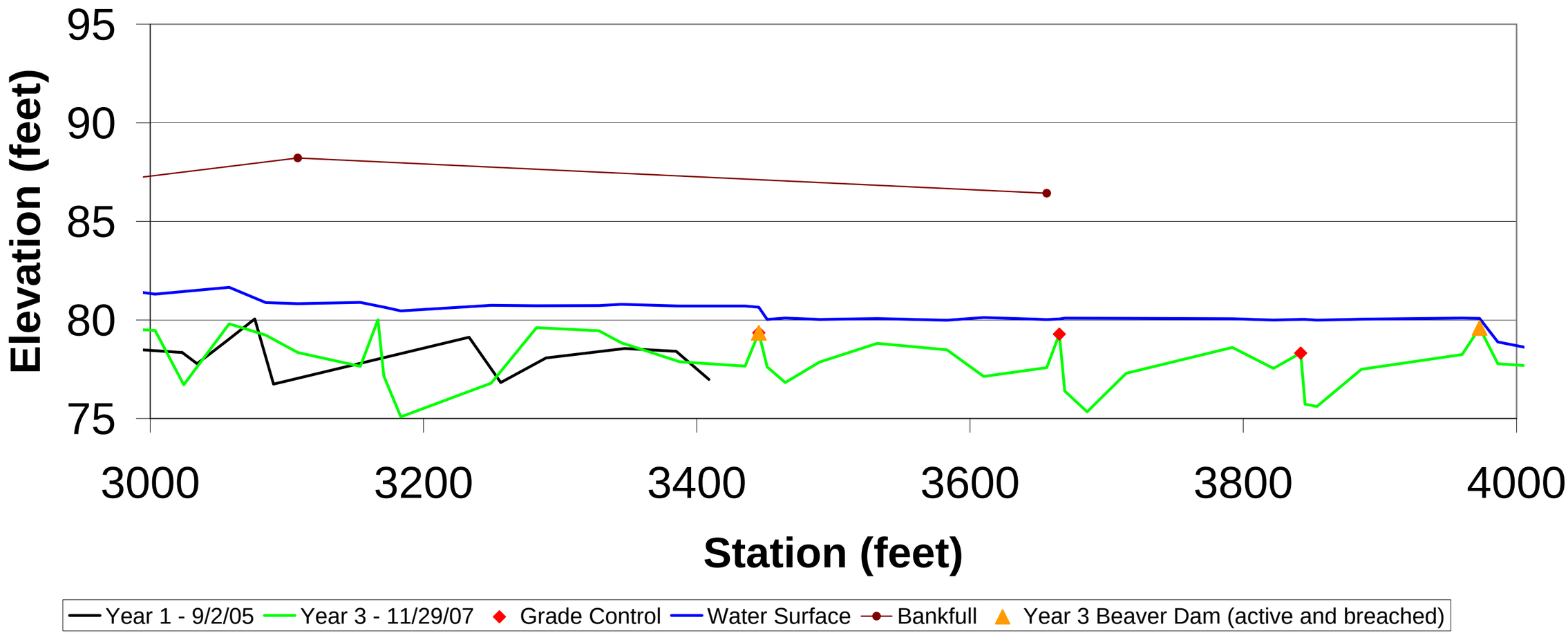
Snow Creek - Year 1 and Year 3 Overlay (2000-3000)

Notes: Hand manipulated for data overlay.



Snow Creek - Year 1 and Year 3 Overlay (3000-4000)

