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The NCDOT Environmental Newsletter

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NCDOT Hydraulics Unit: Unit of Innovation and Change

By: Stephen Morgan, PE, NCDOT State Hydraulics Engineer

View Point

"Change is constant" is one thing I hear a lot around NCDOT. And more so lately. I can certainly attest that yes, innovation and a lot of change has happened over recent years. The size and makeup of our business units, the creation of new business units, the partial de-centralization of the Department are all signs of this change. Some of the other signs of innovation and change may not be as obvious but are just as dramatic, such as electronic biddings and lettings, more flexible and accessible working conditions thanks to virtual meetings, and better access to robust data such as statewide LiDAR. Within the Hydraulics Unit, we are experiencing dramatic shifts in staff. The Highway Trust Fund created in 1989 ushered in a major expansion of the Department and many staff hired in those first few years are at the 30-year retirement mark. In the same time, we have a major influx of smart and engaged Transportation Engineering Associates and interns. We can all agree "change is constant" and when managed well, can be refreshing.

Change must be purposeful to be successful. The recent changes at NCDOT are founded on the unwavering commitment to great customer service. Therefore, the result will be success. So, who are our customers? Many times, we describe our customers as the "travelling public." But in fact, the customers we interact with daily are ourselves. Most of our work comes from requests from other business units and Divisions within the Department. If we want to improve customer service it starts at home, with ourselves. At the recent Transportation Summit, former Governor James Hunt was reflecting on the great progress this state has made and thinking about the future. He said, to stay successful, "Listen to the people and they will tell you what to do." In other

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Mitigating for the Pappy Lane Shipwreck

By*: Matt Wilkerson, EAU Archaeology Team Leader*

Project Spotlight

The NCDOT's Environmental Analysis Unit's Archaeology Team is responsible for implementing studies in a wide variety of settings across North Carolina that are needed to satisfy both state and federal laws pertaining to cultural resources. Much of the team's work centers on terrestrial locations, however, this project overview will focus on the underwater archaeological investigations associated with the Pappy Lane shipwreck (PAS0001) due to

impacts to it associated with STIP B-2500. The B-2500 undertaking is subject to compliance with Section 106 of the National Historic Preservation Act (NHPA) due largely to the use of Federal Highway Administration funds, the need for a Clean Water Act Section 404 permit from the United States Corps of Engineers and the fact that the project is located adjacent to the Cape Hatteras Na-

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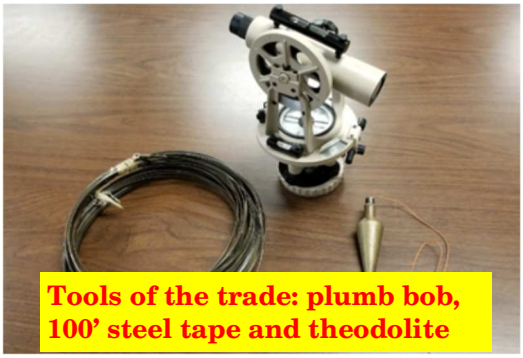
words, let the needs of your customers guide your decisions.

My career with NCDOT began as a summer intern in the Aberdeen District Office of Division 8 in 1988. We were surveying and mapping dirt roads that summer for the secondary road paving program. Many dirt roads were getting paved at that time. Mr. Troy Summers taught me how to survey using a theodolite, steel tape and plumb bob on our three-man survey party. Mapping was on paper. I quickly learned the meaning of the terms station, offset, Point of Intersection (PI), Point of Curvature (PC) and Point of Tangent (PT). When you are laying off chords around the arc of curve from the PC to PT down a dirt road in Richmond County… it's real. Back in the office I learned to decipher the field notes and draft plan sheets by hand. There's something to be said about learning by doing. Nothing like chaining for a mile down a dirt road to learn the value of a total station!



Tools of the trade: plumb bob, 100' steel tape and theodolite

Once our work was finished, I knew the residents along that dirt road would appreciate a smooth riding surface and saying good-bye to that dust cloud that followed every passing car. That summer confirmed civil engineering was a great career choice for me. I certainly had grown very fond of the people and the work at NCDOT.

Later, when I became a full-time employee at NCDOT and was working on the construction survey party in Division 5, I learned very well what slope stakes, blue tops and clearing limits were and how to stake out bridges, box culverts, drainage structures and pipes. I learned how you can set resurfacing grades on roll-plot paper. I gained a great appreciation for driving hubs with a 10-pound hammer, especially on those hot summer days! In the early 1990s was a time of widening the Raleigh Beltline and a lot of roads in and around Raleigh. I had my degree, but now I was learning how all the parts fit together, how it was done in the "real world."

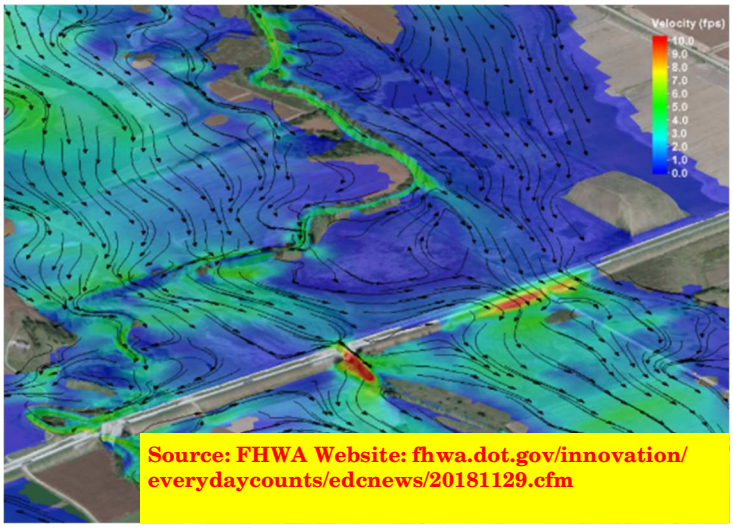
Then, in the Hydraulics Unit, I was out in the field again, this time all over the state. In the 1990s there were many big projects getting designed and constructed as a result of the Highway Trust Fund. Many loop projects were constructed then. I remember walking through the woods on the Charlotte Outer Loop project and the debris from Hurricane Hugo was a challenge to navigate. I can remember walking along the location of the Raleigh Outer Loop near Strickland Road and ACC Boulevard and how quiet it was except for the sounds of nature and the occasional jet overhead from Raleigh-Durham International Airport. Today there is a constant hum of traffic and suburban life in those same locations, with even more jets overhead. Today we are completing the final sections of the Raleigh Outer Loop and adding toll facilities in the Charlotte region to help ease congestion.

