2015 North Carolina Addendum to the Low pH TMDL for the Great Smoky Mountains National Park, TN

September, 2015

Waterbody IDs:

Davidson River: 6-34-(15.5)
Harper Creek: 11-38-34-14
Shooks Creek: 11-29-22
South Toe River: 7-2-52-(1)
Unnamed tributary to Frankum Creek: 11-38-32-9ut3

Submitted by:
NC Department of Environment and Natural Resources
Division of Water Resources
1601 Mail Service Center
Raleigh, NC 27699-1601

1.0 Introduction

The Tennessee Department of Environment and Conservation developed a Total Daily Maximum Load (TMDL) for the Great Smoky Mountains National Park in 2010 to address low pH impairments. The TMDL was approved by EPA Region 4 on September 7, 2010.

In 2012 EPA approved two TMDLs submitted by the North Carolina Division of Water Resources (DWR) for low pH impairments as an addendum to the Great Smokey Mountains TMDL. The current addendum includes five additional low pH impairments in mountain streams identified in the 2014 NC Water Quality Assessment.

Similar to the previously approved TMDLs the waters in the current TMDL drain high elevation undeveloped forested areas in western North Carolina and were included on the 303(d) list in 2014 (Figure 1). The impaired waters and associated assessment units (AUs) are as follows below in Table 1:

Table 1 – Impaired Waters and Associated AUs

Waterbody Name: Assessment Unit	Description	Water Classification	Miles
Davidson River: 6-34-(15.5)	From Avery Creek to Olin Corporation water supply dam	WS-V,B;Tr	2.7
Harper Creek: 11-38-34-14	From source to Wilson Creek	C;Tr,ORW	9.1
Shooks Creek: 11-29-22	From source to Linville River	C;Tr	2.9
South Toe River: 7-2-52-(1)	From source to U.S. Hwy. 19E	B;Tr,ORW	25.9
Unnamed Tributary (UT) to Frankum Creek: 11-38-32-9ut3	From source to Frankum Creek	C;HQW	0.9

2.0 Area Description

All of the watersheds are located in Pisgah National Forest and within the Blue Ridge Level III ecoregion. Level IV subecoregions of the watersheds are Southern Crystalline Ridges and Mountains, High Mountains, Southern Metasedimentary, and Eastern Blue Ridge Foothills. Descriptions from the USDA Ecoregions of North Carolina (USDA, 2002) for these subecoregions are as follows:

- 66d - Southern Crystalline Ridges and Mountains: The Southern Crystalline Ridges and Mountains occur primarily on Precambrian-age igneous and high-grade metamorphic rocks, in contrast to the sedimentary and metasedimentary rocks of 66e and 66g. The crystalline rock types are mostly gneiss and schist, covered by well-drained, acidic, loamy soils. Some small areas of mafic and ultramafic rocks also occur, producing more basic soils. The heterogeneous region has greater relief and higher elevations than 66l, 66c, and 66j. Topographic break and soil types help define the boundary between 66d and 45a, 45e. Elevations of this rough, dissected region are generally 1200-4500 feet, with some higher peaks. The southern part of the region, south of Asheville, is wetter than the north. In the ecoregion meetings, discussions occurred about making the southern, wetter portion of 66d a separate region. Other than precipitation amounts and some anecdotal evidence, however, the differences were not well documented, and the consensus was to not split the region. Other consideration was also given to delineating a Blue Ridge Front or escarpment region on the eastern edge of 66d, or combining the escarpment with 66l. Although the escarpment might be drier than much of 66d, that area tends to be steeper with more relief and not as dry as much of the 66l foothills region.

66d is mostly forested, with chestnut oak (Quercus montana) and other oaks now dominating on most slopes and ridges, earlier dominated by American chestnut (Castanea dentata). Cove forests are common, and northern hardwoods forests are found at higher elevations. There are a few small areas of pasture, apple orchards, Fraser fir Christmas tree farms, or minor cropland at lower elevations.

- 66i - High Mountains: The High Mountains ecoregion includes several disjunct high-elevation areas generally above 4500 feet. The region has a more severe, boreal-like climate than surrounding regions, with wind and ice affecting vegetation, and it has frigid soils rather than mesic soils. Evergreen red spruce (Picea rubens) and Fraser fir (Abies fraseri) forests are found at the higher elevations, and red oak (Quercus rubra) forests and northern hardwood forests with beech (Fagus grandifolia), yellow birch (Betula alleghaniensis), yellow buckeye (Aesculus flava), and sugar maple (Acer sacharrum) are common.

- 66g - Southern Metasedimentary Mountains: The Southern Metasedimentary Mountains in North Carolina contain rocks that are not as strongly metamorphosed as the gneisses and schists of 66d. The geologic materials are mostly late Pre-Cambrian and include metagraywacke, metasiltstone, metasandstone, metaconglomerate, slate, schist, phyllite, and quartzite. These are steep, dissected, biologically-diverse mountains that are densely forested. The Appalachian oak forests and, at higher elevations, the northern hardwoods forests include a variety of oaks and pines, as well as silverbell (Helesia tetraptera), hemlock (Tsuga canadensis), tulip poplar (Liriondendron tulipifera), basswood (Tilia americana), buckeye (Aesculus flava), yellow birch (Betula alleghaniensis), and beech (Fagus grandifolia). The region supports complex and numerous plant communities and a great diversity of plant species. Much of the region is public land managed by the National Park Service or U.S. Forest Service.