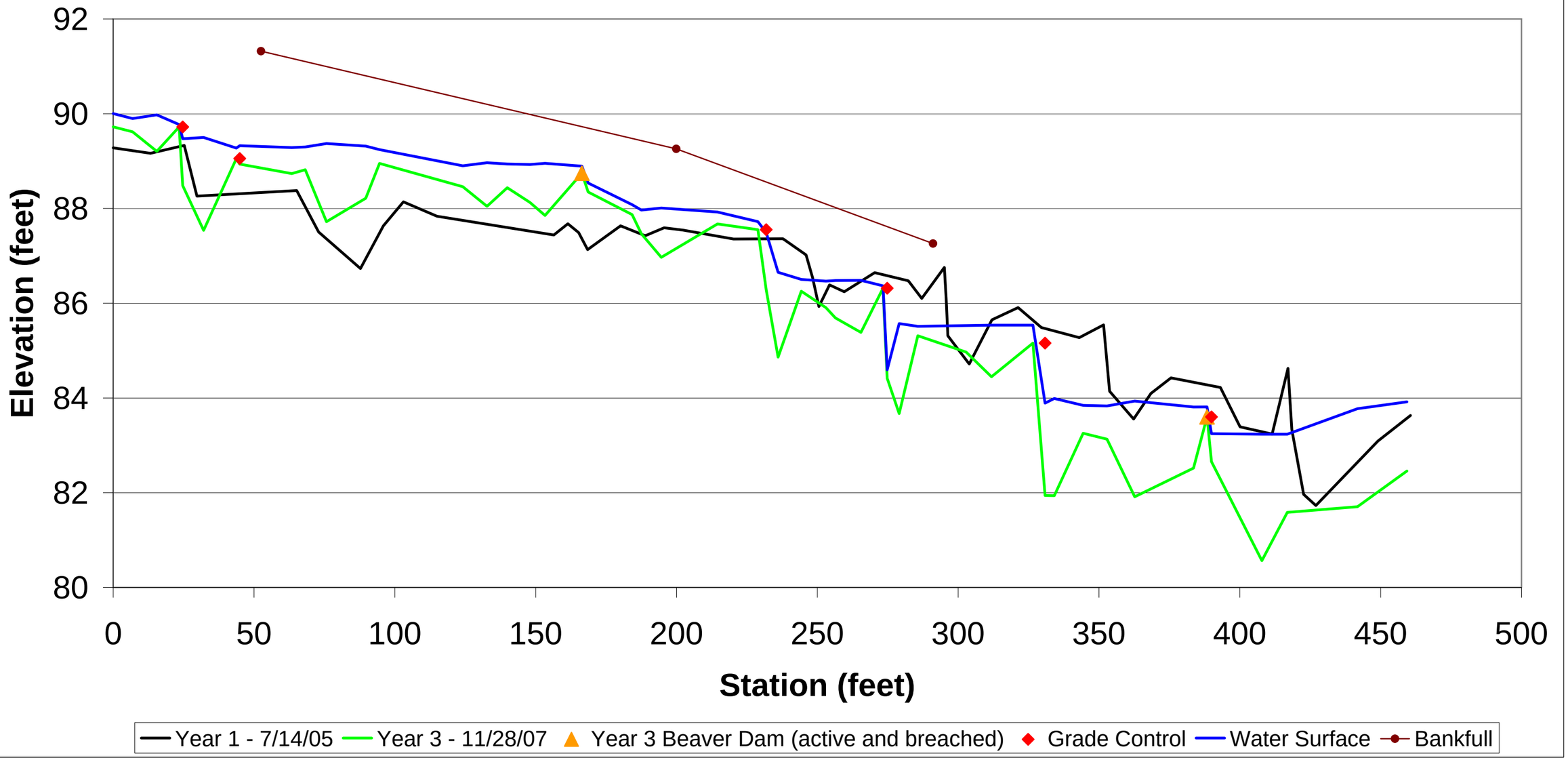
Notes: Hand manipulated for data overlay.



UNNAMED TRIBUTARY

UT to Snow Creek - Year 1 and Year 3 Overlay

Notes: Hand manipulated for data overlay.



