Grant 7538 “Swim Guide” Final Report

Prepared By:

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Executive Summary

Sound Rivers is a nonprofit organization dedicated to protecting the beauty and natural resources of the Neuse and Tar-Pamlico River Basins. In 2018, Sound Rivers received funding from the Albemarle-Pamlico National Estuary Partnership (APNEP) to help launch the Swim Guide Program. Swim Guide was launched to regularly sample waters from the Tar-Pamlico and Neuse rivers for fecal bacteria indicators at popular recreation spots. The funding from APNEP was utilized to train citizen science volunteers and to increase public awareness and engagement on safe swimming conditions. Additionally, Sound Rivers worked to enhance awareness by elected officials on the need for water quality monitoring to support regional economic and conservation goals. Data was compiled for the 22 monitoring stations and assessed for any potential trends.

Introduction

Sound Rivers utilized the Swim Guide website and app, created by the Lake Ontario Waterkeeper, now Swim Drink Fish, to disseminate sampling results from our weekly bacterial monitoring during the summer of 2018. The site and app displays water quality information uploaded by other nonprofits and regulatory groups at over 7,000 beaches in six countries. The program contributes to Sound Rivers' mission by regularly informing the public of water quality criteria relevant to human health while recreating in the water, identifying locations sensitive to fecal bacteria pollution in our watersheds, and by engaging the public through water quality discussions and volunteering.

Each Thursday, a team of volunteers led by a water quality intern in each basin collected samples that were analyzed for fecal bacteria indicators. These results were produced within 24 hours and notified the Riverkeepers of bacterial levels that can cause illness in high concentrations and enough exposure. The results were reported weekly via a text alert system to subscribers, water quality report videos produced by the program interns and disseminated through social media, and accompanied by a press release describing the findings. All results obtained through this affiliate program were entered into the Swim Guide website and app, making the information available to locals and visitors to the rivers. Volunteers were recruited through the SRI membership, followers, and volunteers from other programs, and were trained by program interns and Riverkeepers before there were assigned a sampling site. Volunteer engagement allowed for more individuals to be involved in the science that Sound Rivers conducts and contributed to the monitoring and protection of our waters.

The program also provided a meaningful vocational experience to two student interns studying within the field of environmental science. These interns managed and coordinated all aspects of the Swim Guide program, with supervision from Sound Rivers' staff. The aim of the program was for the interns to gain an understanding of how nonprofits such as Sound Rivers operate, experience community outreach in the field of environmental protection, and to have hands-on experience in scientific monitoring.

Project Goals and Objectives

1. Citizen science volunteers trained to follow SOP
2. Increased public awareness and engagement on safe swimming conditions and causes of pollution
3. Enhanced awareness by elected officials on the need for water quality monitoring to support regional economic and conservation goals
4. Data compiled for 20 monitoring stations on the lower Tar-Pamlico and lower Neuse Rivers and tributaries (Trent River)
5. Evaluations completed to enhance 2019 swim guide monitoring season