You can really get an appreciation for the natural beauty of this great state by getting out in the woods and hiking cross country on a new location project. From the mountains to the coast there are so many wonderful places to see and visit. I also remember in those early days of my Hydraulics Unit career how, I wondered, just how, did Hal Bain, Randy Turner or Alice Gordon really know the wetland limits were "right here." And they probably wondered how we were able to plot those limits *so precisely* on the plan sheets. Then came Global Positioning System units and we no longer were plotting wetland limits on the plans. It seems that some connection is lost when you aren't walking through the woods with the biologist delineating wetlands. It certainly gives you an appreciation of what the biologist does.

The tools we use are changing through innovation. I remember some safety projects that were let using blue line copies of orthophotos with hand drawn design and notes. And I remember the day the first CADD station was put on my desk and telling Andrew Nottingham, my supervisor, I hope this innovation doesn't dimension our ability to think. The tools may have changed, but the teamwork and collaboration aspects continue to be foundational in the success of NCDOT.

One big innovation that will happen very rapidly in the hydraulics world will be the ever-increasing usage of two-dimensional hydraulic modeling. It will provide much more detailed information at any point in the floodplain. This will usher in a new level of hydraulic engineering that will provide much better information to designers, planners and regulators. As we move into three-dimensional (3D) designs the pace of this change will increase tremendously. This change will be very much for the better. I'm excited about the benefits 3D designs will bring to NCDOT.

Another big innovation on the horizon is the science of climate adaptation and resilient design. NCDOT has experienced extreme events over the last several years and these events have been very costly. Being able to asses network vulnerability will become imperative to understanding network reliability. In support of this objective we are developing tools to help make design decisions



Source: FHWA Website: fhwa.dot.gov/innovation/everydaycounts/edcnews/20181129.cfm

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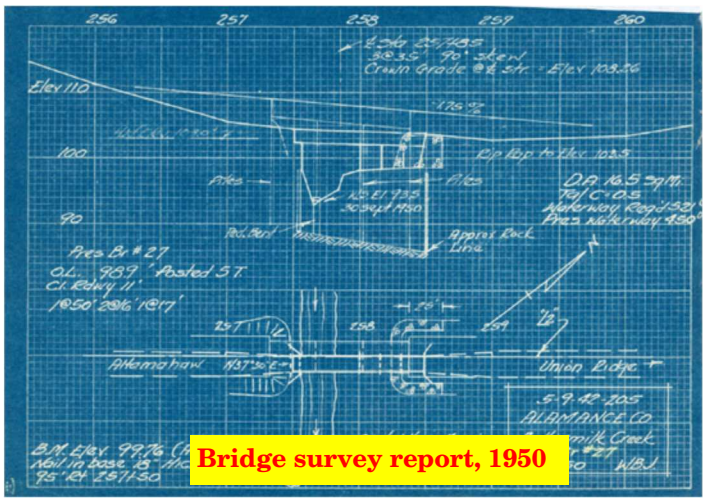
such as creating inundation libraries for the entire state through our partnerships with NC Emergency Management and our consultants.

This type of assessment is becoming even more efficient and detailed thanks to the advances in computing power and the power of Geographic Information System. The Hydraulics Unit, Transportation Planning Division and Environmental Policy Unit are investigating the integration of resilient design criteria for the transportation system. The first step has been to define resiliency for NCDOT and assess the vulnerability of our transportation network. A strong commitment to the needs of our customers is the foundation for the adoption of any new policies, procedures and guidance that come out of this new frontier.

The transportation needs of our citizenry are changing. The transportation needs of the urban city dweller are much different that the needs of our rural citizens. Farm-to-market roads have greatly helped the agriculture industry, whereas most people now work in non-agriculture businesses and commute from the suburbs. To that end, NC Moves 2050 is an initiative by NCDOT to gather input from citizens and communities to shape long-range transportation planning.

ary system and to stabilize, by adding stone, gravel and sand, another 35,000 miles." What a major undertaking! The article goes on to say, "Back in the 1920s, when Frank Page was State Highway Commissioner, engineers were astounded when they discovered that they could pave as many as 1,000 miles of highway in a 12-month period." In Watauga County, roads that were impassable "even by Jeep, 12 months ago" have been improved such that "...youngsters who formerly attended the one-room Lower Elk School will go to the large consolidated school in Deep Gap this autumn." What we do at NCDOT makes real differences in peoples' lives.



Bridge survey report, 1950

Data analytics will no doubt help support planning decisions and NC Moves 2050. Data analytics will increasingly be used to help drive project development decisions. This is the whole premise of ATLAS. The Hydraulics Unit is supporting this initiative by providing data such as hydraulic studies and investigations as well as historical flooding and hydraulic design data. Currently we are scanning, archiving and geo-referencing many folders' worth of documents in support of this project.

Innovation and change brings about new opportunities. When the Hydraulics Unit had to move from our 29-year home in Century Center Building B, we had to make several changes. The space wasn't the same, it was smaller. The move prompted us to reassess our needs and question how we could become more efficient, delivering the same service with less staff while working from a different delivery model. What has made the move and changes along the way manageable is a focus on our customers and reimagining how we can better serve them.

I-40 underwater from Hurricane Florence, NCDOT Communications

As we move into the next 100 years of transportation in North Carolina, it's exciting to think about the opportunities. On the Improving Transportation page of NCDOT, note the first lines on the page:

NCDOT has a history of transformative innovation and change. The Good Roads campaign led to the creation of the Department of Transportation in 1920 to bring better roads to all parts of the state. An article in the September 1950 edition of *North Carolina Roadways* magazine gave an update on the 1949 bond program. That program was created to "pave 12,000 miles of the second-

US 421at New Hanover County Line, Hurricane Florence

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Hydraulics Unit about 1995

Through a variety of programs that touch all forms of travel, the N.C. Department of Transportation is helping drive the state's economy, creating new opportunities for communities and improving quality of life to make North Carolina a better place to live, work and visit

Yes, innovation and change are constant. Our environment and the tools we use are changing. NCDOT is in the innovation and change business, because what we do is transformative. For that reason, I have always been glad to say I work for NCDOT, from day one.

