FINAL
Stream Mitigation Plan
Brown Creek Tributaries Restoration Project

Anson County, North Carolina

NCEEP Project ID No. 95351

Yadkin River Basin: 03040104-061030

USACE Action ID No: SAW-2012-01108

Prepared for:

NC Department of Environment and Natural Resources
Ecosystem Enhancement Program (NCEEP)
1652 Mail Service Center
Raleigh, North Carolina 27699-1652

June 2014

This document was printed using 100% recycled paper.

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

December 17, 2014

Regulatory Division

Re: NCIRT Review and USACE Approval of the UT to Town Creek Stream and Wetland Mitigation Plan; SAW-2013-01280; NCEEP Project # 94648

Mr. Tim Baumgartner
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Dear Mr. Baumgartner:

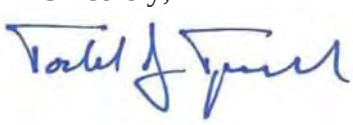
The purpose of this letter is to provide the North Carolina Ecosystem Enhancement Program (NCEEP) with all comments generated by the North Carolina Interagency Review Team (NCIRT) during the 30-day comment period for the UT to Town Creek Stream and Wetland Mitigation Plan, which closed on October 31, 2014. These comments are attached for your review.

Based on our review of these comments, we have determined that no major concerns have been identified with the Draft Mitigation Plan, which is considered approved with this correspondence. However, several minor issues were identified, as described in the attached comment memo, which must be addressed in the Final Mitigation Plan.

The Final Mitigation Plan is to be submitted with the Preconstruction Notification (PCN) Application for Nationwide permit approval of the project along with a copy of this letter. Issues identified above must be addressed in the Final Mitigation Plan. All changes made to the Final Mitigation Plan should be summarized in an errata sheet included at the beginning of the document. If it is determined that the project does not require a Department of the Army permit, you must still provide a copy of the Final Mitigation Plan, along with a copy of this letter, to the appropriate USACE field office at least 30 days in advance of beginning construction of the project. Please note that this approval does not preclude the inclusion of permit conditions in the permit authorization for the project, particularly if issues mentioned above are not satisfactorily addressed. Additionally, this letter provides initial approval for the Mitigation Plan, but this does not guarantee that the project will generate the requested amount of mitigation credit. As you are aware, unforeseen issues may arise during construction or monitoring of the project that may require maintenance or reconstruction that may lead to reduced credit.

Thank you for your prompt attention to this matter, and if you have any questions regarding this letter, the mitigation plan review process, or the requirements of the Mitigation Rule, please call me at 919-846-2564.

Sincerely,



TUGWELL.TODD.JASON.1048429293
2014.12.17 12:37:53 -05'00'

Todd Tugwell
Special Projects Manager

Enclosures

Electronic Copies Furnished:

NCIRT Distribution List
CESAW-RG-R/Elliott

DEPARTMENT OF THE ARMY
WILMINGTON DISTRICT, CORPS OF ENGINEERS
69 DARLINGTON AVENUE
WILMINGTON, NORTH CAROLINA 28403-1343

REPLY TO
ATTENTION OF:

CESAW-RG/Tugwell December 2, 2014

MEMORANDUM FOR RECORD

SUBJECT: UT to Town Creek - NCIRT Comments During 30-day Mitigation Plan Review

PURPOSE: The comments listed below were posted to the NCEEP Mitigation Plan Review Portal during the 30-day comment period in accordance with Section 332.8(g) of the 2008 Mitigation Rule.

NCEEP Project Name: UT to Town Creek Stream and Wetland Restoration Project, Stanly County, NC

USACE AID#: SAW-2013-01280
NCEEP #: 94648

30-Day Comment Deadline: 31 October, 2014

Todd Bowers, USEPA, 17 Oct, 2014:

1. The applicant has omitted the Credit Release Schedule for wetland and stream credit units.
2. Recommend a 7-year monitoring period for vegetation in those areas where forest wetlands (headwater or bottomland hardwoods) are being established. This is per guidance dated October 10, 2008 titled Revised Credit Release Schedule for Forested Wetlands and in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources.
3. While I agree completely with the amount of extra credit generated by the extra buffer widths along Reaches 1-3, I would like some clarity on how the extra width was calculated. Was it from perpendicular lines from valley centerline, top of bank, or stream beltwidth. I recommend the use of beltwidth for sinuous streams such as this to determine buffer width averages.
4. Recommend a figure or map showing the areas where upland, riparian, and forested wetland plantings will occur. Vegetation plots established for monitoring should adequately cover each of these different vegetation communities.
5. Page 3-8: Error in footnotes for Reach 2 in Table 3.4. Need to add footnotes 3 and 4 where appropriate.

6. Page 7-23: Existing conditions state that "wetlands are extremely impaired" yet they scored High to Medium per the NCWAM evaluations. Can the applicant please provide clarity in this situation?
7. Page 7-30 and 31: Stream buffer vegetation refers to Table 7.6. This should be corrected to Table 7.7.
8. Page 7-32: Table 7.7 in Constructed Wetlands the latin name for sweetflag is shown as Nyssa sylvatica. This should be corrected to Acorus calumus.

Travis Wilson, NCWRC, 30 October, 2014:

1. While WRC agrees with the incorporation of the two wetland BMPs into the plan, the design as shown as well as the steep topography on reach 7 give concern that these will function more like traditional storm water retention basins and likely require routine maintenance. The design and location of these BMPs should be such that little to no maintenance is required.

Ginny Baker, NCDWR, 31 October, 2014:

1. Notate on Figure 6 that area upstream of Reach 4, 5, and 7 is non-credited preservation as noted on pg 7-5 in Notes section.
2. Wetland indicator status listed on pages 7-31 and 7-32 should be updated to current National Wetland Plant List for the EMP region for 2014 which does not have "+" and "-" designations. Please correct the following: Liriodendron tulipifera to FACU, Quercus phellos to FAC, Alnus serrulata to OBL, Sambucus Canadensis to Sambucus nigra FAC, Nyssa sylvatica to FAC, Hibiscus moscheutos to FACW, Elymus virginicus to FACW, Tripsacum dactyloides to FACW, Coreopsis lanceolata to FACU, Dichanthelium clandestinum to FAC. http://rsgisias.crrel.usace.army.mil/nwpl_static/viewer.html#
3. DWR will require in our permit conditions that a monitoring gage be placed at the head of and lower end near the confluence for all intermittent streams that are to be restored with Priority 1 techniques that will raise the stream bed and potentially reduce base flow. Reach 7.
4. A vegetation monitoring plot should be added (or moved into) the enhancement area.
5. DWR recommends using burlap, or more natural light weight core fiber material that would degrade quicker rather than geo-tech fabric for soil lifts and grade control/cross vanes etc.
6. DWR recommends leaving some of the stumpage on site rather than complete removal during grading process to promote regrowth.
7. DWR recommends the use of "screenings" from rock quarry for use in riffle pools and backfilling cross vanes, etc. This material fills the gap between #57 stone and sand/soil mediums.

Todd Tugwell, USACE, 2 December, 2014:

1. The mitigation plan indicates 5 years of monitoring for both streams and wetlands, however we have moved to 7 years of monitoring for both per the NCEEP guidance from 2011, and earlier for forested wetlands. Please updated the plan to meet current

monitoring timeframes or provide justification as to why only 5 years of monitoring is proposed.

2. The plan indicates that areas proposed for wetland creation will have to be graded to expose buried hydric soils, however it is not clear how much grading is required, only that it may be more than 12 inches. Please note that extensive grading to create wetlands can result in soils that are compacted and have low vegetation growth, which is one of the reasons for the lower ratio for wetland creation.
3. Table 7.5 appears to be incorrectly referenced in the discussion on page 7-24 as table 7.4. This table shows current hydroperiods generally above 20% on the restoration areas on site, yet the proposed performance standard is only 9%. Please consider a higher performance standard for restoration areas, supported by the reference condition and existing conditions on the site.
4. Buffer widths on the site are proposed to be wider than the standard 50 feet, and additional credit is requested based on draft guidance put out for public notice by the District in 2010. We have agreed to increased credit for wider buffers in certain situations; however several requirements have generally applied to this. To begin with, additional credits should not be provided in areas where the wider buffers are also generating wetland credit, which appears to be the case on parts of this site. Additionally, based on comments received from the public notice, we have revised the draft tables associated with wider buffers, which can be supplied to the provider upon request. The modified tables do not provide for extra credit until the buffer is a minimum of 75' in width (in piedmont and coastal counties), additionally the percent increase in credit is greater than in the draft guidance used by the providers. Also, the calculations provided in Figure 8 are not sufficient to determine how the increases were determined (e.g., how average floodplain widths were determined). Finally, there are some segments within these reaches that appear to be at or below 50 feet in width that were averaged into the segment and now are receiving additional credit. (see stations 22+00 to 23+00, and 36+30). If additional credits will be requested for wider buffers, please coordinate with the District to determine the requirements for this.
5. We do not object to increased stream credit from the construction of BMPs on two of the tributaries; however, it is not clear if these BMPs will result in the loss of existing jurisdictional stream, or whether a channel will be maintained through the BMP. How are these structures proposed to benefit the project, and how was it determined how many credits should result from the addition of these structures?

TUGWELL.TODD.JASON.1048429293
2014.12.02 13:41:05 -05'00'

Todd Tugwell
Special Projects Manager
Regulatory Division

Michael Baker
INTERNATIONAL

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Dr., Ste. 320 | Charlotte, North Carolina 28217
Office: 704.665.2200 | Fax: 704.665.2201

December 23, 2014

Lin Xu, Permit Coordinator and Harry Tsomides, Project Manager
NC Department of Environment and Natural Resources
Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Subject: Task 3: Response Letter to NCIRT 30-day review comments for the UT to Town Creek Restoration Site – Option A, Stanly County
Yadkin Cataloging Unit 03040105
NCEEP Project ID No. 94648; NCDENR Contract No.# 003277
USACE Action ID No.: SAW-2013-01280
Baker Project No.: 120857

Dear Mr. Xu and Mr. Tsomides:

Please find enclosed the Final Mitigation Plan and our responses to the NCIRT review comments dated December 2, 2014 regarding the UT to Town Creek Restoration Site – Option A Project, located in Stanly County, NC. We have revised Final Draft Mitigation Plan documents in response to the referenced review comments and USACE mitigation plan approval letter dated December 17, 2014. Each comment/response has been grouped per the NCIRT reviewer and is outlined below.

Todd Bowers, USEPA, 17 Oct, 2014:

1. The applicant has omitted the Credit Release Schedule for wetland and stream credit units.

   Response: Though the Credit Release Schedule was not required as an inclusionary item for the previous NCEEP Mitigation Plan Document, Version 1.0 (2010a) which was outlined in the RFP #16-00283, we understand this is a requirement of the recent Mitigation Plan Templates. Therefore, we have revised the Mitigation Plan to include the Credit Release Schedule (Section 2). It is located in Table 2.1 on page 2-2.

2. Recommend a 7-year monitoring period for vegetation in those areas where forest wetlands (headwater or bottomland hardwoods) are being established. This is per guidance dated October 10, 2008 titled Revised Credit Release Schedule for Forested Wetlands and in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources.

   Response: *This project was included under the May 13, 2013 letter from NCEEP to the NCIRT in entitled "EEP sites-seven year monitoring". As described in that letter, the described projects were not contracted for seven years of monitoring under the relevant RFPs. Based on that letter, Baker plans to conduct post-restoration monitoring for wetland related mitigation work for five years as contracted. However, as stated in the*

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Dr., Ste. 320 | Charlotte, North Carolina 28217
Office: 704.665.2200 | Fax: 704.665.2201

May 13, 2013 letter from NCEEP to the NCIRT, "In the fourth year of monitoring, EEP will decide if the specific site may qualify for close out after five successful monitoring years. For those, EEP will submit to the IRT for early closure. For any site that EEP does not think meet early closeout criteria, EEP will contract out to complete the final two years" of monitoring (NCEEP, 2013). A copy of the letter has been included in Appendix K for reference and clarification for the monitoring period rationale has been included in Sections 2.2, 9.3, 10.0 and 10.3 of the Mitigation Plan.

3. While I agree completely with the amount of extra credit generated by the extra buffer widths along Reaches 1-3, I would like some clarity on how the extra width was calculated. Was it from perpendicular lines from valley centerline, top of bank, or stream beltwidth. I recommend the use of beltwidth for sinuous streams such as this to determine buffer width averages.

Response: *Average additional buffer widths were calculated from the top of bank to the easement boundary along the proposed restoration alignment at fifty foot intervals.*

4. Recommend a figure or map showing the areas where upland, riparian, and forested wetland plantings will occur. Vegetation plots established for monitoring should adequately cover each of these different vegetation communities.

Response: *Riparian, upland, wetland planting areas have been added to Figure 7 – Proposed Monitoring Device Locations and are also depicted in sheets 24 – 27 of the plan set. Vegetation plot locations have been strategically placed to include an adequate mix of the vegetative communities. See Figure 7 for reference.*

5. Page 3-8: Error in footnotes for Reach 2 in Table 3.4. Need to add footnotes 3 and 4 where appropriate.

Response: *References to footnotes have been revised to reflect the appropriate citation for Reach 2. Upon review of the footnote references within this table it was noted that Reach 4, 5, 6, and 7 also had citation errors. These errors have also been corrected. Please note that due to plan revisions this table is now referred to as Table 4.4 and is located on pages 4-8 and 4-9.*

6. Page 7-23: Existing conditions state that "wetlands are extremely impaired" yet they scored High to Medium per the NCWAM evaluations. Can the applicant please provide clarity in this situation?

Response: *Overall wetland ratings ranged from Low to High, with Wetlands 3 and 5 receiving a Low rating, Wetlands 2, 4, 6, and 7 receiving a Medium rating, and only Wetland 1 receiving a High rating. Within the project area, the extent of the impairments to each wetland varies. The ratings/conditions relate to the cattle's propensity to use the wetland area in question as a wallowing area and/or evidence that the wetland has been historically ditched. Consequently Wetland 1 was able to achieve a High rating because it is located where cattle do not have access and does not have evidence of ditching. Impairments to Wetland 1 are predominantly caused by frequent bush-hogging and rutting from heavy equipment access.*

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Dr., Ste. 320 | Charlotte, North Carolina 28217
Office: 704.665.2200 | Fax: 704.665.2201

7. Page 7-30 and 31: Stream buffer vegetation refers to Table 7.6. This should be corrected to Table 7.7.

   Response: *References to the buffer vegetation table have been revised; however, due to plan revisions this table is now referred to as Table 8.7 and is located on pages 8-31 through 8-32.*

8. Page 7-32: Table 7.7 in Constructed Wetlands the latin name for sweetflag is shown as Nyssa sylvatica. This should be corrected to Acorus calumus.

   Response: *The latin name for sweetflag has been corrected to Acornus calamus; however, due to plan revisions this table is now referred to as Table 8.7 and sweetflag is referenced on page 8-32.*

Travis Wilson, NCWRC, 30 October, 2014:

9. While WRC agrees with the incorporation of the two wetland BMPs into the plan, the design as shown as well as the steep topography on reach 7 give concern that these will function more like traditional storm water retention basins and likely require routine maintenance. The design and location of these BMPs should be such that little to no maintenance is required.

   Response: *Baker understands that routine maintenance for water quality features can be a concern; therefore, both constructed wetlands have been designed and located to minimize long term maintenance needs by:*

   1. *Extending the conservation easement and buffer plantings approximately 30 feet beyond the footprint of each BMP to allow the buffer vegetation to act as pre-treatment feature for both suspended sediment and nutrient loads,*
   2. *Implementing permanent fencing outside the easement to ensure permanent livestock exclusion, and*
   3. *Providing a stable outlet mechanism/spillway for the BMPs to draw down so as to maintain downstream stream functions while maintaining a storage capacity only to support the permanent pool.*

   In addition, Baker will be providing post-construction monitoring and maintenance, as needed, during the monitoring years thereby facilitating the wetland vegetation to become established and functioning as intended prior to project closeout.

Ginny Baker, NCDWR, 31 October, 2014:

1. Notate on Figure 6 that area upstream of Reach 4, 5, and 7 is non-credited preservation as noted on pg 7-5 in Notes section.

   Response: *As requested, a notation has been added to Figure 6 to stipulate that the areas upstream of the proposed design on Reaches 4, 5, and 7, will include enhancement plantings and be included as part of the conservation easement and permanently fenced, but are not being sought for mitigation credit.*

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Dr., Ste. 320 | Charlotte, North Carolina 28217
Office: 704.665.2200 | Fax: 704.665.2201

2. Wetland indicator status listed on pages 7-31 and 7-32 should be updated to current National Wetland Plant List for the EMP region for 2014 which does not have "+" and "-" designations. Please correct the following: Liriodendron tulipifera to FACU, Quercus phellos to FAC, Alnus serrulata to OBL, Sambucus Canadensis to Sambucus nigra FAC, Nyssa sylvatica to FAC, Hibiscus moscheutos to FACW, Elymus virginicus to FACW, Tripsacum dactyloides to FACW, Coreopsis lanceolata to FACU, Dichanthelium clandestinum to FAC. http://rsgisias.crrel.usace.army.mil/nwp1_static/viewer.html#

   Response: *The Proposed Vegetation Plantings Table has been updated to reflect the current National Wetland Plant List for the Eastern Mountains and Piedmont 2014 Regional Wetland Plant List. Please note that due to plan revisions this table is now referred to as Table 8.7 and is located on pages 8-31 through 8-32.*

3. DWR will require in our permit conditions that a monitoring gage be placed at the head of and lower end near the confluence for all intermittent streams that are to be restored with Priority 1 techniques that will raise the stream bed and potentially reduce base flow. Reach 7.

   Response: *Baker will install a groundwater monitoring well, within the thalweg (bottom) of the downstream portion of the restored intermittent reaches (Reach 6 and 7). In addition, a monitoring gage (pressure transducer) will be installed towards the downstream portion of each restored intermittent reach to document base flow. The devices will be inspected on a quarterly/semi-annual basis to document surface hydrology and provide a basis for evaluating general flow response to rainfall events and surface runoff during various water tables levels throughout the monitoring period. See Figure 7 for the approximate location of the additional devices. References to the implementation of these devices has also been included in Section 10.1.1 on page 10-2.*

4. A vegetation monitoring plot should be added (or moved into) the enhancement area.

   Response: *A vegetation monitoring plot has been relocated to the wetland enhancement area of Wetland 3 as suggested. See Figure 7.*

5. DWR recommends using burlap, or more natural light weight core fiber material that would degrade quicker rather than geo-tech fabric for soil lifts and grade control/cross vanes etc.

   Response: *Baker acknowledges this recommendation and will work with the construction contractor to investigate the feasibility of incorporating this application. It has been our experience that non-woven geotextile fabric is more appropriate and effective at capturing finer material which helps seal/maintain structure integrity longer than burlap/coir fiber material.*

6. DWR recommends leaving some of the stumpage on site rather than complete removal during grading process to promote regrowth.

Michael Baker
INTERNATIONAL

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Dr., Ste. 320 | Charlotte, North Carolina 28217
Office: 704.665.2200 | Fax: 704.665.2201

Response: *Baker acknowledges this recommendation and will work with the contractor to incorporate this suggestion when feasible during the construction process.*

7. DWR recommends the use of "screenings" from rock quarry for use in riffle pools and backfilling cross vanes, etc. This material fills the gap between #57 stone and sand/soil mediums.

   Response: *Baker intends to use suitable on-site stream bed material consisting of fine to medium gravels to back fill and/or top dress riffles and stream structures.*

Todd Tuqwell, USA CE, 2 December, 2014:

1. The mitigation plan indicates 5 years of monitoring for both streams and wetlands, however we have moved to 7 years of monitoring for both per the NCEEP guidance from 2011, and earlier for forested wetlands. Please update the plan to meet current.

   Response: *Please see comment response to question 2 under the heading of "Todd Bowers, USEPA, 17 Oct, 2014".*

This letter serves as the formal response to NCIRT comments and shall be submitted in conjunction with the Preconstruction Notification (PCN) for Nationwide Permit (NWP) 27 application approval.

If you have any questions concerning the Final Mitigation Plan, please contact me at 704-665-2206 or via email at ksuggs@mbakerintl.com. With this submittal, we have included six (6) hard copies of the Final Mitigation Plan with NCIRT comments, four (4) copies of the completed PCN, and three (3) CDs with electronic copies of the documents. We look forward to the NWP 27 authorization.

Sincerely,

Kristi Suggs, Project Manager
Michael Baker Engineering, Inc.

Enclosures: Final Mitigation Plan Documents, 401/404 PCN permit application for UT to Town Creek Restoration Site – Option A Project.

FINAL
Stream Mitigation Plan
Brown Creek Tributaries Restoration Project

Anson County, North Carolina

NCEEP Project ID No. 95351

Yadkin River Basin: 03040104-061030

USACE Action ID No: SAW-2012-01108

Prepared for:

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

Prepared by:

Baker

Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490

June 2014

EXECUTIVE SUMMARY

Michael Baker Engineering, Inc. (Baker) proposes to restore 8,201 linear feet (LF) of perennial stream, enhance 2,500 LF of stream, and preserve 511 LF of stream along Hurricane Creek (HC) and four unnamed tributaries (UTs) to Brown Creek, a 303(d) listed stream that flows through the Pee Dee National Wildlife Refuge. The Brown Creek Tributaries Restoration Project (project) site is located in Anson County, North Carolina (NC) (Figure 2.1), approximately four miles southeast of the Town of Ansonville. The project is located in the NC Division of Water Resources (NCDWR) subbasin 03-07-10 and the NC Ecosystem Enhancement Program (NCEEP) Targeted Local Watershed (TLW) 03040104-061030 of the Yadkin River Basin. The purpose of the project is to restore and/or enhance stream and riparian buffer functions along impaired stream channels that flow through the site. A proposed conservation easement consisting of 43 acres (Figure 3.1) will protect all stream reaches and riparian buffers in perpetuity. Examination of the available hydrology and soil data indicate the project will potentially provide numerous water resources and ecological benefits within the Brown Creek watershed and the Yadkin River Basin.

Based on the NCEEP 2009 Lower Yadkin-Pee Dee River Basin Restoration Priority (RBRP) Plan, the Brown Creek Tributaries Restoration Project area is located in an existing targeted local watershed (TLW) within the Yadkin River Basin (http://portal.ncdenr.org/web/eep/rbrps/yadkin), although it is not located in a Local Watershed Planning (LWP) area. The TLW selection criteria for the Yadkin-Pee Dee River Basin targets specific projects that will address water Resources impacts from nonpoint source pollution. The restoration goals for the Yadkin-Pee Dee River Basin targets specific projects which focus on restoring stream functions by maintain and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat.

The primary goals of the project are to improve ecologic functions to the impaired areas as described in the NCEEP 2009 RBRP and are identified below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters,
- Protect and improve water resources by reducing bank erosion, nutrient and sediment inputs,
- Restore stream and floodplain interaction by connecting historic flow paths and promoting natural flood processes, and
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives have been identified:

- Restore existing incised, eroding, and channelized streams by providing access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated bank erosion,
- Plant native species riparian buffer vegetation along stream bank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, addition of woody debris, and reduction of water temperature, and

- Control invasive species vegetation within the project area and, if necessary, continue treatments during the monitoring period.

Table ES.1 Brown Creek Tributaries Restoration Project Overview (Streams)

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Reach	Design Approach	Existing Reach Length (LF)	Design Reach Length (LF)	SMU Credit Ratio	Potential SMUs	Stationing	Comment
Unnamed Tributaries to Brown Creek (Hurricane Creek and UT4 Reaches)							
HC-R1	R	1,896	2,035	1:1	2,035	10+00 to 30+35	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed. Permanent cattle exclusion fencing will be installed around the easement.
HC-R2	R	1,288	1,366	1:1	1,366	30+65 to 44+31	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed until transitioning the new stream back into the existing channel towards the lower section of the reach.
HC-R3	E II	579	579	2.5:1	232	10+00 to 15+79	Enhancement Level II is proposed for the reach. Work will include minor bank sloping and stabilization, limited use of in-stream structures to promote channel stability and bedform diversity, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
UT4-R1a (upstream section)	P	511	511	5:1	102	10+00 to 15+11	Preservation is proposed for the upper portion of the reach up to the existing powerline easement. No work will be performed along this reach and the stream will be protected within a permanent conservation easement.
UT4-R1b (downstream section)	R	906	849	1:1	849	16+31 to 24+80	Restoration will follow a Rosgen Priority Level I and II approach. Work will include bank sloping and stabilization, installation of in-stream structures, grading a bankfull bench to provide floodplain connection, and planting native vegetation.
UT4-R2	R	1,673	1,857	1:1	1,827	24+80 to 43+37	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed.

UT4-R3	R	244	227	1:1	227	28+97 to 31+24	Restoration will follow a Rosgen Priority Level I and II approach. Work will include bank sloping and stabilization, installation of in-stream structures, grading a bankfull bench to provide floodplain connection, and planting native vegetation.
UT4-R4a (upstream section)	R	395	395	1:1	395	10+00 to 13+95	Restoration will follow a Rosgen Priority Level I approach. Work will include bank sloping and stabilization, installation of in-stream structures, raising the bed elevation to provide floodplain connection, and planting native vegetation.
UT4-R4b (downstream section)	R	1,392	1,472	1:1	1,452	14+25 to 28+97	Restoration will follow a Rosgen Priority Level I approach. A new single thread meandering channel will be constructed off-line across the abandoned floodplain. The remnant stream channel will be partially to completely filled and spoil piles removed.
UT4-R5a	E I	386	386	1.5:1	257	10+00 to 13+86	Enhancement Level I is proposed for the reach. Work will include bank sloping and stabilization, limited use of in-stream structures to promote channel stability and bedform diversity, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
UT4-R5b	E I	1,535	1,535	1.5:1	1,024	15+00 to 30+35	Enhancement Level I is proposed for the reach. Work will include bank sloping and stabilization, limited use of in-stream structures to promote channel stability and bedform diversity, vegetation planting in disturbed riparian buffer areas, and permanent cattle exclusion fencing around the easement.
Total		**10,805**	**11,212**	**-**	**9,766**		

The proposed project aligns with overall NCEEP goals, which focus on restoring streams and riparian area values such as maintaining and enhancing water quality, restoring hydrology, and improving fish and wildlife habitat. The proposed natural channel design (NCD) approach will result in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Brown Creek sub-watershed, while improving water quality conditions that support terrestrial and aquatic species, including priority species identified in the Yadkin-Pee Dee River Basin.

This mitigation plan has been written in conformance with the requirements of the following:

- Federal rule for compensatory mitigation project sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8, paragraphs (c)(2) through (c)(14).
- NCDENR Ecosystem Enhancement Program In-Lieu Fee Instrument signed and dated July 28, 2010.

These documents govern NCEEP operations and procedures for the delivery of compensatory mitigation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 RESTORATION PROJECT GOALS AND OBJECTIVES

The North Carolina Ecosystem Enhancement Program (NCEEP) develops River Basin Restoration Priorities (RBRPs) to guide its mitigation activities within each of the state's 17 major river basins and 54 cataloging units. RBRPs designate specific watersheds that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds, designated as Targeted Local Watersheds (TLWs), receive priority for NCEEP planning and restoration project funds. The 2009 Lower Yadkin-Pee Dee River Basin Restoration Priorities plan identifies cataloguing unit (HUC) 03040104-061030 as a TLW (http://portal.ncdenr.org/web/eep/rbrps/yadkin).

The Brown Creek sub-watershed is located in HUC 03040104-061030. The sub-watershed covers 48 square miles. Approximately 28 percent of stream reaches within the sub-watershed have been identified as impaired overall for aquatic life according to 2006 NCDWR 303(d) data. The sub-watershed is characterized by agricultural (15 percent of total area) and forested (69 percent of total area) land uses. Impervious surfaces constitute less than one percent of land use in the watershed (NCEEP, 2009). In addition to inadequate riparian buffers, there are 19 animal operations in the sub-watershed. Within the sub-watershed, there are multiple opportunities to restore, enhance, or preserve streams and riparian buffers.

The project will involve the restoration, enhancement, and preservation of a Rural Piedmont Stream system (NC WAM 2010, Schafale and Weakley 1990) that has been impaired due to past agricultural conversion and cattle grazing. Due to the productivity along and accessibility of these smaller stream systems, many have experienced heavy human and cattle disturbance. Portions of the stream reaches are currently wooded, yet some sections have become highly unstable and are experiencing active widening and downcutting.

Restoration practices will involve raising the existing streambed and reconnecting the streams to their relic floodplain, and restoring natural flows to areas previously drained by ditching activities. The existing channels within the project area will be completely to partially filled to decrease surface and subsurface drainage and raise the local water table. Permanent cattle exclusion fencing will be provided around all proposed reaches and riparian buffers, with the exception of UT4-R5, where cattle lack access. Vegetated buffers in excess of 50 feet will be established along both sides of the reaches and a proposed conservation easement consisting of approximately 43 acres (AC) will protect the site in perpetuity. Additionally, multiple options were submitted with the NCEEP proposal, however only 'Option J' was selected by NCEEP and therefore this mitigation plan only includes this option. The reach designations have remained the same since the proposal in order to be consistent throughout the document.

Animal operations, agricultural development, disturbance of natural riparian buffers (timber harvesting) and other various land-disturbing activities in the Brown Creek sub-watershed have negatively impacted both water resources and streambank stability of the riparian buffers along the Brown Creek tributaries. To improve watershed health, one of the priorities listed in the 2009 Lower Yadkin-Pee Dee RBRP emphasized the need for increased implementation of agricultural best management practices (BMPs) in the Brown Creek watershed. Nutrients, sedimentation, streambank erosion, livestock access to streams, channel modification and the loss of wetlands and riparian buffers were observed stressors within the watershed.

The TLW selection criteria for the Yadkin River Basin targets specific projects that will address water resources impacts from nonpoint source pollution. The proposed project aligns with NCEEP goals, which focus on restoring streams and riparian area values such as maintaining and enhancing water resources, restoring hydrology, and improving fish and wildlife habitat.

The Brown Creek Tributaries Restoration Project was identified as an opportunity to improve water resources and ecological functions within the TLW. The primary restoration goals of the project are described below:

- Create geomorphically stable conditions along the unnamed tributaries across the site,
- Implement agricultural BMPs to reduce nonpoint source inputs to receiving waters,
- Protect and improve water resources by reducing bank erosion, nutrient and sediment inputs,
- Restore stream hydrology by connecting historic flow paths and promoting natural flood processes,
- Restore and protect riparian buffer functions and corridor habitat in perpetuity by establishing a permanent conservation easement.

To accomplish these goals, the following objectives have been identified:

- Restore existing incised, eroding, and channelized streams by providing access to their relic floodplains,
- Prevent cattle from accessing the conservation easement boundary by installing permanent fencing and thus reduce excessive bank erosion and undesired nutrient inputs,
- Increase aquatic habitat value by providing more bedform diversity, creating natural scour pools and reducing sediment from accelerated bank erosion,
- Establish a riparian buffer using native plant species along streambank and floodplain areas, protected by a permanent conservation easement, to increase stormwater runoff filtering capacity, improve bank stability and riparian habitat connectivity, and shade the stream to decrease water temperature,
- Improve aquatic and terrestrial habitat through improved substrate and in-stream cover, the addition of woody debris, and a reduction of water temperature,
- Control invasive species vegetation within the project area and if necessary continue treatments during the monitoring period.

The project will directly address goals identified in the 2009 Lower Yadkin-Pee Dee RBRP, namely to improve watershed conditions and prevent increases to impervious surfaces areas. The proposed natural channel design (NCD) approach will result in a stable riparian stream system that will reduce excess sediment and nutrient inputs to the Brown Creek sub-watershed, while improving water resources conditions that support terrestrial and aquatic species, including priority species identified in the Lower Yadkin River Basin.

2.0 SITE SELECTION

2.1 Project Description and Directions to Project Site

The Brown Creek Tributaries Restoration Project site (site) is located in Anson County, NC, approximately four miles south of the Town of Ansonville, as shown on the Project Site Vicinity Map (Figure 2.1). To access the site from Raleigh, take US Highway 1 south through Sanford, for approximately 40 miles. Take the exit ramp to US 15/501 South to Carthage and then take NC 24/NC 27 West from Carthage for approximately 33 miles before turning onto NC 109 South. Follow NC 109 South for 20 miles and take the first right past Dennis Road. The UT4 site is located just south of the farm access road about one half mile from NC 109. The Hurricane Creek site is located immediately south of Pleasant Grove Church Road approximately 1.5 miles west of the UT4 site.

2.2 Site Selection

The site is located in the NC Division of Water Resources (NCDWR) subbasin 03-07-10 of the Yadkin River Basin (Figure 2.2). The site includes Hurricane Creek and an unnamed headwater tributary (UT) to Brown Creek. The unnamed tributary is referred to as UT4. Soils and topographic information (Figures 2.2, 2.3, 2.4, 2.5, and 2.6) indicate that the area contains predominantly floodplain soils with a small section of upland soils. The site soils consist of almost entirely of Chewacla loam (ChA), with Creedmoor fine sandy loam (CrB) along the tributary to Hurricane Creek.

Hurricane Creek (HC-R1 and HC-R2) and the mainstem of UT4 (UT4-R3 and UT4-R4) are shown as solid blue-line streams on the USGS topographic quadrangle map (Figure 2.2). The tributary (HC-R3) to Hurricane Creek and UT4 (UT4-R1, UT4-R2, and UT4-R3) are not shown as any type of blue-line stream on the USGS map. All stream reaches, except HC-R3, are shown as (unclassified) streams within the project limits on the 2005 Anson County Soil Survey (Anson, 2005). LiDAR imagery for the site shows the presence of historic valleys for each of the project stream systems (Figure 2.6) and field investigations confirmed the location of these valleys.

Field evaluations of intermittent/perennial stream status were made in February 2013. These evaluations were based on North Carolina Division of Water Resources (NCDWR) Methodology for Identification of Intermittent and Perennial Streams and Their Origins, (v4.11) stream assessment protocols. Table 1 below presents the results of the field evaluations along with the assessed status of each project reach. Copies of the NCDWR classification forms can be found in Appendix B.

Table 1. Summary Information for Field Investigations to Determine Intermittent/Perennial Status

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Project Reach Designation	Existing Project Reach Length (ft)	NCDWR Stream Classification Form Score	Watershed Drainage Area (acres) [1]	Stream Status Based on Field Analyses
HC-R1	1,896	26.5	1,075	Intermittent
HC-R2	1,288	31.0	1,331	Perennial
HC-R3	579	23.5	122	Intermittent
UT4-R1	1,417	26.0	218	Intermittent

UT4-R2	1,673	30.0	1,005	Perennial
UT4-R3	244	33.5	1,018	Perennial
UT4-R4	1,884	28.8	275	Intermittent
UT4-R5	2,089	23.5	467	Intermittent

Note 1: Watershed drainage area was approximated based on topographic and LiDAR information at the downstream end of each reach.

2.2.1 Historical Land Use and Development Trends

Land use in the watershed is approximately 48 percent forest, 18 percent active agriculture (chicken farms, cropland, and pasture), and approximately 34 percent pine plantation or successional forests, and less than one percent residential, urban, or transportation uses. Eighty-five percent of stream reaches lack adequate riparian buffers. Recent land use of the site includes active agricultural land managed as pasture for cattle grazing and crop production. Potential for land use change or future development in the area adjacent and upstream to the conservation easement is at least moderate, given the proximity to Charlotte and Union County; the latter grew 60 percent between 2000 and 2009.

Over time, existing channels have incised and the site streams have largely become disconnected from their historic floodplain. Additionally, the riparian buffer has been cleared or narrowed in numerous locations to increase pastureland and tillable acreage. These processes and practices have contributed excessive sediment and nutrient loading to the Hurricane Creek, UT4, and their receiving waters, Brown Creek and the Pee Dee River.

2.2.2 Existing Conditions and Successional Trends

To convert the land for agricultural use, landowners historically cleared portions of the mature forest and manipulated and/or straightened site streams to increase land acreage for grazing and agriculture. Streambank erosion became widespread due primarily to on-going cattle access. Over time, the stream channels became incised and floodplain connectivity was further reduced. The landowners have cleared portions of the riparian buffer area within the site boundary to provide additional land for pasture as shown on a recent historical aerial photograph from 1998 (Figure 2.4).

Baker staff conducted field assessments that included an existing conditions survey and photographic documentation to evaluate and document the impacts of past land use management practices and current site conditions for each project stream reach. The following paragraphs briefly summarize these findings and the results were used to describe the geomorphic (Rosgen) stream classification and existing conditions for the project stream reaches. Sections 7 and 17 describe the restoration approaches proposed to achieve functional uplift and improve overall watershed health.

Reach UT4-R1 begins as an intermittent tributary flowing west for approximately 1,417 LF to the confluence with UT4-R2 and UT4-R5b. Historically, cattle had complete access to the stream, but were removed approximately three years ago. The upstream, stable section (UT4-R1a) is only slightly incised and has an ‘E’ Rosgen stream type classification. The channel crosses a power line easement after 511 LF and then flows through a degraded culvert near approximate station 16+31. Here the channel conditions become degraded as a result of a migrating headcut. In this approximately 786 LF downstream section of UT4-R1b, the unstable channel is classified as a

Rosgen stream type classification of "G" and is transitioning from Evolution Stage III to Stage IV. The buffer width is narrow and most of the trees along the stream banks have been undercut.

Reach UT4-R2 begins at the confluence of UT4-R1 and UT4-R5 and flows west for approximately 1,627 LF. This reach has a poor riparian buffer, especially along the left floodplain. The channel is a deeply incised G stream type with a Bank Height Ratio (BHR) of 3.5. The reach has been channelized, as evidenced by its lack of pattern and the relic spoil piles along the stream banks. Additionally, cattle have access to the channel, actively impacting the stream. The reach is transitioning from Stage III to Stage IV, though it is still downcutting.

Reach UT4-R3 begins at the confluence of UT4-R2 and UT4-R4 and flows north for approximately 242 LF. It has similar characteristics as the lower section of UT4-R4; namely, it is an unstable G stream type with a BHR greater than 3.0, and it has an adequate buffer beyond the right bank and a very narrow buffer along the left side of the stream.

Reach UT4-R4 is a headwater tributary that flows north for approximately 1,716 LF to its confluence with UT4-R2. UT4-R4 has two distinct sections: an upstream, channelized reach with a very poor riparian buffer (pasture); and a downstream reach that is more deeply incised due to a migrating headcut. The riparian buffer on the downstream section is adequate along the right bank but very narrow along the left bank. The upstream section is an incised E stream type in early Stage III of Simon's Channel Evolution (Simon, 1989). The downstream section is an unstable G stream type with a BHR of more than 3.0.

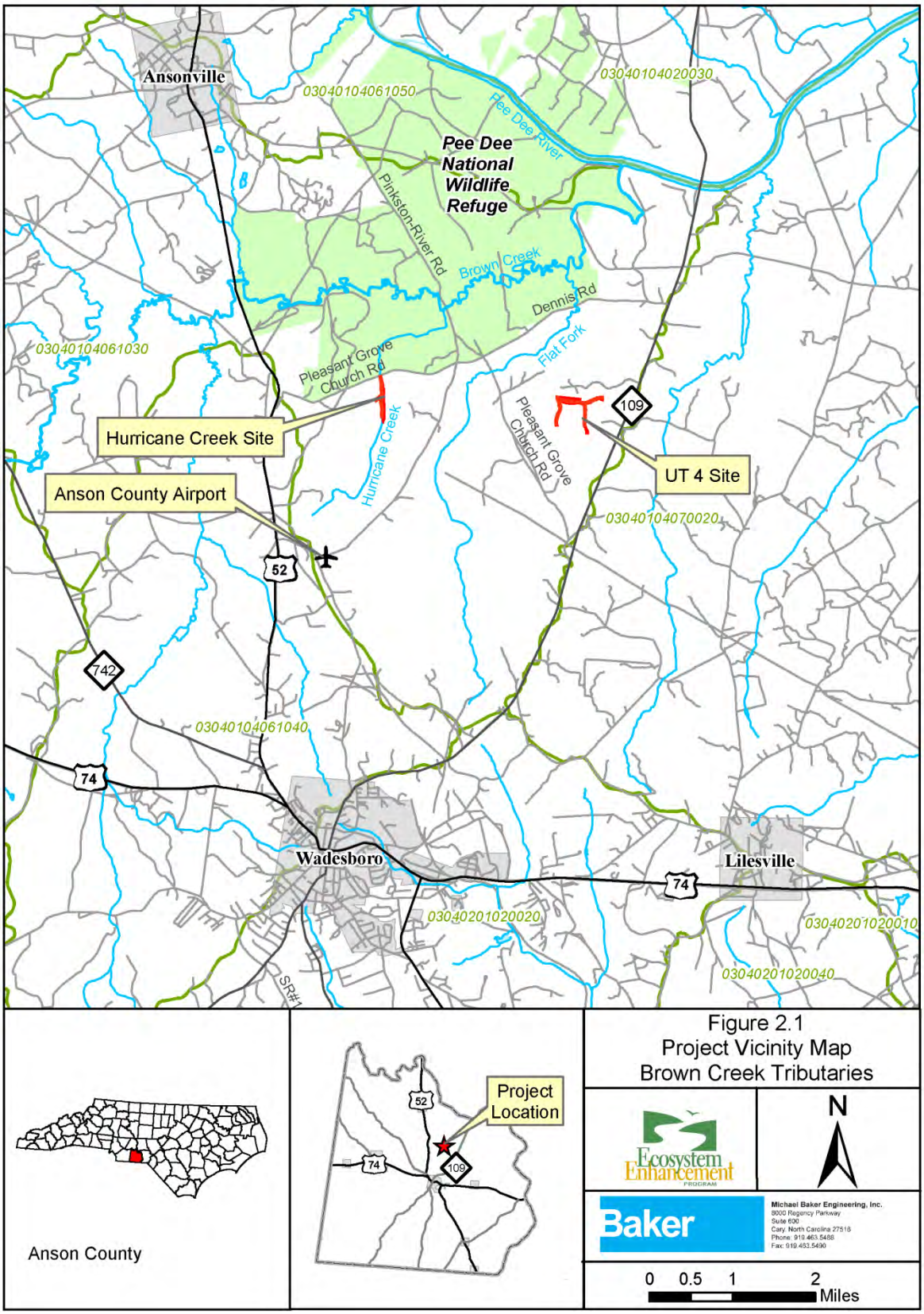
Reach UT4-R5 is an intermittent headwater tributary that flows north for approximately 1,564 LF before joining with UT4-R1. The riparian buffer is narrow, consisting of one or two rows trees (most commonly pine species). Historical cattle impacts are more apparent than UT4-R1. As with UT4-R1, cattle were removed from this reach approximately three years ago. The channel is an unstable G stream type for 311 LF on the downstream end, through which a headcut has migrated upstream. The upper section and majority of UT4-R5 is an incised E stream type channel. Overall, the reach is in Stage III of Simon's Channel Evolution.

Reach HC-R1 flows north from the confluence of two tributaries (one not shown on map) that have incised and have lower channel slopes. Reach HC-R1 has been channelized and is also incised. There are standing pools of water and remnant spoil piles along both banks. The left bank has a mature native hardwood buffer; however, large trees along the bank have fallen into the stream channel indicating the stream is in Stage IV of Simon's Channel Evolution. The channel classifies as either a G or F stream type, depending upon local channel width, and the BHR is approximately 2.0.

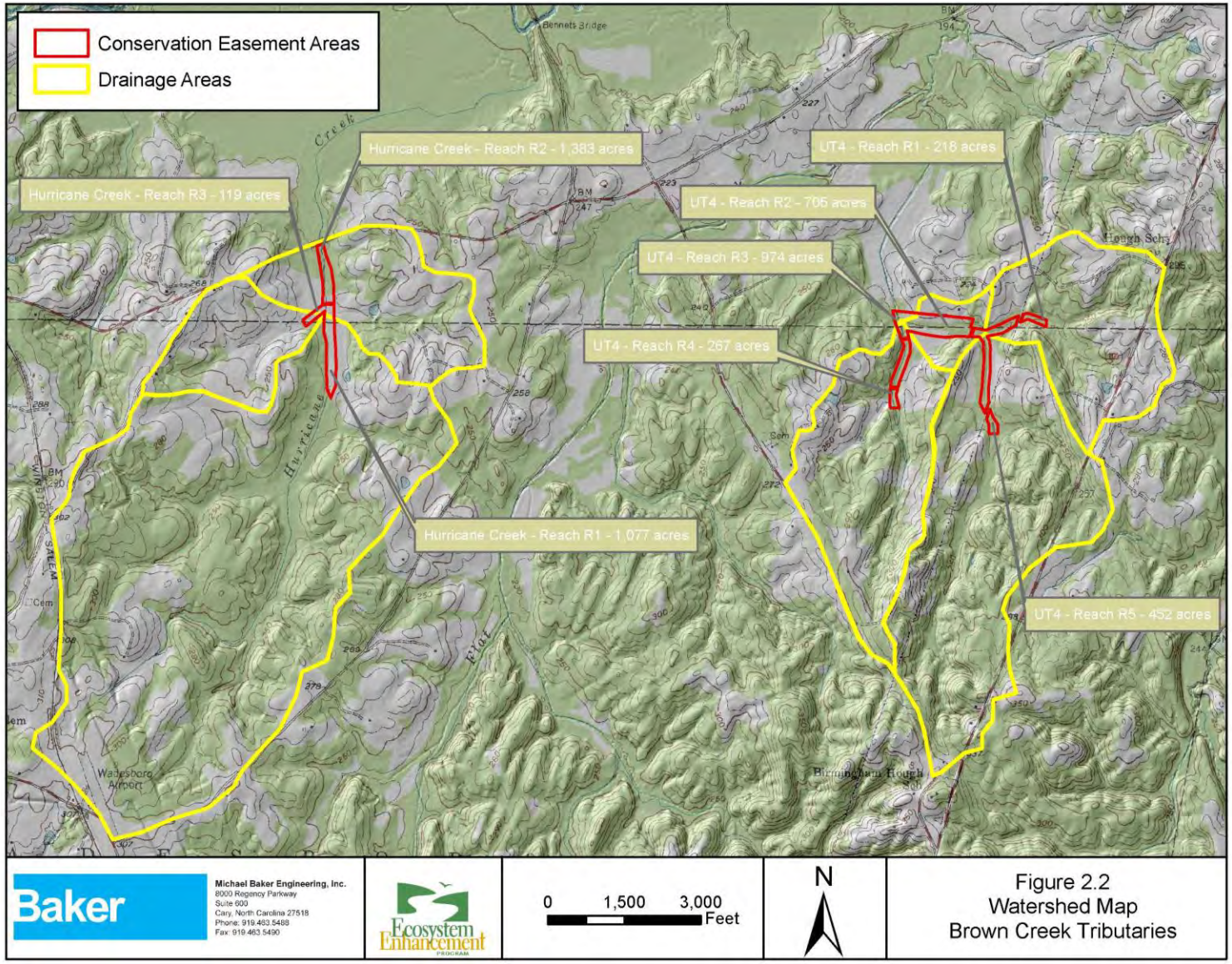
Reach HC-R2 is a perennial stream channel that begins at the confluence of HC-R1 and HC-R3 and flows north to Pleasant Grove Church Road. The riparian buffer is very narrow along both banks, but contains some large individual trees that will be preserved as part of this project. The channel is somewhat incised but does not have the tree damage observed in HC-R1, thus it appears to be in Stage III of Simon's Channel Evolution since widening is not evident. The channel may be classified as an incised E or G stream type with an approximate BHR of 2.0. The channel appears to have been straightened in the past.

Reach HC-R3 is an intermittent tributary that flows east to its confluence with HC-R1, at which point HC-R2 begins. The left bank flows through existing pasture. The channel is classified as an incised E or G stream type, with a BHR between 1.5 and 2.0.

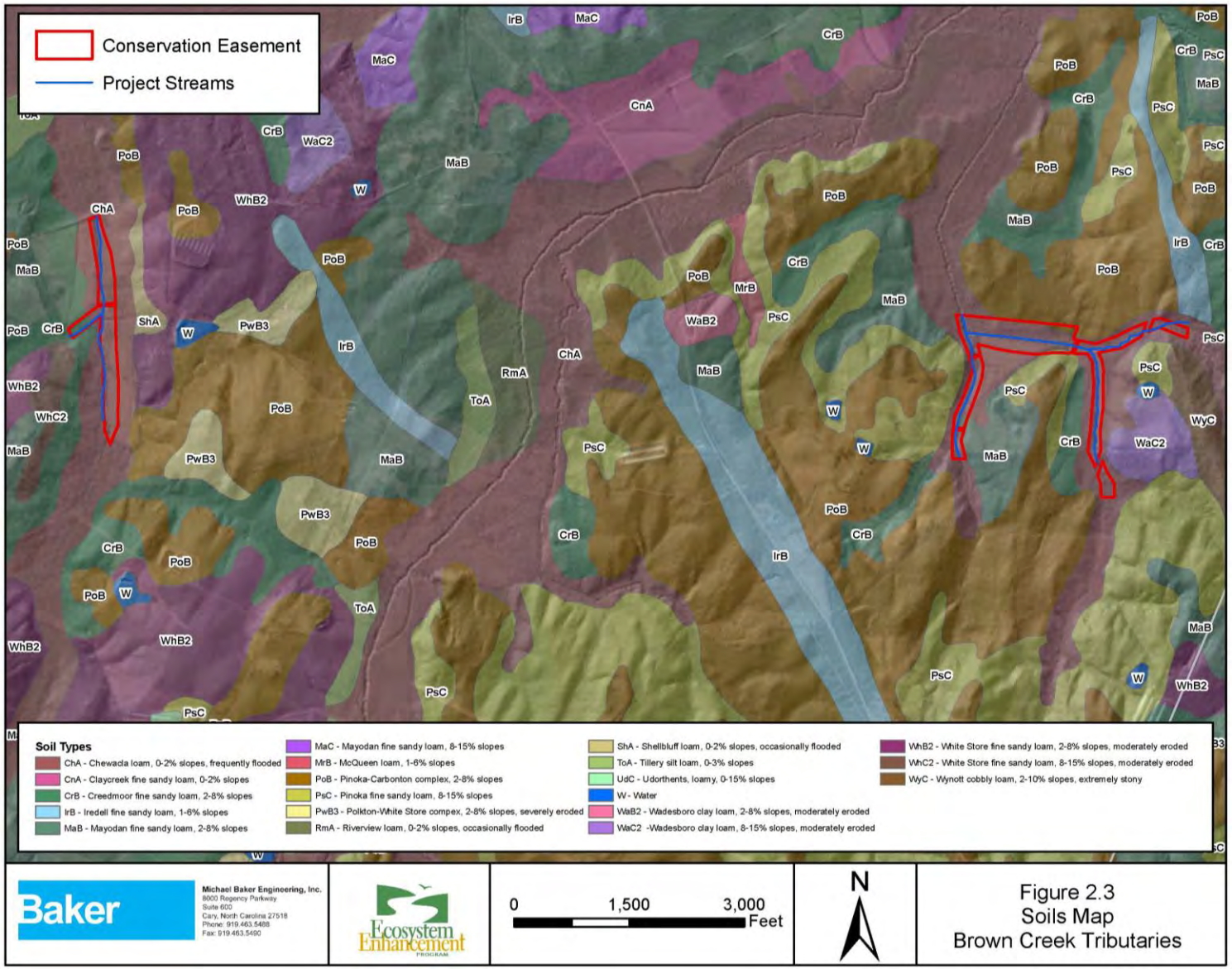
2.3 Vicinity Map



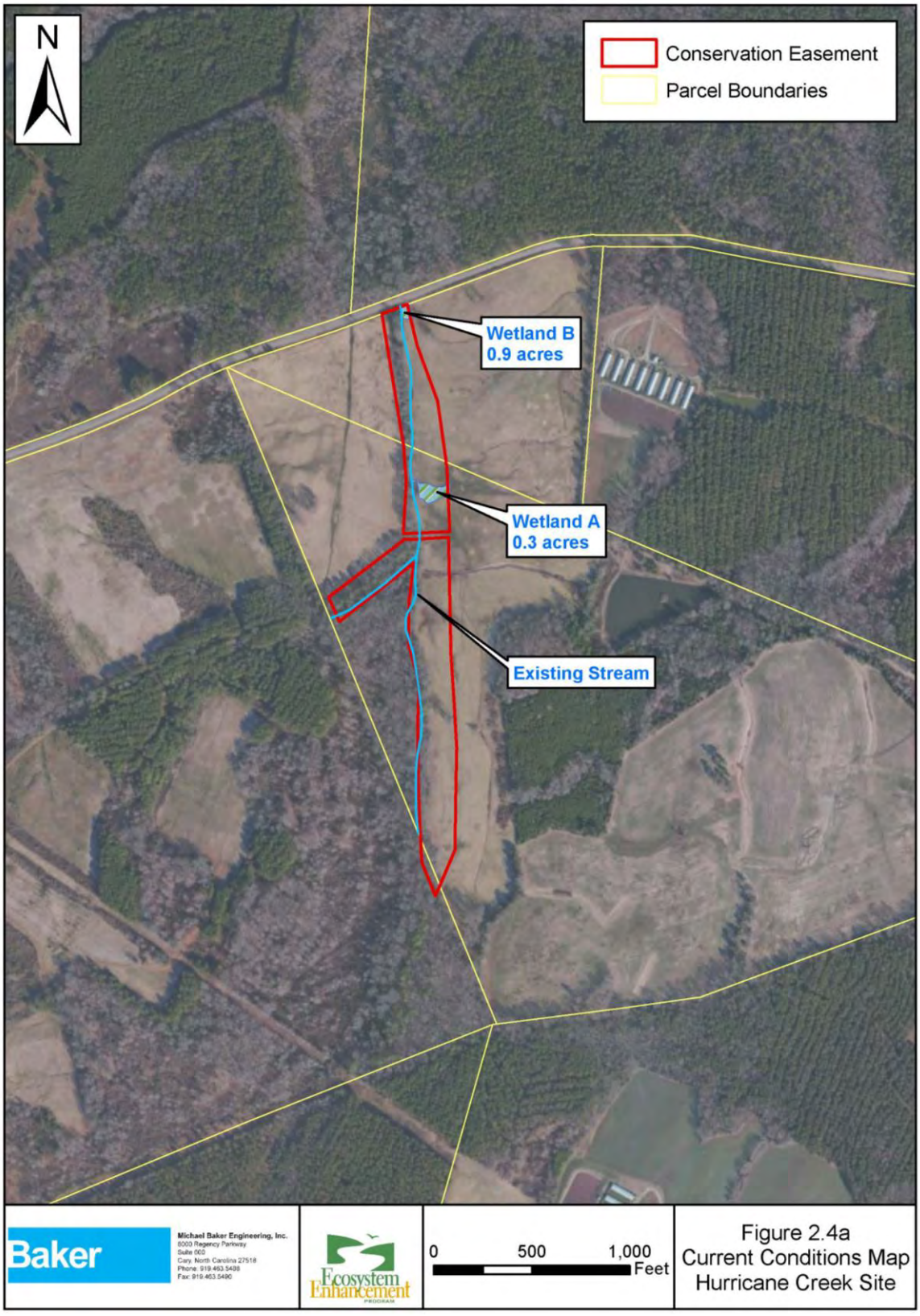
2.4 Watershed Map

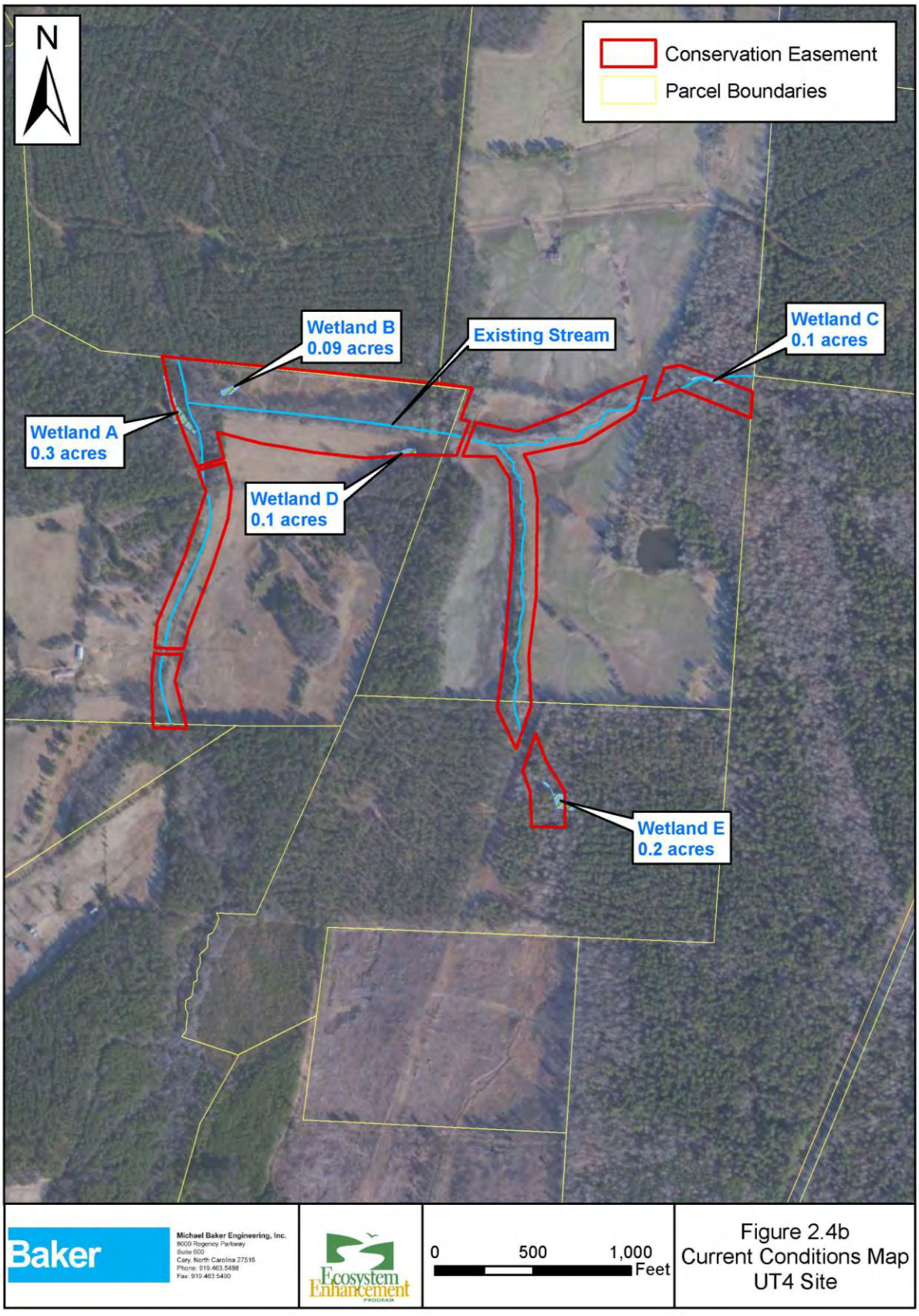


2.5 Soils Map

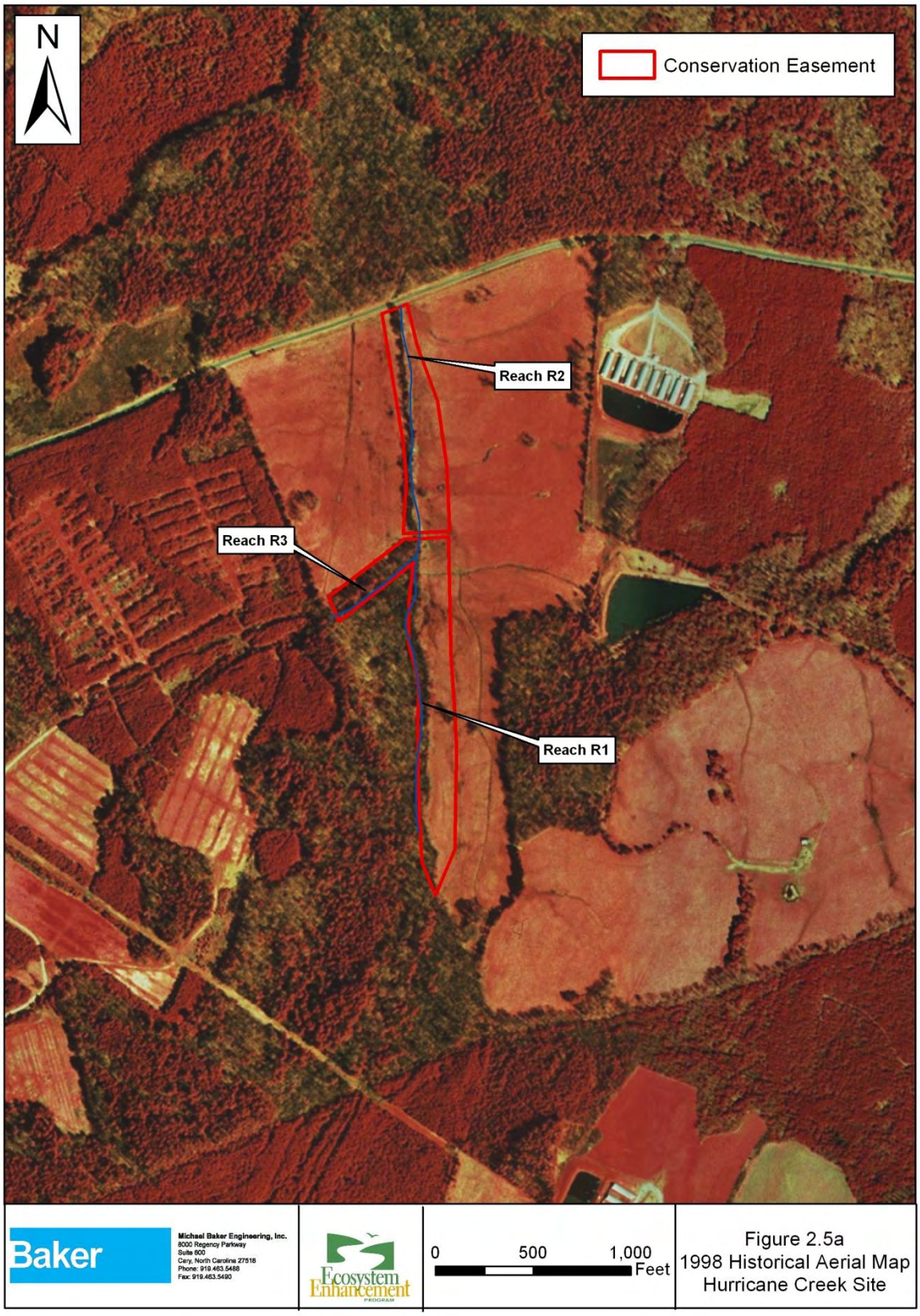

Conservation Easement
Project Streams
Soil Types
ChA - Chewacla loam, 0-2% slopes, frequently flooded
CnA - Claycreek fine sandy loam, 0-2% slopes
CrB - Creedmoor fine sandy loam, 2-8% slopes
IrB - Iredell fine sandy loam, 1-6% slopes
MaB - Mayodan fine sandy loam, 2-8% slopes
MaC - Mayodan fine sandy loam, 8-15% slopes
MrB - McQueen loam, 1-6% slopes
PoB - Pinoka-Carbonton complex, 2-8% slopes
PsC - Pinoka fine sandy loam, 8-15% slopes
PwB3 - Polkton-White Store compex, 2-8% slopes, severely eroded
RmA - Riverview loam, 0-2% slopes, occasionally flooded
ShA - Shellbluff loam, 0-2% slopes, occasionally flooded
ToA - Tillery silt loam, 0-3% slopes
UdC - Udorthents, loamy, 0-15% slopes
W - Water
WaB2 - Wadesboro clay loam, 2-8% slopes, moderately eroded
WaC2 -Wadesboro clay loam, 8-15% slopes, moderately eroded
WhB2 - White Store fine sandy loam, 2-8% slopes, moderately eroded
WhC2 - White Store fine sandy loam, 8-15% slopes, moderately eroded
WyC - Wynott cobbly loam, 2-10% slopes, extremely stony
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
1,500
3,000
Feet
N
Figure 2.3
Soils Map
Brown Creek Tributaries

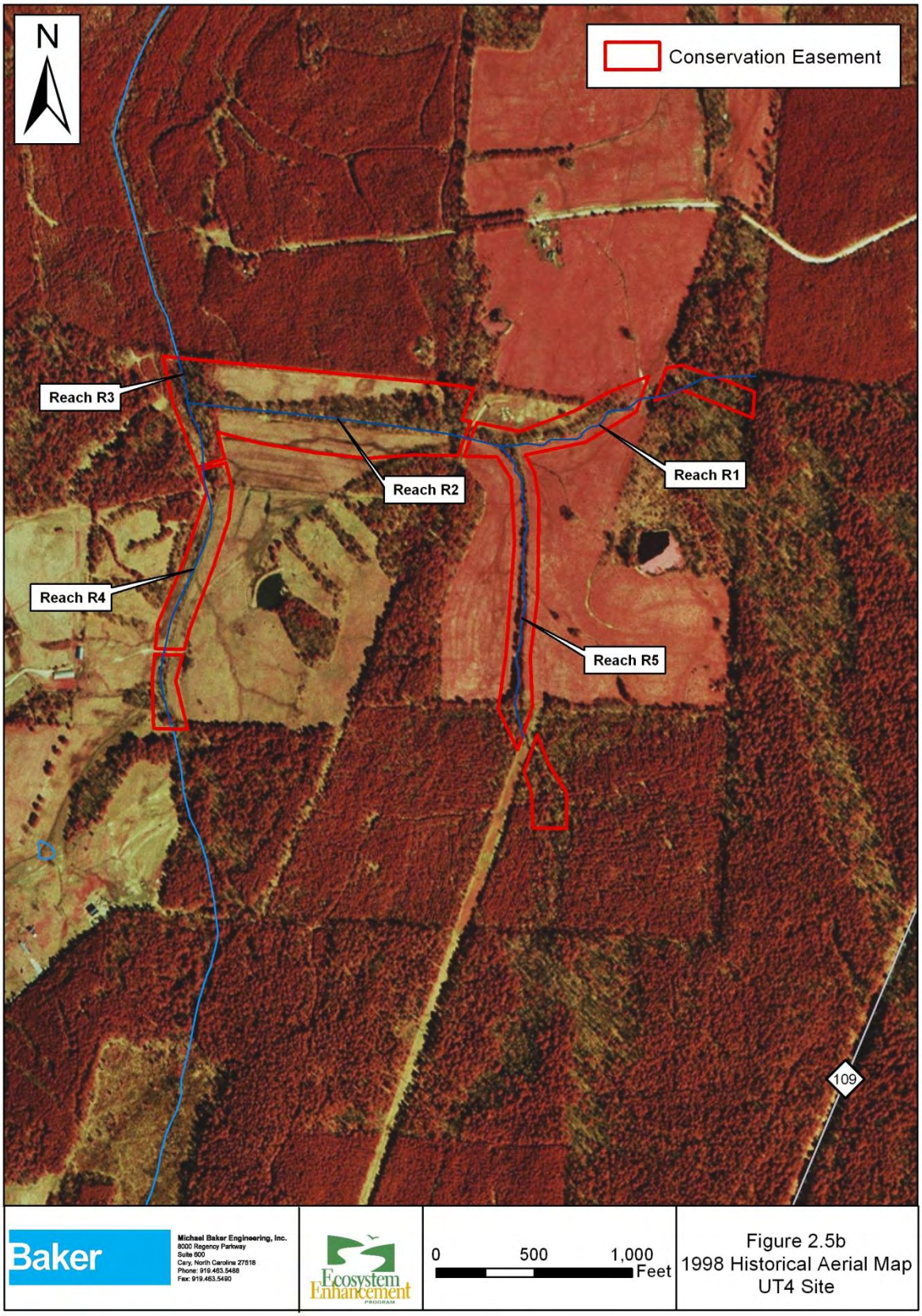
2.6 Current Conditions Maps



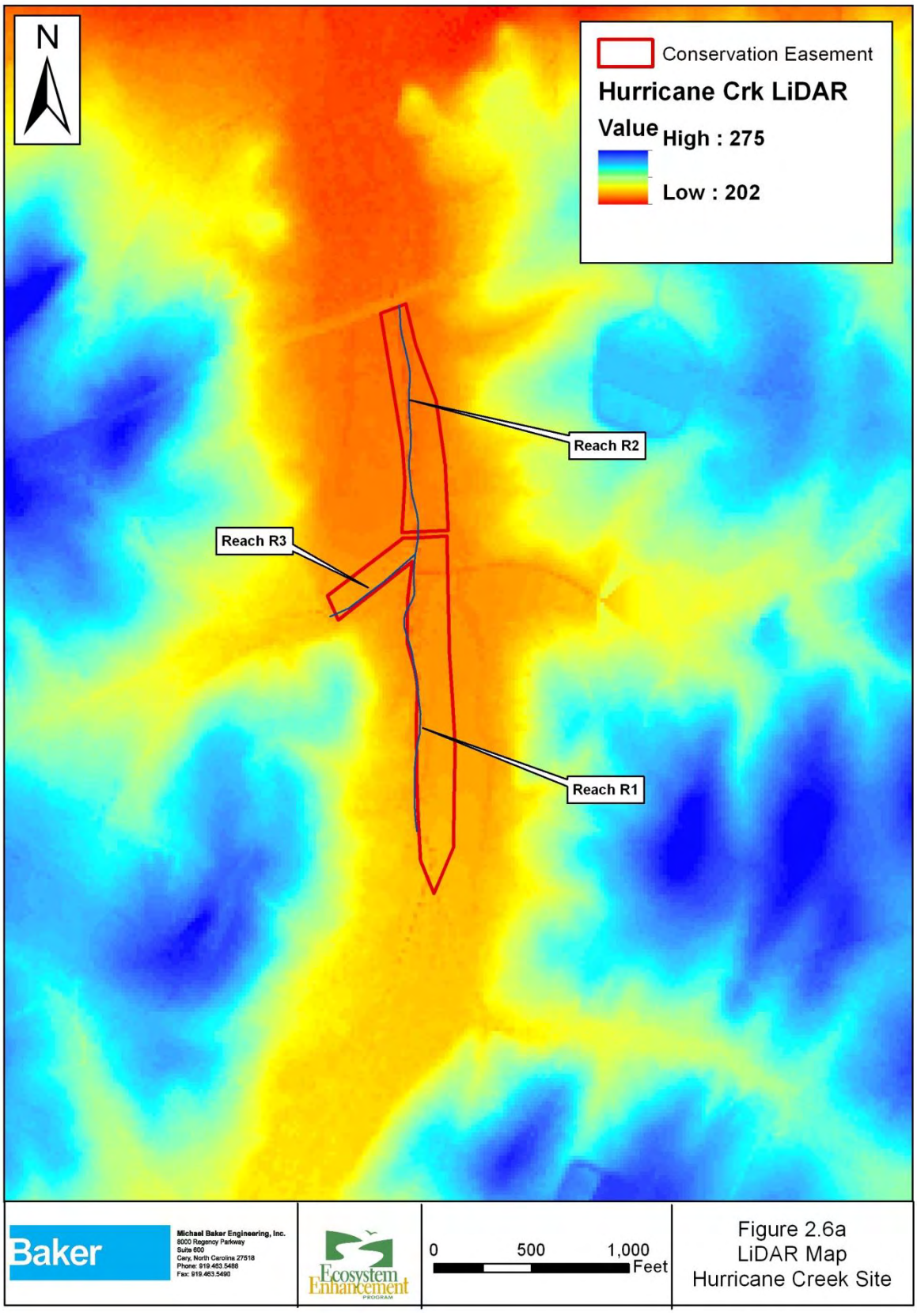

N
Conservation Easement
Parcel Boundaries
Wetland B
0.09 acres
Existing Stream
Wetland C
0.1 acres
Wetland A
0.3 acres
Wetland D
0.1 acres
Wetland E
0.2 acres
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
500
1,000
Feet
Figure 2.4b
Current Conditions Map
UT4 Site

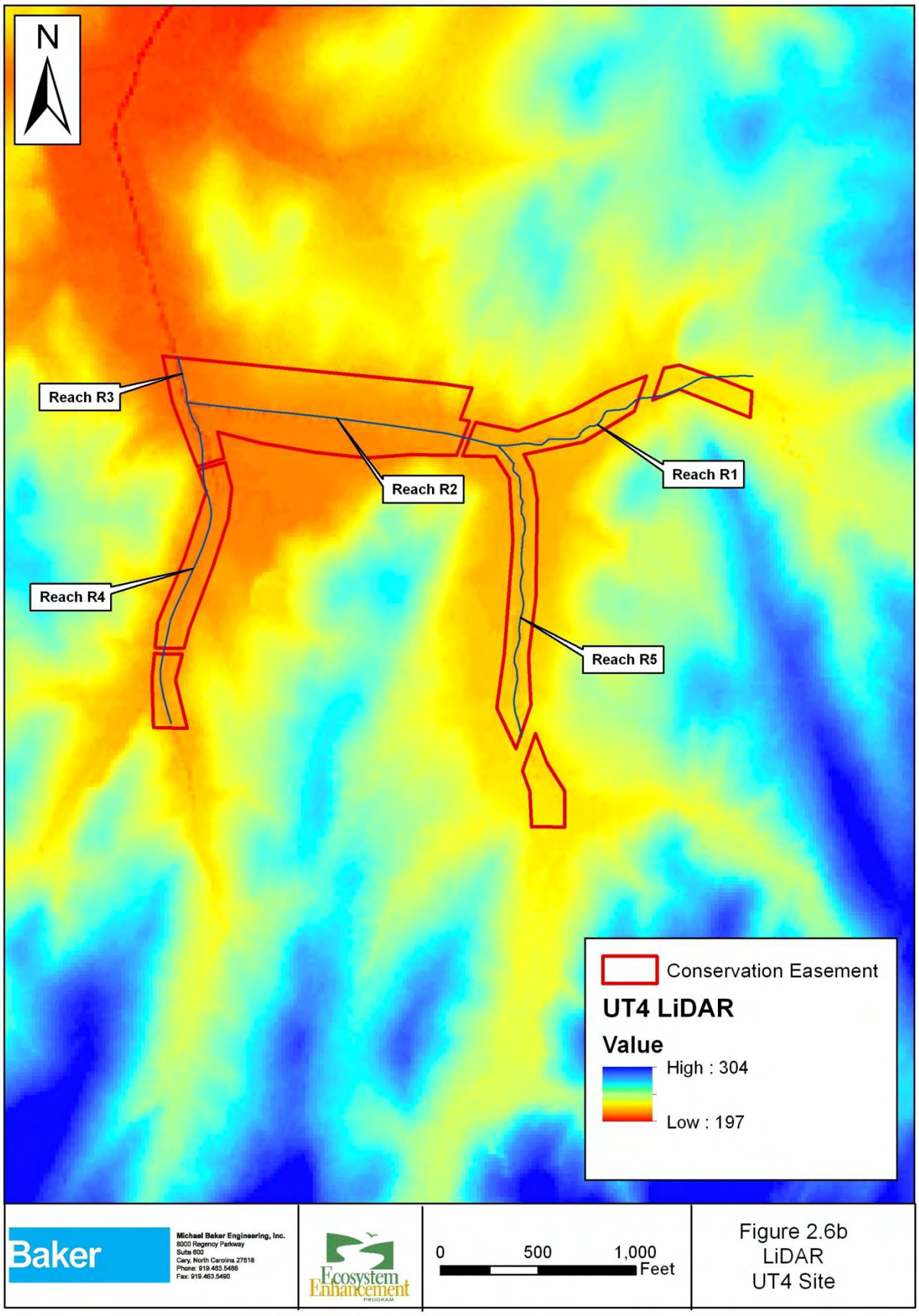
2.7 Historical Conditions Maps




N
Conservation Easement
Reach R3
Reach R2
Reach R1
Reach R4
Reach R5
109
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
500
1,000
Feet
Figure 2.5b
1998 Historical Aerial Map
UT4 Site

2.8 LiDAR Maps




N
Reach R3
Reach R2
Reach R1
Reach R4
Reach R5
Conservation Easement
UT4 LiDAR
Value
High : 304
Low : 197
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
500
1,000
Feet
Figure 2.6b
LiDAR
UT4 Site

2.9 Site Photographs

2.9.1 Hurricane Creek (Reaches HC-R1, HC-R2, HC-R3)

View looking at headwater channel and adjacent wooded floodplain upstream of HC-R1 (10/3/11)

View looking upstream at incised channel near middle of HC-R1 (10/3/11)

View looking at HC-R1 stream crossing near confluence with HC-R3 (6/12/13)

View looking at high bank erosion and poor water quality along upper HC-R2 (6/12/13)

View looking at right floodplain near an unnamed tributary connection with HC-R1 (10/24/11)

View looking west towards Hurricane Creek floodplain and wetland area 'A' (12/18/13)

2.9.2 UT4 (Reaches UT4-R1, UT4-R2, UT4-R3)

View looking upstream at UT4-R1 preservation section (6/12/13)

View looking downstream at culvert crossing to be improved near beginning of UT4-R2 (6/12/13)

View looking upstream at active headcut and channel incision near middle of UT4-R2 (6/12/13)

View looking at existing ford crossing and future easement area near middle of UT4-R2 (6/12/13)

View looking upstream at eroding stream banks and large woody debris along UT4-R3 (6/12/13)

View looking at wetland area 'C' in preservation section along UT4-R1 (12/18/13)

2.9.3 UT4 (Reaches UT4-R4, UT4-R5)

View looking downstream at beginning of UT4-R4 with sparse riparian buffer vegetation (6/12/13)

View looking upstream at headcut along UT4-R5 (12/18/13)

View looking upstream at bank erosion/channel incision along UT4-R5 (6/12/13)

View looking upstream at active headcut and abandoned floodplain along UT4-R4 (6/12/13)

3.0 SITE PROTECTION INSTRUMENT

3.1 Site Protection Instrument Summary Information

The land required for the construction, management, and stewardship of this mitigation project includes portions of the following parcels. A copy of the land protection instrument is included in Appendix A.

Table 3.1 Site Protection Instrument Summary

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project 95351

Parcel Number	Landowner	PIN	County	Site Protection Instrument	Deed Book and Page Numbers	Acreage Protected
CE-1 (HC)	Tom and Janice McRae	648700151016	Anson	00045	1055 / 278-289	3.15
CE-2 (HC)	Tom and Janice McRae	648700230123	Anson	00045	1055 / 278-289	1.98
CE-3 (HC)	Tom and Janice McRae	648700230123	Anson	00045	1055 / 278-289	9.04
CE-1 (UT4)	Alan McRae	648700452885	Anson	02864	1054 / 155-166	1.47
CE-2 (UT4)	Alan McRae	648700452885	Anson	02864	1054 / 155-166	7.30
CE-3 (UT4)	Alan McRae	648700452885	Anson	02864	1054 / 155-166	0.20
CE-4 (UT4)	William M. and Linda Hatem	648700138104	Anson	02859	1054 / 122-134	13.84
CE-5 (UT4)	William M. and Linda Hatem	648700138104	Anson	02859	1054 / 122-134	3.36
CE-6 (UT4)	William M. and Linda Hatem	648700138104	Anson	02859	1054 / 122-134	1.22
CE-7 (UT4)	Terry and Martha Dennis	648700318725	Anson	02863	1054 / 143-154	0.38
CE-8 (UT4)	Terry and Martha Dennis	648700318725	Anson	02863	1054 / 143-154	1.43

Baker has obtained a recorded conservation easement from the current landowners for both project areas (see Appendix A). The easement and survey plat was reviewed and approved by NCEEP and State Property Office (SPO) and is now held by the State of North Carolina. The UT4 easement and survey plat (Deed Book 300 / Pages 9-11) was recorded at the Anson County Courthouse on December 19th, 2013. The Hurricane Creek easement and survey plat was recorded January 10th, 2014 (Deed Book 301 / Page 5). The secured easements will allow Baker to proceed with the restoration project and will restrict the land use in perpetuity.

