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PICKENS COUNTY SOUTH CAROLINA 1868
GREENVILLE COUNTY SOIL & WATER CONSERVATION DISTRICT
Greenville County
FURMAN

Watershed Plan for Sediment in the North Saluda River and Saluda Lake

December 2018

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LIST OF ACRONYMS

ALUS – Aquatic Life Use Support
BMP – Best Management Practice
DOT – Department of Transportation
ECU - Easley Combined Utilities (
EPA – Environmental Protection Agency
EQIP - Environmental Quality Incentives Program
GI – Green Infrastructure
HSG - Hydrologic Soil Groups
HUC – Hydrologic Unit Code
LID – Low Impact Development
MRLC - Multi-Resolution Land Consortium
MSL – Mean Sea Level
NCBI - North Carolina Biotic Index
NLCD - National Land Cover Database
NRCS - Natural Resources Conservation Service
NTU – Nephelometric Turbidity Unit
RC&D - Resource Conservation and Development
SC – South Carolina
SCDHEC - South Carolina Department of Health and Environmental Control
SCDNR - South Carolina Department of Natural Resources
SCFC – South Carolina Forestry Commission
SFI – Sustainable Forestry Initiative
SOS – Save Our Saluda
SRCWF - Savannah River Clean Water Fund
SSR – South Saluda River
STEPL - Spreadsheet Tool for the Estimation of Pollutant Load"
SWCD – Soil and Water Conservation District
TASC - Technical Advisory Stakeholder Committee (
TMDL – Total Maximum Daily Load
USDA - United States Department of Agriculture
USGS – United States Geological Survey
USLE - Universal Soil Loss Equation

1. EXECUTIVE SUMMARY

The following Watershed Plan was developed to address sediment in the North Saluda River and Saluda Lake. It lays the groundwork for implementation of practices and measures to reduce sediment runoff and help prevent future sediment runoff to the river and lake. The Plan was developed by Save Our Saluda (SOS) in cooperation with partnering organizations.

Saluda Lake and its contributing rivers in the Upper Saluda Watershed are vital water resources for local communities in the Upstate of South Carolina. Headwaters of both the North and South Saluda Rivers feed reservoirs which supply water to the greater Greenville area. Watershed areas above the two reservoirs are protected and provide some of the highest quality drinking water in the country. Downstream near Greenville, Saluda Lake supplies water to the Easley area and its dam supplies hydropower. The Upper Saluda Rivers also support business and industry, provide recreational opportunities to thousands of Upstate residents and visitors, and generally support a rich diversity of aquatic life.

Sediment is a significant problem for Saluda Lake. In 2011-2012, approximately 366,600 cubic yards of sediment were dredged from the lake at a cost of approximately seven million dollars to Easley Combined Utilities. Upper parts of Saluda Lake are rapidly filling in with sediment and recent surveys indicate the dredged area of the lake is already 2/3 filled in again after only six years. Projected future dredging costs are near ten million dollars.

Water quality in the lake and rivers upstream is impaired, aquatic habitat is degraded, and recreation is diminished due to sedimentation, particularly in the North Saluda River. Cost effective and sustainable watershed-based solutions are needed for long-term erosion prevention and sediment control. Strategies to minimize soil loss from the Watershed will help protect drinking water sources and downstream property, improve river and lake water quality, restore aquatic habitat conditions, and enhance recreational experiences for property owners and the public.

After prioritizing the North Saluda River for initial focus, project partners were recruited to help support and develop a watershed plan to address sediment in watershed areas above the lake. The project was funded through the South Carolina Department of Health and Environmental Control (SCDHEC) Nonpoint Source Program with support from the partnership. Partners included multiple utilities, county stormwater programs, agricultural agencies, universities, and nonprofit groups whose representatives comprise the Technical Advisory Stakeholder Committee (TASC). The TASC met regularly to help oversee and guide the project, and additional focus meetings were held with agricultural, urban, and forestry stakeholders to discuss practices, regulations, and landowner issues related to sediment runoff in the watershed planning area. A workshop on cover crops and soil health was held in the Watershed and an online survey was conducted to gather public input.

WATERSHED ASSESSMENT AND PLAN

The primary goal of the Watershed Plan is to reduce sediment loading to the river and lake. The Watershed planning area spans the Blue Ridge and Piedmont physiographic regions and encompasses approximately 124.7 square miles in Greenville and Pickens Counties. It includes the North Saluda watershed and drainage areas around Saluda Lake.

Methods

The watershed assessment involved desktop and field surveys to gather land use and water quality data for the watershed planning area. A windshield survey was conducted, and recent aerial photos were evaluated to verify land use mapping and to identify obvious sediment source areas. Modeling of the watershed area was done to estimate existing sediment loading using EPA's "Spreadsheet Tool for the Estimation of Pollutant Load" (STEPL). STEPL incorporates many of the watershed characteristics such as soils, land use, rainfall data and number of agricultural animals. STEPL utilizes the Universal Soil Loss Equation (USLE) to estimate sediment load from surface runoff of different land use areas.

Best management practices (BMPs) and measures were selected and prioritized to address the greatest sources of sediment pollution. These include structural, programmatic, and educational BMPs. Sediment load reduction from implementation of the selected BMPs/management measures was estimated using a number of assumptions, including level of participation and the effectiveness of the practice for reducing sediment loading.

Watershed Assessment Results

Land use data indicate that 77 percent of the North Saluda-Saluda Lake watershed planning area is forested land. Managed rural areas (pastures, crops and hay) make up 8 percent of the total area and 13 percent of land use is categorized as urban. The Upper North Saluda subwatershed above the North Saluda Reservoir is nearly entirely forested and is protected through a conservation easement. As such, the Plan focuses on the lower areas of the Watershed in greatest need of restoration and protection.

Assessment of existing water quality data corroborates designated impairments in the Lower North Saluda River and Saluda Lake related to sediment. High sustained turbidity levels during and following stormflow have been observed in the river and lake. Since the watershed assessment area is largely forested and forests are a fairly stable land use, this indicates that the sediment runoff originates from a relatively small proportion of the watershed drainage area.

Sedimentation is ongoing in the upper parts of Saluda Lake. Data indicate that turbidity in the lake increased during dredging operations, peaked in 2013, and remains higher than pre-dredging levels. STEPL model results indicate that 74% of the overall sediment load originates from the Lower North Saluda River subwatershed and that 67% of the overall sediment load is coming from croplands. STEPL does not estimate gully, streambank, or in-stream erosion (remobilization of legacy sediment, which is significant), only sediment runoff from the land.

Watershed modeling and field observations confirm that intensively managed crop areas in floodplains in lower watershed areas are large contributors of sediment loading to the river and lake downstream. Therefore, these land use areas are the focus for ongoing and future sediment control projects as part of the watershed protection plan described below. Other sediment source areas addressed in the Plan include livestock areas, urban areas (development sites and unpaved driveways), forestry, and streambank erosion.

Watershed Plan

This Watershed Plan for Sediment in the North Saluda River and Saluda Lake identifies priority areas and strategies for watershed restoration and protection. BMPs identified for sediment control are listed below for priority sources.

Agricultural BMPs include:

- Cover crops
- Intercropping
- Conservation tillage
- Vegetated filter strips
- Field borders
- Pollinator strips
- Culvert/ditch stabilization
- Farm road stabilization
- Vegetated waterways
- Sediment control basins
- Terracing and contouring
- Streambank stabilization
- Conservation plans
- Livestock fencing/watering
- Loafing sheds
- Stream crossings
- Cross fencing
- Pasture planting
- Heavy use area stabilization
- Vegetated riparian buffers

Programmatic measures for sediment control for existing and future urban source areas include:

- Land development regulations
- Riparian buffer protections
- Land conservation easement program
- Citizen training and reporting
- Education and outreach
- Watershed Manager

The Plan identifies technical and financial assistance needed for implementation and proposes solutions to help meet those needs. These include grants and programs such as 319 Nonpoint Source Pollution Grants and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP). Community outreach and education efforts were aimed at building community awareness of the Plan and support for the protection and enhancement of land and water resources in the Upper Saluda Watershed. These included hosting a workshop on soil health and cover crops in the Watershed area of focus, conducting an online survey for community feedback, and developing the first implementation project/demonstration site at a crop farm along the North Saluda River near Marietta. Project fact sheets and website materials were developed, including an online interactive watershed map and an educational video currently under development.

Thank you project partners: Clemson Cooperative Extension, Easley Combined Utilities, Furman University, Greenville County, Greenville County Soil and Water Conservation District, Greenville Water, Mountain Bridge Trout Unlimited, Naturaland Trust, Pickens County, Powdersville Water, Renewable Water Resources, Save Our Saluda, South Carolina Department of Health and Environmental Control, South Carolina Department of Natural Resources, South Carolina Rural Water Association, Upstate Forever and Wood Environment & Infrastructure Solutions.

2. INTRODUCTION

The purpose of a Watershed Plan is to identify and assess specific causes and sources of water quality impairments in a given watershed and develop a strategy to address impairments. The Watershed Plan presents a course of action for protection and improvement of water quality and provides an approach to manage and maintain or restore waterbodies to their designated use. Community stakeholders play a critical role in plan development, and the final plan reflects the community's goals for their watershed.

The ultimate goal of this cooperative planning effort for the North Saluda River - Saluda Lake Watershed was to create a roadmap for implementation of best management practices (BMPs) and programmatic measures to help control and minimize sediment runoff to the river and lake. Water quality in the lake and its contributing rivers is impaired, reservoir storage of the lake is reduced, aquatic habitat is degraded, and recreational opportunities are diminished due to the impacts of sedimentation. Water quality is affected not only by the sediment itself, but also by other pollutants the sediment carries with it, such as bacteria, nutrients and pesticides.

The Upper Saluda Watershed above Saluda Lake originates from the South Saluda River near Table Rock, the Middle Saluda River near Caesars Head and Jones Gap, and the North Saluda River above the North Saluda Reservoir (Figure 1). The North Saluda was selected for initial watershed planning due to evidence of excessive sedimentation (Photo 1, Figure 1). The watershed assessment area for this Watershed Plan encompasses 79,807 acres in Greenville and Pickens Counties. Saluda Lake is situated at the most downstream point of the assessment area. Future planning is anticipated for the South and Middle Saluda watershed areas upstream of the lake.

Photo 1. Confluence of the North and South Saluda Rivers during stormflow

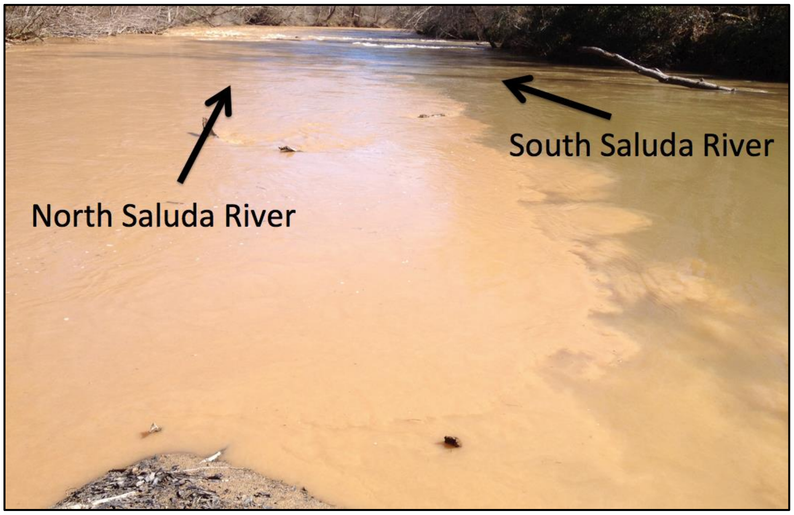
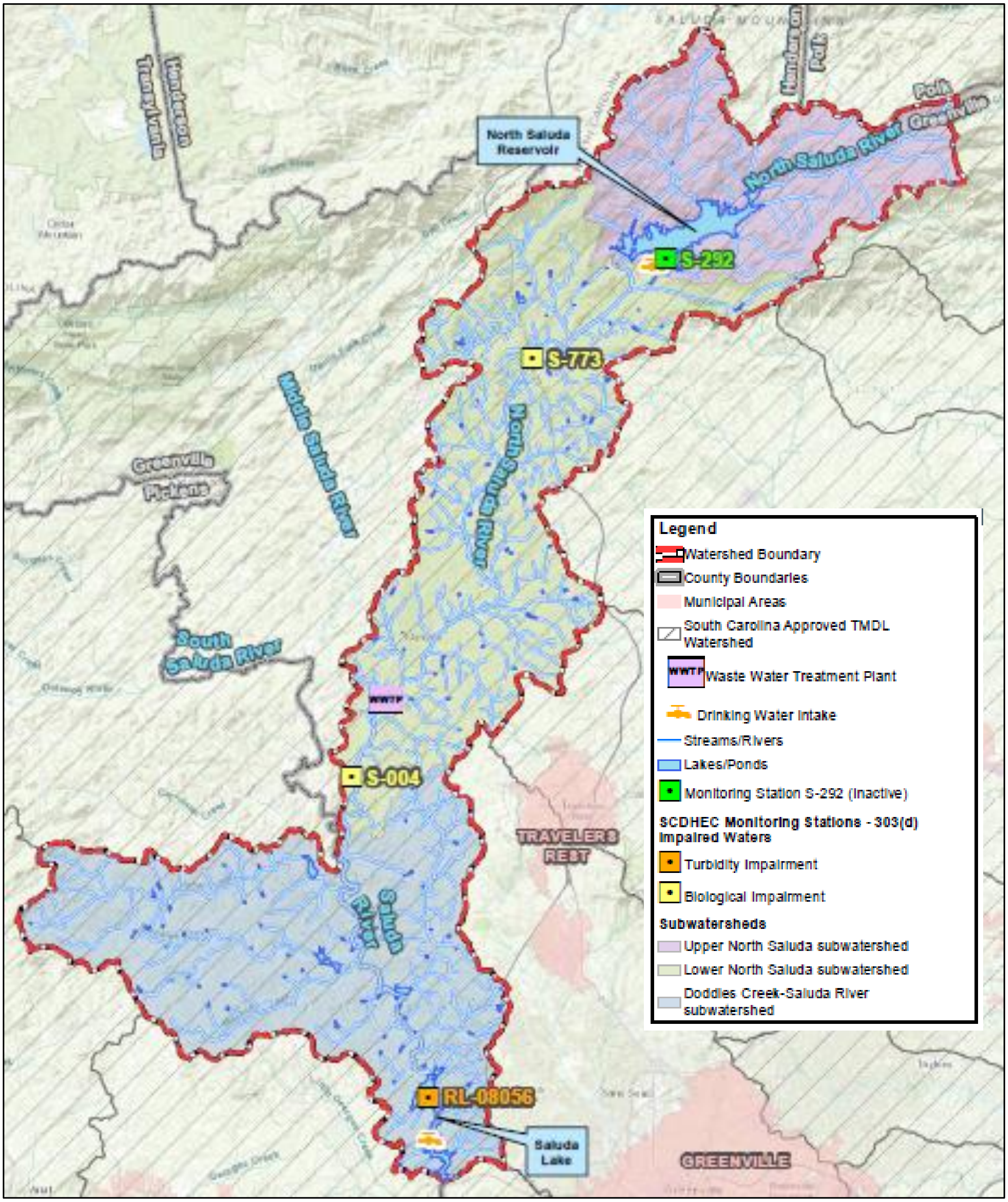


Figure 1. North Saluda River – Saluda Lake Watershed



2.1. Purpose and Need

The North Saluda River and Saluda Lake are vital resources for local communities in the Upstate of South Carolina. The North Saluda River is one of three primary drinking water sources for the greater Greenville area (Photo 2. North Saluda Reservoir (also known as Poinsett Reservoir). Greenville Water supplies drinking water to approximately 500,000 customers, including local industries, institutions, and other retail and wholesale customers in Greenville, Pickens, and Anderson Counties. The river provides irrigation for farms, nurseries, and golf courses and assimilates municipal and industrial wastewater discharges.

Photo 2. North Saluda Reservoir (also known as Poinsett Reservoir)

Saluda Lake is the primary source of water for the greater Easley area. Easley Combined Utilities (ECU) supplies drinking water to approximately 13,000 direct customers in Pickens and Greenville Counties and provides wholesale drinking water to four water districts, serving a total population of approximately 80,000 to 100,00 people in Pickens and Anderson Counties. The dam on the Saluda Lake generates hydropower (Photo 3 and Photo4).

Photo 3. Historic Photo of Saluda Lake Dam

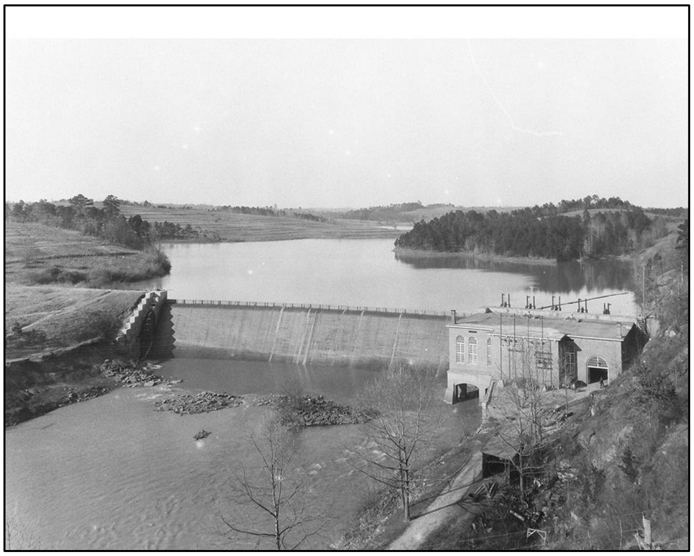


Photo 4. Saluda Lake Dam (2017)

The river and lake provide numerous recreational opportunities, such as boating, fishing, and swimming. Streams and rivers of the Upper Saluda Watershed generally support a rich diversity of aquatic life, and one third of all freshwater fish species in South Carolina can be found here.

Sediment accumulation has been a concern for Saluda Lake for a number of years as upper parts of the lake became filled with sediment, reducing the lake's storage capacity and impacting recreational uses. In the early 1990s, the Pickens and Greenville Soil and Water Conservation Districts, the Foothills Resource Conservation and Development (RC&D) Council, the NRCS, and the South Carolina Department of Natural Resources (SCDNR) partnered to evaluate the lake and develop a plan for sediment removal. A tax district was formed to generate funds to support dredging operations, which began in 2002. The effort was marginally successful and resulted in the recognition of the need for more significant resources to remove the massive amount of accumulated sediment in the lake (Appendix B).

Additional evaluations of Saluda Lake sedimentation were conducted by ECU and in 2011-2012, approximately 366,600 cubic yards of sediment were dredged from the upper lake at a cost of approximately seven million dollars (Photo 5. Saluda Lake Dredging Operation, 2012).

Photo 5. Saluda Lake Dredging Operation, 2012

A comparison of a recent bathymetric survey of the lake to an as-built survey following the 2012 dredging indicates that approximately 66.5 percent of the lake volume regained from sediment removal has been lost again to sediment deposition in only six years (Appendix C). Dredging will be required on a regular basis to reclaim lost reservoir storage and restore recreational areas unless upstream controls are put in place. Dredging is very expensive and does not address sources of sediment, upstream river impairments, or loss of topsoil and land from the contributing watershed area.

Excess sediment levels are also a concern for the health of the streams and rivers that drain to Saluda Lake. Sediment can clog and damage sensitive fish gill tissues and can suffocate organisms that live on or in the bed of lakes and streams. Sediment impairs habitat where thick deposits of suspended material settle out of the water (EPA Victoria, 2012). High amounts of suspended sediment in the water column reduces the amount of light available for plant growth, decreasing the supply of food for other organisms. Sediment is also an effective carrier of other water quality pollutants.

While other pollutants such as bacteria and nutrients are also present and contribute to water quality impairments, these do not pose as much of an immediate threat as the excess levels of sediment in the river and lake. Since sediment is a carrier of other pollutants (e.g. phosphorus, bacteria, metals, pesticides), recommendations presented in this Watershed Plan to correct and remediate the sediment pollution can also be used to address other known and unknown water quality problems.

In addition, because the watershed assessment and planning area is situated between the rapidly growing areas of Easley and Greenville, it is important not only to address current pollution levels, but also to prevent future pollution as growth and development continue to place additional stress on local water resources.

Cost effective and sustainable watershed-based solutions are needed for long-term erosion and sediment control to protect downstream uses. Strategies to minimize soil loss from the Watershed will help protect drinking water supplies, safeguard property values, protect and restore river and lake water quality, enhance recreational experiences, preserve and improve soil health, and support and maintain healthy aquatic ecosystems. Protection and improvement of water quality in the North Saluda River and Saluda Lake will help sustain and improve the local economy and quality of life for these rapidly growing communities.

The following sections describe the Watershed Plan for Sediment in the North Saluda River and Saluda Lake.

2.2. Watershed Plan Development

This Watershed Plan was developed using a collaborative approach. This approach aimed to actively involve local stakeholders with shared goals for watershed protection and restoration in selecting management strategies that may be implemented over time to solve water quality problems within the North Saluda River - Saluda Lake Watershed. Save Our Saluda (SOS) managed and administered the overall project and raised supplemental funding from the partnership to support Watershed Plan development and development of additional educational tools.

Cooperating organizations included:

- Clemson Cooperative Extension
- Easley Combined Utilities
- Furman University
- Greenville County
- Greenville County Soil and Water Conservation District
- Greenville Water
- Mountain Bridge Trout Unlimited
- Naturaland Trust
- Pickens County
- Powdersville Water
- Renewable Water Resources
- Save Our Saluda
- South Carolina Department of Health and Environmental Control
- South Carolina Department of Natural Resources
- South Carolina Rural Water Association
- Upstate Forever
- Wood Environment & Infrastructure Solutions

Representatives from these seventeen partnering organizations formed the Technical Advisory Stakeholder Committee (TASC). Over the span of one year, the TASC met five times to help coordinate and steer project activities. In addition, three brainstorming sessions were held with these and other stakeholders for focused discussions on urban, agricultural and forestry issues related to sediment runoff. An agricultural workshop on cover crops and soil health was held in the watershed focus area to obtain feedback and generate interest in the 319 program from local landowners. An online survey was conducted to reach community members to obtain their input as well: https://www.cognitoforms.com/SaveOurSaluda1/UpperSaludaWatershedSurvey. See Section 10 for additional details about the workshop and survey.

The following data and information were used along with information obtained during brainstorm sessions and TASC meetings to assess watershed conditions, water quality, and to develop and refine management strategies:

- Total Maximum Daily Load (TMDL) developed in 2004 for the Upper Saluda River Basin,
- SCDHEC surface water monitoring data and list of impaired waters,
- Greenville County MS4 stream monitoring data,

- Greenville Water and Easley Combined Utilities stream and lake monitoring data,
- Furman stream monitoring data,
- SOS stream monitoring data,
- SCDNR fish data,
- Land use data,
- A windshield survey of the watershed assessment area, and
- Stakeholder knowledge of the watershed planning area.

This Watershed Plan incorporates this work and includes all SCDHEC's requirements for a Watershed Plan to preserve and restore impaired waterbodies in the watershed planning area. This alignment with SCDHEC guidance is intended to enable project partners to seek future SCDHEC funding to help implement the plan.

2.3. How the Plan Will Be Used

Municipalities and local groups can use this plan as the foundation for local action for sediment control in the North Saluda River - Saluda Lake Watershed. Local, state and federal agencies can use this plan to enhance their understanding of watershed conditions and water quality impairments and to support coordination of monitoring, planning, permitting and regulatory decisions.

The following sections provide a detailed assessment of the Watershed, water quality impairments, and a watershed implementation plan for protection and restoration of the North Saluda-Saluda Lake Watershed. Data and information on land use, water quality and water quality impairments, sources and causes of impairments, and pollutant loading are presented in the following sections. Plan goals, practices and measures to address pollutant loading, guidance for monitoring and evaluation, and information regarding technical and financial assistance are also detailed in the Plan.

3. Watershed Characteristics

3.1. Watershed Assessment Area

The Upper Saluda Watershed, as described herein, begins in the Blue Ridge Mountains of South Carolina near the North Carolina state line. It descends into the Piedmont/Foothills region of South Carolina and drains south to Saluda Lake north of Easley and Greenville (Figure 1).It includes portions of Greenville and Pickens Counties. The watershed assessment area evaluated for this plan includes the entire North Saluda Watershed and additional drainage areas to the Saluda River above Saluda Lake. It does not include the South Saluda Watershed. It encompasses approximately 125 square miles (323 km^2, or 79,807 acres), which is approximately 42% of the drainage area for Saluda Lake.

It includes two drinking water sources. Saluda Lake was built on the Saluda River near Greenville in 1905 for the purpose of hydropower generation and later began to be used as a drinking water source after construction of the Easley Water Treatment Plant in the 1970s. The North Saluda Reservoir (also known as Poinsett Reservoir), was constructed on the North Saluda River in 1956 as a water source for Greenville.

The following three subwatersheds, as defined by United States Geological Survey (USGS) 12-digit Hydrologic Unit Code (HUC12) map delineations, make up the entirety of the watershed planning area (Figure 1):

- The Upper North Saluda River subwatershed (HUC 030501090101, 16,221 acres) encompasses headwater areas above the North Saluda Reservoir. This subwatershed is entirely within Greenville County and is protected through an easement held by the Nature Conservancy. Named tributaries include Brushy Creek, Big Falls Creek, and Little Falls Creek.
- The Lower North Saluda River subwatershed (HUC 030501090102, 33,598 acres) encompasses the remainder of the North Saluda drainage area downstream to its confluence with the South Saluda River. This subwatershed is also entirely within Greenville County. It is mostly rural and includes the Slater-Marietta community. Major tributaries include Calahan Branch, Terry Crek, Mill Creek, Sprigg Creek, Bull Creek, Talley Creek, Railroad Creek, Beaverdam Creek, and Whitmire Branch.
- Doddies Creek-Saluda River subwatershed (HUC 030501090301, 29,987 acres) includes the 330-acre Saluda Lake and drainage areas to the Saluda River between the lake and the confluence of the North and South Saluda Rivers. These include Shoal Creek and Doddies Creek/Machine Creek in Pickens County and Armstrong Creek and Coopers

Creek in Greenville County. The Saluda River forms the county boundary. This subwatershed is also mostly rural with some suburban areas and includes the Dacusville community.

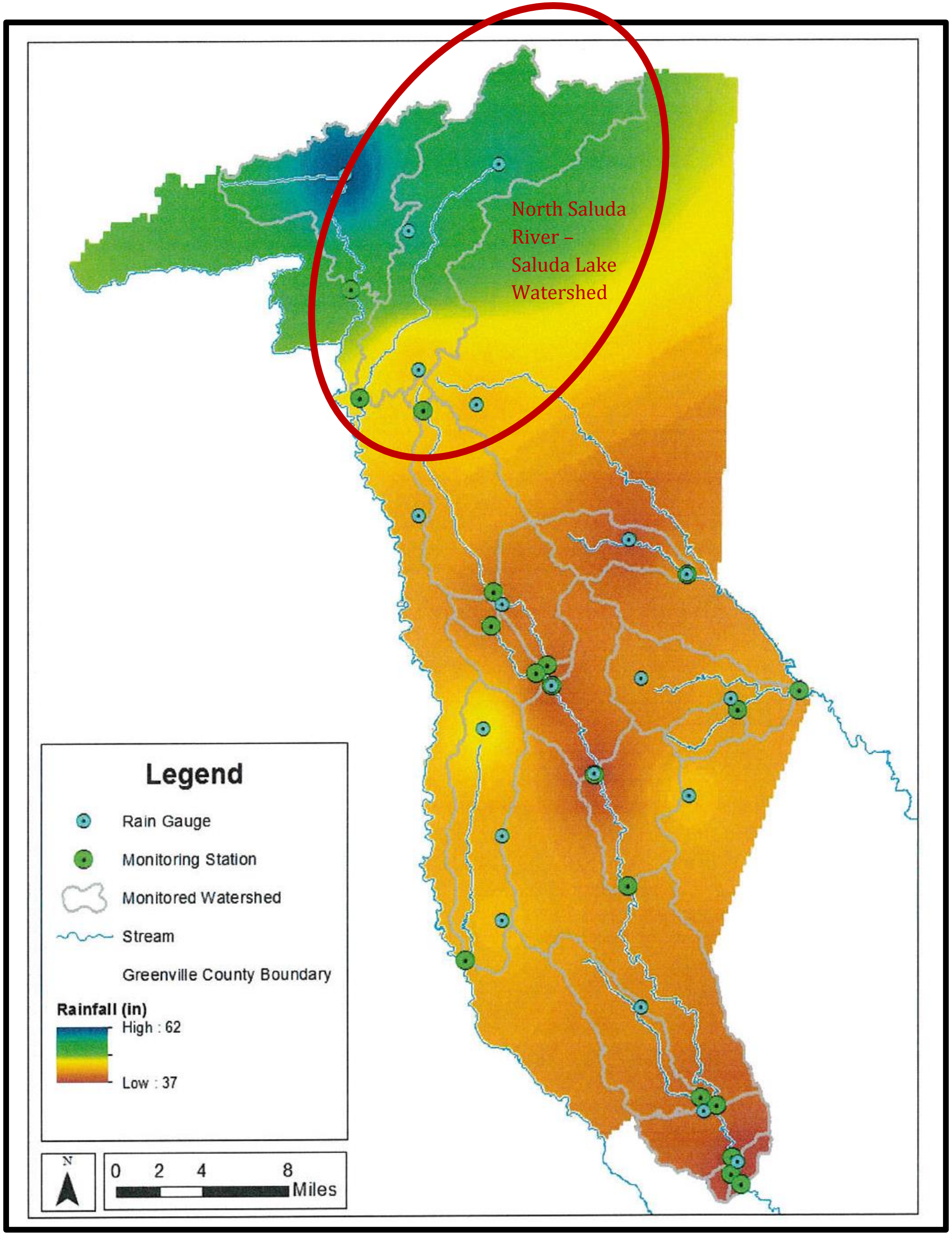
For the purposes of this Watershed Plan, these three subwatersheds are herein collectively referred to as the "North Saluda River - Saluda Lake Watershed," or simply the "Watershed." An online interactive map of the Watershed can be found on the Save Our Saluda website: www.saveoursaluda.org/webmap.

3.2. Climate

South Carolina is situated within the humid subtropical zone. Because the Watershed spans physiographic regions, there is some variability in climatic conditions. According to SCDNR, Pickens County has an average mean temperature of 59.7 °F and an annual average precipitation of 59.0 inches per year, as measured from 1951 to 2016. The Pickens County portion of the Watershed is in the Piedmont region which experiences slightly less rainfall compared to mountainous areas to the north.

Greenville County has an average mean temperature of 60.5 °F and an annual average precipitation from 1893 to 2016 of 50.2 inches per year (http://www.dnr.sc.gov/climate/sco/ClimateData/countyData/county_greenville.php). Rainfall amounts can vary significantly, up to more than 20 inches per year between northern and southern areas of the County (Figure 2). Accordingly, rainfall also varies between upper and lower sections of the Watershed.

Figure 2. Interpolated Rainfall Totals in Greenville County for 2007[1]



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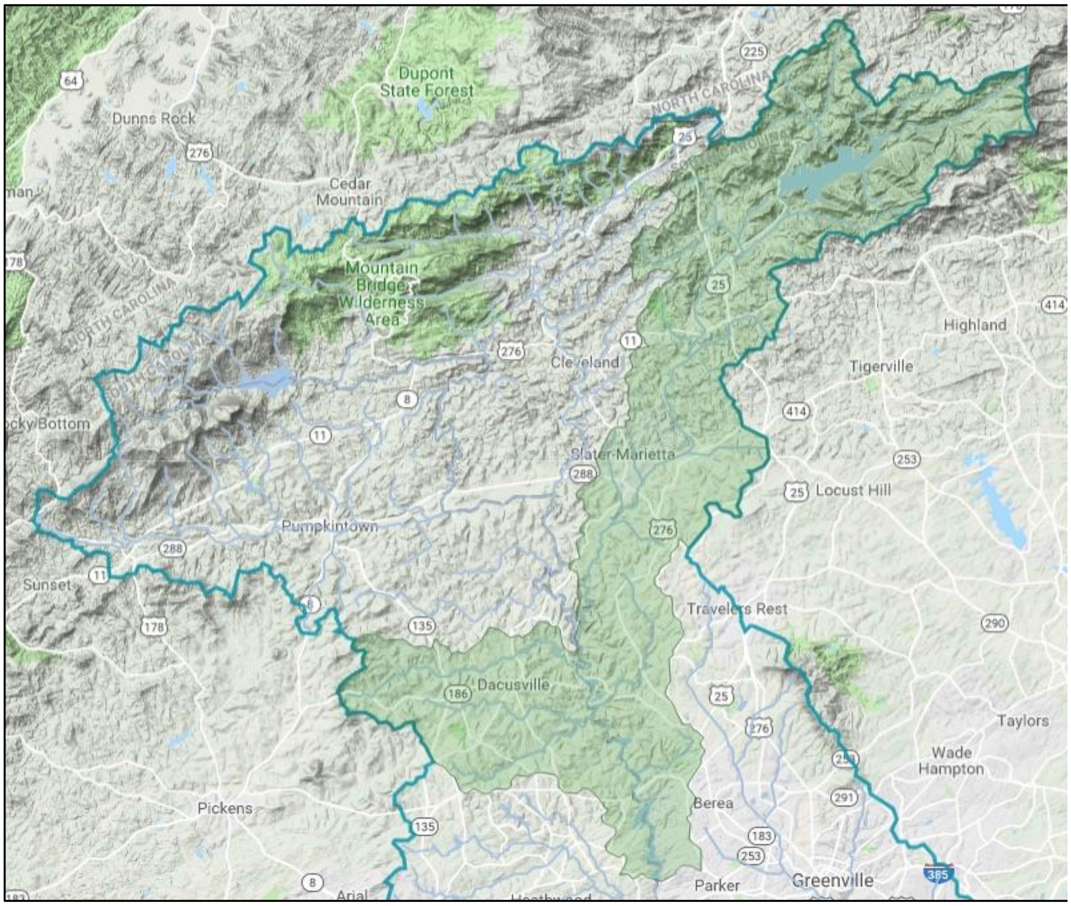
[1] Figure 2 was provided by Greenville County and was interpolated from rainfall totals for the Greenville County 2007 NPDES Permit Year 10 using inverse distance weighting.

3.3. Topography

Greenville and Pickens Counties lie within the Mountain and Piedmont regions of South Carolina. These regions are characterized as mountainous and hilly. The highest elevation in the Watershed is over 3,200 feet above mean sea level (MSL) in the upper mountainous areas and the lowest is around 840 feet MSL in the lower reaches near the lake.

Figure 3 is a screenshot of the online interactive watershed map on the Save Our Saluda website showing the terrain of the watershed planning area. Detailed topographic information can be obtained by visiting saveoursaluda.org/webmap and clicking on Watershed Plan Areas to turn on the data layer showing the North Saluda-Saluda Lake Watershed area. Users can then zoom in and pan to see detailed topography for specific areas.

Figure 3. Terrain Map of the Watershed



3.4. Soils

Soils in very steep to moderately steep mountainous areas in the upper parts of the Watershed are generally well drained and loamy throughout. Soils in gently sloping to moderately steep Piedmont upland areas have loamy surface soils and clayey subsoils and are generally well drained. Soils in level floodplains are loamy throughout and are well to poorly drained.

Soil associations are shown on the general soil maps for Greenville and Pickens Counties (Figures Figure 4 and 5).

Figure 4. Map of Soil Associations in Greenville County

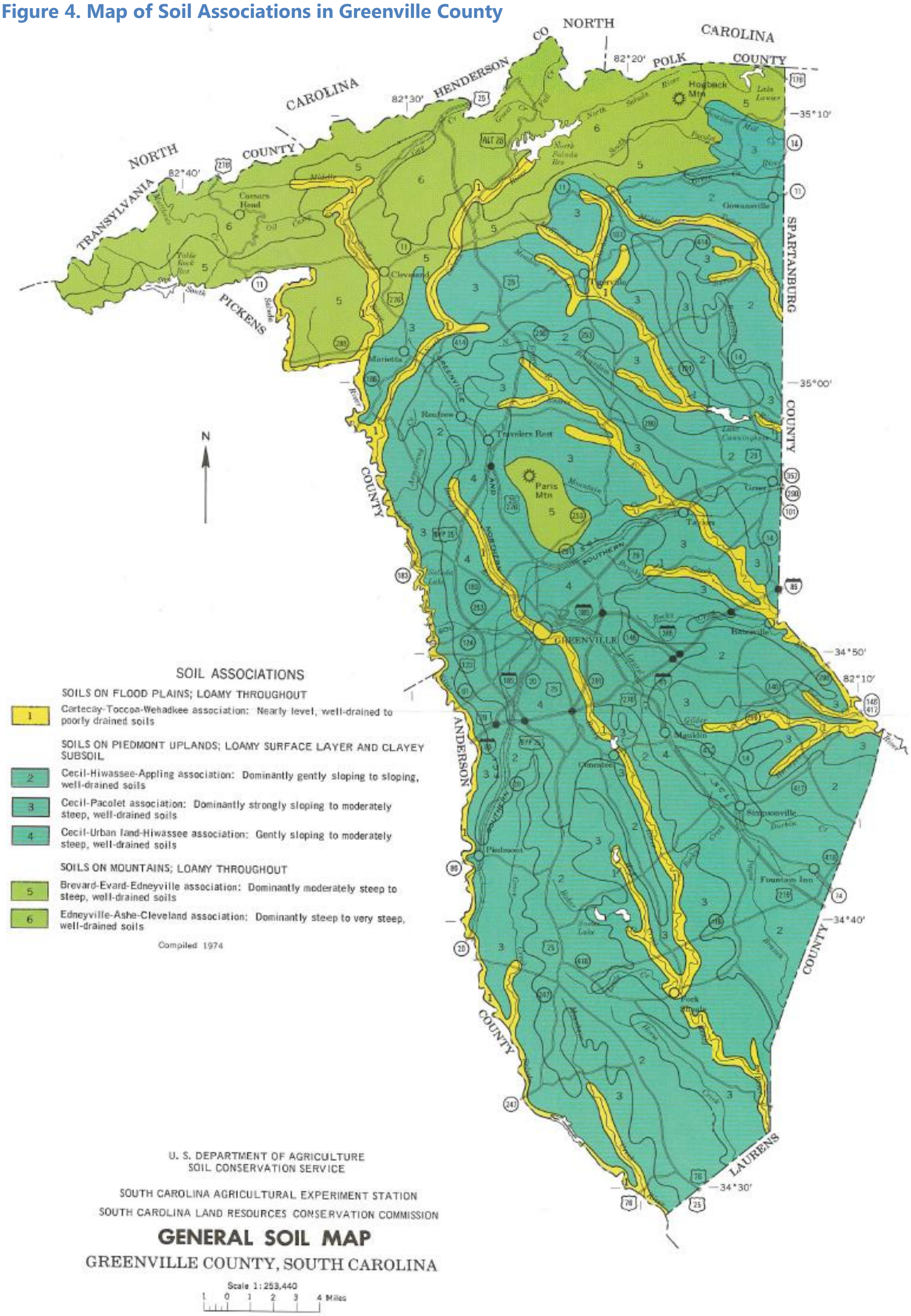


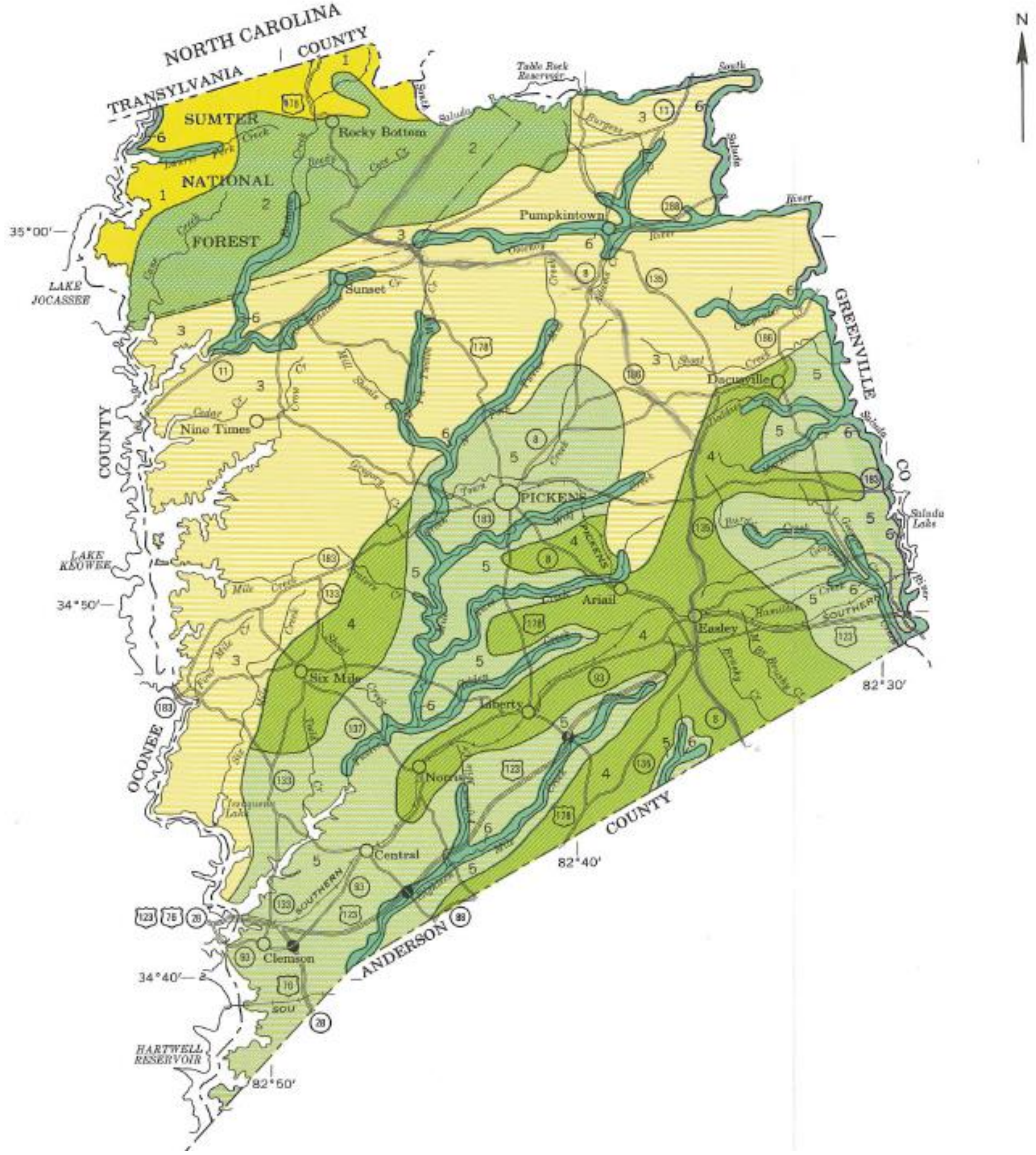
Figure 5. Map of Soil Associations in Pickens County

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
SOUTH CAROLINA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

PICKENS COUNTY, SOUTH CAROLINA

Scale 1:253,440



SOIL ASSOCIATIONS

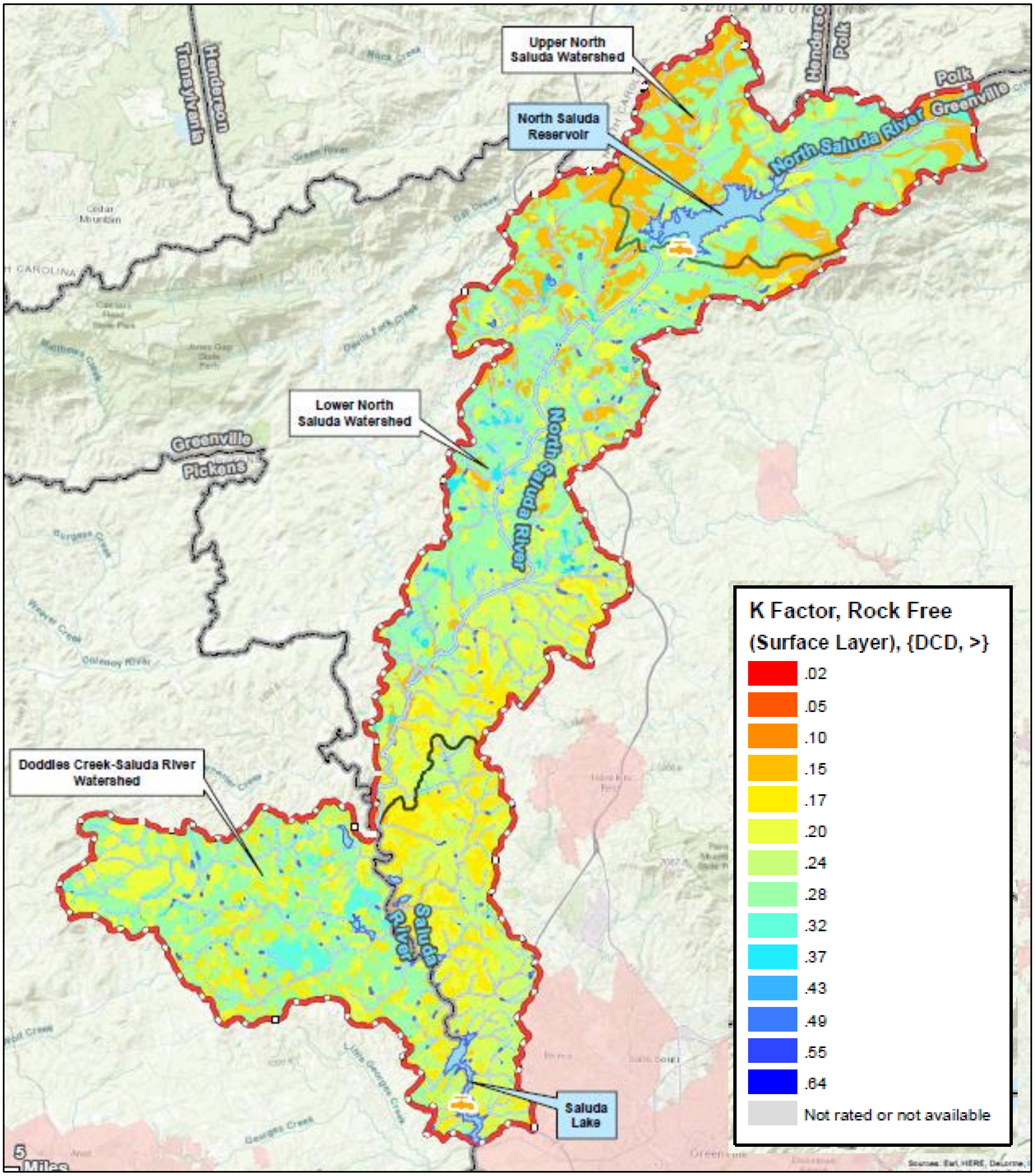
B	1	Edneyville-Porters-Hayesville association: Well-drained, strongly sloping to very steep soils that have a loamy subsoil and are moderately deep or deep to weathered rock; on mountains
C	2	Ashe-Saluda-Stony land association: Excessively drained to well-drained, strongly sloping to very steep soils that have a loamy subsoil and are moderately deep or shallow to weathered rock; on mountains
B	3	Pacolet-Grover-Hiwassee association: Well-drained, moderately steep or steep soils that have a dominantly clayey subsoil and are moderately deep or deep to weathered rock; on uplands
B	4	Cecil-Hiwassee-Madison association: Well-drained, dominantly sloping soils that have a dominantly clayey subsoil and are moderately deep or deep to weathered rock; on uplands
B	5	Cecil-Madison-Pacolet association: Well-drained, strongly sloping to steep soils that have a dominantly clayey subsoil and are moderately deep or deep to weathered rock; on uplands
B-C	6	Toccoa-Chewacla association: Well-drained to somewhat poorly drained, nearly level soils that are dominantly loamy throughout and are subject to flooding; on bottom lands

Soil series mapped in the area of focus within the Watershed (floodplains of the North Saluda River) include Congaree, Chewacla, Cartecay and Toccoa. These soils formed in alluvial sediments and are frequently flooded.

The remainder of this section discusses spatial soils data that was used for watershed modeling to estimate sediment runoff (Section 7).

Figure 6 shows the K Factors of soils in the North Saluda River – Saluda Lake Watershed. The K Factor is an index which quantifies the relative susceptibility of the soil to sheet and rill erosion. As shown, the soils located in the Upper North Saluda River subwatershed are higher K Factor soils (more susceptible to sheet and rill erosion) than soils in the Lower North Saluda River and Doddies Creek-Saluda Lake subwatersheds.

Figure 6. Map of Soil K-Factors in North Saluda River – Saluda Lake Watershed



Hydrologic Soil Groups (HSG) are designations developed by the NRCS that describe the conductivity of water through soil and are used to estimate runoff potential. HSGs are described in greater detail below, categorized in decreasing water transmission capacity from A to D:

Group A is sand, loamy sand or sandy loam types of soils. These soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 inches/hour).

Group B is silt loam or loam. These soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 inches/hour).

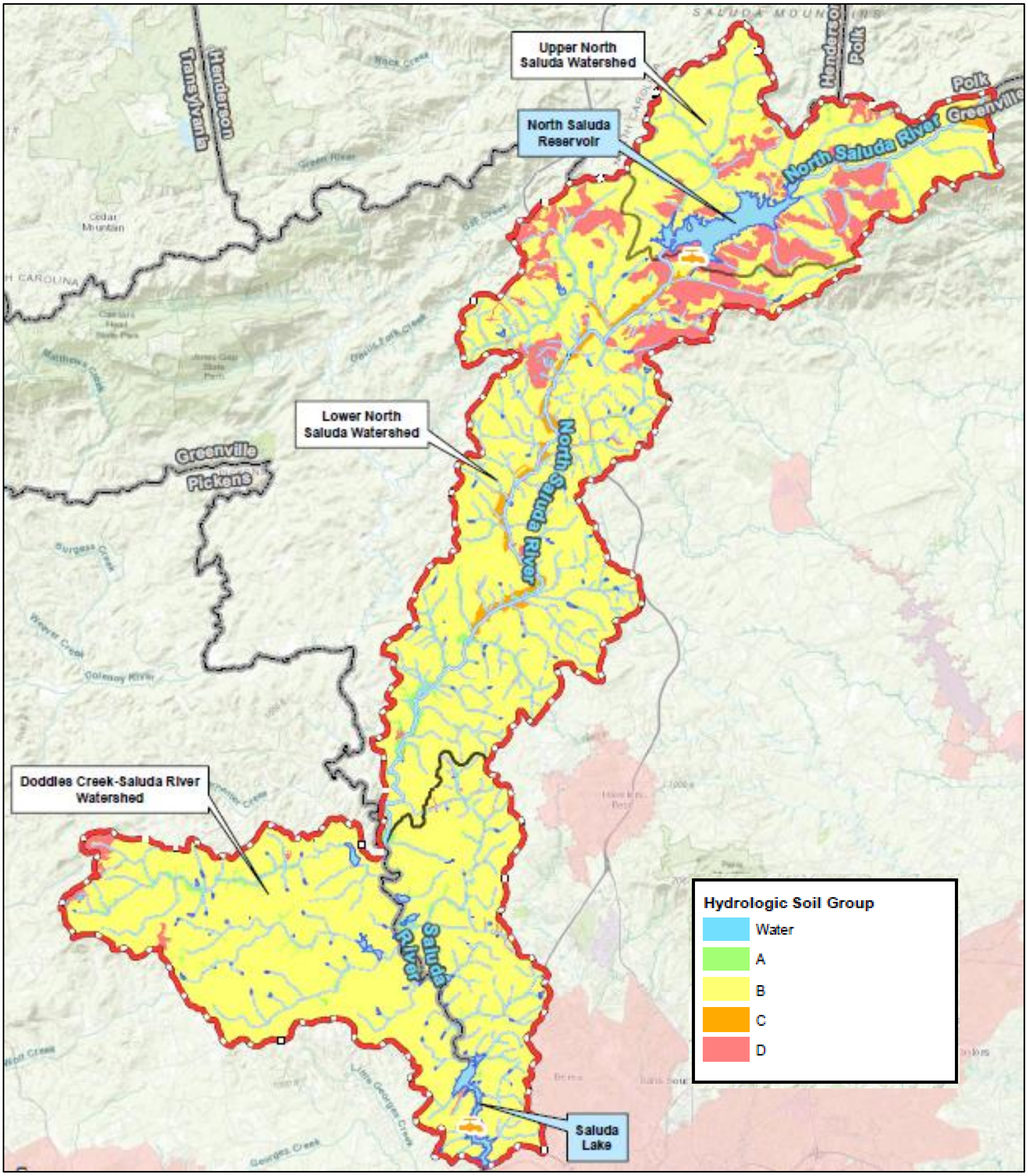
Group C is sandy clay loam. These soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission of (0.05-0.15 inches/hour).

Group D is clay loam, silty clay loam, sandy clay, silty clay or clay. These soils have the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 inches/hour).

While the slope of the soil surface is not considered when assigning HSGs, they can help estimate soil erodibility. Soil erodibility is an estimate of the ability of soils to resist erosion, based on the physical characteristics of each soil. Generally, soils with faster infiltration rates, higher levels of organic matter and improved soil structure have a greater resistance to erosion. Sand, sandy loam and loam textured soils tend to be less erodible than silt, very fine sand, and certain clay textured soils. Therefore, HSGs can aid the decision process of narrowing down potential sources of pollution via increased sediment loads. Understanding the watershed's runoff potential will help narrow down areas that may have a higher potential for pollutant runoff.

HSGs in the Upper and Lower North Saluda River subwatersheds are a mixture of HSG B, C and D soils. HSG C soils exist along much of the North Saluda floodplain between North Saluda Reservoir and Highway 276, where many of the crop farms are located (Figure 7). Additional areas along streams and rivers are HSG A soils. Compared to the Upper and Lower North Saluda River subwatersheds, the Doddies Creek-Saluda River subwatershed contains mostly HSG B soils.

Figure 7. Hydrologic Soil Groups within the North Saluda River - Saluda Lake Watershed



3.5. Land Use

3.5.1. Historic Land Use

Historic land use practices have had a cumulative impact on sediment loading and sediment distribution patterns in the Watershed. Throughout the 1800s and early 1900s, the availability of inexpensive land and labor facilitated the widespread conversion of forestland throughout the southeast Piedmont for cultivation of row crops. Rapid land clearing and nonconservative agricultural practices combined with the cumulative effects of intense rainfall, steep slopes, and highly erosive soils resulted in significant topsoil loss and accelerated erosion and sedimentation across the region during this time. In the South Carolina Piedmont, erosive land use peaked around 1920. The average depth of total erosion from 1700 to 1970 was estimated between 7 and 12 inches for most areas in this region (Trimble, 2008). Over time, streams, rivers, and floodplains became choked with sediment. Formerly cultivated bottomlands became covered with thick deposits of unfertile erosional debris and sediment and were subject to increased frequency of flooding due to the decreased capacity of stream channels to convey floodwaters.

In 1931, over half of the formerly cultivated alluvial land in the southeast Piedmont region was covered by erosional material from a few inches to more than six feet (Bennett, 1931). Approximately 60 percent of South Carolina Piedmont bottomlands became unsuitable for cultivation due to the effects of accelerated sedimentation (Happ, 1945). Streams and rivers began cutting through unstable agricultural sediments deposited in channels and valleys.

The Great Depression of the 1930s led to the creation of various federal jobs programs for soil conservation, flood control and drainage. Many streams and rivers throughout the southeast were straightened and channelized during this time and wetland areas were drained to reclaim flooded alluvial lands. In the decades that followed and with the decline of cotton, many row crop areas were converted to pasture or reverted back to forested land. Erosion and sediment delivery rates also began to decline (Trimble, 2008).

Historic farming in upper reaches of the Watershed was limited to level floodplain areas, and much of the upper Watershed was and remains forested. Lower areas of the North Saluda-Saluda Lake Watershed experienced similar land conversion and land use trends as much of the Southeast Piedmont.

Historic aerial photographs of the Watershed show a largely forested upper watershed with agricultural land use in floodplains (Photo 6). Sections of the river and some tributaries in the Lower North Saluda watershed were historically re-routed/channelized/dredged and adjacent floodplains were drained for farming. Lower watershed areas had a higher proportion of cleared land in upland areas, with the largest areas of forested land being in steeper terrain around the Saluda River upstream of Saluda Lake (Photo 7). In the decades that followed, many farmed areas in the Watershed reverted back to forested land.

Photo 6. Upper North Saluda Watershed Area, 1943
(source: South Carolina USDA Historic Aerial Photographic Collection)

Photo 7. Lower North Saluda Watershed Area, 1943
(source: South Carolina USDA Historic Aerial Photographic Collection)

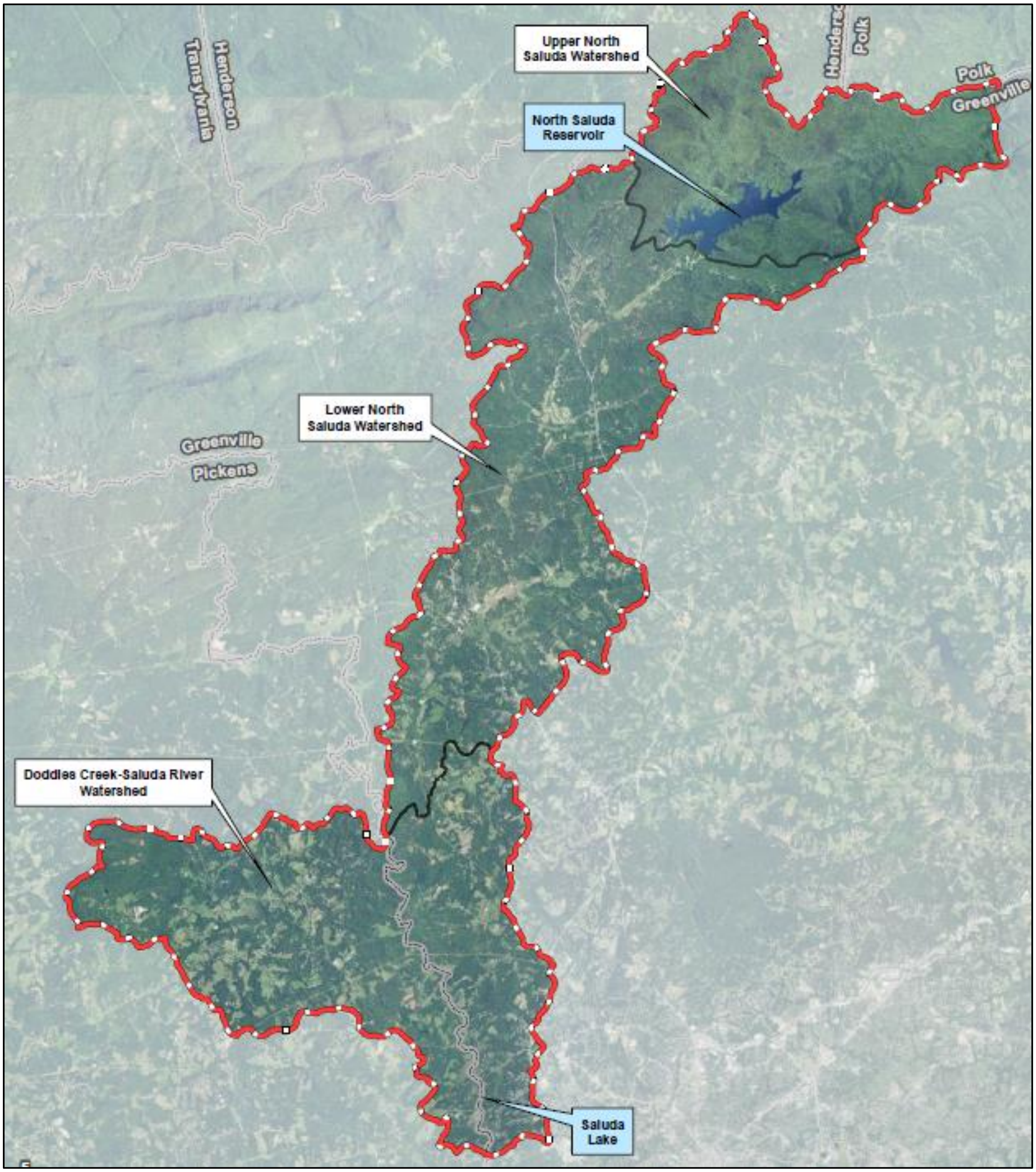
In addition to early land use practices, watershed development, including most significantly construction of highways and roads, also contributed to historic sediment loading and increased stormwater runoff to the river and lake.

The construction and expansion of Highways 25, 276, and 11 involved much land disturbance, as did development of two golf courses in floodplain areas in the Lower North Saluda watershed. Additional details on infrastructure development can be found in the Saluda Lake Sedimentation Analysis report (Appendix C).

3.5.2. Existing Land Use

The watershed assessment involved desktop and field surveys to gather current land use data for the Watershed. The most current Multi-Resolution Land Consortium (MRLC) National Land Cover Database (NLCD) land use data (2011) was used as a baseline Geographic Information System (GIS) data layer to represent existing conditions. The 2011 data was revised using analysis of 2017 aerial photography (Figure 8) and information gathered from a windshield survey of the watershed in 2018. This data was compared to 1992 NLCD land use data to determine land use change.

Figure 8. Aerial Map of North Saluda River – Saluda Lake Watershed



Results of the desktop and field analysis indicate that approximately 77 percent of the watershed is forested, 12 percent is developed, 8 percent is agricultural, and 3 percent is water/wetlands (Figure 10). These land use categories were further broken down into finer land use classifications and land cover for each is given in acres and as a percentage of the overall Watershed for 1992 and 2018 (Table 1).

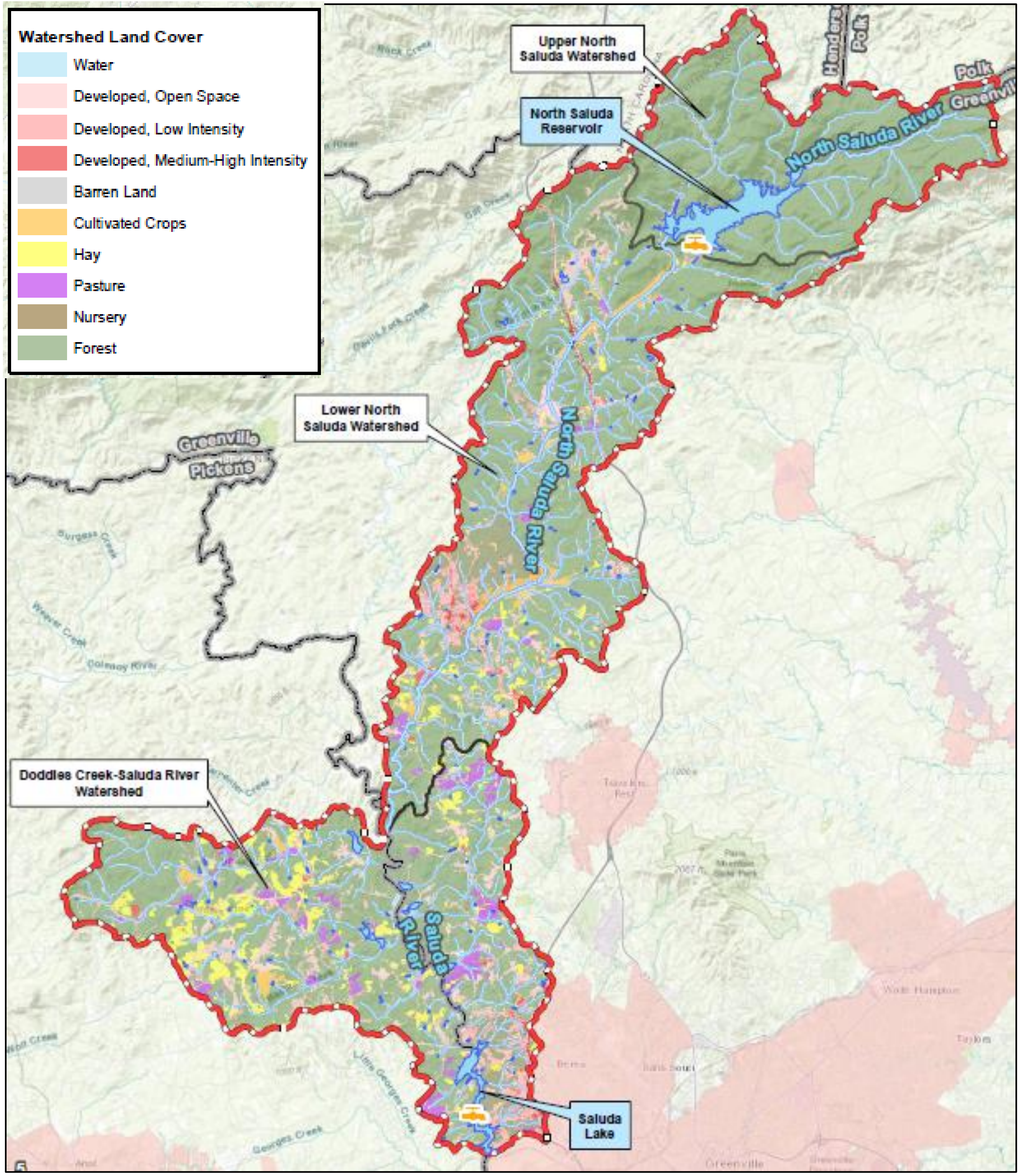
Comparison of the 1992 and 2018 land use data reveal the following:

- The predominant land use (forest/shrubland/herbaceous) decreased by 7.5 percent, with a decrease of over 4,800 acres,
- Developed land more than tripled from 3.5 to 12.4 percent with an increase of 7,260 acres, and
- Agricultural areas (croplands and pastures) decreased approximately 21% from 10.4% to 8.1%, with a slight increase in pasture/hay (+44 acres) and a decrease in cultivated crops (-1,738 acres).

Table 1. Land use distributions in the North Saluda River - Saluda Lake Watershed

	1992 Land Cover Data		**2017/2018 Desktop/Field Analysis**		**Increase/ Decrease (Acres)**
Land Use Classification	**Area (Acres)**	**Percent of Watershed**	**Area (Acres)**	**Percent of Watershed**	
Water	1398	1.8%	1551	1.9%	+153
Developed, Open	2097	2.7%	8028	10.1%	+5931
Developed, Low	152	0.2%	1276	1.6%	+1124
Developed, Medium	375	0.5%	421	0.5%	+46
Developed, High	0	0.0%	159	0.2%	+159
Barren Land	45	0.1%	182	0.2%	+137
Cultivated Crops	3217	4.1%	1479	1.9%	-1738
Pasture/ Hay	4926	6.3%	4970	6.2%	+44
Wetlands	403	0.5%	796	1.0%	+393
Forest/Shrubland/ Herbaceous	65781	83.9%	60946	76.4%	-4835
Total	**78394**	**100.0%**	**79807**	**100.00%**	

Figure 9. North Saluda River – Saluda Lake Watershed Land Use



The following pie charts show the current distribution of land use for the entire Watershed (Figure 10) and for subwatersheds (Figure 11 through Figure 13).

Overall, the Watershed is mostly forested with 13% developed and 8% agriculture. The Upper North Saluda River subwatershed is nearly entirely forested and is protected through a conservation easement. The Lower North Saluda River and Doddies Creek subwatersheds are also mostly forested land, with developed and agricultural areas distributed throughout. Developed areas occur in the Slater-Marietta area, along major roads in the lower part of the Watershed, and in the southwest and southeast Watershed areas on the outskirts of Easley and Greenville. In agricultural areas, the Lower North Saluda River subwatershed has more cropland, situated primarily in floodplain areas, and the Doddies Creek-Saluda lake area has more hay and pastureland.

Figure 10. North Saluda River - Saluda Lake Watershed Land Use

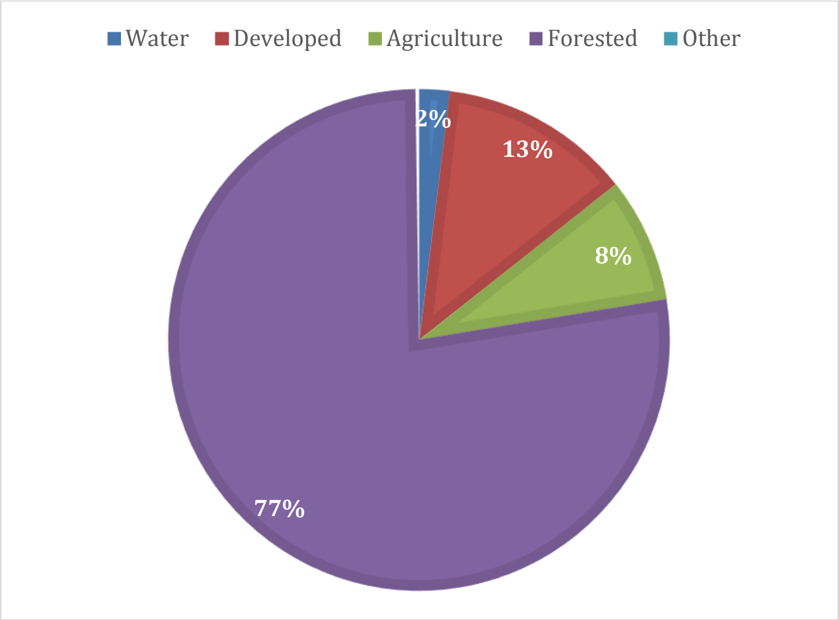


Figure 11. Upper North Saluda River Subwatershed Land Use

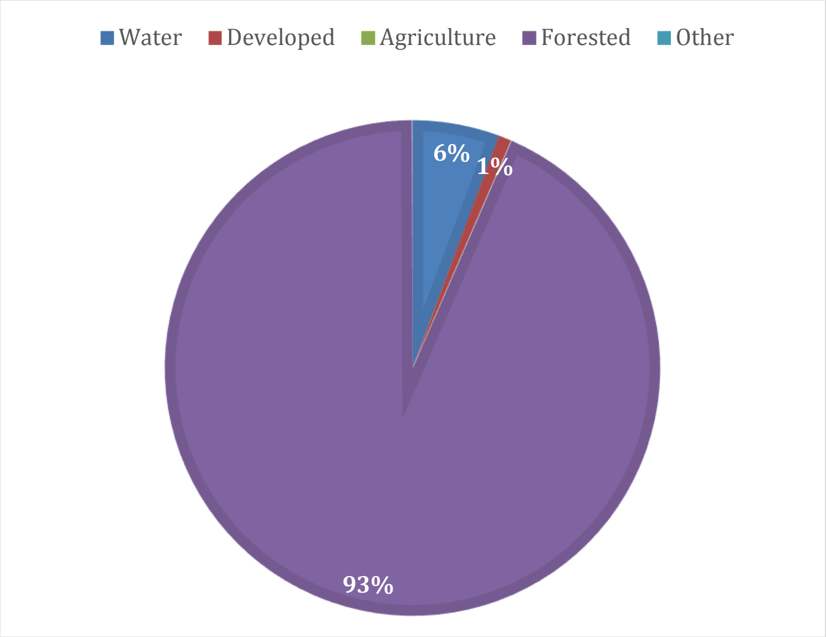


Figure 12. Lower North Saluda River Subwatershed Land Use

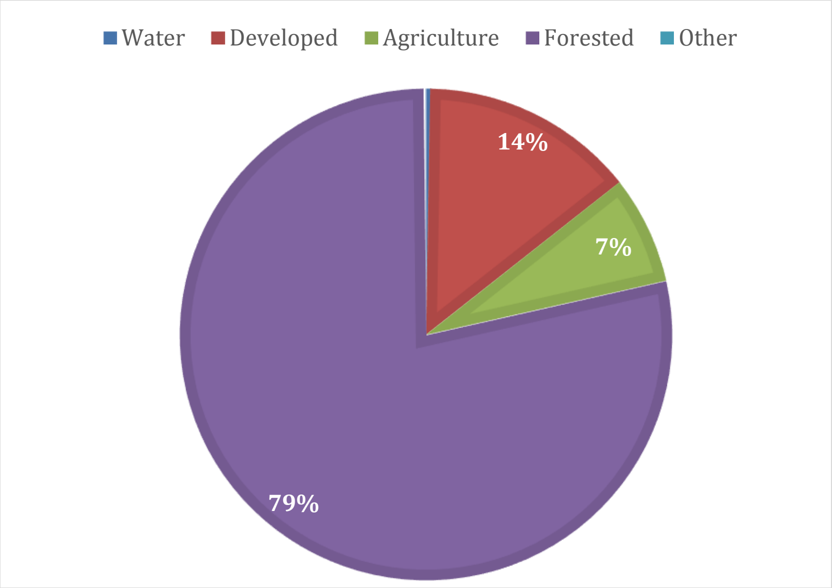
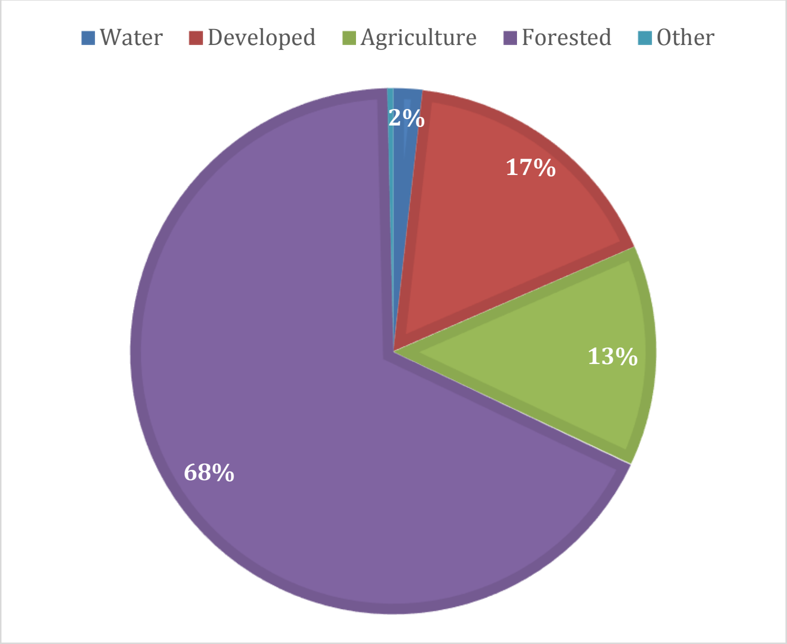


Figure 13. Doddies Creek – Saluda Lake Subwatershed Land Use



There is one permitted minor domestic wastewater surface water discharge and one permitted domestic wastewater land application site. Both are located in the Lower North Saluda watershed.

4. STREAM CLASSIFICATIONS, USES AND IMPAIRMENTS

4.1. Stream Classifications

Streams in the Upper North Saluda from its headwaters downstream to S.C. 42 are classified as Outstanding Resource Waters and Freshwaters. All other streams in the watershed assessment and planning area are classified as Freshwaters (see R.61-68, Water Classifications and Standards; R.61-69, Classified Waters, and https://gis.dhec.sc.gov/watersheds/).

Outstanding Resource Waters are freshwaters (or saltwaters) that are of exceptional recreational or ecological importance or of unusual value or those freshwaters suitable as a source for drinking water supply with minimal treatment. Such waters may include, but are not limited to: waters in national or state parks or wildlife refuges; waters supporting threatened or endangered species; waters under the National Wild and Scenic Rivers Act or South Carolina Scenic Rivers Act; waters known to be significant nursery areas for commercially important species or known to contain significant commercial or public shellfish resources; or waters used for or having significant value for scientific research and study (SCDHEC R.61-68).

Freshwaters are freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of SCDHEC (SCDHEC R.61-68). Freshwaters are suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Freshwaters are also suitable for industrial and agricultural uses.

4.2. Designated Uses

Designated uses in the Watershed that are protected through SCDHEC's water quality standards regulations include:

- Contact recreation (swimming or primary and boating/wading or secondary);
- Drinking water supply;
- Aquatic life uses, which include fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora; and
- Agricultural and industrial uses.

4.3. Water Quality Standards

It is a goal of SCDHEC to maintain and improve all surface waters to a level to provide for the survival and propagation of a balanced indigenous aquatic community of flora and fauna and to provide for recreation in and on the water. Narrative criteria are determined by SCDHEC based on the condition of the waters of the State by measurements of physical, chemical, and biological characteristics of the waters according to their classified uses. In order to determine the biological quality of the waters of the State, it is necessary that the biological component be assessed by comparison to a reference condition(s) based upon similar hydrologic and watershed characteristics that represent the optimum natural condition for that system (SCDHEC R.61-68). SCDHEC's procedures for determining the Aquatic Life Use Support (ALUS) of a stream are detailed in Appendix D. The procedures clarify the criteria used to determine whether a stream is Fully Supporting, Partially Supporting or Not Supporting (SCDHEC, 2012).

In addition to the narrative biological criteria, the numerical water quality standards for freshwater include turbidity levels (except for lakes) not to exceed 50 nephelometric turbidity units (NTUs) provided existing uses are maintained. For freshwater lakes, turbidity levels are not to exceed 25 NTUs provided existing uses are maintained.

4.4. Water Quality Impairments

SCDHEC maintains a network of different types of surface water quality monitoring stations throughout the Watershed. Monitoring data indicate that there are no water quality impairments in the Upper North Saluda River above the North Saluda Reservoir, but that there are multiple impairments in the Lower North Saluda and Doddies Creek-North Saluda subwatersheds. The entire Watershed is within an area with an approved TMDL for bacteria.

As explained in Section 2.1, this Watershed Plan focuses most directly on water quality impairments detailed below as they relate to the heavy sediment load coming from sources in the North Saluda River - Saluda Lake Watershed. Sediment is causing sustained high turbidity levels and habitat degradation in the river and lake and impairs stream biota. Additional data corroborating impairments due to sediment can be found in Section 5.

- S-773 (North Saluda River at Hwy 25) does not meet its designated use for supporting aquatic life due to biological impairment.
- S-004 (North Saluda River at Keeler Bridge Road) does not meet its designated use for supporting aquatic life due to biological impairment.
- RL-08056 (Saluda Lake near the end of Club Circle) does not meet its designated use for supporting aquatic life due to turbidity.

Because sediment is a carrier of bacteria, the BMPs included in this Watershed Plan can also indirectly address other water quality impairments in the Watershed caused by bacteria, particularly those BMPs associated with livestock (see the SC Watershed Atlas: https://gis.dhec.sc.gov/watersheds/).

5. STREAM ASSESSMENTS

Stream assessments were completed for the Watershed area using a combination of existing water quality and biological data and new data collected during the planning period. Existing water quality data includes SCDHEC ambient surface water quality monitoring data, Greenville County MS4 water quality data from North Saluda River, and ECU water quality data from Saluda Lake. Additional water quality data was collected by Furman and Save Our Saluda. Existing biological data includes SCDHEC macroinvertebrate data, Greenville Water macroinvertebrate data, and SCDNR fish data

5.1. Water Quality Data

Water quality was evaluated using turbidity and suspended sediment monitoring data as indicators of river and lake sediment levels. Data collected by SCDHEC, Greenville County, ECU, Furman University, and SOS are described below.