- 66l - Eastern Blue Ridge Foothills: The open low mountains of the Eastern Blue Ridge Foothills are lower in elevation (1000-2800 feet) than most Blue Ridge regions and have more Piedmont influences. The region includes the Brushy Mountains in the north and the South Mountains to the south. Covered with mixed oak and oak-hickory-pine forests, these mountains tend to be slightly drier and warmer than most of Ecoregion 66. The South Mountains contain forested areas that harbor many uncommon or rare plant species, including turkey beard (Xerophyllum asphodeloides) on xeric ridges and one of North America's rarest orchids, the small whorled pogonia (Isotria medeoloides). The boundary with the Piedmont (45) is based mostly on the break in relief and topography, soils, and land cover differences.

Davidson River watershed

The Davidson River watershed covers 40 square miles and is located in Transylvania County (Figure 2). Watershed elevations range from approximately 5900 to 2290 feet. The 2011 National Land Cover Dataset (NLCD) indicates the watershed is 95.5 percent forested. Most of the watershed contains subecoregion 66d with with some 66i along the western ridgeline bordering the Blue Ridge Parkway.

Harper Creek watershed

The Harper Creek watershed covers 14.3 square miles and is located in Avery and Caldwell Counties (Figure 3). Watershed elevations range from approximately 3800 to 1470 feet. The 2011 NLCD indicates the watershed is 96 percent forested. Most of the watershed contains subecoregion 66d with with some 66g on the western quarter of the watershed.

Shooks Creek watershed

The Shooks Creek watershed covers 1.9 square miles and is located in Burke County (Figure 4). Watershed elevations range from approximately 2600 to 1240 feet. The 2011 NLCD indicates that watershed is 90 percent forest. The lower half of the watershed contains subregion 66l and the upper half split between 66g and 66d toward the ridgeline.

South Toe River watershed

The South Toe River watershed covers 58 square miles and is located in Yancey County (Figure 5). Watershed elevations range from approximately 6680 to 2450 feet. The 2011 NLCD indicates the watershed is 91 percent forest. The western ridgeline contains subregion 66i while the remainder contains 66d.

Unnamed tributary to Frankum Creek watershed

The unnamed tributary to Frankum Creek watershed covers 0.53 square miles and is located in Caldwell County (Figure 6). Watershed elevations range from approximately 2066 to 1310 feet. The 2011 NLCD indicates the watershed is 98 percent forest.

