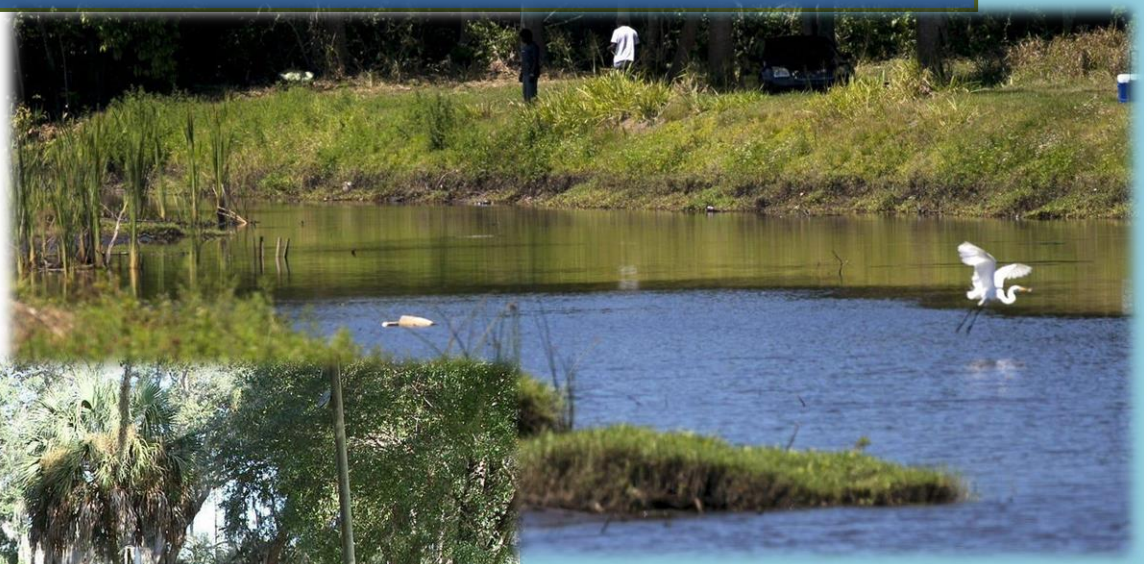
Billy's Creek Community Action Plan (BC-CAP)



Calusa Waterkeeper

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Executive Summary

The following plan serves as a call to action for restoring local tributary, Billy's Creek. Named after Seminole Chief and great Native American activist of his time, Billy Bowlegs, this urban waterway pays homage to our local history. Serving as his inspiration, Thomas Edison's first sight of lush bamboo lining Billy's Creek prompted the establishment of his winter residence in Fort Myers. Following the Florida Land Boom of the early 1920's, communities formed around the abundant waterway, each contributing to the culture we now know as modern Fort Myers. From its early history to the present day memories and life experiences intersect and continue to affirm the significant role Billy's Creek holds in the greater Fort Myers community. Throughout the process of writing the Billy's Creek Community Action Plan (BC-CAP), oral histories were collected in an effort to understand the place Billy's Creek holds in the hearts of the people who live here. Shared with us were stories of learning to swim in the once white, sandy-bottom creek; teaching youth about the local environment with school trips to the creek; and, most popularly, fishing alongside family and friends.

While the historic waterway struggles with pollution and nutrient loading, extreme levels of fecal indicator bacteria (FIB) may pose the most concerning risk to Billy's Creek and the basin community. Fecal pathogens may include bacteria in the genera *Salmonella, Shigella,* and *Vibrio,* and can result in several types of illnesses and diseases in humans, including gastroenteritis and bacillary dysentery, typhoid fever, and cholera. The longest continuous FIB sampling record on Billy's Creek is from Lee County (certified laboratory analysis) with monthly sampling for enterococci bacteria starting in 2001. Their public data consistently indicates FIB levels significantly exceeding the water quality criteria codified in F.A.C Chapter 62-302.530. Calusa Waterkeeper (CWK) and Florida Department of Environmental Protection (FDEP) each conducted source tracing in an effort to identify the source of fecal contamination. CWK and FDEP's findings both indicate humans as a contributing source, however more robust source tracing must be done prior to executing major mitigation efforts. Past interventions have been implemented to assist with restoring Billy's Creek, such as constructing a filter marsh preserve or engaging in community clean-up efforts; however, none have focused on identifying and mitigating the FIB source.

Several reasons may justify why Billy's Creek has yet to undergo proper restoration. The complexity of the hydraulic basin offers some explanation. While Billy's Creek flows 5 miles before meeting the Caloosahatchee River, the hydraulic basin it creates encompasses 12.9 square miles. Both the City of Fort Myers and unincorporated Lee County hold jurisdiction within its boundaries, contributing to a lack of clarity as to which entity is primarily responsible. The people and circumstances making up the basin community are similarly complex. Racial demographics from 2010 Census data describe basin composition as 54.2% Black, 25.0% white, 1.1% American Indian, 0.4% Asian, 0.1% Pacific Islander, and 16.6% described as "some other

race." Because Hispanics can be of any race, they make up 32.2% of the basin population. These numbers indicate that the Black population is the dominant racialized group within the basin by a factor of 2+. Not represented by the numbers is the reality of significantly different living conditions found in the basin. While a minority of riverside residents live in historic Dean Park or high-rise condos, the majority, Black and Brown residents, live in historically underserved parts of the city and county. Elected officials from both undoubtedly have a large role in the restoration process with Councilpersons Watkins-Brown, Streets, Watson, and Bochette, as well as County Commissioner Mann, holding responsibility within basin boundaries. Lack of engagement between regulatory agencies such as the Florida Department of Health (FDOH) and FDEP also contribute to the difficulty in approaching the restoration process. Collaboration between these regulatory agencies could maximize the restoration process as FIB levels far exceeding FDOH's Beach Action Threshold of 70 MPN have been recorded and the creek has been verified impaired by FDEP. While these agencies are willing to help, the bureaucratic protocols they must follow do not always serve to be the most effective pathway for community initiatives. However, the approximately 23,924 residents living in the basin do have the collective ability to demand the restoration process forward.

The contents of BC-CAP highlight the significant impact community members and stakeholders can make when mass concern is addressed, and advocacy elevated. Embracing educational events, expression through art, stakeholder meetings, or the formation of a coalition all serve as methods for community intervention.

It is with this nuanced understanding of both the challenges and capabilities found within the Billy's Creek basin that CWK began thinking of BC-CAP. Entering 2020, CWK had hoped to start the engagement process between all entities, understanding restoration will be achieved when collaboration is the chosen pathway to overcome these challenges. With the support of the Southwest Florida Community Foundation gatherings were being planned- workshops, and several meetings that aimed to make the process as participatory as possible. However, the spread of COVID-19 quickly halted such plans. Working virtually reduced CWK's ability to connect with the community and get significant input. However, CWK was able to meet on several occasions with city officials and staff as well as members of FDEP. We also hosted a preliminary stakeholder meeting in December of 2020. Additionally, CWK began a Billy's Creek oral history project, administered a successful survey for local candidates prior to the election, and made multiple appearances on local news outlets in an effort to spread awareness regarding the state of the creek. Recognizing the limitations it faced, CWK used the year to create a written plan that provides a clear path to begin the restoration process, with the intention of addressing any steps that may need to be adjusted. The final chapter, specifically, tackles one of the most challenging concerns of restoration, financing. As previously mentioned, much of the basin is home to historically underserved communities that deal with several concerns equal to, or more pressing than, restoring Billy's Creek. Therefore, CWK recognizes the need for swift

restoration, not solely from an environmental conservation standpoint, but more appropriately, to achieve environmental justice for our neighbors and colleagues.

I. Historical, Cultural, and Recreational Significance

The name of the creek honors Seminole Indian Chief and prominent activist of his time, Billy Bowlegs (aka. Holato Micco, 1810-1864). Bowlegs tirelessly fought the U.S. federal government's policy of forced "Indian Removal" of the Seminole and other eastern tribes during three long, bloody, expensive wars known as the "Seminole Wars." The wars began in 1817 and ended in 1858 when Chief Bowlegs accepted terms negotiated between himself, other tribal leaders, and U.S. government officials. During the spring of that year, small bands of his people began arriving just east of the Fort (Myers) and camped along the banks of a small creek. On May 4, 1858, a group of Seminole men (38), women and children (85) boarded the steamer Grey Cloud in Fort Myers and began the long journey to Indian Territory - to lands recently set aside specifically for relocated Seminoles. From that time on the creek has been known as "Billy's Creek." This piece of Fort Myers history seems long past; however, the presence today of The Seminole Tribe of Florida, also known as the "unconquered," can be attributed to the life-long dedication of Bowlegs and other Native Americans advocating for tribal independence.

Figure 1. Seminole Chief Billy Bowlegs, 1810-1864.

Florida officially became a U.S. territory in 1821, between the first and second Seminole Wars. This brought with it a surge of immigrants from northern territories, immigrants who changed Florida's scenery with the settlement of small farms and ranches.[1] At the time, cattlery in the fertile, subtropical lands of Southwest Florida was quite profitable.

One of the northerners to visit the area during this time was famous inventor, Thomas Edison. Edison first visited Fort Myers in 1885 in an effort to escape the harshness of the northern

[1] Williams. C.A. (2017). Hidden History of Fort Myer. (pp. 15) Charleston, SC. The History Press.

winters. It was while on a cruise up the Caloosahatchee River that he noticed bamboo growing tall along Billy's Creek. This unique and scenic view prompted him to establish his winter home and lab in Fort Myers.