5.1.1. SCDHEC Ambient Surface Water Quality Monitoring Data

SCDHEC ambient monitoring station S-292 is located on the North Saluda Reservoir and meets its designated use for turbidity (Figure 14). Station S-088 is located on the North Saluda River at Calahan Mountain Road in the upper portion of the Lower North Saluda River subwatershed and also meets its designated use for turbidity (Figure 15). Station S-004 is located toward the bottom of the Lower North Saluda River subwatershed; however, the river at this station does not meet its designated use for supporting aquatic life for benthic macroinvertebrates (

Figure 16), although it does meet its designated use for turbidity. According to the SCDHEC monitoring results, S-004 exceeds water quality standard only 4.5% of the time. This contrasts with results from Greenville County’s continuous stream monitoring station at the same location that indicate impairment due to turbidity (see Section 5.1.2). There is also a monitoring station (RL-08056) located in the upper part of Saluda Lake near the end of Club Circle. The lake at this station does not meet its designated use for supporting aquatic life due to elevated turbidity levels.

Figure 14. Turbidity at SCDHEC Monitoring Station S-292 (North Saluda Reservoir)

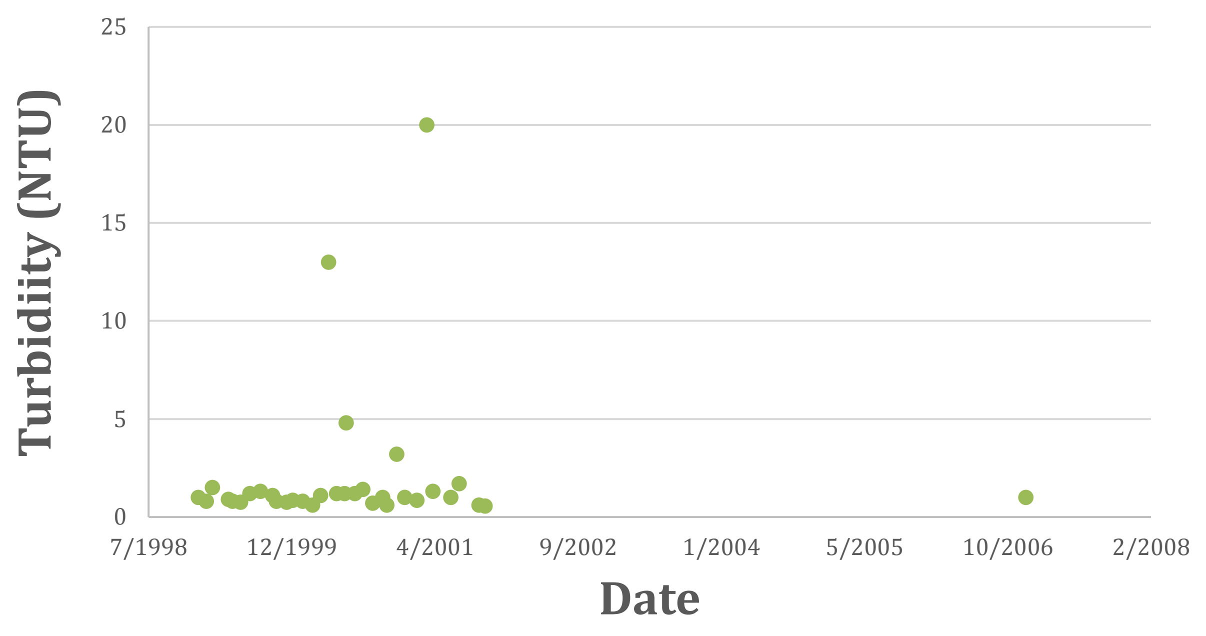


Figure 15. Turbidity at SCDHEC Monitoring Station S-088 (North Saluda River at Calahan Mountain Road)

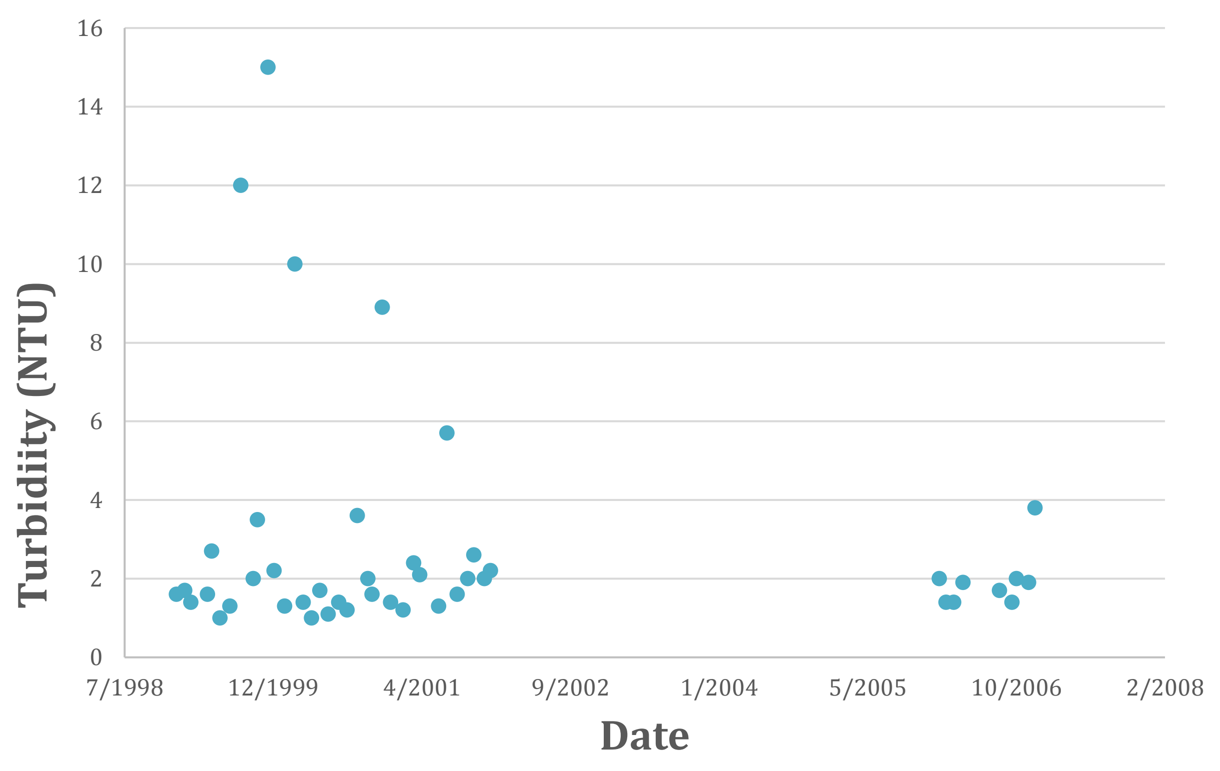
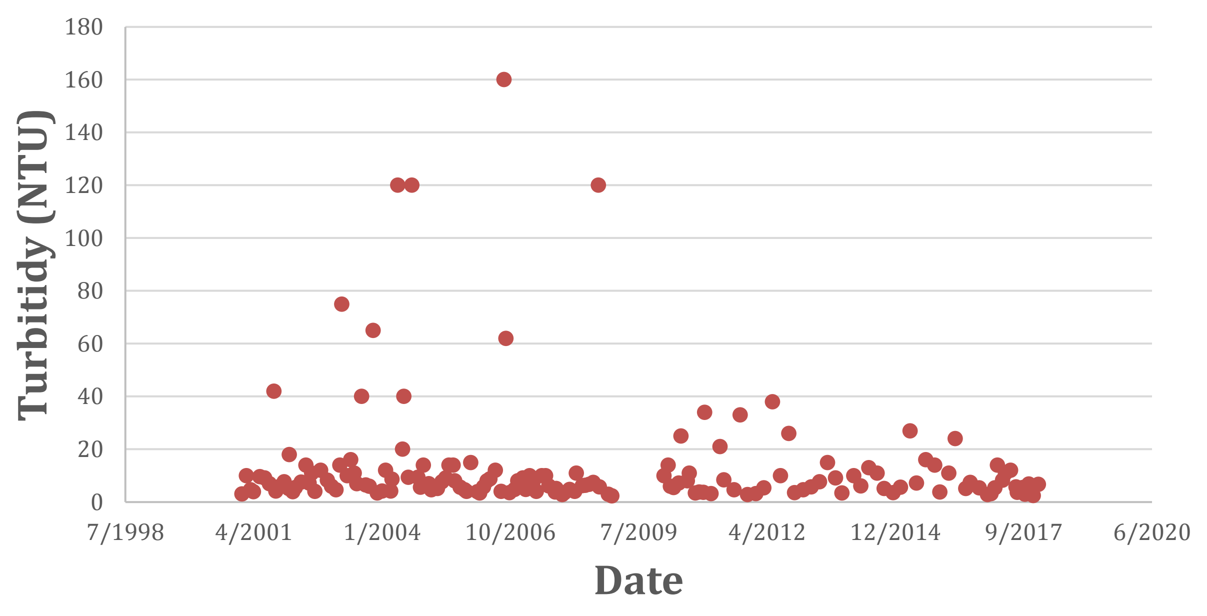


Figure 16. Turbidity at SCDHEC Monitoring Station S-004 (North Saluda River at Keeler Bridge Road)



5.1.2. Greenville County MS4 Water Quality Data

Greenville County maintains seventeen continuous stream monitoring gages across the County that record turbidity at 15-minute intervals. Figure 17 shows turbidity distributions at County monitoring stations. Figure 18 shows the comparison of average turbidity levels to percent forested land use. The red arrow points to the North Saluda River station at Keeler Bridge Road.

The North Saluda station, which coincides with SCDHEC monitoring station S-004, has the highest overall mean turbidity of all the County's continuous monitoring stations (Figure 17) despite its watershed area having the second highest percentage of forest cover (nearly 80%, Figure 18). Because forest is a fairly stable land use, this indicates that the sediment runoff reaching this monitoring station is coming from a relatively small proportion of the Watershed (the 20% of non-forested cover), as described in Section 7. The Keeler Bridge station on the North Saluda River also has the highest daily average total phosphorus concentrations of any other stations in the County. Phosphorus is strongly correlated with sediment.

Figure 17. Daily Average Turbidity at Greenville County Monitoring Stations

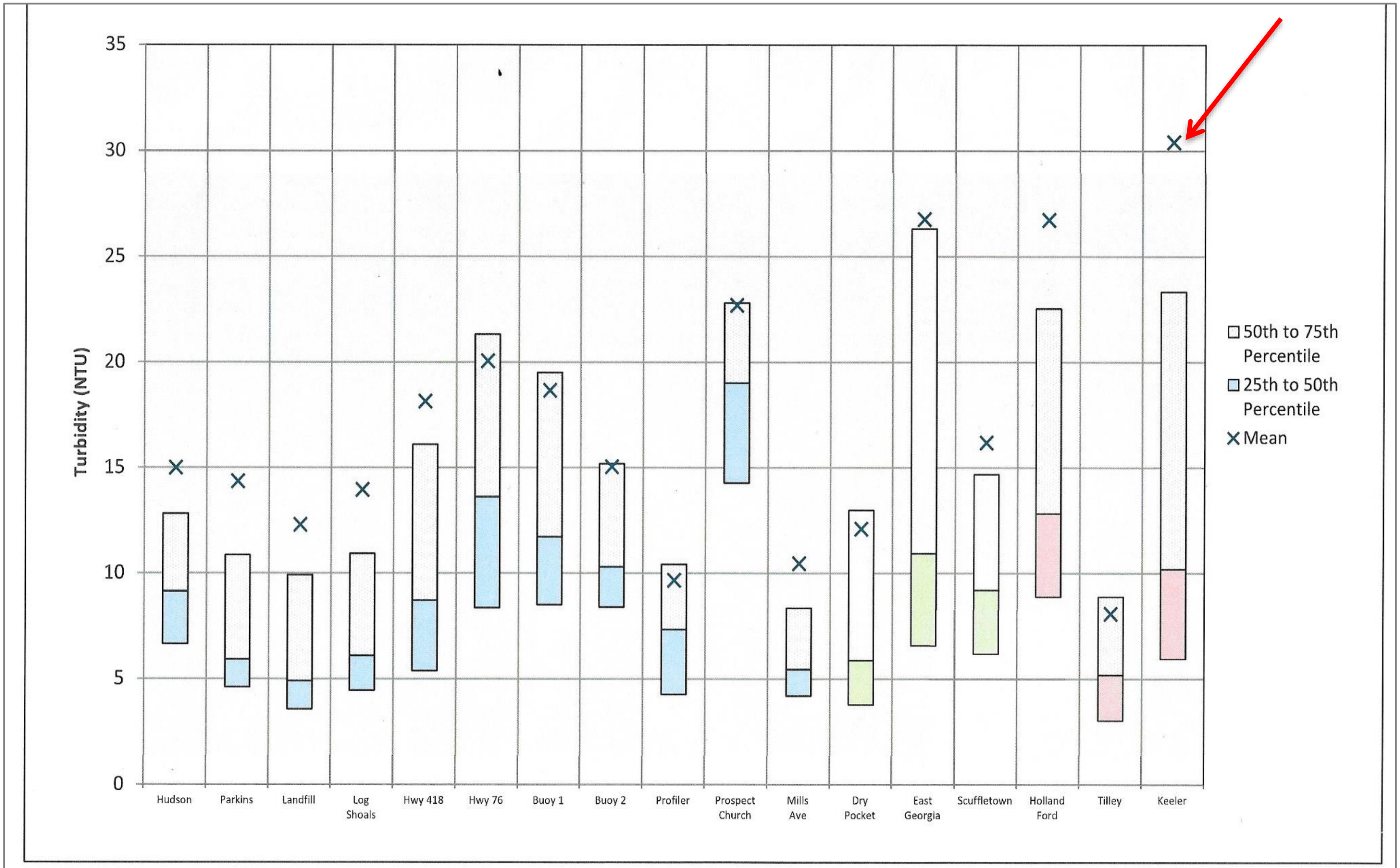


Figure 5-17: Daily average turbidity distributions - all monitored watersheds

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Figure 18. 2017 Average Turbidity vs. Forested Percentages at Greenville County Monitoring Station

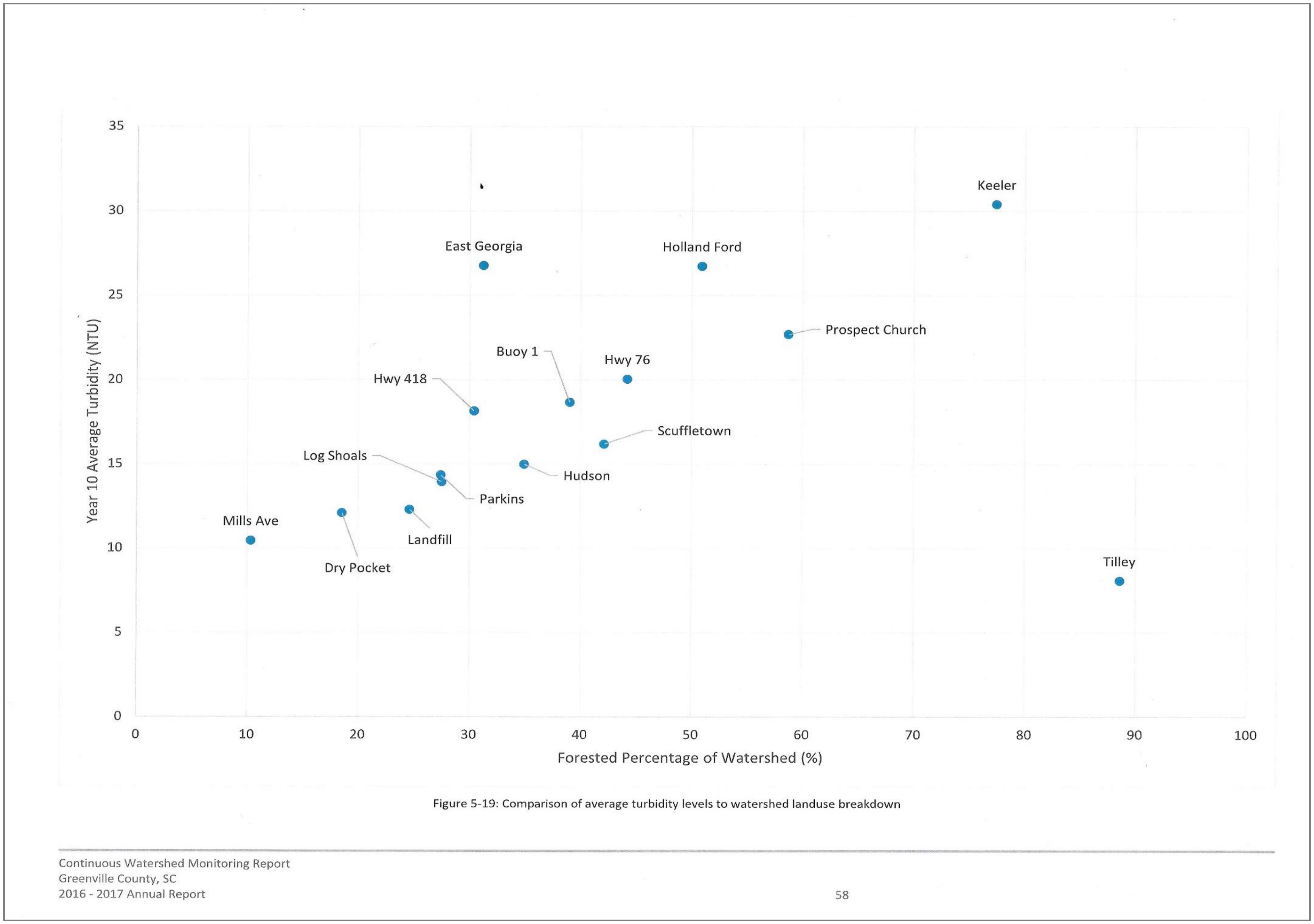

Figure 5-19: Comparison of average turbidity levels to watershed landuse breakdown

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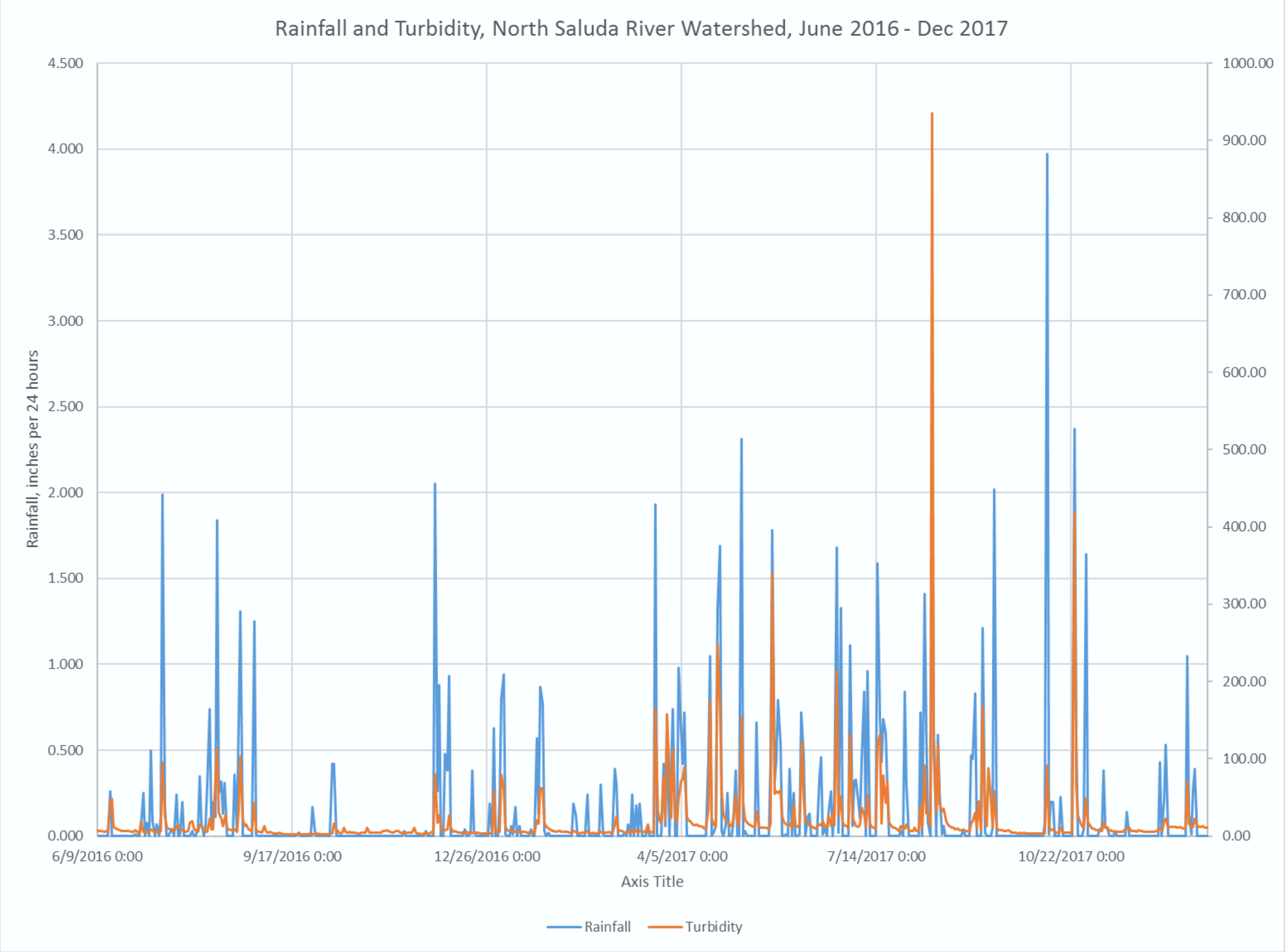
Figure 19 is a graph of turbidity (orange) and rainfall (blue) at Greenville County's Keeler Bridge monitoring station (located at S-004) from June 2016 to December 2017. Note that the rain gauge is situated at the same location as the turbidimeter and that there are likely unmeasured storm events upstream in the watershed that impact turbidity at this station. Likewise, there can be rain at the monitoring station (where the land is relatively stable and no crop farms) and no rain in the upper parts of the watershed which result in low turbidity even though rain registers at the station.

Evaluation of turbidity data from the Keeler Bridge station revealed that turbidity levels exceeded the 50 nephelometric turbidity unit (NTU) standard 10.2 percent of the time during 2016 and 2017. The threshold for impairment is exceedance of the water quality standard for over ten percent of the time.

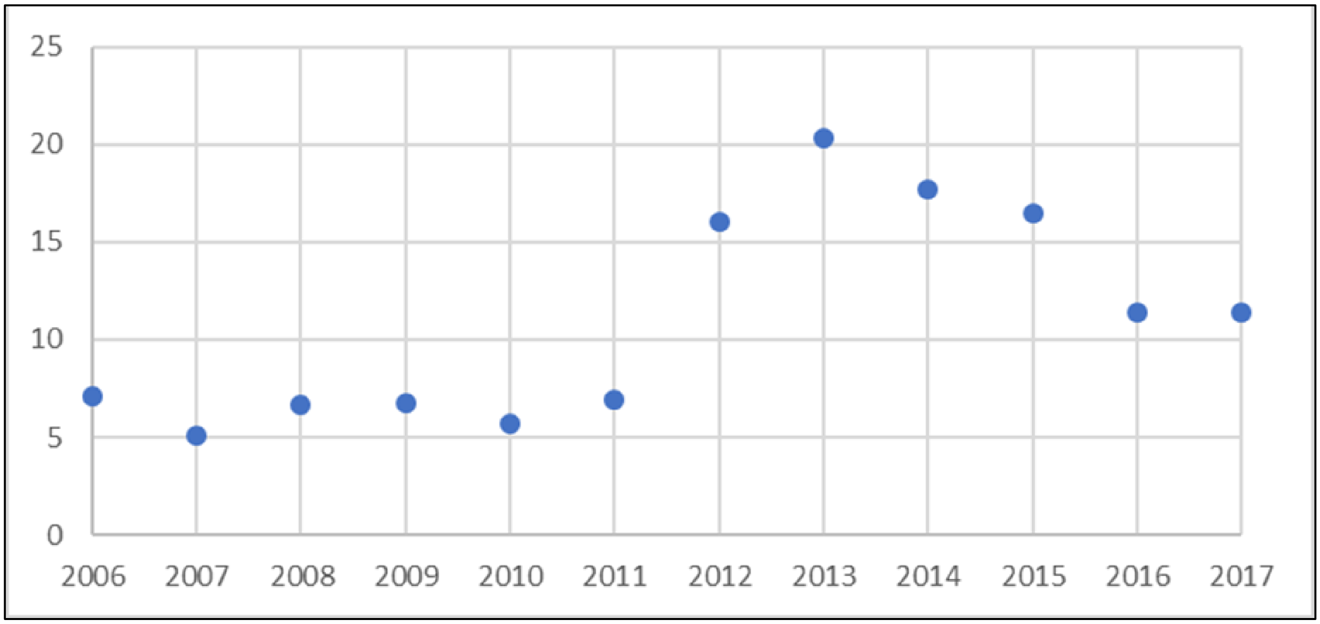
Figure 19. Turbidity (orange) and Rainfall (blue) at the North Saluda station from June 2016 to December 2017


Rainfall and Turbidity, North Saluda River Watershed, June 2016 - Dec 2017
Rainfall, inches per 24 hours
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
1000.00
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
6/9/2016 0:00
9/17/2016 0:00
12/26/2016 0:00
4/5/2017 0:00
7/14/2017 0:00
10/22/2017 0:00
Axis Title
Rainfall
Turbidity

5.1.3. Easley Combined Utilities Water Quality Data

Turbidity is measured daily at the Saluda Lake water treatment plant intake. Turbidity data collected between 2006 and 2017 was evaluated. The annual geometric mean of turbidity peaked at 20 NTU in 2013 (after lake dredging in 2012) and has slowly decreased in more recent years (Figure 20). Average turbidity levels after lake dredging remain higher than before dredging.

Figure 20. Annual Geometric Mean of Turbidity in Saluda Lake 2006-2017



5.1.4. Furman University Water Quality Data

Water quality data was collected by a Furman University student at two locations in the Watershed from June to August 2018. Automated samplers programmed to collect samples during stormflow were installed on the North Saluda River at Callahan Mountain Road just below the North Saluda Reservoir and at Highway 276. Water samples were analyzed for sediment and nutrients. Storm events were captured at the Hwy276 site on June 27-28 and at the Callahan site on July 6 and 19 and on August 2-3, 2018.

Suspended sediment concentrations upstream at the Hwy 276 site were significantly higher than concentrations near the reservoir. Sediment concentrations at the reservoir were generally less than 5 mg/L, with an upper range of 50-110 mg/L during stormflow. At the Hwy 276 site downstream, sediment concentrations ranged from approximately 10-50 mg/L as the storm sampler was triggered up to 1,000-2,000 mg/L at peak stormflow.

5.1.5. Save Our Saluda Water Quality Data

Save Our Saluda collected turbidity data in 2018 from six river sites and one tributary site in the watershed assessment/planning area:

- Four sites on the North Saluda River (LMP, Hwy 11, Hwy 276, and KBR)
- One site on the Saluda River downstream of the North-South confluence (HBR)
- One site on the South Saluda River (for reference, SSR), and
- One site on the tributary bordering the crop farm demonstration site (RRCk).

See Appendix E for site descriptions and locations.

Samples were collected during three baseflow events and two stormflow events. The July 31 sampling followed some light and isolated precipitation in the watershed, which led to enough runoff to create stormflow conditions in the single tributary site (RRCk), but which did not produce enough runoff to create stormflow conditions in river sites. Sampling two days later captured peak stormflow conditions at all river sites. Sampling occurred after peak stormflow for the November stormflow event.

In baseflow and stormflow samples, turbidity in the North Saluda River increased from upstream to downstream and was generally lower in the South Saluda River (SSR) and in the Saluda River (HBR). Baseflow samples were all below the water quality standard of 50 NTU. Turbidity levels exceeded the standard in all stormflow samples at the tributary site. During peak stormflow, turbidity exceeded the standard at all sites. Sites further downstream on the North Saluda River (Hwy 276 and KBR) had turbidity levels >900 NTU, which is six times higher than the level upstream at Hwy 11 (137 NTU; note the most upstream site, LMP, was not sampled for this event). These data suggest higher sediment loading coming from the North Saluda River than from the South Saluda River and increasing in a downstream direction to the confluence. Results are presented in Appendix E.

5.2. Biological Data

5.2.1. SCDHEC Macroinvertebrate Data

There are two SCDHEC biological monitoring stations in the Lower North Saluda subwatershed: S-773 (North Saluda River at Hwy 25) in the upper part of the Lower North Saluda subwatershed, and S-004 (North Saluda River at Keeler Bridge Road) in the lower part of the Lower North Saluda. Both are on the current SCDHEC 303(d) list of impaired waters for not meeting their designated use of supporting aquatic life due to biological impairment. Habitat is impacted by sediment at both locations. 2016 macroinvertebrate sampling indicated that the North Saluda River at S-773 fully supports designated uses and partially supports designated uses at S-004 (Appendix E). The 2018 draft 303(d) list does not include S-773.

5.2.2. Greenville Water Macroinvertebrate Data

Greenville Water commissioned a study in 2017 to assess macroinvertebrates in the watershed areas above the reservoirs they manage on the South and North Saluda Rivers. Macroinvertebrate sample results from the North Saluda River upstream of the North Saluda Reservoir were North Carolina Biotic Index (NCBI) scores of "excellent" and SCDHEC bioclassification scores of "good," which was similar to previous sampling (Appendix E). Since sites are in a protected watershed, this data can help define reference conditions for the Watershed.

Additional macroinvertebrate data is needed to assess additional stream and river reaches in lower areas of the Watershed.

5.2.3. SCDNR Fish Data

SCDNR conducted a fish survey in the North Saluda River at S-004 as part of the SC Small River Rivers Assessment, 2016 – 2019.

(http://www.dnr.sc.gov/fish/fwfi/files/2017_annual_report.pdf). Overall there was a good abundance and diversity of fish collected at this site (21 species) that included suckers, sunfish, minnows, catfish, perch, and livebearers (Appendix E). The presence of five sucker species and three darter species along with several shiners and chubs was noted, as was the size and abundance of some species. This station is situated approximately 3.7 miles downstream of the area of focus of intensively managed floodplain areas and has intact riparian areas extensively upstream.

The North Saluda from the reservoir downstream to Goodwin Bridge Rd is suitable for stocked trout fishing. Trout are stocked at Goodwin Bridge Road.

(http://www.dnr.sc.gov/fish/pdf/TroutBook.pdf)

Additional Information

Past land use practices have impacted aquatic biota at some locations in the watershed.

Sediment runoff into Terry Creek from a golf course development directly upstream of S-773 led to the elimination of a native brook trout population and severe impacts to other aquatic biota (macroinvertebrates). Recent sampling indicates macroinvertebrates at S-773 have recovered;

however, Terry Creek remains unsuitable for trout due to excess sedimentation and watershed impacts.

Immediately downstream, cold water releases from the North Saluda River contribute to lower temperatures in the North Saluda River, creating conditions favorable for trout and other aquatic life.

Additional biological data is needed to assess other areas of the watershed.

5.3. Summary

Assessment of existing water quality and biologic data confirms high quality of water in the Upper North Saluda subwatershed and impairments in the Lower North Saluda River subwatershed and in Saluda Lake related to sediment. High sustained turbidity levels during and following stormflow have been observed in the river and lake. Bedload sediment in the North Saluda is significant, and many lower reaches are characterized by shallow water depths, lack of a discernable thalweg, poorly sorted sediments, and loss of pool-riffle habitat, all of which contribute to impaired aquatic habitat conditions.

6. SEDIMENT SOURCES AND CAUSES

Several possible sources and causes of sediment runoff from the Watershed were identified and evaluated as part of the watershed assessment as a first step towards determining sediment loading to the river and lake. These included agricultural, urban, and other sources. Focus meetings were held and outreach conducted to address major sources as described below.

6.1. Agricultural Sources

6.1.1. Crops

Sediment loading from croplands in the North Saluda River – Saluda Lake Watershed, particularly in floodplain areas, is mostly attributed to frequent soil disturbance and poorly stabilized soils that easily erode into nearby streams and rivers during storm events. Plasticulture row crops are even more susceptible to erosion since the plastic acts as an impervious surface that decreases overall infiltration and increases stormwater runoff (Photo 8. Runoff from Intensively Managed Row Crop Field Adjacent to the North Saluda River Other crops with less intensive management such as soybeans, corn and hay, are less susceptible to increased runoff and soil loss.

Photo 8. Runoff from Intensively Managed Row Crop Field Adjacent to the North Saluda River

According to the NLCD, in 1992, row cropland use accounted for approximately 4.1 percent of the Watershed with a total of 3,217 acres. The 2018 desktop/field analysis indicates that croplands now cover 1.9% percent of the Watershed, or about 1,479 acres (Table 1, Figure 9). There are no crops in the Upper North Saluda subwatershed, and most cropland can be found in floodplain areas along the Lower North Saluda River. Although the overall acreage of cropland within the

Watershed has decreased from historic and from more recent years, croplands in these areas continue to experience significant soil loss on a continuous basis (Photos 9 and 10).

A brainstorming session for agricultural sources was held on April 17, 2018 to further evaluate the crop farming activities that can contribute to sediment loading, to utilize stakeholders' knowledge of farms in the watershed, and to identify agricultural BMPs that help prevent sediment runoff. Attendees included Greenville County Soil and Water Conservation District (SWCD), Greenville NRCS; Clemson Extension, and Save Our Saluda. Agricultural sources including runoff from croplands, animal access areas, and eroding streambanks were discussed along with existing programs to address these sources. Intensively managed croplands in floodplains were identified as appropriate priority areas for restoration due to more intensive management practices and their proximity to the river. The importance of BMPs that can serve the dual purpose of improving soil health and preventing soil loss was emphasized. Cover crops were identified as an accepted and cost-effective BMP to help stabilize and improve cropland soils during the off-season. Other potential BMPs and barriers to implementation were also discussed at the agricultural brainstorm session, further detailed in Section 9.

Photo 9. Sediment discharge to the North Saluda River from floodplain croplands

Photo 10. Sediment discharge to the North Saluda River from tributary draining rural agricultural areas

Other potential BMPs and barriers to implementation were also discussed at the agricultural brainstorm session. These topics are further detailed in Section 9.

6.1.2. Livestock

Pasturelands where livestock such as cattle and horses graze can be a source of sediment to streams, rivers, and other waterbodies.

A primary source of sediment runoff from pastures comes from trampling of streambanks as animals access streams for drinking. Livestock concentrated in smaller areas such as shaded areas, water sources, or feeding areas, often create bare soil conditions leaving such areas vulnerable to erosions. Collectively, runoff from unstabilized or poorly stabilized pastures, high traffic areas, and stream access locations can cause significant sediment loading to nearby waterbodies (Photos 11 and 12). Pasturelands currently cover approximately 6.2% of the Watershed (about 4,970 acres, Table 1).

Photo 11. Poorly managed pastureland along a tributary of North Saluda River

Photo 12. Cattle in Doddies Creek

An estimate of livestock numbers in the watershed was also obtained using the best available data. The USDA National Agricultural Statistics Service reported 3,974 total cattle in Greenville County and 4,229 total cattle in Pickens County in 2012. The non-urbanized Greenville County portion of the Watershed is approximately 6.45 percent of Greenville County, and the non-urbanized Pickens County portion of the Watershed is approximately 4.83 percent of Pickens County. Total livestock in the Watershed was estimated by extrapolating these percentages evenly across each county (Table 2). These extrapolations were used to estimate sediment loadings from livestock farms, as described in Section 7.

Table 2. Livestock Estimates for the North Saluda River - Saluda Lake Watershed

Livestock	Estimated Quantity in Upper North Saluda subwatershed	Estimated Quantity in Lower North Saluda subwatershed	Estimated Quantity in Doddies Creek subwatershed	Estimated Quantity in Total Watershed
Beef Cattle	0	23	290	313
Dairy Cattle	0	2	2	4
Equine	0	15	107	121
Goat/Sheep	0	15	70	85
Hogs	0	3	26	29
Poultry	0	1	8	9

Figure 9 displays the overall acreage of livestock farms (shown in purple shade). Because Greenville Water has an easement on the Upper North Saluda subwatershed, there are no livestock in this subwatershed. Livestock farms are present in lower Watershed areas and are more prevalent in the Doddies Creek – Saluda Lake subwatershed than in the Upper or Lower North Saluda River subwatershed.

6.2. Urban Sources

Urban sources of sediment in the Watershed include runoff from construction sites, dirt driveways and unstabilized open areas and ditches. Urban sources can also cause downstream erosion and sedimentation due to increases in stormwater runoff from connected impervious surfaces. Because urban stormwater flows over hard surfaces and is often concentrated in pipes that discharge directly to surface drainage systems, the increase in the amount and rate of urban runoff can be erosive.

The 2018 land use analysis in Table 1 suggests that developed areas account for approximately 13% (9,884 acres) of the Watershed. Developed areas include the two Cliffs Golf Course communities near Highways 25 and 11, and Slater-Marietta in the northern portion of the Watershed; developed areas along the eastern watershed boundary (Old Whitehorse/White Horse Road/Hwy 25) west of Travelers Rest and Berea; and Dacusville in the lower Watershed.

There is high potential for growth in the Watershed as growth pressures continue from Travelers Rest and the anticipated expansion of the Swamp Rabbit Trail in the upper Watershed, and from the rapidly growing urban areas of Easley and Greenville to the south. Therefore, sediment is of concern with regards to existing land use and future growth and development in the Watershed.

Greenville County is one of three permitted medium municipal separate storm sewer system (MS4s) in South Carolina. According to the SCDHEC Watershed Atlas, the eastern and northern portions of the Watershed fall under Greenville County MS4 permit coverage (59,388 acres), which requires implementation of a program to reduce pollutants in storm water runoff to the County's MS4 conveyances from construction sites. Pickens County is one of approximately 70 permitted small MS4s in the state, though their MS4 is not County-wide. The southwest portion of the Watershed falls within the Pickens County (18,970 acres), though only approximately 15 acres fall within the Pickens MS4 area. However, Pickens County’s Stormwater Ordinance No. 392 is implemented County-wide.

To better understand the impact that urbanization and increased impervious surfaces may have on the watershed, a brainstorming session for urban sources was held with stakeholders on February 23, 2018. Stakeholders at the meeting included Greenville County Stormwater, Pickens County Stormwater and Save Our Saluda. The goal of the meeting was to gain knowledge of the urbanized areas of the watershed, to discuss any erosion, construction and post-construction issues, as well as discuss potential preventative measures for the watershed such as the possible revisions of regulations for future development. Minutes from the meeting can be found in Appendix F. Programmatic measures identified for urban sources are detailed in Section 9.2.

6.2.1. Development Sites

Greenville County requires land disturbance permits for land disturbance greater than 5,000 square feet that include requirements for erosion and sediment control. There are six Greenville County inspectors, one of which is permanently assigned to northern Greenville County.

Greenville County currently has a permanent water quality stream buffer requirement of 30 feet of undisturbed area next to streams draining more than 100 acres and is currently implementing a County-wide Tree Preservation Ordinance requiring a 20-foot buffer around new developments.

Greenville County is investigating revisions to ordinances for (expansion) of existing riparian buffer and tree protection requirements, both of which could help reduce the impact of future development in the Watershed. A general discussion of post-construction stormwater design standards was held during the Urban Brainstorm Session in relation to water quality and channel erosion concerns within the Watershed and how potential incentives could encourage the use of Low Impact Development (LID) and Green Infrastructure (GI) to help minimize runoff. Greenville County has prioritized the Reedy River Watershed to focus on water quality improvements for nutrient impairments.

Pickens County requires land disturbance permits for land disturbance greater than one acre (and for less than one-acre land disturbance in a larger common plan). Pickens County has two construction inspectors to address land disturbance projects county-wide. Pickens County does not have plans to revise their stormwater design regulations or buffer requirements beyond the minimum regulations required by SCDHEC.

6.2.2. Driveways

Most of the County roads and SC Department of Transportation (DOT) roads in the Watershed are paved. There are very few dirt roads. However, there are many dirt driveways that erode and cause sediment to be transported into waterways during rain events.

Photo 13. Erosion from a driveway in North Saluda River – Saluda Lake Watershed

6.3. Other Sources

Other sources of sediment addressed in this Plan include forestry (silvicultural operations) and streambank erosion. These other sources are discussed in more detail below.

Although wildlife can cause erosion (e.g. feral hogs[2]) and influence sediment distribution patterns in streams and rivers (e.g. beaver), wildlife are recognized as potential minor sources/causes of sediment and are not addressed in this Watershed Plan.

There are several areas of open land on private property throughout the watershed. Unstabilized soils in these areas can also be a source of sediment to waterbodies in the watershed.

In addition, there is much historic, or legacy sediment stored in stream and river channels that continues to be remobilized and redistributed within the Watershed drainage system. This Watershed Plan does not address existing in-stream bedload sediment from historic sources and causes.

6.3.1. Forestry (Silvicultural Operations)

Forestlands are present throughout the Watershed and tracts are occasionally timbered. When forestry BMPs are not used in conjunction with planning and executing timbering operations, severe erosion, excessive sediment loading, and stream channel/bank instability can result, particularly in hilly or mountainous areas.

Potential sources of sediment runoff associated with forestry activities include soil disturbance from roads, skid trails, stream crossings, harvesting and site preparation operations, and removal of streamside vegetation and subsequent channel/bank destabilization.

Forestland accounts for the large majority of land use 77% (61,742 acres) in the Watershed (Table 1). Much of this forestland is likely to remain as managed forest into the future. To better understand the impact forestry activities may have on the Watershed, a brainstorming session for Forestry Sources was held on May 1, 2018 to utilize cooperators and stakeholders' knowledge of forestry management in the Watershed. Attendees included the South Carolina Forestry Commission and Save Our Saluda.

The following are findings from the meeting:

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[2] Greenville Water and SCDNR have programs to control feral hogs in the Upper North Saluda Watershed.

- South Carolina’s Best Management Practices for Forestry Manual (1994): Compliance with BMPs is required for forestry activities which involve discharge of dredge or fill materials into jurisdictional wetlands to qualify for the silvicultural exemption under Section 404(f) of the Clean Water Act. Compliance with BMPs is recommended on all sites on which there is a potential for violating water quality criteria as defined by the South Carolina Pollution Control Act.

- The South Carolina Forestry Commission (SCFC) is the lead agency in South Carolina in designing, interpreting, monitoring, and updating forestry BMPs. Sustainable Forestry Initiative (SFI) mills require loggers to take BMP training and implement BMPs according to the Clean Water Act. Most mills are SFI certified which makes the logger training essentially a requirement across the board. Mills who are SFI certified require loggers to be in compliance with SFI and will reject lumber from loggers who do not meet requirements. SCFC provides the half day BMP training to meet the SFI requirement. As well, SCFC conducts Courtesy Exams on active sites monthly and SCDHEC enforces issues the SCFC finds. SCFC’s responses to issues found during Courtesy Exams vary depending on severity but range from requirement of the logger to go back through training, take the necessary remediation steps on the ground, or face fines.

- Silviculture activities are required to have streamside management zones with 40-foot buffers. The latest SCFC BMP implementation survey indicates a 95.5% BMP implementation rate, but acknowledge that one bad job or rain event can cause an issue. Monitoring activities include observations for activities that have the potential to impact water quality (skid trails, harvesting to trucking, haul roads, rutting, severely exposed soils, stream crossings), with a focus on stream crossings due to high potential for impacting water quality.

- If land use is changing from forestry to land disturbance for development, SCFC does not have authority and such unpermitted land disturbance should be reported to the appropriate county.

Greenville Water implements a watershed management plan for the Upper North Saluda Watershed developed in concert with the Nature Conservancy and actively manages vegetative communities and road systems to prevent sediment runoff to the reservoir. The plan is available on the Greenville Water website under Water Resources.
(https://www.greenvillewater.com/wp-content/uploads/2014/02/GW_Watershed_Management_Plan.pdf)

6.3.2. Streambank Erosion

Unstable streambanks are a source of sediment in Lower North Saluda and Doddies Creek-Saluda Lake subwatersheds. Streambank instability can be caused by several factors. Upper soil layers along most Piedmont stream and river corridors are comprised of highly erodible unconsolidated historic sediments that are vulnerable to erosive flows. Erosive stormwater runoff from urban areas further accelerates streambank and stream channel erosion. Streams and rivers lacking adequate streamside vegetation (riparian buffers) are also highly susceptible to streambank erosion and loss of riparian land.

Streams and rivers in southeast Piedmont areas have cut through legacy sediments leaving deep and wide stream channels with overall larger-than-historic channel capacities. Consequently, overbank flows occur less frequently now than they once did due to historic accelerated sedimentation and subsequent channel expansion (Ruhlman and Nutter, 1999). A decreased frequency of overbank flows means that sediment carried during stormflow is less often redistributed in adjacent floodplain areas. Streams and rivers in the Lower North Saluda and Doddies Creek-Saluda Lake subwatersheds have undergone similar land use and channel response patterns. Streambank instability and erosion is not uncommon along stream and river reaches in lower Piedmont regions of the Watershed, particularly on or near agricultural properties (Photos 14-16)

Photo 14. Unstable streambanks and lack of riparian buffer on the North Saluda River

Photo 15. Unstable, incised streambank on the North Saluda River lacking adequate riparian buffer and covered in kudzu vines

Photo 16. Streambank erosion and channel expansion (incision and widening) on the North Saluda River

6.3.3. Dredging

Streams and rivers in agricultural floodplain areas are regularly dredged to remove sediment and to harvest sand for use in farming areas (Photos 17 and 18). While dredging itself is not a source of sediment, it affects stream dynamics and sedimentation distribution patterns in the Watershed. Dredging removes eroded soil/sediment from drainage systems; however, it can be very harmful to streams and rivers and can lead to channel instability, headcutting, increased water velocity and scour, increased stream bank erosion, elevated suspended sediment and turbidity levels, rapid downstream sediment deposition, and damage to aquatic environments. Channelization and dredging alter channel morphology and result in the disconnection of streams and rivers from adjacent floodplain systems, diminishing their ability to capture, detain, and filter floodwaters. Furthermore, continued soil loss from floodplains where crops are grown diminishes soil quality and can exacerbate drainage problems over time. BMPs to improve infiltration and minimize runoff can help reduce the need for dredging for drainage purposes.

See Section 2.1 for details about historical dredging in Saluda Lake.

Photo 17. Small channelized tributary stream in the North Saluda River floodplain

Photo 18. Dredging operation on the bank of the North Saluda River

7. EXISTING SEDIMENT LOAD

The existing sediment load in the Watershed was estimated using the Environmental Protection Agency (EPA) "Spreadsheet Tool for Estimating Pollutant Load" (STEPL) model (http://it.tetratech-ffx.com/steplweb/). STEPL incorporates watershed characteristics such as soils, land use, rainfall data and number of agricultural animals and utilizes the Universal Soil Loss Equation (USLE) and to estimate sediment load from surface runoff of different land use areas. The USLE is composed of six factors to predict the long-term average annual soil loss (A). The equation includes the rainfall erosivity factor (R), the soil erodibility factor (K), the topographic factors (L and S) and the cropping management factors (C and P).

It is important to note that STEPL calculates sheet and rill erosion only and does not account for gully erosion, streambank erosion, or in-stream erosion of legacy sediment.

Based on the types of crops and soil management practices observed in each subwatershed, a Crop Management Factor (C) of 0.9 was used for croplands in the Lower North Saluda River subwatershed and a C factor of 0.4 was used for croplands in the Doddies Creek subwatershed to differentiate between intensively managed plasticulture row crop farming (fruits and vegetables) and less intensively managed croplands (soybeans and corn).

Figures 5 and 6 show the range and distribution of K values and HSG values used in the STEPL model.

Table 3 gives sediment loading results by subwatershed for each sediment source.

Table 3. Current Sediment Load Estimates in the North Saluda River – Saluda Lake Watershed

Source	Sediment Load (ton/yr)			
	Upper North Saluda	Lower North Saluda	Doddies Creek-Saluda Lake	Total Watershed
Urban	16	626	506	1,148
Cropland	0	6,945	775	7,719
Pastureland	0	351	1,178	1,529
Forest	419	591	472	1,481
Total	**434**	**8,513**	**2,930**	**11,878**

The STEPL model estimates approximately 11,878 tons of sediment erode from the Watershed into the North Saluda River, its tributaries and Saluda Lake each year. The following pie charts show the estimated sediment load by land use for each subwatershed and for the entire watershed, as well as relative sediment contribution by subwatershed (Figures 21-25). According to these estimates, 74% of the total sediment load from the Watershed is attributed to erosion from the Lower North Saluda River subwatershed (Figure 25), and 67% is attributed to erosion from croplands (Figure 24).

The following pie charts show the estimated sediment load by land use for each subwatershed (Figures 21-23). The data input into STEPL is included in Appendix J.

Figure 21. Estimated Sediment Load by Land Use in the Upper North Saluda River Subwatershed

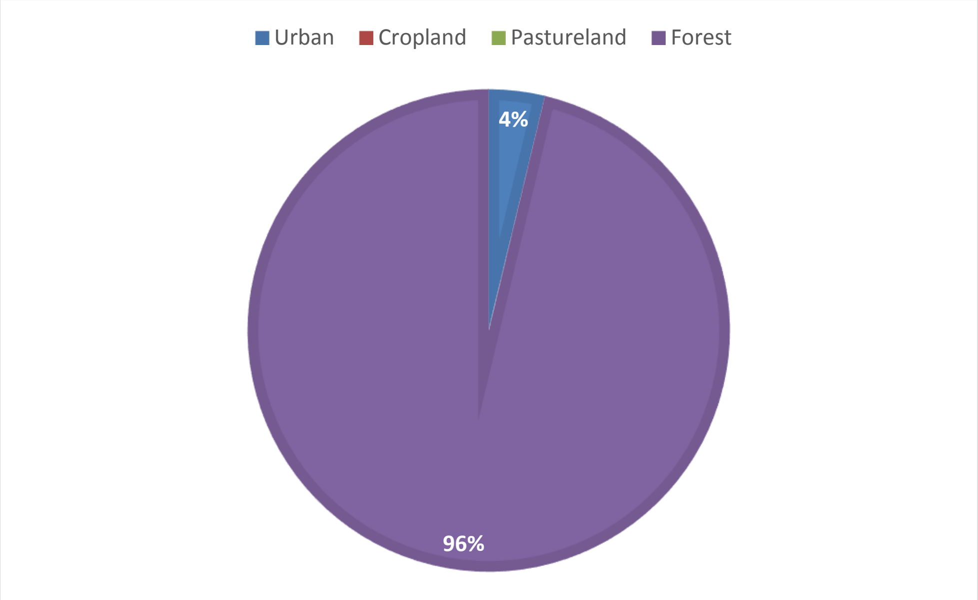


Figure 22. Estimated Sediment Load by Land Use in Lower North Saluda River Subwatershed

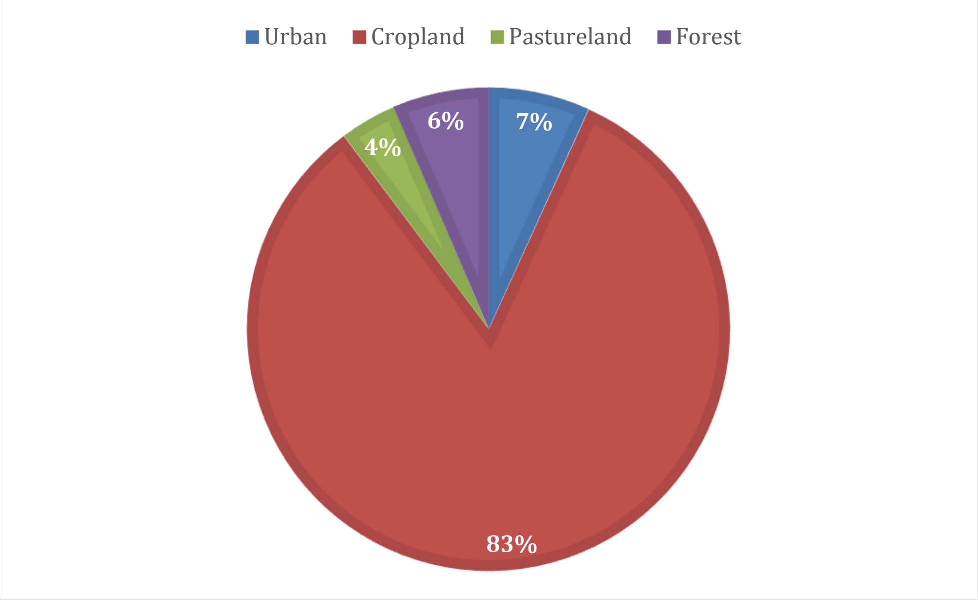


Figure 23. Estimated Sediment Load by Land Use in Doddies Creek -Saluda Lake Subwatershed

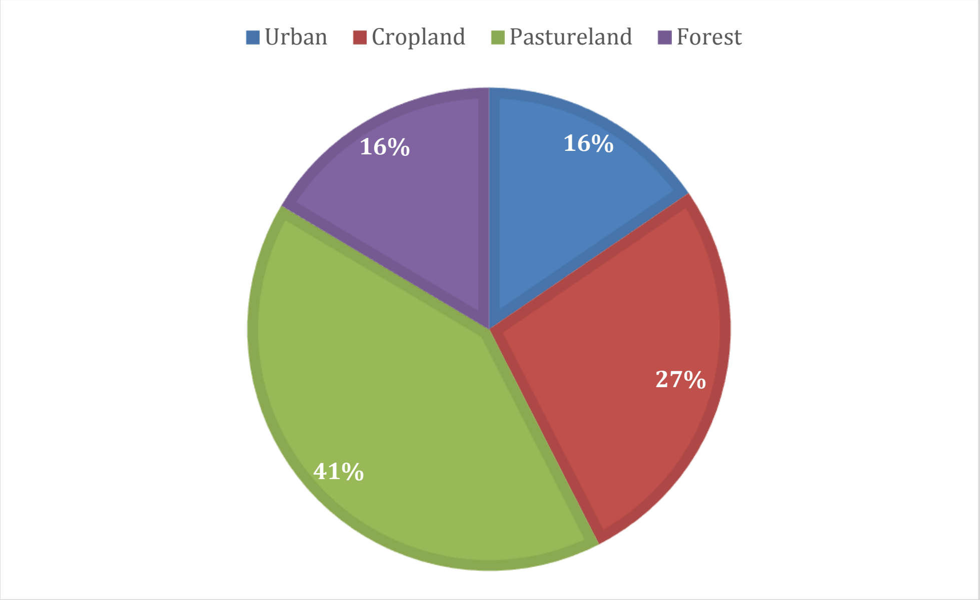


Figure 24. Estimated Sediment Load by Land Use in North Saluda River – Saluda Lake Watershed

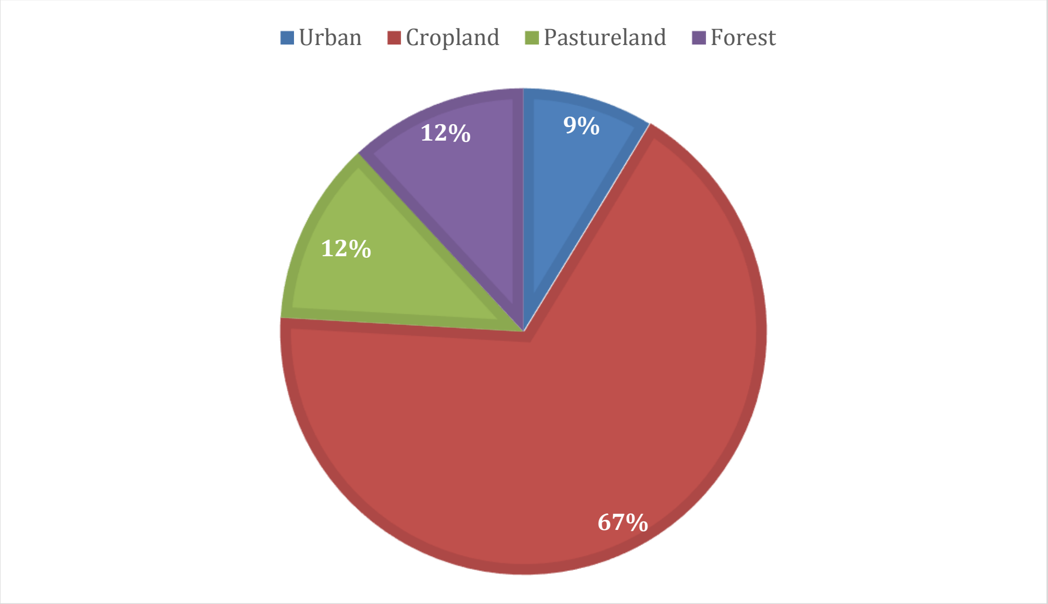
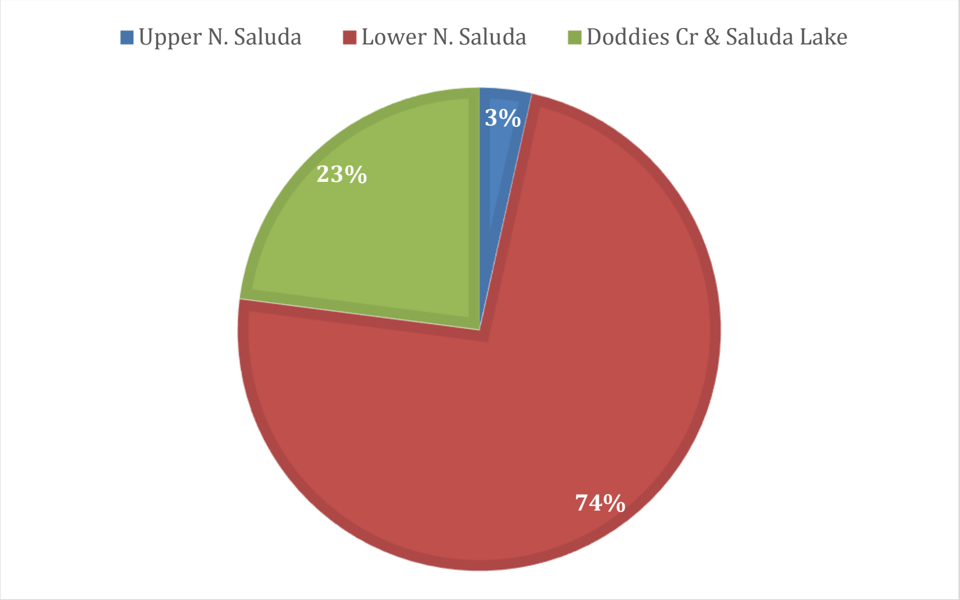


Figure 25. Estimated Sediment Load by Subwatershed in North Saluda River – Saluda Lake Watershed



It is important to note that these load calculations do not include legacy sediment that is already in the streams and rivers. A recent Saluda lake Sedimentation Analysis conducted by Easley Combined Utilities concluded the amount of sediment (both current load and legacy sediment that is moving down the watershed) that has redeposited in the lake is approximately 54,870 tons per year for the past 6 years since Saluda Lake was last dredged.

8. WATERSHED PLAN GOALS

The overarching goal for the Watershed Plan for Sediment in the North Saluda River and Saluda Lake is to improve water quality by reducing sediment runoff to the North Saluda River and Saluda Lake. The following goals and objectives were established by the TASC to help meet this central goal:

Goal #1 – Improve water quality in the North Saluda River - Saluda Lake Watershed (reduce sediment)

- Ensure that waterbodies in the North Saluda River - Saluda Lake Watershed meet or exceed water quality standards
- Ensure that recreational use in North Saluda River and Saluda Lake is not diminished
- Ensure that waterbodies in the North Saluda River - Saluda Lake Watershed support aquatic life and restore trout populations

Goal #2 - Protect and maintain water quality, recreational use, and aquatic habitat in the North Saluda River - Saluda Lake Watershed

- Work with counties to improve land use regulations and enforcement to guide new development in a manner that protects waterbodies in the North Saluda River - Saluda Lake Watershed
- Ensure that recreational use in North Saluda River and Saluda Lake is not diminished
- Coordinate efforts with other groups in the watershed focused on land conservation and protection strategies

Goal #3 - Build community support for the protection and enhancement of the land and water resources of the North Saluda River - Saluda Lake Watershed

- Strengthen ties with the local farmers and residents to promote and implement the Watershed Plan and encourage environmental stewardship within the North Saluda River - Saluda Lake Watershed

9. IMPLEMENTATION PLAN

9.1. Best Management Practices and Programmatic Measures

The implementation plan for the North Saluda River - Saluda Lake Watershed includes BMPs and programmatic measures to reduce sediment runoff, as well as protective measures to prevent runoff.

BMPs and programmatic measures were identified and evaluated to address the sediment sources identified and prioritized during the development of this Watershed Plan. A list of BMPs and programmatic measures selected for each source type in the Watershed is outlined in Table 4 and further described in the following sections.

Table 4. Best Management Practices and Programmatic Measures for Sediment Sources in the North Saluda River - Saluda Lake Watershed

Sources	BMPs	Programmatic Measures
Agricultural		
Runoff from Croplands	• Cover crops and intercropping • Vegetated riparian buffers • Conservation tillage • Vegetated filter strips • Field border • Pollinator strips • Culvert/ditch stabilization • Farm access road stabilization • Vegetated waterways • Sediment control basins • Terracing and contouring • Streambank stabilization • Conservation plans	• Landowner lease conditions (e.g. cover crops, buffers, soil stabilization) • Workshops and field days for farmers • Education and outreach
Livestock in Streams	• Exclusion fencing/well/water trough • Loafing shed, stream crossings • Vegetated riparian buffers • Stream bank stabilization • Conservation plans	• Land conservation easements program • Education and outreach
Runoff from Pastures	• Cross fencing/pasture planting • Heavy use area stabilization • Conservation plans	• Farm workshops and field days • Education and outreach
Urban		
Dirt Driveways, Dirt Roads and Roadside Ditches		• Education and outreach • Training citizens "Muddy Water • Report issues requiring maintenance to County or DOT
Urban Development	• Watershed signs	• Recommendations for permanent water quality buffers • Recommendations for Land development regulations • Recommendations for improving/expanding construction inspection/enforcement

Grant funding can be pursued to provide cost share assistance for the installation of BMPs to reduce sediment loadings from agricultural land and for some of the programmatic measures, such as public education and a Land Conservation Easement Program. Because participation in the program is voluntary, and since landowners are traditionally somewhat skeptical of interference in their operations, effective outreach will be crucial in reaching the appropriate participants. Outreach efforts will aim to recruit farms which would have the biggest impaction on water quality improvement and protection.

The following sections describe best management practices and measures and the anticipated level of participation for implementation, which was used to determine sediment load reductions.

9.1.1. Agricultural Sources – Crop BMPs

It is anticipated that approximately 20% of the croplands in the North Saluda River – Saluda Lake Watershed will participate in implementing BMPs for sediment control every 3 years. This is equivalent to approximately 295 acres of croplands . Intensively managed crop farms in the floodplain of the North Saluda River will be prioritized based on the highest potential for water quality improvements. Figure 10 shows crop farms (orange) identified during the desktop and field evaluation. Photos 19-24 are examples of BMPs for crop farms.

Save Our Saluda is currently working with Naturaland Trust to develop a demonstration project for agricultural BMPs at a crop farm on the Lower North Saluda River. A workshop on soil health and cover crops was held in September 2018 in the Watershed and a number of local farmers attended and expressed interest in 319 and EQIP programs and in additional workshops and field tours, which are anticipated as part of the implementation plan.

Agricultural stakeholders such as NRCS and SWCD will be asked to assist in reviewing participants' farm operations, assessing their resource concerns, developing conservation plans, recommending and selecting appropriate BMPs, technical specifications, and practice standards, and helping to ensure that BMPs are installed correctly. Table 5 gives quantities of crop farm BMPs proposed for the Plan.

Photo 19. Crop Farm Best Management Practice - Riparian Buffer

Riparian buffers *are vegetated areas next to streams, rivers, and wetlands that provide protection from the impacts of adjacent land uses. They can trap sediment and other pollutants thereby providing stream and water quality protection. Riparian buffers also help provide streambank stabilization, flood control, wildlife habitat and other valuable ecosystem benefits.*

Photo 20. Crop Farm Best Management Practice – Cover Crops

Cover crops *can provide multiple benefits in a cropping system. They prevent erosion, improve soil's physical and biological properties, supply nutrients, suppress weeds, improve the availability of soil water, and break pest cycles along with providing various other benefits.*

Photo 21. Crop Farm Best Management Practice – Intercropping

Intercropping *is growing two or more crops in close proximity to each other to prevent erosion, improve soil and water quality, and provide pest management benefits.*

Photo 22. Crop Farm Best Management Practice – No Till Seeding

***No-till** farming is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water that infiltrates into the soil, the soil's retention of organic matter, and its cycling of nutrients. **No-till** protects the soil from excessive erosion, reduces soil aeration from tillage, allows organic matter to accumulate, and improves the overall health of the soil.*

Photo 23. Crop Farm Best Management Practice – Vegetated Filter Strips

*A **vegetated filter strip** is a strip of herbaceous vegetation that filters runoff and removes contaminants before they reach water bodies such as streams and wetlands or water sources. They help reduce soil erosion and protect water quality, among other benefits.*

Photo 24. Crop Farm Best Management Practice – Ditch Stabilization

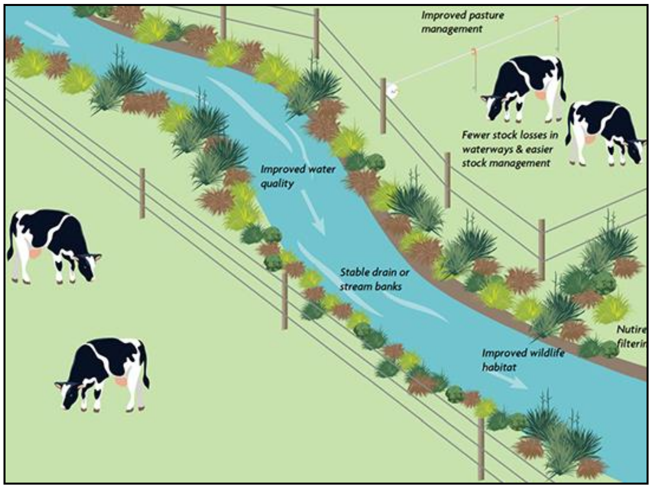
***Ditch stabilization** involves vegetative and/or structural measures to stabilize drainage ditches and prevent erosion and sedimentation from entering downstream waterbodies.*

9.1.2. Agricultural Sources – Livestock BMPs

It is anticipated that approximately 20% of the livestock farms in the Watershed will participate in projects implementing BMPs every 3 years. This is equivalent to approximately 384 acres. Livestock farms located near waterbodies will be prioritized to maximize the potential for water quality improvements. Figure 10 shows the livestock farms (purple) in the Watershed.

As with crop farms, agricultural stakeholders, such as NRCS and SWCD, will be asked to assist in reviewing participants' farm operations, assessing their resource concerns, developing conservation plans, technical specifications and practice standards, and recommending and selecting appropriate BMPs, and helping to ensure they are installed correctly. The BMPs listed in Table 4 and shown in Figure 22 and Photos 24 through 27 are typical BMPs which will be installed to reduce the amount of sediment from livestock farms entering waterbodies. Table 5 gives quantities of livestock BMPs proposed for the Plan.

Photo 25. Livestock Farm Best Management Practice – Livestock Exclusion



*A **livestock exclusion** system is a system of permanent fencing to exclude livestock from streams and critical areas not intended for grazing to improve water quality and stream health. Benefits include reduced soil erosion, sedimentation, pathogen contamination and pollution from dissolved, particulate, and sediment-attached substances. The system includes an alternative water source (typically a well), which also improves livestock health.*

Photo 26. Livestock Farm Best Management Practice – Heavy Use Area Stabilization

Heavy use area stabilization *is the stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures to protect or improve water quality.*

Photo 27. Livestock Farm Best Management Practice – Cross Fencing

Cross-fencing *divides an area to allow rotational grazing of animals. Rotational grazing can help control erosion and prevent sediment runoff, increase pasture yields, improve pasture quality, provide a healthier plant community, better livestock health and performance, and reduced costs to the landowner while providing pasture management flexibility.*

Photo 28. Livestock Farm Best Management Practice – Stream Crossings

Stream crossings *provide a hard, stable area where livestock or equipment can cross streams without damaging the streambed or banks thereby maintaining a higher riparian area/stream quality. They help keep farm water cleaner which can provide health benefits to animals and crops. Stream crossings with stream bank fencing are cost-effective BMPs that can help protect and improve water quality.*

Photo 29. Crop and Livestock Farm Best Management Practice – Stream Stabilization

Streambank stabilization *refers to vegetative and/or structural treatment(s) used to stabilize and protect banks of streams, lakes or other waterbodies to prevent the loss of land and reduce the downstream effects of sediment resulting from bank erosion.*

9.1.3. Barriers to Agricultural Implementation

Barriers to farmer participation in BMP implementation projects include a reluctance to change common practices and resistance to perceived interference of their operations. Several other barriers discussed during the agricultural brainstorm session are leased properties (different owner and operator), language barrier with Hispanic farmers, and hesitancy to reduce acreage for BMPs or conservation easements. Fortunately, many of the BMPs selected to reduce sediment in the streams will also improve soil health, the health of livestock animals, and help preserve land for future generations. Public education will help emphasize the benefits to the landowners.

9.1.4. Urban Sources

In general, urban sources of pollution should be addressed by the MS4s (Greenville and Pickens Counties and the Department of Transportation). However, it is not possible for County personnel to know the locations of all areas of concern for sediment runoff at all times. Therefore, in order to help address the current urban sources of sediment in the Watershed (development sites, dirt driveways, dirt roads and roadside ditches), the Plan includes offering "Muddy Water Watch" training to residents in the Watershed to recognize potential issues with sediment runoff (e.g. Photos 28 ad 29), whether BMPs are properly installed and maintained, where to report various types of issues, and how and when to follow-up. Greenville and Pickens County, SCDOT Stormwater, and SCDHEC staff could benefit from citizens helping to make them aware of problems so that they can determine what corrective actions and enforcement measures are needed. A "Who to Call" list of local jurisdictions in the Upper Saluda Watershed for water quality concerns is available on the Save Our Saluda website:
https://www.saveoursaluda.org/images/Who%20to%20Call.pdf

Photo 30 and Photo 31. Examples of Issues for Muddy Water Watch

See Section 9.2 for protective measures identified to address future urban sources of sediment.

9.1.5. Other Sources

The Plan includes incorporating silviculture sources of sediment in the "Muddy Water Watch" training for residents in the Watershed to recognize sediment issues related to forestry operations, whether BMPs are properly installed and maintained, and where to report forestry related issues and how and when to follow-up. The SC Forestry Commission has only one inspector in 20 counties. Citizens can help make the SCFC aware of problems so that they can determine whether the issue is a water quality violation and if so, report to SCDHEC for enforcement.

9.1.6. BMP Prioritization

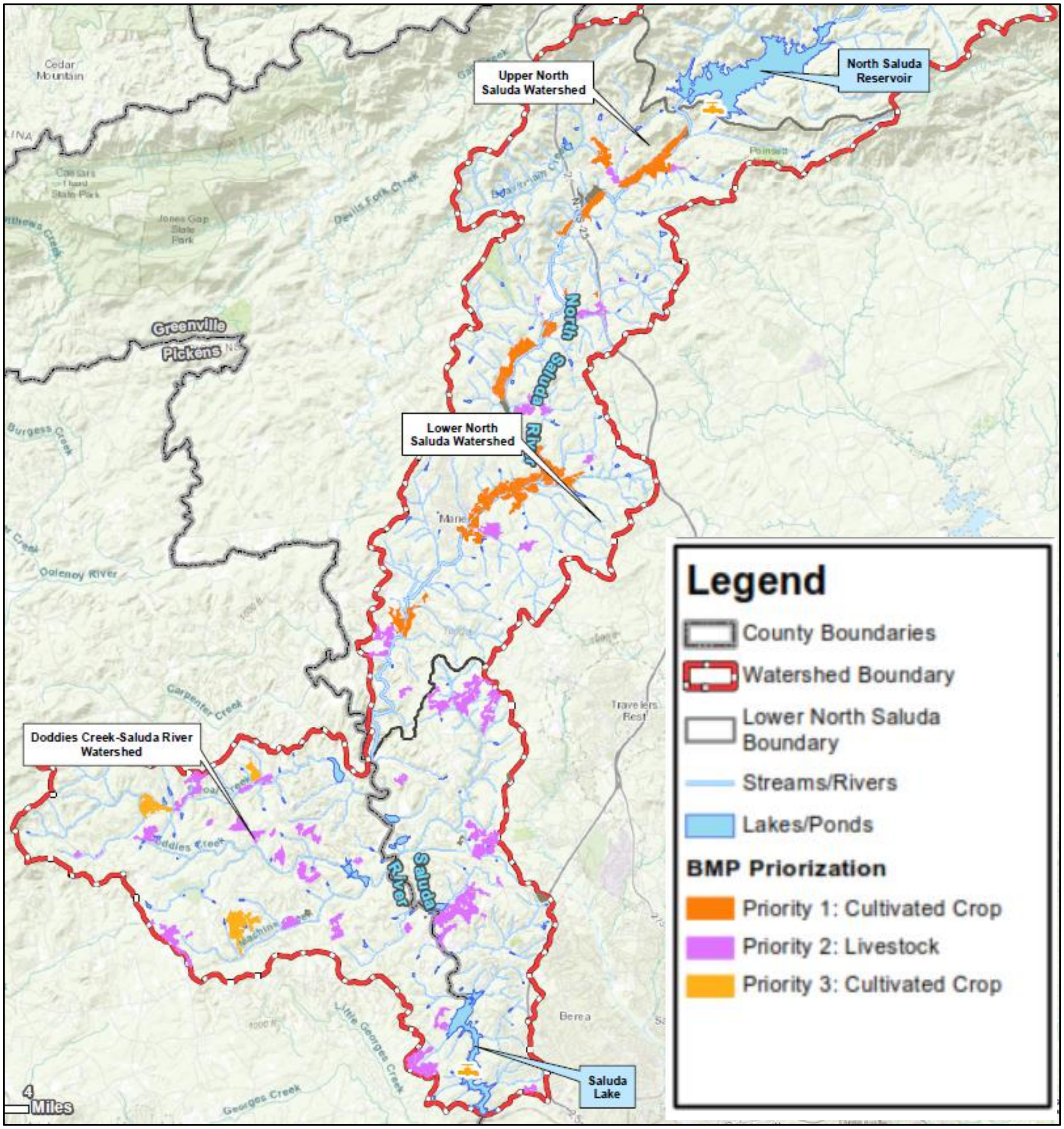
Based on the sediment load estimations by source and by watershed (Section 7), the following order of prioritization has been selected for BMP implementation, as shown in Figure 26.

Priority 1: Intensively managed crop farms in the Lower North Saluda River subwatershed

Priority 2: Livestock farms in both Lower North Saluda River subwatershed and Doddies Creek – Lake Saluda subwatershed.

Priority 3: Other crop farms in the Watershed

Figure 26. Agricultural BMP Prioritization

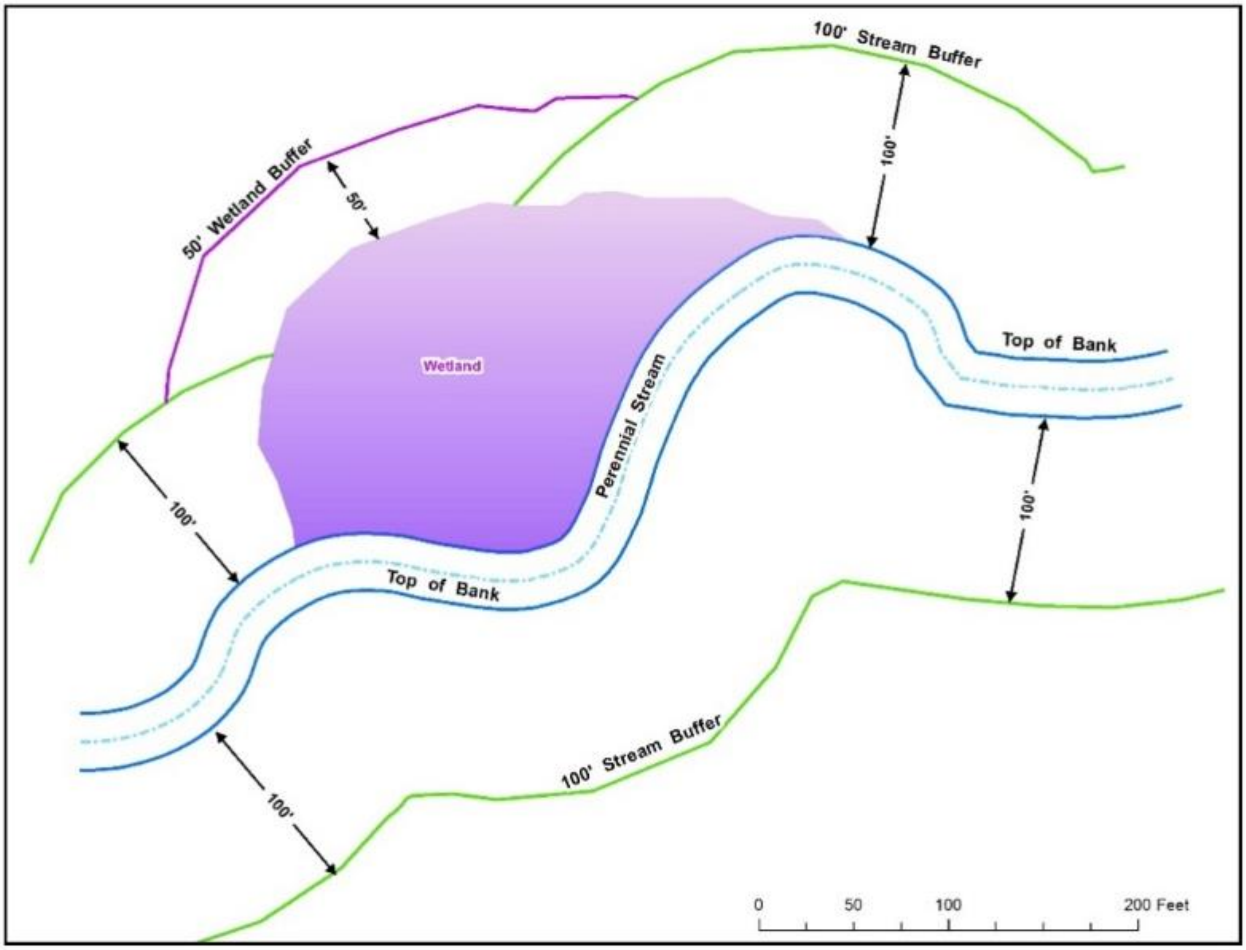


9.2. Programmatic Measures

9.2.1. Land Development Regulations

In addition to current urban-related sources, future urban development can result in additional sediment pollution in the Watershed. The Plan includes continuing pursuit of improvements in land development regulations (such as permanent water quality buffers (Figure 27), tree ordinances and post construction stormwater standards that incentivize designs for minimal runoff). Greenville County has riparian buffer requirements above the state minimum standards for protection only during construction. Pickens County does not have permanent water quality buffer protection requirements in the Watershed.

