# Buffalo Creek Watershed
# Phase 2 Stream Mitigation Plan

NCDENR
North Carolina Department of Environment and Natural Resources

North Carolina Department of Environmental and Natural Resources
Ecosystem Enhancement Program

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# Buffalo Creek Watershed
# Phase II
# Stream Mitigation Plan
# Greensboro, North Carolina

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June 2005

**Buffalo Creek Watershed Phase II**
**Benbow and Brown Bark Parks**
**Phase II Stream Mitigation Plan**

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# Phase II
# Stream Mitigation Plan
# Greensboro, North Carolina

**Prepared for:**

**NC Department of Environment and Natural Resources,**
**Ecosystem Enhancement Program**

**June 2005**

Mitigation Plan Prepared By Buck Engineering PC

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# Executive Summary

In 2004, the North Carolina Ecosystem Enhancement Program (EEP) restored 4,894 feet of streams at two sites in the Buffalo Creek Watershed in Greensboro, North Carolina. The specific reaches in Phase II are located in Benbow Park (South Buffalo Creek) and Brown Bark Park (North Buffalo Creek). Construction began on April 26, 2004, and was completed on August 26, 2004. Final planting was completed on March 30, 2005. Phase I of the project consisted of streams in Gillespie Golf Course and Hillsdale Park and was completed in March 2004. The Phase I Mitigation Report is in a separate binder.

The existing stream channels had low sinuosity and varying levels of incision due to historic channelization. The stream restoration design was based on natural channel design principles and considered differences in drainage area, adjacent land uses, urban constraints, and future development potential. The design addressed the channel dimension, pattern, and profile, based on reference reach parameters and hydraulic geometry relationships. When considering design alternatives, the following alternative was evaluated: creating a stable, meandering channel with bankfull stage, located at the existing floodplain elevation. In Reach 2 at Benbow Park, new channel pattern was established reconnecting the stream with its previous floodplain. In Reach 1 at Benbow Park and at Brown Bark Park, the existing incised channels were enhanced by excavating new floodplain benches at the bankfull stage and installing structures to improve bed features and control channel grade.

A summary of existing and design reach lengths with restoration design approaches is provided in the table below.

| Sub-Project | Existing Length (ft) | Restored Length (ft) | Restoration Approach |
|---|---|---|---|
| Benbow Park Reach 1 | 780 | 780 | Rosgen Priority 2 and 3 – Buffer restoration, bankfull benches and in-stream structures |
| Benbow Park Reach 2 | 972 | 1280 | Rosgen Priority 1 – New pattern, dimension, and profile, reconnected with original floodplain |
| Brown Bark Reach | 2748 | 2834 | Rosgen Priority 2 and 3 – Buffer restoration, bankfull benches and in-stream structures |
| **Total** | **4500** | **4894** | |

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# 1 Introduction

## 1.1 Project Goals

The objectives of Phase II of the Buffalo Creek Watershed stream restoration project were to:

1. Restore unstable stream channels to natural stable forms by modifying dimension, pattern, and/or profile, based on reference reach parameters.
2. Improve floodplain functionality by matching bankfull stage with floodplain elevation.
3. Establish native floodplain vegetation through a forested riparian buffer.
4. Improve the natural aesthetics of the stream corridor.
5. Obtain mitigation credits for unavoidable impacts to streams within the same Hydrologic Unit Code (HUC).

## 1.2 Project Location

The project streams are located in the town of Greensboro in Guilford County, North Carolina (Figures 1.1 and 1.2). These streams are tributaries to the Haw River (USGS Hydrologic Unit 03030002) and are in the Cape Fear River basin.

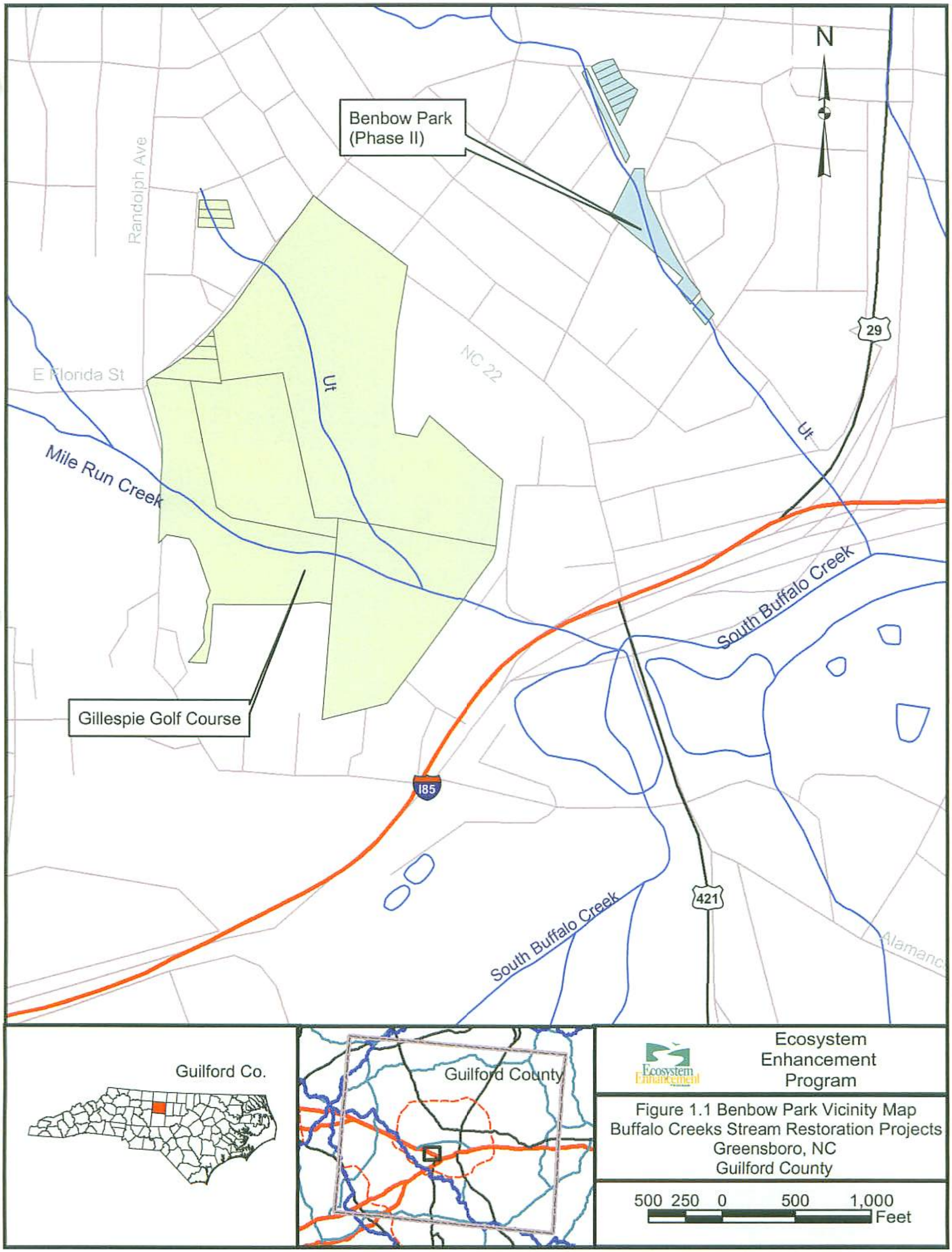
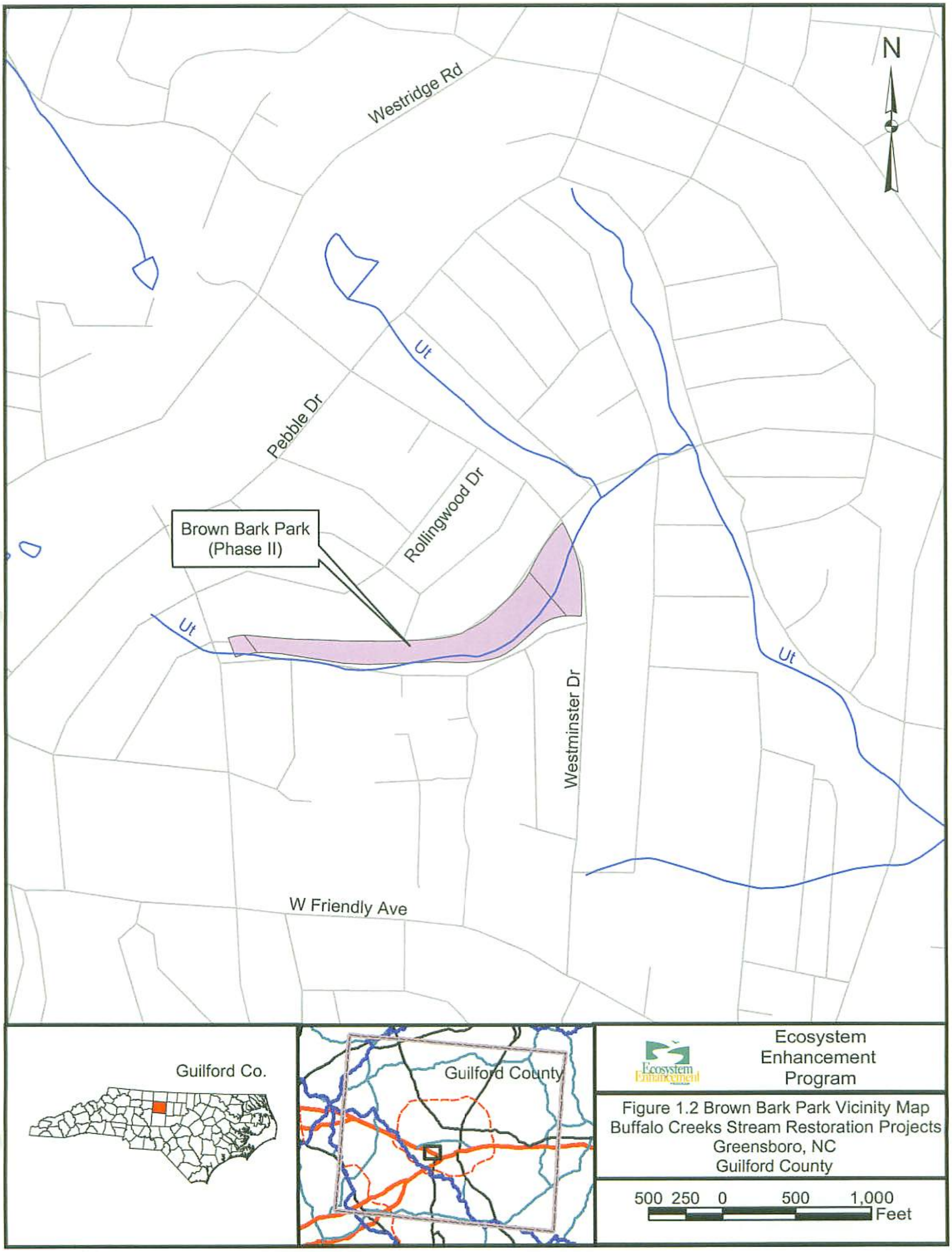



Figure 1.1 Benbow Park Vicinity Map
Buffalo Creeks Stream Restoration Projects
Greensboro, NC
Guilford County




Ecosystem Enhancement Program

Figure 1.2 Brown Bark Park Vicinity Map
Buffalo Creeks Stream Restoration Projects
Greensboro, NC
Guilford County

# 2 Summary

## 2.1 Project Description and Watershed

The project is divided into two locations: Benbow Park and Brown Bark Park. The sites are shown in Figures 1.1 and 1.2. The stream channel lengths and respective drainage areas are listed in Table 2.1.

**Table 2.1 Sites with Existing Stream Lengths and Drainage Areas.**

| Sub-Project Name and Location | Existing Length (ft) | Drainage Area ($mi^2$) |
|---|---|---|
| Benbow Park | 1752 | 0.7 |
| Brown Bark Park | 2748 | 0.3 |
| **Total** | **4500** | **1.0** |

## 2.2 Methodologies Used

Buck Engineering used natural channel design principles and considered differences in drainage area, adjacent land uses. upstream impoundments. and future development potential to restore the stream to the highest level of restoration within the given constraints. The design addressed channel dimension, pattern. and profile. based on reference reach parameters and hydraulic geometry relationships. When considering design alternatives, the following alternative was evaluated: creating a stable, meandering channel with bankfull stage, located at the existing floodplain elevation. In both of these steams, valley or development restrictions did not allow for new channel pattern to be established. The existing incised channels were enhanced by excavating new floodplain benches at the bankfull stage and installing structures to improve bed features and control channel grade.

This process included extensive planning. beginning with the existing condition survey. The survey included longitudinal profile and cross sections. bed material analysis. valley morphology. stream classification. channel stability assessment. channel evolution, riparian conditions, water quality impacts. and photographs. Other data analyzed included watershed conditions and land use survey (historical and present; see Figures 2.1 and 2.2). The second step in the planning process was an analysis of stream potential and restoration alternatives (priority levels of restoration. urban considerations. and build-out scenarios). We conducted the design procedures concurrently with planning. These included reference reach analysis. verification of bankfull stage using the rural and urban the rural and urban Piedmont regional curves, restored channel morphology design (channel dimension, pattern, and profile), sediment transport analysis, structure design and placement, streambank stabilization/bioengineering, design of an erosion and sediment control plan, flood impact analysis, and completion of design plans. Finally, Buck Engineering conducted construction management, including field layout, construction observation, preparation of the as-built survey, and collection of photographs.

## 2.3 Plan View

See plan sheets included under tabs 6 and 11.

## 2.4 Points of Contact

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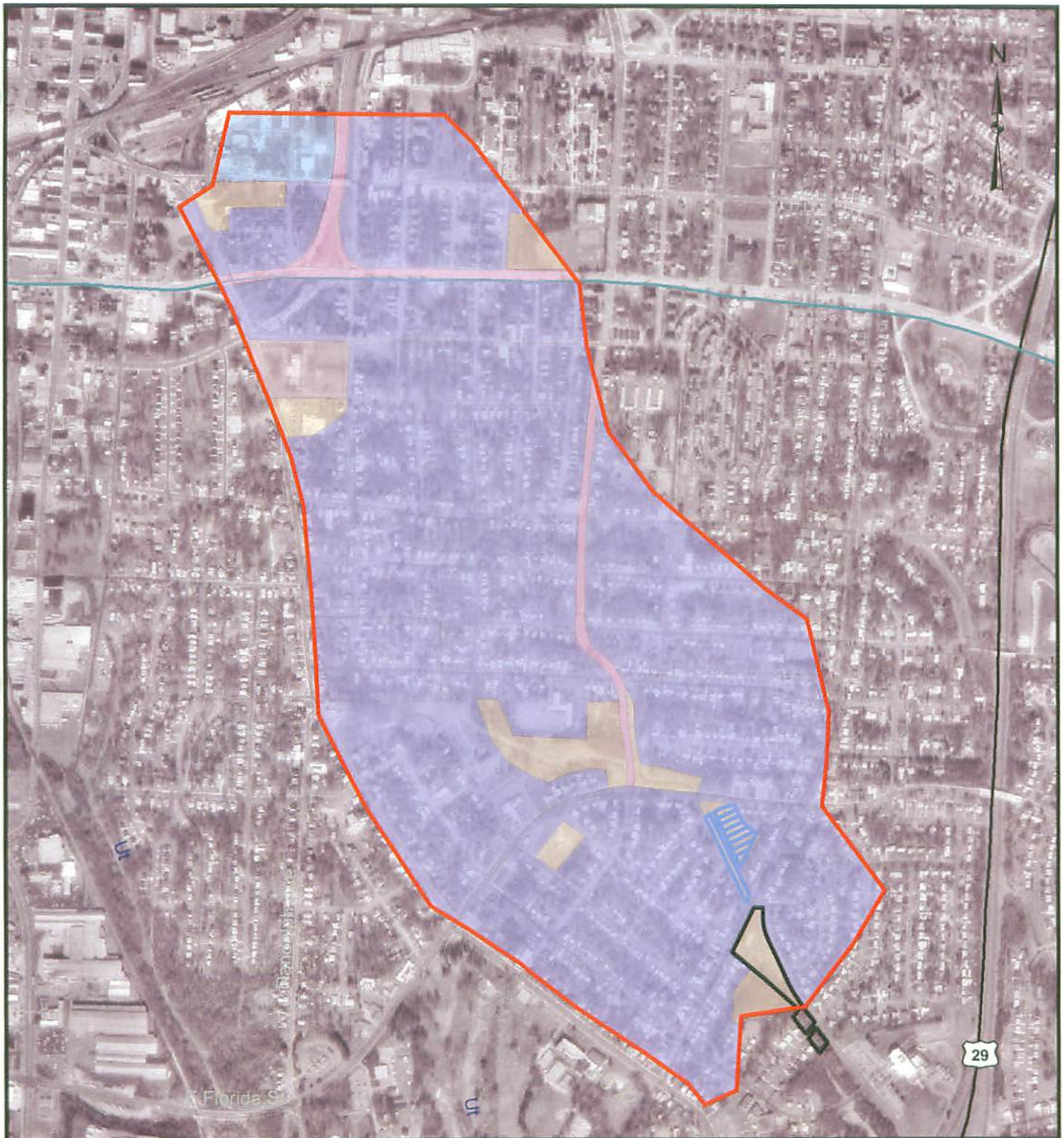


## Legend

- Benbow Watershed
- Roads

**Park Boundaries**

- Benbow
- Clinton Hills

**Land Cover**

- Industrial
- Open Space
- Paved Spaces
- Residential - 2 acre
- Residential - <= 1/8 acre

Ecosystem Enhancement Program

Figure 2.1 Benbow Park Watershed Map
Buffalo Creeks Stream Restoration Projects
Greensboro, NC
Guilford County

500 250 0 500 1,000
Feet


## Legend

Brown Bark Watershed

Roads

**Park Boundaries**

Brown Bark

Chatfield

Forest Hill

**Land Cover**

Forest

Open Space

Residential - 1/3 acre

Residential - 1/4 acre

Ecosystem Enhancement Program

Figure 2.2 Brown Bark Park Watershed Map
Buffalo Creeks Stream Restoration Projects
Greensboro, NC
Guilford County

500 250 0 500 1,000 Feet

# 3 Success Criteria

Environmental components monitored in this project are those that allow an evaluation of channel stability and riparian survivability. Specifically, the success of channel modification, erosion control, seeding, and woody vegetation plantings will be evaluated. This will be accomplished through the following activities for five years after the project is built.

## 3.1 Dimension

Permanent cross sections were established, six at Benbow and six at Brown Bark, with approximately two riffles and two pools per reach, for a total of twelve. Each cross section is marked on both banks with permanent pins set in concrete to establish the exact transect used. A common benchmark is used for cross sections to facilitate easy comparison of year-to-year data. The annual cross-sectional survey includes points measured at all breaks in slope, including top of bank, bankfull stage, and thalweg. Riffle cross sections will be classified using the Rosgen stream classification system.

Success Criteria: There should be little or no change in as-built cross sections. If changes do take place they should be evaluated to determine if they represent a movement toward a more unstable condition (down-cutting, erosion) or are minor changes that represent an increase in stability (settling, increase in vegetative density, deposition along the banks, decrease in width/depth ratio, decrease in cross-sectional area).