Hydraulics Unit 2018

N.C. DEPARTMENT OF TRANSPORTATION

Hydraulics Unit

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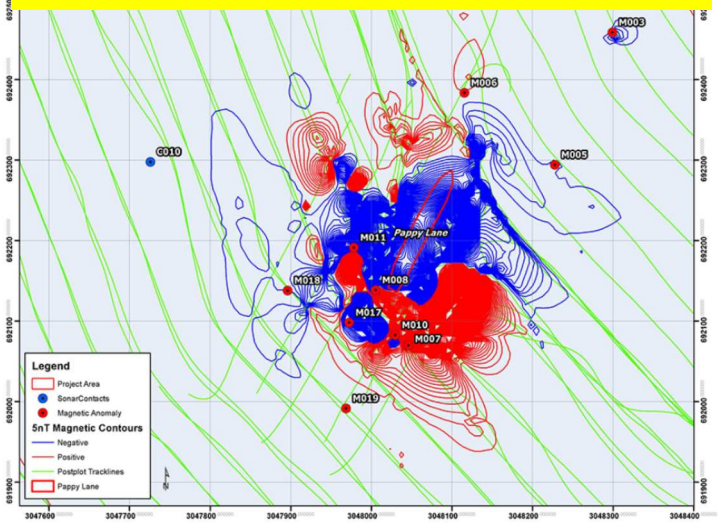
tional Seashore and Pea Island Wildlife Refuge. Before getting into the actual investigations, we first need to go over the key elements of Section 106 of the NHPA. Section 106 requires Federal agencies to take into account the effects of their undertakings on historic properties and to provide the Advisory Council on Historic Preservation (ACHP) with a reasonable opportunity to comment. In addition, Federal agencies are required to consult on the Section 106 process with State Historic Preservation Offices (SHPO), Tribal Historic Preservation Offices (THPO), Indian Tribes (to include Alaska Natives) [Tribes], and Native Hawaiian Organizations (NHO). Historic properties are defined as any prehistoric or historic districts, sites, buildings, structures, or objects that are eligible for or already listed in the National Register of Historic Places (NRHP). Also included are any artifacts, records, and remains (surface or subsurface) that are related to and located within historic properties and any properties of traditional religious and cultural importance to Tribes or NHOs.

In order to be determined eligible for the National Register, resources must possess integrity and satisfy at least one of the following National Register Criteria for Evaluation: (a) are associated with events that have made a significant contribution to the broad patterns of our history; or (b) are associated with the lives of persons significant in our past; or (c) embody the distinctive characteristics of a type, period, or method of construction; or represent the work of a master; or possess high artistic values; or represent a significant and distinguishable entity whose components may lack individual distinction; or (d) have yielded, or may be likely to yield, information important in prehistory or history.

NCDOT initially contracted with Pan American Consultants in 2003 to identify and evaluate any underwater archaeological resources that might be present within the B-2500 project limits in order to comply with Section 106 of the NHPA. None were identified during those investigations. A subsequent scope of work was developed in 2015 to examine additional Pamlico Sound locations that may be impacted by B-2500. That scope called for the establishment of an Area of Potential Effects (APE) that corresponded to the proposed alignments for the Future Extension Concept [Green Line] and the 2014B Revised Bridge on New Location [Yellow Line]. The Green Line will be a corridor measuring about 0.5 mile wide by 4.7 miles long (i.e. 1,320 feet to either side of centerline for a length of about 24,850 feet). This Yellow Line corridor measures 1,000 feet wide by about 9,200 feet long (i.e. 500 feet to either side of centerline). The 2015 scope required the use of both magnetometer and side scan sonar as part of that effort to document any underwater anomalies that might be present that had potential to be archaeological resources.

This map presents layers of magnetic anomalies, sonar contacts, magnetic contours, and survey track lines in relation to the Pappy Lane wreck created in 2016.



The 2016 report of these investigations describe a total of 64 magnetic anomalies and 12 sides-can sonar contacts recorded within the two survey areas. Forty anomalies and 11 sonar targets were recorded in the Future Extension Concept alignment survey area to the north, and 24 anomalies and one sonar target were recorded in the Revised Bridge on New Location corridor survey area. The vast majority of those anomalies or targets were not considered archaeological significant, however, Pan American's report did acknowledge and expand upon the field investigations associated with the Pappy Lane Shipwreck (PAS0001) completed from 2010 to 2016 by Dr. Richards of the UNC Coastal Studies Institute, as this wreck is in the B-2500 APE. This led to a recommenda-

2016 Project Area survey location map. Delineated in green is the "Future Extension" Concept alignment to the north, and in yellow the "Revised Bridge" on New Location corridor survey area that ends at Rodanthe to the south.

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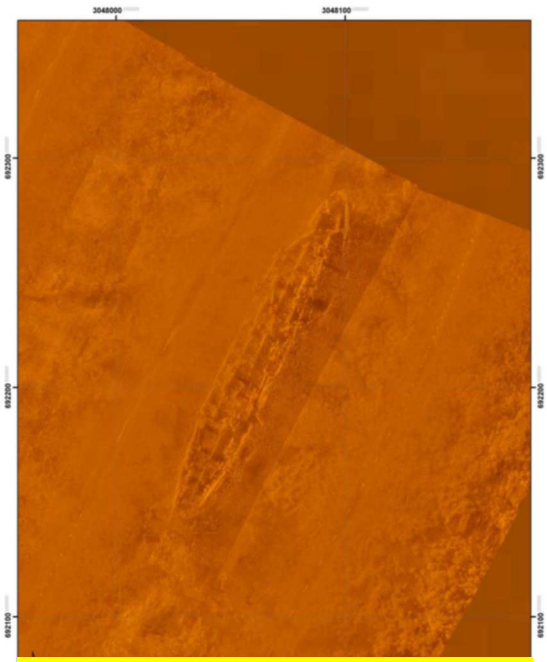