3.1.1 Potential Constraints

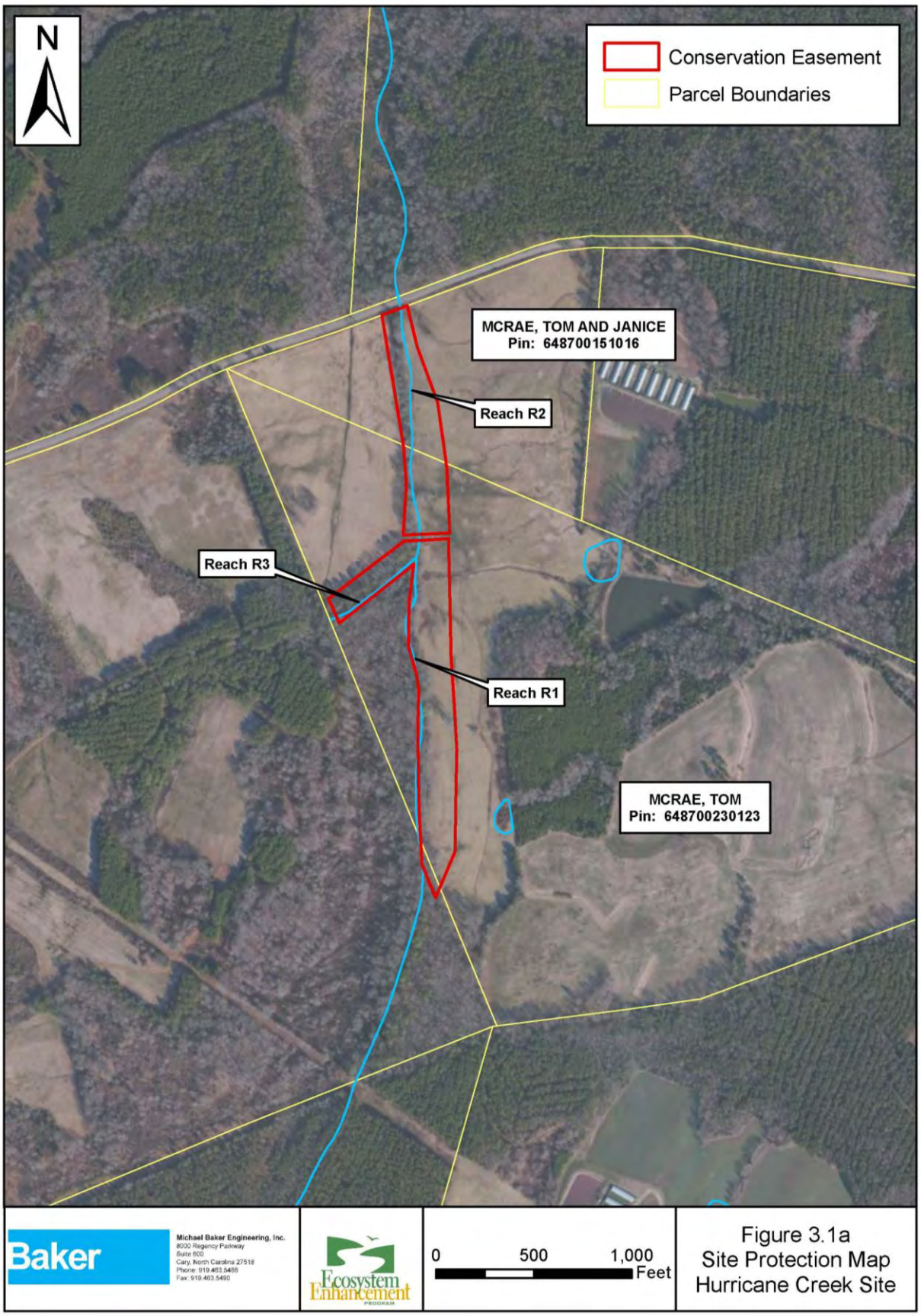
No fatal flaws have been identified at the time of this mitigation plan. Three existing farm crossings along HC-R2, UT4-R2, and UT4-R4 will be improved as part of this project. There are existing utility easements for a transmission line located adjacent to the conservation easement (UT4-R1 and UT4-R5). Riparian buffer widths will be at least 50 feet across along both banks (100 feet minimum total buffer width) for all of the proposed stream reaches. Although a portion of the project reaches are located in a FEMA regulated floodplain ("Zone AE") (Figure 16.1), hydraulic trespass will not result from the proposed project. Other regulatory factors discussed in Section 16, Appendix B were also determined not to pose potential site

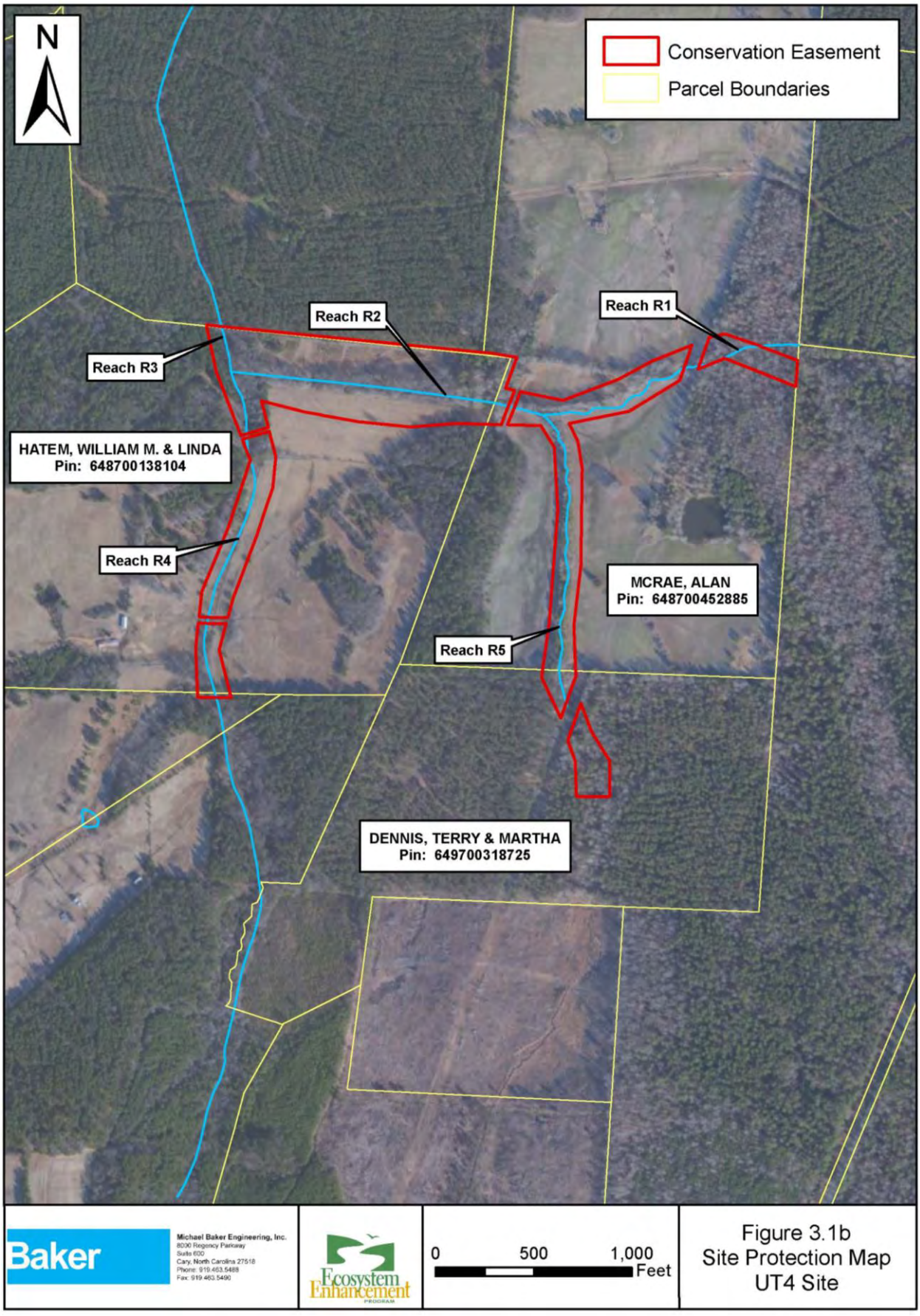
constraints. Construction access and staging areas have been identified and will be determined during final design.

3.2 Site Protection Instrument Figure

The conservation easements for the project area are shown in Figure 3.1a and 3.1b. Copies of the recorded survey plats are included in Section 15, Appendix A.

Figure 3.1 Site Protection Instrument Map




N
Conservation Easement
Parcel Boundaries
Reach R1
Reach R2
Reach R3
Reach R4
Reach R5
HATEM, WILLIAM M. & LINDA
Pin: 648700138104
MCRAE, ALAN
Pin: 648700452885
DENNIS, TERRY & MARTHA
Pin: 649700318725
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
500
1,000
Feet
Figure 3.1b
Site Protection Map
UT4 Site

4.0 BASELINE INFORMATION

Table 4.1 Baseline Information
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Project Information			
Project Name	Brown Creek Tributaries Restoration Project – Hurricane Creek		
County	Anson		
Project Area (acres)	14.1		
Project Coordinates (latitude and longitude)	35.0498 N, -80.0665 W		
Watershed Summary Information			
Physiographic Province	Piedmont		
Geologic Unit	Triassic Basin		
River Basin	Yadkin		
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030		
NCDWR Sub-basin	03-07-10		
Project Drainage Area (acres)	1,383		
Project Drainage Area Percentage Impervious	2%		
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (2%)		
Stream Reach Summary Information			
Parameters	**HC-R1**	**HC-R2**	**HC-R3**
Length of Reach (linear feet)	1,347	1,384	546
Valley Classification (Rosgen)	VII	VII	VII
Drainage Area (acres)	1,077	1,383	119
NCDWR Stream Identification Score	26.5	31.0	23.0
NCDWR Water Resources Classification	Class C		
Morphological Description (Rosgen stream type)	Incised E	Incised E	G/Incised Bc
Evolutionary Trend	Incised	Incised E→G→F	Incised B→G→F
Underlying Mapped Soils	ChA	ChA	CrB
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Non-Hydric
Average Channel Slope (ft/ft)	0.0035	0.0024	0.0108
FEMA Classification	Zone AE	Zone AE	Zone AE
Native Vegetation Community	Piedmont Small Stream		
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)
Essential Fisheries Habitat	No	N/A	Categorical Exclusion (Appendix B)

Table 4.1 Baseline Information
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Project Information					
Project Name	Brown Creek Tributaries Restoration Project – UT4				
County	Anson				
Project Area (acres)	29.2				
Project Coordinates (latitude and longitude)	35.0477 N, -80.0274 W				
Watershed Summary Information					
Physiographic Province	Piedmont				
River Basin	Yadkin				
USGS Hydrologic Unit 8-digit and 14-digit	03040104 / 03040104061030				
DWR Sub-basin	03-07-10				
Project Drainage Area (acres)	974				
Project Drainage Area Percent Impervious	<2%				
CGIA / NCEEP Land Use Classification	2.01.01.01, 2.03.01, 2.99.01, 3.02 / Forest (69%) Agriculture (15%) Impervious Cover (<2%)				
Stream Reach Summary Information					
Parameters	**UT4-R1**	**UT4-R2**	**UT4-R3**	**UT4-R4**	**UT4-R5**
Length of Reach (linear feet)	1,417	1,627	242	1,716	1,564
Valley Classification (Rosgen)	VII	VII	VII	VII	VII
Drainage Area (acres)	218	706	974	267	452
NCDWR Stream Identification Score	28.5	29	32	26	23.5
NCDWR Water Resources	Class C				
Morphological Description (Rosgen stream type)	F/G	Incised E	G	G	Incised Bc /C
Evolutionary Trend	Incised E → Gc→F	Bc→G→F	Bc→G→F	Incised E-> G -> F	Incised E→ G → F
Underlying Mapped Soils	ChA	ChA	ChA	ChA, MaB	ChA
Drainage Class	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Somewhat poorly drained	Moderately well drained
Soil Hydric Status	Hydric	Hydric	Hydric	Hydric	Hydric
Average Channel Slope (ft/ft)	0.0077	0.0053	0.0009	0.0073	0.0038
FEMA Classification	N/A	Zone AE	Zone AE	Zone AE	N/A
Native Vegetation Community	Piedmont Small Stream				
Percent Composition of Exotic/Invasive Vegetation	<5%	<5%	<5%	<5%	<5%

Regulatory Considerations			
Regulation	**Applicable**	**Resolved**	**Supporting Documentation**
Waters of the United States – Section 404	Yes	Yes	Categorical Exclusion (Appendix B)
Waters of the United States – Section 401	Yes	Yes	Categorical Exclusion (Appendix B)
Endangered Species Act	No	N/A	Categorical Exclusion (Appendix B)
Historic Preservation Act	No	N/A	Categorical Exclusion (Appendix B)
Coastal Area Management Act (CAMA)	No	N/A	Categorical Exclusion (Appendix B)
FEMA Floodplain Compliance	Yes	Yes	Categorical Exclusion (Appendix B)

5.0 DETERMINATION OF CREDITS

Table 5.1 Project Components and Mitigation Credits
Brown Creek Tributaries Restoration Project Stream Mitigation Plan, Anson County - NCEEP Project No. 95351

Mitigation Credits

	Stream	Riparian Wetland		Non-riparian Wetland		Buffer	Nitrogen Nutrient Offset	Phosphorus Nutrient Offset
Type	R, E1, E2, P	R	E					
Totals	9,766 SMU	0.0	0.0					

Project Components

Project Component or Reach ID	Stationing/ Location	Existing Footage/ Acreage	Approach	Restoration/ Restoration Equivalent	Restoration Footage or Acreage	Mitigation Ratio
Hurricane Creek - Reach 1	10+00 – 30+35	1,896 LF	Restoration	2,035 SMU	2,035 LF	1:1
Hurricane Creek - Reach 2	30+65 – 44+31	1,288 LF	Restoration	1,366 SMU	1,366 LF	1:1
Hurricane Creek - Reach 3	10+00 – 15+79	579 LF	Enhancement II	232 SMU	579 LF	2.5:1
UT4 – Reach 1a (upstream section)	10+00 – 15+11	511 LF	Preservation	102 SMU	511 LF	5:1
UT4 – Reach 1b (downstream section)	16+31 – 24+80	906 LF	Restoration	849 SMU	849 LF	1:1
UT4 – Reach 2	24+80 – 43+37	1,673 LF	Restoration	1,827 SMU	1,857 LF	1:1
UT4 – Reach 3	28+97 – 31+24	244 LF	Restoration	227 SMU	227 LF	1:1
UT4 – Reach 4a (upstream section)	10+00 - 13+95	395 LF	Restoration	395 SMU	395 LF	1:1
UT4 – Reach 4b (downstream section)	14+25 - 28+97	1,392 LF	Restoration	1,452 SMU	1,472 LF	1:1
UT4 – Reach 5a (upstream section)	10+00 - 13+86	386 LF	Enhancement I	257 SMU	386 LF	1.5:1
UT4 – Reach 5a (downstream section)	15+00 - 30+35	1,535 LF	Enhancement I	1,024 SMU	1,535 LF	1.5:1

Component Summation

Restoration Level	Stream (LF)	Riparian Wetland (AC)		Non-riparian Wetland (AC)	Buffer (SF)	Upland (AC)
		Riverine	Non-Riverine			
Restoration	8,201					
Enhancement I	1,921					
Enhancement II	579					
Creation						
Preservation	511					
High Resources Preservation						

BMP Elements

Element	Location	Purpose/Function	Notes

BMP Elements: BR= Bioretention Cell; SF= Sand Filter; SW= Stormwater Wetland; WDP= Wet Detention Pond; DDP= Dry Detention Pond; FS= Filter Strip; S= Grassed Swale; LS= Level Spreader; NI=Natural Infiltration Area

6.0 CREDIT RELEASE SCHEDULE

All credit releases will be based on the total credit generated as reported by the as-built survey of the mitigation site. Under no circumstances shall any mitigation project be debited until the necessary Department of the Army (DA) authorization has been received for its construction or the District Engineer (DE) has otherwise provided written approval for the project in the case where no DA authorization is required for construction of the mitigation project. The DE, in consultation with the NC Interagency Review Team (NCIRT), will determine if performance standards have been satisfied sufficiently to meet the requirements of the release schedules below. In cases where some performance standards have not been met, credits may still be released depending on the specifics of the case. Monitoring may be required to restart or be extended, depending on the extent to which the site fails to meet the specified performance standard. The release of project credits will be subject to the criteria described in Table 6.1 as follows:

Table 6.1 Credit Release Schedule

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Stream Credits			
Monitoring Year	**Credit Release Activity**	**Interim Release**	**Total Release**
0	Initial Allocation - see requirements below	30%	30%
1	First year monitoring report demonstrates performance standards are being met	10%	40%
2	Second year monitoring report demonstrates performance standards are being met	10%	50% (60%*)
3	Third year monitoring report demonstrates performance standards are being met	10%	60% (70%*)
4	Fourth year monitoring report demonstrates performance standards are being met	5%	65% (75%*)
5	Fifth year monitoring report demonstrates performance standards are being met.	10%	75% (85%*)
6	Sixth year monitoring report demonstrates performance standards are being met.	5%	80% (90%*)
7	Seventh year monitoring report demonstrates performance standards are being met and project has received closeout approval.	10%	90% (100%)

**See Initial Allocation of Released Credits and Subsequent Credit Release descriptions below.*

Initial Allocation of Released Credits

The initial allocation of released credits, as specified in the mitigation plan can be released by the NCEEP without prior written approval of the DE upon satisfactory completion of the following activities:

a. Approval of the Final Mitigation Plan

b. Recordation of the preservation mechanism, as well as a title opinion acceptable to the USACE covering the property

c. Completion of project construction (the initial physical and biological improvements to the mitigation site) pursuant to the mitigation plan; Per the NCEEP Instrument, construction means that a mitigation site has been constructed in its entirety, to include planting, and an as-built report has been produced. As-built reports must be sealed by an engineer prior to project closeout, if appropriate but not prior to the initial allocation of released credits.

d. Receipt of necessary DA permit authorization or written DA approval for projects where DA permit issuance is not required.

Subsequent Credit Releases

All subsequent credit releases must be approved by the DE, in consultation with the NCIRT, based on a determination that required performance standards have been achieved. For stream projects a reserve of 10% of a site's total stream credits shall be released after two bankfull events have occurred, in separate years, provided the channel is stable and all other performance standards are met. In the event that less than two bankfull events occur during the monitoring period, release of these reserve credits shall be at the discretion of the NCIRT. As projects approach milestones associated with credit release, the NCEEP will submit a request for credit release to the DE along with documentation substantiating achievement of criteria required for release to occur. This documentation will be included with the annual monitoring report.

7.0 MITIGATION WORK PLAN

7.1 Target Stream Type(s), Wetland Type(s), and Plant Communities

7.1.1 Target Stream Types

The primary goal when targeting a stream type was to select a site-specific design approach that would return rural piedmont stream functions to a stable state prior to past disturbances. Current assessment methods and data analyses were utilized for identifying lost or impaired functions at the site and to determine overall mitigation potential. Among these are reviewing existing hydrogeomorphic conditions, historical aerials and LiDAR (Light Detection and Ranging) mapping, evaluating stable reference reaches, and a comparison of results from similar past projects in rural piedmont stream systems.

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration of stream functions within the project area. Topography and soils on the site indicate that the project area most likely functioned in the past as a tributary stream system, eventually flowing downstream into the larger Brown Creek system. Assigning an appropriate stream type for the corresponding valley that accommodates the existing and future hydrologic conditions and sediment supply was considered prior to selecting the proposed design approach. This decision was based primarily on the range of the reference reach data available and the desired performance of the site.

7.1.2 Target Wetland Types

No wetland restoration or enhancement is included in this mitigation project.

7.1.3 Target Plant Communities

Native species riparian vegetation will be established in the riparian buffer throughout the site. Schafale and Weakley's (1990) guidance on vegetation communities for Piedmont/Mountain Bottomland Forest (mixed riparian community) and Dry-Mesic Oak-Hickory Forest (Piedmont Subtype), the USACE Wetland Research Program (WRP) Technical Note VN-RS-4.1 (1997), as well as existing mature species identified throughout the project area, were referenced during the development of riparian and adjacent wetland planting lists for the site. In general, bare root vegetation will be planted at a target density of 684 stems per acre. Live stakes will be planted along the channels at a target density of 40 stakes per 1,000 square feet. Using triangular spacing along the stream banks, the live stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing.

Invasive species vegetation, such as Chinese privet (*Ligustrum sinense*), Multiflora rose (*Rosa multiflora*), and Microstegium (*Microstegium vimineum*), will be removed and to allow native plants to become established within the conservation easement. Larger native tree species will be preserved and harvested woody material will be utilized to provide bank stabilization cover and/or nesting habitat. Hardwood species will be planted to provide the appropriate vegetation for the restored riparian buffer areas. The vegetation selection will include native species found in local plant communities such as River birch (*Betula nigra*), Green ash (*Fraxinus pennsylvanica*), Tulip poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), and White oak (*Quercus alba*).

7.2 Design Parameters

Selection of design criteria is based on a combination of approaches, including review of reference reach data, regime equations, evaluation of monitoring results from past projects, and best professional judgment. Evaluating data from reference reach surveys and monitoring results from multiple rural Piedmont stream restoration projects provided pertinent background information and rational to determine

the appropriate design parameters given the existing conditions and overall site potential. The design parameters for the site (shown in Section 17, Appendix C) also considered the USACE *Stream Mitigation Guidelines* (USACE, 2003) and NCEEP's supplemental guidance document *Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* dated November 7, 2011.

The restoration activities and structural elements are justified for the following reasons:

1. Many of the stream sections are incised (Bank Height Ratios greater than 1.5) and the cattle access has resulted in significant degradation throughout the site;
2. Past agricultural and silvicultural activities, such as timber production and channelization, have resulted in bank erosion, sedimentation and the loss of woody vegetation within the riparian zone;
3. Enhancement or preservation measures alone would not achieve the highest possible level of functional lift for many portions of the degraded headwater stream system.

For design purposes, the stream channels were divided into multiple reaches labeled HC-R1, HC-R2, HC-R3, UT4-R1, UT4-R2, UT4-R3, UT4-R4 and UT4-R5, as shown in Table 7.1. Selection of a general restoration approach was the first step in selecting design criteria for the project reaches. The approach was based on the potential for restoration as determined during the site assessment and the specific design parameters were developed so that plan view layout, cross-section dimensions, and profile could be described for developing construction documents. The design philosophy is to use these design parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods of time under the processes of flooding, re-colonization of vegetation, and watershed influences.

Table 7.1 Project Design Stream Types

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Reach	Proposed Stream Type	Approach/Rationale
Hurricane Creek – R1	C	Baker proposes to implement Priority Level I Restoration by utilizing the pasture beyond the existing right bank to restore floodplain connection and a stable Rosgen C type channel. The stream will however, be constructed as close as possible to the existing tree line. This will allow the ease of construction in the pasture, while also taking advantage of the shading, biomass input, etc. of the existing mature riparian trees to remain. This approach will provide the highest ecological functional uplift. A short section of Priority Level II Restoration will be constructed in the upstream section to raise (vertical transition as quickly as possible at an appropriate rate) the incised channel to the existing floodplain. The restored channel will be constructed off-line along the existing field edge. The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel. Riparian buffers in excess of 50 feet will be restored or protected along both sides of the entire reach.
Hurricane Creek – R2	C/Bc	Baker proposes to implement Priority Level I Restoration to continue the stable Rosgen C type channel from HC- R1. As with HC- R1, HC-R2 will be constructed beyond the existing right bank in existing pasture and up against the existing mature riparian buffer trees to remain. In the downstream section, Priority II Restoration will be designed to return the stream to

Table 7.1 Project Design Stream Types

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Reach	Proposed Stream Type	Approach/Rationale
		the existing bed elevation at the downstream end of the project, albeit with floodplain benching. The mature trees will be preserved and the riparian buffers in excess of 50 feet will be restored or protected along the entire reach. These techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from bank erosion. This reach will be designed as a Rosgen C type channel in the upstream Priority Level I section and transition to a Rosgen Bc type channel in the shorter downstream Priority II section. The design width/depth ratio for the channel will range between 10-14, and over time, the channel will likely narrow to an E-type channel due to deposition of sediment and streambank vegetation growth.
Hurricane Creek – R3	C/E	Level II Enhancement is proposed to restore a more stable dimension and profile. The stream only slightly incised and approaches will include permanent exclusion of cattle, minor grading of isolated sections of the degraded stream banks, limited use of structures to promote channel stability and bedform diversity. Riparian buffers in excess of 50 feet will be restored or enhanced along both sides of HC-R3. The existing stream crossing near the downstream end of HC-R3 and its confluence with Hurricane Creek will be improved as part of the proposed project.
UT4 – R1	C/Bc	The proposed strategy for UT4-R1 is to stabilize the active headcut near the culvert crossing and preserve the section upstream of the power line easement. Priority Level I Restoration is proposed along the downstream section to restore a Rosgen C/Bc type channel that is reconnected to its floodplain and provides restored riparian buffers between the stream and adjacent farmland. Riparian buffers in excess of 50 feet will be preserved or restored along both sides of all of UT4-R1.
UT4 – R2	C	UT4-R2 begins at the confluence of UT4-R1 and UT4-R5 and flows west for approximately 1,627 LF. This reach has a minimal riparian buffer, especially on the left floodplain. The channel is a deeply incised Rosgen G type channel with a BHR of 3.5. The reach has been channelized, as evidenced by its lack of pattern and the relic spoil piles on the stream banks. Additionally, cattle have access to the channel, actively impacting the stream. A Priority Level I restoration approach is proposed for this reach to reconnect a Rosgen C type channel

Table 7.1 Project Design Stream Types

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Reach	Proposed Stream Type	Approach/Rationale
		with its existing floodplain, as well as to re-establish pattern and provide bedform diversity. This approach involves constructing the restored channel off-line and along the low part of the valley (to the left side of the existing channel). The benefits of this approach are that floodplain connection is restored, limited impact to desirable native trees along the existing channel, and the ability to provide full restoration of a natural channel pattern and appropriate stream functions. Cattle will be excluded from the project area by fencing and riparian buffers in excess of 50 feet will be restored along all of UT4-R2.
UT4 – R3	Bc	UT4-R3 begins at the confluence of UT4-R2 and UT4-R4 and flows north for approximately 227 LF. It has similar characteristics as the lower section of UT4-R4; namely, an unstable Rosgen G type channel with a BHR greater than 3, as well as an adequate buffer beyond the right bank and a very narrow one on the left. Baker proposes to continue the Priority Level I Restoration from UT4-R2, though it will transition to Priority II Restoration to reconnect with the existing incised channel on the downstream end of the project reach. Nevertheless, a stable Bc stream type channel will be built to reconnect the stream with an active floodplain, as well as to re-establishing pattern and bedform diversity. Riparian buffers in excess of 50 feet will be restored along all of Reach R3.
UT4 – R4	C	UT4-R4 is a headwater tributary that flows north for approximately 1,716 LF to its confluence with UT4-R2. UT4-R4 has two distinct sections: an upstream, channelized reach with a very poor riparian buffer (pasture); and a downstream reach that is more deeply incised due to a migrating headcut. The riparian buffer on the downstream section is adequate on the right bank and very narrow on the left bank. The upstream section is an incised Rosgen E type channel in early Stage III of Simon's Channel Evolution. The downstream section is an unstable Rosgen G type channel with a BHR of more than 3.0. Baker proposes Priority Level I Restoration for the entire reach to reconnect a Rosgen C type channel with its floodplain, as well as to re-establish pattern and provide bedform diversity. Riparian buffers in excess of 50 feet will be restored or protected along both sides of the entire reach.
UT4 – R5	C/E	UT4-R5 is an intermittent headwater channel that flows north for approximately 1,564 LF before joining with UT4-R1. The riparian buffer is narrow, consisting of one or two rows trees (most commonly pine species). Historical cattle impacts are more apparent than UT4-R1. As with UT4-R1, cattle were removed from this reach approximately three years ago. The channel is an unstable Rosgen G type channel for 311 LF

Table 7.1 Project Design Stream Types Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351		
Reach	**Proposed Stream Type**	**Approach/Rationale**
		on the downstream end through which a headcut has migrated upstream. The upper section and majority of UT4-R5 is an incised E channel. Overall, the reach is in Stage III of Simon's Channel Evolution. Baker proposes Level I Enhancement to establish a stable Rosgen C/E type channel for all of UT4-R5. Riparian buffers in excess of 50 feet will be restored or protected along both sides of the entire reach.

7.3 Data Analysis

Baker compiled and assessed watershed information such as drainage areas, historical land use, geologic setting, soil types, and terrestrial plant communities. The results of the existing condition analyses along with reference reach data from previous projects were used to develop a proposed stream restoration design for the project reaches. Numerous sections of the existing tributaries throughout the project area have been straightened/channelized or moved in the past. This manipulation has impacted channels that are now overly deep and overly wide for the given drainage areas. Within the existing forested areas near the upper sections of the project, the site streams are mostly stable and likely existed prior to manipulation as a "Bc" stream type, or a gently meandering step-pool channel. This is evidenced by stable morphological features, the presence of knickpoints and valley morphology. The channel slopes within the main stems are generally consistent with the valley topography.

Additionally, detailed topographic surveys were conducted along the channel and floodplain to determine the elevation of the stream where it flows throughout property, and to validate the valley signatures shown on the LiDAR imagery (Figure 2.6).

The design approach follows the Rosgen "step-wise" methodology in which dimensionless ratios from the reference reach and successful past project experience are used to restore stable dimension, pattern, and profile, as well as proper bankfull sediment-transport competency for the proposed reaches. The stream channel design included analysis of the hydrology, hydraulics, shear stress, sediment transport, and appropriate channel dimensions. The critical shear stress and boundary shear stress analysis was used verify that the design channels will not aggrade nor degrade.

Baker also performed representative pebble counts and collected subpavement samples in order to evaluate bed material characteristics and sediment transport. The results of the substrate analyses were used to classify the streams and to complete shear stress, sediment transport, and stability analyses.

Regional curve equations developed for the North Carolina Piedmont (Harman et al., 1999) estimates bankfull cross-sectional areas of approximately 36 square feet for a 2.16 square mile watershed (Hurricane Creek) and 28.5 square feet for a 1.52 square mile watershed (UT4) (see Appendix C, Table 17.5). However, the existing channels have cross-sectional areas at the top-of-banks of 52 square feet for Hurricane Creek and 94 square feet for lower UT4. Since the Rosgen stream classification system (Rosgen, 1996) depends on the proper identification of bankfull, the stream classification is difficult under these conditions. Lower Hurricane Creek mainstem classifies as a channelized G5c stream type due to its calculated entrenchment ratio (based on an estimation of bankfull area from the NC Piedmont regional curve), channel slope, and channel substrate (sand). The lower section of UT4-R3 also classifies as a channelized G5c stream type.

Throughout the channelized reaches, bedform feature formation is poor with minimal habitat diversity or woody debris except for trees that have slumped or eroded from the stream banks. The riparian buffer vegetation and width are lacking throughout most the project areas with exceptions of HC-R3, UT4-R1,

UT4-R3, and upper UT4-R5. The streams display no measurable meander geometry due to its channelized condition. These conditions generally lead to lateral instability over time; however, a low-flow regime and vegetation on the banks have served to maintain some stability or quasi-equilibrium conditions along various portions of the project reaches.

The proposed design approach will restore hydrologic conditions prior to channelization by raising the local water table and base flow levels, as well as introducing natural flooding. The existing conditions data indicate that proposed mitigation activities will result in re-establishment of functional stream and floodplain ecosystem. The restoration and enhancement efforts, including site protection from a conservation easement, will promote the greatest ecological benefit, a rapid recovery period, and a justifiable and reduced environmental impact over a natural recovery that would otherwise occur through erosional processes with associated impacts on water resources and flooding.

Additionally, by raising the stream bed and reconnecting the active floodplains, the maximum degree of potential uplift will be provided, restoring and/or enhancing stream, buffer, and wetland functions whenever possible. Functional uplift will also be provided to the system by improving and extending wildlife corridors that connect with wooded areas near the upstream and downstream extents of the project reaches. The water quality of the Brown Creek tributaries will be improved by providing permanent cattle exclusion fencing along the tributaries, as well as reducing nutrient and sediment inputs.

8.0 MAINTENANCE PLAN

The site will be monitored on a regular basis and a physical inspection of the site will take place at least once a year throughout the post-construction monitoring period until performance standards are met. These site inspections may identify site components and features that require routine maintenance. Routine maintenance will be most likely in the first two years following site construction and may include the following components as described in Table 8.1:

Table 8.1 Routine Maintenance Components

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Feature	Maintenance through project close-out
Stream	Routine channel maintenance and repair activities may include modifying in-stream structures to prevent piping, securing loose coir matting, and supplemental installations of live stakes and other target vegetation along the project reaches. Areas of concentrated stormwater and floodplain flows that intercept the channel may also require maintenance to prevent bank failures and head-cutting until vegetation becomes established.
Wetland	N/A
Vegetation	Vegetation will be maintained to ensure the health and vigor of the targeted plant community. Routine vegetation maintenance and repair activities may include supplemental planting, pruning, and fertilizing. Exotic invasive plant species will controlled by mechanical and/or chemical methods. Any invasive plant species control requiring herbicide application will be performed in accordance with NC Department of Agriculture (NCDA) rules and regulations.
Site Boundary	Site boundaries will be demarcated in the field to ensure clear distinction between the mitigation site and adjacent properties. Boundaries may be identified by fence, marker, bollard, post, or other means as allowed by site conditions and/or conservation easement. Boundary markers disturbed, damaged, or destroyed will be repaired and/or replaced on an as needed basis.
Farm Road Crossing	The farm crossings within the site may be maintained only as allowed by the recorded Conservation Easement, deed restrictions, rights of way, or corridor agreements.
Beaver Management	Routine maintenance and repair activities caused by beaver activity may include supplemental planting, pruning, and dewatering/dam removal. Beaver management will be implemented using accepted trapping and removal methods only within the recorded Conservation Easement.

9.0 PERFORMANCE STANDARDS

Baker has obtained regulatory approval for numerous stream mitigation plans involving NCDOT and NCEEP full-delivery projects. The success criteria for the project site will follow the mitigation plans developed for these projects, as well as the *Stream Mitigation Guidelines* issued in April 2003 and October 2005 (USACE and NCDWR, 2003) and NCEEP's supplemental guidance document *Monitoring Requirements and Performance Standards for Stream and/or Wetland Mitigation* dated November 7, 2011. All monitoring activities will be conducted for a period of 7 years, unless the site demonstrates complete success by year 5 and no concerns have been identified. An early closure provision may be requested by the provider for some or all of the monitoring components. Early closure may only be obtained through written approval from the USACE in consultation with the NCIRT.

Based on the design approaches, different monitoring methods are proposed for the project reaches. For reaches that involve a combination of traditional Restoration (Rosgen Priority Level I and II) and Enhancement Level I (bed/bank stabilization) approaches, geomorphic monitoring methods will follow those recommended by the 2003 SMG and the 2011 NCEEP supplemental guidance. For any reaches involving Enhancement Level II and Preservation approaches, monitoring efforts will focus primarily on visual inspections, photo documentation, and vegetation assessments. The monitoring parameters shall be consistent with the requirements described in the Federal Rule for compensatory mitigation sites in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.5 paragraphs (a) and (b). Specific success criteria components and evaluation methods are described below.

9.1 Stream Monitoring

Geomorphic monitoring of the proposed restoration reaches will be conducted once a year for a minimum of seven years following the completion of construction to evaluate the effectiveness of the restoration practices. The monitoring will confirm that the restoration is achieving its stated goals of creating geomorphically stable conditions that have reduced bank erosion, as well as nutrient and sediment inputs. Monitored stream parameters include stream dimension (cross-sections), pattern (planimetric survey), profile (longitudinal profile survey), and visual observation with photographic documentation. The success criteria for the proposed Enhancement Level II and Preservation reaches/sections will follow the methods described under Visual Assessment and Vegetation Monitoring. The methods used and related success criteria are described below for each parameter.

9.1.1 Bankfull Events and Flooding Functions

The occurrence of bankfull events within the monitoring period will be documented by the use of a crest gauge and photographs. The crest gauge will be installed on the floodplain within ten feet of the restored channel. The crest gauge will record the highest watermark between site visits, and the gauge will be checked at each site visit to determine if a bankfull event has occurred. Photographs will be used to document the occurrence of debris lines and sediment deposition on the floodplain during monitoring site visits. This monitoring will help establish that the restoration objectives of restoring floodplains and promoting natural flooding processes are being met.

Two bankfull flow events must be documented within a seven-year monitoring period. The two bankfull events must occur in separate years; otherwise, the monitoring will continue until two bankfull events have been documented during the seven-year post construction monitoring period.

9.1.2 Cross-sections

Permanent cross-sections will be installed at an approximate rate of one cross-section per twenty bankfull widths or an average distance interval (not to exceed 500 LF) of restored stream, with approximately ten (10) cross-sections located at riffles, and five (5) located at pools. Each cross-section will be marked on both stream banks with permanent monuments using rebar cemented in place to

establish the exact transect used. A common benchmark will be used for cross-sections and consistently used to facilitate easy comparison of year-to-year data. The cross-section surveys will occur in years one, two, three, five, and seven, and must include measurements of Bank Height Ratio (BHR) and Entrenchment Ratio (ER). The monitoring survey will include points measured at all breaks in slope, including top of stream banks, bankfull, inner berm, edge of water, and thalweg, if the features are present. Riffle cross-sections will be classified using the Rosgen Stream Classification System.

There should be little change in as-built cross-sections. Stable cross-sections will establish that the restoration goal of creating geomorphically stable stream conditions has been met. If changes do take place, they will be documented in the survey data and evaluated to determine if they represent a movement toward a more unstable condition (e.g., down-cutting or erosion) or a movement toward increased stability (e.g., settling, vegetative changes, deposition along the stream banks, or decrease in width/depth ratio). Using the Rosgen Stream Classification System, and all monitored cross-sections should fall within the quantitative parameters (i.e. BHR no more than 1.2 and ER no less than 2.2 for 'C' stream types) defined for channels of the design stream type. Given the smaller channel sizes and meander geometry of the proposed steams, bank pins will not be installed unless monitoring results indicate active lateral erosion.

Reference photo transects will be taken at each permanent cross-section. Lateral photos should not indicate excessive erosion or continuing degradation of the stream banks. Photographs will be taken of both stream banks at each cross-section. The survey tape will be centered in the photographs of the stream banks. The water line will be located in the lower edge of the frame, and as much of the stream bank as possible will be included in each photo. Photographers should make an effort to consistently maintain the same area in each photo over time.

9.1.3 Pattern

The plan view measurements such as sinuosity, radius of curvature, meander width ratio will be taken on newly constructed meanders during baseline (year-0) only. Subsequent visual monitoring will be conducted twice a year, at least five months apart, to document any changes or excessive lateral movement in the plan view of the restored channel.

9.1.4 Longitudinal Profile

A longitudinal profile will be surveyed for the entire length of restored channel immediately after construction to document as-built baseline conditions for the first year of monitoring only. The survey will be tied to a permanent benchmark and measurements will include thalweg, water surface, bankfull, and top of low bank. Each of these measurements will be taken at the head of each feature (e.g., riffle, pool) and at the maximum pool depth. The longitudinal profile should show that the bedform features installed are consistent with intended design stream type. The longitudinal profiles will not be taken during subsequent monitoring years unless vertical channel instability has been documented or remedial actions/repairs are deemed necessary. These measurements will demonstrate that the restored stream profile provides more bedform diversity than the old channel with multiple natural features (such as scour pools and riffles) that provide improved aquatic habitat, as per the restoration objectives.

9.1.5 Bed Material Analyses

After construction, there should be a minimal change in the pebble count data or particle size distribution over time given the current watershed conditions and future upstream sediment supply regime. Since the streams are predominantly sand bed systems with minimal fine/coarse gravel, significant changes in particle size distribution are not expected. A representative sample will be collected in Hurricane Creek (HC-R1) and UT4 (Reach UT4-R2) in locations where riffles are installed as part of the project. The post-construction riffle substrate samples will be compared to the existing riffle substrate data collected during the design phase. Any significant changes (i.e.; aggradation, degradation, embeddedness) will be noted after stream bank vegetation becomes established and a

minimum of two bankfull flows or greater have been documented. If changes are observed within stable riffles and pools, additional sediment transport analyses and calculations may be required.

9.1.6 Visual Assessment

Visual monitoring assessments of all stream sections will be conducted by qualified personnel twice per monitoring year with at least five months in between each site visit for each of the seven years of monitoring. Photographs will be used to visually document system performance and any areas of concern related to stream bank and bed stability, condition of in-stream structures, channel migration, headcuts, live stake mortality, impacts from invasive plant species or animal species, and condition of pools and riffles. This monitoring will be summarized in the Visual Stream Morphology Stability Assessment Table and the Vegetation Conditions Assessment Table, which are used to better document and quantify the visual assessment.

A series of photos over time will be also be used to subjectively evaluate channel aggradation (bar formations) or degradation, stream bank erosion, successful maturation of riparian vegetation, and effectiveness of sedimentation and erosion control measures. More specifically, the longitudinal photos should indicate the absence of developing bars within the channel or excessive increase in channel depth, while lateral photos should not indicate excessive erosion or continuing degradation of the banks. The photographs will be taken from a height of approximately five to six feet to ensure that the same locations (and view directions) at the site are documented in each monitoring period and will be shown on a plan view map. The visual monitoring effort, including the assessment tables and photo locations with descriptions, will be conducted per NCEEP's annual monitoring report guidance (v1.5, June 2012, and Feb 2014 update).

9.1.7 Flow Documentation

Monitoring of flow will be conducted to demonstrate that the restored stream systems classified as intermittent exhibit base flow for some portion of the year during a year with normal rainfall conditions. In order to determine if rainfall amounts are normal for the given year, a rainfall gage will be installed on the site to compare precipitation amounts using tallied data obtained from the Anson County WETS Station and from the automated weather station (Wadesboro, COOP 318964 and Anson County Airport (KAFP-AWOS), approximately two miles south of the site. Data from the weather station can be obtained from the CRONOS Database located on the State Climate Office of North Carolina's website. If a normal year of precipitation does not occur during the first seven years of monitoring, Baker will continue to monitor flow conditions on the site until it documents that the intermittent streams have been flowing during the appropriate times of the year.

The proposed monitoring of the restored intermittent reaches will include a combination of photographic documentation and the installation of groundwater monitoring wells within the thalweg (bottom) of the channel towards the downstream portion of the reach. Along Hurricane Creek, a regular and continuous series of remote photos over time will be used to subjectively evaluate channel flow conditions throughout the year. More specifically, the longitudinal photos should indicate the presence of flow within the channel in order to illustrate water levels within the pools and riffles. The photographs will be taken from a height of approximately five to six feet to ensure that the same locations (and view directions) at the site are documented in each monitoring period and will be shown on a plan view map. The visual monitoring effort, including the photo locations with descriptions, will be included with NCEEP's annual monitoring reports.

The monitoring wells (pressure transducers) along UT4 will be installed towards the downstream portion of restored intermittent reaches. The devices will be inspected on a quarterly/semi-annual basis to document surface hydrology and provide a basis for evaluating general flow response to rainfall events and surface runoff during various water tables levels throughout the monitoring period.

9.2 Vegetation Monitoring

Successful restoration of the vegetation on a site is dependent upon hydrologic restoration, planting of preferred canopy species, and volunteer regeneration of the native plant community. This restoration fulfills the project objective of establishing riparian buffer function and corridor habitat using native plant species. In order to determine if the success criteria are achieved, vegetation-monitoring quadrants will be installed and monitored across the restoration site in accordance with the CVS-NCEEP Protocol for Recording Vegetation, Version 4.1 (2007). The vegetation monitoring plots shall be a minimum of 2% of the planted portion of the site with a minimum of sixteen (16) plots established randomly within the planted riparian buffer areas per Monitoring Levels 1 and 2. No monitoring quadrants will be established within undisturbed wooded areas, such as those along Reaches UT4-R1a and UT4-R5a. The size of individual quadrants will be 100 square meters for woody tree species.

Vegetation monitoring will occur in the fall each year, prior to the loss of leaves. Individual quadrant data will be provided and will include species diameter, height, density, and coverage quantities. Relative values will be calculated, and importance values will be determined. Individual seedlings will be marked such that they can be found in succeeding monitoring years. Mortality will be determined from the difference between the previous year's living, planted seedlings and the current year's living, planted seedlings.

At the end of the first full growing season (from baseline/year 0) or after 180 days between March 1st and November 30th, species composition, stem density, and survival will be evaluated. For each subsequent year, vegetation plots shall be monitored for seven years in years 1, 2, 3, 5 and 7 or until the final success criteria are achieved. The restored site will be evaluated between March and November. The interim measure of vegetative success for the site will require the survival of at least 320, 3-year old, planted trees per acre at the end of year three of the monitoring period. At year five, density must be no less than 260, 5-year old, planted trees per acre. The final vegetative success criteria will be the survival of 210, 7-year old, planted trees per acre at the end of the seven-year monitoring period, which must average 10 feet in height. However, if the performance standard is met by Year 5 and stem densities are greater than 260, 5-year old stems/acre, vegetation monitoring may be terminated with approval by the USACE and the NCIRT.

While measuring species density and height is the current accepted methodology for evaluating vegetation success on mitigation projects, species density and height alone may be inadequate for assessing plant community health. It is understood by the NCIRT that some smaller tree species, such as *Carpinus caroliniana*, will unlikely meet height targets after seven years. For this reason, the vegetation monitoring plan will incorporate the evaluation of additional plant community indices, native volunteer species, and the presence of invasive species vegetation to assess overall vegetative success.

Baker will provide required remedial action on a case-by-case basis, such as: replanting more wet/drought tolerant species vegetation, conducting beaver and beaver dam management/removal, and removing undesirable/invasive species vegetation, and will continue to monitor vegetation performance until the corrective actions demonstrate that the site is trending towards or meeting the standard requirement. Existing mature woody vegetation will be visually monitored during annual site visits to document any mortality, due to construction activities or changes to the water table, that negatively impact existing forest cover or favorable buffer vegetation.

Additionally, herbaceous vegetation, primarily native species grasses, will be seeded/planted throughout the site. During and immediately following construction activities, all ground cover at the project site must be in compliance with the NC Erosion and Sedimentation Control regulations and applicable permitting requirements.

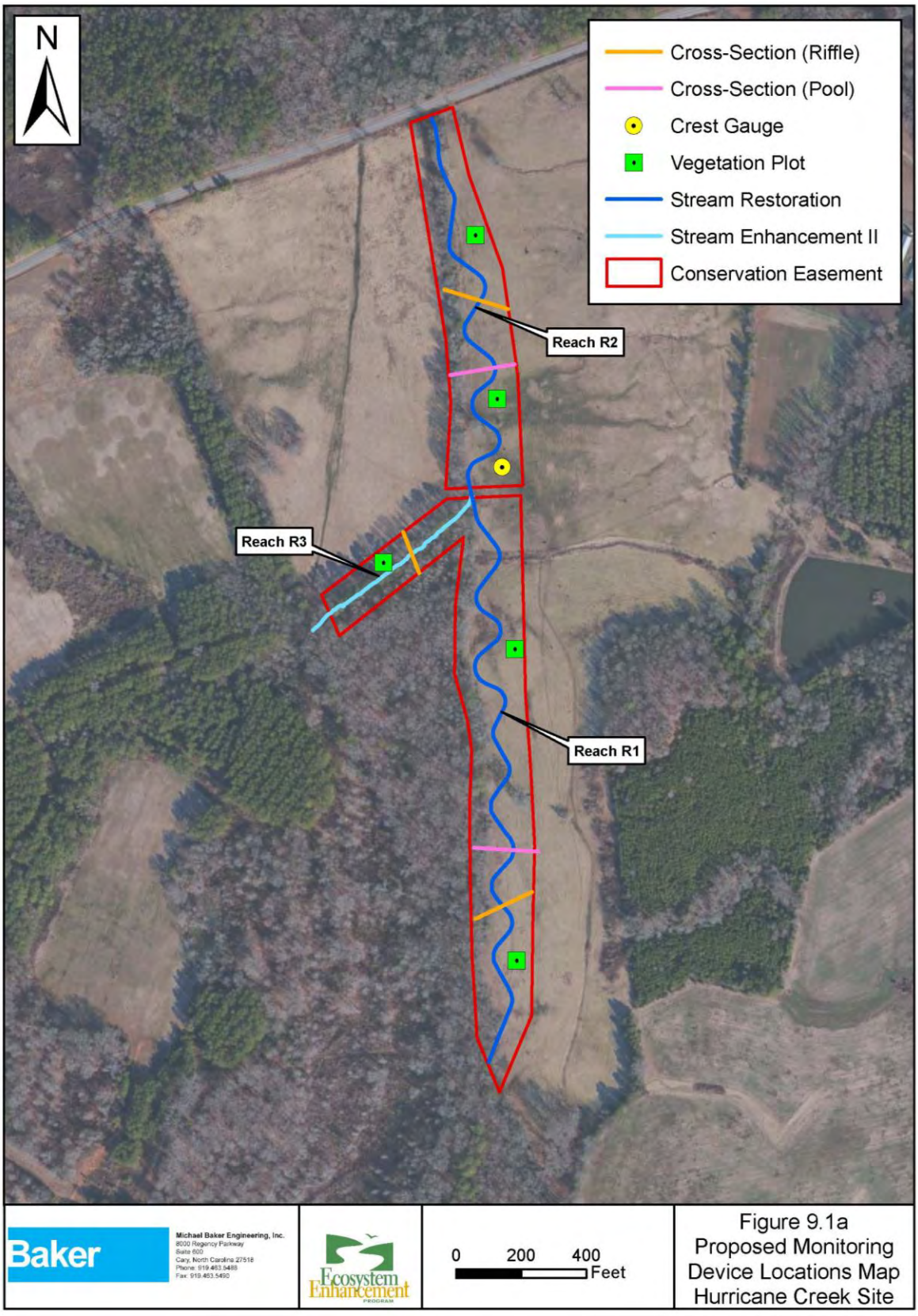
9.3 Wetland Monitoring

No wetlands are proposed at the site therefore wetland monitoring will not be included.

9.4 Stormwater Management Monitoring

No stormwater BMPs are proposed at the site therefore stormwater management monitoring will not be included.

Figure 9.1 Proposed Monitoring Device Locations



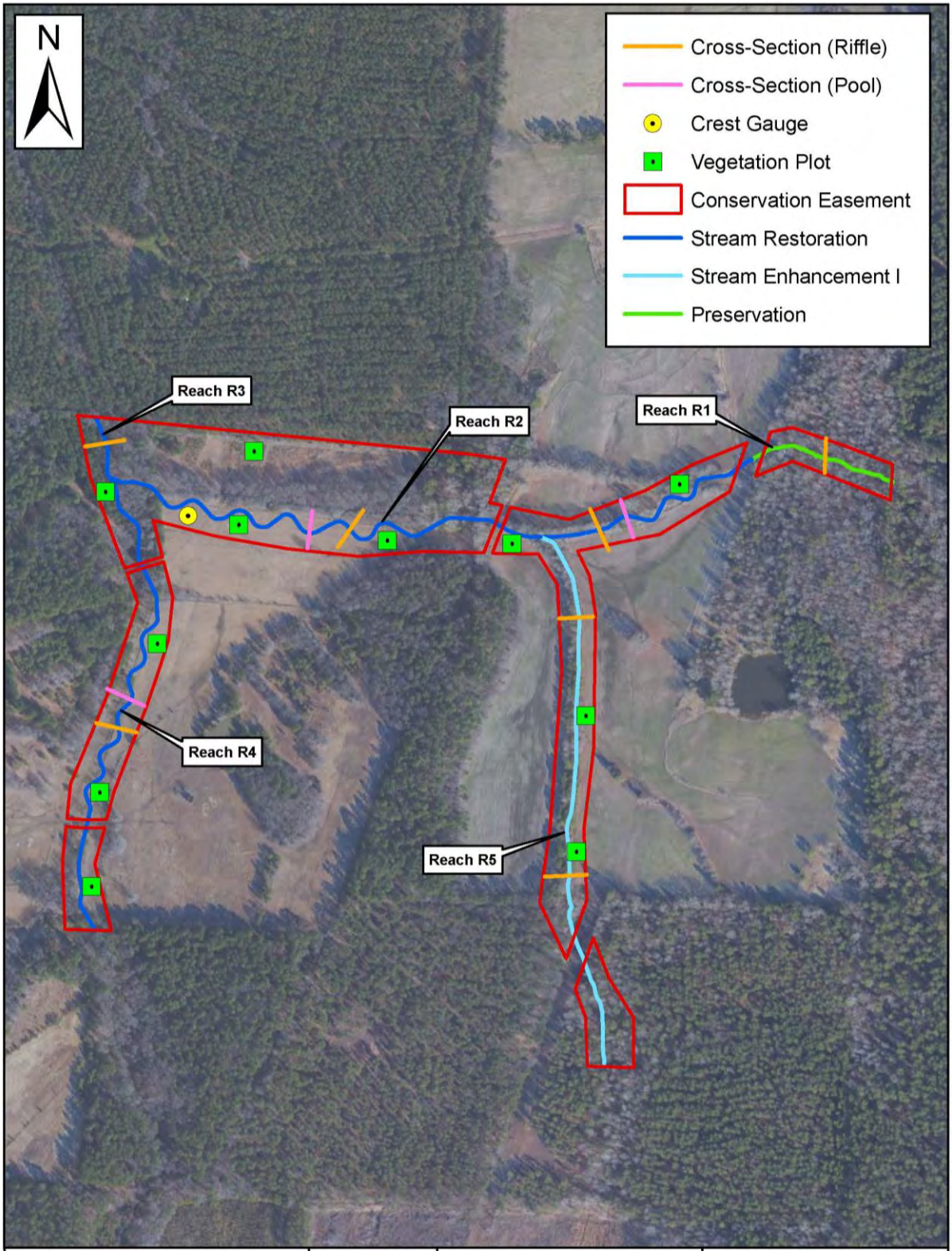


Figure 9.1b
Proposed Monitoring Device Locations Map
UT4 Site

10.0 MONITORING REQUIREMENTS

Annual monitoring reports containing the information defined within Table 10.1 below will be submitted to NCEEP by December 31st of the each year during which the monitoring was conducted. The monitoring report shall provide a project data chronology for NCEEP to document the project status and trends, for population of NCEEP databases for analysis, for research purposes, and to assist in decision making regarding project close-out. Project success criteria must be met by the final monitoring year prior to project closeout, or monitoring will continue until unmet criteria are successfully met.

Table 10.1 Monitoring Requirements

UT to Cane Creek Restoration Project Stream Mitigation Plan - NCEEP Project No. 95729

Required	Parameter	Quantity	Frequency	Notes
X	Pattern	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	As-built Year and as needed	Pattern data, including bank erosion pins/arrays in pool cross-sections, will be collected only if there are indications through profile and dimensional data that significant geomorphological adjustments occurred.
X	Dimension	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCEEP Monitoring Requirements	Monitoring Years 1, 2, 3, 5 and 7	Cross-sections to be monitored over seven (7) years and shall include assessment of bank height ratio (BHR) and entrenchment ratio (ER).
X	Profile	As per November 2011 NCEEP Monitoring Requirements	As-built Year and as needed	For restoration or enhancement I components, 3,000 linear feet or less, the entire length will be surveyed. For mitigation segments in excess of this footage, 30% of the length or 3,000 feet will be surveyed, whichever is greater.
X	Substrate	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines and November 2011 NCEEP Monitoring Requirements	Annually	A substrate sample will be collected if constructed riffles are installed as part of the project. One constructed riffle substrate sample will be compared to existing riffle substrate data collected during the design phase.
X	Surface Water Hydrology	As per April 2003 USACE Wilmington District Stream Mitigation Guidelines	Annually	A crest gauge and/or pressure transducer will be installed on site; the device will be inspected on a quarterly/semi-annual basis to document the occurrence of bankfull events on the project.
X	Vegetation	NCEEP-CVS Guidance	Annually	Vegetation will be monitored using the Carolina Vegetation Survey (CVS) protocols.
X	Exotic Species and Nuisance Vegetation		Semi-Annually	Locations of exotic species and nuisance vegetation will be visually assessed and mapped a minimum of 5 months apart.
X	Visual Assessment	As per November 2011 NCEEP Monitoring Requirements	Semi-Annually and as needed	Representative photographs will be taken to capture the state of the restored channel and vegetated buffer conditions. Stream photos will be preferably taken in the same location when the vegetation is minimal to document any areas of concern or to identify trends.
X	Project Boundary		Semi-Annually	Locations of fence damage, vegetation damage, boundary encroachments, etc. will be mapped

11.0 LONG-TERM MANAGEMENT PLAN

Upon approval for close-out by the NCIRT, the site will be transferred to the NCDENR. This party shall be responsible for periodic inspection of the site to ensure that restrictions required in the conservation easement or the deed restriction document(s) are upheld. Endowment funds required to uphold easement and deed restrictions shall be negotiated prior to site transfer to the responsible party.

The NCDENR Division of Natural Resource Planning and Conservation's Stewardship Program currently houses NCEEP stewardship endowments within the non-reverting, interest-bearing Conservation Lands Stewardship Endowment Account. The use of funds from the Endowment Account is governed by North Carolina General Statue GS 113A-232(d) (3). Interest gained by the endowment fund may be used only for the purpose of stewardship, monitoring, stewardship administration, and land transaction costs, if applicable. The NCDENR Stewardship Program intends manage the account as a non-wasting endowment. Only interest generated from the endowment funds will used to steward the compensatory mitigation sites. Interest funds not used for those purposes will be re-invested in the Endowment Account to offset losses due to inflation.

12.0 ADAPTIVE MANAGEMENT PLAN

Upon completion of site construction, NCEEP will implement the post-construction monitoring protocols previously defined in this document. Project maintenance will be performed as described previously in this document. If, during the course of annual monitoring it is determined the site's ability to achieve site performance standards are jeopardized, NCEEP will notify the USACE of the need to develop a Plan of Corrective Action. The Plan of Corrective Action may be prepared using in-house technical staff or may require engineering and consulting services. Once the Corrective Action Plan is prepared and finalized NCEEP will:

1. Notify the USACE as required by the Nationwide 27 permit general conditions.
2. Revise performance standards, maintenance requirements, and monitoring requirements as necessary and/or required by the USACE.
3. Obtain other permits as necessary.
4. Implement the Corrective Action Plan.
5. Provide the USACE a Record Drawing of Corrective Actions. This document shall depict the extent and nature of the work performed.

13.0 FINANCIAL ASSURANCES

Pursuant to Section IV H and Appendix III of the Ecosystem Enhancement Program's In-Lieu Fee Instrument dated July 28, 2010, the North Carolina Department of Environment and Natural Resources has provided the USACE-Wilmington District with a formal commitment to fund projects to satisfy mitigation requirements assumed by NCEEP. This commitment provides financial assurance for all mitigation projects implemented by the program.

14.0 OTHER INFORMATION

14.1 Definitions

This document is consistent with the requirements of the federal rule for compensatory mitigation sites as described in the Federal Register Title 33 Navigation and Navigable Waters Volume 3 Chapter 2 Section § 332.8 paragraphs (c)(2) through (c)(14). Specifically the document addresses the following requirements of the federal rule:

(2) *Objectives.* A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.

(3) *Site selection.* A description of the factors considered during the site selection process. This should include consideration of watershed needs, onsite alternatives where applicable, and the practicability of accomplishing ecologically self-sustaining aquatic resource restoration, establishment, enhancement, and/or preservation at the compensatory mitigation site. (See § 332.3(d).)

(4) *Site protection instrument.* A description of the legal arrangements and instrument, including site ownership, that will be used to ensure the long-term protection of the compensatory mitigation site (see § 332.7(a)).

(5) *Baseline information.* A description of the ecological characteristics of the proposed compensatory mitigation site and, in the case of an application for a DA permit, the impact site. This may include descriptions of historic and existing plant communities, historic and existing hydrology, soil conditions, a map showing the locations of the impact and mitigation site(s) or the geographic coordinates for those site(s), and other site characteristics appropriate to the type of resource proposed as compensation. The baseline information should also include a delineation of waters of the United States on the proposed compensatory mitigation site. A prospective permittee planning to secure credits from an approved mitigation bank or in-lieu fee program only needs to provide baseline information about the impact site, not the mitigation bank or in-lieu fee site.

(6) *Determination of credits.* A description of the number of credits to be provided, including a brief explanation of the rationale for this determination. (See § 332.3(f).)

(7) *Mitigation work plan.* Detailed written specifications and work descriptions for the compensatory mitigation project, including, but not limited to, the geographic boundaries of the project; construction methods, timing, and sequence; source(s) of water, including connections to existing waters and uplands; methods for establishing the desired plant community; plans to control invasive plant species; the proposed grading plan, including elevations and slopes of the substrate; soil management; and erosion control measures. For stream compensatory mitigation projects, the mitigation work plan may also include other relevant information, such as plan form geometry, channel form (e.g. typical channel cross-sections), watershed size, design discharge, and riparian area plantings.

(8) *Maintenance plan.* A description and schedule of maintenance requirements to ensure the continued viability of the resource once initial construction is completed.

(9) *Performance standards.* Ecologically-based standards that will be used to determine whether the compensatory mitigation project is achieving its objectives. (See § 332.5.)

(10) *Monitoring requirements.* A description of parameters to be monitored in order to determine if the compensatory mitigation project is on track to meet performance standards and if adaptive management is

needed. A schedule for monitoring and reporting on monitoring results to the district engineer must be included. (See § 332.6.)

(11) *Long-term management plan.* A description of how the compensatory mitigation project will be managed after performance standards have been achieved to ensure the long-term sustainability of the resource, including long-term financing mechanisms and the party responsible for long-term management. (See § 332.7(d).)

(12) *Adaptive management plan.* A management strategy to address unforeseen changes in site conditions or other components of the compensatory mitigation project, including the party or parties responsible for implementing adaptive management measures. The adaptive management plan will guide decisions for revising compensatory mitigation plans and implementing measures to address both foreseeable and unforeseen circumstances that adversely affect compensatory mitigation success. (See § 332.7(c).)

(13) *Financial assurances.* A description of financial assurances that will be provided and how they are sufficient to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with its performance standards (see § 332.3(n)). 2) *Objectives.* A description of the resource type(s) and amount(s) that will be provided, the method of compensation (i.e., restoration, establishment, enhancement, and/or preservation), and the manner in which the resource functions of the compensatory mitigation project will address the needs of the watershed, ecoregion, physiographic province, or other geographic area of interest.

14.2 References

Andrews, E. D., 1983. Entrainment of gravel from naturally sorted river bed material, Geological Society of America Bulletin, 94, 1225-1231.

Bratton, S. P. 1976. Resource Division in an Understory Herb Community: Responses to Temporal and Microtopographic Gradients. The American Naturalist 110 (974):679-693.

Cooper, J.E., S.S. Robinson, and J.B. Funderburg (eds.). 1977. Endangered and Threatened Plants and Animals of North Carolina. North Carolina State Museum of Natural History, Raleigh.

Copeland, R.R, D.N. McComas, C.R. Thorne, P.J. Soar, M.M. Jones, and J.B. Fripp. 2001. United States Army Corps of Engineers (USACOE). Hydraulic Design of Stream Restoration Projects. Washington, DC.

Faber-Langendoen, D., Rocchio, J., Schafale, M., Nordman, C., Pyne, M., Teague, J., Foti, T., Comer, P. (2006), *Ecological Integrity Assessment and Performance Measures for Wetland Mitigation*. NatureServe, Arlington, Virginia.

Federal Interagency Stream Restoration Working Group (FISRWG). 1998. Stream corridor restoration: Principles, processes and practices. National Technical Information Service. Springfield, VA.

Hardin, J.W. 1977. Vascular plants. In: Cooper, J.E., S.S. Robinson, and J.B. Funderburg (eds.). Endangered and Threatened Plants and Animals of North Carolina. North Carolina State Museum of Natural History, Raleigh.

Harman, W.A., G.D. Jennings, J.M. Patterson, D.R. Clinton, L.O. Slate, A.G. Jessup, J.R. Everhart, and R.E. Smith. 1999. Bankfull hydraulic geometry relationships for North Carolina streams. *Wildland Hydrology*. AWRA Symposium Proceedings. D.S. Olsen and J.P. Potyondy, eds. American Water Resources Association. June 30-July 2, 1999. Bozeman, MT.

Harman, W., R. Starr. 2011. Natural Channel Design Review Checklist. US Fish and Wildlife Service, Chesapeake Bay Field Office, Annapolis, MD and US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Wetlands Division. Washington, D.C. EPS 843-B-12-005.

Henson, T.H. 1990. Bald eagle. In: Lee, D.S. and J.F. Parnell (eds.). Endangered, Threatened and Rare Fauna of North Carolina, Part III. A Re-evaluation of the Birds. Occasional Papers of the North Carolina Biological Survey. North Carolina Museum of Natural Sciences, Raleigh.

Knighton, D. 1998. *Fluvial Forms and Processes – A New Perspective*. Arnold Publishers. London.

Lane, E. W. 1955. Design of stable channels. Transactions of the American Society of Civil Engineers. Paper No. 2776: 1234-1279.

Lee, M., Peet R., Roberts, S., Wentworth, T. CVS-NCEEP Protocol for Recording Vegetation, Version 4.1, 2007.

Leopold, Luna B., M. Gordon Wolman, and John P. Miller. 1964. *Fluvial Processes in Geomorphology*. San Francisco, CA. (151).

Leopold, L.B., 1994. *A View of the River*. Harvard University Press. Cambridge, Mass.

North Carolina Department of Environment and Natural Resources. 2006. Water Resources Stream Classifications for Streams in North Carolina. Water Resources Section, November 2006. Raleigh, NC.

North Carolina Ecosystem Enhancement Program. 2009. Upper Yadkin River Basin Restoration Priorities. North Carolina Department of Environment and Natural Resources. Raleigh, North

Carolina. [Online WWW]. Available URL: http://www.nceep.net/services/restplans/Upper_Yadkin_RBRP_2009.pdf .

North Carolina Floodplain Mapping Program.2011. [Online WWW]. Available URL: http://www.ncfloodmaps.com.

North Carolina Natural Heritage Program (NHP) Element Occurrence Database (Listing of State and Federally Endangered and Threatened Species of North Carolina). North Carolina Department of Environment and Natural Resources. Raleigh, North Carolina, USA. 2010, 2011. [Online WWW]. Available URL: http://149.168.1.196/nhp/.

Rosgen, D. L., 1994. A classification of natural rivers. Catena 22:169-199.

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

Schafale, M. P., and A. S. Weakley. 1990. Classification of the natural communities of North Carolina, third approximation. North Carolina Natural Heritage Program. Division of Parks and Recreation, NCDENR. Raleigh, NC.

Schumm, S.A., 1960. *The Shape of Alluvial Channels in Relation to Sediment Type*. U.S. Geological Survey Professional Paper 352-B. U.S. Geological Survey. Washington, DC.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. *Earth Surface Processes and Landforms* 14(1):11-26.

Stephens, E. P., 1956. The Uprooting of Trees: a Forest Process. Soil Science Society of America Proceedings 20:113-116.

United States Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. Environmental Laboratory. US Army Engineer Waterways Experiment Station. Vicksburg, MS.

___. 1997. Corps of Engineers Wetlands Research Program. Technical Note VN-rs-4.1. Environmental Laboratory. U.S. Army Engineer Waterways Experiment Station. Vicksburg, MS.

___. 2003. Stream Mitigation Guidelines, April 2003, U.S. Army Corps of Engineers. Wilmington District.

United States Department of Agriculture, Natural Resources Conservation Service Soil Survey Division. 2005. Anson County Soil Survey, [Online WWW]. Available URL: (http://www.nrcs.usda.gov/Internet/FSE_MANUSCRIPTS/north_carolina/NC007/0/Anson.pdf).

___. 2002. Climate Information-Wetlands Retrieval for North Carolina. Natural Resources Conservation Service. Anson County, Wadesboro WETS Station. [Online WWW]. Available URL: (http://www.wcc.nrcs.usda.gov/ftpref/support/climate/wetlands/nc/37007.txt).

United States Department of Agriculture, Natural Resources Conservation Service Soil Survey Division. Personal communication, 2011. NC BEHI/NBS rating curve.

United States Department of Interior, Fish and Wildlife Service (USFWS). Threatened and Endangered Species in North Carolina (County Listing). Anson County. 2010. [Online WWW]. Available URL: http://www.fws.gov/nc-es/es/countyfr.html.

United States Geological Survey (USGS) Land Cover Data. 2002. [Online WWW]. Available URL: http://seamless.usgs.gov/.

United States Geological Survey (USGS) Water-Resources Investigations Report 01-4207. 2001. Estimating the Magnitude and Frequency of Floods in Rural Basins of North Carolina-Revised. Raleigh, NC

This page intentionally left blank.

15.0 APPENDIX A - SITE PROTECTION INSTRUMENT

I, J. David Lee, II, NCPLS L- 4175, certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the boundaries not surveyed are clearly indicated as drawn from information found in Deed Book (See References); that the ratio of precision as calculated is 1:41,117; that this plat was prepared in accordance with G. S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of December, A.D., 2013.

J. David Lee, II, NCPLS L- 4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

FILED Jan 10, 2014 11:47 am
BOOK 00301
PAGE 0005 THRU 0005
INSTRUMENT # 00044

FILED ANSON COUNTY, NC JOANNE S. HUNTLEY REGISTER OF DEEDS

I, J. David Lee, II, NCPLS L-4175, certify to one or more of the following as indicated thus (X):

( ) a. That this plat is of a survey that creates a subdivision of land within the area of a county or municipality that regulates parcels of land;
( ) b. That this plat is of a survey that is located in such portion of a county or municipality that is unregulated as to an ordinance that regulates parcels of land;
( ) c. That this plat is of survey of an existing parcel or parcels of land;
(X) d. That this plat is of a survey of another category, such as the recombination of existing parcels, a court-ordered survey or other exception to the definition of subdivision;
( ) e. That the information available to this surveyor is such that I am unable to make a determination to the best of my professional ability as to provisions contained in (a) through (d) above.

J. David Lee, II, NCPLS L-4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

We, T. A. McRae, III and wife Janice S. McRae, by and through her Attorney in Fact, hereby certify that we are the owners of the properties shown and described hereon, which were conveyed to us by deeds recorded in Deed Book 160 Page 205 (PID#'s 6487-00-15-1016 and 6487-00-23-0123), of the Anson County Registry; and that we hereby adopt this plan of subdivision and grant and convey the easements herein with free consent. Further, we hereby certify that the land as shown hereon is within the subdivision regulation jurisdictions of Anson County, North Carolina.

T. A. McRae, III

Janice S. McRae, by Thomas Allen McRae, III, her Attorney in Fact

State of North Carolina
County of WAKE

I, Robert H. Merritt, Jr., A Notary Public for the County and State aforesaid, do hereby certify that T. A. McRae, III personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 10th day of JANUARY, 2014

Notary Public

My commission expires 5-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

State of North Carolina
County of WAKE

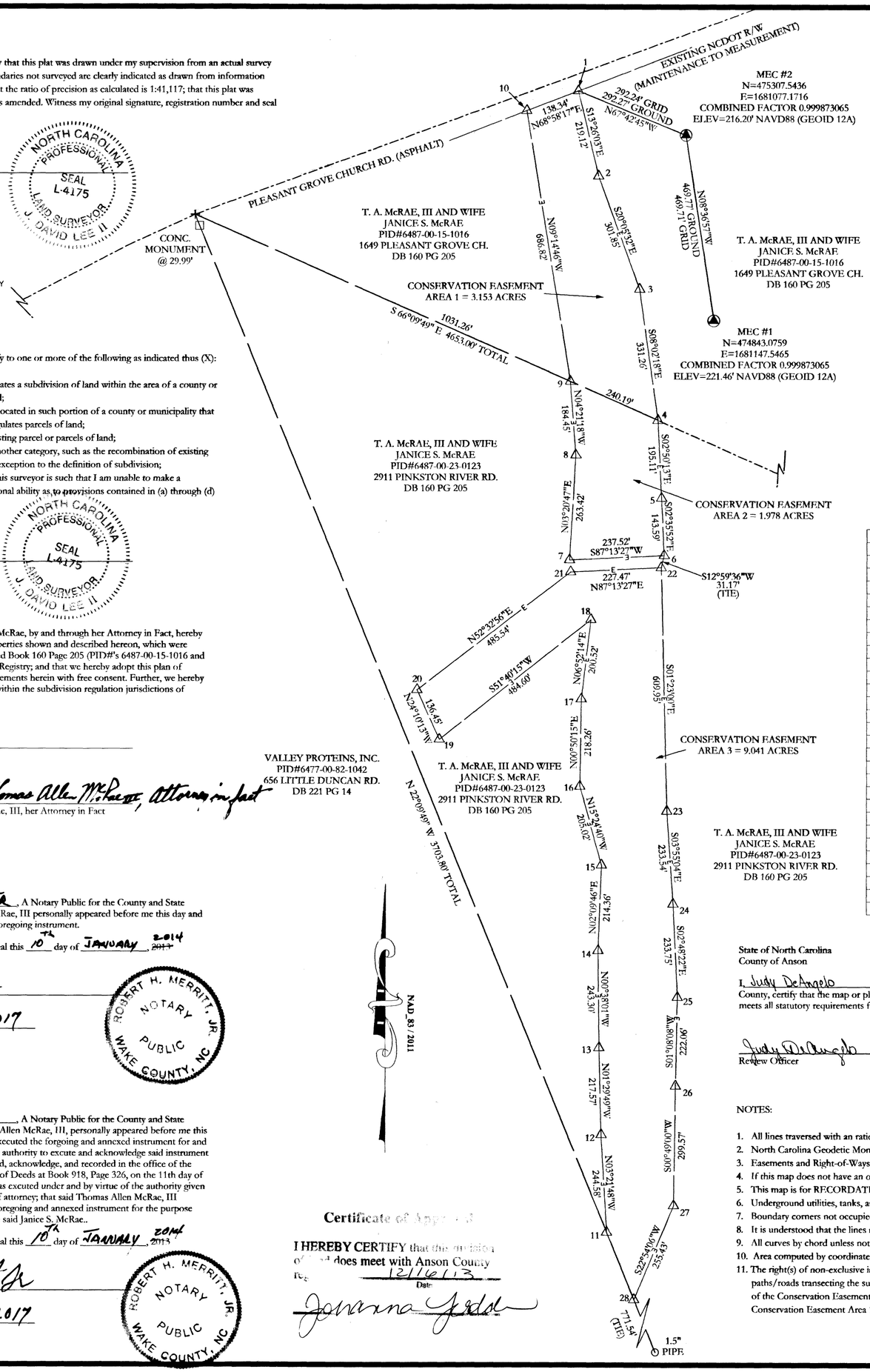
I, Robert H. Merritt, A Notary Public for the County and State aforesaid, do hereby certify that Thomas Allen McRae, III, personally appeared before me this day, and being duly sworn, says that he executed the forgoing and annexed instrument for and in behalf of Janice S. McRae, and that his authority to excute and acknowledge said instrument is contained in an instrument duly excuted, acknowledge, and recorded in the office of the Anson County, North Carolina, Register of Deeds at Book 918, Page 326, on the 11th day of August, 2009, and that this instrument was excuted under and by virtue of the authority given by said instrument granting him power of attorney; that said Thomas Allen McRae, III acknowledged the due execution of the foregoing and annexed instrument for the purpose therein expressed for and in behalf of the said Janice S. McRae..

Witness my hand and official stamp or seal this 10th day of JANUARY, 2014

Notary Public

My commission expires 5-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC



Certificate of Approval

I HEREBY CERTIFY that this division of land does meet with Anson County Regulations.

12/16/13
Date

Johanna Yerdon

NGS OPUS SOLUTION

MEC #1
LAT: 35 3 0.06186 0.018(m)
E LON: 279 56 4.52538 0.006(m)
W LON: 80 3 55.47462 0.006(m)
EL HGT: 36.820(m) 0.013(m)
ORTHO HGT: 67.500(m) 0.026(m)

BASE STATIONS USED
PID DESIGNATION LATITUDE LONGITUDE DISTANCE(m)
DM3995 NCRO ROCKINGHAM CORS ARP N345751.987 W0794747.740 26310.4
DG5755 NCAL ALBEMARLE CORS ARP N352017.303 W0801248.524 34693.9
DF5880 NCMR MONROE CORS ARP N345854.776 W0803125.790 42518.2

NEAREST NGS PUBLISHED CONTROL POINT
FA1999 SIGN N350249.580 W0800518.287 2121.3

MEC #2
LAT: 35 3 4.64742 0.025(m)
E LON: 279 56 3.61917 0.016(m)
W LON: 80 3 56.38083 0.016(m)
EL HGT: 35.209(m) 0.004(m)
ORTHO HGT: 65.888(m) 0.016(m)

BASE STATIONS USED
PID DESIGNATION LATITUDE LONGITUDE DISTANCE(m)
DM3995 NCRO ROCKINGHAM CORS ARP N345751.987 W0794747.740 26382.9
DG5755 NCAL ALBEMARLE CORS ARP N352017.303 W0801248.524 34554.8
DF5880 NCMR MONROE CORS ARP N345854.776 W0803125.790 42520.7

NEAREST NGS PUBLISHED CONTROL POINT
FA1999 SIGN N350249.580 W0800518.287 2125.1

EASEMENT CORNERS

POINT NUMBER	NORTHING	EASTING
1	475418.3859	1680806.7407
2	475205.2615	1680857.6484
3	474921.7795	1680961.3446
4	474593.7763	1681007.6659
5	474398.9028	1681017.3225
6	474255.4644	1681023.8306
7	474243.9615	1680786.5943
8	474506.9301	1680801.9704
9	474690.8426	1680787.9644
10	475368.7431	1680677.6094
11	472560.7814	1680882.1239
12	472804.9364	1680867.7750
13	473022.4284	1680862.0909
14	473265.7162	1680859.4007
15	473479.9185	1680867.4903
16	473677.5631	1680813.0082
17	473895.8036	1680816.1987
18	474094.8804	1680840.1860
19	473794.3394	1680460.0334
20	473918.8238	1680404.1653
21	474214.0730	1680789.6202
22	474225.0893	1681016.8217
23	473615.3174	1681031.5462
24	473382.3250	1681047.5030
25	473148.8554	1681058.9468
26	472926.8386	1681054.5462
27	472627.2958	1681050.2767
28	472392.0027	1680950.8764

State of North Carolina
County of Anson

I, Judy DeAngelo, Review Officer of Anson County, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

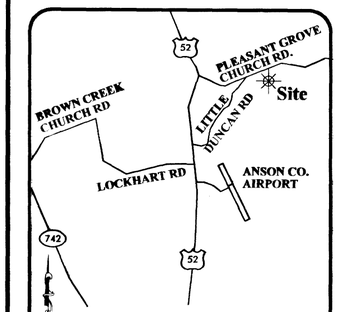
Review Officer 12/16/13 Date

NOTES:

1. All lines traversed with an ratio of precision of 1:41,117.
2. North Carolina Geodetic Monuments were not found within 2000'.
3. Easements and Right-of-Ways not surveyed unless shown otherwise.
4. If this map does not have an original signature and seal, this map is not valid.
5. This map is for RECORDATION.
6. Underground utilities, tanks, and or lines not surveyed unless noted otherwise.
7. Boundary corners not occupied unless noted otherwise.
8. It is understood that the lines not surveyed are checked with adjoining deed and as traversed.
9. All curves by chord unless noted otherwise.
10. Area computed by coordinate method.
11. The right(s) of non-exclusive ingress, egress, and regress over and along any and all existing paths/roads transecting the subject property are reserved by the Grantor(s) and the Grantee(s) of the Conservation Easements for the uses and purposes not inconsistent with the uses of Conservation Easement Area 1 thru 3, described hereon for Conservation Easement purposes.

GRAPIC SCALE
400 300 200 100 0 200 400

"BROWN CREEK TRIBUTARIES PROJECT - HURRICANE CREEK"
CONSERVATION EASEMENT SURVEY
FOR
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM
ON THE PROPERTY OF
T. A. McRAE, III AND WIFE
JANICE S. McRAE
ANSONVILLE TOWNSHIP, ANSON COUNTY
NORTH CAROLINA



VICINITY MAP
NTS

EEP Site ID	95351
SPO Number	04-F
Mulkey Job Number	2012070.00
Survey Dates	09/09/2012 - 10/29/2013
Scale	1" = 200'

Deed References:	
DB 160; PG 205	DB 221; PG 14

No.	Revision/Issue	Date

SYMBOL LEGEND

- △ EASEMENT MONUMENT SET (EEP STANDARD ALUMINUM CAP AND REBAR)
- ○ PROPERTY CORNER
- □ CONCRETE MONUMENT
- + POINT OF INTERSECTION
- ▲ GPS (OPUS) ESTABLISHED POINT
- SURVEYED BOUNDARY LINE
- NON SURVEYED LINE
- —E— EASEMENT LINE
- EDGE OF PAVEMENT
- CENTER OF CREEK
- TIE LINE
- DB = DEED BOOK
- PG = PAGE

MULKEY
ENGINEERS & CONSULTANTS
7500 E. INDEPENDENCE BOULEVARD
SUITE 100
CHARLOTTE, NC 28227
(704) 537-7300
(704) 537-2811 (FAX)
WWW.MULKEYINC.COM

SHEET 1 of 1

FILED Dec 18, 2013 02:40 pm
BOOK 00300
PAGE 0009 THRU 0009
INSTRUMENT # 02859

FILED
ANSON
COUNTY, NC
JOANNE S. HUNTLEY
REGISTER
OF DEEDS

I, J. David Lee, II, NCPLS L- 4175, certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the boundaries not surveyed are clearly indicated as drawn from information found in Deed Book (See References); that the ratio of precision as calculated is 1:116,072; that this plat was prepared in accordance with G. S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of December, A.D., 2013.

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

J. David Lee, II, NCPLS L- 4175

I, J. David Lee, II, NCPLS L-4175, certify to one or more of the following as indicated thus (X):

( ) a. That this plat is of a survey that creates a subdivision of land within the area of a county or municipality that regulates parcels of land;

( ) b. That this plat is of a survey that is located in such portion of a county or municipality that is unregulated as to an ordinance that regulates parcels of land;

( ) c. That this plat is of survey of an existing parcel or parcels of land;

(X) d. That this plat is of a survey of another category, such as the recombination of existing parcels, a court-ordered survey or other exception to the definition of subdivision;

( ) e. That the information available to this surveyor is such that I am unable to make a determination to the best of my professional ability as to provisions contained in (a) through (d) above.

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

J. David Lee, II, NCPLS L-4175

State of North Carolina
County of Anson

I Joy J. Harrison, Review Officer of Anson County, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

Review Officer — Date 12-16-13

We, Louis Edward Hatem and Ella Jillian Hatem, William Michael Hatem, Jr. and Kimberly Diane Hatem, William Michael Hatem and Linda Carlton Hatem, Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis, hereby certify that we are the owners of the properties shown and described hereon, which were conveyed to us by deeds recorded in Deed Book 404 Page 8 (PID#6497-00-15-8104), Deed Book 951 Page 182 (PID#6497-00-45-2885) and Deed Book 211 Page 482 (PID#6497-00-31-8725, of the Anson County Register; and that we hereby adopt this plan of subdivision and grant and convey the easements hereon with free consent. Further, I hereby certify that the land as shown hereon is within the subdivision regulation jurisdictions of Anson County, North Carolina.

Louis Edward Hatem

Louis Edward Hatem

Ella Jillian Hatem

Ella Jillian Hatem

William Michael Hatem, Jr.

Kimberly Diane Hatem

Kimberly Diane Hatem

William Michael Hatem

William Michael Hatem

Linda Carlton Hatem

Linda Carlton Hatem

Alan Dale McRae

Alan Dale McRae

Terry Marshall Dennis, Sr.

Terry Marshall Dennis, Sr.

Martha Hensley Dennis

Martha Hensley Dennis

LINE TABLE		
LINE	BEARING	DISTANCE
L1	N78°22'09"E	80.87'
L2	N21°15'22"E	182.53'
L3	S78°24'20"E	47.97'
L4	S21°15'22"W	188.27'
L5	S73°05'12"W	145.64'
L6	N73°05'12"E	143.54'
L7	S88°15'04"W	60.92'
L8	S88°15'04"W	11.97'
L9	N86°27'21"W	74.65'
L10	N88°15'04"E	65.23'
L11	S86°27'21"E	77.35'

EASEMENT CORNERS					
POINT NUMBER	NORTHING	EASTING	POINT NUMBER	NORTHING	EASTING
1	473917.7194	1694994.1264	37	473866.0754	1692017.6270
2	473785.1175	1694984.1345	38	474102.5302	1691967.8305
3	473931.8850	1694615.8280	39	473958.7390	1693417.9690
4	473876.5517	1694478.0370	40	473937.6377	1693553.1837
5	474039.6857	1694535.4480	41	473778.1180	1693494.1553
6	474055.9892	1694614.6564	42	473768.4760	1693541.1506
7	473988.7400	1694810.5385	43	473559.4736	1692288.1706
8	473819.6329	1694383.8185	44	473428.1530	1692321.4524
9	473661.8748	1694125.2812	45	473269.1910	1692305.2729
10	473599.3514	1693818.9960	46	473113.4903	1692273.8491
11	473507.5840	1693864.5988	47	473030.1552	1692226.1185
12	473369.9492	1693887.0469	48	472706.7651	1692103.6983
13	472869.5467	1693879.8095	49	472607.5688	1692077.0514
14	472568.1116	1693843.3606	50	472605.3441	1692004.1881
15	472310.7660	1693854.2645	51	472609.9592	1691929.6766
16	472091.9796	1693777.4712	52	472738.6274	1691943.3184
17	472298.5410	1693679.3050	53	473068.0354	1692079.3817
18	472572.8961	1693717.2098	54	473409.3849	1692191.4962
19	473157.9303	1693762.1601	55	473517.7137	1692150.8366
20	473476.0447	1693744.0779	56	472577.3066	1692068.9222
21	473588.1644	1693674.4498	57	472442.1953	1692032.6276
22	473592.2491	1693504.7879	58	472195.9423	1692094.3011
23	473762.3598	1693570.9413	59	472199.9352	1691921.9211
24	473717.5797	1693789.2204	60	472452.4471	1691912.9768
25	473823.3866	1694069.3447	61	472589.0978	1691926.5106
26	473919.5653	1694246.7530	62	472575.3158	1692003.7176
27	473999.6666	1694447.1615	63	472168.5117	1693878.8204
28	473593.0169	1693472.8967	64	472020.1966	1693935.6706
29	473596.4212	1693248.4230	65	471875.0898	1694027.0078
30	473580.6444	1693011.4621	66	471689.2642	1694027.3723
31	473608.5763	1692744.0540	67	471692.6547	1693857.0103
32	473656.4426	1692473.1421	68	471873.1737	1693849.6712
33	473713.1747	1692249.0798	69	471979.0479	1693812.0193
34	473578.8821	1692283.2917	70	472294.6778	1693848.6175
35	473536.5126	1692143.9137	71	473594.1441	1693426.0778
36	473731.7010	1692069.4882			

State of North Carolina
County of WAKE

I Robert H. Merritt, JR, A Notary Public for the County and State aforesaid, do hereby certify that Louis Edward Hatem and Ella Jillian Hatem, William Michael Hatem, Jr. and Kimberly Diane Hatem, William Michael Hatem, and Linda Carlton Hatem personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 19 day of DECEMBER, 2013

Notary Public

My commission expires 6-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

State of North Carolina
County of WAKE

I Robert H. Merritt, JR, A Notary Public for the County and State aforesaid, do hereby certify that Alan Dale McRae personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 19 day of December, 2013

Notary Public

My commission expires 6-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

State of North Carolina
County of WAKE

I Robert H. Merritt, JR, A Notary Public for the County and State aforesaid, do hereby certify that Terry Marshall Dennis, Sr. and Martha Hensley Dennis personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official stamp or seal this 19 day of DECEMBER, 2013

Notary Public

My commission expires 6-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

NOTES:

1. All lines traversed with no ratio of precision of 1:116,072.
2. North Carolina Geodetic Monuments were not found within 2000'.
3. Easements and Right-of-Ways not surveyed unless shown otherwise.
4. If this map does not have an original signature and seal, this map is not valid.
5. This map is for RECORDATION.
6. Underground utilities, tanks, and or lines not surveyed unless noted otherwise.
7. Boundary corners not occupied unless noted otherwise.
8. It is understood that the lines not surveyed are checked with adjoining deed and as traversed.
9. All curves by chord unless noted otherwise.
10. Area computed by coordinate method.
11. The right(s) of non-exclusive ingress, egress, and regress over and along any and all existing paths/roads transecting the subject property are reserved by the Grantor(s) and the Grantee(s) of the Conservation Easements for the uses and purposes not inconsistent with the uses of Conservation Easement Area 1 thru 8, described hereon for Conservation Easement purposes.