Fort Myers began to experience even greater economic opportunity after the start of the 20th century. Dean Park, located on the mouth of Billy's Creek, was developed between 1916 and 1920 by businessman John Morgan Dean. The Florida Land Boom, in full swing during the early 1920s, filled Dean Park with the homes of the city's most highly regarded entrepreneurs and civic leaders.[2] These well crafted dwellings still house Fort Myers residents. This historic community remains passionate about engaging the public by hosting house tours, educational lectures, and entertainment events such as "Bar-B-Q and Blues."[3]

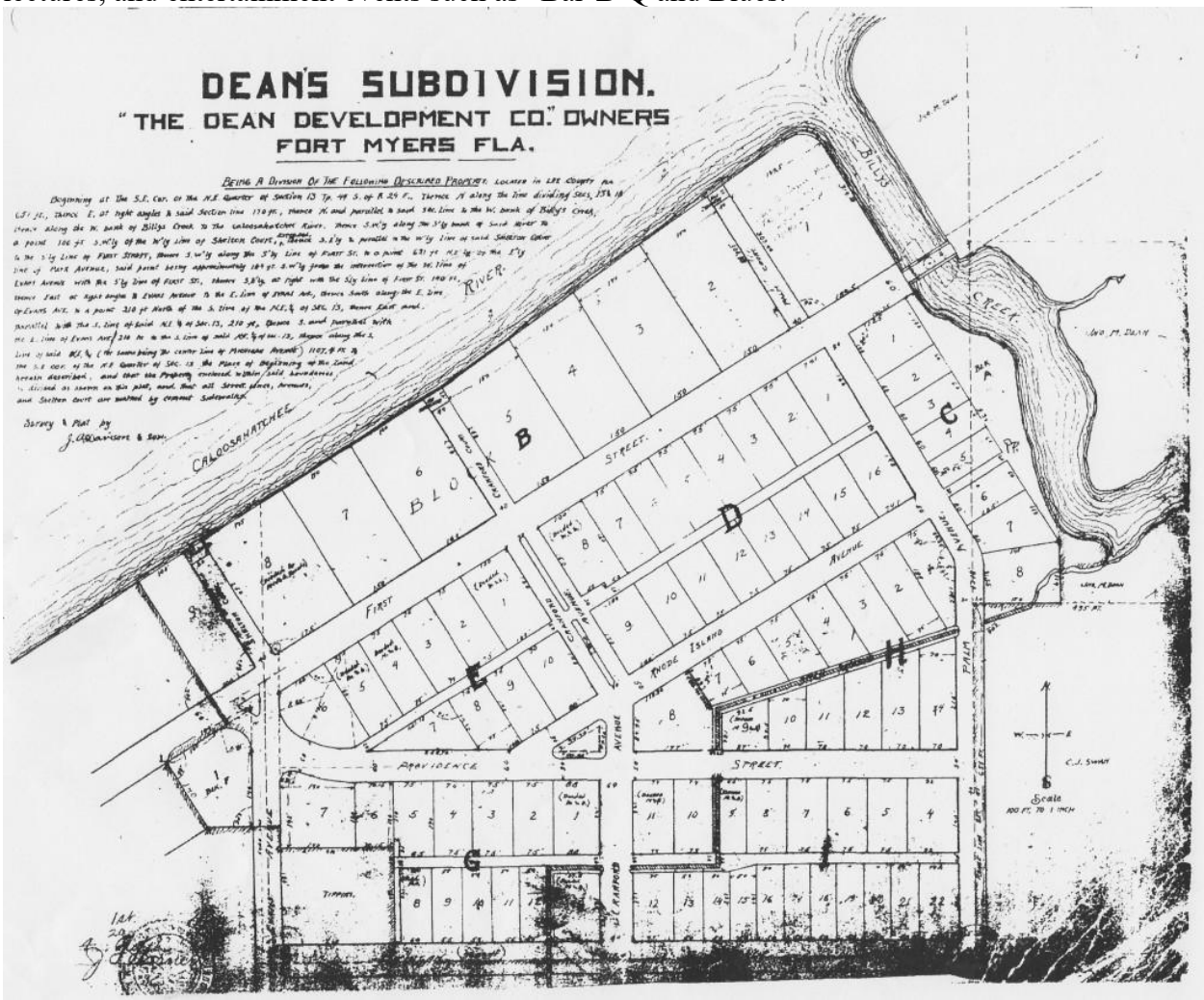


Figure 2. The 1920's map of Dean Park illustrates the proximity of the subdivision to Billy's Creek with a row of creekside homes on Palm Street.

[2] Dean Park Historic District. (n.d.). The Story of Dean Park. https://deanpark.org/about/history/

[3] Upcoming events in Dean Park can be found at https://deanpark.org/events/

Figure 3. View of a Dean Park home today where the annual Bar-B-Q & Blues event provides music, food, and entertainment to community members.

Another historically significant area on the Billy's Creek basin is the Dunbar community. This community derives its name from Paul Laurence Dunbar, the first African American poet to achieve a high level of distinction by both Black and white Americans. The predominantly Black community built on the Dunbar legacy by establishing community resources such as Dunbar Community School. Established in 1926, and partially funded by the community, the school became an active space for Black residents in the greater Fort Myers area, expanding beyond the city to Collier and Charlotte counties.

Figure 4. Entrance of Dunbar Community School, formerly named Dunbar High School from 1927-1962.

Entertainment and commerce in the community thrived at McCullum Hall, located on the northeast corner of Cranford Avenue and Dr. Martin Luther King Jr. Boulevard. Another pillar of the community, its churches - Mount Olive African Methodist Episcopal Church, Friendship Missionary Baptist Church, St. John's First Missionary Baptist Church, and Grace Church - have all stood in Dunbar for decades, and continue to act as its heart. Today, this rich history can be reflected on while visiting the Williams Academy Black History Museum located on Henderson Avenue, attending the annual Martin Luther King Jr. March and Park Celebration or the Dunbar Easter Awaken Parade Weekend. The impact of these educational institutions, economic hubs, and religious centers exhibits the strong organizing efforts and mutual support offered within the Dunbar Community.

Figure 5. A photo from 2017's Martin Luther King Jr. March and Park Celebration. The community gathers at Centennial Park to enjoy the annual event organized by the Dunbar Event Committee. The organization's vision is to "promote education and diversity while empowering in order to build a stronger community".[4]

Unfortunately, the community is no stranger to environmental injustice. In 2018 the community began a class action lawsuit in response to arsenic sludge that had been dumped in the area decades before. The sludge led to arsenic levels rising in the soil around resident's houses and they believed their health had been compromised because of it. Since then, the lawsuit has been dismissed; however, the sludge has been removed. Once again, the Dunbar community, along with others within the hydraulic basin of Billy's Creek, are experiencing environmental concerns - concerns that the environment they live in can be hazardous to their health. It is hoped that in the future Fort Myers will move in a more equitable fashion, providing timely interventions for the wellbeing of all community members, especially those who have been historically underserved.

Reflecting upon the history and culture of the people who have inhabited the creek's basin provides insight into the significance the creek has played in their lives, from the time of Billy Bowlegs and Thomas Edison to today. Recreation on the creek has always been an important part of life in all the distinct communities living along it. People can still be heard reminiscing of their childhood days learning how to swim in the creek at a time when its bottom was still white

[4] Follow the many events planned by Dunbar Event Committee, INC by visiting their Facebook page via https://www.facebook.com/dunbarfestivalcommitteeinc/about/?ref=page_internal.

and sandy. While this experience is no longer common, people can still be found kayaking and riding jet-skis from the mouth of the creek up to Marsh Avenue crossing. This area was part of the Great Calusa Blueway, a series of designated paddling trails, until its removal in recent years. Rope swings can still be found hanging from the canopy of the creek-side, and interviews with community members indicate swimming may still occur. Fishing, the most popular activity, is a pastime shared by people from all areas of the creek. The current state of Billy's Creek poses a threat to the current and future enjoyment of all these activities by basin community members, threatening their health and safety.

Figure 6. A rope swing tied to the tree canopy suggests that residents may still be swimming in the impaired creek.

Figure 7. Two men fishing along Billy's Creek during the summer of 2019.[5]

II. Basin Boundaries & Related Hydrology

Headwaters of Billy's Creek begin at Lucket Road Industrial Park, near Ortiz Circle, moving its water southwest through Nuna Avenue before reaching the Billy's Creek Preserve and Filter Marsh. The artificially made filter marshes within the preserve aid in the sequestration of excess nutrients prior to continuing its path towards the Caloosahatchee River. A straight, canal-like flow persists past Marsh Avenue until near Van Buren Street where the creek begins to take a more natural flow and creek-side vegetation thickens. Crossing under Veronica Shoemaker Boulevard, the creek passes more residential communities, churches, and small businesses. Nearing its mouth, past Palm Beach Avenue where WINK news, Dean's Park, and several high rises are located, the creek meets the Caloosahatchee River, emptying into this great waterbody.

Hydrologically, a much greater area of Fort Myers is supported by Billy's Creek. It offers storm water drainage to a majority of East Fort Myers from Interstate 75 to the downtown area. In terms of outflow into groundwater and surface water, the basin boundaries reach a significant geographic portion of Fort Myers. Spanning 12.9 square miles, both the City of Fort Myers and a portion of unincorporated Lee County hold jurisdiction within the Billy's Creek basin. I 75 lines the creek's northeastern boundary beginning at its crossing with Palm Beach Boulevard. Moving south, the boundary pushes east, past I 75, until reaching its southernmost point at State Road 82. This region of the eastern boundary stretches far enough to include the northern portion of Six Mile Cypress Preserve. Headed westward, the basin lines Ortiz Avenue southbound before reaching Hanson Street, the southernmost boundary of the basin. The basin line then meanders

[5] Amy Bennett Williams. (2019, June 11). Billy's Creek dredging project may relieve flooding on the troubled tributary, but fecal pollution remains a worry. NewsPress. Retrived from https://www.news-press.com/story/tech/science/environment/2019/06/11/fecal-pollution-remains-worry-billys-creek/1379375001/

northwest through residential streets near Edison Avenue before connecting to the westernmost boundary. Beginning after the Caloosahatchee Bridge and stretching up to Palm Beach Boulevard, the western boundary moves north until reaching I 75 once again.