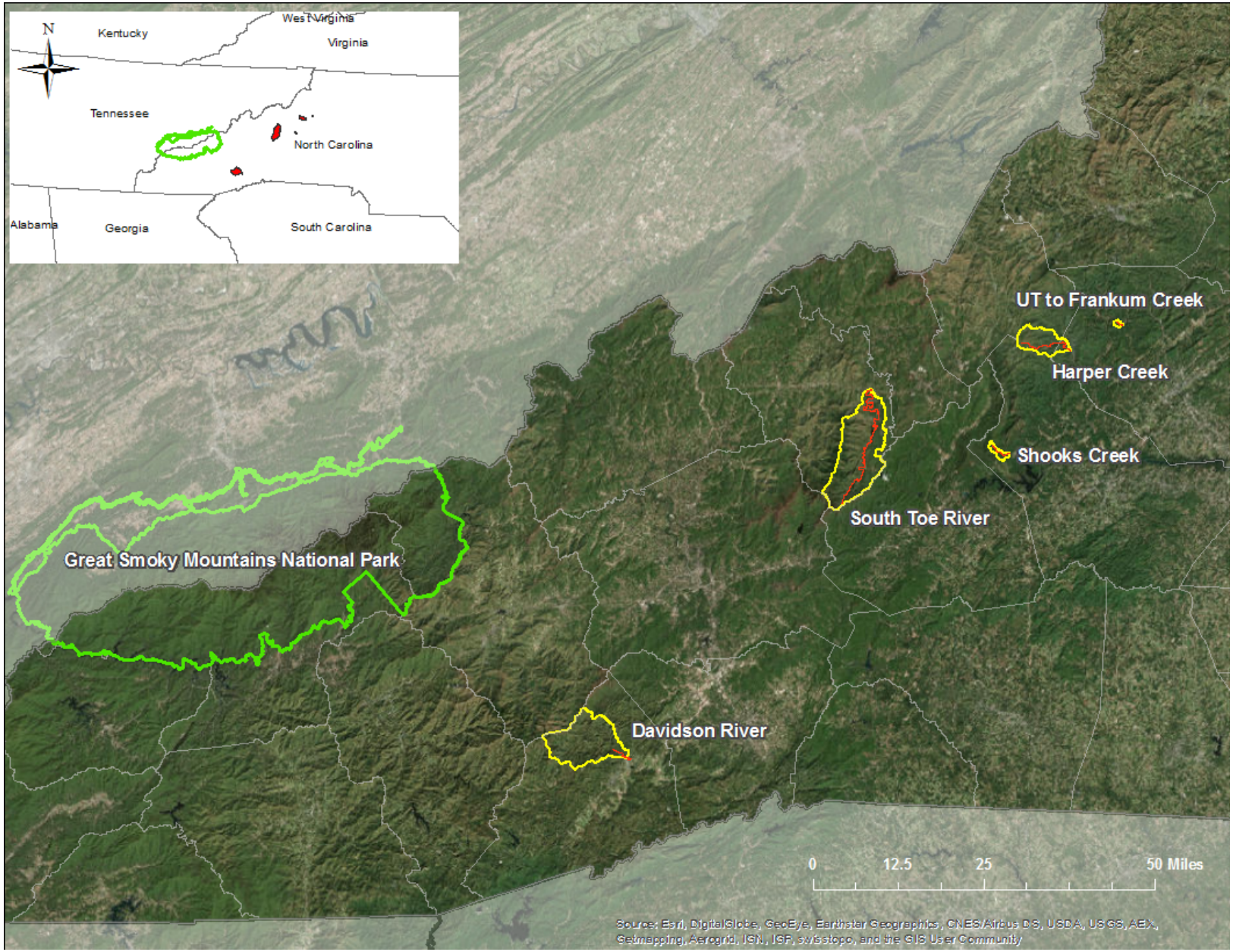

Figure 1 – Low pH Watersheds Overview

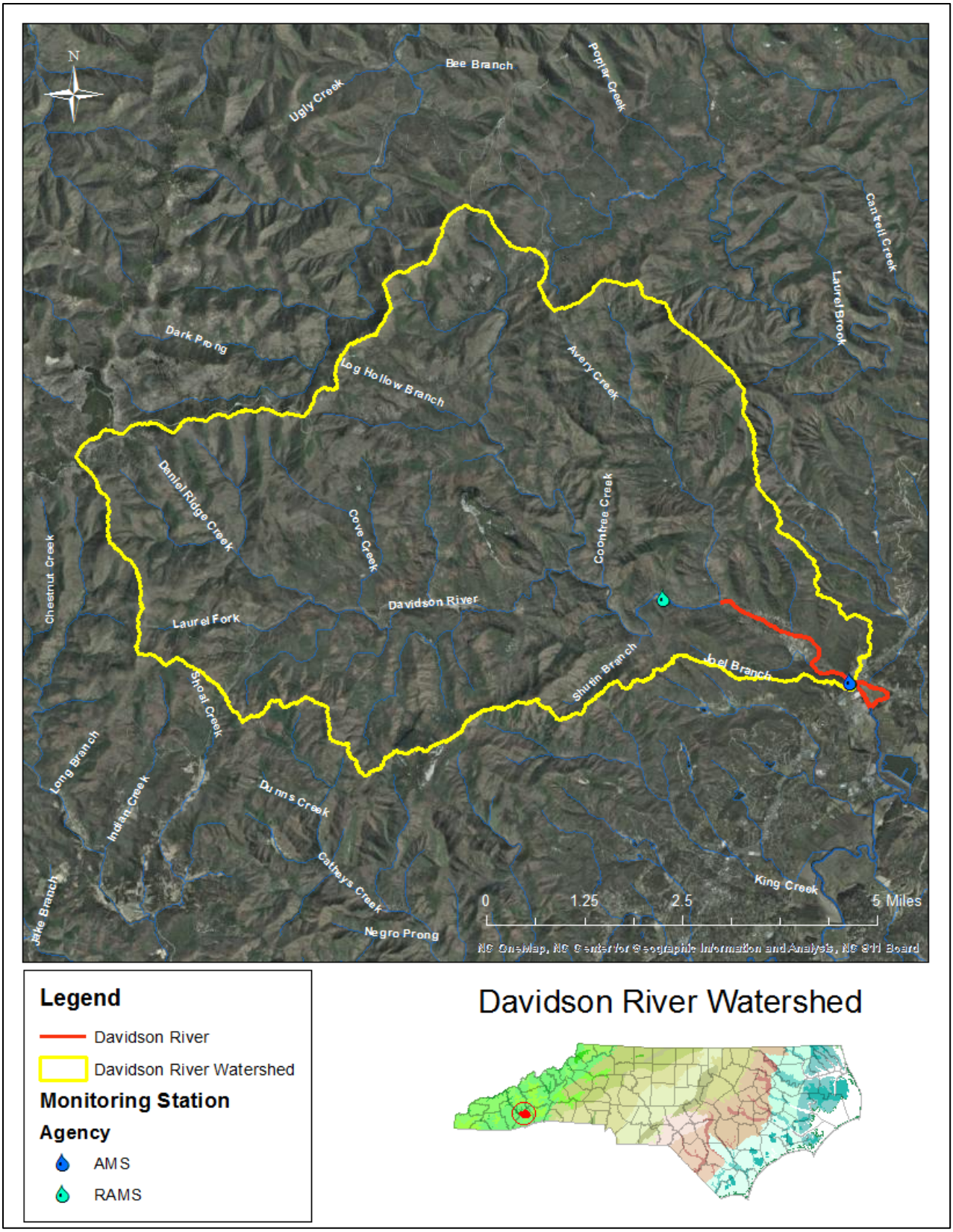

Figure 2 – Davidson River Watershed

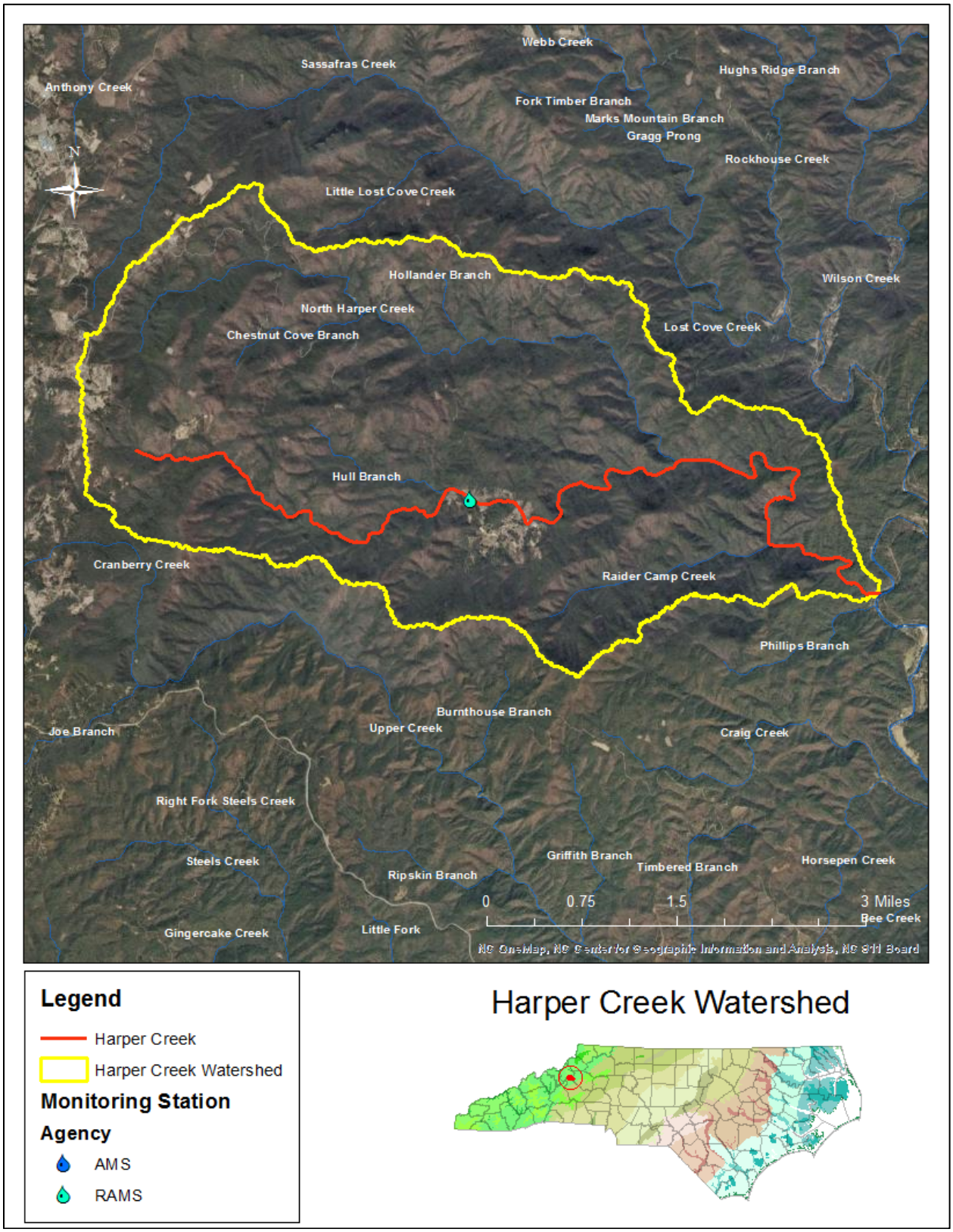

Figure 3 – Harper Creek Watershed

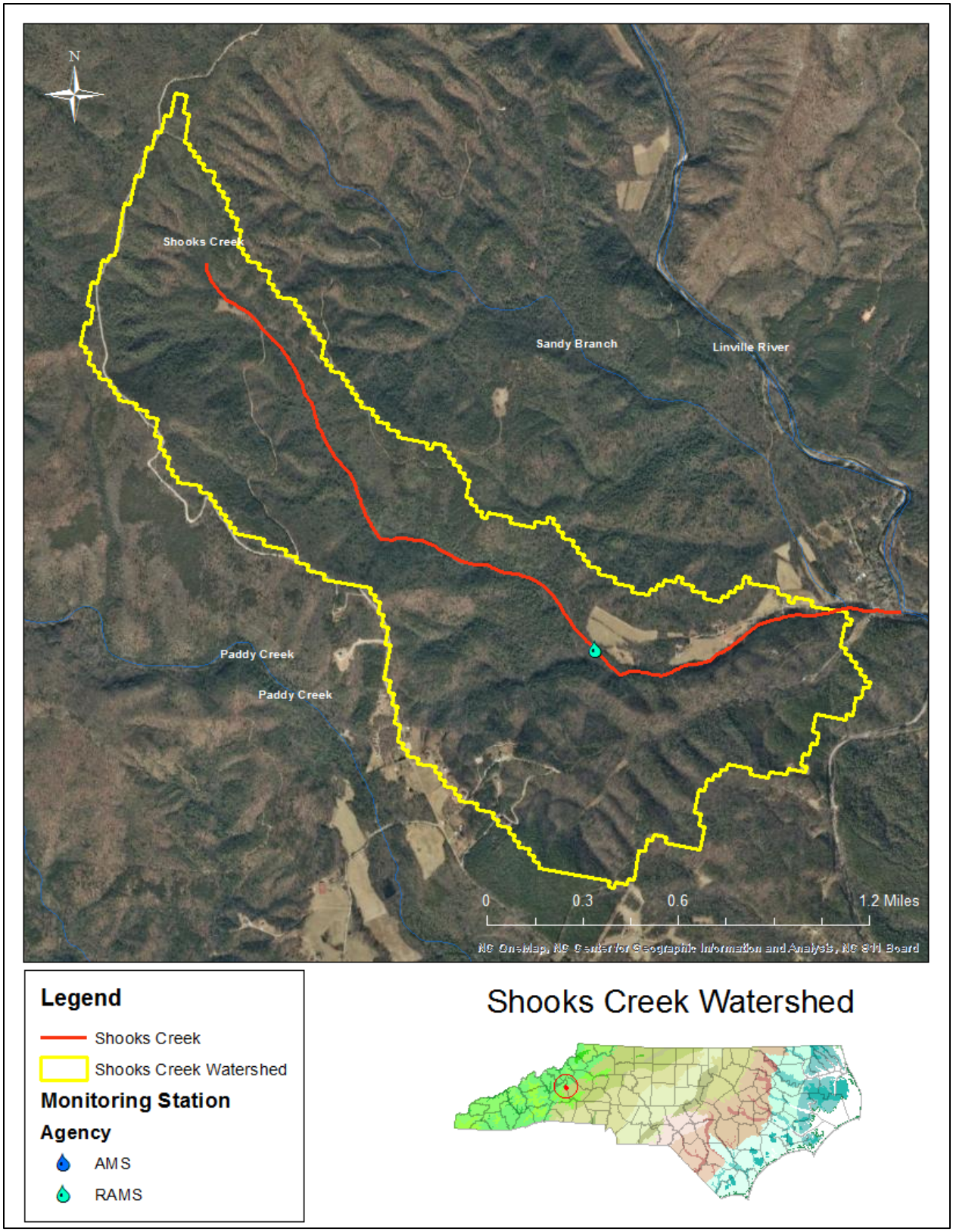