NGS OPUS SOLUTION

MBC #1
LAT: 35 2 43.28072 0.013(m)
E LON: 279 58 40.02849 0.020(m)
W LON: 80 1 19.97151 0.020(m)
EL. HGT: 37.841(m) 0.056(m)
ORTHO HGT: 68.556(m) 0.096(m)

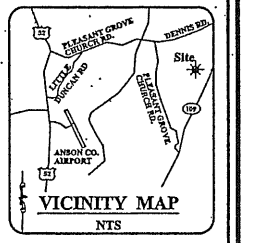
BASE STATIONS USED

PID DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG7402 NCPO POLKTON CORS ARP	N345933.172	W0801037.857	15309.1
DM3995 NCRO ROCKINGHAM CORS ARP	N345751.387	W0779471.740	22466.8
DK4045 NCTR TROY CORS ARP	N352201.845	W0795212.770	38294.0

NEAREST NGS PUBLISHED CONTROL POINT
AG9799 38 WSM N350350.592 W0800131.594 2103.6

MBC #2
UNABLE TO OBTAIN OPUS SOLUTION. VRS WAS USED TO OBTAIN POSITION.

"BROWN CREEK TRIBUTARIES PROJECT - UT4
CONSERVATION EASEMENT SURVEY
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM
ENTRUSTED TO
LOUIS EDWARD HATEM AND
WILLIAM MICHAEL HATEM, JR.,
ALAN DALE MCRAE, AND
TERRY MARSHALL DENNIS, SR.
AND MARTHA HENSLEY DENNIS
ANSONVILLE & WADESBORO TOWNSHIP
ANSON COUNTY, NORTH CAROLINA



VICINITY MAP
NTS

EEP Site ID	95351
SPO Number	04-B, 04-C & 04-D
Mulkey Job Number	2012070.00
Survey Dates	09/09/2012 - 10/30/2013
Scale	1" = 200'

Deed References:	
DB 951; PG 182	DB 404; PG 8
DB 211; PG 482	DB 327; PG 214
DB 734; PG 8	DB 408; PG 84
DB 507; PG 190	

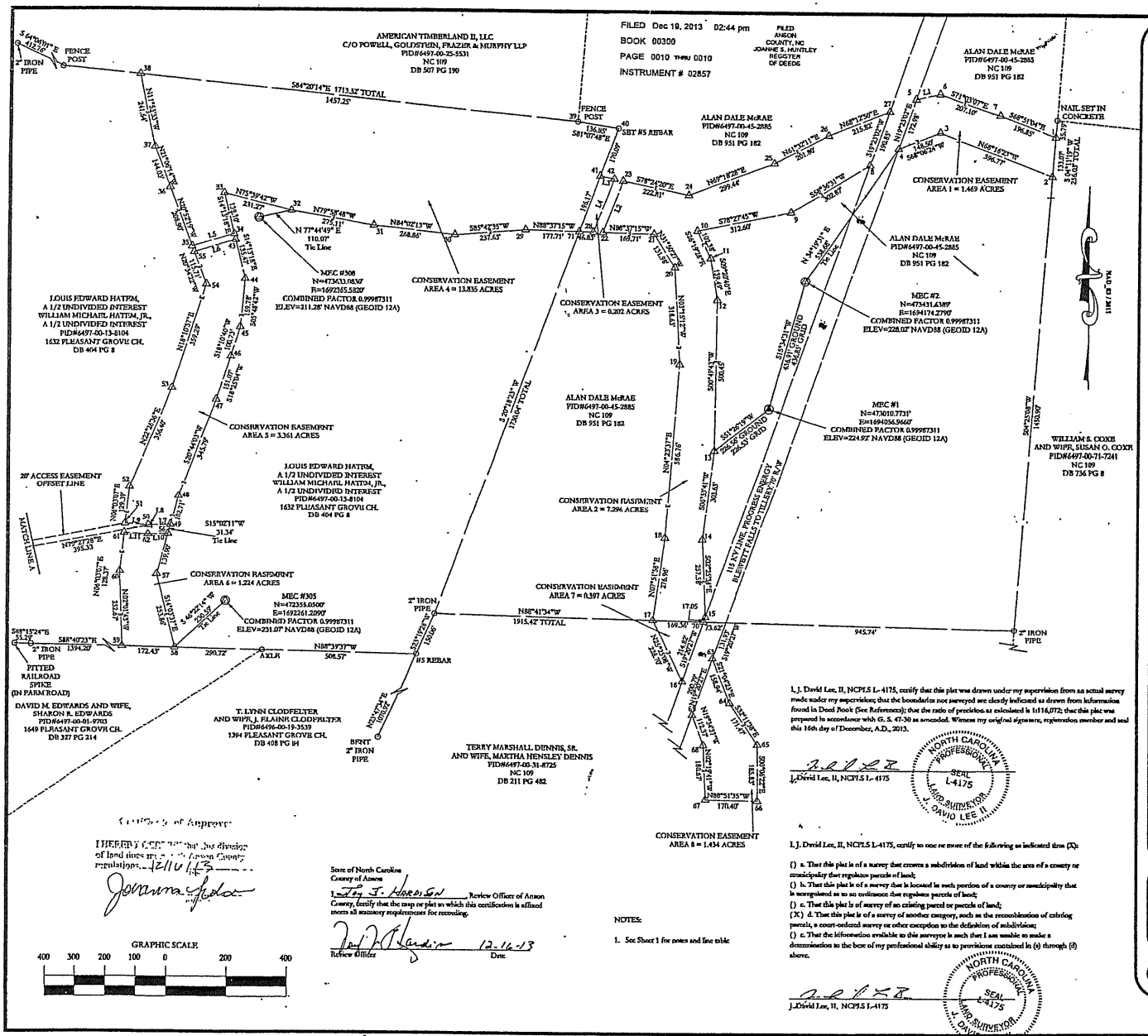
No.	Revision/Issue	Date

SYMBOL LEGEND

- △ EASEMENT MONUMENT SET (REBAR STANDARD ALUMINUM CAP AND HERAN)
- ⊖ PROPERTY CORNER
- + POINT OF INTERSECTION
- GPS (OPUS) ESTABLISHED POINT
- GPS (VRS) ESTABLISHED POINT
- FOOT BRIDGE
- SURVEYED BOUNDARY LINE
- NON SURVEYED LINE
- E EASEMENT LINE
- EDGE OF SOIL ROAD
- CENTER OF CREEK
- TIE LINE
- ACCESS EASEMENT LINE
- DB = DEED BOOK
- PG = PAGE
- R/W = RIGHT OF WAY

MULKEY
ENGINEERS & CONSULTANTS
7500 E. INDEPENDENCE BOULEVARD
SUITE 108
CHARLOTTE, NC 28227
(704) 537-7300
(704) 537-6811 (FAX)
WWW.MULKEYINC.COM

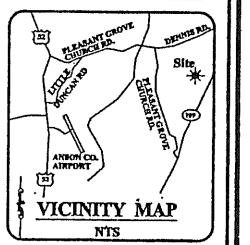
SHEET 1 of 3



"BROWN CREEK TRIBUTARIES PROJECT - UT4" CONSERVATION EASEMENT SURVEY FOR THE STATE OF NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

ON THE PROPERTY OF LOUIS EDWARD HATEM AND WILLIAM MICHAEL HATEM, JR., ALAN DALE McRAE, AND TERRY MARSHALL DENNIS, SR. AND MARTHA HENSLEY DENNIS

ANSONVILLE & WADESBORO TOWNSHIP ANSON COUNTY, NORTH CAROLINA



VICINITY MAP

NTS

RRP Site ID	95351
SPO Number	04-B, 04-C & 04-G
Mulkey Job Number	2012070.00
Survey Dates	09/09/2012 - 10/30/2013
Scale	1" = 200'

Deed References	
DB 951; PG 182	DB 404; PG 8
DB 211; PG 482	DB 327; PG 214
DB 736; PG 8	DB 408; PG 84
DB 507; PG 190	

No.	Revision/Issue	Date

SYMBOL LEGEND

- EASEMENT MONUMENT SET (EEP STANDARD ALUMINUM CAP AND REBAR)
- PROPERTY CORNER
- POINT OF INTERSECTION
- GPS (OPUS) ESTABLISHED POINT
- GPS (VRS) ESTABLISHED POINT
- FOOT BRIDGE
- SURVEYED BOUNDARY LINE
- NON SURVEYED LINE
- EASEMENT LINE
- EDGE OF SOIL ROAD
- CENTER OF CREEK
- TIE LINE
- ACCESS EASEMENT LINE

DB = DEED BOOK
PG = PAGE
R/W = RIGHT OF WAY

MULKEY
ENGINEERS & CONSULTANTS
2620 S. TRYON STREET
SUITE 180
CHARLOTTE, NC 28203
(704) 527-7200
(704) 527-2811 (FAX)
WWW.MULKEYINC.COM

SHEET 2 of 3

Certificate of Approval:

I HEREBY CERTIFY that the division of land shown on this plat is in accordance with the Anson County regulations. 12/16/13

State of North Carolina
County of Anson

I, Joy J. Hardison, Review Officer of Anson County, certify that the map or plat on which this certification is affixed meets all statutory requirements for recording.

Review Officer — Date: 12-16-13

NOTES:

1. See Sheet 1 for notes and line table

I, J. David Lee, II, NCPLS L-4175, certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the boundaries not surveyed are clearly indicated as drawn from information found in Deed Book (See References); that the ratio of precision as calculated is 1:116,072; that this plat was prepared in accordance with G. S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of December, A.D., 2013.

J. David Lee, II, NCPLS L-4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

I, J. David Lee, II, NCPLS L-4175, certify to one or more of the following as indicated thus (X):

( ) a. That this plat is of a survey that creates a subdivision of land within the area of a county or municipality that regulates parcels of land;

( ) b. That this plat is of a survey that is located in such portion of a county or municipality that is unregulated as to an ordinance that regulates parcels of land;

( ) c. That this plat is of survey of an existing parcel or parcels of land;

(X) d. That this plat is of a survey of another category, such as the recombination of existing parcels, a court-ordered survey or other exception to the definition of subdivision;

( ) e. That the information available to this surveyor is such that I am unable to make a determination to the best of my professional ability as to provisions contained in (a) through (d) above.

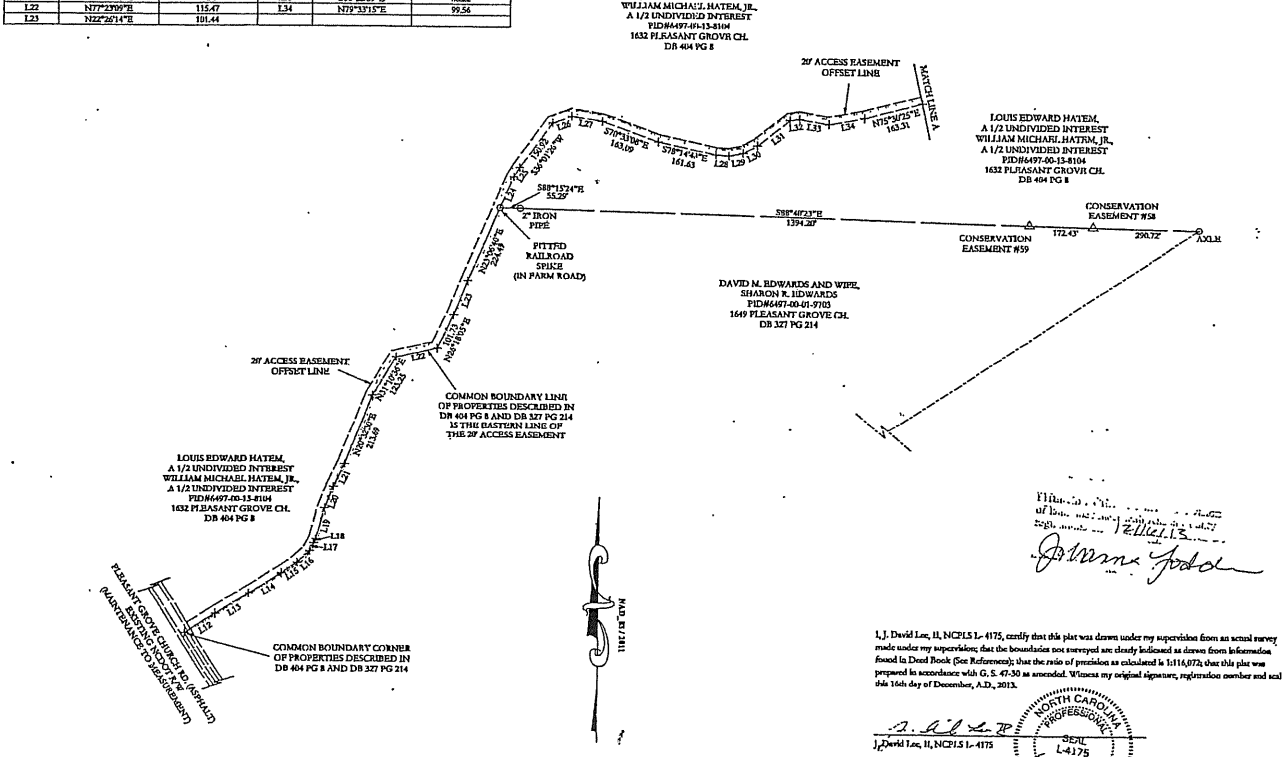
J. David Lee, II, NCPLS L-4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

FILED Dec 19, 2013 02:44 pm
BOOK 00300
PAGE .0011 THRU 0011
INSTRUMENT # 02858

FILED
ANSON
COUNTY, NC
JOANNE E. HUNTLEY
REGISTER
OF DEEDS

LINE TABLE FOR SOUTH EAST EDGE OF 20' ACCESS EASEMENT					
LINE	BEARING	DISTANCE	LINE	BEARING	DISTANCE
L12	N58°47'18"E	101.30	L24	N22°47'19"E	95.03
L13	N58°42'37"E	105.98	L25	N31°28'38"E	31.40
L14	N57°46'35"E	104.01	L26	N70°21'44"E	54.56
L15	N55°38'51"E	51.38	L27	S81°46'46"E	84.79
L16	N48°16'47"E	45.46	L28	S85°37'21"E	36.04
L17	N26°12'47"E	23.80	L29	N79°53'43"E	40.35
L18	N26°13'51"E	13.46	L30	N62°08'24"E	44.64
L19	N14°59'31"E	91.74	L31	N51°53'21"E	112.63
L20	N20°52'57"E	65.68	L32	N82°37'55"E	24.35
L21	N25°56'47"E	70.55	L33	S80°37'09"E	80.22
L22	N77°23'09"E	115.47	L34	N79°33'15"E	99.56
L23	N22°26'14"E	101.44			



GRAPHIC SCALE
400 300 200 100 0 200 400

Seal of North Carolina
County of Anson

I, Joy T. Haralson, Review Officer of Anson County, certify that the map or plat to which this certification is affixed meets all statutory requirements for recording.

Review Officer — Date: 12-16-13

NOTES:

1. See Sheet 1 for notes.

I, J. David Lee, II, NCPLS L- 4175, certify that this plat was drawn under my supervision from an actual survey made under my supervision; that the boundaries not surveyed are clearly indicated as drawn from information found in Deed Book (See References); that the ratio of precision as calculated is 1:116,072; that this plat was prepared in accordance with G. S. 47-30 as amended. Witness my original signature, registration number and seal this 16th day of December, A.D., 2013.

J. David Lee, II, NCPLS L- 4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

I, J. David Lee, II, NCPLS L-4175, certify to one or more of the following as indicated thus (X):

( ) a. That this plat is of a survey that creates a subdivision of land within the area of a county or municipality that regulates parcels of land;
( ) b. That this plat is of a survey that is located in such portion of a county or municipality that is unregulated as to an ordinance that regulates parcels of land;
( ) c. That this plat is of survey of an existing parcel or parcels of land;
(X) d. That this plat is of a survey of another category, such as the recombination of existing parcels, a court-ordered survey or other exception to the definition of subdivision;
( ) e. That the information available to this surveyor is such that I am unable to make a determination to the best of my professional abilities as to provisions contained in (a) through (d) above.

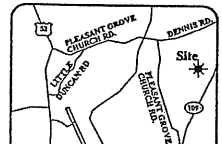
J. David Lee, II, NCPLS L-4175

NORTH CAROLINA PROFESSIONAL SEAL L-4175 LAND SURVEYOR J. DAVID LEE II

"BROWN CREEK TRIBUTARIES PROJECT - UT4"
CONSERVATION EASEMENT SURVEY
FOR
THE STATE OF NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

ON THE PROPERTY OF
LOUIS EDWARD HATEM AND
WILLIAM MICHAEL HATEM, JR.,
ALAN DALE McRAE, AND
TERRY MARSHALL DENNIS, SR.
AND MARTHA HENSLEY DENNIS

ANSONVILLE & WADESBORO TOWNSHIP
ANSON COUNTY, NORTH CAROLINA



VICINITY MAP
NTS

REP Site ID	95351
SPO Number	04-B, 04-C & 04-G
Mulkey Job Number	20120701.00
Survey Dates	09/09/2012 - 10/30/2013
Scale	1" = 200'

Deed References:	
DB 951; PG 182	DB 404; PG 8
DB 211; PG 482	DB 327; PG 214
DB 736; PG 8	DB 408; PG 84
DB 507; PG 190	

No.	Revision/Issue	Date

SYMBOL LEGEND

- EASEMENT MONUMENT SET (REP STANDARD ALUMINUM CAP AND REBAR)
- PROPERTY CORNER
- POINT OF INTERSECTION
- GPS (OPUS) ESTABLISHED POINT
- GPS (VRS) ESTABLISHED POINT
- FOOT BRIDGE
- SURVEYED BOUNDARY LINE
- NON SURVEYED LINE
- EASEMENT LINE
- EDGE OF SOIL ROAD
- CENTER OF CREEK
- TIE LINE
- ACCESS EASEMENT LINE

DB = DEED BOOK
PG = PAGE
R/W = RIGHT OF WAY

MULKEY
ENGINEERS & CONSULTANTS
7500 E. INDEPENDENCE BOULEVARD
SUITE 100
CHARLOTTE, NC 28227
(704) 537-2200
(704) 537-2811 (FAX)
WWW.MULKEYINC.COM

1055
0278

FILED
ANSON COUNTY, NC
JOANNE S. HUNTLEY
REGISTER OF DEEDS

FILED	Jan 10, 2014
AT	11:50 am
BOOK	01055
START PAGE	0278
END PAGE	0289
INSTRUMENT #	00045
RECORDING	$26.00
EXCISE TAX	$512.00

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

STATE OF NORTH CAROLINA

ANSON COUNTY

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT NO: 004641

REVENUE $ 512.00
SPO File Number: 04-F
EEP Project Number: 95351

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this 10th day of JANUARY, 2014, by T. A. McRAE, III and wife, JANICE S. McRAE, whose address is 1718 Pinkston River Road, Wadesboro, North Carolina 28170 ("**Grantor**"), to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc., 8000 Regency Parkway, Suite 600, Cary, North Carolina 27518 and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or

buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number 004641.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Ecosystem Enhancement Program with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain parcels of real property situated, lying, and being in Ansonville Township, Anson County, North Carolina, which parcels are identified by PIN: 6487-00-15-1016 containing approximately 31.28 acres PIN: 6487-00-23-0123 containing approximately 171.11 acres and being conveyed to the Grantor by deed recorded in **Book 160, Page 205,** Anson County Registry, North Carolina (the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of Brown Creek Tributaries-Hurricane Creek, Anson County, North Carolina.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

Conservation Easements identified as Conservation Easement Areas 1, 2 and 3, as shown on a Plat entitled "Brown Creek Tributaries Project-Hurricane Creek" Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program on the Property of T. A. McRAE, III and wife, JANICE S. McRAE, Ansonville Township, Anson County, North Carolina, dated 09/09/2012-10/29/2013, certified by J. David Lee, II, NCPLS L-4175 and recorded in Plat Book 30/, Page 5, Anson County Registry.

TOGETHER with an easement for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement Area" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the

use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat **or as specifically allowed within a fence maintenance zone as described in section D or a Road or Trail described in section H**.

The Grantor reserves the right, for himself, his successors and assigns, to operate motorized vehicles within Crossing Area(s) described on the survey recorded in Plat Book _____, Page _____, of the _____County Registry as "reserved stream crossing". Said crossing shall not exceed ____ feet in width, and must be maintained and repaired by Grantor, his successors or assigns to prevent degradation of the Conservation Easement Area.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. Damage to Vegetation. Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited with the following exception:

Notwithstanding the foregoing, if there is a fence within the Conservation Easement Area, the Grantor reserves the right to mow and maintain vegetation within 10 feet of the Conservation Easement boundary ***as shown on the Survey Plat*** and extending along the entire length of the

fence. The Grantor, his successors or assigns shall be solely responsible for maintenance of the fence for as long as there is livestock on the Grantor's property adjacent to the Conservation Easement Area.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of roads, trails, walkways, or paving in the Conservation Easement Area with the following exception:

Only roads and trails located within the Conservation Easement Area prior to completion of the construction of the restoration project and within crossings shown on the recorded survey plat may be maintained by Grantor, successors or assigns to allow for access to the interior of the Property, and must be repaired and maintained to prevent runoff and degradation to the Conservation Easement Area. Such roads and trails shall be covered with pervious materials such as loose gravel or permanent vegetation in order to minimize runoff and prevent sedimentation.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may

temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property within the Conservation Easement Area to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to maintain, repair or replace the fence at the sole discretion of the Grantee and at the

expense of the Grantor, who agrees to indemnify the Grantee for any costs incurred as a result of maintenance, repair or replacement of the fence if such costs are required to protect the Conservation Easement Area from repeated incidents of grazing or other prohibited activities.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor,

including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Ecosystem Enhancement Program Manager
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

T.A. McRae, III (SEAL)

Janice S. McRae, by Thomas Allen McRae, III, her Attorney-in-Fact (SEAL)

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr., a Notary Public in and for the County and State aforesaid, do hereby certify that **T. A. McRAE, III**, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 10th day of January, 2014.

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

Notary Public
My commission expires: 5-1-2017

STATE OF NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr., a Notary Public for WAKE County, North Carolina do hereby certify that **Thomas Allen McRae, III,** personally appeared before me this day, and being by me duly sworn, says that he executed the foregoing and annexed instrument for and in behalf of **Janice S. McRae,** and that his authority to execute and acknowledge said instrument is contained in an instrument duly executed, acknowledged, and recorded in the office of the Anson County, North Carolina, Register of Deeds at Book 918, Page 326, on the 11th day of August, 2009, and that this instrument was executed under and by virtue of the authority given by sad instrument granting him power of attorney; that the said **Thomas Allen McRae, III** acknowledged the due execution of the foregoing and annexed instrument for the purposes therein expressed for and in behalf of the said **Janice S. McRae**.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 10th day of January, 2014.

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

Notary Public
My Commission Expires: 5-1-2017

00359887

Exhibit 1

Permanent Conservation Easements
Hurricane Creek
Anson County, NC

1. Permanent Conservation Easement (Ref: PIN: 6487-00-15-1016)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled *"Brown Creek Tributaries Project – Hurricane Creek" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of T. A. McRae, III and wife Janice S. McRae,* dated 09/09/2012-10/29/2013, and recorded in Plat Book 301, Page 5, of the Anson County Registry, and being a portion of the parcel owned by *T. A. McRae, III and wife Janice S. McRae* (PIN: 6487-00-15-1016), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=475307.5436 ft., E=1681077.1716 ft, and identified as MEC #2 on the above referenced plat and running N 67°42'45" W 292.27' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 13°26'03" E, 219.12', thence
S 20°05'32" E, 301.85', thence
S 08°02'18" E, 331.26', thence
N 66°09'49" W, 240.19', thence
N 09°14'46" W, 686.82', thence
N 68°58'17" E, 138.34', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 3.153 acres, more or less.

2. Permanent Conservation Easement (Ref: PIN: 6487-00-23-0123)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled *"Brown Creek Tributaries Project – Hurricane Creek" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of T. A. McRae, III and wife Janice S. McRae,* dated 09/09/2012-10/29/2013, and recorded in Plat Book 301, Page 5, of the Anson County Registry, and being a portion of the parcel owned by *T. A. McRae, III and wife Janice S. McRae* (PIN: 6487-00-23-0123), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=475307.5436 ft., E=1681077.1716 ft, and identified as MEC #2 on the above referenced plat and running N 67°42'45" W 292.27'; thence S 13°26'03" E, 219.12'; thence S 20°05'32" E, 301.85'; thence S 08°02'18" E, 331.26' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 02°50'13" E, 195.11', thence
S 02°35'52" E, 143.59', thence
S 87°13'27" W, 237.52', thence

N 03°20'47" E, 263.42', thence
N 04°21'18" W, 184.45', thence
S 66°09'49" E, 240.19', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 1.978 acres, more or less.

3. Permanent Conservation Easement (Ref: PIN: 6487-00-23-0123)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled *"Brown Creek Tributaries Project – Hurricane Creek" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of T. A. McRae, III and wife Janice S. McRae,* dated 09/09/2012-10/29/2013, and recorded in Plat Book 301, Page 5, of the Anson County Registry, and being a portion of the parcel owned by *T. A. McRae, III and wife Janice S. McRae* (PIN: 6487-00-23-0123), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=475307.5436 ft., E=1681077.1716 ft, and identified as MEC #2 on the above referenced plat and running N 67°42'45" W 292.27'; thence S 13°26'03" E, 219.12'; thence S 20°05'32" E, 301.85'; thence S 08°02'18" E, 331.26'; thence S 20°50'13" E, 195.11'; thence S 02°35'52" E, 143.59'; thence S 12°59'36" W, 31.17' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 01°23'00" E, 609.95', thence
S 03°55'04" E, 233.54', thence
S 02°48'22" E, 233.75', thence
S 01°08'08" W, 222.06', thence
S 00°49'00" W, 299.57', thence
S 22°54'06" W, 255.43', thence
N 22°09'49" W, 182.24', thence
N 03°21'48" W, 244.58', thence
N 01°29'49" W, 217.57', thence
N 00°38'01" W, 243.30', thence
N 02°09'46" E, 214.36', thence
N 15°24'40" W, 205.02', thence
N 00°50'15" E, 218.26', thence
N 06°52'14" E, 200.52', thence
S 51°40'15" W, 484.60', thence
N 24°10'13" W, 136.45', thence
N 52°32'56" E, 485.54', thence
N 87°13'27" E, 227.47', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 9.041 acres, more or less.

4. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easement described above and conveyed herein, shall be (1) as provided in this deed, (2) as provided on the Plat referenced below, and (3) from the Public Right-of-Way of Pleasant Grove Church Road to provide ingress, egress, and regress for purposes of accessing the permanent conservation easements(s) set forth above, and as shown on the map recorded in Plat Book 301, Pages 5 of the Anson County Registry.

00361223

FILED
ANSON COUNTY, NC
JOANNE S. HUNTLEY
REGISTER OF DEEDS
FILED Dec 19, 2013
AT 02:46 pm
BOOK 01054
START PAGE 0122
END PAGE 0134
INSTRUMENT # 02859
RECORDING $26.00
EXCISE TAX $664.00

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

STATE OF NORTH CAROLINA

ANSON COUNTY

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT NO: 004641

REVENUE $ 664.00
SPO File Number: 04-B
EEP Project Number: 95351

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this 19th day of December, 2013, by LOUIS EDWARD HATEM and wife, EILA JILLIAN HATEM, whose address is 1500 Turtlewood Drive, Waxhaw, NC 28173, WILLIAM MICHAEL HATEM, JR. and wife, KIMBERLY DIANE HATEM, whose address is 6205 Rosewood Court, Indian Trail, NC 28079 and, as holders of a life estate in the Property (as referenced below), WILLIAM MICHAEL HATEM and wife, LINDA CARLTON HATEM, whose address is 13612 Idlefield Lane, Matthews, NC 28105 (collectively "**Grantor**"), to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc., 8000 Regency Parkway, Suite 600, Cary, North Carolina 27518 and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number 004641.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Ecosystem Enhancement Program with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in Wadesboro Township, Anson County, North Carolina, which parcel is identified by PIN: 6697-00-13-8104 and containing approximately 134.32 acres and being conveyed to William

Michael Hatem, Jr. and Louis Edward Hatem from William Michael Hatem and wife, Linda Carlton Hatem (reserving a life estate in said Property) by deed recorded in **Deed Book 404 at Page 008** of the Anson County Registry, North Carolina (the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of Brown Creek Tributaries-UT4, Anson County, North Carolina.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

Conservation Easements identified as Conservation Easement Areas 4, 5 and 6, as shown on a Plat entitled "Brown Creek Tributaries Project-UT4" Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program on the Property of LOUIS EDWARD HATEM and WILLIAM MICHAEL HATEM, JR., ALAN DALE McRAE, and TERRY MARSHALL DENNIS, SR. and MARTHA HENSLEY DENNIS, Ansonville and Wadesboro Townships, Anson County, North Carolina dated 09/09/2012-10/30/2013, certified by J. David Lee, II, NCPLS L-4175 and recorded in Plat Book 300, Page 9, 10 & 11, Anson County Registry.

TOGETHER with an easement for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement Area" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat **or as specifically allowed within a fence maintenance zone as described in section D or a Road or Trail described in section H.**

The Grantor reserves the right, for himself, his successors and assigns, to operate motorized vehicles within Crossing Area(s) described on the survey recorded in Plat Book _____, Page _____, of the _____County Registry as "reserved stream crossing". Said crossing shall not exceed ____ feet in width, and must be maintained and repaired by Grantor, his successors or assigns to prevent degradation of the Conservation Easement Area.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. Damage to Vegetation. Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited with the following exception:

Notwithstanding the foregoing, if there is a fence within the Conservation Easement Area, the Grantor reserves the right to mow and maintain vegetation within 10 feet of the Conservation Easement boundary ***as shown on the Survey Plat*** and extending along the entire length of the fence. The Grantor, his successors or assigns shall be solely responsible for maintenance of the fence for as long as there is livestock on the Grantor's property adjacent to the Conservation Easement Area.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of roads, trails, walkways, or paving in the Conservation Easement Area with the following exception:

Only roads and trails located within the Conservation Easement Area prior to completion of the construction of the restoration project and within crossings shown on the recorded survey plat may be maintained by Grantor, successors or assigns to allow for access to the interior of the Property, and must be repaired and maintained to prevent runoff and degradation to the Conservation Easement Area. Such roads and trails shall be covered with pervious materials such as loose gravel or permanent vegetation in order to minimize runoff and prevent sedimentation.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored,

enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property within the Conservation Easement Area to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to maintain, repair or replace the fence at the sole discretion of the Grantee and at the expense of the Grantor, who agrees to indemnify the Grantee for any costs incurred as a result of maintenance, repair or replacement of the fence if such costs are required to protect the Conservation Easement Area from repeated incidents of grazing or other prohibited activities.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from

any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor, including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing

sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Ecosystem Enhancement Program Manager
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

Louis Edward Hatem (SEAL)
Louis Edward Hatem

Eila Gillian Hatem (SEAL)
Eila Gillian Hatem

William Michael Hatem, Jr. (SEAL)
William Michael Hatem, Jr.

Kimberly Diane Hatem (SEAL)
Kimberly Diane Hatem

William Michael Hatem (SEAL)
William Michael Hatem

Linda Carlton Hatem (SEAL)
Linda Carlton Hatem

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, JR, a Notary Public in and for the County and State aforesaid, do hereby certify that **LOUIS EDWARD HATEM and wife, EILA GILLIAN HATEM**, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 19th day of December, 2013.

Notary Public

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

My commission expires:

5-1-2017

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, JR, a Notary Public in and for the County and State aforesaid, do hereby certify that **WILLIAM MICHAEL HATEM, JR. and wife, KIMBERLY DIANE HATEM**, Gra ntor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 19th day of December, 2013.

Notary Public

My commission expires:

5-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, JR, a Notary Public in and for the County and State aforesaid, do hereby certify that **WILLIAM MICHAEL HATEM and wife, LINDA CARLTON HATEM**, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 19th day of December, 2013.

Notary Public

My commission expires:

5-1-2017

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

00359165

Exhibit 1

Permanent Conservation Easements
Brown Creek Tributaries Project-UT4
Anson County, NC

1. Permanent Conservation Easement (Ref: PIN: 6497-00-13-8104)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Louis Edward Hatem and William Michael Hatem. Jr.* (PIN: 6497-00-13-8104), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473633.0830 ft., E=1692365.5820 ft, and identified as MEC #308 on the above referenced plat and running N 77°44'49" E, 110.07' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

N 75°39'42" W, 231.27', thence
S 14°13'18" E, 139.10', thence
S 73°05'12" W, 145.64', thence
N 20°52'19" W, 208.90', thence
N 21°06'14" W, 144.03', thence
N 11°53'33" W, 241.64', thence
S 84°20'14" E, 1457.25', thence
S 81°07'48" E, 136.85', thence
S 20°18'23" W, 366.26', thence
N 88°37'15" W, 177.71', thence
S 85°42'35" W, 237.63', thence
N 84°02'13" W, 268.86', thence
N 79°58'48" W, 275.11', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 13.835 acres, more or less.

2. Permanent Conservation Easement (Ref: PIN: 6497-00-13-8104)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Louis Edward Hatem and William Michael Hatem, Jr.* (PIN: 6497-00-13-8104), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=472355.0500 ft., E=1692261.2090'ft, and identified as MEC #305 on the above referenced plat and running S 46°22'14" W,

230.59'; thence N 14°03'37" W, 253.86'; thence N 15°02'11" E, 171.24' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 88°15'04" W, 72.90', thence
N 86°27'21" W, 74.65', thence
N 06°03'07" E, 129.39', thence
N 22°26'36" E, 356.40', thence
N 18°10'57" E, 359.29', thence
N 20°34'22" W, 115.71', thence
N 73°05'12" E, 143.54', thence
S 14°13'18" E, 135.47', thence
S 05°48'42" W, 159.78', thence
S 18°10'40" W, 100.73', thence
S 18°25'04" W, 151.07', thence
S 20°44'03" W, 345.79', thence
S 15°02'11" W, 102.71', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 3.361 acres, more or less.

3. Permanent Conservation Easement (Ref: PIN: 6497-00-13-8104)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Louis Edward Hatem and William Michael Hatem, Jr.* (PIN: 6497-00-13-8104), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=472355.0500 ft., E=1692261.2090'ft, and identified as MEC #305 on the above referenced plat and running S 46°22'14" W, 230.59' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

N 88°39'37" W, 172.43', thence
N 02°01'43" W, 252.67', thence
N 06°03'07" E, 128.37', thence
S 86°27'21" E, 77.35', thence
N 88°15'04" E, 65.23', thence
S 15°02'11" W, 139.90', thence
S 14°03'37" E, 253.86', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 1.224 acres, more or less.

4. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easement described above and conveyed herein, shall be (1) as provided in this deed, (2) as provided on the Plat referenced below, and (3), as provided in the Access Easement recorded at Book 1054, Page 135, Anson County Registry, to provide ingress, egress, and regress for purposes of accessing the permanent conservation easement(s) set forth above, and as shown on the map recorded in Plat Book 300, Pages 9, 10 & 11 of the Anson County Registry.

00361277

FILED
ANSON COUNTY, NC
JOANNE S. HUNTLEY
REGISTER OF DEEDS

FILED	Dec 19, 2013
AT	03:03 pm
BOOK	01054
START PAGE	0143
END PAGE	0154
INSTRUMENT #	02863
RECORDING	$26.00
EXCISE TAX	$66.00

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

STATE OF NORTH CAROLINA

ANSON COUNTY

66 00

REVENUE $ 66.00
SPO File Number: 04-G
EEP Project Number: 95351

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT NO: 004641

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this 19th day of December, 2013, by TERRY MARSHALL DENNIS, SR. and wife, MARTHA HENSLEY DENNIS, whose address is 1930 River Road, Troy, North Carolina 27371 ("**Grantor**"), to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc., 8000 Regency Parkway, Suite 600, Cary, North Carolina 27518 and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or

buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number 004641.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Ecosystem Enhancement Program with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in Ansonville and Wadesboro Townships, Anson County, North Carolina, which parcel is identified by PIN: 6497-00-31-8725 and containing approximately 67.21 acres and being conveyed to the Grantor by deed recorded in **Deed Book 211 at Page 482** of the Anson County Registry, North Carolina (the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of Brown Creek Tributaries-UT4, Anson County, North Carolina.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

Conservation Easements identified as Conservation Easement Areas 7 and 8, as shown on a Plat entitled "Brown Creek Tributaries Project-UT4" Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program on the Property of LOUIS EDWARD HATEM and WILLIAM MICHAEL HATEM, JR., ALAN DALE McRAE, and TERRY MARSHALL DENNIS, SR. and MARTHA HENSLEY DENNIS, Ansonville and Wadesboro Townships, Anson County, North Carolina" dated 09/09/2012-10/30/2013 certified by J. David Lee, II, NCPLS L-4175 and recorded in Plat Book 300, Page 9, 10 & 11, Anson County Registry.

TOGETHER with an easement for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement Area" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the

use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat **or as specifically allowed within a fence maintenance zone as described in section D or a Road or Trail described in section H**.

The Grantor reserves the right, for himself, his successors and assigns, to operate motorized vehicles within Crossing Area(s) described on the survey recorded in Plat Book _____, Page _____, of the _____County Registry as "reserved stream crossing". Said crossing shall not exceed ____ feet in width, and must be maintained and repaired by Grantor, his successors or assigns to prevent degradation of the Conservation Easement Area.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. Damage to Vegetation. Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited with the following exception:

Notwithstanding the foregoing, if there is a fence within the Conservation Easement Area, the Grantor reserves the right to mow and maintain vegetation within 10 feet of the Conservation Easement boundary ***as shown on the Survey Plat*** and extending along the entire length of the

fence. The Grantor, his successors or assigns shall be solely responsible for maintenance of the fence for as long as there is livestock on the Grantor's property adjacent to the Conservation Easement Area.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of roads, trails, walkways, or paving in the Conservation Easement Area with the following exception:

Only roads and trails located within the Conservation Easement Area prior to completion of the construction of the restoration project and within crossings shown on the recorded survey plat may be maintained by Grantor, successors or assigns to allow for access to the interior of the Property, and must be repaired and maintained to prevent runoff and degradation to the Conservation Easement Area. Such roads and trails shall be covered with pervious materials such as loose gravel or permanent vegetation in order to minimize runoff and prevent sedimentation.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may

temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property within the Conservation Easement Area to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to maintain, repair or replace the fence at the sole discretion of the Grantee and at the

expense of the Grantor, who agrees to indemnify the Grantee for any costs incurred as a result of maintenance, repair or replacement of the fence if such costs are required to protect the Conservation Easement Area from repeated incidents of grazing or other prohibited activities.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor,

including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Ecosystem Enhancement Program Manager

State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

Terry Marshall Dennis (SEAL)
Terry Marshall Dennis, Sr.

Martha Hensley Dennis (SEAL)
Martha Hensley Dennis

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, JR, a Notary Public in and for the County and State aforesaid, do hereby certify that **TERRY MARSHALL DENNIS, SR. and wife, MARTHA HENSLEY DENNIS**, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 19th day of December, 2013.

Notary Public

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

My commission expires:

5-1-2017

00359885

Exhibit 1

Permanent Conservation Easements
Brown Creek Tributaries Project-UT4
Anson County, NC

1. Permanent Conservation Easement (Ref: PIN: 6497-00-31-8725)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Terry Marshall Dennis, Sr. and Martha Hensley Dennis* (PIN: 6497-00-31-8725), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473010.7731 ft., E=1694056.9660 ft, and identified as MEC #1 on the above referenced plat and running S 51°26'19" W, 226.56'; thence S 06°53'41" W, 303.63'; thence S 02°25'34" E, 257.58'; thence S 19°20'27" W, 17.05' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 19°20'27" W, 214.82', thence
N 25°25'08" W, 228.70', thence
S 88°41'34" E, 169.36', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 0.397 acres, more or less.

2. Permanent Conservation Easement (Ref: PIN: 6497-00-31-8725)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Terry Marshall Dennis, Sr. and Martha Hensley Dennis* (PIN: 6497-00-31-8725), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473010.7731 ft., E=1694056.9660 ft, and identified as MEC #1 on the above referenced plat and running S 51°26'19" W, 226.56'; thence S 06°53'41" W, 303.63'; thence S 02°25'34" E, 257.58'; thence S 19°20'27" W, 17.05'; thence S 88°41'34" E, 73.62; thence S 19°20'27" W, 131.93' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 21°04'23" E, 158.94', thence
S 32°11'38" E, 171.47', thence

S 00°06'22" E, 185.83', thence
N 88°51'35" W, 170.40', thence
N 02°19'41" W, 180.67', thence
N 19°34'37" W, 112.37', thence
N 19°20'27" E, 200.79', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 1.434 acres, more or less.

3. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easement described above and conveyed herein, shall be (1) as provided in this deed, (2) as provided on the Plat referenced below, and (3), as provided in the Access Easement recorded at Book _____, Page _____, Anson County Registry, to provide ingress, egress, and regress for purposes of accessing the permanent conservation easement(s) set forth above, and as shown on the map recorded in Plat Book 300, Pages 9, 10 & 11 of the Anson County Registry.

00361280

FILED
ANSON COUNTY, NC
JOANNE S. HUNTLEY
REGISTER OF DEEDS

FILED	Dec 19, 2013
AT	03:11 pm
BOOK	01054
START PAGE	0155
END PAGE	0166
INSTRUMENT #	02864
RECORDING	$26.00
EXCISE TAX	$323.00

Prepared by and return to:
Robert H. Merritt, Jr.
Bailey & Dixon, LLP
P. O. Box 1351
Raleigh, NC 27602

STATE OF NORTH CAROLINA

ANSON COUNTY

$323.00

REVENUE $ 323.00
SPO File Number: 04-C
EEP Project Number: 95351

DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS PROVIDED PURSUANT TO FULL DELIVERY MITIGATION CONTRACT NO: 004641

THIS DEED OF CONSERVATION EASEMENT AND RIGHT OF ACCESS, made this 19 day of December, 2013, by ALAN DALE McRAE (unmarried), whose address is 151 Bailey Road, Wadesboro, North Carolina 28170 ("**Grantor**"), to the State of North Carolina, ("**Grantee**"), whose mailing address is State of North Carolina, Department of Administration, State Property Office, 1321 Mail Service Center, Raleigh, NC 27699-1321. The designations of Grantor and Grantee as used herein shall include said parties, their heirs, successors, and assigns, and shall include singular, plural, masculine, feminine, or neuter as required by context.

WITNESSETH:

WHEREAS, pursuant to the provisions of N.C. Gen. Stat. § 143-214.8 et seq., the State of North Carolina has established the Ecosystem Enhancement Program (formerly known as the Wetlands Restoration Program) within the Department of Environment and Natural Resources for the purposes of acquiring, maintaining, restoring, enhancing, creating and preserving wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; and

WHEREAS, this Conservation Easement from Grantor to Grantee has been negotiated, arranged and provided for as a condition of a full delivery contract between Michael Baker Engineering, Inc., 8000 Regency Parkway, Suite 600, Cary, North Carolina 27518 and the North Carolina Department of Environment and Natural Resources, to provide stream, wetland and/or

buffer mitigation pursuant to the North Carolina Department of Environment and Natural Resources Purchase and Services Contract Number 004641.

WHEREAS, The State of North Carolina is qualified to be the Grantee of a Conservation Easement pursuant to N.C. Gen. Stat. § 121-35; and

WHEREAS, the Department of Environment and Natural Resources and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Understanding, (MOU) duly executed by all parties on November 4, 1998. This MOU recognized that the Wetlands Restoration Program was to provide effective compensatory mitigation for authorized impacts to wetlands, streams and other aquatic resources by restoring, enhancing and preserving the wetland and riparian areas of the State; and

WHEREAS, the Department of Environment and Natural Resources, the North Carolina Department of Transportation and the United States Army Corps of Engineers, Wilmington District entered into a Memorandum of Agreement, (MOA) duly executed by all parties in Greensboro, NC on July 22, 2003, which recognizes that the Ecosystem Enhancement Program is to provide for compensatory mitigation by effective protection of the land, water and natural resources of the State by restoring, enhancing and preserving ecosystem functions; and

WHEREAS, the Department of Environment and Natural Resources, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the North Carolina Wildlife Resources Commission, the North Carolina Division of Water Quality, the North Carolina Division of Coastal Management, and the National Marine Fisheries Service entered into an agreement to continue the In-Lieu Fee operations of the North Carolina Department of Natural Resources' Ecosystem Enhancement Program with an effective date of 28 July, 2010, which supersedes and replaces the previously effective MOA and MOU referenced above; and

WHEREAS, the acceptance of this instrument for and on behalf of the State of North Carolina was granted to the Department of Administration by resolution as approved by the Governor and Council of State adopted at a meeting held in the City of Raleigh, North Carolina, on the 8th day of February 2000; and

WHEREAS, the Ecosystem Enhancement Program in the Department of Environment and Natural Resources, which has been delegated the authority authorized by the Governor and Council of State to the Department of Administration, has approved acceptance of this instrument; and

WHEREAS, Grantor owns in fee simple certain real property situated, lying, and being in Ansonville and Wadesboro Townships, Anson County, North Carolina, which parcel is identified by PIN: 6497-00-45-2885 and containing approximately 215.06 acres and being conveyed to the Grantor by deeds recorded in **Deed Book 246 Page 139** and **Book 951, Page 182,** Anson County Registry, North Carolina (the "Property"); and

WHEREAS, Grantor is willing to grant a Conservation Easement and Right of Access over the herein described areas of the Property, thereby restricting and limiting the use of the areas of the Property subject to the Conservation Easement to the terms and conditions and purposes hereinafter set forth, and Grantee is willing to accept said Easement and Access Rights. The Conservation Easement shall be for the protection and benefit of the waters of Brown Creek Tributaries-UT4, Anson County, North Carolina.

NOW, THEREFORE, in consideration of the mutual covenants, terms, conditions, and restrictions hereinafter set forth, Grantor unconditionally and irrevocably hereby grants and conveys unto Grantee, its successors and assigns, forever and in perpetuity, a Conservation Easement along with a general Right of Access, as follows:

The Easement Area consists of the following:

Conservation Easements identified as Conservation Easement Areas 1, 2 and 3, as shown on a Plat entitled "Brown Creek Tributaries Project-UT4" Conservation Easement Survey for The State of North Carolina Ecosystem Enhancement Program on the Property of LOUIS EDWARD HATEM and WILLIAM MICHAEL HATEM, JR., ALAN DALE McRAE and TERRY MARSHALL DENNIS, SR. and MARTHA HENSLEY DENNIS, Ansonville and Wadesboro Townships, Anson County, North Carolina dated 09/09/2012-10/30/2013, certified by J. David Lee, II, NCPLS L-4175 and recorded in Plat Book 300, Page 9, 10 & 11, Anson County Registry.

TOGETHER with an easement for access, ingress, egress and regress as described on the above-referenced recorded plat and this Conservation Easement Deed.

The Conservation Easements described above are hereinafter referred to as the "Easement Area" or the "Conservation Easement Area" and are further set forth in a metes and bounds description attached hereto as Exhibit 1 and incorporated herein by reference.

The purposes of this Conservation Easement are to maintain, restore, enhance, construct, create and preserve wetland and/or riparian resources in the Conservation Easement Area that contribute to the protection and improvement of water quality, flood prevention, fisheries, aquatic habitat, wildlife habitat, and recreational opportunities; to maintain permanently the Conservation Easement Area in its natural condition, consistent with these purposes; and to prevent any use of the Easement Area that will significantly impair or interfere with these purposes. To achieve these purposes, the following conditions and restrictions are set forth:

I. DURATION OF EASEMENT

Pursuant to law, including the above referenced statutes, this Conservation Easement and Right of Access shall be perpetual and it shall run with, and be a continuing restriction upon the

use of, the Property, and it shall be enforceable by the Grantee against the Grantor and against Grantor's heirs, successors and assigns, personal representatives, agents, lessees, and licensees.

II. GRANTOR RESERVED USES AND RESTRICTED ACTIVITIES

The Conservation Easement Area shall be restricted from any development or usage that would impair or interfere with the purposes of this Conservation Easement. Unless expressly reserved as a compatible use herein, any activity in, or use of, the Conservation Easement Area by the Grantor is prohibited as inconsistent with the purposes of this Conservation Easement. Any rights not expressly reserved hereunder by the Grantor have been acquired by the Grantee. Any rights not expressly reserved hereunder by the Grantor, including the rights to all mitigation credits, including, but not limited to, stream, wetland, and riparian buffer mitigation units, derived from each site within the area of the Conservation Easement, are conveyed to and belong to the Grantee. Without limiting the generality of the foregoing, the following specific uses are prohibited, restricted, or reserved as indicated:

A. Recreational Uses. Grantor expressly reserves the right to undeveloped recreational uses, including hiking, bird watching, hunting and fishing, and access to the Conservation Easement Area for the purposes thereof.

B. Motorized Vehicle Use. Motorized vehicle use in the Conservation Easement Area is prohibited except within a Crossing Area(s) or Road or Trail as shown on the recorded survey plat **or as specifically allowed within a fence maintenance zone as described in section D or a Road or Trail described in section H**.

The Grantor reserves the right, for himself, his successors and assigns, to operate motorized vehicles within Crossing Area(s) described on the survey recorded in Plat Book _____, Page _____, of the _____County Registry as "reserved stream crossing". Said crossing shall not exceed ____ feet in width, and must be maintained and repaired by Grantor, his successors or assigns to prevent degradation of the Conservation Easement Area.

C. Educational Uses. The Grantor reserves the right to engage in and permit others to engage in educational uses in the Conservation Easement Area not inconsistent with this Conservation Easement, and the right of access to the Conservation Easement Area for such purposes including organized educational activities such as site visits and observations. Educational uses of the property shall not alter vegetation, hydrology or topography of the site.

D. Damage to Vegetation. Except within Crossing Area(s) as shown on the recorded survey plat and as related to the removal of non-native plants, diseased or damaged trees, or vegetation that destabilizes or renders unsafe the Conservation Easement Area to persons or natural habitat, all cutting, removal, mowing, harming, or destruction of any trees and vegetation in the Conservation Easement Area is prohibited with the following exception:

Notwithstanding the foregoing, if there is a fence within the Conservation Easement Area, the Grantor reserves the right to mow and maintain vegetation within 10 feet of the Conservation Easement boundary ***as shown on the Survey Plat*** and extending along the entire length of the

fence. The Grantor, his successors or assigns shall be solely responsible for maintenance of the fence for as long as there is livestock on the Grantor's property adjacent to the Conservation Easement Area.

E. Industrial, Residential and Commercial Uses. All industrial, residential and commercial uses are prohibited in the Conservation Easement Area.

F. Agricultural Use. All agricultural uses are prohibited within the Conservation Easement Area including any use for cropland, waste lagoons, or pastureland.

G. New Construction. There shall be no building, facility, mobile home, antenna, utility pole, tower, or other structure constructed or placed in the Conservation Easement Area.

H. Roads and Trails. There shall be no construction or maintenance of roads, trails, walkways, or paving in the Conservation Easement Area with the following exception:

Only roads and trails located within the Conservation Easement Area prior to completion of the construction of the restoration project and within crossings shown on the recorded survey plat may be maintained by Grantor, successors or assigns to allow for access to the interior of the Property, and must be repaired and maintained to prevent runoff and degradation to the Conservation Easement Area. Such roads and trails shall be covered with pervious materials such as loose gravel or permanent vegetation in order to minimize runoff and prevent sedimentation.

I. Signs. No signs shall be permitted in the Conservation Easement Area except interpretive signs describing restoration activities and the conservation values of the Conservation Easement Area, signs identifying the owner of the Property and the holder of the Conservation Easement, signs giving directions, or signs prescribing rules and regulations for the use of the Conservation Easement Area.

J. Dumping or Storing. Dumping or storage of soil, trash, ashes, garbage, waste, abandoned vehicles, appliances, machinery, or any other material in the Conservation Easement Area is prohibited.

K. Grading, Mineral Use, Excavation, Dredging. There shall be no grading, filling, excavation, dredging, mining, drilling, hydraulic fracturing; removal of topsoil, sand, gravel, rock, peat, minerals, or other materials.

L. Water Quality and Drainage Patterns. There shall be no diking, draining, dredging, channeling, filling, leveling, pumping, impounding or diverting, causing, allowing or permitting the diversion of surface or underground water in the Conservation Easement Area. No altering or tampering with water control structures or devices, or disruption or alteration of the restored, enhanced, or created drainage patterns is allowed. All removal of wetlands, polluting or discharging into waters, springs, seeps, or wetlands, or use of pesticide or biocides in the Conservation Easement Area is prohibited. In the event of an emergency interruption or shortage of all other water sources, water from within the Conservation Easement Area may

temporarily be withdrawn for good cause shown as needed for the survival of livestock on the Property.

M. Subdivision and Conveyance. Grantor voluntarily agrees that no further subdivision, partitioning, or dividing of the Conservation Easement Area portion of the Property owned by the Grantor in fee simple ("fee") that is subject to this Conservation Easement is allowed. Any future transfer of the Property shall be subject to this Conservation Easement and Right of Access and to the Grantee's right of unlimited and repeated ingress and egress over and across the Property to the Conservation Easement Area for the purposes set forth herein.

N. Development Rights. All development rights are permanently removed from the Conservation Easement Area and are non-transferrable.

O. Disturbance of Natural Features. Any change, disturbance, alteration or impairment of the natural features of the Conservation Easement Area or any intentional introduction of non-native plants, trees and/or animal species by Grantor is prohibited.

The Grantor may request permission to vary from the above restrictions for good cause shown, provided that any such request is not inconsistent with the purposes of this Conservation Easement, and the Grantor obtains advance written approval from the N.C. Ecosystem Enhancement Program, whose mailing address is 1652 Mail Services Center, Raleigh, NC 27699-1652.

III. GRANTEE RESERVED USES

A. Right of Access, Construction, and Inspection. The Grantee, its employees and agents, successors and assigns, receive a perpetual Right of Access to the Conservation Easement Area over the Property at reasonable times to undertake any activities to restore, construct, manage, maintain, enhance, protect, and monitor the stream, wetland and any other riparian resources in the Conservation Easement Area, in accordance with restoration activities or a long-term management plan. Unless otherwise specifically set forth in this Conservation Easement, the rights granted herein do not include or establish for the public any access rights.

B. Restoration Activities. These activities include planting of trees, shrubs and herbaceous vegetation, installation of monitoring wells, utilization of heavy equipment to grade, fill, and prepare the soil, modification of the hydrology of the site, and installation of natural and manmade materials as needed to direct in-stream, above ground, and subterraneous water flow.

C. Signs. The Grantee, its employees and agents, successors or assigns, shall be permitted to place signs and witness posts on the Property to include any or all of the following: describe the project, prohibited activities within the Conservation Easement, or identify the project boundaries and the holder of the Conservation Easement.

D. Fences. The Grantee, its employees and agents, successors or assigns, shall be permitted to place fencing on the Property within the Conservation Easement Area to restrict livestock access. Although the Grantee is not responsible for fence maintenance, the Grantee reserves the right to maintain, repair or replace the fence at the sole discretion of the Grantee and at the

expense of the Grantor, who agrees to indemnify the Grantee for any costs incurred as a result of maintenance, repair or replacement of the fence if such costs are required to protect the Conservation Easement Area from repeated incidents of grazing or other prohibited activities.

E. Crossing Area(s). The Grantee is not responsible for maintenance of crossing area(s), however, the Grantee, its employees and agents, successors or assigns, reserve the right to repair crossing area(s), at its sole discretion and to recover the cost of such repairs from the Grantor if such repairs are needed as a result of activities of the Grantor, his successors or assigns.

IV. ENFORCEMENT AND REMEDIES

A. Enforcement. To accomplish the purposes of this Conservation Easement, Grantee is allowed to prevent any activity within the Conservation Easement Area that is inconsistent with the purposes of this Conservation Easement and to require the restoration of such areas or features in the Conservation Easement Area that may have been damaged by such unauthorized activity or use. Upon any breach of the terms of this Conservation Easement by Grantor, the Grantee shall, except as provided below, notify the Grantor in writing of such breach and the Grantor shall have ninety (90) days after receipt of such notice to correct the damage caused by such breach. If the breach and damage remains uncured after ninety (90) days, the Grantee may enforce this Conservation Easement by bringing appropriate legal proceedings including an action to recover damages, as well as injunctive and other relief. The Grantee shall also have the power and authority, consistent with its statutory authority: (a) to prevent any impairment of the Conservation Easement Area by acts which may be unlawful or in violation of this Conservation Easement; (b) to otherwise preserve or protect its interest in the Property; or (c) to seek damages from any appropriate person or entity. Notwithstanding the foregoing, the Grantee reserves the immediate right, without notice, to obtain a temporary restraining order, injunctive or other appropriate relief, if the breach is or would irreversibly or otherwise materially impair the benefits to be derived from this Conservation Easement, and the Grantor and Grantee acknowledge that the damage would be irreparable and remedies at law inadequate. The rights and remedies of the Grantee provided hereunder shall be in addition to, and not in lieu of, all other rights and remedies available to Grantee in connection with this Conservation Easement.

B. Inspection. The Grantee, its employees and agents, successors and assigns, have the right, with reasonable notice, to enter the Conservation Easement Area over the Property at reasonable times for the purpose of inspection to determine whether the Grantor is complying with the terms, conditions and restrictions of this Conservation Easement.

C. Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury or change in the Conservation Easement Area caused by third parties, resulting from causes beyond the Grantor's control, including, without limitation, fire, flood, storm, and earth movement, or from any prudent action taken in good faith by the Grantor under emergency conditions to prevent, abate, or mitigate significant injury to life or damage to the Property resulting from such causes.

D. Costs of Enforcement. Beyond regular and typical monitoring expenses, any costs incurred by Grantee in enforcing the terms of this Conservation Easement against Grantor,

including, without limitation, any costs of restoration necessitated by Grantor's acts or omissions in violation of the terms of this Conservation Easement, shall be borne by Grantor.

E. No Waiver. Enforcement of this Easement shall be at the discretion of the Grantee and any forbearance, delay or omission by Grantee to exercise its rights hereunder in the event of any breach of any term set forth herein shall not be construed to be a waiver by Grantee.

V. MISCELLANEOUS

A. This instrument sets forth the entire agreement of the parties with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings or agreements relating to the Conservation Easement. If any provision is found to be invalid, the remainder of the provisions of the Conservation Easement, and the application of such provision to persons or circumstances other than those as to which it is found to be invalid, shall not be affected thereby.

B. Grantor is responsible for any real estate taxes, assessments, fees, or charges levied upon the Property. Grantee shall not be responsible for any costs or liability of any kind related to the ownership, operation, insurance, upkeep, or maintenance of the Property, except as expressly provided herein. Upkeep of any constructed bridges, fences, or other amenities on the Property are the sole responsibility of the Grantor. Nothing herein shall relieve the Grantor of the obligation to comply with federal, state or local laws, regulations and permits that may apply to the exercise of the Reserved Rights.

C. Any notices shall be sent by registered or certified mail, return receipt requested to the parties at their addresses shown herein or to other addresses as either party establishes in writing upon notification to the other.

D. Grantor shall notify Grantee in writing of the name and address and any party to whom the Property or any part thereof is to be transferred at or prior to the time said transfer is made. Grantor further agrees that any subsequent lease, deed, or other legal instrument by which any interest in the Property is conveyed is subject to the Conservation Easement herein created.

E. The Grantor and Grantee agree that the terms of this Conservation Easement shall survive any merger of the fee and easement interests in the Property or any portion thereof.

F. This Conservation Easement and Right of Access may be amended, but only in writing signed by all parties hereto, or their successors or assigns, if such amendment does not affect the qualification of this Conservation Easement or the status of the Grantee under any applicable laws, and is consistent with the purposes of the Conservation Easement. The owner of the Property shall notify the State Property Office and the U.S. Army Corps of Engineers in writing sixty (60) days prior to the initiation of any transfer of all or any part of the Property or of any request to void or modify this Conservation Easement. Such notifications and modification requests shall be addressed to:

Ecosystem Enhancement Program Manager
State Property Office
1321 Mail Service Center
Raleigh, NC 27699-1321

and

General Counsel
US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

G. The parties recognize and agree that the benefits of this Conservation Easement are in gross and assignable provided, however, that the Grantee hereby covenants and agrees, that in the event it transfers or assigns this Conservation Easement, the organization receiving the interest will be a qualified holder under N.C. Gen. Stat. § 121-34 et seq. and § 170(h) of the Internal Revenue Code, and the Grantee further covenants and agrees that the terms of the transfer or assignment will be such that the transferee or assignee will be required to continue in perpetuity the conservation purposes described in this document.

VI. QUIET ENJOYMENT

Grantor reserves all remaining rights accruing from ownership of the Property, including the right to engage in or permit or invite others to engage in only those uses of the Conservation Easement Area that are expressly reserved herein, not prohibited or restricted herein, and are not inconsistent with the purposes of this Conservation Easement. Without limiting the generality of the foregoing, the Grantor expressly reserves to the Grantor, and the Grantor's invitees and licensees, the right of access to the Conservation Easement Area, and the right of quiet enjoyment of the Conservation Easement Area,

TO HAVE AND TO HOLD, the said rights and easements perpetually unto the State of North Carolina for the aforesaid purposes,

AND Grantor covenants that Grantor is seized of said premises in fee and has the right to convey the permanent Conservation Easement herein granted; that the same is free from encumbrances and that Grantor will warrant and defend title to the same against the claims of all persons whomsoever.

IN TESTIMONY WHEREOF, the Grantor has hereunto set his hand and seal, the day and year first above written.

Alan Dale McRae (SEAL)
Alan Dale McRae, Unmarried

NORTH CAROLINA
COUNTY OF WAKE

I, Robert H. Merritt, Jr, a Notary Public in and for the County and State aforesaid, do hereby certify that **ALAN DALE McRAE, Unmarried**, Grantor, personally appeared before me this day and acknowledged the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto set my hand and Notary Seal this the 19th day of December, 2013.

Notary Public

ROBERT H. MERRITT, JR. NOTARY PUBLIC WAKE COUNTY, NC

My commission expires:

5-1-2017

00359886

Exhibit 1

Permanent Conservation Easements
Brown Creek Tributaries Project-UT4
Anson County, NC

1. Permanent Conservation Easement (Ref: PIN: 6497-00-45-2885)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Alan Dale McRae* (PIN: 6497-00-45-2885), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473431.6389 ft., E=1694174.2790 ft, and identified as MEC #2 on the above referenced plat and running N 34°19'31" E 538.68' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

N 19°23'02" E, 172.98', thence
N 78°22'09" E, 80.87', thence
S 71°03'07" E, 207.10', thence
S 68°51'04" E, 196.85', thence
S 04°11'19" W, 133.07', thence
N 68°16'23" W, 396.77', thence
S 68°06'24" W, 148.50', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 1.469 acres, more or less.

2. Permanent Conservation Easement (Ref: PIN: 6497-00-45-2885)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Alan Dale McRae* (PIN: 6497-00-45-2885), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473010.7731 ft., E=1694056.9660 ft, and identified as MEC #1 on the above referenced plat and running S 51°26'19" W, 226.56' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

S 06°53'41" W, 303.63', thence

S 02°25'34" E, 257.58', thence
S 19°20'27" W, 17.05', thence
N 88°41'34" W, 169.36', thence
N 07°51'58" E, 276.96', thence
N 04°23'37" E, 586.76', thence
N 03°15'12" W, 318.63', thence
N 31°50'27" W, 131.98', thence
N 88°37'15" W, 169.71', thence
N 21°15'22" E, 182.53', thence
S 78°24'20" E, 222.81', thence
N 69°18'28" E, 299.44', thence
N 61°32'11" E, 201.80'thence
N 68°12'50" E, 215.82', thence
S 19°23'02" W, 190.85', thence
S 58°36'31" W, 302.87', thence
S 78°27'45" W, 312.60', thence
S 26°19'28" E, 102.38', thence
S 09°20'40" E, 139.49', thence
S 00°49'43" W, 500.45', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 7.296 acres, more or less.

3. Permanent Conservation Easement (Ref: PIN: 6497-00-45-2885)

A permanent conservation easement over a portion of land in Ansonville Township, Anson County, North Carolina, as shown on a Plat entitled "*Brown Creek Tributaries Project-UT4" Conservation Easement Survey for the State of North Carolina – Ecosystem Enhancement Program on the Property of Louis Edward Hatem and William Michael Hatem, Jr., Alan Dale McRae, and Terry Marshall Dennis, Sr. and Martha Hensley Dennis,* dated 09/09/2012-10/30/2013, and recorded in Plat Book 300, Page 9, 10 & 11, of the Anson County Registry, and being a portion of the parcel owned by *Alan Dale McRae* (PIN: 6497-00-45-2885), more particularly described as follows:

Commencing at an #5 rebar and cap with NC Grid (NAD 83/2011) Coordinates of N=473633.0830 ft., E=1692365.5820 ft, and identified as MEC #308 on the above referenced plat and running N 77°44'49" E, 110.07'; thence S 79°58'48" E, 275.11'; thence S 84°02'13" E, 268.86'; thence N 85°42'35" E, 237.63'; thence S 88°37'15" E, 177.71' to a set #5 rebar with cap, which is the **POINT AND PLACE OF BEGINNING;** thence continuing the following courses and distances:

N 20°18'23" E, 196.17', thence
S 78°24'20" E, 47.97', thence
S 21°15'22" W, 188.27', thence
N 88°37'15" W, 46.83', to the **POINT AND PLACE OF BEGINNING,** said permanent conservation easement containing 0.202 acres, more or less.

4. Access to the Permanent Conservation Easements

Access to and through the permanent conservation easement described above and conveyed herein, shall be (1) as provided in this deed, (2) as provided on the Plat referenced below, and (3), as provided in the Access Easement recorded at Book _____, Page _____, Anson County Registry, to provide ingress, egress, and regress for purposes of accessing the permanent conservation easement(s) set forth above, and as shown on the map recorded in Plat Book 300, Pages 9, 10 & 11 of the Anson County Registry.

00361222

16.0 APPENDIX B - BASELINE INFORMATION DATA

16.1 USACE Routine Wetland Determination Forms - per regional supplement to 1987 Manual

Brown Creek - Hurricane Creek
Wetland A

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Hurricane Creek - Wetland A City/County: Anson Sampling Date: 12/18/13
Applicant/Owner: NCEEP State: NC Sampling Point: WCA
Investigator(s): Ed Snail Section, Township, Range:
Landform (hillslope, terrace, etc.): Flood Plain Local relief (concave, convex, none): concave Slope (%): >5%
Subregion (LRR or MLRA): LRR-P Lat: 35.0490241 Long: -80.0657772 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla Loam NWI classification: PEM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:
Area is depression / swale in active pasture.
Flow to Hurricane Creek wetland.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- X Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ____ Depth (inches): 0-6"
Water Table Present? Yes ____ No X Depth (inches): >20"
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): >20"

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Surface water present due to Restrictive clay layer. Clay layer did not appear saturated in soil pits.

Brown Creek - Hurricane Creek wetland A

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: wet A

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Sapling Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover: ____ 20% of total cover: ____			
Herb Stratum (Plot size: 5-Foot radius)			
1. Hydrocotyle ranunculoides	85%	Y	OBL
2. Juncus effusus	5%	N	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	90 = Total Cover		
50% of total cover: 45 20% of total cover: 17			
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover: ____ 20% of total cover: ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species ____	x 1 = ____
FACW species ____	x 2 = ____
FAC species ____	x 3 = ____
FACU species ____	x 4 = ____
UPL species ____	x 5 = ____
Column Totals: ____ (A)	____ (B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- X 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: (Include photo numbers here or on a separate sheet.)

- Hydrophytic vegetation is present. Area grazed by cattle.

Brown Creek- Hurricane Creek
Wetland A

SOIL Sampling Point: WetA

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20"	10YR 3/3	90	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- X Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Clay layer

Depth (inches): Surface

Hydric Soil Present? Yes X No ___

Remarks:

Hydric soil present due to redox features and low chroma color.

Brown Creek - Hurricane Creek
wetland B

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Hurricane Creek - wet B City/County: Anson Sampling Date: 12/18/13
Applicant/Owner: NCEEP State: NC Sampling Point: wet B
Investigator(s): Ed Smail Section, Township, Range:
Landform (hillslope, terrace, etc.): Flood plain Local relief (concave, convex, none): concave Slope (%): 2%
Subregion (LRR or MLRA): LRR-P Lat: 35.051490 Long: -80.066534 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla loam NWI classification: PEM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
Area is depression / drainage swale in active pasture.
Flow to Hurricane creek culvert.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- X Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ____ Depth (inches): 0-1"
Water Table Present? Yes ____ No X Depth (Inches): >20"
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): >20"

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Surface water present due to restrictive clay layer. Clay layer did not appear saturated in soil pods.

Brown Creek, Hurricane Creek
Wetland A

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: wet B

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Sapling Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Herb Stratum (Plot size: 5-Foot radius)			
1. Hydrocotyle ranunculoides	80%	Y	OBL
2. Carex sp.	5%	N	FACW
3. Juncus effusus	5%	N	FACW
4. Andropogon virginicus	5%	N	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	95 = Total Cover		

50% of total cover: 47.5 20% of total cover: 19

Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		

50% of total cover: _____ 20% of total cover: _____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- X 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

- Hydrophytic vegetation present. Area grazed by cattle.

Brown Creek Hurricane Creek Wetland B

SOIL

Sampling Point: WCE B

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20"	10YR 3/4	80	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Clay

Depth (inches): Surface

Hydric Soil Present? Yes X No ___

Remarks:

- Hydric soil present due to redox features present in a depression.

Brown Creek - UT 4
wetland A/B

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown Creek - UT 4 - Wet A/B City/County: Anson Sampling Date: 12/18/13
Applicant/Owner: NCEEP State: NC Sampling Point: Wet A
Investigator(s): Ed Small Section, Township, Range:
Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): concave Slope (%): >5%
Subregion (LRR or MLRA): LRR-P Lat: 35.047965 Long: -80.029195 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla Loam NWI classification: PEM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X No ____	
Wetland Hydrology Present?	Yes X No ____	

Remarks:
Area is inundated depression in back swamp of stream floodplain

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- X Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ____ Depth (inches): 0-6"
Water Table Present? Yes ____ No X Depth (inches): >20"
Saturation Present? (includes capillary fringe) Yes ____ No X Depth (inches): >20"

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Surface water present due to restrictive clay layer. Clay layer did not appear saturated in soil pits

Brown Creek - UT4 wetland A/B

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: Wet A

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
6.			
	_____ = Total Cover		
50% of total cover: _____	20% of total cover: _____		
Sapling Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
6.			
	_____ = Total Cover		
50% of total cover: _____	20% of total cover: _____		
Shrub Stratum (Plot size: 10-Foot radius)			
1. Liquidambar styraciflua	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		
Herb Stratum (Plot size: 5-Foot radius)			
1. Juncus effusus	20	Y	FACW
2. Ludwigia palustris	20	Y	OBL
3. Carex sp.	20	Y	FACW
4. Eupatorium capillifolium	20	Y	FAC
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	80 = Total Cover		
50% of total cover: 40	20% of total cover: 16		
Woody Vine Stratum (Plot size: _____)			
1.			
2.			
3.			
4.			
5.			
	_____ = Total Cover		
50% of total cover: _____	20% of total cover: _____		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 80 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species _____	x 1 = _____
FACW species _____	x 2 = _____
FAC species _____	x 3 = _____
FACU species _____	x 4 = _____
UPL species _____	x 5 = _____
Column Totals: _____ (A)	_____ (B)

Prevalence Index = B/A = _____

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes X No _____

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is present.

Brown Creek: DP-4
Wetland A/B

SOIL Sampling Point: Wet A

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4"	10YR 3/3	80%	10YR 5/6	20	C	M	Clay	
4-20"	10YR 3/1	90%	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Clay

Depth (inches): Surface

Hydric Soil Present? Yes X No ___

Remarks:

Hydric soil present due to redox features and gray colors observed in the matrix

Brown Creek - UT4 wetland C

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown Creek - UT4 - Wetland C City/County: Anson Sampling Date: 12/19/13
Applicant/Owner: NCEEP State: NC Sampling Point: Wet C
Investigator(s): Ed Small Section, Township, Range:
Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): concave Slope (%): >5%
Subregion (LRR or MLRA): LRR-P Lat: 35.048051 Long: -80.020225 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla Loam NWI classification: PFO
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ____	**Is the Sampled Area within a Wetland?** Yes X No ____
Hydric Soil Present?	Yes X	No ____	
Wetland Hydrology Present?	Yes X	No ____	

Remarks:
Area is depression in back swamp of floodplain.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No X	Depth (inches): ____
Water Table Present?	Yes ____	No X	Depth (inches): >20"
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): >20"

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Wetland hydrology is present. Area is an overflow during flood events and has direct connection to stream channel.

Brown Creek SP4
Wetland C

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: wet c

Tree Stratum (Plot size: 10' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	20	Y	FAC
2. Platanus occidentalis	5	Y	FACW
3.			
4.			
5.			
6.			
	25 = Total Cover		
50% of total cover: 12.5	20% of total cover: 5		
Sapling Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5' radius)			
1. Andropogon virginicus	5	Y	FAC
2. Allium vineale	5	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 75 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- X 1 - Rapid Test for Hydrophytic Vegetation
- ___ 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes X No ___

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is present

Broom Creek: ST 9
wetland C

SOIL Sampling Point: wetc

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20+	10YR 4/3	80	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- X Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No ____

Remarks:

Hydric soil is present due to chroma/redox features required to meet F19.

Brown Creek UT4 wetland D

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown Creek - UT4 - wetland D City/County: Anson Sampling Date: 12/16/13
Applicant/Owner: NCSSP State: NC Sampling Point: wet D
Investigator(s): SD Small Section, Township, Range:
Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): concave Slope (%): 2-5%
Subregion (LRR or MLRA): LRR-P Lat: 35.047007 Long: -80.084911 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla Loam NWI classification: PEM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes X No
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No	**Is the Sampled Area within a Wetland?** Yes X No
Hydric Soil Present?	Yes X No	
Wetland Hydrology Present?	Yes X No	

Remarks:
Area is closed depression - active pasture.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- X Surface Water (A1)
- __ High Water Table (A2)
- __ Saturation (A3)
- __ Water Marks (B1)
- __ Sediment Deposits (B2)
- __ Drift Deposits (B3)
- __ Algal Mat or Crust (B4)
- __ Iron Deposits (B5)
- __ Inundation Visible on Aerial Imagery (B7)
- __ Water-Stained Leaves (B9)
- __ Aquatic Fauna (B13)
- __ True Aquatic Plants (B14)
- __ Hydrogen Sulfide Odor (C1)
- __ Oxidized Rhizospheres on Living Roots (C3)
- __ Presence of Reduced Iron (C4)
- __ Recent Iron Reduction in Tilled Soils (C6)
- __ Thin Muck Surface (C7)
- __ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- __ Surface Soil Cracks (B6)
- __ Sparsely Vegetated Concave Surface (B8)
- __ Drainage Patterns (B10)
- __ Moss Trim Lines (B16)
- __ Dry-Season Water Table (C2)
- __ Crayfish Burrows (C8)
- __ Saturation Visible on Aerial Imagery (C9)
- __ Stunted or Stressed Plants (D1)
- __ Geomorphic Position (D2)
- X Shallow Aquitard (D3)
- __ Microtopographic Relief (D4)
- __ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes X	No ____	Depth (inches): 0-4"
Water Table Present?	Yes ____	No X	Depth (inches): >20"
Saturation Present? (includes capillary fringe)	Yes ____	No X	Depth (inches): >20"

Wetland Hydrology Present? Yes X No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Wetland hydrology is present due to restrictive clay layer. Saturation was not observed - soil pods of clay layer

Brown Creek-WP4 wetland D

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: WET D

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Sapling Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Shrub Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Herb Stratum (Plot size: 5' radius)			
1. Juncus effusus	5	Y	FACW
2. Carex sp.	5	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		
Woody Vine Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
50% of total cover:	20% of total cover:		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes Y No

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation present. Area grazed by cattle.

Brown Crk - ... wetland 10

SOIL

Sampling Point: Wet 10

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-20"	10YR 4/3	80	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- X Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- X Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: Clay

Depth (inches): Surface

Hydric Soil Present? Yes X No ___

Remarks:

Hydric soil present due to low chroma colors and presence of redox features

Brown Creek UT4 wetland E

WETLAND DETERMINATION DATA FORM – Eastern Mountains and Piedmont Region

Project/Site: Brown Creek - UT4 - Wetland E City/County: Anson Sampling Date: 12/19/13
Applicant/Owner: NCSCP State: NC Sampling Point: wet E
Investigator(s): ED Small Section, Township, Range:
Landform (hillslope, terrace, etc.): Floodplain Local relief (concave, convex, none): concave Slope (%): 750's
Subregion (LRR or MLRA): LRR-P Lat: -35.042152 Long: -80.032401 Datum: NAD 83
Soil Map Unit Name: ChA - Chewacla Loam NWI classification: PFO
Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No _____ (If no, explain in Remarks.)
Are Vegetation _____, Soil _____, or Hydrology _____ significantly disturbed? Are "Normal Circumstances" present? Yes _____ No X
Are Vegetation _____, Soil _____, or Hydrology _____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes V No _____	**Is the Sampled Area within a Wetland?** Yes X No _____
Hydric Soil Present?	Yes Y No _____	
Wetland Hydrology Present?	Yes Y No _____	

Remarks:
Area is back swamp of floodplain with direct surface connection to stream channel.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes _____ No X Depth (inches): _____
Water Table Present? Yes _____ No X Depth (inches): 720"
Saturation Present? (includes capillary fringe) Yes _____ No X Depth (inches): 720"

Wetland Hydrology Present? Yes X No _____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Wetland hydrology present. Area acts as outflow during flood events, and has direct connection to stream channel.

Brown Creek - WT-4
wetland 2

VEGETATION (Five Strata) – Use scientific names of plants. Sampling Point: WET 2

Tree Stratum (Plot size: 10'-radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Liquidambar styraciflua	20	Y	FAC
2. Pinus taeda	20	Y	FAC
3.			
4.			
5.			
6.			
	40 = Total Cover		
50% of total cover: 20	20% of total cover: 8		
Sapling Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
	= Total Cover		
50% of total cover:	20% of total cover:		
Shrub Stratum (Plot size: 10'-radius)			
1. Liquidambar styraciflua	10	Y	FAC
2.			
3.			
4.			
5.			
6.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		
Herb Stratum (Plot size: 5'-radius)			
1. Andropogon virginicus	5	Y	FAC
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	5 = Total Cover		
50% of total cover: 2.5	20% of total cover: 1		
Woody Vine Stratum (Plot size: 10'-radius)			
1. Smilax glauca	5	Y	FAC
2. vitis rotundifolia	5	Y	FAC
3.			
4.			
5.			
	10 = Total Cover		
50% of total cover: 5	20% of total cover: 2		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:	Multiply by:
OBL species	x 1 =
FACW species	x 2 =
FAC species	x 3 =
FACU species	x 4 =
UPL species	x 5 =
Column Totals: (A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ___ 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Five Vegetation Strata:

Tree – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling – Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub – Woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody plants, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vine – All woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes X No

Remarks: (Include photo numbers here or on a separate sheet.)

Hydrophytic vegetation is present.

Brown Creek WT-11 wetland E

SOIL Sampling Point: wet E

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	%	Redox Features Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20+	10YR 4/3	80	10YR 5/6	20	C	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10) **(LRR N)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1) **(LRR N, MLRA 147, 148)**
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) **(MLRA 147, 148)**
- ___ Thin Dark Surface (S9) **(MLRA 147, 148)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Iron-Manganese Masses (F12) **(LRR N, MLRA 136)**
- ___ Umbric Surface (F13) **(MLRA 136, 122)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 148)**
- ___ Red Parent Material (F21) **(MLRA 127, 147)**

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(MLRA 147)**
- ___ Coast Prairie Redox (A16) **(MLRA 147, 148)**
- X Piedmont Floodplain Soils (F19) **(MLRA 136, 147)**
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: _____

Depth (inches): _____

Hydric Soil Present? Yes X No _____

Remarks:

Hydric soil is present due to chroma/redox required to meet F19.

Brown Creek Tributaries Photo Log, Wetland Areas (unverified), 12/23/13

Hurricane Creek – Wetland Area ‘A’

Hurricane Creek – Wetland Area ‘B’

UT4 – Wetland Area ‘A’

UT4 – Wetland Area ‘B’

UT4 – Wetland Area ‘C’

UT4 – Wetland Area ‘D’

Brown Creek Tributaries Photo Log, Wetland Areas (unverified), 12/23/13

UT4 – Wetland Area ‘E’

U.S. Fish and Wildlife Service

National Wetlands Inventory

Hurricane Creek

Jun 4, 2014

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

User Remarks:

Brown Creek Tributaries

U.S. Fish and Wildlife Service
National Wetlands Inventory

UT4

Jun 4, 2014

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

User Remarks:

16.2 NCWAM Forms - Existing Wetlands

NC Wetland Assessment Method (NCWAM) Forms were not included for this project, as the NC Division of Water Resources and the USACE did not require them at the time this project was evaluated.