Figure 27. Example Schematic of Permanent Water Quality Riparian Buffers



9.2.2. Land Conservation

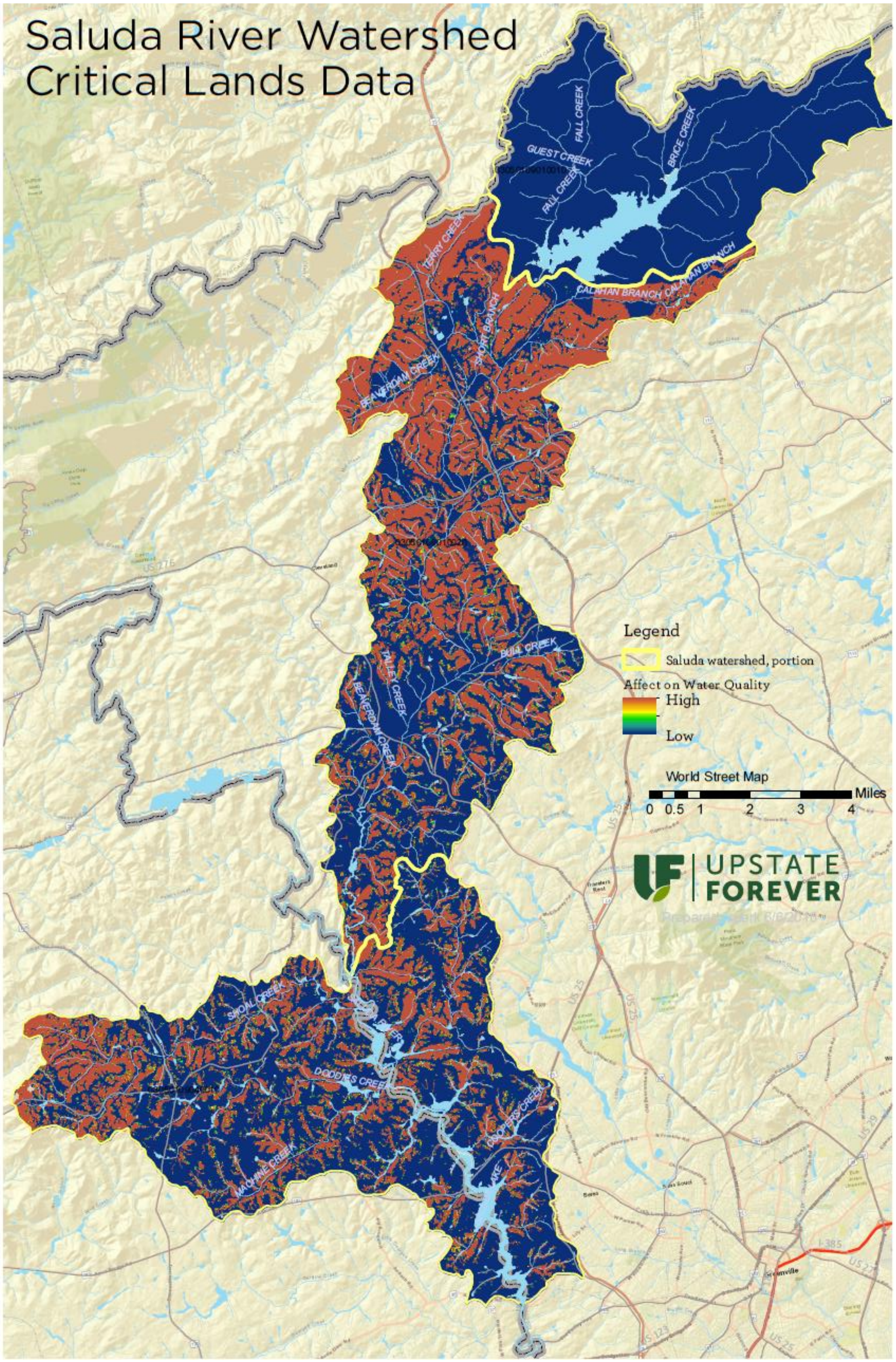
Land conservation is a tool to help protect water quality by permanently protecting existing lands from future development. It includes both land acquisition and protection through conservation easements. It is a legal agreement between a landowner and a non-profit land trust or public agency (qualified to hold such interests) that limits uses of the land while offering private landowners flexibility in managing their land. The land trust/agency is responsible for monitoring the easement area and enforcing the terms of the agreement. The land trust is responsible for monitoring the easement and enforcing its terms, including annual monitoring visits. Landowners benefit from granting conservation easements to a qualified holder through monetary or tax incentives associated with the easement value. If donating to a land trust permanently protects important conservation resources, then the donation qualifies as a tax-deductible, charitable donation.

Photo 32. Example Conservation Easement Property

The Plan includes potential 319 grant funding to develop a land conservation easement program in the Watershed in cooperation along with project partners. Upstate Forever, with assistance from Furman University, developed a watershed map of high value lands for protection of water quality in the Upstate. The map was developed using the Invest Model (http://naturalcapitalproject.stanford.edu/invest/) to assess ecosystem services and included factors such as mature forests, bird diversity, carbon sequestration, and areas in which water quality would be impacted if developed. Figure 24 is a clip of that map showing critical lands in the North Saluda River - Saluda Lake Watershed prioritized for protection by Upstate Forever – This map can be used to identify priority parcels for land conservation (Figure 28).

During the course of the planning process, project partners (Save our Saluda, Easley Combined Utilities, and Naturaland Trust), worked together to secure protection for a high value property for water quality situated between the South and North Saluda Rivers (225 acres) approximately seven miles upstream of Saluda Lake.

Figure 28. Upstate Forever's North Saluda River – Saluda Lake Critical Lands Map



9.2.3. Public Education and Outreach

Education and outreach during implementation of the Plan will be crucial. Examples include educational workshops and field days focused on soil health, pasture management, stream restoration and riparian buffer management, estate planning, etc. These should be planned to help engage with landowners in the Watershed. The Save Our Saluda website will be used to keep the public informed about the progress of implementation of the Plan. Landowners who participate in implementing BMPs will also be educated on the operation and maintenance of the BMPs.

Signs at stream crossings and/or entering the watershed are also valuable tools for raising public awareness.

Photo 33. Example stream crossing signs

See additional public education and outreach incorporated into the development of this mentioned in Section 10.

9.3. Plan Implementation

The TASC members involved with the creation of the North Saluda River – Saluda Lake Watershed Plan to address sediment will continue to oversee the Plan implementation. Currently, the members of the TASC are:

- Clemson Cooperative Extension
- Easley Combined Utilities
- Furman University

- Greenville County
- Greenville County Soil and Water Conservation District
- Greenville Water
- Mountain Bridge Trout Unlimited
- Naturaland Trust
- Pickens County
- Powdersville Water
- Renewable Water Resources
- Save Our Saluda
- South Carolina Department of Health and Environmental Control
- South Carolina Department of Natural Resources
- South Carolina Rural Water Association
- Upstate Forever

9.4. Milestones

This Plan includes milestones to meet the Watershed Plan goals outlined in Section 8 within 15 years. Interim and long term measurable milestones are outlined in Table 5 below. As funding is obtained to implement this Plan, progress evaluations will be provided to the TASC and DHEC, and possible adjustments or revisions of the Plan may be needed.

Table 5. North Saluda River – Saluda Lake Watershed Plan Measurable Milestones

Sources	BMPs		Years 1 - 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15		Programmatic Measures	Years 1 – 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15
Agricultural Sources														
Crop Farms (Total estimated 1,476 acres, assuming 75% overall participation in 15 years, 1,107 acres)	Cover Crops, Intercropping, Vegetated Riparian Buffers, Conservation Tillage, Vegetated Filter Strips/Field Borders/Pollinator Strips, Culvert/Ditch stabilization, Farm access road stabilization, Vegetated Waterways, Sediment control basins, Terracing and contouring, Stream bank stabilization, Conservation Plans	Crop Farms, 221 acres	20%						Landowner lease conditions (buffers, stabilization requirements, etc)	✓	✓	✓	✓	✓
		Crop Farms, 221 acres		20%										
		Crop Farms, 221 acres			20%				Workshops/Field Days	✓	✓	✓	✓	✓
		Crop Farms, 221 acres				20%								
		Crop Farms, 221 acres					20%							
Livestock Farms (Total estimated 1,920 acres, assuming 25% overall participation in 15 years, 480 acres)	Exclusion fencing/well/water trough, Loafing shed, Vegetated Riparian Buffers, Stream Crossings, Stabilization of Stream Banks, Cross fencing/Pasture Planting, Heavy Use Area Stabilization, Conservation Plans	Livestock Farms, 96 acres	20%						Workshops/Field Days	✓	✓	✓	✓	✓
		Livestock Farms, 96 acres		20%										
		Livestock Farms, 96 acres			20%									
		Livestock Farms, 96 acres				20%								
		Livestock Farms, 96 acres					20%							
Urban Sources														
Dirt Driveways, Dirt Roads and Roadside Ditches	See Programmatic Measures								Public Education and Outreach	✓	✓	✓	✓	✓
									Training citizens "Muddy Water Watch"	✓	✓	✓	✓	✓
Urban Development	See Programmatic Measures								Recommendations for Permanent Water Quality Buffer Regulations and Management	✓	✓			
									Recommendations for Post-Construction Design Regulations		✓	✓	✓	
									Set- Up Land Conservation Program	✓				
									Implement Land Conservation Program		✓	✓	✓	✓
									Watershed Signs (100 signs)	20%	20%	20%	20%	20%

10. PUBLIC INVOLVEMENT AND EDUCATION

Several strategies were employed to obtain public input into the development of the Plan. The TASC was formed at the outset of the planning project and initially consisted of twelve project partners. The partnership has since grown to seventeen cooperating stakeholder organizations, each with a different role in the process and each with valuable input to the Plan. The TASC met five times throughout the development of the Plan and provided support and guidance on technical and financial decisions. TASC meeting minutes can be found in Appendix F.

A workshop entitled "Boosting Soil Health for Crop Productivity" was held on September 12, 2018 in the Watershed that focused on soil health and runoff prevention for croplands (Appendix G). The workshop included presentations from Save Our Saluda, a USDA/NRCS Conservation Agronomist, and a regional farmer who implements sustainable practices. A demonstration of a rainfall simulator on various cover crop types was given by SCDNR, with support from the South Carolina Forage and Grazing Lands Coalition.

Videos of the workshop rainfall simulator demonstration can be found on the project website: https://www.saveoursaluda.org/projects/watershed-planning.html

Photo 34. Rainfall Simulator Demonstration at Soil Health Workshop

A survey of workshop attendees indicated concern for sediment in the North Saluda River and Saluda Lake; interest in more workshops and field tours to show agricultural BMPs; and interest in learning more about EQIP and 319 programs for assistance with BMP implementation.

Additionally, an online survey was conducted to obtain feedback from the public on concerns and solutions regarding sediment control, and to reach out to identify landowners potentially interested in soil stabilization projects. The feedback obtained from the 78 participants in the online survey results and 5 participants in the workshop survey are included in Appendix H. The following is a summary of the results from the citizen survey:

- 96% stated that water quality of local streams, rivers and lakes are very important to them,
- 90% have concerns about sediment in the Upper Saluda Rivers or Saluda Lake,
- 95% think protective measures are needed to protect local streams, rivers, wetlands and lakes as development of the watershed increases, and
- 94% support riparian buffer requirements at new development sites for protection of streams, rivers, lakes and wetlands.

Through information gathered from the workshop, the online survey, and from other communications, a database of contacts was developed of potential landowners for implementation.

The watershed project was presented at the 2018 South Carolina Water Resources Conference in Columbia in October. The manuscript can be found in Appendix I.

Filming for a project video is underway, which will help raise awareness of issues related to sediment in the Watershed and resources available to help support restoration and protection efforts.

For additional information about planned public education activities throughout the implementation of the Plan, see Section 9.

11. MEASURES OF SUCCESS

11.1. Monitoring Plan

11.1.1. SCDHEC Monitoring

According to the 2018 State of South Carolina Monitoring Strategy, both Saluda Lake monitoring stations (S-250 and S-314) are inactive and the only active ambient water quality monitoring stations in the Watershed are S-292 (located on the North Saluda Reservoir) and S-004 (at the bottom of the Lower North Saluda River subwatershed). To better understand the impact of project implementation, if 319 grant funding is awarded, Save Our Saluda plans to request that SCDHEC activate S-773 (at Highway 25, just below numerous crop farms in the floodplains of the North Saluda River).

11.1.2. Easley Combined Utilities Monitoring

Easley Combined Utilities plans to continue to monitor turbidity in Saluda Lake at the intake to their water treatment plant.

11.1.3. Greenville County Monitoring

Greenville County plans to continue to monitor turbidity in Keeler Bridge Road (S-004).

11.2. Sediment Loading Sources

11.2.1. Evaluation Method

In addition to evaluation of monitoring data proposed above, the success of this Plan, per source, will be evaluated based on:

<u>Agricultural Sources</u>

1. Crop Farms
    - The quantity of crop farmers within the watershed who participate in outreach initiatives
    - The quantity of crop farmers who develop conservation plans
    - The quantity of BMPs that are implemented at crop farms
    - The quantity of landowners that update their lease conditions

2. Livestock Farms
    - The quantity of livestock farmers within the watershed who participate in outreach initiatives
    - The quantity of livestock farms who develop conservation plans
    - The quantity of BMPs that are implemented at livestock farms

Follow up surveys will be conducted to determine if there has been a change in attitudes, knowledge, and future conservation efforts regarding agricultural practices.

Urban Sources

- The quantity of sediment-related illicit discharges reported to counties and DOT
- The quantity of parcels with land conservation easements
- Improvements in post-construction stormwater regulations
- The quantity of watershed/stream signs installed
- The quantity of citizens who participate in outreach initiatives

Follow up surveys will be conducted to determine if there has been a change in attitudes, knowledge about water quality.

11.2.2. Anticipated Sediment Load Reductions

Agricultural – Cropland Sources

Implementation of BMPs on agricultural properties is voluntary and therefore will likely not reach 100% participation. As such, the Plan assumes participation by 75% of crop farms over 15 years. Sediment load reductions for crop farm sources were estimated using this participation rate, estimated current annual sediment loadings detailed in Section 7, and load reductions for typical crop farm BMPs. Because current practices at crop farms in the Watershed often include leaving bare soil for the entire off-season, it is anticipated that the use of cover crops to improve soil health in addition to a variety of other BMPs to stabilize soil, would result in a 50% reduction in sediment load. This percent reduction was applied to the crop farm sediment load. Therefore, from crop farm BMPs installed, it is estimated that 2,895 tons of sediment per year will be reduced in the the North Saluda River–Saluda Lake Watershed by the implementation of this 15 year Plan. Table 6 provides details of the estimated load reduction calculations to the North Saluda River - Saluda Lake Watershed from proposed BMPs by Year 15.

Agricultural – Livestock Sources

Implementation of BMPs on agricultural properties is voluntary and therefore will likely not reach 100% participation. As such, the Plan has anticipated participation by 25% of livestock farms over 15 years. Sediment load reductions for livestock sources were estimated using this participation rate, estimated current annual sediment loadings detailed in Section 7, and load reductions for typical livestock BMPs. Because it is anticipated that the bulk of the livestock load reductions will result from stream exclusion fencing with alternative water sources, the 40% sediment load reduction factor cited for "off stream watering with fencing" was applied to the livestock sediment load of 25% of the livestock farms: (Simpson and Weammert 2009). Therefore, from livestock BMPs installed, it is estimated that 153 tons of sediment/ year will be reduced in the the North Saluda River–Saluda Lake Watershed by this Plan. Table 6 provides details of the estimated load reduction calculations to the North Saluda River–Saluda Lake Watershed from proposed BMPs by Year 15.

Urban Sources

The education and implementation of "Muddy Water Watch" will have some effect on sediment load from urban sources in the Watershed, though it is difficult to quantify. The other urban source BMPs which include watershed signs, a Land Conservation Program and improved land development regulations are preventative in nature and thus would prevent future sediment load, but will not reduce current load.

Table 6. Estimated Load Reductions to the North Saluda River–Saluda Lake Watershed from Proposed BMPs by Year 15

Loading Source	BMPs	Existing Sediment Loading (tons/yr)	Comments	Estimated % participating	Estimated % Reduction	Sediment Load Removed by BMPs (tons/yr)
Agricultural - Croplands	*Total loading	7,719				
	Cover Crops, Intercropping, Vegetated Riparian Buffers, Conservation Tillage, Vegetated Filter Strips/Field Borders/Pollinator Strips, Culvert/Ditch stabilization, Farm access road stabilization, Vegetated Waterways, Sediment control basins, Terracing and contouring, Streambank stabilization, Conservation Plans		75% crop acreage participate of approximately 1,479 acres: 1,109 acres participating	75%	50%	2,895
Agricultural - Livestock	*Total loading	1,529				
	Exclusion fencing/well/water trough, Loafing shed, Stream Crossings, Vegetated Riparian Buffers, Stream bank stabilization, Conservation Plans		25% livestock acreage participate of approximately 1,529 acres: 382 acres participating	25%	40%	153
			TOTAL LOAD REDUCTIONS			**3,048 tons/year**

12. FINANCIAL NEEDS AND OPPORTUNITIES

12.1. Financial Needs

Table 7 shows the estimated costs to implement this Plan. The costs have been broken down into 3-year periods to coincide with a typical 319 grant period.

Table 7. Estimated Financial Needs for North Saluda River - Saluda Lake Watershed Plan Implementation

Sources	BMPs		Years 1 - 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15	Programmatic Measures	Years 1 – 3	Years 4 - 6	Years 7 - 9	Years 10 - 12	Years 13 - 15
Agricultural Sources													
Crop Farms (Total estimated 1,476 acres, assuming 75% overall participation in 15 years, 1107 acres)	Cover Crops, Intercropping, Vegetated Riparian Buffers, Conservation Tillage, Vegetated Filter Strips/Field Borders/Pollinator Strips, Culvert/Ditch stabilization, Farm access road stabilization, Vegetated Waterways, Sediment control basins, Terracing and contouring, Stream bank stabilization, Conservation Plans	Crop Farms, 221 acres	$334,000					Landowner lease conditions (buffers, stabilization requirements, etc)	✓	✓	✓	✓	✓
		Crop Farms, 221 acres		$334,000									
		Crop Farms, 221 acres			$334,000			Workshops/Field Days	$10,000	$10,000	$10,000	$10,000	$10,000
		Crop Farms, 221 acres				$334,000							
		Crop Farms, 221 acres					$334,000						
Livestock Farms (Total estimated 1,920 acres, assuming 25% overall participation in 15 years, 480 acres)	Exclusion fencing/well/water trough, Loafing shed, Vegetated Riparian Buffers, Stream Crossings, Stabilization of Stream Banks, Cross fencing/Pasture Planting, Heavy Use Area Stabilization, Conservation Plans	Livestock Farms, 96 acres	$166,000					Workshops/Field Days	$10,000	$10,000	$23,000	$23,000	$23,000
		Livestock Farms, 96 acres		$166,000									
		Livestock Farms, 96 acres			$166,000								
		Livestock Farms, 96 acres				$166,000							
		Livestock Farms, 96 acres					$166,000						
Urban Sources													
Dirt Driveways, Dirt Roads and Roadside Ditches	See Programmatic Measures							Public Education and Outreach	See above	See above	See above	See above	See above
								Training citizens "Muddy Water Watch"	$13,000	$13,000	$13,000	$13,000	$13,000
Urban Development	See Programmatic Measures							Recommendations for Permanent Water Quality Buffer Regulation and Management	✓	✓			
								Recommendations for Post-Construction Design Regulations		✓	✓	✓	
								Set- Up Land Conservation Program	$100,000				
								Implement Land Conservation Program		$150,000	$150,000	$150,000	$150,000
								Watershed Signs (100 signs)	$20,000	$20,000	$20,000	$20,000	$20,000
TOTAL Per 3-Year Period			$500,000	$500,000	$500,000	$500,000	$500,000		$153,000	$203,000	$203,000	$203,000	$203,000

TOTAL **$3,465,000**

12.2. Watershed Manager

This Plan establishes the need for a watershed manager to address current and future water quality issues in the Upper Saluda River Watershed and Saluda Lake and to facilitate implementation of this Plan. There are currently no such positions within any local government, private or non-profit organizations specifically for this purpose. In order to properly protect and restore the Upper Saluda River Watershed, a paid watershed manager is needed.

12.3. Grant Funding Opportunities

Several types of grant and self-supporting funding may be available to implement watershed restoration and protection practices and land conservation measures outlined in this Watershed Plan.

Nonpoint Source Grants Programs (319 Grants)

SCDHEC receives an annual grant allocation from EPA to implement nonpoint source abatement strategies as described in the state's Nonpoint Source Management Plan. A portion of these funds are passed on through a competitive grant process to stakeholder groups, government entities, or other agencies interested in conducting projects that reduce or prevent nonpoint source water pollution through the implementation of an approved Watershed Plan that addresses impaired waters. These funds are known as Section 319 grants and pay up to 60% of eligible project costs, with the applicant providing a 40% non-federal match.

NRCS Environmental Quality Incentives Program (EQIP)

EQIP is a voluntary program administered by the USDA NRCS that provides financial and technical assistance to farmers to help plan and implement conservation practices that improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland.

In South Carolina, EQIP will pay 75 percent of the costs of eligible conservation practices under the general sign-up. Eligible landowners who are historically underserved, of limited resources, socially disadvantaged, and beginning farmers are eligible for 90 percent cost share. A ranking tool is used to prioritize applications based on the resource concerns that each county selected. Farms within an approved TMDL watershed and farms that are part of a 319 implementation grant are typically ranked high to receive EQIP funds. Therefore, landowners may apply for EQIP funds to potentially maximize the effect of 319 grant funds.

Other Grant Sources

Other grant sources may be available to help with funding needs. These include private grants from foundations, corporations, businesses, and individuals, and additional financial support from cooperating partner organizations.

12.4. Self-Supporting Funding

Land Conservation Fund

Utilities, counties, and/or local municipalities could consider developing a local land conservation bank to fund land conservation in the Watershed. Purchased land or land protected through conservation easements can serve to protect water quality and downstream drinking water sources and help mitigate the impact of future development. The fund could help support land acquisition and/or costs associated with setting up and maintaining conservation easements on critical riparian lands that have been prioritized for water quality protection.

One example of a Land Conservation fund in South Carolina is the Savannah River Clean Water Fund (SRCWF) which arranges financing and uses partnerships to stretch and multiply conservation investments and reach conservation goals on a regional or watershed scale. The fund has five water utilities signed on to provide approximately $1,000,000 annually for Land Conservation and Management. The SRCWF has hired an executive director, constituted a board of directors and received their non-profit, tax exempt status. The SRCWF has concluded that high priority lands should be permanently protected, identified conservation easements as the most cost-effective tool, and recognizes that important but less critical lands can help water quality through adoption and use of appropriate land management practices. This results in a total financial need (with cost share contributions) of $67 Million. Assuming individual landowner transactions over multiple decades, the SRCWF's goal is to raise on average $2 Million per year to implement their plan for Land Conservation and Management.

Stormwater Utility Fee

Greenville County has a stormwater utility fee that could help fund implementation of portions of the Watershed Plan. Pickens County does not have a stormwater utility fee.

Landowner Support

If 319 grant opportunities are made available for implementation of this Plan, landowners could be asked to provide match for installation of BMPs to satisfy match requirements of the grant. Some landowners may be able to perform in-kind labor as a way to match these funds.

13. TECHNICAL ASSISTANCE

Assistance from local agricultural and cooperative extension agencies will be crucial to recruiting landowners and developing conservation plans and recommendations for agricultural BMPs.The participation of the TASC will impact the ability to conduct an effective and efficient social marketing campaign and ensure implementation of the Plan.

A consultant may be needed at times to assist with tasks such as project oversight, reporting, and social marketing.

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APPENDIX A

Figures

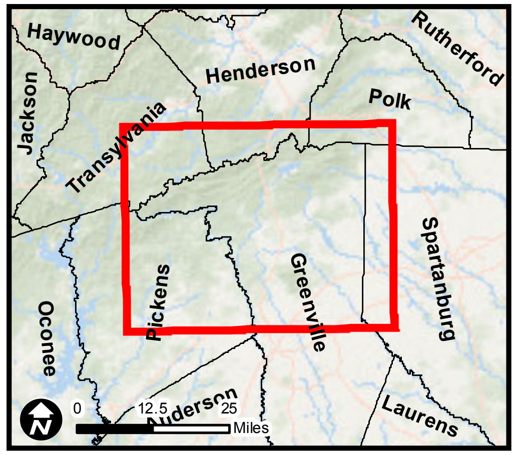

Figure 1. Watershed Map

North Saluda River-Saluda Lake Watershed,
Greenville and Pickens County,
South Carolina

Legend

- 🟥 Watershed Boundary
- ▭ County Boundaries
- Municipal
- ▨ South Carolina Approved TMDL Watershed
- WWTP Waste Water Treatment Plant
- Drinking Water Intake
- Streams/Rivers
- Lakes/Ponds
- 🟩 Monitoring Station S-292 (Inactive)

SCDHEC Monitoring Stations - 303(d) Impaired Waters

- 🟧 Turbidity Impairment
- 🟨 Biological Impairment

Subwatersheds

- Upper North Saluda subwatershed
- Lower North Saluda subwatershed
- Doddies Creek-Saluda River subwatershed

SAVE OUR SALUDA

wood.

Job No. 6250-18-0106
Drawn By: BWS
Reviewed By: AV
Date: 12/5/2018

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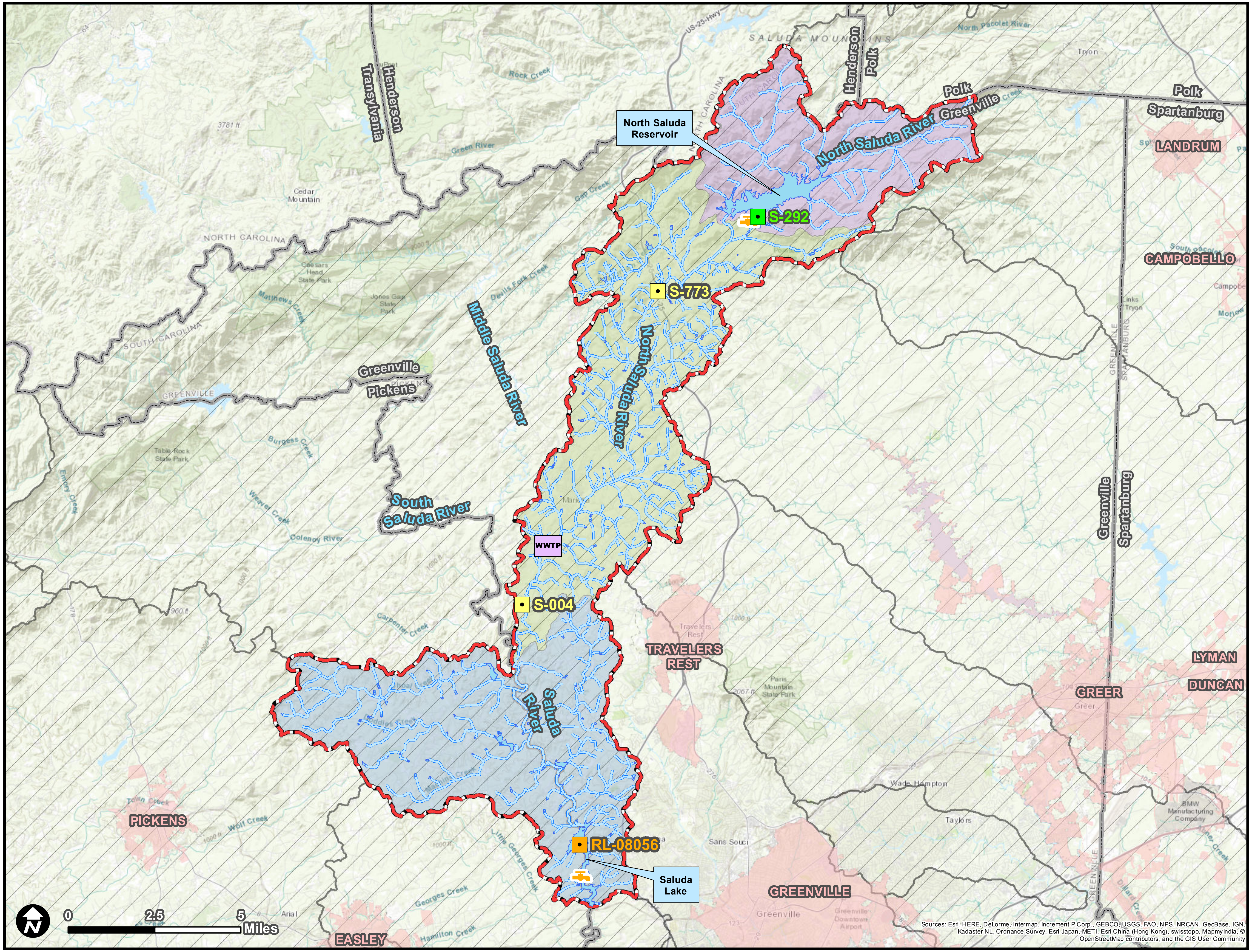

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\North Saluda River Watershed\Figure 1. Watershed Features.mxd

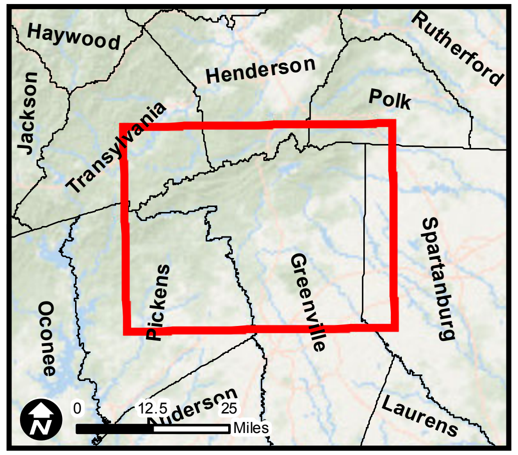

Figure 6. Soil K Factors Map

North Saluda River-Saluda Lake Watershed,
Greenville and Pickens County,
South Carolina

Legend

- ▭ Watershed Boundary
- ▭ County Boundaries
- ▭ Municipal Areas
- — Streams/Rivers
- ▭ HUC-12 Watershed Boundary
- ▭ Lakes/Ponds

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Reviewed By: AV

Date: 12/5/2018

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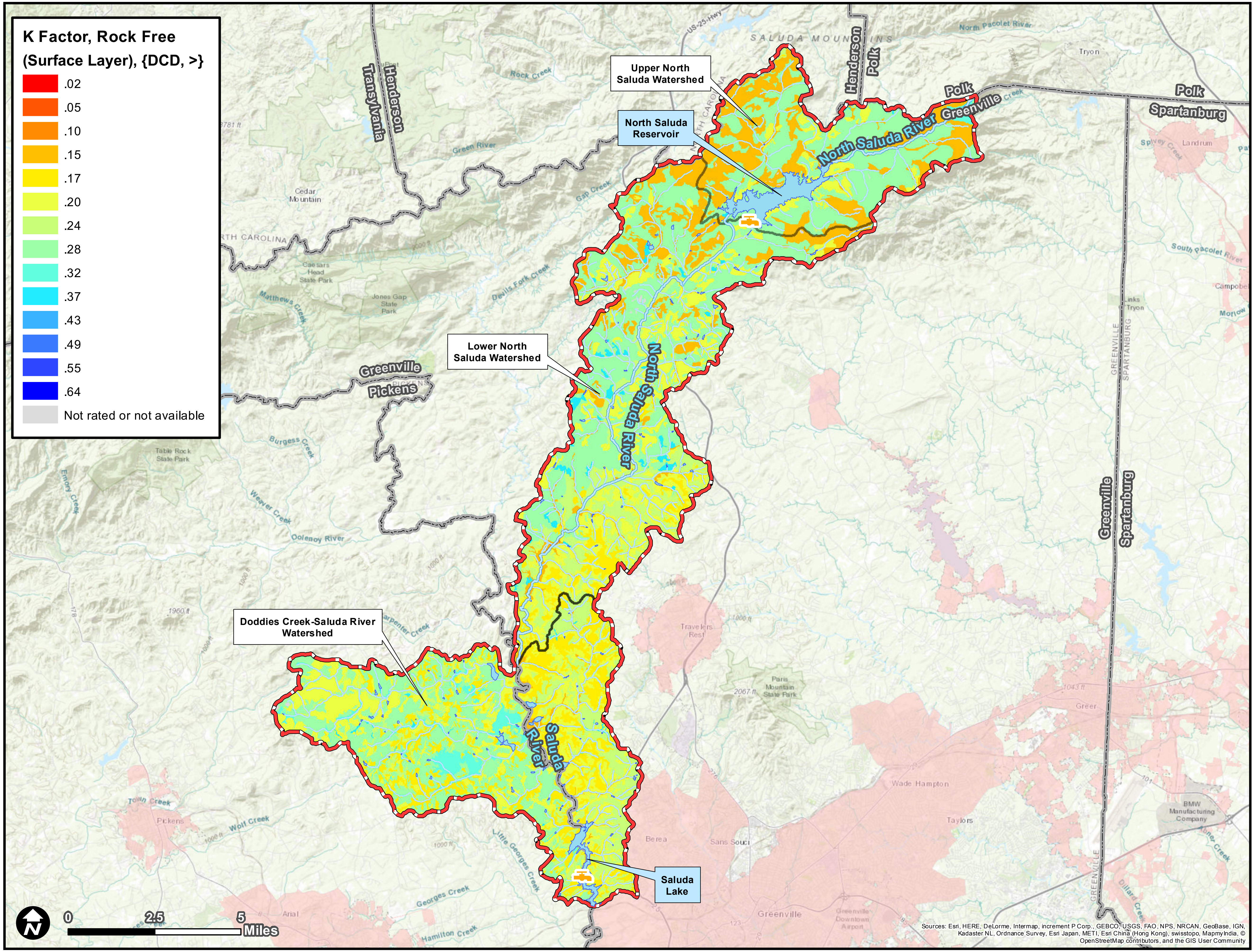

K Factor, Rock Free (Surface Layer), {DCD, >}

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- 🟩 .28
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- 🟦 .37
- 🟦 .43
- 🟦 .49
- 🟦 .55
- 🟦 .64
- ⬜ Not rated or not available

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

P:\Environmental\2012 + Projects\0160 - North Saluda River Watershed\North Saluda River WBP\GIS\North Saluda River Watershed\Figure 6. Soil K Factor Map.mxd

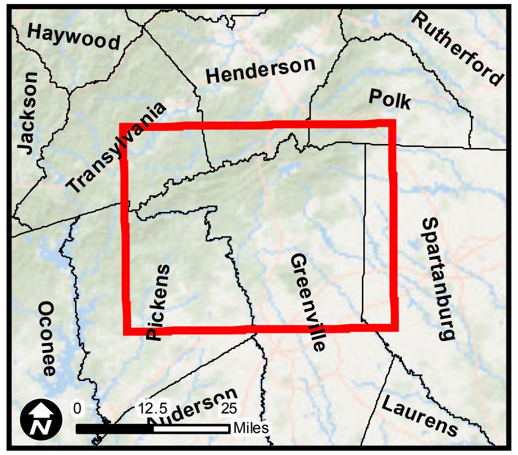

Figure 7. Hydrologic Soil Group Map

North Saluda River-Saluda Lake Watershed,
Greenville and Pickens County,
South Carolina

Legend

- 🟥 Watershed Boundary
- ▭ County Boundaries
- ▭ Municipal Areas
- — Streams/Rivers
- ▭ HUC-12 Watershed Boundary
- ▭ Lakes/Ponds

Save Our Saluda

wood.

Job No. 6250-18-0106

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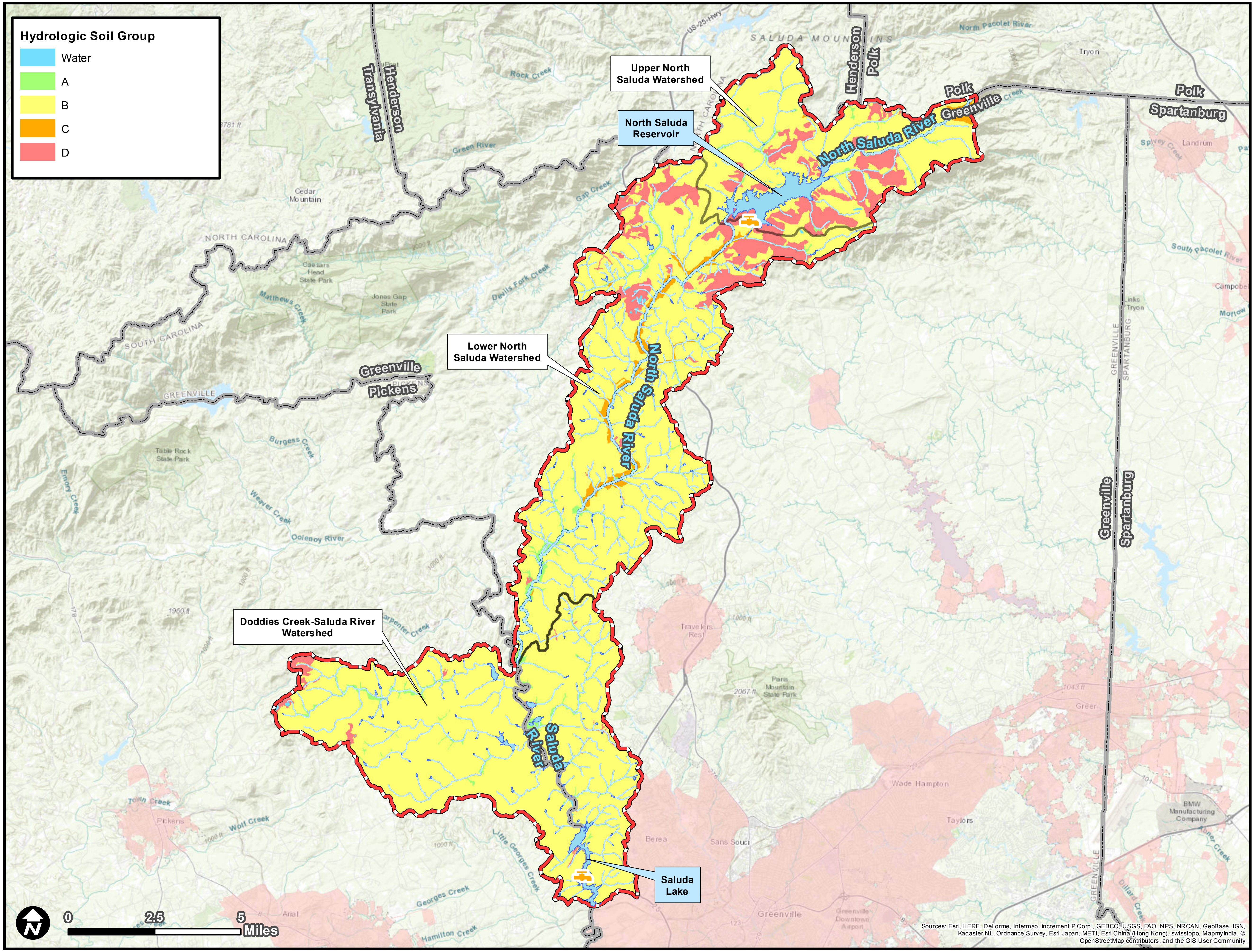

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P:\Environmental\2012 + Projects\0160 - North Saluda River Watershed\North Saluda River WBP\GIS\North Saluda River Watershed\Figure 7. Hydrologic Soil Group Map.mxd

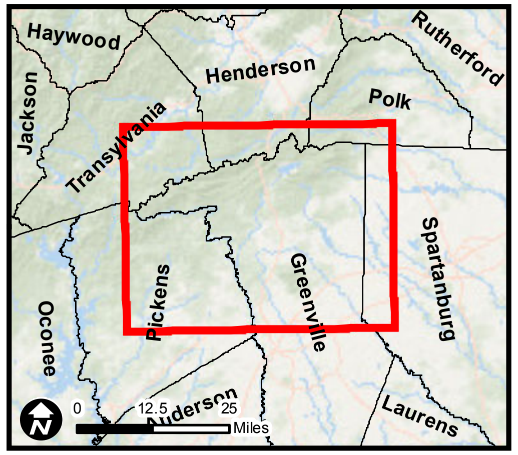

Figure 9. Land Use Map

North Saluda River-Saluda Lake Watershed,
Greenville and Pickens County,
South Carolina

Legend

🟥 Watershed Boundary
▭ County Boundaries
🟥 Municipal Areas
— Streams/Rivers
▭ HUC-12 Watershed Boundary
🟦 Lakes/Ponds

SAVE OUR SALUDA

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Reviewed By: AV
Date: 12/5/2018

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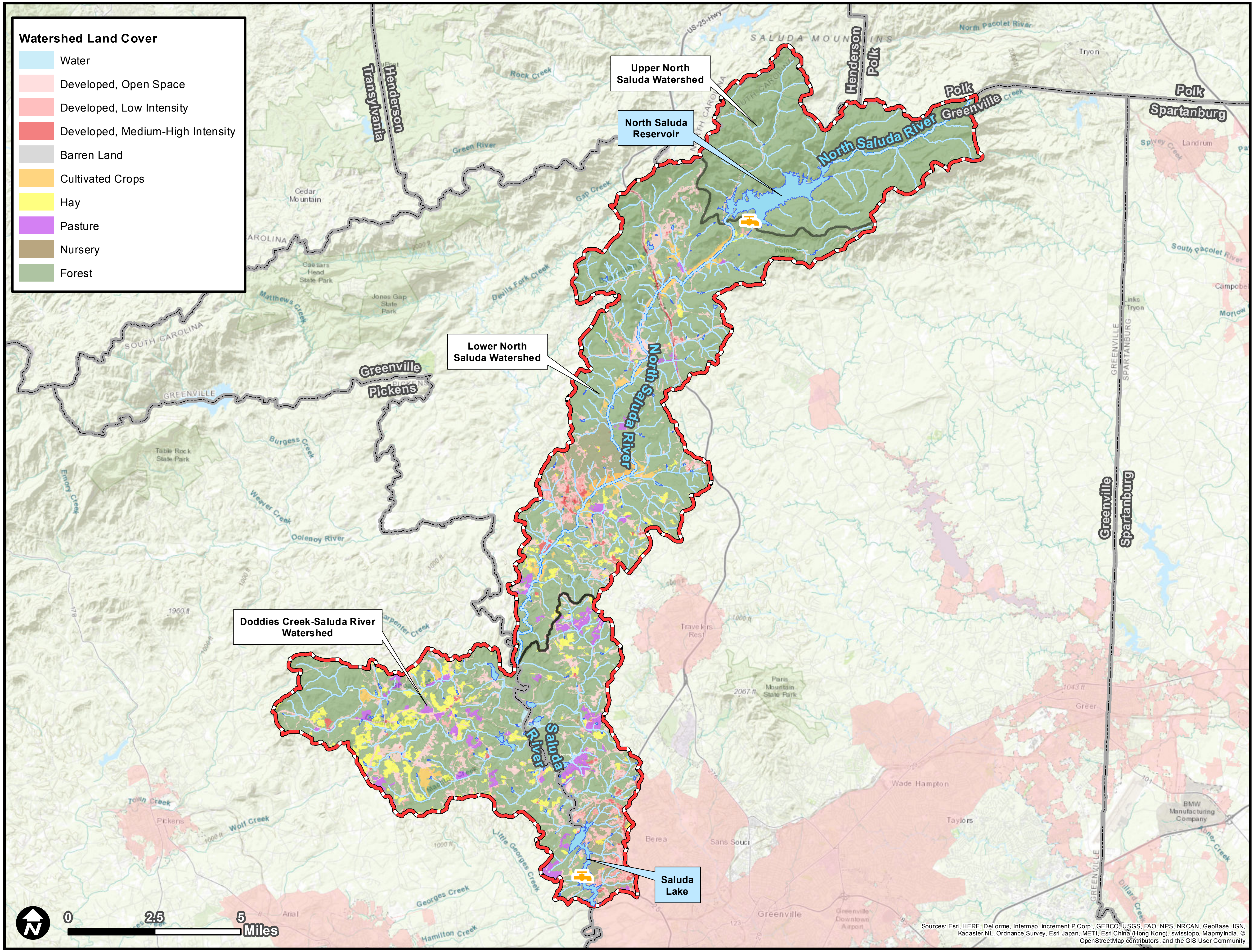

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P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\North Saluda River Watershed\Figure 9. Land Use Map.mxd

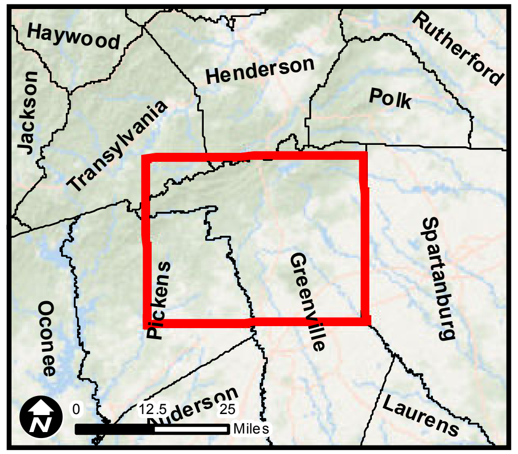

Figure 10. Agricultural BMP Prioritization

North Saluda River-Saluda Lake Watershed,
Greenville and Pickens County,
South Carolina

Legend

▭ County Boundaries
▭ Watershed Boundary
▭ Lower North Saluda Boundary
— Streams/Rivers
🟦 Lakes/Ponds

BMP Priorization

🟧 Priority 1: Cultivated Crop
🟪 Priority 2: Livestock
🟨 Priority 3: Cultivated Crop

Save Our Saluda

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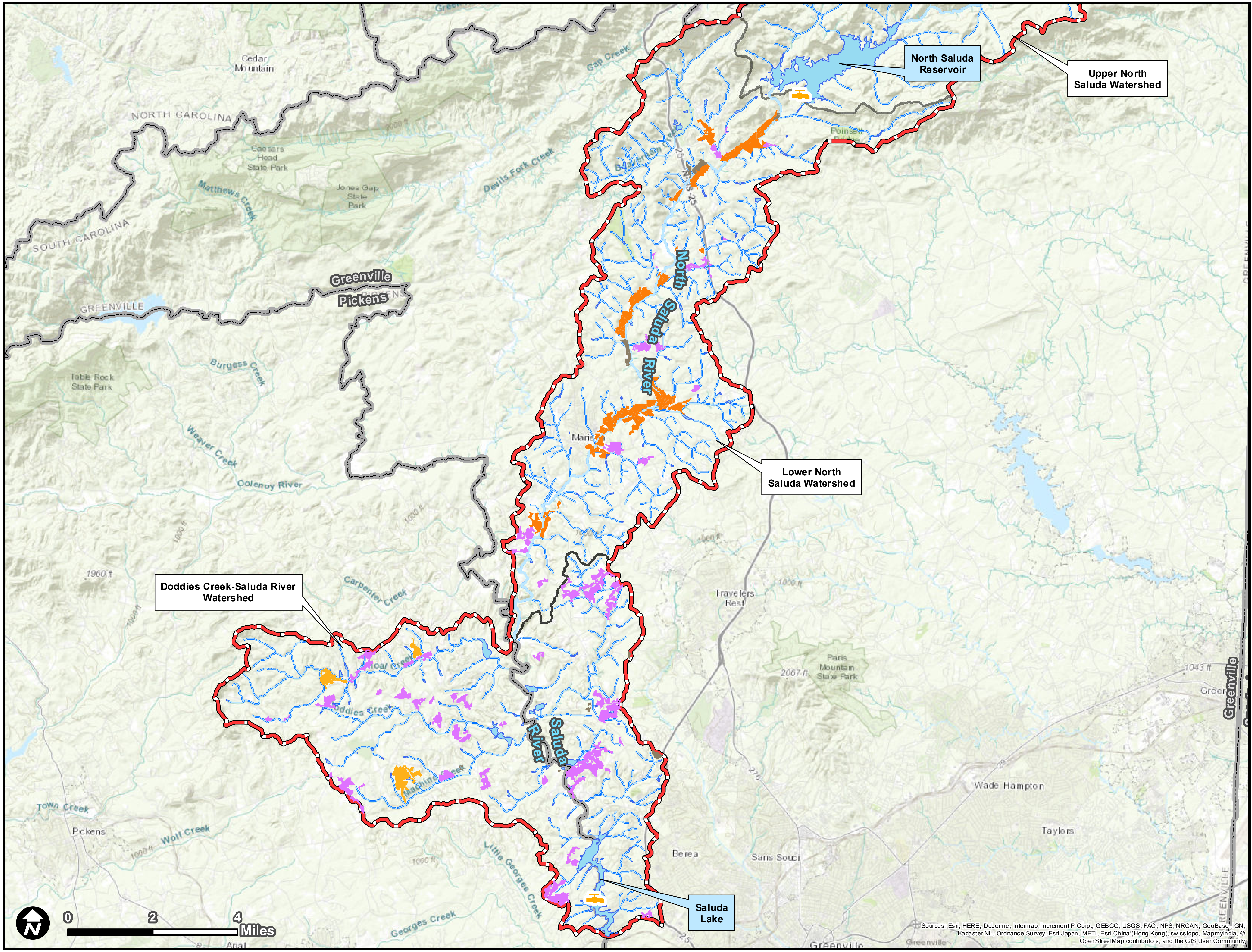

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P:\Environmental\2012 + Projects\0160 - North Saluda River WBP\GIS\North Saluda River Watershed\Figure 10. Agricultural BMP Priorization10.3.mxd

APPENDIX B

Saluda Lake Restoration Committee Project

Upstate's Saluda Lake Revived through Grassroots Conservation Effort

By Amy O. Maxwell, USDA-NRCS public affairs specialist

Saluda Lake near Greenville, South Carolina, is the site of an innovative restoration project and a prime example for other communities to follow. There are many key players in the project that began nearly ten years ago, but the Saluda Lake Restoration Committee, including residents Sam Glenn and Bruce Gaston, are breaking new ground when it comes to the locally-led conservation process. The group joined forces in the early 90's to address sediment buildup in the lake that could have a widespread effect on many resources, including the Easley water treatment system, which depends on the lake as its primary water source. The problem involved the deposit of sediments in the lake, also known as eutrophication. The process is caused by run-off that carries soil from agricultural fields, construction sites, and other urban areas. The Pickens and Greenville Soil and Water Conservation District's, The Foothills Resource Conservation and Development Council (RC&D) and the USDA-Natural Resources Conservation Service (NRCS) provided the Saluda Lake Homeowners Association with an evaluation of the lake and contributing watershed in 1994. The report was also developed with the cooperation of The South Carolina Department of Natural Resources (SCDNR).

This report highlighted the harmful effects of erosion on the lake and prompted a group of citizens to take action to reverse the damage done to this important natural resource. The 331-acre Saluda Lake was constructed in 1905 for the purpose of creating hydroelectric power. Duke Power Company formerly owned the lake then sold it to North Brook Energy, LLC. The history surrounding the lake may explain some of the erosion problems.

For instance, in the 1920's and 30's, cotton farming was the rule, and conservation practices were not yet the standard. Farming practices in this fragile watershed area (comprised of highly erodible soils) contributed much of the sediment found in the lake today. Additionally, the creation of roads and highways also had an effect on the lake, particularly the construction of Highways 25 and 11. These highways were constructed at a time when erosion control ordinances were not yet in place. The sediment concern is compounded by the fact that the Easley water treatment system draws approximately eight million gallons of water per day from the lake for drinking water. In addition, more than 150 homeowners utilize the lake and the general public considers the lake an important source for recreation. The lake is also part of a 200,000-acre watershed and is the site for over 100 condominiums and a public boat launch. Nearly one hundred years after its creation, the lake is in desperate need of restoration. “I grew up on this lake and have seen first-hand the effects of sediment build-up, and realized I had to do something about it, before it was too late,” explained Gaston.

The Saluda Lake Restoration Committee first formed a tax district in the surrounding area in an effort to help garner funding for the project. “We spent several years just laying the groundwork for this massive effort,” said Gaston. “The permitting process alone took four years and there were times when I wasn’t sure the project would ever happen,” admitted Gaston. They persevered and in 1994 an initial meeting between all the key players brought the project into focus.

NRCS used ground-penetrating radar and Global Positioning System (GPS) technology to profile the lake bottom and provide data on the thickness and distribution of sediment. Data illustrated that the lake was undergoing tremendous changes—the depth at the backwaters of the lake was original recorded at a depth of 20-feet deep. Today, it is only four feet deep or less in some places. Additional data concludes there is over 1 million yards of sediment, or “muck” that has built up in the lake over time. The solution to this sediment buildup is to remove it, which is done through dredging, or the removal of accumulated lake-bottom sediments. The process will take several years.

Foothills RC&D Coordinator Dave Demarest has been a central force in the project since the beginning. “The dredging project began with the installation of a 2,500 foot maintenance road which cost $70,000.” Dredging Operations Manager Steve Cooper was awarded the job and agreed to charge for only the unmarketable materials pumped from the lake. That’s because of the potential for commercial value of the clean sand that comprises some of the sediment. “The real beauty of this project appeared when we discovered that most of the materials we were removing from the lake were marketable,” said Demarest. NRCS Geologist Kim Kroeger studied the sediment and determined that it was composed of primarily clean sands, while the remainder was silt and clay. The discovery meant that the dredging process would be even more remarkable in terms of conservation. “This project is a prime example of good conservation—we are basically removing the sediment to clean the lake, but the sand is reusable and profitable,” remarked Demarest.

Foothills RC&D Council Chair Wes Cooler kicked off a meeting and tour recently at the Saluda Lake Boat Landing where local residents and council members gathered for an update on the project. “This is a fine example of what locally-led conservation efforts can accomplish,” he emphasized. “The residents at Saluda Lake were concerned about the condition of the lake and in protecting the resources associated with this watershed.” And the effort is protecting much more than just the Saluda Lake area. “This project has a widespread effect throughout both Greenville and Pickens counties,” said Demarest. “The focus is Saluda Lake, but this initiative benefits thousands of people in the surrounding area and a whole host of natural resources.” For more information about Saluda Lake, visit www.geocities.com/norwood_dr/saludalanding.htm or contact the Foothills RC&D at (864) 467-2775.

APPENDIX C

Saluda Lake Sedimentation Analysis

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'29 YEARS OF RESPONSIVE SERVICE'

TECHNICAL MEMORANDUM

To:	Joel D. Ledbetter, P. E. Easley Combined Utilities
From:	Ben R. Wofford, Jr., P. E.
Project:	***Saluda Lake Sedimentation Analysis***
Project No.:	1824
Date:	October 25, 2018

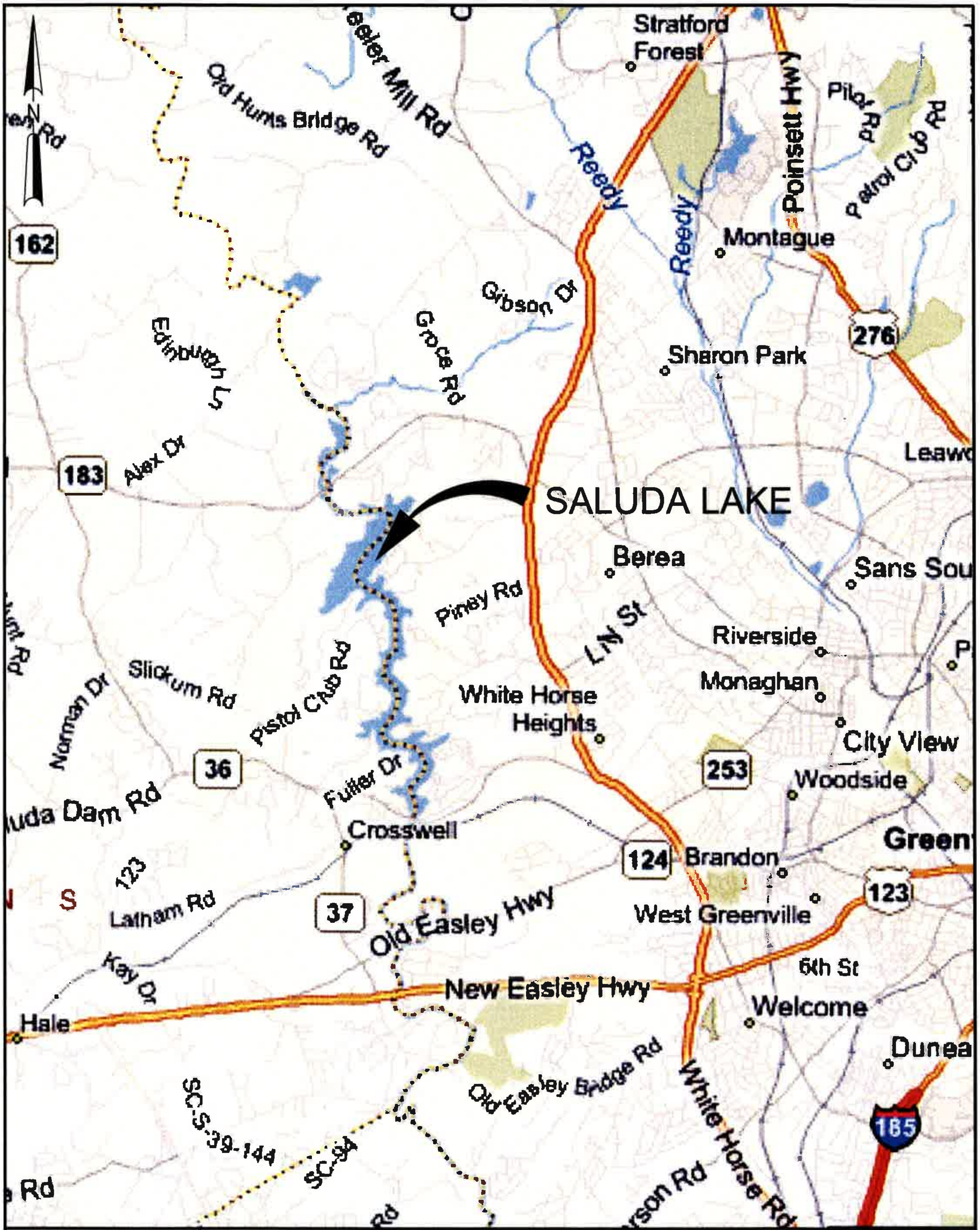
SECTION I - INTRODUCTION

1.1 Background

The municipal water system for the City of Easley and the surrounding area is owned and operated by Easley Combined Utilities (ECU). This water system serves approximately 13,300 retail customers and provides wholesale drinking water for four water districts in Pickens and Anderson Counties in Upstate South Carolina. ECU relies on Saluda Lake as the single water source for the Don L. Moore Water Treatment Plant. This water treatment plant is a state-of-the-art facility capable of treating 18 million gallons per day (MGD). A location map of Saluda Lake and surrounding areas is presented as Figure 1-1.

1.2 Current Watershed Initiatives

Save Our Saluda, a non-profit conservation organization, has obtained a grant award from the South Carolina Department of Health and Environmental Control's (SCDHEC) Nonpoint Source Program to complete a cooperative watershed plan to address sediment in the North Saluda River and further deposition into Saluda Lake. Sediment is a significant pollutant affecting water supply, water quality, aquatic habitat, and recreational uses in Saluda Lake. Sediment runoff has been identified as a major problem for rivers and lake systems by occupying available water storage capacity and serving as a transport mechanism for harmful bacteria, pesticides, and excess nutrient loading from fertilizers further degrading water quality.



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LOCATION MAP
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

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FIGURE 1-1

OCTOBER 2018

This watershed planning initiative involves integrated financial and technical support from eleven stakeholders. The study is proposed to investigate and recommend implementation of appropriate Best Management Practices (BMPs) in agricultural land use areas to control erosion and capture sediment at the point of occurrence. When sediment is contained at the source, further transport and deposit to other areas within the watershed is minimized. Preliminary insight from the group has identified riparian buffers using native plant species, grass swales and sediment catchment basins as target BMPs for use in deploying demonstration projects for agricultural sites in the watershed.

1.3 Purpose and Scope

ECU is a large stakeholder for this study as the protection of its sole drinking water source is paramount for current ECU customers and future generations. ECU's initial effort is to evaluate the extent of sedimentation that is occurring in the upper reaches of Saluda Lake. The information will assist ECU in long-range water plant management and will help define comprehensive Saluda River Watershed planning initiatives.

The scope of work includes conducting a bathymetric survey of Saluda Lake to reflect the current lake bottom topography in the upper reach of Saluda Lake. This current survey data will be compared with the record survey from a previous dredging project coordinated by ECU in 2012. The direct comparison of these two surveys should indicate the amount of sedimentation that has occurred during the six-year period. Additional review and commentary will be addressed in this technical memorandum.

SECTION II - SALUDA RIVER BASIN CHARACTERISTICS, PLANNING AND HYDROLOGY

2.1 Location and Description

A drainage basin is a delineated land area into which precipitation collects and is distributed to creeks and rivers discharging to points further downstream. Basin boundaries are formed along ridges of higher topographic elevation draining to lower elevations. The Saluda River is an approximate 200-mile river run and is the mainstem of the Saluda River Basin. The drainage basin extends from the upstate to the midlands of South Carolina. The drainage basin encompasses 2,523 square miles and includes 5,609 total stream miles originating from the approximate North Carolina state line continuing to the City of Columbia. There are fourteen distinct watersheds within the drainage basin. The drainage basin includes areas within Greenville, Pickens, Anderson, Abbeville, Laurens, Greenwood, Newberry, Saluda, Lexington, and Richland Counties. A map of the greater Saluda River Basin is presented as Figure 2-1.

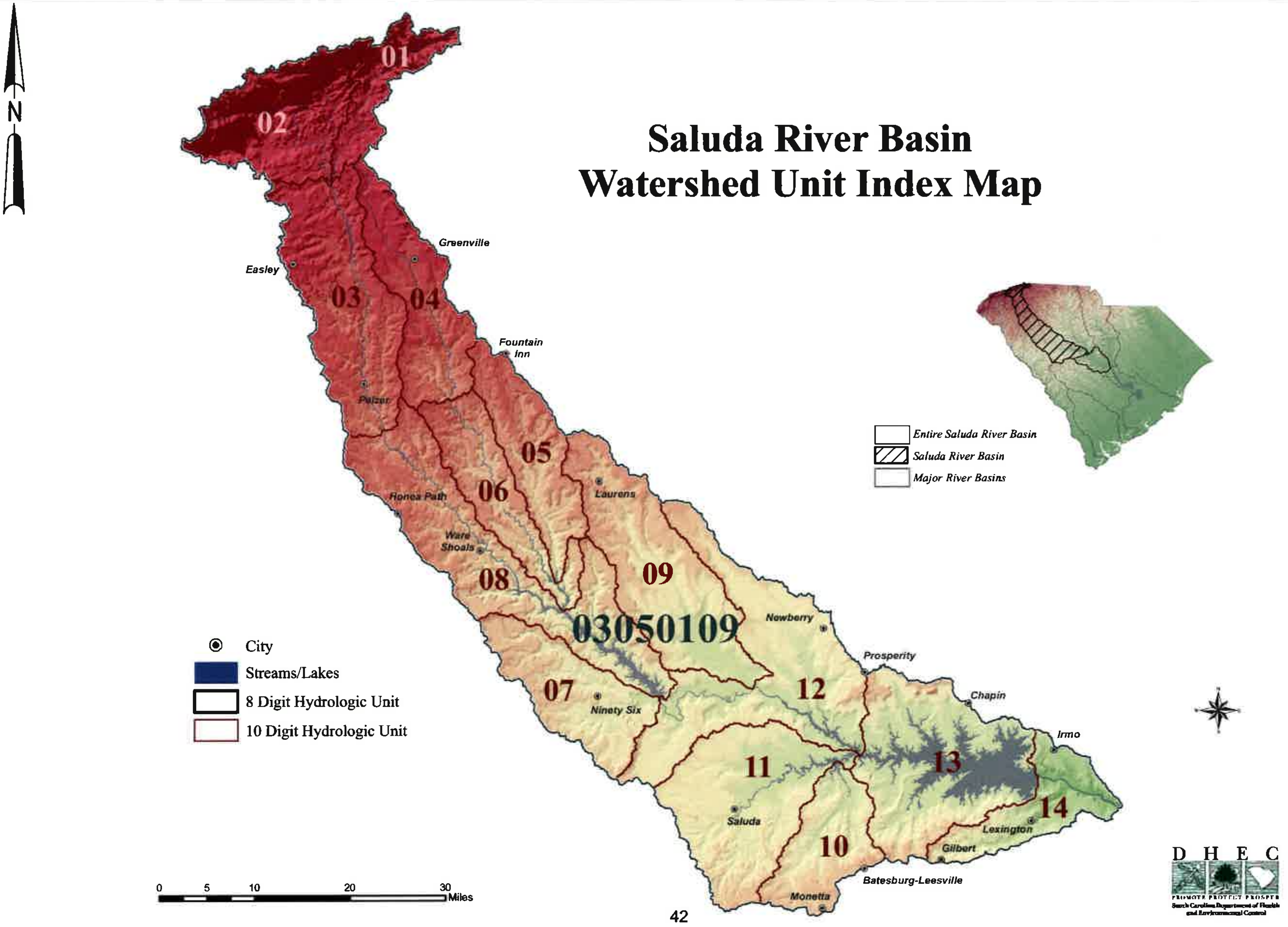

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IMAGE FROM SCDHEC WEBSITE

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SALUDA RIVER WATERSHED BASIN INDEX MAP
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

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FIGURE 2-1

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The drainage area for Saluda Lake comprises portions of three of the fourteen watersheds from the Saluda Basin including the North Saluda, South Saluda, and approximately twenty percent of the Saluda River Watersheds. The general descriptions of these watersheds will be discussed in the subsequent sections.

2.2 North Saluda River Watershed

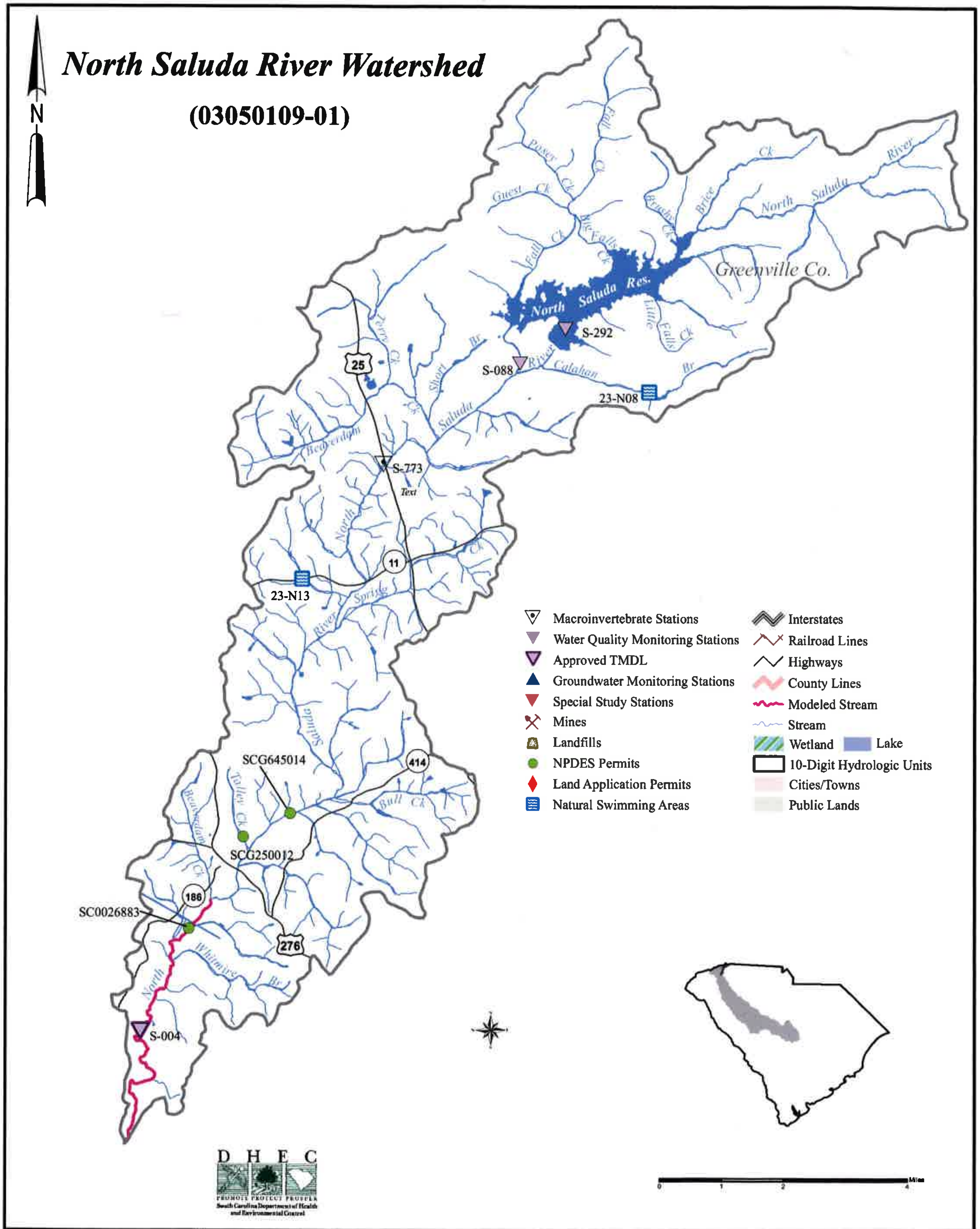
The North Saluda River Watershed is in Greenville County and consists of primarily the North Saluda River and its tributaries. The watershed includes approximately 48,400 acres of land. Land use in the watershed includes 77.8 percent forests, 10.2 percent farms and agriculture, 9.3 percent urban areas, 2.1 percent water, 0.3 percent barren areas, and 0.3 percent forested wetlands. There is a total of 191.3 stream miles and approximately 1,140 acres of lakes within this watershed.

The headwaters of the North Saluda River originates near the North Carolina State line and generally flows in a southwesterly direction through the watershed. In 1956 a dam was constructed on the North Saluda River creating the Poinsett Reservoir as an additional drinking water source for the City of Greenville. The North Saluda River outflow from the Poinsett Reservoir continues southwest and flows for approximately 15 miles through agricultural lands, residential communities, passing under several major highway corridors to the confluence with the South Saluda River near Slater-Marietta. Numerous tributaries converge with the North Saluda River mainstem along its entire reach, including Big Falls Creek, Beaverdam Creek, Calahan Branch, Bull Creek, and Whitmire Branch. A map of the North Saluda Watershed is presented as Figure 2-2.

2.3 South Saluda River Watershed

The South Saluda River Watershed is in portions of Pickens and Greenville Counties and consists of primarily the South Saluda River and its tributaries. The watershed includes approximately 109,600 acres of land. Land use in the watershed includes 83.9 percent forests, 8.6 percent farms and agriculture, 5.9 percent urban areas, 0.6 percent water, 0.6 percent forested wetlands, and 0.4 percent barren areas. There are a total of 417.5 stream miles and approximately 690 acres of lakes within this watershed.

The headwaters of the South Saluda River is the border between Pickens and Greenville Counties and originates near Sassafras Mountain just south of the North Carolina State line. The South Saluda River generally flows in an easterly and then due south direction through the watershed. In 1925, a dam was constructed on the South Saluda River creating the Table Rock Reservoir, a primary drinking water source for the City of Greenville. The South Saluda River outflow from the Table Rock Reservoir continues eastward for about 6 miles to the Cleveland Community and



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NORTH SALUDA RIVER WATERSHED
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

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FIGURE 2-2

OCTOBER 2018

turns southward for approximately 9 miles merging with the Middle Saluda River. From this confluence point, the South Saluda River continues for approximately 5 additional miles to merge with the North Saluda River. The South Saluda River mainstem route flows through a state park, forests, agricultural lands, and sparsely populated residential communities and parallels and passes under several major highway corridors. Numerous tributaries converge with the South Saluda River mainstem along its entire reach, including Matthews Creek, Middle Saluda River, Oolenoy River, and Carpenters Creek. A map of the South Saluda Watershed is presented as Figure 2-3.

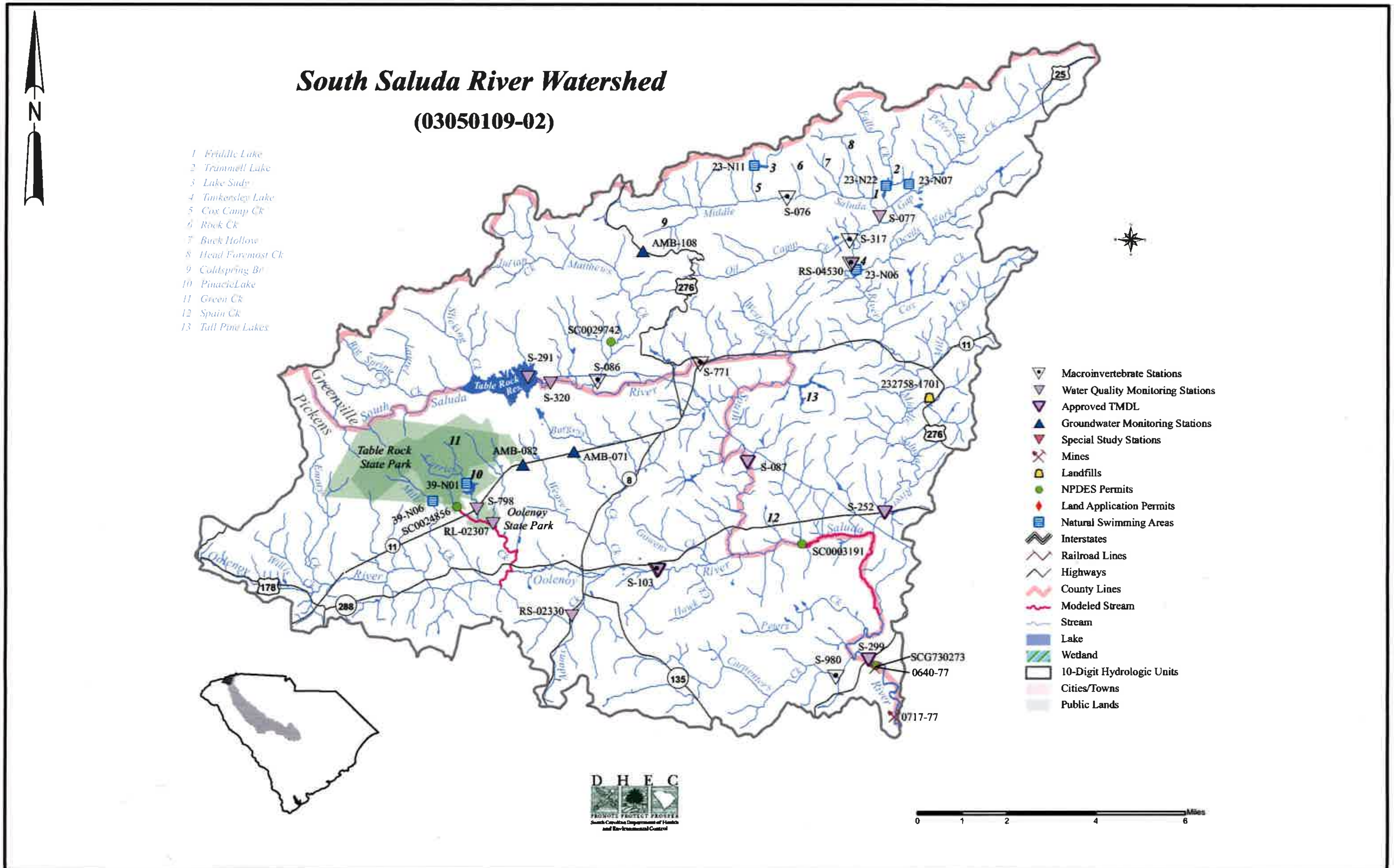
2.4 Saluda River Watershed

The Saluda River Watershed is in portions of Anderson, Pickens, and Greenville Counties and consists of primarily the Saluda River and its tributaries. The watershed includes approximately 148,670 acres of land. Land use in the watershed includes 42.5 percent forests, 24.9 percent farms and agriculture, 28.9 percent urban areas, 1.9 percent forested wetlands, 1.1 percent water, and 1.0 percent barren areas. There are a total of 635.9 stream miles and approximately 1,150 acres of lakes within this watershed. However, the scope of this technical memorandum includes study of only the contributing watersheds for Saluda Lake. As such, the study area includes only the approximate northern thirty percent of this watershed.

The headwaters of the Saluda River are located near the border between Pickens and Greenville Counties and originates at the confluence of the South Saluda and North Saluda Rivers just northeast of Dacusville. The Saluda River generally flows in a southerly direction for approximately 6 miles to Saluda Lake near Farrs Bridge Road. The length of Saluda Lake is approximately 3.5 miles to the spillway of the dam. In 1905, the dam was constructed on the Saluda River creating Saluda Lake for the purpose of creating hydroelectric power. The Saluda River mainstem route flows through forests, agricultural lands, and sparsely populated residential areas. Numerous tributaries converge with the Saluda River mainstem along the area of interest, including Shoal Creek, Doddies Creek, and Armstrong Creek. A map of the Saluda River Watershed is presented as Figure 2-4.

2.5 Historical Basin Planning

The history of basin planning in South Carolina can be traced back to The United States Environmental Protection Agency (EPA) and the Federal Water Pollution Control Act. Known as the "Clean Water Act of 1972" (CWA), this federal law delegated watershed planning requirements to individual states. In South Carolina, SCDHEC initially published basin planning reports for the major drainage basins in the mid 1970s. SCDHEC's Bureau of Water is involved statewide to coordinate basin planning initiatives to enhance water quality management. These basin planning assessments fulfill several EPA requirements of the CWA.