Project Deliverables Completed

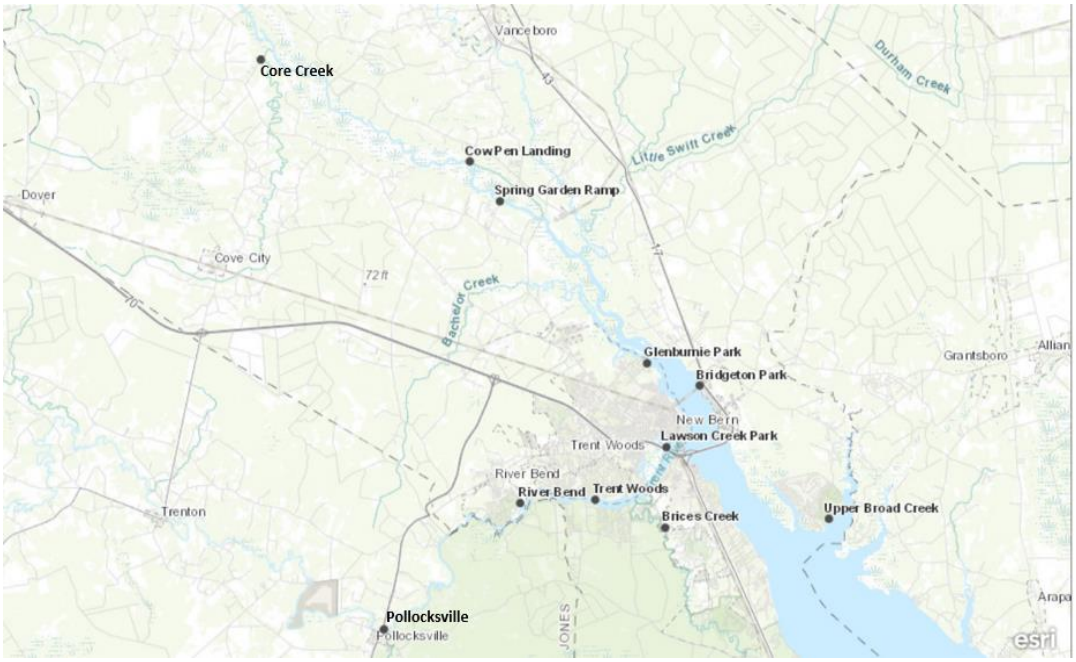
1. Volunteer Training Manual/Presentation
2. Quality Control/Assurance Plan
3. Swim Guide map with red, yellow, green indicators and website page on Sound Rivers site
4. Data uploaded weekly to SRI website
5. Swim Guide Fact Sheet
6. Weekly, weekend water report videos distributed by email and social media
7. Press release on program launch and end of season program results
8. 1-2 page swim guide fact sheet and summary of water quality results distributed to coastal legislators
9. 280 water samples analyzed and results tabulated
10. Ongoing program evaluations completed by intern conversations with volunteers

Methodology and Execution

Site Selection

Sound Rivers staff selected ten sites in each river basin based on their perceived use, notoriety, placement within the watershed, and distance from the NC DEQ Division of Marine Fisheries' (DMF) sampling locations. The program aimed to select sites in freshwaters where the DMF does not conduct their own recreational water quality sampling, while filling in gaps in more saline waters. Freshwater mandated the use of *E. coli* as a fecal bacteria indicator, while more saline waters mandated the use of *Enterococcus* as a fecal bacteria indicator. Historical salinity data provided by the DMF that was in an approximate area near each proposed site was evaluated and conservative estimates were made on how saline brackish sites could become. Sites were then selected for the *Enterococcus* indicator if there was a slight chance based on past seasons if salinity could reach 10 ppt, above which *E. coli* fails to be a reliable indicator. Additionally, as all DMF sites use *Enterococcus* bacterial indicators, sites downstream of DMF with one exception due to local salinity levels, Blount's Creek, were designated as *Enterococcus* sites. Upstream sites, as well as Washington's Waterfront were designated as *E. coli* sites.

Neuse River Sampling Sites



Tar-Pamlico River Sampling Sites

Enterococcus-screened sites are marked in orange.

Additionally, a community group in each watershed offered to sponsor a new site, which added the Swan Point site, sponsored by the Old Ford Ruritan Club on the Tar-Pamlico River, and the Upper Broad Creek site, sponsored by the Blackbeard Sailing Club on the Neuse River.

Sample Collection

Citizen Science volunteers were recruited and asked to participate in a one-hour training session before beginning the program. Program interns developed a volunteer training manual (see appendix) and completed a hands-on training session for all volunteers involved in sample collection. Volunteers were instructed on the proper technique to collect and deliver samples and were supplied with a sample collection kit and guidebook for the field. Sampling was conducted primarily by volunteers and was supplemented by interns when volunteers were not available or when the sampling site was located on private property. The QAPP developed for this project was followed at all times (see appendix). Sampling began Thursday, May 31, 2018 and continued every Thursday through August 30, 2018.

Each Thursday, volunteers returned to the same sampling location and recorded temperature and if appropriate, salinity, of the water, as well as general site observations of human and wildlife activity, and how the water looked. A sterile sample was collected along with a temperature control bottle and immediately put on ice. Once at the office, volunteers measured and recorded the temperature control and stored samples in a refrigerator for analysis.