16.3 NCDWR Stream Classification Forms

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11 REACH 1

Date: 2/15/13	**Project/Site:** Brown Creek Hurricane Branch	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 26.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** Ansonville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 14.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

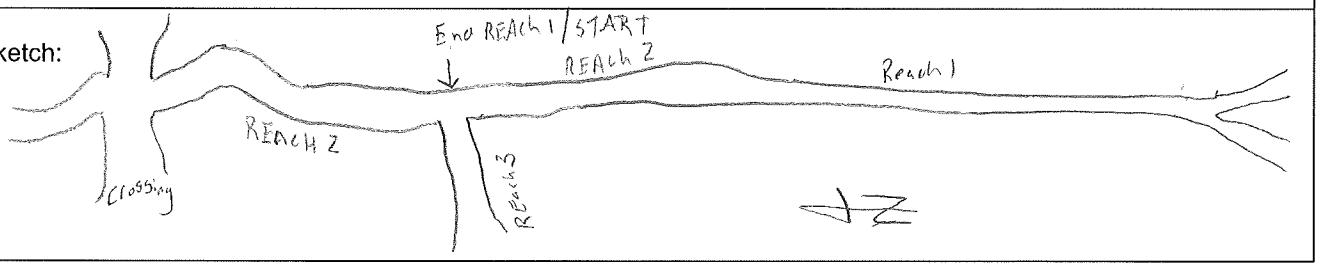
B. Hydrology (Subtotal = 5.5)				
12. Presence of Baseflow	(0)	1	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 6.5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	0	(1)	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11 REACH 2

Date: 2/15/13	**Project/Site:** Brown Creek Hurricane Branch	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 31	**Stream Determination (circle one)** Ephemeral Intermittent Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	2	(3)
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

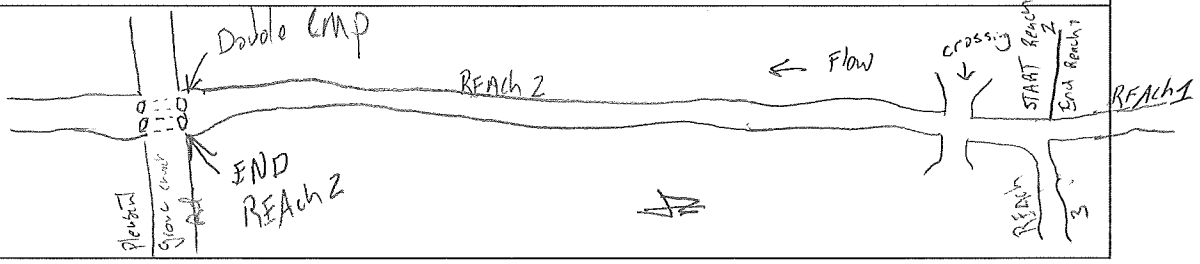
B. Hydrology (Subtotal = 9.5)				
12. Presence of Baseflow	0	1	(2)	3
13. Iron oxidizing bacteria	0	1	(2)	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 8.0)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11 REACH 3

Date: 2/15/13	**Project/Site:** Brown Creek Hurricane Branch	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** Ansonville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	(0)	1	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	(0)	0.5	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

B. Hydrology (Subtotal = 5)				
12. Presence of Baseflow	(0)	1	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 5.5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:

NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 2/14/13	**Project/Site:** Brown Creek UT4 – REACH 1	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** ANSON	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 26	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** Ansonville *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	(0)	1	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

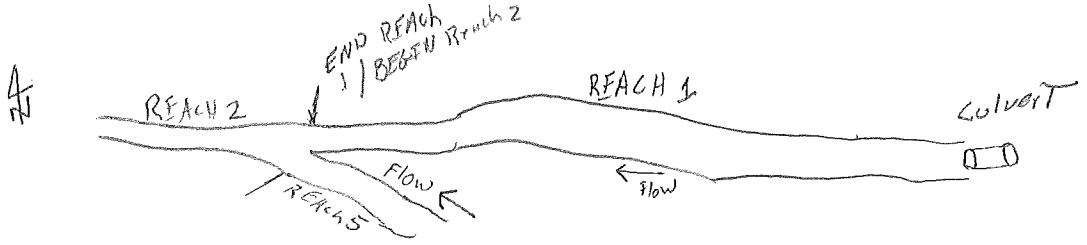
B. Hydrology (Subtotal = 5.5)				
12. Presence of Baseflow	(0)	1	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	0	0.5	(1)	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 8)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	0	(1)	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



NC DWQ Stream Identification Form Version 4.11

Date: 2/14/13	**Project/Site:** Brown Creek UT4 - REACH 2	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 30	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 17)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	1	(2)	3
9. Grade control	0	0.5	(1)	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	No = 0		(Yes = 3)	

[a] artificial ditches are not rated; see discussions in manual

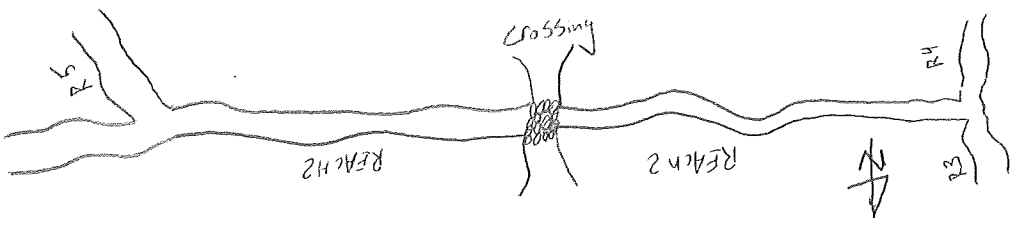
B. Hydrology (Subtotal = 7.5)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 5.5)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 2/14/13	**Project/Site:** Brown Creek UT 4 - REACH 3	**Latitude:**
Evaluator: P. Lynch / H. Caldwell	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 33.5	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 13.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	1	(2)	3
5. Active/relict floodplain	(0)	1	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	1	(2)	3
8. Headcuts	(0)	1	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	(0.5)	1	1.5
11. Second or greater order channel	No = 0		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

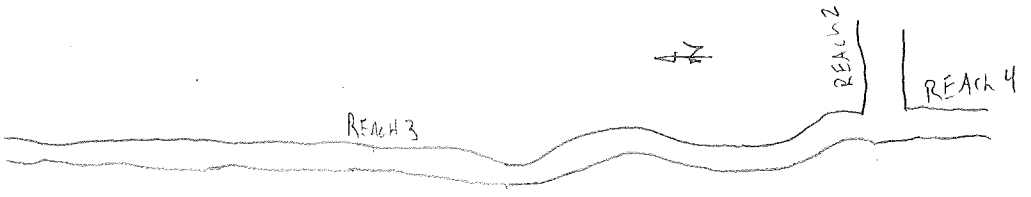
B. Hydrology (Subtotal = 10.5)				
12. Presence of Baseflow	0	1	2	(3)
13. Iron oxidizing bacteria	0	1	(2)	3
14. Leaf litter	1.5	(1)	0.5	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		Yes = 3	

C. Biology (Subtotal = 9.5)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	0	(1)	2	3
22. Fish	0	(0.5)	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



NC Division of Water Quality –Methodology for Identification of Intermittent and Perennial Streams and Their Origins v. 4.11

NC DWQ Stream Identification Form Version 4.11

Date: 2/14/13	**Project/Site:** Brown creek UT 4 / R4 (Up Stream of crossing)	**Latitude:**
Evaluator: H. Caldwell / R. Lynch	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 28.75	**Stream Determination (circle one)** Ephemeral Intermittent (Perennial)	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 12.5)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	1	(2)	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	0	(0.5)	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

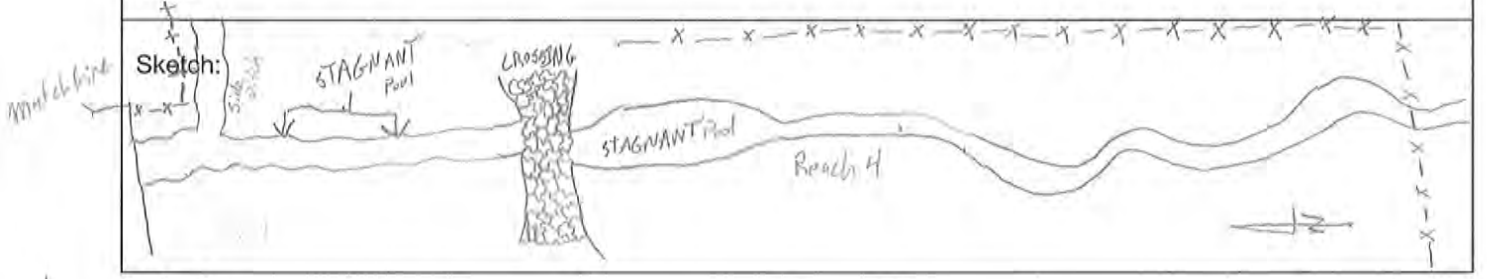
B. Hydrology (Subtotal = 6)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	(0)	1	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	0.5	(1)	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

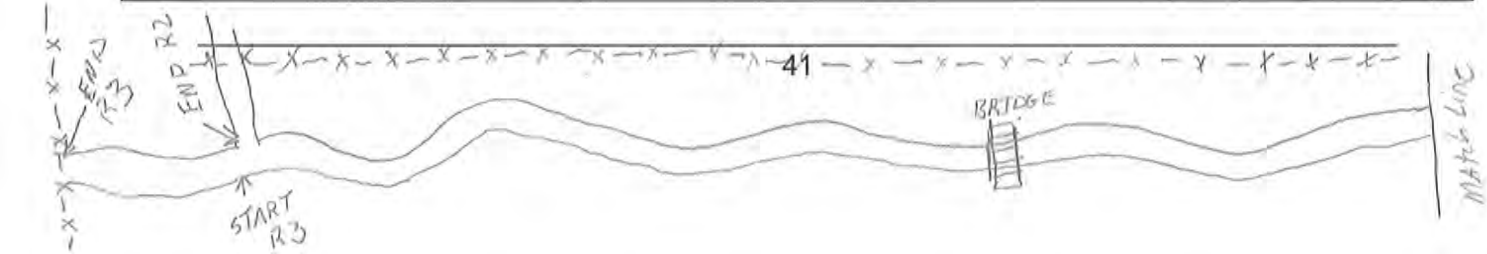
C. Biology (Subtotal = 10.75)				
18. Fibrous roots in streambed	(3)	2	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	0	(1)	2	3
21. Aquatic Mollusks	0	(1)	2	3
22. Fish	0	(0.5)	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	0	(0.5)	1	1.5
25. Algae	(0)	0.5	1	1.5
26. Wetland plants in streambed	(FACW = 0.75); OBL = 1.5 Other = 0			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:





NC DWQ Stream Identification Form Version 4.11

Date: 2/14/13	**Project/Site:** Brown Creek UT 4- REACH 5	**Latitude:**
Evaluator: P. Lynch / H. Gallagher	**County:** Anson	**Longitude:**
Total Points: *Stream is at least intermittent if ≥ 19 or perennial if ≥ 30** 23.5	**Stream Determination (circle one)** Ephemeral (Intermittent) Perennial	**Other** *e.g. Quad Name:*

A. Geomorphology (Subtotal = 11)	Absent	Weak	Moderate	Strong
1[a]. Continuity of channel bed and bank	0	1	2	(3)
2. Sinuosity of channel along thalweg	0	(1)	2	3
3. In-channel structure: ex. riffle-pool, step-pool, ripple-pool sequence	0	(1)	2	3
4. Particle size of stream substrate	0	(1)	2	3
5. Active/relict floodplain	0	(1)	2	3
6. Depositional bars or benches	0	(1)	2	3
7. Recent alluvial deposits	0	(1)	2	3
8. Headcuts	0	(1)	2	3
9. Grade control	(0)	0.5	1	1.5
10. Natural valley	0	0.5	(1)	1.5
11. Second or greater order channel	(No = 0)		Yes = 3	

[a] artificial ditches are not rated; see discussions in manual

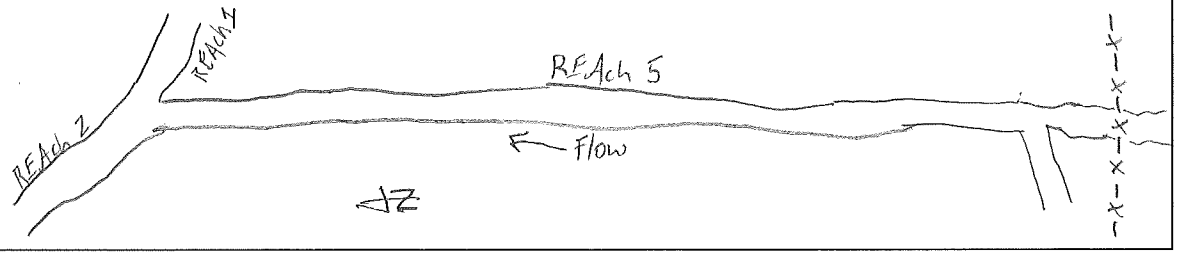
B. Hydrology (Subtotal = 6.5)				
12. Presence of Baseflow	0	(1)	2	3
13. Iron oxidizing bacteria	0	(1)	2	3
14. Leaf litter	1.5	1	(0.5)	0
15. Sediment on plants or debris	0	(0.5)	1	1.5
16. Organic debris lines or piles	0	(0.5)	1	1.5
17. Soil-based evidence of high water table?	No = 0		(Yes = 3)	

C. Biology (Subtotal = 6)				
18. Fibrous roots in streambed	3	(2)	1	0
19. Rooted upland plants in streambed	(3)	2	1	0
20. Macrobenthos (note diversity and abundance)	(0)	1	2	3
21. Aquatic Mollusks	(0)	1	2	3
22. Fish	(0)	0.5	1	1.5
23. Crayfish	0	(0.5)	1	1.5
24. Amphibians	(0)	0.5	1	1.5
25. Algae	0	(0.5)	1	1.5
26. Wetland plants in streambed	FACW = 0.75; OBL = 1.5 (Other = 0)			

*perennial streams may also be identified using other methods. See p. 35 of manual.

Notes:

Sketch:



16.4 FHWA Categorical Exclusion Form

Appendix A

Categorical Exclusion Form for Ecosystem Enhancement Program Projects
Version 1.4

Note: Only Appendix A should to be submitted (along with any supporting documentation) as the environmental document.

Part 1: General Project Information	
Project Name:	Brown Creek Tributaries Restoration Project (Option J)
County Name:	Anson
EEP Number:	004641
Project Sponsor:	Michael Baker Engineering, Inc.
Project Contact Name:	Chris L. Yow
Project Contact Address:	7800 Airport Center Dr., Ste. 100, Greensboro, NC 27409
Project Contact E-mail:	cyow@mbakercorp.com
EEP Project Manager:	Harry Tsomides

Project Description

The Brown Creek Tributaries Project is located in Anson County, approximately 5.5 miles north of Wadesboro in the Yadkin River Basin (Figure 1). The Project site includes Hurricane Creek and its tributaries (West Site) and unnamed tributaries to Flat Fork (East Site), all of which flow into Brown Creek, a 303(d) listed stream that flows through the Pee Dee National Wildlife Refuge. A combination of restoration, enhancement, and/or preservation will be implemented on the site to improve and protect approximately 9,750 linear feet of stream channel. This project will be used to obtain 9,693 stream mitigation credits for the NC Ecosystem Enhancement Program.

For Official Use Only

Reviewed By:

Date — **EEP Project Manager**

Conditional Approved By:

Date — **For Division Administrator FHWA**

☐ **Check this box if there are outstanding issues**

Final Approval By:

2-5-13

Date — **For Division Administrator FHWA**

Part 2: All Projects Regulation/Question	Response
Coastal Zone Management Act (CZMA)	
1. Is the project located in a CAMA county?	☐ Yes ☑ No
2. Does the project involve ground-disturbing activities within a CAMA Area of Environmental Concern (AEC)?	☐ Yes ☐ No ☑ N/A
3. Has a CAMA permit been secured?	☐ Yes ☐ No ☑ N/A
4. Has NCDCM agreed that the project is consistent with the NC Coastal Management Program?	☐ Yes ☐ No ☑ N/A
Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Has the zoning/land use of the subject property and adjacent properties ever been designated as commercial or industrial?	☐ Yes ☑ No ☐ N/A
3. As a result of a limited Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☑ No ☐ N/A
4. As a result of a Phase I Site Assessment, are there known or potential hazardous waste sites within or adjacent to the project area?	☐ Yes ☐ No ☑ N/A
5. As a result of a Phase II Site Assessment, are there known or potential hazardous waste sites within the project area?	☐ Yes ☐ No ☑ N/A
6. Is there an approved hazardous mitigation plan?	☐ Yes ☐ No ☑ N/A
National Historic Preservation Act (Section 106)	
1. Are there properties listed on, or eligible for listing on, the National Register of Historic Places in the project area?	☐ Yes ☑ No
2. Does the project affect such properties and does the SHPO/THPO concur?	☐ Yes ☐ No ☑ N/A
3. If the effects are adverse, have they been resolved?	☐ Yes ☐ No ☑ N/A
Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act)	
1. Is this a "full-delivery" project?	☑ Yes ☐ No
2. Does the project require the acquisition of real estate?	☑ Yes ☐ No ☐ N/A
3. Was the property acquisition completed prior to the intent to use federal funds?	☐ Yes ☑ No ☐ N/A
4. Has the owner of the property been informed: * prior to making an offer that the agency does not have condemnation authority; and * what the fair market value is believed to be?	☑ Yes ☐ No ☐ N/A

Part 3: Ground-Disturbing Activities Regulation/Question	Response
American Indian Religious Freedom Act (AIRFA)	
1. Is the project located in a county claimed as "territory" by the Eastern Band of Cherokee Indians?	☐ Yes ☑ No
2. Is the site of religious importance to American Indians?	☐ Yes ☐ No ☑ N/A
3. Is the project listed on, or eligible for listing on, the National Register of Historic Places?	☐ Yes ☐ No ☑ N/A
4. Have the effects of the project on this site been considered?	☐ Yes ☐ No ☑ N/A
Antiquities Act (AA)	
1. Is the project located on Federal lands?	☐ Yes ☑ No
2. Will there be loss or destruction of historic or prehistoric ruins, monuments or objects of antiquity?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Archaeological Resources Protection Act (ARPA)	
1. Is the project located on federal or Indian lands (reservation)?	☐ Yes ☑ No
2. Will there be a loss or destruction of archaeological resources?	☐ Yes ☐ No ☑ N/A
3. Will a permit from the appropriate Federal agency be required?	☐ Yes ☐ No ☑ N/A
4. Has a permit been obtained?	☐ Yes ☐ No ☑ N/A
Endangered Species Act (ESA)	
1. Are federal Threatened and Endangered species and/or Designated Critical Habitat listed for the county?	☑ Yes ☐ No
2. Is Designated Critical Habitat or suitable habitat present for listed species?	☑ Yes ☐ No ☐ N/A
3. Are T&E species present or is the project being conducted in Designated Critical Habitat?	☐ Yes ☑ No ☐ N/A
4. Is the project "likely to adversely affect" the species and/or "likely to adversely modify" Designated Critical Habitat?	☐ Yes ☑ No ☑ N/A
5. Does the USFWS/NOAA-Fisheries concur in the effects determination?	☐ Yes ☐ No ☑ N/A
6. Has the USFWS/NOAA-Fisheries rendered a "jeopardy" determination?	☐ Yes ☐ No ☑ N/A

Executive Order 13007 (Indian Sacred Sites)	
1. Is the project located on Federal lands that are within a county claimed as "territory" by the EBCI?	☐ Yes ☑ No
2. Has the EBCI indicated that Indian sacred sites may be impacted by the proposed project?	☐ Yes ☐ No ☑ N/A
3. Have accommodations been made for access to and ceremonial use of Indian sacred sites?	☐ Yes ☐ No ☑ N/A
Farmland Protection Policy Act (FPPA)	
1. Will real estate be acquired?	☑ Yes ☐ No
2. Has NRCS determined that the project contains prime, unique, statewide or locally important farmland?	☑ Yes ☐ No ☐ N/A
3. Has the completed Form AD-1006 been submitted to NRCS?	☑ Yes ☐ No ☐ N/A
Fish and Wildlife Coordination Act (FWCA)	
1. Will the project impound, divert, channel deepen, or otherwise control/modify any water body?	☑ Yes ☐ No
2. Have the USFWS and the NCWRC been consulted?	☑ Yes ☐ No ☐ N/A
Land and Water Conservation Fund Act (Section 6(f))	
1. Will the project require the conversion of such property to a use other than public, outdoor recreation?	☐ Yes ☑ No
2. Has the NPS approved of the conversion?	☐ Yes ☐ No ☑ N/A
Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)	
1. Is the project located in an estuarine system?	☐ Yes ☑ No
2. Is suitable habitat present for EFH-protected species?	☐ Yes ☐ No ☑ N/A
3. Is sufficient design information available to make a determination of the effect of the project on EFH?	☐ Yes ☐ No ☑ N/A
4. Will the project adversely affect EFH?	☐ Yes ☐ No ☑ N/A
5. Has consultation with NOAA-Fisheries occurred?	☐ Yes ☐ No ☑ N/A
Migratory Bird Treaty Act (MBTA)	
1. Does the USFWS have any recommendations with the project relative to the MBTA?	☐ Yes ☑ No
2. Have the USFWS recommendations been incorporated?	☐ Yes ☐ No ☑ N/A
Wilderness Act	
1. Is the project in a Wilderness area?	☐ Yes ☑ No
2. Has a special use permit and/or easement been obtained from the maintaining federal agency?	☐ Yes ☐ No ☑ N/A

16.5 FEMA Compliance - NCEEP Floodplain Requirements Checklist

The topography of the site supports the design without creating the potential for hydrologic trespass. The site is located in a FEMA mapped area and therefore a hydraulic analysis was required to obtain a "No-Rise/No-Impact" certification. The project will likely require a Letter of Map Revision (LOMR) following construction in order to document changes (reductions) to Base Flood Elevations (BFEs). The NCEEP Floodplain Checklist was provided to the Anson County Floodplain Manager along with this report.

EEP Floodplain Requirements Checklist

This form was developed by the National Flood Insurance program, NC Floodplain Mapping program and Ecosystem Enhancement Program to be filled for all EEP projects. The form is intended to summarize the floodplain requirements during the design phase of the projects. The form should be submitted to the Local Floodplain Administrator with three copies submitted to NFIP (attn. State NFIP Engineer), NC Floodplain Mapping Unit (attn. State NFIP Coordinator) and NC Ecosystem Enhancement Program.

Project Location

Name of project:	Brown Creek Tributaries Restoration Project
Name if stream or feature:	Hurricane Creek (HC) and Unnamed Tributaries (UT4) to Brown Creek
County:	Anson
Name of river basin:	Yadkin
Is project urban or rural?	Rural
Name of Jurisdictional municipality/county:	Anson County
DFIRM panel number for entire site:	6486J
Consultant name:	Ken Gilland, PG Michael Baker Engineering, Inc.
Phone number:	919-463-5488
Address:	8000 Regency Parkway, Suite 600 Cary, NC 27518

Design Information

Michael Baker Engineering, Inc. proposes to restore 8,201 linear feet (LF) of perennial stream, enhance 2,500 LF of stream, and preserve 511 LF of stream along Hurricane Creek (HC) four unnamed tributaries (UTs) to Brown Creek, a 303(d) listed stream that flows through the Pee Dee National Wildlife Refuge. The project site is located in Anson County, North Carolina (NC) (see Figure 1), approximately four miles southeast of the Town of Ansonville. The project is located in the NC Division of Water Resources (NCDWR) subbasin 03-07-10 and the NC Ecosystem Enhancement Program's (NCEEP) Targeted Local Watershed (TLW) 03040104-061030 of the Yadkin River Basin. The purpose of the project is to restore and/or enhance stream and riparian buffer functions along areas where the impaired stream channel flows through the site. The project will potentially provide numerous water resources and ecological benefits within the Brown Creek watershed and the Yadkin River Basin. A conservation easement consisting of 43 acres (Figure 3.1) will protect all stream reaches and riparian buffers in perpetuity

Reach	**Length**	**Priority**
HC-R1	*2,035 LF*	*Restoration*
HC-R2	*1,366 LF*	*Restoration*
HC-R3	*579 LF*	*Enhancement II*
UT4-R1 (upstream section) *UT4-R1 (downstream section)*	*511 LF and* *849 LF*	*Preservation and* *Restoration*
UT4-R2	*1,857 LF*	*Restoration*
UT4-R3	*227 LF*	*Restoration*
UT4-R4	*1,867 LF*	*Restoration*
UT4-R5	*1,921 LF*	*Enhancement I*

Floodplain Information

Is project located in a Special Flood Hazard Area (SFHA)?

◉ Yes ○ No

If project is located in a SFHA, check how it was determined:

☐ Redelineation

☐ Detailed Study

☑ Limited Detail Study

☐ Approximate Study

☐ Don't know

List flood zone designation:

Check if applies:

☑ AE Zone

- ○ Floodway
- ◉ Non-Encroachment
- ○ None

☐ A Zone

- ○ Local Setbacks Required
- ○ No Local Setbacks Required

If local setbacks are required, list how many feet:

Does proposed channel boundary encroach outside floodway/non-encroachment/setbacks?

○ Yes ◉ No

Land Acquisition (Check)

☐ State owned (fee simple)

☐ Conservation easment (Design Bid Build)

☑ Conservation Easement (Full Delivery Project)

Note: if the project property is state-owned, then all requirements should be addressed to the Department of Administration, State Construction Office (attn: Herbert Neily, (919) 807-4101)

Is community/county participating in the NFIP program?

◉ Yes ○ No

Note: if community is not participating, then all requirements should be addressed to NFIP (attn: State NFIP Engineer, (919) 715-8000)

Name of Local Floodplain Administrator: Keith Gaskins
Phone Number: 704-694-5818

Floodplain Requirements

This section to be filled by designer/applicant following verification with the LFPA

☐ No Action

☑ No Rise

☐ Letter of Map Revision

☐ Conditional Letter of Map Revision

☐ Other Requirements

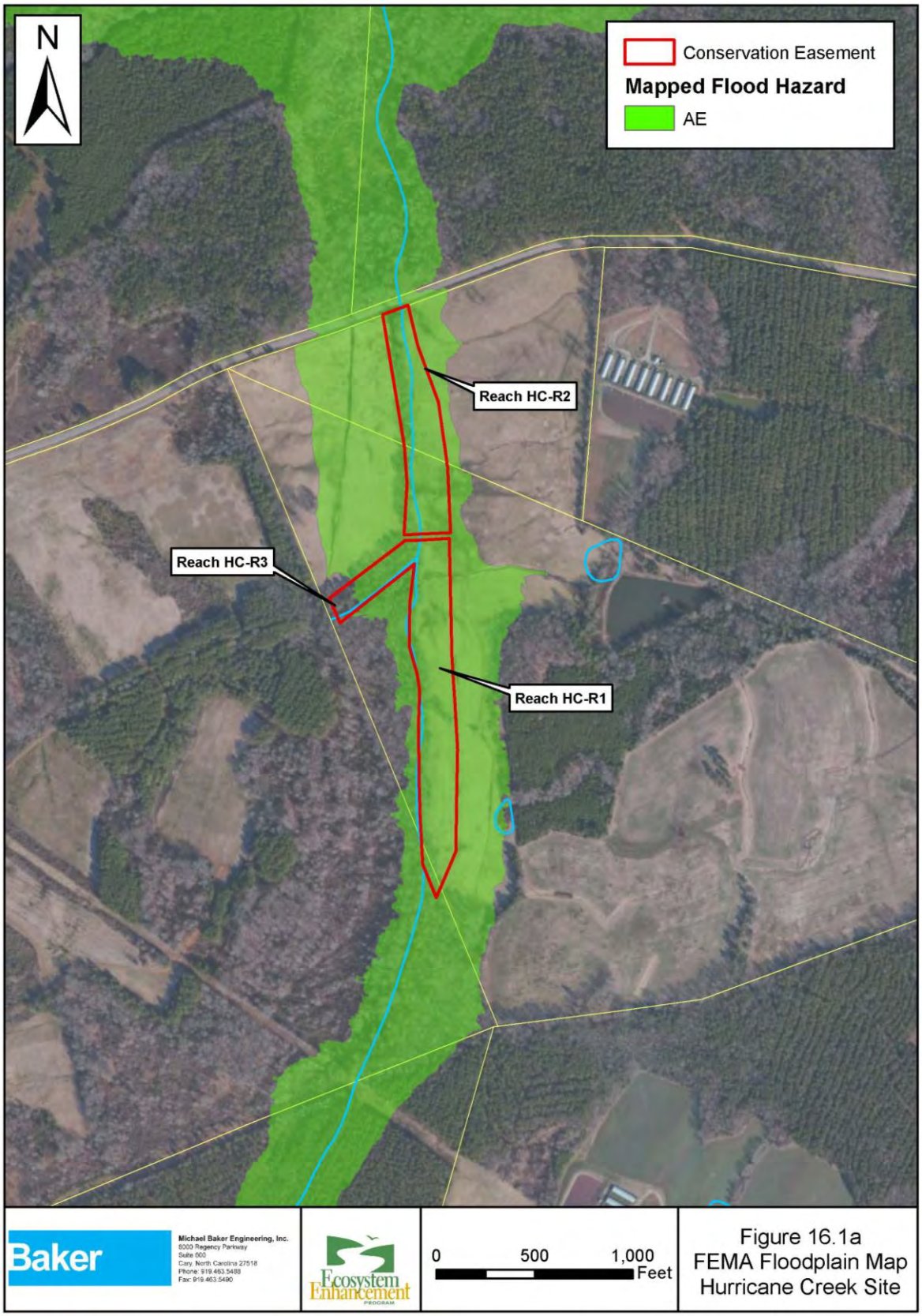
List other requirements:

Comments:
No bridges or culverts are proposed within the AE Zone. The anticipated action is a no-rise followed up with a LOMR post-construction (assuming that the reduction in BFE is >0.10'). If modeling results in minimal rise, a CLOMR will be submitted. No structures are proposed within the project area so redesign is not likely to be required for a small rise.

Name: Ken Gilland Signature: Ken Gilland

Title: Professional Geologist Date: 12/4/13

Figure 16.1 FEMA Floodplain Map



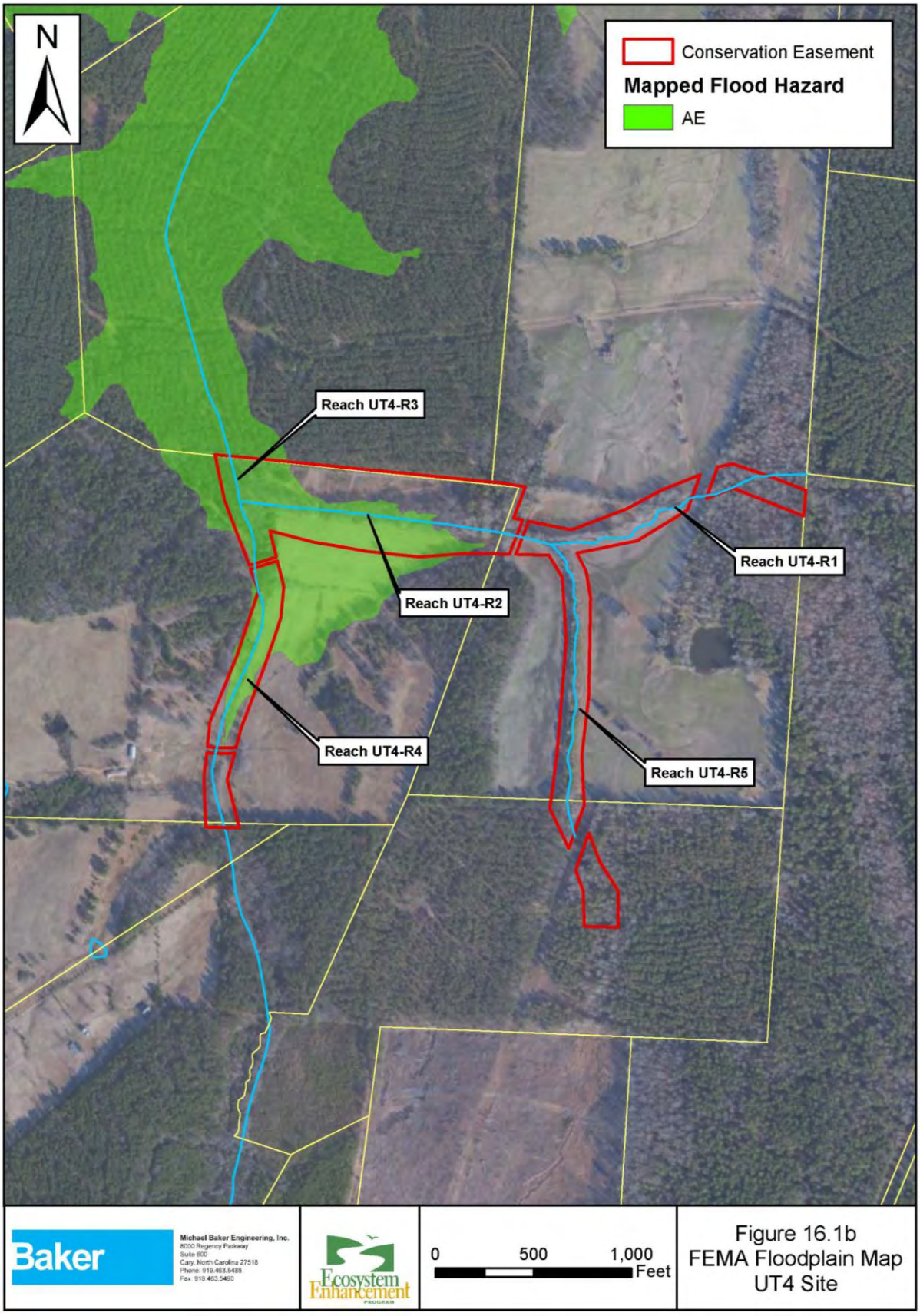


Figure 16.1b
FEMA Floodplain Map
UT4 Site

Brown Creek Tributaries(Hurricane Creek) - Stream Restoration

Anson County, North Carolina

Application for
Conditional Letter of Map Revision (CLOMR)

Prepared For:
North Carolina Ecosystem Enhancement Program
1652 Mail Service Center
Raleigh, NC 27699-1652

Prepared By:

Michael Baker Engineering, Inc.
5550 Seventy-Seven Center Drive
Suite 320
Charlotte, NC 28217

FIRM License #: F-1084

February 12, 2014

Table of Contents

Application Package for FEMA Conditional Letter of Map Revision
Brown Creek Tributaries (Hurricane Creek) - Stream Restoration

5550 Seventy Seven Center Dr.
Suite 320
Charlotte, North Carolina 28217

Phone: 704-665-2216
Fax: 704-665-2201

February 12, 2014

Keith Gaskins, Chief Inspector
Anson County
107 E. Ashe Street
Wadesboro, NC 28170

RE: Application Package for FEMA Conditional Letter of Map Revision
Hurricane Creek – Stream Restoration

Dear Mr. Gaskins:

Michael Baker Engineering, Inc. is contracted by the North Carolina Ecosystem Enhancement Program (NC EEP) to conduct a stream restoration project on two streams in north central Anson County. One of the streams is Hurricane Creek and the other is an unnamed (unstudied) tributary to Flat Fork. Hurricane Creek is a FEMA regulated stream; therefore a hydraulic analysis of the proposed changes associated with this restoration project has been conducted.

The hydraulic analysis conducted for this project indicates that the proposed design will result in a rise on the floodplain elevations, floodway elevations, and/or floodway width within the project area along Hurricane Creek during the base flood event. Therefore, we have enclosed a Conditional Letter of Map Revision (CLOMR) application package for your review. As the Floodplain Administrator for Anson County, we ask that you review the contents, sign the Community Acknowledgement portion of Section D of the "Overview and Concurrence Form" and return to us for submittal to the NC Floodplain Mapping Program.

If you have any questions regarding this submittal, please contact me at (704) 665-2216 or by email at khiggins@mbakercorp.com.

Sincerely,

Kevin Higgins

Kevin Higgins, PE, CFM
Water Resources Engineer

Enclosures

Baker

January 6, 2014

Mr. Edward Curtis
NC Floodplain Mapping Program
NC Division of Emergency Management
Hazard Mitigation Section
1830-B Tillery Place, Raleigh, NC 27604

Subject: NCEEP Floodplain Requirements Checklist: Brown Creek Tributaries Restoration Project, Anson County, North Carolina. NCDWR sub-basin 03-07-10, USGS hydrologic unit 03040104, NCEEP Project Number 95351

Dear Mr. Curtis:

Please find enclosed one copy of the NCEEP Floodplain Requirements Checklist for the Brown Creek Tributaries Restoration Project in Anson County, North Carolina (see Figure 1). The project site is located approximately four miles southeast of the Town of Ansonville, within cataloging unit 03040104 and NC Division of Water Resources (NCDWR) subbasin 03-07-10 of the Yadkin River Basin.

Currently, the project reaches are impacted by on-going agricultural use, cattle access, and the lack of adequate riparian buffers. Project goals include the Priority Level I/II restoration of approximately 8,201 linear feet (LF) of stream, Enhancement I & II of approximately 2,500 LF of stream and preservation of 511 LF of stream for the purpose of obtaining stream mitigation credit in the Yadkin River Basin. A topographic map of the project area is shown in Figure 2, the soils in the project area are shown in Figure 3, LiDAR mapping in Figure 4, and area floodplains in Figure 5. The proposed restoration plan for the site is shown in Figure 6.

Project activities will include filling drainage ditches, raising the existing stream bed, establishing riparian buffers, restoring and stabilizing degraded stream channels, and installing in-stream structures. As per our previous discussion with the Local Floodplain Manager about the project, Baker has prepared the following checklist to summarize the potential floodplain impacts of the project.

Sincerely,

Ken Gilland

Ken Gilland, P.G.

Enclosures

Cc: Keith Gaskins, Chief Inspector Anson County
Harry Tsomides, North Carolina Ecosystem Enhancement Program
John Gerber, NC Floodplain Mapping Unit

Baker

January 6, 2014

Harry Tsomides, Project Manager
NC Ecosystem Enhancement Program
5 Ravenscroft Drive, Suite 102
Asheville, NC 28801

Subject: NCEEP Floodplain Requirements Checklist: Brown Creek Tributaries Restoration Project, Anson County, North Carolina. NCDWR sub-basin 03-07-10, USGS hydrologic unit 03040104, NCEEP Project Number 95351

Dear Mr. Tsomides:

Please find enclosed one copy of the NCEEP Floodplain Requirements Checklist for the Brown Creek Tributaries Restoration Project in Anson County, North Carolina (see Figure 1). The project site is located approximately four miles southeast of the Town of Ansonville, within cataloging unit 03040104 and NC Division of Water Resources (NCDWR) subbasin 03-07-10 of the Yadkin River Basin.

Currently, the project reaches are impacted by on-going agricultural use, cattle access, and the lack of adequate riparian buffers. Project goals include the Priority Level I/II restoration of approximately 8,201 linear feet (LF) of stream, Enhancement I & II of approximately 2,500 LF of stream and preservation of 511 LF of stream for the purpose of obtaining stream mitigation credit in the Yadkin River Basin. A topographic map of the project area is shown in Figure 2, the soils in the project area are shown in Figure 3, LiDAR mapping in Figure 4, and area floodplains in Figure 5. The proposed restoration plan for the site is shown in Figure 6.

Project activities will include filling drainage ditches, raising the existing stream bed, establishing riparian buffers, restoring and stabilizing degraded stream channels, and installing in-stream structures. As per our previous discussion with the Local Floodplain Manager about the project, Baker has prepared the following checklist to summarize the potential floodplain impacts of the project.

Sincerely,

Ken Gilland

Ken Gilland, P.G.

Enclosures

Cc: Keith Gaskins, Chief Inspector Anson County
Edward Curtis, NC Floodplain Mapping Program
John Gerber, NC Floodplain Mapping Unit

I. PROJECT NARRATIVE

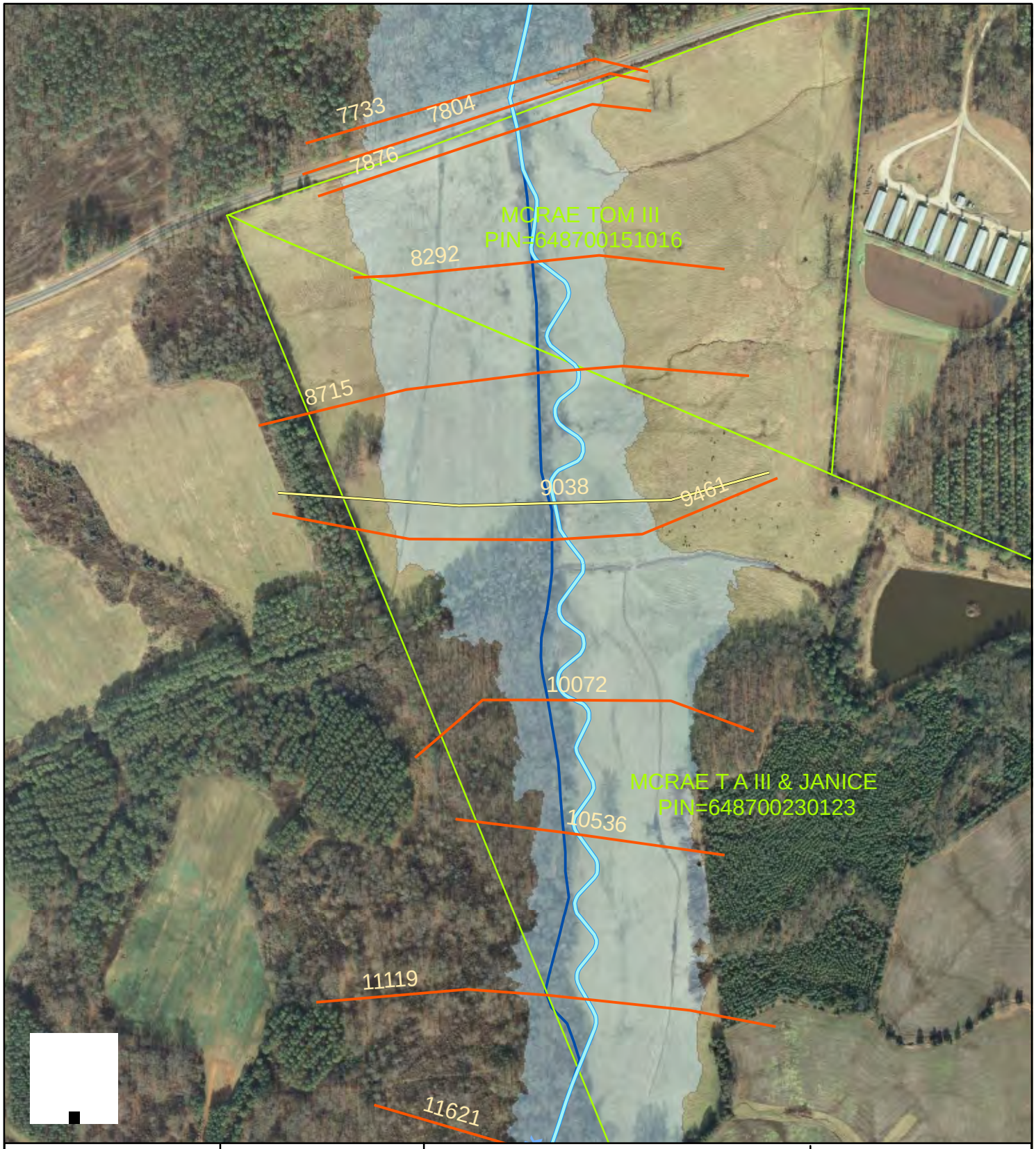
Overview

Michael Baker Engineering, Inc. (Baker) was contracted by the North Carolina Ecosystem Enhancement Program (NC EEP) to design a stream restoration project along a portion of Hurricane Creek in north central Anson County, NC. The stream restoration project also includes portions of several unnamed tributaries to Flat Fork. Some of the proposed design along the unnamed tributaries is located within the mapped floodplain of Flat Fork, but the unnamed tributaries are not FEMA-regulated streams. A study area map is provided in Figure 1. A hardcopy of the proposed stream restoration plans are provided in Appendix A.

Hurricane Creek is a FEMA-regulated stream, referenced on Flood Insurance Rate Map (FIRM) Panel 3710648600J (Effective Date 08/19/2008). The project area is located within a mapped AE Zone that was established through a Limited Detailed Study. Therefore, the project area has published base flood elevations (BFEs) and a "non-encroachment zone" that is published but not mapped. A portion of the Effective FIRM panel with the project area highlighted is provided in Figure 2.

Since part of the proposed project construction will take place within the non-encroachment zone of Hurricane Creek, floodplain regulations require that a hydraulic analysis be conducted to determine what impact the proposed design will have on the water surface elevations, floodway elevations, and / or floodway widths. This report summarizes the methods and findings of the analysis. The CLOMR application forms and supporting information (e.g. hydraulic models, proposed plans, etc.) are included in the appendices to this report.

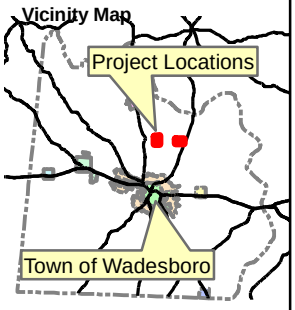
It is anticipated that once project construction is completed and an "as-built" survey conducted, a formal Letter of Map Revision (LOMR) application will be submitted per FEMA regulations.



Baker

400 200 0 Feet

Vicinity Map



Anson County, NC

Legend

- Prop_StreamCL
- Effective_StreamCL
- BrownCrkTribs_Parcels
- Added XS
- Effective XS

Floodzones

- FW
- AE
- X

Project Area Map

Tributaries to Brown Creek - Stream Restoration

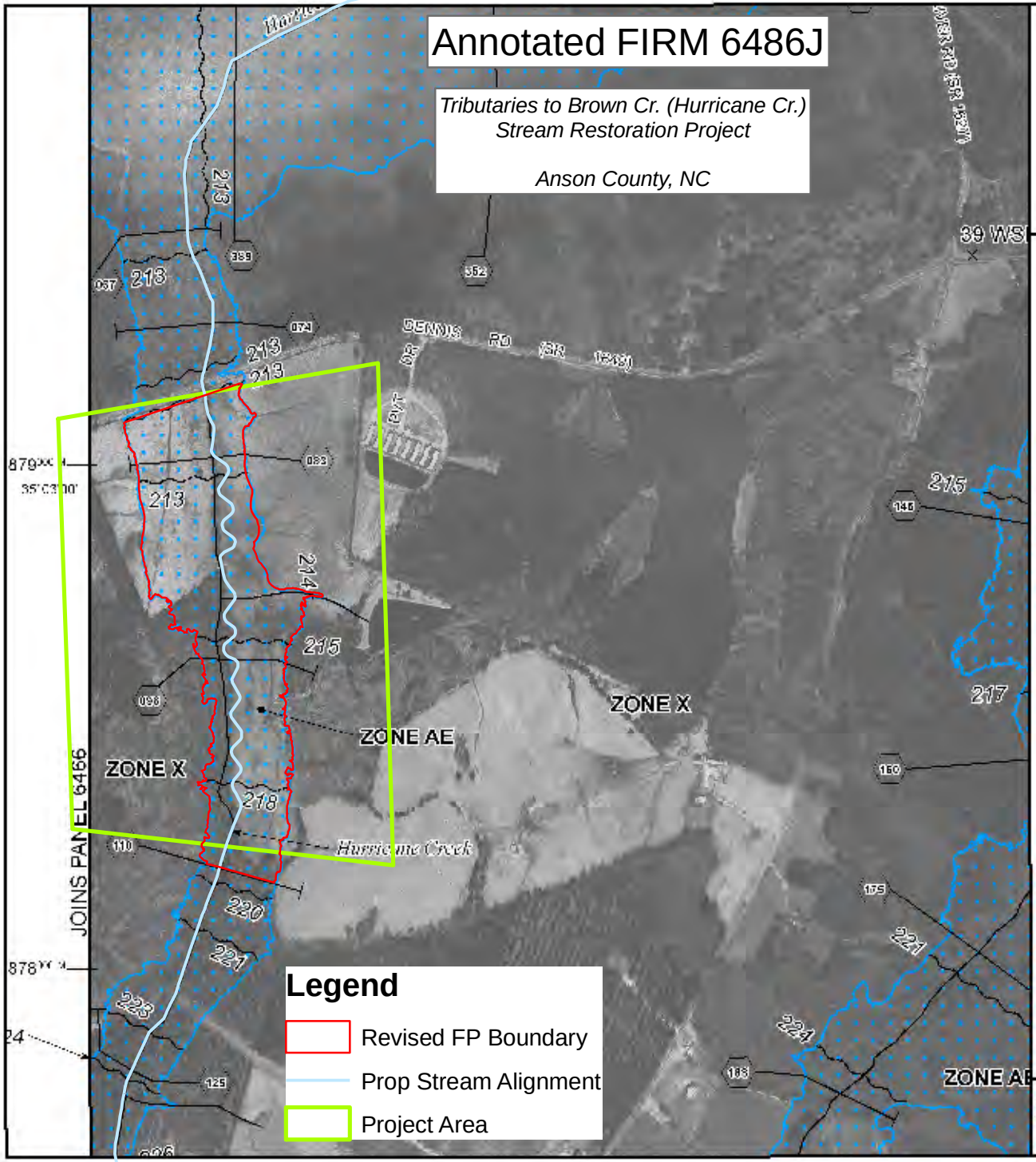
CLOMR Application

February 2014

Annotated FIRM 6486J

Tributaries to Brown Cr. (Hurricane Cr.)
Stream Restoration Project

Anson County, NC



GRID NORTH

MAP SCALE 1" = 1,000' (1 : 12,000)

500 0 500 1,000 1,500 2,000 FEET

PANEL 6486J

FIRM

FLOOD INSURANCE RATE MAP

NORTH CAROLINA

PANEL 6486

CONTAINS

COMMUNITY	CID No.	PANEL	SUFFI
ANSON COUNTY	370...	6486	

EFFECTIVE DATE
AUGUST 19, 2008

MAP NUMBER
3710648600J

State of North Carolina
Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

II. HYDRAULIC MODELING SUMMARY

In order to evaluate the potential effects of the proposed restoration design on the floodplains and floodways, FEMA guidelines specify that a series of hydraulic models be developed. Below is a description of the hydraulic models used / developed for preparation of this No-Rise analysis. All models and supporting information are included in digital format on the enclosed CD.

Effective Hydraulic Model

The Effective Flood Insurance Study (FIS) for Anson County is dated August 19, 2008. Anson County's Community Identification Number is 370284. The Effective hydraulic model for Hurricane Creek was developed to produce this FIS and associated FIRM panel(s). The effective HEC-RAS hydraulic model and Flood Insurance Study (FIS) report were obtained from the North Carolina Floodplain Mapping Program (www.ncfloodmaps.com). The FIRM panel was obtained from the FEMA Map Service Center (www.fema.gov).

Duplicate Effective Model

The Duplicate Effective Model is a copy of the hydraulic analysis used in the Effective FIS that is run by the person performing the Flood Study analysis. For this study the Duplicate Effective Model was created by opening the Effective hydraulic model for Hurricane Creek in HEC-RAS (Version 4.1.0) and running it on local computers. There are no changes between this model and the Effective Model.

Corrected Effective / Existing Model

The Corrected Effective Model is the model that is developed to correct any errors in the Duplicate Effective Model, and/or to incorporate more detailed topographic information or additional hydraulic cross sections into the analysis in order to more accurately define the terrain under pre- and post-project conditions. The Existing Model is the model that is developed to incorporate any man-made modifications that have occurred in the floodplain since the date of the Effective Model into the Corrected Effective Model. No known man-made changes have been made since the issuance of the Effective maps/models, therefore the Corrective Effective Model and the Existing Model are identical.

A detailed survey of the stream channel and immediate overbanks was performed for this project. Ground elevations for overbank areas beyond the survey data were obtained from bare earth LiDAR points from the North Carolina Floodplain Mapping Program. The Anson County geodatabase cross section (MAPXSLN) layer shows cross sections within the project area at station 7876, 8277, 8610, 9115, 9600, 10,000, and 10,500, and 11,024. In addition, one (1) supplemental cross section (9005) was added within the project limits in order to more accurately define channel geometry and roughness at the proposed cattle crossing.

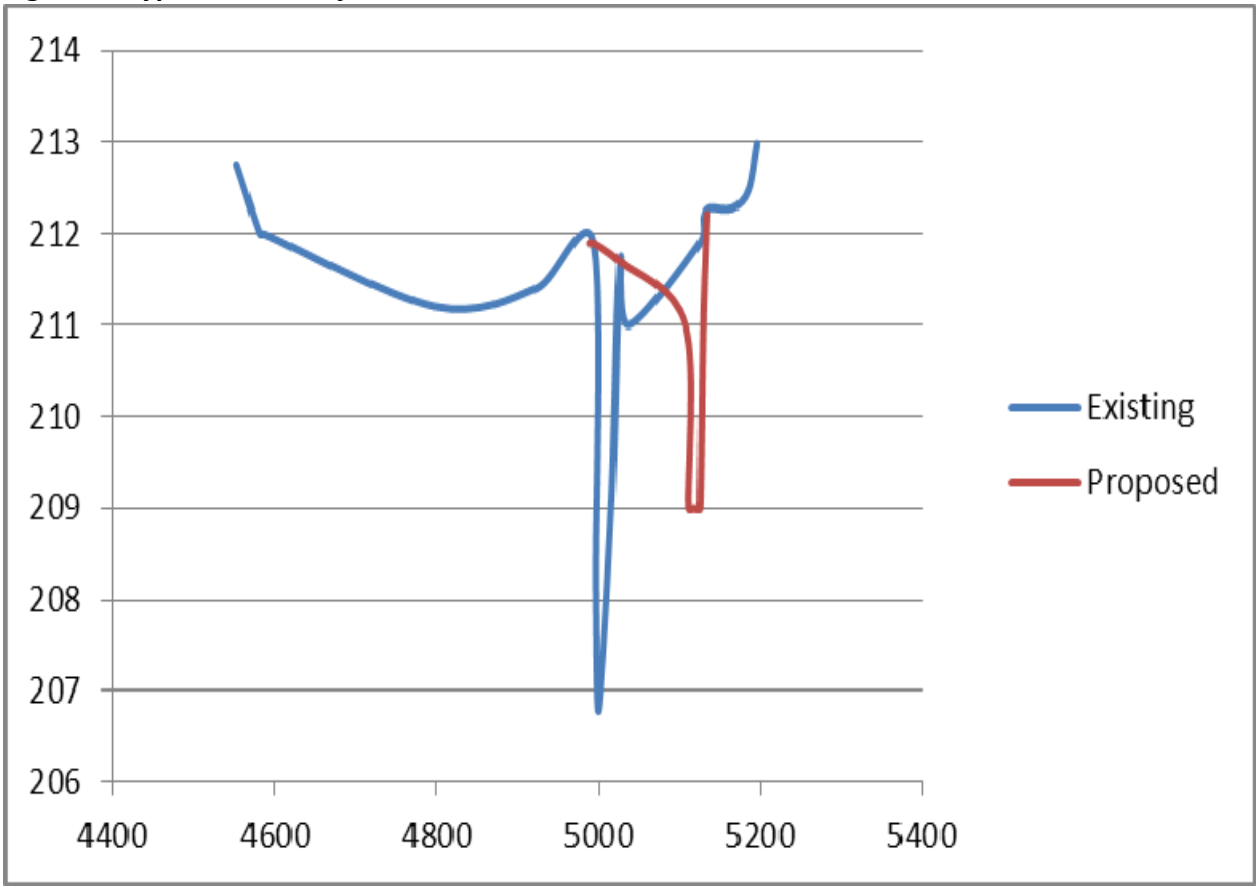
Supplemental cross section hydraulic parameters (i.e. Manning's n values, contraction/expansion coefficients, etc.) were set to be consistent with those in the Effective Model. Downstream reach lengths were modified at cross section 9115 to account for the added cross section. In addition, floodway encroachment stations were added to the supplemental cross section in HEC-RAS so as to maintain the original width and spacing from stream centerline of the Effective Model.

Figure 1 shows the locations of all of the cross sections in the Corrected Effective Model (with station/alignment scale).

Post-Project Model

A Post-Project Model reflects conditions of a given area based on proposed conditions. The Post-Project Model was created for this analysis by incorporating the proposed grading and modified manning's roughness coefficients associated with the stream restoration project on Hurricane Creek into the Corrected Effective HEC-RAS model. No other modifications were made between the Corrected Effective and Post-Project models. Figure 4 depicts a typical comparison of the Corrected Effective and Post-Project model cross sections geometry for a cross section that intersects Hurricane Creek.

Figure 4. Typical Post-Project vs. Corrected Effective Cross Section



III. HYDRAULIC ANALYSIS RESULTS AND CONCLUSIONS

To evaluate the potential impacts of the proposed restoration project on the floodplain and encroachment area, the results of the Post-Project Model were compared with those of the Corrected Effective Model. Results of the hydraulic analysis show that there are increases and decreases to the water surface elevations, increases to the floodway elevations, and no changes to the floodway widths resulting from the proposed stream improvements to Hurricane Creek. The maximum increase in water surface elevation as a result of the project is 0.36 feet at cross section 9115. The maximum decease in water surface elevation is 0.01 feet at cross section 11500. No insurable structures are located within the effective floodplain of Hurricane Creek in the project area. Therefore, no insurable structures will be impacted as a result of the proposed rise in base flood elevation.

The table below shows the comparison of the water surface elevations (WSEs), floodway widths, and floodway elevations for the eleven (11) cross sections evaluated for this CLOMR. The complete HEC-RAS models and results are provided in the enclosed CD.

TABLE 1. 100-year Water Surface Elevation Comparison Summary

Station *	Eff. Model (EFF)	Dup. Eff. Model (DUPEF)	Corr. Eff Model (COREF)	Proposed Model (PROP)	Change (PROP - COREF)
7876	212.74	212.74	212.74	212.74	0.00
8277	212.9	212.91	212.91	212.93	0.02
8610	213.17	213.17	213.12	213.23	0.11
9003	N/A	N/A	213.64	213.91	0.27
9115	214.03	214.03	213.79	214.15	0.36
9600	215.32	215.32	215.46	215.51	0.05
10000	216.39	216.39	216.46	216.54	0.08
10500	218.19	218.19	218.09	218.35	0.26
11024	219.86	219.86	219.75	219.82	0.07
11500	221.09	221.08	221.11	221.10	-0.01
12000	222.37	222.37	222.37	222.37	0.00

* Effective River Stations

TABLE 2. Floodway Comparison Summary						
Station *	Corrected Effective Model (COREF)		Proposed Model (PRP)		Change (PRP - COREF)	
	FW Width	FW Elev	FW Width	FW Elev	FW Width	FW Elev
7876	208.95	213.43	208.95	213.43	0.00	0.00
8292	344.33	213.73	344.33	213.75	0.00	0.02
8715	328.39	213.90	328.39	214.02	0.00	0.12
9230	326	214.32	326.00	214.66	0.00	0.34
9344	325.32	214.38	325.32	214.86	0.00	0.48
9955	270.28	216.15	270.28	216.28	0.00	0.13
10419	252.03	217.18	252.03	217.29	0.00	0.11
11002	285.23	218.76	285.23	219.04	0.00	0.28
11503	227.53	220.37	227.53	220.46	0.00	0.09
11979	252.09	221.79	252.09	221.80	0.00	0.01
12479	312.93	223.07	312.93	223.08	0.00	0.01

* Proposed (Post-Project) River Stations

Tributaries to Brown Cr.- (Hurricane Creek) Stream Restoration Workmap

MCRAE TOM III
PIN = 648700151016

MCRAE T A III & JANICE
PIN = 648780230123

BCP 220
BCP 219
BCP 215
BCP 214
BCP 210

Legend

- Effective Stream
- Survey_shots
- 100YR_REVISED

Project_XS

TYPE

- Added XS
- Effective XS
- Proposed alignment
- Project Area

LIDAR_survey_contours1ft

Type

- Major
- Minor
- BrownCrkTribs_Parcels

MAPFLDHAZAR

ZONE_LID, FLDWAY_LID

- 0.2 PCT ANNUAL CHANCE FLOOD HAZARD, <Null>
- AE, <Null>
- AE, FLOODWAY
- X, <Null>

Baker

Tributaries to Brown Creek (Hurricane Cr) Stream Restoration Project

Anson County, NC

100 50 0 100 Feet

1 inch = 100 feet

February 2014

Horizontal Datum = NAD83
Vertical Datum = NAVD88

17.0 APPENDIX C - MITIGATION WORK PLAN DATA AND ANALYSES

17.1 Channel Morphology (Rosgen Analysis)

17.1.1 Existing Conditions

17.1.1.1 Channel Classification

Hurricane Creek (HC) is a perennial stream with a total drainage area of 2.16 square miles at the downstream terminus of HC-R2. HC-R3 is an intermittent unnamed tributary to HC with a drainage area of 0.19 square miles. UT4 includes intermittent reaches UT4-R4, UT4-R5, and upper UT4-R1. Beginning in lower UT4-R1 section, the main stem channel is perennial. The total drainage area for UT4 is 1.52 square miles (Figure 2.2). Historically, the project streams have been negatively impacted due to agricultural conversion and cattle grazing.

Hurricane Creek

HC-R1 flows north from the confluence of two tributaries that are currently incised and have low channel slopes. HC-R1 has been channelized and is also incised. There are standing pools of water and remnant spoil piles along both banks. The left bank has a mature native hardwood buffer; however, large trees along the bank have fallen into the stream channel indicating the stream is in Stage IV of Simon's Channel Evolution. The channel classifies as either a 'G' or 'F' stream type, depending upon local channel widths, and the BHR is approximately 2.0. HC-R2 begins at the confluence of HC-R1 and HC-R3 and flows north to Pleasant Grove Church Road. The riparian buffer is very narrow along both banks, but contains some large individual trees that shall be preserved. The channel is moderately incised but has not experienced the tree loss observed in HC-R1, thus it appears to be in Stage III of Simon's Channel Evolution since widening is not evident. The channel can be classified as an incised 'E' or 'G' stream type with an approximate BHR of 2.0. The channel appears to have been straightened in the past. HC-R3 is an intermittent tributary that flows east to its confluence with HC-R1, at which point HC-R2 begins. The left bank flows through existing pasture. The channel is classified as an incised 'E' or 'G' stream type, with a BHR between 1.5 and 2.0.

UT4

UT4-R1 begins as an intermittent tributary flowing west. It has an adequate riparian buffer with historical cattle access. Cattle were removed from this reach approximately three years ago. The upstream portion of the channel is a slightly incised E stream type that appears to be moderately stable. Once UT4-R1a reaches a power line easement at approximately 511 LF, it transitions to a degraded channel with a migrating headcut. In this downstream section of UT4-R1b, the channel is an unstable 'G' stream type for approximately 906 LF and is transitioning from Stage III to Stage IV. The buffer is very thin and most of the trees on the stream banks have been undercut. UT4-R2 begins at the confluence of UT4-R1 and UR4-R5 and flows west for approximately 1,627 LF. This reach has a poor riparian buffer, especially on the left floodplain. The channel is a deeply incised 'G' stream type with a BHR of 3.5. The reach has been channelized, as evidenced by its lack of pattern and the relic spoil piles on the stream banks. Additionally, cattle have access to the channel, actively impacting the stream. The reach is transitioning from Stage III to Stage IV, though it is still downcutting. UT4-R3 begins at the confluence of UT4-R2 and UT4-R4 and flows north for approximately 242 LF. It has the same characteristics as the lower section of UT4-R4; namely, an unstable 'G'

channel with a BHR greater than 3, as well as an adequate buffer beyond the right bank and a very thin one on the left.

UT4-R4 is a headwater reach that flows north for approximately 1,716 LF to its confluence with UT4-R2. UT4-R4 has two distinct sections: an upstream, channelized reach with a very poor riparian buffer (pasture); and a downstream reach that is more deeply incised due to a migrating headcut. The riparian buffer on the downstream section is adequate on the right bank and very thin on the left bank. The upstream section is an incised E channel in early Stage III of Simon's Channel Evolution. The downstream section is an unstable 'G' stream type with a BHR of more than 3.0. UT4-R5 is an intermittent headwater channel that flows north for approximately 1,564 LF before joining with UT4-R1. The riparian buffer is narrow, consisting of one or two rows trees (most commonly pine species). Historical cattle impacts are more apparent than UT4-R1.

As with UT4-R1, cattle were removed from this reach approximately three years ago. The channel is an unstable G stream type for 311 LF on the downstream end through which a headcut has migrated upstream. The upper section and majority of UT4-R5 is an incised 'E' stream type. Overall, the reach is in Stage III of Simon's Channel Evolution.

Table 17.1 represents geomorphic data compiled from the existing condition survey.

Table 17.1a Representative Existing Conditions Geomorphic Data for Hurricane Creek Reaches: Stream Channel Classification Level II

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	HC-R1		HC-R2	
	XS1	XS2	XS3	XS4
Existing Reach Length (ft)	1,896		1,288	
Drainage Area (sq. mi.)	1.68		2.16	
Bankfull Discharge, Q_{bkf} (cfs)*	129.5		155.0	
Feature Type	Pool	Riffle	Pool	Riffle
Rosgen Stream Type	-	E	-	E
Bankfull Width (W_{bkf}) (ft)	12.9	13.5	16.8	16.0
Bankfull Mean Depth, (d_{bkf}) (ft)	2.2	2.2	1.8	2.2
Width to Depth Ratio (W_{bkf}/d_{bkf})	5.7	6.0	9.2	7.4
Cross-Sectional Area, A_{bkf} (sq ft)	28.9	30.0	30.7	34.6
Bankfull Max Depth (d_{mbkf}) (ft)	3.0	2.8	2.8	3.5
Floodprone Width (W_{fpa}) (ft)	88.9	106	87.3	162
Entrenchment Ratio ((W_{fpa}/W_{bkf})) (ft)	6.9	7.9	5.2	10.1
Bank Height Ratio**	1.8	1.7	2.0	1.3
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	10+96	11+37	33+58	33+82
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	4.3		4.4	
Channel Materials (Particle Size Index – d50) – Based on Bulk Sample***				
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.13 / 0.33 / 0.6 / 4.5 / 14.1 (R1) 0.11 / 0.23 / 0.3 / 1.4 / 4.0 (R2)			
Average Valley Slope (ft/ft)	0.0025 (HC-R1 & HC-R2)			
Average Water Surface Slope (S)	0.0023 (HC-R1 & HC-R2)			
Average Channel Sinuosity (K)****	1.07			

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate system-wide self-recovery is unlikely
***Bulk samples taken since pebble count procedure not applicable for sand-bed streams
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured because the channel exhibits minimal pattern since it has been straightened/channelized.

Table 17.1a Representative Existing Conditions Geomorphic Data for Hurricane Creek Reaches: Stream Channel Classification Level II
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	HC-R3	
	XS5	XS6
Existing Reach Length (ft)	579	
Drainage Area (sq. mi.)	0.19	
Bankfull Discharge, Q_{bkf} (cfs)*	26.5	
Feature Type	Pool	Riffle
Rosgen Stream Type	-	Bc
Bankfull Width (W_{bkf}) (ft)	5.9	5.7
Bankfull Mean Depth, (d_{bkf}) (ft)	1.08	1.02
Width to Depth Ratio (W_{bkf}/d_{bkf})	5.5	5.6
Cross-Sectional Area, A_{bkf} (sq ft)	6.3	5.8
Bankfull Max Depth (d_{mbkf}) (ft)	1.5	1.2
Floodprone Width (W_{fpa}) (ft)	8.7	9.1
Entrenchment Ratio ((W_{fpa}/W_{bkf})) (ft)	1.5	1.6
Bank Height Ratio**	2.2	2.0
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	15+36	15+80
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	4.5	
Channel Materials (Particle Size Index – d50) – Based on Bulk Sample***		
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.29 / 0.63 / 1.0 / 3.4 / 6.7	
Average Valley Slope (ft/ft)	0.0080	
Average Water Surface Slope (S)	0.0078	
Average Channel Sinuosity (K)****	1.02	

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate system-wide self-recovery is unlikely
***Bulk samples taken since pebble count procedure not applicable for sand-bed streams
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured because the channel exhibits minimal pattern since it has been straightened/channelized.

Table 17.1b Representative Existing Conditions Geomorphic Data for UT4 Project Reaches: Stream Channel Classification Level II
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	UT4-R1			UT4-R2
	XS1	XS2	XS3	XS4
Existing Reach Length (ft)	1,417			1,673
Drainage Area (sq. mi.)	0.34			1.10
Bankfull Discharge, Q_{bkf} (cfs)*	41.0			95.6
Feature Type	Riffle	Pool	Riffle	Riffle
Rosgen Stream Type	F	-	G	G
Bankfull Width (W_{bkf}) (ft)	11.7	7.0	8.6	13.8
Bankfull Mean Depth, (d_{bkf}) (ft)	0.9	1.6	1.3	1.7
Width to Depth Ratio (W_{bkf}/d_{bkf})	13.2	4.5	6.5	8.0
Cross-Sectional Area, A_{bkf} (sq ft)	10.5	11.0	11.3	23.8
Bankfull Max Depth (d_{mbkf}) (ft)	1.2	1.9	1.9	2.5
Floodprone Width (W_{fpa}) (ft)	15.6	8.5	12.7	36.6
Entrenchment Ratio ((W_{fpa}/W_{bkf})) (ft)	1.3	1.2	1.5	2.7
Bank Height Ratio**	2.1	3.0	2.4	1.5
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	12+86	21+16	21+31	38+86
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	3.6 – 3.9			4.0
Channel Materials (Particle Size Index – d50): UT4-R1 based on Bulk Sample***				
Channel Materials (Particle Size Index – d50): UT4-R2 based on Reach-wide Pebble Count				
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.06 / 0.34 / 2.12 / 36.6 / 101.8 (R2)			
Average Valley Slope (ft/ft)	0.0067			
Average Water Surface Slope (S)	0.0058			
Average Channel Sinuosity (K)***	1.15			

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate system-wide self-recovery is unlikely
***Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured because the channel exhibits minimal pattern since it has been straightened/channelized.

Table 17.1b Representative Existing Conditions Geomorphic Data for UT4 Project Reaches: Stream Channel Classification Level II

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	UT4-R2	UT4-R3	UT4-R4	
	XS5	XS6	XS7	XS8
Existing Reach Length (ft)	1,673	244	1,787	
Drainage Area (sq. mi.)	1.10	1.52	0.42	
Bankfull Discharge, Q_{bkf} (cfs)*	95.6	120.5	47.4	
Feature Type	Pool	Riffle	Riffle	Pool
Rosgen Stream Type	-	G	G	-
Bankfull Width (W_{bkf}) (ft)	14.8	13.1	7.7	9.7
Bankfull Mean Depth, (d_{bkf}) (ft)	1.9	2.2	1.6	2.3
Width to Depth Ratio (W_{bkf}/d_{bkf})	7.8	6.0	5.0	4.3
Cross-Sectional Area, A_{bkf} (sq ft)	28	28.7	12.0	21.8
Bankfull Max Depth (d_{mbkf}) (ft)	2.7	3.2	2.1	4.0
Floodprone Width (W_{fpa}) (ft)	19.3	18.3	10.9	23.3
Entrenchment Ratio ((W_{fpa}/W_{bkf})) (ft)	1.3	1.4	1.4	2.4
Bank Height Ratio**	3.1	2.3	3.1	2.0
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	39+40	43+78	28+29	28+10
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	-	4.1	3.9	
Channel Materials (Particle Size Index – d50) – UT4-R3 based on Reach-wide Pebble Count Channel Materials (Particle Size Index – d50) – UT4-R4 based on Bulk Sample***				
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.06 / 0.15 / 0.48 / 10.3 / 130.2 (UT4-R3) 0.13 / 0.43 / 1.5 / 14.2 / 22.6 (UT4-R4)			
Average Valley Slope (ft/ft)	0.0067			
Average Water Surface Slope (S)	0.0058			
Average Channel Sinuosity (K)****	1.15			

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate system-wide self-recovery is unlikely
***Bulk samples taken since pebble count procedure not applicable for sand-bed streams
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured because the channel exhibits minimal pattern since it has been straightened/channelized.

Table 17.1b Representative Existing Conditions Geomorphic Data for UT4 Project Reaches: Stream Channel Classification Level II
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	UT4-R5	
	XS9	XS10
Existing Reach Length (ft)	1,921	
Drainage Area (sq. mi.)	0.71	
Bankfull Discharge, Q_{bkf} (cfs)*	69.3	
Feature Type	Riffle	Riffle
Rosgen Stream Type	Bc	E
Bankfull Width (W_{bkf}) (ft)	16.8	23.5
Bankfull Mean Depth, (d_{bkf}) (ft)	0.7	0.7
Width to Depth Ratio (W_{bkf}/d_{bkf})	25.2	36.0
Cross-Sectional Area, A_{bkf} (sq ft)	11.2	15.4
Bankfull Max Depth (d_{mbkf}) (ft)	1.3	2.4
Floodprone Width (W_{fpa}) (ft)	33.6	94.3
Entrenchment Ratio ((W_{fpa}/W_{bkf})) (ft)	2.0	4.0
Bank Height Ratio**	1.7	1.0
Longitudinal Stationing of Cross-Section Along Existing Thalweg (ft)	17+73	21+26
Bankfull Mean Velocity, V_{bkf}= (Q_{bkf}/A_{bkf}) (ft/s)	4.5	
Channel Materials (Particle Size Index – d50) – Based on Bulk Sample***		
d_{16} / d_{35} / d_{50} / d_{84} / d_{95} (mm)	0.30 / 0.70 / 1.3 / 5.5 / 8.4 (R5)	
Average Valley Slope (ft/ft)	0.0035	
Average Water Surface Slope (S)	0.0033	
Average Channel Sinuosity (K)****	1.08	

*Bankfull discharge estimated using NC Piedmont Regional Curve (Harman et al., 1999)
**High bank height ratios (values greater than 2.0 indicate system-wide self-recovery is unlikely
***Bulk samples taken since pebble count procedure not applicable for sand-bed streams
****Additional meander geometry information such as meander width, meander length, and radius of curvature were not measured because the channel exhibits minimal pattern since it has been straightened/channelized.

17.1.1.2 Valley Classification

The Brown Creek Tributaries Site is located in central Anson County in the Piedmont physiographic region of North Carolina. Undisturbed Piedmont valleys in this region are generally classified as Valley Type 'VII' (Rosgen, 2006). The underlying geology of the project area within the Wadesboro sub-basin of the Triassic Basin geologic formation and Level III Ecoregion. This geology consists of sedimentary conglomerate, fanglomerate, sandstone, and mudstone (Geologic Map of North Carolina, NC Geological Survey, 1998). The hydrophysiographic region is characterized by broad, rolling, interstream divides across variable slopes along well-defined drainage ways and receives moderately high rainfall with precipitation averaging 47.0 inches per year (NRCS, 1998).

17.1.1.3 Channel Morphology and Stability Assessment

Baker and Mulkey Engineers and Consultants, Inc. (Mulkey) performed general topographic and planimetric surveying of the project site and produced a 1-foot contour map based on survey data in order to create plan set base mapping (see Section 18.0, Appendix D). Eighteen representative cross-sections (3 riffles/3 pools on Hurricane Creek and 7 riffles/5 pools on UT4) and longitudinal profiles were also surveyed to assess the current condition and overall stability of the stream channels. The existing riffle cross-section locations and geomorphic data are shown in Figures 17.1 and 17.2 respectively and compared with the Rosgen Channel Stability Assessment shown in Table 17.2.

Since consistent bankfull indicators could not be identified in the field, bankfull cross-sectional areas were estimated using the NC Rural Piedmont Regional Curve to compare stability ratings. The representative riffle cross-sections have Bank Height Ratios (BHR) ranging from 1.3 to greater than 2.0. Some the cross-section data illustrate the presence of existing spoil and overburden from channelization and the lack of natural floodplain deposits.

The longitudinal profile indicate Reaches 1 and 2 of Hurricane Creek have an average valley slope of 0.0025 ft/ft, with uniform bed morphology in the top half and deeper pools in the lower half. Hurricane Creek has a sinuosity of 1.07, a result of prior straightening/ channelization. The reaches are moderately incised and unstable in areas through which headcuts are present and remnant spoil piles from past channelization prevent flows from spreading onto the floodplain. HC-R3 is slightly steeper (0.0078 ft/ft), has a sinuosity of 1.02 and a BHR of 2.0. This reach is mostly stable throughout due to bank vegetation and root mass preventing excessive degradation.

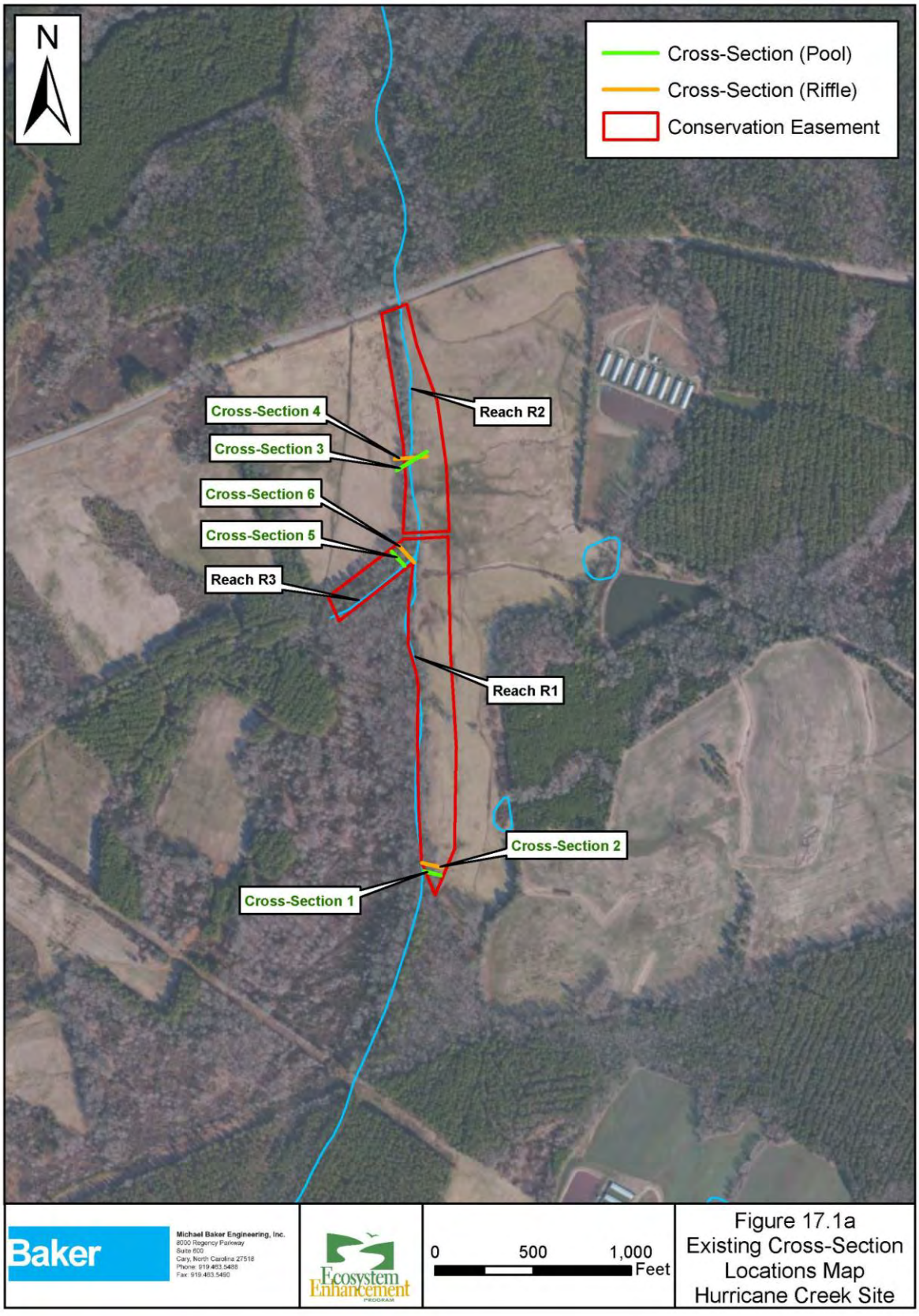
The longitudinal profiles for UT4 Reaches have average valley slopes that range from 0.0035 ft/ft to 0.0067 ft/ft, with a flatter gradients in the upper portions followed by a steeper grade with occasional short pool lengths through the lower portion of the reaches. These reaches have lower sinuosities ranging from 1.15 to 1.08, a result of some prior straightening/ channelization. The bedform morphology is similar throughout most of UT4 Reaches as they become moderately to severely incised towards the lower portion of the channels.

Table 17.2 Rosgen Channel Stability Assessment
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Stability Rating	Bank Height Ratio (BHR)
Stable (low risk of degradation)	1.0 - 1.05
Moderately unstable	1.06 - 1.3
Unstable (high risk of degradation)	1.3 - 1.5
Highly unstable	>1.5

Notes: Rosgen, D. L. (2001) A stream channel stability assessment methodology. Proceedings of the Federal Interagency Sediment Conference. Reno, NV. March, 2001.