## 3.2 Pattern and Profile

A longitudinal profile was completed after construction and will be conducted at the end of years one, three, and five (for a total of four times). Measurements include thalweg, water surface, bankfull stage, and top of low bank. Each measurement is taken at the head of facets, e.g. riffle, run, pool, and glide, and the maximum pool depth. The survey is tied to a permanent benchmark. The survey is also used to calculate sinuosity.

Success Criteria: The longitudinal profiles should show that the bedform features are remaining stable, e.g., they are not aggrading or degrading over the five-year period. Short term aggradation/degradation may occur, depending on the peak annual discharge. The gravel bed pools should remain deep with flat water surface slopes and the riffles should remain steeper and shallower than the pools. Bedforms observed should be consistent with those observed in "E" and "C" type channels. The pattern should not change and there should be no change in sinuosity. The pool/riffle sequence should also remain constant.

## 3.3 Bed Material Analysis

We did not complete a bed material analysis since these are sand or small gravel streams. We do not expect significant coarsening over time.

## 3.4 Photo Reference Sites

Photographs used to evaluate restored sites will be made with a 35-mm camera using slide film, or a digital camera. Reference sites were photographed before construction and will be taken once a year for at least five years following construction. After construction, reference sites were marked with wooden stakes.

Longitudinal reference photos: Photographs will be taken looking downstream at designated locations. Reference photo locations were marked and described for future reference. Points are close enough together to provide an overall view of the reach. The angle of the shot depended on what angle provided the best view and was noted for future shots. When modifications to reference photo have to be made due to obstructions or other reasons, the position will be noted along with any landmarks and the same position used in the future.

Success Criteria: Photographs will be used to qualitatively evaluate channel aggradation or degradation, bank erosion, success of riparian vegetation, and effectiveness of erosion control measures. Longitudinal photos should indicate the absences of developing bars within the channel or an excessive increase in channel depth. Lateral photos should not indicate excessive erosion or continuing degradation of the bank over time. A series of photos over time should indicate successional maturation of riparian vegetation. Vegetative success should include initial herbaceous growth, followed by increasing densities of woody vegetation, and ultimately a mature overstory with herbaceous understory.

## 3.5 Vegetation Survival Plots

Survival of planted vegetation will be evaluated using survival plots and counts.

Survival of live stakes will be evaluated using plots that include a stake count of at least 100 stakes. Live-stake plots are collocated with bare-root plots. Evaluations of live-stake survival will continue for at least five years. When stakes do not survive, a determination will be made as to the need for replacement; in general, if greater than 25% die, replacement will be done.

Survival of rooted vegetation will be evaluated using three plots and will continue for at least five years to determine survival. The plots are 25 ft by 100 ft for forested buffer (bare roots) and all stems were flagged and counted. When rooted vegetation does not survive, a determination will be made as to the need for replacement; in general, if greater than 25% die, replacement will be done.

Success Criteria: The interim measure of vegetative success will be the survival of at least 320 three-year-old planted trees per acre at the end of year three of the monitoring period. The final vegetative success criteria will be the survival of 260 five-year-old planted trees per acre at the end of year five of the monitoring period. In addition, for the five-year monitoring period, the presence of volunteer facultative softwood species such as red maple, sweet gum, and loblolly pine will be limited to less than 10% each of the total number of trees utilized to determine success. These trees may contribute more than 10% of the total trees on the site, but they will not constitute more than 10% each of the 260 trees per acre.

## 3.6 Benthic Macroinvertebrate Monitoring

The NC Division of Water Quality will conduct benthic macroinvertebrate monitoring.

# 4 Monitoring Schedule and Methods

Monitoring will be conducted annually for five years. Buck Engineering conducted the as-built survey and will conduct the first-year survey. Annual surveys will be conducted in September, starting in 2005 and ending in September 2009.

The cross sections will be surveyed each year using a tape and level between the permanent cross-sectional pins. The longitudinal survey will be done using a total station or level for the first year and then every two years for a total of four times (as-built is complete, then September 2005, September 2007, and September 2009).

The photographs will be taken every year (Buck Engineering will use a digital camera for the first year). Photographs will include the cross sections listed above, as well as longitudinal photographs taken from the photo locations listed on the plan view. These supplement the cross-sectional photos to ensure the entire reach is covered.

Vegetation survival plots will be counted annually. The plots for both bare-root plantings and live stakes are shown on the plan view. For success criteria, the three-year period is through September 2006, and the 5-year period is through September 2008.

# 5 Mitigation

## 5.1 Mitigation Proposal

The following tables list the proposed mitigation available after completing the project.

**Table 5-1a Proposed Mitigation for Benbow Park (South Buffalo Creek).**

| Reach | Restored Length (ft) | Category |
|---|---|---|
| Benbow Reach 1 | 780 | Restoration |
| Benbow Reach 2 | 972 | Restoration |
| **Total** | **2060** | |

**Table 5.1b Proposed Mitigation for Brown Bark Park (North Buffalo Creek).**

| Reach | Restored Length (ft) | Category |
|---|---|---|
| Brown Bark Reach | 2834 | Restoration |
| **Total** | **2834** | |

## 5.2 Design Summary

The stream restoration design for the unnamed tributaries in Benbow Park (South Buffalo Creek) and Brown Bark Park (North Buffalo Creek) was based on natural channel design principles. The design took into account differences in drainage area, adjacent land uses, upstream impoundments, and future development potential. The streambank, bankfull bench, and terrace scarp were seeded with millet or rye to provide temporary erosion control. The streambank and terrace scarp were covered with erosion control matting.

Cross vanes were used throughout the reaches to provide grade control, provide bank protection, narrow the low flow channel and improve the riffle/pool sequence. J-hooks and root wads divert velocity vectors in the channel away from the banks. The stormwater outfalls were stabilized by mimicking a step/pool channel as shown in the plan sheets.

## 5.3 Benbow Reach 1

The natural channel design for Reach 1 of Benbow Park was based on a combined Rosgen Priority 2 and 3 restoration approach. A new floodplain was created at a lower elevation by excavating a stable bankfull bench of varying width. The resulting bank height ratio is 1.0. The incised Rosgen type "E5" channel was changed to a "B5c" channel as part of the restoration work. Bedform was improved through the use of instream structures. Instream structures were used to provide grade control, protect streambanks, and enhance bedform.

## 5.4 Benbow Reach 2

The natural channel design for Reach 2 of Benbow Park was based on a Rosgen Priority 1 restoration approach. The existing straight channel was replaced with a new meandering channel at a higher bed elevation. which gives it access to its existing flood plain. The existing channel Rosgen type "E" channel functioned like a type "Gc" channel due to its high banks. The restored "E" channel improved the following functions:

1) Hydrology functions improved by creating a bankfull channel and floodplain. All flows greater than bankfull are stored on the floodplain.
2) Geomorphology functions were improved by creating a channel that could transport the sediment load without aggrading or degrading while diversifying the bedform with riffles and pools.
3) Biology functions were improved by providing riffle and pool habitats along with terrestrial habitats in the buffer.

Root wads were used to stabilize the streambanks and improve aquatic habitat. Instream structures were used to provide grade control, protect streambanks. and enhance bedform.

## 5.5 Brown Bark Reach

The natural channel design for the Brown Bark Reach was based on a combined Rosgen Priority 2 and 3 restoration approach. A new floodplain was created at a lower elevation by excavating a stable bankfull bench of varying width. The resulting bank height ratio is 1.0. The existing Rosgen type "C5/E5" was changed to a "B5/C5" as part of the restoration work. New pattern and profile were created from station 17+50 to 19+50 and from station 32+00 to 37+75. Bedform was improved through the use of instream structures. Instream structures were used to provide grade control. protect streambanks. and enhance bedform.

## 5.6 Riparian Restoration Design

The riparian restoration design for Benbow Park is at Tab 5 and Brown Bark Park is at Tab 10.

## 5.7 Mitigation Credit

The NC EEP will complete the mitigation credit proposal. Buck Engineering has provided them a plan view, showing reaches and sub-reaches.

# 6 Maintenance and Contingency Plans

The project was subject to several large storm events directly after construction, without the benefit of vegetation beyond temporary seeding. Ninety-six percent of the rock structures had no damage and are functioning as planned. In addition, 98% of the restored streambanks are stable and functioning properly. To address the problem areas, Buck Engineering conducted construction supervision at the site in April 2005. Work included minor repair to structures and stabilizing streambanks (through shaping, seeding, matting, and bioengineering).

Buck Engineering will report maintenance concerns during the first year of monitoring. After that time, the NC EEP will be responsible for maintenance reporting.

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Benbow Park

| Point # | Northing | Easting | Elevation | Decription | Stationing |
|---|---|---|---|---|---|
| 1052 | 839607.0173 | 1770879.72 | 738.76 | X1 LPIN | 13+30.42 |
| 1049 | 839489.1359 | 1770919.417 | 731.57 | X1 RPIN | |
| 1034 | 839528.015 | 1770897.491 | 731.50 | X2 LPIN | 14+95.03 |
| 1030 | 839540.261 | 1770899.634 | 732.25 | X2 RPIN | |
| 1019 | 839571.3625 | 1770882.839 | 734.44 | X3 LPIN | 16+10.37 |
| 1014 | 839578.55 | 1770868.158 | 732.38 | X3 RPIN | |
| 601 | 838161.7182 | 1771508.618 | 726.66 | X4 LPIN | 23+36.79 |
| 392 | 838172.8612 | 1771373.511 | 727.36 | X4 RPIN | |
| 370 | 838400.8291 | 1771270.387 | 728.43 | X5 LPIN | 25+10.19 |
| 364 | 838449.5987 | 1771285.937 | 727.99 | X5 RPIN | |
| 108 | 838022.1954 | 1771622.967 | 724.25 | X6 LPIN | 26+92.99 |
| 103 | 839470.6664 | 1771048.42 | 743.35 | X6 RPIN | |

**Benbow Park Reach 1**

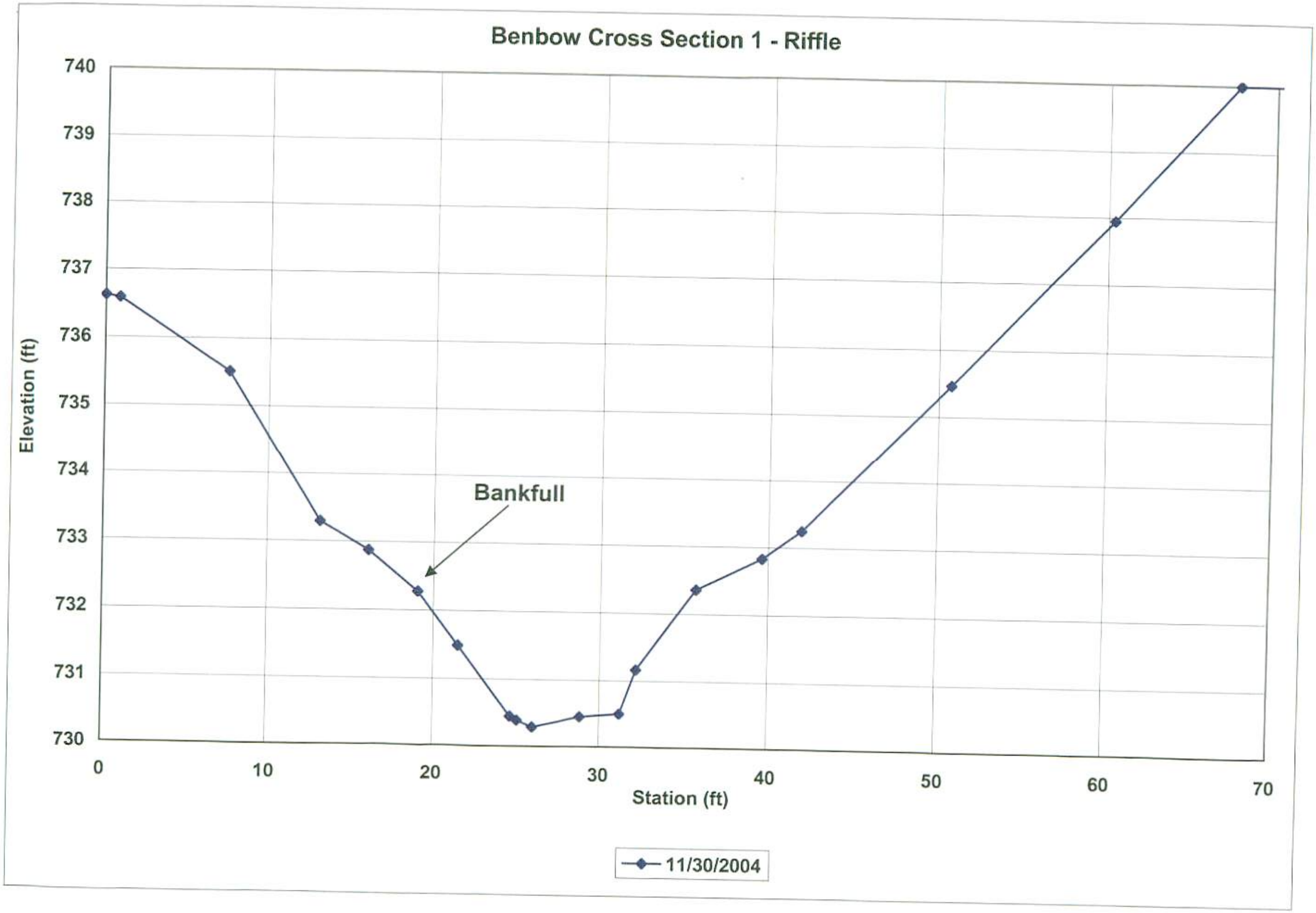
Cross Section Dimension Summary

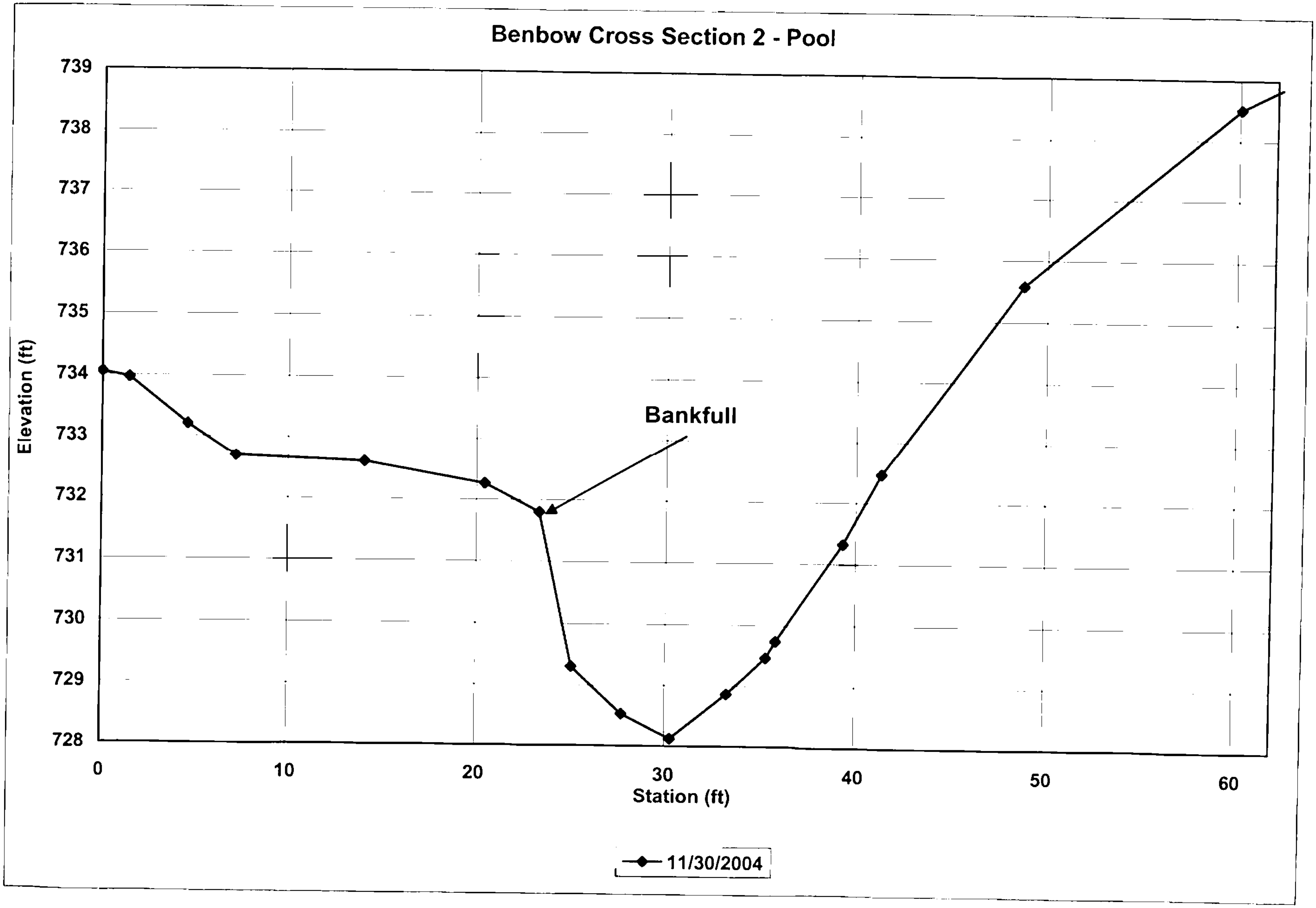
| XSEC | STA | Date | Feature | Str Type | Wfpa | Wbkf | Dbkf | W/D | Abkf | Dmax | ER | BHR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13+30 | 11/30/2004 | Riffle | B5c | 35 | 16.4 | 1.3 | 13.1 | 20.5 | 2.0 | 2.2 | 1.0 |
| | 13+30 | Y1 | Riffle | | | | | | | | | |
| | 13+30 | Y2 | Riffle | | | | | | | | | |
| | 13+30 | Y3 | Riffle | | | | | | | | | |
| | 13+30 | Y4 | Riffle | | | | | | | | | |
| 2 | 14+95 | 11/30/2004 | Pool | | 49 | 16.9 | 2.4 | 7.2 | 39.7 | 3.7 | 2.9 | 1.0 |
| | 14+95 | Y1 | Pool | | | | | | | | | |
| | 14+95 | Y2 | Pool | | | | | | | | | |
| | 14+95 | Y3 | Pool | | | | | | | | | |
| | 14+95 | Y4 | Pool | | | | | | | | | |
| 3 | 16+10 | 11/30/2004 | Riffle | B5c | 38 | 20.3 | 1.2 | 15.1 | 20.3 | 1.7 | 2.2 | 1.0 |
| | 16+10 | Y1 | Riffle | | | | | | | | | |
| | 16+10 | Y2 | Riffle | | | | | | | | | |
| | 16+10 | Y3 | Riffle | | | | | | | | | |
| | 16+10 | Y4 | Riffle | | | | | | | | | |

Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

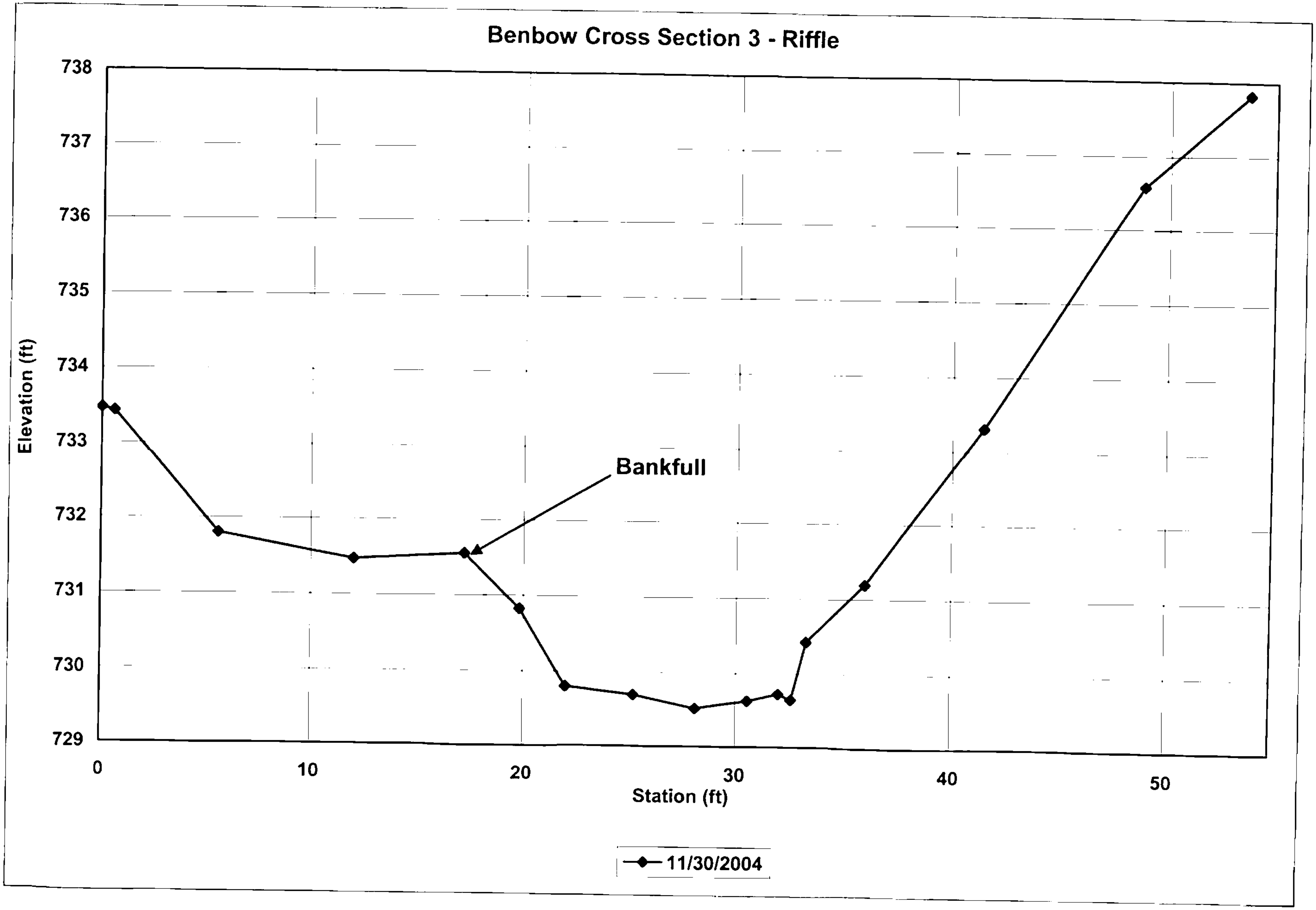
Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)


Benbow Cross Section 1 - Riffle
740
739
738
737
736
735
734
733
732
731
730
Elevation (ft)
0
10
20
30
40
50
60
70
Station (ft)
Bankfull
11/30/2004



Benbow Cross Section 2 - Pool
Elevation (ft)
739
738
737
736
735
734
733
732
731
730
729
728
0
10
20
30
40
50
60
Station (ft)
Bankfull
11/30/2004


Benbow Cross Section 3 - Riffle
Elevation (ft)
738
737
736
735
734
733
732
731
730
729
Bankfull
0
10
20
30
40
50
Station (ft)
11/30/2004

**Benbow Park Reach 2**

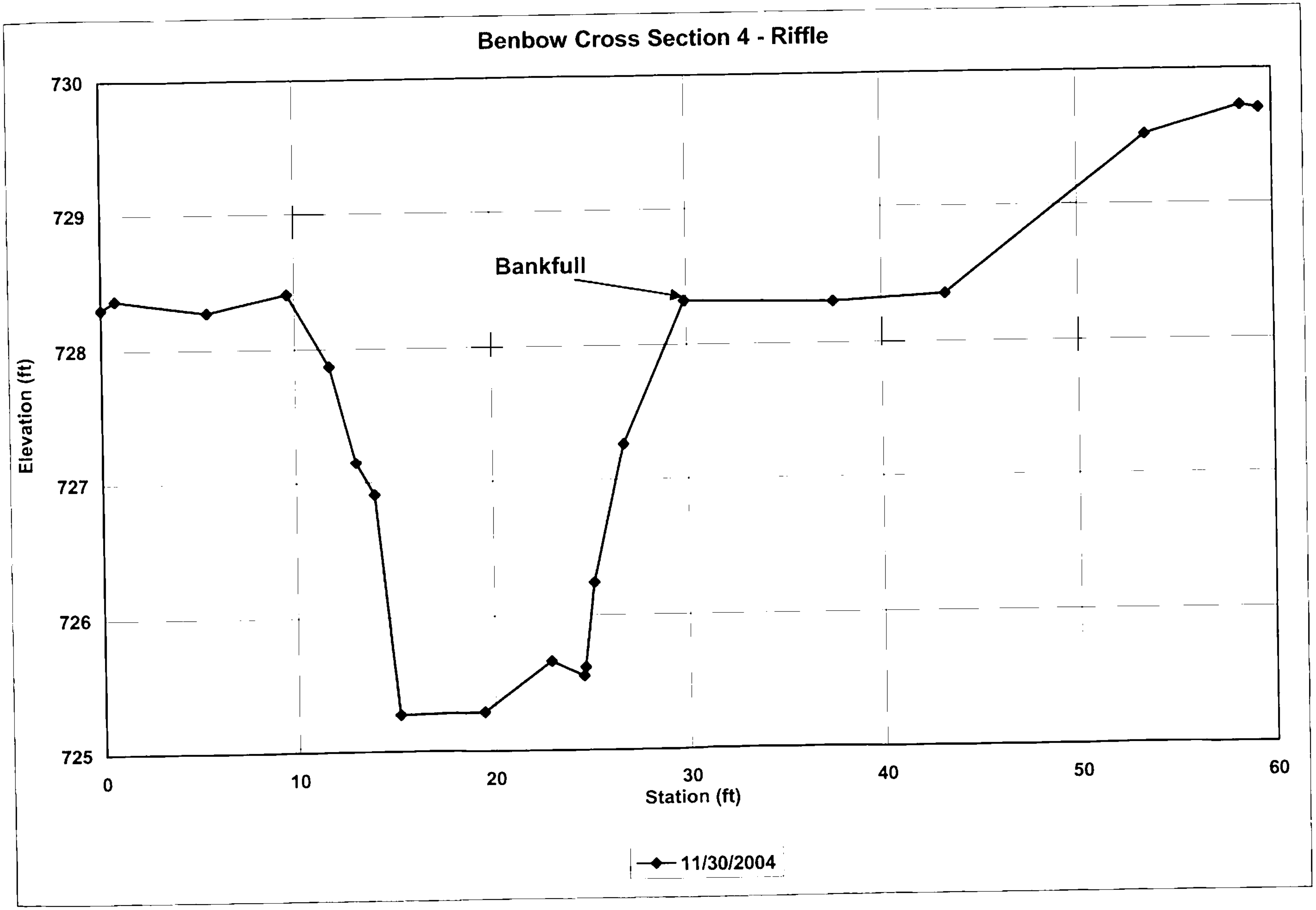
Cross Section Dimension Summary

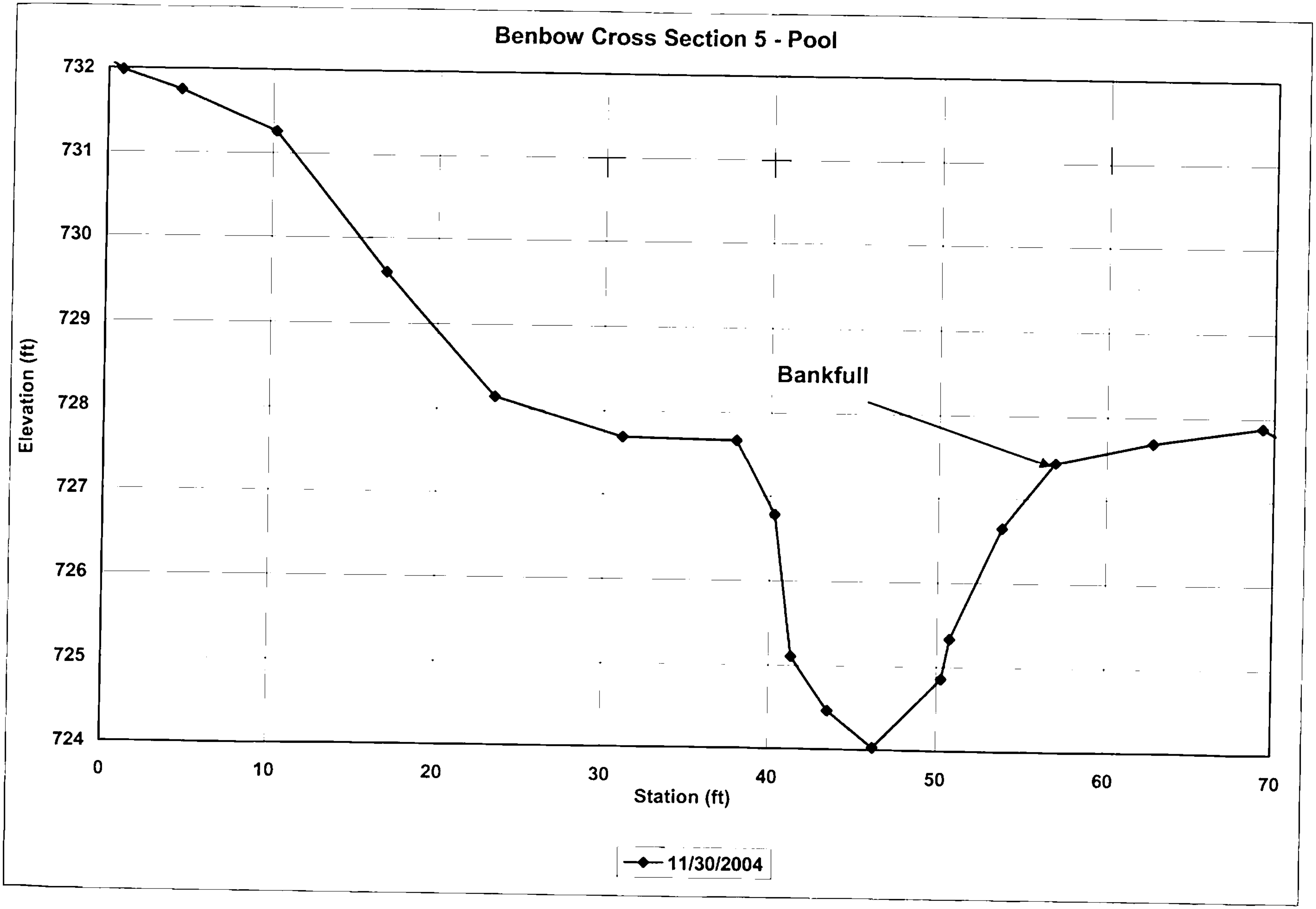
| XSEC | STA | Date | Feature | Str Type | Wfpa | Wbkf | Dbkf | W/D | Abkf | Dmax | ER | BHR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 23+36 | 11/30/2004 | Riffle | E5 | 59 | 20.0 | 1.9 | 10.4 | 38.1 | 3.0 | 3.0 | 1.0 |
| | 23+36 | Y1 | Riffle | | | | | | | | | |
| | 23+36 | Y2 | Riffle | | | | | | | | | |
| | 23+36 | Y3 | Riffle | | | | | | | | | |
| | 23+36 | Y4 | Riffle | | | | | | | | | |
| 5 | 25+10 | 11/30/2004 | Pool | | 58 | 18.4 | 1.9 | 9.6 | 35.5 | 3.4 | 3.2 | 1.0 |
| | 25+10 | Y1 | Pool | | | | | | | | | |
| | 25+10 | Y2 | Pool | | | | | | | | | |
| | 25+10 | Y3 | Pool | | | | | | | | | |
| | 25+10 | Y4 | Pool | | | | | | | | | |
| 6 | 26+92 | 11/30/2004 | Riffle | E5 | 49 | 18.5 | 1.8 | 10.3 | 33.2 | 2.7 | 2.7 | 1.0 |
| | 26+92 | Y1 | Riffle | | | | | | | | | |
| | 26+92 | Y2 | Riffle | | | | | | | | | |
| | 26+92 | Y3 | Riffle | | | | | | | | | |
| | 26+92 | Y4 | Riffle | | | | | | | | | |

Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

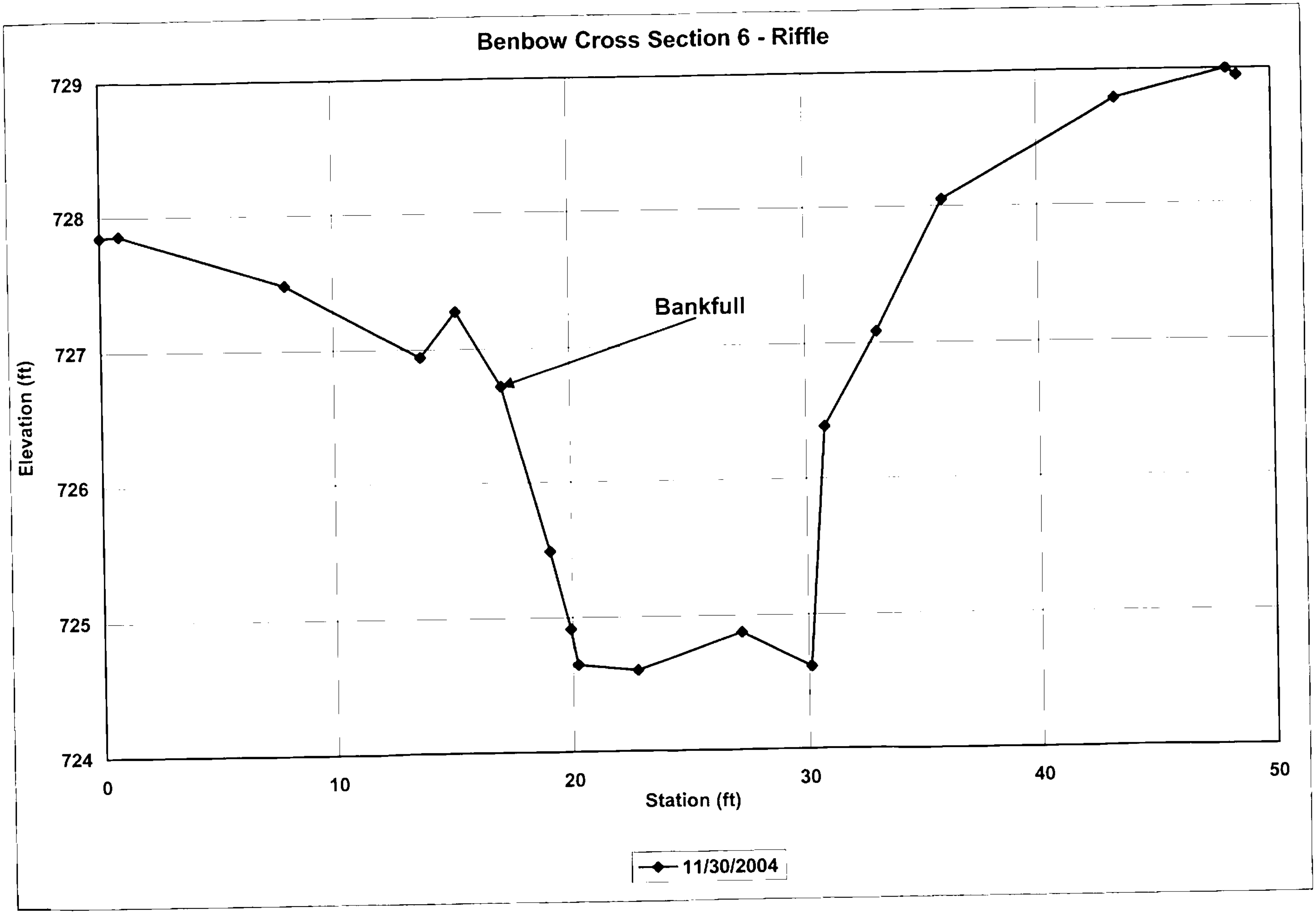
Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

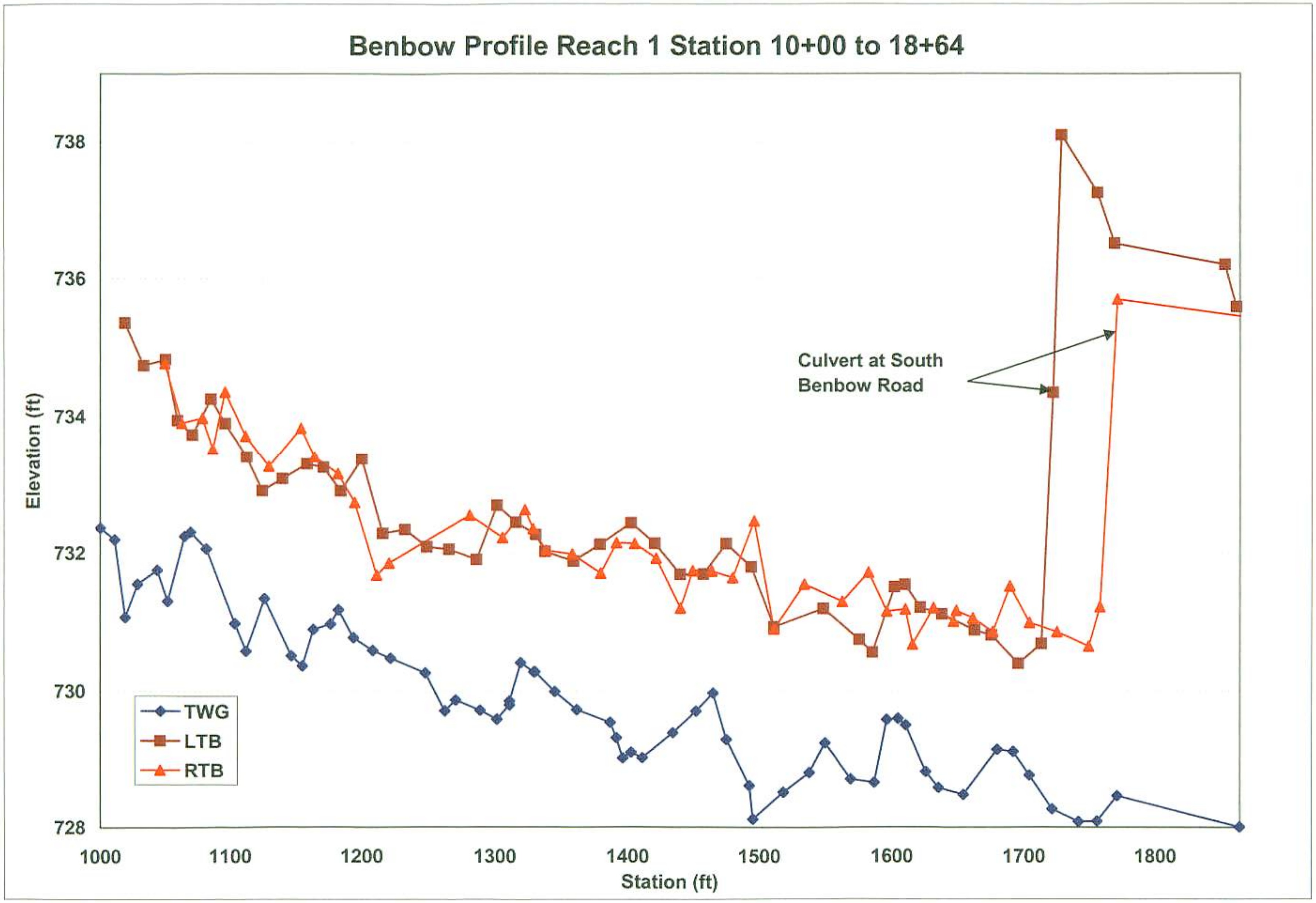
Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)