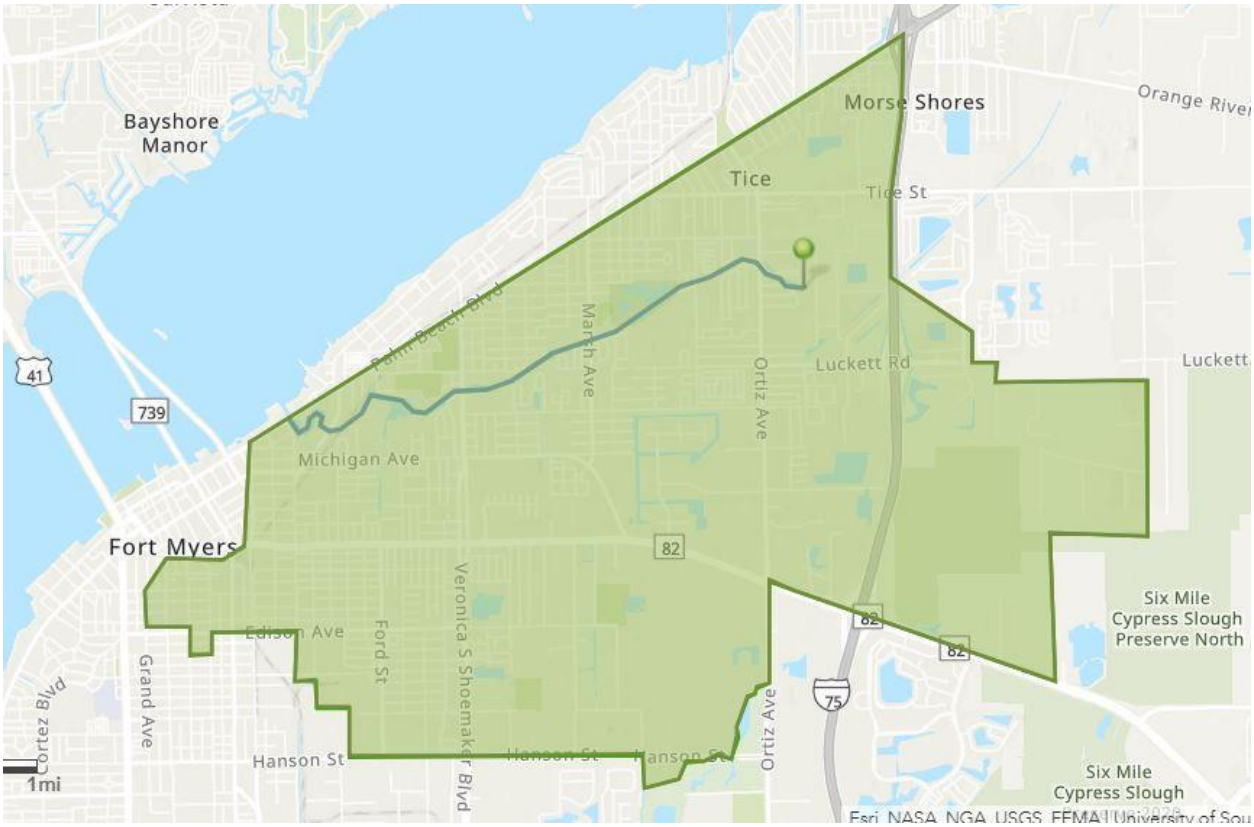


Figure 8. Map identifies creek headwaters and flow into the Caloosahatchee River and outlines the 12.9 square mile Billy's Creek Basin

Despite the scenic nature of the urban waterway and its dense mangrove canopy, the current condition of Billy's Creek is heavily impaired. Litter and anthropogenic debris have settled into the creek, now as common a sight as the animals that live there. Several clean-up efforts on Billy's Creek have brought about temporary change; however, within a short time the litter accumulates once again. In addition to the trash, debris enters Billy's Creek from stormwater and shallow groundwater runoff. As described above, the creek offers drainage for a large portion of East Fort Myers. Canals and drainage ditches that mitigate flooding on roads and within neighborhoods, then flow into Billy's Creek. The journey from road, to drainage ditch, to creek, offers a long pathway for nutrient accumulation. Lawn clippings, vegetative debris, fertilizers, animal and human waste, oil and other pollutants from roads, and sediments are all sources of excess nutrients in the creek.

III. Water Quality and Regulatory Background

The following chapter references a series of figures and tables which support the written explanation of the data. In an effort to increase readability, all figures for this chapter can be found in Appendix A.

Public waterbodies in Florida are classified by designated use and assessed for attaining water quality standards assigned to the various waterbody classifications. Each public waterbody statewide is assigned to one of five Basin Groups that are assessed on a staggered five-year cycle. Multiple sources, including but not limited to, state agencies, local governments, and non-government organizations conduct water quality sampling and provide the results to the Florida Department of Environmental Protection (FDEP). FDEP organizes these water quality data into a comprehensive statewide water quality database established by rule with protocols for sampling and quality control provisions relative to assessment. At the end of each five-year Water Basin Group Cycle, FDEP summarizes the water quality data respective to the waterbody in question and determines whether that waterbody is in attainment of its designated use.

The assessed parameters and associated criteria with respect to waterbody classification are numerous and codified in F.A.C. Chapter 62-302. These parameters include a wide array of substances or elements important for aquatic life support, as well as contaminants that are of public health significance that stem from Clean Water Act authority and related federal CFR rules. For regulatory compliance, Florida has adopted criteria for water quality parameters and associated conditions under which a waterbody is determined impaired as outlined in the State's Impaired Waters Rule, F.A.C. Chapter 62-303.

The Classification, Assessment and Current Status of Water Quality in Billy's Creek Emphasizing Fecal Indicator Bacteria (FIB)

Billy's Creek is classified as a Class III, predominantly marine waterbody in Florida. The designated uses of Class III waterbodies are defined in F.A.C. Chapter 62-302.400 as "Fish Consumption; Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife." Billy's Creek is part of the Basin Group III currently in its fourth five-year assessment cycle ending in 2021. Billy's Creek is assessed as part of the Caloosahatchee Group, Orange River Planning unit and assigned the unique waterbody identification number (WBID) 3240J. Billy's Creek is currently verified impaired for iron and fecal coliform bacteria. The impairment for fecal coliform bacteria was determined during the first five-year assessment cycle ending in 2005 and a Total Maximum Daily Load (TMDL) was projected for development in 2009. To date, a TMDL developed for fecal coliform bacteria in Billy's Creek has not occurred.

As part of new EPA guidelines, Florida stopped assessing for fecal and total coliform bacteria in Class III waters in 2016 and instead started assessing waters for the parameters enterococci bacteria in predominantly marine waters and E. coli in predominantly fresh waters effective 2-17-16. The water quality criteria for enterococci and E. coli bacteria as codified in F.A.C. Chapter 62-302.530 are as follows:

Enterococci bacteria: MPN or MF counts shall not exceed a monthly geometric mean of 35 nor exceed the Ten Percent Threshold Value (TPTV) of 130 in 10% or more of the samples during

any 30-day period.[6] Monthly geometric means shall be based on a minimum of 10 samples taken over a 30-day period.

E. coli bacteria: MPN or MF counts shall not exceed a monthly geometric mean of 126 nor exceed the Ten Percent Threshold Value (TPTV) of 410 in 10% or more of the samples during any 30-day period. Monthly geometric means shall be based on a minimum of 10 samples taken over a 30-day period.

As a result of the FDEP criteria rule change regarding fecal bacteria in 2016, Billy's Creek will be assessed primarily for enterococci bacteria at the end of the Group 3 Basin assessment cycle ending in 2021. The headwaters of Billy's Creek downstream to the Billy's Creek Filter Marsh is absent of tidal reach due to a water control structure just downstream of the filter marsh and as such Billy's Creek may also be assessed by FDEP for E. coli, the appropriate FIB parameter in freshwater.

Health Risks Associated with the Presence of FIB in Surface Waters

FIB such as E. coli and enterococci are used as indicators of fecal pathogens. Direct testing for pathogens is expensive and often impractical and why indicator bacteria are used as fecal pathogen indicators. Fecal pathogens may include bacteria in the genera *Salmonella, Shigella,* and *Vibrio,* and can result in several types of illnesses and diseases in humans, including gastroenteritis and bacillary dysentery, typhoid fever, and cholera.[7] Human viruses and parasites from animals including Giardia and Cryptosporidia from wild or domestic animals are additional pathogens that may be indicated by FIB. [8] Respiratory illness can also result from elevated FIB but is less often reported.[9] Other health endpoints include rash, eye ailments, earache, and infected cut.[10] Probable rates of gastrointestinal illness associated with enterococci bacteria can be derived from the follow graph:[11]

[6] MPN or most probable number is the number of organisms most likely to have produced lab results in a particular test.

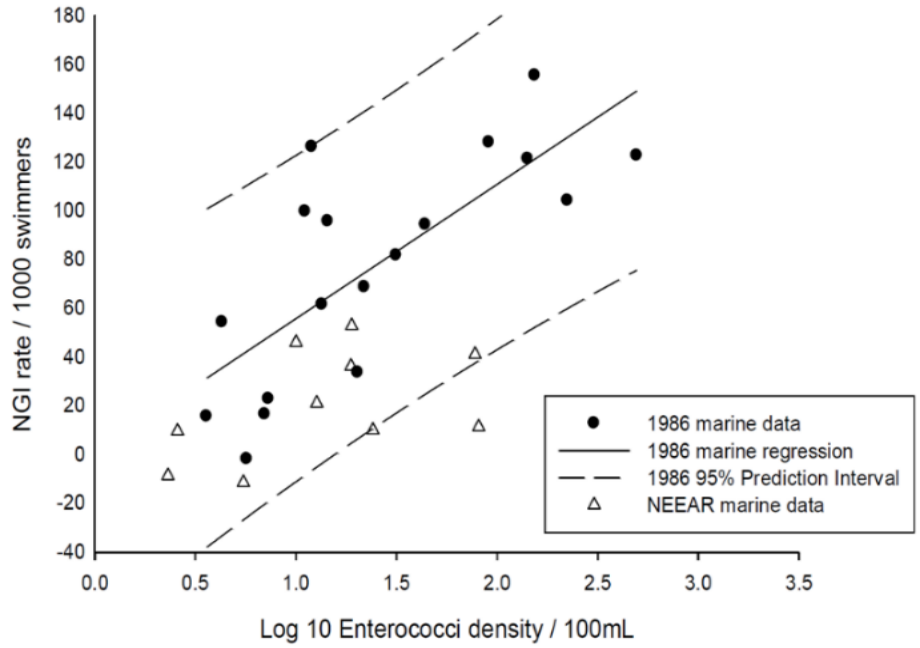
[7] Ajar Nath Yadav, Neelam Yadav, Divjot Kour, Akhilesh Kumar, Kritika Yadav, Amit Kumar, Ali A. Rastegari, Shashwati Ghosh Sachan, Bhanumati Singh, Vinay Singh Chauhan, Anil Kumar Saxena, Chapter 1 - Bacterial community composition in lakes, Editor(s): Suhaib A. Bandh, Sana Shafi, Nowsheen Shameem, Freshwater Microbiology, Academic Press, 2019, Pages 1-71, ISBN 9780128174951, https://doi.org/10.1016/B978-0-12-817495-1.00001-3.