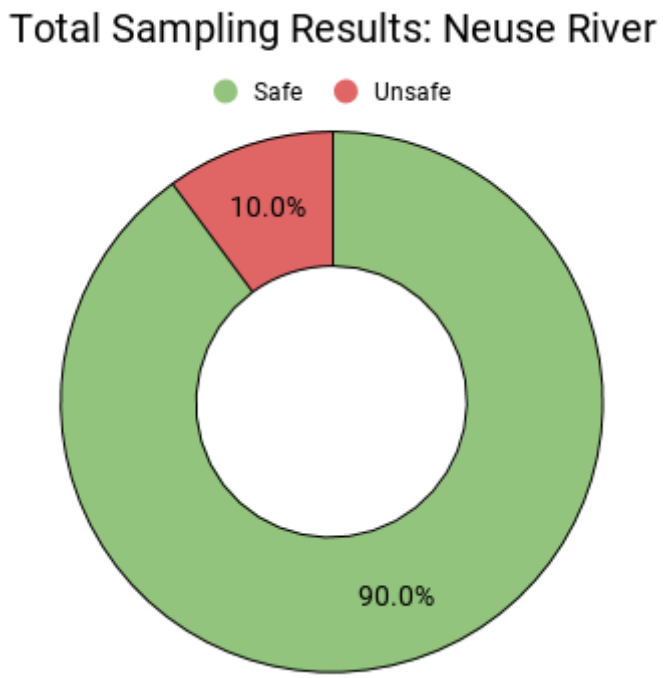
Sample Processing

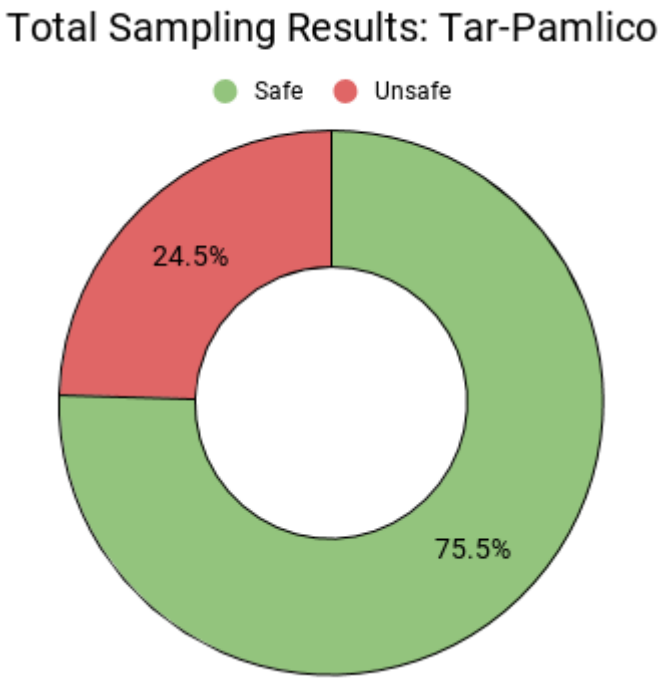
Once the samples were collected, they were processed using the IDEXX system of reagents and incubation. Samples are incubated for approximately 24 hours before analysis. After incubation, *E. coli* concentration was determined by counting fluorescing wells and quantified using the IDEXX Quanti-Tray MPN Table. Any samples with greater than 235 MPN/100 mL exceeded fecal bacteria concentrations considered safe for swimming according to standards set by the EPA for Designated Beach Areas in the 1986 Ambient Water Quality Criteria for Bacteria. Samples in saline water were analyzed using the same process, but screened for *Entero* and used a maximum concentration of 104 MPN/100 mL.