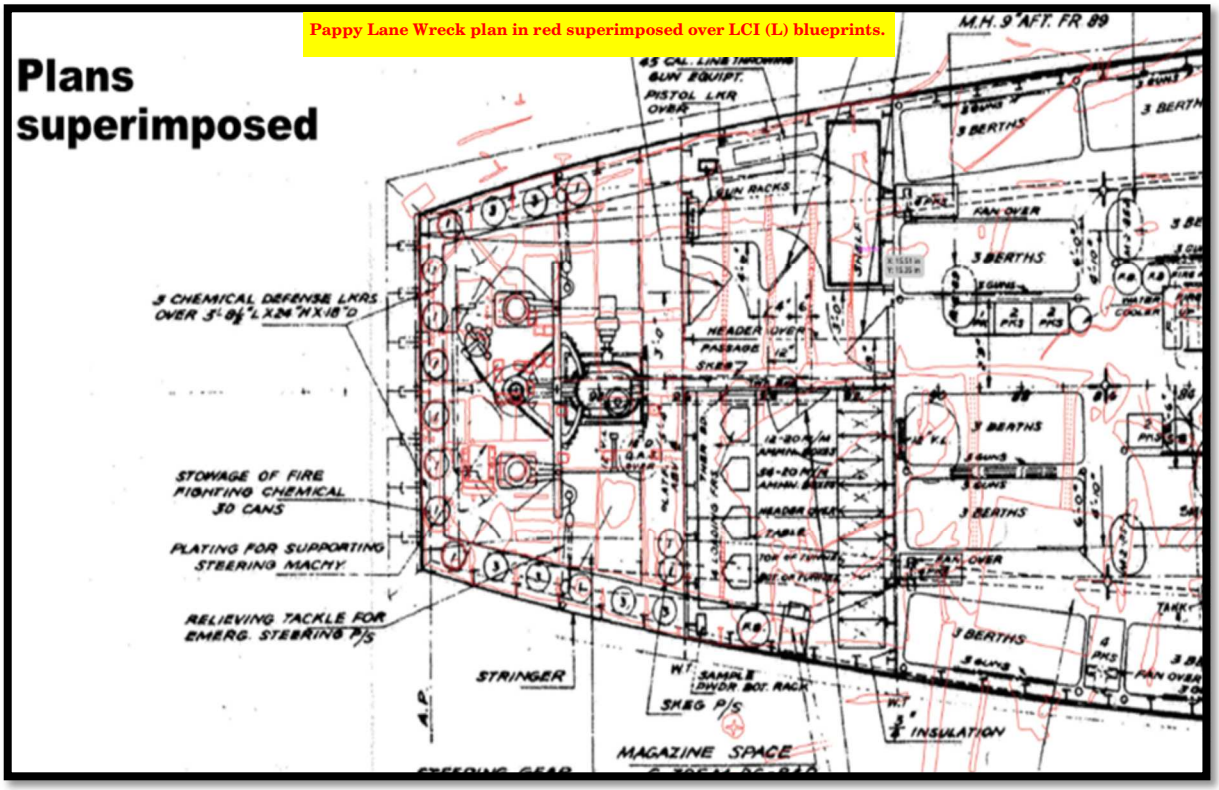
Sonar Image of PAS0001 obtained during the 2016 Pan American investigations.

tion, in consultation with the SHPO, that PAS0001 be considered eligible for the NRHP under Criterion D for its information potential per the potential association between PAS0001 and the U.S. Lighthouse Service, U.S. Coast Guard (USCG), NCDOT road construction projects, and American steel-shipbuilding.

Due to the proximity of the National Register Eligible Pappy Lane Shipwreck to the B-2500 alignment and construction zone, the project was determined to have an adverse effect on the resource. In early 2017, the NCDOT Archaeology Team participated in the development of a research proposal for (PAS0001) in partnership with The Underwater Archaeology Branch of the Office of State Archaeology (OSA), the University of North Carolina Coastal Studies Institute (UNC-CSI), East Carolina University (ECU), and NCDOT's Research and Development Unit designed to mitigate the adverse effects to the shipwreck. That research proposal sought to further establish the wrecks significance including the true origin and function of the vessel (other than its last likely functional use as a "barge"), record the site in detail prior to any construction impacts and "ground truth" any other magnetic anomalies around the wreck that may affect the construction process. Underwater excavations of the stem and stern as well as trenching across the hull to obtain cross sections of the wreck were planned.

As a result of the specific structural features identified during the archaeological excavations, underwater mapping of the vessel and additional background research, it was determined that the ship's hull remnant was once a component of an amphibious assault gunboat, Landing Craft Support (LCS). This type of vessel was designed, constructed, and used by the United States Navy during World War II. The Pappy Lane Shipwreck most likely represents the remains of the USS LCS(L)(3)123, which participated in the Battle of Okinawa and was involved in the landing at Iwo Jima before being repurposed. After application of the NRHP criteria, the 2017 field investigations reaffirmed the October 27, 2016 determination that the Pappy Lane Shipwreck is eligible under Criterion D. However, the loss of integrity associated with its location, design, setting, materials, and workmanship, compromises the site and therefore the Pappy Lane Shipwreck is not recommended as eligible for the NRHP under Criteria A, B or C.

A 2018 comprehensive report written by Dr. Richards detailing the field investigations associated with the February 2017 research proposal is now on file at the North Carolina OSA. The project's public outreach requirements including the creation of the project's Pappy Lane website, and the participation in the Science of the Sound lecture series were completed in January of 2018. Currently NCDOT is consulting with the SHPO to further interpret the Pappy Lane Shipwreck including incorporating aspects of the report findings into the interpretive exhibits and kiosks that will be constructed along NC-12 as part of the B-2500 project. This project's successful outcome was due in large part to the cooperation among the following agencies and organizations: Federal Highway Administration, SHPO, NC Division of Coastal Management, USACE, OSA, NC Department of Environmental Quality, USCG, ECU, UNC-CSI and NCDOT.



Pappy Lane Wreck plan in red superimposed over LCI (L) blueprints.