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SOUTH SALUDA RIVER WATERSHED
SALUDA LAKE SEDIMENTATION ANALYSIS
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FIGURE 2-3

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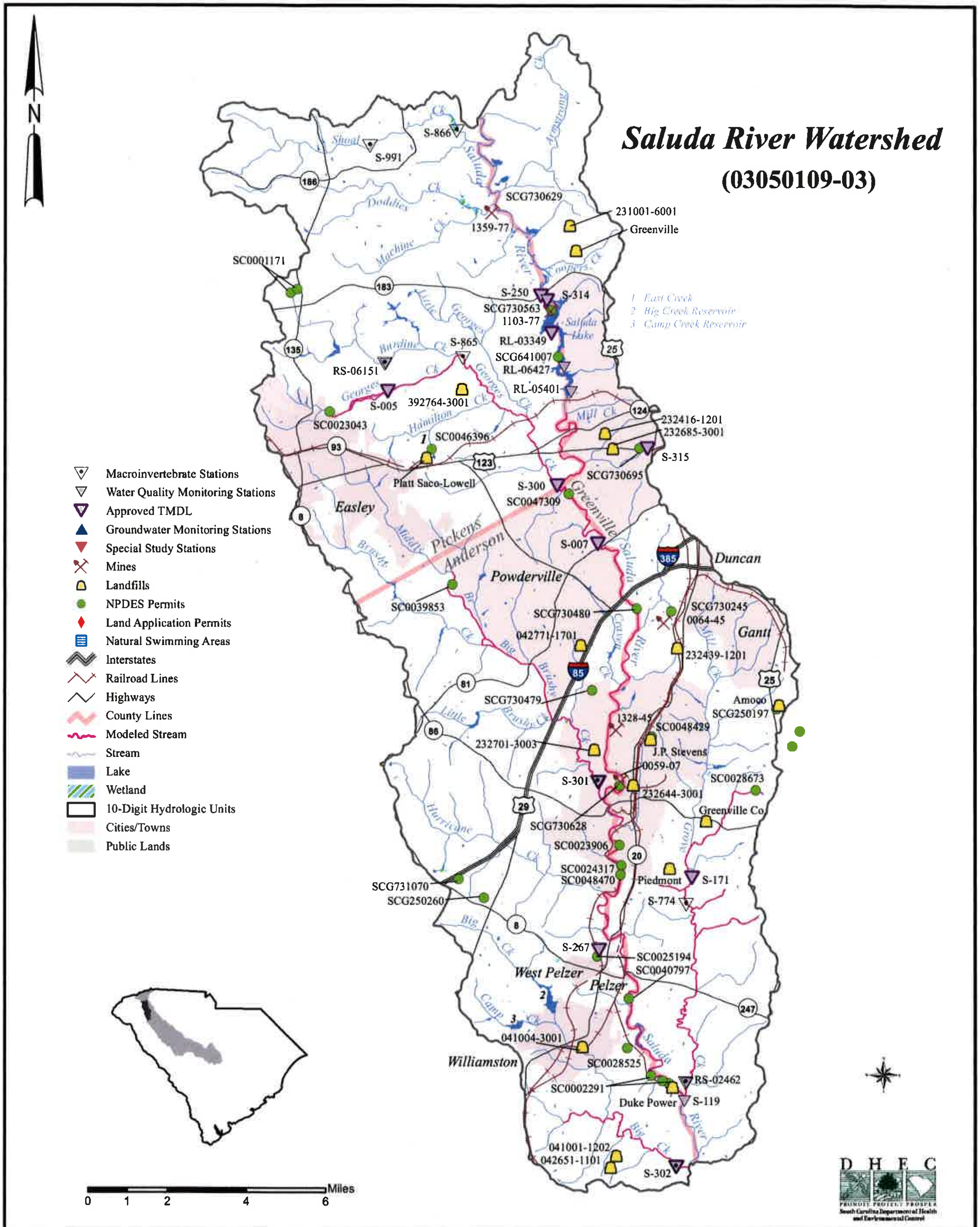

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SALUDA RIVER WATERSHED
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

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FIGURE 2-4

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There are many parameters used by SCDHEC to evaluate watersheds. These parameters are known as water quality indicators and are used to describe the condition of a waterbody. This evaluation is critical for the health and welfare of South Carolina citizens to ensure that water is safe for drinking, recreation, and will support aquatic life; all desirable attributes for Saluda Lake.

Water quality indicators typically include study of the following parameters:

- Turbidity - Turbidity can be defined generally as cloudiness of water and can be caused by growth of aquatic phytoplankton and/or presence of suspended solids. Sedimentation can be a contributing factor to the presence of turbidity.

- Nutrients – Phosphorus and nitrogen are the most common nutrients found in water bodies. These nutrients are oxygen demanding substances and are undesirable due to the aiding in the growth of aquatic plants. Sediment-laden runoff can be a transport mechanism for nutrients.

- E. Coli – E. Coli is an indicator bacteria for other pathogens which may be present in a water body. E. Coli typically impairs water bodies through discharges from failing septic systems, illicit connections and runoff containing animal wastes.

- Dissolved Oxygen – Oxygen is essential for aquatic organisms. If dissolved oxygen falls below minimum requirements for survival, aquatic organisms will be stressed. While oxygen levels in water bodies may fluctuate naturally, excessive nutrient discharge has the potential to cause excessive plant growth thereby reducing dissolved oxygen. Sediment-laden runoff with nutrient loading can be a contributing factor for reduced levels of dissolved oxygen.

- Macroinvertebrate Populations – A balanced and varied group of macroinvertebrate organisms is an indicator of a healthy water body. Macroinvertebrates are useful indicators because these populations typically respond quickly to fluctuations in the aquatic environment. Sediment-laden runoff can be a potential threat due to the presence of excessive nutrients or other toxic pollutants.

- Fish Tissue – Many pollutants may exist in a water body at low enough concentrations that they are not easily measurable. However, through the process of biomagnification, a pollutant increases in concentration as it travels up the food chain. For this reason, the analysis of fish tissue can determine the presence of pollutants that may be present in water bodies at low levels. Sediment-laden runoff can be a transport mechanism for these pollutants.

- pH – pH is the measure of the hydrogen ion concentration of water. Low pH values are found typically in waters rich in dissolved organic matter. High pH can be attributed with high algae presence. Photosynthesis by algae consumes carbon dioxide during the day, which may trigger a rise in pH. At night, algae respire and release carbon dioxide. In active lakes, carbon dioxide may decrease to low levels creating a rise in pH.

  Sediment-laden runoff can be a potential trigger to pH fluctuations due to the presence of excessive nutrients which can influence algal blooms.

- Biochemical Oxygen Demand – Five-day biochemical oxygen demand (BOD_5) is the amount of oxygen required for microbial metabolism of organic compounds in water over a five-day period. Matter containing carbon or nitrogen uses dissolved oxygen from the water as it decomposes, which can result in lower dissolved oxygen in water bodies. The discharge of BOD_5 from a permitted discharger is regulated by the NPDES Permit limits. Sediment laden runoff rich in organics can add additional stress to dissolved oxygen concentrations.

The above water quality indicators are important tools for watershed water quality assessments. Of interest in almost all of the above parameters is the role of sediment transport and its adverse effect on water quality. It is therefore apparent that the potential problems associated with excessive sedimentation in Saluda Lake are two-fold.

- Firstly, excessive sedimentation occupies valuable water storage capacity from Saluda Lake. Saluda Lake is ECU's primary source for drinking water.

- Secondly, sediment is a significant pollutant affecting water supply, water quality, aquatic habitat, and recreational uses. Sediment runoff transports pollutants, nutrients and pesticides that degrade water quality and increase costs for water treatment facilities. Sediment can also create odor and taste problems for drinking water.

Fortunately for the Saluda Lake, water quality parameters remain excellent. It is important to remain vigilant in the protection of this natural resource for future generations.

2.6 Watershed Hydrology and Stream Dynamics

Watersheds are a valuable natural resource. Rivers, streams and lakes are an important part of watersheds because they sustain life. Water is used for drinking supplies, irrigation, production of hydro-electricity, transportation, recreation, and as habitat. Rivers and stream waters also recharge underground aquifers by discharging water downward through their streambeds. While most of the water in watersheds is derived from precipitation runoff, there is contribution from groundwater sources. Weather patterns are directly related to the amount and location of precipitation in the watershed, which in turn influences river and stream flow.

Rivers and streams typically originate at the highest elevation within the watershed and transport water by gravity to lower elevations. Rivers and streams are dynamic systems that are constantly changing due to variation in precipitation flow inputs and through other natural and human caused factors. Natural streamflow variation is influenced by precipitation volume, evaporation, groundwater discharge and recharge, and vegetation water uptake. Human caused streamflow variation is influenced by water use withdrawal and discharge, irrigation use and return, land use changes that alter infiltration, and sometimes flow adjustments for hydroelectric power generation.

Streams drain the land as a key part of the nature's water cycle within the watershed. As streams flow downhill, they carry rocks and sediment particles defining a path called a channel. Streams typically reflect land use changes with changes in channel geometry due to the natural and human induced factors listed above. Channel changes can influence stream velocity which will have an impact on whether particles settle out and are deposited or transported further downstream.

Other stream classifications include the flow pattern, in which streams can be characterized by the movement of individual water molecules. In laminar flow, each fluid molecule moves in a parallel path typically with uniform velocity. Turbulent flow refers to fluid molecules moving in irregular paths typically with random velocity fluctuations. In most cases, especially with high degrees of elevation changes, stream flow will be turbulent. Turbulent flow will keep sediment in suspension longer than laminar flow.

As a stream continues in a downstream direction, the discharge will usually increase because additional water is added from other tributaries. As the discharge increases, the average width and depth will typically increase as well. The stream gradient will usually decrease as elevations transition from steeper slopes to flatter slopes. When the gradient of a stream suddenly changes by discharging into a reservoir, the stream velocity will reduce proportionally resulting in sediment deposition. Initially, coarse objects and sand will settle out first, but suspended clays and finer particles can be transported further and may take longer to settle.

2.7 Saluda Lake Watershed Analysis

The Saluda Lake Watershed contains approximately 201,000 acres and is generally fan-shaped. The headwater elevation in the northwest portion on the watershed along the mainstem of the South Saluda River is approximately 2,900 feet MSL. Correspondingly, the headwater elevation in the northeast portion on the watershed along the mainstem of the North Saluda River is approximately 2,500 feet MSL. Of interest, both of these two headwaters initially flow through water supply reservoirs. Therefore, the actual river run dynamics (and any sediment transport) will occur from the outflow of the reservoirs. The outflow elevations of the Poinsett Reservoir and Table Rock Reservoir are approximately 1,100 feet MSL and 1,150 feet MSL respectively. The Saluda Lake spillway elevation is 849 feet MSL Therefore, the elevation change for the North Saluda River is 251 feet and 301 feet for the South Saluda River. The Middle Saluda River originates near Jones Gap State Park and converges with the South Saluda near the Cleveland community. The Middle Saluda mainstem elevation near Jones Gap State Park is approximately 1,350 MSL. This represents an elevation change of approximately 500 feet above Saluda Lake. The confluence of the South Saluda and Middle Saluda occurs at 940 feet MSL, indicating that the Middle Saluda mainstem elevation change is approximately 410 feet. The mainstem river inventories for the Saluda Lake Watershed are presented in Table 2.1.

TABLE 2.1: SALUDA LAKE WATERSHED MAINSTEM INVENTORIES

River	River Length to Saluda Lake (mi)	Outflow Elevation (MSL)	Saluda Lake Elevation (MSL)	Elevation Change (Feet)
North Saluda	21	1,100	849	251
South Saluda	26	1,150	849	301
Middle Saluda	19	1,350	849	501

Land use causes impact on the dynamics of a watershed with direct correlation to stream flow. Undeveloped and natural areas generate smaller volumes of runoff because precipitation has a better chance to infiltrate. Highly developed or bare areas produce higher volumes of stormflow because the precipitation cannot infiltrate impervious surfaces. Higher stormwater runoff volumes can accelerate erosion, particularly for construction sites. It should be noted that agriculture or forest harvesting operations can be susceptible to erosion if proper land management practices are not followed. The land use inventories for the Saluda Lake Watershed are presented in Table 2.2. Of special consideration, the Saluda River Watershed land use data reflects only the drainage area contributing to Saluda Lake.

TABLE 2.2: SALUDA LAKE WATERSHED LAND USE INVENTORIES

Category	North Saluda River (ac)	South Saluda River (ac)	Saluda River (ac)	Total (ac)
Forests	37,655	91,954	23,650	153,260
Agriculture	4,937	9,426	14,706	29,068
Urban	4,501	6,466	2,881	13,849
Water	1,016	658	473	2,147
Wetland	145	658	860	1,663
Barren	145	438	430	1,014
Total	48,400	109,600	43,000	201,000

It is interesting to note that approximately 76 percent of the Saluda Lake Watershed area is forested land. Second in rank is agricultural lands at approximately 14 percent.

SECTION III - SALUDA LAKE HISTORY

3.1 General

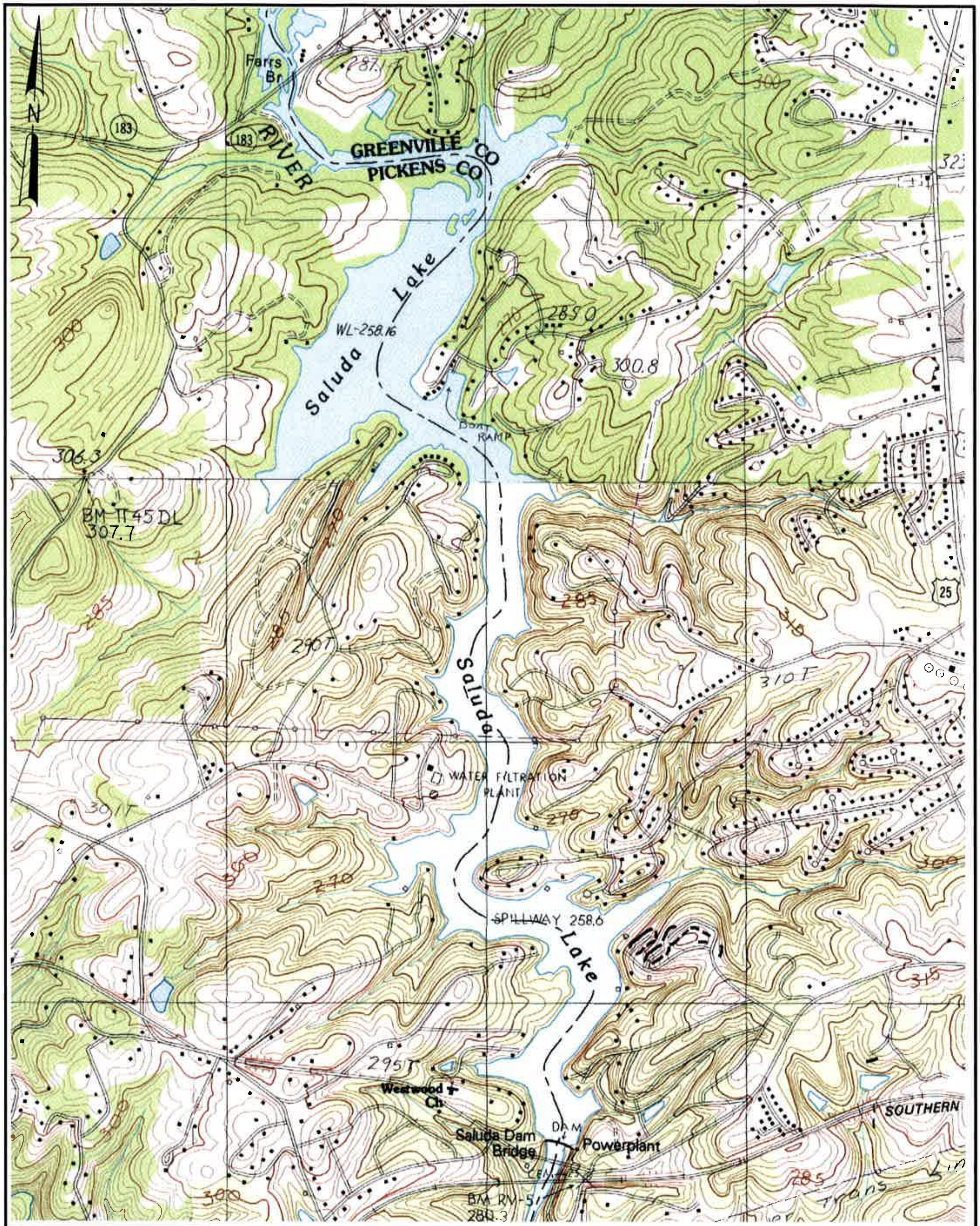
Saluda Lake is a 331-acre lake that was constructed in 1905 for hydroelectric power generation. The lake is located in the upstate of South Carolina on the Saluda River separating Pickens County and Greenville County. A topographic map of Saluda Lake is presented as Figure 3-1. The dam and water surface area were purchased by Duke Power Company in 1934 and later sold to North Brook Energy, LLC in 1996. North Brook Energy continues to operate the hydroelectric facility which contains four generators. Easley Combined Utilities relies on the lake as its primary water supply and has an agreement with North Brook Energy to withdraw water from the lake.

More than 150 homeowners and the public use the lake for recreational purposes. Lake users have been impacted by the volume of sediment that is entering the lake. Studies have indicated the sedimentation is transported by run-off that originates from agricultural fields, construction sites, and other urban areas. Approximately 20 years ago, most of the upper portion of the lake had been rendered unnavigable because the sediment buildup had formed a large island and made much of the upper area too shallow for boats.

3.2 Watershed History

Much of the upper watershed is predominantly rural. Historic land use within the watershed reveal extensive row cropping. The current acreage for the watershed indicates over 29,000 acres are used for agricultural purposes; approximately 14.5 percent of land area. There are indications that larger areas were used for agriculture in the past, but after the decline in cotton farming in the 1940s and 1950s, many areas were converted to forest cover.

In 1935, Congress passed the Soil Conservation Act, creating the Soil Conservation Service (SCS). The SCS was founded to provide technical assistance for farmers to help reduce water and wind erosion for the nation's soils. Major conservation practices developed by the SCS include contour cultivation, use of vegetative strips, planting cover crops during dormant seasons to improve soil and reduce erosion, and many other methods. Many of the conservation initiatives began as demonstration projects through work by the Civilian Conservation Corps. Prior to this agency being created and the benefits achieved, history indicates erosion and sedimentation was a widespread problem in many areas of the nation including the Saluda River Watershed.



SCALE: 1" = 500'

PORTIONS OF USGS DACUSVILLE, EASLEY, GREENVILLE AND PARIS MOUNTAIN QUADS

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TOPOGRAPHIC MAP
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

FIGURE 3-1

OCTOBER 2018

Infrastructure expansion also would play a large part in changing land use during the last century, specifically in the major highway systems discussed below:

> US Highway 25 – Originally planned in 1927, this major highway route originated in Augusta, Georgia, traveled through Greenville on to Travelers Rest. From Travelers Rest the highway continued northeast, towards Tuxedo, North Carolina. The Poinsett Reservoir was constructed adjacent to the US Highway 25 corridor in 1956. In 1964, additional lanes were added continuing through the Travelers Rest area to approximately where present-day SC Highway 11 crosses. Later, in 1973 work continued with a major 4-lane re-route through the upper part of the watershed towards Hendersonville, North Carolina, bypassing Tuxedo. This upper work was the culmination of many years of significant rock-blasting, heavy excavation, and difficult grading work through rugged mountain terrain.
>
> US Highway 276 – Originally planned in 1932 as an auxiliary route of US 76, this major highway route originated in Laurens, South Carolina, traveled through Greenville on to Travelers Rest. In Travelers Rest, US 276 overlaps with US 25. From Travelers Rest, the highway turned and continued northwest, to Brevard, North Carolina. In the late 1950s and early 1960s, additional lanes were added continuing through the Travelers Rest area. Later US 276 was expanded to a 4-lane highway continuing through Marietta, South Carolina. From Marietta, the highway continues out of the watershed on to North Carolina as a 2-lane highway.
>
> SC Highway 11 – This highway route was originally was part of the Cherokee Native-American Path that traveled east-west at the foothills of the Blue Ridge Mountains. The route originates near Fair Play, South Carolina and continues through northern Greenville County on to Gaffney, South Carolina. Originally just a system of small two-lane State Roads, the roadway was rerouted in the early 1970s and renamed the Cherokee Foothills Scenic Highway. Additional turning lanes have been added in congested areas in recent history but the majority of the route through the Saluda River Watershed remains a 2-lane highway. In the Cleveland Community, SC Highway 11 overlaps US 276.

Highway infrastructure construction can have a large impact on a watershed. Early road systems were typically constructed over early trade and commerce routes or "farm to market" travel paths. As indicated by the historical account above, many of the modern road construction have been occurring through the watershed for approximately 100 years, primarily due to increased popularity of the automobile.

The significance of these two activities on Saluda Lake is that the lake was constructed in 1905. Poor soil management practices in the past during construction or agriculture activities have generated soil erosion and sediment transport. The destination for uncontrolled sedimentation in the watershed historically has been Saluda Lake.

3.3 Previous Lake Studies

In 1994, the Saluda Lake Homeowners Association (SLHA) requested the Soil Conservation Service (SCS), through the Pickens and Greenville Soil and Water Conservation Districts, provide an updated inventory and evaluation of Saluda Lake and the contributing watershed in Pickens and Greenville Counties in South Carolina. The purpose of the study was to determine the current condition of the contributing watershed, the status and condition of Saluda Lake, and to provide the Association with feasible alternatives to improve the quality of the lake for recreation and municipal water supply for Easley Combined Utilities.

The 1994 Report revealed soil loss estimates of 134,000 tons per year. This study made comparisons to a previous report conducted in 1979 which revealed soil loss estimates of 441,000 tons per year. These sedimentation rates would significantly affect the water storage volume in the lake. By direct comparison there was significant reduction between the two studies. However, these data sources should be evaluated independently as the contributing factors for each data set are different. For example, the 1979 data could reflect soil losses that occurred through erosion of topsoil or other easily erodible soil material. Data from the 1994 report should be evaluated independently as soil conditions could be less susceptible to erosion because much of the topsoil had previously been eroded and transported. Additional factors that should be considered when comparing the data would be rainfall amount and intensity, changes in ground cover and changes in land use. The common denominator revealed from both studies is that high volume sedimentation has been a problem.

In 2007, ECU requested Design South prepare an updated evaluation of the extent of sediment that has deposited in the upper reaches of Saluda Lake. This evaluation culminated in a preliminary engineering report (PER). Specifically, the PER identified the type of sediment that was being deposited, developed an approximation of the sediment volume and present design criteria and appropriate methods to remove the sediment. The PER postulated that if 40 percent of the 1994 erosion rate had been deposited into the lake, the estimated amount of sediment would be approximately 50,000 tons per year. At 100 pounds per cubic foot or 1.35 tons per cubic yard, this would equate to approximately 37,000 cubic yards of material per year. Over a thirteen-year period (1994 to 2007), an additional 481,000 cubic yards of sediment may have entered Saluda Lake using the SCS 1994 report estimations.

3.4 Previous Geotechnical Explorations

QORE Property Sciences was engaged by ECU to perform a geotechnical exploration of the upper 100-acre portion of Saluda Lake in November 2005. Ten soil boring locations were selected by QORE in the designated area. These locations were staked and surveyed and are depicted in

Figure 3-2. The soil borings were performed with a drill rig mounted on a barge. Boring locations B-6 and B-8 were not used because the drill rig could not access them due to shallow water.

The drilling, sampling, and testing procedures were performed in general accordance with ASTM standards and established engineering practice. Soil test boring was terminated at depths of 21 to 24 feet below the lake level and records of these borings were included in the geotechnical report. The QORE Soil Test Boring Records are included as Appendix A.

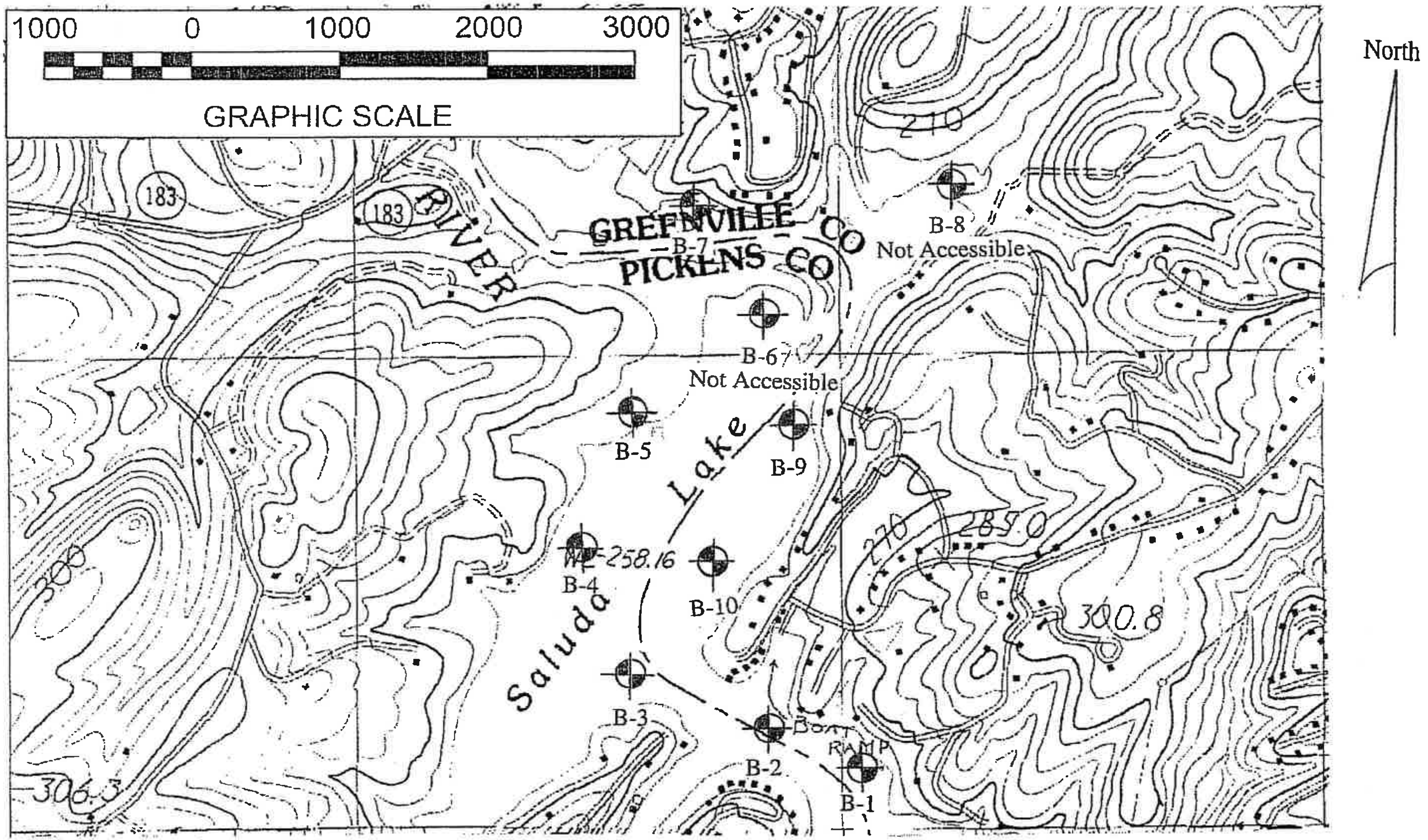
The boring records and visual soil classifications indicated that most of the soils encountered in the explored areas of the lake consisted of very soft silts with varying concentrations of organics, clays, and sands. We offer the following specific commentary on specific boring sites below; these boring sites are listed from higher reaches of Saluda Lake to areas further into the lake.

> Site B-7 – This location is the northern-most sample site in Saluda Lake. The sample includes dark brown alluvium with coarse sand, silt, leaves, and wood fragments.
>
> Site B-10 – This location is the approximate middle of the area of interest for Saluda Lake. The sample includes dark sandy silt with organics.
>
> Site B-3 – This location is the approximate junction between the larger northern area and the smaller southern area of interest for Saluda Lake. The sample includes dark brown silt.
>
> Site B-1 – This location is the southern-most sample site in Saluda Lake. The sample includes soft dark grayish brown silt with sand.

The boring samples revealed that the lake bottom consisted of very soft sediments and in some cases sands. Of note, the boring records indicate more sands were encountered in the upper reaches of the lake with finer material further downstream. Finer sediments are typically alluvial soils transported and deposited by water. These findings are consistent with the stream dynamics discussion from Section 2.6; coarse material will be deposited initially with fine material falling out of suspension later when stream velocities are abruptly slowed when discharging into a reservoir.

3.5 Previous Dredging Operations

An initial dredging operation began on Saluda Lake in 2002 performed by Cooper Sand and Gravel. This dredging operation was based upon capturing primarily sand dredged from the lake for sale. The dredging was performed at no cost to Saluda Lake Homeowner's Association (SLHA) as long as the dredged material was marketable. Alternatively, the SLHA could pay for other areas to be dredged at their expense if no marketable material was found. These areas included areas around boat docks and boat ramps.



⊕ : Approximate Boring Location

Ref.: "USGS Topographic Map"

SCALE: NTS

IMAGE FROM QORE, INC.

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BORING LOCATION PLAN
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

FIGURE 3-2

OCTOBER 2018

The primary area that was dredged for marketable sand was the area between Farr's Bridge and the first bend in the lake. This area is where the Saluda River enters and is where most of the sedimentation is occurring. By 2006, most of the marketable material had been dredged from this area of the lake and the contractor terminated the dredging operation.

The 2007 PER provided recommendations for a subsequent dredging project. Specifically, approximately 320,000 cubic yards of sediment was recommended for removal. The scope of the project was not only dredging work, but included hauling, dewatering, and disposal of the dredged material. The project was competitively bid and awarded for construction in 2011. Work was initiated in 2011 and completed in 2012.

3.6 Previous Bathymetric Surveys

A survey of Saluda Lake was conducted in 2005 by Dunn and Associates, Inc. that included an area from Farr's Bridge to approximately 140 feet south of the eastern shore public boat ramp. This survey was conducted using a single beam acoustic sounder transmitting sound waves from the bottom of a boat to measure the depth of the lake directly underneath. By navigating the boat in sequential rows across the upper portion of the lake, a very accurate profile of the lake bottom was able to be obtained to create a 1-foot contour map. This contour information helped formulate recommendations for dredging volume for the 2011-2012 project.

3.7 Previous Aerial Photography

Historical aerial photos of this area from 1972, 1986, 1997, and 2003 were obtained from Greenville County and are included as Appendix B-1. From these historical photos it is apparent that in the upper part of the lake an island developed beginning probably in the mid 1960s. In the 1986 photo, the island is beginning to become visible above the water surface and later in 1997 a very large island is visible. In the time between the 1997 photo and the 2003 photo, the island continues to expand above the water surface and some significant tree and understory plant growth is visible.

Aerial photos of the lake were also taken in 2006. Selected pictures are included as Appendix B- 2 to B-5. These photos were very instrumental in assessing the extent of the sediment buildup in the upper portion of the lake. These photos were taken when the water level was approximately five feet below normal full pool elevation, which clearly depicted the areas of sediment buildup. As discussed in Section 3.5, much of this sediment accumulation was removed during the dredging project completed in 2012. What is alarming however is the image presented as Appendix B-6 obtained from Google earth. This 2018 image depicts the reforming of the large island in the upper portion of the lake.

SECTION IV - ADDITIONAL SURVEYING AND MAPPING WORK

4.1 Recent Bathymetric Survey

In July and August 2018, ESP Associates, Inc. was commissioned to perform a current bathymetric survey on the upper portion of Saluda Lake. The survey was conducted in two larger areas in the northern part of the lake. The proposed bathymetric survey areas include approximately 48.15 acres of Saluda Lake and are presented as Figure 4-1. The work was performed by sending single frequency acoustic soundings from a small jon boat across the bottom floor of the lake. This procedure collects the underwater topography. Extremely shallow areas of the lake were collected using Global Navigation Satellite System survey techniques.

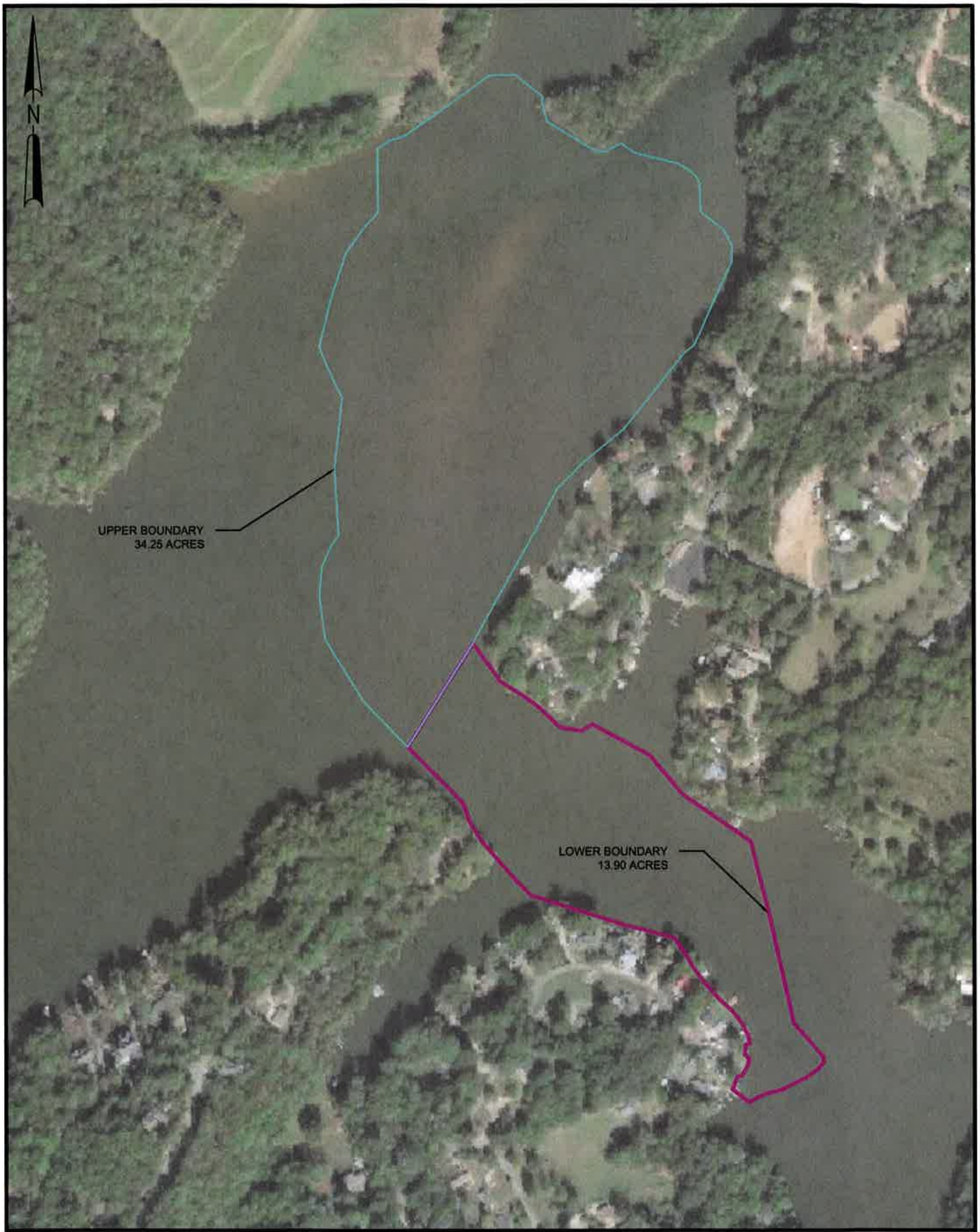
The purpose of the survey was to estimate how much additional sediment has accumulated within Saluda Lake since the completion of the major dredging project. The dredging project work that was completed in 2012 included preparation of a record survey. The direct comparison of these two surveys should provide a reasonable prediction of sediment accumulation that has occurred over the six-year period.

4.2 Mapping Applications

Initially, the 2012 Record Survey was reviewed. The 2012 survey elevations were imported, and a base map was created using CAD software. The 2012 data was isolated, and a topographic surface was created for this data alone. Next, the new survey data was added to the base file. The 2018 data was also isolated, and a topographic surface created for this data. This procedure was followed to ensure that there was no co-mingling of data points and the two surfaces could be compared.

The next task was to create topographic map for each of the surveys. Topographic relief maps were prepared and are presented as Figure 4-2 for the 2012 survey and Figure 4-3 for the 2018 survey. A relief map is a type of topographic map that doesn't use contour lines. Instead, elevation data is colored to show changes in elevation. Shallower water depth values are depicted as lighter colors and deeper water depth elevations values are shown with darker colors. Elevations are also grouped as bands of approximately six feet. The goal is for the color contrast to create a shadow effect providing easily discernable water depth information.

Next, a contour elevation overview map of the 2018 survey was created. The two record survey surfaces were used to create cross-section views. The cross-section view provides an instant comparison of the two surveys as both elevations are present in the same viewport. Using the surfaces created from the 2012 survey and the 2018 survey, the volume of sediment deposited since the completion of the dredging was calculated. The overview map and the cross-section lake elevations are presented in Appendix C.



SCALE: 1" = 400'

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BATHYMETRIC SURVEY AREAS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

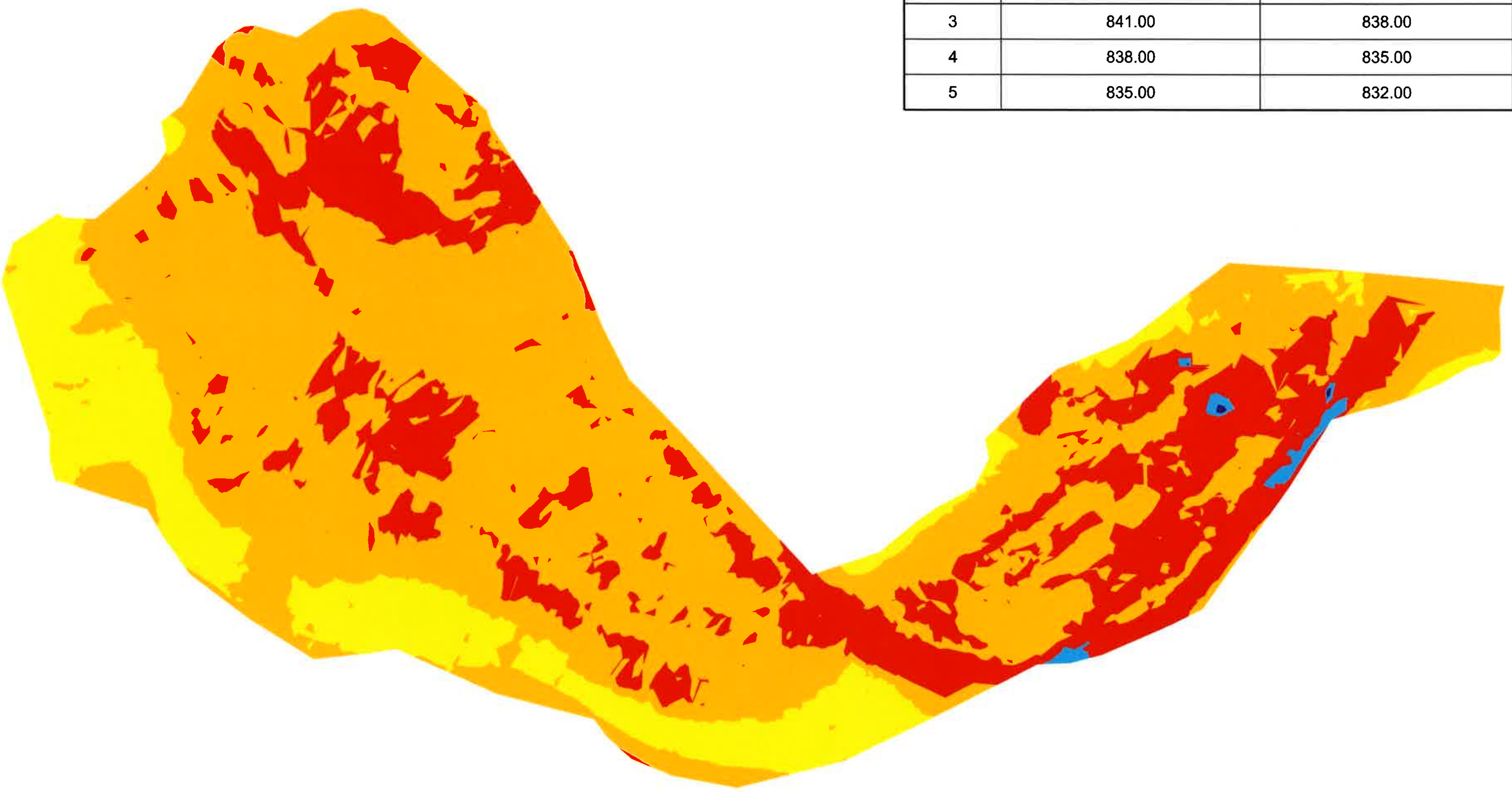
PROJ. NO. 1824

FIGURE 4-1

OCTOBER 2018

ELEVATIONS TABLE

NUMBER	MAXIMUM ELEVATION (MSL)	MINIMUM ELEVATION (MSL)	AREA (AC)	COLOR
1	849.00	844.00	6.83	🟨
2	844.00	841.00	28.75	🟧
3	841.00	838.00	11.05	🟥
4	838.00	835.00	0.21	🟦
5	835.00	832.00	0.01	🟪



SCALE: 1" = 250'

DESIGN SOUTH
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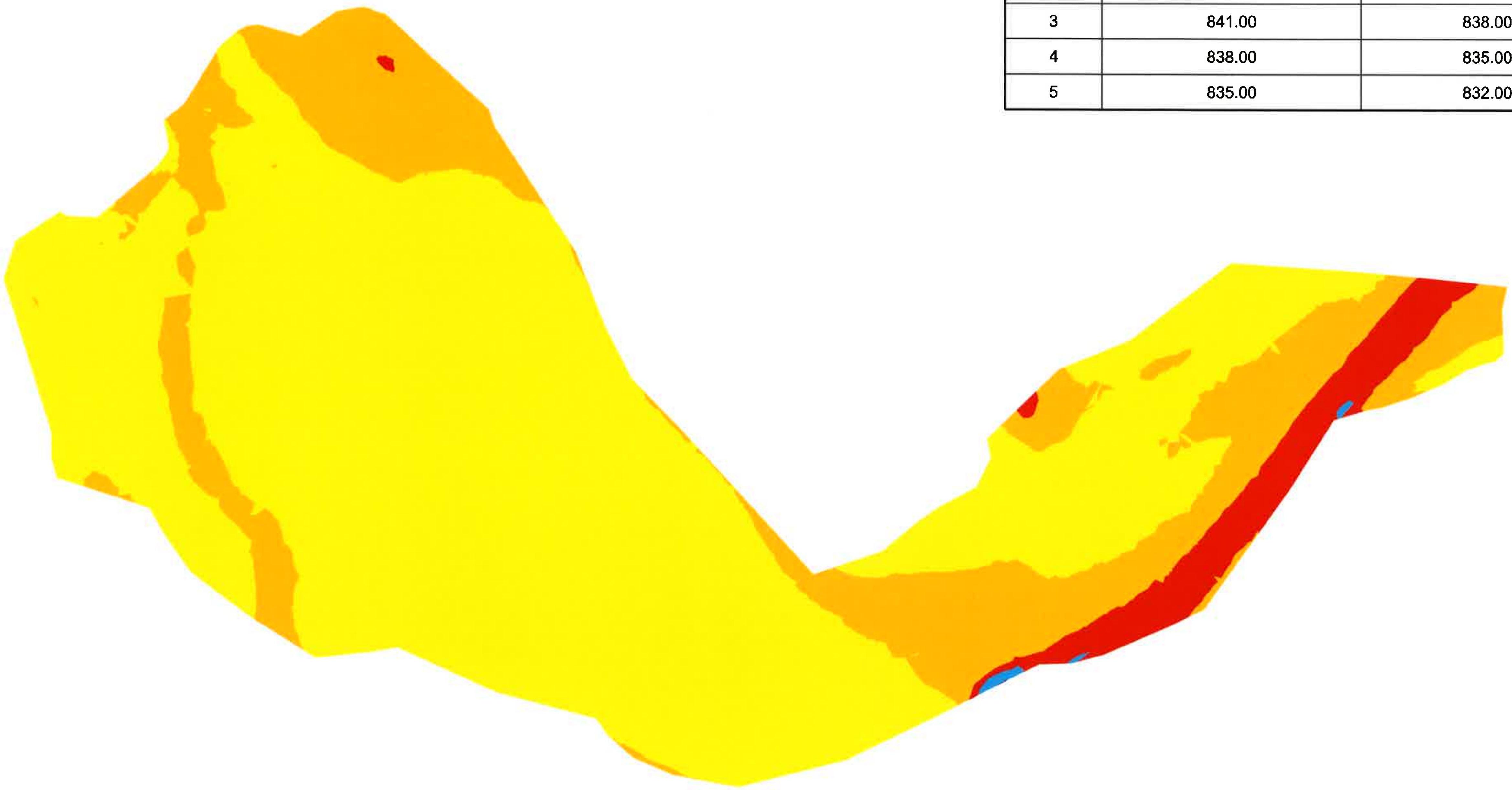
engineers architects planners

DREDGING RECORD TOPOGRAPHY 2012
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

FIGURE 4-2

OCTOBER 2018



ELEVATIONS TABLE				
NUMBER	MAXIMUM ELEVATION (MSL)	MINIMUM ELEVATION (MSL)	AREA (AC)	COLOR
1	849.00	844.00	34.53	🟨
2	844.00	841.00	10.15	🟧
3	841.00	838.00	2.12	🟥
4	838.00	835.00	0.06	🟦
5	835.00	832.00	0.00	🟪

SCALE: 1" = 250'

DESIGN SOUTH
PROFESSIONALS, INC.
engineers architects planners

CURRENT TOPOGRAPHY 2018
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

FIGURE 4-3

OCTOBER 2018

4.3 Survey Results

The calculated newly deposited sediment volume for Saluda Lake during the six-year period from 2012 to 2018 is presented in Table 4.1. Based on comparison of the record survey from 2012 and the current 2018 survey, the total amount of sediment that has been transported and deposited into the upper reaches of Saluda Lake is approximately 243,868 cubic yards. This volume correlates to an average sedimentation rate of 40,645 cubic yards per year which is comparable to the 37,000 cubic yards per year referenced in Section 3.3 of this memorandum using the estimation methodology from the Dredging Project PER.

TABLE 4.1: SALUDA LAKE CALCULATED SEDIMENTATION VOLUME

Map Station Interval	Volume (cu. yd.)
1+00 to 2+00	1,334.68
2+00 to 3+00	2,477.49
3+00 to 4+00	3,157.54
4+00 to 5+00	4,134.05
5+00 to 6+00	4,258.67
6+00 to 7+00	4,969.64
7+00 to 8+00	4,421.46
8+00 to 9+00	3,949.61
9+00 to 10+00	3,321.60
10+00 to 11+00	2,633.37
11+00 to 12+00	2,666.71
12+00 to 13+00	3,776.89
13+00 to 14+00	4,665.74
14+00 to 15+00	5,042.61
15+00 to 16+00	5,515.32
16+00 to 17+00	7,470.09
17+00 to 18+00	8,456.96
18+00 to 19+00	9,585.49
19+00 to 20+00	11,566.04
20+00 to 21+00	12,690.07
21+00 to 22+00	13,286.87
22+00 to 23+00	14,167.31
23+00 to 24+00	16,095.52
24+00 to 25+00	16,547.02
25+00 to 26+00	16,485.86
26+00 to 27+00	15,711.81
27+00 to 28+00	13,938.49
28+00 to 29+00	11,802.16
29+00 to 30+00	9,126.83
30+00 to 31+00	7,899.86
31+00 to 31+50	2,712.42
TOTAL	243,868.17

4.4 Rainfall Analysis

Precipitation has a direct relationship to the amount of runoff that may occur within a watershed. The volume of runoff can be dependent on many factors including soil type, soil moisture conditions, and intensity and duration of the precipitation. The average rainfall in the Saluda Lake Watershed is over 50 inches per year. Rainfall data from the Cleveland Community for the past 20 years was tabulated and is included in Appendix D. This area was selected because of its proximity to the convergence of the North and South Saluda Rivers. The 20-year record precipitation was reviewed to identify larger than average rainfall years and significant rainfall intensity periods. Of interest, the average rainfall for the past five years is over 60 inches per year with almost 85 inches recorded for 2013.

Rainfall events higher than 2 inches in a 24-hour period are highlighted in the data. The largest rainfall event occurring during the 20-year period was 6.92 inches recorded on August 12, 2007. These extreme events can be significant because the prolonged intensity of the rainfall can cause significant erosion after the ground becomes saturated. The higher events occurred on average about two times a year. This frequency is not considered excessive.

4.5 Runoff Estimations and Impact

The SCS developed a method for determining the approximate amount of runoff from a particular area. This method was designed for use for a single storm event and is based on the area's soil type, land use, treatment, and hydrologic condition. For the purpose of this study, we chose to approximate the amount of runoff that would be generated from agricultural lands.

The first step in our analysis was to determine the predominant soil type. In the Saluda Lake Watershed, the predominant soil is a Type B, which has a moderate infiltration rate when thoroughly wetted. Next, we developed a composite Curve Number which is based on the land use. We developed a Curve Number which averaged the different types of agriculture found in the watershed. Our composite Curve Number was 75.2. We then performed calculations for several rainfall events to determine an order of magnitude runoff prediction for agricultural lands in the watershed. The rainfall events selected were 2.0-inches, the two-year storm event of 4.2-inches, and the 6.92-inches maximum event recorded during the 20-year period. Results are presented in Table 4.2 below.

TABLE 4.2: SALUDA LAKE WATERSHED - AGRICULTURAL LAND RUNOFF POTENTIAL

Storm Event (in.)	Estimated Runoff (in.)	Runoff Volume per 1 acre (Gal.)
2.0	0.4	10,860
4.2	1.8	48,900
6.9	4.1	111,330

The runoff calculations indicate there is a large volume of runoff generated by intense rain storms. While it is difficult to predict the exact amount of sediment that is eroded and transported per gallon of water, runoff volume coupled with extended rainfall durations can potentially transport more sediment if erodible soils are present. The most common types of soils present within the Saluda Lake Watershed are sandy and clay loams which are both erodible soils.

SECTION V - PROJECTIONS

5.1 Sediment Projections

In summary, the recent bathymetric survey reveals that approximately 243,868 cubic yards of sediment has been redeposited in Saluda Lake during the last six years; an average of 40,645 cubic yards per year. During dredging operations, detailed tracking information was kept regarding the quantity of dredged sediments removed. The final volume was tabulated as 366,600 cubic yards. Therefore, approximately 66.5 percent of the sediment volume removed from the dredging project in 2012 has been redeposited in the past six years. If the sedimentation average of 40,645 cubic yards per year continues, the sedimentation rate will be similar to the 2011 conditions in approximately three years (2022).

Impact to ECU will be primarily in the form of lost water storage volume in the reservoir. The water intake for ECU's water treatment plant is a little over a mile away from the highest sedimentation loading area. The recent bathymetric survey revealed that the shallowest part of Saluda Lake is in the upper portion of the lake where the island is developing. Further comparison of the two recent bathymetric survey areas (Figures 4-2 and 4-3) indicate that the sediment deposition has raised areas south of the large island by several feet.

5.2 Cost Implications

The final accounting for the 2012 dredging project indicates that 366,600 cubic yards of sediment was removed at a cost of $6,751,730; a cost of approximately $18.41 per cubic yard. Using the approximate $18.50 unit cost per yard from 2012, and projecting to 2022 dollars at assumed 5 percent interest, the unit cost may be on the order of $27.00 per yard ($9.9M).

5.3 Partnerships

The Saluda Lake Watershed has a large percentage of protected areas that will not be used for future development. Many of these areas include State Parks, forests, protected reservoirs, conservation easements, and other areas. Groups such as Upstate Forever, Naturaland Trust, The Nature Conservancy, and South Carolina Department of Natural Resources as well as private corporations and citizens have set aside tens of thousands of acres as protected lands. Many of these protected areas originate as one parcel, but the combined environmental protection will reap countless benefits for watershed natural resource protection for generations to come.

5.4 Recommendations

A holistic planning program should be developed to identify, rank, and deploy appropriate sediment reduction schemes within the Saluda Lake Watershed. Due to the rate of sedimentation in Saluda Lake, it is recommended that BMPs are carefully evaluated for much of the agricultural lands within the watershed as possible. Future dredging operations should be studied and phased. ECU may also evaluate moving the location of their raw water intake structure further downstream if sediment levels continue. Lastly environmental stewardship should be included in the plan for water resource protection.

BRW/psh

Attachments

REFERENCES

1. USDA, Soil Conservation Service, Columbia, South Carolina (1994) Inventory and Evaluation Report for Saluda Lake and Contributing Watershed, August 1994.

2. QORE™, Inc. (2005) Draft Report of Geotechnical Exploration for Saluda Lake Dredging Project, for Easley Combined Utilities.

APPENDIX A

QORE Geotechnical Report
Soil Test Boring Records

SOIL TEST BORING RECORD

QORE™ PROPERTY SCIENCES

BORING NO: **B-1**

PROJECT: Saluda Lake Dredging Project	JOB NO: 7316	REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina		
ELEVATION: 849 Feet (Full Pool)	BORING STARTED: 11/2/2005	BORING COMPLETED: 11/2/2005
DRILLING METHOD: Mud Rotary	RIG TYPE: Barge	HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered	BORING DIAMETER (IN): 6	SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	STANDARD PENETRATION RESISTANCE (N) 1 10 20 30 40 50 70 100	BLOWS / 6"
	849	0	Top of Water				
		5					
	840	10	**Alluvium** - Very Soft Dark Grayish Brown Silt with Sand (ML)				
							WOH
		15					WOH
							WOH
		20					WOH
							WOH
							WOH
	826		Boring Terminated				
		25					
		30					

BORING_RECORD 7316.GPJ QOR_CORP.GDT 12/13/05

SOIL TEST BORING RECORD

QORE™
PROPERTY SCIENCES

BORING NO: **B-2**

PROJECT: Saluda Lake Dredging Project	JOB NO: 7316	REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina		
ELEVATION: 849 Feet (Full Pool)	BORING STARTED: 11/2/2005	BORING COMPLETED: 11/2/2005
DRILLING METHOD: Mud Rotary	RIG TYPE: Barge	HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered	BORING DIAMETER (IN): 6	SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	STANDARD PENETRATION RESISTANCE (N) 1 10 20 30 40 50 70 100	BLOWS / 6"
	849	0	Top of Water				
	848		**Alluvium** - Very Soft Dark Brown and Dark Grayish Brown Sandy Silt with Some Organics (Leaves) (ML)				WOR WOH WOH WOH WOH WOH WOH
		5					
		10					
		15					
		20					
	828		Boring Terminated				
		25					
		30					

SOIL TEST BORING RECORD

QORE™ PROPERTY SCIENCES

BORING NO: **B-3**

PROJECT: Saluda Lake Dredging Project	JOB NO: 7316	REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina		
ELEVATION: 849 Feet (Full Pool)	BORING STARTED: 11/2/2005	BORING COMPLETED: 11/2/2005
DRILLING METHOD: Mud Rotary	RIG TYPE: Barge	HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered	BORING DIAMETER (IN): 6	SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	STANDARD PENETRATION RESISTANCE (N) 1 10 20 30 40 50 70 100	BLOWS / 6"
	849	0	Top of Water				
		5					
	842		**Alluvium - Very Soft Dark Brown Silt with Sand (ML)**				WOR
		10					
							WOR
	837		**Alluvium - Very Soft Dark Brown Silt (ML)**				WOR
		15					
							WOH
		20					WOH
							WOH
	827		Boring Terminated				
		25					
		30					

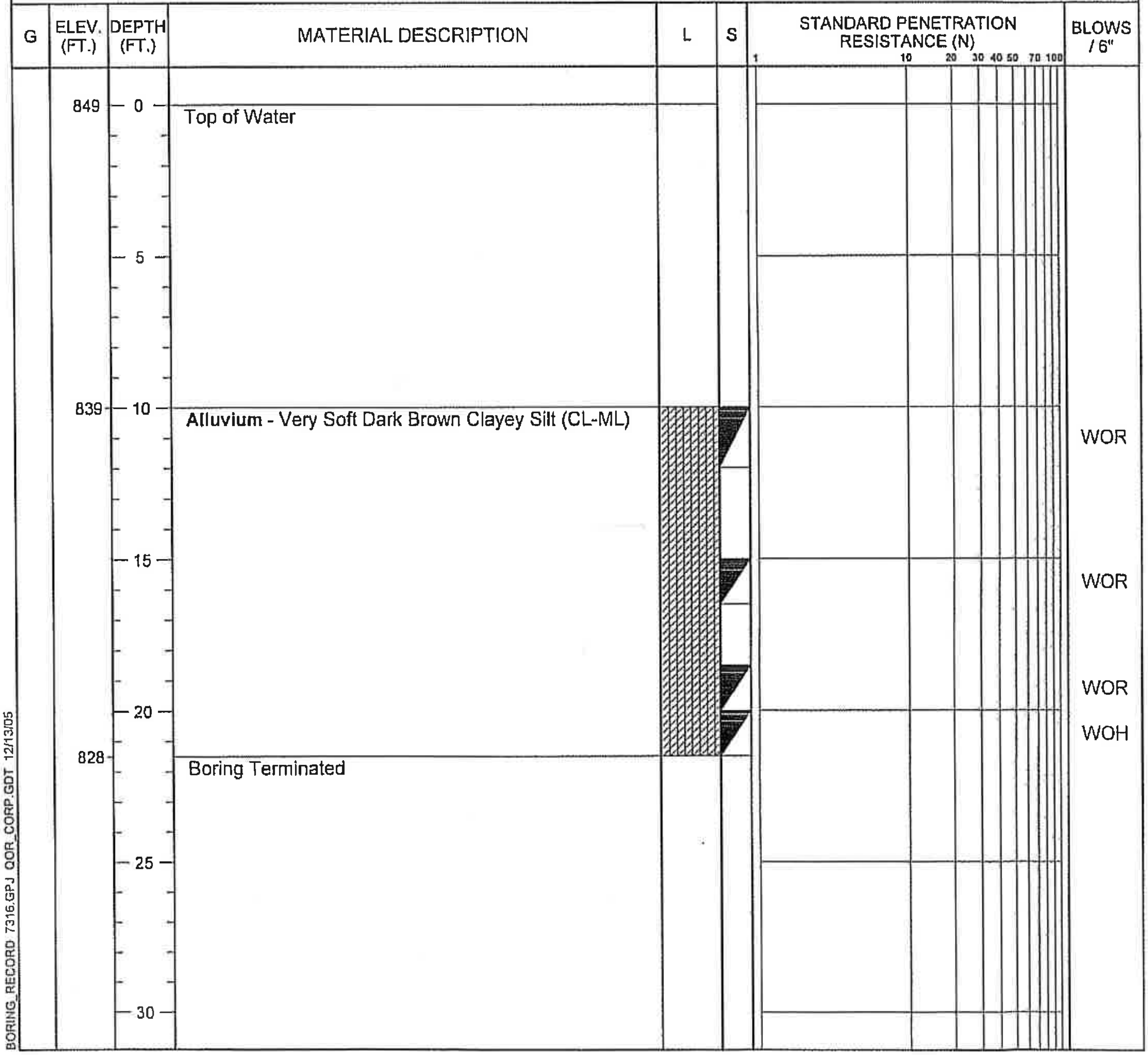
SOIL TEST BORING RECORD

QORE™ PROPERTY SCIENCES

BORING NO: **B-4**

PROJECT: Saluda Lake Dredging Project	JOB NO: 7316	REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina		
ELEVATION: 849 Feet (Full Pool)	BORING STARTED: 11/2/2005	BORING COMPLETED: 11/2/2005
DRILLING METHOD: Mud Rotary	RIG TYPE: Barge	HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered	BORING DIAMETER (IN): 6	SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer



G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	BLOWS / 6"
	849	0	Top of Water	
	839	10	**Alluvium** - Very Soft Dark Brown Clayey Silt (CL-ML)	WOR WOR WOR WOH
	828		Boring Terminated	

SOIL TEST BORING RECORD

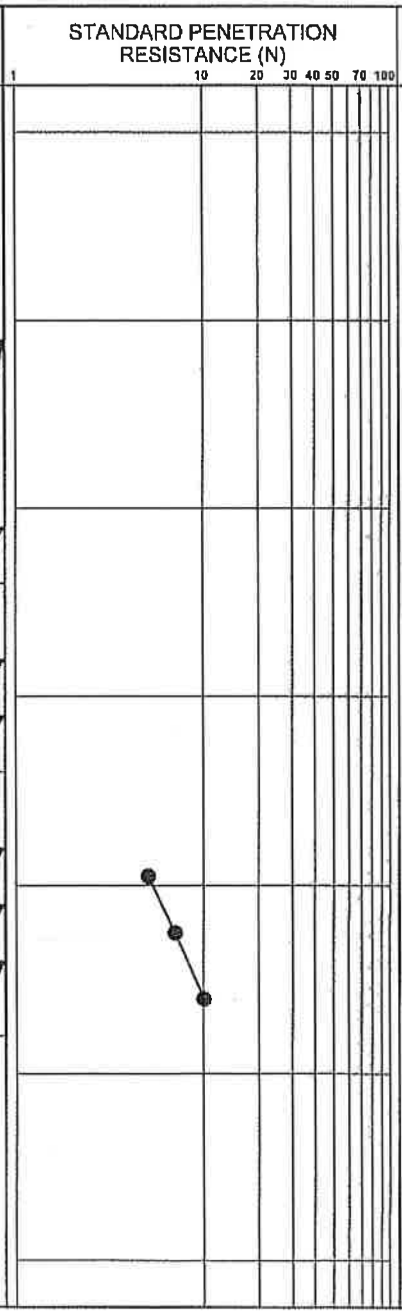
QORE™ PROPERTY SCIENCES

BORING NO: **B-5**

PROJECT: Saluda Lake Dredging Project
JOB NO: 7316
REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina
ELEVATION: 849 Feet (Full Pool)
BORING STARTED: 11/3/2005
BORING COMPLETED: 11/3/2005
DRILLING METHOD: Mud Rotary
RIG TYPE: Barge
HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered
BORING DIAMETER (IN): 6
SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	BLOWS / 6"
	849	0	Top of Water			
		5				
	844		**Alluvium** - Very Soft Dark Brown Clayey Silt (CL-ML)			
						WOR
		10				
						WOR
		15				WOH
						WOH
	830		**Alluvium** - Loose Gray and Yellowish Brown Slightly Micaceous Silty Fine to Medium Sand (SM)			0-2-3
		20				
	828		**Alluvium** - Firm to Stiff Reddish Brown Silt with Sand (ML)			2-3-4
						4-4-6
	825		Boring Terminated			
		25				
		30				



SOIL TEST BORING RECORD

QORE™
PROPERTY SCIENCES

BORING NO: **B-7**

PROJECT: Saluda Lake Dredging Project
JOB NO: 7316
REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina
ELEVATION: 849 Feet (Full Pool)
BORING STARTED: 11/3/2005
BORING COMPLETED: 11/3/2005
DRILLING METHOD: Mud Rotary
RIG TYPE: Barge
HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered
BORING DIAMETER (IN): 6
SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	STANDARD PENETRATION RESISTANCE (N) 1 10 20 30 40 50 70 100	BLOWS / 6"
	849	0	Top of Water				
	847		**Alluvium** - Very Loose Dark Brown Fine to Coarse Sand with Silt and Organics (leaves and wood fragments) (SP-SM)				WOH
		5					WOH
							WOH
							WOH
		10					
							WOR
	837		**Alluvium** - Very Soft Dark Brown Sandy Silt (ML)				WOR
		15					
		20					WOH
	828		Boring Terminated				
		25					
		30					

SOIL TEST BORING RECORD

QORE™ PROPERTY SCIENCES

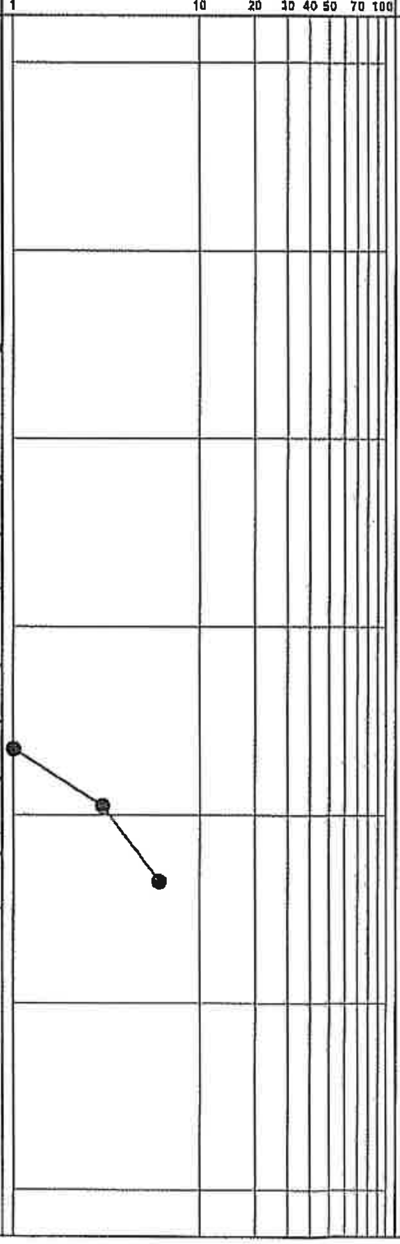
BORING NO: **B-9**

PROJECT: Saluda Lake Dredging Project
JOB NO: 7316
REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina
ELEVATION: 849 Feet (Full Pool)
BORING STARTED: 11/4/2005
BORING COMPLETED: 11/4/2005
DRILLING METHOD: Mud Rotary
RIG TYPE: Barge
HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered
BORING DIAMETER (IN): 6
SHEET 1 OF 1

Remarks: WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	BLOWS / 6"
	849	0	Top of Water			
		5				
	842		**Alluvium** - Very Soft Dark Grayish Brown Sandy Silt with Organics (leaves and wood fragments) (ML)			WOR WOR WOR
		10				
	834	15	**Alluvium** - Very Loose to Loose Grayish Brown Silty Fine to Medium Sand (SM)			WOH 0-0-1 1-1-2 3-3-3
		20				
	827		Boring Terminated			
		25				
		30				

STANDARD PENETRATION RESISTANCE (N)



SOIL TEST BORING RECORD

QORE™
PROPERTY SCIENCES

BORING NO: **B-10**

PROJECT: Saluda Lake Dredging Project
JOB NO: 7316
REPORT NO: 106566
PROJECT LOCATION: Pickens and Greenville Counties, South Carolina
ELEVATION: 849 Feet (Full Pool)
BORING STARTED: 11/4/2005
BORING COMPLETED: 11/4/2005
DRILLING METHOD: Mud Rotary
RIG TYPE: Barge
HAMMER: Rope and Cathead
GROUNDWATER: Not Encountered
BORING DIAMETER (IN): 6
SHEET 1 OF 1

Remarks: Boring moved approximately 40 feet west of the staked location.

WOR = Weight of Rod
WOH = Weight of Hammer

G	ELEV. (FT.)	DEPTH (FT.)	MATERIAL DESCRIPTION	L	S	STANDARD PENETRATION RESISTANCE (N) 1 10 20 30 40 50 70 100	BLOWS / 6"
	849	0	Top of Water				
	847		**Alluvium** - Very Soft Dark Grayish Brown Sandy Silt with Organics (Leaves) (ML)				WOR
		5					WOR
	843		**Alluvium** - Very Soft Dark Grayish Brown Silt with Sand (ML)				WOH WOH
		10					WOH WOH
		15					WOH WOH
		20					WOH
	828		Boring Terminated				
		25					
		30					

APPENDIX B

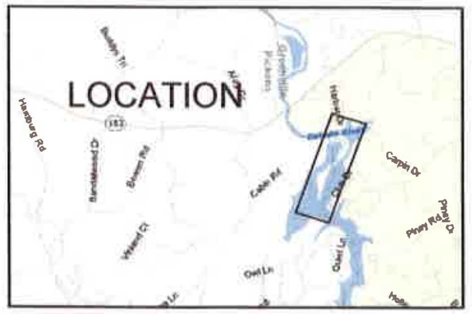
Historic Aerial Photographs

1972

1986

1997

2003



SCALE: N.T.S.

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HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

APPENDIX B-1

OCTOBER 2018

SCALE: N.T.S.

2006 IMAGERY

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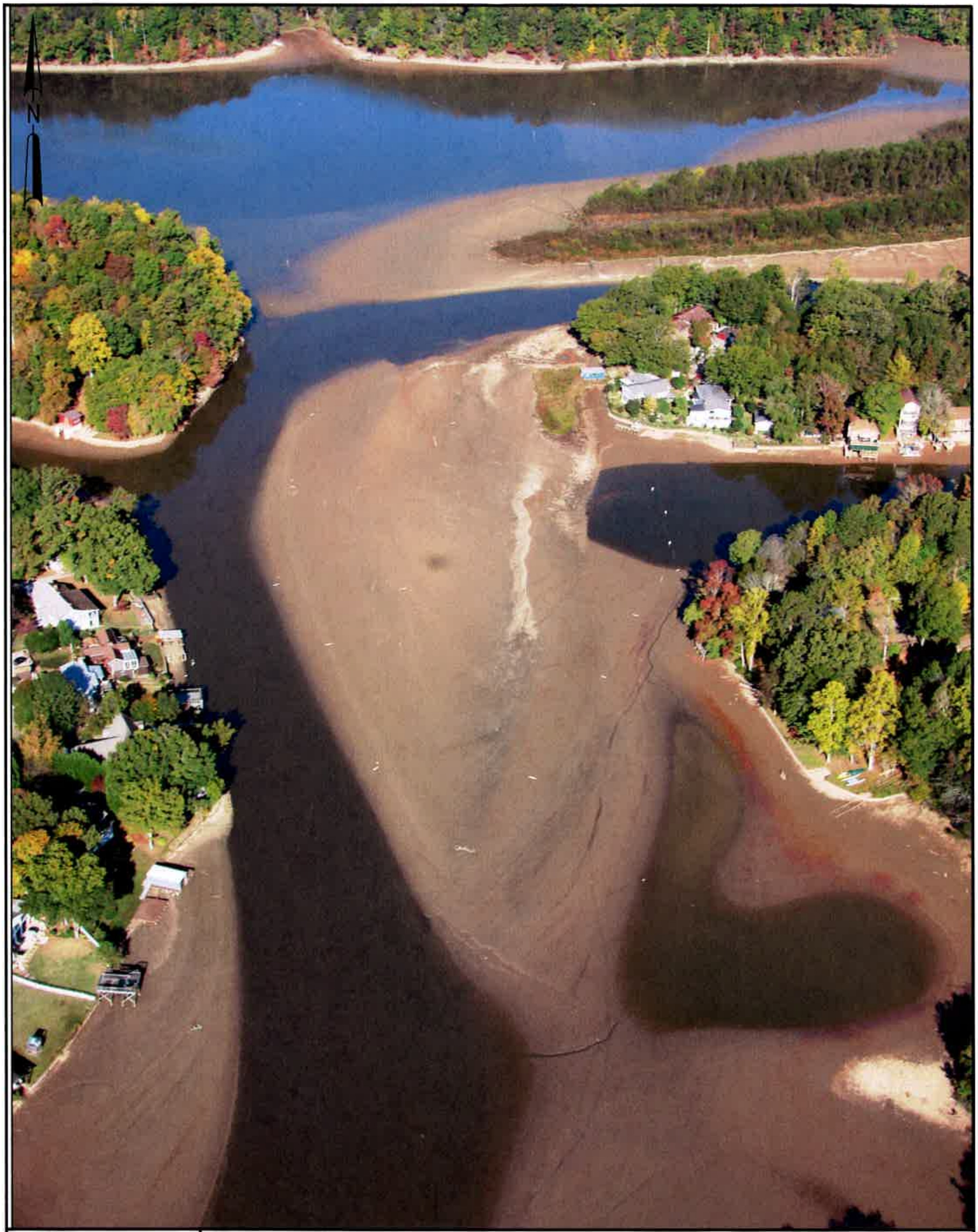
HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

APPENDIX B-2

OCTOBER 2018



SCALE: N.T.S.

2006 IMAGERY

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HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

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APPENDIX B-3

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SCALE: N.T.S.

2006 IMAGERY

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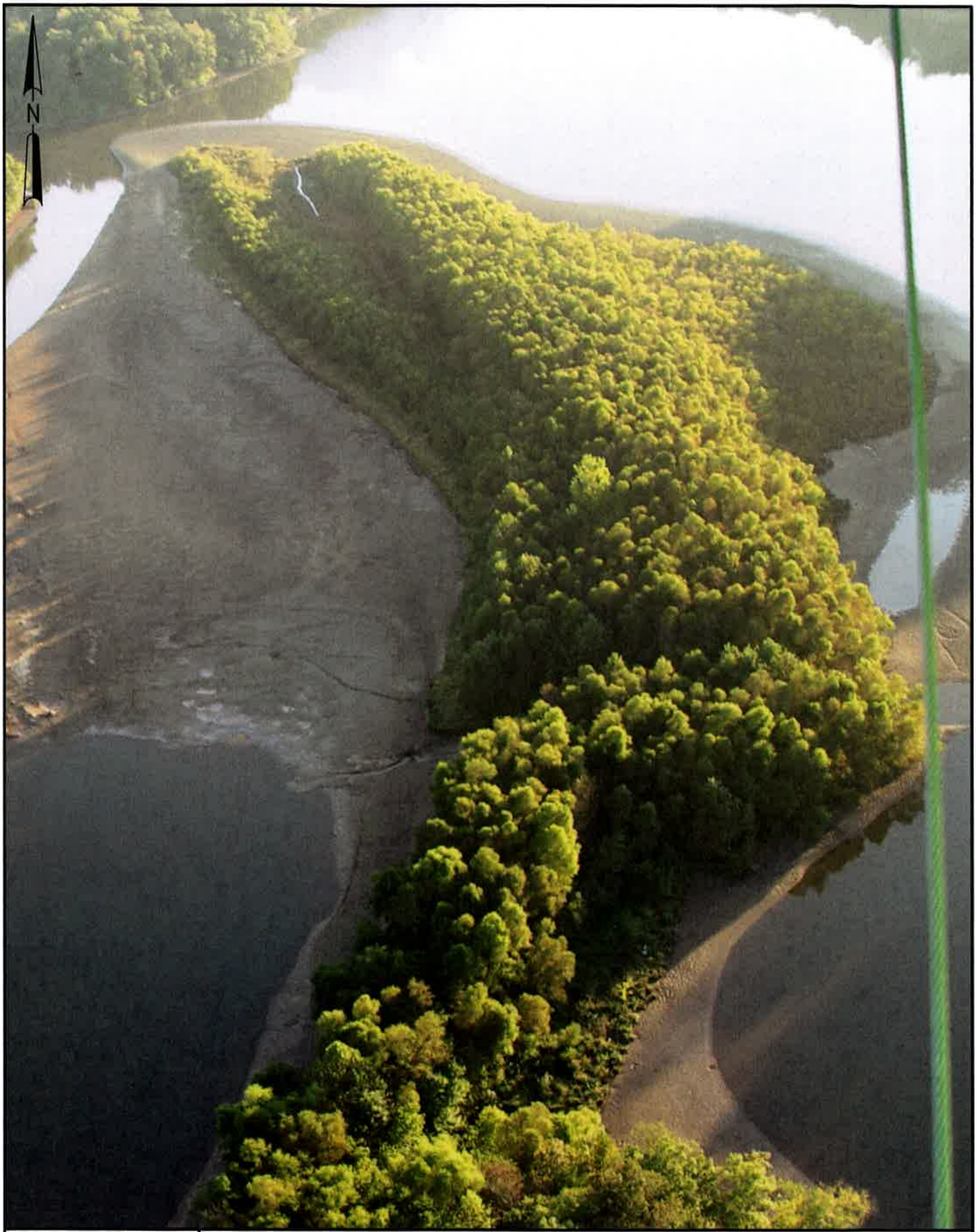
HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

APPENDIX B-4

OCTOBER 2018



SCALE: N.T.S.

2006 IMAGERY

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HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
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APPENDIX B-5

OCTOBER 2018

SCALE: N.T.S.