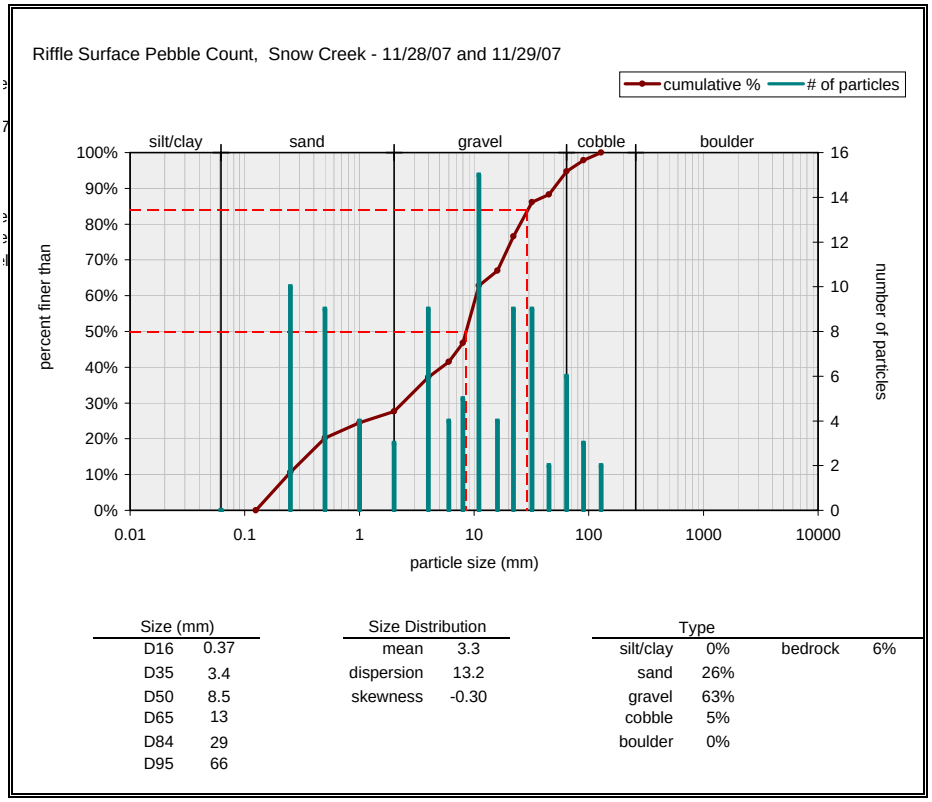
SNOW CREEK

REACH 1

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**0**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**10**
medium sand	0.25 - 0.5	**9**
coarse sand	0.5 - 1	**4**
very coarse sand	1 - 2	**3**
very fine gravel	2 - 4	**9**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**5**
medium gravel	8 - 11	**15**
medium gravel	11 - 16	**4**
coarse gravel	16 - 22	**9**
coarse gravel	22 - 32	**9**
very coarse gravel	32 - 45	**2**
very coarse gravel	45 - 64	**6**
small cobble	64 - 90	**3**
medium cobble	90 - 128	**2**
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		94
bedrock		**6**
clay hardpan		
detritus/wood		
artificial		
total count:		100

Note: XS1 RIFFLE



Size (mm)	
D16	0.37
D35	3.4
D50	8.5
D65	13
D84	29
D95	66

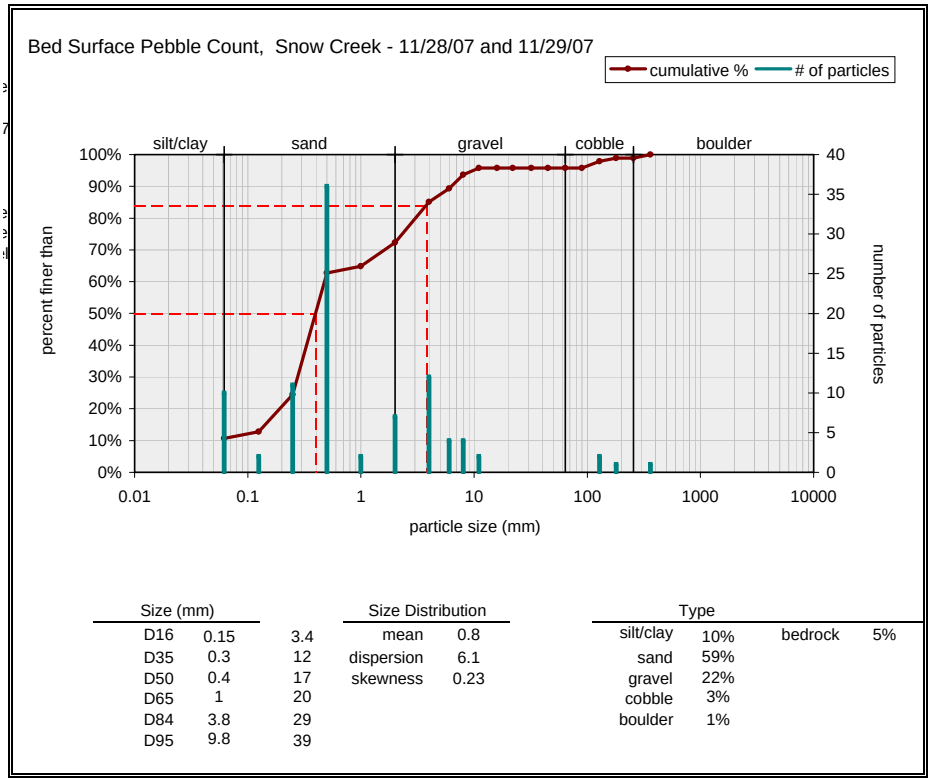
Size Distribution	
mean	3.3
dispersion	13.2
skewness	-0.30