Figure 17.1 Existing Cross-Section Locations for Project Reaches



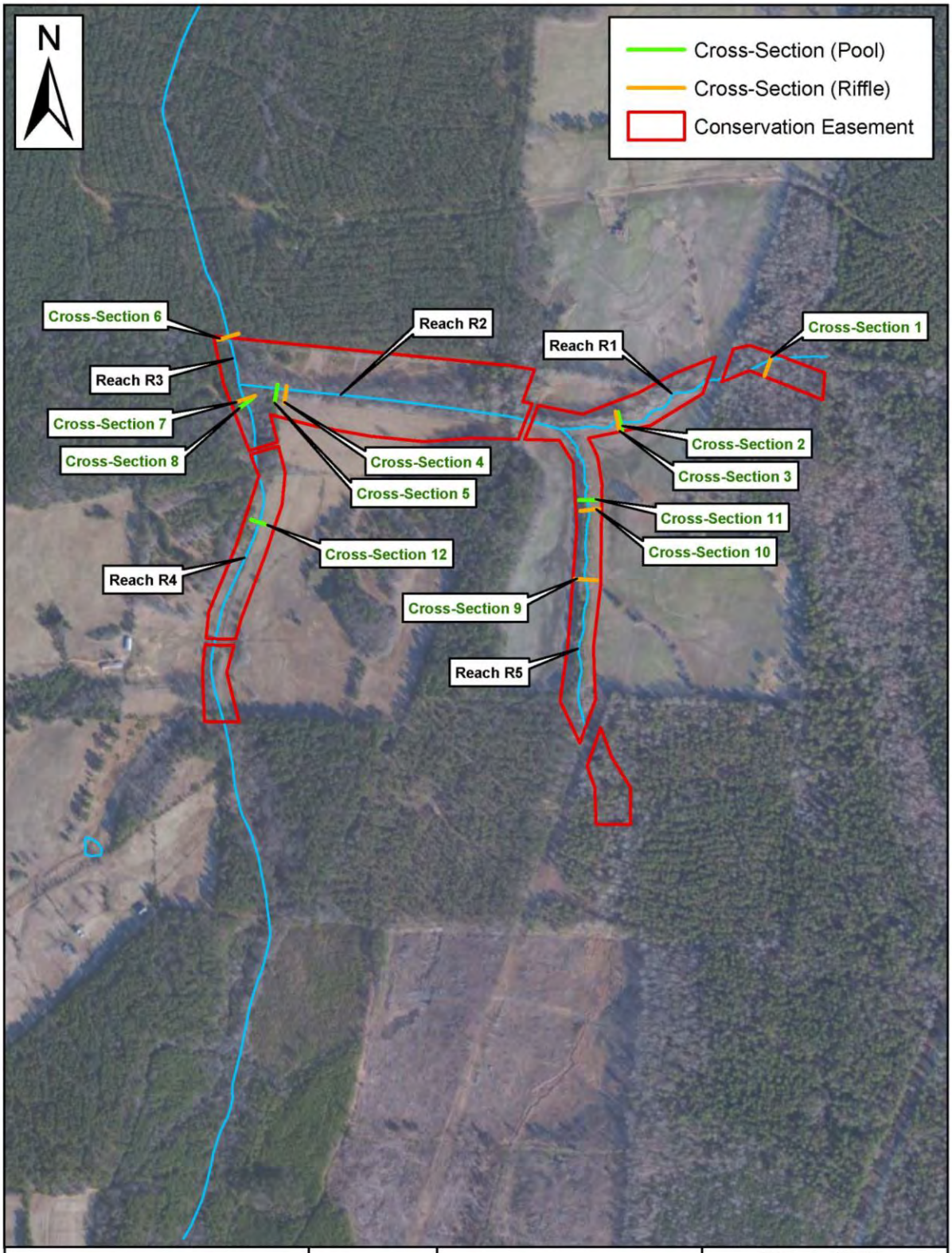

N
Cross-Section (Pool)
Cross-Section (Riffle)
Conservation Easement
Cross-Section 6
Reach R2
Reach R1
Cross-Section 1
Reach R3
Cross-Section 7
Cross-Section 8
Cross-Section 4
Cross-Section 5
Cross-Section 2
Cross-Section 3
Cross-Section 11
Cross-Section 10
Cross-Section 12
Reach R4
Cross-Section 9
Reach R5
Baker
Michael Baker Engineering, Inc.
8000 Regency Parkway
Suite 600
Cary, North Carolina 27518
Phone: 919.463.5488
Fax: 919.463.5490
Ecosystem Enhancement Program
0
500
1,000
Feet
Figure 17.1b
Existing Cross-Section
Locations Map
UT4 Site

Figure 17.2 Existing Riffle Cross-Section for Project Reaches (HC-R1)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	29.9	13.46	2.23	2.84	6.04	1.7	7.9	216.3	218.39

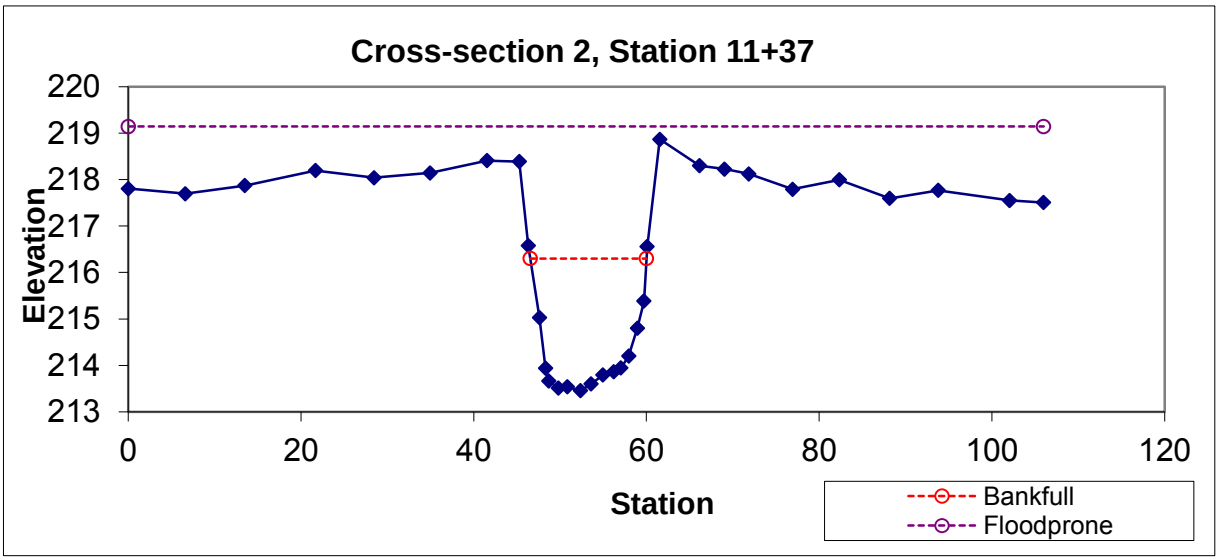


Figure 17.2 Existing Riffle Cross-Section for Project Reaches (HC-R2)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	E	34.6	16.01	2.16	3.46	7.41	1.3	10.1	210.3	211.32

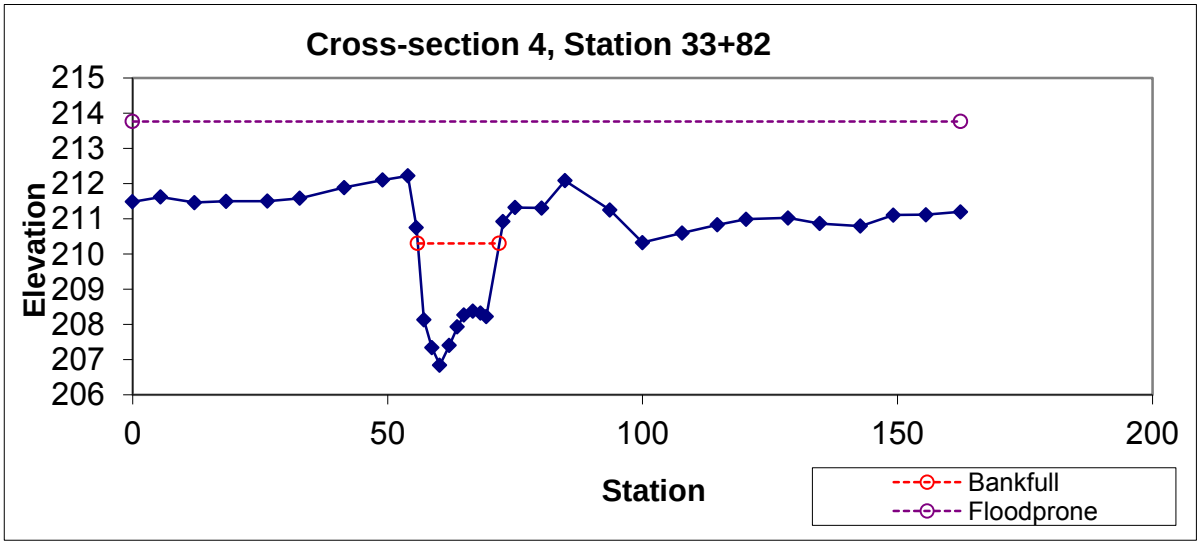


Figure 17.2 Existing Riffle Cross-Sections for Project Reaches (HC-R3)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	5.8	5.73	1.02	1.23	5.63	2.0	1.6	211.8	212.99

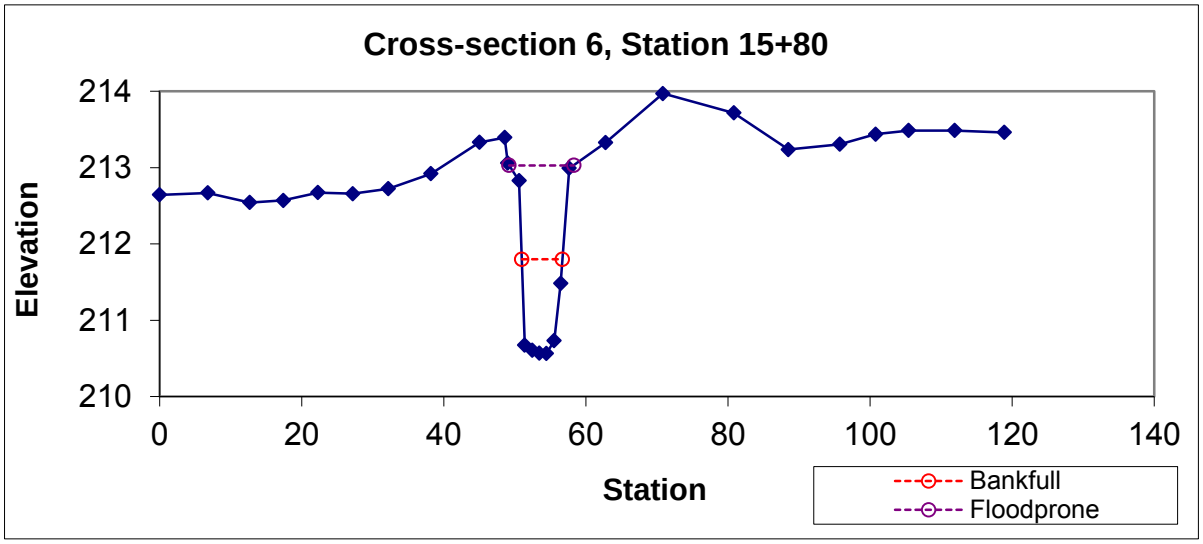


Figure 17.2 Existing Riffle Cross-Sections for Project Reaches (UT4-R1)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	F	10.5	11.73	0.89	1.23	13.17	2.1	1.3	223.05	224.43

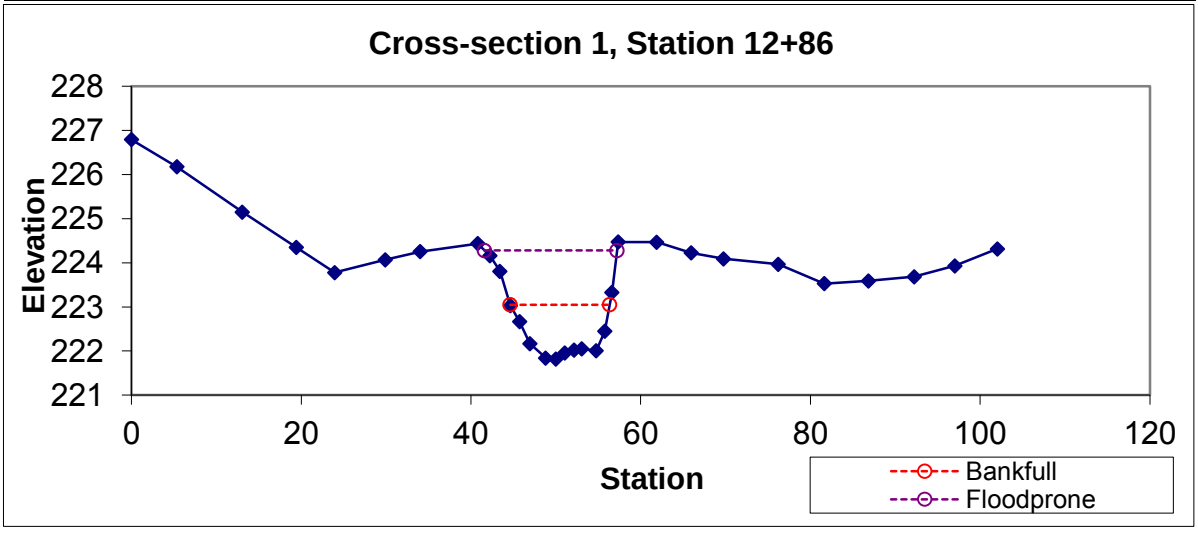


Figure 17.2 Existing Riffle Cross-Sections for Project Reaches (UT4-R1)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	11.3	8.56	1.32	1.85	6.46	2.4	1.5	215.9	218.44

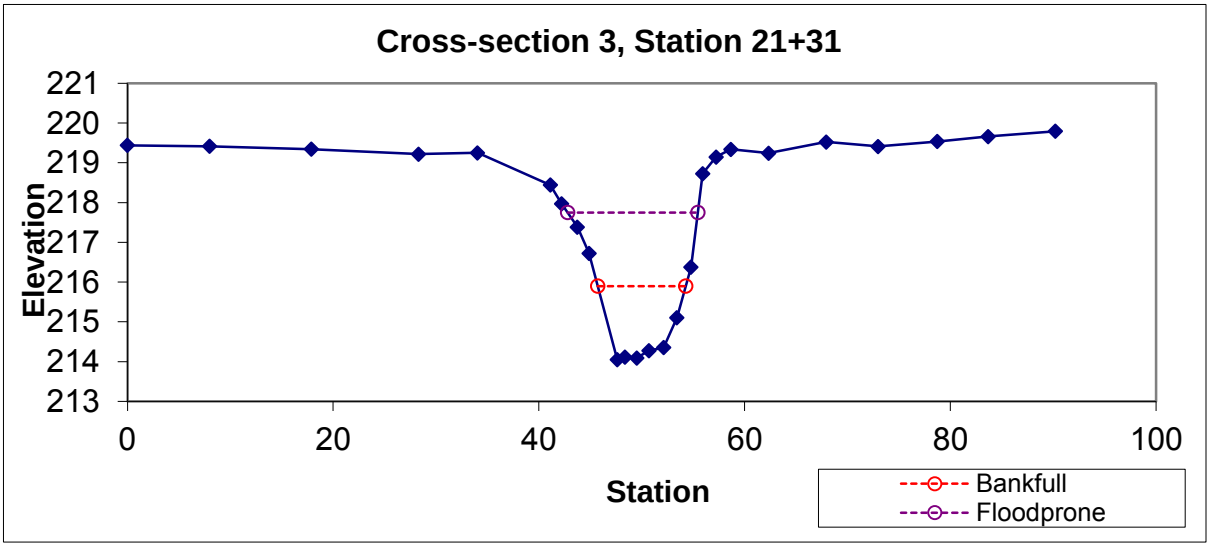


Figure 17.2 Existing Riffle Cross-Section for Project Reaches (UT4-R2)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	23.8	13.75	1.73	2.47	7.95	1.4	2.7	207	208.11

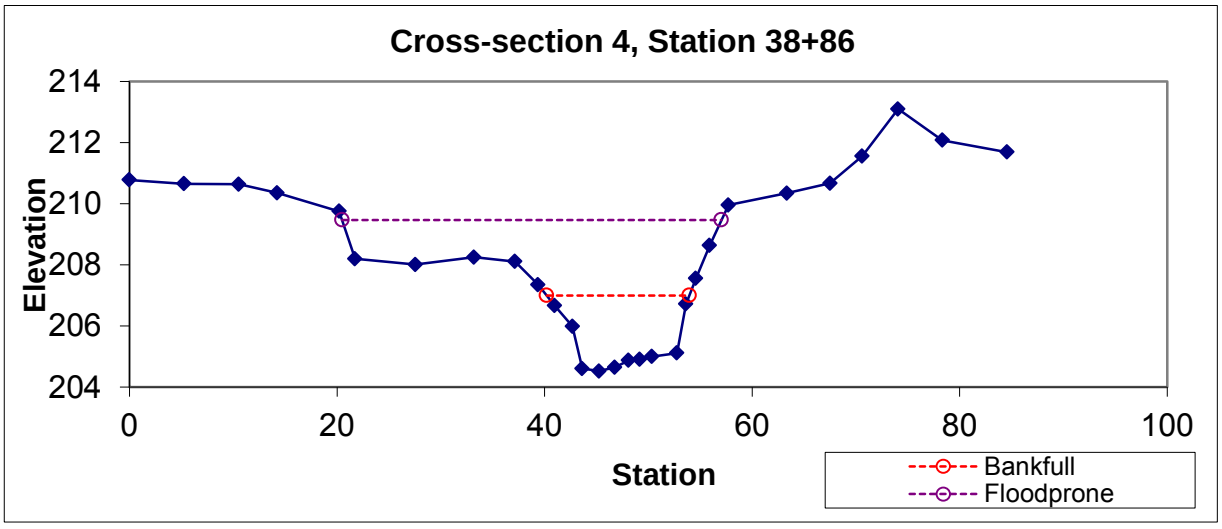


Figure 17.2 Existing Riffle Cross-Section for Project Reaches (UT4-R3)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	28.7	13.08	2.2	3.2	6.0	2.3	1.4	205.61	209.68

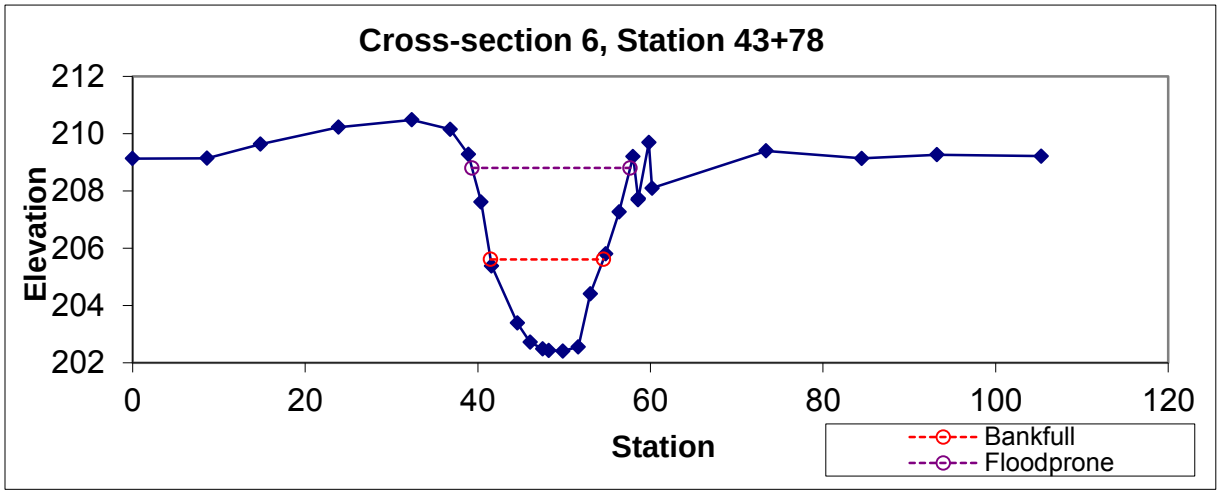


Figure 17.2 Existing Riffle Cross-Section for Project Reaches (UT4-R4)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	G	12.0	7.71	1.56	2.11	5.0	3.1	1.4	205.21	209.72

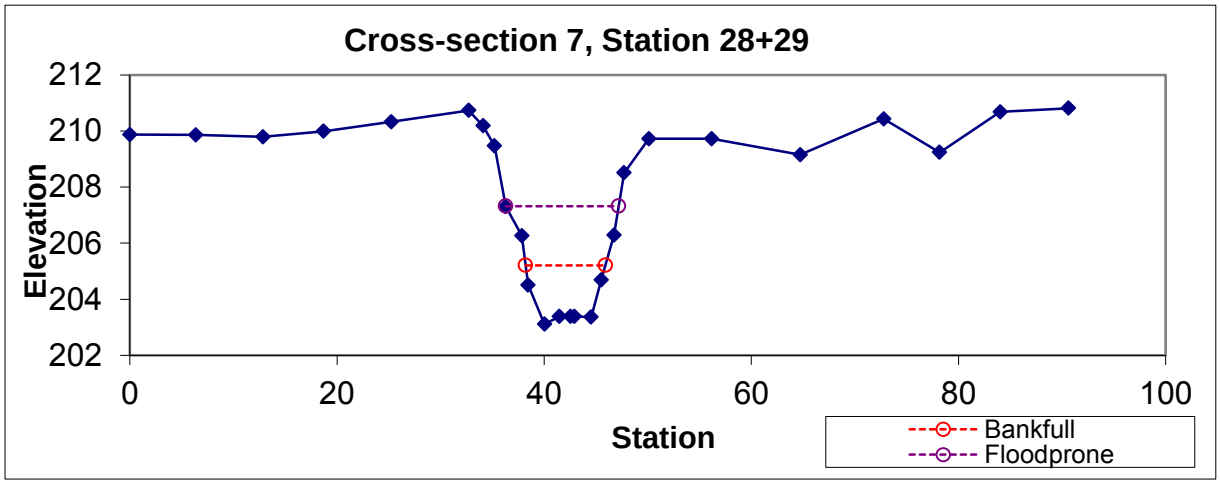
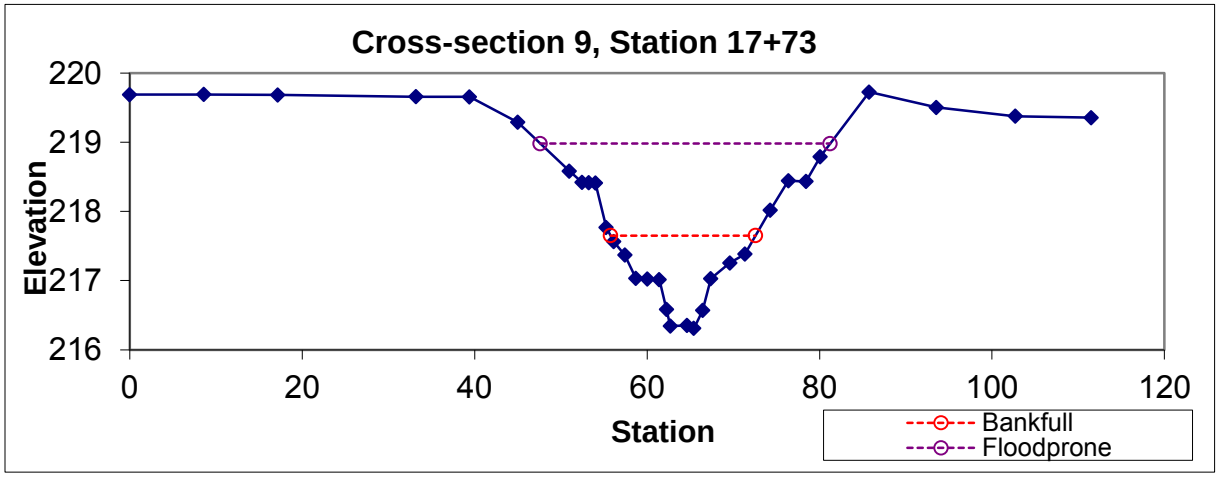


Figure 17.2 Existing Riffle Cross-Sections for Project Reaches (UT4-R5)

Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	Bc	11.2	16.78	0.67	1.34	25.2	1.7	2.0	217.65	218.58



Feature	Stream Type	BKF Area	BKF Width	BKF Depth	Max BKF Depth	W/D	BH Ratio	ER	BKF Elev	TOB Elev
Riffle	C	15.3	23.52	0.65	2.4	36.0	1.0	>3.7	217.6	217.46

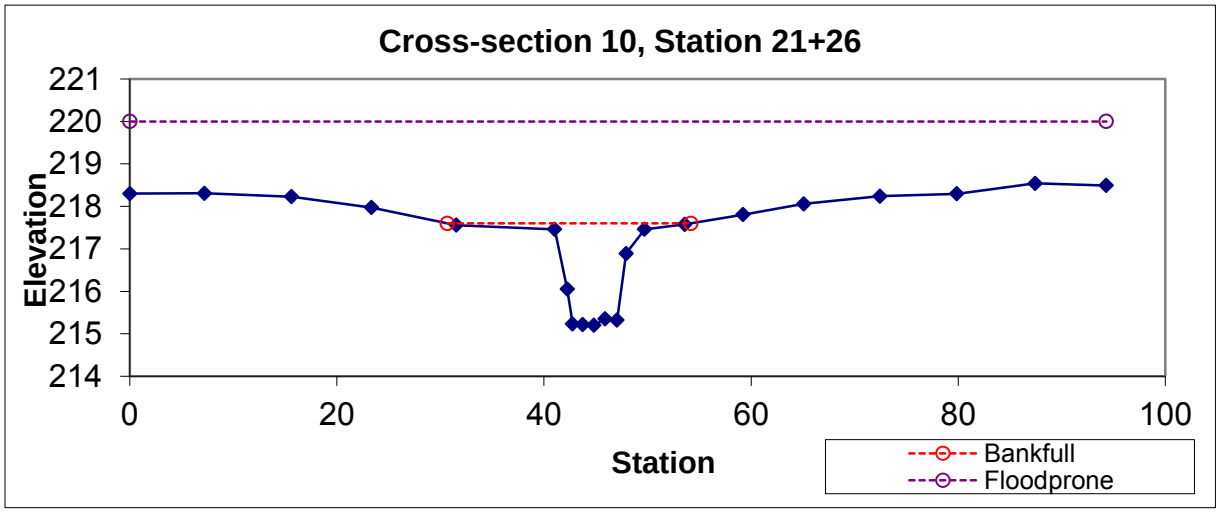
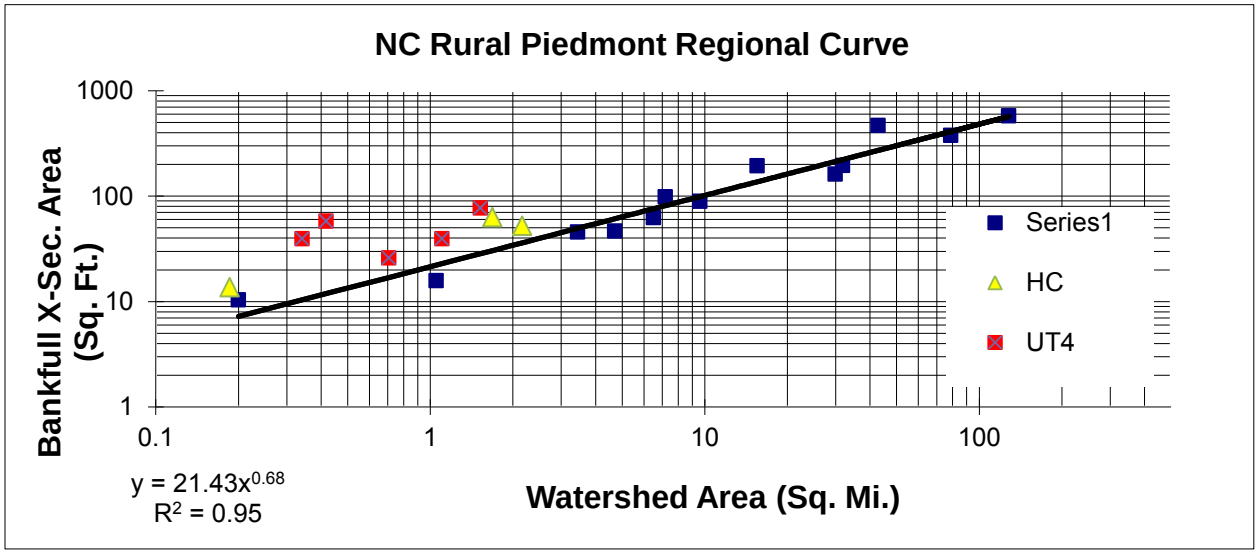


Figure 17.2a NC Rural Piedmont Regional Curve Existing Cross-Section Data Comparison



17.1.1.4 Bank Erosion Prediction (BEHI/NBS)

Sedimentation from bank erosion is a significant pollutant to water resources and aquatic habitat. Predicting stream bank erosion rates and annual sediment yields using the Bank Assessment for Non-point source Consequences of Sediment (BANCS) method (Rosgen 1996, 2001a) considers two bank erodibility estimation tools: the Bank Erosion Hazard Index (BEHI), and Near Bank Stress (NBS). This rating method is used to describe existing bank conditions and statistically quantify the erosion potential of a stream reach in feet/year.

Since it is an estimation/prediction method, the intent is to be used as a relative comparison for pre- and post-restoration conditions.

Published curve data were initially developed from sites in Colorado with varying sediment sources, vegetation, and fluvial geomorphic processes characteristic of that region. Although the published BEHI/NBS curve is not directly applicable to piedmont streams in North Carolina, it can provide a framework to develop similar relations in other hydrophysiographic regions. Therefore, Baker used local unpublished NC piedmont BEHI and NBS ratings (obtained through personal communication with NRCS, 2011) to estimate sediment loss and support field observations and banks height measurements taken during existing conditions assessment.

The BEHI/NBS estimates for the existing conditions (pre-construction) suggests that Hurricane Creek (71 tons) and UT4 (76 tons) systems contribute approximately 147 tons of sediment per year to downstream waters and eventually the Brown Creek system. The majority of BEHI ratings varied from 'low' to 'moderate' with a few shorter sections rating on the 'high' category based changes in the velocity gradient, stream pattern, bank heights and shear stress. This is typical of a degraded stream system with active bank erosion in multiple areas. After stabilizing stream banks using the proposed restoration measures, post-construction BEHI/NBS estimates typically predict a significant decrease in sediment loading throughout the entire project area, especially considering the sediment supply entering the system from the upstream drainages and headwater tributaries.

17.1.1.5 Channel Evolution

Channel stability is defined as the stream's ability to transport incoming flows and sediment loads supplied by the watershed without undergoing significant changes over a geologically short time-scale. A generalized relationship of stream stability was proposed by Lane (1955); it states that the product of sediment load and sediment size is

in balance with the product of stream slope and discharge, or stream power. A change in any one of these variables induces physical adjustment of one or more of the other variables to compensate and maintain the proportionality.

Longitudinally, the water and sediment flows delivered to each subsequent section are the result of the watershed and upstream or backwater (downstream) conditions. Water and sediment pass through the channel, which is defined by its shape, material, and vegetative condition. Flow and sediment are either stored or passed through at each section along the reach. The resulting physical changes are a balancing act between gravity, friction, and the sediment and water being delivered into the system (Leopold et al., 1964).

Observed stream response to induced instability, as described by Simon's (1989) Channel Evolution Model, involve extensive modifications to channel form resulting in profile, cross-sectional, and plan form changes, which often take decades or longer to achieve resolution. The Simon (1989) Channel Evolution Model characterizes typical evolution in six steps:

I. Pre-modified
II. Channelized
III. Degradation
IV. Degradation and widening
V. Aggradation and widening
VI. Quasi-equilibrium.

The channel evolution process is initiated once a stable, well-vegetated stream that interacts frequently with its floodplain is disturbed. Channelization, dredging, changing land use, removal of streamside vegetation, upstream or downstream channel modifications, and/or change in other hydrologic variables result in adjustments in channel morphology to compensate for the new condition(s). Disturbance commonly results in an increase in stream power that can cause degradation, often referred to as channel incision (Lane, 1955). Incision eventually leads to over-steepening of the banks and, when critical bank heights are exceeded, the banks begin to fail and mass wasting of soil and rock leads to channel widening. Incision and widening continue moving upstream in the form of a head-cut. Eventually the mass wasting slows, and the stream begins to aggrade. A new, low-flow channel begins to form in the sediment deposits. By the end of the evolutionary process, a stable stream with dimension, pattern, and profile similar to those of undisturbed channels forms in the deposited alluvium. The new channel is at a lower elevation than its original form, with a new floodplain constructed of alluvial material (FISRWG, 1998).

The channel stability assessment incorporated qualitative and quantitative site observations using detailed topographic data collected for the project. Conclusions reached from these methods were used to define overall channel stability and determine appropriate restoration approaches for the site. The main stem channel of Hurricane Creek is a perennial stream that originates from a watershed that is predominantly forested with agricultural land comprising much the remaining land use. Hurricane Creek is incised, but not particularly entrenched in most sections as evidenced by ER's greater than 2.0. The main stem channel of UT4 is also a perennial stream that originates from a watershed that is predominantly forested with agricultural land comprising much the remaining land use. However, due to past channelization and straightening, UT4 is moderately to severely incised in most sections as evidenced by an bank height ratios greater than 1.5.

The vast majority of Hurricane Creek and UT4 do not have adequate existing buffer widths greater than 50 feet along both stream banks. The project reaches vary between

Stage III and IV of channel evolution. Thus, both systems overall are in a degradational phase of channel evolutionary sequence and, if left unfettered, would continue to degrade and widen further in order to reach Stage 6 (quasi-equilibrium), all due to lack of access to relic floodplain.

17.1.2 Proposed Morphological Conditions

After examining the assessment data collected at the site and exploring the potential for restoration, an approach was developed that would address restoration of stream functions within the project area while minimizing disturbance to existing wooded areas. Prior to impacts from past channelization, topography and soils on the site indicate that the project area most likely functioned in the past as a tributary stream system, eventually flowing into the larger Brown Creek system.

Therefore, Baker formulated a design approach to restore and/or enhance this type of system. First, an appropriate stream type for the valley type, slope, and desired stream functions was selected and designed to restore and/or enhance historic flow patterns throughout the project area. Then a design plan was developed in order improve the floodplain hydrology and base flow interaction impaired by current cattle impacts, active degradation, and other agricultural land manipulations.

17.1.2.1 Proposed Design Approach and Criteria Selection

For design purposes, the main stem of Hurricane Creek was divided into two reaches labeled HC-R1 and HC-R2 (see Figure 17.2). The unnamed tributary reach is labeled HC-R3. The three unnamed tributaries to Brown Creek (UT4) were divided into five reaches labeled UT4-R1, UT4-R2, UT4-R3, UT4-R4, and U4-R5. Selection of a general restoration approach was the first step in selecting design criteria for the reaches.

The approaches were based on the potential for restoration as determined during the site assessment. Next, the specific design parameters were developed so that plan view layout, cross-section dimensions, and a longitudinal profile could be described for developing construction documents. The design philosophy is to use these design parameters as conservative values for the selected stream types and to allow natural variability in stream dimension, facet slope, and bed features to form over long periods under the processes of flooding, re-colonization of vegetation, and watershed influences.

After selecting an appropriate design approach for the site based on field assessments and functional lift potential, proposed stream design values and design criteria were selected using common reference reach ratios and guidelines (Harman, Starr, 2011). Table 17.3 presents the design parameters used for the proposed reaches. Following initial application of the design criteria, detailed refinements were made to accommodate the existing valley type and channel morphology. This was done to minimize unnecessary disturbance of the riparian area, and to allow for some natural channel adjustment following construction. The design plans have been tailored to produce a cost and resource efficient design that is constructible, using a level of detail that corresponds to the tools of construction.

HC-R1 Restoration

A Priority Level I restoration approach is proposed for the reach to fully restore stream functions and a floodplain connection. The lowest part of the stream valley runs mostly in the field along the existing tree line to the east of the degraded stream channel. Starting at the project boundary, the bed elevation will be raised gradually to provide a reconnection to the geomorphic floodplain. The restored channel will be constructed off-line along the existing field edge, and will be designed as a Rosgen C/E type channel. The stream will however, be constructed as close as possible to the existing tree line.

This will allow the ease of construction in the pasture, while also taking advantage of the shading, biomass input, etc. of the existing mature riparian trees to remain. This approach will also minimize the number of existing trees that will need to be removed during construction.

The design width/depth ratio for the channel will be 13, and over time, the channel will narrow slightly to an 'E' stream type from deposition of sediment and stream bank vegetation growth. In-stream structures will include constructed riffles for grade control and aquatic habitat (bed material for the existing stream is sand/gravel), grade control j-hook vanes, log vanes, and log step-pools for stream bed/bank stability, and habitat diversity.

The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel. Shallow vernal pools will be incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff.

Riparian buffers in excess of 50 feet will be restored or protected along all of HC-R1. The existing ford crossing will be and improved and permanent fencing will installed to exclude cattle from entering the restored stream.

HC-R2 Restoration

A Priority Level I Restoration approach will continue along HC-R2. The reach will be constructed beyond the existing right bank in existing pasture and also as close as possible to the existing tree line as previously described. In the downstream section, a Priority level II restoration approach will be utilized to lower the stream to the existing bed elevation, albeit with floodplain benching. The proposed techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from bank erosion. This reach will be designed as a Rosgen 'C' stream type in the upstream Priority Level I section and transition to a Rosgen 'Bc' stream type in the shorter Priority II section downstream. The design width/depth ratio for the channel will range between 10-14 as the channel transitions to the downstream end of the project. The mature trees along the channel will be preserved whenever possible and the riparian buffers in excess of 50 feet will be restored or protected along the entire reach.

At the downstream end of the reach, the restored channel must transition down to the elevation of Hurricane Creek near the road crossing; therefore, rock and log step pools, cross vanes, and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, channel banks will be graded to stable slopes, and bankfull benches will be incorporated to further promote stability and re-establishment of riparian vegetation to the confluence.

HC-R3 Enhancement

Work on HC-R3 will primarily involve Level II Enhancement approaches on a majority of the reach. Due to the presence of bank vegetation along much of this reach, the stream shows minimal channel incision or downcutting. Level II Enhancement is proposed to restore a more stable dimension and profile. Minor channel bank stabilization and in-stream structures are proposed to enhance bedform morphology for the portions of the reach where the riparian buffer and/or channel has been impacted.

A new, culverted crossing will be installed at the beginning of the reach to provide access across to the upstream property. The crossing will be designed to pass a 10-year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing.

Riparian buffers in excess of 50 feet will be restored or protected along all of HC-R3. and fencing will installed to permanently exclude cattle from entering the stream.

UT4-R1a Preservation

Preservation is proposed for the upstream portion of the reach up to the existing powerline easement. The stream and riparian buffer are currently stable and no future developments or impacts are expected within the upper watershed. No work will be performed along this reach and the existing stream and riparian buffer will be protected within a permanent conservation easement.

UT4-R1b Restoration

Downstream of the powerline easement crossing, the proposed restoration will follow a Rosgen Priority Level I and II approach. The degraded channel banks will be graded to stable slopes, and bankfull benches will be incorporated in the upper section to further promote stability and re-establishment of riparian vegetation to the confluence. In-stream structures such as rock and log step pools, log jams, and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision.

The restored channel will be designed and constructed as a Rosgen 'Bc' stream type. The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material excavated from construction of the restored channel.

The existing culverted crossing will be improved to allow access across the powerline easement. Riparian buffers in excess of 50 feet will be restored or protected along the entire reach length.

UT4-R2 Restoration

A Priority Level I Restoration approach will continue along UT4-R2. The reach will be constructed beyond the existing left bank in existing pasture. The proposed techniques will allow restoration of a stable channel form with appropriate bedform diversity, as well as improved channel function through improved aquatic habitat, more frequent overbank flooding, restoration of riparian and terrestrial habitats, exclusion of cattle and associated pollutants, and decreased erosion and sediment loss from bank erosion. This reach will be designed as a meandering Rosgen 'C' stream type The design width/depth ratio for the channel will range between 10-14. The mature trees along the existing channel will be preserved whenever possible and the riparian buffers in excess of 50 feet will be restored or protected along the entire reach.

At the downstream end of the reach, the restored channel will connect to the bed elevation at the UT4-R3/UT4-R4 confluence; therefore, rock and log step pools, and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, channel banks will be graded to stable slopes, and bankfull benches may be incorporated to further promote stability and re-establishment of riparian vegetation to the confluence.

The existing, unstable channel will be partially to completely filled along its length using a combination of existing spoil piles that are located along the reach and fill material

excavated from construction of the restored channel. Vernal pools will be incorporated along the filled abandoned channel to provide habitat diversity and improved detention of runoff.

Riparian buffers in excess of 50 feet will be restored or protected along all of UT4-R2. The existing ford crossing will be and improved and permanent fencing will installed to exclude cattle from entering the restored stream.

UT4-R3 Restoration

This reach will be designed as a Rosgen 'Bc' stream type throughout the shorter reach section. The design width/depth ratio for the channel will range between 10-14 as the channel transitions to the downstream end of the project. The mature trees along the channel will be preserved whenever possible and the riparian buffers in excess of 50 feet will be restored or protected along the entire reach.

The restored channel must transition down to the existing bed elevation near the project boundary; therefore, rock and log step pools, cross vanes, and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision. Along this downstream transition section, channel banks will be graded to stable slopes, and bankfull benches may be incorporated to further promote stability and re-establishment of riparian vegetation to the confluence.

UT4-R4 Restoration

Restoration will follow a Rosgen Priority Level I approach. In the upstream section (UT4-R4a), degraded channel banks will be graded to stable slopes, and in-stream structures will be incorporated to raise the bed elevation, promote stability and re-establishment of riparian vegetation. In-stream structures such as rock and log step pools, log jams, and/or constructed riffle structures will be installed to control grade, dissipate energies, and eliminate the potential for upstream channel incision.

The existing ford crossing will be improved to allow access across the conservation easement. Riparian buffers in excess of 50 feet will be restored or protected along the entire reach length. Below the stream crossing, the existing, unstable channel will be partially to completely filled along its length using a material excavated from construction of the restored channel. The restored channel (UT4-R4b) will be designed as a Rosgen 'Bc' stream type and meander slightly across the existing geomorphic floodplain before its confluence with UT4-R2.

UT4-R5 Enhancement

Work on UT4-R5 will primarily involve Level I Enhancement approaches on a majority of the reach. Due to the presence of bank vegetation along some of the reach sections, the stream shows minimal channel incision or downcutting. Level I Enhancement is proposed to restore a more stable dimension and profile. Localized channel bank stabilization and in-stream structures are proposed to enhance bedform morphology for the portions of the reach where the riparian buffer and/or channel has been impacted or active headcuts are present.

A new, culverted crossing will be installed near the beginning of the reach to provide access across to the upstream property. The crossing will be designed to pass a 10-year return period event, with excess capacity on the floodplain to pass larger events without damaging the crossing.

Riparian buffers in excess of 50 feet will be restored or protected along all of HC-R3. and fencing will installed to permanently exclude cattle from entering the stream.

Table 17.3 Natural Channel Design Criteria for Project Reaches

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	Design Values			Rationale
	HC-R1	HC-R2	HC-R3	
Stream Type (Rosgen)	E5/C5	E5/B5c	B5c	Note 1
Bankfull Discharge, Qbkf (cfs)	110.0	130.0	22.0	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	3.9	4.2	3.2	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	28.0	31.0	6.9	Note 7
Bankfull Riffle Width, Wbkf (ft)	19.1	20.1	9.1	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	1.5	1.6	0.8	d=A/W
Width to Depth Ratio, W/D (ft/ft)	13	13	12	Note 3
Width Floodprone Area, Wfpa (ft)	45 - 79	49 - 85	21 - 36	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	>2.2	>2.2	1.8 - 2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	1.8	2.0	1.0	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2	1.2	1.2	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0	1.0	1.0	Note 6
Meander Length, Lm (ft)	130 - 230	140 - 250	N/a	Note 7
Meander Length Ratio, Lm/Wbkf	7.0 - 14.0	7.0 - 14.0	N/a	Note 7
Radius of Curvature, Rc (ft)	39 - 55	40 - 60	N/a	Note 7
Rc Ratio, Rc/Wbkf *	2 – 3	2 - 3	N/a	Note 7
Belt Width, Wblt (ft)	69 - 140	74 - 150	N/a	Note 7
Meander Width Ratio, Wblt/Wbkf	3.5 - 6.5	3.5 - 6.5	N/a	Note 7
Sinuosity, K (TW length/ Valley length)	1.2	1.2	N/a	Note 7
Valley Slope, Sval (ft/ft)	0.0023	0.0025	0.0080	Sval / K
Channel Slope, Schan (ft/ft)	0.0120	0.0160	0.0040	
Average Slope Riffle, Srif (ft/ft)	0.0170	0.0170	0.0050	
Riffle Slope Ratio, Srif/Schan	1.1 – 1.4	1.1 – 1.4	1.1 – 1.4	Note 8
Slope Pool, Spool (ft/ft)	0.001 – 0.003	0.001 – 0.003	0.001 – 0.005	
Pool Slope Ratio, Spool/Schan	0.1 – 0.2	0.1 – 0.2	0.1 – 0.4	Note 8
Pool Max Depth, Dmaxpool (ft)	3.0	3.2	2.0	
Pool Max Depth Ratio, Dmaxpool/Dbkf	2.0	2.0	2.0	Note 7
Pool Width, Wpool (ft)	26.0	27.0	13.0	
Pool Width Ratio, Wpool/Wbkf	1.4	1.3	1.4	Note 9
Pool-Pool Spacing, Lps (ft)	80 – 138	85 - 149	18 - 50	
Pool-Pool Spacing Ratio, Lps/Wbkf	4 – 7	4 – 7	2 - 5	Note 7

Notes:

1. A 'C' stream type is appropriate for a lower slopes (generally less than 0.015 ft/ft), wider alluvial valleys (generally greater than 100 ft). A 'Bc' stream type is appropriate for higher slopes (generally greater than 0.015 ft/ft), in more confined valleys. The channel dimension was based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

2. Bankfull discharge analysis was estimated by comparing the Manning's equation (n = ~0.4) with regional curve data to represent post-construction conditions as vegetation becomes established.

3. The W/D ratio was selected based on relationships of W/D ratio to slope in NC Piedmont reference reach streams, as well as sediment transport analyses and past project evaluation.

4. Required for Rosgen stream classification.

5. Ratio was based on past project evaluation of similar design channels as well NC Piedmont reference reach streams.

6. A bank height ratio near 1.0 ensures that all flows greater than bankfull will spread onto a floodplain. This minimizes shear stress in the channel and maximizes floodplain functionality, resulting in lower risk of channel instability.

7. Design Values were chosen based on common small piedmont stream reference reach data and past project evaluation.

8. Due to the small channel sizes, facet slopes were not calculated for the proposed design. Past project experience has shown that these minor changes in slope between bedform features form naturally within the constructed channel, provided that the overall design channel slope is maintained after construction.

9. Design Values were chosen based on reference reach comparison and past project evaluation. It is more conservative to design a pool wider than the riffle. Over time, the pool width may narrow from sediment deposits and vegetation growth, which is considered to be a positive evolutionary step towards stability.

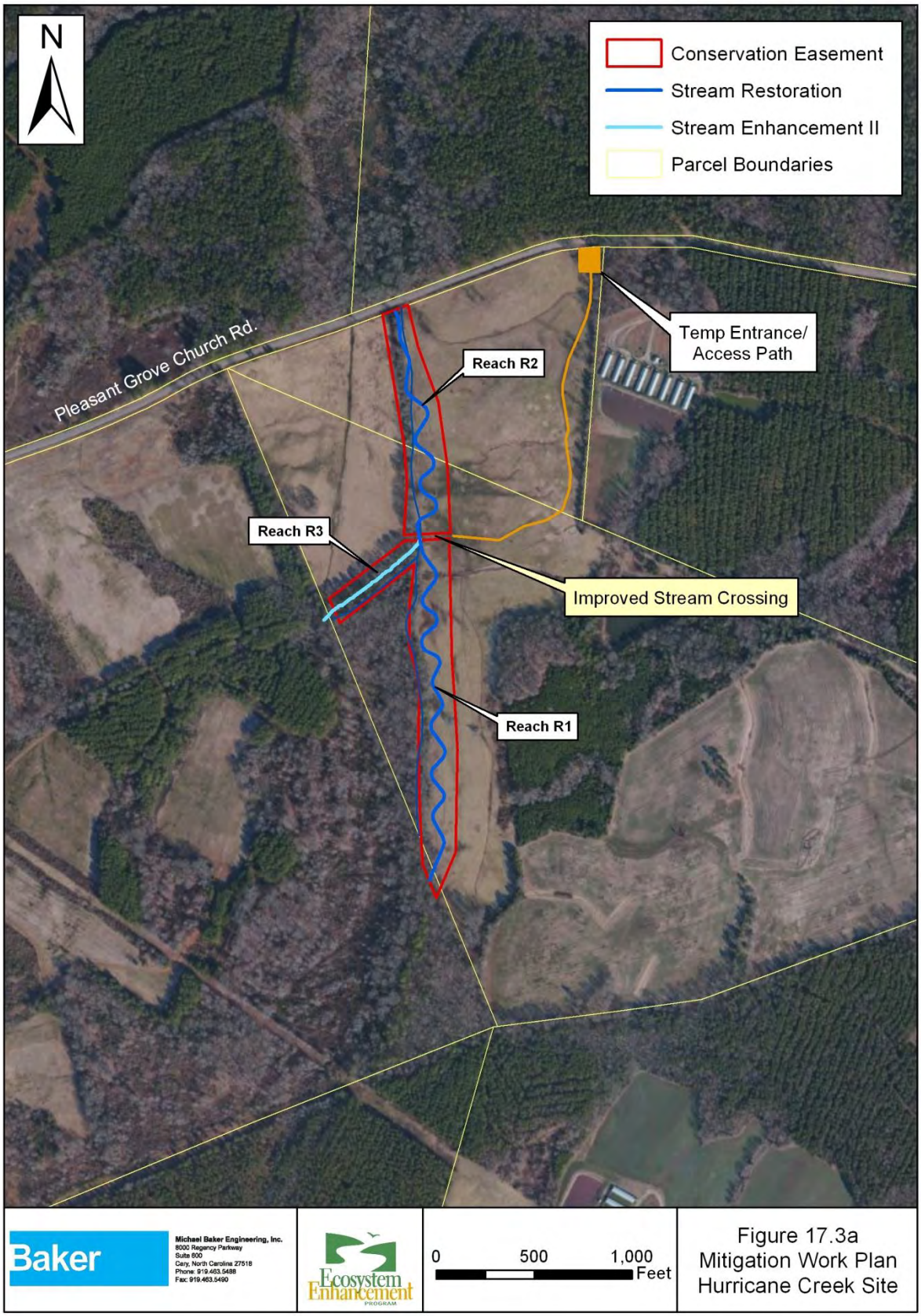
Table 17.3 Natural Channel Design Criteria for Project Reaches

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	Design Values					Rationale
	UT4-R1	UT4-R2	UT4-R3	UT4-R4	UT4-R5	
Stream Type (Rosgen)	C4/B4c	C4	B4c	C4/B4c	C4/E4	Note 1
Bankfull Discharge, Qbkf (cfs)	37.0	80.0	103.0	40.0	60.0	Note 2
Bankfull Mean Velocity, Vbkf (ft/s)	3.7	3.8	3.7	3.6	3.8	V=Q/A
Bankfull Riffle XSEC Area, Abkf (sq ft)	10.0	21.0	28.0	11.0	16.0	Note 7
Bankfull Riffle Width, Wbkf (ft)	11.4	16.5	19.8	12.0	13.9	$\sqrt{Abkf * W / D}$
Bankfull Riffle Mean Depth, Dbkf (ft)	0.9	1.3	1.4	0.9	1.2	d=A/W
Width to Depth Ratio, W/D (ft/ft)	13	13	13	13	12	Note 3
Width Floodprone Area, Wfpa (ft)	26 - 46	38 - 66	44 - 76	28 - 48	32 - 55	
Entrenchment Ratio, Wfpa/Wbkf (ft/ft)	>2.2	>2.2	1.8 - 2.2	>2.2	>2.2	Note 4
Riffle Max Depth @ bkf, Dmax (ft)	1.1	1.6	1.7	1.1	1.5	
Riffle Max Depth Ratio, Dmax/Dbkf	1.2 - 1.4	1.2 - 1.4	1.2 - 1.4	1.2 - 1.4	1.2 - 1.4	Note 5
Bank Height Ratio, Dtob/Dmax (ft/ft)	1.0	1.0	1.0	1.0	1.0	Note 6
Meander Length, Lm (ft)	70 - 90	115 - 180	N/a	84 -140	N/a	Note 7
Meander Length Ratio, Lm/Wbkf	7 - 9	7 - 11	N/a	7 - 12	N/a	Note 7

Radius of Curvature, Rc (ft)	23 - 34	33 - 50	N/a	24 - 36	N/a	Note 7
Rc Ratio, Rc/Wbkf *	2 - 3	2 - 3	N/a	2 - 3	N/a	Note 7
Belt Width, Wblt (ft)	40 - 80	60 - 100	N/a	40 - 70	N/a	Note 7
Meander Width Ratio, Wblt/Wbkf	3.5 - 7.0	3.5 - 6.0	N/a	3.5 - 6.0	N/a	Note 7
Sinuosity, K (TW length/ Valley length)	1.11	1.19	N/a	1.12	N/a	Note 7
Valley Slope, Sval (ft/ft)	0.0067	0.0063	0.0080	0.0069	0.0035	Sval / K
Channel Slope, Schan (ft/ft)	0.0058	0.0034	0.0078	0.0063	0.0033	
Average Slope Riffle, Srif (ft/ft)	0.0078	0.0040	0.0130	0.0100	0.0050	
Riffle Slope Ratio, Srif/Schan	1.1 – 1.7	1.1 – 1.5	1.1 – 1.8	1.1 – 1.5	1.1 – 1.5	Note 8
Slope Pool, Spool (ft/ft)	0.001 - 0.003	0.001 - 0.003	0.001 - 0.003	0.001 - 0.003	0.001 - 0.003	
Pool Slope Ratio, Spool/Schan	0.0 - 0.2	0.0 - 0.2	0.0 - 0.4	0.0 - 0.4	0.0 - 0.2	Note 8
Pool Max Depth, Dmaxpool (ft)	2.4	1.8	3.5	2.2	2.4	
Pool Max Depth Ratio, Dmaxpool/Dbkf	1.5 - 3.5	1.5 - 3.5	2.0 - 3.5	1.5 - 3.5	1.5 - 3.5	Note 7
Pool Width, Wpool (ft)	15.0	24.0	26.0	16.0	18.0	
Pool Width Ratio, Wpool/Wbkf	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5	Note 9
Pool-Pool Spacing, Lps (ft)	39 - 80	32 - 65	45 - 80	42 - 82	50 - 90	
Pool-Pool Spacing Ratio, Lps/Wbkf	3 - 7	3.5 - 7	2 - 6	3 - 7	4 - 7	Note 7

Figure 17.3 Mitigation Work Plan Map



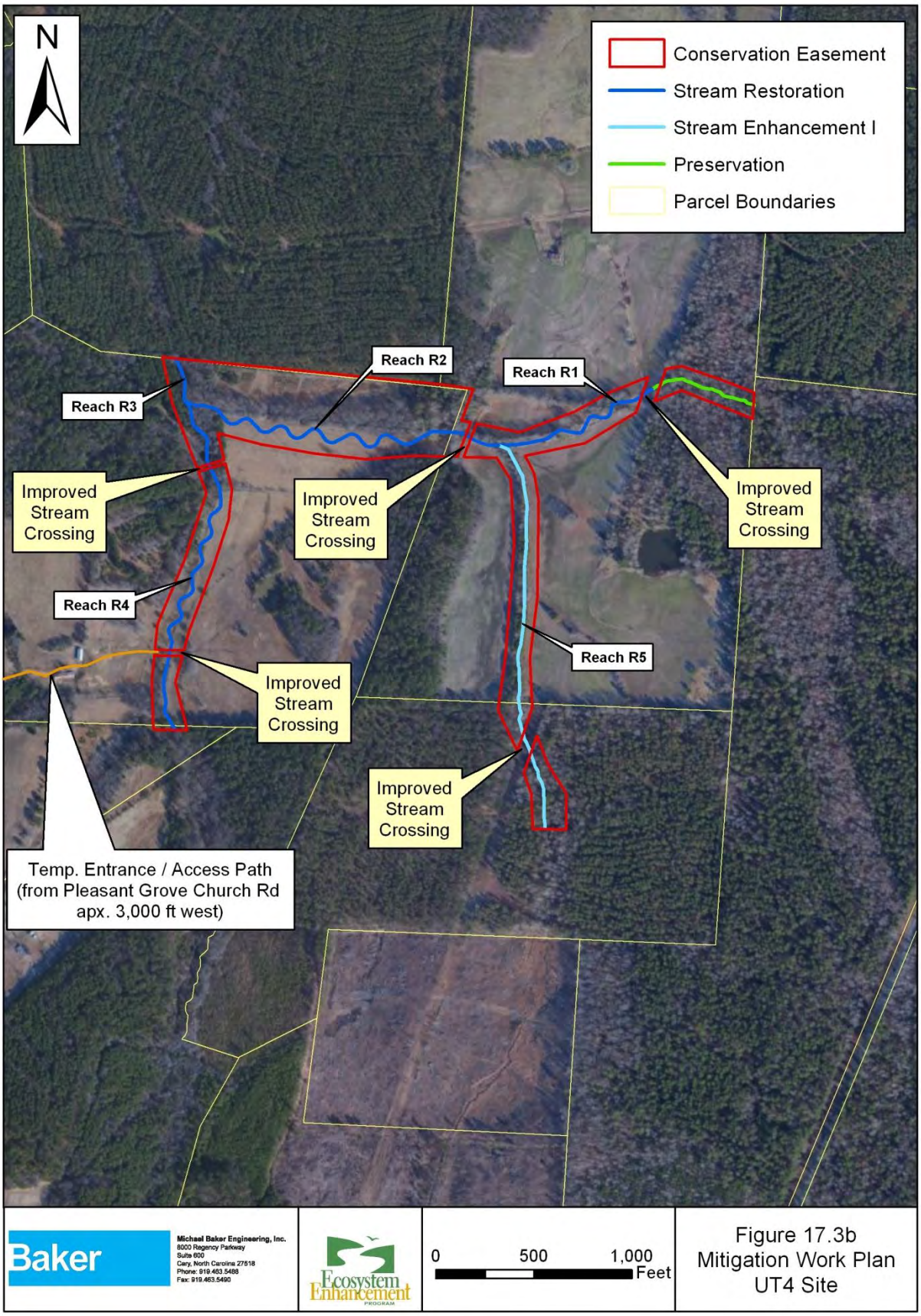


Figure 17.3b
Mitigation Work Plan
UT4 Site

17.1.3 Reference Reach Data Indicators

Reference reach surveys are valuable tools for comparison. The morphologic data obtained such as dimension, pattern, and profile can be used as a template for design of a stable stream in a similar valley type with similar bed material. In order to extract the morphological relationships observed in a stable system, dimensionless ratios are developed from the surveyed reference reach. These ratios can be applied to a stream design to allow the designer to 'mimic' the natural, stable form of the target channel type.

While reference reach data can be a useful aid in designing channel dimension, pattern, and profile, there are limitations in smaller stream systems. The flow patterns and channel formation for most reference reach quality streams is often controlled by slope, drainage areas and larger trees and/or other deep rooted vegetation. Some meander geometry parameters, such as radius of curvature, are particularly affected by vegetation control. Pattern ratios observed in reference reaches may not be applicable or are often adjusted in the design criteria to create more conservative designs that are less likely to erode after construction, before the permanent vegetation is established. Often the best reference data is from adjacent stable stream reaches, or reaches within the same watershed.

For comparison purposes, Baker selected a local reference reach from the NCDOT database and compared with internal reference data, in the location shown on Figure 17.4. The data shown on Table 17.4 helped to provide a basis for evaluating the valley slope and topography of the project site and determining the stream systems that may have been present historically and/or how they may have been influenced by changes within the watershed.

The reference site is an examples of a small "Rural Piedmont Stream," and falls within the same climatic, topographical, physiographic and ecological region as the Brown Creek Tributaries site. The site is located in the Triassic Basin, west of the Carolina Sand hills/Outer Coastal Plain region. These systems exist as the floodplains of smaller intermittent/perennial streams in which flows tend to be relatively steady, with floods of short duration, and seasonal periods of low flow.

The undisturbed native plant communities within these areas primarily consist of Piedmont Bottomland Hardwood Forest (mixed riparian community) and Dry-Mesic Oak-Hickory Forest (mixed hardwoods and pine) as described by Schafale and Weakely (1990). The dominant canopy species of a Piedmont/Mountain bottomland forest area included Yellow poplar (*Liriodendron tulipifera*), American sycamore (*Platanus occidentalis*), Sweetgum (*Liquidambar styraciflua*), Green ash (*Fraxinus pennsylvanica*), Red maple (*Acer rubrum*), Black gum (*Nyssa sylvatica*), and Black willow (*Salix nigra*). Understory species included box elder (*Acer negundo*), Flowering dogwood (*Cornus florida*), Ironwood (*Carpinus caroliniana*), Black cherry (*Prunus serotina*), alder (*Alnus serrulata*), Elderberry (*Sambucus canadensis*), Red bud (*Cercis canadensis*), and Persimmon (*Diospyros virginiana*). Woody vine and herbaceous species consisted of poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), trumpet creeper (*Campsis radicans*), pokeweed (*Phytolacca americana*), dog fennel (*Eupatorium capillifolium*), shallow sedge (*Carex lurida*), flat sedge (*Cyperus strigosus*), fescue (*fescue* spp.), and little bluestem (*Schizachyrium scoparium*).

The Dry-Mesic Oak-Hickory Forest ecological community is typically located on hillsides in an upland transition from the Piedmont/Mountain Bottomland Forest. The dominant overstory species of these upslope areas include Sweetgum (*Liquidambar styraciflua*), Tulip poplar (*Liriodendron tulipifera*), Red maple (*Acer rubrum*), Loblolly pine (*Pinus taeda*), Northern red oak (*Quercus rubra*), White oak (*Quercus alba*), Shag-bark hickory (*Carya ovata*), Mockernut hickory (*Carya tomentosa*), Green ash (*Fraxinus pennsylvanica*), and

Hackberry (*Celtis occidentalis*). Mid-canopy species include Red bud (*Cercis canadensis*), Red mulberry (*Morus rubra*), green ash, Red cedar (*Juniperus virginiana*), Service berry (*Amelanchier arborea*), and buckeye (*Aesculus sylvatica*). Herbaceous and vine species consisted of Poison ivy (*Toxicodendron radicans),* grape (Vitis spp.), Virginia creeper (*Parthenocissus quinquefolia*), trumpet creeper (*Campsis radicans*), Christmas fern (*Polystichum acrostichoides*), yellow root (*Xanthorhiza simplicissima*), Nepal grass (*Microstegium vimineum*), and Japanese honeysuckle (*Lonicera japonica*).

The primary soils series at the stream reference sites include Shellbluff (ShA), Chenneby (CnA), Congaree (Co) can be generally described as silty loam alluvium/medium sand found on flatter slopes typically ranging from 0-2-4 percent (NRCS Soil Survey). These series are frequently flooded and consist of deep, somewhat poorly to well drained, moderately permeable soils. These soils are commonly found in throughout the floodplain and lower valley areas (base of slopes) of the reference sites. The series descriptions are similar to the soils evaluated on the project site.

Figure 17.4 Reference Stream Location Map

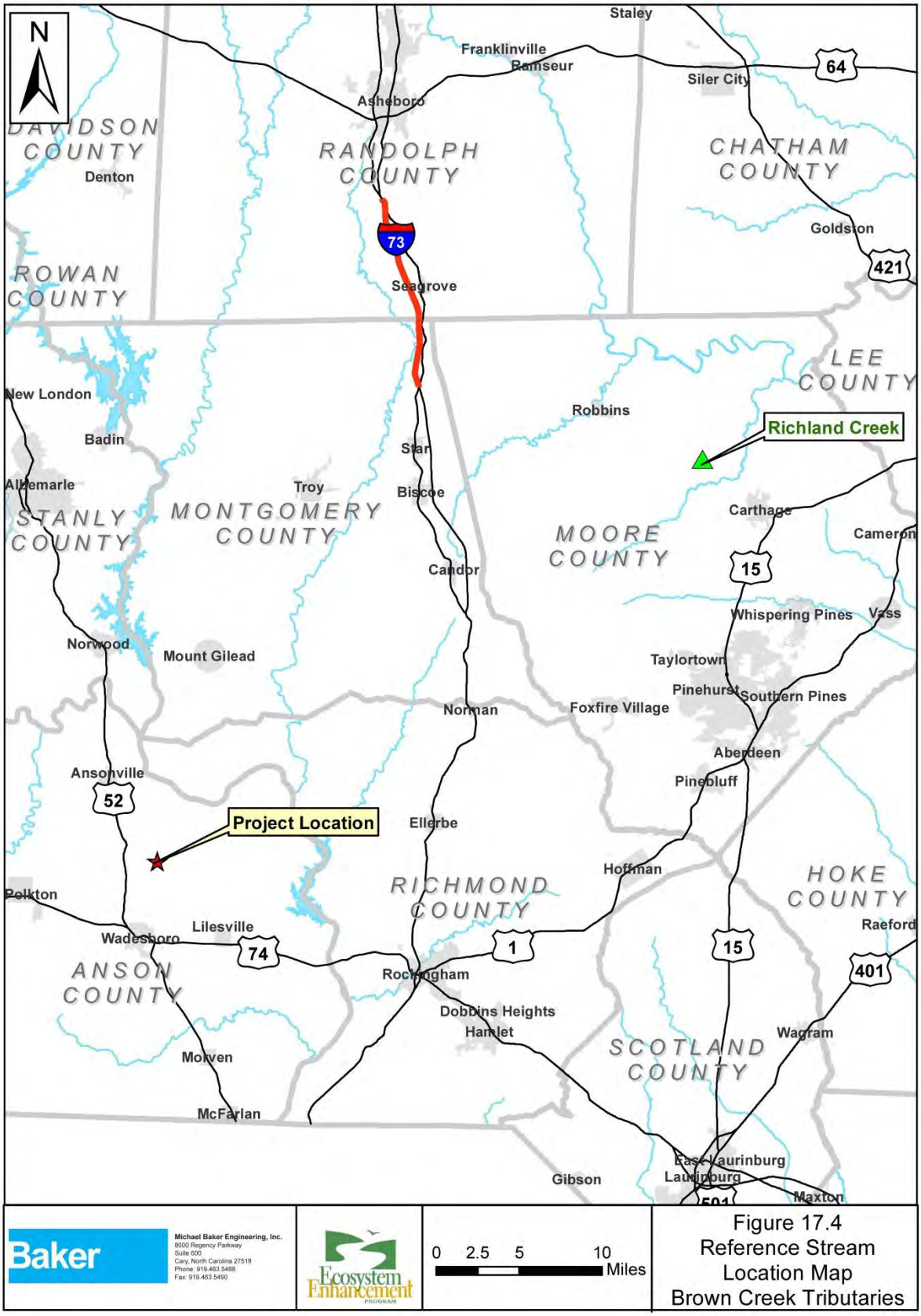


Table 17.4 Reference Reach Parameters Used to Inform Design Ratios

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	Richland Creek	
	Min	Max
Stream Type	C4	
Drainage Area – square miles	1.00	
Bankfull Width (w_{bkf}) – feet	16.2	16.7
Bankfull Mean Depth (d_{bkf}) – feet	0.9	0.9
Width/Depth Ratio (w/d ratio)	18.0	18.6
Cross sectional Area (A_{bkf}) – SF	15.0	15.5
Bankfull Mean Velocity (v_{bkf}) - fps	N/P	
Bankfull Discharge (Q_{bkf}) – cfs	N/P	
Bankfull Max Depth (d_{mbkf}) - feet	1.4	1.5
d_{mbkf} / d_{bkf} ratio	1.6	1.7
Low Bank Height to d_{mbkf} Ratio	1.0	
Floodprone Area Width (w_{fpa}) – feet	50	53
Entrenchment Ratio (ER)	3.0	3.3
Meander length (L_m) – feet	90	94
Ratio of meander length to bankfull width (L_m/w_{bkf})	5.5	5.7
Radius of curvature (R_c) – feet	14.3	26.1
Ratio of radius of curvature to bankfull width (R_c / w_{bkf})	0.9	1.6
Belt width (w_{blt}) – feet	25	40
Meander Width Ratio (w_{blt}/W_{bkf})	1.5	2.4
Sinuosity (K) Stream Length/ Valley Distance	1.2	
Valley Slope – feet per foot	0.0136	
Channel Slope ($s_{channel}$) – feet per foot	0.0133	
Pool Slope (s_{pool}) – feet per foot	0.00	0.0014
Ratio of Pool Slope to Average Slope (s_{pool} / $s_{channel}$)	0.00	0.11
Maximum Pool Depth (d_{pool}) – feet	2.5	
Ratio of Pool Depth to Average Bankfull Depth (d_{pool}/d_{bkf})	2.8	
Pool Width (w_{pool}) – feet	11.1	
Ratio of Pool Width to Bankfull Width (w_{pool} / w_{bkf})	0.7	
Pool Area (A_{pool}) – square feet	20.1	
Ratio of Pool Area to Bankfull Area (A_{pool}/A_{bkf})	1.3	
Pool-to-Pool Spacing – feet	37.3	95.8
Ratio of Pool-to-Pool Spacing to Bankfull Width (p-p/w_{bkf})	2.3	5.8
Riffle Slope (s_{riffle}) – feet per foot	0.013	0.0413
Ratio of Riffle Slope to Average Slope (s_{riffle}/ s_{bkf})	1.0	3.1
Material (d_{50})	Very Coarse Gravel	
d_{16} – mm	6.0	
d_{35} – mm	N/P	
d_{50} – mm	45.0	
d_{84} – mm	125.0	
d_{95} – mm	N/P	

Notes:
NC Department of Transportation, Reference Reach Database
N/P: Data was not provided in the NCDOT reference reach database
Values in this chart were rounded and may differ slightly from actual values.

17.2 Bankfull Verification Analysis

17.2.1 Bankfull Stage and Discharge

Bankfull stage and its corresponding discharge are the primary variables used to develop a natural channel design. However, the correct identification of the bankfull stage in the field can be difficult and subjective (Williams, 1978; Knighton, 1984; and Johnson and Heil, 1996). Numerous definitions exist of bankfull stage and methods for its identification in the field (Wolman and Leopold, 1957; Nixon, 1959; Schumm, 1960; Kilpatrick and Barnes, 1964; and Williams, 1978). The identification of bankfull stage in the humid Southeast can be especially difficult because of dense understory vegetation and a long history of channel modification and subsequent adjustment in channel morphology.

It is generally accepted that bankfull stage corresponds with the discharge that fills a channel to the elevation of the active floodplain and represents a breakpoint between processes of channel formation and floodplain development. The bankfull discharge, which also corresponds with the dominant discharge or effective discharge, is thought to be the flow that moves the most sediment over time in stable alluvial channels.

Field indicators include the back of point bars, significant breaks in slope, changes in vegetation, the highest scour line, or the top of the stream bank (Leopold, 1994). The most consistent bankfull indicators for streams in the Piedmont of North Carolina are the backs of point bars, breaks in slope at the front of flat bankfull benches, or the top of the stream banks (Harman et al., 1999). Upon completion of the field survey and geomorphic assessment, accurate identification of bankfull stage could not be made in all reach sections throughout the site due to incised/impaired channel conditions.

Although some indicators were apparent in some portions with lower stream bank heights and discernible scour features, the reliability of the indicators was inconsistent due to the altered condition of the stream channels. For this reason, bankfull stage was estimated using regional curve information.

17.2.2 Bankfull Hydraulic Geometry Relationships (Regional Curves)

Regional curves are based on the channel forming discharge theory, which states that one unique flow can yield the same channel morphology as the full range of flows. Hydraulic geometry relationships are often used to predict channel morphology features and their corresponding dimensions. The stream channel hydraulic geometry theory developed by Leopold and Maddock (1953) describes the interrelations between dependent variables such as width, depth, and area as functions of independent variables such as watershed area or discharge. These relationships can be developed at a single cross-section or across many stations along a reach (Merigliano, 1997). Hydraulic geometry relationships are empirically derived and can be developed for a specific river or extrapolated to a watershed in the same physiographic region with similar rainfall/runoff relationships (FISRWG, 1998).

Regional curves developed by Dunne and Leopold (1978) relate bankfull channel dimensions to drainage area. A primary purpose for developing regional curves is to aid in identifying bankfull stage and dimension in un-gaged watersheds, as well as to help estimate the bankfull dimension and discharge for natural channel designs (Rosgen, 1994). Gage station analyses throughout the United States have shown that the bankfull discharge has an average return interval of 1.5 years or 66.7% annual exceedence probability on the maximum annual series (Dunne and Leopold, 1978; Leopold, 1994).

Publicly available and in-house bankfull regional curves are available for a range of stream types and physiographic provinces. The NC Rural Piedmont Regional Curve (Harman et al., 1999) and an unpublished NC Piedmont Regional Curve being developed by the Natural

Resources Conservation Service (A. Walker private communication, 2012) were used for comparison to other more site-specific means of estimating bankfull discharge. The tributaries on the site are small streams; small streams are poorly represented on the regional curves.

It has been found that the NC Piedmont Regional Curve Equations may slightly overestimate discharge and channel dimension for smaller streams, such as those present at this site. The unpublished NC Piedmont Regional Curve corresponds closer to the bankfull discharge for the site streams. In addition to comparing regional curve information, the bankfull velocity and discharge estimates were compared using the WARSSS (Wildland Hydrology, 2006) methodology (Rosgen and Silvey, 2005). Based on these data, Baker estimated bankfull flows using these comparisons shown in Table 17.5.

Baker has implemented numerous projects in smaller ungaged drainages in North Carolina, and has produced "mini-curves" specific to these projects. The growing number of data points on these small stream curves provides another reference and supporting evidence for the selection of bankfull indicators that produce smaller dimensions and flow rates than the published regional data.

It is also important to note that variations in channel geometry, or stream types, are not accounted for in the regional curve. For example, the regional curves only include stable stream types. Channel slope, valley type, channel type, and sediment supply, as well as information gained from the regression and Manning's equations were all considered during office verification of the field data.

Table 17.5 NC Rural Piedmont Regional Curve Equations
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

NC Piedmont Rural Regional Curve Equations (Harman et al., 1999)		NC Piedmont Rural Regional Curve Equations (Unpublished Revised NC Rural Piedmont Regional Curve (NRCS, 2008)	
$Q_{bkf} = 66.57\ A_w^{0.89}$	$R^2=0.97$	$Q_{bkf} = 58.26\ A_w^{0.78}$	$R^2=0.99$
$A_{bkf} = 21.43\ A_w^{0.68}$	$R^2=0.95$	$A_{bkf} = 15.65 A_w^{0.69}$	$R^2=0.99$
$W_{bkf} = 11.89\ A_w^{0.43}$	$R^2=0.81$	$W_{bkf} = 11.64\ A_w^{0.46}$	$R^2=0.98$
$D_{bkf} = 1.50\ A_w^{0.32}$	$R^2=0.88$	$D_{bkf} = 1.15\ A_w^{0.28}$	$R^2=0.96$

17.2.3 Conclusions for Channel Forming Discharge

Baker used various methods for evaluating the bankfull stage and dominant discharge for the project reaches. As described above in Section 17.2.1, Rosgen's stream classification system (Rosgen, 1996) depends on the proper field identification of consistent geomorphic features related to the active floodplain. Baker identified and surveyed cross-sections to represent reach-wide conditions. Although bankfull stage verification was not possible in the field for all reaches under current conditions, the surveyed cross-section data used for the regional curve comparison fell near or above the 95% confidence interval and within an acceptable range of values.

Additional bankfull estimation methods, such as the commonly accepted Manning's equation, were compared to interpret and adjust field observations in order to select the appropriate design criteria and justification for the design approach. Although the site streams are predominantly sand-bed with a limited upstream sediment supply, a few shorter sections of Reach UT4-R2 contain a coarser gravel substrate. Therefore, various methods from WARSSS (Rosgen, 2006) were used to compute the velocity and bankfull discharge along

this reach as another comparison that considers substrate particles and boundary roughness. The Friction Factor to Relative Roughness Ratio (method relates hydraulic radius, d84, and shear velocity to flow velocity), Manning Equation with the Manning's n from the friction factor and relative roughness were considered. However, these calculations rely on basic assumptions since they require the designer to correctly identify bankfull stage and stream type, vegetation influence, use the proper sediment sampling techniques relative to local sediment supply and characterization, and to select an appropriate Manning's 'n' as the roughness coefficient.

Baker also referenced the 2-year flow frequency using the published NC USGS regression equation $Q_2 = 135\ DA^{0.702}$ for rural basins in the blue ridge-piedmont hydrologic areas of North Carolina (USGS, 2001). As expected, these values fall slightly above the bankfull flow, but can be extrapolated to represent a wider range of flows. A bankfull flow typically has a return interval (RI) between 1 to 1.5 years, so it can be appropriate to compare flows with frequencies in this range versus survey data and field observations. However, this best fit curve approach often fits poorly to the dataset being that it falls at the low end of the curve.

Hydraulic models, such as HEC-RAS, can predict bankfull flow stage and hydraulic conditions using topographic information for the stream channel and confirm field indicators of bankfull stage. An existing hydraulic model was developed for the FEMA flood study along Hurricane Creek, but with limited bankfull indicators and no USGS gage information available, the channel geometry and cross-section information was not detailed enough for estimating the bankfull parameters.

After considering these estimation methods and results (physical measurements, regional curves and regression equations), Baker ultimately estimated the design bankfull discharge using unpublished NRCS North Carolina Rural Piedmont Regional Curve and the published NC Rural Piedmont Regional Curve to determine the appropriate dimensions and flows that best correspond to bankfull.

Using the rationale described above, Table 17.6 provides the bankfull discharge analyses and comparisons based on the regional curves, the Manning's equation discharges calculated from the representative cross-sections for each reach, and the design discharge calculated based on the proposed design cross-sections for all project reaches.

Table 17.6a Design Discharge Analysis

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Estimating Method	Bankfull Velocity (ft/sec)	Bankfull Discharge (cfs)
	Hurricane Creek (R1, R2, R3)	
NC Rural Piedmont Regional Curve[1]	4.3, 4.4, 4.5	129.5, 155.0, 26.5
NRCS NC Rural Piedmont Regional Curve[2]	2.9, 3.0, 2.8	87.4, 106.1, 15.7
Baker Design Estimate	3.9, 4.2, 3.2	110.0, 130.0, 22.0
NC Rural Regression Equation[3]	---	194.3, 231.8, 42.0

Notes:
[1] NC Piedmont Regional Curve (Harman et al., 1999).
[2] Unpublished Revised NC Rural Piedmont Regional Curve developed by NRCS (A. Walker personal communication, 2008).
[3] NC USGS rural regression equation for 2-year flood recurrence interval, $Q_2 = 135\ DA^{0.702}$ (USGS, 2001)

Table 17.6b Design Discharge Analysis

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Estimating Method	Bankfull Velocity (ft/sec)	Bankfull Discharge (cfs)
	UT4 (R1, R2, R3, R4, R5)	
NC Rural Piedmont Regional Curve[1]	3.9, 4.0, 4.1, 3.9, 4.5	40.9, 95.6, 120.5, 47.3, 69.2
NRCS NC Rural Piedmont Regional Curve[2]	2.4, 2.6, 2.8, 2.5, 2.9	25.2, 62.8, 80.7, 29.5, 44.4
Friction Factor to Relative Roughness Ratio method[3]	4.4 (R2 only)	106.7 (R2 only)
Manning's "n" from friction factor and relative roughness[3]	4.2 (R2 only)	101.4 (R2 only)
Manning's "n" from stream type[3]	2.8 (R2 only)	66.9 (R2 only)
Baker Design Estimate	3.7, 3.8, 3.7, 3.6, 3.8	37.0, 80.0, 103.0, 40.0, 60.0
NC Rural Regression Equation[4]	---	63.3, 144.3, 181.1, 73.4, 106.1

Notes:
[1] NC Piedmont Regional Curve (Harman et al., 1999).
[2] Unpublished Revised NC Rural Piedmont Regional Curve developed by NRCS (A. Walker personal communication, 2008).
[3] WARSSS, 2006 spreadsheets. Bankfull discharge estimates vary based on Manning's Equation for the riffle cross-section. Bankfull stage roughness estimates (*n*-values) ranged from approximately 0.033 to 0.055 based on channel slopes, depth, bed material size, and vegetation influence.
[4] NC USGS rural regression equation for 2-year flood recurrence interval, $Q_2 = 135\ DA^{0.702}$ (USGS, 2001)

17.3 Sediment Transport Analysis

17.3.1 Background and Methodology

The purpose of a sediment transport analysis is to ensure that the stream restoration design creates a stable channel that does not aggrade or degrade over time. The overriding assumption is that the site should be transporting the total sediment load delivered from upstream sources, thereby being a "transport" reach and classified as a stable Rosgen "B", "C" or "E" type channel. The ability of the stream to transport its total sediment load can be quantified through two measures: sediment transport competency (force) and sediment transport capacity (power). Lane (1955) describes a generalized relationship of stream stability and dynamic equilibrium wherein the product of sediment load and sediment size is proportional to the product of stream slope and discharge. In sand-bed or fine-grained streams, sediment transport capacity is a critical analysis, whereas in gravel/cobble bed streams, sediment transport competency is a critical analysis. The project reaches were separated for sediment transport analyses based on median particle size and channel slope and dimension.

Sediment transport capacity is a stream's ability to move a mass of sediment through a cross-section dimension, and is a measurement of stream power, often expressed in units of watts/square meter (Watts/meter^2). Competency is a stream's ability to move particles of a given size and is a measurement of force, often expressed as units of pounds per square foot (lbs/ft^2). A streams competency is estimated in terms of the relationship between critical and actual depth, at a given slope, and occurs when the critical depth produces enough shear stress to move the largest (d100) sub pavement particle. The sediment transport prediction calculations shown on Table 17.7 include shear stress, tractive force, and critical dimensionless shear stress, which help to determine a particle size class (e.g., sand, gravel, cobble) that is mobile, or entrained, under various flow conditions (WARSSS, 2006).

In sand-bed streams, all particle sizes are mobile during bankfull flows; therefore, there is no need to determine the competency or maximum particle size that the stream can transport. The total volume of sediment transported through a cross-section consists of bedload plus suspended load fractions.

Suspended load is normally composed of fine sand, silt, and clay particles transported in the water column. Bedload is generally composed of larger particles, such as course sand, gravels, and cobbles, which are transported by rolling, sliding, or hopping (saltating) along the bed.

Sediment transport capacity of sand-bed streams can be assessed directly using actual monitored data from bankfull events if a sediment transport rating curve has been developed for the project site. Since a site specific rating curve was not developed, other empirical relationships from sand-bed streams were compared to published values and reference streams that have similar characteristics such as slope and bedform morphology. Comparing the calculated design shear stress and stream power values for the project reaches to those computed for sand-bed reference reaches is useful to determine if the values predicted for the design channels are within an acceptable range of those found in other stable sand-bed systems.

17.3.2 Sampling Data Results

Sediment samples, including bulk, pebble counts and pavement/subpavement, were collected along the tributaries and then dry sieved in a lab and obtain a sediment size distribution, determine dimensionless critical shear stress, and calculate/predict corresponding slope and depth required to move the d100 largest particle class size. When appropriate, pebble counts were conducted to classify the streams and the sieve data shown in Figure 17.5 indicate that the dominant bed material in the stream channel is coarse sand/fine gravel under current conditions. It should be noted that the modified Wolman pebble count (Rosgen, 1994) is not appropriate for sand-bed systems; therefore, a subpavement (bulk sample) procedure was used to characterize the bed material for Hurricane Creek (main stem) and UT4-R5. A majority of the site reaches contain a sand and silt, with a limited fine gravel bottom due to the parent soil material and cattle impacts along eroding stream banks. The samples were collected to confirm these initial observations and further site investigations were conducted to identify additional sediment sources within the watershed.