[8] EPA Wastewater Technology Fact Sheet, Bacterial Source Tracking, https://www3.epa.gov/npdes/pubs/bacsortk.pdf

[9] EPA Recreational Water Quality Criteria. 2012. OFFICE OF WATER 820-F-12-058.

[10] IBID

[11] IBID



Summary of Spatial Occurrence and Temporal Levels of FIB in Billy's Creek

Several data sets for primarily enterococci bacteria exist for Billy's Creek. The longest continuous sampling record is from Lee County (certified laboratory analysis) with monthly sampling for enterococci bacteria starting in 2001 at two locations: the intersection of the Creek and Veronica Shoemaker Boulevard (BILLGR20), and Ortiz Avenue (BILLGR60). Sampling at both stations has continued into 2020 (See Appendix A, Figure 1).

Four sampling stations on Billy's Creek were monitored for enterococci bacteria by the City of Fort Myers from 2005 to 2010 (See Appendix A, Table 1). The reason sampling ceased in 2010 is unknown.

The data for both enterococci and E. coli bacteria significantly exceeds the water quality criteria codified in F.A.C Chapter 62-302.530 in 2016 as described above. The monthly average (2001-2020) for enterococci bacteria at Lee County's BILLGR20 (Veronica Shoemaker Blvd.) station is 742.8 MPN or equivalent and 1332.3 MPN or equivalent for station BILLGR60 (Ortiz Avenue). Monthly data for enterococci from stations BILLGR20 and BILLGR60 are illustrated in Appendix A, Figures 1 and 2, documenting variability and at times extreme exceedance during certain months. Lee County started sampling for E. coli in 2016 at the BILLGR60 sampling station representing freshwater conditions where E. coli would be the appropriate parameter. As with enterococci, E. coli levels significantly exceed the respective state criteria described above (See Appendix A, Figure 3).

Fort Myers officials have speculated that the high levels of enterococci bacteria (FIB) are sourced from the Caloosahatchee River with an incoming tide. An examination of Caloosahatchee River enterococci levels at upstream and downstream sampling stations of the mouth of Billy's Creek indicate significantly lower levels in the river as opposed to those in

Billy's Creek (See Appendix A, Figure 4). There is no tidal influence at the upper reach of Billy's Creek east of the Billy's Creek Filter Marsh and could not be influenced by the Caloosahatchee River.

Source Tracing as Tool in the Process of Restoring FIB Contaminated Waters

An early step in the process of restoring a waterbody contaminated with FIB is to determine the sources of contamination. FIB in surface and groundwaters originate from naturally occurring sources such as the feces of warm-blooded animals including humans. Human sources are typically sourced from the process of collecting, conveying, and treating sewage involved with central sewer systems and septic tanks.

Chemical tracers that link or more precisely identify sources of FIB are often grouped into two categories as molecular and non-molecular types. [12] Those in the molecular group include methods associated with DNA fingerprinting with respect to human and non-human sources. Non-molecular markers include caffeine, sucralose, acetaminophen, ibuprofen, Naproxen and optical brighteners that are more typically associated with human sources involving treated or untreated (raw sewage) wastewater. [13]

Stable isotopes of nitrogen, oxygen, and boron are used as tools for indirect sourcing of water that may originate from variable sources such as rain, soil, artificial fertilizers, manure, treated or untreated wastewater. This methodology is used to better understand where water constituents such as nitrate (nitrogen and oxygen isotopes) and boron (boron isotope) originate with implications for contributing sources. Isotope tracing that identifies manure or wastewater sources can help in identifying causes of elevated FIB. Please refer to the following linked documents that describe the science behind stable isotope tracing and utility for identifying contributing sources https://calusawaterkeeper.org/wp-content/uploads/2020/12/Beta-isotopic-source-tracing-whitepaper.pdf.

Results of FDEP Potential FIB Sources in Billy's Creek

The earliest source tracing we are aware of in Billy's Creek was conducted by FDEP at the request of Calusa Waterkeeper (CWK) on 6/28/18. Eight locations sampled ranged from Billy's Creek at East Billy Creek Drive, near the headwaters downstream to the Seaboard St. crossing, to just upstream of the mouth of Billy's Creek on the Caloosahatchee River (See Appendix A, Figure 5). Additionally, Ford and Zapato canals that feed into the creek were included to further identify sources of FIB. FDEP followed their own adopted protocols for sampling and analysis conforming with certified laboratory standards.

The 6/28/18 FDEP sampling results identified that sucralose can be detected in both treated and untreated (raw sewage) wastewater, at six of the eight Billy's Creek sampling sites. The highest values for sucralose were at Seaboard St. and in the Ford Canal at Gallee Way. Acetaminophen, Naproxen and Ibuprofen, typically associated with untreated wastewater (raw sewage) was

[12] EPA Wastewater Technology Fact Sheet, Bacterial Source Tracking, https://www3.epa.gov/npdes/pubs/bacsortk.pdf
[13] IBID

detected at Seaboard St., just downstream of the Ft. Myers wastewater treatment plant (See Appendix A, Figure 5). DNA associated with human sources was detected at four of the eight sampling locations. DNA associated with avian sources was detected at five of the eight stations and ruminant (cattle or grazing animals) DNA at two of the eight stations (See Appendix A, Figure 5).

Results of CWK FIB Source Tracing in Billy's Creek

CWK conducted stable isotope sampling in Billy's Creek as a two-phase approach. Sampling methods and analyses were those provided by BETA Laboratory following USGS methods. The Phase I sampling occurred on 6/11/20 at the following Billy's Creek locations: Shady Oaks Park (BC3), Veronica Shoemaker Boulevard (BC4), Marsh Avenue (BC6), Nuna Avenue (BC7), Ortiz Avenue (BC8) and at Ortiz Circle (BC9). Three additional samples, representing a potential mixing zone in the Caloosahatchee River upstream of the mouth of Billy's Creek, were collected at Tarpon Street Pier (R1), Royal Palm Park (R2), and Old Olga Road (R3). All samples excluding BC7-9 (no tidal influence) were collected on both high and low tides for comparison. Nitrate (NO^3) was the water constituent sampled at each station enabling the assessment of both ^{15}N and ^{18}O stable isotopes and ultimately their sources. All samples for isotope assessment were split to include analysis of associated enterococci bacteria. The analysis of samples for enterococci bacteria was conducted at the CWK Laboratory at FGCU Buckingham facility using IDEXX technology following IDEXX methods and FDEP protocols for sampling. Isotope sampling and analysis protocols were provided by BETA and Isobar Science (boron isotope analysis).

The ^{15}N and ^{18}O isotopes assessed in Phase I were attributed to a manure / sewage source category with $\delta^{15}N$ values ranging from 8.84 to 12.4 $^{0}/_{00}$ (See Appendix A, Figures 6 and 7). Similar research by Lapointe et al., 2004[14], and Swart et al., 2013[15] using stable isotopes to trace potential sewage sources determined that $\delta^{15}N$ values greater than 8 $^{0}/_{00}$ were attributed to sewage sources. The assessment of tidal influence on the isotope values was that denitrification occurred during the outgoing tide which influenced the availability of nitrate with implications for isotope utility as a source tracer (See Appendix A, Figure 8).

Enterococci values for Phase I were highly variable on 6/11/20 and ranged from 41.0 MPN / 100ml at Veronica Shoemaker Boulevard (BC4) to 5475.0 MPN / 100 ml at Ortiz Circle (BC9) (See Appendix A, Figure 6).

The second phase of the isotope tracer study involved samples for nitrate (^{15}N and ^{18}O stable isotopes) and boron (^{11}B). Sampling was conducted on 9/30/20 at six locations on Billy's Creek on an outgoing tide: Shady Oakes Park (BC3), Veronica Shoemaker Boulevard (BC4), Marsh Avenue (BC6), Nuna Avenue (BC7), Ortiz Avenue (BC8), and Ortiz Circle (BC9). $\delta^{15}N$ values

[14] LaPointe et al. 2004. Lower Florida Keys: discrimination of local versus regional nitrogen sources. Journal of Experimental Marine Biology and Ecology, Volume 308, Issue 1, 8 September 2004, Pages 23-58.
[15] Swart, et al. 2013. Sources of dissolved inorganic nitrogen in a coastal lagoon adjacent to a major metropolitan area, Miami Florida (USA). Applied Geochemistry 38 (2013) 134–146.

for Phase II were very similar to the Phase I sampling indicating a manure / sewage source. Phase I and Phase II values for $\delta^{15}N$ are compared in Appendix A, Figure 9. Results for the boron ^{11}B values and the cross plot of ^{15}N and ^{11}B are reported in Appendix A, Figures 10-14. The ^{11}B assessment indicates a range of possible sources, but manure was considered the primary source at all sampling stations except Ortiz Circle where sewage may have had a greater influence (See Appendix A, Figure 13). Phase II results are summarized in Appendix A, Figure 14. Unfortunately, the addition of ^{11}B did not significantly resolve the source to a greater degree than the ^{15}N isotope assessment implicating manure / sewage as the primary source category.

Enterococci results for Phase II sampling on 9/30/20 followed the same sampling and analysis protocols as Phase I. Enterococci values ranged from 650.0 MPN / 100 ml at Veronica Shoemaker Boulevard (BC4) to 2247 MPN / 100 ml at Ortiz Circle (BC9) (See Appendix A, Figure 15).