Type			
silt/clay	0%	bedrock	6%
sand	26%		
gravel	63%		
cobble	5%		
boulder	0%		

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**10**
very fine sand	0.062 - 0.125	**2**
fine sand	0.125 - 0.25	**11**
medium sand	0.25 - 0.5	**36**
coarse sand	0.5 - 1	**2**
very coarse sand	1 - 2	**7**
very fine gravel	2 - 4	**12**
fine gravel	4 - 6	**4**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	**2**
large cobble	128 - 180	**1**
very large cobble	180 - 256	
small boulder	256 - 362	**1**
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		94
bedrock		**5**
clay hardpan		
detritus/wood		
artificial		
total count:		99

Note: XS2 POOL



Size (mm)		
D16	0.15	3.4
D35	0.3	12
D50	0.4	17
D65	1	20
D84	3.8	29
D95	9.8	39

Size Distribution	
mean	0.8
dispersion	6.1
skewness	0.23

Type			
silt/clay	10%	bedrock	5%
sand	59%		
gravel	22%		
cobble	3%		
boulder	1%		

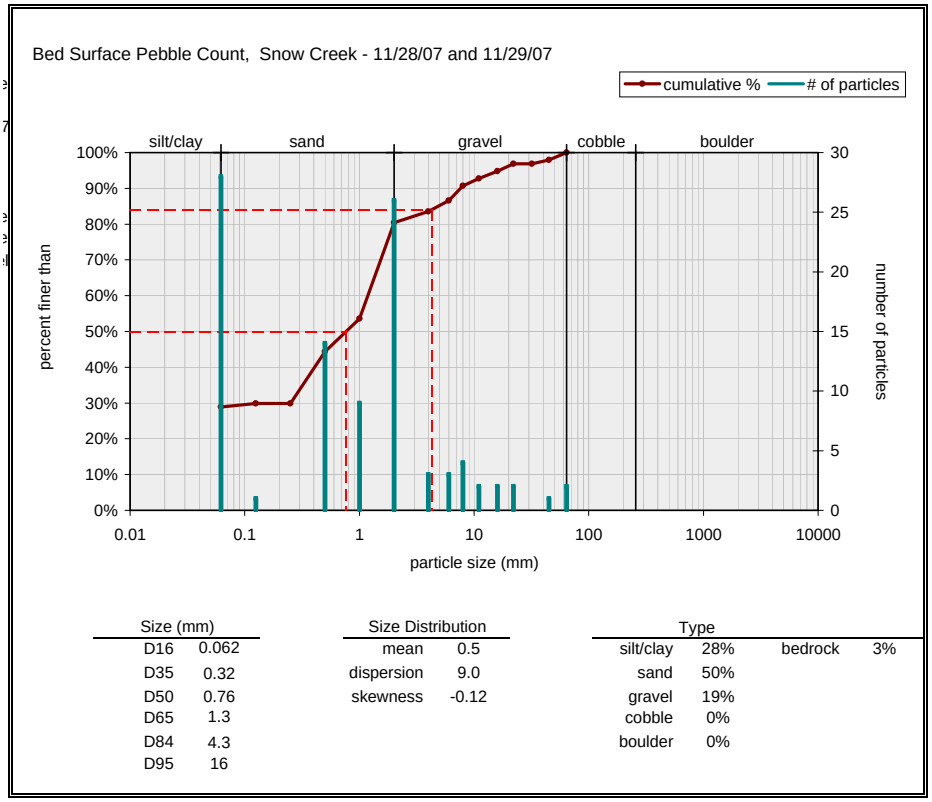