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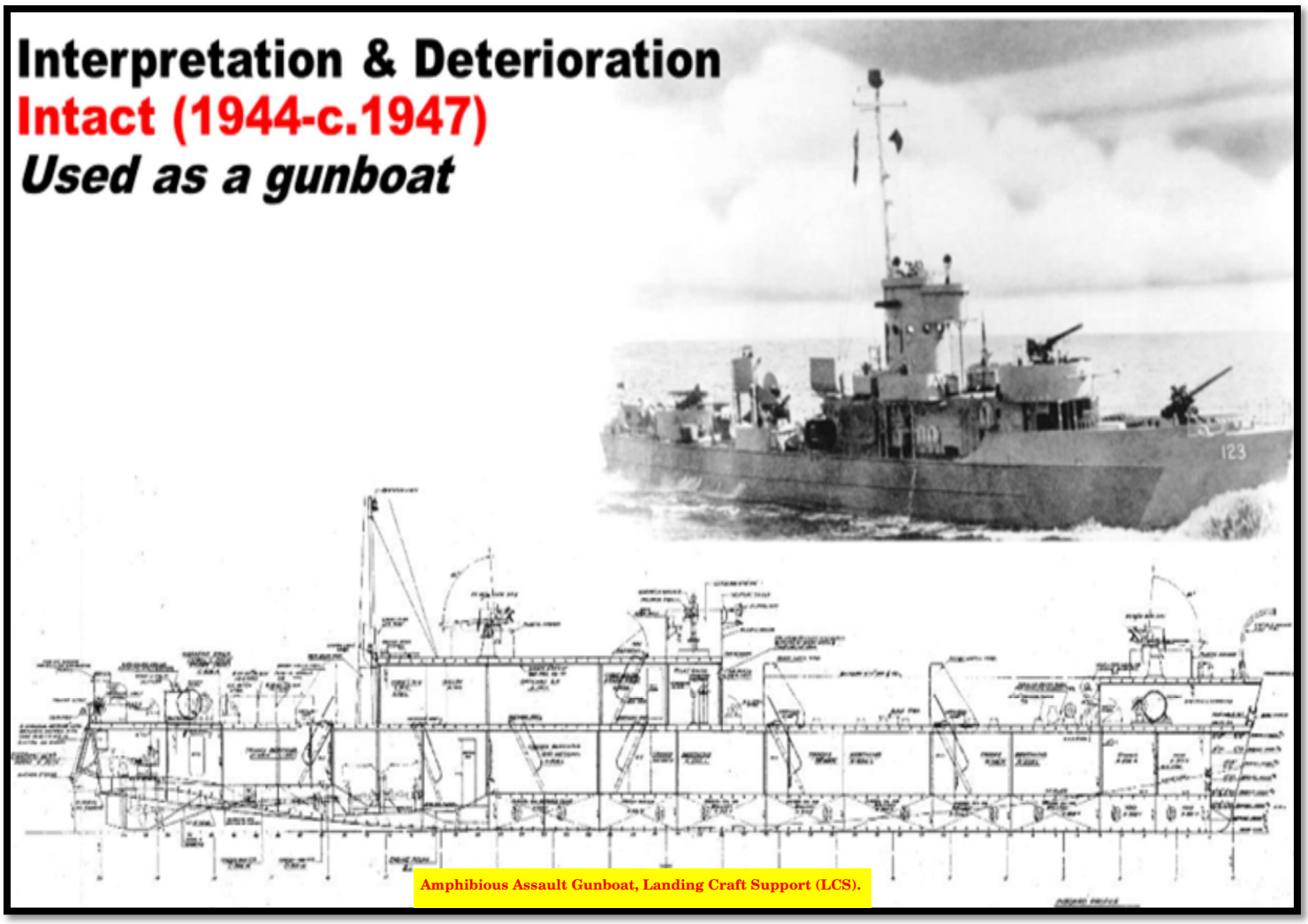
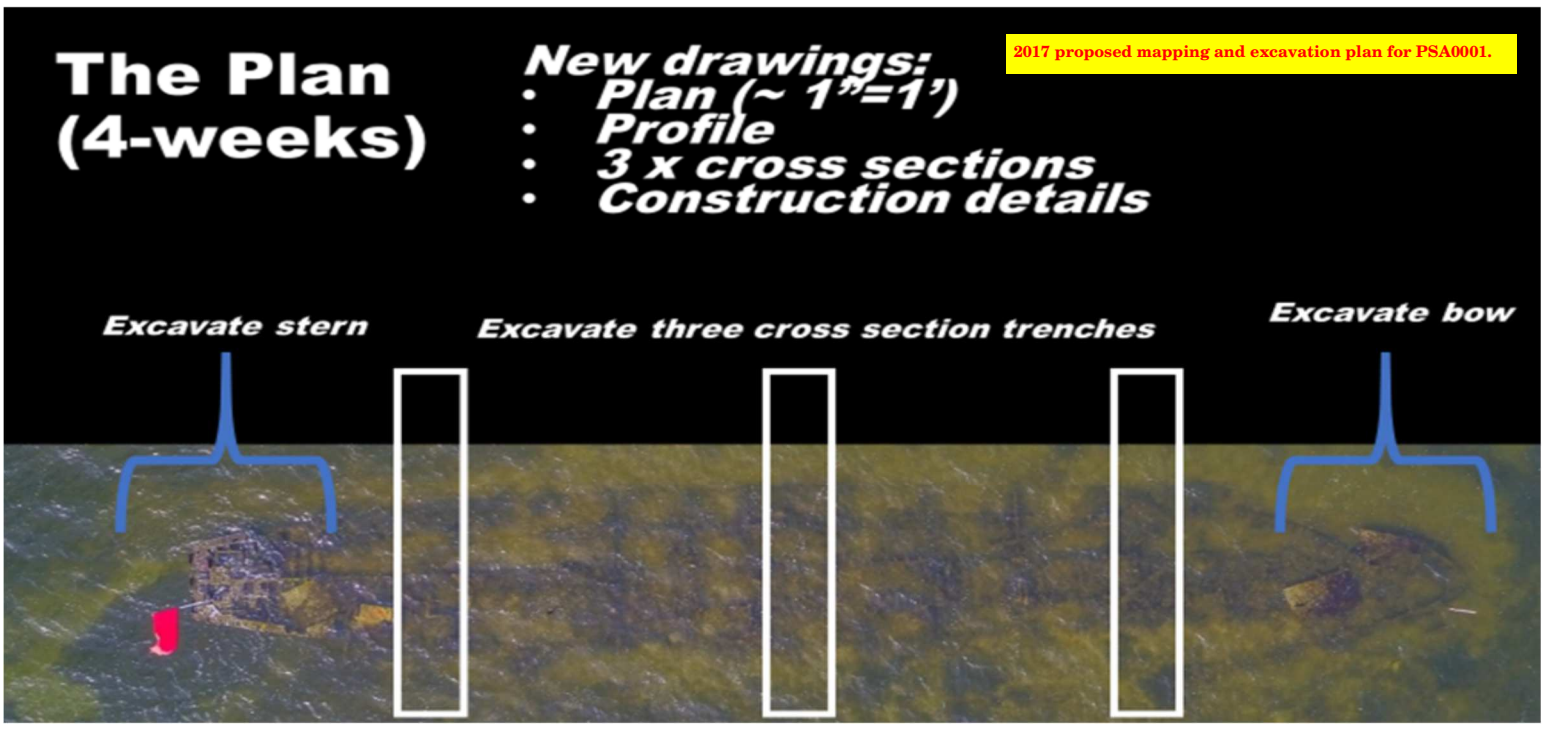


Amphibious Assault Gunboat, Landing Craft Support (LCS).