CWK also conducted sampling (split samples) for eDNA in Billy's Creek associated with the 9/30/20 isotope and enterococci sampling. The sampling protocols and equipment for eDNA were provided by Jonah Ventures Laboratory in Colorado. eDNA sequences were reported from a variety of sources including human, bovine, poultry, dog, and E. coli bacteria (See Appendix A, Tables 2 and 3). The majority of eDNA source types detected were from human and E. coli with human having the highest number of copies detected at Veronica Shoemaker Boulevard (BC4) and E. coli with the second most eDNA copies detected at Ortiz Avenue (BC8) (See Appendix A, Table 2). Sources of E. coli bacteria can include both human and animal sources. The full eDNA report can be viewed at https://calusawaterkeeper.org/wp-content/uploads/2020/12/Jonah-DNA-results-9-30-20.pdf. .

Summary of Source Tracing by FDEP and CWK

Both FDEP and CWK sampling strategies involving both molecular and non-molecular tracing markers revealed a variety of potential FIB sources including both animal and human. The next step in the restoration of Billy's Creek will require further evaluation of where the various FIB source indicators originate. Animal sources are likely domestic animals kept as a source of food or pets, especially in the upper reaches of Billy's Creek, upstream of the Billy's Creek Filter Marsh. Wildlife are also potential sources but on-site observations have not indicated abundant wildlife such as bird rookeries in the urban Billy's Creek watershed.

Human sources could include septic tanks and leaky wastewater pipes that convey raw sewage to the Central Fort Myers Wastewater Treatment Plant and leaky pipes that convey treated wastewater for discharge to the Caloosahatchee River. There are relatively few septic tanks in the Billy's Creek Basin reportedly near Nuna Avenue. Ward 4 Councilman Kevin Anderson indicated there were 94 active permits for septic tanks in the Billy's Creek basin in an email on April 19, 2019. We are, however, unaware of any information confirming treated or untreated wastewater contributions to FIB in Billy's Creek from septic tanks or leaky wastewater pipes.

The sewage conveyance infrastructure as part of Fort Myers Public Works Department is periodically responsible for Sanitary Sewer overflows (SSOs) and some of these documented incidents have contributed significant volumes of raw sewage to Billy's Creek. However, it is

unlikely that SSOs are primarily responsible for the continuously elevated levels of FIB in Billy's Creek since 2001, when consistent sampling started by Lee County. The levels of FIB reported in the Caloosahatchee up and downstream of the mouth of Billy's Creek (See Appendix A, Figure 4), are considerably lower than levels reported in Billy's Creek. As such, it is reasonable to conclude that the Billy's Creek watershed is primarily responsible as the geographic source of the high FIB levels in Billy's Creek since at least 2001.

The next phase of source evaluation should involve direct assessment of sewage conveyance lines using automated visual detection of sewage line integrity or methods involving dye tracing from either sewage conveyance lines or septic tanks. Animal or human contributions, from, for example homeless individuals or areas where animals are concentrated, should be assessed by the FDEP Walk the Watershed process for evaluating these potential sources leading to mitigation strategies for reducing FIB to compliance levels.

The FIB historical summaries and source tracing information contained in this report should aid in the verification of water quality impairment when Billy's Creek is evaluated in 2021. The overall goal being restoration for compliance with FIB water quality standards and for protection of public health.

IV. Basin Demographics

As previously mentioned in Chapter II, the hydraulic basin of Billy's Creek is 12.9 square miles. With a majority of residents located within city limits, four of the six city wards are represented in the basin: Wards 1, 2, 3, and 4. As of November 3rd, 2020 those council seats are occupied by Councilpersons Watkins-Brown, Streets, Watson, and Bochette, respectively. Also making up a significant area of the basin, Unincorporated Lee County holds jurisdiction within the northern boundaries, representing District 5 of the County. County Commissioner, Frank Mann, was re-elected to serve this district in 2020.

Demographic Analysis

2020 vintage data estimates that the area has a population of approximately 23,924 people, with an average household size of 3.1. Racial demographics from 2010 Census data describe basin composition as 54.2% Black, 25.0% white, 1.1% American Indian, 0.4% Asian, 0.1% Pacific Islander, and 16.6% described as "some other race." Because Hispanics can be of any race, they make up 32.2% of the basin population. These numbers indicate that the Black population is the dominant racialized group within the basin by a factor of 2+. Furthermore, 51% of properties on the creek are renter occupied with an annual per capita income of $13,119.[16] Appendix B – Basin Demographics - provides more in-depth information about the Billy's Creek basin.

Chapter 1 describes the culture and history of the basin, providing insight into the non-homogeneous nature of the area. GIS mapping technology also describes this as seen in figure 1.

[16] U.S. Census Bureau, Census 2010 Summary File 1. Esri converted Census 2000 data into 2010 geography.

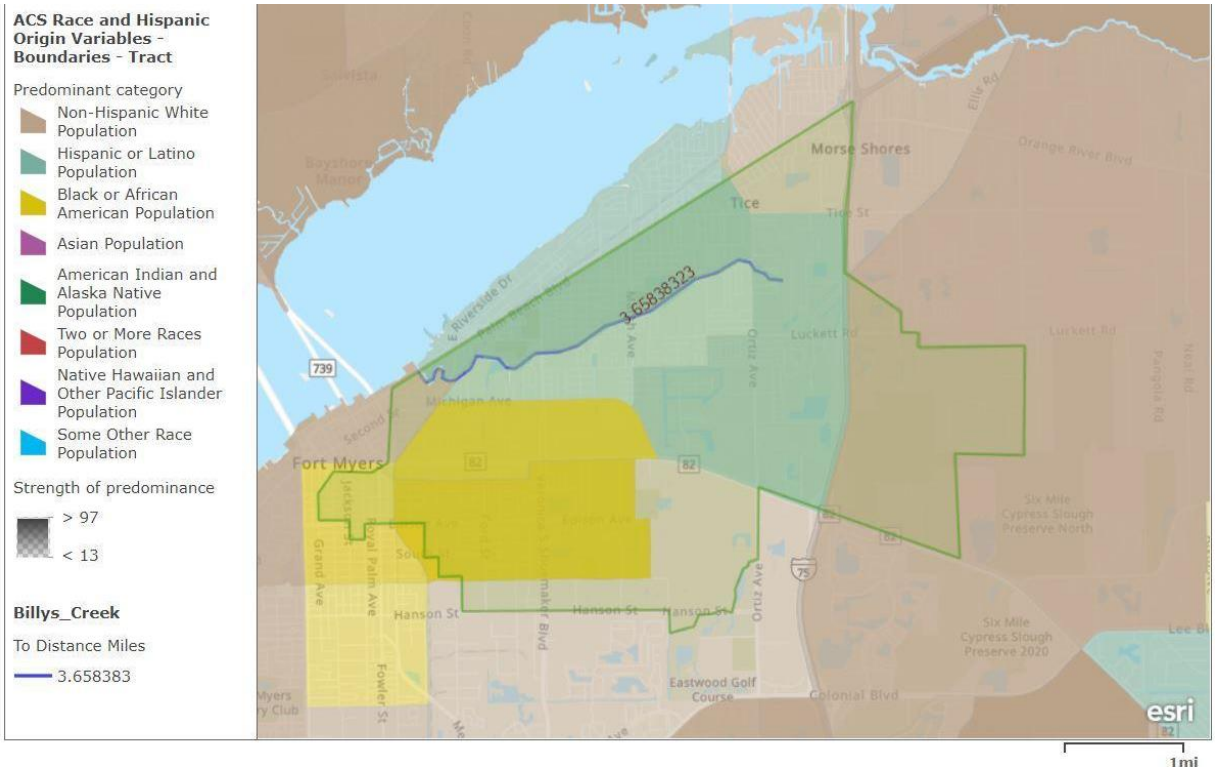


Figure 9. Map depicts predominant race and strength of race predominance within the Billy's Creek basin area.[17]

Understanding and Elevating Demographic Complexity

Nearly all regions of the United States are experiencing an increase in racial and ethnic diversity in a way never seen before. Fort Myers, and more specifically, the Billy's Creek basin, are a clear example of this phenomenon. Unfortunately, discussions around a city's diversity and cultural pockets often serve to further separate its residents, making cohesive change difficult to achieve.

The term demographic complexity relates to the interconnectedness of people despite their cultural and/or ethnic differences. The Billy's Creek basin exemplifies a region where both poverty and luxury can be found, where English is the predominant language in some areas, while Spanish or Creole is the main spoken language in others. The Billy's Creek basin was one of the last areas in the U.S. to desegregate its schools and businesses. It is also an area that is living with the impacts of increased frequency and intensity of hurricanes, as felt during 2017's Hurricane Irma. The Billy's Creek Basin is a place where art and culture are shared indoors at places like Alliance for the Arts, or on the streets during Centennial Park's Sunday night drum circle. Community gems such as The Quality of Life Center and the S.T.A.R.S Complex support youth as they grow. Spots like Shady Oaks and Billy Bowlegs Park offer refreshing green space and recreation to all who wish to experience it.

[17] Access this GIS Map at https://arcg.is/0qSCaz

As already determined, the basin is complex, both demographically and circumstantially. Acknowledging demographic complexity and making space for it in conversations of creek restoration and beyond is crucial for properly approaching the community engagement process. Carl Moore's definition of community explains that it "exists when people who are interdependent struggle with the traditions that bind them and the interests that separate them in order to realize a future that is an equitable improvement of the past."[18] As a community composed of many smaller communities, dialog and intervention in the basin must allow for participants to engage with those who are different from them. Social interventions allow community members and stakeholders to struggle through the dynamics that bring their separate interests into focus while, at the same time, discovering the shared traditions that unite them.

V. Strategies for Community Intervention

As the previous chapter details, community action can be easily halted when demographically complex populations do not make space for different methods of dialogical expression and understanding. A short chapter from *Dialog and Demographic Complexity* by Dr. Caesar McDowell, accessible via PDF in Appendix C, offers five structural processes and purposes for conversation that prompt community members to struggle through a new cognitive path. Engaging in conversation in new ways may be the spark to forming greater community cohesion.

As stated at the beginning of this document, the goal of the Billy's Creek Community Action Plan is to guide the restoration process of the creek while offering methods to increase public participation from those residing within the basin. This chapter offers several avenues for community members to play a greater role in the plan implementation process.