2018 GOOGLE IMAGE

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HISTORICAL AERIAL IMAGERY
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

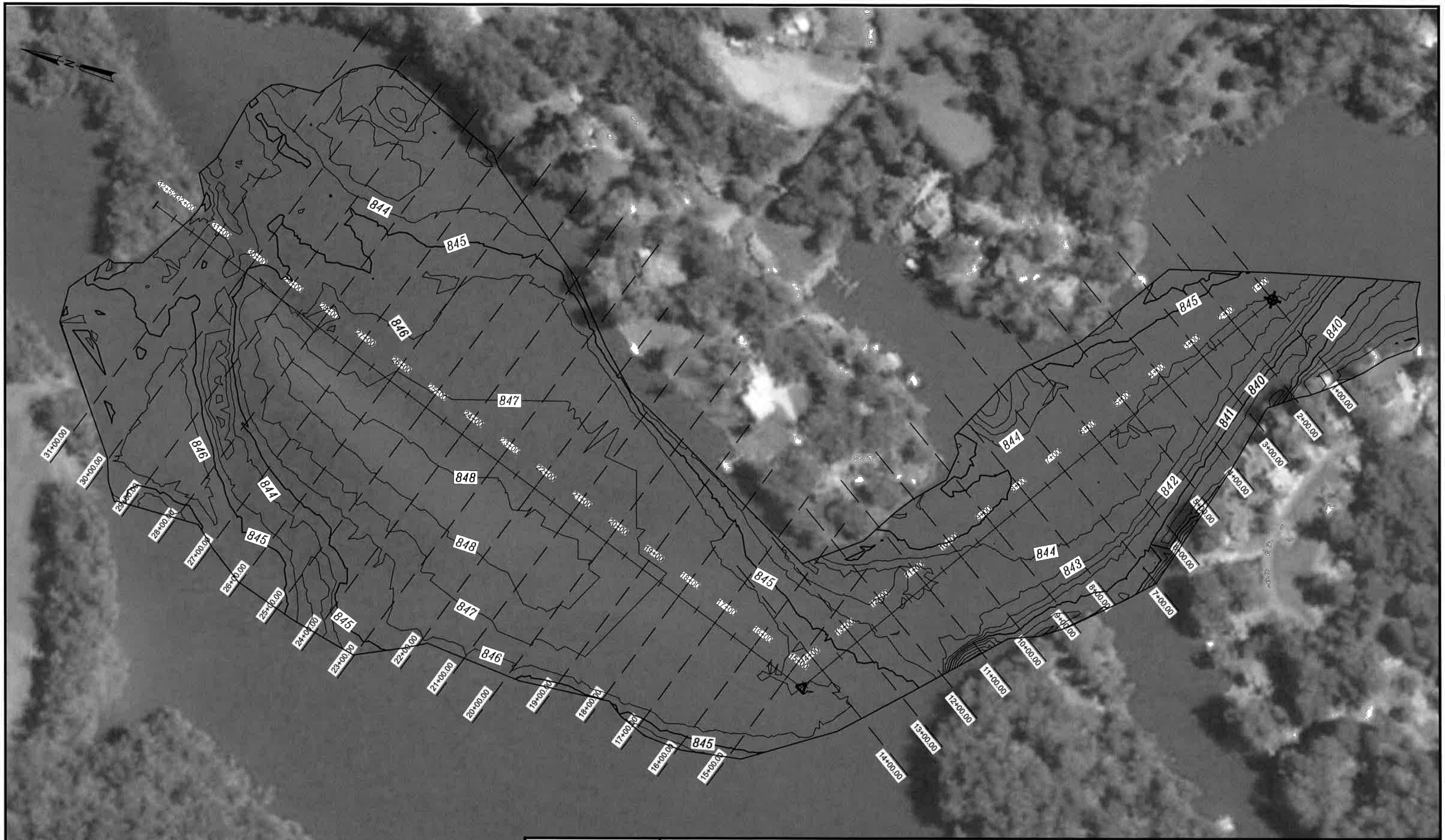
PROJ. NO. 1824

APPENDIX B-6

OCTOBER 2018

APPENDIX C

Mapped Lake Cross Sections
2012 and 2018 Surveys



SCALE: 1" = 200'-0"

NOTE: TOPOGRAPHIC INTERVALS REFLECT 2018 SURVEY DATA

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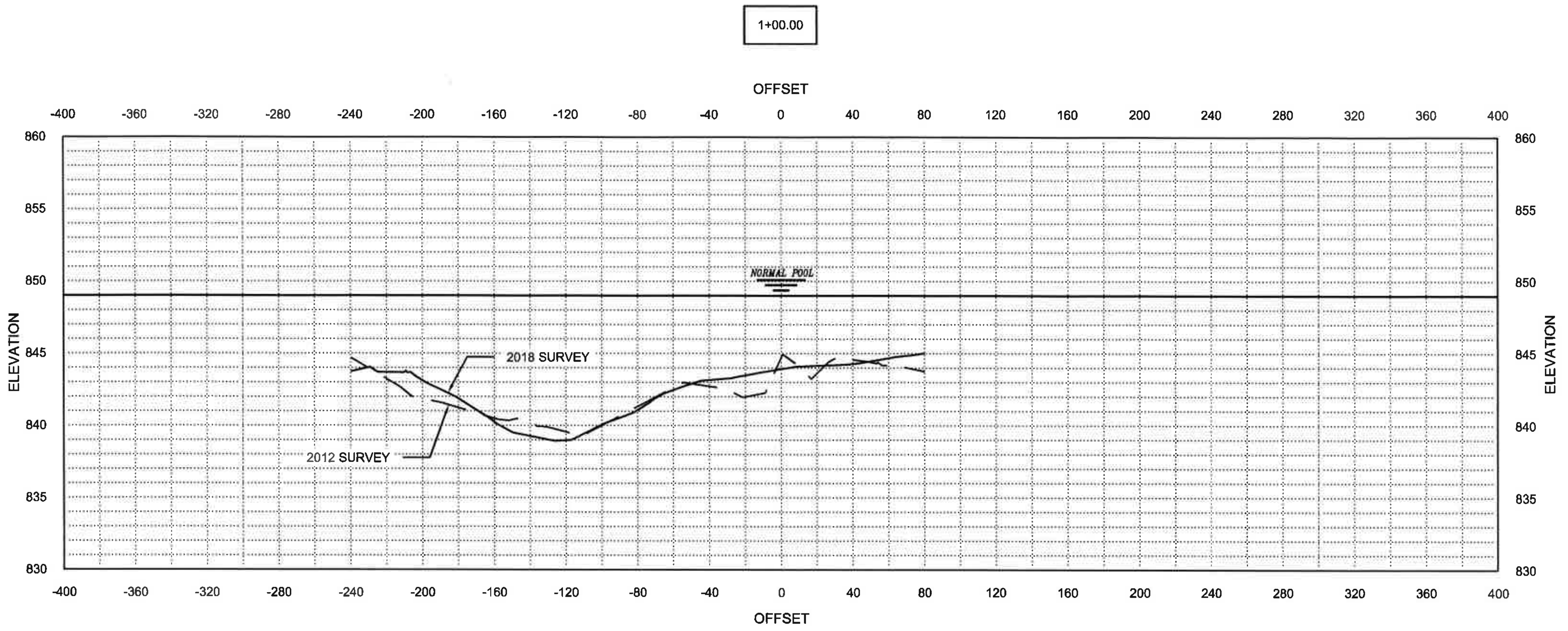
SECTION OVERVIEW
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

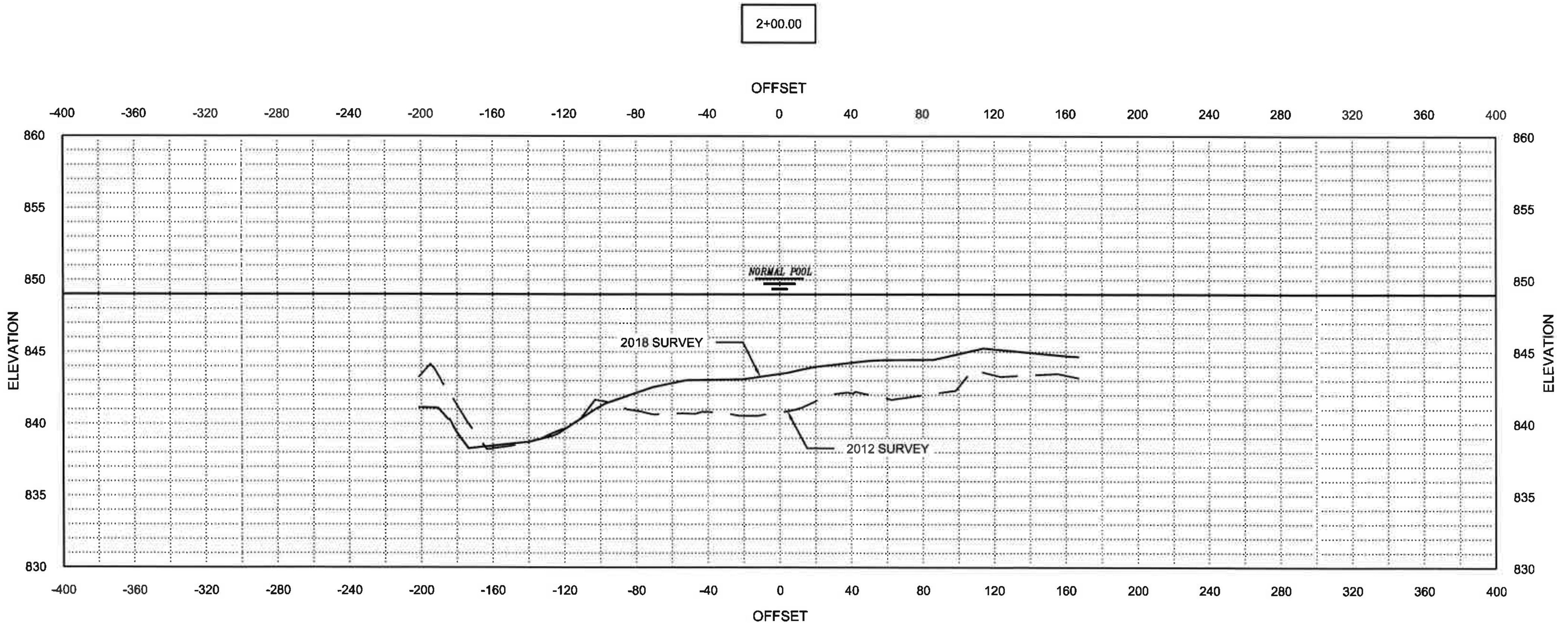
PROJ. NO. 1824

SHEET 1 OF 17

OCTOBER 2018



STATION 1+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 2+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

SHEET 2 OF 17

OCTOBER 2018

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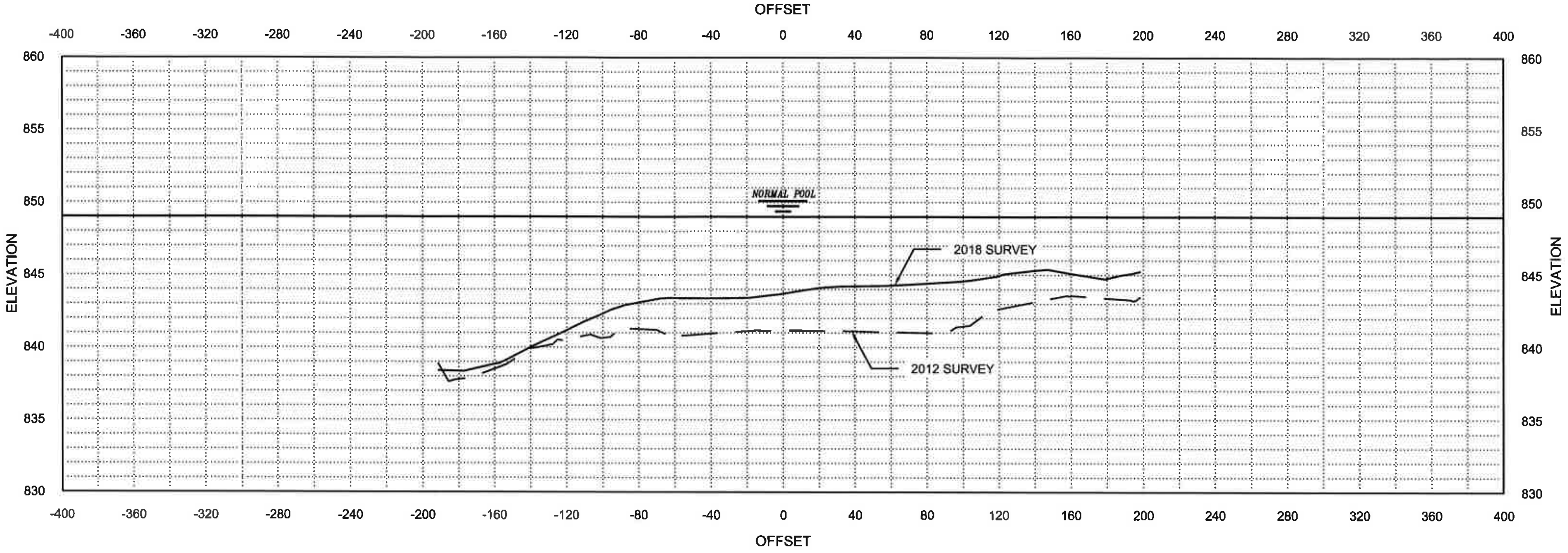
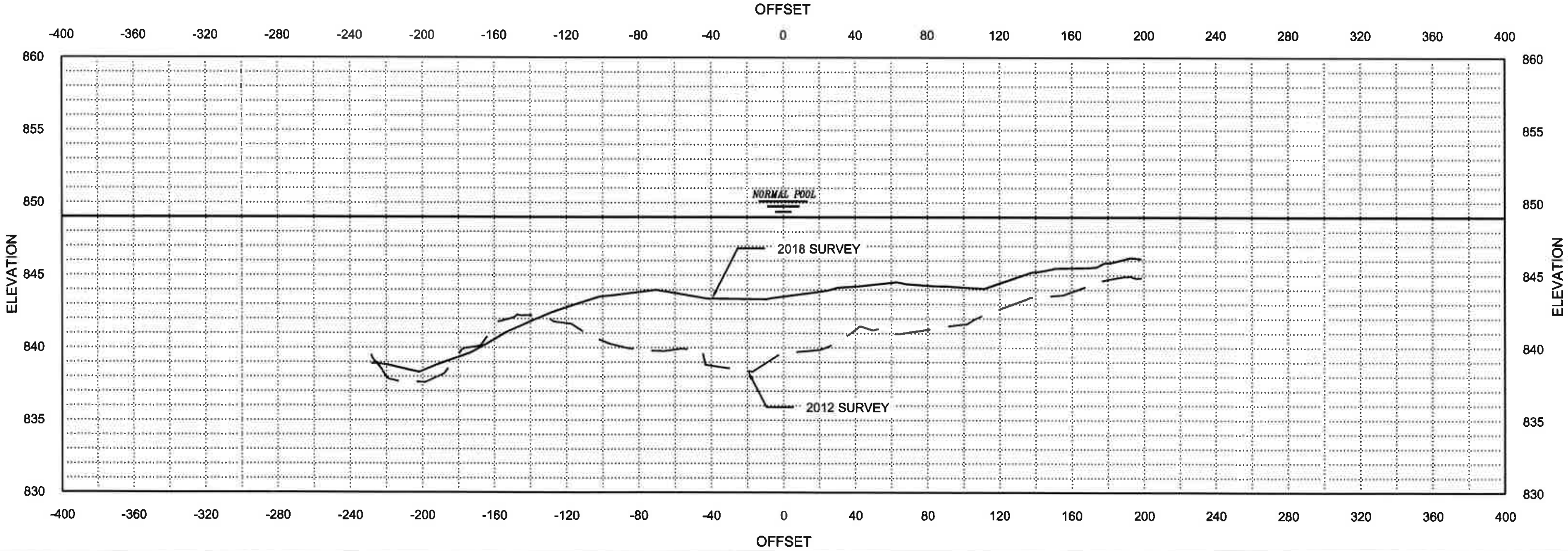
3+00.00



STATION 3+00

HORIZ.; 1" = 80' AND VERT.; 1" = 10'

4+00.00



STATION 4+00

HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

SHEET 3 OF 17

OCTOBER 2018

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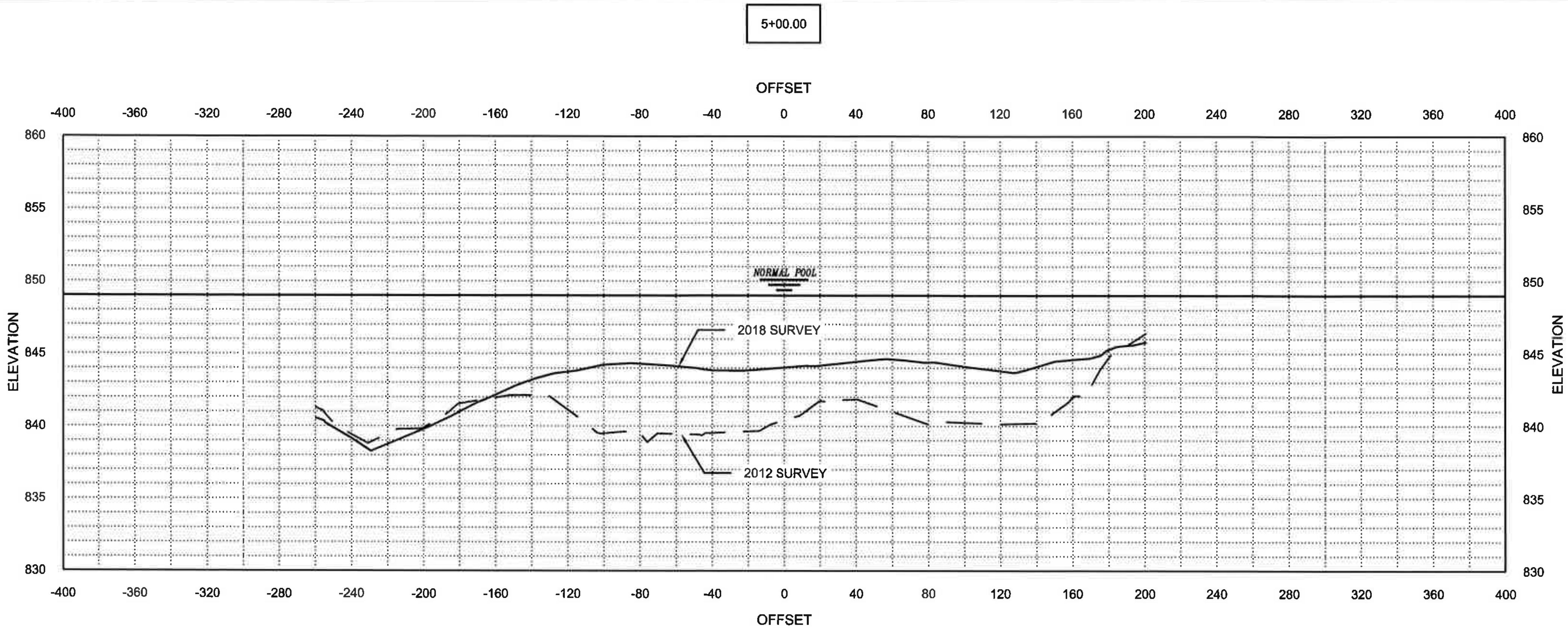
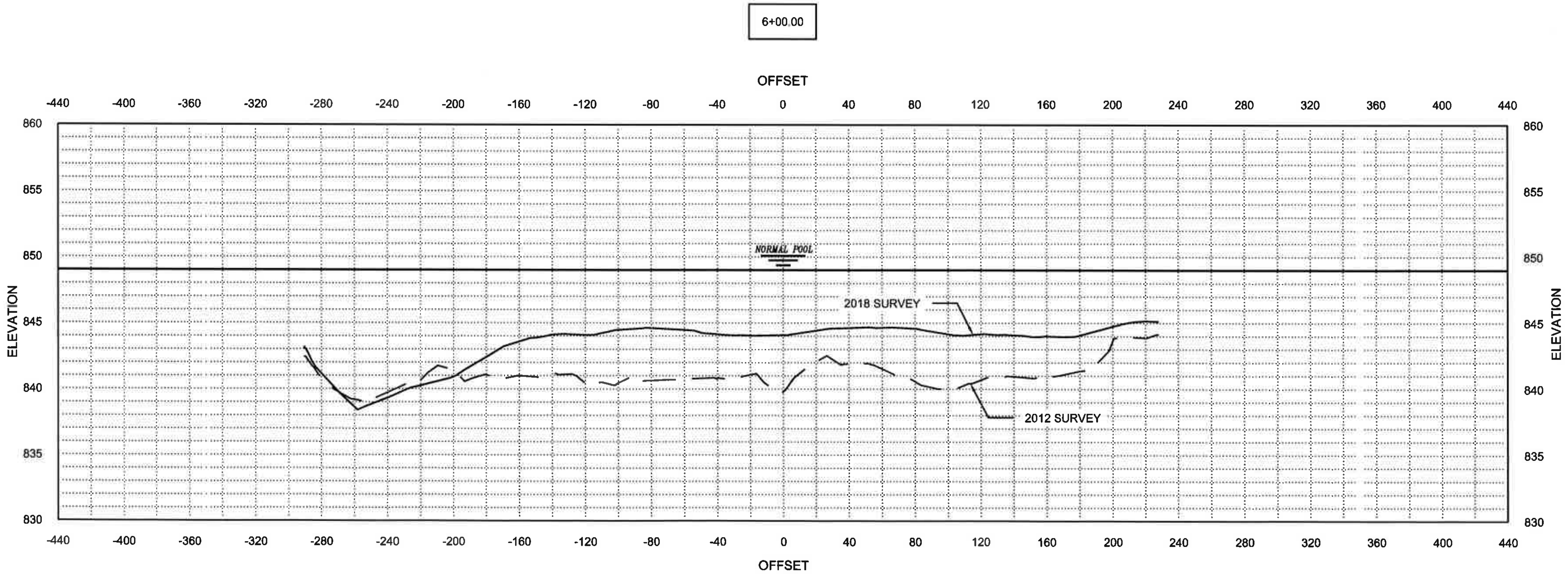


STATION 5+00 HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 6+00 HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

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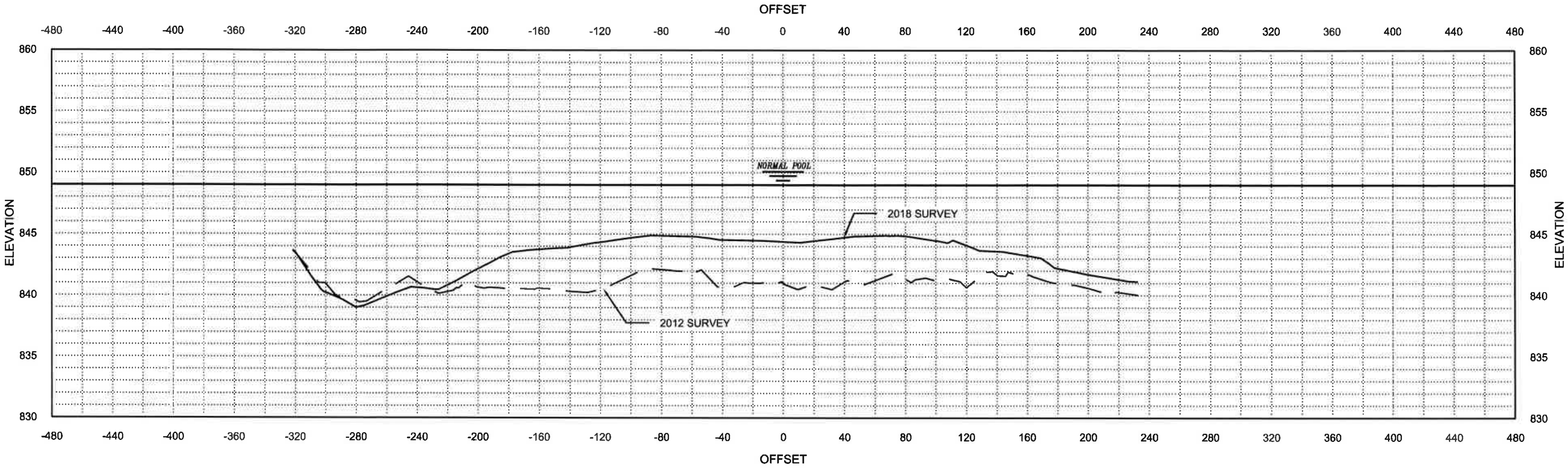
OCTOBER 2018

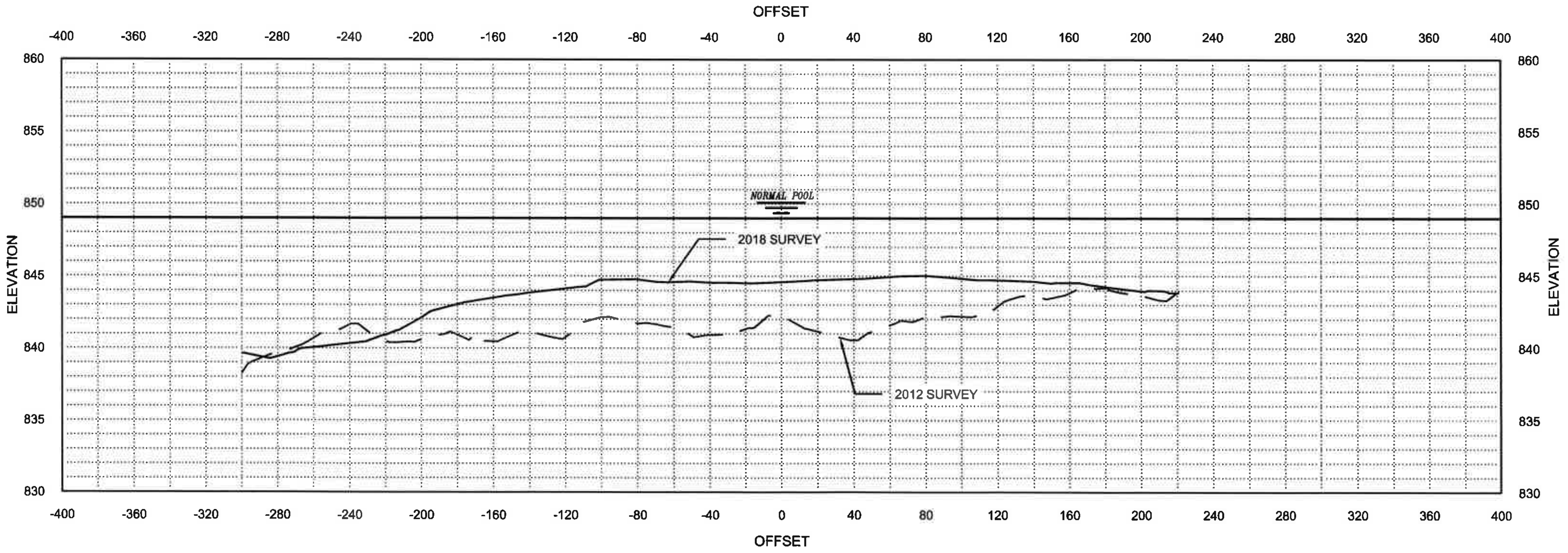
7+00.00



STATION 7+00

HORIZ.; 1" = 80' AND VERT.; 1" = 10'

8+00.00



STATION 8+00

HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

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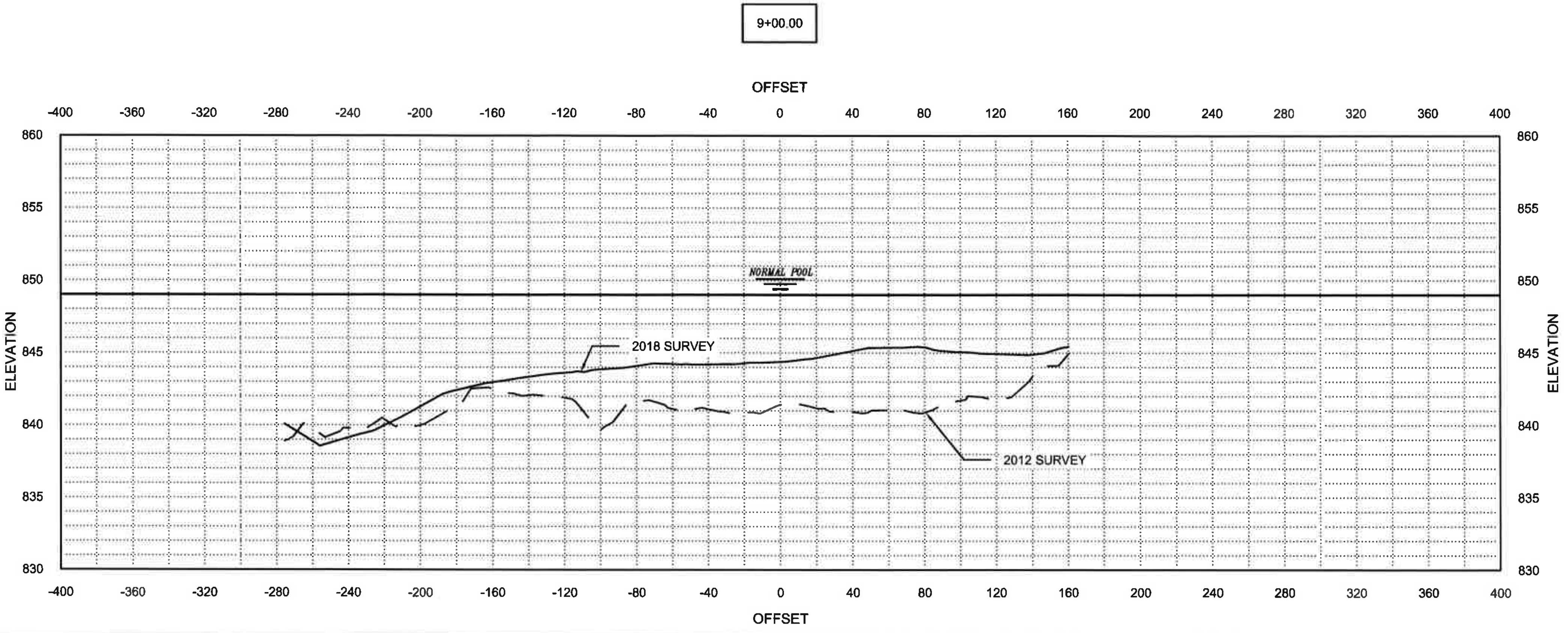
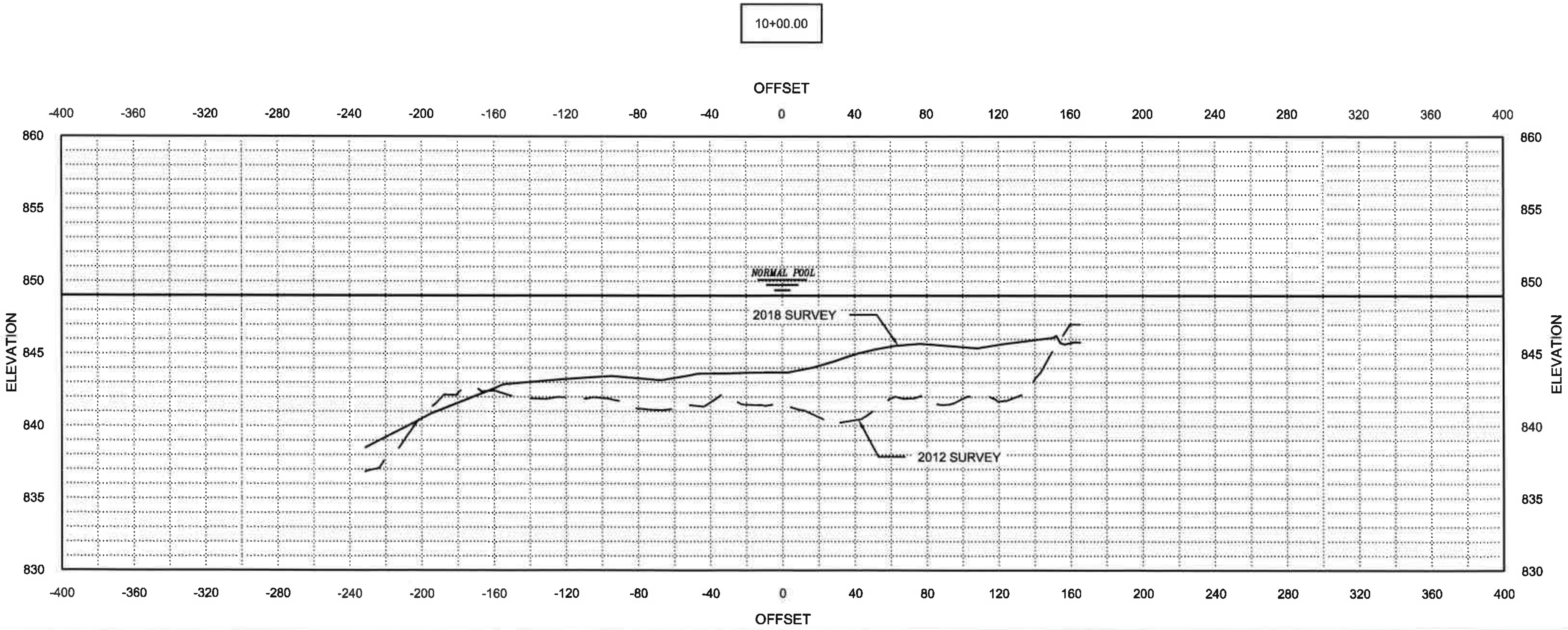
OCTOBER 2018



STATION 9+00	HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 10+00	HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

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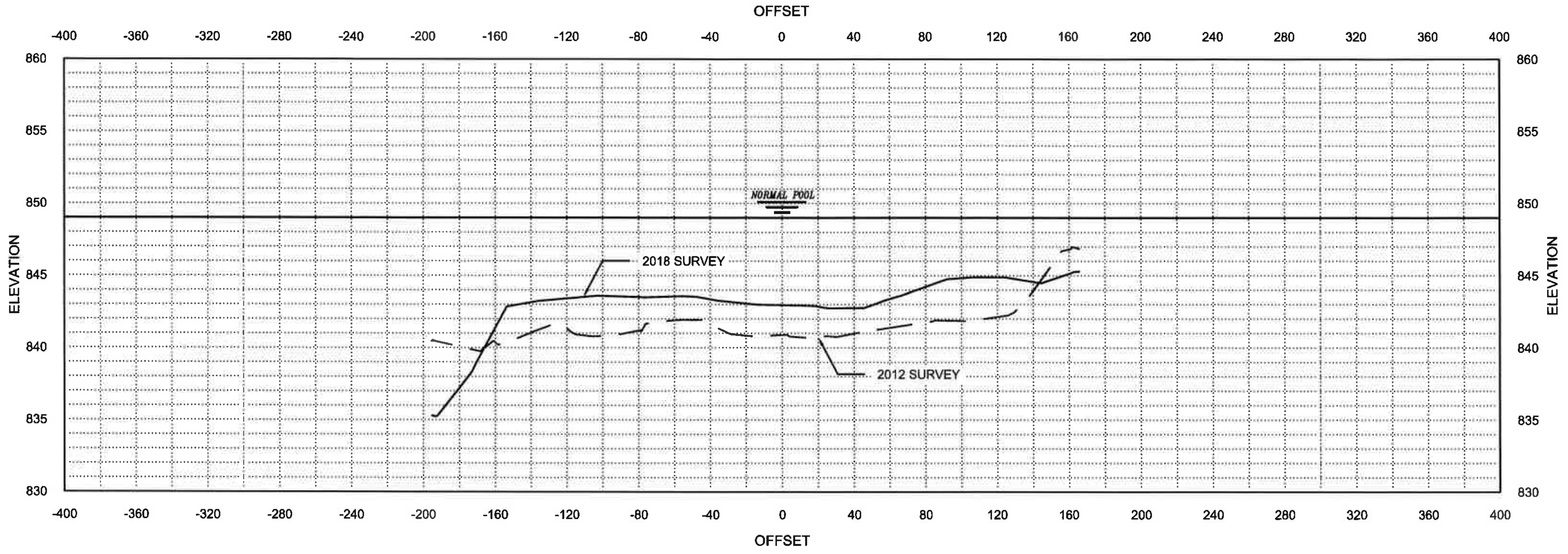
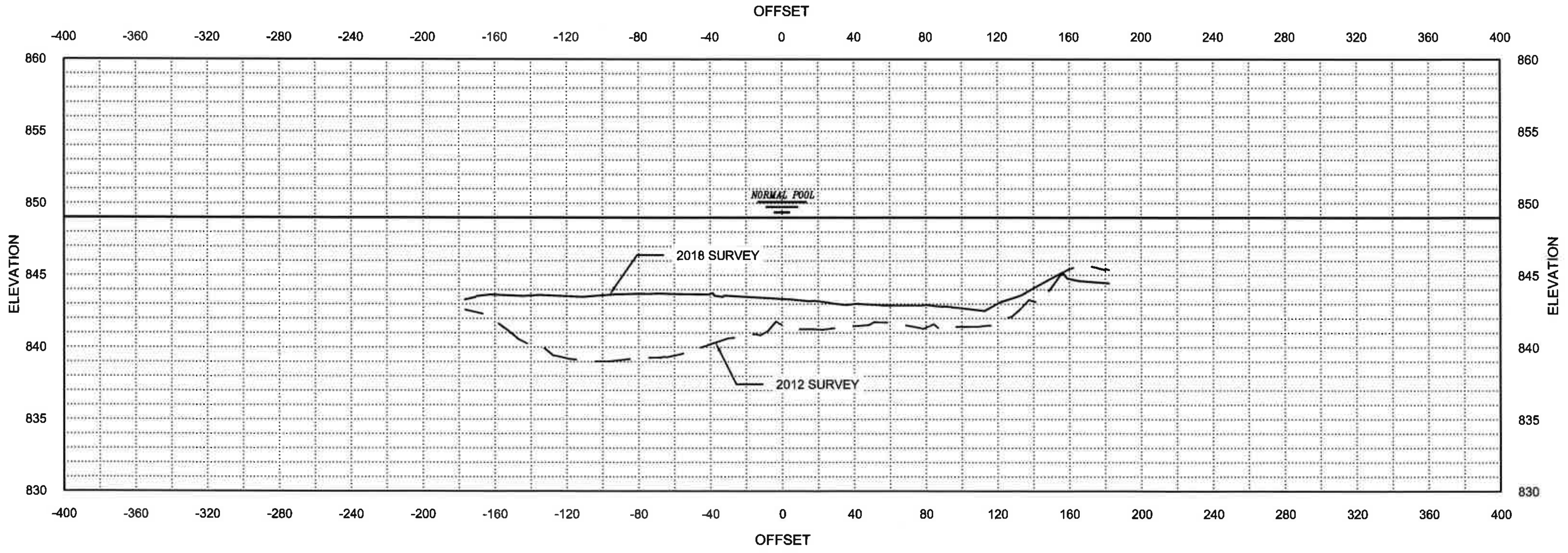
11+00.00



STATION 11+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

12+00.00



STATION 12+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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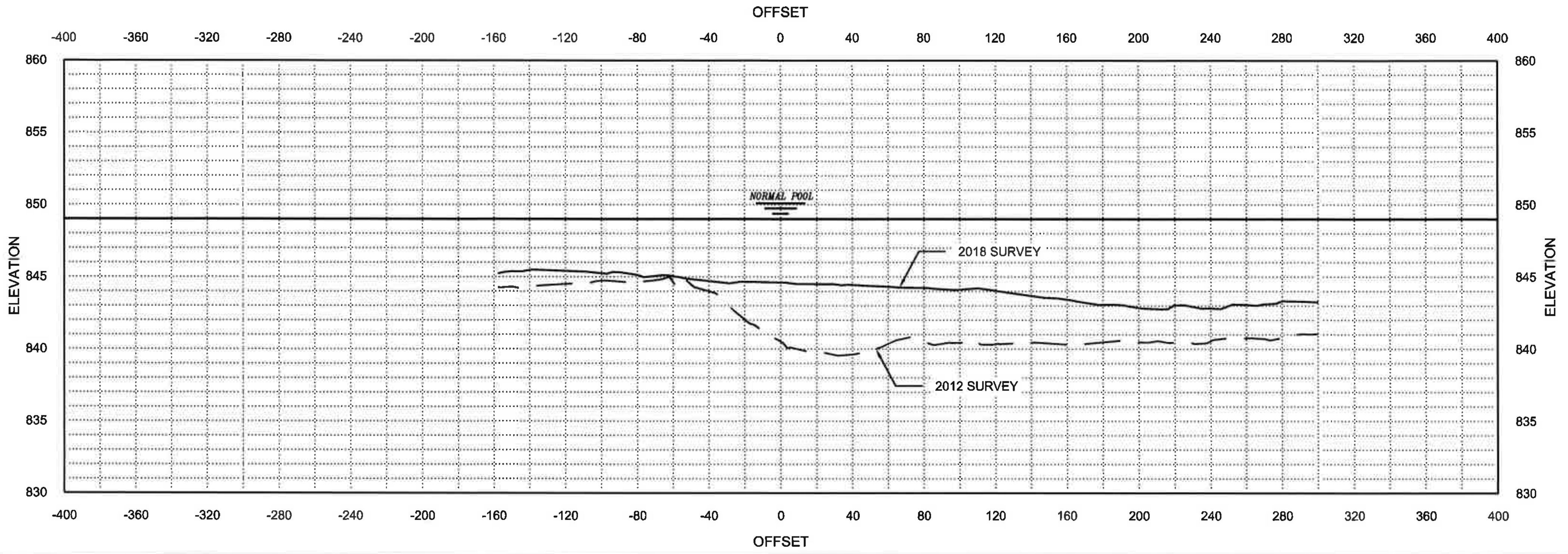
SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

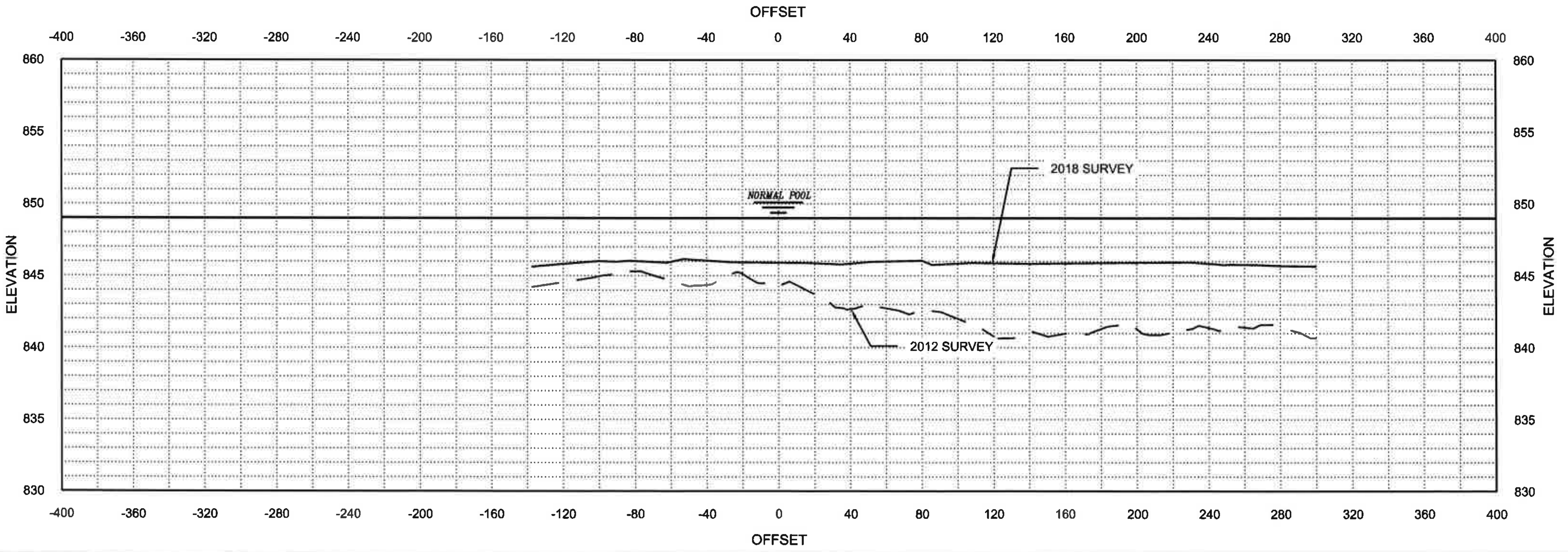
PROJ. NO. 1824
SHEET 7 OF 17
OCTOBER 2018

13+00.00



STATION 13+00 HORIZ.; 1" = 80' AND VERT.; 1" = 10'

14+00.00



STATION 14+00 HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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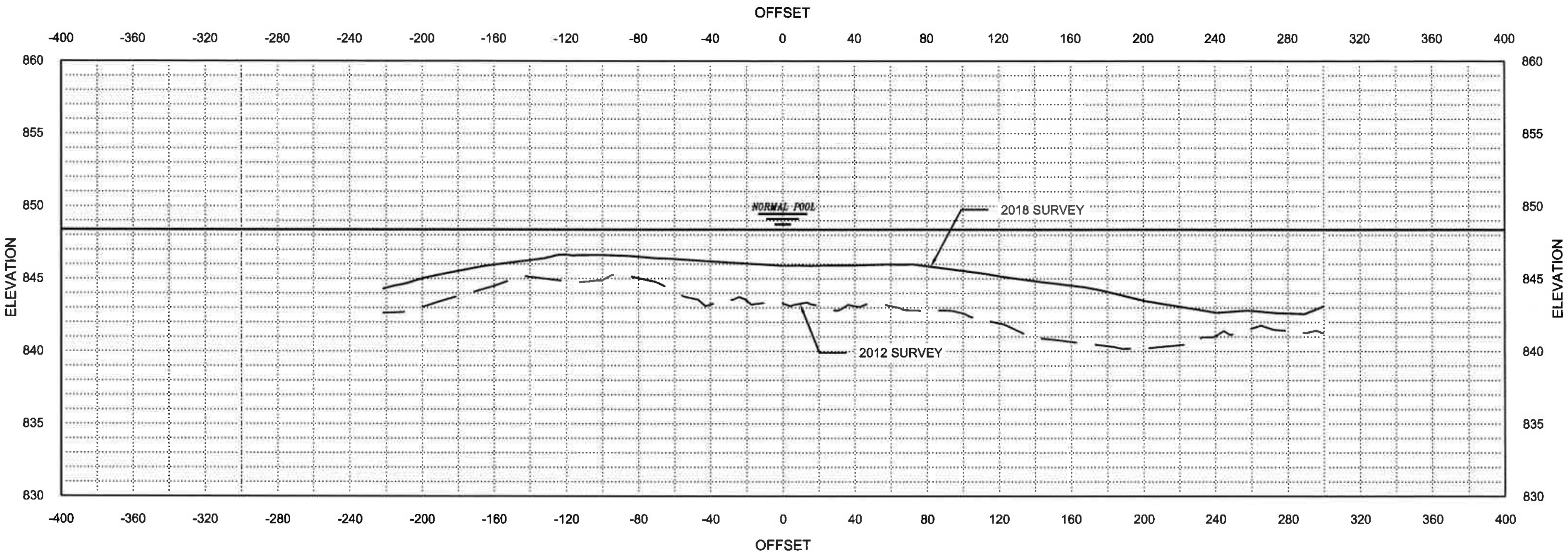
SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

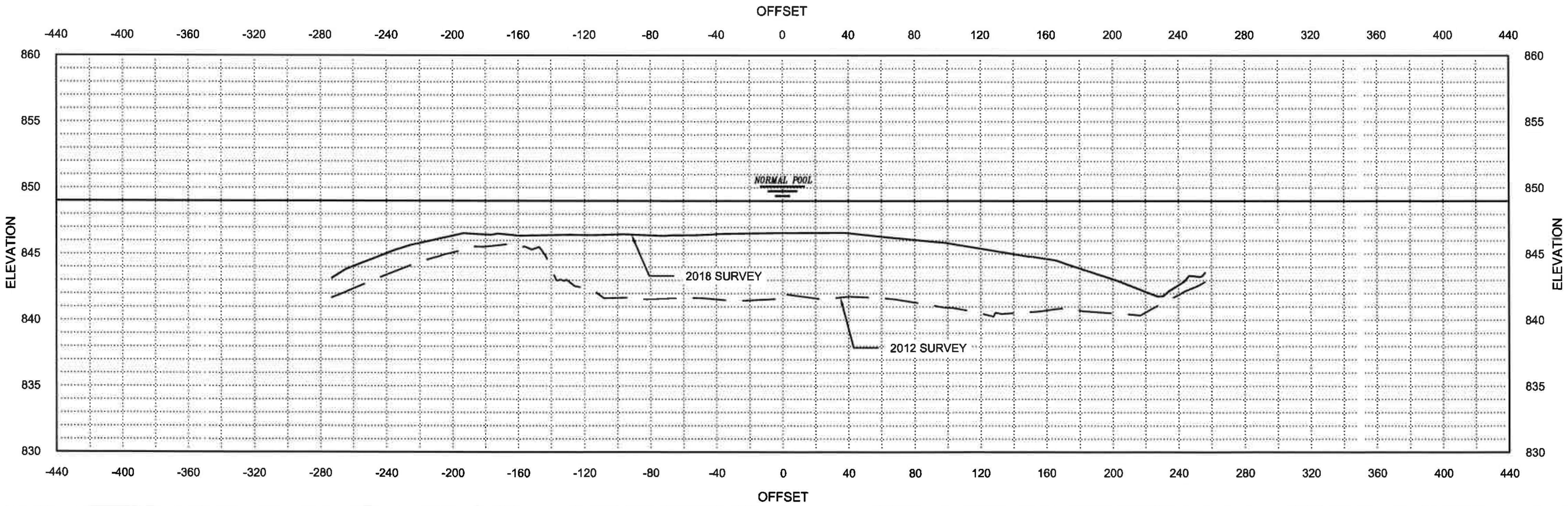
PROJ. NO. 1824
SHEET 8 OF 17
OCTOBER 2018

15+00.00



STATION 15+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

16+00.00



STATION 16+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824

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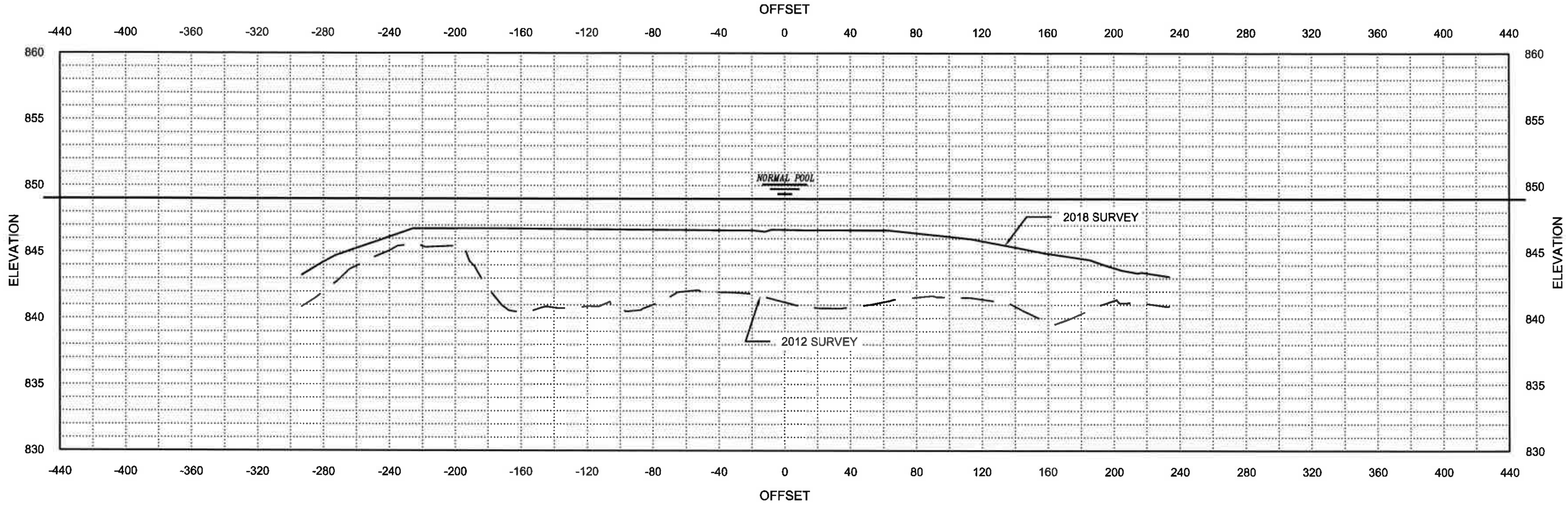
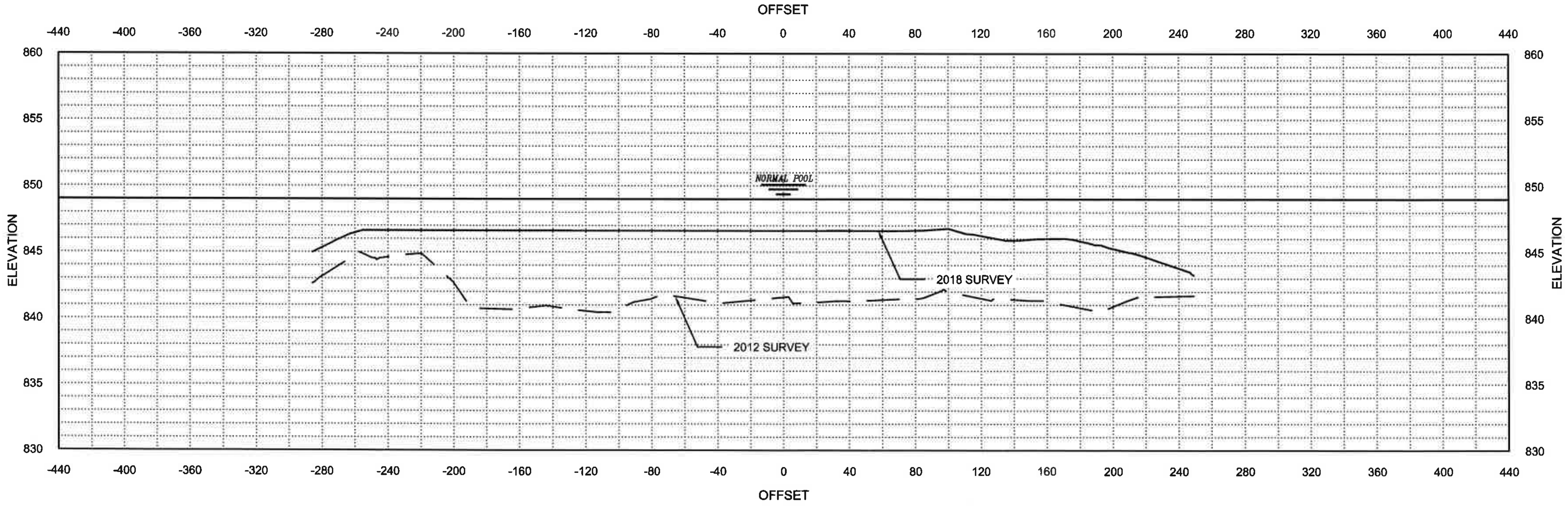
OCTOBER 2018

17+00.00



STATION 17+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

18+00.00



STATION 18+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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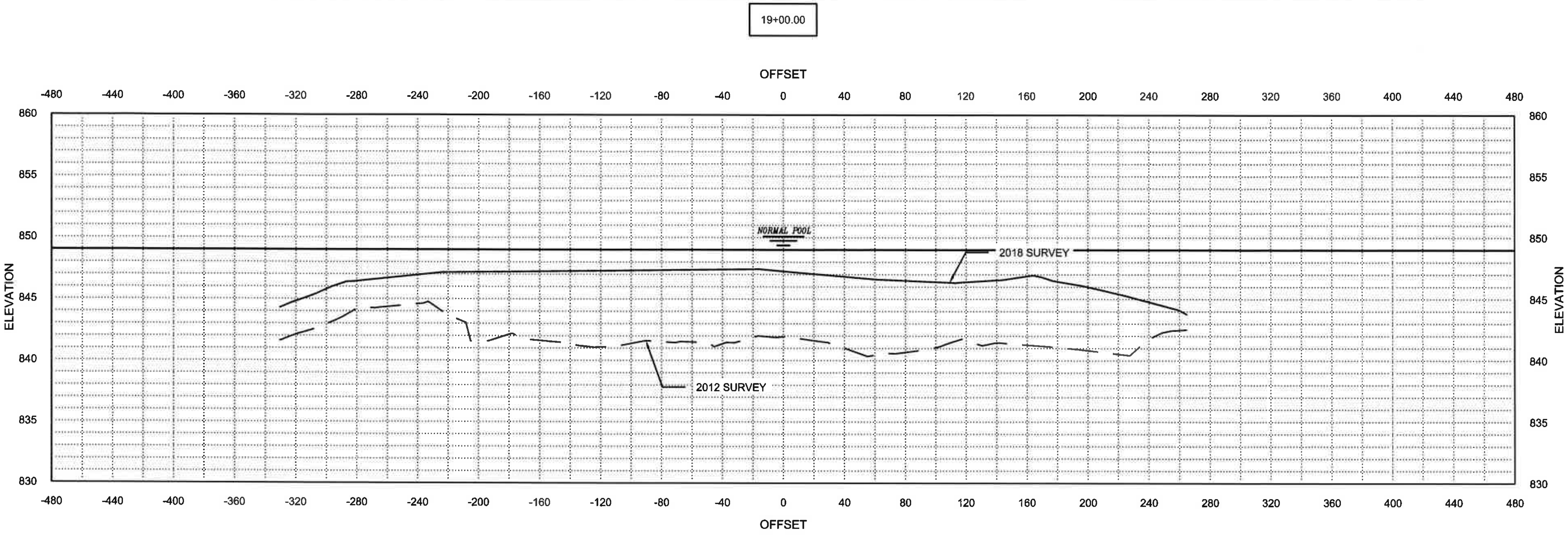
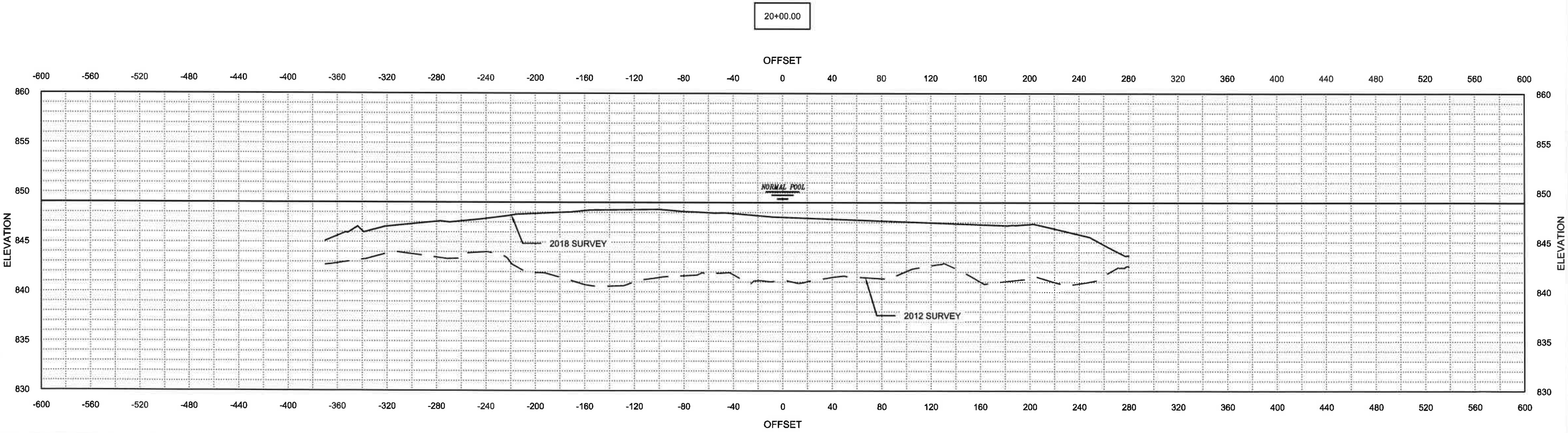
SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824
SHEET 10 OF 17
OCTOBER 2018



STATION 19+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 20+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824
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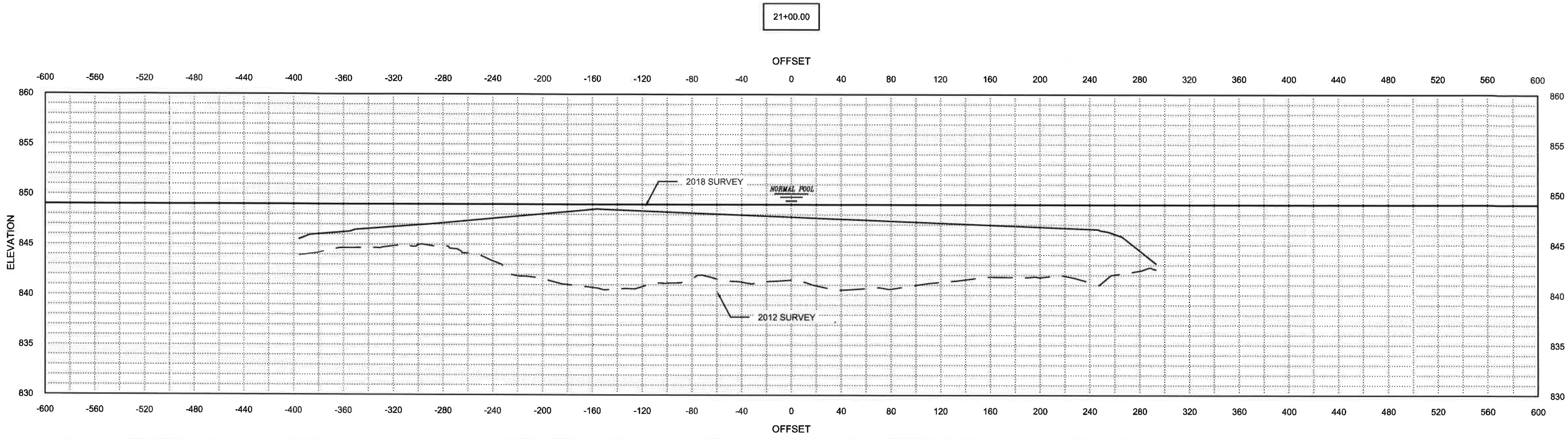
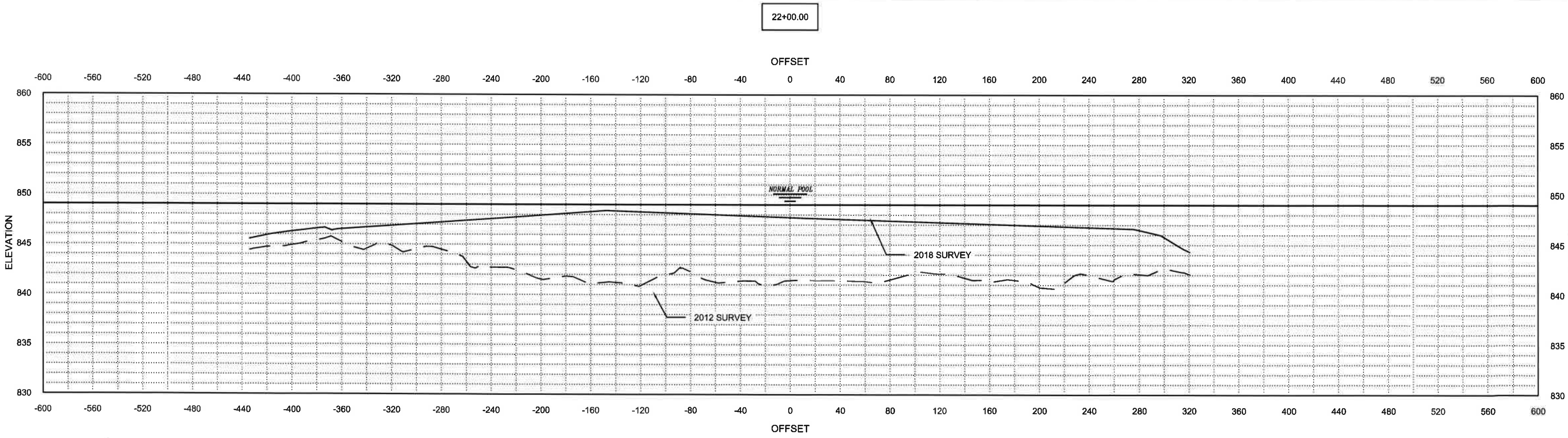
OCTOBER 2018



STATION 21+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 22+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824
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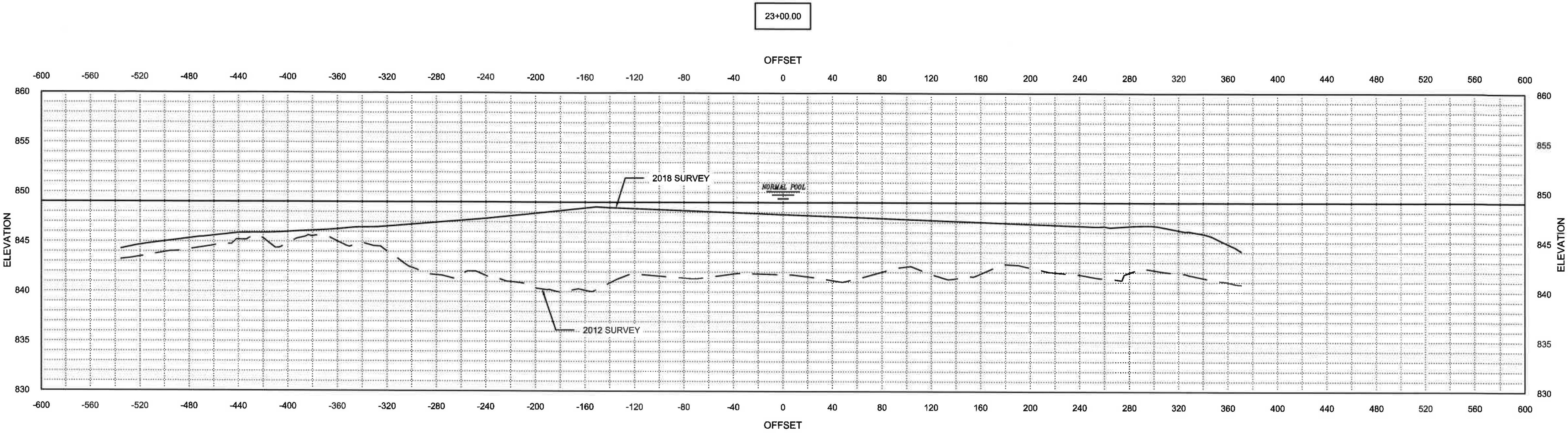
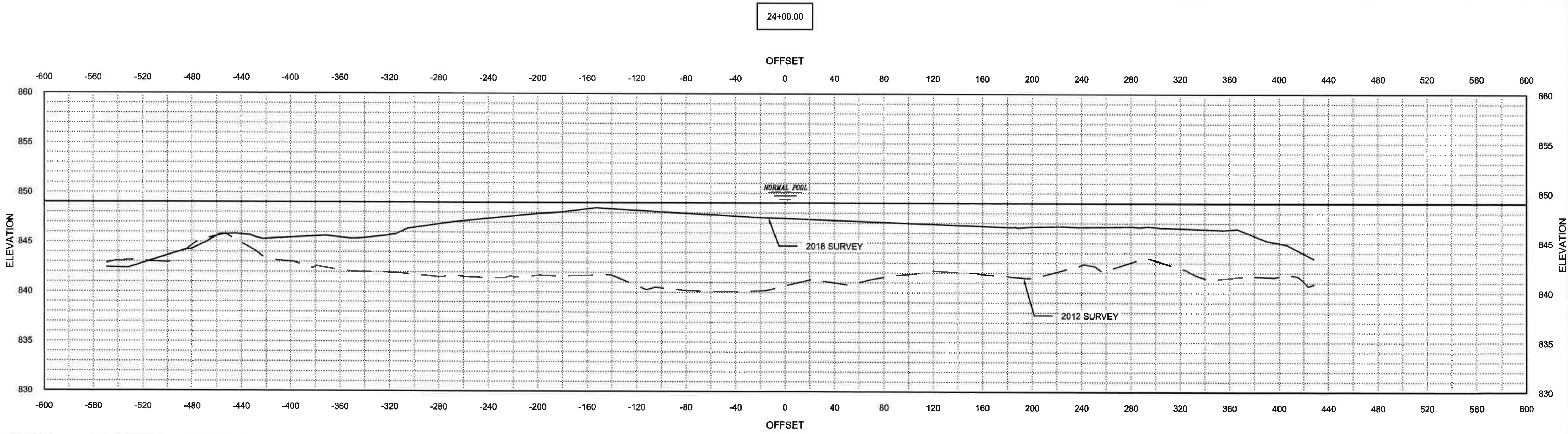
OCTOBER 2018



STATION 23+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 24+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

PROJ. NO. 1824
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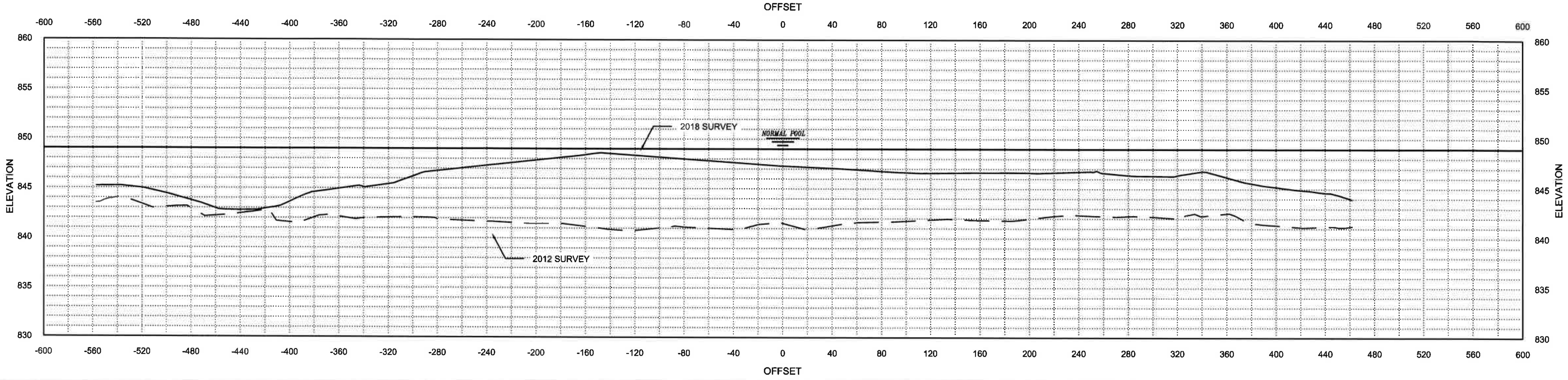
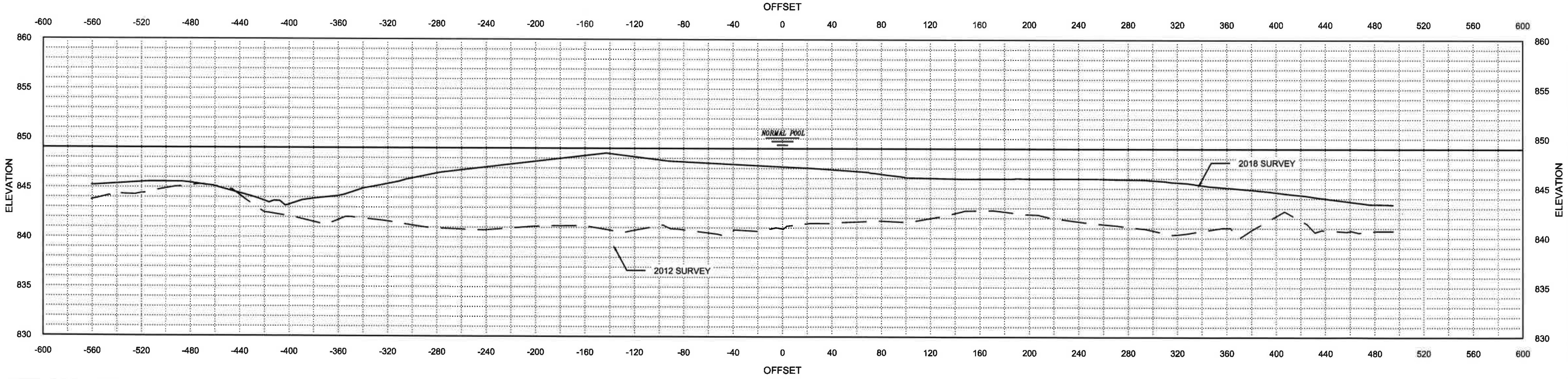
OCTOBER 2018

25+00.00



STATION 25+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

26+00.00



STATION 26+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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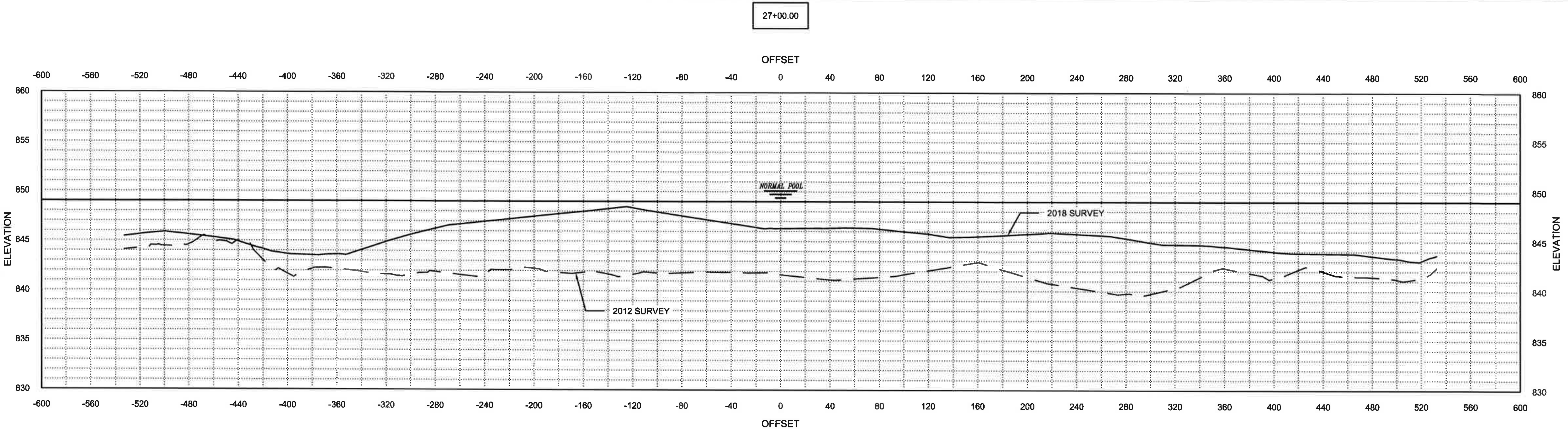
SECTION VIEWS
SALUDA LAKE SEDIMENTATION ANALYSIS
EASLEY COMBINED UTILITIES

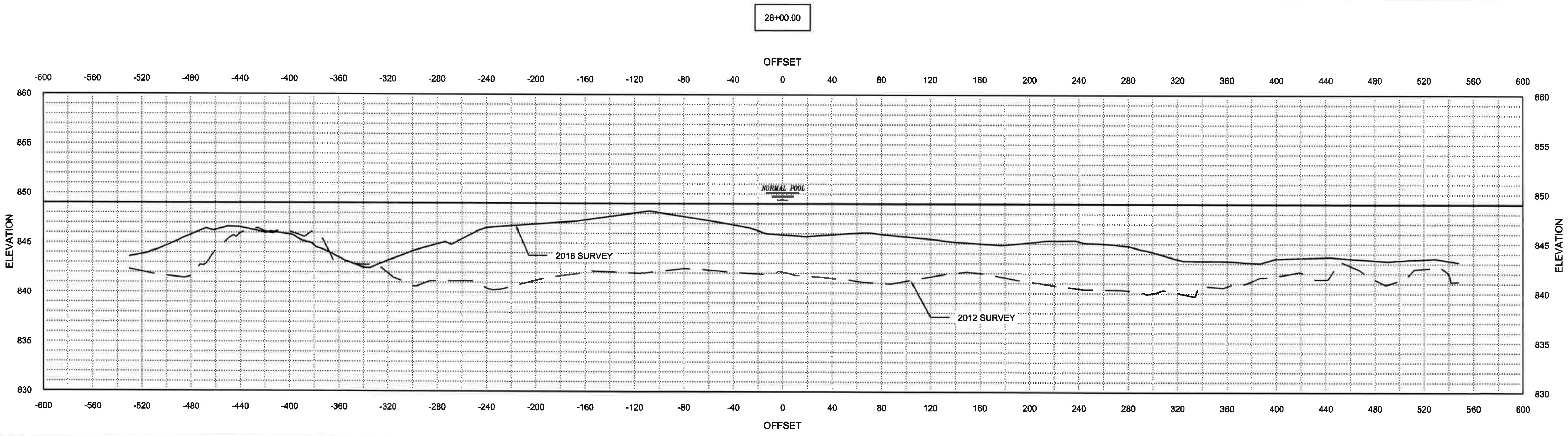
PROJ. NO. 1824

SHEET 14 OF 17

OCTOBER 2018



STATION 27+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 28+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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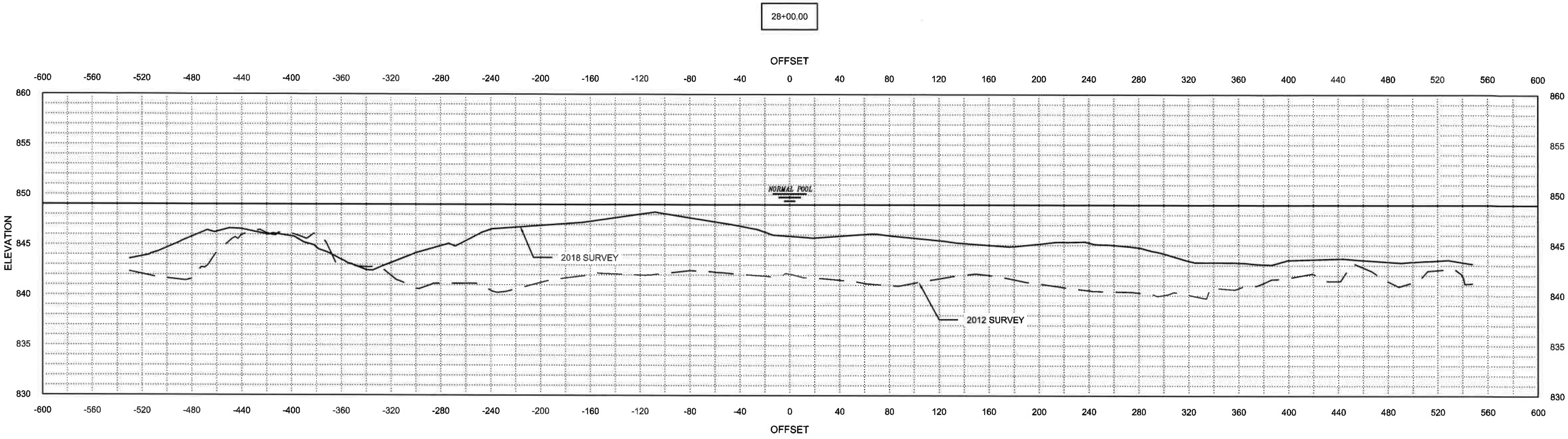
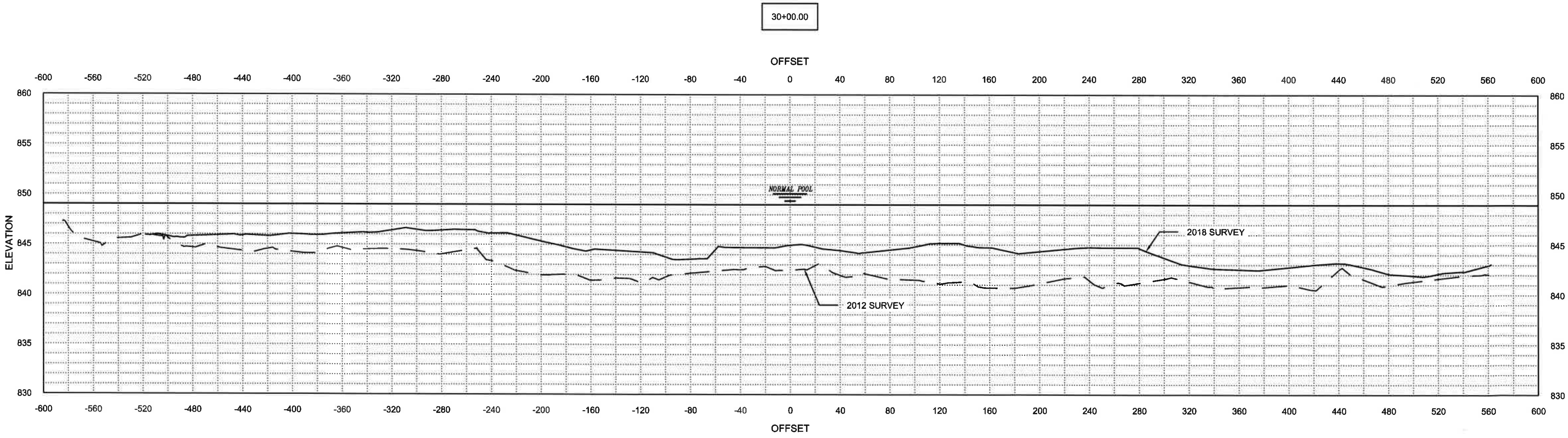


STATION 28+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'