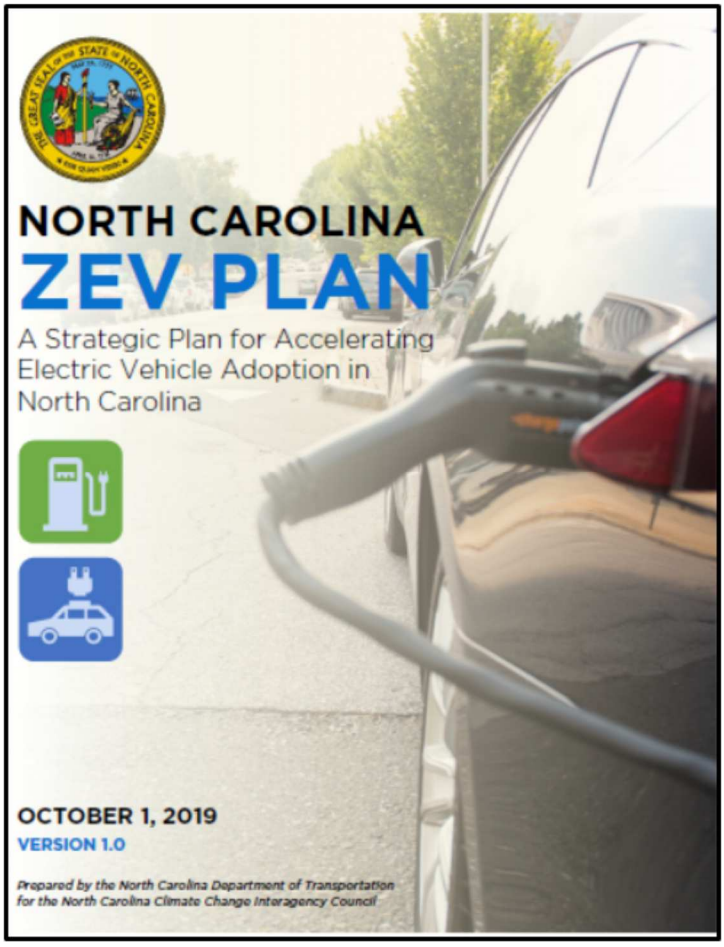


2017 proposed mapping and excavation plan for PSA0001.

Executive Order 80

Colin Mellor, NCDOT Environmental Policy Unit—Eastern Regional Manager

On Aug. 15, 2019, the National Oceanic and Atmospheric Administration (NOAA) announced that globally, July 2019 was the hottest month ever recorded on Earth. Climate scientists conclude that the emissions resulting from the burning of fossil fuels contribute to the increase in global temperature. On Oct. 29, 2018, Governor Roy Cooper signed Executive Order No. 80, North Carolina's Commitment to Address Greenhouse Gas Emissions and Transition to a Clean Energy Economy (EO80). EO80 calls for a 40% reduction in statewide greenhouse gas emissions from 2005 levels by 2025. In addition, the order sets a goal of at least 80,000 registered zero emission vehicles (ZEVs) in North Carolina by 2025.



North Carolina's transportation sector contributed 32% of the states total greenhouse gas emissions in 2017, so achieving this ZEV goal is an important step in lowering overall greenhouse gas emissions. ZEVs are not only a cleaner more efficient means of moving passengers, they also connect with North Carolina's ambition of creating and supporting clean energy jobs. When EO80 was signed, less than 10,000 electric vehicles were registered in North Carolina.

Section 5 of EO80 specifically charged the North Carolina Department of Transportation (NCDOT) – in coordination with the North Carolina Department of Environmental Quality (NCDEQ) – with developing a NC ZEV Plan to guide ZEV adoption in North Carolina. Per EO80, the ZEV Plan is to establish interstate and intrastate zero emissions vehicle corridors, increase the installation of zero emission vehicle infrastructure, and outline best practices for increasing zero emission vehicle adoption in North Carolina. This NC ZEV Plan focuses on the adoption of both fully electric vehicles and plug -in-hybrids.

The plan is the result of stakeholder outreach within North Carolina, research into successful practices in other states, assessment of what will be needed from industry partners to help adoption and defining efforts to drive broader acceptance of these zero emission vehicles in the general public.

Over 1,200 stakeholders representing the general public as well as industry members, universities, environmental groups, local government, and other North Carolina state agencies took part in a comprehensive series of engagement meetings, workshops, and surveys. From this input, this ZEV Plan identifies four action areas to support ZEV adoption:

Education – Educate across a variety of topics such as pricing and affordability, vehicle range per charge, charging costs and options, and availability of vehicles and charging. Education and marketing for the public, as well as potentially for dealerships and fleet owner/operators.
Convenience – Increase ease of charging and comfort in the overall electric vehicle network to alleviate concerns regarding range per charge and replacement of traditional internal combustion engines.

Affordability – Reduce upfront costs through potential financial incentives, as well as helping develop a used-car market to provide a more appealing range of vehicle types at more prices.

Policy – Establish policies that promote electric vehicle adoption and revise or remove those that inhibit adoption. State alliances and coalitions may also encourage continued investment.

For each area, the NC ZEV Plan recommends strategies, lead actors, key stakeholders, and an implementation timeline.

As of January 31, 2020, there are 11,664 electric and 8,426 plug-in-hybrid vehicles registered in NC. While the work of implementing the ZEV Plan begins, work on other Sections of EO80 continues. Section 8 of EO80 asks all cabinet agencies to reduce the energy and water consumption at their facilities. The goal is to reduce energy consumption per square foot in state-owned buildings by at least 40% from fiscal year (FY) 2002-2003 levels. The NCDOT is already well on the way to reaching this goal with FY 17-18 showing a reduction in energy and water usage per square foot for NCDOT of 33% and 52% respectively from a baseline FY of 2004-2005. Section 9 of EO80 asks the cabinet agencies to integrate climate adaptation and resiliency planning into their policies, programs, and operations (i) to support communities and sectors of the economy that are vulnerable to the effects of climate change

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Summary of NC ZEV Plan Recommended Strategies

Education	Convenience	Affordability	Policy
*Regularly post NC vehicle registration online	***Facilitate fast charging collaboration**	*Financial Incentives	*Regional electric vehicle initiative
*EV marketing campaign	*Develop workplace charging programs	*Original equipment manufacturer rebates	*Electric vehicle user fees
***Coordinate Ride & Drive events**	*Charging in rest areas	*Green vehicle loans w/credit unions	*Update building codes
*Fleet education and outreach	***Establish consistent wayfinding signage**	*Create dealership incentives	*Conversion to electric transit fleets
*Guidance document on charging infrastructure	*Enhance corridor definitions	*Encourage secondary electric vehicle markets	*Motor fleet shift to zero emissions vehicles
			*Innovative EV rate design

Bold Text indicates work already started

and (ii) to enhance the agencies' ability to protect human life and health, property, natural and built infrastructure, cultural resources, and other public and private assets of value to North Carolinians.

The NCDEQ, with the support of the other cabinet agencies and informed by stakeholder engagement, shall prepare a North Carolina Climate Risk Assessment and Resiliency Plan for the Council to submit to the Governor by March 1, 2020. The NCDOT is currently preparing the Transportation section of this plan and working with the Climate Change Interagency Council, formed under EO80, to complete the plan for submittal to the Governor. Each of the most likely future climate impacts—increased drought, increased and more intense precipitation, heat waves, hurricanes, and rising sea level—are expected to have substantial consequences for our state's coastal and cultural resources, transportation and other infrastructure, water supplies, agriculture, natural systems, public health, and our citizens' homes and livelihoods.