First, in order to maintain this effort for the long term, formation of a committed group of stakeholders representative of the various interests and communities in the basin needs to take place. Starting off small with those who are initially interested is a good first step. However, as this smaller group begins to organize, outreach must be prioritized so this collaborative effort encompasses all voices of the basin. Doing so would naturally form a coalition, defined as a temporary alliance of distinct parties, persons, or states for joint action.[19]

Strategies for Community Outreach

The FDEP toolkit for restoring bacteria-impaired waters, linked in Appendix D, contains a list of suggested strategies for social marketing (Section 3.1.2.2). Informing the public of the prolonged impairment of Billy's Creek and the health risk associated with its state is critical for the greater good of those living and working on the watershed. Informative pamphlets, PSAs, presentations, and websites are all useful ways for leading organizations to not only inform the public, but to offer suggestions on how to reduce individual impacts on the situation.

However, it can be argued that the power of community-based outreach surpasses any of these efforts because it builds a strong sense of common purpose among those living on the creek

[18] McDowell, C. pp. 218. *Dialog and Demographic Complexity.*

[19] Merriam-Webster. (n.d.). Coalition. In Merriam-Webster.com dictionary. Retrieved December 9, 2020, from https://www.merriam-webster.com/dictionary/coalition

basin. A team of basin members, including youth, can have a great impact on community awareness by applying their gained knowledge of social networking in the local area. Often PSAs and presentations have limited reach and impact due to a variety of structural and social barriers. Social media campaigns can be much more successful if they are directed towards the Lee County area in a strategic way. The use of polls, infographics, hashtags, and even memes, can amplify the issue at hand in a more consistent sense.[20] A youth-led outreach team has the capability to identify heavily trafficked socializing platforms and maximize efforts within those spaces. The benefit of this type of outreach process is proven by the rapid flow of information to and between all distinct communities of the basin.

The following paragraphs are suggestions community members can apply if interested in engaging in an outreach group. Suggestions are based on scholarly research, podcasts, books, and conversations associated with building communal care and action. These suggestions can be used to make the Billy's Creek Community Action Plan a stronger and more equitable effort, while promoting a framework for Fort Myers residents to use in the future.

Providing both analog and digital options for outreach ensures a greater segment of the public is reached. Identifying locations in the basin where information is shared will advance all efforts of community-based outreach. Institutions such as the public library can amplify outreach by allowing flyers and infographics to be posted. Public infrastructure, local institutions, and common spaces are all community assets to consider in outreach efforts. In the process of finding these physical spaces, connections with the people inside of them also form, producing stronger networks.

This theory of asset-based community development is sourced from a short paragraph in the book, *"Mainstreet, How a City's Heart Connects us All"* by Mindy Thompson Fullilove. A helpful activity based on this excerpt was developed by FGCU student Lewis Gopher and used by FGCU students to outline assets specific to Fort Myers. As a group, a first step can be to complete this activity and use it as a guide for outreach efforts (Figure 2). The result of completing the ABCD Activity is a robust list of personalized capabilities and connections to local organizations and institutions that could prove valuable in the near future.

[20] Merriam-Webster defines a meme as an amusing or interesting item (such as a captioned picture or video) or genre of items that is spread widely online especially through social media. https://www.merriam-webster.com/dictionary/meme

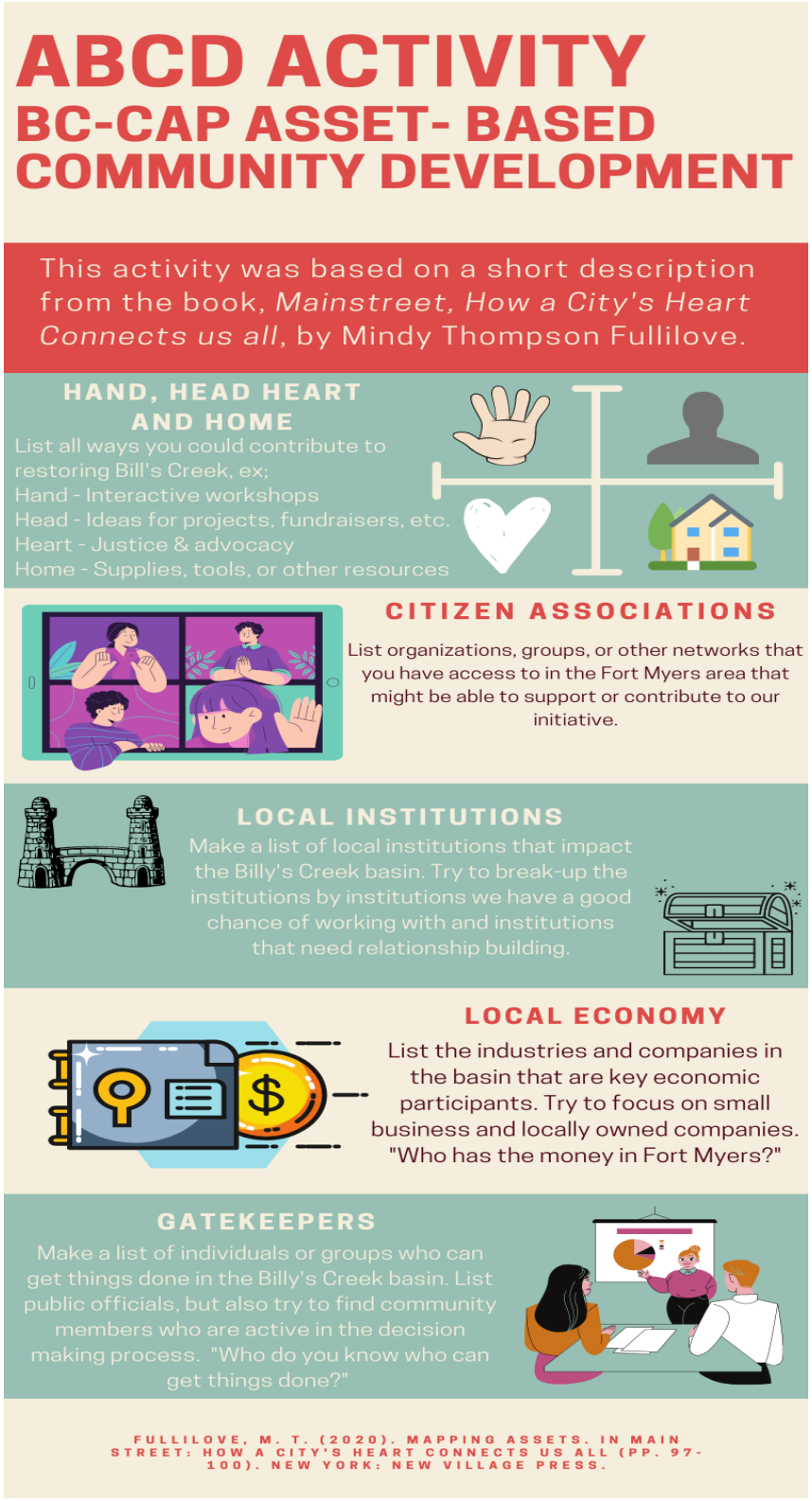


Figure 10. Asset Based Community Development (ABCD) Activity developed by Lewis Gopher based on an excerpt from Mindy Thompson Fullilove's book "Mainstreet, How a City's Heart

Connects us all".[21] *The goal of this activity is to list all possible assets that can strengthen the work of the collective.*

As for digital means of outreach, provided is a list of digital platforms and media, and how they can be applied to BC-CAP outreach:

- Eventbrite - This online platform is a one-stop shop for all events in Fort Myers and beyond. It is a common place to discover what is going on both physically and virtually in the area. With categories to choose from such as *Free*, *Charity & Causes*, and *Music*, an outreach group can develop a variety of events aligned with each category. Offering free events increases financial accessibility to basin residents; charity and cause events provide an opportunity for people to learn about Billy's Creek and support the Billy's Creek Community Action Plan (BC-CAP); music or art centered events provide another outlet for people to express themselves and their connection to the issue.

- Florida Stories - *Florida Stories* is an app developed by the Florida Humanities Council that provides walking tours of historical, cultural, and architectural sites all over the state of Florida. Users can go at their own pace with GPS enabled directions and audio narrations. The app can also offer a virtual tour if users are unable to physically travel to locations. The combination of maps, audio narration, and photos for each site make this app a great medium for learning about the local area. The app currently has a tour of the Dunbar Community. Its content was incorporated into chapter 1 of this plan. The tour offers a deeper dive into the people and places that have made, and continue to make, Dunbar a people-based community. The content for Dunbar was compiled by the Lee County Black History Society. A possible effort for community members wanting to highlight the people, places, and history of the Billy's Creek Basin might be to develop content for another Fort Myers based *Florida Stories*, one with emphasis on the ecologically sound past of Billy's Creek and the efforts being carried out to keep it alive not only for its wildlife, but for its human inhabitants as well.

- Infographics - Infographics can transform complex issues into easily digestible visuals for community members. Available FIB data on Billy's Creek and source tracing information can become confusing or disinteresting to the public, causing disengagement. Providing pictures, diagrams, and short captions can significantly increase the public's understanding of the issue and their desire to become involved. Data Journalist, Mona Chalabi, uses art and data to produce enticing and informative pieces that highlight various issues present not only in local communities but in society as a whole.[22]

[21] Fullilove, M. T., & Merrifield, A. (2020). *Main street: How a city's heart connects us all*. NY, NY: New Village Press.

[22] View Mona Chalabi's work at https://monachalabi.com/#

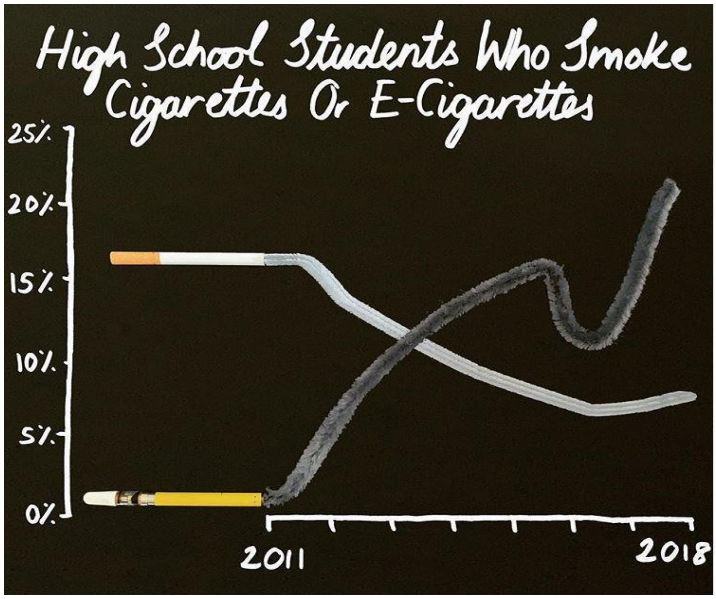


Figure 11. Data visualization by Mona Chalabi created to raise awareness of e-cigarette smoking within the high school student population.