Benbow Cross Section 4 - Riffle
730
729
728
727
726
725
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
Station (ft)
11/30/2004

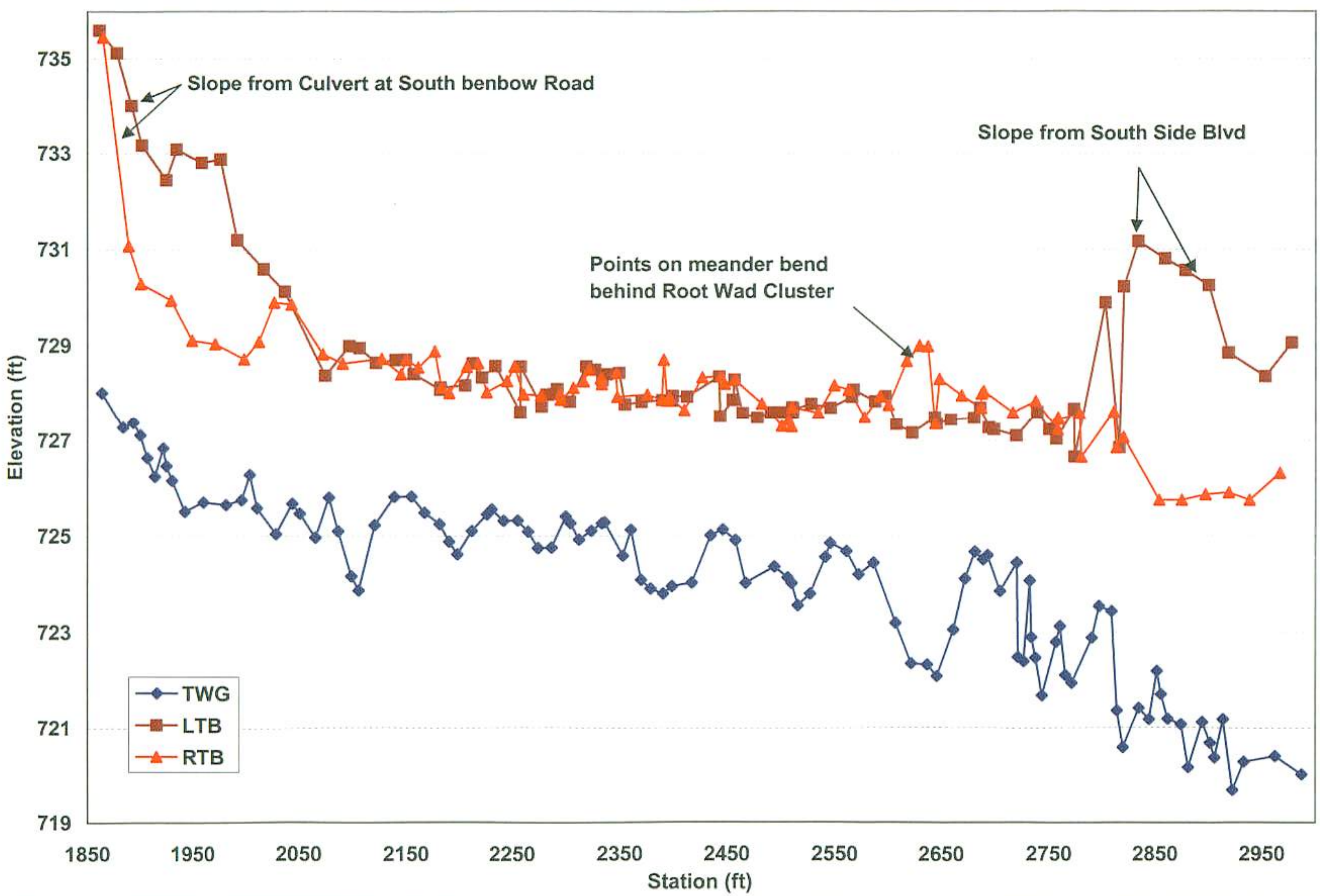


Benbow Cross Section 5 - Pool
732
731
730
729
728
727
726
725
724
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
70
Station (ft)
11/30/2004


Benbow Cross Section 6 - Riffle
Elevation (ft)
729
728
727
726
725
724
Bankfull
0
10
20
30
40
50
Station (ft)
11/30/2004


Benbow Profile Reach 1 Station 10+00 to 18+64
Elevation (ft)
738
736
734
732
730
728
1000
1100
1200
1300
1400
1500
1600
1700
1800
Station (ft)
Culvert at South Benbow Road
TWG
LTB
RTB

## Benbow Profile Reach 1 Station 18+64 to 29+86



# Buffalo Creeks Watershed Phase II
# Benbow Park
# Photo Log

## Reach 1

**Photo Points 1-16**

## Reach 2

**Photo Points 17-44**

**Notes:**

1. Photo point locations are shown on the plan views. Descriptive locations and views follow on the next two pages.
2. All photos are oriented downstream (unless otherwise noted).
3. Photo locations include longitudinal photos and cross sections.

# Buffalo Creeks Watershed Phase II
# Benbow Park
# Photo Point Locations

| Photo Point | Location | View |
|---|---|---|
| **Reach 1** | | |
| 1 | Top of Florida Avenue Culvert | Project Start |
| 2 | Thalweg (TW) at invert of Cross Vane #1 | Cross Vane (CV) #1 |
| 3 | TW Constructed Riffle (CR) #1 | CR #1 |
| 4 | TW at CV (CR) #2 | CV #2 |
| 5 | TW at Knick point and natural riffle | Natural riffle |
| 6 | TW at natural riffle | Natural riffle |
| 7 | TW at CV #3 | Cross Section (CS) #1 |
| 8 | TW at ~Station 13+50 | Downstream |
| 9 | TW at CV #4 | CV #4 |
| 10A | TW at CR #2 | CR #2 |
| 10B | TW at CR #2 looking at Step Pool #2 | Step Pool (SP) #2 |
| 11A | TW at tail of riffle (TOR) CR #2 | Vegetation Plot #1 |
| 11B | TW at TOR of riffle CR #2 | CS #2 |
| 12A | Looking left ~ Station 15+90 | SP #3 |
| 12B | TW at CR #3 | CS #3 |
| 13 | Invert at Rock Vane #1 | Rock vane #1 |
| 14 | TW at CR #4 | CR #4 |
| 15 | TW at CV #4 | CV #4 |
| 16 | Top of South Benbow Street culvert, upstream side | Reach 1 End |
| **Reach 2** | | |
| 17 | Top of South Benbow Street culvert downstream side | Reach 2 Start |
| 18A | TW at Double Drop (DD) CV #1 upstream | Stabilized South Benbow Street culvert |
| 18B | TW at DD CV #1 | DD CV #1 |
| 19 | TW at DD CV #2 | DD CV #2 |
| 20 | TW at Rock Vane (RV) #1 | RV #1 |
| 21 | TW at "J" Hook #1 | J Hook #1 |
| 22 | 15' upstream from bridge | Pedestrian Bridge |
| 23A | Pedestrian Bridge looking upstream | Reach 2 Start |
| 23B | Pedestrian Bridge looking downstream | DD CV #3 |
| 24 | TW at DD CV#3 | DD CV #3 |
| 25 | TW at RV #2 | RV #2, Root Wad #1 |
| 26 | TW at CR #1 | CR #1 |
| 27 | TW at RV #3 | RV #3, Root Wad #2 |
| 28 | Looking right at ~ Station 22+00 | SP #2 |

| Photo Point | Location | View |
|---|---|---|
| 29 | TW at CR #2 | CR #2, Root Wad #3 |
| 30 | TW at RV #4 | RV #4 |
| 31A | TW at CR #3 | Playground Equipment |
| 31B | TW at CR #3 | CR #3 |
| 32 | TW at RV #4 | RV #4 |
| 33 | Looking right at ~ Station 24+00 | SP #3 |
| 34 | TW at CR #4 | CS #5 |
| 35 | TW at CR #5 | CR #5 |
| 36A | Top of bank at RV #5 | Vegetation Plot |
| 36B | TW at RV #5 | Aerial sewer, Root Wad #6 |
| 37 | TW at CR #6 | CR #6 |
| 38 | TW at DD CV #4 | DD CV #4 |
| 39 | TW at RV #6 | RV #6 |
| 40 | TW at DD CV #5 | DD CV #5 |
| 41 | TW at DD CV #6 | DD CV #6 |
| 42 | TW at DD CV #7 | DD CV #7 |
| 43 | 20' Downstream from CV#7 | Culvert at Belcrest Road |
| 44 | Top of Belcrest Road culvert looking upstream | Reach 2 End |

PP#1 Reach 1 (R1) Upstream View from Culvert at Florida Avenue

PP#2 R1 Cross Vane #1

PP#3 R1 Constructed Riffle #1

PP#4 R1 Cross Vane #2

PP#5 R1 Natural Riffle

PP#6 R1 Natural Riffle

PP# 7 R1 Cross Vane #3 and Cross Section #1

PP#8 R1 Downstream View

PP#9 R1 Cross Vane #4

PP#10A R1 Toe protection on left bank into Constructed Riffle #2

PP#10B R1 Step Pool #2

PP#11A R1 Bare-root and Live-stakes Plot #1

PP#11B R1 Cross Section #2 Pool

PP#12A R1 Step Pool #3

PP#12B R1 Constructed Riffle #3 and Cross Section #3

PP#13 R1 Rock Vane

PP#14 R1 Constructed Riffle #4

PP#15 R1 Cross Vane #4

PP#16 R1 Upstream View from South Benbow Road

PP#17 R2 Downstream View from South Benbow Road

PP#18A R2 upstream view of stabilized culvert from invert of Double Drop Cross Vane #1

PP#18B R2 Double Drop Cross vane #1

PP#19 R1 Double Drop Cross Vane #2

PP#20 R1 Rock Vane #1

PP#21 R1 J Hook #1

PP#22 R2 Newly Installed Pedestrian Bridge

PP#23A R2 Upstream View from Pedestrian Bridge

PP#23B R2 Downstream view from Pedestrian Bridge

PP#24 R2 Double Drop Cross Vane #3

PP#25 R2 Rock Vane #2, and Root Wad Cluster #1

PP#26 R2 Constructed Riffle #1

PP#27 R2 Rock Vane #3, Step pool #2, and Root Wad Cluster #2

PP#28 R2 Step Pool #2

PP#29 R2 Constructed Riffle #2 and Root Wad Cluster #3

PP#30 R2 Rock Vane #4 and Constructed Riffle #3

PP#31A R2 Relocated Playground with new equipment

PP#31B R2 Constructed Riffle #3, Rock Vane #4, and Cross Section #4

PP#32 R2 Rock Vane #4, Step Pool #3, and Root Wad Cluster #4

PP#33 R2 Step Pool #3

PP#34 R2 Constructed Riffle #4, Root Wad Cluster #5, and Cross Section #5

PP#35 R2 Constructed Riffle #5

PP#36A R2 Bare-root and Live-stakes Plot #2

PP#36B R2 Rock Vane #5, newly installed aerial sewer and Root Wad Cluster #6

PP#37 R2 Constructed Riffle #6, Cross Section #6

PP#38 R2 Double Drop Cross Vane #4

PP#39 R2 Rock Vane #6

PP#40 R2 Double Drop Cross Vane #5

PP#41 R2 Double Drop Cross Vane #6

PP#42 R2 Double Drop Cross Vane #7

PP#43 R2 Toe protection and rock weir into culvert at end of R2

PP#44 R2 Upstream view from Belcrest Road at end of R2

# Buffalo Creek Watershed Phase II
# Benbow Park
# Vegetation Survival Plots

## Bare-Root Plantings

| Reach 1 | Photo Point (#) | Planted (stems) | Year 1 (stems) | Year 2 (stems) | Year 3 (stems) | Year 4 (stems) | Year 5 (stems) |
|---|---|---|---|---|---|---|---|
| Plot #1 | 11A | 43 | | | | | |
| Plot #2 | 37 | 39 | | | | | |

## Live Stakes

| Reach 1 | Photo Point (#) | Planted (stakes) | Year 1 (stakes) | Year 2 (stakes) | Year 3 (stakes) | Year 4 (stakes) | Year 5 (stakes) |
|---|---|---|---|---|---|---|---|
| Plot #1 | 11A | 100 | | | | | |

**Note: Live stakes counted from eastern end of plot down to step pool #3 at Station 15+90**

**Notes:**

1. All plots are shown on the plan views. All plot corners are marked with a wooden stake and orange flagging tape.
2. Each counted stem or live stake is marked with pink flagging tape.
3. Photo point locations are shown on the plan views.
4. Bare root Plots are 25x100 feet.
4. Use successive columns for survivability from year to year.

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 6 |

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 28421 ENGINEER C. HEATH WADSWORTH

APPROVED BY:

DATE:


BUCK ENGINEERING
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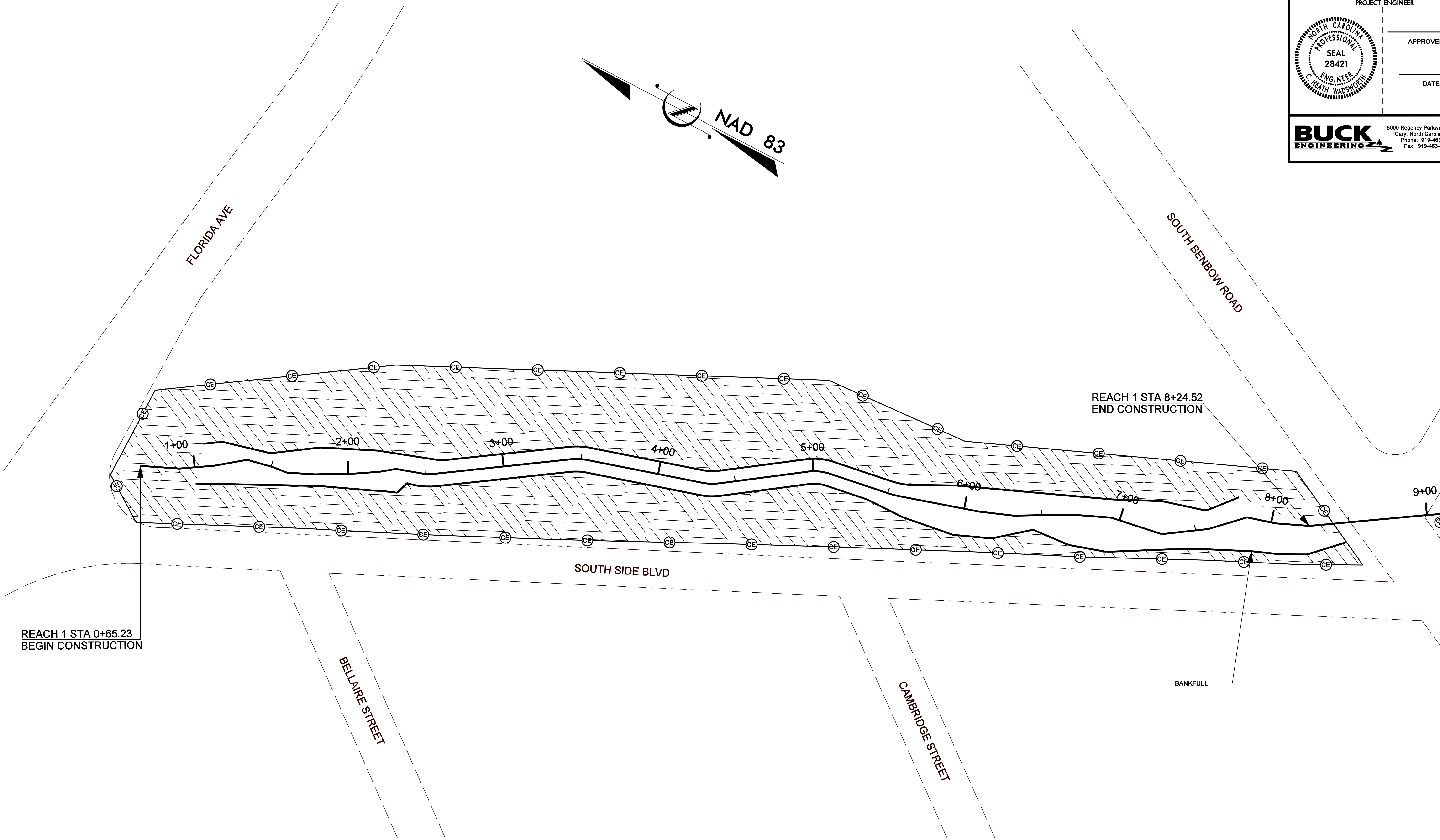
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490


FORESTED BUFFER

APPROXIMATE CONSERVATION EASEMENT BOUNDARY

SEE SHEET 1-C FOR PLANTING SPECIFICATIONS

# VEGETATION PLAN REACH 1

30 15 0 30 60

SCALE (FT)

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 7 |

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 28421 ENGINEER C. HEATH WADSWORTH

APPROVED BY:

DATE: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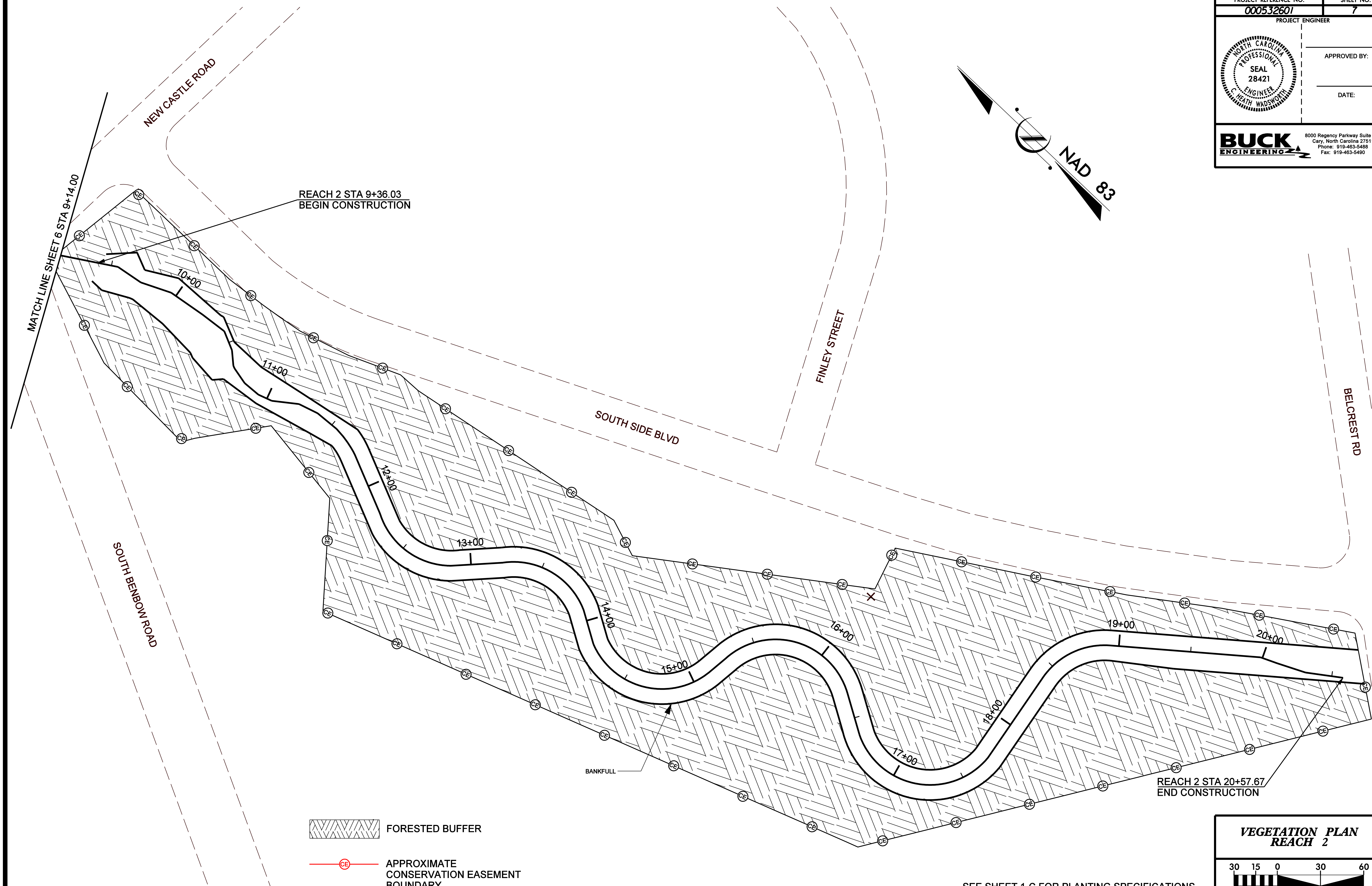
Fax: 919-463-5490


SEE SHEET 1-C FOR PLANTING SPECIFICATIONS

## VEGETATION PLAN REACH 2

30 15 0 30 60
SCALE (FT)

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 4 |

PROJECT ENGINEER

**AS-BUILT**
**PLAN VIEW**

BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
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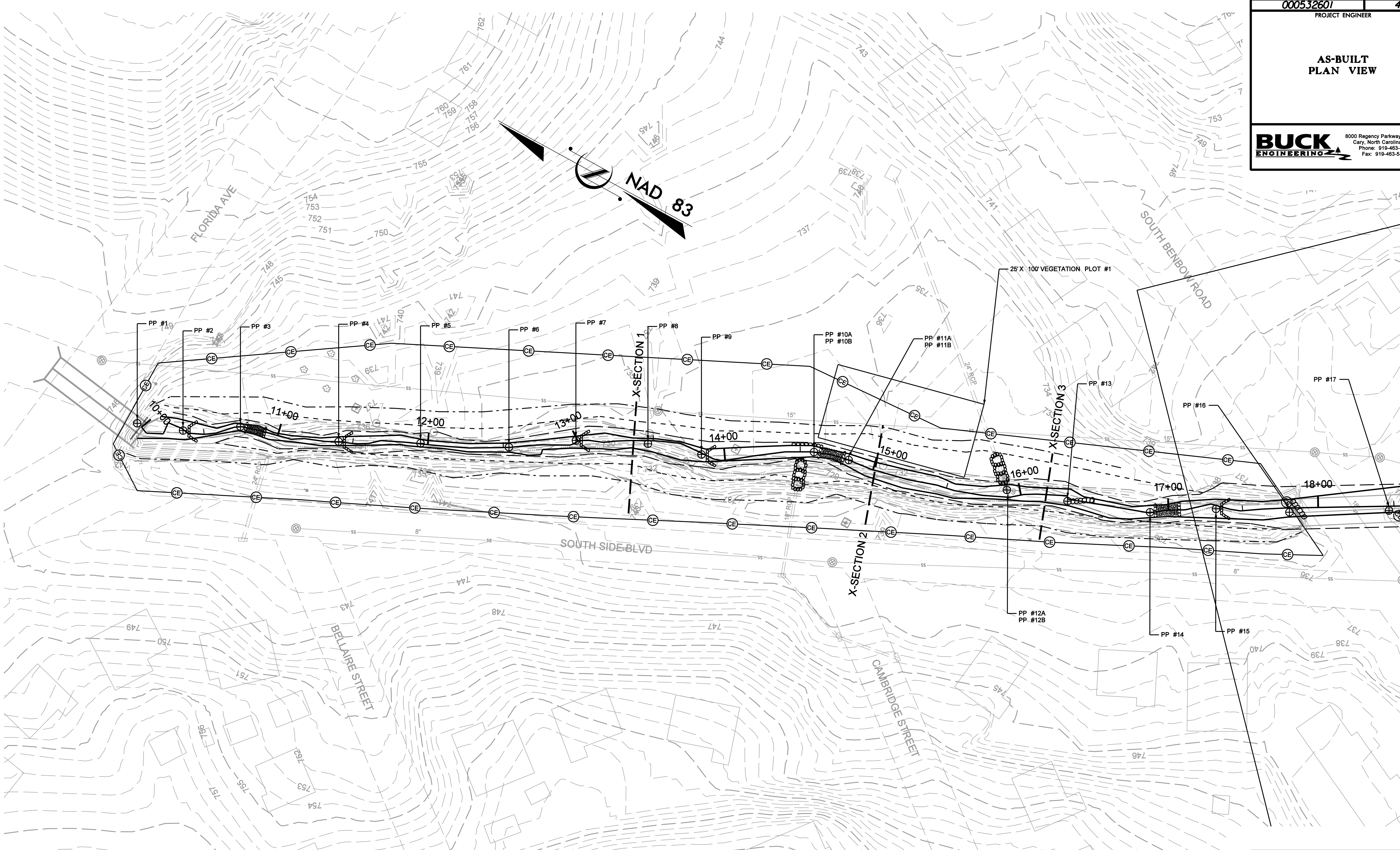
Fax: 919-463-5490




## PLAN VIEW

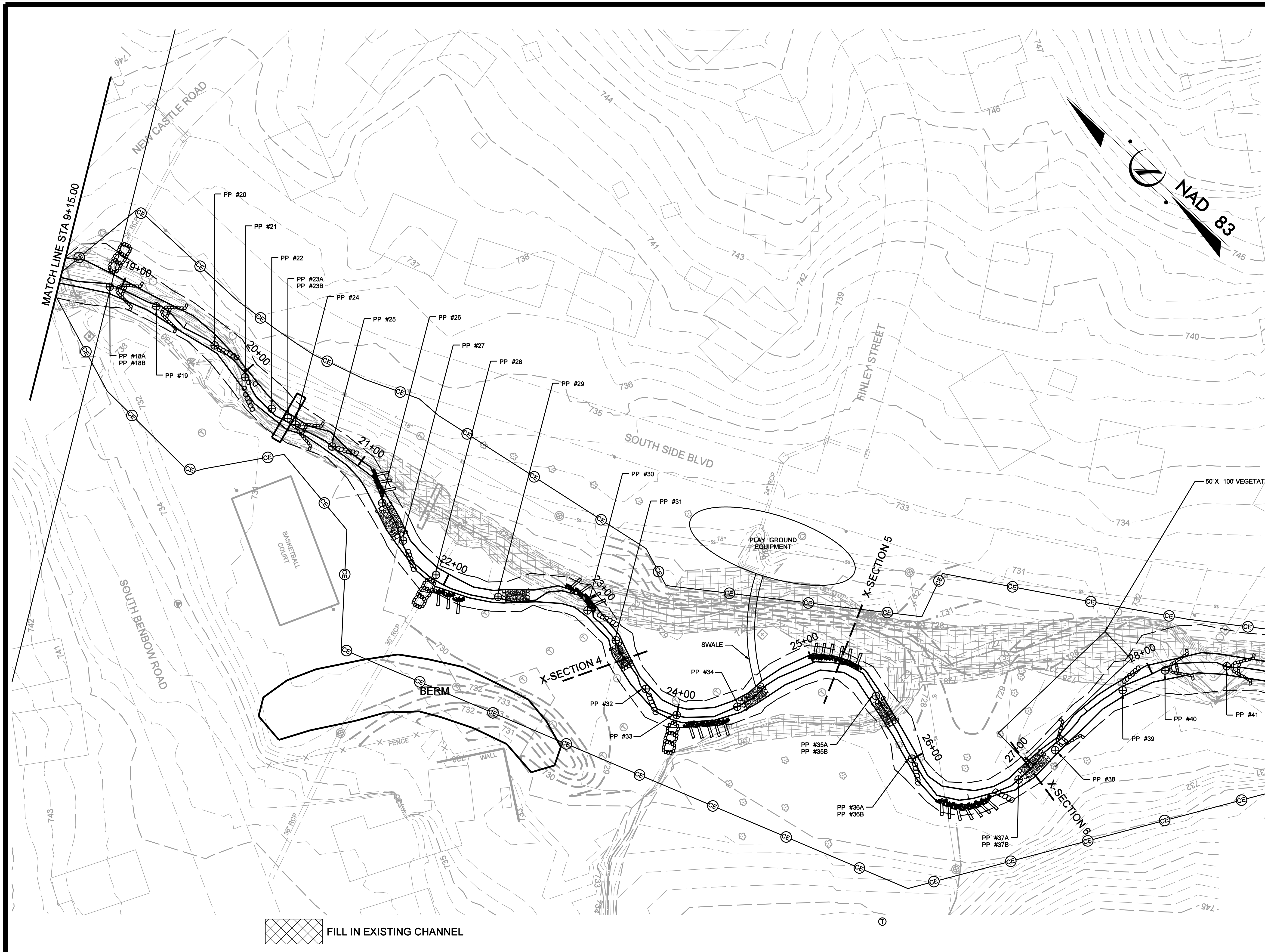
SCALE (FT): 30 15 0 30 60

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 5 |

PROJECT ENGINEER

**AS-BUILT PLAN VIEW**


BUCK ENGINEERING
8000 Regency Parkway Suite 200
Cary, North Carolina 27511
Phone: 919-463-5488
Fax: 919-463-5490


*PLAN VIEW*

30 15 0 30 60

SCALE (FT)

Cross Section Pin Locations

Brown Bark Park

| Point # | Northing | Easting | Elevation | Decription | Stationing |
|---|---|---|---|---|---|
| 390 | 855070.1726 | 1748409.484 | 838.84 | X1 LPIN | 12+34.25 |
| 384 | 855075.0999 | 1748413.425 | 839.46 | X1 RPIN | |
| 265 | 855304.4092 | 1748522.768 | 837.42 | X2 LPIN | 16+68.46 |
| 261 | 855310.8407 | 1748528.558 | 837.30 | X2 RPIN | |
| 219 | 855422.0214 | 1748545.871 | 836.78 | X3 LPIN | 20+25.84 |
| 213 | 855455.9505 | 1748556.826 | 836.09 | X3 RPIN | |
| 135 | 855114.3164 | 1748406.482 | 841.77 | X4 LPIN | 29+31.94 |
| 131 | 855145.3961 | 1748428.682 | 841.61 | X4 RPIN | |
| 330 | 855173.9729 | 1748470.188 | 838.17 | X5 LPIN | 35+67.76 |
| 326 | 855174.6076 | 1748465.624 | 838.38 | X5 RPIN | |
| 301 | 855213.7276 | 1748502.679 | 837.45 | X6 RPIN | 36+69.19 |
| 307 | 855207.1236 | 1748495.875 | 838.37 | X6 LPIN | |