North Carolina has already suffered the effects of numerous tropical storms and hurricanes. Recently, Hurricanes Matthew, Florence, and Dorian have wreaked havoc on eastern North Carolina as well as some areas of the Piedmont and mountains. Changing air and ocean temperatures may mean that these storms may become more frequent and will likely be more intense, potentially leading to increased roadway flooding, washouts, and rockslides. The NCDOT has already begun to find solutions to the disruptions caused by recent storms. A Flood Resilience and Feasibility Study was commissioned for I-95 and I-40. Results from this study are guiding potential future projects on I-95 near Lumberton. Funding was legislated for a vulnerability assessment of the state's Strategic Transportation Corridors that will soon be underway. The NCDOT is also collaborating to extend the use of a tool developed by NC Emergency Management (NCEM) known as FIMAN (the Flood Inundation Mapping and Alert Network). The FIMAN provides real-time data on stream elevation, rainfall, and weather parameters from over 550 gages across the state. The data are posted on the internet to provide real-time flood inundation maps and alerts. The NCDOT's collaboration with NCEM produced a version of FIMAN for transportation (FIMAN-T). The FIMAN-T combines real-time gage data and flood models of FIMAN with roadway and bridge data so NCDOT will be able to provide real-time flood inundation maps and alerts specifically addressing roadways and bridges that may be or become flooded.

NCDOT will continue its work to achieve the goals of EO80. The goals of energy-use reduction and resilience to a changing climate are directly aligned with the core of NCDOT's mission - connecting people, products and places safely and efficiently.

Stormwater Research, Is It Important?

By: Brian Lipscomb, PE & Ryan Mullins, PE, Hydraulics Unit Highway Stormwater Program

Numerous agencies, private organizations, and special interest groups demand protection of the environment and our water resources. The NCDOT's own mission statement even includes the terms 'environmental sensitivity' when delivering and maintaining the transportation infrastructure. But what does environmental sensitivity mean and how do you do it?

For the Hydraulics Unit, it starts with asking questions and exploring how we can do things better. Questions such as:

- What's in stormwater runoff from transportation facilities? And, is it toxic?
- How do you treat the runoff?
- Can we make existing practices better?
- How do we put it into practice?

Typical monitoring setup for brdge deck runoff

Highway Stormwater Program (HSP) staff from the Hydraulics Unit have collaborated with the Research and Development Unit to grow a robust research program, working toward answering these questions, while spurring many more along the way. After all, researchers will tell you that any good research just leads to more research. Getting to the answers of these questions takes a lot of effort and cannot be done alone. To facilitate these efforts and the program, NCDOT has partnered in a three-year collaboration with numerous universities, United States Geological Survey (USGS), NC Coastal Federation (NCCF), and a number of professional engineering firms.

Just how much research has been done? Andy McDaniel, Co-Director of the Highway Stormwater Program, noted that since 1998, numerous projects have been sponsored through the HSP Research Program, including monitoring over 70 sites and over 2,700 individual storm events across the state. The volume of data generated necessitated the HSP to develop the Stormwater Research Monitoring DataBase (STORMDATA) to consolidate and track data generated under the HSP Research Program. A portion of this database was provided to the USGS for addition to the national Highway Runoff Database (HRDB). This 'small' subset included data from 140 storm events for 39 highway-runoff sites, with 195 analytes uploaded to the national HRDB from only six North Carolina highway-runoff research reports, including NCDOT's Bridge Stormwater Program. Just to give some perspective on exactly how much data that really is, Ryan Mullins, the Task Leader for the HSP's Research Program, noted that research data supplied from NCDOT's projects nearly doubled the size of the national database.

We've established that NCDOT has a lake's worth of data, but is it just water under the bridge, sitting stagnant and soon forgotten, or is it a rushing river of information shaping the current and future landscape of NC, the country, or the entire globe? It's most definitely the latter! So what does this wealth of research knowledge include, what does it tell us, and possibly most importantly, what are we doing with it?

Research has been able to characterize the chemical makeup of highway stormwater runoff, providing NCDOT with a knowledge of what parameters of concern (POCs) are common in roadway runoff and which are not. Even further, if they're present due to makeup of the transportation facility, the vehicles using the facility, or naturally occurring in the soils or from atmospheric deposition. This has afforded the Department the ability to forego costly expenditures to meet requirements on Total Maximum Daily Load regulations for constituents that the highway is not a significant contributor. Mega taxpayer money savings there!

Where this research has identified a number of POCs present in highway runoff, they have not been at toxic concentrations. As part of the Bridge Stormwater Program, the HSP collaborated with the NC Department of Environmental Quality (NCDEQ) to develop a new monitoring protocol to assess stormwater impacts on *Ceriodaphnia* , a type of water flea whose ability to survive and reproduce is a good indicator of water quality. The results were extremely favorable, and the method of testing has become a standard for toxicity

Influent and effluent from a stormwater BMP

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monitoring. Using this study and others, the Department has been able to justify elimination of costly, non-effective, and sometimes detrimental closed drainage systems on a few coastal bridges and focus treatment efforts on more effective and appropriate locations.

Ceriodaphnia from BSP

An early focus of the research program was to quantify the effectiveness of stormwater control measures (SCM), also known as best management practices (BMPs), to treat stormwater. This information provided a firm foundation for the development of standard specifications and design guidance for SCMs and has been incorporated into NCDOT's BMP Toolbox, a design guidance manual for SCMs. Continuing research has aided in refining these designs or adding various features to even further enhance a given BMP's treatment efficiency. A research project conducted near Mingo Creek in Wake County evaluated the effectiveness of using upturned elbows in media filters to produce an Internal Water Storage zone to increase nitrogen removal and reduce total discharge through increased infiltration. This design aspect is now not only used by NCDOT but is also required in NCDEQ's stormwater manual and the codified Minimum Design Criteria for non-transportation projects, per Brian Lipscomb, a member of the HSP. A recent project looking into Dry Detention Basins has even shown that allowing a basin to become overgrown , which could be viewed as a lack of maintenance, can be very good for the environment. The study has shown overgrown basins have better nutrient removal and increased infiltration and evapotranspiration, thus reduced volume of runoff. This could lead to design changes and different maintenance protocols resulting in cost savings to the Department over the lifespan of these devices.

Research led to upturned underdrains to create an internal water storage zone becoming common practice

How is all this valuable information put into practice? As mentioned previously, device specific research and monitoring information is used in the development, additions and revisions to the Stormwater BMP Toolbox. The information is also used to influence policy documents, such as the Guidelines for Drainage Studies and Hydraulic Design, as well as the Post-Construction Stormwater Program (PCSP) Manual. There is exciting work underway that is planned to impact an upcoming PCSP update. Using the national Highway Runoff Database and additional stream data from North Carolina rivers, the USGS developed a North Carolina edition of the Stochastic Empirical Loading and Dilution Model (SELDM). Originally developed by the Federal Highway Administration and USGS, SELDM estimates flows, concentrations, and loads of stormwater constituents to assess the risk for adverse effects of runoff to the receiving water. Approximately

Over-grown dry detention basins can provide better performance

70,000 typical roadway projects to various receiving water scenarios are being run to assess the risk for potential effects of stormwater runoff on downstream water quality. The model can also show the potential benefits to water quality by implementing SCMs to treat stormwater runoff. In the future, these SELDM results are planned to be used in developing a project catalog for use in stormwater management planning throughout the state. This will provide an earlier look into the need, and level of stormwater treatment for the majority of transportation projects, which paints a reasonable level of expectation for both design teams and regulatory agencies.