- Polls & surveys - Platforms such as Google forms or Instagram polls and questions can be used to gain understanding of who knows about the BC-CAP and what they think solutions could be. This is also a good way to gain a greater contact list for stakeholder meetings.

- Hashtags - The use of hashtags over the last decade has proven their impact if done correctly. As a group, determining a unique and catchy hashtag related to restoring Billy's Creek could provide a digital means to keep people connected to plan progress. Prior to adopting a hashtag, members should determine if it is already in use, so as avoid confusion with other causes.

Additional avenues for outreach can and should be used to build upon the above suggestions. It is important to acknowledge that social networks are already established throughout the basin community. Identifying these networks and working with them will increase the chances for collaboration more than attempting to start from scratch. With community members leading the effort, the process will become more fluid than it will be if outside organizations were to lead.

Hosting Social interventions

Restoration is predominantly up to the city and the county, as is how they choose to prioritize necessary funding in upcoming fiscal years. Because of this it is hard to know what can really be accomplished by outreach and action. Although sometimes difficult to recognize, community participation can be the greatest catalyst for local governments to take action on behalf of Billy's Creek. Community members raising awareness among basin stakeholders, keeping the conversation around creek restoration alive, and exhibiting a mass desire for change will be a key factor in this process. Hosting social interventions throughout the process will be a primary method of action.

Take for example another community-based effort co-led by Antonio Moya-Latorre. In his Master's thesis, *The Sparking Cycle,* Antonio shows how community members drastically changed their community's unofficial trash dumping ground into a greenspace for community members to enjoy for gardening, playing, and gathering. While elected officials were part of the process, community members, including children, played the greatest role by *sparking* care and involvement from a majority living within the area. Through community meetings, art workshops, theatrical performances and more, his team was able to highlight the capabilities of those within the community, making participants understand how they tie into the bigger picture of dump site cleanup and park creation.

Figure 12. The unofficial dumping ground of the community, Jardim Colombo, before intervention.[23]

[23] Photos sources from Antonio Moya-Latorre's Master's Thesis, *The Sparking Cycle.* Antonio Moya-Latorre_THE SPARKING CYCLE_lq (2).pdf

Figure 13. Groups of residents work on the 3D model and share their own designs for the dumping ground turned park.

Figure 14. Community members organize for the first ever festival to be held on site following clean up and months of work transforming the space. In 2020, the community held their third annual festival, exemplifying the longevity of their work from three years prior.

While the situation with Billy's Creek is different in many ways from Jardim Colombo, there is much to learn from what Antonio and his team accomplished. The question advocates for Billy's Creek must consider is how can their capabilities be used to elevate the restoration process? Thinking about events centered around Billy's Creek in creative ways such as storytelling, sign making (refer to next chapter), educational workshops, meetings in the park, and so on are means to keeping the cause relevant and rooted in community participation. One idea CWK has considered is teaming up with stakeholders to form a Billy's Creek newsletter that provides monthly updates as well as photos from recent events, community member highlights, upcoming coalition meeting dates, and a logo page of all supporting groups.

Currently, CWK is leading a virtual intervention in response to in-person limitations due to COVID-19. Recognizing the power of stories and their capability to connect us to each other and places, CWK began collecting oral histories from people in the Billy's Creek Basin. Contributors were asked to record a short video describing their connection to Billy's Creek.

*Figure 15. One of the videos contributed to the Billy's Creek Oral Histories. Longtime community member and retired teacher, Bill Hammond, shares his experience. Click **here** to access Bill's and other basin member's videos.*

Despite not being able to gather during this time, oral histories allow for the basin community to understand the need for restoration beyond what data and regulatory code indicate. CWK encourages the continuation of the Billy' Creek Oral History Project and would like to work in co-collaboration with community members to keep growing the stories collected and shared. Through building a virtual space of voices for Billy's Creek greater social connection may be achieved, as well as inspiring future stories about the historic waterway.

VI. Mitigating Bacterial Contamination

Building advocacy and people power within the basin can significantly expedite the restoration process of Billy's Creek and create more equitable solutions on its path. However, the level of intervention needed on Billy's Creek necessitates commitment and action from elected officials and regulatory agencies. The City of Fort Myers, Lee County, South Florida Water Management District (SFWMD), FDEP, and FDOH must coordinate their activities and include the public and NGOs in their efforts. Collaboration among these entities will result in a network of professionals that will reduce bureaucratic struggle by responsibly connecting with stakeholders and acting in their best interest to reduce harmful FIB contaminants, as well as other pollutants, in Billy's Creek. Commitment on behalf of all entities to work with transparency and in a collaborative spirit will be the single most important factor when implementing BC-CAP.

The following information offers a series of short, medium, and long term strategies for the above members to implement while addressing the currently dangerous state of Billy's Creek due to FIB contamination. Also helpful, FDEP's toolkit on Restoring Bacteria-Impaired Waters, included as Appendix D, provides a thorough guide for stakeholders seeking to identify and eliminate pathogens in their surface waters.

Increasing Warning Signs of FIB Dangers

The first, most pressing, step to take is implementing bilingual warning signs along Billy's Creek to inform the community of the harmful bacteria present in the water. Billy's Creek constitutes a portion of the Great Calusa Blueway, a series of local paddling trails. While it remains on the trail map, people paddling the urban waterway may have no idea of the health risk they are exposing themselves to. CWK previously helped organize biannual Billy's Creek clean-ups and deployed a fleet of kayaks to assist. After learning of the high FIB levels, CWK ceased this clean-up to prevent putting people at risk. Unfortunately, despite CWK and other organizations like Keeping Lee County Beautiful ceasing clean up efforts on the creek, people are still interacting closely with the creek waters. A **local news interview** from 2018 indicates that children often play on the water's edge after returning home from their school day.

CWK requested that city, county, and state entities post appropriate signs along Billy's Creek where people fish and/or launch boats, warning residents of the FIB contamination and to avoid contact with the water or eating fish caught in the creek. Confused jurisdictional responsibilities between local authorities and FDOH complicated timely action from these various government entities. The City of Fort Myers and Lee County subsequently stepped up to post bilingual signs warning of dangerous bacteria contamination. Unfortunately, the county sign in the Ortiz Circle area is no longer up even though FIB levels remain dangerously high in this area. The city posted a sign on the side of Veronica Shoemaker bridge below the bridge roadway. This sign, however, is not readily visible by people who may fish off the bridge. Signage needs to be visible by land and water. Furthermore, the city could post signs on the lots they own along Billy's Creek.

CWK recognizes the removal of signs like the one on Ortiz Circle may lead participating entities to rethink their approaches when implementing needed signage. Although it remains unknown who took the signs down and for what reason, being proactive and considering social

complexities may lead to improved solutions. It is probable to assume that some people living on the creek may feel a sense of disconnection and distrust of the government. Posting signs in residential areas without prior communication to those who live there can feel intrusive. A solution may be for leading entities, such as the city and the county, to collaborate with schools and other organizations in the basin, such as Alliance for the Arts, to create an interactive event. At such an event, youth will learn about the complexities of Billy's Creek and why they must exercise caution around it. There will also be a time for expression, when youth of all ages can paint, draw, or color paper signs to help make their neighborhoods aware of the creek's condition. To ensure the signs are clear, older students can assist younger ones. The finale to the event comes with the selection of several of these paper signs to be made into real signs for the city and county to post. This intervention not only engages basin youth in local socio-environmental issues, but also provides a new form of creative awareness that community members may be more willing to accept as it was created by their children and neighbors.

Increase Source Testing

Chapter III addresses the source testing previously conducted by CWK and FDEP, determining the necessity for more robust testing. It is imperative that all entities come to a common conclusion on what the source of contamination is so the health risks can be fully evaluated and proper mitigation strategies can be devised. Conflicting narratives of the source are currently being shared with the public, either indicating it comes from birds and dogs, or conversely, that it comes from humans. The city, however, needs to test more often and in more locations for source markers and at different times of the year to make a definitive determination. Such testing will not only determine the FIB source, but alert officials as to the location of FIB "hot spots."

Additional to increased source testing, regular trend monitoring should be carried out by both jurisdictions to measure progress towards meeting the Total Maximum Daily Load (TMDL) and water quality targets. Monthly testing at consistent sites along the creek is ideal for repetitive testing.[24] Figure 3 is a map of the sites CWK has been testing at since 2017.

[24] Section 2.5.2 of FDEP's Fecal Indicator **toolkit** provides further detail on testing protocols.