**Brown Bark Park**

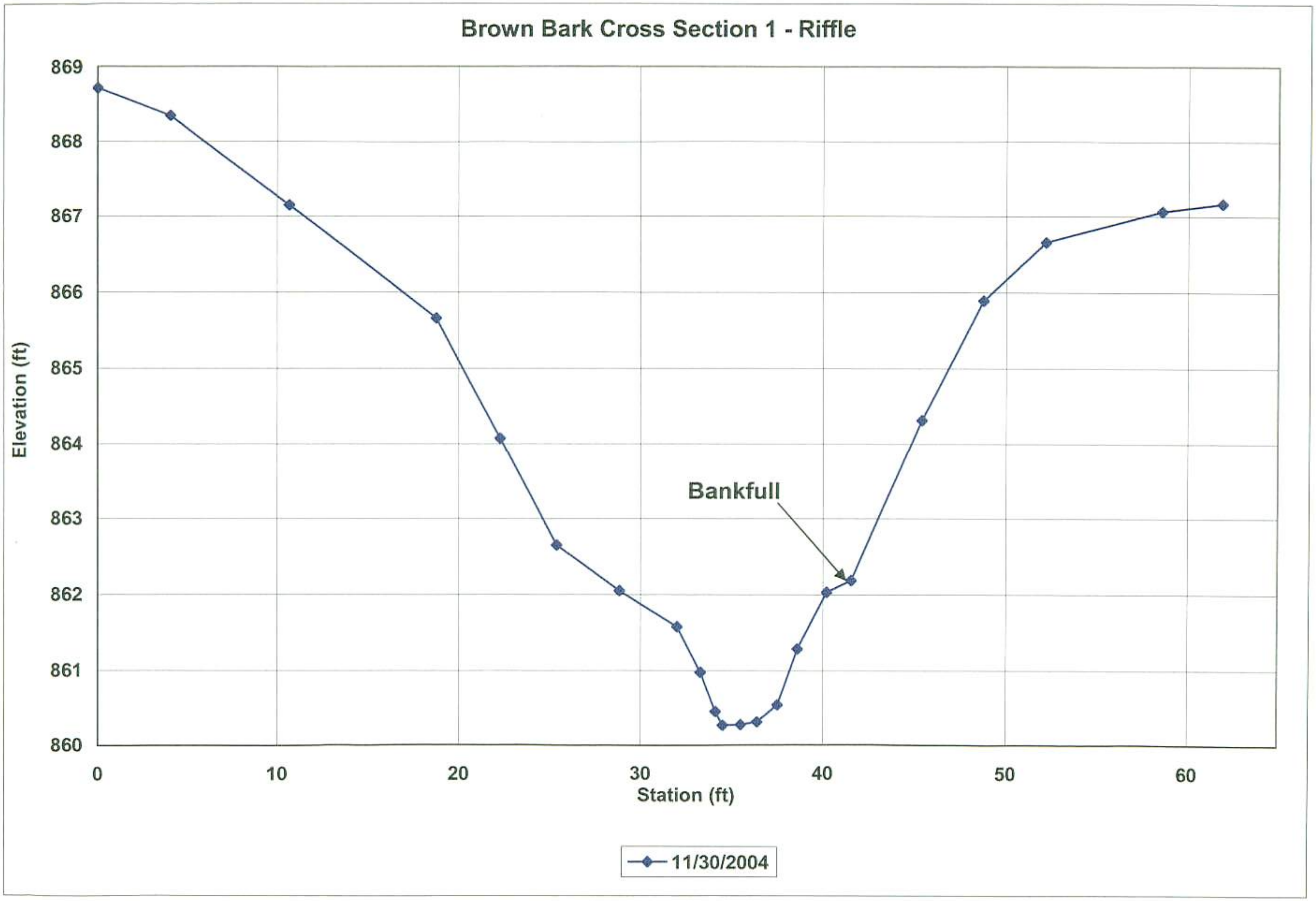
Cross Section Dimension Summary

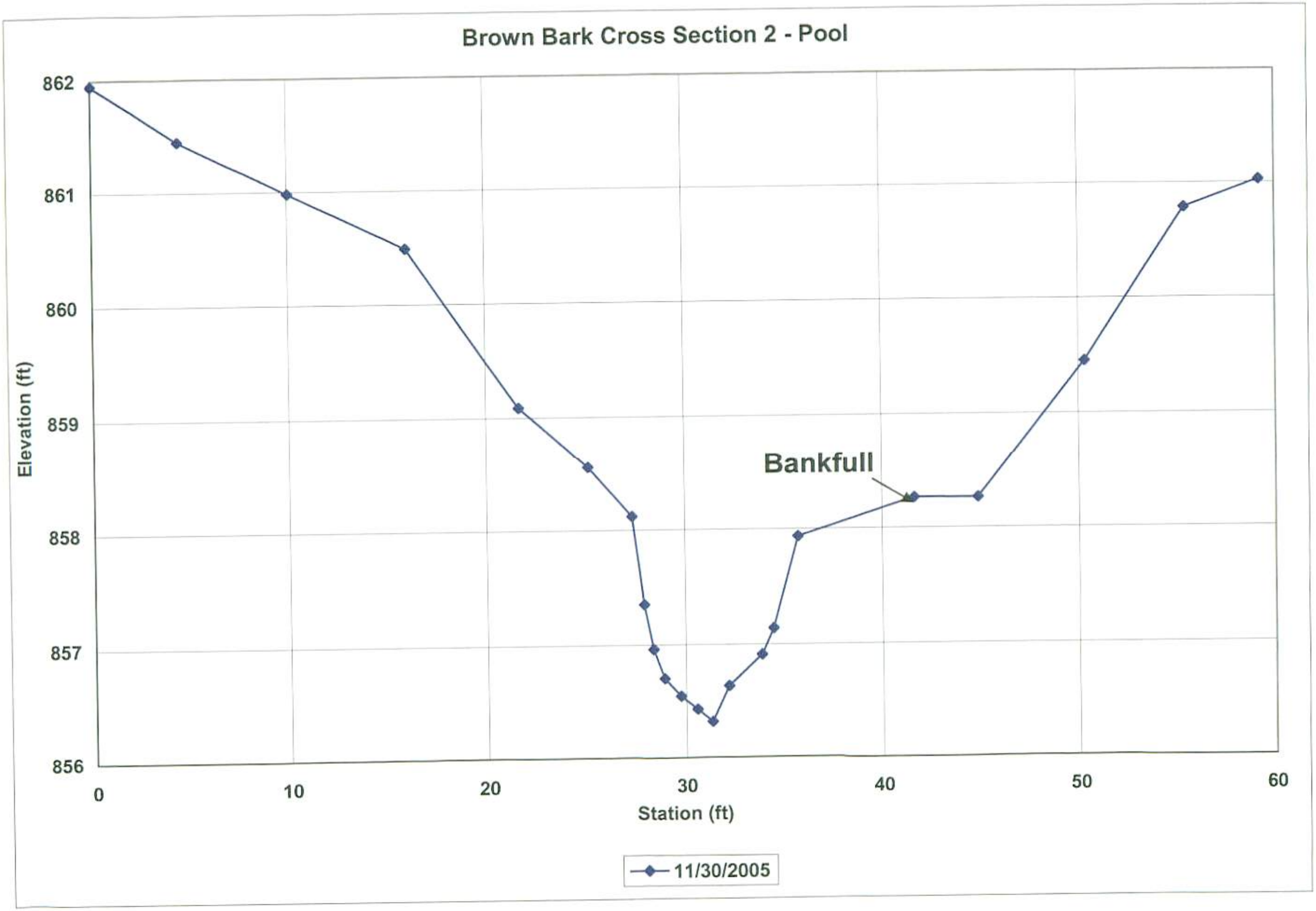
| XSEC | STA | Date | Feature | Str Type | Wfpa | Wbkf | Dbkf | W/D | Abkf | Dmax | ER | BHR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 12+34 | 11/30/2004 | Riffle | B5c | 23 | 13.5 | 0.9 | 15.0 | 12.2 | 1.9 | 1.7 | 1.0 |
| | 12+34 | Y1 | Riffle | | | | | | | | | |
| | 12+34 | Y2 | Riffle | | | | | | | | | |
| | 12+34 | Y3 | Riffle | | | | | | | | | |
| | 12+34 | Y4 | Riffle | | | | | | | | | |
| 2 | 16+68 | 11/30/2004 | Pool | | 36 | 15.0 | 0.8 | 18.0 | 12.5 | 1.9 | 2.4 | 1.0 |
| | 16+68 | Y1 | Pool | | | | | | | | | |
| | 16+68 | Y2 | Pool | | | | | | | | | |
| | 16+68 | Y3 | Pool | | | | | | | | | |
| | 16+68 | Y4 | Pool | | | | | | | | | |
| 3 | 20+25 | 11/30/2004 | Riffle | C5c | 48 | 19.3 | 1.2 | 16.1 | 23.2 | 3.3 | 2.5 | 1.0 |
| | 20+25 | Y1 | Riffle | | | | | | | | | |
| | 20+25 | Y2 | Riffle | | | | | | | | | |
| | 20+25 | Y3 | Riffle | | | | | | | | | |
| | 20+25 | Y4 | Riffle | | | | | | | | | |

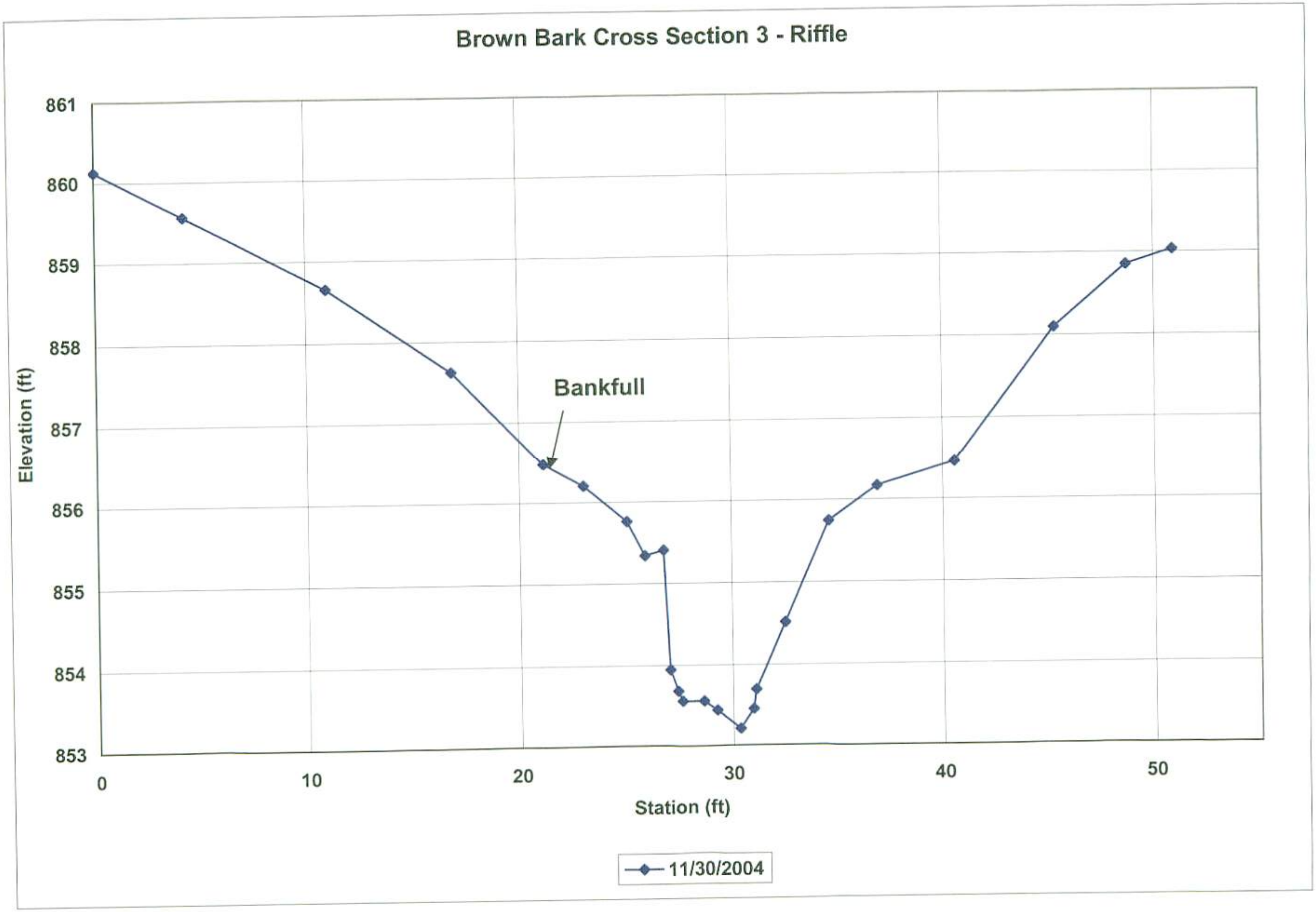
Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)


Brown Bark Cross Section 1 - Riffle
869
868
867
866
865
864
863
862
861
860
Elevation (ft)
0
10
20
30
40
50
60
Station (ft)
Bankfull
11/30/2004


Brown Bark Cross Section 2 - Pool
862
861
860
859
858
857
856
Elevation (ft)
Bankfull
0
10
20
30
40
50
60
Station (ft)
11/30/2005


Brown Bark Cross Section 3 - Riffle
861
860
859
858
857
856
855
854
853
Elevation (ft)
Bankfull
0
10
20
30
40
50
Station (ft)
11/30/2004

**Brown Bark Park**

Cross Section Dimension Summary

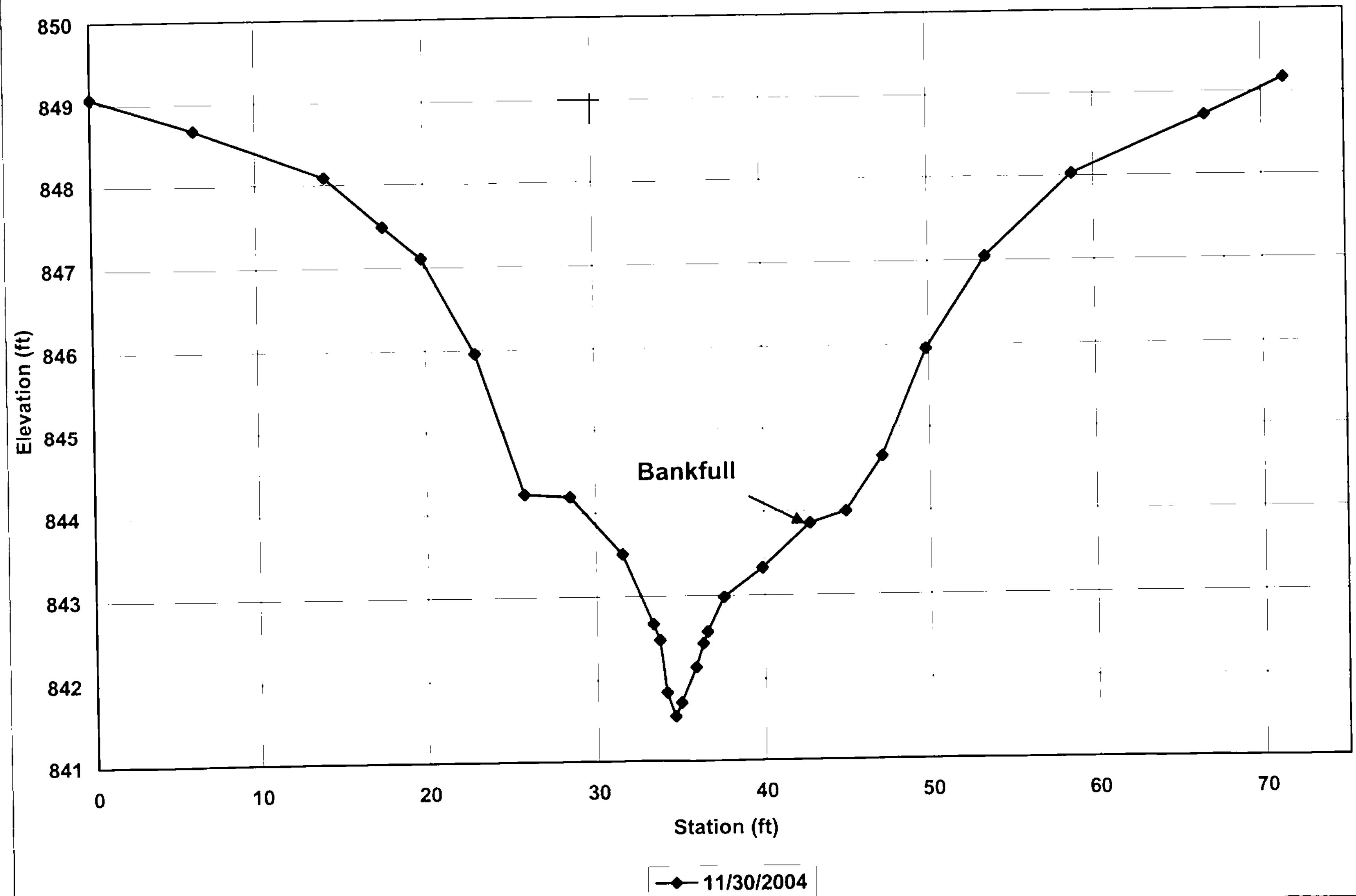
| XSEC | STA | Date | Feature | Str Type | Wfpa | Wbkf | Dbkf | W/D | Abkf | Dmax | ER | BHR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 29+31 | 11/30/2004 | Pool | | 30 | 15.5 | 0.8 | 18.8 | 12.9 | 2.4 | 1.9 | 1.0 |
| | 29+31 | Y1 | Pool | | | | | | | | | |
| | 29+31 | Y2 | Pool | | | | | | | | | |
| | 29+31 | Y3 | Pool | | | | | | | | | |
| | 29+31 | Y4 | Pool | | | | | | | | | |
| 5 | 35+67 | 11/30/2004 | Riffle | C5c | 50 | 14.0 | 0.9 | 16.0 | 12.3 | 1.7 | 3.6 | 1.0 |
| | 35+67 | Y1 | Riffle | | | | | | | | | |
| | 35+67 | Y2 | Riffle | | | | | | | | | |
| | 35+67 | Y3 | Riffle | | | | | | | | | |
| | 35+67 | Y4 | Riffle | | | | | | | | | |
| 6 | 36+69 | 11/30/2004 | Riffle | C5c | 59 | 19.4 | 0.8 | 23.4 | 16.1 | 2.1 | 3.6 | 1.0 |
| | 36+69 | Y1 | Riffle | | | | | | | | | |
| | 36+69 | Y2 | Riffle | | | | | | | | | |
| | 36+69 | Y3 | Riffle | | | | | | | | | |
| | 36+69 | Y4 | Riffle | | | | | | | | | |

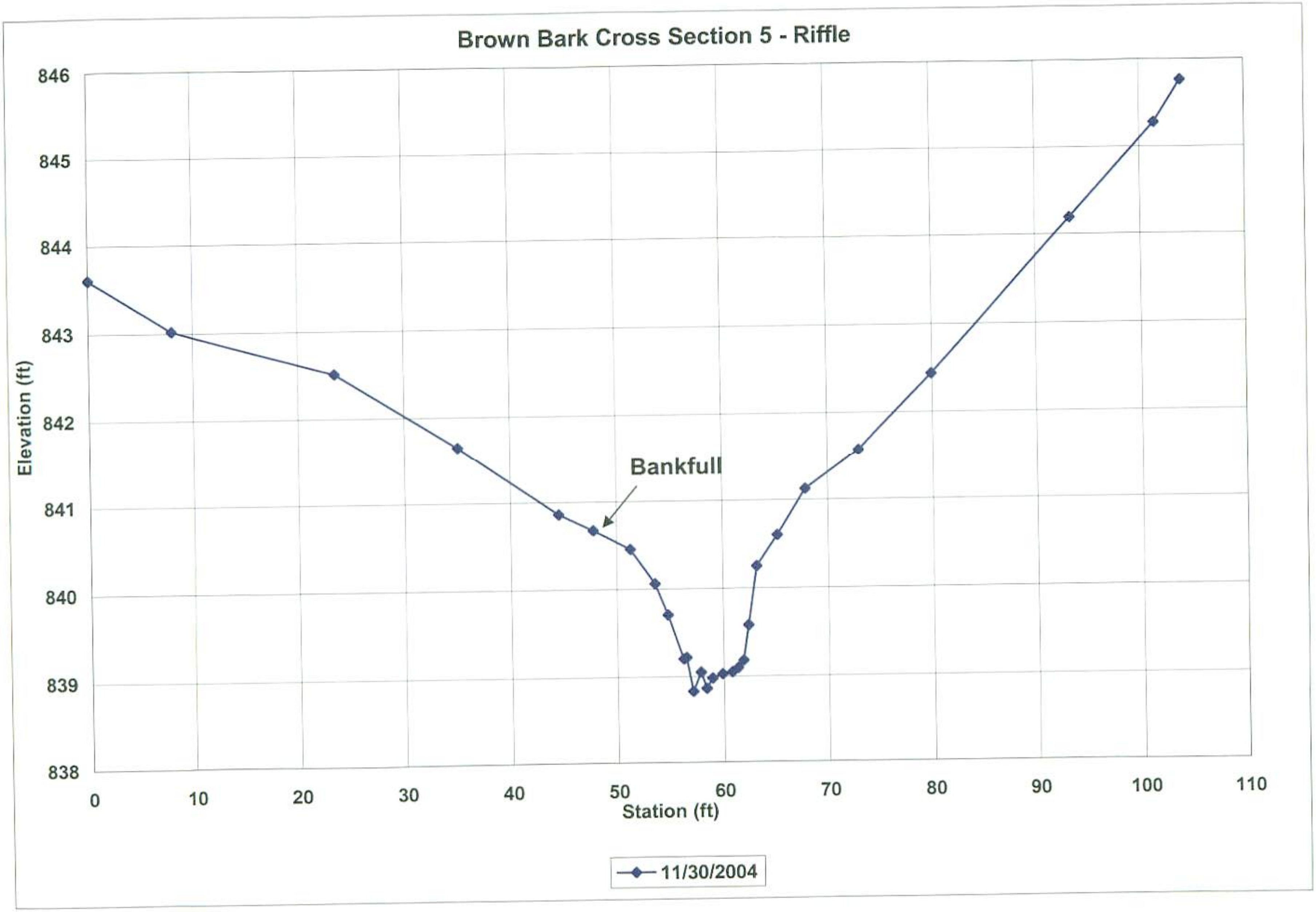
Str Type = Rosgen Classification
Wfpa = Width Flood Prone Area (ft)
Wbkf = Bankfull Width (ft)

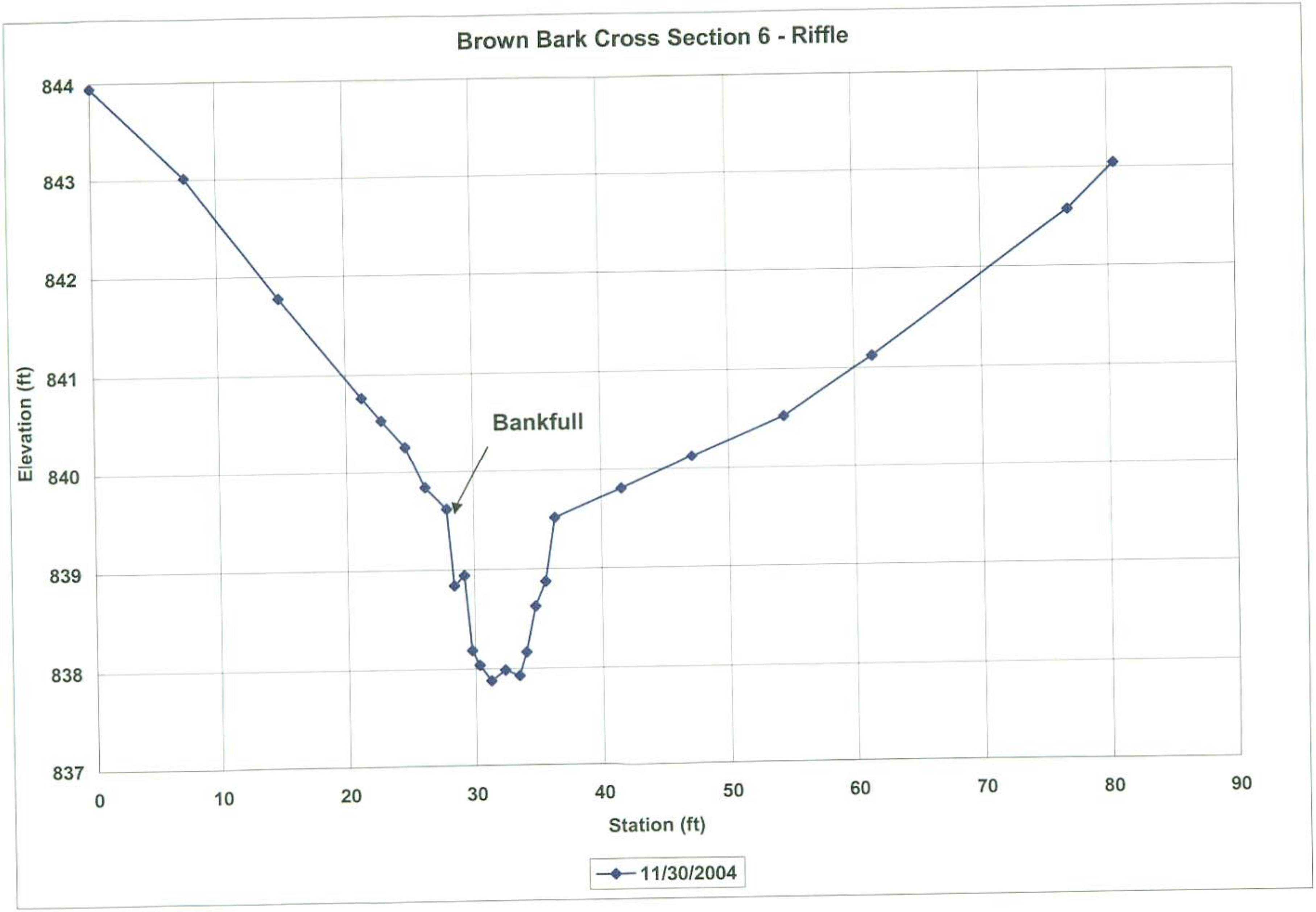
Dbkf = Bankfull Mean Depth (ft)
W/D = Bkf Width to Depth Ratio (ft/ft)
Abkf = Bkf Cross Section Area (sq ft)