Figure 4 – Shooks Creek Watershed

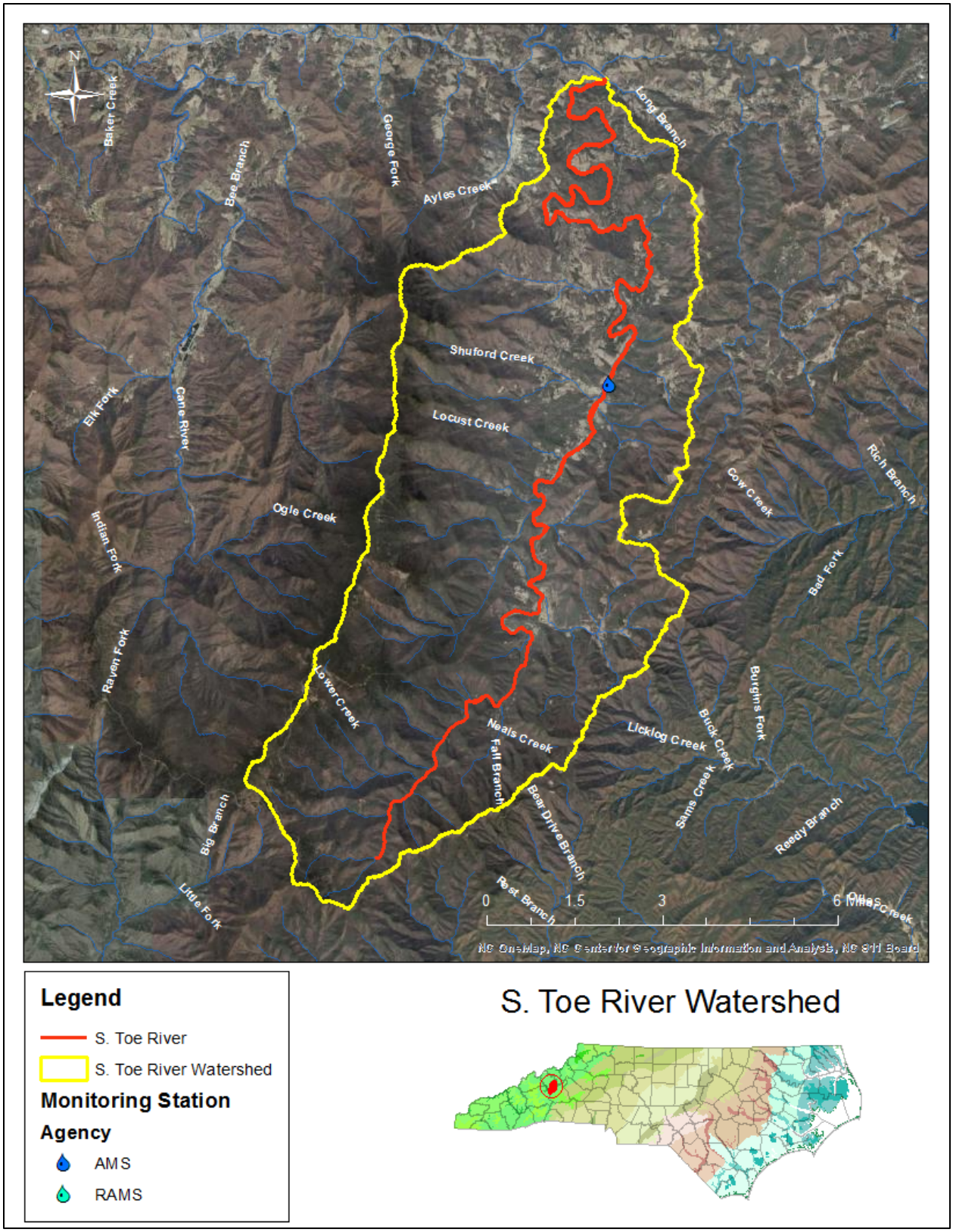

Figure 5 – South Toe River Watershed

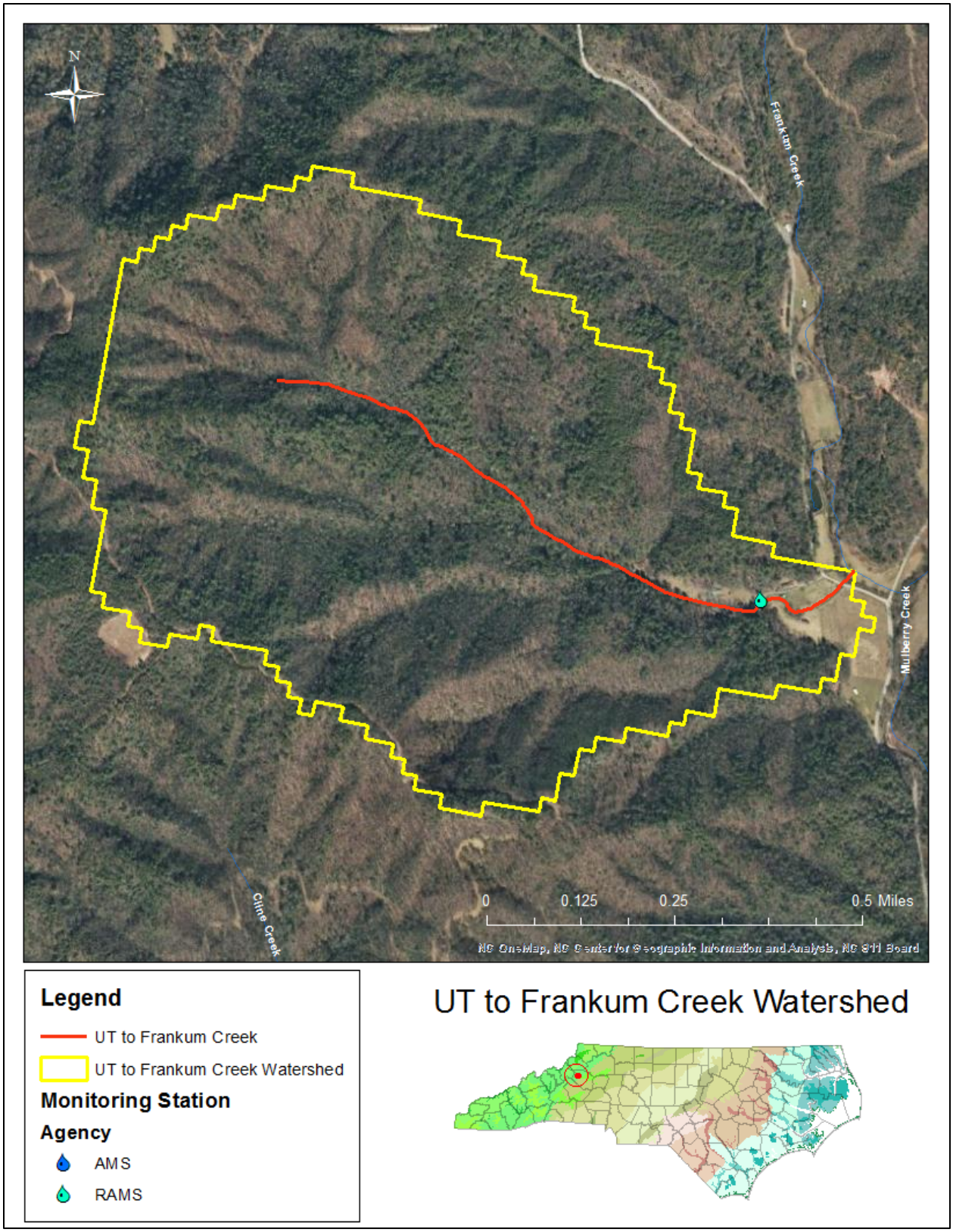

Figure 6 – UT to Frankum Creek Watershed

3.0 Documentation of Impairment

The five identified assessment units were listed in Category 5 of the 2014 North Carolina Integrated Report for low pH. Waters within this classification, according to 15A NCAC 02B.0221 (Fresh Surface Water Quality Standards for Class C Waters), must meet the following water quality standard for pH in order to meet their designated use: "pH shall be normal for the waters in the area, which generally shall range between 6.0 and 9.0 except that swamp waters may have a pH as low as 4.3 if it is the result of natural conditions." Data collected on these streams through the NC Ambient Monitoring System and NC Random Ambient Monitoring System are shown in Appendix A.