Figure 17.5 Sediment Particle Size Distribution

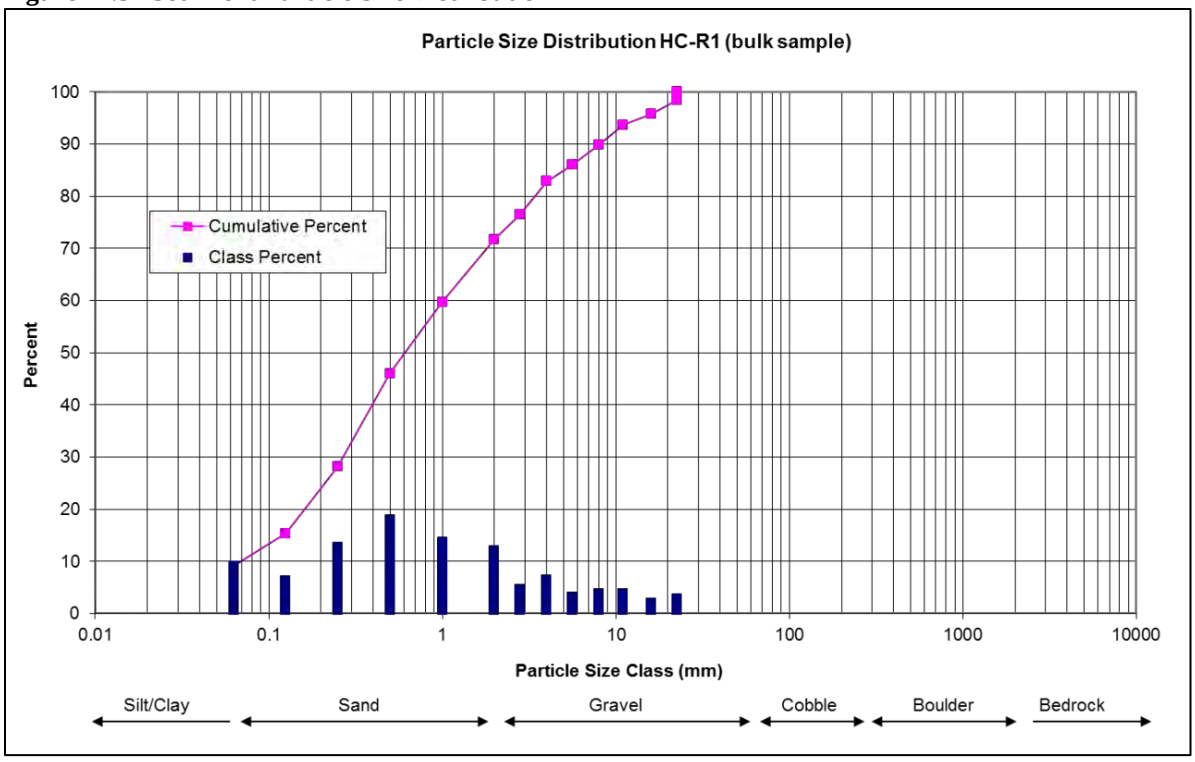
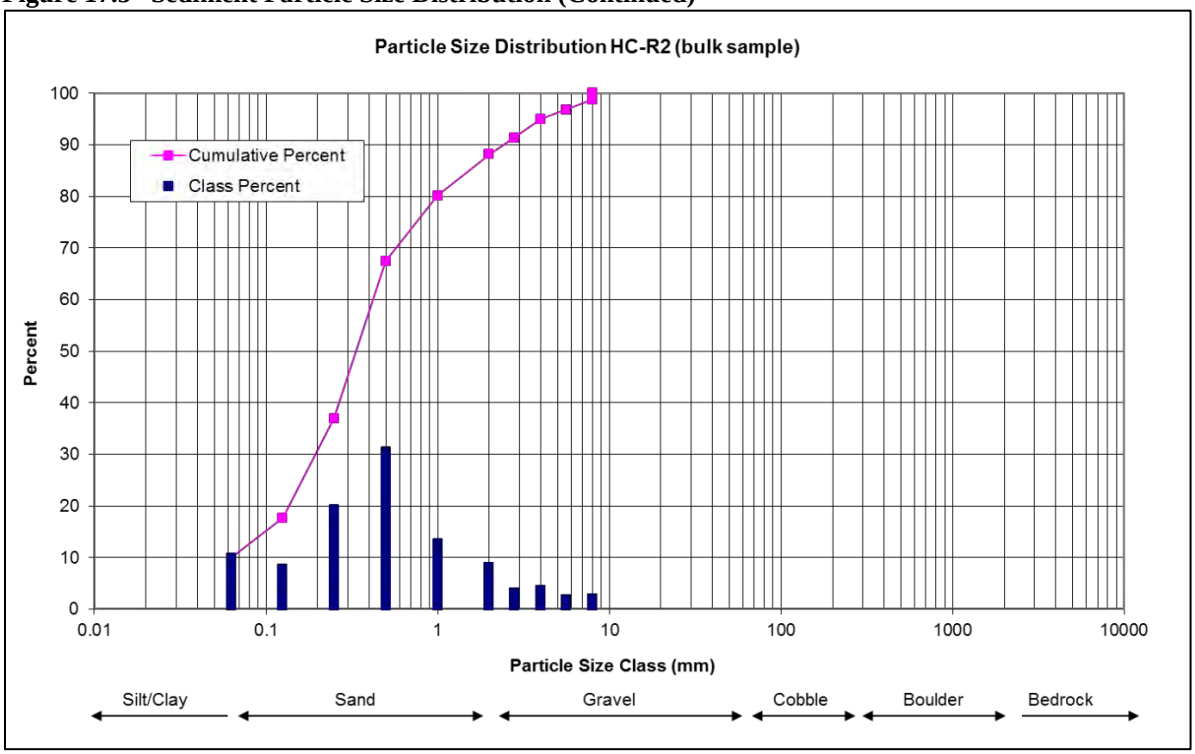


Figure 17.5 Sediment Particle Size Distribution (Continued)



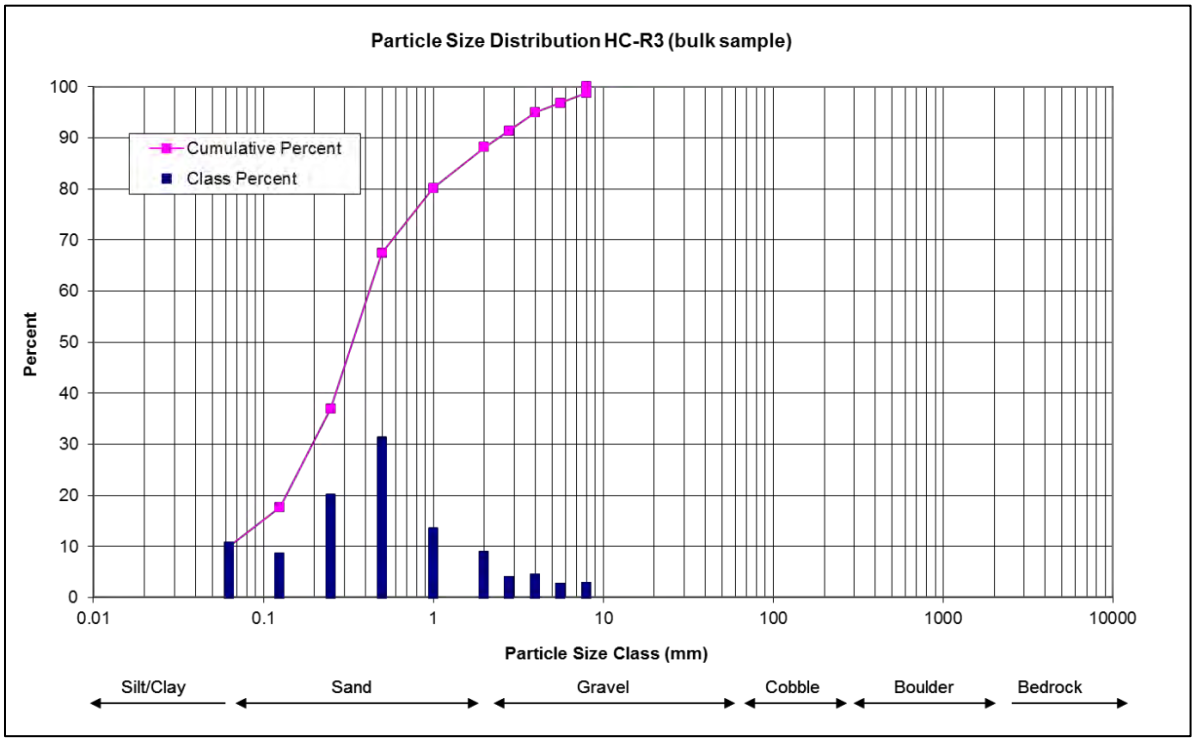
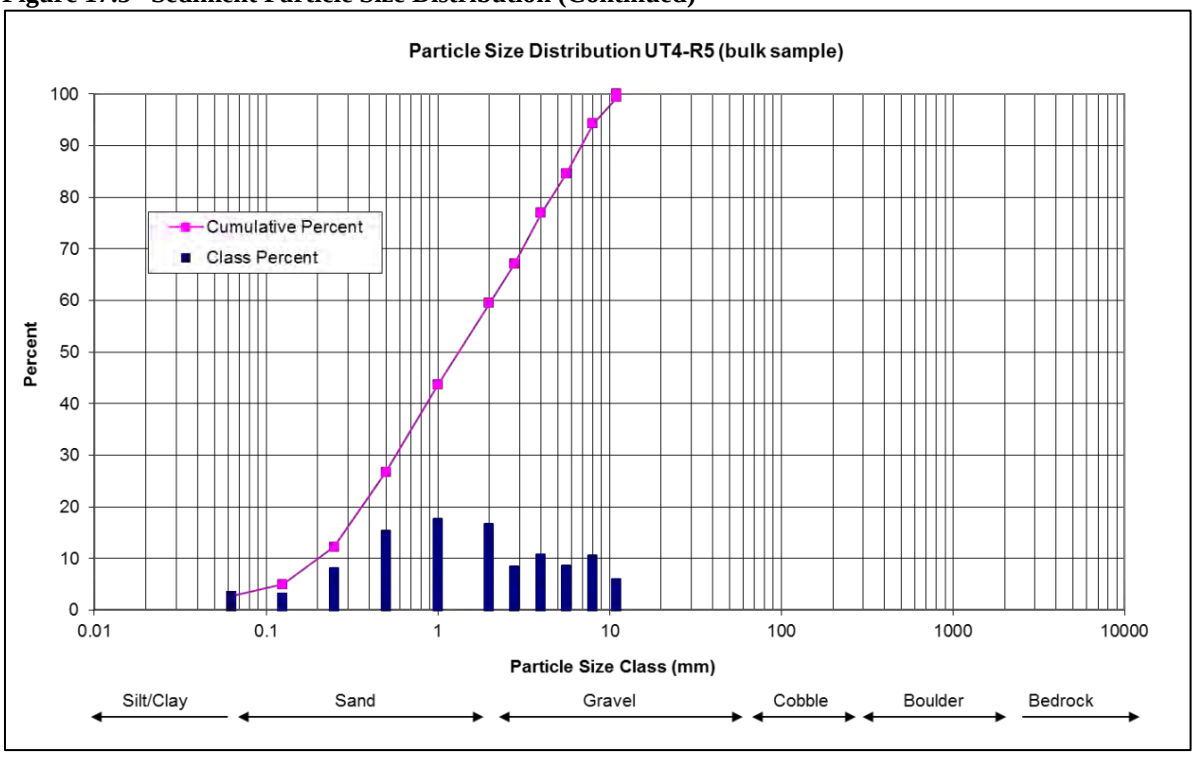


Figure 17.5 Sediment Particle Size Distribution (Continued)



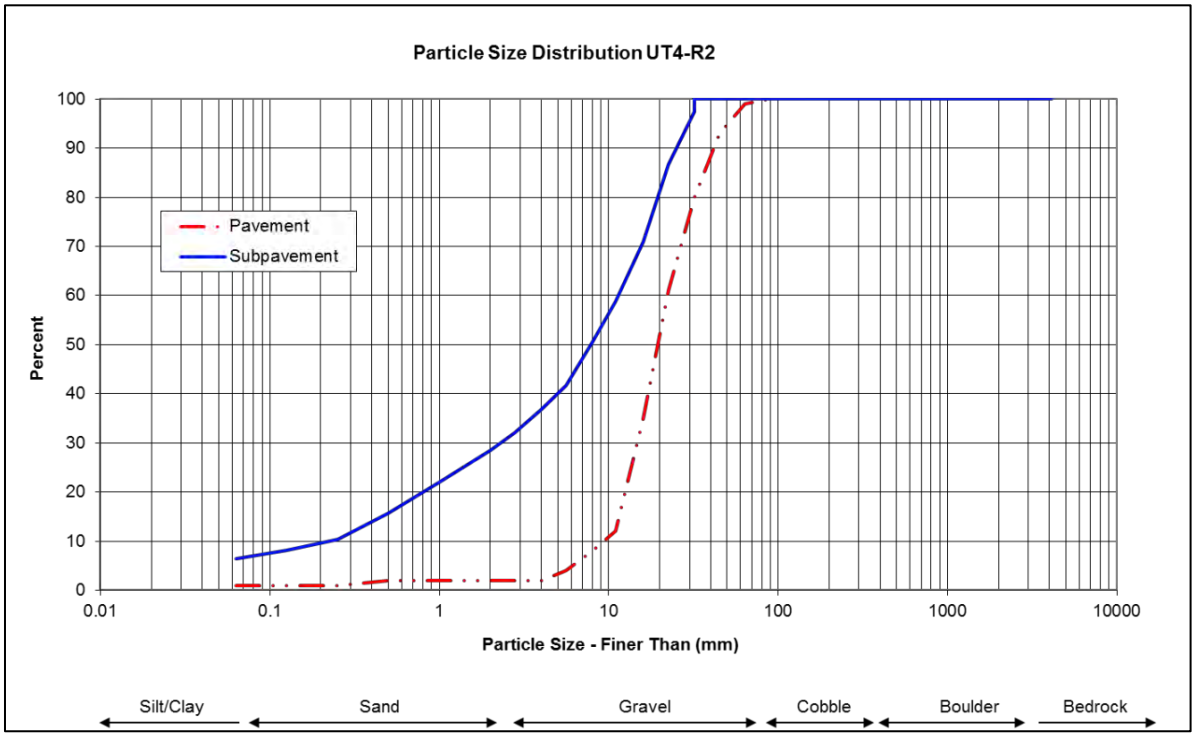
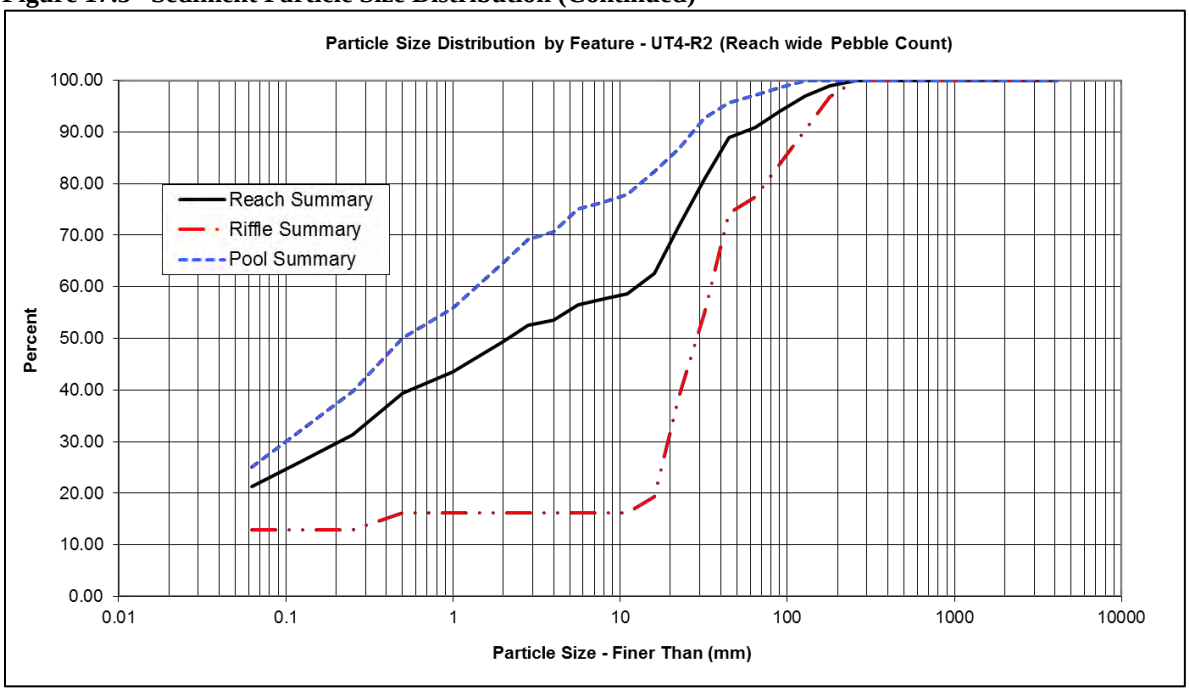
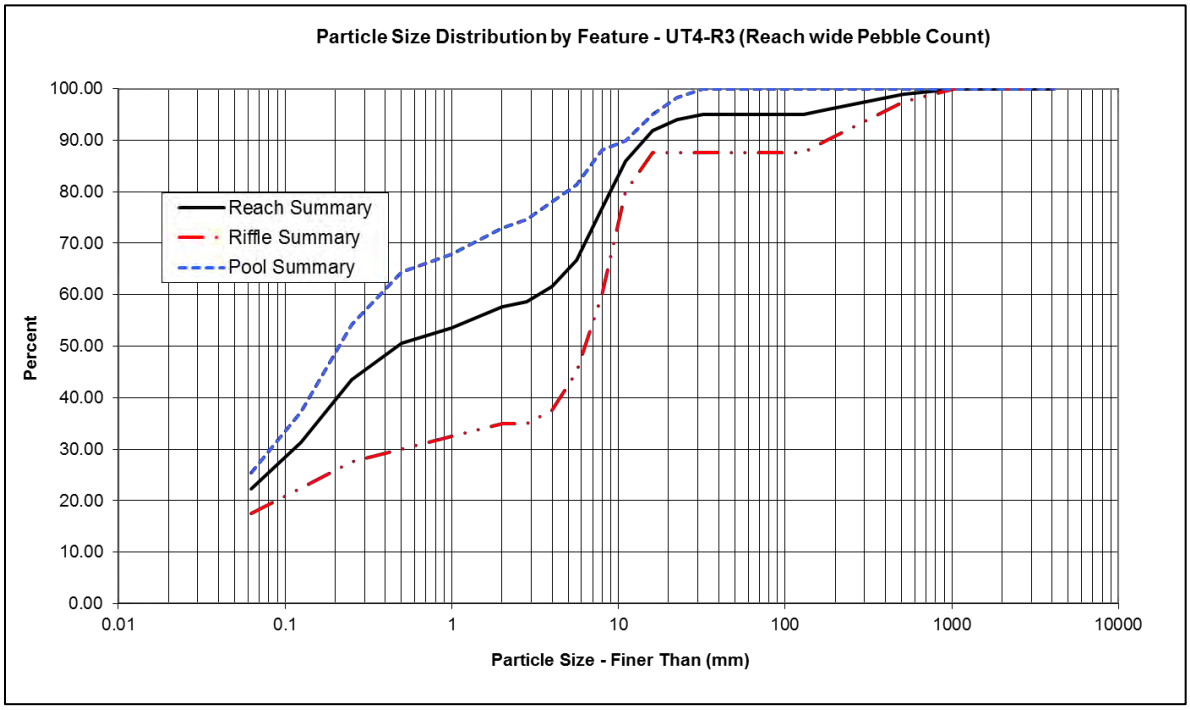


Figure 17.5 Sediment Particle Size Distribution (Continued)





17.3.3 Predicted Channel Response

The existing streams are predominantly coarse sand and fine gravel, with a few localized sections of coarser material in Reach UT4-R2 that help control grade, as well as a sandier substrate in some flatter channel sections. Based on field observations within the project area and upper watershed, the streams receive mostly finer materials from stream bank erosion and contributions from the upstream drainage. However, further visual field investigations made during the proposal phase confirmed that the sediment supply from upstream sources appears to be somewhat limited during larger storm events due to smaller headwater drainages, floodplain access, and influences from vegetation cover. While it is predicted that the restoration and enhancement efforts will reduce localized stream bed/bank erosion, the channels must still transport smaller bedload material from upstream sources while maintaining stream bed/bank stability.

The system is in the process of transitioning from an incised 'E' to a 'G/F' stream type; meaning that the channels have abandoned their active floodplain and started deepening/widening to form a new channel that can appropriately move the required sediment load. Sediment transport capacity was compared for the existing channels and the design conditions for restored stream systems. Table 17.7 shows bankfull boundary shear stress and stream power values for existing and design conditions along Hurricane Creek (downstream reach HC-R2), UT4-R2 and UT4-R4b. Currently, the downstream portion of HC-R2 has a slightly higher bankfull boundary shear stress and stream power value than the existing incised channel. This is likely due to increased design channel slopes towards the bottom of the reach as the bed elevation is lowered to match the existing culvert. However, the increase in shear stress and velocity is considered minimal since flows greater than bankfull will spread out over the geomorphic floodplain as described further in the design approach.

A sediment transport competency/entrainment comparison was also calculated for UT4-R2 since some coarser material (small gravel) was observed locally and sampled within the reach. Boundary shear stress was plotted on Shield's Curve to estimate the largest moveable particle, as shown in Table 17.7, the Shield's Curve predicts the mobility or entrainment of the largest particle (d_{100}) observed in the subpavement. Both of these sediment transport competency analyses confirm the ability of the proposed design channel to transport a coarser sediment load. The restored streams will be reconnected to their geomorphic floodplain which will encourage more natural sediment deposition features (i.e., point bars) and allow entrained particles to deposit onto the floodplain during larger storm flows.

As a design consideration, the proposed stone substrate material mix (riffle armor) will contain particle sizes considerably larger than the d_{100} to achieve vertical stability immediately after construction. The site has mostly flatter channel slopes throughout the site tributaries (<1%). In general, the proposed design channels with riffle slopes greater than 0.2% will be constructed using larger colluvial-size particles in order to mimic the natural armoring present stable channel sections. Any concerns regarding further channel degradation and vertical stability will be addressed by installing a combination of grade control structures such as constructed riffles and log/rock step pools in straighter channel segments.

The proposed enhancement reaches are relatively stable and will not involve system-wide channel modifications to dimension, pattern and profile. Sediment samples were collected in these reaches to represent the substrate particle size distribution, however sediment transport calculations were not included given the minimal sediment supply in the upper watershed and lack of consistent sediment deposition features.

Table 17.7 Boundary Shear Stress and Stream Power for Existing and Proposed Conditions

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Parameter	HC-R2 Existing Conditions[1]	HC-R2 Proposed Conditions	UT4-R2 Existing Conditions	UT4-R2 Proposed Conditions	UT4-R4b Existing Conditions[1]	UT4-R4b Proposed Conditions
Bankfull Discharge Estimate, Q (cfs)	130.0	130.0	80.0	80.0	40.0	40.0
Bankfull XSC Area (square feet)	34.6	31.0	23.8	21.0	12.0	11.0
Mean Bankfull Velocity (cfs)	3.8	4.2	4.4	4.4	3.4	3.6
Bankfull Width, W (feet)	16.0	20.1	13.8	16.5	7.7	12.0
Bankfull Mean Depth, D (feet)	2.1	1.6	1.7	1.3	1.6	0.9
Width to Depth Ratio, w/d (feet/foot)	7.4	13.0	7.9	13.0	5.0	13.0
Wetted Perimeter (feet)	20.3	23.2	17.3	19.1	10.8	13.8
Hydraulic Radius, R (feet)	1.5	1.3	1.4	1.1	1.1	0.8
Channel Slope (feet/ foot)	0.0023	0.0034	0.0058	0.0090	0.0058	0.0054
Boundary Shear Stress, τ (lbs/ft^2)	0.21	0.31	0.62	0.51	0.39	0.27
Subpavement d_{100} (mm)	8.0	140.0	32.0	140.0	22.6	140
Largest Moveable Particle (mm) per Modified Shield's Curve	---	---	120	180	70	90
Predicted Critical Depth (feet)	---	---	1.1	1.5	0.6	0.6
Predicted Critical Slope (feet/ foot)	---	---	0.005	0.005	0.006	0.006
Stream Power (W/m^2)	17.0	17.7	30.5	39.6	27.3	16.4

Note[1]: Boundary shear stress and stream power relationships for HC-R2 (downstream) and UT4-R4b were also compared with sand-bed streams reference data with similar geomorphic characteristics and flow regimes.

17.4 Existing Vegetation Assessment

The riparian areas within and adjacent to the proposed project area consists of successional forest, pasture, agricultural fields, and disturbed pine forest, as described by Schafale and Weakley (1990). Historic land management surrounding the project area has been primarily for agricultural and silvicultural purposes through the alteration of drainage patterns and the significant removal of native species vegetation in the riparian zone. The wooded portions of the site consist of a combination of basic Mesic Forest in the uplands with Piedmont/Mountain Alluvial Forests and Bottomland Forest in the lower areas and floodplains on the site (Schafale and Weakley, 1990). Some of these areas lack understory vegetation due to extensive livestock use and grazing. The riparian buffer areas overall ranged from somewhat disturbed to very disturbed and a general description of each community follows.

17.4.1 Successional Deciduous Forest

This community is primarily located along the wooded sections of the project area. Other sections in disturbed areas contain successional deciduous vegetation are periodically mowed for hay and crop production. American sycamore (*Platanus occidentalis*), Sweetgum (*Liquidambar styraciflua*), Pines

(*Pinus spp*.), Tulip poplar (*Liriodendron tulipifera*) and Red maple (*Acer rubrum*) are the dominant regenerating deciduous trees located in these areas.

17.4.2 Agricultural Fields and Pasture Areas

This community covers approximately 60-75 percent of the project area perimeter. Currently, pasture areas are used for grazing, and agricultural fields have been used for cultivated crop production. Vegetation within open fields and pasture areas is primarily comprised of fescues, clovers, water pennywort (*Hydrocotyle ranunculoides*) and Dog fennel (*Eupatorium capillifolium*). In narrow wooded riparian areas within the pastures and fields, the canopy is dominated by Longleaf pine (*Pinus palustris*) and Loblolly pine (*Pinus taeda*), and understory species consist of Red maple (*Acer rubrum*), Sweetgum (*Liquidambar styraciflua*). Woody shrub and vine species include Chinese privet (*Ligustrum sinense*), Poison ivy (*Toxicodendron radicans*) and Greenbrier (*Smilax rotundifolia*). Herbaceous species consist of Dog fennel (*Eupatorium capillifolium*) Sedge (*Carex spp.)* and Soft rush (*Juncus effusus*).

17.4.3 Disturbed Pine Forest

These forested areas comprise approximately 15 to 25 percent of the project area. Ditches, spoil piles, ruts, and other evidence of land disturbance suggest these forested areas were once used for agriculture or pasture. The canopy is dominated by Loblolly pine (*Pinus taeda*) but also includes Sweetgum (*Liquidambar styraciflua*), Tulip poplar (*Liriodendron tulipifera*), and Water oak (*Quercus nigra*). Woody shrub and vine species include Chinese privet (*Ligustrum sinense*), Giant cane (*Arundinaria gigantea*), Greenbrier (*Smilax rotundifolia*), Blackberry (*Rubus spp*.). Herbaceous species include Netted chainfern (*Woodwardia areolata*) and Stiltgrass (*Microstegium vimineum*).

17.4.4 Invasive Species Vegetation

The primary invasive species vegetation present on the project site are primarily Chinese privet (*Ligustrum sinense*), Stiltgrass (*Microstegium vimineum*) and Multiflora rose (*Rosa multiflora*) and which were found interspersed primarily throughout the riparian buffer areas primarily in areas along the stream banks.

17.5 Site Wetlands

17.5.1 Jurisdictional Wetland Assessment

The proposed project area was reviewed for the presence of wetlands and waters of the United States in accordance with the provisions on Executive Order 11990, the Clean Water Act, and subsequent federal regulations. Wetlands have been defined by the USACE as "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3(b) and 40 CFR 230.3 (t)). The areas in the project boundaries that displayed one or more wetland characteristics were reviewed to determine the presence of wetlands. The wetland characteristics included:

1. Prevalence of hydrophytic vegetation.
2. Permanent of periodic inundation or saturation.
3. Hydric soils.

On June 5, 2007, the USACE and US Environmental Protection Agency (USEPA) issued joint guidance for their field offices for Clean Water Act jurisdictional determinations in response to the Supreme Court's decision in the consolidated cases of Rapanos v. United States and Carabell v. United States (USEPA and USACE, 2007). Based on this guidance, the agencies assert jurisdiction over the following waters:

- Traditional navigable waters (TNWs)
- Wetlands adjacent to TNWs
- Non-navigable tributaries of TNWs that are considered relatively permanent waters (RPWs). Such tributaries flow year-round or exhibit continuous flow for at least 3 months.
- Wetlands that directly abut RPWs.

The agencies decide jurisdiction over the following waters based on a standardized analysis to determine whether they have a significant nexus with a traditional navigable water:

- Non-navigable tributaries that are not relatively permanent waters (non-RPWs)
- Wetlands adjacent to non-RPWs
- Wetlands that are adjacent to but do not directly abut an RPW.

The significant nexus analysis is fact-specific and assesses the flow characteristics of a tributary and the functions performed by all its adjacent wetlands to determine if they significantly affect the physical, chemical, and biological integrity of downstream TNWs. A significant nexus exists when a tributary, in combination with its adjacent wetlands, has more than a speculative or insubstantial effect on the physical, chemical, or biological integrity of a TNW.

The USACE and USEPA apply the significant nexus standard within the limits of jurisdiction specified by the Supreme Court decision in the case of Solid Waste Agency of Northern Cook County (SWANCC) v. US Army Corps of Engineers. Under the SWANCC decision, the USACE and USEPA cannot regulate isolated wetlands and waters that lack links to interstate commerce sufficient to serve as a basis for jurisdiction under the Clean Water Act. Though isolated wetlands and waters are not regulated by the USACE, within the state of North Carolina isolated wetlands and waters are considered "waters of the state" and are regulated by the NCDWR under the isolated wetlands rules (15A NCAC 2H .1300).

Following a desktop review of the National Wetland Inventory (NWI), NRCS soil survey and USGS quadrangle maps, the project area was evaluated for potential impacts to jurisdictional wetlands. Baker wetland scientists conducted a field survey of the project area in February and December 2013 to investigate potential wetlands within hydric soils area and confirm perennial and intermittent streams in the project area. In total, the field survey identified five separate wetland areas containing hydric soil indicators and a predominance of hydrophytic vegetation and wetland hydrology. These areas were identified, flagged, and mapped, as show in the current conditions map, Figure 2.4.

The baseline information data included in Section 16, Appendix B represents the existing wetlands found within the project area during the field investigations utilizing the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (Version 2.0). The data submitted with this final mitigation plan will be included with the formal 401/404 (PCN) permit application for obtaining preliminary jurisdictional determination from the USACE. Wetland mapping will be included to depict the locations of the existing wetlands and any potential impact areas. Most of the identified areas along Hurricane Creek and UT4 exhibited marginal hydrologic indicators, dominated by herbaceous species currently subject to cattle grazing or agricultural practices. All identified areas are located along the floodplain within depressional areas and/or hill slope seeps adjacent to the stream channels. The proposed mitigation approach for the site will seek to improve wetland functions or avoid impacts to these areas, if possible, in order to restore a stable stream system with adjacent riparian wetlands system.

17.5.2 Wetland Impacts and Considerations

It is likely that wetland pockets and floodplain pools were historically present in some of these locations after evaluating existing topography, soils, hydrology and hydrophytic vegetation within the project reaches. The original plant community located in these wetlands was most likely indicative of other wetlands in the region, but past agricultural land use practices have altered the composition of the plant community currently present. Wetland stressors, such as man-made dams, ponds and ditching, have

altered the hydrological connections within the project area. The main tributaries were likely deepened to capture various sources of seepage to increase land available for agricultural use, which exacerbated channel incision and exerts a drainage effect on the adjacent fields.

After completing the proposed stream restoration practices, these areas will likely experience a more natural hydrology and flooding regime, and the riparian buffer area will be planted with native woody vegetation that is tolerant of wetter conditions. The design approach will also enhance any potential areas of adjacent fringe or marginal wetlands through higher water table conditions (elevated stream profile) and a more frequent over-bank flooding regime. Stream profiles will be raised along various reaches, which will lead to higher water table conditions adjacent to the channels and more frequent out-of-bank flooding of adjacent wetland areas.

17.5.3 Climatic Conditions

The average growing season (defined as the period in which air temperatures are maintained above 28° Fahrenheit at a frequency of 5 years in 10) for the project locale is 248 days, beginning in April and ending in October (NRCS Anson County WETS Station: Wadesboro, NC, 2005). The area experiences an average annual rainfall of 47.04 inches (Wadesboro, NC NRCS Anson County Soil Survey 1998) as shown on Table 17.7. During 2013, weather station (Wadesboro, COOP 318964) recorded 52.28 inches of rain. In much of the southeastern US, average rainfall exceeds average evapotranspiration losses and these areas experience a moisture excess during most years. Excess water leaves a site by groundwater flow, surface runoff, channelized surface flow, or deep seepage. Annual losses due to deep seepage, or percolation of water to confined aquifer systems, are usually small and are not considered a significant loss pathway for excess water. Although groundwater flow can be significant in some systems, most excess water is lost via surface and shallow subsurface flow.

Table 17.7 Comparison of Monthly Rainfall Amounts for Project Site vs. Long-term Averages

Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Month-Year	Observed Monthly Precipitation (in)	WETS Table Average Monthly Precipitation (in)	Deviation of Observed from Average (in)
Jan-2013	3.19	4.22	-1.03
Feb-2013	4.79	3.98	0.81
Mar-2013	2.69	4.51	-1.82
Apr-2013	6.08	2.65	3.43
May-2013	4.19	3.95	0.24
Jun-2013	6.91	4.28	2.63
Jul-2013	10.48	5.26	5.22
Aug-2013	3.45	4.67	-1.22
Sept-2013	2.09	3.72	-1.63
Oct-2013	1.71	3.42	-1.71
Nov-2013	2.96	2.92	0.04
Dec-2013	3.74	3.45	0.29
Sum	**52.28**	**47.04**	**+5.24**

17.5.4 Soil Characterization

Soils at the Brown Creek Tributaries Restoration Project site were initially determined using NRCS soil survey data for Anson County. The areas proposed for stream restoration, enhancement, and preservation are mapped mostly as Chewacla (ChA) loam, Creedmoor (CrB) and Mayodan (MaB) soils. Chewacla soils are classified as hydric soils and all others are non-hydric. Figure 2.3 shows soil conditions throughout the project area and the soil descriptions are shown on Table 17.8.

Table 17.8 NRCS Soil Series (Anson County Soil Survey, USDA-SCS, 1960)
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Soil Name	Landform	Hydric Soil	Description
Chewacla	Floodplains	Yes	Somewhat poorly drained soils formed in low-lying depressions. Slope ranges from 0 to 2%. Permeability is moderate.
Creedmoor	Hillslopes	No	Somewhat poorly drained soils formed on broad ridges. Slope ranges from 2 to 8%. Permeability is very slow.
Mayodan	Hillslopes	No	Well drained soils formed on broad ridges. Slopes range from 2 to 8%. Permeability is moderate.

17.5.5 Plant Community Characterization

Based on historical aerials, site reconnaissance and the landowner's verification, a majority of the proposed stream restoration area is comprised of pasture land, narrow tree canopy and successional vegetation. Historically, the surrounding pasture areas have been used for cattle production. Current canopy vegetation within the existing delineated wetlands is dominated by Longleaf pine (*Pinus palustris*) and Loblolly pine (*Pinus taeda*), Red maple (*Acer rubrum*), Sycamore (*Platanus occidentalis*), and Green ash (*Fraxinus pennsylvanica*). Understory and woody shrub species include Black willow (*Salix nigra*), Chinese privet (*Ligustrum sinense*), Tag alder (*Alnus serrulata*). Herbaceous and vine species consist of Muscadine (*Vitis rotundifolia*), Sedge (*Carex spp.),* Soft rush (*Juncus effusus*) and greenbrier (*Smilax rotundifolia*).

17.5.6 Proposed Riparian Vegetation Plantings

The vegetative components of this project include stream bank, floodplain, and transitional upland planting and described as the riparian buffer zone. These planting boundaries are shown on the revegetation plan sheets in Section 18, Appendix D. In addition to riparian buffer zone, any areas of the site that lack diversity, are disturbed or adversely impacted by the construction process, will be planted.

Bare-root trees, live stakes, and permanent seedlings will be planted within designated areas of the conservation easement. A minimum 50-foot buffer will be established along both stream banks (100-foot total minimum width) for all of the proposed stream reaches within the project boundary. In many areas, the buffer width will be in excess of 50 feet along one or both stream banks (more than 100-foot total width) and will encompass adjacent jurisdictional wetland areas. In general, bare-root vegetation will be planted at a total target density of 680 stems per acre. Planting will be conducted during the dormant season, with all trees installed between the last week of November and the third week of March.

Selected species for hardwood revegetation planting are presented in Table 17.10. Tree species selected for restoration and enhancement areas will be weak to tolerant of flooding. Weakly tolerant species are able to survive and grow in areas where the soil is saturated or flooded for relatively short periods of time. Moderately tolerant species are able to survive in soils that are saturated or flooded for several months during the growing season. Flood tolerant species are able to survive on sites in which the soil is saturated or flooded for extended periods during the growing season (WRP, 1997).

Observations will be made during construction of the site regarding the relative wetness of areas to be planted as compared to the revegetation plan. The planting zone will be determined based on these comparisons, and planted species will be matched according to their wetness tolerance and the anticipated wetness of the planting area. It should be noted that smaller tree species planted in the understory, such as *Carpinus caroliniana,* will unlikely meet the height targets for tree species after seven years.

Once trees are transported to the site, they will be planted within two days. Soils across the site will be prepared by sufficiently loosening prior to planting. Trees will be planted by manual labor using a dibble bar, mattock, planting bar, or other approved method. Planting holes for the trees will be sufficiently deep to allow the roots to spread out and down without "J-rooting." Soil will be loosely compacted around trees once they have been planted to prevent roots from drying out.

Live stakes will be installed at a minimum of 40 stakes per 1,000 square feet and stakes will be spaced two to three feet apart in meander bends and six to eight feet apart in the riffle sections using triangular spacing along the stream banks between the toe of the stream bank and bankfull elevation. Site variations may require slightly different spacing.

Permanent seed mixtures will be applied to all disturbed areas of the project site. Table 17.11 lists the species, mixtures, and application rates that will be used. A mixture is provided that is suitable for stream bank, floodplain, and adjacent wetland areas. Mixtures will also include temporary seeding (rye grain or browntop millet) to allow for application with mechanical broadcast spreaders. To provide rapid growth of herbaceous ground cover and biological habitat value, the permanent seed mixture specified will be applied to all disturbed areas outside the stream banks of the restored stream channel. The species provided are deep-rooted and have been shown to proliferate along restored stream channels, providing long-term stability.

Temporary seeding will be applied to all disturbed areas of the site that are susceptible to erosion. These areas include constructed stream banks, access roads, side slopes, and spoil piles. If temporary seeding is applied from November through April, rye grain will be used and applied at a rate of 130 pounds per acre. If applied from May through October, temporary seeding will consist of browntop millet, applied at a rate of 40 pounds per acre.

Table 17.10 Proposed Bare-Root and Live Stake Species
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Botanical Name	Common Name	% Planted by Species	Wetland Tolerance
Riparian Buffer Plantings - Overstory 8' x 8' spacing - 680 stems/Acre			
Fraxinus pennsylvanica	Green Ash	9%	FACW
Betula nigra	River Birch	9%	FACW
Liriodendron tulipifera	Tulip Poplar	6%	FAC
Quercus phellos	Willow Oak	6%	FACW-
Quercus michauxii	Swamp Chestnut Oak	9%	FACW-
Nyssa sylvatica	Black Gum	6%	FAC
Platanus occidentalis	American Sycamore	9%	FACW-
Quercus alba	White Oak	6%	FACU
Riparian Buffer Plantings - Understory 8' x 8' spacing - 680 stems/Acre			
Diospyros virginiana	Persimmon	5%	FAC

Lindera benzoin	Spicebush	5%	FACW
Hamamelis virginiana	Witch hazel	5%	FAC-
Alnus serrulata	Tag alder	5%	FACW
Viburnum dentatum	Arrowwood Viburnum	5%	FAC
Itea virginica	Virginia sweetspire	5%	FACW+
Asimina triloba	Paw paw	5%	FAC
Carpinus caroliniana	American Hornbeam	5%	FAC
Riparian Live Stake Plantings			
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

Table 17.11 Proposed Permanent Seed Mixture
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Botanical Name	Common Name	% Planted by Species	Density (lbs/ac)	Wetland Tolerance
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	100%	15	

Note: Final species selection may change due to refinement or availability at the time of planting. If species substitution is required, the planting Contractor will submit a revised planting list to Baker for approval prior to the procurement of plant stock.

17.6 Site Construction

17.6.1 Site Grading, Structure Installation, and Other Project Related Construction

A general construction sequence is provided below and included on the plan set for the Brown Creek Tributaries Restoration Project.

1. Contractor shall contact North Carolina "One Call" Center (1.800.632.4949) before any excavation.
2. Contractor shall prepare stabilized construction entrances and haul roads as indicated on the plans.
3. The Contractor shall mobilize equipment, materials, prepare staging area(s) and stockpile area(s) as shown on the plans.
4. Construction traffic shall be restricted to the area denoted as "Limits of Disturbance" or "Haul Roads" on the plans.
5. The Contractor shall install temporary rock dams at locations indicated on the plans.
6. The Contractor shall install temporary silt fence around the staging area(s). Temporary silt fencing will also be placed around the temporary stockpile areas as material is stockpiled throughout the construction period.
7. The Contractor shall install all temporary and permanent stream crossings as shown on the plans in accordance with the NC Erosion and Sediment Control Planning and Design Manual. The existing channel and ditches on site will remain open during the initial stages of construction to allow for drainage and to maintain site accessibility.
8. The Contractor shall construct only the portion of channel that can be completed and stabilized within the same day.
9. The Contractor shall apply temporary seed and mulch to all disturbed areas at the end of each work day.
10. The Contractor shall clear and grub an area adequate to construct the stream channel and grading operations after all Sedimentation and Erosion Control practices have been installed and approved. In general, the Contractor shall work from upstream to downstream and in-stream structures and channel fill material shall be installed using a pump-around or flow diversion measure as shown on the plans.
11. The Contractor will begin construction by excavating channel fill material in areas for Hurricane Creek and UT4. The Contractor may fill ditches which do not contain any water during the grading operations. Along ditches with water or stream reaches, excavated material should be stockpiled in areas shown on the plans. In any areas where excavation depths will exceed 10 inches, topsoil shall be stockpiled and placed back over these areas to a depth of eight inches to achieve design grades and create a soil base for vegetation.
12. Contractor shall begin construction on HC-R1 at Station 10+00 and proceed in a downstream direction. This section of design channel will be constructed offline and in the dry, since it will be excavated through the field areas. The Contractor shall excavate the channel to design grades in all areas except within 10 feet of the top of existing stream banks.
13. After excavating the channel to design grades, install in-stream structures, grassing, matting, and transplants in this section, and ready the channel to accept flow per approval by the Engineer.
14. Water will be turned into the constructed channel once the area in and around the new channel has been stabilized. Immediately begin plugging, filling, and grading the abandoned channel, as indicated on plans, moving in a downstream direction to allow for drainage of the old channels. No water shall be turned into any section of channel prior to the channel being completely stabilized with all structures installed.

15. The new channel sections shall remain open on the downstream end to allow for drainage during rain events.
16. Any grading activities adjacent to the stream channel shall be completed prior to turning water into the new stream channel segments. Grading activities shall not be performed within 10 feet of the new stream channel banks. The Contractor shall NOT grade or roughen any areas where excavation activities have not been completed.
17. Once a stream work phase is complete, apply temporary seeding, permanent seeding, and mulch to any areas disturbed during construction. Apply permanent seeding mixtures, as shown on the vegetation plan. Temporary seeding shall be applied in all areas susceptible to erosion (i.e. disturbed ditch banks, steep slopes, and spoil areas) such that ground cover is established within 15 working days following completion of any phase of grading. Permanent ground cover shall be established for all disturbed areas within 15 working days or 90 calendar days (whichever is shorter) following completion of construction.
18. Contractor shall improve and construct the existing farm road crossings (HC-R1 near station 30+55, UT4-R4 near station 14+10 and UT4-R2 near station 26+50) by installing permanent ford crossings, culverts, stabilizing side slopes, and raising road bed elevations according to the plans and specifications.
19. All disturbed areas should be seeded and mulched before leaving the project. Remove temporary stream crossings and any in-stream temporary rock dams. All waste material must be removed from the project site.
20. The Contractor shall treat areas of invasive species vegetation throughout the project area according to the plans and specifications prior to demobilization.
21. The Contractor shall plant woody vegetation and live stakes, according to planting details and specifications. The Contractor shall complete the reforestation (bare-root planting) phase of the project and apply permanent seeding at the appropriate time of the year.
22. The Contractor shall ensure that the site is free of trash and leftover materials prior to demobilization of equipment from the site.

17.6.2 In-stream Structures and Other Construction Elements

A variety of in-stream structures are proposed for the Brown Creek Tributaries Restoration Project site. Structures such as log vanes, rock cross vanes, constructed riffles, root wads, log weirs, and cover logs will be used to stabilize the newly-restored stream and improve habitat functions. Woody debris will be harvested through the construction of this project and incorporated whenever possible. Table 17.12 summarizes the use of in-stream structures at the site.

Table 17.12 Proposed In-Stream Structure Types and Locations
Brown Creek Tributaries Restoration Project Stream Mitigation Plan - NCEEP Project No. 95351

Structure Type	Location
Root Wads	In locations along outside of meander bends or against one stream bank in straight reaches to increase pool diversity and provide refugium for fish.
Grade Control J-Hook Vanes	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and stream bed/bank erosion.
Grade Control Log Jam	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.
Log Vanes	Located throughout various meander bends to prevent possible stream bank erosion.
Log Weirs / Step Pools	In locations where grade control is necessary to prevent possible

	downcutting or headcut migration, and bed erosion.
Toe Wood w/ Cover Logs	Located along outside bends to prevent stream bank erosion, increase pool diversity and provide refugium for fish.
Constructed Riffles	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.
Ditch Plug / Channel Block	Installed along some or all of remnant channel segments to prevent subsurface flow.
Vegetation Transplants	In locations outside of meander bends to increase stream bank stability and cover.
Vegetated Geolift	In locations outside of meander bends to create and/or increase stream bank stability and reduce near bank stress.
Rock Cross-vanes	In locations where grade control is necessary to prevent possible downcutting or headcut migration, and bed erosion.

Root Wads

Root wads are placed at the toe of the stream bank along the outside of meander bends for the creation of habitat and for stream bank protection. Root wads include the root mass or root ball of a tree plus a portion of the trunk. They are used to armor a stream bank and reduce near bank stress by deflecting stream flows away from the stream bank. In addition to stream bank protection, they provide structural support to the stream bank and habitat for fish and other aquatic animals. They also serve as a food source for aquatic insects. Root wads will be placed throughout the project reaches primarily to improve aquatic habitat and provide cover.

Grade Control J-Hook Vanes

Grade control j-hook vanes are utilized to provide grade control and protect the stream banks. These vanes may be constructed out of logs and/or rock boulders. The structure arms turn water away from the stream banks and re-direct flow energies toward the center of the channel. In addition to providing stability to stream banks, grade control j-hook vanes also promote pool scour and provide structure within the pool habitat. Grade control j-hooks have two to three boulders placed in a hook shape at the upstream end of the vane. The primary difference between regular j-hooks and grade control j-hooks is the way that the "hook" part of the structure is constructed. Regular j-hooks are constructed to have gaps between the header boulders in the hook to promote flow convergence. Grade control j-hooks do not have gaps between the header boulders in the hook and also have a boulder sill built from the outside of the hook over to the opposite stream bank such that the structure can serve as a grade control feature. Grade control j-hooks still promote scour in the downstream pool, thus providing habitat benefit.

Grade Control Log Jams

A grade control log jam is created by placing woody material in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial grade control and establish riffle habitat within the restored channel, prior to the formation of a stabilized streambed. These structures can be substituted for traditional constructed riffles using rock material, in a similar way as natural riffles; the surfaces and interstitial spaces are crucial to the life cycles of many aquatic species.

Log Vanes

A log vane is used to provide cover for aquatic organisms in the downstream scour pool and with a potential secondary benefit of protecting stream banks by reducing near-bank stress and redirecting flow away from the stream bank. The length of a single vane structure can span one-half to two-thirds the bankfull channel width. Vanes are located just downstream of the point where the stream flow intersects the stream bank at an acute angle in a meander bend.

Log Weirs / Step Pools

Log weirs and step pools are used to provide grade control as well as provide a secondary pool habitat benefit for aquatic organisms. A log weir consists of two logs stacked (a header log and a footer log) and installed perpendicular to the direction of flow. This center structure sets the invert elevation of the streambed. A step pool sequence or log/rock "rollers" are also commonly used in confined settings where sinuosity is less than 1.2 and in drainage areas less than 3 square miles, and located based on pool-to-pool spacing ratios. They can be used as floodplain interceptors to intercept concentrated floodplain flows from swales, ditches, low points, oxbow pond or vernal pool drains, etc. and to drain such flow to the restored channel in a stable and natural manner.

Toe Wood with Cover Logs

Toe wood structures are typically constructed in meandering streams using a combination of native materials such as logs, branches, brush, live cuttings, sods mats, transplants, and soil. The structure helps ensure long-term stability against eroding banks and can enhance aquatic and terrestrial habitat within the pool area by establishing a source of detritus and large woody debris. The structures are located along the outer meander bends and should cover at least the lower half of the bank such that the toe wood is submerged and saturated to avoid premature deterioration. The upper bank contains live cuttings in combination with sod mats, live stakes, transplants, or geolifts to cover the toe wood up to the bankfull stage.

A cover log is placed along the outside of a meander bend to provide habitat in the pool area. It is most often installed in conjunction with root wads. The log is buried into the outside stream bank of the meander bend; the opposite end extends through the deepest part of the pool and may be buried in the inside of the meander bend, in the bottom of the point bar. The placement of the cover log near the bottom of the stream bank slope on the outside of the bend encourages scour in the pool. This increased scour provides a deeper pool for bedform variability.

Constructed Riffles

A constructed riffle is installed by placing coarse bed material (gravel, cobble, and small boulders) in the stream at specific riffle locations along the profile. The purpose of this structure is to provide initial grade control and establish riffle habitat within the restored channel, prior to the natural establishment of an armored streambed.

Wood material can also be incorporated with rock for these structures, and function in a similar way as natural riffles; the surfaces and interstitial spaces are crucial to the life cycles of many aquatic macroinvertebrate species.

Ditch Plug / Channel Block

A compacted earth plug will be installed by filling the existing ditch to prevent subsurface flows and improve site hydrology. The fill material used for ditch plugs shall come from a nearby borrow area and be free of debris, rocks, trash, etc. and shall consist of compactable soil material.

Vegetation Transplants

Vegetation transplants will be identified before starting construction as viable candidates (species and size) for uprooting and relocation. Areas that must be cleared will maximize the harvesting of transplants; transplants will be taken from other areas as suitable to enhance the rapid development of vegetative growth along the constructed channel.

Vegetated Geolift

Geolifts are a bioengineering measure used to stabilize stream banks. Geolifts are most commonly used along the outside of stream meander bends. They are essentially a series of large overlapping soil "burritos," or "lifts", constructed using coir fiber erosion control matting and native soils. Live cutting

materials, or whips, from specific woody native species plants are planted in the layers between the lifts. A stone or woody brush toe base is typically installed to provide protection at the toe of the stream bank and to provide a foundation for the geolifts. The geolifts are installed on top of the base material to comprise the entire restored stream bank up to the bankfull channel elevation. Geolifts can be used to effectively stabilize restored stream banks for all sizes of streams simply by varying the number of lifts required to form the stream bank.

Rock Cross-vanes

The cross-vane structure is commonly used to provide grade control, improve bed form diversity and pool habitat, center increased flow energies within the bankfull channel, and protect the localized stream banks. Cross-vanes are placed within long riffle or straighter channel sections. The structure arms (vanes) turn water away from the banks and re-direct flow energies toward the center of the channel. Wood material can also be incorporated with rock for these structures, and function in a similar way.

18.0 APPENDIX D - PROJECT PLAN SHEETS

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	128975	1	40

NORTH CAROLINA ECOSYSTEM ENHANCEMENT PROGRAM

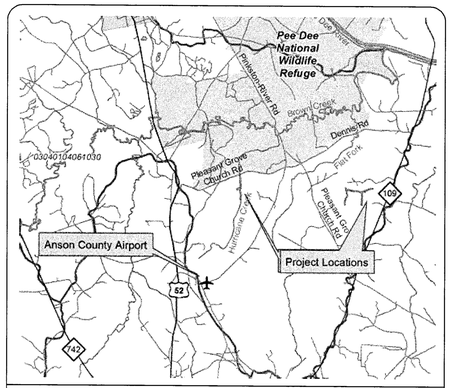
ANSON COUNTY

LOCATION: APPROX. 4 MILES SOUTHEAST OF THE TOWN OF ANSONVILLE.

TYPE OF WORK: STREAM RESTORATION, ENHANCEMENT, AND PRESERVATION

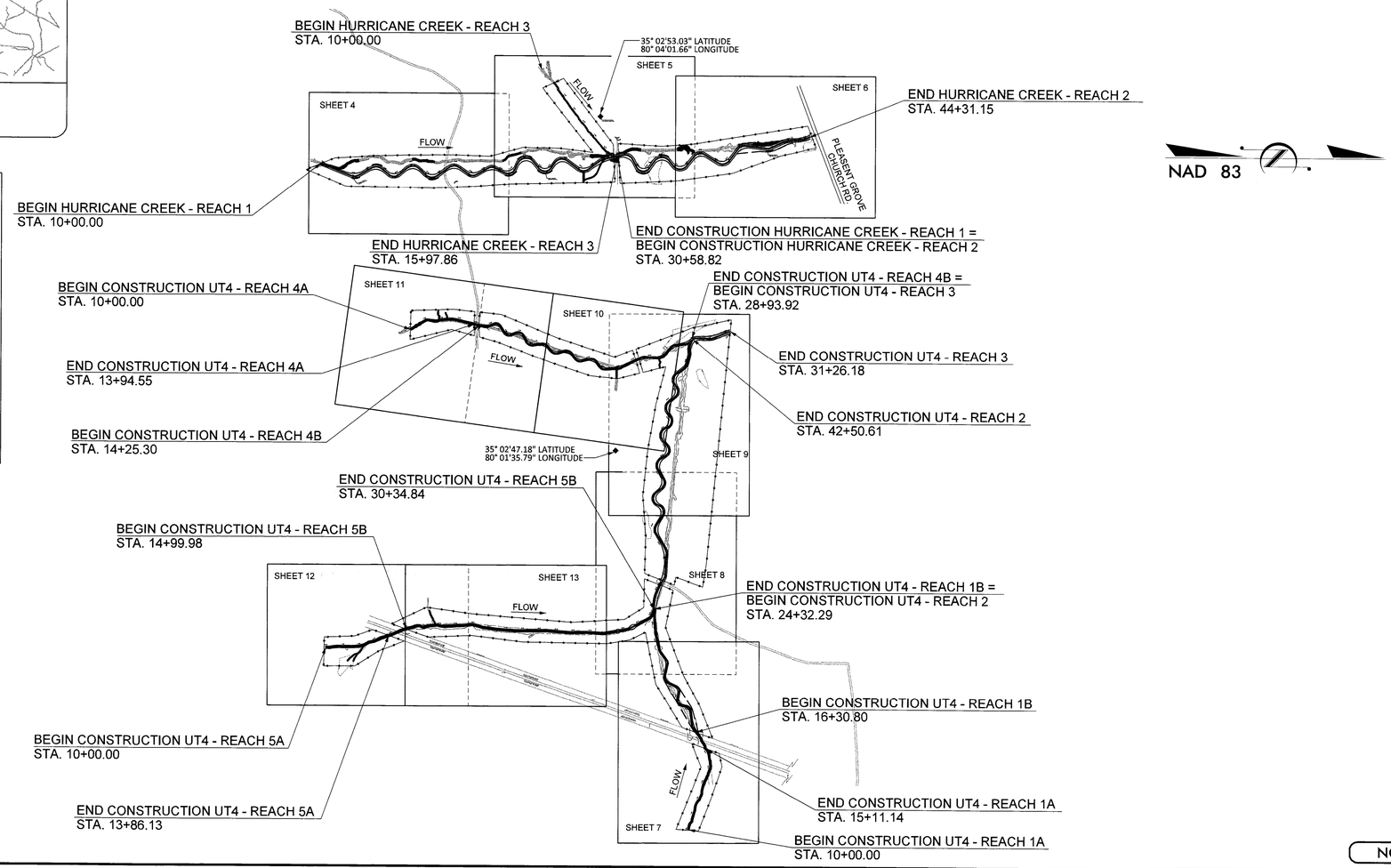
BROWN CREEK TRIBS

PROJECT: 128975



VICINITY MAP

INDEX OF SHEETS



NAD 83

NCEEP ID NO. 95351

GRAPHIC SCALES

20 10 0 20 40
PLANS

20 10 0 20 40
PROFILE (HORIZONTAL)

5 0 5 10
PROFILE (VERTICAL)

DESIGN SUMMARY

PROPOSED	HURRICANE CREEK REACH 1	LENGTH	= 2,034 FEET
PROPOSED	HURRICANE CREEK REACH 2	LENGTH	= 1,366 FEET
PROPOSED	HURRICANE CREEK REACH 3	LENGTH	= 598 FEET
PROPOSED	UT4 – REACH 1	LENGTH	= 1,360 FEET
PROPOSED	UT4 – REACH 2	LENGTH	= 1,857 FEET
PROPOSED	UT4 – REACH 3	LENGTH	= 227 FEET
PROPOSED	UT4 – REACH 4	LENGTH	= 1,837 FEET
PROPOSED	UT4 – REACH 5	LENGTH	= 1,921 FEET

PREPARED FOR THE OFFICE OF:

Ecosystem Enhancement PROGRAM

NCDENR
ECOSYSTEM ENHANCEMENT PROGRAM
1652 MAIL SERVICE CENTER
RALEIGH, NC 27699–1652

CONTACT: HARRY TSOMIDES
PROJECT MANAGER

PREPARED IN THE OFFICE OF:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

LETTING DATE:

WILLIAM SCOTT HUNT, III, P.E.
PROJECT ENGINEER

KAYNE VAN STELL
PROJECT MANAGER

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

SIGNATURE: *P.E.*

2/26/03

STREAM CONVENTIONAL SYMBOLS
SUPERCEDES SHEET 1-B

ROCK J-HOOK
ROCK VANE
OUTLET PROTECTION
ROCK CROSS VANE
DOUBLE DROP ROCK CROSS VANE
TEMPORARY SILT CHECK
ROOT WAD
LOG J-HOOK
LOG VANE
LOG WEIR
LOG CROSS VANE
CONSTRUCTED RIFFLE
BOULDER CLUSTER
LOG ROLLER
GRADE CONTROL LOG JAM
LOG STEP POOL

SAFETY FENCE
TAPE FENCE
100 YEAR FLOOD PLAIN
CONSERVATION EASEMENT
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
LIMITS OF DISTURBANCE
FOOT BRIDGE
TEMPORARY STREAM CROSSING
PERMANENT STREAM CROSSING
TRANSPLANTED VEGETATION
TREE REMOVAL
TREE PROTECTION
DITCH PLUG
CHANNEL FILL
BRUSH MATTRESS
GEOLIFT

**NOTE: ALL ITEMS ABOVE MAY NOT BE USED ON THIS PROJECT

GENERAL NOTES

1. THE CONTRACTOR IS REQUIRED TO INSTALL INSTREAM STRUCTURES USING A TRACK HOE WITH A HYDRAULIC THUMB OF SUFFICIENT SIZE TO PLACE BOULDERS (3' x 2' x 2'), LOGS AND ROOTWADS.
2. WORK IS BEING PERFORMED AS AN ENVIRONMENTAL RESTORATION PLAN. THE CONTRACTOR SHOULD MAKE ALL REASONABLE EFFORTS TO REDUCE SEDIMENT LOSS AND MINIMIZE DISTURBANCE OF THE SITE WHILE PERFORMING THE CONSTRUCTION WORK.
3. CONSTRUCTION IS SCHEDULED TO BEGIN SUMMER 2014.
4. CONTRACTOR SHOULD CALL NORTH CAROLINA "ONE-CALL" BEFORE EXCAVATION STARTS. (1-800-632-4949)
5. ENGINEER WILL FLAG SIGNIFICANT TREES TO BE SAVED PRIOR TO CONSTRUCTION.
6. ALL GRADING ACTIVITIES SHALL TAKE PLACE WITHIN THE CONSERVATION EASEMENT OR LIMITS OF DISTURBANCE UNLESS SHOWN OTHERWISE.

PROJECT REFERENCE NO.	SHEET NO.
128975	1-A

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22757 ENGINEER WILLIAM SCOTT HUNT III
06.10.14

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

STANDARD SPECIFICATIONS

NORTH CAROLINA
EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL
MARCH 2009 (REV 2013)

6.05 TREE PRESERVATIN AND PROTECTION
6.06 TEMPORARY GRAVEL CONSTRUCTION ENTRANCE
6.24 RIPARIAN AREA SEEDING
6.60 TEMPORARY SEDIMENT TRAP
6.62 TEMPORARY SILT FENCE
6.63 TEMPORARY ROCK DAM
6.70 TEMPORARY STREAM CROSSING

VEGETATION SELECTION

The following table lists the bare root vegetation selection for the project site. Total planting area is approximately 29 acres and will vary based on areas denuded during construction. Species shall be planted at density of 680 stems per acre and a minimum of 50 feet from the stream banks to the revegetation limits. Exact placement of species will be determined prior to site planting and based on apparent wetness of planting locations and per the vegetation specialist. Refer to the Revegetation Plan Sheets & Construction Specifications for vegetation planting locations and riparian buffer requirements.

Riparian Buffer - Trees (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**	**Approx. Number of Stems**
Fraxinus pennsylvanica	Green Ash	9%	FACW	1,775
Betula nigra	River Birch	9%	FACW	1,775
Liriodendron tulipifera	Tulip Poplar	6%	FAC	1,183
Quercus phellos	Willow Oak	6%	FACW-	1,183
Quercus michauxii	Swamp Chestnut Oak	9%	FACW-	1,775
Nyssa sylvatica	Black Gum	6%	FAC	1,183
Platanus occidentalis	American Sycamore	9%	FACW-	1,775
Quercus alba	White Oak	6%	FACU	1,183
	Sub-total	60%		**11,832**
Riparian Buffer - Understory (8'x8' spacing - 680 stems/acre)				
Scientific Name	**Common Name**			
Diospyros virginiana	Persimmon	5%	FAC	986
Alnus serrulata	Tag alder	5%	FACW	986
Lindera benzoin	Spicebush	5%	FACW	986
Hamamelis virginiana	Witch hazel	5%	FAC-	986
Viburnum dentatum	Arrowwood Viburnum	5%	FAC	986
Itea virginica	Virginia sweetspire	5%	FACW+	986
Carpinus caroliniana	American Hornbeam	5%	FAC	986
Asimina triloba	Paw paw	5%	FAC	986
	Sub-total	40%		**7,888**
	Total Bare-roots			**19,720**

Permanent herbaceous seed mixtures for the project site shall be planted throughout the floodplain and riparian buffer areas. Permanent seed mixtures shall be applied with temporary seed, as defined in the construction specifications.

Scientific Name	**Common Name**	**% Planted By Species**	**Total lbs per Acre**	**Wetland Tolerance**
Andropogon gerardii	Big blue stem	10%	1.50	FAC
Dichanthelium clandestinum	Deer Tongue	15%	1.50	FACW
Carex crinata	Fringed sedge	10%	2.25	FACW+
Chasmanthium latifolium	River oats	5%	1.50	FACU
Elymus virginicus	Virginia wild rye	15%	1.50	FAC
Juncus effusus	Soft rush	5%	2.25	FACW+
Panicum virgatum	Switchgrass	10%	1.50	FAC+
Polygonum pensylvanicum	Pennsylvania Smartweed	5%	0.75	FACW
Schizachyrium scoparium	Little blue stem	10%	0.75	FACU
Tripsacum dactyloides	Eastern gamagrass	5%	0.75	FAC+
Sorghastrum nutans	Indiangrass	10%	0.75	FACU
	Total	**100%**	**15.0**	

Live staking will be applied to all restored streambanks following the details in this plan set and according to the construction specifications.

Scientific Name	**Common Name**	**% Planted By Species**	**Wetland Tolerance**
Cornus amomum	Silky Dogwood	10%	FACW+
Salix nigra	Black Willow	10%	OBL
Salix sericea	Silky Willow	40%	OBL
Sambucus canadensis	Elderberry	40%	FACW-

The following table lists temporary seed mix for the project site. All disturbed areas will be stabilized using mulch and temporary seed as defined in the construction specifications.

Planting Dates	**Species Name**	**Rate (lbs/acre)**
September to March	Annual Rye Grain (Cool Season)	130
April to August	Browntop Millet (Warm Season)	40

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_1A.dgn
mcgehee

2/26/03

PROJECT REFERENCE NO.	SHEET NO.
128975	1-B
NCEEP ID NO. 95351	

*S.U.E = SUBSURFACE UTILITY ENGINEER

STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

CONVENTIONAL SYMBOLS

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

BOUNDARIES AND PROPERTY:

- State Line
- County Line
- Township Line
- City Line
- Reservation Line
- Property Line
- Existing Iron Pin — EIP
- Property Corner
- Property Monument — ECM
- Parcel/Sequence Number — 23
- Existing Fence Line
- Proposed Woven Wire Fence
- Proposed Chain Link Fence
- Proposed Barbed Wire Fence
- Existing Wetland Boundary — WLB
- Proposed Wetland Boundary — WLB
- Existing Endangered Animal Boundary — EAB
- Existing Endangered Plant Boundary — EPB

BUILDINGS AND OTHER CULTURE:

- Gas Pump Vent or U/G Tank Cap
- Sign — S
- Well — W
- Small Mine
- Foundation
- Area Outline
- Cemetery
- Building
- School
- Church
- Dam

HYDROLOGY:

- Stream or Body of Water
- Hydro, Pool or Reservoir
- Jurisdictional Stream — JS
- Buffer Zone 1 — BZ 1
- Buffer Zone 2 — BZ 2
- Flow Arrow
- Disappearing Stream
- Spring
- Wetland
- Proposed Lateral, Tail, Head Ditch — FLOW
- False Sump

RAILROADS:

- Standard Gauge — CSX TRANSPORTATION
- RR Signal Milepost — MILEPOST 35
- Switch — SWITCH
- RR Abandoned
- RR Dismantled

RIGHT OF WAY:

- Baseline Control Point
- Existing Right of Way Marker
- Existing Right of Way Line
- Proposed Right of Way Line — RW
- Proposed Right of Way Line with Iron Pin and Cap Marker — RW
- Proposed Right of Way Line with Concrete or Granite Marker — RW
- Existing Control of Access — CA
- Proposed Control of Access — CA
- Existing Easement Line — E
- Proposed Temporary Construction Easement — E
- Proposed Temporary Drainage Easement — TDE
- Proposed Permanent Drainage Easement — PDE
- Proposed Permanent Utility Easement — PUE
- Proposed Temporary Utility Easement — TUE
- Proposed Permanent Easement with Iron Pin and Cap Marker

ROADS AND RELATED FEATURES:

- Existing Edge of Pavement
- Existing Curb
- Proposed Slope Stakes Cut — C
- Proposed Slope Stakes Fill — F
- Proposed Wheel Chair Ramp — WCR
- Existing Metal Guardrail
- Proposed Guardrail
- Existing Cable Guiderail
- Proposed Cable Guiderail
- Equality Symbol
- Pavement Removal

VEGETATION:

- Single Tree
- Single Shrub
- Hedge
- Woods Line
- Orchard
- Vineyard — Vineyard

EXISTING STRUCTURES:

MAJOR:

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

MINOR:

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

UTILITIES:

POWER:

- Existing Power Pole
- Proposed Power Pole
- Existing Joint Use Pole
- Proposed Joint Use Pole
- Power Manhole — P
- Power Line Tower
- Power Transformer
- U/G Power Cable Hand Hole — HH
- H-Frame Pole
- Recorded U/G Power Line — P
- Designated U/G Power Line (S.U.E.*) — P

TELEPHONE:

- Existing Telephone Pole
- Proposed Telephone Pole
- Telephone Manhole — T
- Telephone Booth
- Telephone Pedestal — T
- Telephone Cell Tower
- U/G Telephone Cable Hand Hole — HH
- Recorded U/G Telephone Cable — T
- Designated U/G Telephone Cable (S.U.E.*) — T
- Recorded U/G Telephone Conduit — TC
- Designated U/G Telephone Conduit (S.U.E.*) — TC
- Recorded U/G Fiber Optics Cable — T FO
- Designated U/G Fiber Optics Cable (S.U.E.*) — T FO

WATER:

- Water Manhole — W
- Water Meter
- Water Valve
- Water Hydrant
- Recorded U/G Water Line — W
- Designated U/G Water Line (S.U.E.*) — W
- Above Ground Water Line — A/G Water

TV:

- TV Satellite Dish
- TV Pedestal — C
- TV Tower
- U/G TV Cable Hand Hole — HH
- Recorded U/G TV Cable — TV
- Designated U/G TV Cable (S.U.E.*) — TV
- Recorded U/G Fiber Optic Cable — TV FO
- Designated U/G Fiber Optic Cable (S.U.E.*) — TV FO

GAS:

- Gas Valve
- Gas Meter
- Recorded U/G Gas Line — G
- Designated U/G Gas Line (S.U.E.*) — G
- Above Ground Gas Line — A/G Gas

SANITARY SEWER:

- Sanitary Sewer Manhole
- Sanitary Sewer Cleanout
- U/G Sanitary Sewer Line — SS
- Above Ground Sanitary Sewer — A/G Sanitary Sewer
- Recorded SS Forced Main Line — FSS
- Designated SS Forced Main Line (S.U.E.*) — FSS

MISCELLANEOUS:

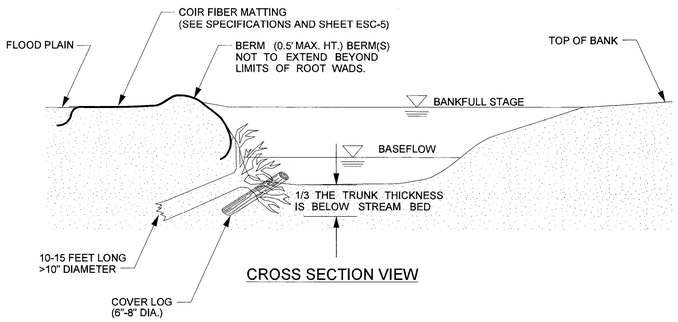
- Utility Pole
- Utility Pole with Base
- Utility Located Object
- Utility Traffic Signal Box — S
- Utility Unknown U/G Line — ?UTL
- U/G Tank; Water, Gas, Oil
- A/G Tank; Water, Gas, Oil
- U/G Test Hole (S.U.E.*)
- Abandoned According to Utility Records — AATUR
- End of Information — E.O.I.

6/18/2004
R:\128975\Design\Plans\128975_HC_PSH_1B.dgn

2/26/03

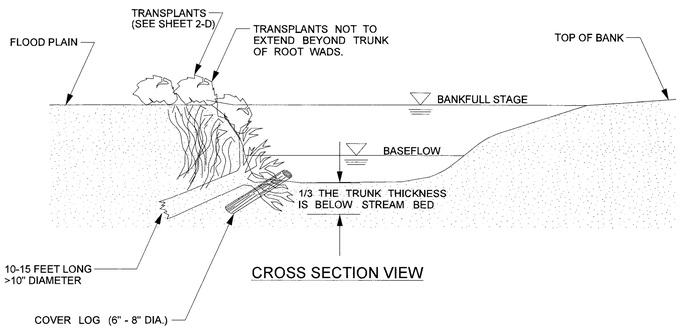
ROOT WADS

ROOT WADS WITHOUT TRANSPLANTS
USE IF TRANSPLANTS ARE NOT AVAILABLE ON-SITE



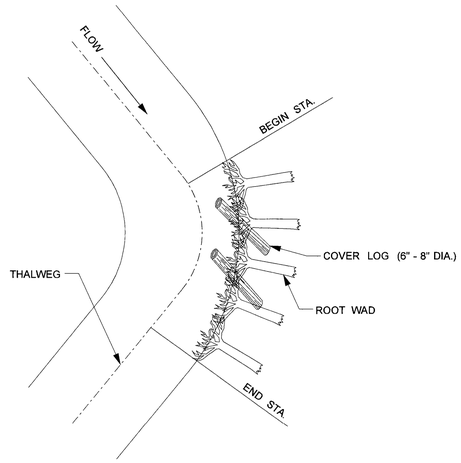
CROSS SECTION VIEW

ROOT WADS WITH TRANSPLANTS
USE IF TRANSPLANTS ARE AVAILABLE ON-SITE



CROSS SECTION VIEW

PLAN VIEW

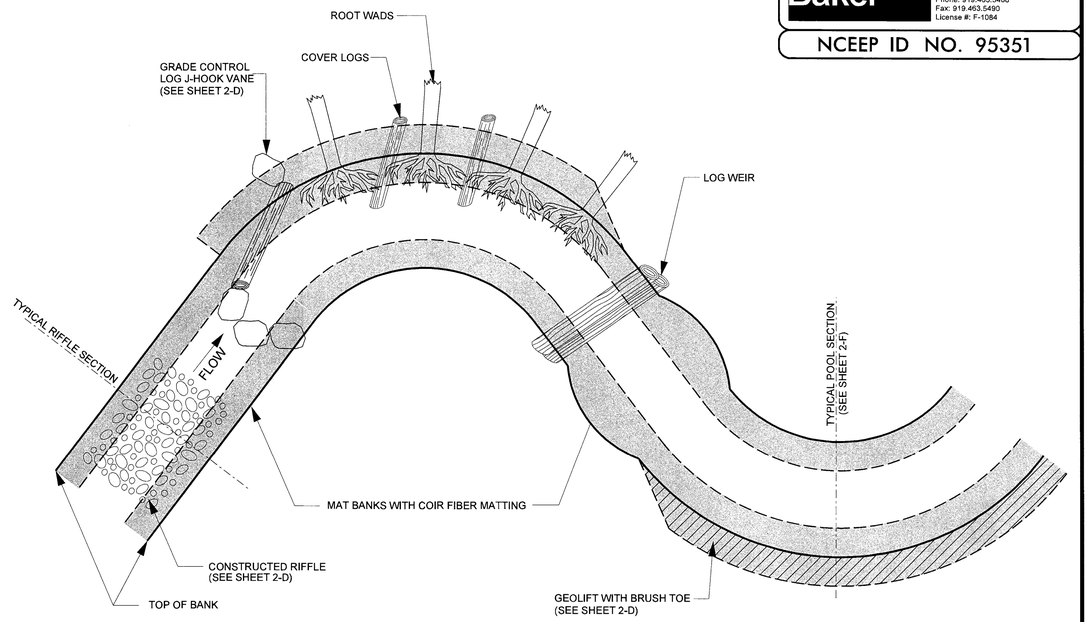


NOTES:
1. INSTALLATION USING THE TRENCHING METHOD REQUIRES THAT A TRENCH BE EXCAVATED FOR THE LOG PORTION OF THE ROOT WAD. ONE-THIRD OF THE ROOT WAD SHOULD REMAIN BELOW NORMAL BASE FLOW CONDITIONS OR CHANNEL BOTTOM.
2. THE NUMBER OF ROOTWADS ESTIMATED MAY VARY DEPENDING ON THE ROOTMASS SIZE. IN GENERAL, ROOTWADS SHOULD PROTECT THE OUTER MEANDER BEND AS SHOWN. SEE PLANS FOR APPROXIMATE STATION AND LOCATION.
3. INSTALL COVER LOGS BETWEEN ROOTWADS TO PROVIDE HABITAT ONLY WHEN AVAILABLE FROM ON-SITE HARVESTING.

TYPICAL STRUCTURE PLACEMENT

STRUCTURE NOTES:
1. GENERALLY LOG WEIRS, ROOT WADS, LOG VANES AND COIR FIBER MATTING WILL BE INSTALLED IN THE LOCATION AND SEQUENCE AS SHOWN.
2. ADDITIONAL STRUCTURES OR CHANGES TO STRUCTURE LOCATIONS MAY BE MADE BY THE DESIGN ENGINEER DURING CONSTRUCTION.

NOTES:
1. COIR FIBER MATTING TO BE INSTALLED ON ALL RESTORED STREAMBANKS EXCEPT ON POINT BARS.
2. IF ROOT WADS DO NOT COVER ENTIRE SLOPE ON OUTSIDE OF MEANDER BENDS, COIR FIBER MATTING IS NEEDED.
3. ROOT WADS SHALL BE ANGLED APPROXIMATELY 90° TOWARDS THE STREAMBANK.



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HINES III
06.18.14

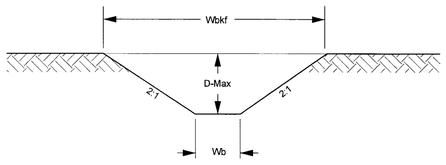
APPROVED BY:

DATE:

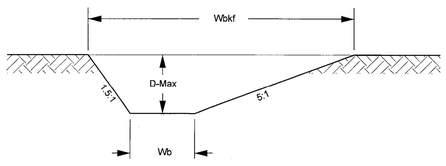
Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

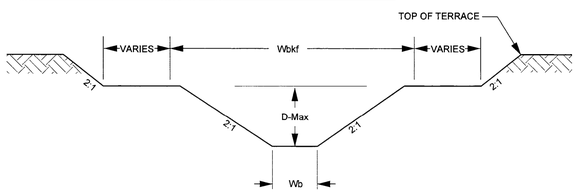
TYPICAL RIFFLE, POOL CROSS SECTIONS



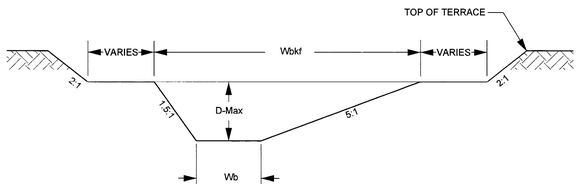
RIFFLE



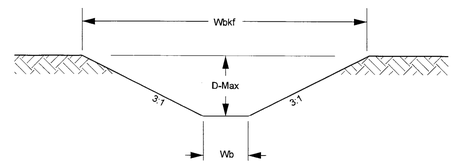
POOL



RIFFLE WITH BANKFULL BENCH



POOL WITH BANKFULL BENCH



STEP-POOL

HURRICANE CREEK						UT4									
REACH 1		REACH 2		REACH 3		REACH 1		REACH 2		REACH 3		REACH 4		REACH 5	
RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL	RIFFLE	POOL
19.1	26.0	20.1	27.0	9.1	13.0	11.4	15.0	16.5	24.0	19.8	26.0	12.0	16.0	13.9	18.0
1.8	3.0	1.9	3.2	1.0	2.0	1.1	2.4	1.6	3.0	1.7	3.7	1.1	2.2	1.5	2.4
13.0	13.9	13.0	13.7	12.0	12.1	13.0	11.2	13.0	13.5	14.0	13.3	13.0	13.1	12.0	12.5
28.0	48.8	31.0	53.1	6.9	14.0	10.0	20.2	21.0	42.8	28.0	59.1	11.0	19.5	16.0	25.9
11.8	6.5	12.4	6.2	5.3	1.0	7.1	1.8	10.2	4.5	13.0	4.0	7.4	1.7	8.0	3.6

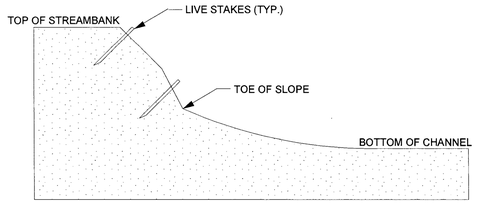
WIDTH OF BANKFULL (Wbkf)
MAXIMUM DEPTH (D-Max)
WIDTH TO DEPTH RATIO (Wbkf / D)
BANKFULL AREA (Abkf)
BOTTOM WIDTH (Wb)

NOTES:
1. DURING CONSTRUCTION CORNERS OF DESIGN CHANNEL WILL BE ROUNDED AND A THALWEG WILL BE SHAPED PER DIRECTION OF ENGINEER.
2. POOLS SHOWN ABOVE ARE LEFT POOLS ONLY.

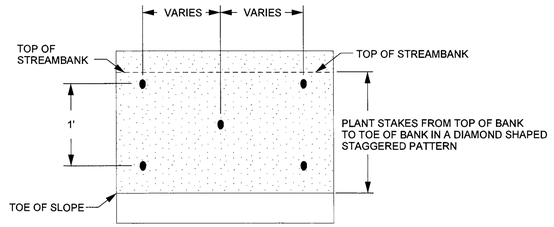
6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_2.dgn
mcneil

2/26/03

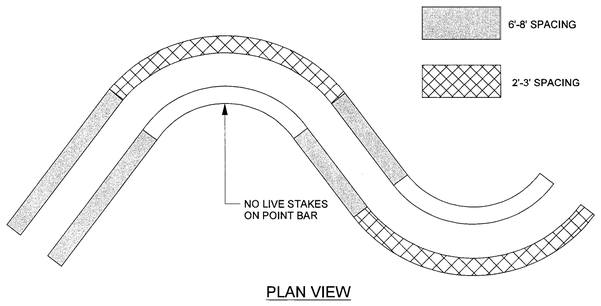
LIVE STAKING



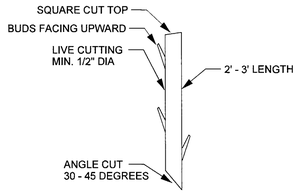
CROSS SECTION VIEW



PLAN VIEW



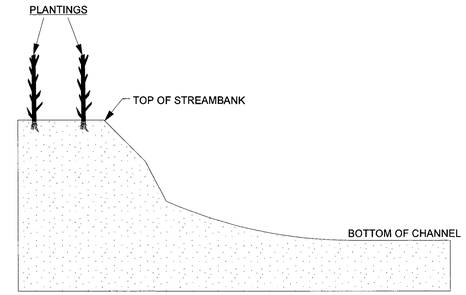
PLAN VIEW



LIVE STAKE DETAIL

NOTES:
1. STAKES PRODUCED FROM ON-SITE SHOULD BE CUT AND INSTALLED ON THE SAME DAY.
2. DO NOT INSTALL STAKES THAT HAVE BEEN SPLIT.
3. STAKES MUST BE INSTALLED WITH BUDS POINTING UPWARDS.
4. STAKES SHOULD BE INSTALLED PERPENDICULAR TO BANK.
5. STAKES SHOULD BE 1/2 TO 2 INCHES IN DIAMETER AND 2 TO 3 FT LONG.
6. STAKES SHOULD BE INSTALLED LEAVING 1/5 OF STAKE ABOVE GROUND.
7. DO NOT LIVE STAKE POINT BARS ALONG MEANDER BENDS.

PLANTING SPECIFICATIONS



CROSS SECTION VIEW OF BARE ROOT PLANTING

NOTES:
1. PLANT BARE ROOT SHRUBS AND TREES TO THE WIDTH OF THE BUFFER/PLANTING ZONE AS SHOWN ON THE PLANS.
2. ALLOW FOR 6-10 FEET BETWEEN PLANTINGS, DEPENDING ON SIZE.
3. LOOSEN COMPACTED SOIL.
4. PLANT IN HOLES MADE BY A MATTOCK, DIBBLE, PLANTING BAR, OR OTHER APPROVED MEANS.
5. PLANT IN HOLES DEEP AND WIDE ENOUGH TO ALLOW THE ROOTS TO SPREAD OUT AND DOWN WITHOUT J-ROOTING.
6. KEEP ROOTS MOIST WHILE DISTRIBUTING OR WAITING TO PLANT BY MEANS OF WET CANVAS, BURLAP, OR STRAW.
7. HEEL-IN PLANTS IN MOIST SOIL OR SAWDUST IF NOT PROMPTLY PLANTED UPON ARRIVAL TO PROJECT SITE.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-A

PROJECT ENGINEER

APPROVED BY:

DATE:

Baker

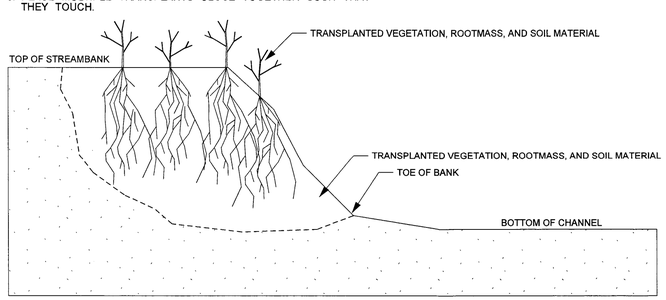
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

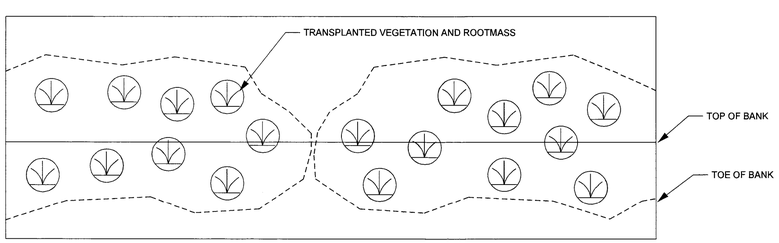
TRANSPLANTED VEGETATION

NOTES:

1. EXCAVATE A HOLE IN THE BANK TO BE STABILIZED THAT WILL ACCOMMODATE THE SIZE OF TRANSPLANT TO BE PLACED. BEGIN EXCAVATION AT THE TOE OF THE BANK.
2. EXCAVATE TRANSPLANT USING A FRONT END LOADER. EXCAVATE THE ENTIRE ROOT MASS AND AS MUCH ADDITIONAL SOIL MATERIAL AS POSSIBLE. IF ENTIRE ROOT MASS CAN NOT BE EXCAVATED IN ONE BUCKET LOAD, THE TRANSPLANT IS TOO LARGE AND ANOTHER SHOULD BE SELECTED.
3. PLACE TRANSPLANT IN THE BANK TO BE STABILIZED SO THAT VEGETATION IS ORIENTATED VERTICALLY.
4. FILL IN ANY HOLES AROUND THE TRANSPLANT AND COMPACT.
5. ANY LOOSE SOIL LEFT IN THE STREAM SHOULD BE REMOVED.
6. PLACE MULTIPLE TRANSPLANTS CLOSE TOGETHER SUCH THAT THEY TOUCH.