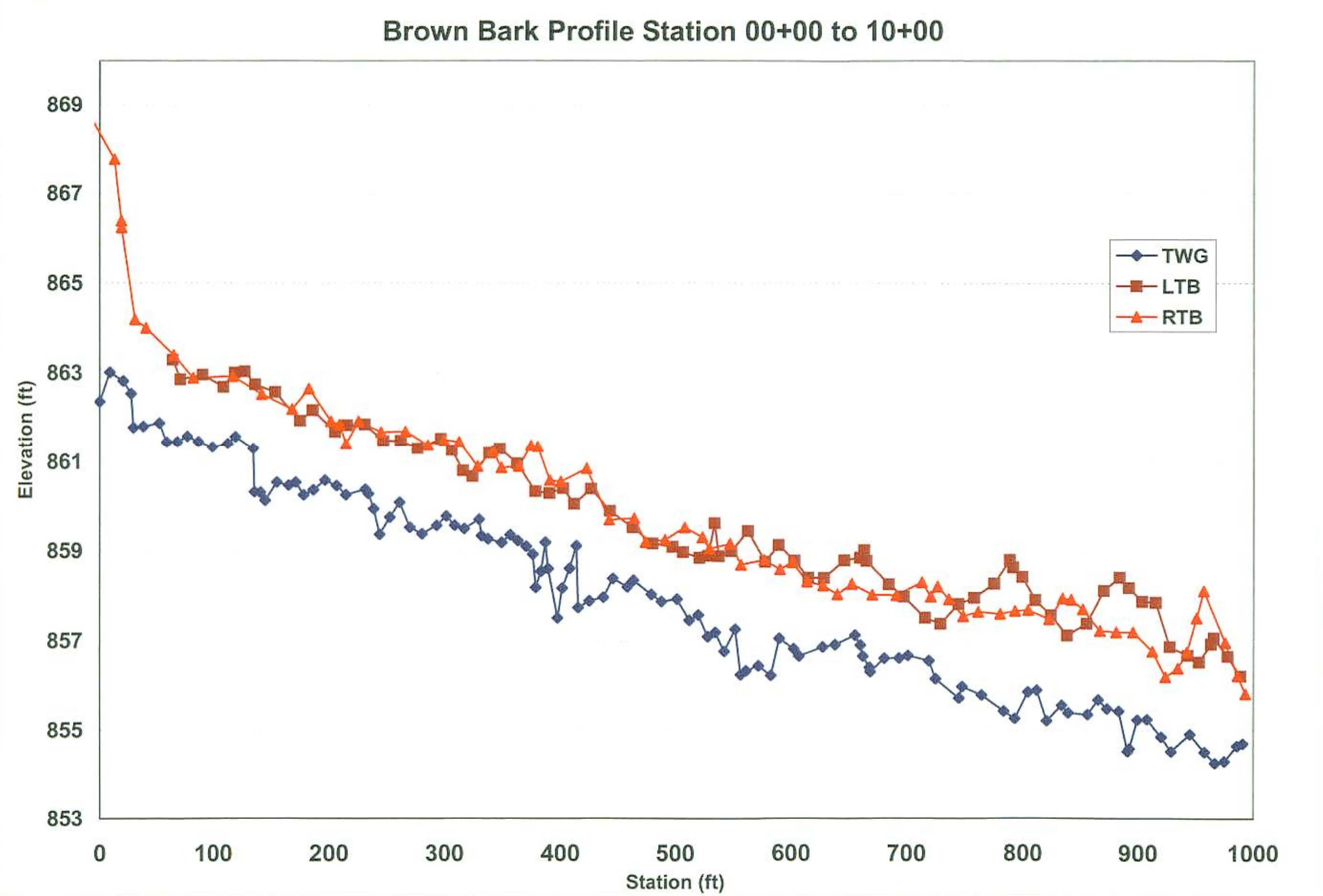
Dmax = Bankfull Maximum Depth (ft)
ER = Entrenchment Ratio, Wfpa/Wbkf (ft/ft)
BHR = Bank Height Ratio, Dtob/Dmax (ft/ft)

## Brown Bark Cross Section 4 - Pool

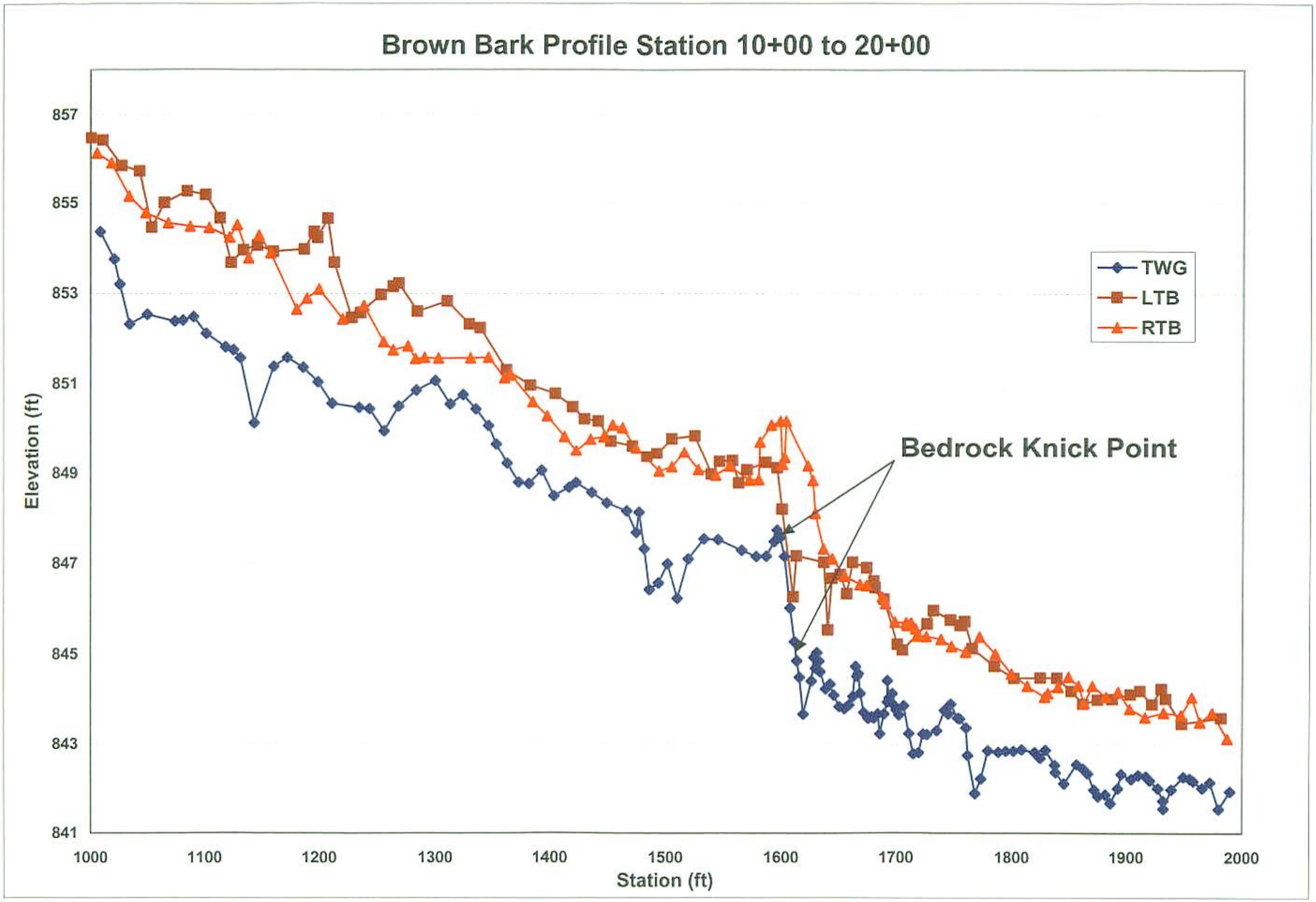


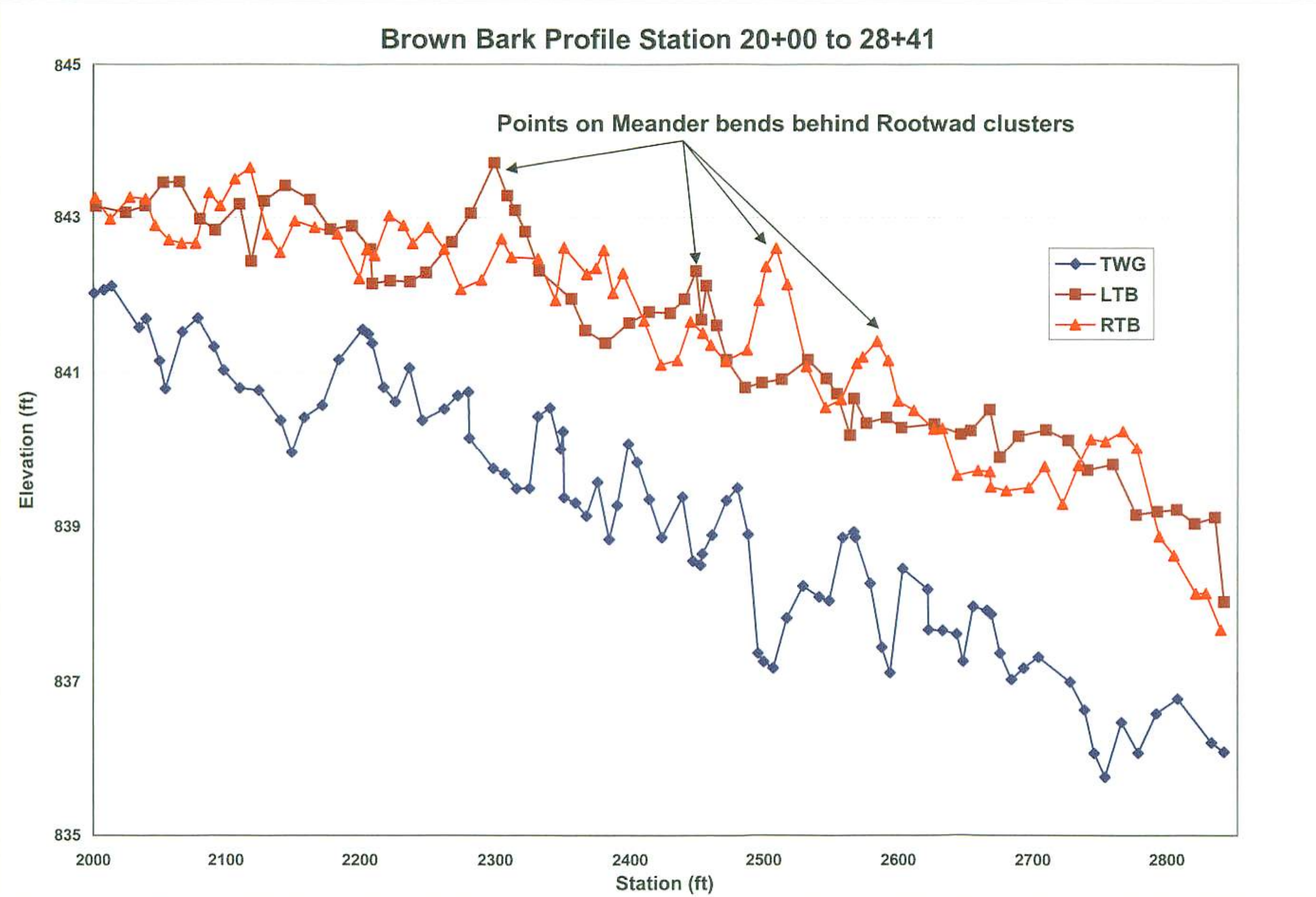

Brown Bark Cross Section 5 - Riffle
Elevation (ft)
846
845
844
843
842
841
840
839
838
0
10
20
30
40
50
60
70
80
90
100
110
Station (ft)
Bankfull
11/30/2004


Brown Bark Cross Section 6 - Riffle
Elevation (ft)
844
843
842
841
840
839
838
837
0
10
20
30
40
50
60
70
80
90
Station (ft)
Bankfull
11/30/2004



Brown Bark Profile Station 00+00 to 10+00
869
867
865
863
861
859
857
855
853
Elevation (ft)
0
100
200
300
400
500
600
700
800
900
1000
Station (ft)
TWG
LTB
RTB


Brown Bark Profile Station 10+00 to 20+00
Elevation (ft)
857
855
853
851
849
847
845
843
841
Station (ft)
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
TWG
LTB
RTB
Bedrock Knick Point


Brown Bark Profile Station 20+00 to 28+41
Points on Meander bends behind Rootwad clusters
TWG
LTB
RTB
Elevation (ft)
845
843
841
839
837
835
Station (ft)
2000
2100
2200
2300
2400
2500
2600
2700
2800

# Buffalo Creek
# Brown Bark Park
# Photo Log

## Reach 1

**Photo Points 1-43**

**Notes:**

1. Photo point locations are shown on the plan views. Descriptive locations and views follow on the next two pages.
2. All photos are oriented downstream (unless otherwise noted).
3. Photo locations include longitudinal photos and cross sections.

# Buffalo Creek
# Brown Bark Park
# Photo Point Locations

| Photo Point | Location | View |
|---|---|---|
| 1 | Top of Watauga Drive Culvert | Project Start |
| 2 | Thalweg (TW) at invert of Constructed (CR)Riffle #1 | CR #1 & Vegetation Plot #1 |
| 3 | TW at CR #1 | Step Pool #1 |
| 4 | TW at invert of Cross Vane (CV) #1 | CV #1 |
| 5 | TW at CR #2 | CR#2 & XSEC #1 |
| 6 | TW at invert of CV #2 | CV #2 |
| 7 | TW at Station 13+75 | Meander Bend |
| 8 | TW at invert of CV #3 | CV#3 |
| 9 | TW at CR#3 | CR#3 |
| 10 | TW at CV #4 | CV #4 |
| 11 | TW at CV #5 | CV#5, Root Wad Cluster #1 (RWC), & XSEC #2 |
| 12 | TW at CV #6 | CV #6 |
| 13 | TW 15' upstream from CR #4 | CR #4 |
| 14 | TW 15' upstream from RWC #2 | RWC #2 |
| 15 | TW at CR #5 | CR #5 |
| 16 | TW 15' upstream from RWC #3 | RWC #3 |
| 17 | TW 15' upstream from CR #7 | CR #7 & RWC #4 |
| 18 | TW 15' upstream from CR #8 | CR #8 and pedestrian bridge |
| 19 | TW 15' upstream from CR #9 | CR #9 XSEC #3 |
| 20A | TW at Station 20+00 | Natural Riffle |
| 20B | Looking left at Station 20+00 | Step Pool #2 |
| 21A | TW at Station 21+90 | Downstream view |
| 21B | Looking right at Station 21+90 | Constructed Swale from RCP |
| 22 | TW at Station 22+80 | Downstream View |
| 23 | TW at Station 24+00 | Downstream View |
| 24 | TW at Station 25+50 | Downstream View of Bedrock knick point |
| 25 | Right Bank at Top of Knick point at Station 26+00 | RWC #4, transplants, & boulder/rip-rap toe protection |
| 26 | TW of Knick Point at Station 26+00 | RWC #5 with toe protection |
| 27 | Top of RWC #5 | RWC #6 |
| 28 | TW at CR #10 | CR #10 & Vegetation Plot #2 |
| 29A | TW at Station 28+50 looking right | Step Pool #6 |
| 29B | TW at Station 28+50 looking downstream | XSEC #4 |
| 30 | TW at Station 29+60 downstream view | Natural Riffle |

| Photo Point | Location | View |
|---|---|---|
| 31 | TW at Station 30+50 looking right | Step Pool #7 |
| 32 | TW 15' upstream from CR #11 | CR #11 & RWC #7 |
| 33 | TW 15' upstream from CR #12 | CR #12 & RWC #8 |
| 34 | TW 15' upstream from CR #13 | CR #13 & RWC #9 |
| 35 | TW 15' upstream from CR #14 | CR #14, RWC #10, & XSEC #4 |
| 36 | TW 15' upstream from CR #15 | CR #15 & RWC #11 |
| 37 | TW 15' upstream from CR #16 | CR #16, RWC #12, & XSEC #5 |
| 38 | TW 15' upstream from CR #17 | CR #17 & RWC #13 |
| 39 | TW 15' upstream from CR #18 | CR #18, RWC #14, & XSEC #6 |
| 40 | TW at Station 36+75 | Run into RWC #15 |
| 41 | TW at Station 37+55 | RWC #16 & Reach end at West Minister Drive culvert |
| 42 | Top of West Minister Drive culvert | Upstream view from end of reach |
| 43 | Type of conservation easement marker used on-site | |

PP1 Beginning of Reach

PP2 Riffle #1 Bare-root and Live-stakes Plot #1

PP3 Step Pool #1

PP4 Cross Vane #1

PP5 Riffle #2 and Cross Section #1

PP6 Cross Vane #2

PP7 Meander Bend

PP8 Cross Vane #3

PP9 Riffle #3

PP10 Cross Vane #4

PP11 Cross Vane #5, Root Wad Cluster #1 and Cross Section #2

PP12 Cross Vane #6

PP13 Riffle #4

PP14 Root Wad Cluster #2

P15 Riffle #5

PP16 Riffle #6 Root Wad Cluster #3

PP17 Riffle #7 and Root Wad Cluster #4

PP18 Riffle #8 and Pedestrian Footbridge

PP19 Riffle #9 & Cross Section 3

PP20A Natural Riffle

PP20B Swale into Step Pool #2

PP21A Downstream View

PP21B Swale from RCP on Right Bank

PP22 Run and Riffle

PP23 Run

PP24 Run into Bedrock Knick point with 3 ft drop. Step Pool #5 on Right Bank

PP 25 Knick point with 90 degree bend with Root Wad Cluster #4, Transplants, and toe protection

PP26 Root Wad Cluster #5 with toe protection

PP27 Root Wad Cluster #6

PP#28 Riffle #10, Cross Section #3 and Bare Root Plot #2

PP#29B Step Pool #6

PP#29A Downstream View Meander Bend with Transplant and Cross Section #4

PP#30 Riffle

PP#31 Swale into Step Pool #7

PP#32 Riffle #11 and Root Wad Cluster #7

PP#33 Riffle #12 and Root Wad Cluster #8

PP#34 Riffle #13 and Root Wad Cluster #9

PP#35 Riffle #14, Root Wad Cluster #10, and Cross Section #4

PP#36 Riffle #15 and Root Wad Cluster #11

PP#37 Riffle #16, Root Wad Cluster #12, and Cross Section #5

PP#38 Riffle #17 and Root Wad Cluster #13

PP#39 Riffle #18, Root Wad Cluster #14, and Cross Section #6

PP#40 Run into Root Wad Cluster #15

PP#41 Root Wad Cluster #16 into Culvert at Reach End

PP#42 Upstream view from end of project

Conservation Easement Marker

# Buffalo Creek Watershed Phase II
# Brown Bark Park
# Vegetation Survival Plots

## Bare-Root Plantings

| Reach 1 | Photo Point (#) | Planted (stems) | Year 1 (stems) | Year 2 (stems) | Year 3 (stems) | Year 4 (stems) | Year 5 (stems) |
|---|---|---|---|---|---|---|---|
| Plot #1 | 2 | 30 | | | | | |
| Plot #2 | 28 | 49 | | | | | |

## Live Stakes

| Reach 1 | Photo Point (#) | Planted (stakes) | Year 1 (stakes) | Year 2 (stakes) | Year 3 (stakes) | Year 4 (stakes) | Year 5 (stakes) |
|---|---|---|---|---|---|---|---|
| Plot #1 | 2 | 100 | | | | | |

Note: Live stakes counted from eastern end of plot down to Station 12+50

**Notes:**

1. All plots are shown on the plan views. All plot corners are marked with a wooden stake and orange flagging tape.
2. Each counted stem or live stake is marked with pink flagging tape.
3. Photo point locations are shown on the plan views.
4. Bare root plots are 25x100 feet.
4. Use successive columns for survivability from year to year.