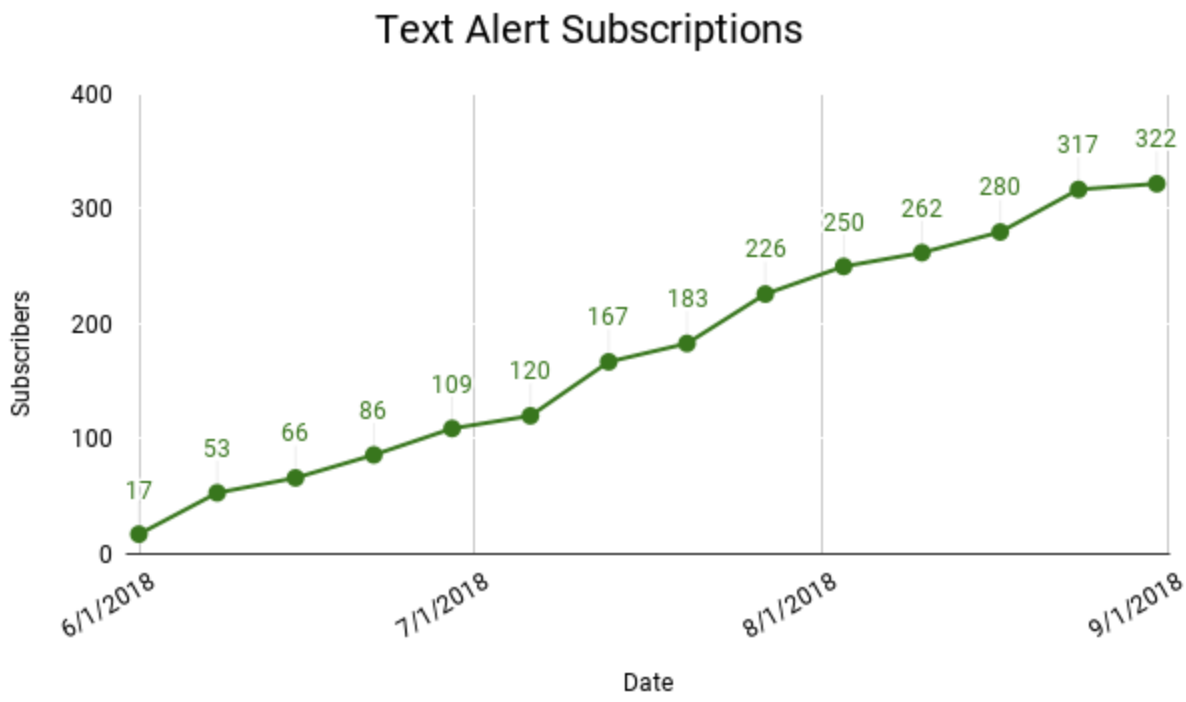
Dissemination

The results and recommendations on safe swimming areas were disseminated to the public through the Swim Guide website and smartphone app, weekly text alerts, weekly water report videos, and Sound Rivers website and social media in order to notify as many people as quickly as possible to Sound Rivers' findings. Sound Rivers boasts a large social media presence and posted information through Sound Rivers' main Facebook account, in addition to the Tar-Pamlico Riverkeeper and Lower Neuse Riverkeeper Facebook pages, and the three twitter accounts associated to these names. When bacteria results exceeded water quality standards, a press release was issued to area news media.

Results and Conclusions







Tar-Pamlico: River Health and Possible Contributing Factors

On the Tar-Pamlico, overall site health was shown to be lower than the Lower Neuse, with sites passing the applicable EPA standard in 75.5% of all samples collected. Several sites can be strongly attributed to the lowering of the average; Bath Creek, Broad Creek, nor Woodstock Point has passed more than 40% of the time sampled. Some possible causes to these high rates of failure are poorly maintained private septic tanks, runoff from animal feeding operations, and localized fecal input from wildlife. A cause that is more likely for Bath Creek and Broad Creek are the adjacent marinas that could be close enough to produce spikes in bacteria through improper boat waste disposal. This potential cause is sporadic; Broad creek experienced high bacterial levels on June 12th and July 19th with little to no precipitation prior to sampling (figure 5, 7). Similar spikes in bacteria without heavy prior rains can also be found at healthy sites, with weak to moderate correlation coefficients to rain events at Blount's Creek (0.38), the Greenville Town Commons (0.08), Port Terminal (0.38), Tranter's Creek (0.41) and Washington's waterfront (0.36). Some sites' failure on certain weeks can be explained by site-specific events that can drive up bacterial levels for a short amount of time such as improper waste disposal or animal and wildlife fecal input.

Due to absence of point source discharges, rainfall is a strong indicator for bacteria for Chocowinity Bay. Bacterial sources are attributable to non-point sources via stormwater runoff. There is a marina located at Cypress Landing, but the absence of a pump out and strict regulations make this source unlikely. Other potential inputs include septic drainage from an upstream RV park, but source tracking would need to be completed. From these observations, a cautionary attitude considering bacterial levels and precipitation can be drawn from certain sites but does not offer a strong widespread indicator for high bacteria levels. Among saline sites, salinity proved to show similar correlations; weak relationships at

Broad Creek, Bath Creek, and Woodstock Point, and a negative correlation at Chocowinity Bay. The relationships at Chocowinity Bay also show that heavy precipitation is frequently followed by higher bacterial levels, and lower salinity levels can be explained by the large amount of rain input at this site (figures 5, 14, 16). However, an additional dynamic occurring at saline sites is the use of Enterococcus at varying salinity levels, and its effect on accuracy. Enterococcus was used as a conservative indicator for brackish areas, and there may be a possibility that these sites are saline enough for Enterococcus bacteria to grow well, but not enough for dangerous species that it serves as an indicator for.