4.0 Source Assessment

There are two NPDES permitted discharges located in the Davidson River Watershed. The Sliding Rock Recreational Area (Permit NC0020460) operated by the U.S. Forest Service is authorized to discharge a monthly average of 5,000 gallons per day of treated domestic effluent. No pH violations were observed for this facility as far back as 2008. The NC Wildlife Resources Commission operates a fish hatchery under a general permit NCG530079. Under the general permit the hatchery is required to maintain pH levels between 6.0 and 9.0 for any discharge. Upon reviewing monitoring data and permit information, there is no indication these NPDES discharges are contributing to the low pH levels observed in the Davidson River. There are no point sources in the remaining watersheds.

All of the watersheds are at least 90 percent forested, leaving little opportunity for other types of land disturbance activities to cause low pH in these waters. As referenced in the original TMDL, the likely cause for lower pH in these waters is atmospheric acidity from sulfate and nitrate deposition that has over time reduced the acid neutralizing capacity (ANC) of these watersheds.

Low pH in western North Carolina streams due to atmospheric deposition of acidic compounds has been well documented by others as well. Recent USDA Forest Service surveys have shown widespread occurrence of streams having low ANC and pH values in the mountains of western North Carolina, attributable to deposition of sulfur compounds from the atmosphere (USDA, 2014).

5.0 TMDL Reductions

The 2010 Great Smoky Mountains TMDL uses ANC as a surrogate parameter with instream target values ranging from 6-50 µeq/L. Because there is no site specific ANC available for these streams, the default instream ANC target of 50 µeq/L is recommended for these streams.

All of the addendum watersheds are located within 40 to 80 miles of the Great Smokey Mountains National Park. Based on this proximity, full implementation of the 2010 Great Smoky Mountains TMDL would result in regional air quality improvement, and the ANC target of 50 µeq/L in the addendum waters is expected to be achieved. Recent data show average annual 2007-2009 wet deposition of sulfate and inorganic nitrogen in the southeast was 43 and 23 percent lower respectively than in 1989-1991 (NAPAP, 2011). However large amounts of previously deposited sulfate, naturally low availability of base cations and continued deposition of acidic compounds may contribute a slow recovery of ANC in the southern Appalachians (NAPAP, 2011).

DWR may reevaluate the need for individual TMDLs for the addendum waters if the required targets are determined to be insufficient.

6.0 Public Participation

The 2010 Great Smoky Mountains TMDL was placed on Public Notice for a 60-day period. Notice was given via the following: Tennessee Department of Environment and Conservation website, TN NPDES permit Public Notice mailing, and letter sent to water quality partners.

A draft of this addendum to the Great Smoky Mountains TMDL was publicly noticed through the DWR TMDL listserv, Water Resources Research Institute listserv, and the DWR Public Events Calendar from August 6, 2015 through September 8, 2015. The addendum was also available on DWR's website at http://portal.ncdenr.org/web/wq/ps/mtu/tmdl/tmdls during the comment period. No comments were received. A copy of this notice is provided in Appendix B.

7.0 Literature Cited

NAPAP. 2011. National Acid Precipitation Assessment Program Report to Congress 2011: An Integrated Assessment. National Precipitation Assessment Program, Washington, D.C.

USDA, 2002. US Department of Agriculture Natural Resources Conservation Service. Ecoregions of North Carolina. By Glenn Griffith, Omernik James, and Jeffrey Comstock.

USDA, 2014. US Department of Agriculture Forest Service. Air Assessment for the Nantahala and Pisgah National Forests. This document is available on the Forest Service website at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprd3795477.pdf

Appendix A: NC Monitoring Data

NC RAMS Data	
Davidson River - E0750000	
Date	pH Result
4/17/2009	6.2
5/29/2009	6.1
11/24/2010	6.8
3/12/2010	6.0
2/24/2010	5.7
1/9/2009	5.2
2/6/2009	5.4
3/24/2009	5.8
6/19/2009	6.2
7/24/2009	5.7
8/11/2009	6.7
9/4/2009	6.9
10/9/2009	6.7
11/13/2009	6.6
12/15/2009	6.1
1/20/2010	5.7
Minimum	**5.2**
Maximum	**6.9**
Average	**5.93**
% Results Below Standard	**37.5%**

NC AMS Data	
Davidson River - E0850000	
Date	pH Result
1/28/2008	5.9
2/20/2008	5.6
3/31/2008	6.9
4/24/2008	6.6
5/28/2008	6.3
6/24/2008	6.5
7/21/2008	6.9
8/25/2008	5.3
9/16/2008	6.4
10/13/2008	6.2
11/24/2008	6.5
12/8/2008	6.3
1/22/2009	6.2
2/12/2009	6.0
3/19/2009	6.2
4/17/2009	6.1
5/27/2009	6.2
6/25/2009	6.2
7/9/2009	6.2
8/11/2009	6.5
9/28/2009	6.3
11/9/2009	6.2
12/15/2009	5.6
1/14/2010	5.6
2/4/2010	5.9
3/16/2010	6.2
4/6/2010	5.7
11/23/2010	6.7
11/5/2013	6.8
12/4/2013	6.6
Minimum	**5.3**
Maximum	**6.9**
Average	**5.93**
% Results Below Standard	**23.3%**