SNOW CREEK

REACH 2

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**28**
very fine sand	0.062 - 0.125	**1**
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	**14**
coarse sand	0.5 - 1	**9**
very coarse sand	1 - 2	**26**
very fine gravel	2 - 4	**3**
fine gravel	4 - 6	**3**
fine gravel	6 - 8	**4**
medium gravel	8 - 11	**2**
medium gravel	11 - 16	**2**
coarse gravel	16 - 22	**2**
coarse gravel	22 - 32	
very coarse gravel	32 - 45	**1**
very coarse gravel	45 - 64	**2**
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		97
bedrock		**3**
clay hardpan		
detritus/wood		
artificial		
total count:		100

Note: XS3 GLIDE

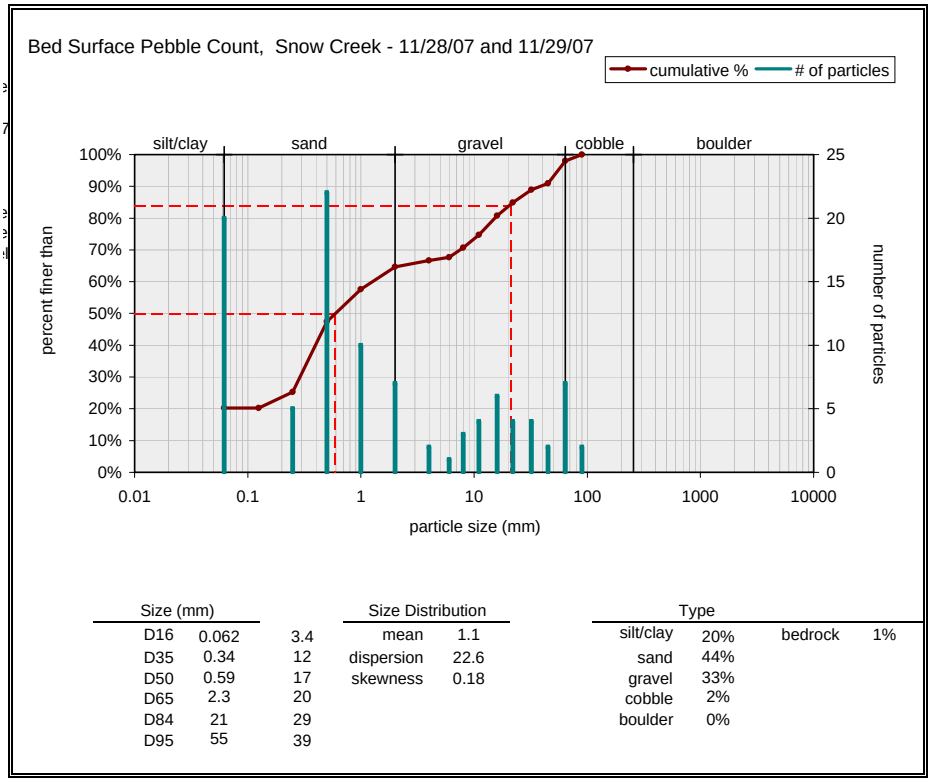


Size (mm)		Size Distribution		Type			
D16	0.062	mean	0.5	silt/clay	28%	bedrock	3%
D35	0.32	dispersion	9.0	sand	50%		
D50	0.76	skewness	-0.12	gravel	19%		
D65	1.3			cobble	0%		
D84	4.3			boulder	0%		
D95	16						