Overall trends found within the various sites are that saline locations on the North side of the Pamlico River are experiencing repeated input of fecal bacteria, even at less developed sites, with weak correlation to precipitation, suggesting inputs from other sources as well. Thankfully, many freshwater locations used frequently by small boaters and paddlers, such as Tranter's Creek and the Greenville area, are frequently safe and do not appear to regularly face high bacterial levels after rain events.

Lower Neuse: River Health and Possible Contributing Factors

Overall basin health in the Lower Neuse has displayed surprisingly healthy results over the course of the summer with sites passing the applicable EPA standard 90.0% of the time (figure 2). Of the 10.0% of overall site fails, River Bend on the Trent is responsible for 5 out of 10 site fails, with Brices Creek, Pollocksville, and Lawson Park also contributing. Possible causes for high failure rates are similar to those in the Tar-Pamlico including poorly maintained private septic tanks, runoff from animal feeding operations, and localized fecal input from wildlife. With a weak negative correlation between precipitation and bacteria levels at River Bend, it is unlikely that the recurring failure at this site is due to runoff from concentrated animal feeding operations. River Bend is located directly next to a wastewater treatment facility. This proximity prompts further sampling and investigation into whether waste from this facility is contributing to the high levels of fecal bacteria found at River Bend. Brices Creek has failed the second most often at 27% of sampling events. Brices creek has a very strong positive correlation between bacteria and precipitation, indicating runoff due to precipitation is a likely contributor to site failures. This runoff could be due to concentrated animal feeding operations or more localized wildlife fecal input. Given the location of Brices Creek, it is unlikely to be experiencing runoff from CAFOs. It is, however, located next to a popular recreational park and the Croatan Forest, and runoff from both these sources could contribute.

Lawson Park and Pollocksville have failed 22% and 11% of sampling events, respectively. Given the infrequency of failure at these sites, it's likely that failure was due to a specific incident such as someone improperly disposing of boat waste or an extremely heavy rain event. Both sites have strong positive correlations between bacteria and precipitation, however, looking at precipitation and bacteria levels over time shows that, for both sites, large rain events do not always lead to bacteria exceedances. Lawson Park's location close to downtown New Bern as well as the high amount of boat traffic received makes it likely that sources of fecal bacteria pollution are more localized. Pollocksville's rural location and proximity to animal feeding operations makes it more susceptible to fecal bacteria pollution due to runoff. Of the several large rain events that occurred over the course of the program, Pollocksville only failed when almost 5 inches of rain had accumulated over the course of 5 days, double the accumulation of any other rain event that summer; likely leading to the increased runoff with fecal bacteria.

Similar to the Tar-Pamlico river basin, precipitation cannot consistently predict bacteria levels across the basin. While some sites such as Pollocksville and Brices Creek display strong relationships between bacteria and precipitation, there are just as many sites that display weak and even negative relationships, indicating other factors must be considered when determining the greatest contributors to high levels of fecal pollution.

Indicators of Success

1. Percent of sampling sites analyzed weekly (Goal 100%) – **Result – 98%**
2. Percent of project outputs/products completed (Goal 100%) – **Result – 100%**
3. Number of social media posts / reach (Goal 20 posts / reach – 40,000) – **Result - 29 Posts, 48,570 reach**
4. Number of website interactions (Goal 500) **– Result - 6906**
5. Number of citizens participating in sampling (Goal 20) – **Result - 26**
6. Number of traditional media stories (Goal 5) – **Result - 6**
7. Number of views of our Weekend Water Report videos (Goal 500) – **Result - 19,802**
8. Number of persons that sign up to receive Sound Rivers Weekend Water Report text alerts (Goal 500) – **Result - 322 ****
9. Number or requests for data by research partners and agencies – **Result - 2**
10. Amount of additional funding leveraged ($13,000) – **Result - $13,950** ($11,750 cash + $2200 in-kind)

** Originally, the goal was listed for weekly email subscribers. However, the decision was made that weekly text alerts are a better form of communication. Text alerts allow for quicker dissemination and reception of information.

Appendices Attached

Appendix A – Volunteer Training Manual

Appendix B – Quality Control/Assurance Plan

Appendix C – Swim Guide Fact Sheet

Appendix D – Results Summary