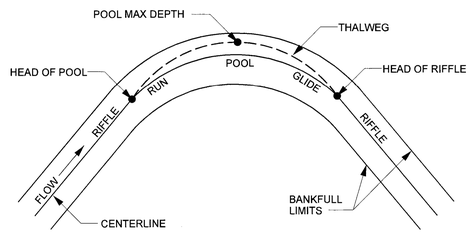


CROSS SECTION VIEW

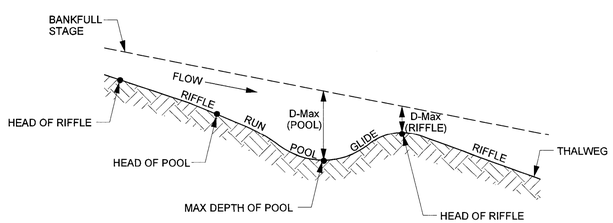


PLAN VIEW

TYPICAL PLAN VIEW AND PROFILE



PLAN VIEW



PROFILE VIEW

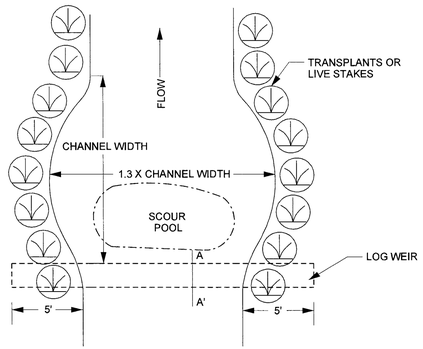
NOTES:

1. THE POINTS SHOWN, e.g. HEAD OF RIFFLE, HEAD OF POOL AND MAX DEPTH OF POOL ARE THE CONTROL POINTS USED TO CUT THE PROFILE; HOWEVER, THE CONTRACTOR SHOULD CREATE SMOOTH TRANSITIONS BETWEEN CONTROL POINTS AS SHOWN ABOVE.
2. THE DOWNSTREAM HEAD OF RIFFLE ELEVATION SHOULD NOT EXCEED THE HEAD OF POOL ELEVATION.
3. THE CHANGE IN WIDTH BETWEEN THE RIFFLES AND POOLS SHOULD OCCUR GRADUALLY OVER THE ENTIRE LENGTH OF THE BEND.

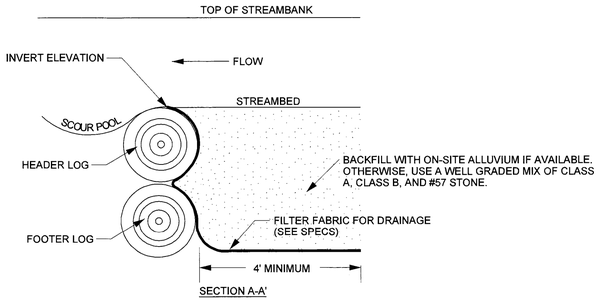
6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_2a.dgn
mcDell

2/26/03

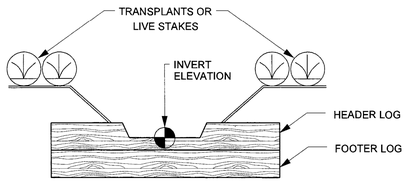
LOG WEIR



PLAN VIEW



SECTION A-A'

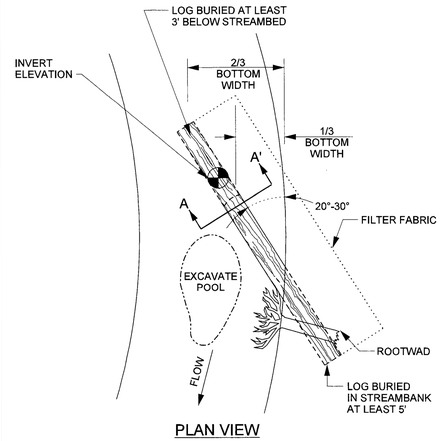


CROSS SECTION VIEW

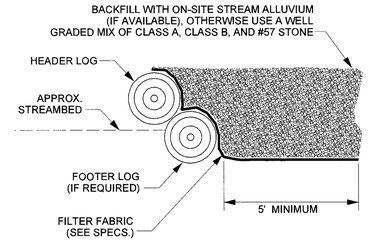
NOTES:

1. LOGS SHOULD BE AT LEAST 12 INCHES IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. LOGS >24 INCHES IN DIAMETER MAY BE USED ALONE WITHOUT AN ADDITIONAL LOG. FILTER FABRIC SHOULD STILL BE USED TO SEAL AROUND LOG.
3. PLACE FOOTER LOGS FIRST AND THEN HEADER (TOP) LOG. SET HEADER LOG AT A MAXIMUM OF 3 INCHES ABOVE THE INVERT ELEVATION.
4. CUT A NOTCH IN THE HEADER LOG APPROXIMATLEY 30% OF THE CHANNEL BOTTOM WIDTH AND EXTENDING DOWN TO THE INVERT ELEVATION. NOTCH SHALL NOT EXCEED 3 INCHES IN DEPTH.
5. USE FILTER FABRIC FOR DRAINAGE TO SEAL GAPS BETWEEN LOGS.
6. PLACE TRANSPLANTS FROM TOE OF STREAMBANK TO TOP OF STREAMBANK.

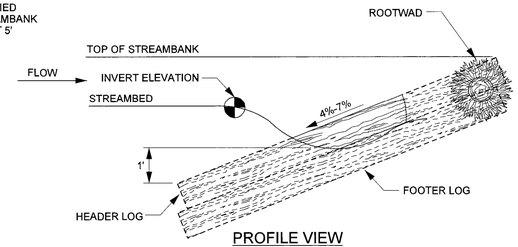
LOG VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
4. FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-B

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNTER

APPROVED BY:

DATE:

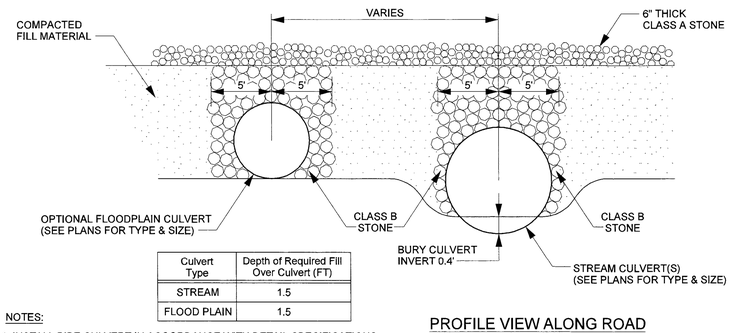
Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

PERMANENT ROAD CULVERT CROSSING

NOT TO SCALE

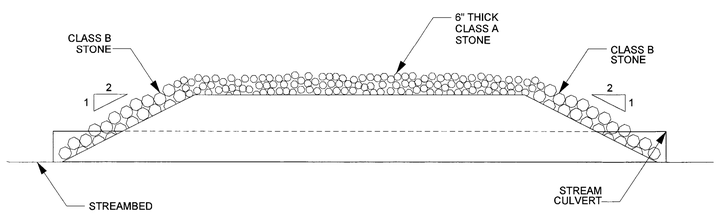


Culvert Type	Depth of Required Fill Over Culvert (FT)
STREAM	1.5
FLOOD PLAIN	1.5

PROFILE VIEW ALONG ROAD

NOTES:

1. INSTALL PIPE CULVERT IN ACCORDANCE WITH DETAIL SPECIFICATIONS.
2. INSTALL COIR FIBER MATTING FOR EROSION CONTROL ALONG FILL SLOPES

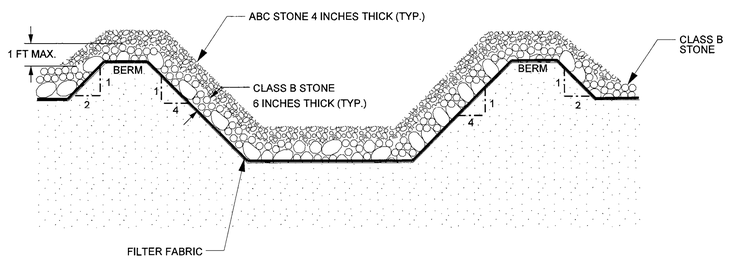


CROSS SECTION

NOTES:

1. TYPICAL SECTION APPLIES TO UT4 REACH 1B AT APPROXIMATE STATION 16+30 AND HC REACH 3, STATION 10+00.
2. CULVERTS ARE TO BE EVENLY SPACED MINIMUM OF 24" APART.
3. MINIMUM OF 18" COVER FOR ALL PIPES.

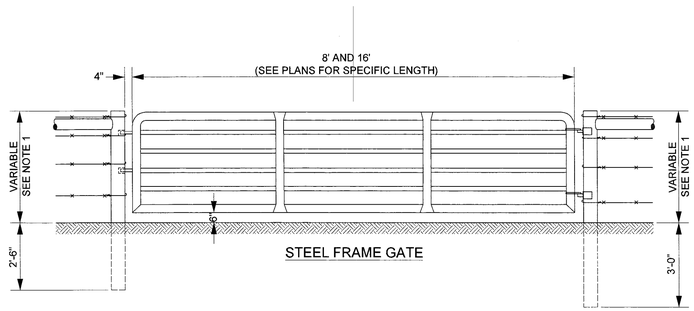
PERMANENT FORD STREAM CROSSING



NOTES:

1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM. COMPLETE ONE SIDE BEFORE STARTING ON THE OTHER SIDE.
4. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
5. GRADE SLOPES TO A 4:1 SLOPE. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES.
6. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL.
7. A STABILIZED PAD OF CLASS B STONE, 1 FOOT THICK, LINED WITH FILTER FABRIC FOR DRAINAGE SHALL BE USED OVER THE BERM AND ACCESS SLOPES. ABC STONE APPROXIMATLEY 4 INCHES THICK ADDED TO TOP LAYER.
8. WIDTH OF THE CROSSING SHALL BE SUFFICIENT TO ACCOMMODATE THE LARGEST VEHICLE CROSSING THE CHANNEL.
9. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED.

STEEL GATES



STEEL FRAME GATE

NOTES:

1. POST HEIGHT DIMENSION SHALL BE THE SAME AS REQUIRED FOR THE ADJACENT FENCE.
2. CONSTRUCT AN END OR STRESS PANEL, AS REQUIRED IN THE SPECIFICATION, ON EACH SIDE OF GATE.
3. HINGES AND LOCKS SHALL BE INSTALLED AS SPECIFIED BY GATE MANUFACTURER.

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_2b.dgn
mcasey

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-C

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 6/18/14 WILLIAM SCOTT HUNT III

APPROVED BY:

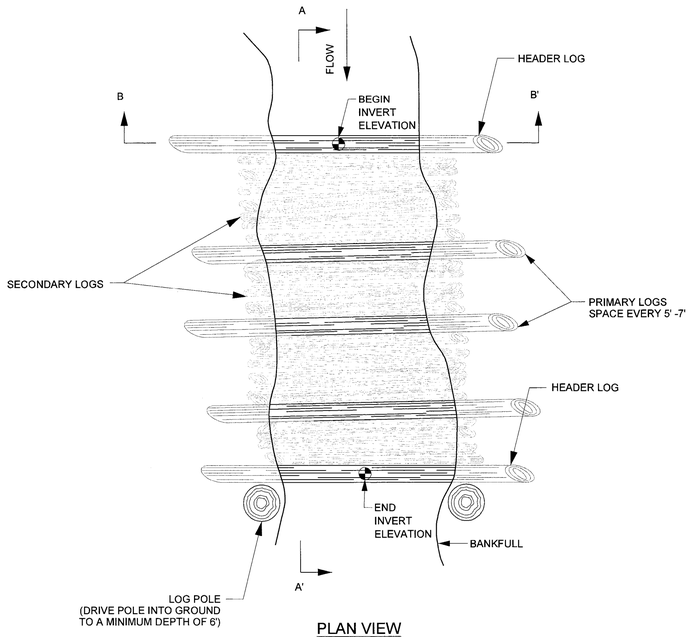
DATE:

Baker

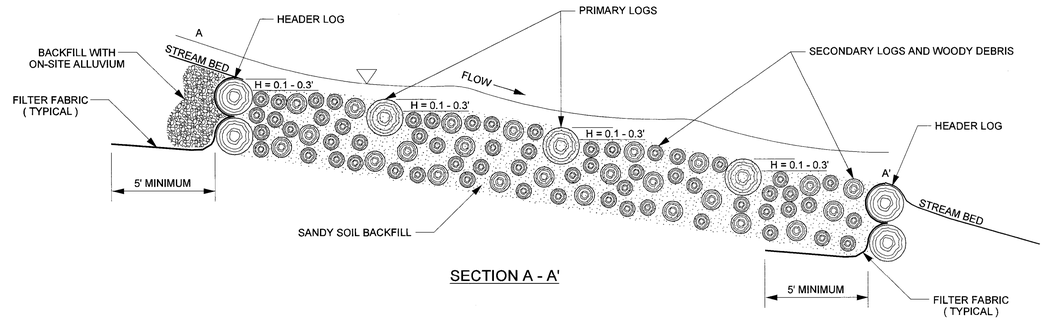
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

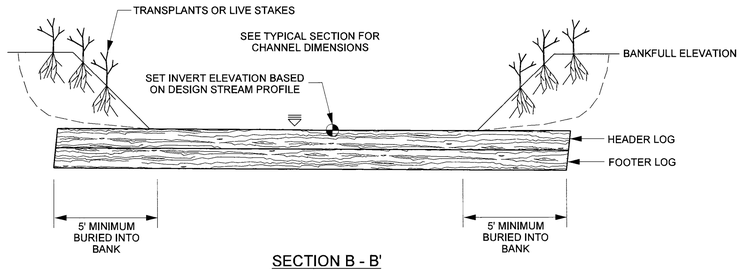
GRADE CONTROL LOG JAM



PLAN VIEW



SECTION A - A'

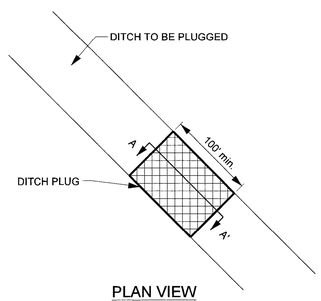


SECTION B - B'

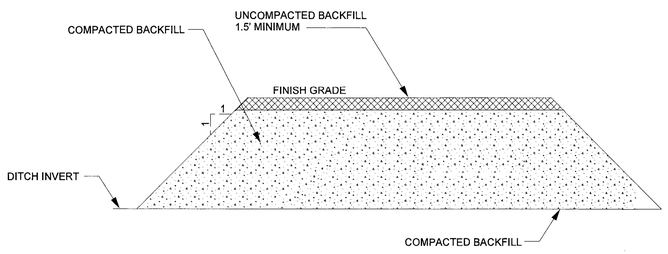
NOTES:

1. PRIMARY LOGS SHOULD BE AT LEAST 10" OR MORE IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD PREFERRED, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SECONDARY LOGS SHOULD BE AT LEAST 1" IN DIAMETER AND NO LARGER THAN 10", AND EXTEND INTO THE BANK 2 FEET ON EACH SIDE. WOOD MATERIAL SHALL BE VARYING DIAMETER TO ALLOW MATERIAL TO BE COMPACTED.
3. VERTICAL POSTS SHOULD BE AT LEAST 10" IN DIAMETER AND SHOULD BE DRIVEN INTO THE GROUND A MINIMUM OF 6'.
4. FILTER FABRIC SHOULD BE NAILED TO THE HEADER LOG BELOW THE BACKFILL.
5. ROOTWADS AND COIR FIBER MATTING CAN BE USED INSTEAD OF TRANSPLANTS OR LIVE STAKES, PER DIRECTION OF ENGINEER.
6. AFTER TRENCH HAS BEEN EXCAVATED A LAYER OF SECONDARY LOGS AND WOODY DEBRIS SHOULD BE PLACED WITH MINIMAL GAPS. A LAYER OF ON-SITE ALLUVIUM SHOULD BE APPLIED TO FILL VOIDS BETWEEN SECONDARY LOGS BEFORE ADDITIONAL LAYERS ARE PLACED.

DITCH PLUG



PLAN VIEW

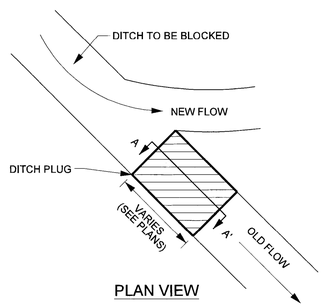


SECTION A - A'

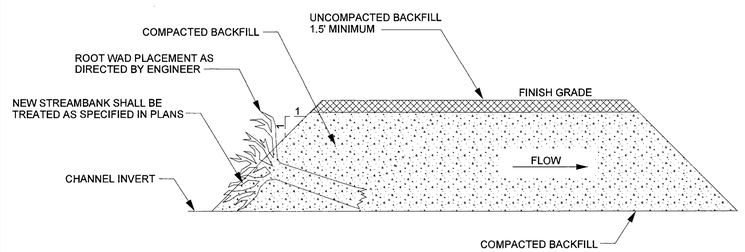
NOTES:

1. COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. FILL DITCH TO TOP OF BANKS OR AS DIRECTED BY ENGINEER.

CHANNEL BLOCK



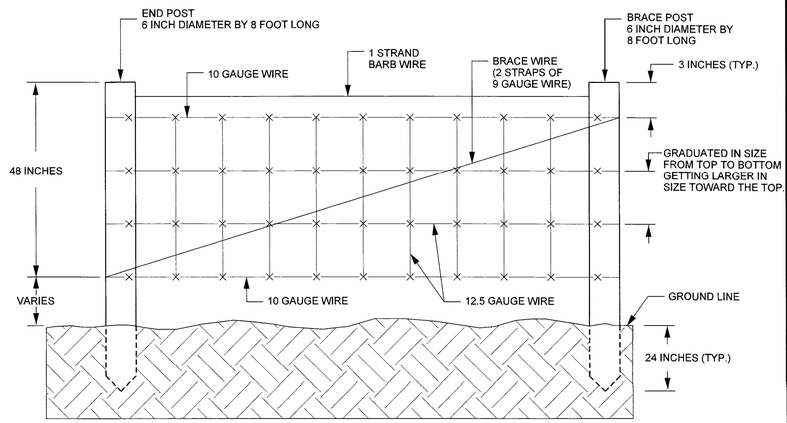
PLAN VIEW



NOTES:

1. COMPACT BACKFILL USING ON-SITE HEAVY EQUIPMENT IN 10 INCH LIFTS.
2. FILL DITCH TO TOP OF BANKS OR AS DIRECTED BY ENGINEER.

WOVEN FIELD FENCE



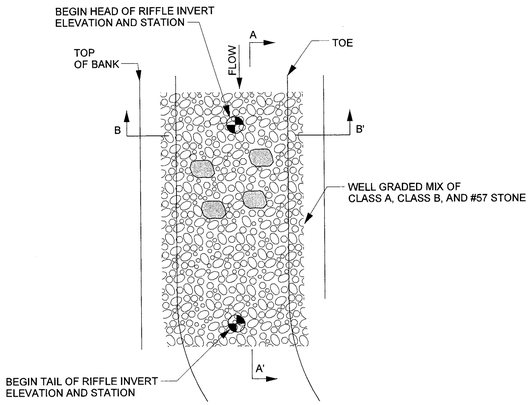
NOTE:

1. END POSTS SHALL BE INSTALLED AT A SPACING OF 10-15 FEET.

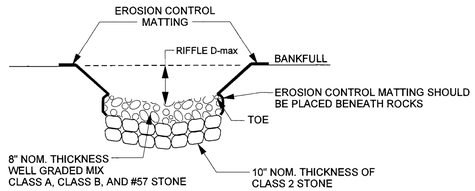
6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_2c.dgn
mpacey

2/26/03

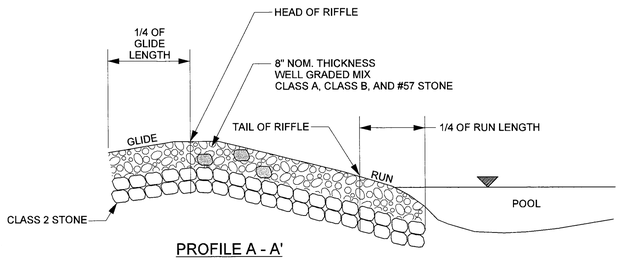
CONSTRUCTED RIFFLE



PLAN VIEW



SECTION B - B'



PROFILE A - A'

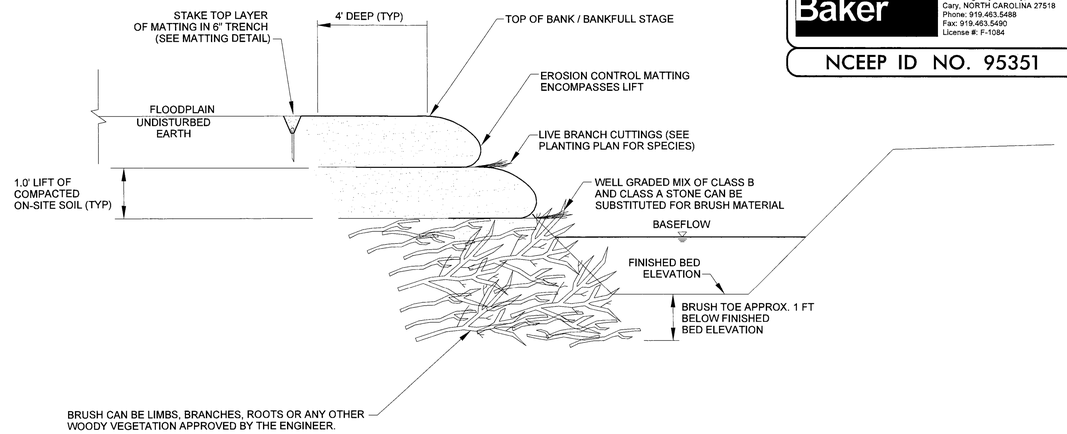
NOTES:

1. UNDERCUT CHANNEL BED ELEVATION 18 INCHES TO ALLOW FOR LAYERS OF STONE.
2. INSTALL EROSION CONTROL MATTING ALONG COMPLETED BANKS SUCH THAT THE EROSION CONTROL MATTING AT THE TOE OF THE BANK EXTENDS DOWN TO THE UNDERCUT ELEVATION.
3. INSTALL SUB LAYER OF CLASS 2 STONE.
4. INSTALL A WELL GRADED MIX OF SPECIFIED STONE, COMPACTED TO GRADE.
5. FINAL CHANNEL BED SHAPE SHOULD BE ROUNDED, SMOOTH, AND CONCAVE, WITH THE ELEVATION OF THE BED 0.2 FT DEEPER IN THE CENTER THAN AT THE EDGES.
6. RIFFLE LENGTHS WILL VARY. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR BEGINNING AND ENDING STATIONS AND ELEVATIONS.

GEOLIFT WITH BRUSH TOE

NOTES:

1. LIVE BRANCH CUTTINGS SHALL BE THE SAME SPECIES AS THE LIVE STAKES AND SHALL BE INSTALLED DURING VEGETATION DORMANCY.
2. LIVE BRANCH CUTTINGS SHALL BE INSTALLED AT A DENSITY OF 20-30 CUTTINGS PER LINEAR FOOT AND A MAXIMUM DIAMETER OF 2.5 INCHES.
3. NUMBER OF SOIL LIFTS MAY VARY IN GENERAL LIFTS SHALL EXTEND TO THE TOP OF BANK OR BANKFULL STAGE.
4. GEOLIFTS TO BE INSTALLED IN CHANNEL SECTIONS ALONG SIDE SLOPES STEEPER THAN 2:1 AND/OR ADJACENT TO HILL SLOPES.



NOTES:

1. WHEN GEOLIFTS ARE BUILT ABOVE ROOTWAD CLUSTER, USE LARGE STONE BACKFILL BEHIND ROOT MASS TO BUILT FOUNDATION.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-D

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 06.18.14 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

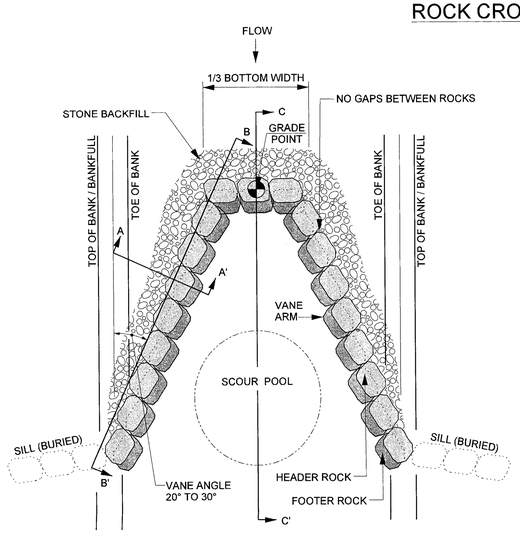
DATE:

Baker

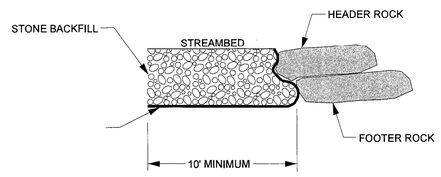
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

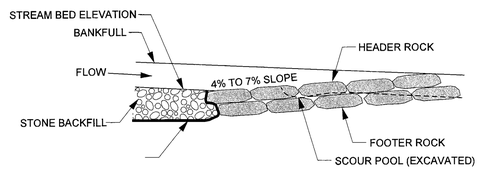
ROCK CROSS VANE



PLAN VIEW



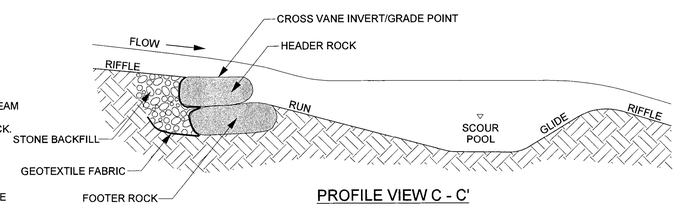
SECTION A - A'



PROFILE VIEW B - B'
VANE ARM

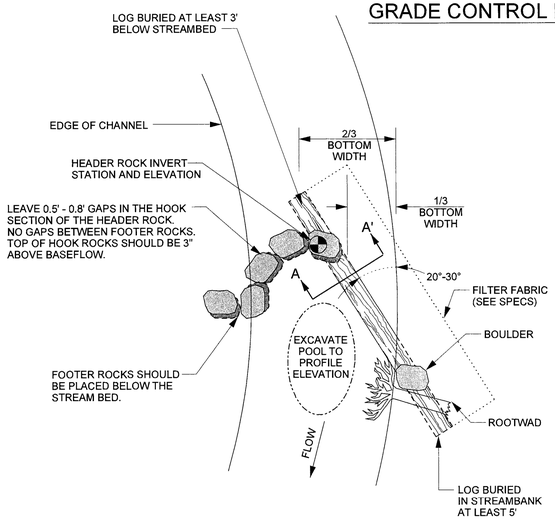
NOTES FOR ALL VANE STRUCTURES:

1. INSTALL BEGINNING AT THE TOP OF THE HEADER ROCKS AND EXTEND DOWNWARD TO THE DEPTH OF THE BOTTOM FOOTER ROCK, AND THEN UPSTREAM TO A MINIMUM OF TEN FEET.
2. DIG A TRENCH BELOW THE BED FOR FOOTER ROCKS AND PLACE FILL ON UPSTREAM SIDE OF VANE ARM, BETWEEN THE ARM AND STREAMBANK.
3. START AT BANK AND PLACE FOOTER ROCKS FIRST AND THEN HEADER (TOP) ROCK.
4. CONTINUE WITH STRUCTURE, FOLLOWING ANGLE AND SLOPE SPECIFICATIONS.
5. AN EXTRA ROCK CAN BE PLACED IN SCOUR POOL FOR HABITAT IMPROVEMENT.
6. USE HAND PLACED STONE TO FILL GAPS ON UPSTREAM SIDE OF HEADER AND FOOTER ROCKS.
7. AFTER ALL STONE BACKFILL HAS BEEN PLACED, FILL IN THE UPSTREAM SIDE OF THE STRUCTURE WITH ON-SITE ALLUVIUM TO THE ELEVATION OF THE TOP OF THE HEADER ROCK.

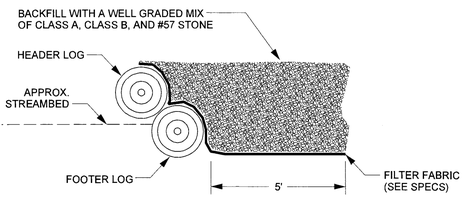


PROFILE VIEW C - C'

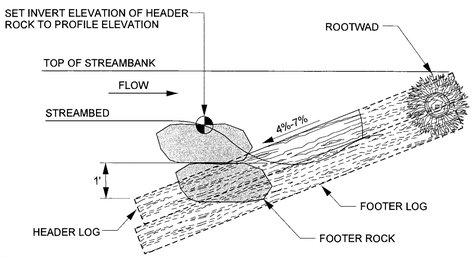
GRADE CONTROL LOG J-HOOK VANE



PLAN VIEW



SECTION A - A'



PROFILE VIEW

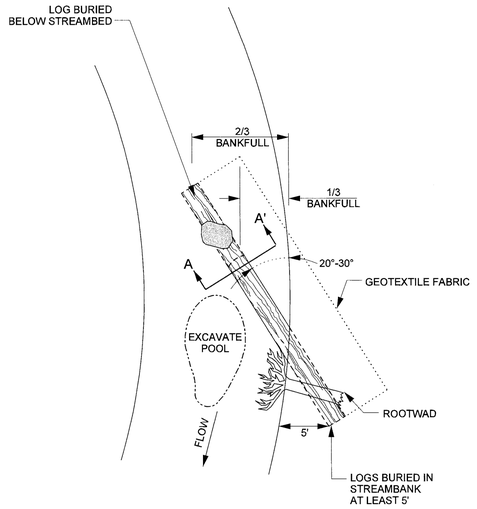
NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE 3' x 2' x 2'.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT SECURES THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDERS SHOULD BE PLACED ON TOP OF HEADER LOG FOR ACHORING.
6. HEADER BOULDERS TO BE PLACED 0.5 TO 0.8 FEET APART.
7. NON-WOVEN FILTER FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
8. FOOTERS SHALL BE INSTALLED SUCH THAT 1/4 TO 1/3 OF THE LENGTH IS DOWNSTREAM OF THE HEADER.

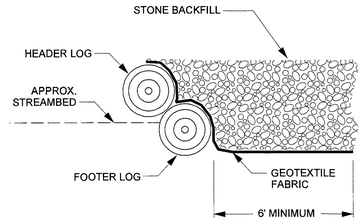
6/18/2014
G:\128975\Design\Plans\128975_HC_PSH_2d.dgn
mcgee

2/26/03

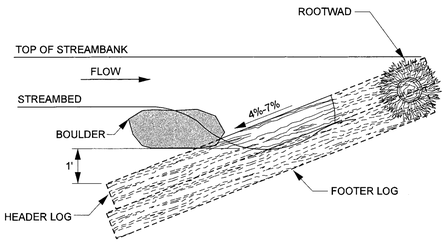
LOG VANE



PLAN VIEW



SECTION A - A'

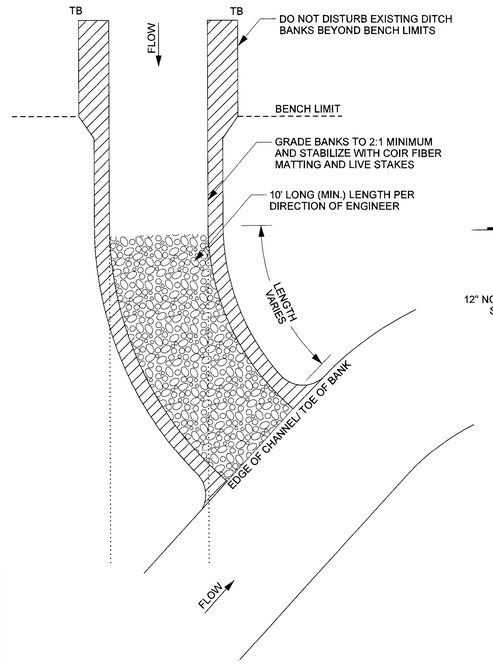


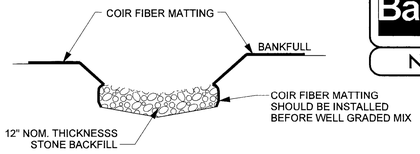
PROFILE VIEW

NOTES:

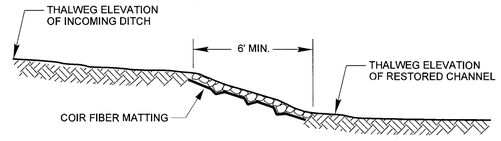
1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED.
2. BOULDERS MUST BE OF SUFFICIENT SIZE TO ANCHOR LOGS.
3. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOGS.
4. ROOTWADS SHOULD BE PLACED BENEATH THE HEADER LOG AND PLACED SO THAT IT LOCKS THE HEADER LOG INTO THE BANK. SEE ROOTWAD DETAIL.
5. BOULDER SHOULD BE PLACED ON TOP OF HEADER LOG FOR ANCHORING.
6. GEOTEXTILE FABRIC SHOULD BE NAILED TO THE LOG BELOW THE BACKFILL.
7. TRANSPLANTS CAN BE USED INSTEAD OF ROOTWADS, PER DIRECTION OF ENGINEER.

TIE-IN SWALE





CROSS-SECTION



TYPICAL PROFILE FOR SWALE

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	2-E

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22957 ENGINEER WILLIAM SCOTT HUNNICUTT III

APPROVED BY:

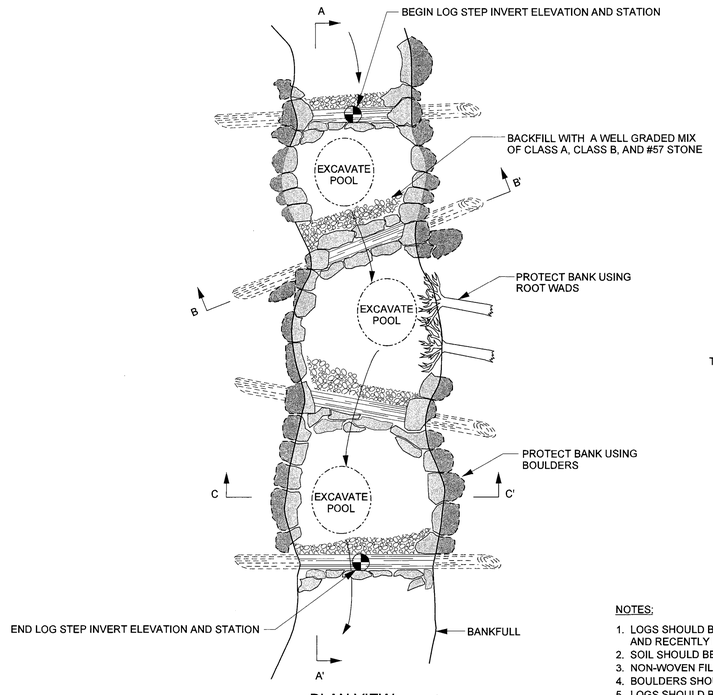
DATE:

Baker

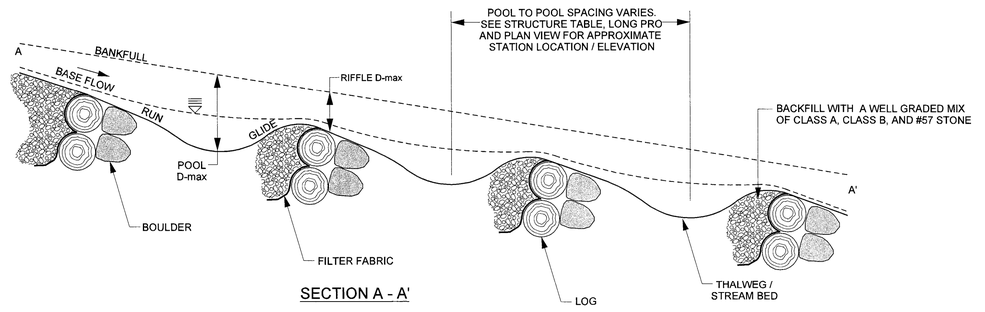
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

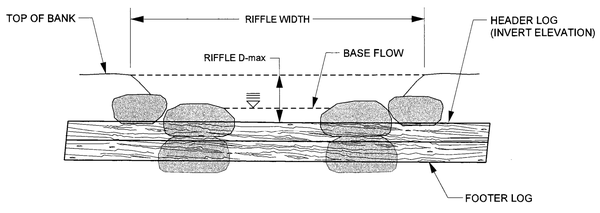
LOG AND ROCK STEP-POOL



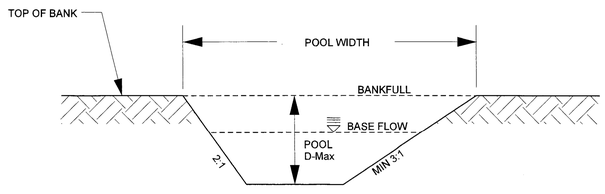
PLAN VIEW



SECTION A - A'



SECTION B - B'



SECTION C - C'

NOTES:

1. LOGS SHOULD BE AT LEAST 10" IN DIAMETER, RELATIVELY STRAIGHT, HARDWOOD, AND RECENTLY HARVESTED AND EXTENDING INTO THE BANK 5' ON EACH SIDE.
2. SOIL SHOULD BE COMPACTED WELL AROUND BURIED PORTIONS OF LOG.
3. NON-WOVEN FILTER FABRIC SHOULD BE NAILED/STAPLED TO THE LOG BELOW THE BACKFILL.
4. BOULDERS SHOULD BE 3' X 2' X 2' AND PLACED ON TOP OF HEADER LOG FOR ANCHORING.
5. LOGS SHOULD BE ANGLED 60° - 70° FROM THE STREAM BANK AND CROSS SLOPES SHOULD NOT EXCEED 2%.
6. STEP HEIGHTS/DROPS SHALL NOT EXCEED 0.4 FT AND POOL DEPTHS NOT TO EXCEED 1.8 FT.
7. THE NUMBER LOG STEPS MAY VARY BETWEEN BEGIN AND END STATIONING DEPENDING ON LOG DIAMETER SIZE. SEE LONGITUDINAL PROFILE AND STRUCTURE TABLE FOR STATION AND ELEVATION.

6/18/2004
R:\128975\Design\Plans\128975_HC_PSH_2e.dgn
mr25541

2/26/03

GENERAL CONSTRUCTION SEQUENCE

MICHAEL BAKER ENGINEERING, INC. WILL PROVIDE CONSTRUCTION OBSERVATION DURING THE CONSTRUCTION PHASE OF THIS PROJECT. THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE USED DURING IMPLEMENTATION OF THE PLAN. CONTRACTOR SHALL REFER TO THE APPROVED SEDIMENTATION AND EROSION CONTROL PLAN FOR SPECIFIC CONSTRUCTION SEQUENCE ITEMS AND SHALL BE RESPONSIBLE FOR FOLLOWING THE APPROVED PLANS AND PERMIT CONDITIONS.

1. CONTRACTOR SHALL CONTACT NORTH CAROLINA "ONE CALL" CENTER (1.800.632.4949) BEFORE ANY EXCAVATION.
2. CONTRACTOR SHALL PREPARE STABILIZED CONSTRUCTION ENTRANCES AND HAUL ROADS AS INDICATED ON THE PLANS.
3. THE CONTRACTOR SHALL MOBILIZE EQUIPMENT, MATERIALS, PREPARE STAGING AREA(S) AND STOCKPILE AREA(S) AS SHOWN ON THE PLANS.
4. CONSTRUCTION TRAFFIC SHALL BE RESTRICTED TO THE AREA DENOTED AS "LIMITS OF DISTURBANCE" OR "HAUL ROADS" ON THE PLANS.
5. THE CONTRACTOR SHALL INSTALL TEMPORARY ROCK DAMS AT LOCATIONS INDICATED ON THE PLANS.
6. THE CONTRACTOR SHALL INSTALL TEMPORARY SILT FENCE AROUND THE STAGING AREA(S). TEMPORARY SILT FENCING WILL ALSO BE PLACED AROUND THE TEMPORARY STOCKPILE AREAS AS MATERIAL IS STOCKPILED THROUGHOUT THE CONSTRUCTION PERIOD.
7. THE CONTRACTOR SHALL INSTALL ALL TEMPORARY AND PERMANENT STREAM CROSSINGS AS SHOWN ON THE PLANS IN ACCORDANCE WITH THE NC EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL. THE EXISTING CHANNEL AND DITCHES ON SITE WILL REMAIN OPEN DURING THE INITIAL STAGES OF CONSTRUCTION TO ALLOW FOR DRAINAGE AND TO MAINTAIN SITE ACCESSIBILITY.
8. THE CONTRACTOR SHALL CONSTRUCT ONLY THE PORTION OF CHANNEL THAT CAN BE COMPLETED AND STABILIZED WITHIN THE SAME DAY.
9. THE CONTRACTOR SHALL APPLY TEMPORARY SEED AND MULCH TO ALL DISTURBED AREAS AT THE END OF EACH WORK DAY.
10. THE CONTRACTOR SHALL CLEAR AND GRUB AN AREA ADEQUATE TO CONSTRUCT THE STREAM CHANNEL AND GRADING OPERATIONS AFTER ALL SEDIMENTATION AND EROSION CONTROL PRACTICES HAVE BEEN INSTALLED AND APPROVED. IN GENERAL, THE CONTRACTOR SHALL WORK FROM UPSTREAM TO DOWNSTREAM AND IN-STREAM STRUCTURES AND CHANNEL FILL MATERIAL SHALL BE INSTALLED USING A PUMP-AROUND OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLANS.
11. THE CONTRACTOR WILL BEGIN CONSTRUCTION BY EXCAVATING CHANNEL FILL MATERIAL IN AREAS SHOWN ON THE PLANS. THE CONTRACTOR MAY FILL DITCHES WHICH DO NOT CONTAIN ANY WATER DURING THE GRADING OPERATIONS. ALONG DITCHES WITH WATER OR STREAM REACHES, EXCAVATED MATERIAL SHOULD BE STOCKPILED IN AREAS SHOWN ON THE PLANS. IN ANY AREAS WHERE EXCAVATION DEPTHS WILL EXCEED 10 INCHES, TOPSOIL SHALL BE STRIPPED, STOCKPILED AND PLACED BACK OVER THESE AREAS TO A MINIMUM DEPTH OF EIGHT INCHES TO ACHIEVE DESIGN GRADES AND CREATE A SOIL BASE FOR VEGETATION.
12. CONTRACTOR SHALL BEGIN CONSTRUCTION ON HURRICANE CREEK-REACH 1 AND UT4-REACH 1B AND PROCEED IN A DOWNSTREAM DIRECTION. THIS SECTION OF DESIGN CHANNEL WILL BE CONSTRUCTED OFFLINE AND IN THE DRY, SINCE IT WILL BE EXCAVATED THROUGH THE FIELD AREAS. THE CONTRACTOR SHALL EXCAVATE THE CHANNEL TO DESIGN GRADES IN ALL AREAS EXCEPT WITHIN 10 FEET OF THE TOP OF EXISTING STREAM BANKS.
13. AFTER EXCAVATING THE CHANNEL TO DESIGN GRADES, INSTALL IN-STREAM STRUCTURES, GRASSING, MATTING, AND TRANSPLANTS IN THIS SECTION, AND READY THE CHANNEL TO ACCEPT FLOW PER APPROVAL BY THE ENGINEER.
14. WATER WILL BE TURNED INTO THE CONSTRUCTED CHANNEL ONCE THE AREA IN AND AROUND THE NEW CHANNEL HAS BEEN STABILIZED. IMMEDIATELY BEGIN PLUGGING, FILLING, AND GRADING THE ABANDONED CHANNEL, AS SHOWN ON PLANS, MOVING IN A DOWNSTREAM DIRECTION TO ALLOW FOR DRAINAGE OF THE OLD CHANNELS. NO WATER SHALL BE TURNED INTO ANY SECTION OF CHANNEL PRIOR TO THE CHANNEL BEING COMPLETELY STABILIZED WITH ALL STRUCTURES INSTALLED.
15. THE NEW CHANNEL SECTIONS SHALL REMAIN OPEN ON THE DOWNSTREAM END TO ALLOW FOR DRAINAGE DURING RAIN EVENTS.
16. ANY GRADING ACTIVITIES ADJACENT TO THE STREAM CHANNEL SHALL BE COMPLETED PRIOR TO TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS. GRADING ACTIVITIES SHALL NOT BE PERFORMED WITHIN 10 FEET OF THE NEW STREAM CHANNEL BANKS. THE CONTRACTOR SHALL NOT GRADE OR ROUGHEN ANY AREAS WHERE EXCAVATION ACTIVITIES HAVE NOT BEEN COMPLETED.
17. ONCE A STREAM WORK PHASE IS COMPLETE, APPLY TEMPORARY SEEDING, PERMANENT SEEDING, AND MULCHING TO ANY AREAS DISTURBED DURING CONSTRUCTION. APPLY PERMANENT SEEDING MIXTURES, AS SHOWN ON THE VEGETATION PLAN. TEMPORARY SEEDING SHALL BE APPLIED IN ALL AREAS SUSCEPTIBLE TO EROSION (I.E. DISTURBED DITCH BANKS, STEEP SLOPES, AND SPOIL AREAS) SUCH THAT GROUND COVER IS ESTABLISHED WITHIN 15 WORKING DAYS FOLLOWING COMPLETION OF ANY PHASE OF GRADING. PERMANENT GROUND COVER SHALL BE ESTABLISHED FOR ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER IS SHORTER) FOLLOWING COMPLETION OF CONSTRUCTION.
18. CONTRACTOR SHALL IMPROVE AND CONSTRUCT THE EXISTING FARM ROAD CROSSINGS BY INSTALLING PERMANENT CULVERTS AND/OR FORD CROSSINGS, STABILIZING SIDE SLOPES, AND MODIFYING THE FARM ROAD BED ELEVATIONS ACCORDING TO THE PLANS AND SPECIFICATIONS.
19. ALL DISTURBED AREAS SHOULD BE SEEDED AND MULCHED BEFORE LEAVING THE PROJECT. REMOVE TEMPORARY STREAM CROSSINGS AND ANY IN-STREAM TEMPORARY ROCK DAMS. ALL WASTE MATERIAL MUST BE REMOVED FROM THE PROJECT SITE.
20. THE CONTRACTOR SHALL TREAT AREAS OF INVASIVE SPECIES VEGETATION THROUGHOUT THE PROJECT AREA ACCORDING TO THE PLANS AND SPECIFICATIONS PRIOR TO DEMOBILIZATION.
21. THE CONTRACTOR SHALL PLANT WOODY VEGETATION AND LIVE STAKES, ACCORDING TO PLANTING DETAILS AND SPECIFICATIONS. THE CONTRACTOR SHALL COMPLETE THE REFORESTATION (BARE-ROOT PLANTING) PHASE OF THE PROJECT AND APPLY PERMANENT SEEDING AT THE APPROPRIATE TIME OF THE YEAR.
22. THE CONTRACTOR SHALL ENSURE THAT THE SITE IS FREE OF TRASH AND LEFTOVER MATERIALS PRIOR TO DEMOBILIZATION OF EQUIPMENT FROM THE SITE.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	3

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

2/26/03

BEGIN CONSTRUCTION HURRICANE CREEK - REACH 1
STA. 10+00.00

NAD 83

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	4

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 27067 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

VALLEY PROTIENS, INC.
PID#6477-00-82-1042
656 LITTLE DUNCAN RD.
DB 221 PG 14

T. A. McRAE, III AND WIFE
JANICE S. McRAE
PID#6487-00-23-0123
2911 PINKSTON RIVER RD.
DB 160 PG 205

TIE INTO EXISTING FENCE

INSTALL WOVEN WIRE FENCE (TYP.)

DO NOT DISTURB EXISTING TREES OUTSIDE OF CONSERVATION EASEMENT

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INSTALL GEOLIFT w/BRUSH TOE (TYP.)

FLOW

INSTALL ROOT WADS (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL J-HOOK (TYP.)

INSTALL WOVEN WIRE FENCE (TYP.)

INSTALL CONSTRUCTED RIFFLE (TYP.)

INSTALL LOG JAM (TYP.)

MATCHLINE SHEET 5 STA. 23+00.00

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+

4' BWF 215

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

HURRICANE CREEK PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_04.dgn
mcarey

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	5

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNNICUTT III

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83

VALLEY PROTIENS, INC.
PID#9477-00-82-1042
656 LITTLE DUNCAN RD.
DB 221 PG 14

T. A. McRAE, III AND WIFE
JANICE S. McRAE
PID#9487-00-23-9123
2911 PINKSTON RIVER RD.
DB 160 PG 205

S 22°09'49" E 3703.87'

BEGIN CONSTRUCTION REACH 3
STA. 10+00.00

INSTALL PERMANENT CULVERT STREAM CROSSING
(1) 36" RCP AT 0.4' BELOW STREAMBED ELEVATION.

TIE INTO EXISTING FENCE

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INSTALL WOVEN WIRE FENCE (TYP.)

35° 02'53.03" LATITUDE
80° 04'01.66" LONGITUDE

INSTALL LOG JAM (TYP.)

INSTALL LOG WEIR (TYP.)

FLOW

DO NOT DISTURB EXISTING TREES OUTSIDE OF CONSERVATION EASEMENT

INSTALL 16' GATE

DO NOT DISTURB EXISTING WELL

END CONSTRUCTION REACH 3
STA. 15+97.86

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INSTALL WOVEN WIRE FENCE (TYP.)

INSTALL GRADE CONTROL J-HOOK VANE (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL GEOLIFT w/BRUSH TOE (TYP.)

INSTALL ROOT WADS (TYP.)

CATTLE CROSSING

TIE EXISTING DITCH INTO PROPOSED CHANNEL W/ TIE-IN SWALE

INSTALL PERMANENT FORD STREAM CROSSING

END CONSTRUCTION HURRICANE CREEK - REACH 1 =
BEGIN CONSTRUCTION HURRICANE CREEK - REACH 2
STA. 30+55.00

DO NOT DISTURB EXISTING WATER LINE APPROX. 12"-18" DEEP

INSTALL 8' GATE

INSTALL 16' GATE

INSTALL 8' GATE

DO NOT DISTURB EXISTING WELL

MATCHLINE SHEET 4 STA. 23+00.00

MATCHLINE SHEET 6 STA. 35+50.00

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

HURRICANE CREEK PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_05.dgn
mcneil

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	6

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

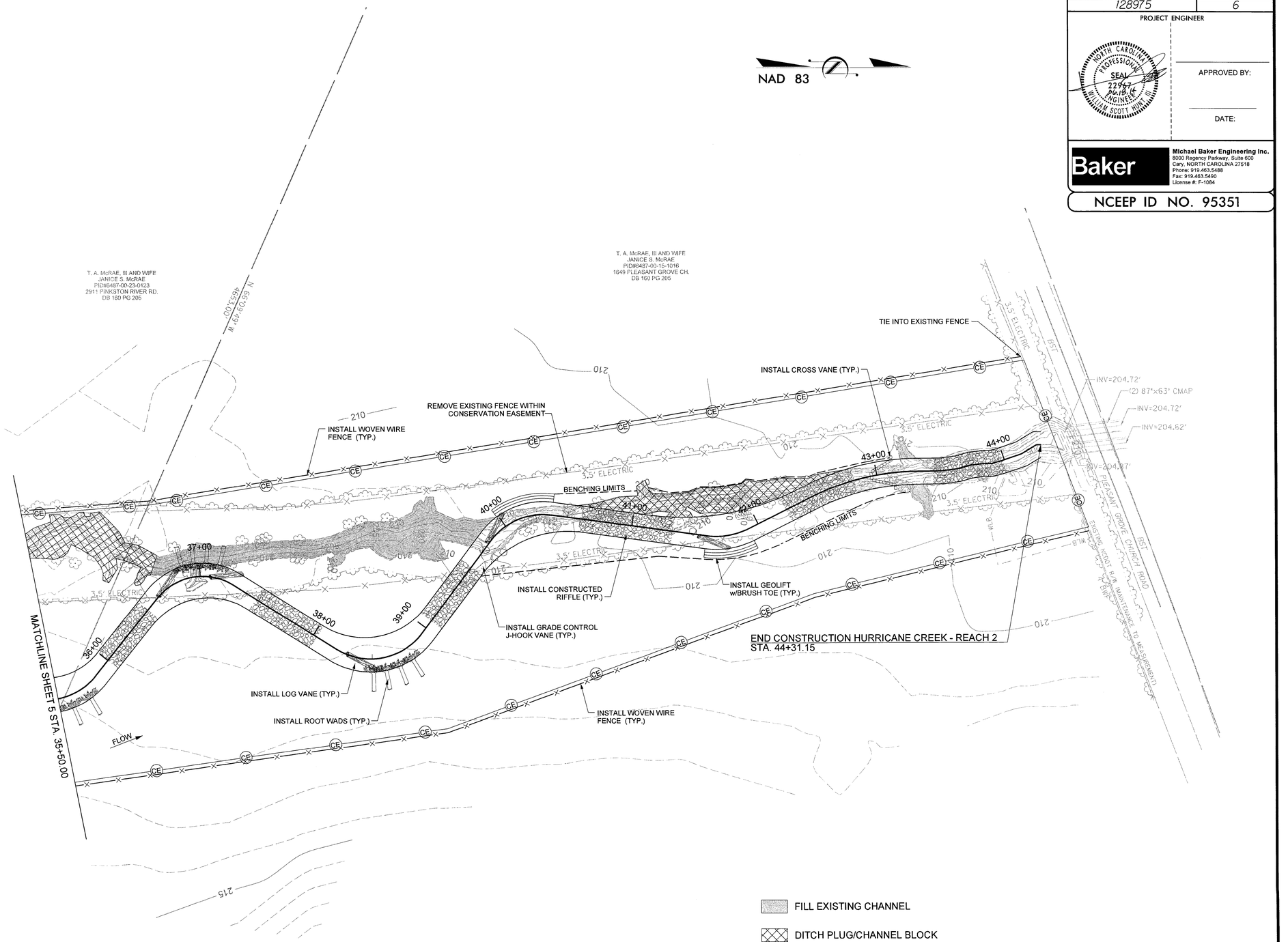
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

HURRICANE CREEK PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2004
R:\128975\Design\Plans\128975_HC_PSH_06.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	7

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83

ALAN DALE McRAE
PID#6497-00-45-2685
NC 109
DB 951 PG 182

115 KV LINE PROGRESS ENERGY
BLEWETT FALLS TO TILLERY

TWIN PP

70' 115 KV LINE R/W

BEGIN CONSTRUCTION UT4 - REACH 1A
STA. 10+00.00

END CONSTRUCTION UT4 - REACH 1A
STA. 15+11.14

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00

INSTALL GEOLIFT w/BRUSH TOE (TYP.)

BENCHING LIMITS

INSTALL GRADE CONTROL J-HOOK VANE (TYP.)

INSTALL ROOT WADS (TYP.)

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INV=220.53'
INV=220.02'
24" CMP

INV=219.32'
INV=219.32'

INSTALL PERMANENT CULVERT STREAM CROSSING
REMOVE EXISTING CMP AND REPLACE WITH (1) 36" RCP
INV. IN = 219.60
INV. OUT = 219.40

BEGIN CONSTRUCTION UT4 - REACH 1B
STA. 16+30.80

MATCHLINE SHEET 8 STA. 22+00.00

NAIL SET IN CONCRETE

FLOW

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

NOTE:

NO CONSTRUCTION ACTIVITIES SHALL BE PERFORMED ALONG UT4 - REACH 1A FROM STA. 10+00.00 TO 15+11.00 (PRESERVATION SECTION ONLY)

UT4 PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_UT4_PSH_07.dgn

2/25/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	8

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III
06-18-14

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

NAD 83

MATCHLINE SHEET 13 STA. 27+00.00

INSTALL LOG WEIR (TYP.)

INSTALL LOG JAM (TYP.)

ALAN DALE McRAE
PID#6497-00-45-2835
NC 109
DB 951 PG 182

LOUIS EDWARD HATEM, A UNDIVIDED INTEREST
WILLIAM MICHAEL HATEM, JR., A UNDIVIDED INTEREST
PID#6497-00-13-8104
1632 PLEASANT GROVE CH.
DB 404 PG 8

END CONSTRUCTION UT4 - REACH 5
STA. 30+34.84

TIE INTO EXISTING FENCE

INSTALL 8' GATE

INSTALL WOVEN WIRE FENCE (TYP.)

INSTALL LOG AND ROCK STEP POOL (TYP.)

INSTALL PERMANENT FORD STREAM CROSSING

INSTALL ROOT WADS (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL CONSTRUCTED RIFFLE (TYP.)

MATCHLINE SHEET 9 STA. 32+00.00

MATCHLINE SHEET 7 STA. 22+00.00

END CONSTRUCTION UT4 - REACH 1B =
BEGIN CONSTRUCTION UT4 - REACH 2
STA. 24+80.08

FLOW

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

S 81°07'58" E
136.89'

FENCE POST

AMERICAN TIMBERLAND II, LLC
C/O POWELL, GOLDSTEIN, FRAZER & MURPHY LLP
PID#6497-00-25-5531
NC 109
DB 507 PG 190

UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_UT4_PSH_08.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	9

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83

MATCHLINE SHEET 8 STA. 32+00.00

MATCHLINE SHEET 10 STA. 24+00.00

LOUIS EDWARD HATEM, A UNDIVIDED INTEREST
WILLIAM MICHAEL HATEM, JR., A UNDIVIDED INTEREST
PID#6497-03-13-8194
1632 PLEASANT GROVE CH.
DB 404 PG 8

AMERICAN TIMBERLAND II, LLC
C/O POWELL, GOLDSTEIN, FRAZER & MURPHY LLP
PID#6497-09-25-5531
NC 109
DB 507 PG 190

INSTALL WOVEN WIRE FENCE (TYP.)

INSTALL LOG VANE (TYP.)

INSTALL TRANSPLANTS (TYP.)

REMOVE EXISTING FENCE WITHIN CONSERVATION EASEMENT

INSTALL GEOLIFT w/BRUSH TOE (TYP.)

INSTALL ROOT WADS (TYP)

INSTALL LOG JAM (TYP)

REMOVE AND RELOCATE FOOT BRIDGE (BY OTHERS)

INSTALL 16' GATE

INSTALL LOG & ROCK STEP POOL (TYP.)

INSTALL 8' GATE

INSTALL J-HOOK (TYP.)

INSTALL ROCK CROSS VANE (TYP)

EXISTING FENCE TO REMAIN ALONG PROPERTY LINE

TIE INTO EXISTING FENCE

FLOW

END CONSTRUCTION UT4 - REACH 4B =
BEGIN CONSTRUCTION UT4 - REACH 3
STA. 28+96.70

END CONSTRUCTION UT4 - REACH 2
STA. 43+36.87

END CONSTRUCTION UT4 - REACH 3
STA. 31+24.16

S 84°20'14" E
1713.32'

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2004
R:\128975\Design\Plans\128975_UT4_PSH_09.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	10

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22867 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

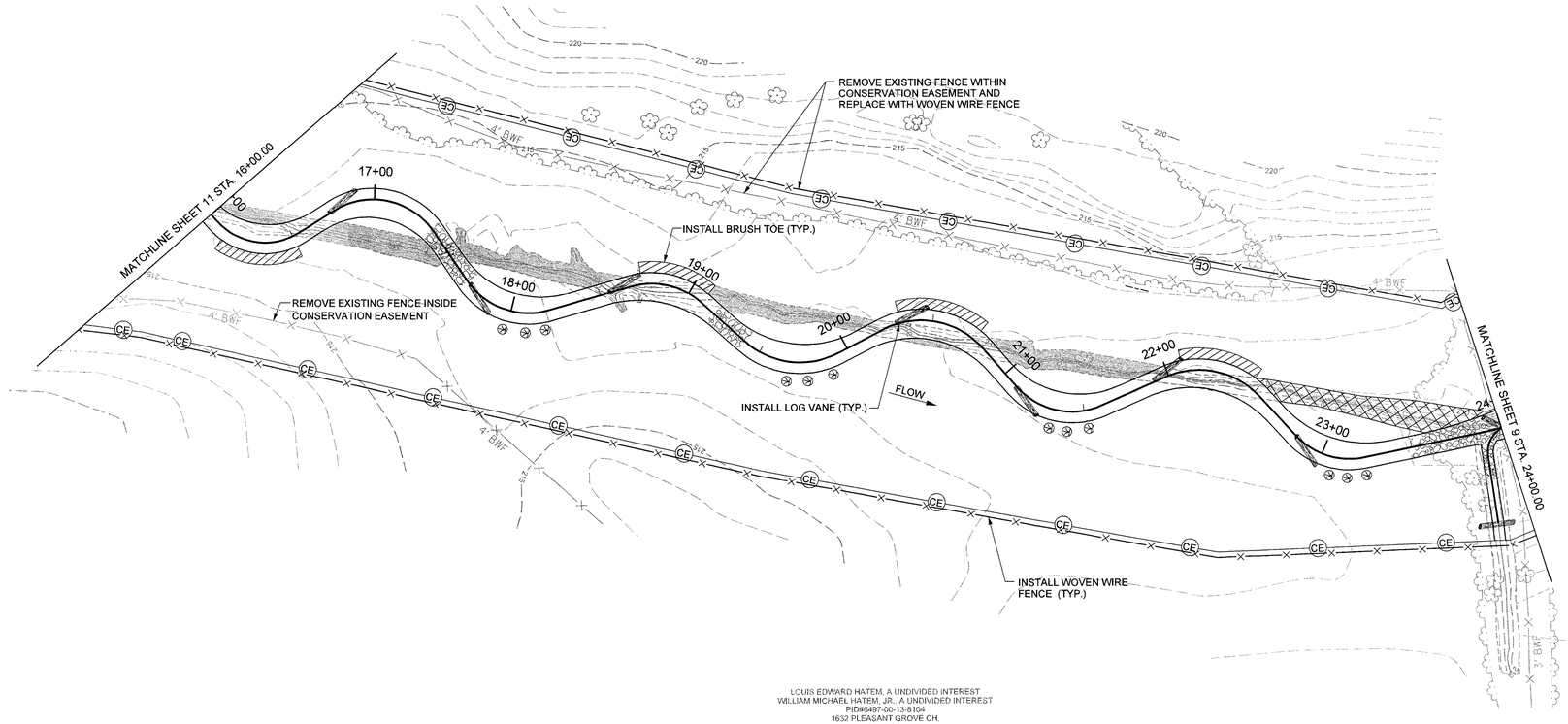
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/16/2014
R:\128975\Design\Plans\128975_UT4_PSH_10.dgn
mgeisl

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	11

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNNIII

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83

DAVID M. EDWARDS AND WIFE,
SHARON R. EDWARDS
PID#6497-00-01-9703
1649 PLEASANT GROVE CH.
DB 327 PG 214

END CONSTRUCTION UT4 - REACH 4A
STA. 13+94.55

INSTALL 16' GATE

INSTALL 8' GATE

BEGIN CONSTRUCTION UT4 - REACH 4B
STA. 14+25.30

INSTALL WOVEN WIRE FENCE (TYP.)

TIE INTO EXISTING FENCE

INSTALL LOG WEIR (TYP.)

INSTALL BRUSH TOE (TYP.)

INSTALL LOG JAM (TYP.)

FLOW

INSTALL PERMANENT FORD STREAM CROSSING

INSTALL ROOTWADS (TYP)

MATCHLINE SHEET 10 STA. 15+00.00

TIE INTO EXISTING FENCE

INSTALL WOVEN WIRE FENCE (TYP.)

INSTALL 16' GATE

REMOVE EXISTING FENCE INSIDE CONSERVATION EASEMENT

BEGIN CONSTRUCTION UT4 - REACH 4A
STA. 10+00.00

LOUIS EDWARD HATEM, A UNDIVIDED INTEREST
WILLIAM MICHAEL HATEM, JR., A UNDIVIDED INTEREST
PID#6497-00-13-8104
1632 PLEASANT GROVE CH.
DB 404 PG 8

T. LYNN CLODFELTER
AND WIFE, J. ELAINE CLODFELTER
PID#6496-00-13-3539
1384 PLEASANT GROVE CH.
DB 408 PG 84

AXLE

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT4 PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2004
R:\128975\Design\Plans\128975_UT4_PSH_11.dgn
jrogers

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	12

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

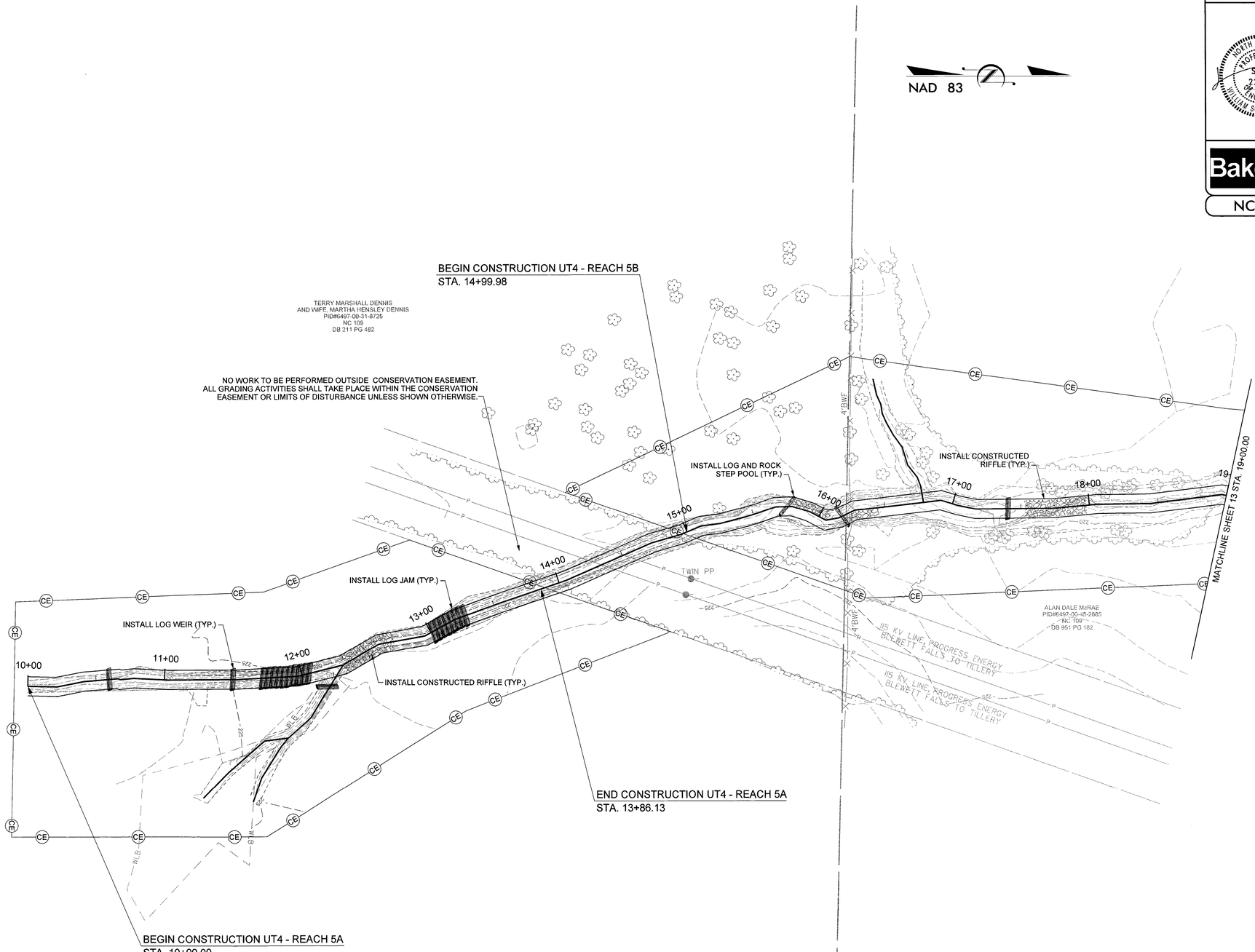
APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351



UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2004
R:\128975\Design\Plans\128975_UT4_PSH_12.dgn
mcgee

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	13

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22867 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

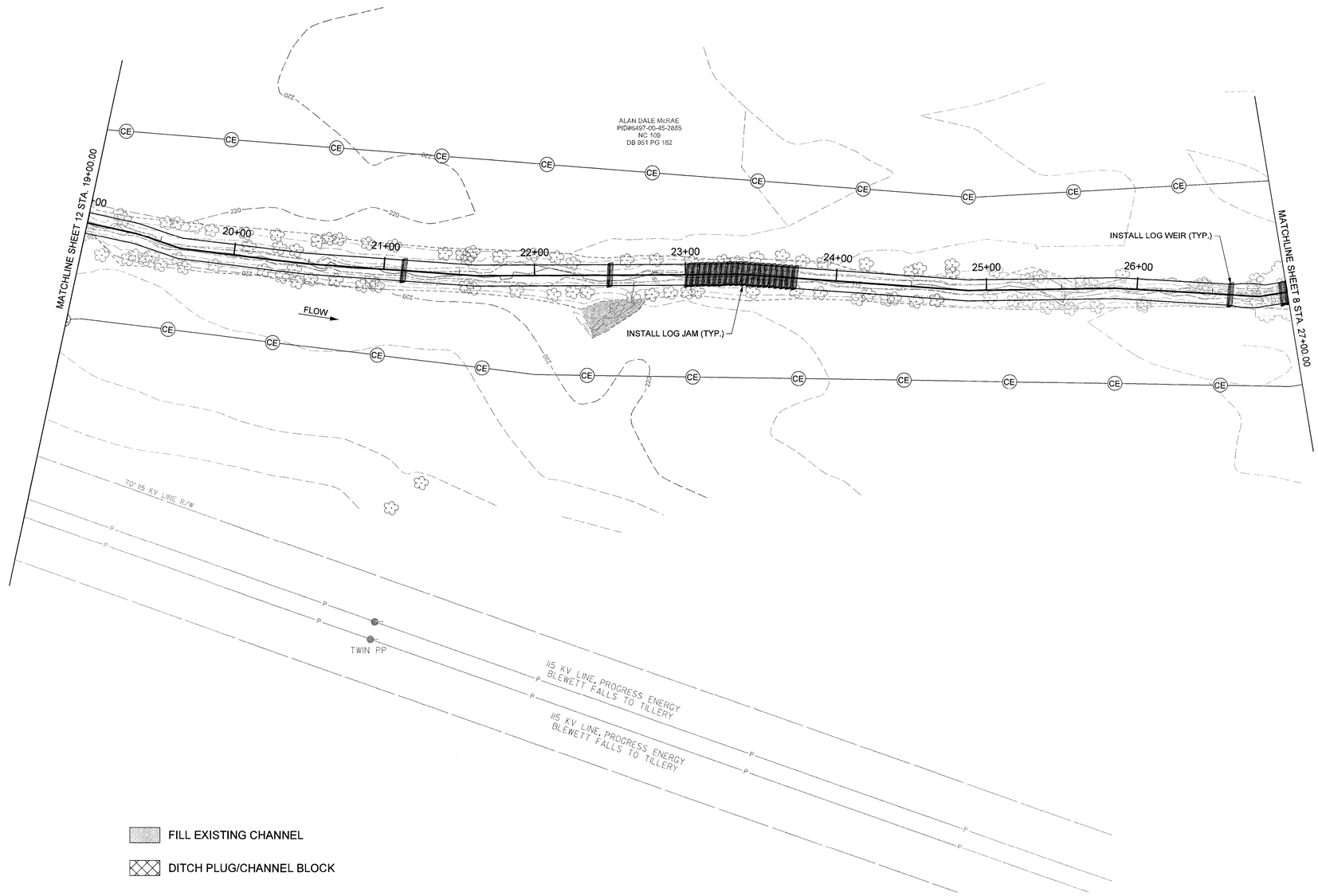
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

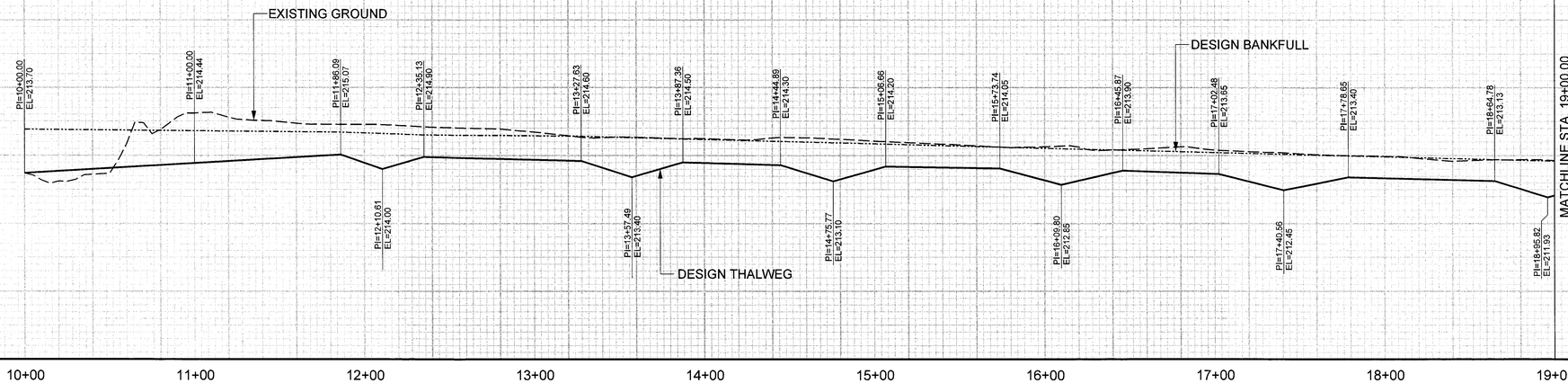
UT4
PLAN VIEW

40 20 0 40 80
SCALE (FT)

6/18/2004
R:\128975\Design\Plans\128975_UT4_PSH_13.dgn

2/26/03

HURRICANE CREEK - REACH 1



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	14

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNTER

APPROVED BY:

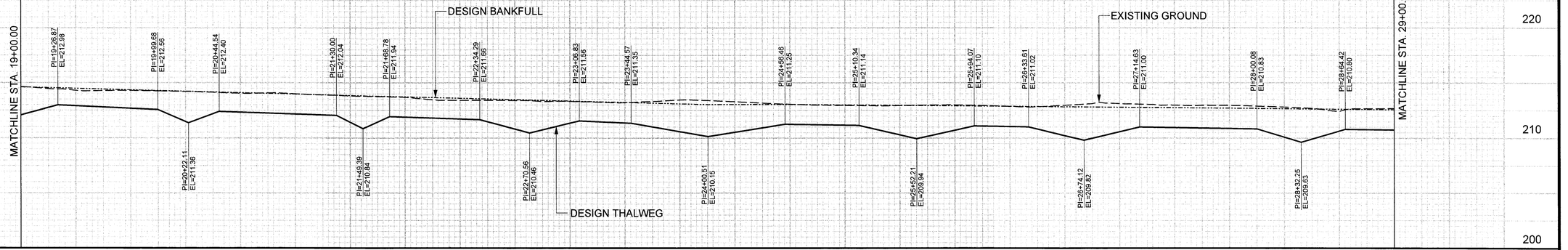
DATE:

Baker

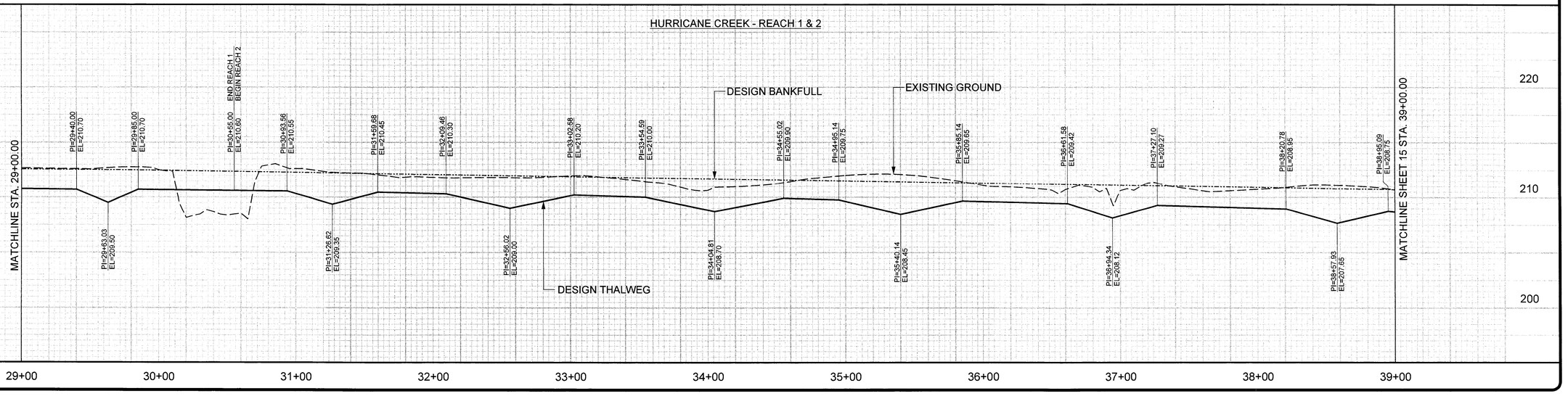
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

HURRICANE CREEK - REACH 1



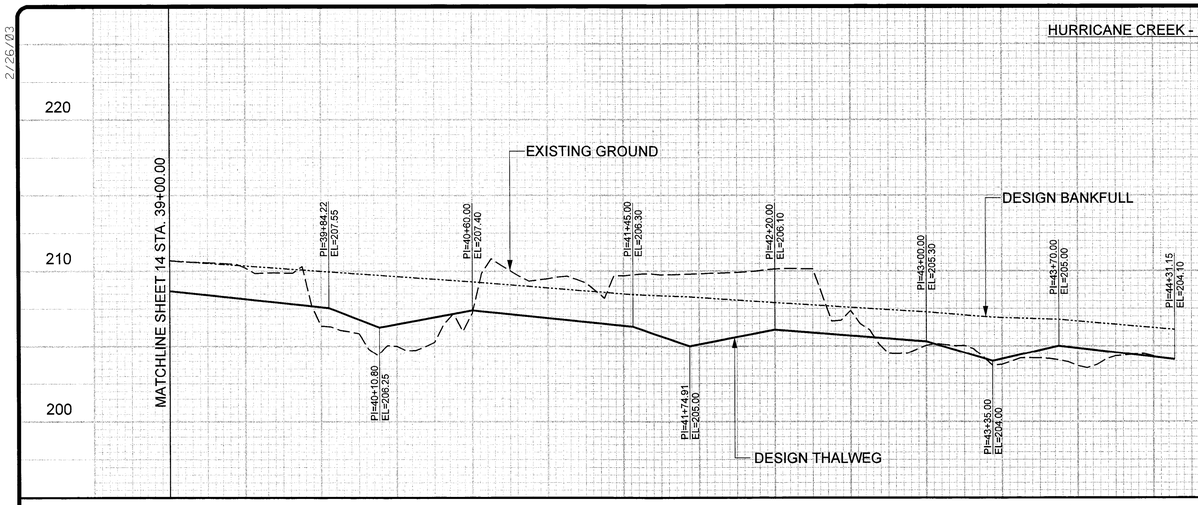
HURRICANE CREEK - REACH 1 & 2



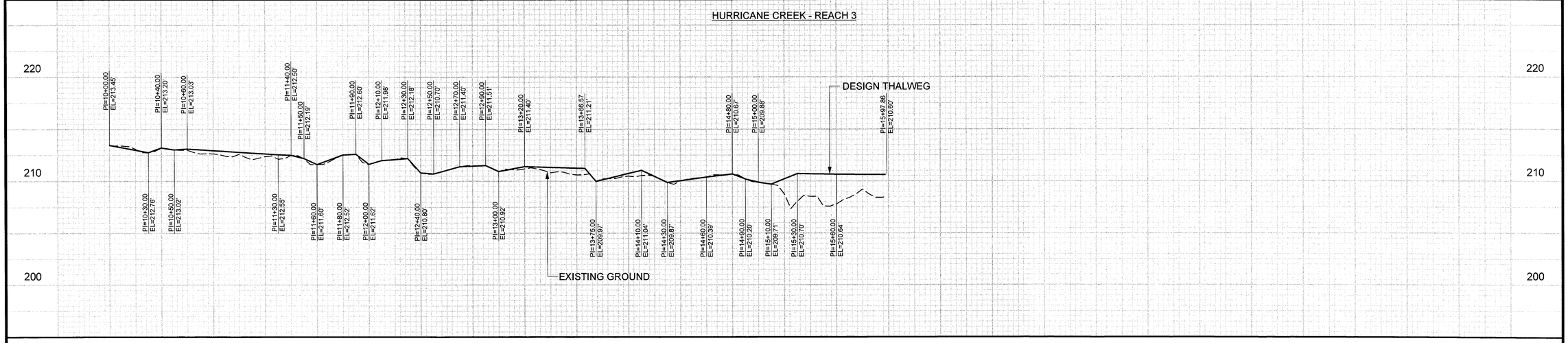
6/18/2014
R:\128975\Design\Plans\128975_PFL_14.dgn
04:24:46 PM

2/26/03

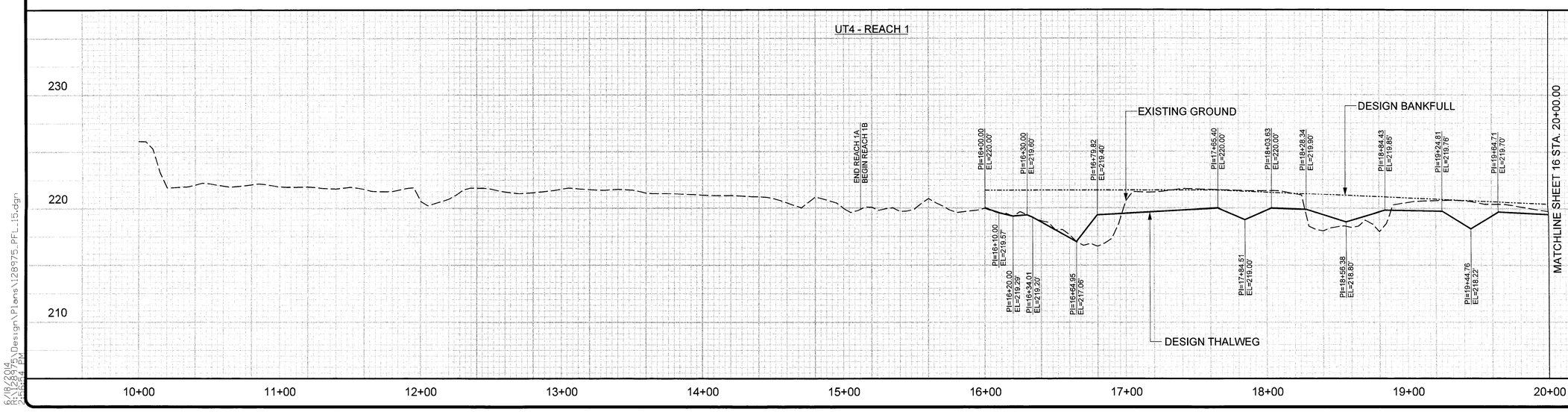
HURRICANE CREEK - REACH 2



HURRICANE CREEK - REACH 3



UT4 - REACH 1



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	15

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

APPROVED BY:

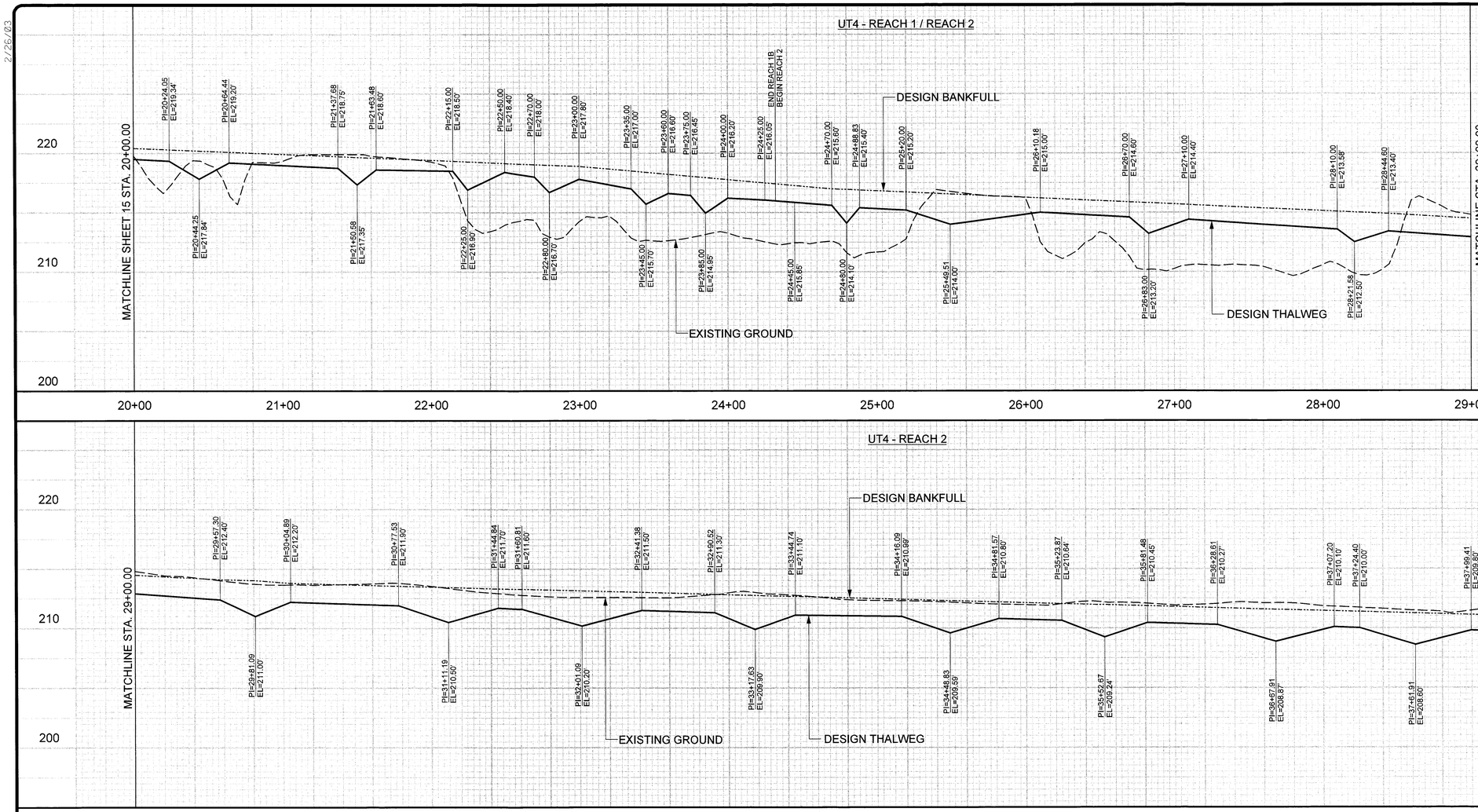
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

2/26/03



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	16

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

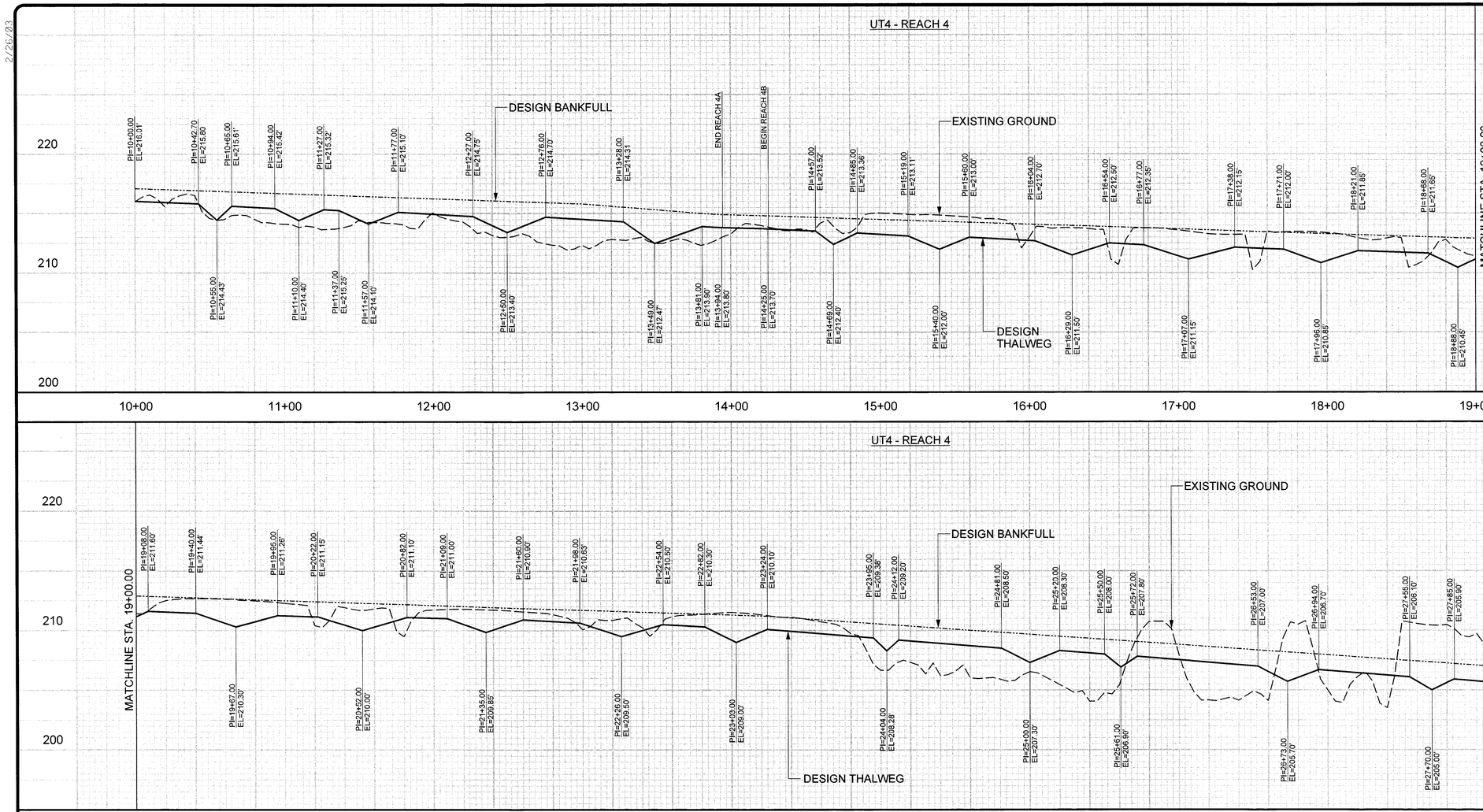
Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

6/18/2014
R:\128975\Design\Plans\128975_PFL_16.dgn
2:47:16 PM

2/26/03



BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	17

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

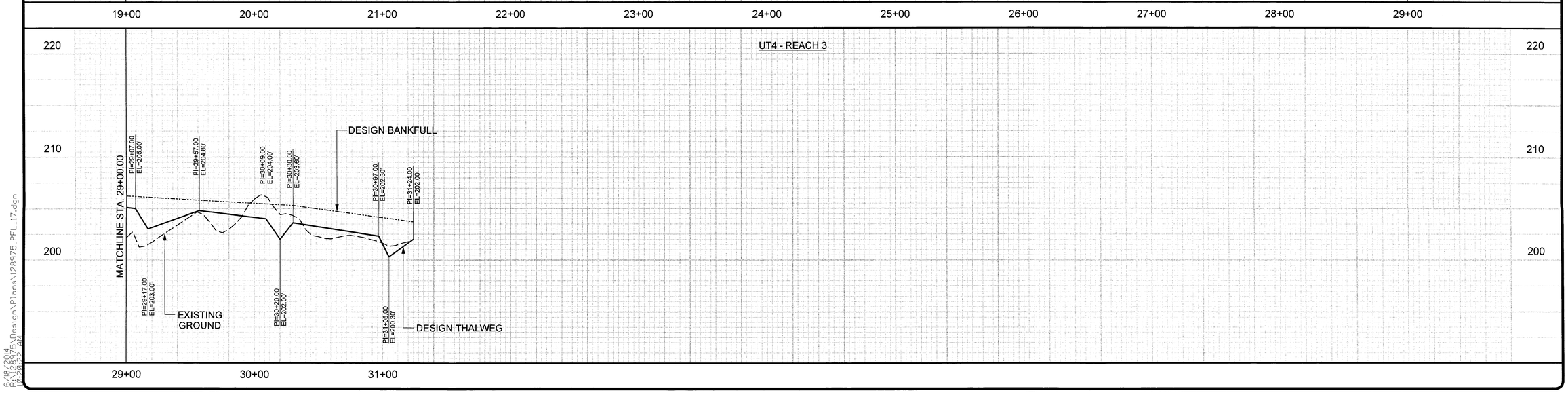
APPROVED BY:

DATE:

Baker

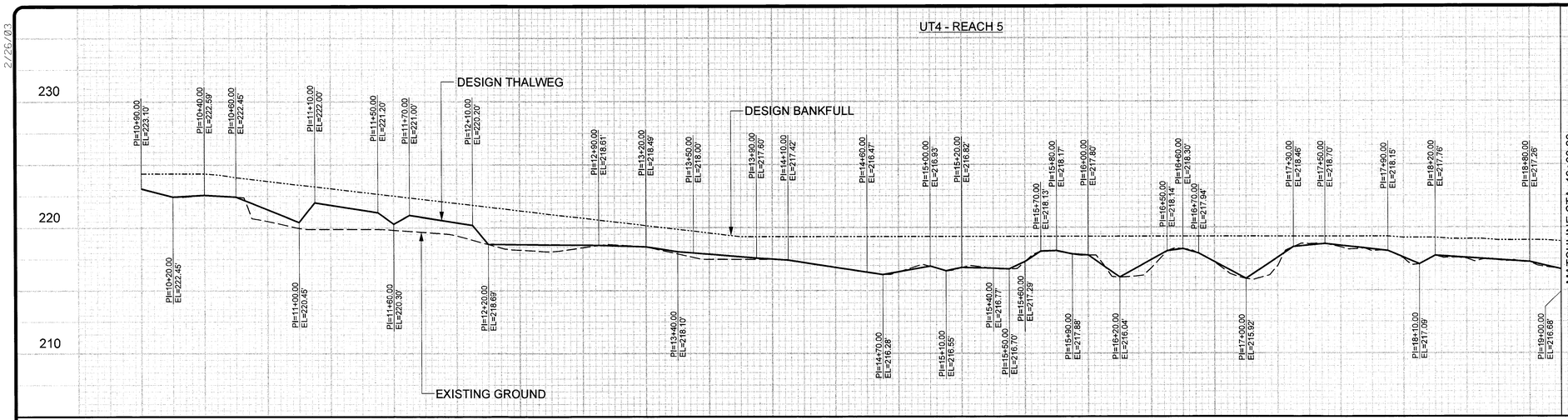
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

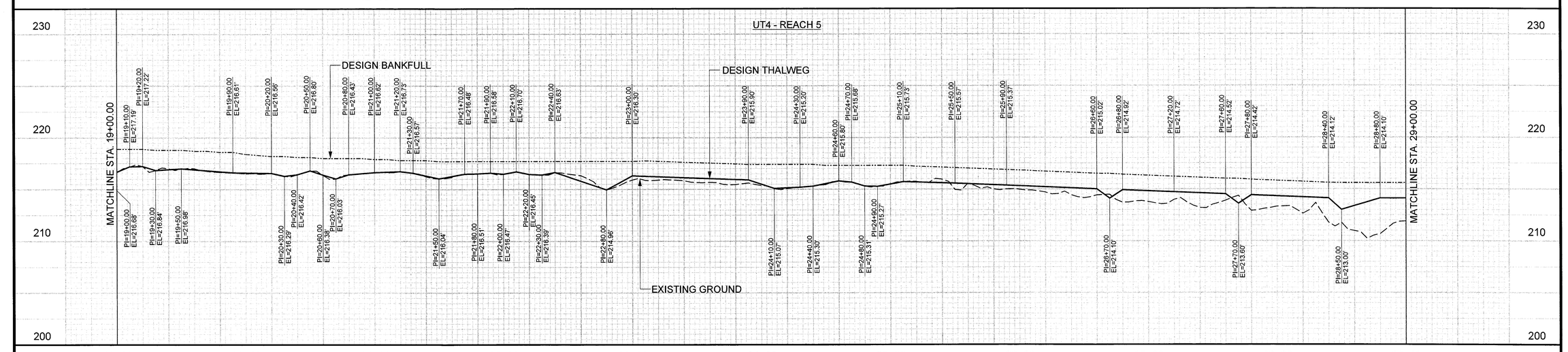
NCEEP ID NO. 95351

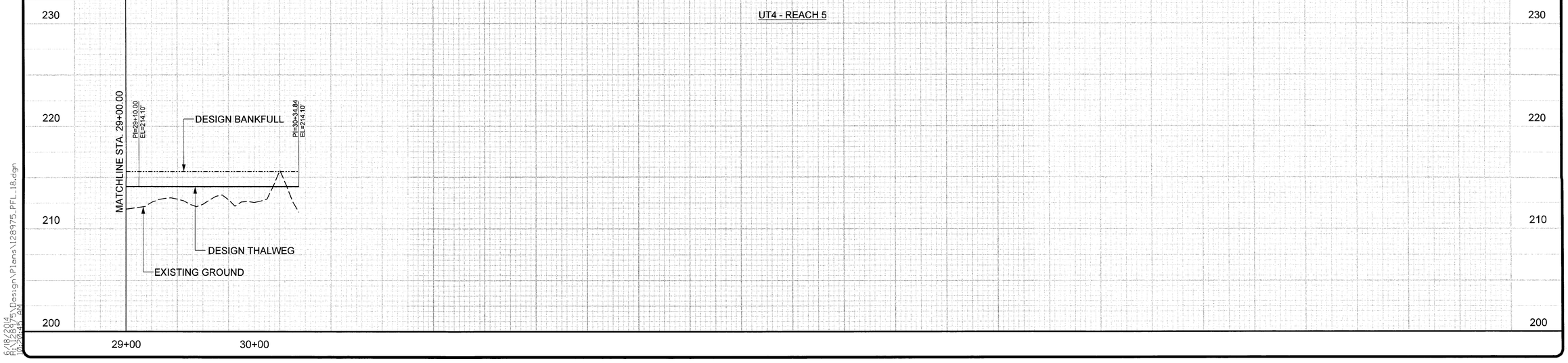


6/18/2014
R:\128975\Design\Plans\128975_PFL_17.dgn
mhall

2/26/03







BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	18

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22965 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

6/18/2004
R:\128975\Design\Plans\128975_PFL_18.dgn
10:28:15 AM

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	19

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

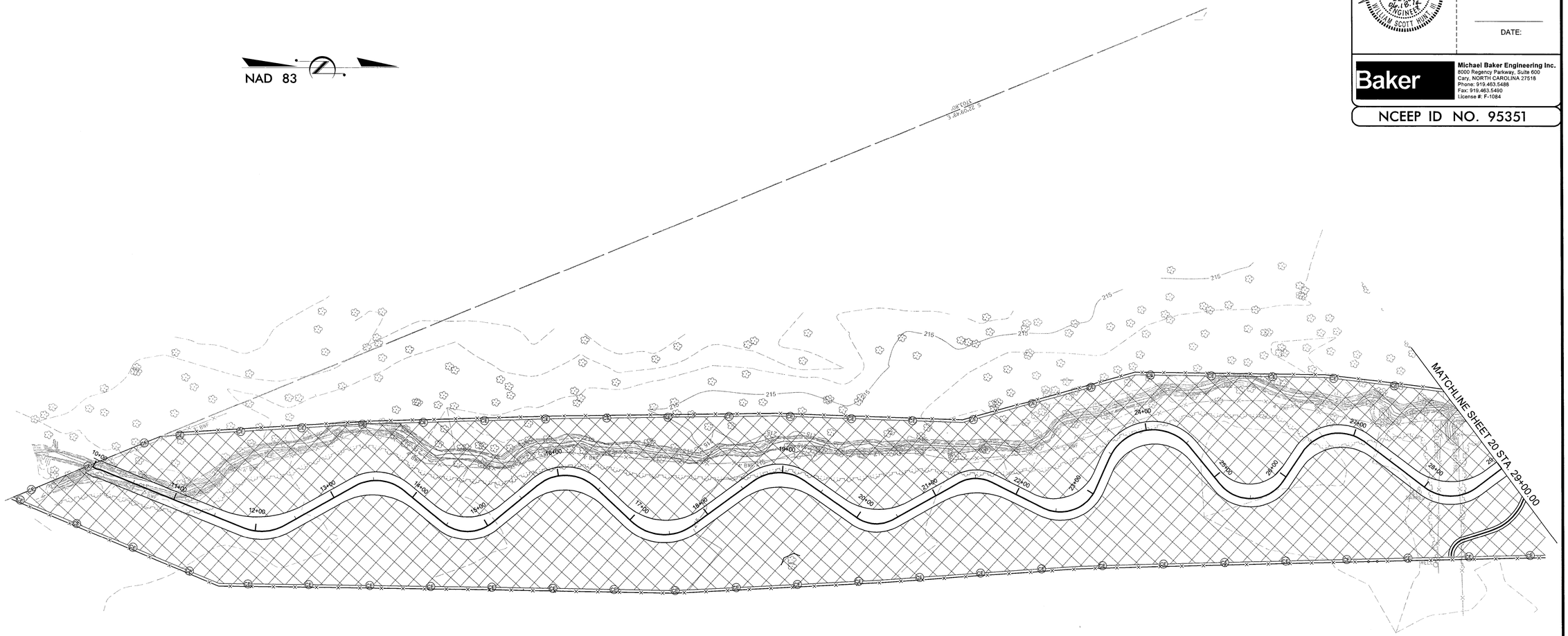
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:

1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

HURRICANE CREEK VEGETATION PLAN

60 30 0 60 120
SCALE (FT)

6/18/2004
8:21:28 AM
R:\128975\Design\Plans\128975_HC_PSH_VEG_19.dgn

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	20

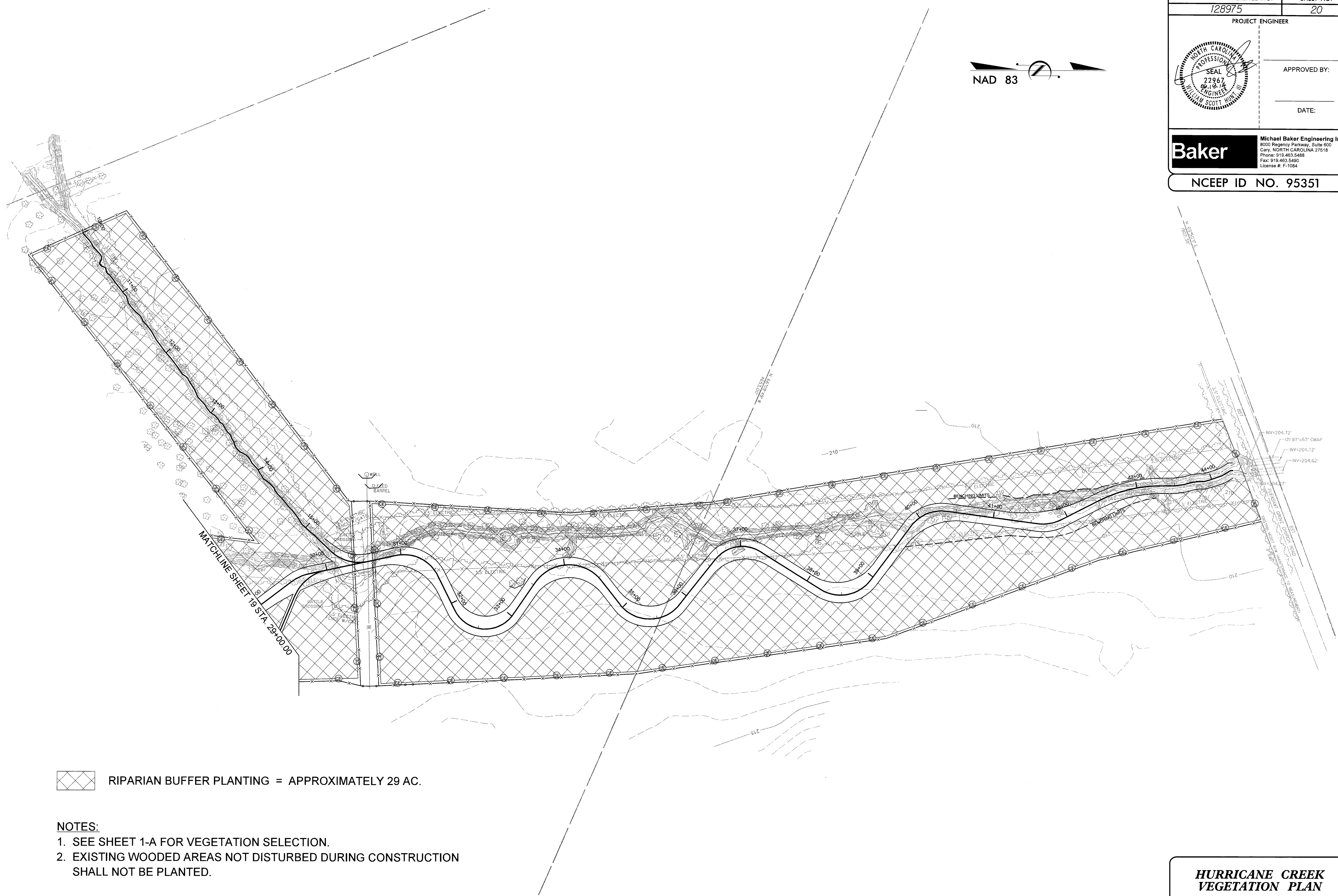
PROJECT ENGINEER

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:

1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

HURRICANE CREEK VEGETATION PLAN

60 30 0 60 120

SCALE (FT)

2/26/03

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_VEG_20.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	21

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

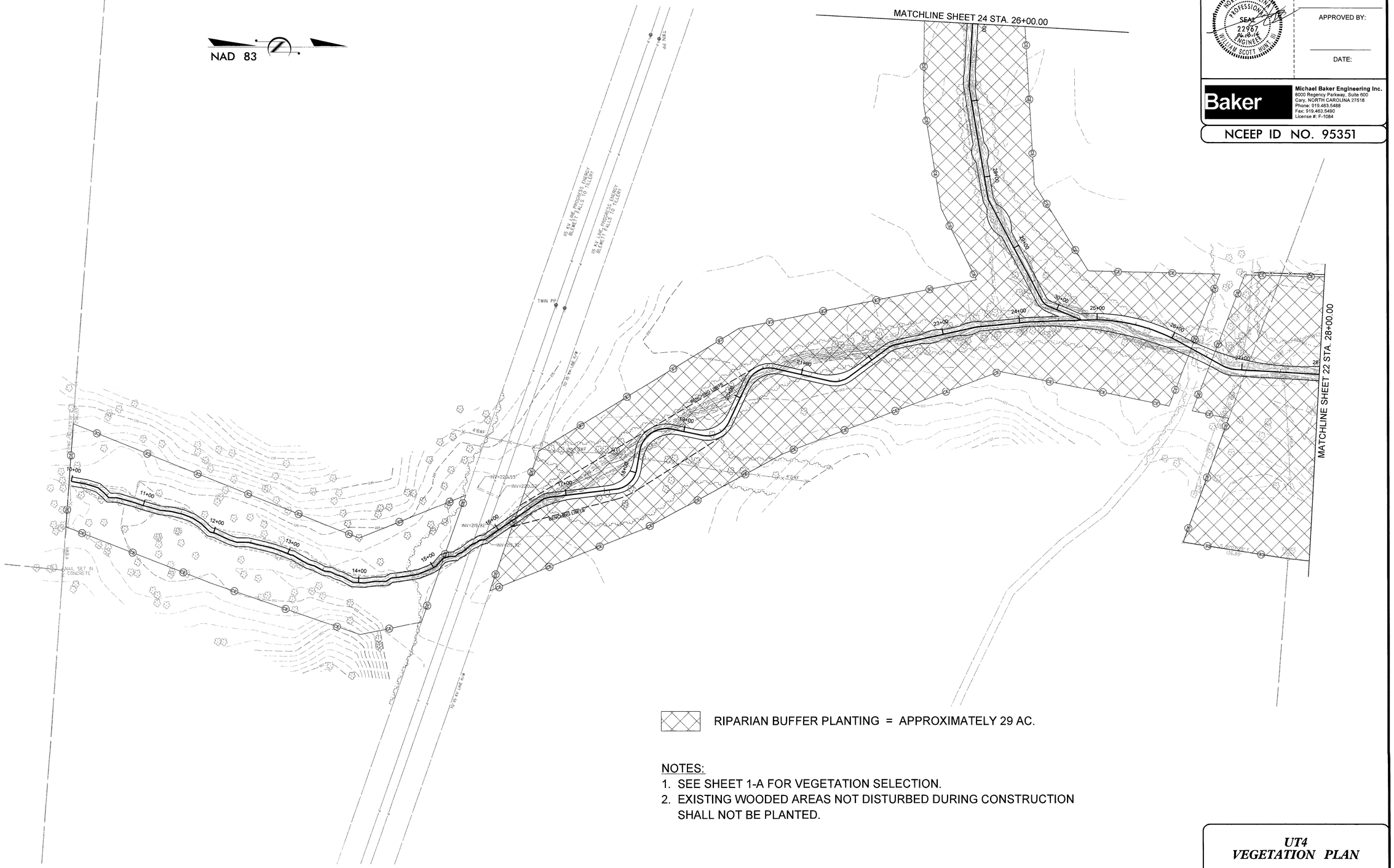
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT4
VEGETATION PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_VEG_21.dgn
mrandall

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	22

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

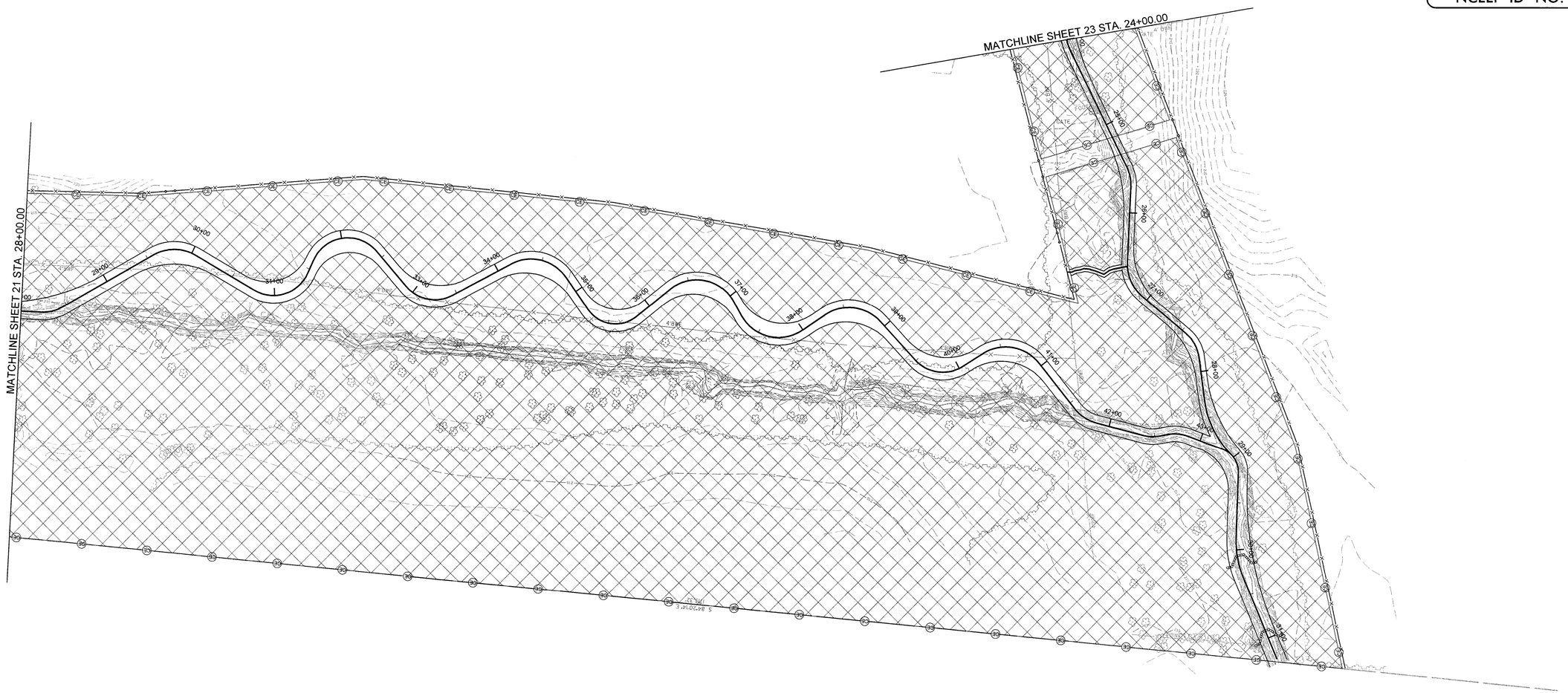
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:

1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT4
VEGETATION PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_VEG_22.dgn
mcoffey

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	23

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

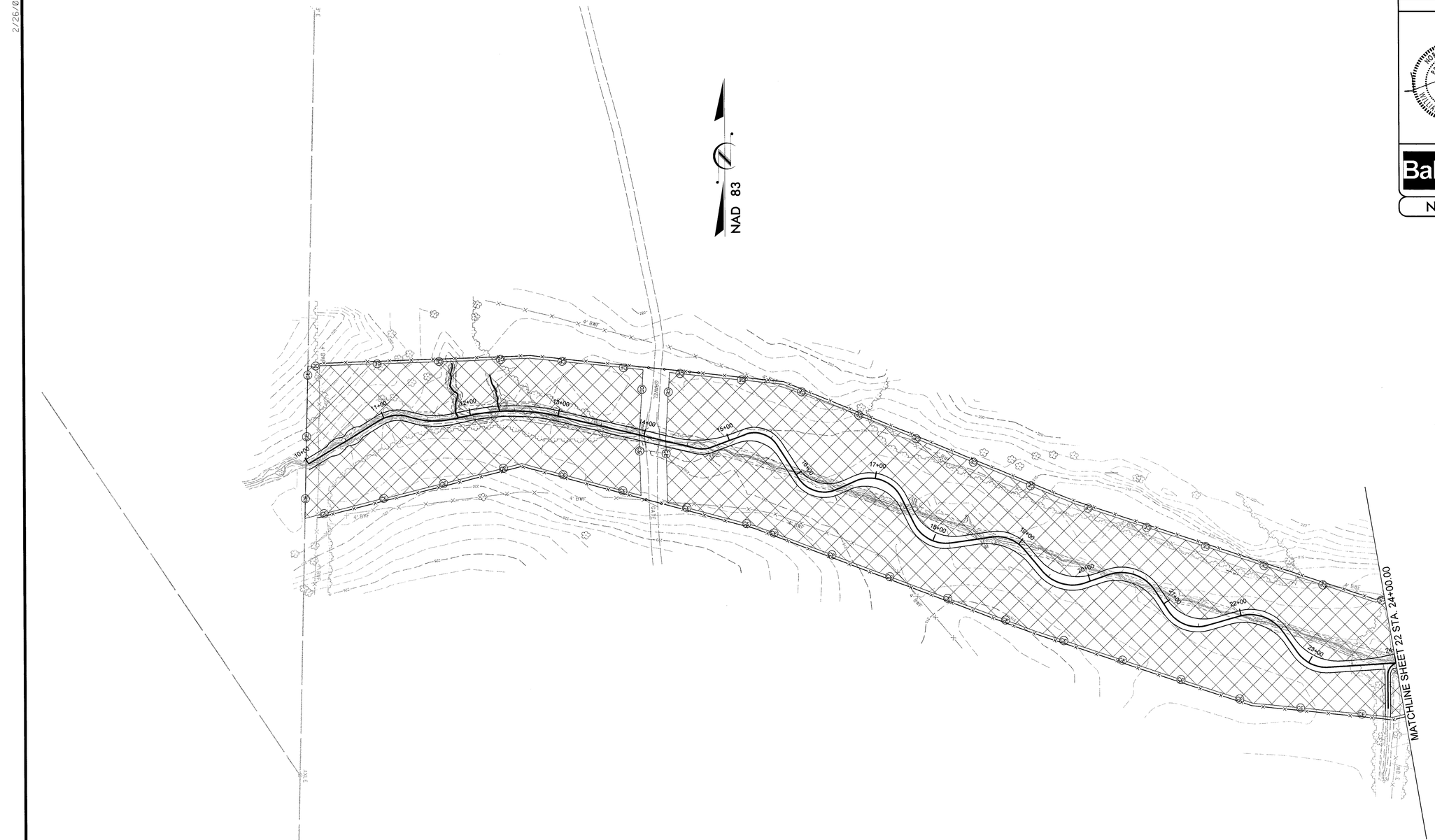
APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT4
VEGETATION PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_VEG_23.dgn
mcasey

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	24

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22861 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

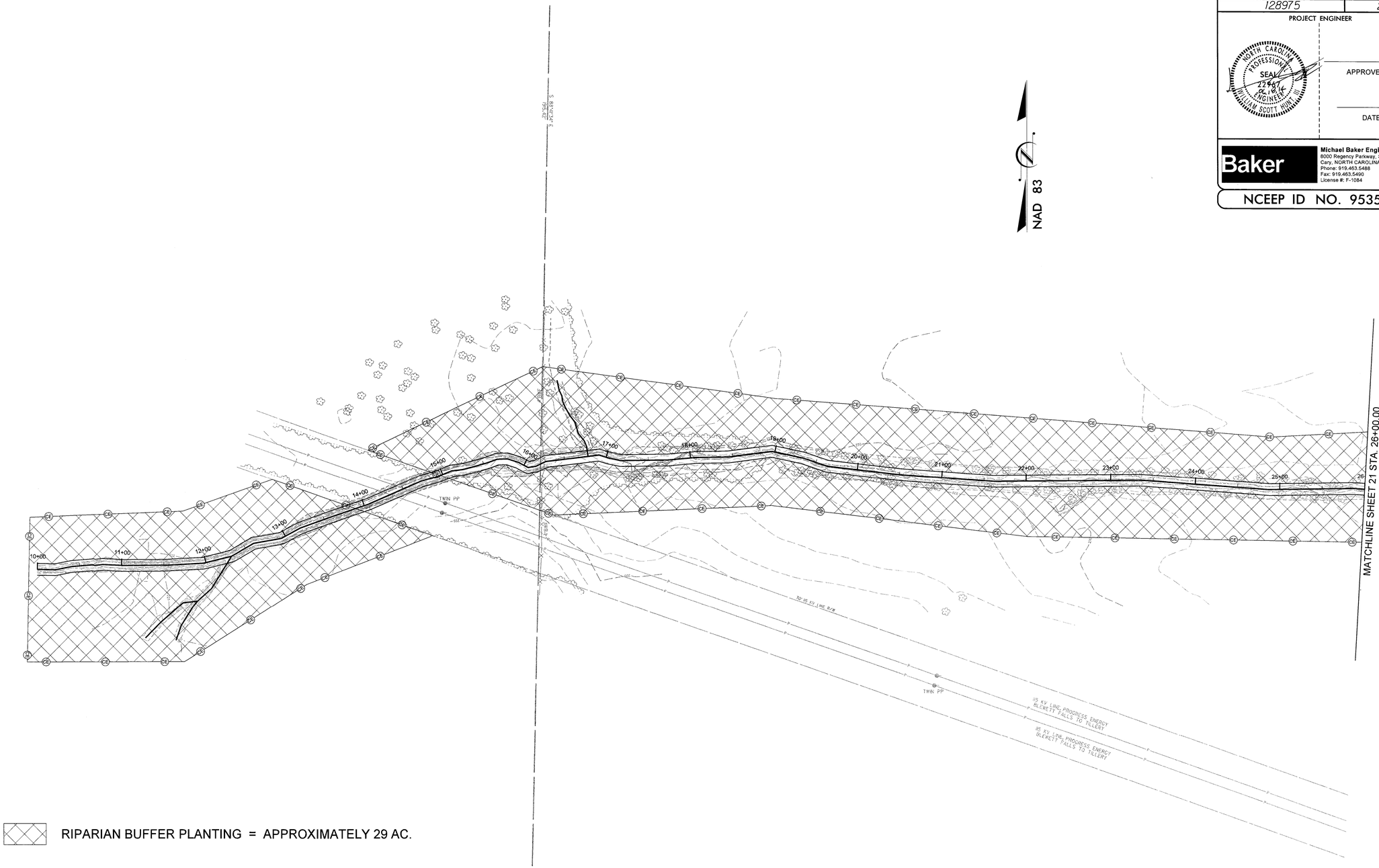
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



RIPARIAN BUFFER PLANTING = APPROXIMATELY 29 AC.

NOTES:
1. SEE SHEET 1-A FOR VEGETATION SELECTION.
2. EXISTING WOODED AREAS NOT DISTURBED DURING CONSTRUCTION SHALL NOT BE PLANTED.

UT4
VEGETATION PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_VEG_24.dgn
mpaez

STATE	BAKER PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
NC	128975	EC-1	9

NORTH CAROLINA
ECOSYSTEM ENHANCEMENT PROGRAM

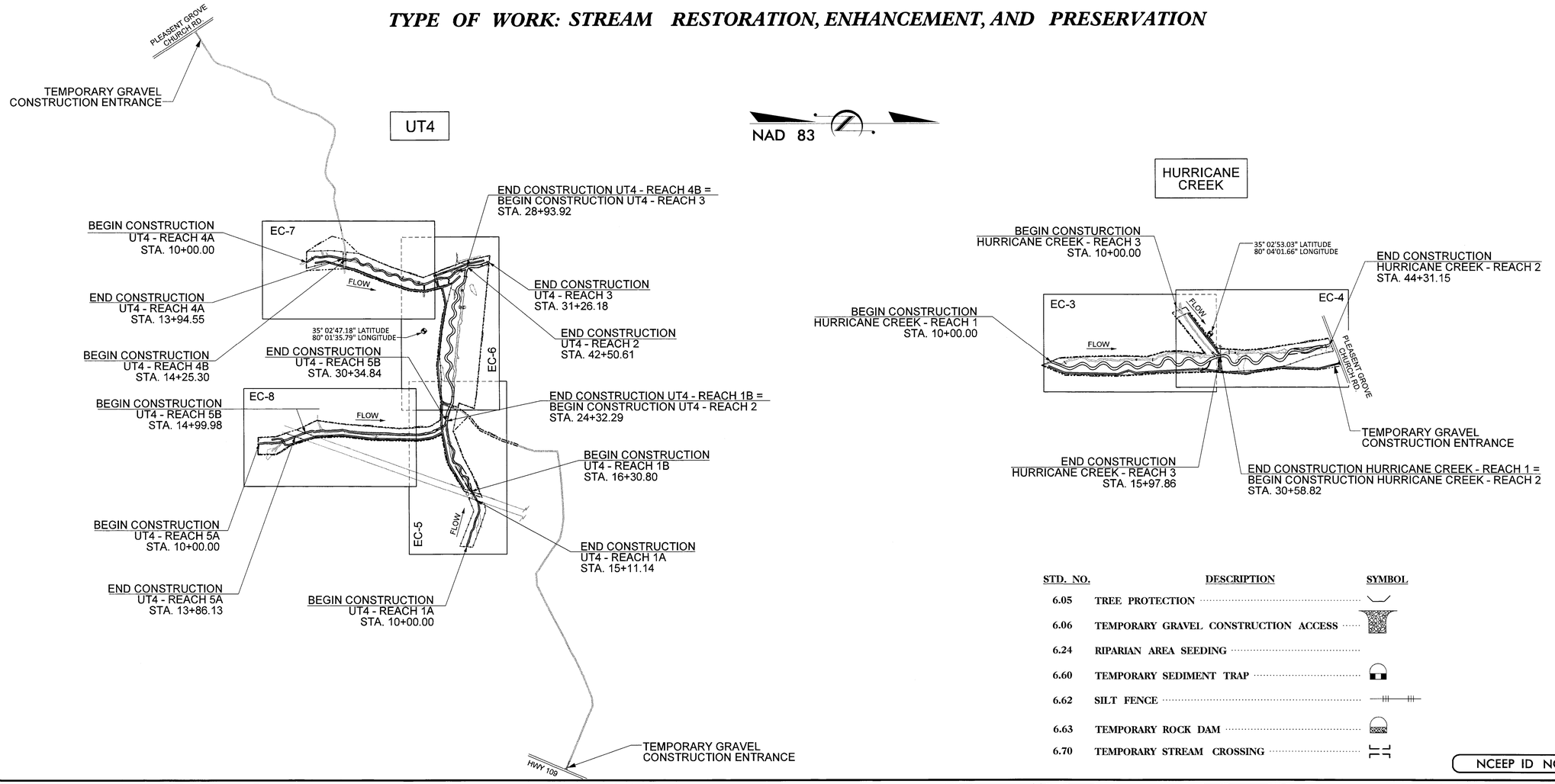
EROSION & SEDIMENTATION CONTROL PLAN

LOCATION: APPROX. 4 MILES SOUTHEAST OF THE TOWN OF ANSONVILLE.

TYPE OF WORK: STREAM RESTORATION, ENHANCEMENT, AND PRESERVATION

BROWN CREEK TRIBS

PROJECT: 128975



STD. NO.	DESCRIPTION	SYMBOL
6.05	TREE PROTECTION	
6.06	TEMPORARY GRAVEL CONSTRUCTION ACCESS	
6.24	RIPARIAN AREA SEEDING	
6.60	TEMPORARY SEDIMENT TRAP	
6.62	SILT FENCE	
6.63	TEMPORARY ROCK DAM	
6.70	TEMPORARY STREAM CROSSING	

NCEEP ID NO. 95351

GRAPHIC SCALES

40 0 40 80

PLANS

THIS PROJECT CONTAINS EROSION & SEDIMENTATION CONTROL PLANS FOR ALL PHASES OF CONSTRUCTION.

TOTAL DISTURBED AREA = 50.5 Acres

PROJECT STANDARDS

THE FOLLOWING STANDARDS AS THEY APPEAR IN THE "NC EROSION & SEDIMENTATION CONTROL PLANNING AND DESIGN MANUAL" AND ARE APPLICABLE TO THIS PROJECT AND BY REFERENCE HEREBY ARE CONSIDERED PART OF THE PLANS.

6.05	TREE PROTECTION
6.06	TEMPORARY GRAVEL CONSTRUCTION ACCESS
6.24	RIPARIAN AREA SEEDING
6.60	TEMPORARY SEDIMENT TRAP
6.62	SILT FENCE
6.63	TEMPORARY ROCK DAM
6.70	TEMPORARY STREAM CROSSING

PREPARED IN THE OFFICE OF:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

LETTING DATE:

WILLIAM SCOTT HUNT, III, P.E.
PROJECT ENGINEER

KAYNE VAN STELL
PROJECT MANAGER

PROJECT ENGINEER

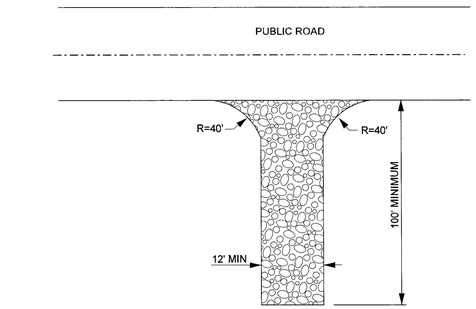
NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

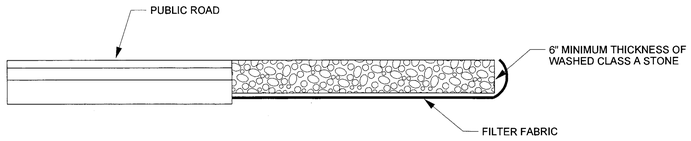
P.E.

SIGNATURE:

2/26/03

TEMPORARY GRAVEL CONSTRUCTION ENTRANCE /EXIT

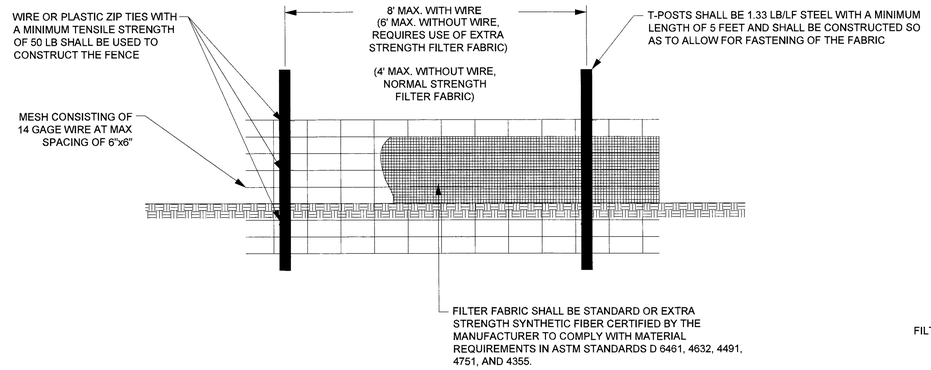


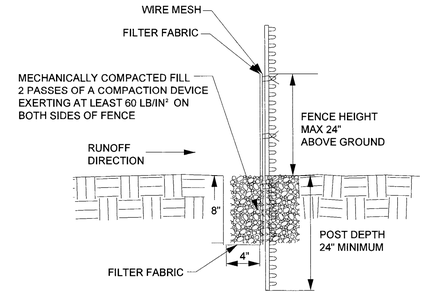


NOTES:

SPECIFICATION NO. 6.06 - CONSTRUCTION ACCESS "N.C. EROSION AND SEDIMENT CONTROL PLANNING AND DESIGN MANUAL MARCH 2009"

TEMPORARY SILT FENCE





NOTES:

1. AVOID JOINTS, UNAVOIDABLE JOINTS MUST HAVE 4' OF CLOTH OVERLAP AND SHOULD TIE INTO THE NEXT ADJACENT POST.
2. PLACE ON CONTOUR EXCEPT ENDS WHICH SHOULD BE 1' ABOVE GRADE TO PREVENT CUT AROUND.
3. WRAP APPROX. 6" OF FABRIC AROUND END POSTS AND SECURE WITH TIES.
4. REMOVE ONCE AREA IS STABLE.
5. CONTRACTOR SHALL SIDE CAST SPOIL MATERIAL FROM TRENCHING FOR SILT FENCE ONTO HIGH GROUND OR ONTO THE PERMITTED WETLAND IMPACT SIDE TO AVOID UNPERMITTED WETLAND IMPACTS.

PROJECT REFERENCE NO.	SHEET NO.
128975	EC-2

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT, III

APPROVED BY:

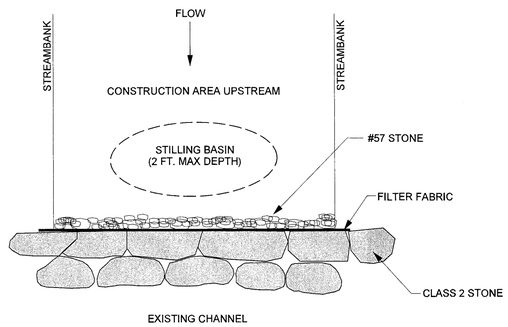
DATE:

Baker

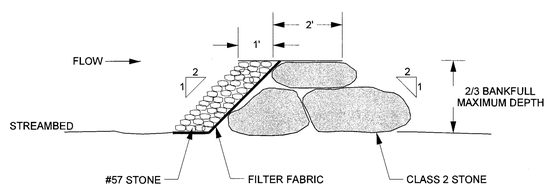
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

TEMPORARY ROCK DAM



PLAN VIEW

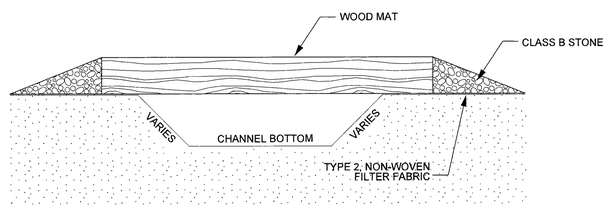


CROSS SECTION

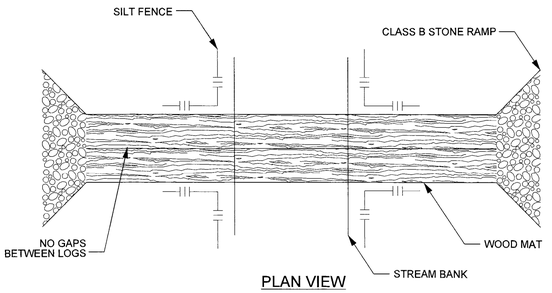
NOTES:

CLEAN OUT STILLING BASIN OF TRAPPED SEDIMENT PRIOR TO REMOVAL.

TEMPORARY STREAM CROSSING - WOOD MAT



CROSS SECTION



PLAN VIEW

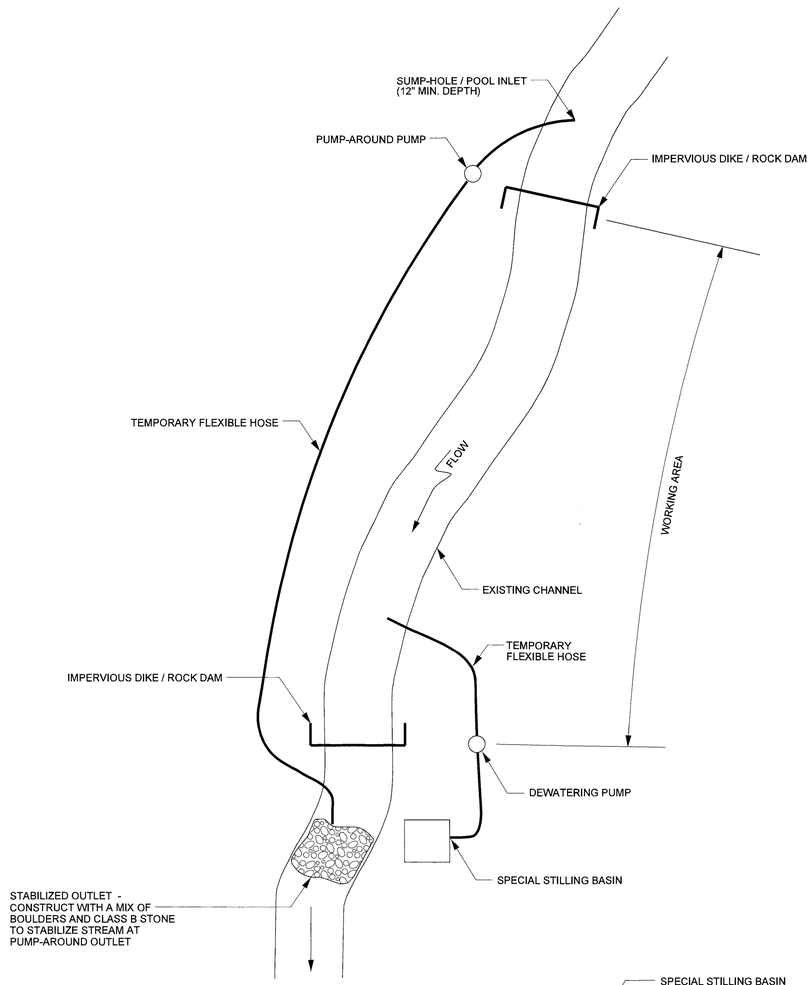
NOTES:

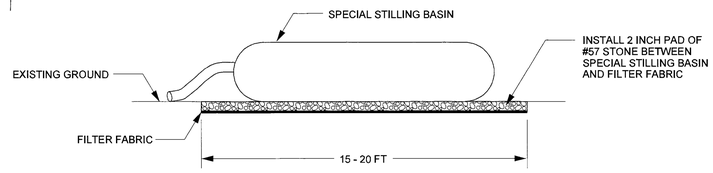
1. CONSTRUCT STREAM CROSSING WHEN FLOW IS LOW.
2. HAVE ALL NECESSARY MATERIALS AND EQUIPMENT ON-SITE BEFORE WORK BEGINS.
3. MINIMIZE CLEARING AND EXCAVATION OF STREAMBANKS. DO NOT EXCAVATE CHANNEL BOTTOM.
4. LINE STREAMBANK AND ACCESS RAMP AREA WITH NON-WOVEN FILTER FABRIC.
5. INSTALL STREAM CROSSING AT RIGHT ANGLE TO THE FLOW.
6. TRANSPLANT SOD FROM ORIGINAL STREAMBANK ONTO SIDE SLOPES FOR LATER USE.
7. MAINTAIN CROSSING SO THAT RUNOFF IN THE CONSTRUCTION ROAD DOES NOT ENTER EXISTING CHANNEL BY INSTALLING SILT FENCE ON ALL FOUR CORNERS ADJACENT TO THE STREAM. SEE SILT FENCE DETAIL.
8. STABILIZE AN ACCESS RAMP OF CLASS B STONE TO THE EDGE OF THE MUD MAT.
9. THE WOOD MAT SHALL BE OF SUFFICIENT SIZE AND WIDTH TO SUPPORT THE LARGEST VEHICLE CROSSING THE CHANNEL.
10. CONTRACTOR SHALL DETERMINE AN APPROPRIATE RAMP ANGLE ACCORDING TO EQUIPMENT UTILIZED, RECOMMENDED AT A 5:1 SLOPE.

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_02.dgn
mcdell

2/26/03

TYPICAL PUMP-AROUND OPERATION





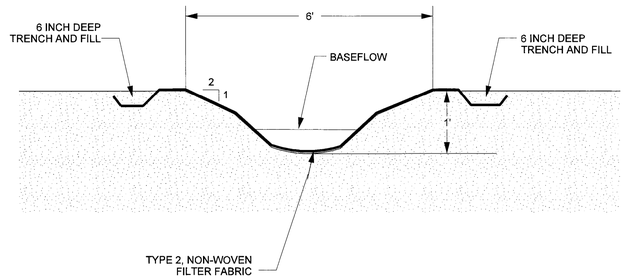
SEQUENCE OF CONSTRUCTION FOR TYPICAL PUMP-AROUND

1. INSTALL STABILIZED OUTLET AT THE DOWNSTREAM END OF THE DESIGNATED PROJECT WORKING AREA.
2. THE CONTRACTOR WILL INSTALL THE PUMP-AROUND PUMP AND THE TEMPORARY FLEXIBLE HOSE THAT WILL CONVEY THE BASE FLOW FROM UPSTREAM OF THE WORK SITE TO THE SPECIAL STILLING BASIN OR STABILIZED OUTLET.
3. INSTALL UPSTREAM IMPERVIOUS DIKE AND BEGIN PUMPING OPERATIONS FOR STREAM DIVERSION.
4. INSTALL THE DOWNSTREAM IMPERVIOUS DIKE AND PUMPING APPARATUS IF NEEDED TO DEWATER THE ENTRAPPED AREA. THE PUMP AND HOSE FOR THIS PURPOSE SHALL BE OF SUFFICIENT SIZE TO DEWATER THE WORK AREA. THIS WATER WILL FLOW INTO A SPECIAL STILLING BASIN.
5. THE CONTRACTOR WILL PERFORM STREAM RESTORATION WORK IN ACCORDANCE WITH THE PLAN AND FOLLOWING THE GENERAL CONSTRUCTION SEQUENCE.
6. THE CONTRACTOR WILL EXCAVATE ANY ACCUMULATED SILT AND DEWATER BEFORE REMOVAL OF THE IMPERVIOUS DIKE. REMOVE IMPERVIOUS DIKES, PUMPS, AND TEMPORARY FLEXIBLE HOSE STARTING WITH THE DOWNSTREAM DIKE FIRST.
7. THE CONTRACTOR WILL COMPLETE ALL GRADING AND STABILIZATION IN ONE DAY WITHIN THE PUMP-AROUND AREA BETWEEN THE IMPERVIOUS DIKES.
8. ONCE THE WORKING AREA IS COMPLETED, REMOVE THE SPECIAL STILLING BASIN AND STABILIZED OUTLET AND STABILIZE DISTURBED AREAS WITH SEED AND MULCH.

NOTES:

1. EXCAVATION SHALL BE PERFORMED IN ONLY DRY SECTIONS OF CHANNEL.
2. IMPERVIOUS DIKES SHOULD BE USED TO ISOLATE WORK AREAS FROM STREAM FLOW.
3. THE CONTRACTOR SHALL NOT DISTURB MORE AREA THAN CAN BE STABILIZED IN ONE WORKING DAY.
4. THE PUMP-AROUND PUMP SHOULD ADEQUATELY CONVEY BASEFLOW CONDITIONS OF THE STREAM.

TEMPORARY DIVERSION CHANNEL



NOTES:

1. DIMENSIONS OF DIVERSION CHANNEL MAY BE ALTERED TO FIT SLOPE CONDITIONS.
2. ALIGN SEAMS OF FILTER FABRIC TO OVERLAP IN THE DIRECTION OF FLOW.
3. MAX SIDE SLOPE 2:1.
4. SEE TECHNICAL SPECIFICATIONS FOR FILTER FABRIC MATERIAL.

PROJECT REFERENCE NO.	SHEET NO.
128975	EC-2A

PROJECT ENGINEER

APPROVED BY:

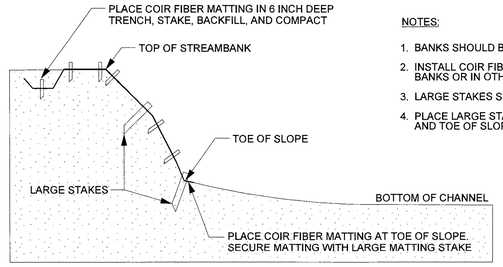
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

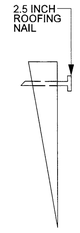
EROSION CONTROL MATTING



CROSS SECTION VIEW

NOTES:

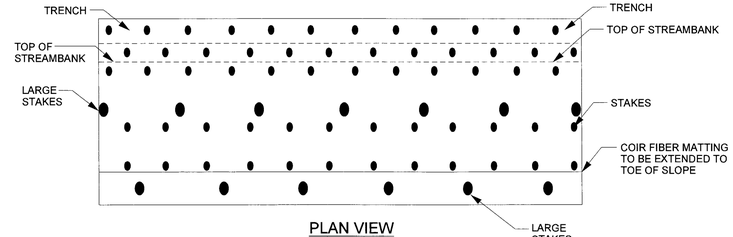
1. BANKS SHOULD BE SEEDED PRIOR TO PLACEMENT OF MATTING.
2. INSTALL COIR FIBER MATTING PER SPECIFICATIONS ALONG STREAM BANKS OR IN OTHERS LOCATIONS SPECIFIED BY ENGINEER.
3. LARGE STAKES SHOULD NOT BE SPACED FURTHER THAN 36" APART.
4. PLACE LARGE STAKES ALONG ALL SEAMS, IN THE CENTER OF BANK, AND TOE OF SLOPE.



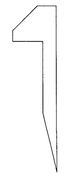
TYPICAL LARGE MATTING STAKE

THE WOOD STAKE SHALL HAVE THE FOLLOWING DIMENSIONS:

LEG LENGTH	17.00 IN (43.18 CM) (TAPERED TO POINT)
WIDTH	1.5 IN (3.81 CM)
THICKNESS	1.5 IN (3.81 CM)



PLAN VIEW



TYPICAL SMALL MATTING STAKE

THE WOOD STAKE SHALL HAVE THE FOLLOWING DIMENSIONS:

LEG LENGTH	11.00 IN (27.94 CM)
HEAD WIDTH	1.25 IN (3.18 CM)
HEAD THICKNESS	0.40 IN (1.02 CM)
LEG WIDTH	0.60 IN (1.52 CM) (TAPERED TO POINT)
LEG THICKNESS	0.40 IN (1.02 CM)
TOTAL LENGTH	12.00 IN (30.48 CM)

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-3

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 06.18.14 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

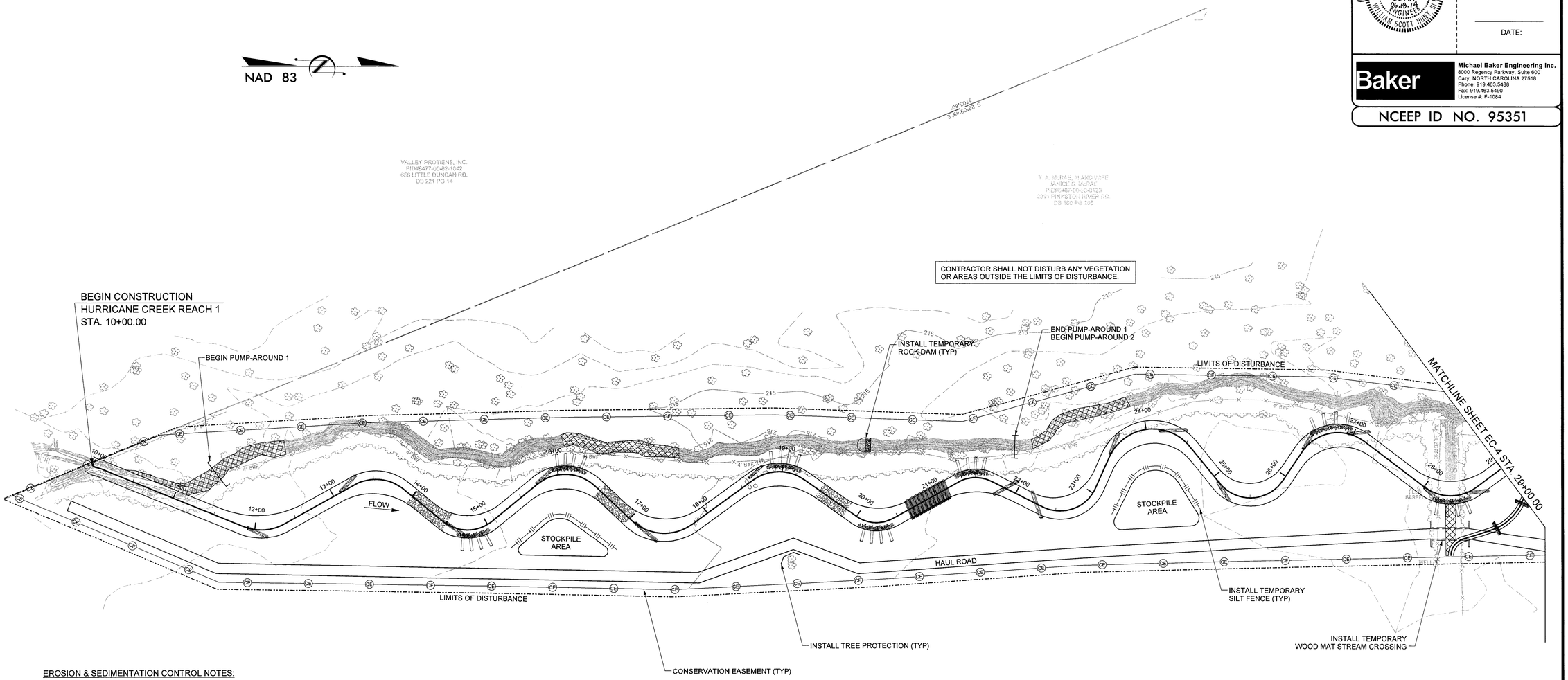
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.

2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.

3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.

4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.

5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.

6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.

7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.

8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

HURRICANE CREEK EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120

SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_03.dgn
mcarey

2/26/03

EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.
2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.
3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.
4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.
5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.
6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.
7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.
8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

NAD 83

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-4

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22941 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

PERMANENT CULVERT STREAM CROSSING

BEGIN CONSTRUCTION REACH 3
STA. 10+00.00

T. A. McRAE, III AND WIFE
JANICE S. McRAE
PID#9487-60-23-0123
2911 PINKSTON RIVER RD.
D/B 160 PG 266

FLOW

HAUL ROAD

LIMITS OF DISTURBANCE

END CONSTRUCTION
HURRICANE CREEK REACH 3
STA. 15+97.86

END PUMP-AROUND 2
BEGIN PUMP-AROUND 3

INSTALL TEMPORARY
ROCK DAM (TYP)

MATCHLINE SHEET EC-3 STA 29+00.00

PERMANENT FORD
STREAM CROSSING

END CONSTRUCTION
HURRICANE CREEK REACH 1
BEGIN CONSTRUCTION
HURRICANE CREEK REACH 2
STA. 30+55.00

STOCKPILE
AREA

INSTALL TEMPORARY
SILT FENCE (TYP)

T. A. McRAE, III AND WIFE
JANICE S. McRAE
PID#9487-00-15-1016
1945 PLEASANT GROVE CH.
D/B 160 PG 266

END PUMP-AROUND 3

INSTALL TEMPORARY
ROCK DAM (TYP)

121.87'x63" CMAP

CONSERVATION EASEMENT (TYP)

STAGING /STOCKPILE
AREA

DO NOT DISTURB
EXISTING WETLANDS (TYP)

END CONSTRUCTION
HURRICANE CREEK REACH 2
STA. 44+31.15

INSTALL TEMPORARY
WOOD MAT STREAM CROSSING

INSTALL TEMPORARY GRAVEL
CONSTRUCTION ENTRANCE
WITH 24" DIA. CMP

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

HURRICANE CREEK EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_04.dgn
mpeel

2/26/03

EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.

2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.

3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.

4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.

5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.

6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.

7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.

8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-5

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83

MATCHLINE SHEET EC-8 STA. 26+00.00

BEGIN CONSTRUCTION
UT4 REACH 1A
STA. 10+00.00

END CONSTRUCTION
UT4 REACH 1A
STA. 15+11.14

BEGIN PUMP-AROUND 1

BEGIN CONSTRUCTION
UT4 REACH 1B
STA. 16+30.80

END PUMP-AROUND 1
BEGIN PUMP-AROUND 2

END CONSTRUCTION
UT4 REACH 5
STA. 30+34.84

END CONSTRUCTION
UT4 REACH 1B =
BEGIN CONSTRUCTION
UT4 REACH 2
STA. 24+80.08

PERMANENT CULVERT CROSSING

PERMANENT FORD STREAM CROSSING

INSTALL TEMPORARY WOOD MAT STREAM CROSSING

INSTALL TEMPORARY ROCK DAM (TYP)

INSTALL TEMPORARY SILT FENCE (TYP)

NO CONSTRUCTION ACTIVITIES ARE PROPOSED IN PRESERVATION AREA FROM STA. 10+00 TO STA. 15+11.

CONSERVATION EASEMENT (TYP)

CONSTRUCTION ENTRANCE LOCATED AT HWY 109 APPROXIMATELY 4,700 FEET FROM CONSERVATION EASEMENT (SEE SHEET EC-1 FOR OVERVIEW)

STOCKPILE AREA

STAGING/ STOCKPILE AREA

LIMITS OF DISTURBANCE

HAUL ROAD

BENCHING LIMITS

FLOW

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

MATCHLINE SHEET EC-6 STA. 28+00.00

UT 4
EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120
SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_05.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-6

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

APPROVED BY:

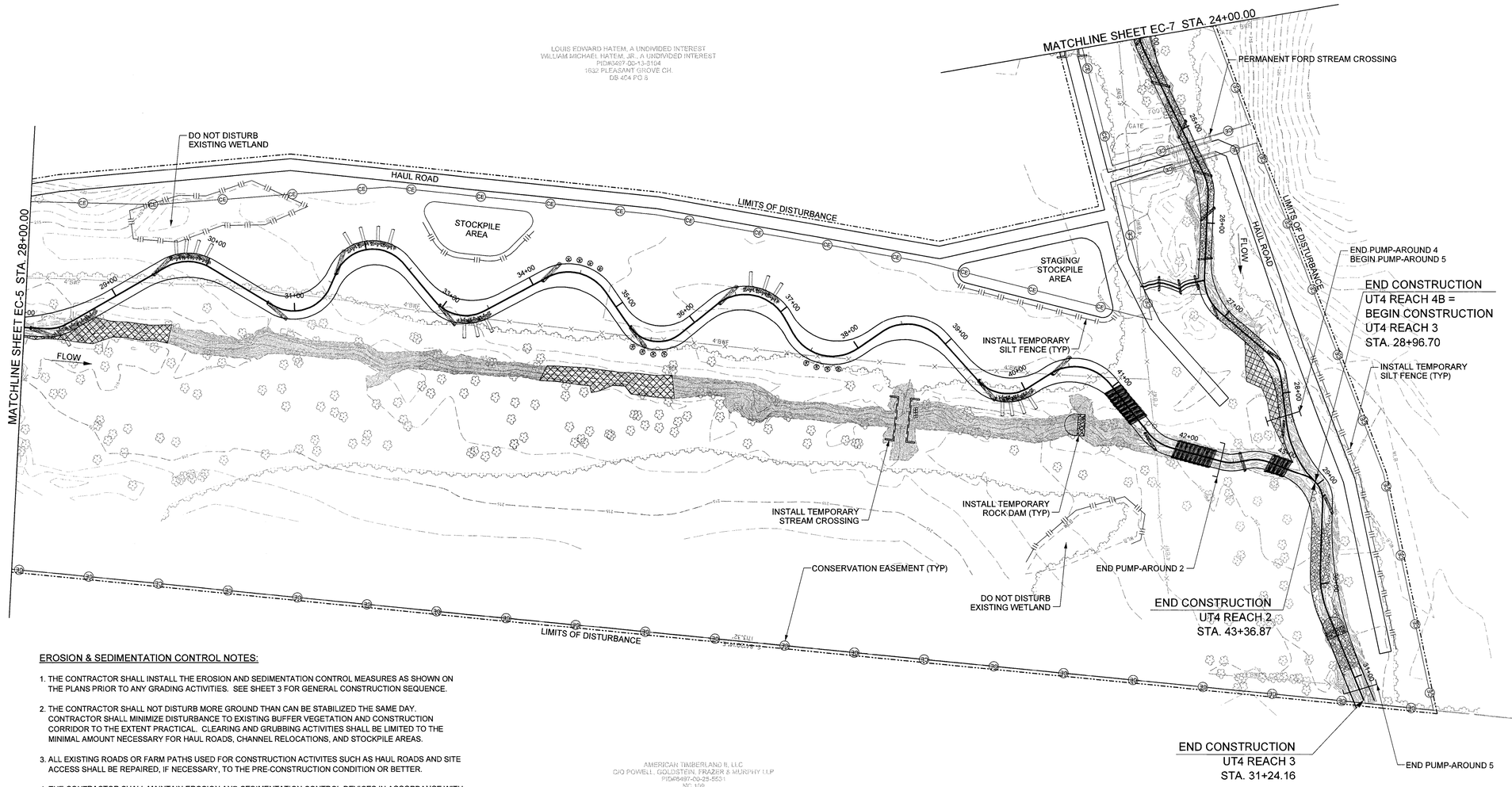
DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351

NAD 83



EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.
2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.
3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.
4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.
5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.
6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.
7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.
8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT 4 EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120

SCALE (FT)

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_26.dgn
mpatel

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-7

PROJECT ENGINEER

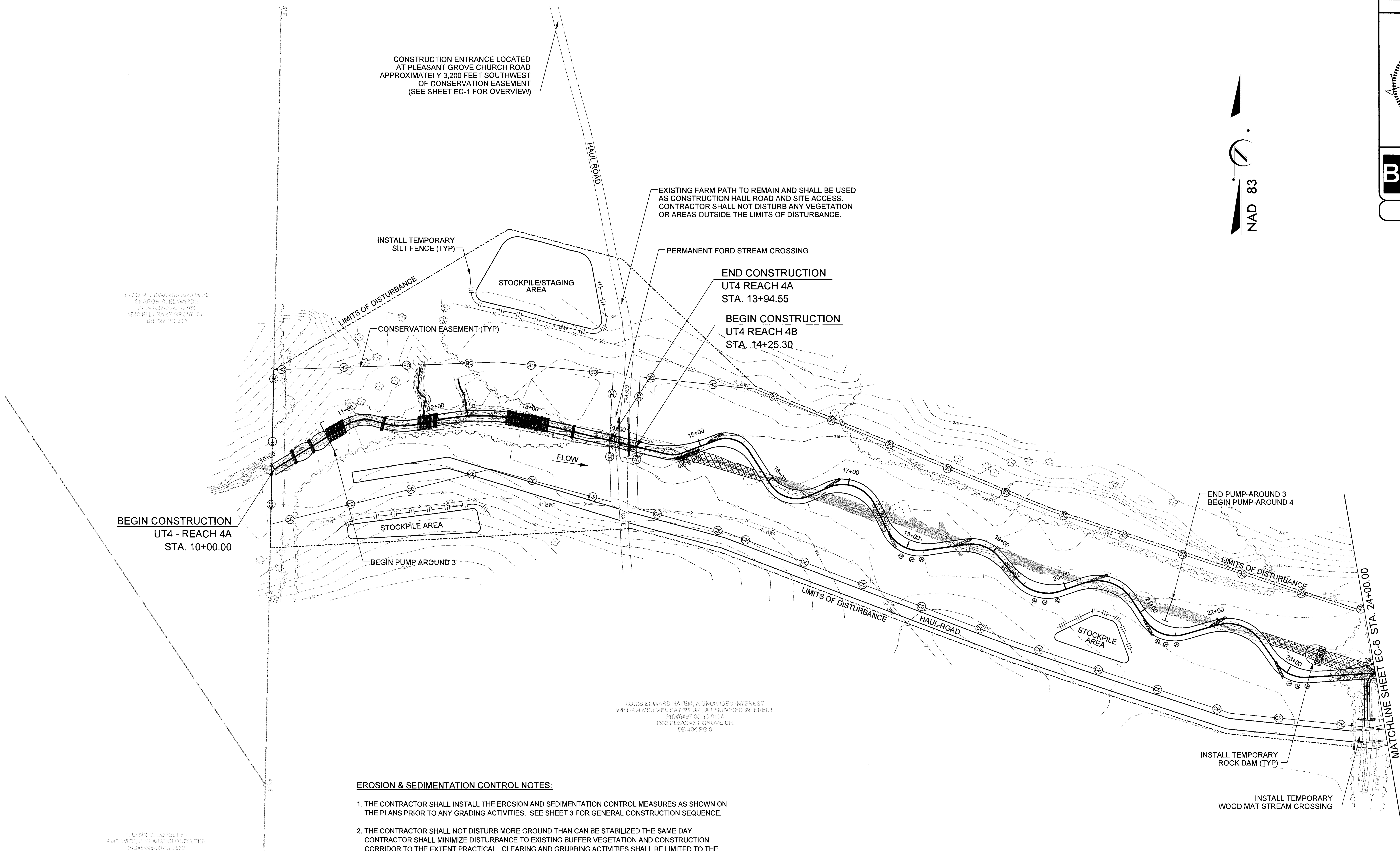
NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 22967 WILLIAM SCOTT HUNT III

APPROVED BY:

DATE:

Baker
Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351



EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.
2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.
3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.
4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.
5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.
6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.
7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.
8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT 4
EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120
SCALE (FT)

2/26/03

6/18/2014
R:\128975\Design\Plans\128975_HC_PSH_EC_07.dgn

2/26/03

BAKER PROJECT REFERENCE NO.	SHEET NO.
128975	EC-8

PROJECT ENGINEER

NORTH CAROLINA PROFESSIONAL SEAL 22967 ENGINEER WILLIAM SCOTT HUNT III

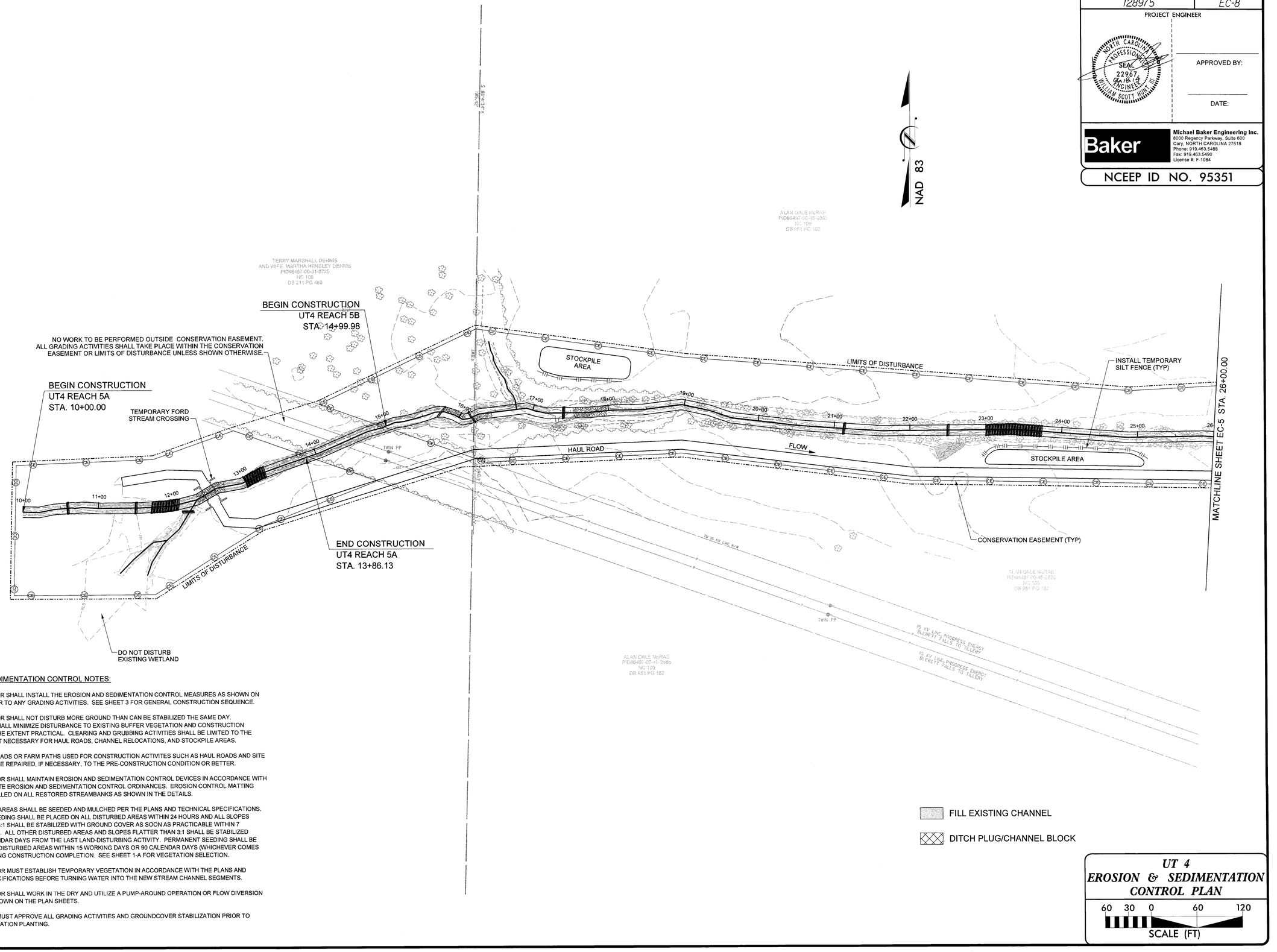
APPROVED BY:

DATE:

Baker

Michael Baker Engineering Inc.
8000 Regency Parkway, Suite 600
Cary, NORTH CAROLINA 27518
Phone: 919.463.5488
Fax: 919.463.5490
License #: F-1084

NCEEP ID NO. 95351



EROSION & SEDIMENTATION CONTROL NOTES:

1. THE CONTRACTOR SHALL INSTALL THE EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THE PLANS PRIOR TO ANY GRADING ACTIVITIES. SEE SHEET 3 FOR GENERAL CONSTRUCTION SEQUENCE.

2. THE CONTRACTOR SHALL NOT DISTURB MORE GROUND THAN CAN BE STABILIZED THE SAME DAY. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO EXISTING BUFFER VEGETATION AND CONSTRUCTION CORRIDOR TO THE EXTENT PRACTICAL. CLEARING AND GRUBBING ACTIVITIES SHALL BE LIMITED TO THE MINIMAL AMOUNT NECESSARY FOR HAUL ROADS, CHANNEL RELOCATIONS, AND STOCKPILE AREAS.

3. ALL EXISTING ROADS OR FARM PATHS USED FOR CONSTRUCTION ACTIVITES SUCH AS HAUL ROADS AND SITE ACCESS SHALL BE REPAIRED, IF NECESSARY, TO THE PRE-CONSTRUCTION CONDITION OR BETTER.

4. THE CONTRACTOR SHALL MAINTAIN EROSION AND SEDIMENTATION CONTROL DEVICES IN ACCORDANCE WITH THE APPROPRIATE EROSION AND SEDIMENTATION CONTROL ORDINANCES. EROSION CONTROL MATTING SHALL BE INSTALLED ON ALL RESTORED STREAMBANKS AS SHOWN IN THE DETAILS.

5. ALL DISTURBED AREAS SHALL BE SEEDED AND MULCHED PER THE PLANS AND TECHNICAL SPECIFICATIONS. TEMPORARY SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 24 HOURS AND ALL SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED WITH GROUND COVER AS SOON AS PRACTICABLE WITHIN 7 CALENDAR DAYS. ALL OTHER DISTURBED AREAS AND SLOPES FLATTER THAN 3:1 SHALL BE STABILIZED WITHIN 14 CALENDAR DAYS FROM THE LAST LAND-DISTURBING ACTIVITY. PERMANENT SEEDING SHALL BE PLACED ON ALL DISTURBED AREAS WITHIN 15 WORKING DAYS OR 90 CALENDAR DAYS (WHICHEVER COMES FIRST) FOLLOWING CONSTRUCTION COMPLETION. SEE SHEET 1-A FOR VEGETATION SELECTION.

6. THE CONTRACTOR MUST ESTABLISH TEMPORARY VEGETATION IN ACCORDANCE WITH THE PLANS AND TECHNICAL SPECIFICATIONS BEFORE TURNING WATER INTO THE NEW STREAM CHANNEL SEGMENTS.

7. THE CONTRACTOR SHALL WORK IN THE DRY AND UTILIZE A PUMP-AROUND OPERATION OR FLOW DIVERSION MEASURE AS SHOWN ON THE PLAN SHEETS.

8. THE ENGINEER MUST APPROVE ALL GRADING ACTIVITIES AND GROUNDCOVER STABILIZATION PRIOR TO RIPARIAN VEGETATION PLANTING.

FILL EXISTING CHANNEL

DITCH PLUG/CHANNEL BLOCK

UT 4
EROSION & SEDIMENTATION CONTROL PLAN

60 30 0 60 120
SCALE (FT)

R:\128975\Design\Plans\128975_HC_PSH_EC_08.dgn
6/18/2014