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**20**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**5**
medium sand	0.25 - 0.5	**22**
coarse sand	0.5 - 1	**10**
very coarse sand	1 - 2	**7**
very fine gravel	2 - 4	**2**
fine gravel	4 - 6	**1**
fine gravel	6 - 8	**3**
medium gravel	8 - 11	**4**
medium gravel	11 - 16	**6**
coarse gravel	16 - 22	**4**
coarse gravel	22 - 32	**4**
very coarse gravel	32 - 45	**2**
very coarse gravel	45 - 64	**7**
small cobble	64 - 90	**2**
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		99
bedrock		**1**
clay hardpan		
detritus/wood		
artificial		
total count:		100

Note: XS4 POOL



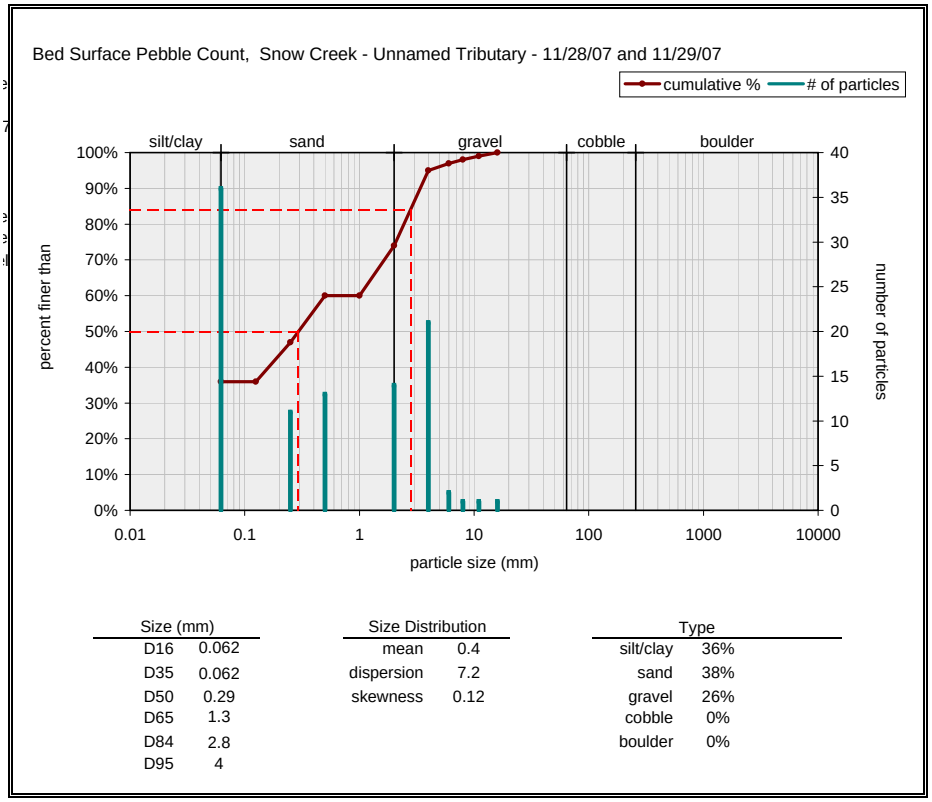
Size (mm)			Size Distribution		Type			
D16	0.062	3.4	mean	1.1	silt/clay	20%	bedrock	1%
D35	0.34	12	dispersion	22.6	sand	44%		
D50	0.59	17	skewness	0.18	gravel	33%		
D65	2.3	20			cobble	2%		
D84	21	29			boulder	0%		
D95	55	39						

UNNAMED TRIBUTARY

Bed Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**36**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	**11**
medium sand	0.25 - 0.5	**13**
coarse sand	0.5 - 1	
very coarse sand	1 - 2	**14**
very fine gravel	2 - 4	**21**
fine gravel	4 - 6	**2**
fine gravel	6 - 8	**1**
medium gravel	8 - 11	**1**
medium gravel	11 - 16	**1**
coarse gravel	16 - 22	
coarse gravel	22 - 32	
very coarse gravel	32 - 45	
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note: xs 1 pool