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 7 |

PROJECT ENGINEER

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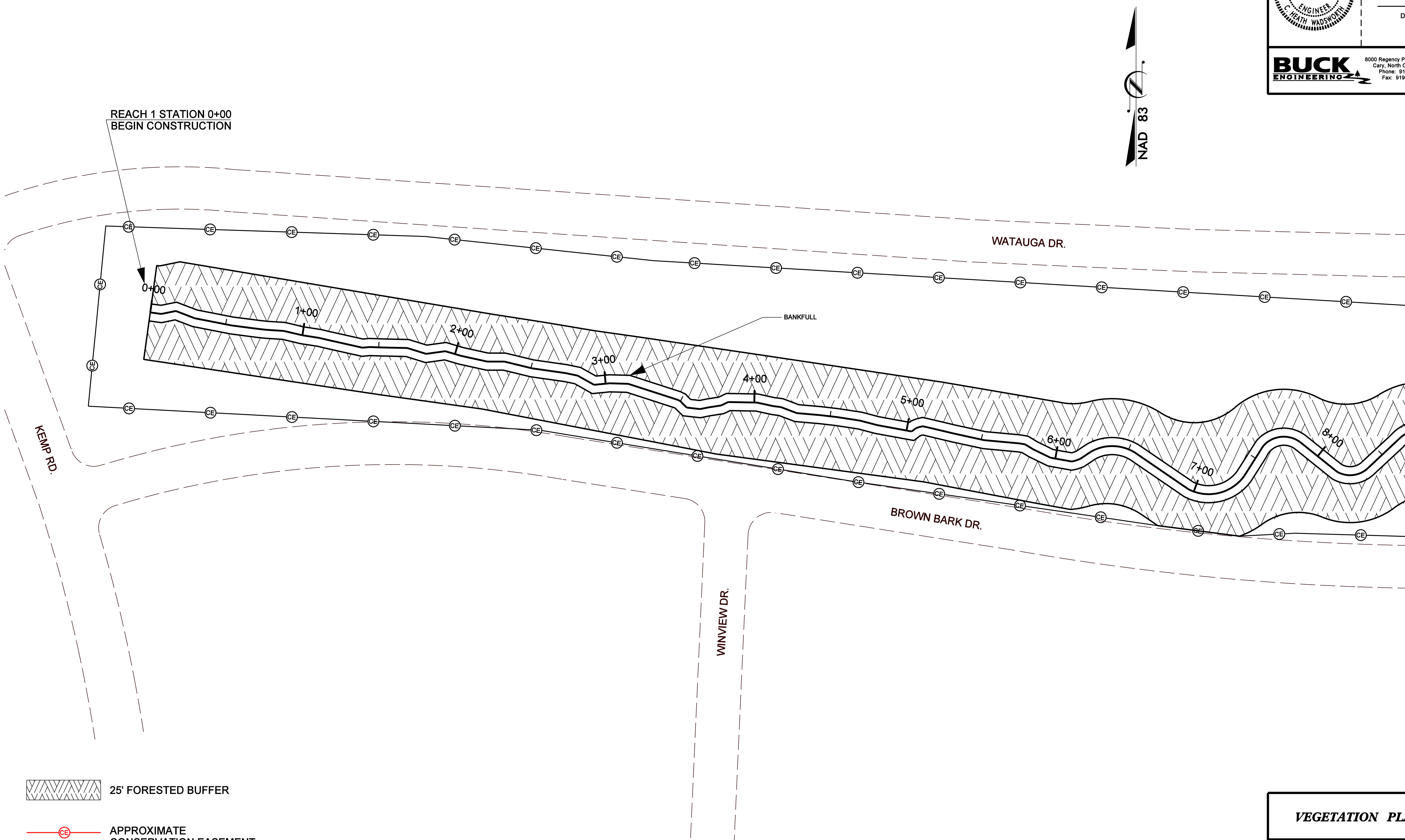


25' FORESTED BUFFER

APPROXIMATE CONSERVATION EASEMENT BOUNDARY

SEE SHEET 1-C FOR PLANTING SPECIFICATIONS

## VEGETATION PLAN

30 15 0 30 60
SCALE (FT)

PROJECT REFERENCE NO. 000532601 | SHEET NO. 8

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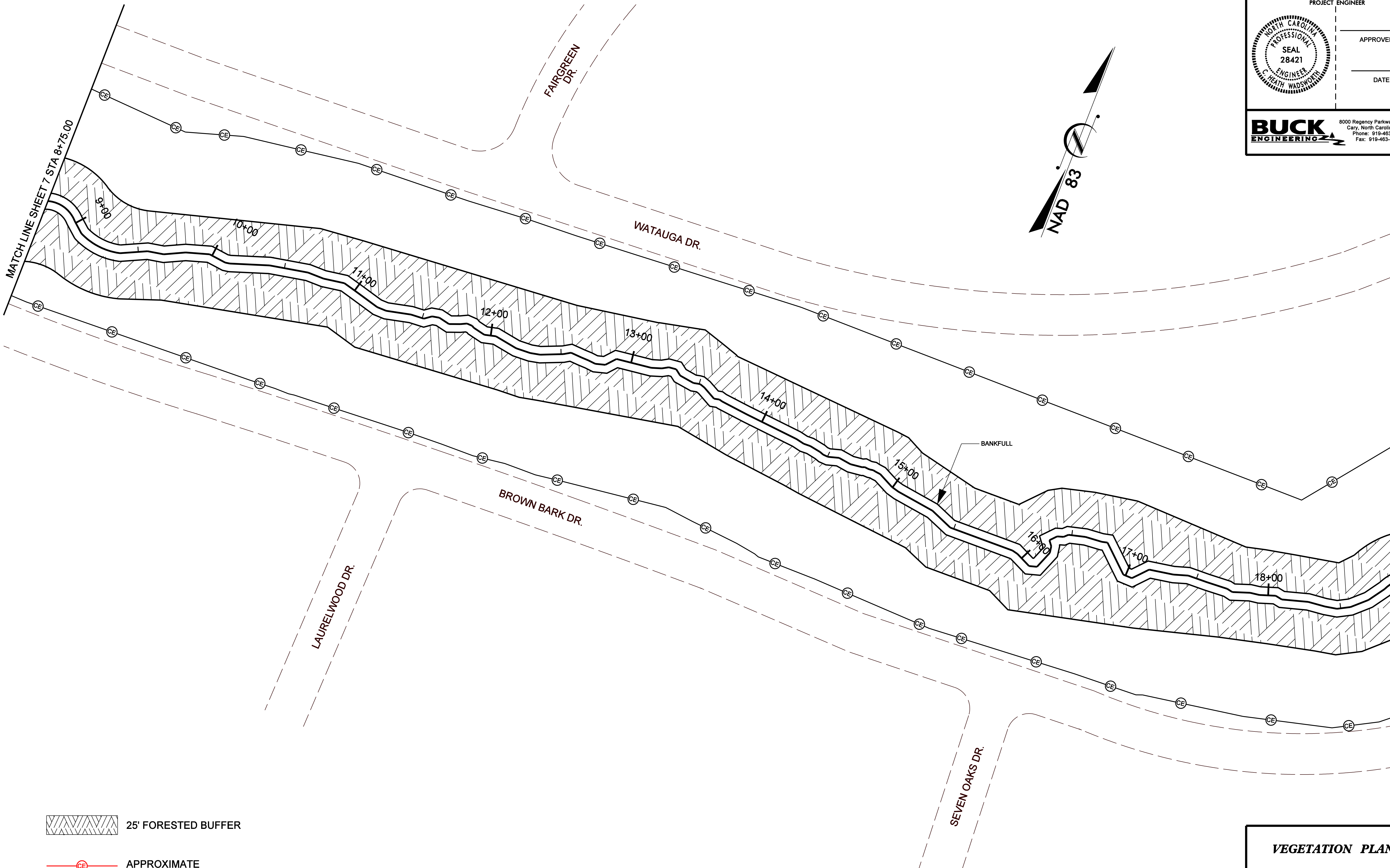


25' FORESTED BUFFER

APPROXIMATE CONSERVATION EASEMENT BOUNDARY

SEE SHEET 1-C FOR PLANTING SPECIFICATIONS

## VEGETATION PLAN

SCALE (FT): 30 15 0 30 60

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 9 |

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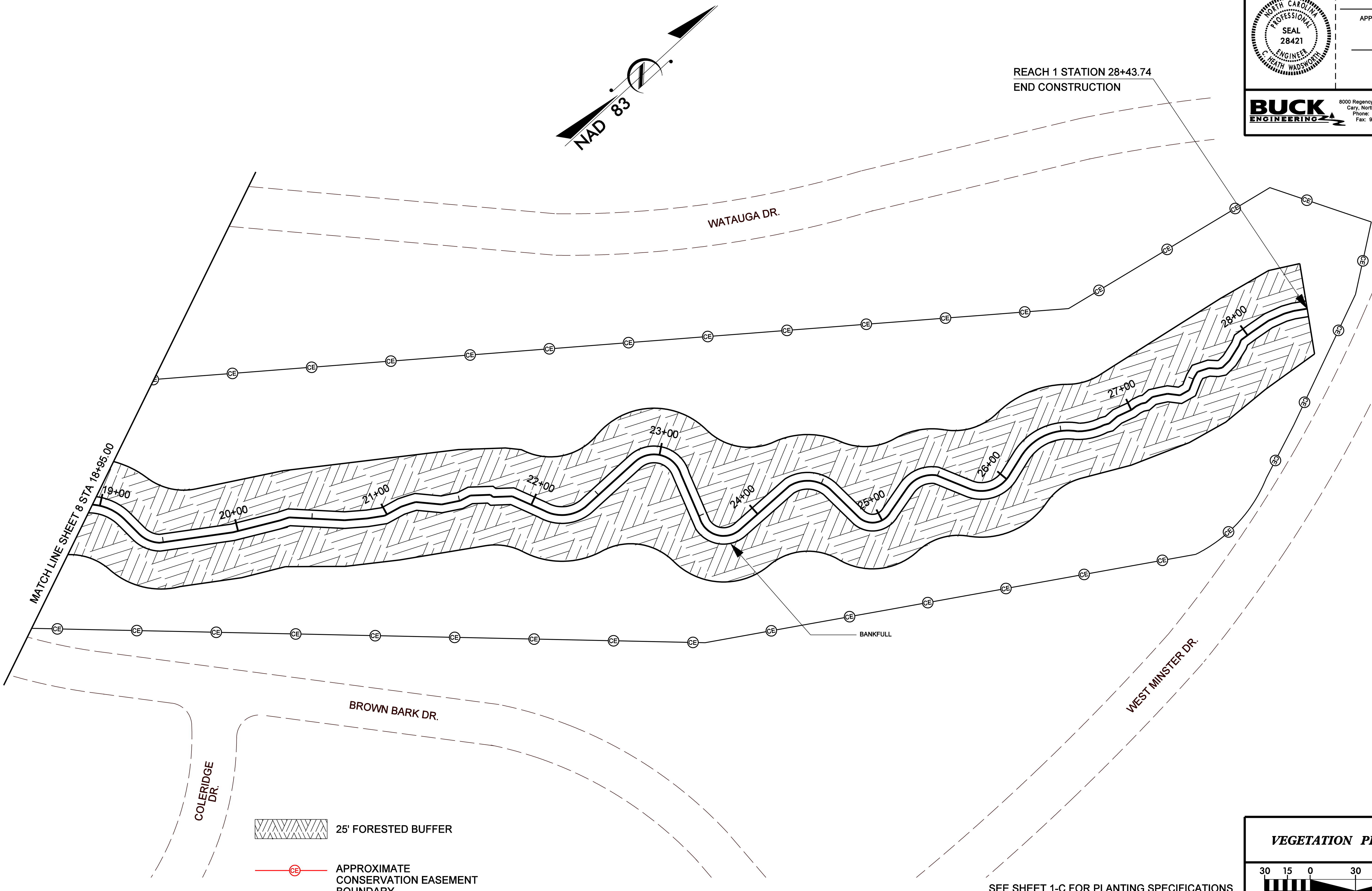


SEE SHEET 1-C FOR PLANTING SPECIFICATIONS

*VEGETATION PLAN*

30 15 0 30 60
SCALE (FT)

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 4 |

PROJECT ENGINEER

**AS-BUILT PLAN VIEW**


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FILL IN EXISTING CHANNEL

***PLAN VIEW***

SCALE (FT): 30 15 0 30 60

| PROJECT REFERENCE NO. | SHEET NO. |
|---|---|
| 000532601 | 5 |

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# AS-BUILT PLAN VIEW

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FILL IN EXISTING CHANNEL

## PLAN VIEW

SCALE (FT): 30 15 0 30 60

| PROJECT REFERENCE NO. | SHEET NO. |
| --- | --- |
| 000532601 | 6 |

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**AS-BUILT PLAN VIEW**

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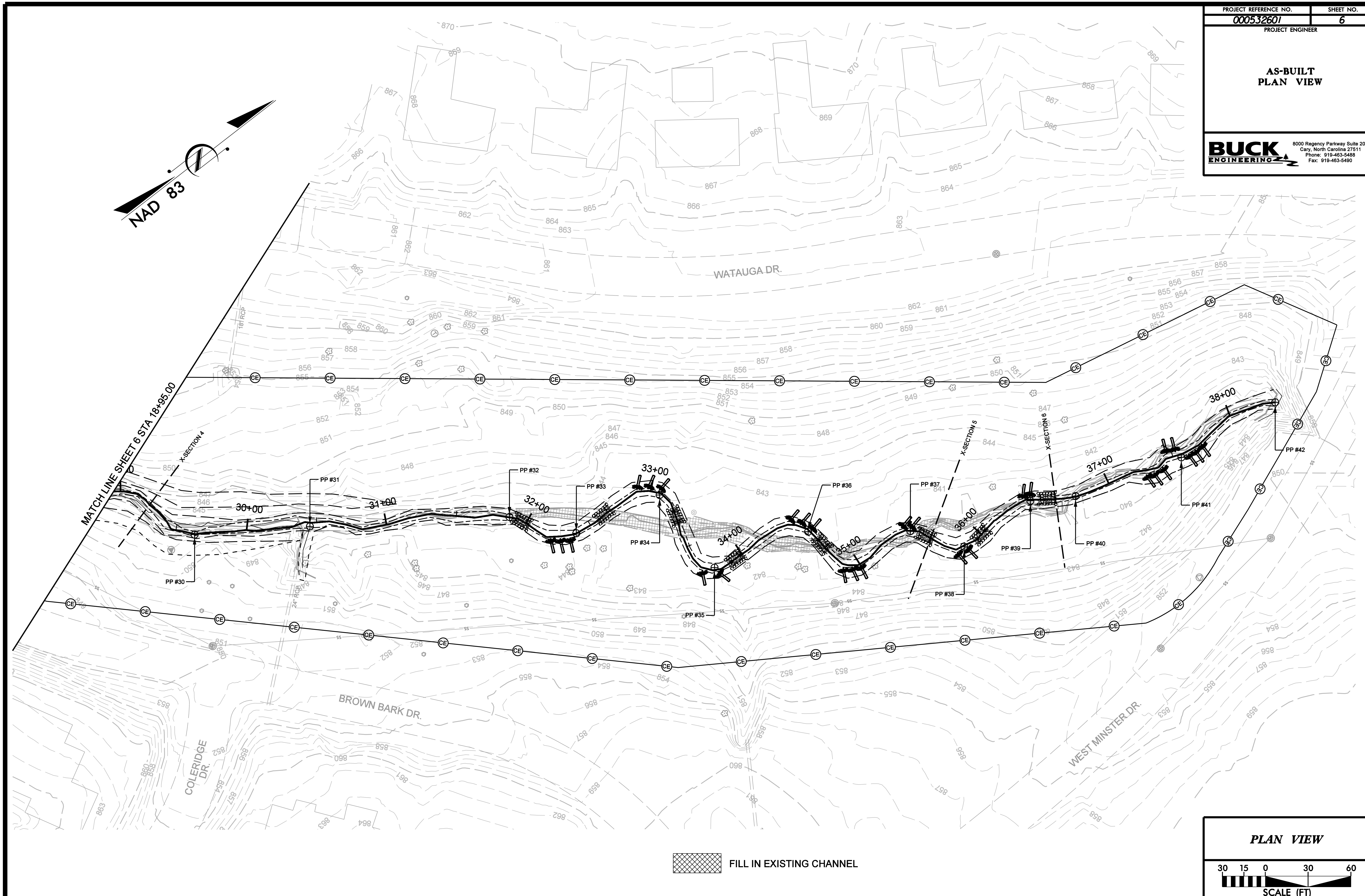


*PLAN VIEW*

30 15 0 30 60
SCALE (FT)