Double-ring infiltrometer used for measuring infiltration

The HSP continues to sponsor new research projects and is currently focusing on improvements and optimization of current practices to evaluate stormwater runoff quality and to select, design and construct SCMs. These continued efforts result in the Department being able to deliver transportation projects while maintaining environmental stewardship.

Please contact the Hydraulics Unit, Highway Stormwater Program for more information on any past, present, or future stormwater research projects, ideas and opportunities.

RIBBON CUTTINGS

Please join me in congratulating Cheryl Knepp and Bill Barrett for their recent promotions within the Environmental Analysis Unit's (EAU) Biological Surveys and Environmental Coordination & Permitting (ECAP) Groups, respectively. Cheryl specializes in database management, bat investigations and plant surveys and analysis. Previously, Cheryl was the Program Manager for the NC Plant Conservation Program. This position held a great deal of responsibility and provided career growth in staff and resource prioritization. A big congratulations to Cheryl in your new role as Environmental Program Consultant within the Biological Surveys Group!!!

Bill was recently promoted to Environmental Program Consultant in the Western Region of the ECAP Group. Bill has been a cornerstone of this group for over 15 years where he prepares permit applications, performs various natural resource investigation, and manages consultant contractors that perform much of this work. Bill is a seasoned professional in coordinating with the environmental resource agencies and with NCDOT Division Offices statewide.

Congratulations to both of these folks and we look forward to seeing your progress and extensive contributions as you transition in to your new roles within the EAU!!!

EAU Christmas Luncheon

The Environmental Analysis Unit held its annual Christmas luncheon on December 17th. The event was catered by Meadows Grill from the town of Meadow and the food was most excellent. There were also small gifts that were selected by drawing numbers. Many were in the festive spirit and dressed up in all kind of Christmas attire. We had a visit from Santa Claus and his top elf. It was a great opportunity for staff to reflect back on a busy and successful year and to enjoy fellowship while getting in to the Christmas spirit.

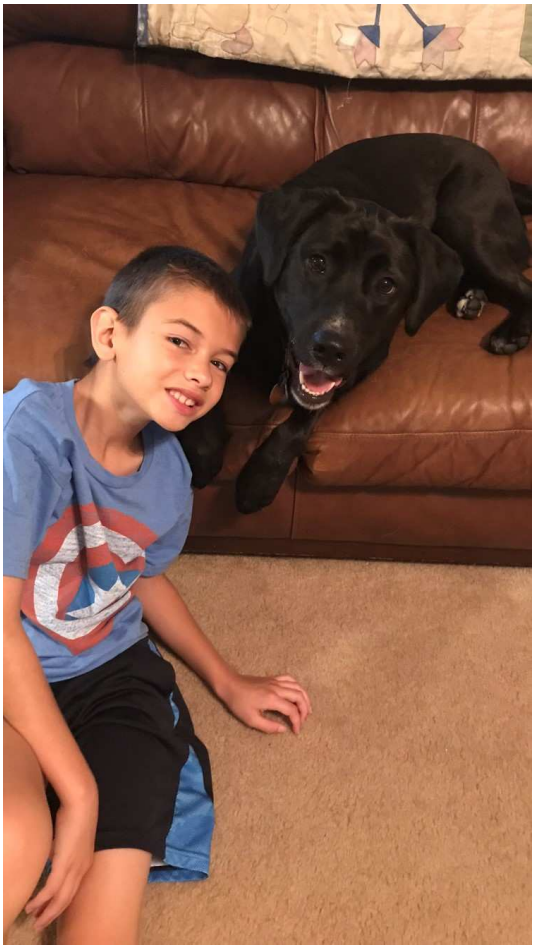
There was also money raised by all NCDOT employees across the Century Center complex for Christmas gifts for our hardworking custodial staff. They were presented with Christmas envelopes on December 20th at a short presentation held in the CCA Technical Services Conference Room. These ladies work so hard year round and always bring a pleasant attitude to their job. We consider them part of our team. A big thanks to Felipa, Gabriela, Janeth and Elvira for everything that you all do!!!

Employee Spotlight

Jason Elliott, EAU Monitoring & Stewardship Group

Jason Elliott is an engineer in the Monitoring and Stewardship Group within the Environmental Analysis Unit. He began his career with NCDOT after graduation from NC State University in 1998. Growing up on a farm in god's country, (that's Randolph County for those not familiar with the location), Jason grew up with a desire to work in nature without the worry of whether or not it would rain the next day. While following in his dad's footsteps would have been a logical choice, a fancy job with the State of NC made for an easy decision.

Jason initially started work as a temporary employee within the Roadside Environmental Unit in May 1998. In June 1999, he accepted a permanent position within REU-in the Soil and Water Engineering Section. In this position he worked in the erosion and sediment control field completing erosion control inspections and design work. In 2004, he accepted a position within the Engineering Group in EAU. In his current role in EAU, Jason is responsible for the design of stream and wetland projects statewide. This includes coordination and development of design plans within central units of DOT, as well as Division personnel. Jason coordinates the design and permitting of the Mitigation Sites with State and Federal Regulatory Agencies. This position also requires coordination and contracting with consulting firms, who assist the Department as well as providing construction assistance as needed within the Divisions once the projects are let to construction. Other duties include Permit Compliance involving on-site stream/wetland monitoring and the long-term site stewardship of over 350 mitigation sites statewide.



2019 Governor's Awards for Excellence

Dianne Wilson of the Environmental Analysis Unit's (EAU) Public Involvement, Community Studies & Visualization Group was recognized as a nominee for the 2019 Governor's Awards for Excellence. Dianne works tirelessly to provide the public with the latest information on transportation projects statewide. Several nights a week she is traveling statewide to provide the forward facing message to the public in both small workshops as well as larger public hearing where she may have over 400 citizens in attendance. She is always very receptive to any and all types of questions and is very factual and informative with her answers. She brings a pleasant personality to the workplace and is always leading in collaborations and solving problems through the use of teamwork. Dianne epitomizes the hard work and effort that many staff with in the EAU possess. Thanks, Dianne, for your continued contributions to the Department and this nomination is very well deserved!!!