STATION 30+00 | HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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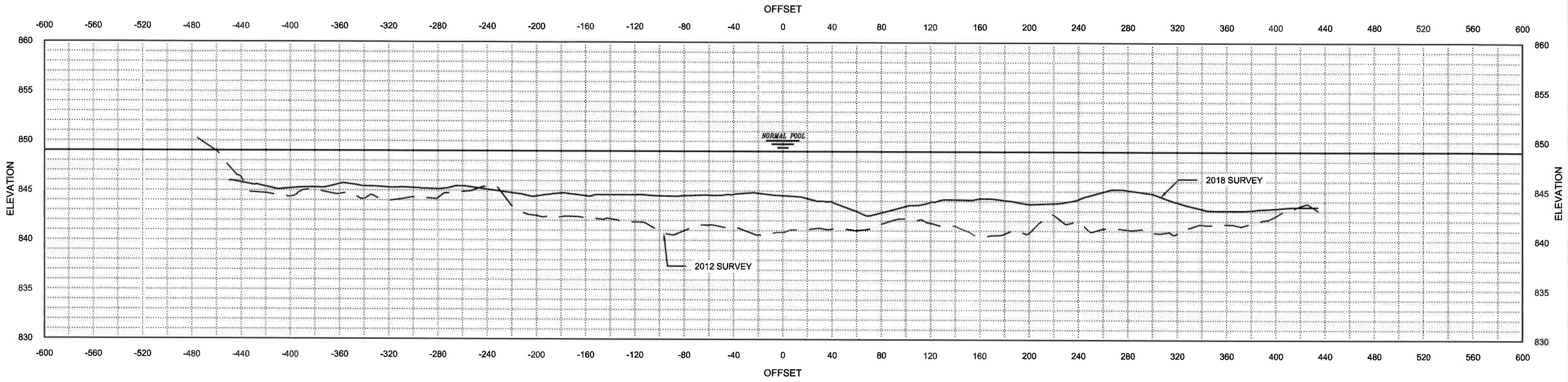

STATION 31+00

HORIZ.; 1" = 80' AND VERT.; 1" = 10'

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APPENDIX D

Rainfall Data – Cleveland Community
1998 - 2017

Rainfall (inches) in Cleveland Community

Month	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
January	8.18	4.33	4.71	3.10	4.97	2.35	1.48	3.06	5.06	7.15	2.70	4.01	7.74	2.56	4.55	8.66	3.80	4.53	4.38	5.51	4.30
February	6.69	4.36	3.20	3.06	1.95	4.58	3.45	3.60	1.81	3.62	4.16	2.60	4.88	2.99	1.15	4.48	2.99	4.05	4.49	1.23	7.34
March	4.77	2.86	4.94	6.31	5.41	5.75	1.52	6.35	1.60	5.32	5.19	7.06	3.62	11.28	3.88	4.74	3.83	2.64	2.00	5.19	
April	7.41	4.28	5.60	0.88	0.94	6.39	1.95	4.31	3.19	2.03	5.13	3.41	4.40	4.04	4.53	6.84	5.85	6.59	1.37	8.84	
May	3.46	1.48	2.81	3.90	4.44	7.13	2.64	3.46	1.69	2.26	2.91	7.06	5.42	2.46	6.89	6.72	3.01	1.75	6.15	7.80	
June	6.45	7.04	4.09	3.06	1.52	4.74	5.16	10.79	10.68	1.30	0.17	5.90	3.04	2.95	2.77	9.85	5.98	4.29	1.13	4.99	
July	2.95	4.20	2.59	4.37	3.10	8.43	5.30	9.91	3.88	3.03	5.70	4.16	3.26	3.92	7.54	14.84	5.46	2.28	4.62	3.71	
August	6.69	1.57	2.61	1.28	3.19	8.33	3.73	5.43	6.37	8.73	5.80	2.06	6.34	3.23	12.14	9.20	7.36	4.40	5.17	6.78	
September	2.60	2.78	4.20	5.26	8.29	1.49	14.09	0.51	4.84	0.65	0.96	6.84	3.20	6.44	4.07	3.96	3.04	3.56	1.25	4.67	
October	2.33	6.58	0.17	0.83	5.09	1.07	1.46	2.81	5.76	1.60	2.11	6.86	1.78	1.88	3.49	1.37	4.46	9.17	0.98	9.12	
November	3.15	2.46	4.51	1.79	4.79	2.51	6.42	2.36	3.75	2.62	2.01	7.25	3.45	7.07	0.53	6.14	5.14	9.81	2.14	1.26	
December	3.84	3.14	3.58	2.95	7.85	3.33	7.54	5.48	5.08	6.59	6.95	9.66	3.80	5.29	5.68	8.00	3.12	11.60	3.38	2.91	
Total	58.52	45.08	43.01	36.79	51.54	56.10	54.74	58.07	53.71	44.90	43.79	66.87	50.93	54.11	57.22	84.80	54.04	64.67	37.06	62.01	11.64

*Data from NOAA

Rainfall (inches) in Cleveland Community

Day	1998											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1	0.00	0.00	0.00	0.20	1.85	0.02	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.80	0.00	0.00	0.00	0.30	0.01	0.00	0.00	0.00	0.78	0.00
4	0.00	1.53	0.00	1.42	0.12	0.00	0.00	0.00	0.70	0.15	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.68	0.32	0.00	0.00	0.17	0.00	0.00
6	0.14	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00
7	0.20	0.00	0.08	0.00	0.18	0.00	0.00	0.00	0.00	0.31	0.00	0.00
8	2.92	0.00	1.92	0.00	0.32	0.00	0.00	0.00	0.00	1.70	0.00	0.00
9	0.00	0.29	1.53	0.79	0.00	0.00	0.00	0.30	0.03	0.00	0.05	0.30
10	0.00	0.00	0.00	0.00	0.11	1.00	0.00	0.33	0.00	0.00	0.03	0.00
11	0.00	0.00	0.00	0.00	0.27	0.66	0.00	0.00	0.00	0.00	0.63	0.00
12	0.00	0.86	0.00	0.00	0.00	0.19	0.00	0.05	0.00	0.00	0.00	0.00
13	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94
14	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.90	0.00	0.00	0.03	0.25
15	0.20	0.00	0.00	0.16	0.00	0.00	0.00	0.83	0.00	0.00	0.85	0.20
16	0.30	0.30	0.00	0.00	0.00	0.00	0.00	3.70	0.00	0.00	0.00	0.00
17	1.20	1.19	0.00	1.92	0.00	0.00	0.21	0.06	0.00	0.00	0.73	0.00
18	0.00	0.23	0.10	0.13	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00
19	0.30	0.00	0.73	0.25	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00
20	0.00	0.00	0.32	1.40	0.00	0.97	0.00	0.00	0.00	0.00	0.00	0.30
21	0.00	0.00	0.09	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.02	0.00
22	0.00	0.00	0.00	0.32	0.00	0.39	0.00	0.00	0.93	0.00	0.00	0.03
23	1.49	0.94	0.00	0.29	0.00	1.51	0.02	0.00	0.00	0.00	0.00	0.07
24	0.03	0.00	0.00	0.12	0.00	0.01	0.58	0.00	0.00	0.00	0.00	1.22
25	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.32
26	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00
27	0.28	0.55	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
28	1.06	0.00	0.00	0.09	0.26	0.00	0.73	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.21
30	0.00	0.00	0.00	0.31	0.00	0.32	0.00	0.00	0.94	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**8.18**	**6.69**	**4.77**	**7.41**	**3.46**	**6.45**	**2.95**	**6.69**	**2.60**	**2.33**	**3.15**	**3.84**

Rainfall (inches) in Cleveland Community

Day	1999											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.52	0.00	3.05	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00
2	0.00	1.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00
3	0.73	0.00	0.12	0.00	0.00	1.18	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.05	0.11	0.00	0.00	0.17	0.00	0.00	0.00	0.35	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.85	0.00	0.00
6	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.24	0.00	0.00	0.47
7	0.00	0.00	0.00	0.00	0.33	0.00	0.35	0.00	0.00	0.00	0.00	0.00
8	0.02	0.00	0.00	0.00	0.24	0.00	0.00	0.03	0.00	0.00	0.00	0.00
9	0.32	0.00	0.40	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.44	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00	0.02
11	0.00	0.00	0.00	0.00	0.00	0.00	2.11	0.00	0.00	2.61	0.00	0.42
12	0.00	0.00	0.00	0.00	0.01	0.00	0.35	0.00	0.00	0.05	0.04	0.00
13	0.00	0.00	0.00	0.00	0.01	0.00	0.48	0.00	0.00	0.13	0.00	0.18
14	0.09	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40
15	0.49	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.30	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	1.45	0.00	0.02	0.00	0.00	0.00	0.00
18	0.72	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
20	0.00	0.83	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.13
21	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.05	0.01
22	0.03	0.00	0.48	0.00	0.00	0.00	0.39	0.00	0.25	0.00	0.00	0.51
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	1.45	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.24	0.00	0.95	0.12	0.57	0.00	0.00	0.00	0.00
26	0.00	0.00	0.14	0.00	0.01	1.78	0.00	0.00	0.00	0.00	1.28	0.00
27	0.00	0.00	0.37	0.10	0.23	0.04	0.00	0.00	0.15	0.00	0.03	0.00
28	0.00	0.09	0.00	0.32	0.00	0.82	0.24	0.00	1.91	0.00	0.00	0.00
29	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00
30	0.17	0.00	0.00	0.24	0.00	0.05	0.13	0.00	0.12	0.00	0.00	0.00
31	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00
Total	**4.33**	**4.36**	**2.86**	**4.28**	**1.48**	**7.04**	**4.20**	**1.57**	**2.78**	**6.58**	**2.46**	**3.14**

Rainfall (inches) in Cleveland Community

Day	2000											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.60	0.15	0.00	0.00	0.00
2	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.14	0.31	0.00	0.00	0.00
3	0.00	0.00	0.00	1.80	1.70	0.00	0.00	0.53	0.03	0.00	0.00	0.00
4	0.22	0.00	0.14	0.42	0.00	0.02	0.00	0.05	0.14	0.00	0.00	0.23
5	0.67	0.00	0.00	0.00	0.00	0.07	0.00	0.40	0.01	0.00	0.09	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.08	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00
9	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00
10	2.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.81	0.00
11	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.90	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.02
13	0.00	0.42	0.00	0.48	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
14	0.00	1.19	0.00	0.10	0.00	0.00	0.05	0.00	0.09	0.00	0.10	0.52
15	0.00	0.01	0.00	1.02	0.00	0.76	0.02	0.00	0.15	0.00	0.00	0.10
16	0.00	0.00	0.00	0.15	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.48
17	0.00	0.00	1.93	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.25	1.81
18	0.12	0.23	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
19	0.04	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.46	0.00	0.08	0.15
20	0.21	0.00	2.09	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.05	0.15
21	0.00	0.00	0.00	0.00	0.01	0.92	0.00	0.43	0.63	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.10	0.23	0.00	0.00	0.15	0.00	0.00	0.00
23	0.72	0.00	0.00	0.00	0.00	0.00	0.17	0.00	1.63	0.00	0.00	0.00
24	0.00	0.00	0.00	0.02	0.67	0.00	0.11	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.55	0.09	0.00	0.63	0.00	0.00	0.17	1.80	0.00
26	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.08	0.42	0.00	0.12	0.00
27	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
28	0.00	0.45	0.08	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
29	0.01	0.00	0.00	0.00	0.10	0.29	0.40	0.00	0.00	0.00	0.00	0.00
30	0.40	0.00	0.01	0.02	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00
31	0.22	0.00	0.00	0.00	0.00	0.00	0.80	0.38	0.00	0.00	0.00	0.00
Total	**4.71**	**3.20**	**4.94**	**5.60**	**2.81**	**4.09**	**2.59**	**2.61**	**4.20**	**0.17**	**5.00**	**3.58**

Rainfall (inches) in Cleveland Community

Day	2001											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.20	0.01	0.00	0.21	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.01	1.22	0.00	0.00	0.09	0.00	0.00	0.00
3	0.00	0.00	0.05	0.00	0.00	0.00	0.22	0.00	0.51	0.00	0.00	0.00
4	0.00	0.00	0.50	0.32	0.00	0.00	0.09	0.22	1.08	0.00	0.00	0.00
5	0.00	0.00	0.13	0.00	0.00	0.00	0.31	0.07	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.26	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
8	0.27	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.27	0.06	0.00	0.00	0.00	0.00	0.00
10	0.00	0.10	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.10
11	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.61	0.00	0.00	0.00	1.25
12	0.30	0.20	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.02	0.00	0.00
13	0.00	0.05	1.30	0.00	0.00	0.00	0.18	0.00	0.26	0.04	0.00	0.14
14	0.00	0.04	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.18
15	0.03	0.02	0.51	0.00	0.00	0.08	0.00	0.00	0.06	0.00	0.00	0.00
16	0.00	0.02	0.47	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
18	0.19	0.77	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.76
19	1.20	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
20	0.55	0.00	0.20	0.00	0.03	0.00	0.48	0.00	0.06	0.00	0.00	0.00
21	0.00	0.00	1.23	0.00	0.21	0.00	0.00	0.00	0.51	0.00	0.00	0.00
22	0.00	0.44	0.00	0.00	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.07	0.00	0.00	0.56	0.85	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.56	0.00	1.52	0.52
25	0.00	0.75	0.00	0.00	0.57	0.10	1.36	0.00	0.92	0.27	0.05	0.00
26	0.00	0.55	0.00	0.00	0.59	0.30	0.93	0.00	0.00	0.00	0.00	0.00
27	0.00	0.05	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.24	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.55	0.00	1.68	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.22	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
Total	**3.10**	**3.06**	**6.31**	**0.88**	**3.90**	**3.06**	**4.37**	**1.28**	**5.26**	**0.83**	**1.79**	**2.95**

Rainfall (inches) in Cleveland Community

Day	2002											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.12	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.23	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.17	0.00	1.08	0.00	0.02	0.00	0.04	0.00	0.00	0.00	0.00	0.00
4	0.20	0.00	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.48	0.00	0.37	0.00	0.00	0.00	0.00	1.78
6	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	1.57	0.00
7	0.12	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.29	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.31	0.00	0.41	0.00	0.00	0.00	0.00	0.02	0.30	0.00
11	0.00	0.00	0.00	0.24	0.00	0.00	0.73	0.00	0.00	0.18	0.99	1.66
12	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00
13	0.00	0.00	1.04	0.49	0.00	0.00	1.27	0.00	0.00	0.00	0.00	0.33
14	0.00	0.00	0.00	0.00	0.26	0.00	0.14	0.00	1.36	0.36	0.00	0.79
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	2.01	0.56	0.00	0.00
16	0.00	0.00	0.00	0.08	0.00	0.00	0.28	1.65	1.42	2.52	1.35	0.00
17	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.56	0.50	0.00	0.15	0.00
18	0.00	0.00	0.27	0.04	0.31	0.00	0.00	0.04	0.02	0.00	0.00	0.00
19	0.17	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.19	0.00	0.00	0.00
20	1.85	0.00	0.08	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	1.28
21	0.05	0.37	0.00	0.06	0.00	0.00	0.00	0.00	0.03	0.09	0.06	0.00
22	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.02	0.00	0.00
23	1.27	0.00	0.00	0.00	0.00	0.01	0.10	0.00	0.24	0.00	0.00	0.00
24	0.14	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.01	0.00	1.04
25	0.78	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	1.04	0.00	0.00	0.00
27	0.00	0.00	0.24	0.00	0.00	1.33	0.12	0.31	0.88	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.01	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00
31	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**4.97**	**1.95**	**5.41**	**0.94**	**4.44**	**1.52**	**3.10**	**3.19**	**8.29**	**5.09**	**4.79**	**7.85**

Rainfall (inches) in Cleveland Community

Day	2003											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.46	0.00	0.12	0.00	0.00	0.00	2.43	0.48	0.00	0.00	0.00	0.00
2	0.14	0.00	0.00	0.00	0.00	0.00	0.99	1.29	0.00	0.00	0.00	0.00
3	0.34	0.00	0.00	0.00	0.52	0.04	0.21	0.52	0.00	0.03	0.00	0.00
4	0.00	0.35	0.00	0.00	0.00	1.14	0.00	0.00	0.03	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.14	0.00	0.00	0.00
6	0.00	0.00	1.27	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.12	0.00
7	0.00	0.52	0.00	1.48	1.45	1.25	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.52	0.00	1.10	0.00	0.42	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.12	0.00	0.93	0.00	0.00
10	0.00	0.19	0.00	0.11	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	1.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.04	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.07	0.00	0.00
14	0.02	0.00	0.03	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.19	0.03	0.00	0.00	0.11	1.92	0.00	0.00	0.00	0.00	0.00
16	0.00	0.01	0.54	0.00	0.00	0.12	0.30	0.00	0.00	0.00	0.00	0.00
17	0.00	0.62	0.11	0.00	0.00	0.06	0.22	0.00	0.00	0.00	0.00	0.00
18	0.26	0.00	0.26	0.82	0.00	0.14	0.19	1.87	0.00	0.00	0.00	0.00
19	0.00	0.00	0.12	0.57	0.06	0.04	0.47	0.33	0.00	0.00	2.08	0.00
20	0.00	0.00	2.34	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00
21	0.10	0.00	0.17	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00
22	0.00	0.36	0.00	0.00	1.13	0.00	0.30	0.89	0.00	0.00	0.00	0.00
23	0.42	1.72	0.00	0.00	2.56	0.00	0.00	1.33	1.23	0.00	0.00	0.00
24	0.00	0.00	0.76	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.12	0.09	0.00	0.00	0.00
27	0.00	0.62	0.00	1.33	0.00	0.31	0.10	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.31	0.00
29	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
30	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.07	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00
Total	**2.35**	**4.58**	**5.75**	**6.39**	**7.13**	**4.74**	**8.43**	**8.33**	**1.49**	**1.07**	**2.51**	**3.33**

Rainfall (inches) in Cleveland Community

Day	2004											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	1.06	0.00	0.24	0.00	0.21	0.00	0.00	0.60
2	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	1.30	0.00	1.00	0.00
3	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.34	0.00
4	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	1.85	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
6	0.00	1.02	0.00	0.00	0.00	0.00	0.04	0.00	0.10	0.00	0.00	0.35
7	0.00	1.38	0.00	0.00	0.00	0.00	0.02	0.00	2.20	0.00	0.00	0.84
8	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	3.80	0.00	0.00	0.17
9	0.12	0.00	0.00	0.00	0.13	0.00	0.01	0.00	0.00	0.00	0.00	1.93
10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35
11	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
12	0.00	0.00	0.00	0.31	0.00	0.00	1.22	0.50	0.00	0.00	1.66	0.00
13	0.00	0.27	0.00	1.27	0.00	0.00	0.00	0.90	0.00	0.30	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.16	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.07	0.00	0.02	0.00	2.70	0.00	0.00	0.00
18	0.37	0.00	0.00	0.00	0.03	0.00	0.17	0.30	0.30	0.00	0.00	0.00
19	0.00	0.08	0.08	0.00	0.06	0.00	0.10	0.00	0.00	0.85	0.16	0.00
20	0.00	0.00	0.00	0.00	0.00	0.42	0.20	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.04	0.00	0.00	1.01	0.00	0.70	0.00	0.00	0.04	0.00
22	0.00	0.00	0.00	0.00	0.00	0.86	0.72	0.37	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.43	0.07	0.00	0.00	0.00	0.29	2.30
24	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.15	0.70	0.00
25	0.56	0.00	0.00	0.00	0.00	0.49	0.02	0.50	0.00	0.00	0.14	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.37	0.00	0.28	0.62	0.00	0.30	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.56	0.28	0.00	2.63	0.00	0.20	0.00
29	0.23	0.00	0.00	0.00	0.00	0.24	0.02	0.46	0.00	0.12	0.00	0.00
30	0.00	0.00	0.65	0.00	0.54	0.38	0.40	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.35	0.00	0.21	0.00	1.01	0.00	0.00	0.00	0.00	0.00
Total	**1.48**	**3.45**	**1.52**	**1.95**	**2.64**	**5.16**	**5.30**	**3.73**	**14.09**	**1.46**	**6.42**	**7.54**

Rainfall (inches) in Cleveland Community

Day	2005											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	1.21	1.80	0.53	0.46	0.00	0.00	0.00	0.00
2	0.00	0.04	0.00	0.05	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.88	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
5	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	1.06
6	0.24	0.00	0.00	0.00	0.00	0.00	0.92	0.00	0.00	2.16	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.32	0.00	0.00
8	0.00	0.00	0.69	0.25	0.00	0.65	4.60	1.06	0.00	0.33	0.00	0.00
9	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.68
10	0.00	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.16	0.07	0.31	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00	0.44	0.20	0.21	0.00	0.00	0.00	0.00
13	0.45	0.00	0.00	0.45	0.00	0.45	0.45	0.00	0.00	0.00	0.00	0.00
14	1.35	0.09	0.00	1.50	0.00	0.00	0.46	0.00	0.00	0.00	0.00	0.00
15	0.00	0.21	0.00	0.20	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.22
16	0.00	0.03	0.89	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.13	2.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.15	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.22	0.00	0.00	0.00	0.30	0.21	0.00	0.00	0.00	0.00	0.00
21	0.00	0.65	0.00	0.00	1.31	0.06	0.00	0.50	0.00	0.00	0.36	0.00
22	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
23	0.04	0.00	0.42	0.53	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
24	0.00	0.60	0.00	0.12	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56
26	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	2.00	0.37	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00
28	0.45	0.88	1.00	0.00	0.00	2.34	0.00	0.77	0.00	0.00	0.00	0.40
29	0.53	0.00	0.00	0.00	0.00	0.65	1.65	0.00	0.51	0.00	0.21	0.05
30	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.51	0.00
31	0.00	0.00	0.75	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**3.06**	**3.60**	**6.35**	**4.31**	**3.46**	**10.79**	**9.91**	**5.43**	**0.51**	**2.81**	**2.36**	**5.48**

Rainfall (inches) in Cleveland Community

Day	2006											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00
3	1.12	0.52	0.00	0.29	0.00	1.53	0.00	0.00	0.20	0.00	0.00	0.00
4	0.60	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.45	0.58	0.00	0.48	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.58	0.00	0.16	0.00	0.00	0.00	0.00	0.00
7	0.00	0.08	0.00	0.00	0.34	0.00	0.06	0.00	0.16	0.00	1.03	0.00
8	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.14	0.00	0.03	0.62	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.79	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.46	0.00	0.00	0.00	0.00	0.04	2.70	0.00	0.08	0.21	0.00
13	0.60	0.00	0.03	0.00	0.00	0.07	0.00	0.05	1.50	0.00	0.00	0.03
14	0.20	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.27	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00
16	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00
17	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.43	0.12	0.00	0.00	0.00	0.00	0.20	0.00	0.00	3.31	0.00	0.00
19	0.00	0.00	0.00	0.70	0.00	0.05	0.00	0.00	0.67	0.00	0.00	0.00
20	0.00	0.00	0.03	0.00	0.54	0.00	0.28	0.00	0.00	0.15	0.00	0.00
21	0.00	0.02	1.20	0.43	0.00	0.00	0.10	0.66	0.00	0.00	0.00	0.00
22	0.34	0.00	0.10	1.26	0.12	0.00	0.35	2.05	0.08	0.63	0.21	2.00
23	0.06	0.20	0.00	0.00	0.11	0.00	0.00	0.22	0.00	0.00	0.00	0.45
24	0.23	0.00	0.00	0.00	0.00	0.00	1.96	0.00	0.83	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.04	0.00	0.00	1.70
26	0.00	0.00	0.00	0.07	0.00	5.85	0.00	0.00	0.00	0.00	0.00	0.03
27	0.00	0.00	0.00	0.00	0.00	1.79	0.00	0.00	0.00	0.80	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00
30	0.59	0.00	0.00	0.04	0.00	0.00	0.00	0.41	0.00	0.00	0.43	0.08
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.79
Total	**5.06**	**1.81**	**1.60**	**3.19**	**1.69**	**10.68**	**3.88**	**6.37**	**4.84**	**5.76**	**3.75**	**5.08**

Rainfall (inches) in Cleveland Community

Day	2007											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1	1.70	0.00	0.00	0.08	0.00	0.00	0.97	0.00	0.00	0.00	0.00	0.00
2	0.00	0.60	4.22	0.00	0.00	0.18	0.54	0.16	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.41	0.00	0.00
5	1.60	0.00	0.00	0.00	1.47	0.00	0.00	0.00	0.00	0.07	0.00	0.00
6	0.55	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	1.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.19	0.06	0.00	0.00	6.92	0.00	0.00	0.00	0.00
13	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.61	0.00	0.00	0.00	0.43	0.00	0.00	0.27	0.00	0.62	0.00
15	0.00	0.00	0.00	1.00	0.00	0.13	0.00	0.00	0.38	0.00	0.00	0.00
16	0.07	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.13
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.08	0.00	0.54
20	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.11	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	1.02	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	1.03	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.18	0.00	1.23
24	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.48	0.00	0.45	0.00	0.00
25	0.00	1.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.40	0.13	0.03	0.00	0.00	0.79	0.50
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.12	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.01
30	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.10	0.00	0.00	0.00	0.75
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.34
Total	**7.15**	**3.62**	**5.32**	**2.03**	**2.26**	**1.30**	**3.03**	**8.73**	**0.65**	**1.60**	**2.62**	**6.59**

Rainfall (inches) in Cleveland Community

Day	2008											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	1.58	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.48	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.07	0.00	0.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
5	0.00	0.00	1.26	1.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.19	0.00	0.39	0.00	0.00	1.65	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
9	0.02	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.07	1.63	0.00	0.00
10	0.28	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.85	0.00	0.00	0.00	0.50	0.00	0.90	0.00	0.00	0.00	0.00	1.95
12	0.00	0.00	0.00	0.13	0.00	0.10	0.00	0.00	0.00	0.00	0.00	1.70
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.41	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.10	0.31
16	0.00	0.00	1.03	0.00	0.54	0.00	0.00	0.11	0.49	0.00	0.00	0.19
17	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.96
18	0.00	0.89	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.13	0.00	1.63	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00
21	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.55
22	0.00	0.62	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00
23	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.65
26	0.00	0.46	0.00	0.00	0.00	0.00	0.07	2.31	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	1.27	0.20	0.00	0.00	1.98	0.10	0.00	0.00	0.00
28	0.00	0.00	0.00	0.92	0.00	0.07	0.25	0.12	0.00	0.00	0.00	0.58
29	0.00	0.00	0.26	0.00	0.00	0.00	1.05	0.12	0.00	0.00	1.00	0.00
30	0.28	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.30	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2.70**	**4.16**	**5.19**	**5.13**	**2.91**	**0.17**	**5.70**	**5.80**	**0.96**	**2.11**	**2.01**	**6.95**

Rainfall (inches) in Cleveland Community

Day	2009											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	1.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.11
2	0.00	0.00	0.60	0.55	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.63
3	0.00	0.05	0.00	0.02	0.25	0.17	0.00	0.15	0.00	0.00	0.00	1.98
4	0.54	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	1.00	1.46	0.00	0.21	0.00	1.07	0.00	0.04
6	1.27	0.00	0.00	0.00	0.07	0.00	0.00	0.17	0.00	0.05	0.00	0.00
7	1.72	0.00	0.00	0.00	0.62	0.00	0.24	0.00	0.00	0.10	0.00	0.00
8	0.03	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.02	0.00	0.08	0.00	0.00	0.00	0.00	2.30
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.74	0.33	0.00
11	0.00	0.00	0.00	1.40	0.00	0.36	0.00	0.00	0.00	0.00	4.75	0.00
12	0.00	0.57	0.00	0.00	0.00	1.28	0.00	0.00	0.00	0.00	0.05	0.00
13	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.48	0.00	0.66	0.00	0.53
14	0.00	0.00	0.69	0.25	0.15	0.00	0.00	0.00	0.00	0.21	0.00	0.00
15	0.00	0.05	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.04
16	0.00	0.00	0.13	0.00	0.00	1.42	0.00	0.00	0.00	0.40	0.00	0.00
17	0.00	0.00	0.20	0.00	0.20	0.62	0.45	0.32	0.27	0.58	0.00	0.00
18	0.00	0.50	0.00	0.00	0.65	0.11	0.00	0.00	1.31	0.00	0.42	0.00
19	0.00	0.13	0.21	0.00	0.00	0.24	0.00	0.00	1.21	0.00	0.12	1.80
20	0.00	0.00	0.00	0.65	0.00	0.00	0.00	0.25	0.79	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.16	0.93	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.90	0.00
24	0.00	0.00	0.00	0.00	0.80	0.00	0.93	0.00	0.00	0.71	0.00	1.84
25	0.00	0.00	0.35	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.04	0.14
26	0.00	0.00	0.56	0.00	0.26	0.00	0.00	0.00	0.12	0.00	0.00	0.00
27	0.00	0.00	0.28	0.00	0.67	0.06	0.00	0.00	0.94	0.00	0.00	0.00
28	0.45	1.30	1.54	0.00	0.30	0.00	0.22	0.00	0.00	1.50	0.00	0.00
29	0.00	0.00	0.00	0.00	0.24	0.00	1.01	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00	0.00	0.00	0.00	0.60	0.17	0.00	0.26	0.00	0.25
Total	**4.01**	**2.60**	**7.06**	**3.41**	**7.06**	**5.90**	**4.16**	**2.06**	**6.84**	**6.86**	**7.25**	**9.66**

Rainfall (inches) in Cleveland Community

Day	2010											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.07	0.00	0.00	0.00	0.00	0.30	0.00	0.20	0.00	0.08	0.00	2.67
2	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.28	0.16	0.00	1.13	0.23	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.30	0.00	0.00	2.23	0.00	0.00	0.38	0.00
5	0.00	1.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
6	0.00	1.47	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.15	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.05	0.00	0.00	0.00	0.09	0.26	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.16	0.00	0.08	0.06	0.00	0.40	0.04	0.00	0.00	0.00
12	0.00	0.00	0.61	0.00	0.09	0.00	0.00	0.00	0.30	0.00	0.00	0.27
13	0.00	0.09	0.96	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
14	0.00	0.00	0.02	0.00	0.00	0.00	0.10	0.10	0.00	0.00	0.00	0.00
15	0.00	0.40	0.00	0.00	0.00	0.48	0.00	1.47	0.00	0.00	0.00	0.00
16	1.95	0.00	0.00	0.00	0.00	0.44	2.16	0.48	0.00	0.00	0.60	0.46
17	0.05	0.00	0.00	0.00	0.38	0.45	0.00	0.00	0.00	0.00	0.59	0.00
18	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.01	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.30	0.00	0.00	0.18	0.00	0.00	0.00	0.10	0.00	0.09	0.00	0.00
22	0.30	0.62	1.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
25	3.12	0.06	0.00	2.82	0.15	0.00	0.00	0.02	0.00	0.05	0.00	0.00
26	0.00	0.00	0.16	0.00	0.00	0.40	0.21	0.00	0.05	0.64	0.24	0.41
27	0.00	0.00	0.00	0.00	0.22	0.00	0.02	0.82	1.92	0.48	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.72	0.44	0.00	0.00
29	0.00	0.00	0.55	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.26	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.17	0.00	1.52	0.00
31	1.00	0.00	0.00	0.00	2.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**7.74**	**4.88**	**3.62**	**4.40**	**5.42**	**3.04**	**3.26**	**6.34**	**3.20**	**1.78**	**3.45**	**3.81**

Rainfall (inches) in Cleveland Community

	2011											
Day	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1	0.00	0.06	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	1.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.15	0.00	0.00	0.50	0.00	0.00	0.03	0.00	0.00	1.09	0.00
5	0.00	1.15	0.00	0.92	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00
6	0.00	0.00	0.92	0.00	0.00	0.00	0.93	0.00	2.27	0.00	0.00	0.33
7	0.00	0.00	2.32	0.00	0.00	0.00	0.11	0.00	0.04	0.00	0.00	1.02
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
9	0.00	0.00	0.15	0.00	0.00	0.12	0.74	0.31	0.00	0.00	0.00	0.00
10	0.33	0.00	1.74	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00
11	0.36	0.00	0.04	0.00	0.00	0.00	0.00	0.05	0.00	0.12	0.00	0.00
12	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.91	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.30	0.29	0.00	0.00	0.00	0.14	0.00	0.00
15	0.00	0.00	0.00	0.00	0.26	0.00	0.92	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.81	1.71	0.00	0.75	0.24	0.00	0.00	0.00	1.00	0.00
17	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	1.37	0.00
18	0.13	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.05	0.00	0.00	0.00	0.00	0.21	0.00	0.22	0.00	0.54	0.00	0.00
20	0.00	0.00	0.10	0.00	0.00	0.14	0.00	0.55	0.00	0.23	0.00	0.00
21	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.72	0.00	0.07	1.00
22	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	2.00	0.00	0.06	0.18
23	0.00	0.00	0.00	0.00	0.00	0.71	0.00	0.00	1.08	0.00	0.58	1.31
24	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.25	0.00	0.00	0.00	0.07	0.00	0.00	0.05	0.00	0.00	0.00
26	0.75	0.00	0.00	0.20	0.00	0.00	0.98	0.00	0.08	0.00	0.00	0.00
27	0.00	0.00	2.49	0.00	1.28	0.00	0.00	0.00	0.20	0.00	0.00	1.22
28	0.00	0.00	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.04
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	2.27	0.00
30	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
31	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**2.56**	**2.99**	**11.28**	**4.04**	**2.46**	**2.95**	**3.92**	**3.23**	**6.44**	**1.88**	**7.07**	**5.29**

Rainfall (inches) in Cleveland Community

Day	2012											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.73	0.00	0.64	0.00	0.00
2	0.00	0.11	0.50	0.00	0.00	0.00	0.00	0.00	0.00	1.73	0.00	0.00
3	0.00	0.00	1.21	0.65	0.00	0.00	0.00	0.68	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.13	0.00	1.14	0.55	0.00	0.00	0.00
5	0.00	0.28	0.00	0.46	0.00	0.33	0.00	0.00	0.36	0.00	0.00	0.00
6	0.00	0.00	0.00	1.15	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.09	0.00	0.42	0.00	0.00
8	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.27	0.00	0.00	0.20	0.00
9	0.09	0.00	0.56	0.00	1.12	0.00	0.07	0.20	0.05	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0.00	0.00	0.00	0.00
11	0.58	0.00	0.00	0.00	0.00	0.36	3.94	1.05	0.00	0.00	0.00	0.30
12	0.58	0.00	0.00	0.00	0.00	0.80	0.85	0.82	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.33	0.00
14	0.00	0.00	0.04	0.00	3.96	1.12	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.04	0.00	0.67	0.00	0.00	0.70	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.02	0.00	0.00	0.00	1.00	0.00	1.53	0.00	0.00	0.63
18	0.86	0.00	0.50	1.54	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.15
19	0.00	0.00	0.00	0.15	0.00	0.00	0.27	0.31	0.75	0.00	0.00	0.00
20	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	1.25	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	1.30
22	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.05	0.42	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00
24	0.88	0.00	0.30	0.00	0.50	0.00	0.00	0.32	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.45
26	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	1.85
27	0.31	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.18	0.00	0.00	0.71	0.00	0.00	0.86	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.08	0.00	0.00	0.00	0.00
31	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**4.55**	**1.15**	**3.88**	**4.53**	**6.89**	**2.77**	**7.54**	**12.14**	**4.07**	**3.49**	**0.53**	**5.68**

Rainfall (inches) in Cleveland Community

Day	2013											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.01	0.30	0.76	0.48	0.00	0.00	0.00
2	0.86	0.00	0.00	0.00	0.01	0.00	0.74	0.28	0.18	0.00	0.00	0.00
3	0.00	0.03	0.00	0.00	0.08	1.54	0.05	0.00	0.00	0.00	0.28	0.00
4	0.00	0.00	0.00	0.00	0.00	0.01	1.70	0.00	0.07	0.00	0.00	0.10
5	0.00	0.00	0.00	0.71	2.35	0.00	1.00	0.00	0.00	0.00	0.00	0.15
6	0.00	0.00	0.58	0.00	1.14	0.56	0.89	1.21	0.00	0.00	0.00	0.73
7	0.00	0.00	0.00	0.00	0.00	0.64	0.77	0.12	0.00	1.15	0.03	0.00
8	0.00	0.65	0.00	0.00	0.19	0.41	0.05	0.67	0.00	0.00	0.00	0.10
9	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	1.50
10	0.00	0.00	0.00	0.00	0.00	1.09	0.59	0.19	0.00	0.00	0.00	0.49
11	0.24	0.66	0.00	0.00	0.00	0.60	0.06	0.11	0.00	0.00	0.00	0.00
12	0.51	0.00	1.70	1.30	0.10	0.00	0.00	0.68	0.00	0.00	0.00	0.00
13	0.00	0.22	0.00	0.00	0.00	0.00	1.82	0.16	0.47	0.00	0.00	0.00
14	0.76	0.00	0.00	0.00	0.00	0.10	0.23	0.00	0.00	0.11	0.00	0.00
15	0.74	0.00	0.00	0.32	0.00	0.00	0.22	1.33	0.00	0.00	0.00	1.31
16	1.57	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00
17	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	2.24	0.00	0.00	1.26	1.30	3.41	0.20	0.39	0.00	0.00	1.16	0.00
19	0.00	0.00	0.67	0.00	0.30	0.20	0.00	1.49	0.00	0.00	0.00	0.00
20	0.00	0.26	0.00	1.06	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.20	0.00	0.00	0.00	0.00
22	0.00	0.55	0.00	0.00	0.00	0.00	0.79	0.00	2.10	0.00	0.42	0.21
23	0.00	0.00	0.00	0.00	1.25	0.00	0.16	0.22	0.00	0.11	0.00	2.00
24	0.00	0.57	1.17	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.15
25	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.40	0.00	0.00	0.00
26	0.05	1.44	0.00	0.00	0.00	0.24	0.00	0.00	0.26	0.00	0.00	0.00
27	0.00	0.10	0.00	0.00	0.00	0.70	4.35	0.00	0.00	0.00	1.25	0.00
28	0.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
29	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.26
30	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00
31	1.27	0.00	0.57	0.00	0.00	0.00	0.08	0.80	0.00	0.00	0.00	0.00
Total	**8.66**	**4.48**	**4.74**	**6.84**	**6.72**	**9.85**	**14.84**	**9.20**	**3.96**	**1.37**	**6.14**	**8.00**

Rainfall (inches) in Cleveland Community

Day	2014											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.32	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.27	0.21	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.10	0.00	0.00	0.00	0.71	0.00	0.00	0.69	0.00	0.00
5	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.22	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	1.24	2.60	0.00	0.00	0.00	0.14	0.00	0.00	0.12	0.31
8	0.00	0.00	0.22	0.40	0.00	0.16	0.00	0.00	0.22	0.08	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.56	0.00	0.00	0.00	0.00
10	0.68	0.00	0.00	0.00	0.39	0.44	0.00	2.00	0.00	0.00	0.00	0.00
11	1.78	0.09	0.00	0.00	0.10	0.27	0.00	0.00	0.00	0.00	0.00	0.00
12	0.55	0.00	0.03	0.00	0.00	1.09	0.00	0.00	0.15	0.61	0.00	0.00
13	0.00	0.87	0.08	0.00	0.00	0.00	0.00	1.61	1.85	0.72	0.00	0.00
14	0.25	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.40	0.00	0.00	0.00
15	0.00	0.05	0.00	0.84	1.47	0.00	0.00	0.00	0.10	2.36	0.00	0.00
16	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00
17	0.00	0.00	1.10	0.00	0.00	1.53	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.10	0.18	0.00	0.30	0.00	0.54	0.12	0.00	0.00	1.31	0.00
19	0.00	0.50	0.00	0.99	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.18	0.00	0.10	0.80	1.17	0.00	0.00	0.00	0.13
21	0.00	0.70	0.00	0.00	0.00	0.82	0.10	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.02	0.00	0.00	2.38	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.23	0.41
24	0.00	0.00	0.10	0.00	0.00	0.17	0.00	0.00	0.00	0.00	2.40	1.91
25	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12
26	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.66	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00
28	0.00	0.00	0.00	0.00	0.18	0.00	0.17	0.00	0.00	0.00	0.00	0.00
29	0.05	0.00	0.25	0.00	0.00	0.32	0.00	0.00	0.12	0.00	0.00	0.20
30	0.00	0.00	0.28	0.00	0.29	0.52	0.00	0.00	0.00	0.00	0.00	0.04
31	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00
Total	**3.80**	**2.99**	**3.83**	**5.85**	**3.01**	**5.98**	**5.46**	**7.36**	**3.04**	**4.46**	**5.14**	**3.12**

Rainfall (inches) in Cleveland Community

Day	**2015**											
	January	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
1	0.00	0.00	0.07	0.00	0.00	0.61	0.00	0.00	0.00	0.75	0.17	0.28
2	0.00	1.43	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.81	1.68	1.72
3	0.60	0.00	0.00	0.13	0.00	0.22	0.42	0.00	0.00	1.42	1.21	0.05
4	0.00	0.00	0.15	0.06	0.00	0.28	0.28	0.00	0.00	1.98	0.00	0.00
5	2.14	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00
6	0.00	0.00	0.20	0.00	0.00	0.28	0.05	0.00	0.00	0.00	0.48	0.00
7	0.00	0.00	0.00	0.77	0.00	0.03	0.00	0.22	0.00	0.00	0.48	0.00
8	0.00	0.00	0.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00
9	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.42	0.00	1.79	0.00
10	0.00	0.52	0.00	0.13	0.00	0.53	0.00	0.30	1.20	0.00	0.34	0.00
11	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.12	0.00	0.91	0.00	0.00
12	0.71	0.00	0.00	0.00	0.30	0.33	0.00	0.57	0.00	0.00	0.00	0.00
13	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
14	0.00	0.00	1.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18
15	0.00	0.00	0.10	0.26	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.69
16	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	1.04	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.09
18	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.59	0.00	0.00	0.15	0.22
19	0.00	0.00	0.07	0.50	0.10	0.06	0.00	0.40	0.00	0.00	2.40	0.00
20	0.00	0.00	0.31	0.88	0.23	0.00	0.12	0.38	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.73	0.00	0.41	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81
23	0.15	0.00	0.05	0.00	0.00	0.00	0.00	1.70	0.00	0.00	0.00	0.42
24	0.90	0.05	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	2.45
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.00	0.00	0.70
26	0.00	0.58	0.00	0.22	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.60
27	0.00	0.00	0.11	0.03	0.87	0.20	0.00	0.00	0.09	0.45	0.00	0.00
28	0.00	0.00	0.09	0.00	0.00	0.14	0.00	0.00	0.11	2.34	0.00	0.00
29	0.00	0.00	0.00	0.00	0.25	0.00	0.92	0.00	0.10	0.21	0.00	1.70
30	0.00	0.00	0.22	0.05	0.00	0.00	0.22	0.00	0.10	0.00	1.01	0.25
31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.45
Total	**4.53**	**4.05**	**2.64**	**6.59**	**1.75**	**4.29**	**2.28**	**4.40**	**3.56**	**9.17**	**9.82**	**11.61**

Rainfall (inches) in Cleveland Community

Day	2016											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.00	0.43	1.70	0.00	0.00	0.00	1.03	0.00	0.00	0.60
2	0.00	0.00	0.25	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.12	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.80	0.21	0.69	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.50
5	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35
6	0.15	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.69
7	0.91	0.00	0.00	0.00	0.00	0.05	0.06	0.75	0.00	0.00	0.00	0.10
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.98	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.70	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	2.00	0.20	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.02	0.40	0.00	0.23	0.00	0.00	0.21	0.00	0.00	0.00	0.00
14	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
15	0.00	0.00	0.61	0.00	0.00	0.75	0.00	0.00	0.00	0.00	0.00	0.00
16	1.69	0.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.02	0.02	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.19
19	0.00	0.00	0.00	0.00	0.85	0.00	0.20	0.00	0.00	0.00	0.00	0.15
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00
21	0.00	0.00	0.10	0.00	0.79	0.00	0.00	1.06	0.00	0.00	0.00	0.00
22	0.71	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.79	1.97	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.88	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.06	0.00	0.04	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.08
28	0.00	0.00	0.15	0.00	0.00	0.30	0.00	0.00	0.22	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.68
30	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.30	0.00
31	0.00	0.00	0.00	0.00	1.24	0.00	0.66	0.00	0.00	0.00	0.00	0.00
Total	**4.38**	**4.49**	**2.00**	**1.36**	**6.15**	**1.13**	**4.62**	**5.17**	**1.25**	**0.98**	**2.14**	**3.38**

Rainfall (inches) in Cleveland Community

Day	2017											
	January	February	March	April	May	June	July	August	September	October	November	December
1	0.00	0.00	0.54	0.00	0.00	0.09	0.59	0.00	0.75	0.00	0.00	0.00
2	1.13	0.00	0.41	0.00	0.75	0.00	0.00	0.00	0.73	0.00	0.00	0.00
3	0.69	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00
4	0.02	0.00	0.00	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00
5	0.00	0.00	0.00	0.00	2.22	1.17	0.10	0.93	0.00	0.00	0.03	0.00
6	0.00	0.00	0.00	1.49	0.00	0.20	0.00	0.00	0.54	0.00	0.00	0.52
7	0.50	0.00	0.00	0.00	0.09	0.00	0.01	0.88	0.68	0.00	0.00	0.00
8	0.00	0.20	0.12	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.73	0.00
9	0.00	0.16	0.00	0.00	0.00	0.00	1.10	1.12	0.00	2.43	0.11	0.94
10	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.05
11	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.06	0.00	0.38	0.00	0.00	0.00	0.00	1.49	1.77	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.49	0.21	0.00	0.00	0.20	0.00	0.07	0.00
14	0.00	0.00	0.15	0.00	0.00	0.00	0.00	1.13	0.00	0.00	0.00	0.00
15	0.00	0.28	0.00	0.09	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00
16	0.00	0.21	0.00	0.00	0.00	0.48	0.53	0.00	0.00	0.37	0.00	0.00
17	0.02	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00
18	0.01	0.00	0.01	0.31	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	1.52	0.00	0.07	0.00	0.00	0.00	0.00	0.11	0.00
20	0.54	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.21
21	0.00	0.00	0.00	0.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66
22	1.22	0.30	1.53	0.00	1.30	0.12	0.00	0.00	0.00	0.00	0.00	0.00
23	1.23	0.08	0.00	1.17	0.10	0.74	0.00	0.00	0.00	0.66	0.00	0.20
24	0.00	0.00	0.00	1.64	0.45	0.15	0.00	0.00	0.00	4.00	0.00	0.33
25	0.00	0.00	0.00	1.15	0.40	0.18	0.00	0.00	0.00	0.00	0.00	0.00
26	0.04	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.61	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	1.62	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.68	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00
Total	**5.51**	**1.23**	**5.19**	**8.84**	**7.80**	**4.99**	**3.71**	**6.78**	**4.67**	**9.12**	**1.26**	**2.91**

APPENDIX D

SCDHEC’s procedures for determining the Aquatic Life Use Support (ALUS) of a stream

Section 1 Aquatic Macroinvertebrates

1.0 Introduction

Aquatic macroinvertebrates are insects and other invertebrates associated with streams, rivers, lakes, and estuaries. Aquatic macroinvertebrate communities can be useful indicators of water quality because they respond to integrated stresses over time, and reflect fluctuating environmental conditions. Community response to various pollutants (e.g. organic, toxic, and sediment) may be assessed through interpretation of diversity, known organism tolerances, and, in some cases, relative abundance and feeding behavior types.

Regional ambient monitoring generates data, which represent the general biological condition of state waters that may be subject to a variety of point and nonpoint source impacts. The Aquatic Biology Section (ABS) uses these ambient macroinvertebrate data to support a variety of state and federal programs. Additionally, special macroinvertebrate studies are conducted at various sites to evaluate specific potential point and nonpoint source pollution impacts.

1.1 Field Collection Methods

1.1.2 Timed-qualitative Multiple Habitat Sampling Protocol

The ABS uses a timed-qualitative, multiple habitat sampling protocol (MHSP) to collect macroinvertebrates. Multiple habitat sampling of some type is widely used by many regulatory and non-regulatory agencies both in the United States and abroad (Barbour, et al., 1997; USEPA, 1997; Marchant, et al., 1997). The greatest benefit from using the MHSP is that it enables resource managers to collect representative macroinvertebrate taxa from the wide variety of natural habitats in a stream. Since macroinvertebrates occupy a variety of habitat types, many taxa may be excluded when select habitats are sampled by specific sampling devices (e.g. Surber net, Ponar dredge, etc.). This may lead to exclusion of a variety of taxa and spurious assessments.

At ambient monitoring sites, a team of two or three biologists (never less than two) samples for aquatic macroinvertebrates for approximately three person-hours (three person-hours represent three biologists sampling for one hour, or two biologists sampling for one and one half hours). With the aid of a D-frame dip net, kick net, metal sieve, white pan and a fine mesh sampler, all the available natural habitats are sampled. Macroinvertebrates are also collected directly from the habitat with forceps. All macroinvertebrates are placed in jars or vials filled with 85% ethanol (EtOH) and labeled with the station number, collector, and collection date. If a station number has not been established other data such as county, stream name, and nearest road is listed on the label. It is highly desirable to list the latitude and longitude on the label unless this information is readily available through a geographic information system.

The goal of the sampling team is to collect as many different macroinvertebrate taxa as possible during the allotted time. Although the MHSP is a qualitative method, the actual collection of samples is a disciplined procedure designed to ensure that all the habitats present at a site are thoroughly sampled, irrespective of what type of habitat is available or where the sample is collected. Rivers and streams from the mountains to the coastal plain of South Carolina vary in habitat type and amount available for colonization by macroinvertebrates. For example, mountain sites are often dominated by rock/gravel riffle stream substrate, woody debris, and root wads, while coastal sites are dominated by aquatic vegetation, root wads, woody debris, and sandy to muddy stream substrate. Between the mountains and coastal plain lies the piedmont, which has a combination of some or all of the above habitats. Regardless of what region or what kind of habitat is being sampled, the MHSP insures that an adequet representation of the macroinvertebrate community is obtained. The following is a discussion of the MHSP with detailed steps on how to properly collect macroinvertebrate samples from the variety of stream habitats.

A. Chironomidae and Small Macroinvertebrate Collection Procedure

A very important component of the macroinvertebrate community is the midge family Chironomidae. Midges generally account for at least 50% of the total species diversity in most systems (Merritt and Cummins, 1996). Since midges are relatively small, they are collected with fine mesh samplers. The fine mesh samplers are made with Nytex (micro-screen cloth material) that has a mesh size of 300 µm. One sampler is a mesh bag, 0.5 m by 1.0 m, made from a folded sheet of Nytex sewn together on two sides. This bag is used to collect midges from the sand. The other sampler is a 13.0 cm long by 10.0 cm diameter piece of PVC pipe with a Nytex covering on one end. This is used to strain water from the bucket in which midges are washed from the habitats. Although the objective of the fine mesh net is to collect midges, it can also collect other small macroinvertebrates.

Collection Steps:

1. Fill a 19.0 liter bucket approximate one half full with water.

2. Collect two or three samples of all the habitat types present at a stream site by hand (rocks, sticks, leaf packs, root wads, etc.) and rinse in the bucket to remove midges and other macroinvertebrates. Attached root wads and vegetation may be rinsed directly in the bucket without detachment.

3. Since some midge taxa are sand dwellers, select a sandy bottom site in the stream and collect midges by placing the small mesh bag on the bottom with the open end facing upstream. Disturb approximately a 1.0 m^2 area of the sand upstream of the bag and let the sand and midges drift into the bag. Collect three sand samples from three different areas of the stream. The bag is only used when there are sandy bottom areas available.

4. Empty the contents of the bag into the same bucket of water that contains the other habitat washes and rinse the bag up and down in the bucket to remove the attached midges.

5. Rinse and remove by hand as much of the larger debris as possible from the bucket and discard. Stir the water in the bucket and strain through the Nytex covered pipe.

6. Remove small portions of the detritus left in the bottom of the Nytex pipe and place in a white pan 1/4 filled with water. Spread the detritus evenly in the pan by hand so that the macroinvertebrates can be seen against the white background. With the aid of forceps and an eye-dropper, collect the midges and other small macroinvertebrates and preserve them in a jar filled with 85% EtOH.

7. Repeat step 6 until all the detritus in the Nytex pipe has been examined.

Do not collect more than 100 midges, but collect them in relative proportion to the size classes present. Other macroinvertebrates are sampled proportional to the relative abundance in each pan picked. Although the emphasis of the fine mesh sampler is to collect small macroinvertebrates, larger macroinvertebrates are collected as they are encountered.

B. D-frame Dip Net Collection Procedure

The habitat type most often sampled with the dip net is root wad habitat. Root wads are usually present at all stream sites, often at the margins, and they support a variety of small caddisflies and other taxa. Aquatic vegetation, when present, is also sampled with the dip net.

Collection Steps:

1. Root wads are sampled by repeatedly jabbing a D-frame dip net (500 μm mesh size) into the root along a stretch of bank until the net is about 1/4 full of detritus and root debris. Several root wads are washed down by hand into the dip net to remove firmly attached macroinvertebrates. Aquatic vegetation is sampled by sweeping the dip net through the vegetation two or three times.

2. Rinse the bottom of the dip net in the stream to remove excess mud and silt. If excess sediment or silt is present it is helpful to rinse the sample by dipping water into the net and allowing it to drain, all the time swirling the contents with your hand. This can be done several times in rapid succession. Remove small portions of the detritus left in the net and spread it evenly in a white pan 1/4 filled with water. Do not attempt to sort through so much detritus that the bottom of the pan is obscured.

3. Using forceps, remove macroinvertebrates from the pan and place in jar of 85% EtOH. It is helpful to allow the contents of the pan to settle and become still. This facilitates seeing the small macroinvertebrates as they begin to move about.

Based on the quality of the root banks and/or aquatic vegetation, collect one or two dip net samples in the root banks and two or three samples in the aquatic vegetation.

C. Kick Net Collection Procedure

The kick net is a 1.0 m^2 sheet of Nytex (500 µm mesh size) attached on two sides to 1.5 m long poles. The kick net is used to sample rock/gravel riffles and snags/leaf packs.

Collection Steps:

1. Place the kick net slightly downstream of the area to be sampled (snags/leaf packs and/or rock/gravel riffle). Disturb about 1.0 m^2 of the habitat and catch the debris and macroinvertebrates that drift into the net.

2. Spread the kick net out on a sand bar or a flat area on the bank and collect macroinvertebrates from the net with forceps and preserve them in a jar of 85% EtOH.

If the habitat is mostly snags/leaf packs, a minimum of two kick net samples should be taken. If the habitat is a mix of both rock/gravel riffle and snags/leaf packs, a minimum of one kick net sample should be taken from each habitat. In streams that are mostly rock/gravel riffle, a minimum of two kick net samples should be taken in the riffle areas. One kick net sample should be taken from a high velocity riffle area and the other from a low velocity riffle area.

D. Sieve Collection Procedure

Sieves are used to sample all habitat types and are also used during visual collections. Sieve sizes used are the U.S. #30 (0.6 mm openings) and the U.S. #10 (2.0 mm openings). The #10 sieve is used primarily in the sand while the #30 is used on all habitat types. The sieve enables the biologist to sample large amounts of habitat quickly and is invaluable for collecting sediment-dwelling taxa such as: Odonata (dragonflies), Gastropoda (snails), Pelecypoda (clams, mussels), Polycentropodidae (burrowing caddisflies), sand case building and burrowing caddisflies (Molannidae, Sericostomadidae, Dipseudopsidae, Odontoceridae), and Ephemeridae (burrowing mayflies). The sieve can be used effectively in the same habitat types that are sampled with the dip net and kick net.

Collection Steps:

1. Visually inspect the sand and mud for signs of macroinvertebrate activity. For example, the movement of burrowing odonates and mussels leaves trails in the sand. Small holes can be seen in the mud, clay, or sand in areas where burrowing mayflies are found. The tubes of *Phylocentropus* sp. larvae, when present, can be seen extending above the substrate.

2. With either the #10 or #30 sieve, sample the mud or sand where there are signs of macroinvertebrate activity (use #10 sieve primarily for sand substrates). Sift the excess sand, mud, silt, and detritus in the stream to trap macroinvertebrates in the sieve.

3. Collect macroinvertebrates from the sieve and place them in jar of 85% EtOH.

4. With the #30 sieve, sample root wad and snag sites and process as above.

F. Visual Collection Procedure

The collection procedure described above generally reguires1.5 person-hours to complete. For an additional 1.5 person-hours, stream habitats are visually searched for macroinvertebrates, and collected directly from the habitat with forceps and placed in jars filled with 85% EtOH. This requires removing rocks and logs from the water for inspection. For example, rocks and logs are searched for taxa such as the retreat building *Psychomyia* sp. (caddisfly) and for retreat building Hydropsychidae. The undersides of rocks are examined for macroinvertebrates such as Ephemeroptera (mayflies), Plecoptera (stoneflies), Gastropoda (snails), Psephenidae (water pennies) and Megaloptera (hellgrammites). The crevices in rocks and logs are searched for caddisflies such as *Nyctiophylax* sp., *Pycnopsyche* sp., and *Ceraclea* sp. Decaying logs are picked apart to reveal midges and other taxa. Aquatic vegetation, sticks, and limbs are visually searched for small caddisflies (Hydroptilidae and Brachycentridae) and other macroinvertebrates. Mature leaf packs, snags, and root wads are sampled with a #30 sieve to collect a variety of other macroinvertebrates.

G. Collection Procedures Summary

No attempt is made to collect all specimens encountered. If a taxon can be reliably identified in the field, only 10-15 specimens are collected, other taxa are collected in approximate proportion to their abundance in each sampling method (net, pan, sieve, etc.). Since the emphasis of the MHSP method is to collect different taxa, abundance is considered only in a relative sense (see Data Analysis). Some taxa are not collected including: Nematoda, Collembola, semiaquatic Coleoptera, and all Hemiptera except Naucoridae, Belostomatidae, Corixidae, and Nepidae. These are not collected because they are most often found on the water surface or on the banks, and are generally thought of as semiaquatic.

There is no established distance of stream reach sampled at any particular site. If there is good, fairly evenly distributed natural habitat, approximately 100 m of stream (both sides) is routinely sampled. In streams where there is sparse habitat, the distance covered may be more than 100 m. For ambient monitoring activities most sites are accessed at road bridges and are sampled upstream of the bridge, however, some situations may warrant sampling downstream (e.g. access and/or habitat limitations).

As previously noted, the MHSP is a three person-hour sampling effort. Approximately one hour is devoted to use of the kick net and dip net, while about one half hour is devoted to the fine mesh samplers. The rest of the time (one and one half hours) is spent using sieves and forceps to make visual collections of all habitat types present.

As a general rule, when teams of biologists sample a site, each one independently uses one of the three sampling devices (dip net, kick net, fine mesh nets) to sample the appropriate habitat. Upon completion, visual collections are begun and the sieve is used extensively. It is helpful for the sampling team to discuss the kinds and numbers of taxa present and absent at a site. This results in more efficient sampling. It is important that the field staff be trained and experienced macroinvertebrate taxonomist to use the MHSP effectively.

The sampling methodology described above requires that freshwater streams and rivers be wadeable for efficient sample collection. High water conditions can impair sampling efficiency by making some critical habitats inaccessible due to water depth and clarity. An underestimate of taxa richness may lead to spurious results. If high water levels and turbid conditions make sampling difficult, it is better to return to the site under more amenable sampling conditions.

Generally, nonwadeable rivers are not sampled for macroinvertebrates. However, when necessary, a boat is used to access the natural habitats for sampling. The sampling methodology remains the same but the duration may be increased to insure that all natural habitats have been adequately sampled. In low water areas, the river is sampled as a wadeable stream. Otherwise, the available natural habitat is sampled from the boat with dip nets and sieves and/or by dragging logs, sticks, root wads, etc., into the boat.

1.1.3 Equipment

1. D-frame dip net
2. Kick net
3. Sieves (U.S. number 10 and 30)
4. 13.0 cm (length) by 10.0 cm (dia) PVC fine mesh sampler
5. Fine mesh bag
6. 19.0 liter bucket
7. White pan
8. Forceps
9. Collection vials and jars filled with 85% EtOH
10. Collection labels and EtOH-proof pen or pencil
11. Physicochemical parameter equipment (pH meter, dissolved oxygen/temperature meter, conductivity meter, and stick thermometer)

1.2 Habitat Assessment

Habitat assessment is an important step towards understanding the effects of pollution on macroinvertebrate communities. The ABS conducts two kinds of habitat assessments at each sampling site. The first is a comprehensive assessment adopted from the Environmental Protection Agency’s (EPA) *Revisions to Rapid Bioassessment Protocols for Use in Streams and Rivers* (Appendix 1), and the second is a simplified form developed to meet specific needs of the ABS (Appendix 2). Instructions are included on the forms explaining how to evaluate each of the habitat metrics. Habitat metrics are independently evaluated by each biologist and averaged for a final score (on a single form).

The EPA habitat assessment (EPA-HA) provides a thorough evaluation of several conditions at a stream site that could affect stream habitat quality. It provides clues to why certain habitat types may be present or absent, and information about the general stream condition at the assessment site. Since the EPA-HA is a standardized form, it is very useful for reporting purposes and sharing data among the Southeastern states. In South Carolina the EPA-HA high gradient form is used in Blueridge and Piedmont ecoregions while the low gradient form is used for the Southeastern Plains and the Middle Atlantic Coastal Plains.

The simplified habitat assessment form (ABS-HA) provides more detailed information about instream macroinvertebrate habitat. It enables ABS biologists to make better assessments on the role of stream habitat in situations where pollution is involved. The form classifies the habitat into five categories and rates them from excellent to non-existent. This permits visualization of the habitats when the data are being analyzed, and helps to explain the presence or absence of certain taxa. In addition, the ABS-HA helps ABS biologists to cluster stations according to shared habitats when comparisons are made among stations.

1.3 Physicochemical Sampling Procedures

The stream dissolved oxygen, pH, temperature, and conductivity are measured at the time of macroinvertebrate sampling. Results are recorded in the Field Quality Control Logbook (Appendix 3). Specific operation and calibration procedures are followed as documented in the Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (SCDHEC, 2010).

1.4 Laboratory Methods

1.4.1 Sample Handling and Identification

At the end of each sampling day EtOH is decanted and the samples are reconstituted with fresh 85% EtOH. After returning to the ABS laboratory the samples are logged into the Macroinvertebrate Central Receiving Logbook (MCRL) (Appendix 4) and stored in a locked cabinet for further processing.

Before the sorting and identification of a macroinvertebrate sample begins, the taxonomist assumes custody of the sample by signing for it in the MCRL. Custody remains with the taxonomist until the sample has been identified and these data are recorded. Sample completion is noted in the MCRL.

Macroinvertebrates are generally sorted by taxonomic order and placed into separate vials or petri dishes for further identification. Specimens not requiring slide mounting are identified using a stereo dissecting scope capable of at least 40x magnification. Midges, some baetid mayflies, and on occasion other taxonomic groups are mounted on labeled (date and locality) slides with CMC-10 mounting media and identified with a compound microscope capable of 1000x magnification. Identifications are made to the lowest practical taxonomic level using the appropriate taxonomic references.

Midges are transferred to water and allowed to settle before mounting. A drop of CMC-10 mounting media is placed on a labeled slide, and the specimen(s) is oriented in the media so that the ventral side of the head capsule is up. To get the head arranged properly, it may be necessary to separate it from the body. A cover slip is placed over the specimen and gentle pressure is applied to spread the mouthparts. Several midges may be mounted on one slide. Slides are allowed to dry at least two days before identification.

Baetidae and certain other taxa that require slide mounting are set aside in a petri dish and the entire body or body parts are mounted, as necessary, for identification. A drop of CMC 10 mounting media is placed on a labeled slide. The whole specimen or parts such as the head or legs are placed in the drop of CMC 10 and, with forceps, a cover slip is placed over the specimen. Gentle pressure is applied to the cover slip to reveal the structures necessary for identification. Several specimens may be mounted on one slide. Slides are sometimes placed on a drying rack for two days before identification, although some taxa can be identified immediately.

After the sorted macroinvertebrates (except Chironomidae and some Baetidae) from a station have been identified and these data recorded on bench sheets, they are placed together in a single jar of 85% EtOH. This jar is labeled with station, date collected, and person who identified the sample, and is stored at least five years in the ABS voucher collection. If a new taxa record (i.e. one not previously collected from South Carolina) is identified from a site, it is removed from the voucher collection and stored separately in the ABS reference collection. A note is made on a bench sheet (a form used to record the number of taxa and specimens identified) when a specimen is relocated to the reference collection. Slide mounted specimens are stored separately in cabinets according to sample date and station. If mounted Chironomidae or other taxa are transferred to the reference collection, this is noted on the bench sheet.

1.4.2 Data Analysis

The taxa list, physicochemical data, and habitat information are entered into computer data base. This program is used for data management and reporting purposes.

Because the MHSP is a timed-qualitative method, metrics that require quantitative collection methods are not used. Two metrics that have proven to be very effective in evaluating macroinvertebrate data collected by qualitative methods are the EPT and biotic indices (Lenat, 1993; Wallace, 1996; Barbour, 1997). The EPT index is the total number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa collected at a site. Most EPT taxa are very intolerant of pollution and, in general, a high EPT count indicates excellent water quality.

The biotic index (BI) is the average pollution tolerance of all organisms collected (based on assigned index values for taxa) and the calculation factors in relative abundances. The index is based on a scale from 0 to 10, with 10 representing the most impaired stream conditions.

$$\text{Biotic Index (BI)} = \sum(\text{Tví})(\text{ní})/N$$

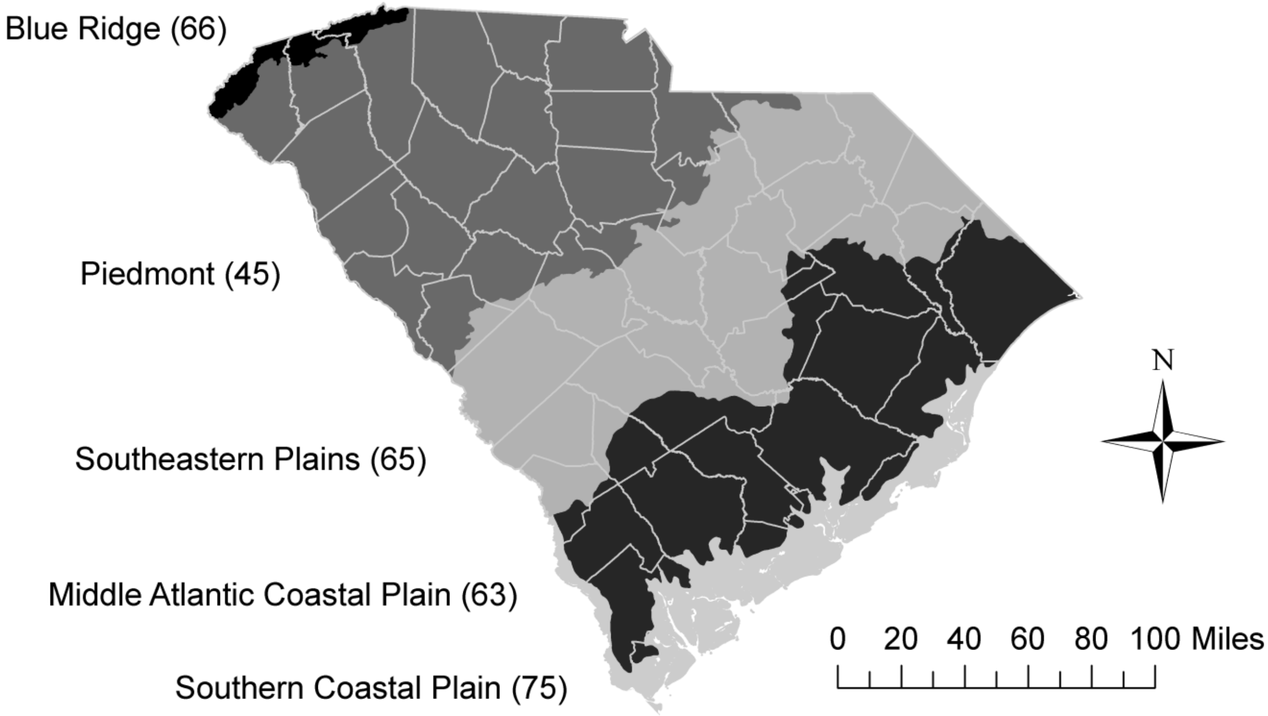
TVί = ίth taxon tolerance value
nί = ίth taxon abundance value
N = sum of all abundance values

Tolerance values were developed in North Carolina (NCDEHNR, 1997) and the SCDHEC uses a modification of these values (Appendix 4). Taxa with no assigned tolerance value are excluded from the calculation.

The calculation of the BI does not include all specimens collected in a sample but rather a maximum of 10 specimens per taxon. This is done to ensure that the BI for a site will not be biased because some taxa are more successfully collected than others. Since most taxa cannot be accurately identified in the field, it is common for some taxa to be more abundant in a sample. Taxa collected from freshwater streams are designated as Rare (1-2 individuals), Common (3-9 individuals) or Abundant (>10 individuals) and are assigned a 1, 3, and 10, respectively, for the calculation of the BI. If there are less than 100 total organisms in a sample, the BI is not used. Instead, the EPT index is used along with other data to assign a bioclassification.

Macroinvertebrate communities change across ecoregions so different BI and EPT criteria are used to establish bioclassifications for streams based on the ecoregion in which they occur. Figure 1 shows the ecoregions in South Carolina (after Omernik 1987, and Griffith et. al 2002). Macroinvertebrate Biocriteria have been established for 3 of South Carolina’s 5 level III ecoregions: Blue Ridge (66), Piedmont (45), and Southeastern Plains (65). Numeric biocriteria for the Middle Atlantic Coastal Plain (63) has yet to be fully developed but is currently being evaluated. Many of the streams in this ecoregion are swamp-like and become cry or stagnant in the summer months. Thus the macroinvertebrate diversity in these systems is often low and the organisms that are present tend to be hardy species that can tolerate extreme environmental conditions. This makes the stressor signal weak and often it is difficult to distinquish anthropogenic perturbation from natural environmental conditions.

Figure 1. Level 3 Ecoregions of South Carolina
(after Omernik, 1987)



Bioclassification of streams in South Carolina is based on the combination of equally weighted BI and EPT scores, and parallels North Carolina's criteria range:

Excellent = 5 Good = 4 Good-Fair = 3 Fair = 2 Poor = 1

Since North Carolina and South Carolina share similar ecoregions, the North Carolina bioclassification criteria are applied to South Carolina streams. The following tables are used to determine the scores for the EPT taxa richness values and BI values.

Score	BI Values			EPT Values		
	BR (66)	P (45)	SEP (65)	BR (66)	P (45)	SEP (65)
5.0	<4.0	<5.14	<5.42	>43	>33	>29
4.6	4.00-4.04	5.14-5.18	5.42-5.46	42-43	32-33	28
4.4	4.05-4.09	5.19-5.23	5.47-5.51	40-41	30-31	27
4.0	4.10-4.83	5.24-5.73	5.52-6.00	34-39	26-29	22-26
3.6	4.84-4.88	5.74-5.78	6.01-6.05	32-33	24-25	21
3.4	4.89-4.93	5.79-5.83	6.06-6.10	30-31	22-23	20
3.0	4.94-5.69	5.84-6.43	6.11-6.67	24-29	18-21	15-19
2.6	5.70-5.74	6.44-6.48	6.68-6.72	22-23	16-17	14
2.4	5.75-5.79	6.49-6.53	6.73-6.77	20-21	14-15	13
2.0	5.80-6.95	6.54-7.43	6.78-7.68	14-19	10-13	8-12
1.6	6.96-7.00	7.44-7.48	7.69-7.73	12-13	8-9	7
1.4	7.01-7.05	7.49-7.53	7.74-7.79	10-11	6-7	6
1.0	>7.05	>7.53	>7.79	0-9	0-5	0-5

Borderline classifications are assigned near half-step values (1.4, 2.6, etc.) and are defined as boundary EPT and BI values. The two ratings are averaged together to produce a combined score, which determines the final bioclassification. When the combined score falls between two bioclassifications, it is either rounded up or down based on whether the decimal fraction is larger or smaller than 0.5.

In cases where the decimal fraction is exactly 0.5, other metrics are considered to determine which bioclassification to assign. Metrics considered are: taxa richness, EPT abundance, feeding groups (i.e. filter feeders, predators, etc.) and habitat information. Three biologists independently evaluate the information from a stream site and form a majority consensus on which bioclassification to assign.

Bioclassification of streams is important because it helps resource manager's prioritize cleanup and protection efforts. This information is reported in the 305b report to the United States Environmental Protection Agency. The Clean Water Act (Section 305b) requires that States report the conditions of their waters to congress. In the 305b report, macroinvertebrates are used to make a determination on a stream's aquatic life use support (ALUS). The criteria used to measure ALUS are summarized in three categories: Fully Supporting, Partially Supporting and Not Supporting.

Fully Supporting: Reliable data indicate functioning, sustainable biological assemblages (e.g. fish, macroinvertebrates, or algae) none of which has been modified significantly beyond the natural range of the reference condition.

Partially Supporting: At least one assemblage indicates moderate modification of the biological community as compared to the reference condition.

Not Supporting: At least one assemblage indicates a severely impacted macroinvertebrate community. Data clearly indicate severe modification of the biological community compared to the reference condition.

The Aquatic Biology Section determines the ALUS based on the bioclassification of the stream:

Bioclassification	ALUS
Excellent and Good	Fully Supporting
Good-Fair and Fair	Partially Supporting
Poor	Not Supporting

This method is also used to make stream impairment judgments for South Carolina's Watershed Water Quality Management Strategy and for point/nonpoint source impact assessments.

1.4.3 Data Analysis for Special Studies

Special studies often involve using sites upstream from a point source discharge or a non-point source area as a control. The site downstream from the potential impact can then be compared with this upstream reference station for assessment purposes. By comparing final bioclassification scores an assessment can be made. The following represents the levels of impairment and their associated change in bioclassification scores.

Level of Impairment	Decrease in Bioclassification Score
Unimpaired	<0.4
Slightly Impaired	0.6-1.4

Moderately Impaired	1.6-2.4
Severely Impaired	>2.6

If the decrease is 0.5, 1.5, or 2.5, professional judgment is used to decide whether to move up or down on the scale. Total Taxa Richness, Total Count and other metrics may be consulted to help determine the level of impairment in this situation.

The above scale is used as a general guide and there are situations where professional judgment may override the assessment. A common example is when the control is also impaired. This is common in urban watersheds where the biological community is often stressed (see Allen 2004 for a review). In such streams if the control is Poor (1), for example, it is a mathatical impossibility to show a decrease in the bioassessment score since 1 is the lowest category. This is not to suggest that the point source discharge could not contribute to degradation of water quality. In this situation, water chemistry, toxicity tests, or other means may be more appropriately used to determine the potential for an effluent to cause degredation. However even in these situations biassessments can be valuable. The change in species composition, feeding groups, or habits of the animals making up the macroinvertebrate communities can sometimes help determine impact. These studies can also help track long-term trends or provide clues to catastrophic events in which substantial numbers of species are missing from a downstream site relative to the control.

In situations where a bioclassification cannot be calculated for a downstream site due to a paucity of organisms, an assessment of impact will be based on weight of evidence. Metrics such as EPT taxa richness, total taxa richness, and abundance of organisms will be used to compare the control site with the study site.

1.5 Quality Assurance

All macroinvertebrate samples are logged into the Aquatic Biology Section's Macroinvertebrate Central Receiving Logbook upon delivery to the lab. Entries on the Macroinvertebrate Sampling Form are checked for agreement as to the number of jars and vials of samples collected from each station. The logbook serves to track sample possession and to document progress through initial log in, sorting, taxonomic identification, and data recording. The number of jars and/or vials containing the samples at each phase of sample processing, identification, and storage is recorded in the logbook. The identification data are recorded on a macroinvertebrate bench sheet. Completed bench sheets along with habitat assessment forms and any other hard copy related to a sample are kept on permanent file. Using the completed bench sheet, the data are then entered into a computer database. After data are entered into the database they are printed out on spreadsheets. These spreadsheets are compared to the original bench sheets and corrections made if needed.

Ten percent of all identified samples are selected at random to be evaluated for taxonomic accuracy. The quality assurance (QA)/quality control (QC) reviewer records the findings in the permanently bound Macroinvertebrate QA/QC Logbook (Appendix 6). Count accuracy is also checked and similar QA/QC measures (checking counts of other samples identified by errant taxonomist) are taken if average count error (all taxa) exceeds 10%. A sample is chosen for

QA/QC after 10 samples have been identified. Each set of 10 completed samples is numbered. A single sample is randomly chosen by picking a coin from a jar of coins numbered one through ten. Each taxonomist is assigned a number and is chosen to perform QA/QC by random picking from numbered coins. The taxonomist that conducted the initial identifications is not eligible to conduct QA/QC on that sample. Disagreements are resolved between the QA/QC taxonomist and the original taxonomist, and the results are recorded in the QA/QC logbook.

To evaluate the precision of the field techniques 10% of the stations are sampled twice. This involves the selection of two adjacent stream reaches on the same stream. Each reach should be similar to each other with respect to habitat and hydrology. Each reach is sampled using the timed MHSP described above preferably on the same day. Each reach is treated as a separate station with a final bioclassification score calculated for each segment. Precision is determined by comparing the two bioclassification scores, which ideally should be the same.

Taxonomists use current, accepted taxonomic references in making identifications as well as in interpreting the results (see References). In addition, primary literature is kept on file and used when the above keys are not appropriate. Taxonomists also attend workshops and in-service training sessions to expand their knowledge and competence.

1.6 Index Period

For ambient monitoring SCDHEC's index period is 15 June to 15 September for the Blueridge, Piedmont, and Southeastern Plains ecoregions while it is 15 January to 15 March in the Middle Atlantic Coastal Plain Ecoregion. Attempts are mode to stay away from the margins of these date brackets if time permits. Special studies in which an upstream control site can be used theoretically can be conducted at any time of the year. A summer sample is often used but recent findings demonstrate that a winter sample may be more valuable, particularly in small watersheds. This is because the upstream control often has a better macroinvertebrate community when water levels are higher and more stable, making any potential change more noticeable.

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APPENDIX 1
USEPA Habitat Assessment Forms
(From Barbour et. al. 1997.)

Forms can be downloaded at:

http://water.epa.gov/scitech/monitoring/rsl/bioassessment/index.cfm

Macroinvertebrate Habitat Assessment - Short Form

Station _____________ Date _____________ Time _____________ #Jars _____ #Vials ______

Stream Name ______________________ Location ____________________ County _________

Collectors Names ______________________________ Field QC Logbook _______Page# _____

Air Temp (C) ______ pH (SU)______ DO (mg/l)_______ H20 Temp (C)______ Cond (umhos/cm)_______

Aquatic Habitat Score: Excellent = 5 Good = 4 Good - Fair = 3 Fair = 2 Poor = 1 Nonexistent = 0

***Habitat**	**Score**						**Comments**
Root Banks	5	4	3	2	1	0	
Logs, Sticks, Snags	5	4	3	2	1	0	
Rock/Gravel Riffle	5	4	3	2	1	0	
Mature Leaf Pack	5	4	3	2	1	0	
Aquatic Vegetation	5	4	3	2	1	0	
Total							

*If aufwuchs and/or sediment on the habitats appear to adversely affect colonization by macroinvertebrates, this impact is noted in the comments section; however, the habitat score does not change.