Size (mm)	
D16	0.062
D35	0.062
D50	0.29
D65	1.3
D84	2.8
D95	4

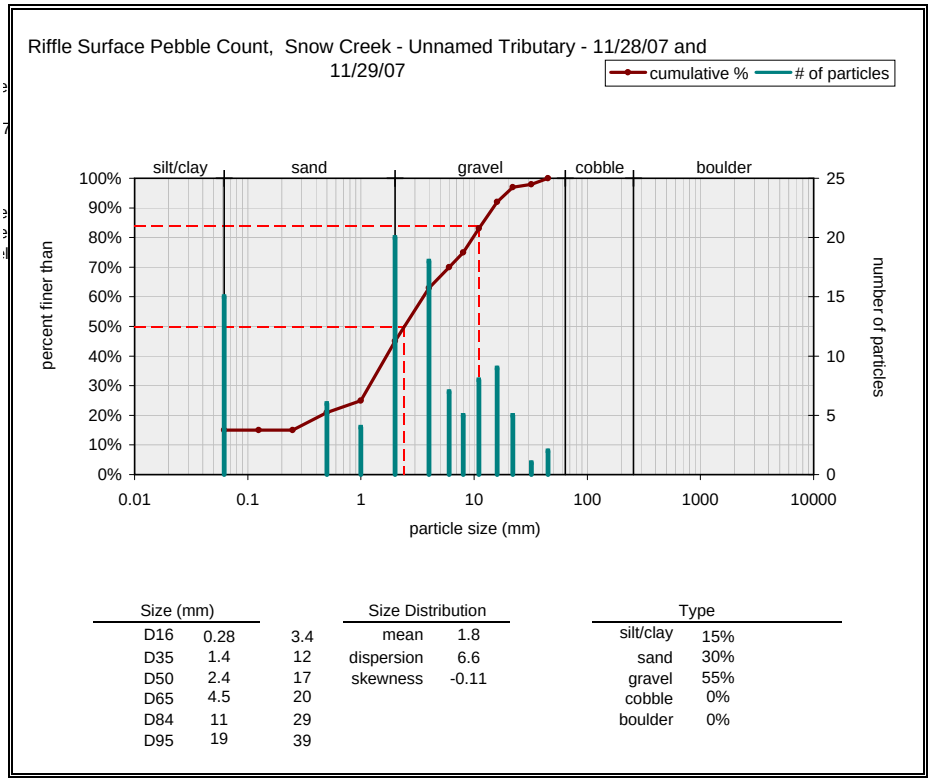
Size Distribution	
mean	0.4
dispersion	7.2
skewness	0.12

Type	
silt/clay	36%
sand	38%
gravel	26%
cobble	0%
boulder	0%

Riffle Surface

Material	Size Range (mm)	Count
silt/clay	0 - 0.062	**15**
very fine sand	0.062 - 0.125	
fine sand	0.125 - 0.25	
medium sand	0.25 - 0.5	**6**
coarse sand	0.5 - 1	**4**
very coarse sand	1 - 2	**20**
very fine gravel	2 - 4	**18**
fine gravel	4 - 6	**7**
fine gravel	6 - 8	**5**
medium gravel	8 - 11	**8**
medium gravel	11 - 16	**9**
coarse gravel	16 - 22	**5**
coarse gravel	22 - 32	**1**
very coarse gravel	32 - 45	**2**
very coarse gravel	45 - 64	
small cobble	64 - 90	
medium cobble	90 - 128	
large cobble	128 - 180	
very large cobble	180 - 256	
small boulder	256 - 362	
small boulder	362 - 512	
medium boulder	512 - 1024	
large boulder	1024 - 2048	
very large boulder	2048 - 4096	
total particle count:		100
bedrock	----------	
clay hardpan	----------	
detritus/wood	----------	
artificial	----------	
total count:		100

Note: xs 2 Riffle



Size (mm)		
D16	0.28	3.4
D35	1.4	12
D50	2.4	17
D65	4.5	20
D84	11	29
D95	19	39

Size Distribution	
mean	1.8
dispersion	6.6
skewness	-0.11

Type	
silt/clay	15%
sand	30%
gravel	55%
cobble	0%
boulder	0%