NC RAMS Data	
Harper Creek - C1379000	
Date	**pH Result**
1/27/2009	6.2
2/25/2009	6.2
3/26/2009	6.2
4/21/2009	5.7
5/19/2009	6.0
6/24/2009	6.1
7/28/2009	6.4
8/21/2009	6.2
9/29/2009	6.3
10/16/2009	6.3
11/12/2009	5.7
12/14/2009	5.3
3/31/2010	5.8
12/1/2010	6.9
Minimum	**5.3**
Maximum	**6.9**
Median	**6.2**
Average	**5.93**
% Results Below Standard	**28.6%**

NC RAMS Data	
Shooks Creek - C0990000	
Date	**pH Result**
1/16/2009	5.9
2/16/2009	6.2
3/18/2009	6.0
4/6/2009	5.0
5/21/2009	6.3
6/9/2009	5.8
7/21/2009	5.1
8/24/2009	6.3
9/23/2009	6.3
10/23/2009	6.1
12/16/2009	5.6
1/28/2010	4.7
2/19/2010	5.1
3/18/2010	5.6
11/18/2010	7.2
Minimum	**4.7**
Maximum	**7.2**
Median	**5.9**
Average	**5.4**
% Results Below Standard	**53.3%**

NC AMS Data	
S. Toe River - E8200000	
Date	pH Result
1/14/2008	6.4
2/6/2008	5.7
3/5/2008	5.3
4/2/2008	6.2
5/14/2008	6.4
6/30/2008	6.8
7/20/2008	7.0
8/27/2008	4.9
9/29/2008	6.4
11/4/2008	6.5
12/4/2008	6.1
1/28/2009	6.0
2/25/2009	6.1
3/26/2009	5.8
4/21/2009	5.1
5/19/2009	5.9
6/24/2009	6.1
7/28/2009	6.3
8/19/2009	5.9
9/15/2009	6.3
10/22/2009	6.5
1/28/2010	6.0
2/22/2010	5.8
3/15/2010	5.5
4/13/2010	6.3
12/1/2010	6.2
10/29/2013	6.9
11/14/2013	6.8
12/11/2013	6.5
Minimum	**4.9**
Maximum	**7**
Median	**6.2**
Average	**5.8**
% Results Below Standard	**31.0%**

NC RAMS Data	
UT to Frankum Creek - C1431000	
Date	**pH Result**
1/28/2009	6.4
2/18/2009	6.4
3/10/2009	7.0
4/15/2009	5.8
5/12/2009	6.5
6/22/2009	6.6
7/20/2009	5.6
8/28/2009	6.3
9/30/2009	6.5
10/26/2009	6.6
11/4/2009	6.5
12/16/2009	5.7
1/27/2010	5.7
2/23/2010	6.2
3/29/2010	6.3
11/15/2010	6.5
Minimum	**5.6**
Maximum	**7**
Median	**6.4**
Average	**6.1**
% Results Below Standard	**25.0%**

Appendix B – Copy of Public Notice

From: Behm, Pamela
To: Painter, Andy
Subject: FW: [wrri-news] Digest (1 messages)
Date: Friday, September 11, 2015 9:22:16 AM

-----Original Message-----
From: wrri-news-owner@lists.ncsu.edu [mailto:wrri-news-owner@lists.ncsu.edu]
Sent: Friday, August 07, 2015 4:21 AM
To: wrri-news@lists.ncsu.edu
Subject: [wrri-news] Digest (1 messages)

The WRRI Daily Digest
Volume 1 : Issue 1335 : "text" Format

Messages in this Issue:
201508/7 : Public Comment Period - 2015 Draft NC Addendum to the Low pH TMDL for the Great Smoky Mountains National Park, TN
"Painter, Andy" <andy.painter@ncdenr.gov>

Date: Thu, 6 Aug 2015 16:06:24 +0000
From: "Painter, Andy" <andy.painter@ncdenr.gov>
To: "wrri-news@lists.ncsu.edu" <wrri-news@lists.ncsu.edu>
Subject: Public Comment Period - 2015 Draft NC Addendum to the Low pH TMDL for the Great Smoky Mountains National Park, TN
Message-ID:
<CY1PR09MB041059EA88A39B7316DBCCB8F3740@CY1PR09MB0410.namprd09.prod.outlook.com>

August 6, 2015

North Carolina Department of Environment and Natural Resources, Division of Water Resources

Now Available for Public Comment

2015 DRAFT NC Addendum to the Low pH TMDL for the Great Smoky Mountains National Park, TN

This draft TMDL report was prepared as a requirement of the Federal Water Pollution Control Act, Section 303(d). Interested parties are invited to comment on the draft TMDL report by September 7, 2015. Comments concerning the report should be directed to Andy Painter at andy.painter@ncdenr.gov<mailto:andy.painter@ncdenr.gov>.

The draft TMDL can be downloaded from the following website:
http://portal.ncdenr.org/c/document_library/get_file?uuid=c9f22457-c981-4f76-b9e9-8e0446db3db4&groupId=38364

[Attachment of type text/html removed.]