**Velocity/Flow:	Fully Supporting	Partially Supporting	Not Supporting
Sedimentation:	Little or no	Moderate	Severe

**The degree to which there is diversity of flow supportive of macroinvertebrate colonization of the variety of habitats.

APPENDIX E

Biological Data

- SCDHEC Macroinvertebrate data
- Greenville Water Macroinvertebrate Data
- SCDNR Fish Data
- Save Our Saluda Turbidity Data

SCDHEC 2016 Macroinvertebrate Study

	S-773	S-004
Count	423	282
Taxa Richness	57	37
EPT Index	25	12
Biotic Index	4.38	6.15
EPT Score	3.6	2
Biotic Index Score	5	3.0
Bioclassification Score	4.3	2.5
Bioclassification	Good	Good/Fair
Aquatic Life Use	**Fully Supporting**	**Partially Supporting**

MACROINVERTEBRATE ASSESSMENT OF THE NORTH SALUDA AND THE SOUTH SALUDA RIVERS ABOVE NORTH SALUDA RESERVOIR AND TABLE ROCK RESERVOIR GREENVILLE COUNTY, SOUTH CAROLINA

SEPTEMBER 2017

Submitted To:

GREENVILLE WATER
Travelers Rest, South Carolina

Submitted by:

CARNAGEY BIOLOGICAL SERVICES, LLC
636 Westwood Drive
Lexington, South Carolina
803-233-6952

SCDHEC Laboratory Certification No. 32572

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I. SUMMARY

On 07 September 2017, CARNAGEY BIOLOGICAL SERVICES, LLC (SCDHEC Laboratory Certification Number 32572) conducted an instream macroinvertebrate community assessment of the North Saluda River and the South Saluda River above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina. The objective of this assessment was to determine the condition of the macroinvertebrate community of these streams to aid in monitoring the health of these reservoirs, which are that main source of water for the City of Greenville and surrounding areas.

Data from this assessment indicated that both the North Saluda and South Saluda Rivers were high quality bodies of water. Both rivers had NCBI scores of "excellent" and SCDHEC bioclassification scores of "good. Most metrics were similar to those measured in 2016. The EPT index in both rivers was slightly lower in 2017. This is probably due to natural variations.

All water chemistry parameters measured in conjunction with this assessment were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

II. INTRODUCTION

On 07 September 2017, an instream macroinvertebrate assessment was conducted on the North Saluda River and the South Saluda River above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina. The objective of this assessment was to determine the condition of the macroinvertebrate community in these rivers utilizing the South Carolina Multi-habitat Rapid Bioassessment.

III. DESCRIPTION OF STUDY AREA

Aquatic macroinvertebrates were collected from The North Saluda River above North Saluda Reservoir and from the South Saluda River above Table Rock Reservoir, Greenville County, South Carolina (Figures 1 and 2, respectively). Samples were collected from a stretch of river approximately 100 meters in length.

The North Saluda River sample location was in a stretch of river approximately 1000 meters upstream of the river's confluence with North Saluda Reservoir. The river at this location was approximately 1.5 to 2.5 meters wide and 0.1 to 0.3 meters deep. A long run was located in this section, in addition to a number of riffles and small pools. The hard substrate at this location consisted of boulders, cobble and gravel. Sand, and to a lesser degree silt, were located throughout the station. Other substrates available for colonization included root mats, small logs and other moody debris, and leaf packs in the pools and in the shallowest riffles.

The collection location in the South Saluda River was in a stretch of river approximately 700 meters upstream of the river's confluence with Table Rock Reservoir. The stream at this station was approximately 3.5 to 4.5 meters wide and 0.1 to 0.3 meters deep. Several riffles were located in this station, as well as a few small pools and a short run. The hard substrate at this location consisted of large boulders, cobble, and gravel over sand and silt. Other substrates available for colonization were a few root mats along the bank, logs and smaller woody debris, and a few leaf packs in the slower reaches of the station.

IV. METHODS

A. Field Sampling

Aquatic macroinvertebrates were qualitatively collected with a D-frame aquatic dip net, a U.S. Standard No. 30 sieve, and by hand picking organisms from substrates with forceps. The multiple habitat approach, where specimens from all available habitats (stream margins, leaf packs, water-soaked logs, and sand deposits) are pooled to form one aggregate sample,

Figure 1. Sampling location for macroinvertebrates collected from the North Saluda River above North Saluda Reservoir, Greenville County, South Carolina.

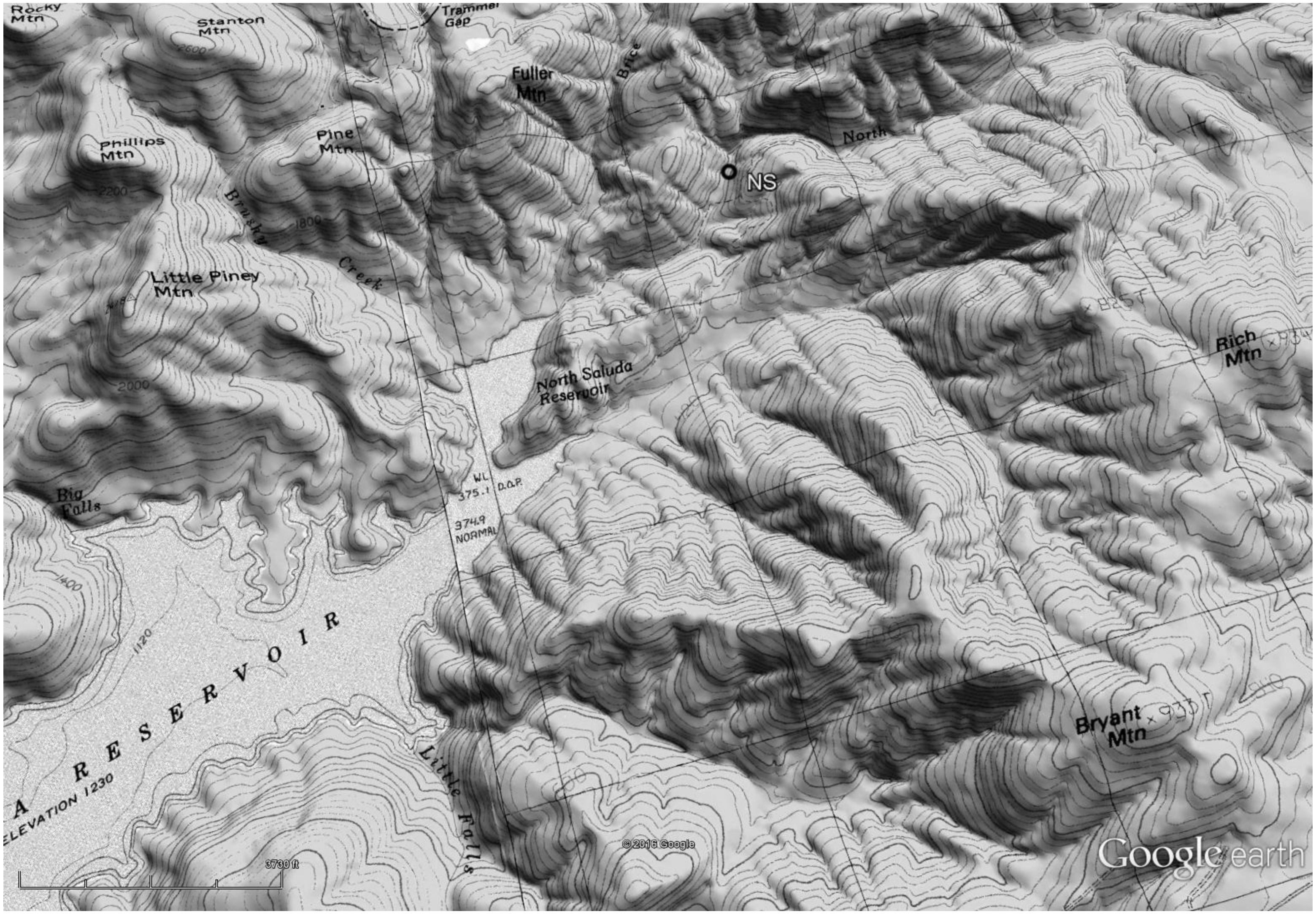
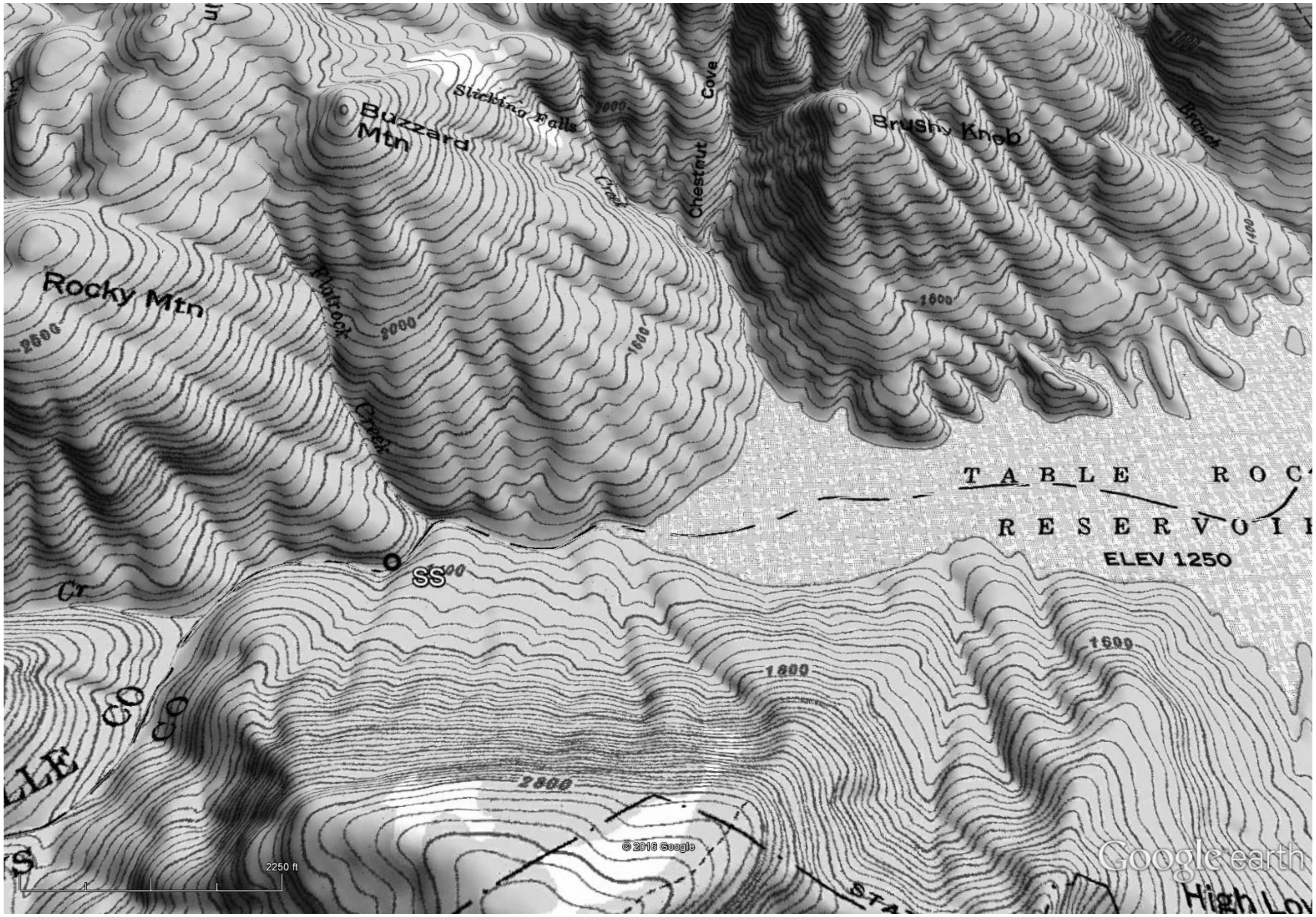


Figure 2. Sampling location for macroinvertebrates collected from the South Saluda River above Table Rock Reservoir, Greenville County, South Carolina.



was utilized as the sampling procedure. Samples were preserved in the field with 70% ethanol. Each sample represented two man-hours per station. Sampling procedures and habitat types were kept similar at each station to enable species and numerical population comparisons between stations. Habitat scores were determined using the *Habitat Assessment Field Data Sheet for Low Gradient Streams* (Barbour *et al*., 1999).

B. Water Chemistry

Water chemistry parameters measured at each station in conjunction with the macroinvertebrate sampling included pH, conductivity, dissolved oxygen, and temperature.

C. Sample Processing

Upon return to the laboratory, macroinvertebrates were removed from the associated sample debris with the aid of an Meiji RZ stereo microscope. The macroinvertebrates which required higher magnification for identification were identified using an Olympus BH-2 compound microscope equipped with a phase contrast. Identifications were made to the lowest positive taxonomic level and enumerated with the aid of appropriate microscopic techniques and taxonomic keys. All specimens will be maintained in the CARNAGEY BIOLOGICAL SERVICES, LLC voucher collection for five years or placed into the permanent reference collection.

D. Data Analysis

Comparisons of the macroinvertebrate communities were based on changes in taxonomic composition between sampling sites and on the known tolerance levels and life history strategies of the organisms encountered. Changes in taxonomic composition were determined using metrics outlined in Rapid Bioassessment Protocol III of the US EPA's *Rapid Bioassessment Protocols for Use in Streams and Rivers* (Plafkin *et al.* 1989) and SCDHEC's *Standard Operating and Quality Control Procedures for Macroinvertebrate Sampling* (SCDHEC, 1999). These metrics included the following:

1) Taxa richness - The number of different taxa found at a particular location is an indication of diversity. Reductions in community diversity have been positively associated with various forms of environmental pollution, including nutrient loading, toxic substances, and sedimentation (Barbour *et al*., 1996; Fore *et al*., 1996; Rosenberg and Resh, 1993; Shackleford, 1988).

2) EPT index - EPT Index is the number of taxa from the insect orders Ephemeroptera, Plecoptera and Trichoptera found at a station. These three insect orders are considered to be intolerant of adverse changes in water quality, especially temperature and

dissolved oxygen, and therefore, a reduction in these taxa is indicative of reduced water quality (Barbour *et al*., 1996; Lenat, 1988).

3) Chironomidae taxa and abundance - The Chironomidae are a taxonomically and ecologically diverse group with many taxa that are tolerant of various forms of pollution. The chironomids are often the dominant group encountered at impacted or stressed sites (Rosenberg and Resh, 1993).

4) Ratio of EPT and Chironomidae abundance - The relative abundance of these four indicator groups is a measure of community balance. When compared to a reference site, good biotic conditions are reflected in a fairly even distribution among these four groups (Plafkin *et al*., 1989). The value of this ratio is reduced by impact due to the general reduction of the more sensitive EPT taxa and an increase in the more tolerant chironomid taxa.

5) Ratio of scraper/scraper and filtering collectors - When compared to a reference site, shifts in the dominance of a particular feeding type may indicate a community responding to an over-abundance of a particular food source or toxicants bound to a particular food source (Rosenberg and Resh, 1993).

6) Shredder/total number of specimens collected - When compared to a reference or control site, reductions in the relative abundance of shredders can indicate changes in the quality or quantity of riparian zone vegetation or the presence of toxic substances bound to organic carbon contained in the leaf and woody material which comprises their food source (Plafkin *et al*., 1989).

7) Percent contribution of dominant taxon - This measures the redundancy and evenness of the community structure. It assumes a highly redundant community reflects an impaired community because as the more sensitive taxa are eliminated, there is often a significant increase in the remaining tolerant forms (Barbour *et al*., 1996; Shackleford, 1988).

8) North Carolina biotic index (Table 1) - This index utilizes a pollution tolerance value developed over a wide range of conditions and pollution types to assess the amount of impact (North Carolina Department of Environment, Health and Natural Resources, 1997). The values range from 0-10, increasing as water quality decreases. Taxa are designated as Rare (1-2 specimens), Common (3-9 specimens), or Abundant (≥10 specimens) and assigned a 1, 3, or 10 abundance code, respectively, for calculation of the NCBI.

9) SCDHEC bioclassification – Bioclassification is determined by averaging scores for the NCBI and EPT index at each station, then rating sites as "Excellent, Good, Good-Fair, Fair, or Poor" (SCDHEC, 1999).

Table 1. Procedures used in the calculation of selected metrics used in this report.

Metric	**Procedure**
Community Loss Index	CL = d-a/e Where: a = number of taxa common to both samples. d = total number of taxa present in sample A. e = total number of taxa present in sample B.
Jaccard Coefficient of Similarity	JCS = a/a+b+c Where: a = number of taxa common to both samples. b = number of taxa present in sample B but not A. c = number of taxa present in sample A but not B.
Sörensen Coefficient	C_S= 2a/(d+e) Where: a = number of taxa common to both samples. d = the number of taxa present in sample A. e = the number of taxa present in sample B.
North Carolina Biotic Index	NCBI = TV_iN_i/N Where: TV_i = the tolerance for the *i*th taxon. N_i = the abundance code of the $_i$th taxon. N = sum of abundance codes for all taxa in the sample.

V. RESULTS

A. Physicochemical Analysis

The water chemistry parameters measured in conjunction with the macroinvertebrate assessment are presented in Table 2. All parameters monitored were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

Table 2. Physicochemical data collected in conjunction with the macroinvertebrate assessment of the North Saluda River (NS) and the South Saluda River (SS) above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina, 07 September 2017.

	Station	
Parameter	**NS**	**SS**
Water temperature (^{o}C)	14.18	15.64
pH (SU)	6.34	6.55
Conductivity (µmho/cm)	23	17
Dissolved oxygen (mg/l)	9.67	9.29

B. Macroinvertebrate Community Analysis

A total of 561 specimens representing 72 taxa were collected from the two sampling locations during this assessment. The results are presented in tabular form. The taxa list, number of specimens collected, and relative abundance for each taxon are presented in Table 3 for each station. Bioassessment metrics for each sampling station are presented in Table 4. The numbers of specimens and relative abundance of the dominant taxa (>5%) are listed in

Table 5 for each sampling station. Habitat assessment scores are presented in Table 6 for each station.

The sampling effort in the North Saluda River, yielded 290 specimens representing 47 taxa (Table 3). An EPT index of 24 was calculated for this station, and the North Carolina biotic index value of 3.33 resulted in a water quality rating of "excellent" (Table 4). The SC Bioclassification score of 4.0 indicated a “good” rating for Station 1. The Chironomidae were represented by 8 taxa and contributed 7% of the collection. The dominant functional feeding group was the collector-filterers, which contributed 26% of the collection. The dominant taxon was *Leuctra* sp., which contributed 13% of the specimens collected (Table 5).

The collection in the South Saluda River yielded 271 specimens representing 59 taxa (Table 3). An EPT index of 33 was calculated for this station, and the North Carolina biotic index value of 2.96 results in a water quality rating of "excellent" (Table 4). The SC Bioclassification score of 4.3 indicated a “good” rating for Station 2. The Chironomidae were represented by 13 taxa and contributed 11% of the collection. The dominant functional feeding group was the scrapers, which contributed 24% of the collection. The dominant taxon was *Maccaffertium modestum*., which contributed 9% of the specimens collected (Table 5).

VI. DISCUSSION

Data from this assessment indicated that both the North Saluda and South Saluda Rivers were high quality bodies of water. Both rivers had NCBI scores of "excellent" and SCDHEC bioclassification scores of "good. Most metrics were similar to those measured in 2016. The EPT index in both rivers was slightly lower in 2017. This is probably due to natural variations.

All water chemistry parameters measured in conjunction with this assessment were within water quality standards for Class FW waters of the State of South Carolina (SCDHEC, 1998).

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Table 3. Macroinvertebrates, their tolerance values (TV), functional feeding groups (FG), and relative abundance collected from the North Saluda River (NS) and the South Saluda River (SS) above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina, 07 September 2017.

				No. of Individuals		**Relative Abundance**	
Seq	**Taxon**	**TV**	**FG**	**NS**	**SS**	**NS**	**SS**
Annelida							
Oligochaeta							
Lumbriculida							
Lumbriculidae							
1	Eclipidrilus lacustris	7.03	SC	2		0.01	
Tubificida							
Naididae							
2	Pristina jenkinae		SC	2	3	0.01	0.01
3	Uncinais uncinata		SC	1		0.00	
Arthropoda							
Insecta							
Coleoptera							
Dryopidae							
4	Helichus basalis	5.4	SC	9	1	0.03	0.00
Dytiscidae							
5	Neoporus sp.	8.62	P	1		0.00	
Elmidae							
6	Ancyronyx variegatus	6.49	CG		1		0.00
7	Dubiraphia quadrinotata	5.93	CG	1		0.00	
8	Macronychus glabratus	4.58	CG	6	4	0.02	0.01
9	Oulimnius nitidulus	1.8	CG		2		0.01
Psephenidae							
10	Psephenus herricki	2.35	SC	8	14	0.03	0.05
Diptera							
Athericidae							
11	Atherix sp.	2.1	P		1		0.00
Ceratopogonidae							
12	Bezzia/Palpomyia sp.	6.86	P		1		0.00
Chironomidae							
13	Ablabesmyia mallochi	7.19	P		2		0.01
14	Brillia flavifrons	5.2	SH		5		0.02
15	Corynoneura sp.		CG	1		0.00	

* CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals		Relative Abundance	
Seq	**Taxon**	**TV**	**FG**	**NS**	**SS**	**NS**	**SS**
Chironomidae cont.							
16	Eukiefferiella brehmi gr.	2.7	CG	4		0.01	
17	Hydrobaenus sp.	9.54	SC		2		0.01
18	Larsia sp.	9.3	P	2	3	0.01	0.01
19	Nanocladius balticus gr.	7.07	CG		1		0.00
20	Natarsia sp.	9.95	P	4	4	0.01	0.01
21	Parametriocnemus sp.	3.65	CG	1	1	0.00	0.00
22	Polypedilum aviceps	3.65	SH	2	1	0.01	0.00
23	Polypedilum halterale gr.	7.3	SH		4		0.01
24	Rheotanytarsus exiguus gr.	5.89	CF	5	3	0.02	0.01
25	Rheotanytarsus tuberculata	5.89	CF		1		0.00
26	Sublettia coffmani	1.6	CG		1		0.00
27	Tanytarsus sp.	6.76	CF	1	1	0.00	0.00
Dixidae							
28	Dixa sp.	2.55	CG	15	1	0.05	0.00
Simuliidae							
29	Simulium ubiquitum		CF	15	5	0.05	0.02
Tipulidae							
30	Hexatoma sp.	4.31	P	8	1	0.03	0.00
Ephemeroptera							
Baetidae							
31	Acentrella turbida	4	CG	2	2	0.01	0.01
32	Baetis intercalaris	4.99	CG	1	9	0.00	0.03
33	Baetis tricaudatus	1.63	CG	5	20	0.02	0.07
34	Plauditus cingulatus	2	CG		3		0.01
Caenidae							
35	Caenis sp.	7.41	CG		2		0.01
Ephemerellidae							
36	Drunella tuberculata	0.001	CG		1		0.00
37	Eurylophella verisimilis	4.3	CG	2	3	0.01	0.01
38	Teloganopsis deficiens	2.8	CG	1	4	0.00	0.01
Heptageniidae							
39	Epeorus vitreus	1.03	CG	9	8	0.03	0.03
40	Heptagenia marginalis gr.	2.57	SC	1	1	0.00	0.00
41	Maccaffertium modestum	5.5	SC	27	25	0.09	0.09

* CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals		Relative Abundance	
Seq	**Taxon**	**TV**	**FG**	**NS**	**SS**	**NS**	**SS**
Isonychiidae							
42	Isonychia sp.	3.45	CF	1		0.00	
Leptophlebiidae							
43	Paraleptophlebia mollis	0.94	CG	3		0.01	
Megaloptera							
Corydalidae							
44	Nigronia fasciatus	5.55	P	1		0.00	
Odonata							
Aeshnidae							
45	Boyeria vinosa	5.89	P	2	2	0.01	0.01
Plecoptera							
Capniidae							
46	Allocapnia sp.	2.52	SH		2		0.01
Leuctridae							
47	Leuctra sp.	0.67	SH	38	3	0.13	0.01
Nemouridae							
48	Amphinemura wui	3.33	SH		5		0.02
Peltoperlidae							
49	Tallaperla sp.	1.2	SH		2		0.01
Perlidae							
50	Acroneuria abnormis	2.06	P	9	5	0.03	0.02
51	Agnetina annulipes	0.001	P		11		0.04
52	Paragnetina ichusa	0.001	P		2		0.01
53	Paragnetina immarginata	1.38	P	3	3	0.01	0.01
Perlodidae							
54	Isoperla sp.		P	1		0.00	
Pteronarcyidae							
55	Pteronarcys scotti	1.67	SH	2	10	0.01	0.04
Trichoptera							
Brachycentridae							
56	Brachycentrus spinae	0.001	CF		12		0.04
57	Micrasema rickeri	0.001	SH		15		0.06
Glossosomatidae							
58	Glossosoma nigrior	1.55	SC	8	14	0.03	0.05

* CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 3. Continued.

				No. of Individuals		Relative Abundance	
Seq	**Taxon**	**TV**	**FG**	**NS**	**SS**	**NS**	**SS**
Hydropsychidae							
59	Arctopsyche irrorata	0.001	CF	3	4	0.01	0.01
60	Cheumatopsyche sp.	6.22	CF	35	17	0.12	0.06
61	Hydropsyche sparna	2.7	CF	4	3	0.01	0.01
Lepidostomatidae							
62	Lepidostoma sp.	0.9	SH	20		0.07	
Leptoceridae							
63	Ceraclea ancylus	2.29	CG		2		0.01
64	Oecetis georgia	3	P		2		0.01
65	Oecetis persimilis	4.7	P	2		0.01	
Limnephilidae							
66	Pycnopsyche sp.	2.52	SH	3	4	0.01	0.01
Philopotamidae							
67	Dolophilodes distinctus	0.81	CF	9	3	0.03	0.01
Psychomyiidae							
68	Lype diversa	4.05	SC	1	3	0.00	0.01
Rhyacophilidae							
69	Rhyacophila sp.		P		1		0.00
Uenoidae							
70	Neophylax aniqua		SC		3		0.01
Mollusca							
Bivalvia							
Unionoida							
Pisidiidae							
71	Pisidiidae Genus species		CF	1	2	0.00	0.01
Gastropoda							
Mesogastropoda							
Pleuroceridae							
72	Pleurocera proxima		SC	8		0.03	

* CF = collector-filterer, CG = collector-gatherer, OM = omnivore, P = predator, SC = scraper, SH = shredder

Table 4. Rapid bioassessment metrics calculated for the North Saluda River (NS)and the South Saluda River (SS) above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina, 07 September 2017.

	Station	
Metric	**NS**	**SS**
Taxa Richness	47	59
Number of Specimens	290	271
EPT Index	24	33
EPT Abundance	190	204
Chironomidae Taxa	8	13
Chironomidae Abundance	20	29
EPT/Chironomidae Abundance	9.50	7.03
North Carolina Biotic Index	3.33	2.96
SCDHEC Bioclassification	4.00	4.30
Percent Collector-Filterers	25.52	18.82
Percent Collector-Gatherers	17.59	23.99
Percent Omnivores	0.00	0.00
Percent Predators	11.38	14.02
Percent Scrapers	23.10	24.35
Percent Shredders	22.41	18.82
Scraper/Collector-Filterers	0.91	1.29
Percent Dominant Taxon	13.10	9.23
Number Of Dominant Taxa	6	6

Table 5. Dominant taxa (> 5% of the collection) for the North Saluda River (NS) and the South Saluda River (SS) above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina, 07 September 2017.

Station NS			**Station SS**		
Taxon	**No.**	**Rel. Abd.**	**Taxon**	**No.**	**Rel. Abd.**
Leuctra sp.	38	13.10	Maccaffertium modestum	25	9.23
Cheumatopsyche sp.	35	12.07	Baetis tricaudatus	20	7.38
Maccaffertium modestum	27	9.31	Cheumatopsyche sp.	17	6.27
Lepidostoma sp.	20	6.90	Micrasema rickeri	15	5.54
Dixa sp.	15	5.17	Psephenus herricki	14	5.17
Simulium ubiquitum	15	5.17	Glossosoma nigrior	14	5.17

Table 6. Habitat assessment scores determined in conjunction with the macroinvertebrate assessment for the North Saluda River (NS) and the South Saluda River (SS) above North Saluda Reservoir and Table Rock Reservoir, Greenville County, South Carolina, 07 September 2017.

Habitat Parameter	**Sta. NS**	**Sta. SS**
1. Epifaunal Substrate/Available Cover	20	20
2. Pool Substrate Characterization	20	18
3. Pool Variability	10	10
4. Sediment Deposition	20	20
5. Channel Flow Status	20	20
6. Channel Alteration	20	20
7. Channel Sinuosity	20	18
8. Bank Stability (Left Bank (LB))*	10	10
Bank Stability (Right Bank (RB))*	10	10
9. Vegetative Protection (LB)*	10	10
Vegetative Protection (RB)*	10	10
10. Riparian Vegetative Zone (LB)*	10	10
Riparian Vegetative Zone (RB)*	10	10
Total Score	**190**	**186**

* Left or right bank is determined when facing downstream

2016 SCDNR Fish Monitoring Data

Common name	Scientific name	Family
White Sucker	*Catostomus commersoni*	Catostomidae (Suckers)
Northern Hog Sucker	*Hypentelium nigricans*	
Notchlip Redhorse	*Moxostoma collapsum*	
V-Lip Redhorse	*Moxostoma pappillosum*	
Striped Jumprock	*Scartomyzon rupiscartes*	
Redbreast Sunfish	*Lepomis auritus*	Centrarchidae (Sunfish)
Bluegill	*Lepomis macrochirus*	
Largemouth Bass	*Micropterus salmoides*	
Greenfin Shiner	*Cyprinella chloristia*	Cyprinidae (Minnows)
Rosyface Chub	*Hybopsis rubrifrons*	
Bluehead Chub	*Nocomis leptocephalus*	
Greenhead Shiner	*Notropis chlorocephalus*	
Spottail Shiner	*Notropis hudsonius*	
Sandbar Shiner	*Notropis scepticus*	
Snail Bullhead	*Ameiurus brunneus*	Ictaluridae (Catfish)
Flat Bullhead	*Ameiurus platycephalus*	
Margined Madtom	*Noturus insignis*	
Carolina Fantail Darter	*Etheostoma brevispinum*	Percidae (Perches)
Seagreen Darter	*Etheostoma thalassinum*	
Piedmont Darter	*Percina crassa*	
Eastern Mosquitofish	*Gambusia holbrooki*	Poeciliidae (Livebearers)

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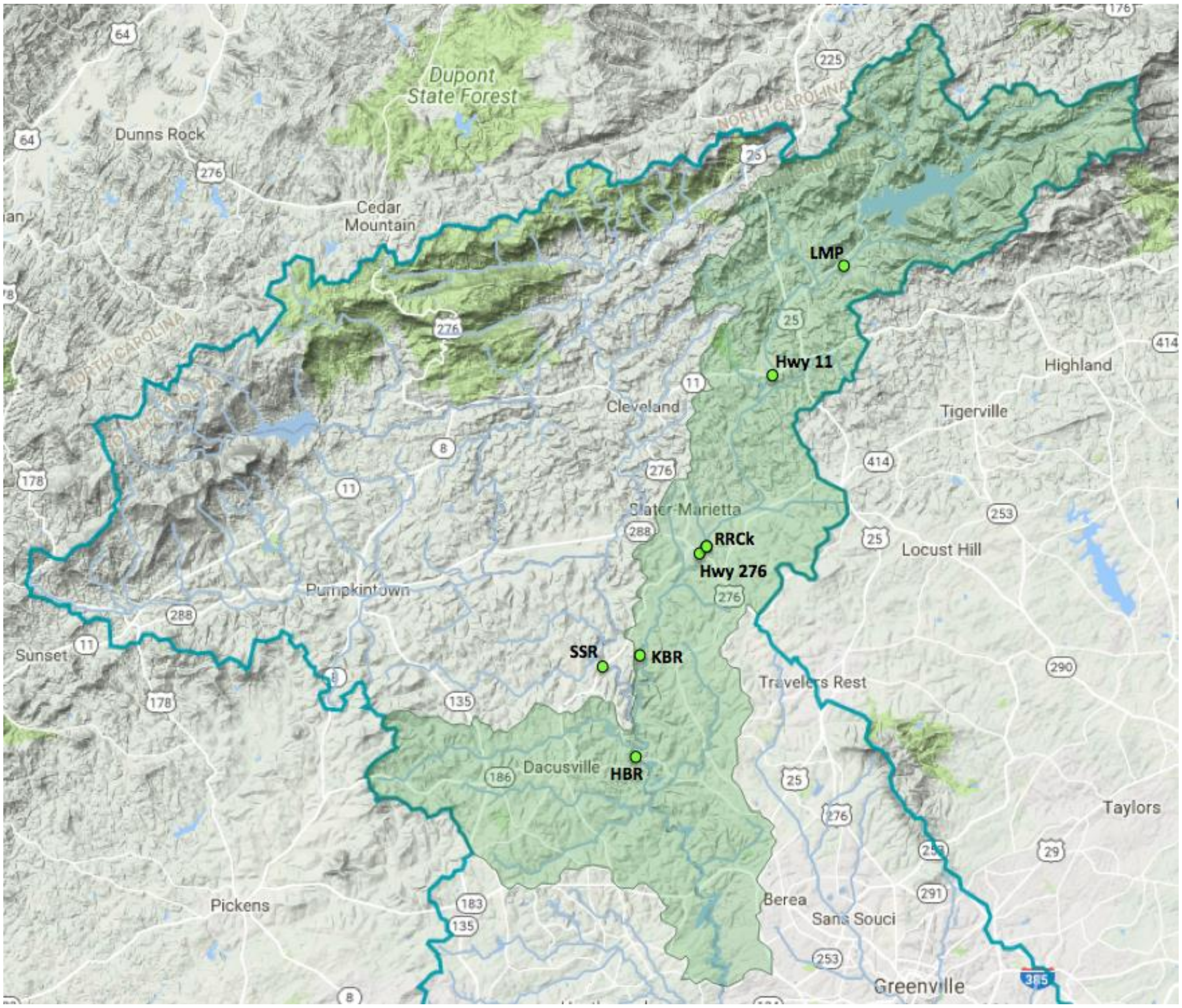
2018 Save Our Saluda Turbidity Monitoring



Sampling locations for Save Our Saluda turbidity monitoring.

LMP – North Saluda River at Les Mullinax Park

Hwy 11 – North Saluda River at Highway 11

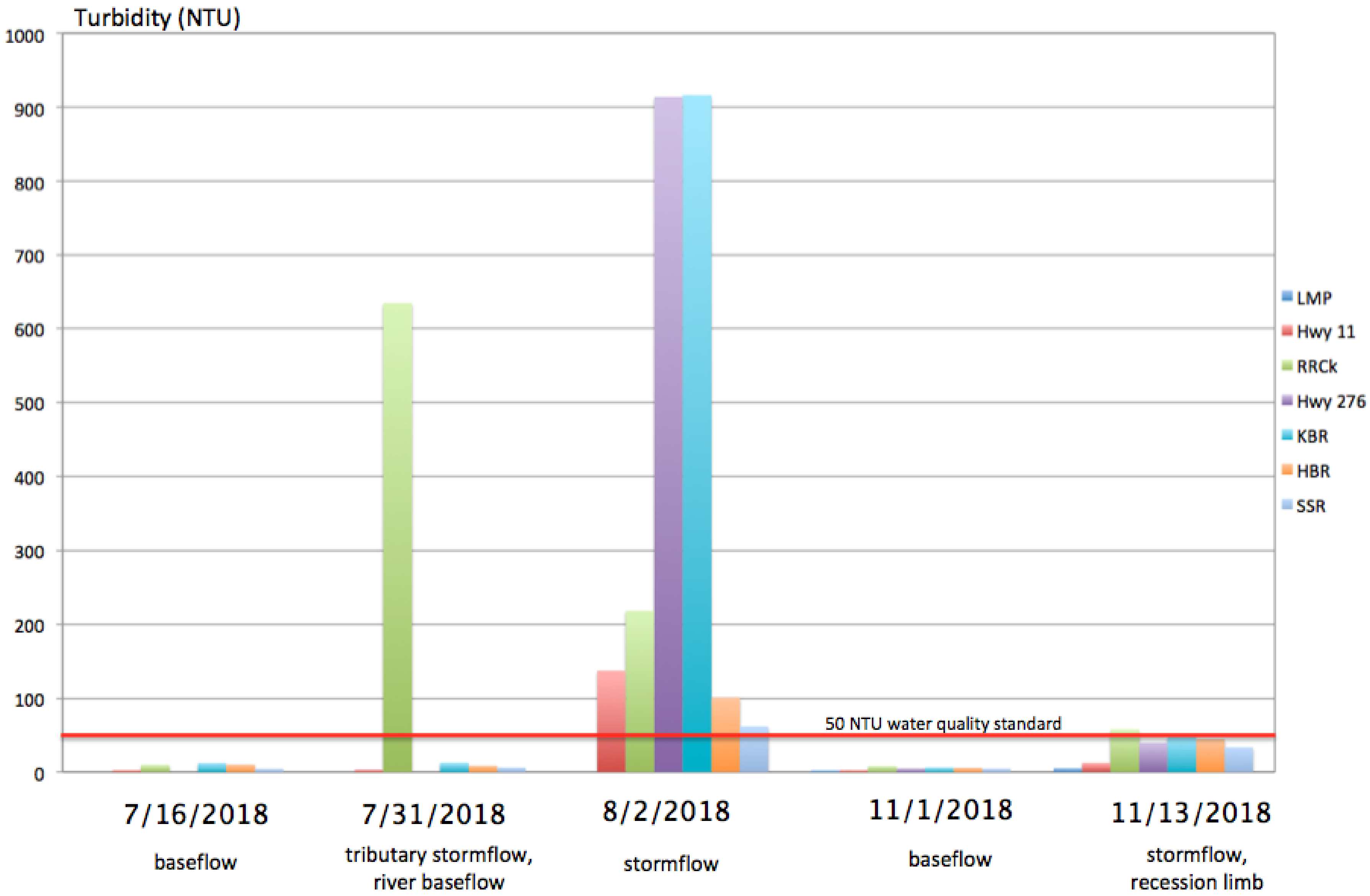
RRCk – Railroad Creek upstream of confluence with North Saluda River

Hwy 276 – North Saluda River at Hwy 276

KBR – North Saluda River at Keeler Bridge Road

HBR –Saluda River at Hunts Bridge Road

SSR – South Saluda River at Highway 186



Turbidity (NTU)
1000
900
800
700
600
500
400
300
200
100
0
50 NTU water quality standard
LMP
Hwy 11
RRCk
Hwy 276
KBR
HBR
SSR
7/16/2018
baseflow
7/31/2018
tributary stormflow, river baseflow
8/2/2018
stormflow
11/1/2018
baseflow
11/13/2018
stormflow, recession limb

Turbidity Data for North Saluda-Saluda Lake Watershed Plan.

Site	Date	Time	Result	Avg	Date	Time	Result	Avg	Date	Time	Result	Avg	Date	Time	Result	Avg	Date	Time	Result	Avg
LMP													11/1/18	5:00 PM	2.2	2.5		12:08 PM	5.08	5.1
															3.0				5.54	
															2.2				4.8	
Hwy 11	7/16/18	4:23 PM	3.5	2.7	7/31/18	4:16 PM	3.16	3.2	8/2/18	5:12 PM	138	137	11/1/18	5:15 PM	2.57	2.7	11/13/18	12:25 PM	12.88	12.3
			2.3				3.18				138				2.77				11.5	
			2.2				3.13				135				2.83				12.4	
RRCk	7/16/18	3:44 PM	9.5	9.4	7/31/18	3:45 PM	655	635	8/2/18	4:10 PM	216	218	11/1/18	5:32 PM	7.68	7.7	11/13/18	12:48 PM	55.4	57.3
			9.3				618				236				8.04				58.6	
			9.6				631				201				7.48				57.9	
Hwy 276										4:35 PM	867	914	11/1/18	5:43 PM	5.06	4.8	11/13/18	12:55 PM	39	39.8
											913				4.81				38.7	
											963				4.58				41.6	
KBR	7/16/18	3:00 PM	11.3	11.9	7/31/18	5:40 PM	12.1	12.5	8/2/18	6:05 PM	851	917	11/1/18	6:32 PM	6.01	6.1	11/13/18	1:09 PM	52.9	48.4
			12.7				12.1				917				6.48				47.4	
			11.6				13.4				982				5.71				44.8	
HBR	7/16/18	5:10 PM	10.5	9.6	7/31/18	6:00 PM	7.33	8.1	8/2/18	5:45 PM	92.3	101	11/1/18	6:10 PM	4.69	5.5	11/13/18	1:38 PM	40.4	44.6
			9.0				9.02				104.1				6.39				43.9	
			9.4				7.80				105.6				5.44				49.4	
SSR	7/16/18	5:21 PM	4.1	4.2	7/31/18	6:13 PM	5.69	5.7	8/2/18	5:55 PM	64.4	62	11/1/18	5:55 PM	4.41	4.4	11/13/18	1:27 PM	36.8	33.3
			4.5				6.08				61.3				4.72				31.8	
			4.1				5.46				59.1				3.94				31.2	

APPENDIX F

TASC Meeting Agendas and Minutes

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING MINUTES

Date: October 18, 2017
Time: 10:00 a.m.
Location: Berea Library

Present: Joel Ledbetter, General Manager, Easley Combined Utilities
Tyler Morgan, Operations Engineer, Easley Combined Utilities
Nick Rubin, Source Water Protection and GIS Specialist, SC Rural Water Association
Kirsten Robertson, Manager, Greenville County Soil and Water Conservation District
Joel Jones, Chief Technical Officer, Renewable Water Resources
George Dickert, District Extension Director, Clemson Cooperative Extension
Mark Scott, Freshwater Fisheries Research, SC Department of Natural Resources
Cindy Roper, Save Our Saluda
Melanie Ruhlman, Save Our Saluda

Meeting Purpose: Project kick-off meeting to review project, planning process, and to discuss RFP for consulting services

Melanie Ruhlman provided a project overview (the PowerPoint will be uploaded to a shared TASC folder):

- The purpose of the DHEC-funded watershed-based plan (WBP) is to help control nonpoint source pollution, protect source water, and to establish eligibility for implementation funding. The goal of the WBP is to address sediment loading in the North Saluda River and Saluda Lake.
- The WBP is a stakeholder process involving eleven partners who make up the TASC, whose role is to provide direction, guidance, and technical and other support throughout the project.
- Rationale for a plan directed at sediment control was presented.
- Justification for targeting Saluda Lake and the North Saluda River was presented.
- Project objectives, watershed area, and EPA's nine key elements for WBPs were reviewed.
- Project tasks were outlined and include desktop and field surveys, BMP recommendations, pollutant loading analysis, and development of implementation milestones/schedule/budget.
- The need for a sediment loading target was discussed. Mark Scott of SC DNR presented findings of a sediment study in the nearby Broad River Watershed that could be applicable to this project. Materials related to this work will be uploaded to the shared TASC folder.
- Public outreach was discussed. Target community groups will be identified. Partnership match monies will be used for education outreach tools.
- Project budget and a general timeline were reviewed.

Agroecosystem Management Project on the North Saluda River:

- A separate grant-funded project developed as part of the WBP to install BMPs on a 50 acre agricultural site near Marietta. SOS and Naturaland Trust obtained grants for riparian restoration, road/culvert stabilization, and grass filter strips. Project work is underway.

Request for Proposal:

- SOS will obtain consulting services to assist in plan development. $40K of grant money is allocated for this purpose. The state requires a competitive bidding process prior to securing a contract for services.
- The draft RFP was distributed prior to the meeting and a final will be placed in the project folder. Attendees reviewed the scope of work and evaluation criteria and discussed the RFP process. The TASC will be responsible for evaluating proposals.
- Proposals will be evaluated according to the criteria and schedule outlined in the RFP. It was decided that all proposals would be initially evaluated for qualifications. Costs will be evaluated and negotiated separately. The award will be made to the highest technically-ranked firm whose offer is determined to be the most advantageous to the project goals.

Next Steps:

- The RFP will be published on SCBO beginning next week. The TASC requested that the RFP also be sent directly to qualified consultants.
- Proposals will be placed in a shared project folder for evaluation by the TASC.
- Proposal scoring will be conducted via email prior to the next TASC meeting, which is tentatively scheduled for the last week in November. The primary objective of the meeting will be to select a consultant.

Melanie Ruhlman
Project Manager
Save Our Saluda

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING MINUTES

Date: December 1, 2017
Time: 10:00 a.m.
Location: Berea Library

Present:
Joel Ledbetter, General Manager, Easley Combined Utilities
Tyler Morgan, Operations Engineer, Easley Combined Utilities
Rebecca West, Chief Operations Officer, Greenville Water
Kirsten Robertson, Manager, Greenville County Soil and Water Conservation District
Joel Jones, Chief Technical Officer, Renewable Water Resources
Mac Stone, Executive Director, Naturaland Trust
Cindy Roper, Save Our Saluda
Melanie Ruhlman, Save Our Saluda

Meeting Purpose: Proposal evaluations and selection of consultant

Introduction and Overview

- Melanie provided a project overview including review of goals, justification, project elements, and information about sediment transport and impacts in the watershed,
- Update on related Agroecosystem Management Project on the North Saluda River. Riparian buffer planting scheduled for December 15, and
- Interactive watershed map on SOS website that features project area:

  www.saveoursaluda.org/webmap

Technical Proposal Evaluations

- Two proposals were received, one from Amec Foster Wheeler Environment & Infrastructure Solutions, and the other from Jennings Environmental
- Proposal evaluation scoring criteria were distributed to the TASC and resultant scores for each firm were compiled (thank you Cindy!).
- Melanie and Cindy presented series of slides showing compiled results of the technical proposal evaluations by the TASC. Amec won out with an overall score of 93 vs 78 for Jennings.
- There were no questions about the evaluations.
- Comments on proposals:
    - No biologist issue v. educational outreach and 319 experience
    - 319 track record very important
    - Amec projects more in line with our watershed planning project
    - Jennings stronger emphasis on in-stream restoration, less on watershed BMPs

Cost Proposals

- Jennings bid- $50,000
- AMEC bid - $45,000
- $40,000 is the project budget for consulting services
- Raised possibility of getting additional funding support from the TASC
- Discussed possibility of changes in the scope of work from the selected consultant (Amec) to reduce the cost. This would mean shaving off some activities. Melanie will inquire with consultant as to this possibility and report back to TASC via email.
- Other costs savings could include shared data from the partnership, or possibly additional help from a Clemson student
- Funds already committed by TASC ($10,500) are already allocated for education and monitoring.

Other

- Monitoring issue discussed - DHEC doesn't fund additional water quality monitoring without a Quality Assurance Project Plan (QAPP), which is outside of the project scope. Additional data can be collected and included in the plan, but may not be used in any regulatory or official capacity.
- Partners expressed willingness to share available and relevant watershed data, as have others not present. We will begin assimilating data in January.

Next Steps:

- Hope for contract by mid-December
- We will finalize project schedule with consultant
- Next TASC meeting mid January

All minutes and other meeting materials will be uploaded to the shared TASC folder.

Melanie Ruhlman
Project Manager
Save Our Saluda

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING MINUTES

Date: January 29, 2018
Time: 11:00 a.m.
Location: Berea Library, Greenville, SC

Present: Tyler Morgan, Operations Engineer, Easley Combined Utilities
Joel Jones, Chief Technical Officer, Renewable Water Resources
Dyke Spencer, Executive Director, Powdersville Water
Mac Stone, Executive Director, Naturaland Trust
Nick Rubin, Source Water Protection and GIS Specialist, SC Rural Water Association
Kyle Bennett, Pickens County
Melanie Brown, Coordinator and Qualitative Analyst, Furman University
Brannon Andersen, Professor and Chair, Earth and Environmental Sciences, Furman
William Powell, Save Our Saluda
Letitia Short, Save Our Saluda
Melanie Ruhlman, Save Our Saluda
Angela Vandelay, Amec Foster Wheeler

- Melanie R. welcomed stakeholders, including new partners Dyke Spencer from Powdersville Water and Kyle Bennett from Pickens County.
- Angela provided an overview of watershed based plans, reviewed the goals and objectives for the North Saluda River/Saluda Lake plan, reviewed justification for targeting sediment and the North Saluda/Saluda Lake Watershed, and shared examples of other similar watershed planning and implementation projects:
  - Shaws Creek Watershed in Aiken and Edgefield Counties – to address sediment, nutrients, bacteria, and
  - Twenty-five Mile Creek Watershed in Kershaw, Richland and Fairfield Counties - to address bacteria and macroinvertebrates.
- Three category sources of sediment were presented. Brainstorming session will be scheduled for each source type with appropriate stakeholders:
  - Agriculture,
  - Urban Runoff,
  - Forestry/Other
- Available Data Sources were discussed and partners offered to provide watershed data.
- Project approach and the monthly schedule of tasks were reviewed.
- Additional funded items were discussed (additional monitoring, community meetings, educational and media materials, video). Example videos were shown. It was agreed that any video produced as part of this planning project should be aimed at general educational related to sediment and water quality.
- It was suggested that the owner of the Saluda dam, Northbrook, be invited to be a partner. Melanie R. will follow up.

- Status update of first agricultural implementation project on North Saluda River was provided (Naturaland Trust Agroecosystem Management Project on North Saluda River).

**Minutes and other meeting materials will be uploaded to the shared TASC folder.*

Action Items:

1. Melanie Ruhlman (SOS) – Contact Greenville County to request GIS parcel data, flow data, and surface water quality data.
2. Melanie Ruhlman (SOS) – Contact Greenville Water to request flow and surface water quality data.
3. Tyler Morgan (Easley Combined Utility) – Send surface water quality data to Melanie Ruhlman (back to date of dredging of lake).
4. Melanie Brown (Furman University) – Send most recent runoff model report for North Saluda River.
5. Melanie Ruhlman (SOS) – Contact Northbrook to invite as a project partner.
6. Melanie Ruhlman (SOS) – Coordinate 1st Brainstorm Session (update – the timing has shifted and the Urban Brainstorm Session will be scheduled first).
7. Angela Vandelay (AmecFW)– Conduct desktop review of watershed.
8. Mac Stone (Naturaland Trust) and Melanie Ruhlman (SOS) – Develop a storyboard for a public education video about the North Saluda River Watershed.

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING MINUTES

Date: May 2, 2018
Time: 10:00 a.m.
Location: Berea Library, Greenville, SC

Present: Alex Dye, Easley Combined Utilities
Joel Ledbetter, Easley Combined Utilities
Dyke Spencer, Powdersville Water
Rebecca West, Greenville Water
Kyle Bennett, Pickens County
Brannon Andersen, Furman University
Letitia Short, Save Our Saluda
Melanie Ruhlman, Save Our Saluda
Angela Vandelay, Wood Environment & Infrastructure Solutions

- After introductions, reviewed the agenda
- Reviewed proposed Watershed Based Plan Goals. Current draft goals as follows. Please provide any comments/edits to Melanie and Angela by 5/22/18.

  Goal #1 – Improve water quality in North Saluda River and Saluda Lake (reduce sediment)
  - *Ensure that North Saluda River and Saluda Lake meet or exceed water quality standards for sediment*
  - *Ensure that recreational use in North Saluda River and Saluda Lake is not diminished by sediment*
  - *Ensure that North Saluda River and Saluda Lake support aquatic life (with regards to sediment)*

  Goal #2 - Protect and maintain water quality, recreational use, and aquatic habitat from
  - *Work with counties to improve land use regulations and enforcement to guide new development in a manner that protects North Saluda River Watershed and Saluda Lake from sediment*
  - *Coordinate efforts with other groups in the watershed focused on land conservation and protection strategies*

  Goal #3 - Build community support for the protection and enhancement of the land and water resources of the North Saluda River and Saluda Lake Watershed
  - *Strengthen ties with the local farmers and residents to promote and implement the Watershed Based Plan and encourage environmental stewardship within the watershed*
- Reviewed current relevant impairments in watershed:

  S-773 (North Saluda River at Hwy 25) – Biological
  S-004 (North Saluda River at Keeler Bridge Rd) – Biological and E.Coli
  RS-13125 (Old Railroad Creek at Valley Road)– E.Coli
  RL-08056 (Saluda Lake) – Turbidity

- Interpolated rainfall data from Greenville County (red arrows show 2 rain gauges in North Saluda River Watershed). The Upper 2 HUCs in North Saluda River Watershed get higher than average rain compared to the southern portion of the watershed and the rest of Greenville County.

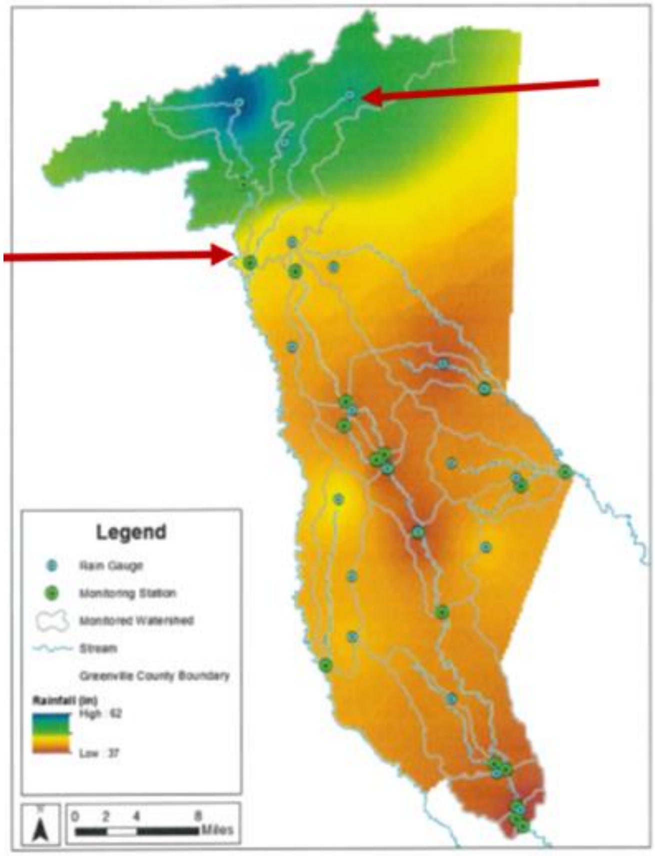


Figure 3-3: Interpolated rainfall totals for the 2007 NPDES Permit Year 10 using inverse distance weighting.

- Nitrogen levels at County's one continuous monitoring station in the North Saluda Watershed (on the North Saluda River at Keeler Bridge Road, located below most of the farms in the Lower North Saluda River Watershed) had a mean nitrogen concentration in 2017 of 0.6 mg/L, much **lower** than almost all the other stations in Greenville County.

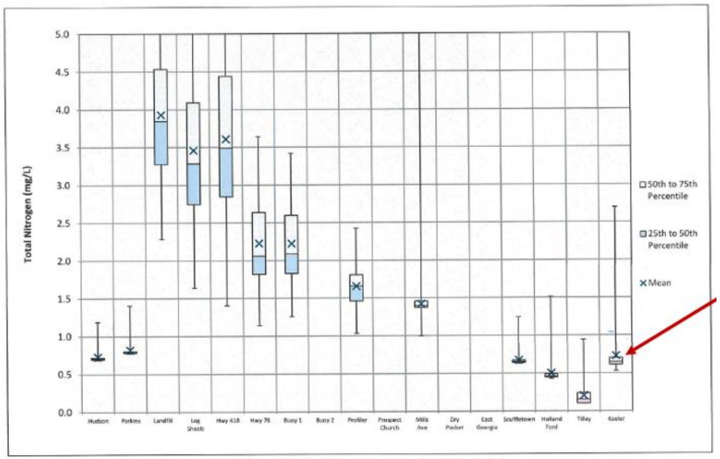


Figure 5-21: Calculated daily average TN concentrations - all monitored watersheds

- On the other hand, Total Phosphorous levels in the North Saluda River at Keeler Bridge Road had a mean Total Phosphorous concentration in 2017 of 0.083 mg/L, much **higher** than all the other stations in Greenville County.

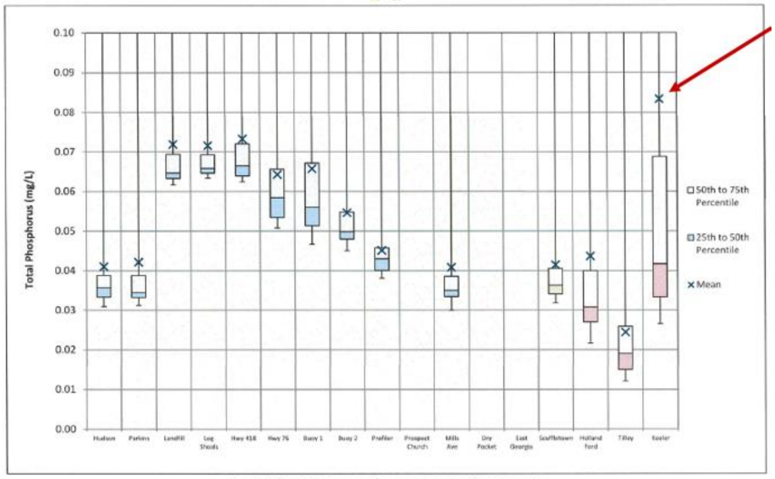


Figure 5-22: Calculated daily average TP concentrations - all monitored watersheds

- In support of field observations, turbidity levels in the North Saluda River at Keeler Bridge Road had a mean turbidity concentration in 2017 of 31 NTU, much **higher** than all the other stations in Greenville County.

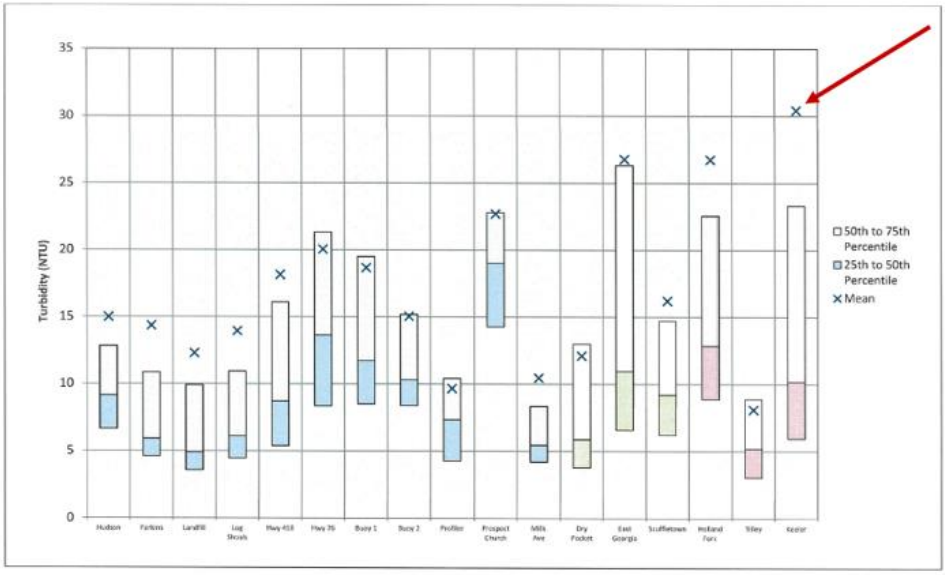


Figure 5-17: Daily average turbidity distributions - all monitored watersheds

- The area draining to Keeler Bridge Road includes the protected Upper North Saluda River watershed and the Lower North Saluda River watershed with extensive crop fields in the floodplain. This site has the highest mean turbidity level in comparison to other monitoring sites in the County, even though its watershed has the second highest percentage of forested area (80%). This indicates that there is likely more sediment loading coming from a smaller relative watershed area compared to other sites.

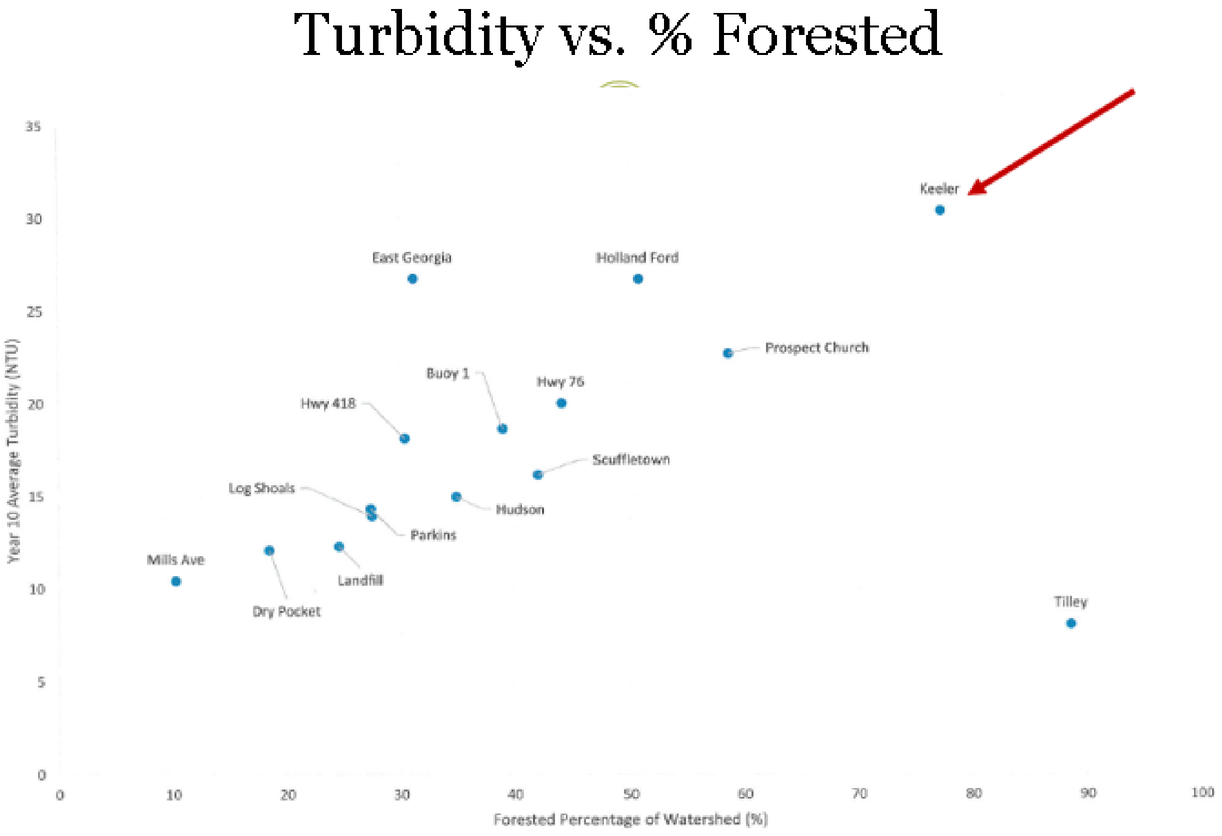
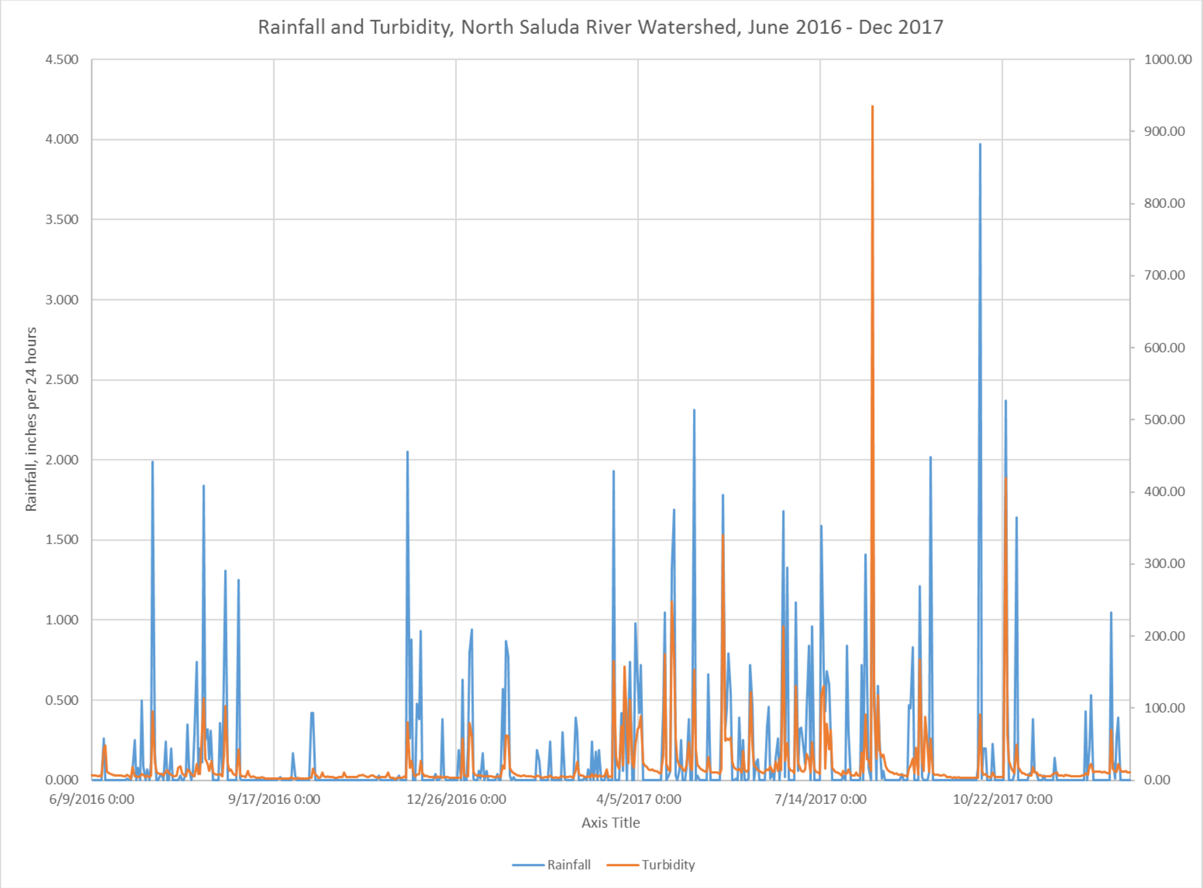
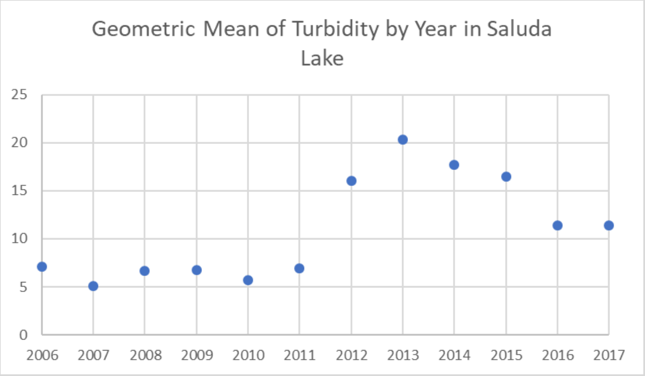


Figure 5-19: Comparison of average turbidity levels to watershed landuse breakdown

- The following is a graph of tubidity (orange) and rainfall (blue) at Greenville County's Keeler Bridge monitoring station (located at S-004) from June 2016 to December 2017. Note that the rain gauge is located at the same location as the turbidimeter. There are likely unmeasured storm events upstream in the watershed that impact turbidity at this station. Likewise, there can be rain at the monitoring station (where the land is relatively stable and no crop farms) and no rain in the upper parts of the watershed which result in low turbidity even though rain registers at the station.



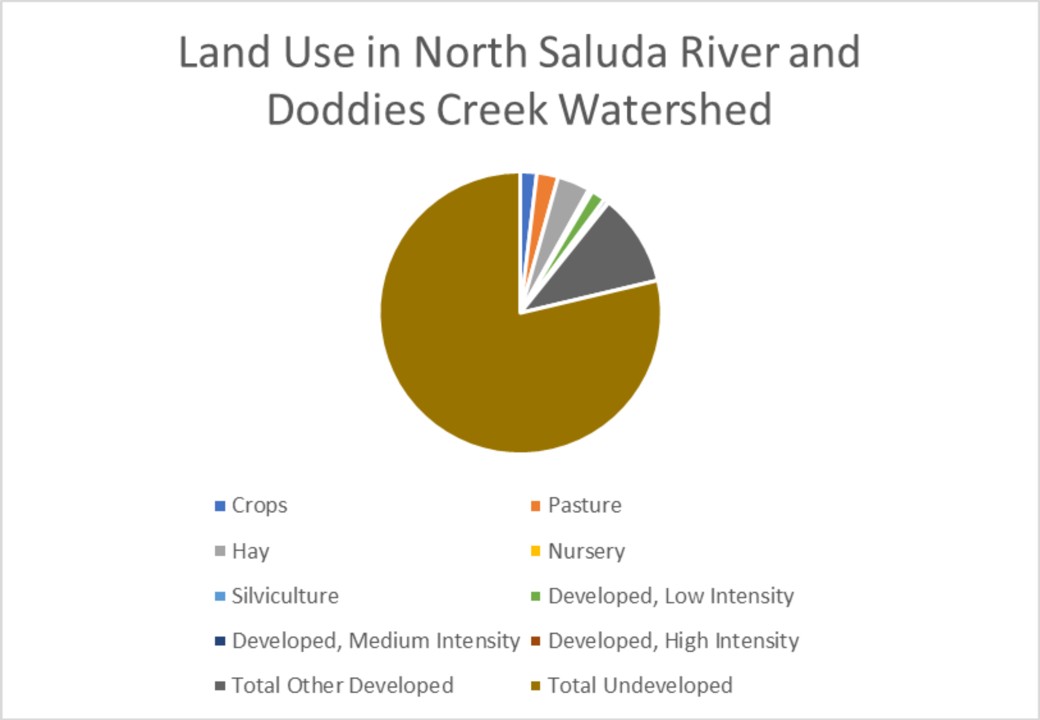
- The annual geometric mean of turbidity at the Saluda Lake water treatment plant intake peaked at 20 NTU in 2013 (after dredging of the lake) and has slowly decreased to 11 NTU in 2016, where it remained in 2017. However, these mean turbidity levels remain much higher than the 5 to 7 NTU levels from 2006 to 2012.



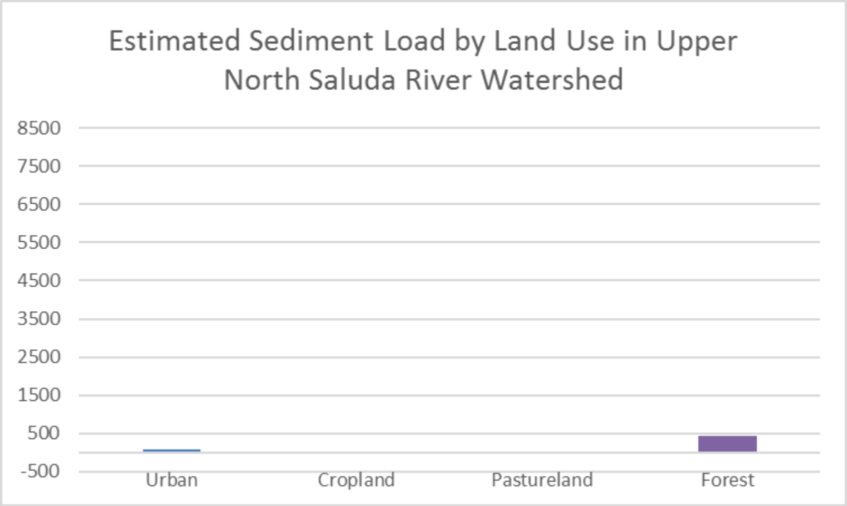
- SCDNR conducted a fish survey in North Saluda River at S-004 in 2016, with the following comments:
    - A list of fish species collected identified was presented. Overall there was a good abundance and diversity of fish species at this site.
    - The presence of five sucker species and three darter species along with several shiners and chubs (minnow family) is generally a positive indicator.
    - Carolina Fantail Darter (*Etheostoma brevispinum*) was very abundant and included some of the largest specimens of that species that I've seen in SC (also some very large Seagreen Darters, *E. thalassinum*).
    - The abundance and size of Striped Jumprocks (*Scartomyzon rupiscartes*) was also noteworthy.
- The 2016 DHEC macroinvertebrate sampling results showed: fully supporting S-773 (in the upper portion of Lower North Saluda River) and partially supporting at S-004 (bottom of Lower North Saluda River). Both sites remain on SCDHEC's list of impaired waters. According to communications with the DHEC aquatic biologist, S-773 remains on the list of impaired waters due to the catastrophic sampling event in the very early 2000s immediately following construction activities at the Cliffs Valley in which the macroinvertebrate community was nearly entirely eliminated. A native population of brook trout was also eliminated and has not recovered.
- Reviewed watershed data collected from field survey, desktop survey and existing monitoring data:

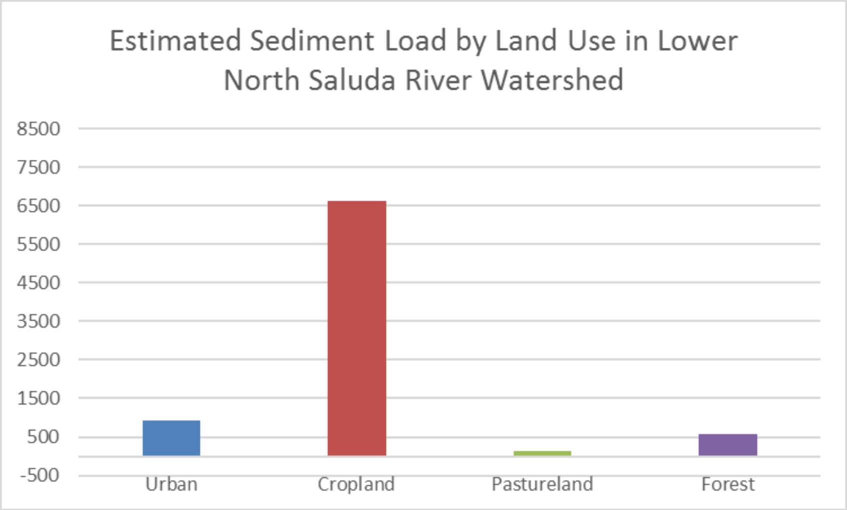
Acres/ % of Land Use/ % of Subwatershed	Upper North Saluda River	Lower North Saluda River	Doddies Creek – Saluda River
Crop Farms	0/0%/0%	1,025 / 69%/3.2%	451 / 31%/1.5%
Pasture	0/0%/0%	477 / 25%/1.5%	1,443 / 75%/4.8%
Hay fields	0/0%/0%	894 / 30%/2.8%	2,046 / 70%/6.8%
Nurseries	0/0%/0%	216 / 85%/0.7%	38 / 15%/0.1%
Silviculture	0/0%/0%	20 / 19%/0.1%	88 / 81%/0.3%
Golf Courses	0/0%/0%	433 / 100%/1.3%	0 / 0%/0%
High Int. Urban	0/0%/0%	43 / 52%/0.1%	40 / 48%/0.1%
Medium Int. Urban	0/0%/0%	190 / 49%/0.6%	191 / 51%/0.6%
Low Int. Urban	28 / 2%/0.2%	546 / 43%/1.7%	695 / 55%/2.3%
Other Developed	239/3%/1.5%	3,837/48%/11.9%	3,874/49%/12.9%
Non-Developed	16,101/26%/98%	24,921/40%/77%	21,121/34%/70%

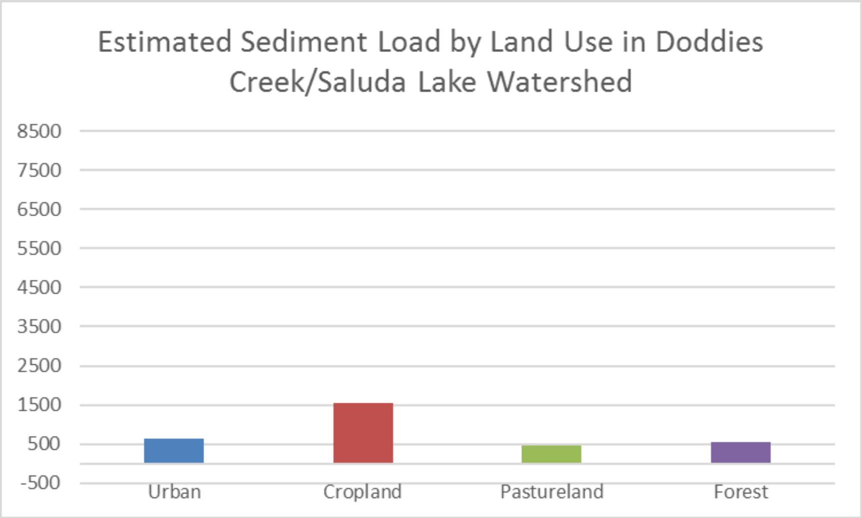
- Note the following:
  - 69% of crop farms are on the Lower North Saluda River watershed
  - 75% of the pastures are in the Doddies Creek – Saluda River watershed
  - 81% of silviculture is in Doddies Creek – Saluda River watershed
  - Medium and high intensity urbanized acreage is fairly equal in both Lower North Saluda River and Doddies Creek – Saluda River watershed

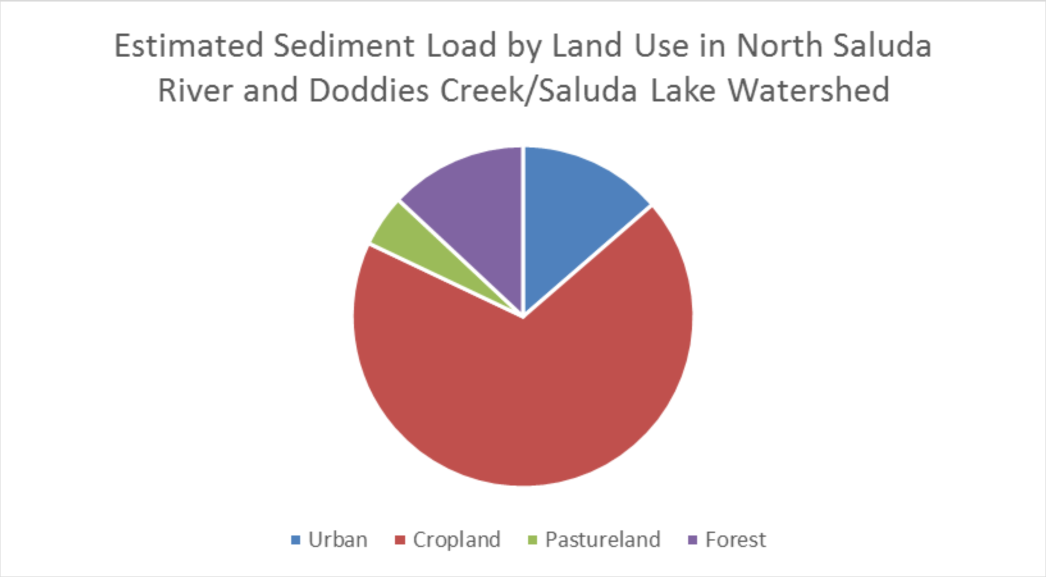


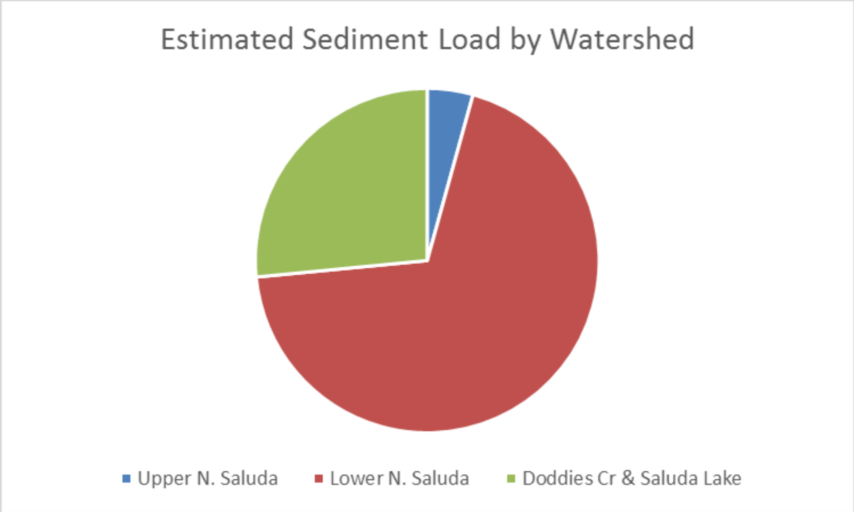
  - Note that more 75% of the watershed is currently undeveloped, which is unlikely to be a significant source of sediment. Therefore, a very small percentage of land area in the watershed appears to be contributing most of the sediment to the waterbodies.


Estimated Sediment Load by Land Use in Upper North Saluda River Watershed
8500
7500
6500
5500
4500
3500
2500
1500
500
-500
Urban
Cropland
Pastureland
Forest

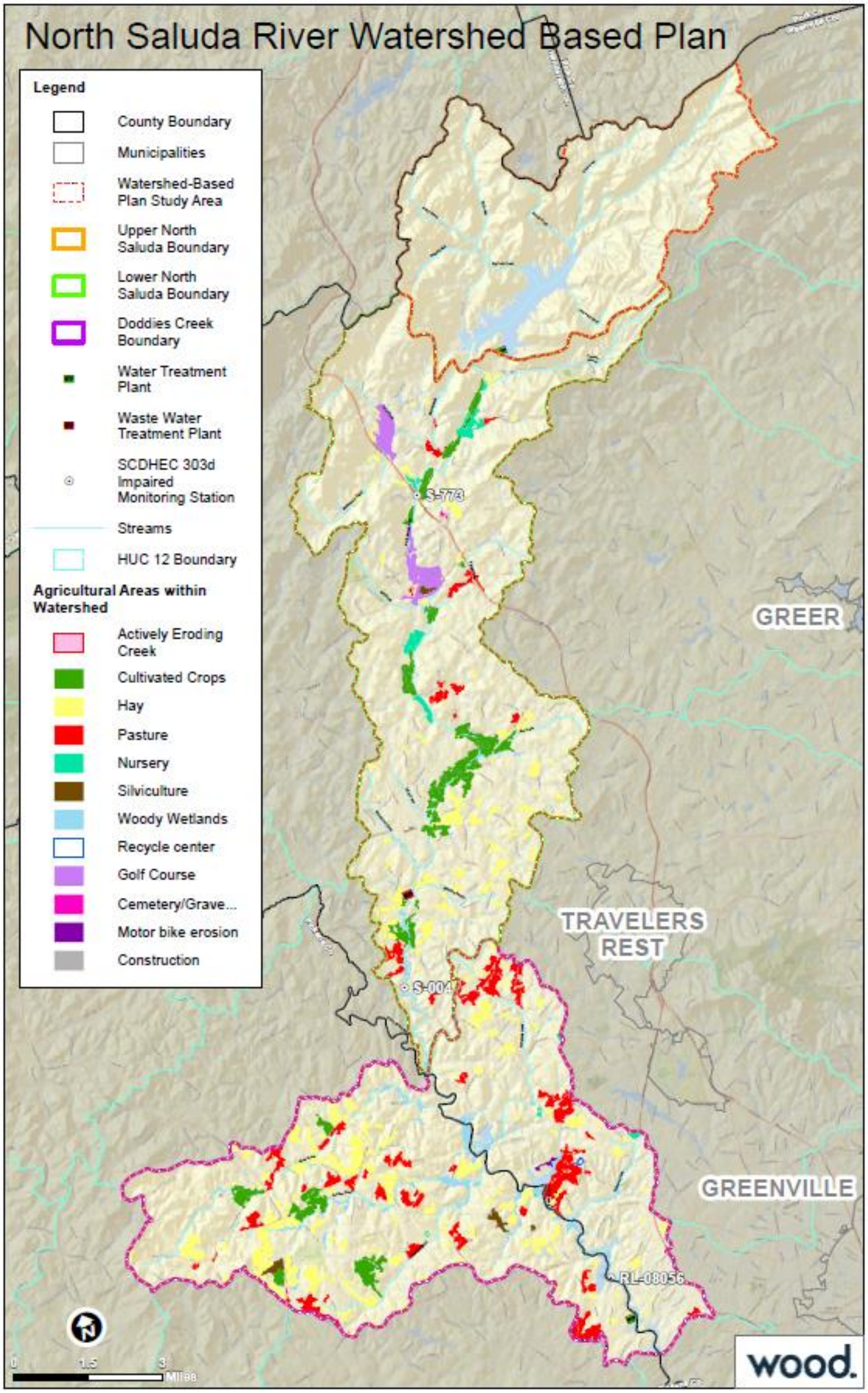

Estimated Sediment Load by Land Use in Lower North Saluda River Watershed
8500
7500
6500
5500
4500
3500
2500
1500
500
-500
Urban
Cropland
Pastureland
Forest


Estimated Sediment Load by Land Use in Doddies Creek/Saluda Lake Watershed
8500
7500
6500
5500
4500
3500
2500
1500
500
-500
Urban
Cropland
Pastureland
Forest





- Note that the STEPL model employs simple algorithms to calculate sediment load from surface runoff of different land uses, but does not estimate erosion from stream bank erosion.
- These preliminary model results will likely be refined with additional data and evaluation.
- According to the preliminary STEPL model results:
  - 57% of the sediment load is coming from W2 (Lower North Saluda River watershed) and 43% of the sediment load is coming from W3 (Doddies Creek – Saluda River watershed).
  - 62% of the sediment load is coming from croplands, 23% from urban and 15% from pastureland.


North Saluda River Watershed Based Plan
Legend
County Boundary
Municipalities
Watershed-Based Plan Study Area
Upper North Saluda Boundary
Lower North Saluda Boundary
Doddies Creek Boundary
Water Treatment Plant
Waste Water Treatment Plant
SCDHEC 303d Impaired Monitoring Station
Streams
HUC 12 Boundary
Agricultural Areas within Watershed
Actively Eroding Creek
Cultivated Crops
Hay
Pasture
Nursery
Silviculture
Woody Wetlands
Recycle center
Golf Course
Cemetery/Grave...
Motor bike erosion
Construction
S-773
S-004
RL-08056
GREER
TRAVELERS REST
GREENVILLE
0
1.5
3
Miles
wood.

- Urban Brainstorm Session:
  - Minutes from the Urban Brainstorm Session with Pickens County and Greenville County stormwater staff are attached.
  - Note that MS4 permits require the counties to detect and eliminate illicit discharges to the county's municipal separate storm sewer system (inlets, pipes, ditches draining the county's roads or properties). The MS4 permit does not require counties to detect and eliminate illicit discharges that runoff directly to Waters of the State.
  - Save Our Saluda will continue working with SC Rivers Forever, a statewide network of river organizations, to push for improved state-wide post-construction stormwater design standards for water quality.
  - Save Our Saluda will also draft a letter for all TASC members to sign requesting input into Greenville County's new riparian buffer regulations.
- Agricultural Brainstorm Session
  - Minutes from the Agricultural Brainstorm Session with Greenville SWCD and NRCS and Clemson Extension are attached. Pickens SWCD and NRCS were invited, but did not attend.
  - Save Our Saluda plans to apply for a 319 grant to implement agricultural BMPs
  - Other sources of funding for ag BMPs also identified, including NRCS and SARE
  - Recruitment of farmers will be a challenge and therefore the lower the match required, the better participation will be. This will require higher match from stakeholders.
  - It will also be important to find a good part-time employee to recruit farmers, write conservation plans and inspect BMPs, ideally a retired NRCS or SWCD employee. It will also be important to find someone to manage the grant and Watershed Based Plan implementation from a "bigger picture" perspective.
  - Working to identify speakers and farmers for upcoming workshop in Sept and future "Farm Tours" – Greenbrier, Happy Cow, Beechwood Farms, Mills River
- Forestry Brainstorm Session
  - Minutes from Forestry Brainstorm Session with SC Forestry Commission are attached.
- Ag Workshop (begin educating crop farmers about cover crops and soil health, including a Rainfall Simulator)
  - Tentatively scheduled for September
  - SOS will invite Hendersonville farmer (Farmers listen to farmers). May need to pay.
  - SOS is seeking a sponsor for lunch
  - Will create a Fact Sheet with local seed sources, seeding methods, equipment needs
- Types of Ag BMPs were reviewed, and shown in pics below

Riparian Buffer

Cover Crops

Intercropping

No Till Seeding

Vegetated Filter Strips

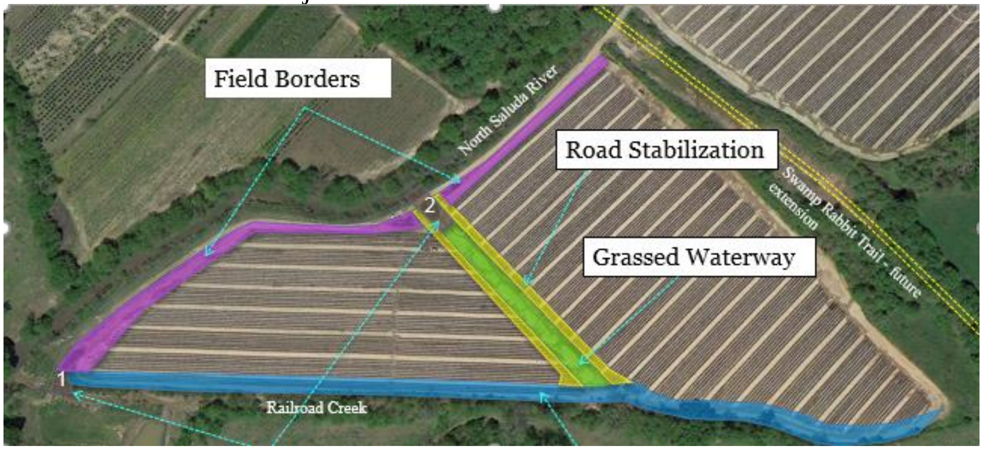
Ditch Stabilization

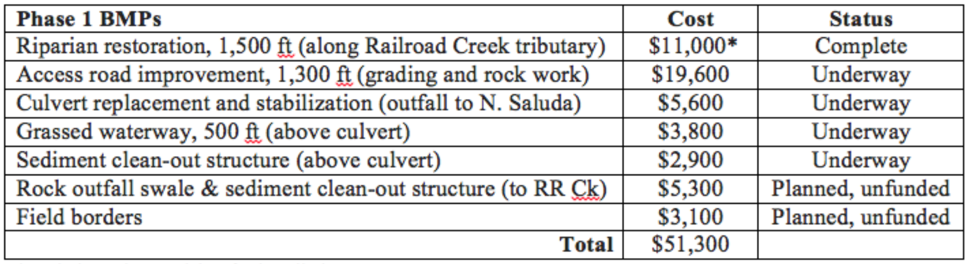
Livestock Exclusion

Heavy Use Area Stabilization

- Land Conservation Program
    - In order to meet Goal #2 (Protect and maintain water quality, recreational use, and aquatic habitat), a Conservation Easement Program would help protect undeveloped (or revert to undeveloped) properties, particularly riparian buffer areas along streams/river, from more intensive land uses that would result in more pollutant runoff.
    - May be possible to get a 319 grant to help set up and implement a voluntary Conservation Easement Program
    - There is a key property currently available for purchase near the confluence between North and South Saluda Rivers.
- Schedule
    - Project is on-schedule (except moved Workshop to September due to farmer schedules).
    - Next TASC meeting will be in July
    - WBP is due in September

- Agricultural BMP Demo Project

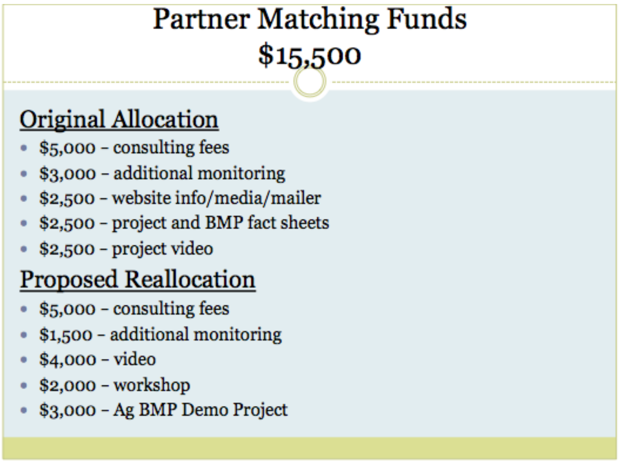




Phase 1 BMPs	Cost	Status
Riparian restoration, 1,500 ft (along Railroad Creek tributary)	$11,000*	Complete
Access road improvement, 1,300 ft (grading and rock work)	$19,600	Underway
Culvert replacement and stabilization (outfall to N. Saluda)	$5,600	Underway
Grassed waterway, 500 ft (above culvert)	$3,800	Underway
Sediment clean-out structure (above culvert)	$2,900	Underway
Rock outfall swale & sediment clean-out structure (to RR Ck)	$5,300	Planned, unfunded
Field borders	$3,100	Planned, unfunded
Total	$51,300	

*Excludes volunteer labor for installation

- Project has additional needs. Melanie asked TASC to rearrange some of the "Additional Activities" funded through non-federal partner match, to help complete the additional needs at the Ag Demo Site.
    - The $5K for consulting fees stays the same
    - The additional monitoring is reduced since Furman is providing data
    - Website, fact sheets, and media tools can be developed within the scope of the plan
    - Funding needed for the workshop to engage farmers
    - Funding needed to complete the first phase of the ag BMP Demo Project
- If a TASC member disagrees with this reallocation, please notify Melanie by 5/25/18.



Partner Matching Funds
$15,500

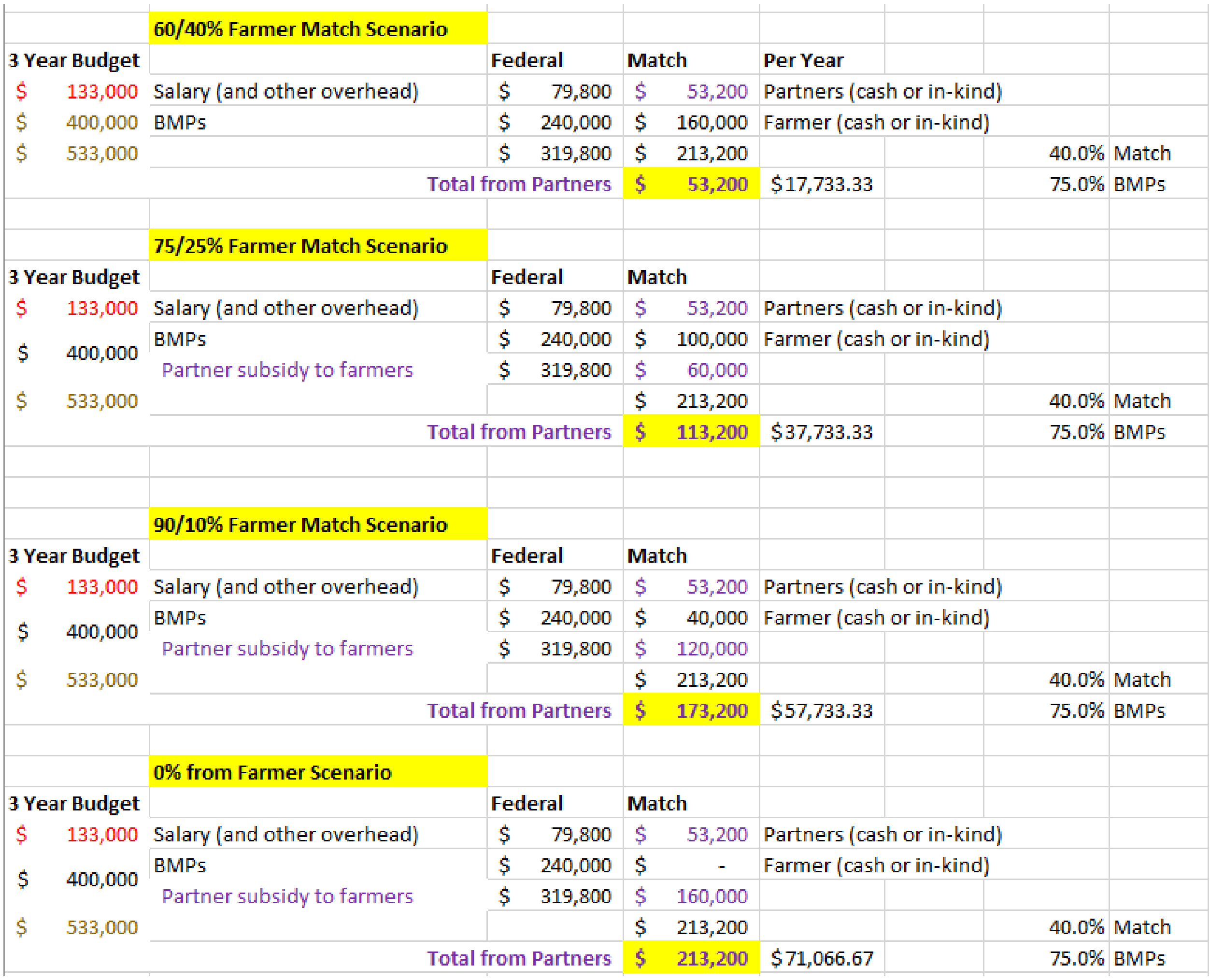
Original Allocation

- $5,000 – consulting fees
- $3,000 – additional monitoring
- $2,500 – website info/media/mailer
- $2,500 – project and BMP fact sheets
- $2,500 – project video

Proposed Reallocation

- $5,000 – consulting fees
- $1,500 – additional monitoring
- $4,000 – video
- $2,000 – workshop
- $3,000 – Ag BMP Demo Project

- Ag 319 Budget Scenarios
  - The following are scenarios for ballpark costs for 3 potential Ag 319 budget options, each with different cost share required of farmers (40%, 25% and 10%). Of course, the lower the match required from the farmers, the higher their voluntary participation will be.
  - Note that, for these scenarios (for a total grant budget of $533,000), the maximum matched salary/overhead budget is $133,000 (over 3 years which is approximately $44,000/year). This is bare-bones salary/overhead that the grant will match. Additional salary/overhead needs (ex. For a 2nd part-time employee with different skills) would likely be required above this amount and would require additional donation above the yellow highlighted numbers for each possible scenario.



	60/40% Farmer Match Scenario						
3 Year Budget		**Federal**	**Match**	**Per Year**			
$ 133,000	Salary (and other overhead)	$ 79,800	$ 53,200	Partners (cash or in-kind)			
$ 400,000	BMPs	$ 240,000	$ 160,000	Farmer (cash or in-kind)			
$ 533,000		$ 319,800	$ 213,200			40.0%	Match
		Total from Partners	$ 53,200	$17,733.33		75.0%	BMPs
	75/25% Farmer Match Scenario						
3 Year Budget		**Federal**	**Match**				
$ 133,000	Salary (and other overhead)	$ 79,800	$ 53,200	Partners (cash or in-kind)			
$ 400,000	BMPs	$ 240,000	$ 100,000	Farmer (cash or in-kind)			
	Partner subsidy to farmers	$ 319,800	$ 60,000				
$ 533,000			$ 213,200			40.0%	Match
		Total from Partners	$ 113,200	$37,733.33		75.0%	BMPs
	90/10% Farmer Match Scenario						
3 Year Budget		**Federal**	**Match**				
$ 133,000	Salary (and other overhead)	$ 79,800	$ 53,200	Partners (cash or in-kind)			
$ 400,000	BMPs	$ 240,000	$ 40,000	Farmer (cash or in-kind)			
	Partner subsidy to farmers	$ 319,800	$ 120,000				
$ 533,000			$ 213,200			40.0%	Match
		Total from Partners	$ 173,200	$57,733.33		75.0%	BMPs
	0% from Farmer Scenario						
3 Year Budget		**Federal**	**Match**				
$ 133,000	Salary (and other overhead)	$ 79,800	$ 53,200	Partners (cash or in-kind)			
$ 400,000	BMPs	$ 240,000	$ -	Farmer (cash or in-kind)			
	Partner subsidy to farmers	$ 319,800	$ 160,000				
$ 533,000			$ 213,200			40.0%	Match
		Total from Partners	$ 213,200	$71,066.67		75.0%	BMPs

- SC Water Resources Conference
  - Abstract has been accepted at the SCWRC for Melanie Ruhlman, Angela Vandelay and Cindy Roper to present: <u>Cooperative Planning for Source Water Protection: Targeting Sediment in the Saluda River</u>. Abstract is attached.

**Minutes and other meeting materials will be uploaded to the shared TASC folder.*

Action Items:

1. TASC members – Review WBP goals and submit comments/edits to Melanie and Angela
2. TASC members – Send concerns, if any, about re-allocating $3,000 of the additional activities' budget to the Demonstration Project to Melanie Ruhlman by 5/25/2018.
3. TASC members – Review the budgetary needs for the Agricultural 319 grant, and evaluate how your organization and/or fundraising assistance can contribute toward this need. The next 319 implementation grant RFP should be issued in February 2019, so match funds need to be raised by then.
4. Angela to compare sediment load to other watersheds.
5. Melanie, Angela and Brandon investigate SARE grant possibility.
6. Mac Stone (Naturaland Trust) and Melanie Ruhlman (SOS) – Develop a storyboard for a public education video about the North Saluda River Watershed.

TECHNICAL ADVISORY STAKEHOLDER COMMITTEE

Watershed-Based Plan
for Sediment in the North Saluda River and Saluda Lake

TASC MEETING MINUTES

Date:	December 3, 2018
Time:	10:00 a.m.
Location:	Berea Library, Greenville, SC

Present:

Alex Dye, Easley Combined Utilities
Joel Ledbetter, Easley Combined Utilities
Dyke Spencer, Powdersville Water
Rebecca West, Renewable Water Resources
Joel Jones, Renewable Water Resources
Angie Price, Renewable Water Resources
Geoffrey Habron, Furman University
Heather Nix, Greenville Water
Mac Stone, Naturaland Trust
Nick Rubin, South Carolina Rural Water Association
Kyle Bennett, Pickens County
Scottie Ferguson, Pickens County
Pam Barber, Upstate Forever
Melanie Ruhlman, Save Our Saluda
Angela Vandelay, Wood Environment & Infrastructure Solutions

- After introductions, reviewed the agenda
- Reviewed several sections of the Draft Watershed Plan:
    - Addition of restoration of trout population to Watershed Goals
    - Draft estimate of sediment load from the watershed to waterbodies in the North Saluda-Saluda Lake watershed assessment area is 16, 055 tons per year, based on STEPL model (updated estimate: 11, 878 tons/yr), with majority coming from croplands in the Lower North Saluda River subwatershed.
    - Recent Saluda Lake Sedimentation Study shows that the previously dredged area of Saluda Lake (upper 100 acres) is already 2/3 filled in again with sediment after only six years. The study determined that an average of 54,870 tons per year have deposited in the upper reaches of Saluda Lake since it was dredged in 2012. Legacy sediment in the system, stream bank erosion, and sediment loading from the South Saluda Watershed (which are not captured in the STEPL model) account for the additional sediment loading to the lake.
    - Implementation Plan – BMPs and Preventative Measures
    - Estimated Sediment Load Reduction 3,238 tons/year (updated estimate: 3,048 tons/yr) after 15 years of implementation schedule.

  - Implementation Costs – The Plan includes BMPs and education totaling between $650,000 and $703,000 per 3-year period (some of which could come from grant funding).
  - Requesting DHEC add a water quality monitoring Station at S-773 if 319 funding is approved.
  - Great input from Public Survey
  - Schedule – Watershed Plan is due 12/31/18. Comments from TASC are due by 12/11/18
  - Geoffrey Habron (Furman University) suggested a couple of implementation ideas worth looking into:
    - Development of a labelling program, ex. "North Saluda Safe"
    - Linking the farmer's required match to the conservation value
    - Could look at cumulative impact if multiple farms adjacent to each other install BMPs.
  - Heather Nix of Greenville Water asked about prioritization of properties for land conservation. Upstate Forever has done some prioritization. Further prioritization will be completed when funding is available for land conservation.
- Cover crop workshop in September was very successful, though turnout was a little low due to the hurricane.
- Melanie presented the project at the SC Water Resources Conference
- Furman will get monitoring data to Melanie for including in the Plan
- The project video is in process
- The 319 grant proposal for development of a WBP for the South Saluda is due on December 6th. Letters of Support are needed before the deadline.
- The 319 implementation grant request for proposals is expected in January or February. In order to provide a 10% match to farmers, a minimum of $173,200 is needed from partners. $110,000 has already been secured. Will be seeking contributions toward the remaining $63,200+ over the next month or two.

APPENDIX G

Workshop Materials

You are cordially invited!

Please join us for a free workshop on

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY

Slater Hall, Slater, SC • Sept. 12 • 9 am to 1 pm
All participants will receive a free sample of cover crop seed.

FEATURED SPEAKERS:
Gordon Mikell, Soil Agronomist from USDA-NRCS
Jason Davis, owner, North River Farms

PLUS A RAINFALL-RUNOFF SIMULATOR DEMONSTRATION!

FREE LUNCH

RAFFLE PRIZES!

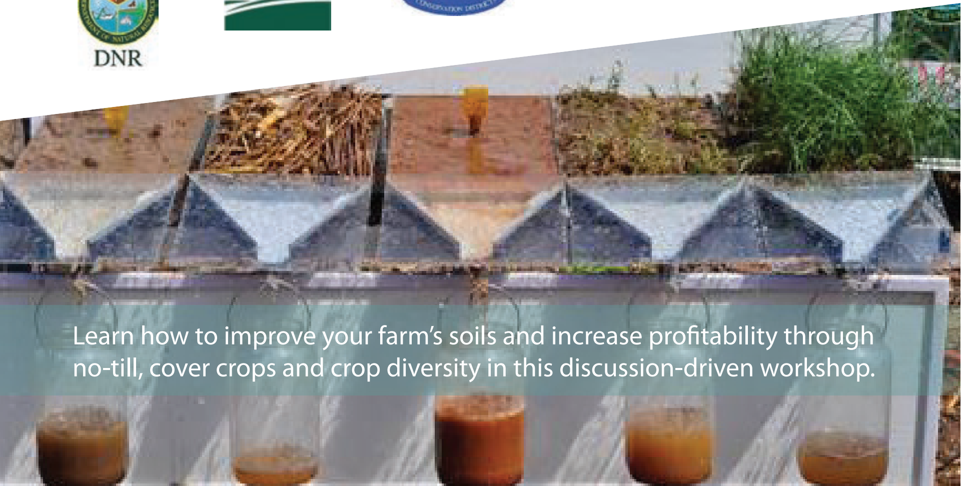
SAVE OUR SALUDA

Please RSVP by Sept 7th (space is limited)
Call or text: (864) 270-7629 or
email: info@saveoursaluda.org

Workshop presented as part of the Watershed Plan for North Saluda River and Saluda Lake in cooperation with:

- Easley Combined Utilities
- Clemson Cooperative Extension
- Furman University
- Greenville County
- Greenville County Soil and Water Conservation District
- Greenville Water
- Mountain Bridge Trout Unlimited
- Naturaland Trust
- Pickens County
- Powdersville Water
- Renewable Water Resources
- Save Our Saluda
- SC Department of Health and Environmental Control
- SC Department of Natural Resources
- South Carolina Rural Water Association
- Wood

Rainfall simulator demonstration brought to you by...



Learn how to improve your farm’s soils and increase profitability through no-till, cover crops and crop diversity in this discussion-driven workshop.

Save Our Saluda
P.O. Box 345
Marietta, SC 29661

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY

Wokshop, September 12, 2018, 9 am to 1 pm
Slater Hall, Slater, South Carolina

AGENDA

9:00 Welcome and Introduction
Melanie Ruhlman, Save Our Saluda

9:15 North Saluda/Saluda Lake Watershed Plan, 319 Program
Angela Vandelay, Wood

9:30 Agricultural Demonstration Site near Marietta
Melanie Ruhlman, Save Our Saluda

9:45 Rainfall Simulator – *SC Forage & Grazing Lands Coalition, Gordon Mikell, NRCS Conservation Agronomist*

10:30 Break

10:45 Agricultural BMPs in the Mills River Watershed
Jason Davis, North River Farms, Mills River, NC

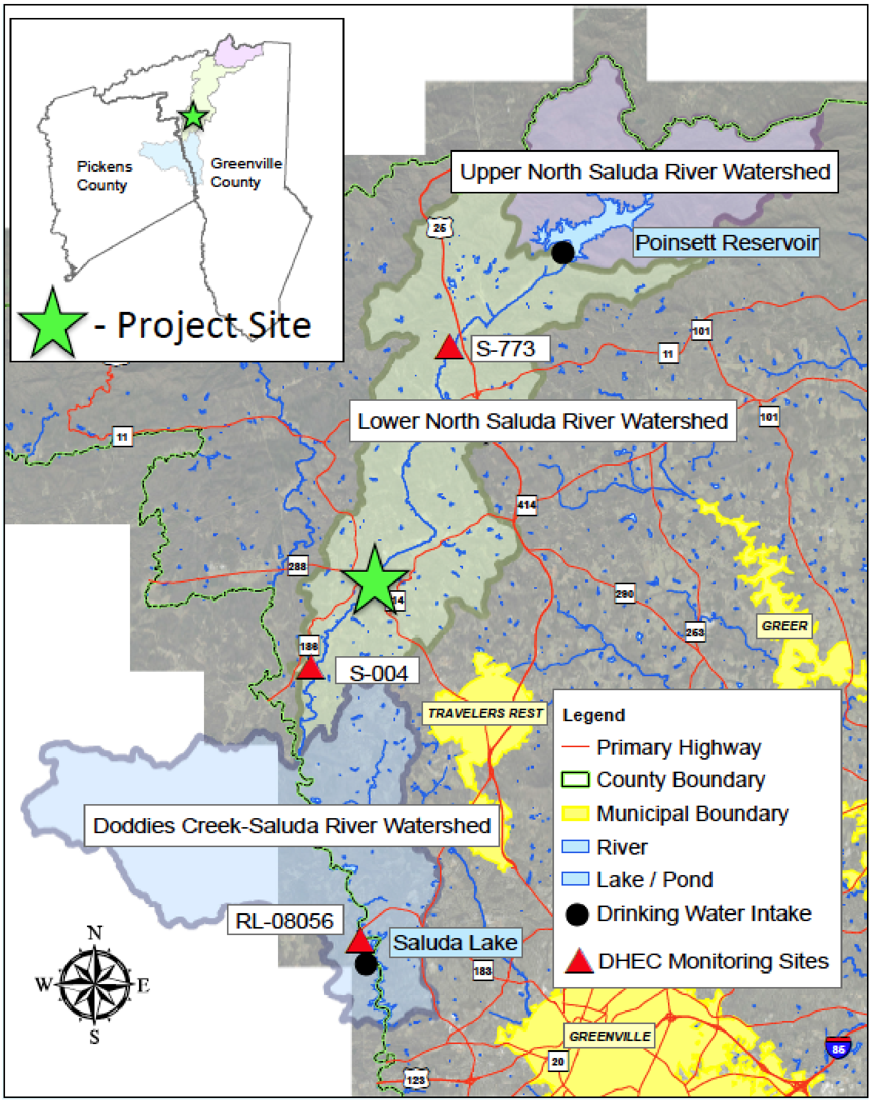
11:15 Cover Crops, Soil Health and Farm Bill Programs
Gordon Mikell, NRCS Conservation Agronomist

12:00 Lunch/Q&A/Panel Discussion/Raffle

1:00 Adjourn

WATERSHED PLAN FOR THE NORTH SALUDA RIVER AND SALUDA LAKE

Save Our Saluda, in cooperation with partnering organizations, is developing a watershed plan to address sediment in the North Saluda River and Saluda Lake. The plan will enable eligibility for significant funding for implementation of best management practices to help reduce sediment runoff and stabilize stream banks. The project is funded through the South Carolina Department of Health and Environmental Control Nonpoint Source Program with support from the partnership.



If you are a landowner in the watershed planning area and are interested in participating in the 319 grant program to help pay for Agricultural Best Management Practices at your farm, please contact us!

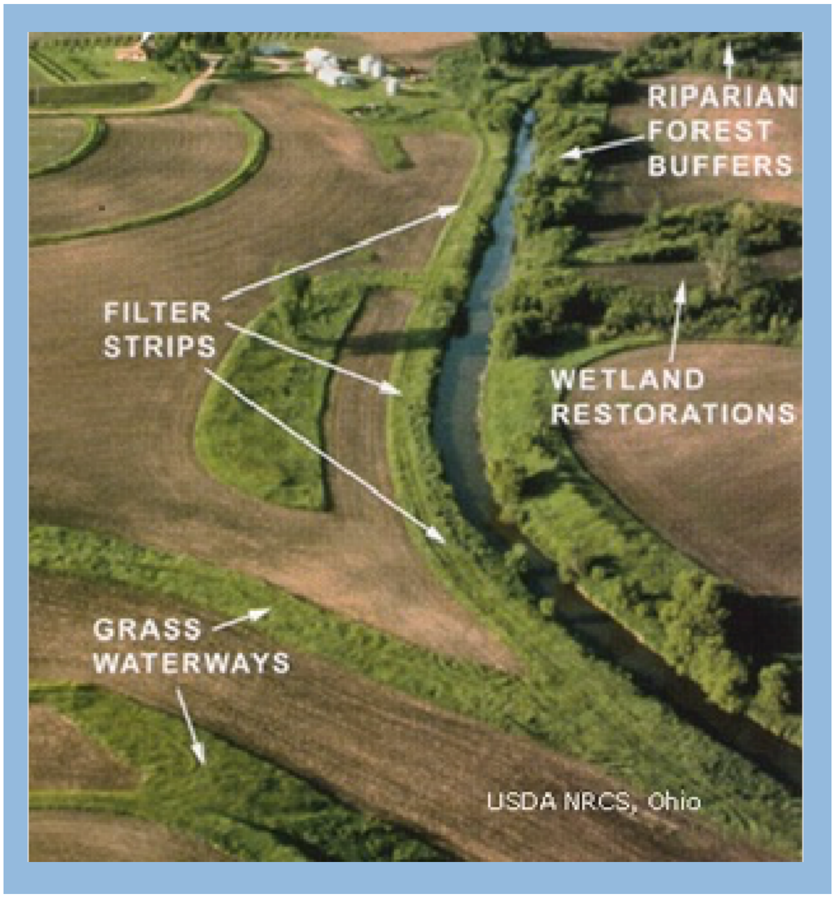
Stay tuned to our website and social media for updates.

Contact Information

Save Our Saluda
P.O Box 345
Marietta, South Carolina 29661

info@saveoursaluda.org | www.saveoursaluda.org |
www.facebook.com/saveoursaluda | www.instagram.com/saveoursaluda

Agricultural Best Management Practices Funded Through 319 Program
• Cover crops
• Intercropping
• Vegetated Riparian Buffers
• Vegetated Filter Strips
• Field Borders
• Pollinator Strips
• Culvert and Ditch Stabilization
• Farm access road stabilization
• Vegetated Waterways
• Sediment Control Basins
• Terracing and Contouring
• Streambank Stabilization
• Conservation Plans
• Livestock Fencing and Watering
• Loafing Sheds
• Stream Crossings
• Cross Fencing
• Pasture Planting
• Heavy Use Area Stabilization



USDA NRCS, Ohio

PROJECT PARTNERS

EASLEY COMBINED UTILITIES
dhec Healthy People. Healthy Communities.
ReWa renewable water resources
South Carolina Department of Natural Resources
Save Our Saluda
wood.
CLEMSON COOPERATIVE EXTENSION
Greenville Water
FURMAN
POWDERSVILLE WATER Quality on Tap
TROUT UNLIMITED MOUNTAIN BRIDGE
NATURALAND TRUST
SCRWA
PICKENS COUNTY SOUTH CAROLINA 1868
GREENVILLE COUNTY SOIL & WATER CONSERVATION DISTRICT
Greenville County

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY WORKSHOP SURVEY

September 12, 2018

1. How satisfied were you with today's workshop? Please rate each session
1-very satisfied, 2-satisfied, 3- neutral, 4- unsatisfied, 5-very unsatisfied

• Welcome and Introduction (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	1	[✓ 2]	3	4	5
• Agricultural Demonstration Site (Melanie Ruhlman)	1	[✓ 2]	3	4	5
• Rainfall simulator	[✓ 1]	2	3	4	5
• Agricultural BMPs in Mills River Watershed (Jason Davis)	[✓ 1]	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	[✓ 1]	2	3	4	5

2. Do you think installing soil stabilization practices at your farm might benefit your operation? ___ In what way(s)?
They are already in place with silt Traps, but I do not think they are effective.

3. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
Yes

4. Do you have concerns about sediment in the North Saluda River and Saluda Lake? Yes
Please explain your concerns. I think there is too much sand being harvested from the river which Increases the amount of bank erosion.

5. Do you have additional suggestions for improving soil health? More cover crops.

6. Do you have additional suggestions for reducing runoff? Farm hydroponically.

7. Do you have suggestions for improving this workshop? Take tours of Beechwood Farms.

8. What types of workshops/field tours would you be interested in attending in the future? Local Farm tours.

9. Any additional comments or questions? (use back for more space, if needed) I thought this was a good Idea and we should have actual Farm tours.

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY WORKSHOP SURVEY

September 12, 2018

1. How satisfied were you with today's workshop? Please rate each session
~~1~~5-very satisfied, ~~2~~4-satisfied, 3- neutral, ~~4~~2- unsatisfied, ~~5~~1-very unsatisfied
   - Welcome and Introduction (Melanie Ruhlman) 1 2 3 4 [✓ 5]
   - Watershed Plan, 319 Program (Angela Vandelay) 1 2 3 4 [✓ 5]
   - Agricultural Demonstration Site (Melanie Ruhlman) 1 2 3 4 [✓ 5]
   - Rainfall simulator 1 2 3 4 [✓ 5]
   - Agricultural BMPs in Mills River Watershed (Jason Davis) 1 2 3 4 [✓ 5]
   - Cover Crops, Soil Health and Farm Bill (Gordon Mikell) 1 2 3 4 [✓ 5]
2. Do you think installing soil stabilization practices at your farm might benefit your operation? ✓ In what way(s)?
Soil erosion sedament in river
3. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm? Yes - Also would like to know correct department for help with Chemical Shed Cost Share.
4. Do you have concerns about sediment in the North Saluda River and Saluda Lake? Yes
Please explain your concerns. many Sediment to E. Coli + Contamination
5. Do you have additional suggestions for improving soil health? Ground cover more Riparian and filter strips
Sub Soiling
6. Do you have additional suggestions for reducing runoff?
7. Do you have suggestions for improving this workshop?
8. What types of workshops/field tours would you be interested in attending in the future?
9. Any additional comments or questions? (use back for more space, if needed)

Would take help w/ cover crop seed going into winter or next spring.

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY WORKSHOP SURVEY

September 12, 2018

1. How satisfied were you with today's workshop? Please rate each session

1-very satisfied, 2-satisfied, 3- neutral, 4- unsatisfied, 5-very unsatisfied

• Welcome and Introduction (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	[✓ 1]	2	3	4	5
• Agricultural Demonstration Site (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Rainfall simulator	[✓ 1]	2	3	4	5
• Agricultural BMPs in Mills River Watershed (Jason Davis)	[✓ 1]	~~2~~	~~3~~	~~4~~	~~5~~ Excellent!!
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	[✓ 1]	2	3	4	5

2. Do you think installing soil stabilization practices at your farm might benefit your operation? ___ In what way(s)?

n/a Not a farmer

3. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?

n/a

4. Do you have concerns about sediment in the North Saluda River and Saluda Lake? Yes-

Please explain your concerns. Not only farming which is everywhere in our flood plains but also in the near future development is coming.

5. Do you have additional suggestions for improving soil health?

Cover crops yes Meadow strips yes

No till farming yes crop rotation yes

6. Do you have additional suggestions for reducing runoff? Enforcement of existing laws by Greenville County

7. Do you have suggestions for improving this workshop? A microphone for speakers / Speakers need to repeat questions asked

8. What types of workshops/field tours would you be interested in attending in the future? ___

9. Any additional comments or questions? (use back for more space, if needed) We need to get more farmers involved - Disappointed in their lack of interest in this workshop

When you have a small group let folks introduce themselves - tell why they're present - What they are looking for?

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY WORKSHOP SURVEY

September 12, 2018

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1. How satisfied were you with today's workshop? Please rate each session

1-very satisfied, 2-satisfied, 3- neutral, 4- unsatisfied, 5-very unsatisfied

• Welcome and Introduction (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	[✓ 1]	2	3	4	5
• Agricultural Demonstration Site (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Rainfall simulator	[✓ 1]	2	3	4	5
• Agricultural BMPs in Mills River Watershed (Jason Davis)	[✓ 1]	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	[✓ 1]	2	3	4	5

2. Do you think installing soil stabilization practices at your farm might benefit your operation? ___ In what way(s)?

N/A - no farm but mulch/ground cover practices will benefit Trees Greenville + my home practices

3. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?

N/A - Trees Greenville could partner on creating riparian buffers, vegetation strips, etc

4. Do you have concerns about sediment in the North Saluda River and Saluda Lake? Yes

Please explain your concerns. Generally know smaller streams + waterways North of Pickens downtown are very close to homes, lawns, farms, + new development/clearing

5. Do you have additional suggestions for improving soil health? Trees! !! as mentioned

6. Do you have additional suggestions for reducing runoff? no but interested in rain gardens + how site designs incorporate trees

7. Do you have suggestions for improving this workshop? was great + informative. I enjoy small group discussions in between talks if possible - share ideas

8. What types of workshops/field tours would you be interested in attending in the future? riparian buffer/vegetation strip design, roots + soil health

9. Any additional comments or questions? (use back for more space, if needed)

N/A - Thanks for inviting us + organizing this! Important to keep the convos going.

BOOSTING SOIL HEALTH FOR CROP PRODUCTIVITY WORKSHOP SURVEY

September 12, 2018

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1. How satisfied were you with today's workshop? Please rate each session
1-very satisfied, 2-satisfied, 3- neutral, 4- unsatisfied, 5-very unsatisfied

• Welcome and Introduction (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Watershed Plan, 319 Program (Angela Vandelay)	[✓ 1]	2	3	4	5
• Agricultural Demonstration Site (Melanie Ruhlman)	[✓ 1]	2	3	4	5
• Rainfall simulator	[✓ 1]	2	3	4	5
• Agricultural BMPs in Mills River Watershed (Jason Davis)	[✓ 1]	2	3	4	5
• Cover Crops, Soil Health and Farm Bill (Gordon Mikell)	[✓ 1]	2	3	4	5

2. Do you think installing soil stabilization practices at your farm might benefit your operation? ___ In what way(s)?
Not a Farm

3. Would you be interested in EQIP or 319 funding to help pay for soil stabilization practices at your farm?
N/A

4. Do you have concerns about sediment in the North Saluda River and Saluda Lake? /
Please explain your concerns. Needs to be controlled

5. Do you have additional suggestions for improving soil health?

6. Do you have additional suggestions for reducing runoff?

7. Do you have suggestions for improving this workshop?

8. What types of workshops/field tours would you be interested in attending in the future?

9. Any additional comments or questions? (use back for more space, if needed)
N/A

APPENDIX H

Online Survey Results

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-47	Yes	well		No		0.00		0.00		0.00		0.00		0.00		0.00	No		No	No			No	No		11/14/2018 9:35 PM
1-25	No	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	No		No	No		Lack of erosion control requirements of the agricultural industry	No	No		11/13/2018 10:55 AM
1-48	Yes	public water system	Don't Know	No	4 – Not important at all	1.0		0.00		0.00		0.00		0.00		0.00	No		No	No			No	No		11/14/2018 9:38 PM
1-63	No	public water system	Greenville area	Yes	1 – Very Important	4.0	2 – Important	3.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	No		Yes	No		As a note to the riparian buffer requirements question: I support this, but qualified by the allowance of those who own land including one of these areas to be able to still use the land around and across the rivers (i.e., construct small bridges for transportation to and from a farm or home that may cut through the buffer).	No	No		11/21/2018 9:38 AM
1-59	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	No			No	No		11/21/2018 5:38 AM
1-57	No	public water system	Easley area	No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	2 – Important	3.0	Yes	Maintaining a 100 foot buffer	Yes	No			No	No		11/19/2018 8:41 AM
1-49	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	Yes	Legislative reinforcement of clean water act standards that are less influenced by executive/administrative decisions	Yes	No			No	No		11/15/2018 8:55 AM
1-3	No	public water system	Greenville area	No	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	No			No	No		11/13/2018 12:22 AM
1-26	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		No	Yes			No	No		11/13/2018 11:14 AM
1-22	Yes	public water system	Easley area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	Yes		No	Yes	We heard they previously pumped sediment out. But they stopped, why?	1. Easley Powdersville water boat ramp. The ramp states for residents. We have seen multiple people trying to get their boats in and out at the same time with children in the water. People regularly fish off the ramp. 2. Dumping trash has increased this year on the lake.	No	No		11/13/2018 9:56 AM
1-78	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	MBTU should assist with water quality monitoring on periodic basis utilizing their own water quality meters.	Yes	Yes		Aquatic invertebrate surveys is of concern to me.	No	No		12/3/2018 10:37 AM
1-77	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		12/1/2018 9:44 AM
1-76	No	well		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Mandated 25 foot undisturbed buffer - similar to what GA EPD has on all waters in the state of GA	Yes	Yes			Yes	No		11/30/2018 1:14 PM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-75	No	public water system	Greenville area	No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/30/2018 10:22 AM
1-74	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	I think more neighborhood watches are necessary in the Laurel and Hardy Lake area to protect that area.	Yes	Yes		See above.	No	No		11/29/2018 8:13 PM
1-73	No	public water system	Easley area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	I don't think that large developments, such as subdivisions should be allowed anywhere near a designated wetland.	Yes	Yes			No	No		11/29/2018 11:34 AM
1-71	No	public water system	Greenville area	No	1 – Very Important	4.0	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/29/2018 8:09 AM
1-70	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/29/2018 8:04 AM
Jan-69	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Buffer zones, riparian parks & green space, public outreach to landowners	Yes	Yes	Stronger sediment & erosion control requirements not just at construction sites, but post-construction requirements for inspections & repairs for farms, commercial sites, residential development, silviculture activities, etc.		No	No		11/29/2018 7:54 AM
1-68	No	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/29/2018 7:48 AM
1-67	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/27/2018 2:17 PM
1-66	No	public water system	Greenville area	No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Approach stormwater runoff with stricter regulations. Adopt the new buffer requirement recommendations up for a vote in Greenville County. Continue to work with farmers on water protections.	Yes	Yes	I'm no water expert, but perhaps working to avoid its entering the watershed in the first place?		No	No		11/21/2018 4:20 PM
1-65	Yes	public water system	Don't Know	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	Yes		Yes	Yes			No	No		11/21/2018 2:46 PM
1-64	No	public water system	Easley area	No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/21/2018 10:50 AM
1-62	No	public water system	Greenville area	No	1 – Very Important	4.0	4 – Not important at all	1.0	1 – Very Important	4.0	3 – Not very important	2.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/21/2018 8:33 AM
1-61	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/21/2018 6:49 AM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-60	Yes	public water system	Easley area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/21/2018 6:07 AM
1-58	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/20/2018 10:52 AM
1-56	No	public water system		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Impact fees paid by developers to fund programs for Watershed improvements!	Yes	Yes	Protection of the riparian buffers; stricter measures for sediment control for all land clearing activities!		Yes	No		11/17/2018 9:18 PM
1-55	Yes	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/17/2018 5:24 PM
1-54	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/16/2018 9:21 PM
1-53	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	Yes		Yes	Yes			No	No		11/16/2018 7:37 PM
1-52	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Rivers and streams need 25' to 50' of green way protection and good canopies for temperature protection. Agricultural sediment and poor land practices runoff choke streams, rivers and lakes, killing the plants and animals that naturally live in the watersheds. Sedimentation needs to be kept out of our drinking water as do fertilizers, pesticides, and other agricultural and poor land practices pollutants. River and lake banks need to be stabilized and animals must be be kept out of our drinking water. How disgusting and unhealthy that we let farm animals urinate and defecate in our drinking water.	Yes	Yes	Yes, for afore stated reasons.	Given the rapid growth the area is experiencing, the classic enemy of our natural resources is the three Ps: People, Pollution and Politics. We are fortunate to live in a beautiful part of the world. One of the premier benefits of this area is its natural beauty, and an abundance of clean water, thanks to our predecessors who had the foresight to protect our water sources many years ago. We need to be better stewards of these resources by taking all reasonable measures to protect them..	Yes	Yes	David	11/16/2018 3:23 PM
1-51	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/16/2018 9:26 AM
1-50	No	public water system	Greenville area	No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/15/2018 11:00 AM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-46	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	I think run-off and sedimentation is a very large problem where I live, Saluda Lake. The lake continue to fill with sediment impacting over-all water quality, and quality of life. There are significant problems with waterfront maintenance by homeowners. Many docks on the lake are in disrepair, and many trees fall from properties into the lake causing navigation and safety hazards (never cleared). We need some kind of lake authority. Finally, the dam owners do not regulate lake level in consideration of lake front properties. Too much variation in lake level. Finally, the dam owners have no means of communicating dam and lake conditions to lake front residents. This is my biggest issue at this time.	Yes	Yes	See above	There needs to be more campaigning with residents about dumping and throwing trash on ground and into the lake and streams. And we need more law enforcement with this issue.	No	No		11/14/2018 7:54 PM
1-45	Yes	well		Yes	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Restriction of pesticides from farms going into the watershed. And restricting farmers pulling water from flowing streams and especially in times of low water flow.	Yes	Yes			No	No		11/14/2018 6:39 PM
1-44	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	protect critical lands that influence water quality and quantity; buy land that will have a future positive impact without the need for engineered solutions like large stormwater ponds	Yes	Yes	provide for more wetlands and places for oxbows to naturally occur upstream, and trace sources of turbidity to find specific solutions; create a list of best management practices for businesses and residences adjacent to and on lands that highly influence water quality. Provide special attention to higher than usual storm flows and the potential of sediment movement and how to mitigate for these high energy occurrences.	Yes, there is a lack of funding currently to address the needs of land protection. Gradual land protection now and into the future will avoid and minimize the need for large, expensive engineered solutions that will require continuous maintenance while providing limited benefits to wildlife and water quality.	Yes	Yes	Scott	11/14/2018 3:51 PM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-43	Yes	well		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/14/2018 2:50 PM
1-42	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Teach the children how important it is to protect our rivers and streams. Maybe supply elementary schools with flyers showing ways to protect our water ways...inform the young so they will carry that with them the rest of their lives. Create buffer requirements for new developments'. Patrol the river in kayaks to look for raw waste discharge. I live along the Saluda on Hwy 81 in Greenville. Several years ago we took pictures of active drain pipes discharging into the river as we kayaked from the Saluda damn to Hwy.81 and turned them over to the environmental folks. I think it helped~! Maybe have a weekend river float music gathering and have folks take pictures of problem areas along the river and then share at days end.	Yes	Yes	Farms and animals can be a big problem. Several years ago in Anderson county Hwy.81 area we had problems with a cattle farm and the cows would wade in the river, now it's a park with a launch site for kayaks. Big improvement~!!	Need to promote the importance of the Saluda...most people take it for granted and don't have a clue of it's history. Once people become proud of something they respect it more.	No	No		11/14/2018 1:30 PM
1-41	No	well		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/14/2018 8:17 AM
1-40	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 10:50 PM
1-39	No	well		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/13/2018 8:18 PM
1-38	No	public water system	Easley area	No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 7:55 PM
1-37	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Something needs to be done to prevent Saluda Lake from filling up again. Property values are adversely effected by it's degradation. It is a lovely lake that should be maintained in order to provide adequate recreation facilities for our area's burgeoning population.	Yes	Yes	I am concerned about run-off from (a) company / companies that is / are upstream from the dam.	Is there a statute allowing 10 feet of waterfront property to be accessed by the public? I am concerned if someone needs to get ashore and some areas are posted, "no trespassing"	No	No		11/13/2018 7:04 PM
1-36	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 4:30 PM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-35	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Kee	Yes	Yes			No	No		11/13/2018 3:43 PM
1-34	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 3:23 PM
1-33	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 2:59 PM
1-32	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes	Dredge again and often	My girlfriend gets uti's and therefore won't swim with me anymore in the lake	No	No		11/13/2018 1:57 PM
1-31	No	public water system		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Promotion of conservation easements. Restrictions on density and proximity of development along the rivers. Enforcement of pollution control laws and non-point-source planning.	Yes	Yes			No	No		11/13/2018 12:05 PM
1-30	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 12:05 PM
1-29	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Regular Testing of Water Quality via aquatic species, water, & plants. Requirements for adequate silt control in high use areas, including residential & commercial building.	Yes	Yes			No	No		11/13/2018 11:54 AM
1-28	No	public water system		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Sediment conrol through planning and planting.	Yes	Yes	vegetated buffers along the waterways		No	No		11/13/2018 11:53 AM
1-27	No	public water system	Easley area	No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Stiffer littering fines and enforcement, better land use planning by all counties and cities in the Upstate, better source-water regulations and public education	Yes	Yes	Aggressive storm-water management and BMPs for the Upper Saluda	Saluda Lake is currently a raw water source for probably 70,000-100,000 people and it is filling in at an alarming rate due to poor land use practices by a few landowners.	No	No		11/13/2018 11:51 AM
1-24	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Continued monitoring of water quality and adding of enforcement personnel punish violators.	Yes	Yes	Better zoning and codes combined with public money used as incentives yes.	Better monitor Land Management practices including clear-cut	Yes	No		11/13/2018 10:37 AM
1-23	No	public water system	Greenville area	No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes		Where is the sediment coming from? Is it man-made? Have there been toxicology reports? Are any of the local universities studying the ecology of this area?	No	No		11/13/2018 10:13 AM
1-21	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 9:37 AM
1-20	Yes	public water system		No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Protected properties, better agricultural practices, riparian buffers.	Yes	Yes	conserved land, better agricultural practies	preventing discharges into them. Litter	Yes	Yes	Frank	11/13/2018 9:21 AM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilization Stream Stablization Etc	Name_First	Entry_Timestamp
1-19	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes	A catch basin just north of Saluda lake that is constantly dredging to catch silt as it comes down the river. The silt could be sold as sand or fill.		No	No		11/13/2018 9:16 AM
1-18	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 8:55 AM
1-17	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Agricultural cover crops	Yes	Yes			No	No		11/13/2018 8:33 AM
1-16	No	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/13/2018 8:27 AM
1-15	No	public water system	Other	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 8:14 AM
1-14	Yes	public water system	Easley area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Homeowners need to be more aware of the impact of their practices on the lake. Ex: washing cars and allowing the waste water to run into the lake. Need speed limts and horsepower limits on the lake. Boaters are oblivious to the impact of high speeds in small coves. Need better enforcement. Perhaps limit certain areas to non-motorized boats? Post signs, buoys.	Yes	Yes	Homeowners should have to get a work permit when building docks or doing land grading work on property adjacent to the lake. DNR and DHEC should inspect. Saluda Lake is not as protected as other reservoirs. Need to publish the name and contact numbers for the "owners" of the Lake. I heard it is no longer controlled by Easley Utilities? I am not sure that private ownership serves the best interests of the lake. I would like to learn more.	More public awareness and education is needed. Occasional boaters, jet skiers, etc appear to have no clue as to the damage they do. More enforcement is needed on weekends; especially holiday weekends. Teenagers need more information. Even though there are no restrictions on the lake, I personally chose to not own any motorized boats. Gasoline, oil and high speeds contribute to the degradation of the lake (in my opinion.)	No	No		11/13/2018 8:11 AM
1-13	Yes	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Keep the soil on the land not as sedament in the rivers.	Yes	Yes			Yes	No		11/13/2018 7:38 AM
1-12	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 7:09 AM
1-11	No	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			Yes	No		11/13/2018 7:07 AM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilization Stream Stablization Etc	Name_First	Entry_Timestamp
1-10	Yes	public water system	Easley area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Pumping systems to pump sediment out as it flows down stream	Yes	Yes	Pumping systems to pump sediment out as it flows down. My understanding is that some were in place years and years ago which helped keep the sediment out.	Just all that has been noted	No	No		11/13/2018 6:55 AM
1-9	Yes	public water system	Greenville area	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes		I am a homeowner on Saluda Lake and am very concerned with the water quality of the lake in which my children play. Every time it rains, the lake gets so muddy that we can't swim for many days. I am very concerned with the farming chemicals runoff that is filling our lake.	No	No		11/13/2018 6:41 AM
1-8	No	public water system		No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 6:39 AM
1-7	No	public water system		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	Yes		Yes	Yes			No	No		11/13/2018 6:00 AM
1-6	No	public water system	Greenville area	No	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Public access is required in the North Saluda watershed for transparent monitoring of the area.	Yes	Yes	Remove Saluda Lake dam or license the hydropower station	Lack of access to upper lakes could allow illegal dumping without public monitoring.	No	No		11/13/2018 5:24 AM
1-5	Yes	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	A tributary to the North Saluda runs through my property. This summer on several early mornings this stream was the darkest brown from sediment but it had not rained in days and the night before this same stream was crystal clear (I have photos). As the Waterfall Community is now upstream, I suspect something a foul. That said, closer monitoring is needed on these developers and their ever increasing projects in our once pristine watershed. /-=<	Yes	Yes	Monitoring and follow up if odd sediment discharge is observed.	Access issues for nonmotorized recreational float craft (e.g.canoes, kayaks, sit on tops, stand up paddle boards, etc).	Yes	Yes	Damon	11/13/2018 2:47 AM
1-4	No	public water system	Other	No	1 – Very Important	4.0	2 – Important	3.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	no	Yes	Yes	no	no	No	No		11/13/2018 1:37 AM

Upper Saluda Watershed Survey_Id	Do You Live In Or Own Land In The Upper Saluda River Watershed	Does Your Drinking Water Come From A Well Or Public Water System	If Public Please Choose The Specific Source Of Water	Do You Access Waters Of The Upper Saluda For Fishing Paddling Swimming Or Other Recreational Purposes	How Important To You Is Water Quality Of Local Streams Rivers And Lake	How Important To You Is Water Quality Of Local Streams Rivers And Lake_Rating	How Important To You Is Recreational Use Of Local Streams Rivers And Lake	How Important To You Is Recreational Use Of Local Streams Rivers And Lake_Rating	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake	How Important To You Is Healthy Fisheries And Aquatic Conditions Of Local Streams Rivers And Lake_Rating	How Important To You Is Land Conservation For Protection Of Drinking Water	How Important To You Is Land Conservation For Protection Of Drinking Water_Rating	RatingScale Questions_HowImportantToYouIsLandConservationForWaterQualityAndStreamHealth	How Important To You Is Land Conservation For Water Quality And Stream Health_Rating	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits	How Important To You Is Land Conservation For Wildlife And Other Environmental Benefits_Rating	Do You Think Protective Measures Are Needed To Protect Local Streams Rivers Wetlands And Lakes As Development Of The Watershed Increases	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Support Riparian Buffer Requirements At New Development Sites For Protection Of Streams Rivers Lakes And Wetlands	Do You Have Concerns About Sediment In The Upper Saluda Rivers Or Saluda Lake	If Yes Do You Have Suggestions For Protective Measures Or Practices	Do You Have Other Concerns Regarding Rivers Of The Upper Saluda Watershed Or Saluda Lake	Do You Or Someone You Know Own A Farm In The Upper Saluda River Watershed	IfYes Would You Like To Be Notified If when Funding Is Available To Help Pay For Management Practices such As Cover Crops Exclusion Or Cross Fencing Culvert ditch Stabilzation Stream Stablization Etc	Name_First	Entry_Timestamp
1-2	No	public water system	Don't Know	Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Natural riparian buffers seem cheap (free), as easy to maintain as anything can be, and very effective for the cost. Enforce laws that are already on the books. Developers, farmers, golfers, and everyone else must protect what we have. The demand for clean water will only rise, and the supply of it is going to lessen no matter what we do, so fight for every drop. Protect our land, water, wildlife, and natural resources even if it means losing (or not gaining) jobs because once those resources are depleted, the jobs will go away anyway.	Yes	Yes	Follow the advise of experts. Enforce the laws. Hold parties accountable. Make fines go directly into a special sediment-prevention fund?		Yes	Yes	Clayton	11/12/2018 11:31 PM
1-1	Yes	well		Yes	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	1 – Very Important	4.0	Yes	Clear and effective riparian buffer ordinance.	Yes	Yes	Enforcement to reduce runoff from construction sites, promotion of agricultural BMPs to reduce soil migration.	Many agricultural areas seem to locate chemical mixing areas very near water bodies. I am concerned about spills or dumping (via tank cleaning) of toxic chemicals.	Yes	No		11/12/2018 10:16 AM
1-72	No	public water system	Other	Yes	2 – Important	3.0	1 – Very Important	4.0	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	2 – Important	3.0	Yes		Yes	Yes		I live in Greenwood but since Lake Greenwood is formed from the Reedy and Saluda protection of the water quality of the Saluda River is essential to our community.	No	No		11/29/2018 8:56 AM

APPENDIX I

SCWRC Manuscript

Cooperative Planning for Source Water Protection: Targeting Sediment in the Upper Saluda River Watershed

Melanie Ruhlman[1], Angela Vandelay[2], Cindy Roper[3]

AUTHORS: [1]Water Resources Specialist, North Wind, Inc., 777 Lowndes Hill Rd., Greenville, SC 29607, USA, and President, Save Our Saluda, P.O. Box 345, Marietta, SC 29661, USA, [2]Senior Environmental Engineer, Wood Environment & Infrastructure Solutions, 720 Gracern Road, Suite 132, Columbia, SC 29210, USA, [3]PhD student, Policy Studies, Environmental and Natural Resource Policy, Clemson University, Clemson, SC 29634, USA.

REFERENCE: *Proceedings of the 2018 South Carolina Water Resources Conference*, held October 17-18, 2016 at the Columbia Metropolitan Convention Center.

ABSTRACT. Save Our Saluda, in cooperation with partnering organizations, is developing a watershed plan to address sediment in the North Saluda River and Saluda Lake. The plan lays the groundwork for implementation of practices and measures to help reduce sediment runoff and stabilize streambanks to improve and protect the health of the river and lake. The project is funded through the South Carolina Department of Health and Environmental Control (SCDHEC) Nonpoint Source Program with support from the partnership.

INTRODUCTION

The U.S. Environmental Protection Agency lists sediment as the most common pollutant in rivers, streams, lakes and reservoirs. While natural erosion produces nearly 30 percent of the total sediment in the United States, accelerated erosion from human use of land accounts for the remaining 70 percent (https://cfpub.epa.gov/npstbx/files/ksmo_sediment.pdf). Water quality, aquatic life, recreational use, and downstream reservoir storage are all adversely affected by sedimentation. Excess sediment not only fills rivers and lakes, it carries with it pollutants such as bacteria, nutrients, pesticides and metals that further degrade water quality and stream health.

Rivers and floodplains of the southeast Piedmont carry and store large quantities of legacy sediment from post-European settlement (Trimble, 2008). Present day land use practices also contribute significant amounts of newly eroded sediment to downstream waterbodies each year. Stream channel erosion is an additional contributing factor to overall sediment loading in Piedmont riverine systems. Stormwater runoff from developed areas can further destabilize streams and accelerate channel and streambank erosion. Because it is a nonpoint source pollutant, cooperative watershed-based solutions are needed to address water quality and other problems associated with sediment.

BACKGROUND

Saluda Lake and its contributing rivers in the Upper Saluda Watershed are vital water resources for local communities in the Upstate (Figure 1). Headwaters feed Table Rock Reservoir on the South Saluda River and Poinsett Reservoir on the North Saluda River, supplying water to the greater Greenville area. Watershed areas above each of these reservoirs are protected through conservation easements and provide some of the highest quality drinking water in the country. Downstream near Greenville, Saluda Lake supplies water to the Easley area and its dam supplies hydropower. The Upper Saluda Rivers also support business and industry and provide recreational opportunities to thousands of Upstate residents and visitors.

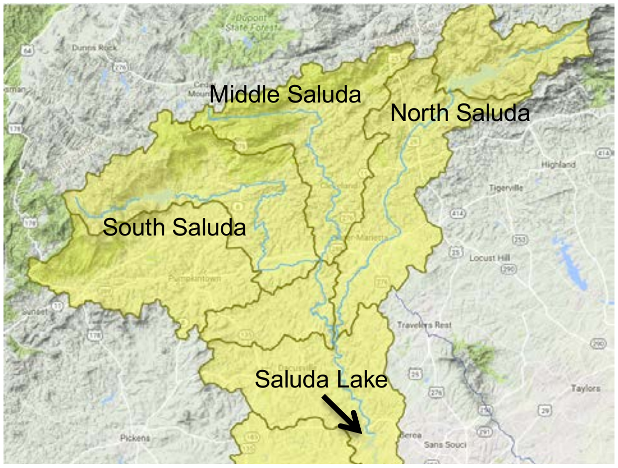

Figure 1. Upper Saluda Watershed

Sediment is a significant problem for Saluda Lake. In 2011-2012, approximately 320,000 cubic yards of sediment was dredged from the lake at a cost of seven million dollars to Easley Combined Utilities. Upper parts of Saluda Lake are already rapidly filling in with sediment again. Water quality in the lake and rivers upstream is impaired, aquatic habitat is degraded, and recreation is diminished due to sedimentation, particularly in the North Saluda River (Figure 2).

Cost effective and sustainable watershed-based solutions are needed for long-term erosion prevention and sediment control. Strategies to minimize soil loss from the watershed will help protect drinking water sources, improve river and lake water quality, restore aquatic habitat conditions, and enhance recreational experiences for property owners and the public.

Figure 2. North-South Saluda Rivers Confluence

After prioritizing the North Saluda River for initial focus, a local non-profit organization, Save Our Saluda, recruited and coordinated project partners to develop a watershed plan to address sediment in the North Saluda River and Saluda Lake. The project was funded through the SCDHEC's Nonpoint Source Program with support from the partnership. Partners include multiple utilities, county stormwater programs, agricultural agencies, universities, and nonprofit groups whose representatives comprise the Technical Advisory Stakeholder Committee (TASC). The TASC met regularly to help oversee and guide the project, and additional focus meetings were held with agricultural, urban, and forestry stakeholders to discuss practices, regulations, and landowner issues related to sediment runoff in the watershed planning area.

WATERSHED ASSESSMENT AND PLAN

The primary goal of the watershed plan is to reduce sediment loading to the river and lake. The plan lays the groundwork for implementation of best management practices (BMPs) and other protective measures to help control sediment runoff. Community outreach and education efforts are aimed at building community support for the protection and enhancement of land and water resources in the Upper Saluda Watershed.

Spanning Blue Ridge and Piedmont physiographic regions, the watershed planning area includes the Upper and Lower North Saluda subwatersheds and drainage areas around Saluda Lake (Doddies Creek-Saluda River subwatershed). It encompasses approximately 122.5 square miles in Greenville and Pickens Counties.

Methods

The watershed assessment involved desktop and field surveys to gather land use and water quality data for the watershed planning area. A windshield survey was conducted to verify 2011 USGS National Land Cover Database land use mapping and to identify any obvious sediment source areas. Modeling of the watershed area was done using EPA's "Spreadsheet Tool for the Estimation of Pollutant Load" (STEPL). STEPL incorporates many of the watershed characteristics such as soils, land use, rainfall data and number of agricultural animals. It utilizes the Universal Soil Loss Equation (USLE) to estimate sediment load from surface runoff of different land use areas.

BMPs and other measures were selected and prioritized to address the greatest sources of sediment pollution. These include structural, programmatic, and educational BMPs. Sediment load reduction from implementation of the selected BMPs/management measures was estimated using a number of assumptions, included level of participation and the effectiveness of the practice for reducing sediment loading.

Watershed Assessment Results

Land use data indicate that 77 percent of the North Saluda-Saluda Lake watershed planning area is forested land. Managed rural areas (pastures, crops and hay) make up 8 percent of the total area and 13 percent of land use is categorized as urban.

Assessment of existing water quality data corroborates designated impairments in the North Saluda River and Saluda Lake related to sediment. High sustained turbidity levels during and following stormflow have been observed in the North Saluda River and Saluda Lake. Greenville County has 17 continuous stream monitoring gages across the county that record turbidity at 15-minute intervals. The North Saluda station has the highest overall mean turbidity of all the county's stations despite its watershed area being the second highest percentage of forest cover (nearly 80%). Because forest is a fairly stable land use, this indicates that the sediment runoff reaching this monitoring station is coming from a relatively small proportion of the watershed. Bedload sediment in the North Saluda is significant, and many reaches are characterized by shallow water depths, lack of a discernable thalweg, poorly sorted sediments, and loss of pool-riffle habitat, all of which contribute to impaired aquatic habitat conditions.

Sedimentation is ongoing in the upper parts of Saluda Lake. Data indicate that turbidity in the lake increased during dredging operations, peaked in 2013, and remains higher than pre-dredging levels.

STEPL model results indicate that 74% of the overall sediment load originates from the Lower North Saluda River watershed and that 67% of the overall sediment load is coming from croplands. It should be noted that STEPL does not estimate in-stream erosion.

Watershed modeling and field observations confirm that intensively managed crop areas in floodplains are large contributors of sediment loading to the river and lake downstream. Therefore, these land use areas are the focus for ongoing and future sediment control projects as part of the watershed protection plan described below.

Watershed Plan Implementation

The Watershed Plan for the North Saluda River and Saluda Lake identifies areas and strategies for watershed restoration and protection. Priority sources of sediment loading from the watershed planning area include:

- Runoff from crop farms,
- Livestock in streams,
- Runoff from pastures,
- Runoff from dirt roads, driveways, and roadside ditches,
- Runoff from development sites, and
- Eroding streambanks.

BMPs identified for sediment control are listed below for priority sources. Agricultural BMPs include:

- Cover crops
- Intercropping
- Conservation tillage
- Vegetated filter strips
- Field borders
- Pollinator strips
- Culvert/ditch stabilization
- Farm road stabilization
- Vegetated waterways
- Sediment control basins
- Terracing and contouring
- Streambank stabilization
- Conservation plans
- Livestock fencing/watering
- Loafing sheds
- Stream crossings
- Cross fencing
- Pasture planting
- Hay use area stabilization
- Vegetated riparian buffers

Programmatic measures for sediment control for existing and future urban source areas include:

- Land development regulations,
- Riparian buffer protections,
- Land conservation easement program,
- Citizen training and reporting, and
- Education and outreach.

The plan identifies technical and financial assistance needed for implementation and proposes solutions to help meet those needs, including grants and programs such as 319 Nonpoint Source Pollution Grants and the USDA NRCS Environmental Quality Incentives Program (EQIP).

DISCUSSION

Watershed planning provides a framework for action for restoration and protection of local water resources. Numerous stakeholders have a variety of motivations to protect and improve water quality. Engaging the stakeholders to cooperate to achieve the same overall goals of protecting and improving water quality can be both efficient and cost effective.

Watershed-based plans typically address nonpoint sources of pollution and do not include regulatory requirements. Developing a meaningful, cooperative watershed plan helps gain involvement from stakeholders, documents the water quality issues and proposed solutions, and will enable eligibility to obtain funding for implementation.

Many water quality issues require continued regional dialogue, cooperation, and stakeholder engagement for effective, long-term solutions. Additional planning and implementation efforts are ongoing for the Upper Saluda River Watershed above Saluda Lake. These include the first implementation project at a crop farm on the North Saluda River near Marietta, a crop farm workshop held in September 2018, and pursuit of funding to prepare a Watershed Plan for the South Saluda River Watershed. The TASC continues to support project stakeholder efforts to improve water quality by reducing sediment in waterbodies in the Upper Saluda River Watershed.

Thank you project partners: Clemson Cooperative Extension, Easley Combined Utilities, Furman University, Greenville County, Greenville County Soil and Water Conservation District, Greenville Water, Mountain Bridge Trout Unlimited, Naturaland Trust, Pickens County, Powdersville Water, Renewable Water Resources, Save Our Saluda, SC Department of Health and Environmental Control, SC Department of Natural Resources, SC Rural Water Association, Upstate Forever, Wood Environment & Infrastructure Solutions.

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Trimble, S.W. 2008. *Man-induced soil erosion on the Southern Piedmont*. Ankeny, Iowa: Soil and Water Conservation Society. New, Enhanced Edition of the 1974 edition with a Forward by Andrew Goudie (Oxford) and an introductory essay by S. W. Trimble.

APPENDIX J

STEPL Input Data

State South Carolina ▾

Export Data

County Greenville ▾

Weather Station _SC-Greenville_Mean ▾

Calculate Manure Application Months: Manure Application

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors		
									0.937	0.605	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	136	0	0	15153	0	0	0-24%	15289	69	114	0.938
W2	4739	1212	1173	26318	0	0	0-24%	33442	69	114	0.938
W3	5008	267	3797	20271	0	0	0-24%	29343	58	114	0.795
W4	0	0	0	0	0	0	0-24%	0	58	114	0.795
W5	0	0	0	0	0	0	0-24%	0	58	114	0.795
W6	0	0	0	0	0	0	0-24%	0	58	114	0.795
W7	0	0	0	0	0	0	0-24%	0	58	114	0.795
W8	0	0	0	0	0	0	0-24%	0	58	114	0.795
W9	0	0	0	0	0	0	0-24%	0	58	114	0.795
W10	0	0	0	0	0	0	0-24%	0	58	114	0.795

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied on Cropland	# of months manure applied on Pastureland
W1	0	0	0	0	0	0	100	100	9	6
W2	23	2	3	15	15	1	0	0	0	0
W3	290	2	26	70	107	8	0	0	0	0
W4	0	0	0	0	0	0	0	0	0	0
W5	0	0	0	0	0	0	0	0	0	0
W6	0	0	0	0	0	0	0	0	0	0
W7	0	0	0	0	0	0	0	0	0	0
W8	0	0	0	0	0	0	0	0	0	0
W9	0	0	0	0	0	0	0	0	0	0
W10	0	0	0	0	0	0	0	0	0	0
Total	313	4	29	85	122	9	100	100		

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0
W2	0	2.43	2	0	0
W3	0	2.43	2	0	0
W4	0	2.43	2	0	0
W5	0	2.43	2	0	0
W6	0	2.43	2	0	0
W7	0	2.43	2	0	0
W8	0	2.43	2	0	0
W9	0	2.43	2	0	0
W10	0	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000

W2	300.000	0.247	0.858	0.9	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W3	300.000	0.247	0.858	0.4	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W4	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W5	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W6	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W7	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W8	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W9	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000
W10	300.000	0.247	0.858	0.200	0.935	300.000	0.247	0.858	0.040	1.000	300.000	0.247	0.858	0.003	1.000

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%	Soil E. coli conc. (#/100mg)
W1	○	●	○	○	B	0.080	0.031	0.160	0.000
W2	○	●	○	○	B	0.080	0.031	0.160	0.000
W3	○	●	○	○	B	0.080	0.031	0.160	0.000
W4	○	●	○	○	B	0.080	0.031	0.160	0.000
W5	○	●	○	○	B	0.080	0.031	0.160	0.000
W6	○	●	○	○	B	0.080	0.031	0.160	0.000
W7	○	●	○	○	B	0.080	0.031	0.160	0.000
W8	○	●	○	○	B	0.080	0.031	0.160	0.000
W9	○	●	○	○	B	0.080	0.031	0.160	0.000
W10	○	●	○	○	B	0.080	0.031	0.160	0.000

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportation	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultiva	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Cropland	**1.9**	**0.3**	**4**	0
1a. w/ manure	8.1	2	12.3	0
2. M-Cropland	**2.9**	**0.4**	**6.1**	0
2a. w/ manure	12.2	3	18.5	0
3. H-Cropland	**4.4**	**0.5**	**9.2**	0
3a. w/ manure	18.3	4	24.6	0
4. Pastureland (see Table 10 for default values with manure)				
5. Forest	**0.2**	**0.1**	**0.5**	0
6. User Defin	**0**	**0**	**0**	0

7a. Nutrient concentration in shallow groundwater (mg/l) and E. coli (MPN/100ml)(may be modified)

Landuse	N	P	BOD	E. coli
Urban	1.5	0.063	0	0
Cropland	1.44	0.063	0	0
Pastureland	1.44	0.063	0	0
Forest	0.11	0.009	0	0
Feedlot	6	0.07	0	0
User-Defined	0	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	136	0	2	0	3	0	0	0	0	95	100
W2	4739	1	1	0	4	0	12	0	0	82	100
W3	5008	2	0	0	4	0	14	0	0	80	100
W4	0	15	10	10	10	10	30	5	5	5	100
W5	0	15	10	10	10	10	30	5	5	5	100
W6	0	15	10	10	10	10	30	5	5	5	100
W7	0	15	10	10	10	10	30	5	5	5	100

W8	0	15	10	10	10	10	30	5	5	5	100
W9	0	15	10	10	10	10	30	5	5	5	100
W10	0	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	0	0	0	0	0
W2	1212	0	0	0	0
W3	267	0	0	0	0
W4	0	0	0	0	0
W5	0	0	0	0	0
W6	0	0	0	0	0
W7	0	0	0	0	0
W8	0	0	0	0	0
W9	0	0	0	0	0
W10	0	0	0	0	0

10. Pastureland Nutrient concentration in runoff (mg/l) and E. coli (MPN/100ml)

Land use	N	P	BOD	E. coli
1. L-Pasturela	**4**	**0.3**	**13**	0
1a. w/ manure	4	0.3	13	0
2. M-Pasturel	**4**	**0.3**	**13**	0
2a. w/ manure	4	0.3	13	0
3. H-Pasturel	**4**	**0.3**	**13**	0
3a. w/ manure	4	0.3	13	0