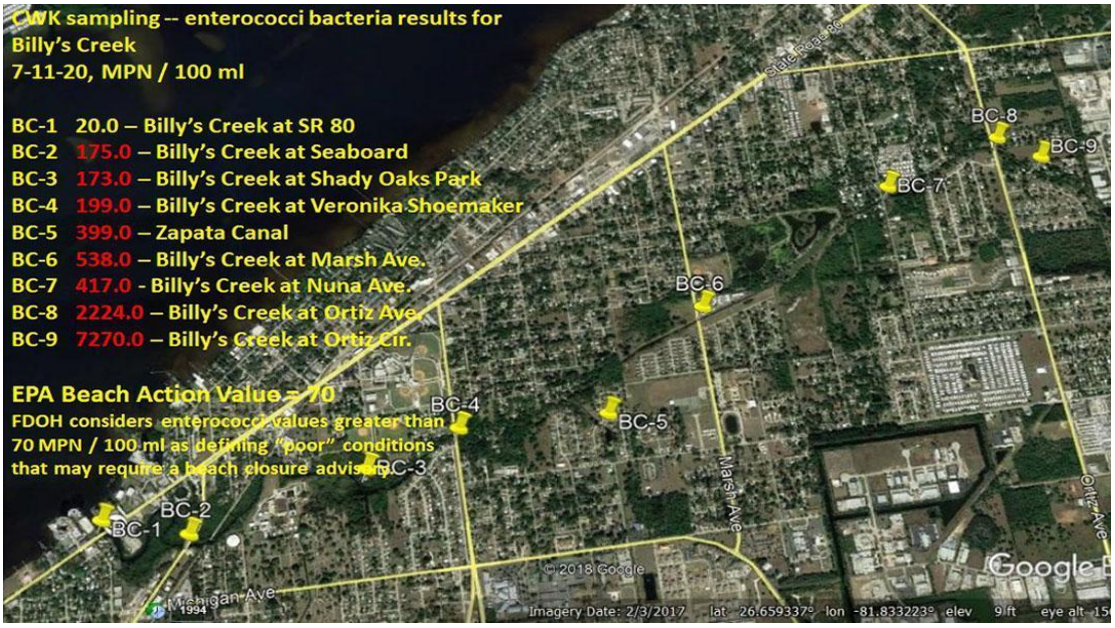


Figure 16. Map from CWK's website provides visual and descriptive locations for source testing and regular trend testing. Both city and county jurisdictions are included in CWK's testing sites.[25]

Assess Sewage Infrastructure & Repair Leaky Pipes

Prioritizing efforts in regard to the basin's current sewage infrastructure is needed in the short, medium, and long term restoration process of Billy's Creek. In the short to medium term, the city and county need to assess the condition and capacity of the sewer system in the basin. Leaky pipes must intermittently be repaired; however, this is not a long-term solution, but rather a temporary measure until a greater infrastructure initiative can be implemented. The EPA's Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems, included as Appendix D, provides additional avenues of methodology to evaluate sewer condition and capacity for better management practice.

The Ortiz Circle area has the highest FIB readings of all the Billy's Creek locations that CWK samples. As such, it represents the logical location to start corrective action. Complicating the FIB situation, several large developments have recently been built along Ortiz Avenue (i.e., The Vistas at Eastwood, Salus Care and The Edison Apartment Flats). When these new developments tie into the existing wastewater lines, depending on their condition and capacity, the situation could become much worse.

East Fort Myers has an extensive sewer system; however, due to its age and material type, the condition and capacity of these collection lines needs improvement.[26]The city must test the sewer lines in the Billy's Creek area to determine where leaks exist. In addition to visual inspection, smoke testing and close-circuit television (CCTV) are needed for such assessments. The city must also indicate if the sewer lines are clay, cast iron or PVC pipe.

[25] Additional maps and FIB results from previous testing events found at https://calusawaterkeeper.org/issues/bacteria-monitoring/

[26] "Central Fort Myers Area Study," revised in August 1990.

Force main route inspections would serve to ensure normal functioning and help identify such problems as unusual noise, vibration, pipe joint leakage and displacement, valve arrangement and leakage, lift station operation and performance, discharge pump rates and speed, and pump suction and discharge pressures.[27] Testing will determine if the city can retrofit some of the older lines as an interim measure or if extensive sewage replacement is needed. This must be a priority. Defective septic tanks, mentioned in Chapter III, could also contribute to the problem. Including the 94 permitted septic tanks from the basin while testing for leaks is a viable method to ensure treated or untreated sewage is not contributing to the FIB problem in Billy's Creek.

Update and Implement City Master Sewage Plan

Repairing sewage leaks with patches is not a viable long-term solution, as previously noted. Beyond these short-term solutions, the city's medium to long term effort must prioritize updating and implementing the Fort Myers Sanitary Sewer Master Plan. While this document was last updated in 2005, many of its recommended interventions have not been implemented, such as establishing a third wastewater treatment plant. The 2005 plan recommended that a third plant, to be located in East Fort Myers, should be up and running by 2009 to account for growth in the area. Developing a new wastewater plant and replacing sewage infrastructure would come at no small cost to the city. However, the long-term impact if nothing is done will pose an even greater cost to the city and to the people of Fort Myers, especially as growth continues. In 2020 Fort Myers was named the fastest growing city of the year.[28]

Recognizing that this is a time sensitive responsibility, Fort Myers candidates were asked by CWK to complete a **questionnaire** prioritizing specific initiatives if they were elected. 12 out of the 14 candidates completed the survey and all ranked the questions "Update the City's Master Sewer Plan" and "Implement the Updated Master Sewer Plan" as a critical priority.

Several of the mitigation strategies mentioned are indirect ways to reduce FIB contamination. Proactive protocols to managing the creek and sewage infrastructure is imperative for ensuring creek health over time. However, emphasis must be on conducting source tracing with results all entities agree upon and forming direct mitigation strategies thereafter.

VII. Future Funding Opportunities & Plan Implementation

Highlighted throughout this plan is the fact that the majority of basin residents have been historically underserved - underserved economically, socially, and environmentally. Located in a predominantly Black and Latino area of Fort Myers, a level of responsibility must be met to satisfy the health and environmental needs of people systematically left on the margins. Responsibility in the context of restoring Billy's Creek mandates those in charge listen to and

[27] CDM Smith Progress Report; prepared for the City of Fort Myers in response to FDEP Consent Order OGC Case No. 18-0043; March 6, 2018; 31.5 Infrastructure Condition.
[28] City of Fort Myers. (2020, October 13). *Fort Myers regains top spot as 2020's fastest growing city in America.* *https://cityftmyers.com/CivicAlerts.aspx?AID=1179*

work alongside community members, while also taking timely action to implement the mitigation strategies suggested in this plan.

Financing the aforementioned mitigation projects will certainly be the greatest hurtle. While the city and county do not have the resources to finance projects alone, there are a variety of funding opportunities offered by a number of local, state, and national agencies, and, as the theme of this plan continues to affirm, collaboration will be key to moving forward.

The following list offers funding opportunities that can be used for projects spanning from short to long term. Short term projects such as small repairs, signage, educational activities, and community events can be accomplished with smaller community grants. Long term projects such as replacing sewage tanks/pipes and implementing further components of an updated Master Sewer Plan can be partially funded by several of the funding sources towards the end of the list:

- U.S. Environmental Protection Agency: EPA offers environmental justice grants for local organizations to organize and provide outreach. The demographics and economic factors in East Fort Myers argue for an environmental justice grant. Environmental justice demands the restoration of Billy's Creek

- Coastal & Heartland National Estuary Partnership (CHNEP) offers conservation grants ranging from $500-$3,000 to support larger projects that implement their Comprehensive Conservation and Management Plan (CCMP). The purpose and nature of BC-CAP is in alignment with the goals of CCMP, making this grant a viable option for community advocates working to implement BC-CAP with educational events and community interventions. For more information regarding CHNEP's Conservation Grant and access to the most recent application, visit https://www.chnep.org/conservation-grants.

- The Cape Coral Community Foundation offers grants beyond Cape Coral, to the Lee, Collier, and Charlotte County Community. To be eligible, applicants must be from a tax-exempt organization under Section 501(c)(3) of the IRS code and be designated as such for at least 2 years. Of the available grants, the Community Impact Initiative is most appropriate for BC-CAP implementation. Grants under the Community Impact Initiative are awarded up to $5,000. For more information or to apply, visit https://www.capecoralcf.org/offerings/grant-initiatives/.

- The Southwest Florida Community Foundation, with requirements similar to the Cape Coral Community Foundation, offers grants to support nonprofits with their project goals. CWK received funding from them for the 2020 fiscal year, providing us the financial support to develop BC-CAP and carry out related activities.
- South Florida Water Management District (SFWMD) has a grant program to support BMAPs. BC falls within the existing Caloosahatchee Watershed BMAP, and the existing

BC filter marshes received SFWMD funds. The SFWMD grant fund has a preference for shovel ready projects. A SFWMD grant could fund the proposed linear park along Veronica Shoemaker Boulevard.

- Florida Department of Environmental Protection (FDEP) provides a variety of potential funding for wastewater, stormwater, and other priorities. Many are pass-through funds, such as US EPA 319 grant funds for stormwater projects. Additionally, US EPA provides brownfield loans and grants to restore watersheds, the Center for Watershed Protection awards grants for technical assistance and the CARES Grant for watershed education.

- Tax Increment Funds (TIF): Many of the city's TIF projects, to date, have gone toward helping large condo developers' pay their construction loans. Several of the existing Caloosahatchee waterfront condo high-rises near BC received TIFs. But TIFs for large condos in this area may no longer prove viable. The developer for the proposed Allure and One condo developments has decided not to go forward with these projects. Restoring BC and preventing flooding in East Fort Myers may prove the more viable way to incentivize development in this area. Some environmental projects discussed herein could receive TIFs.

- Lee County Tourist Development Council (TDC): The TDC could use the tax revenue it collects to help fund kayak launch sites, waterfront pocket parks, a river/board walk and the Legacy Island park. TDC funds were used to establish the Great Calusa Blueway.

- Florida Fish and Wildlife Commission (FWC): FWC has a grant program that funds public access to the water. This grant program could help fund launch sites, waterfront pocket parks and a river/board walk.

- Stormwater Utility Tax: The city has a stormwater utility tax. Revenue from this tax helped fund the BC dredging project.

The city and the county share responsibility, in addition to seeking funding, to budget accordingly to ensure BC-CAP is implemented. CWK predicts that in five years, if entities plan with consideration, Billy's Creek could be restored and become a safe resource for the community to use and enjoy once again.

VIII. References

Ajar Nath Yadav, Neelam Yadav, Divjot Kour, Akhilesh Kumar, Kritika Yadav, Amit Kumar, Ali A. Rastegari, Shashwati Ghosh Sachan, Bhanumati Singh, Vinay Singh Chauhan, Anil Kumar Saxena, Chapter 1 - Bacterial community composition in lakes, Editor(s): Suhaib A. Bandh, Sana Shafi, Nowsheen Shameem, Freshwater Microbiology, Academic Press, 2019, Pages 1-71, ISBN 9780128174951, https://doi.org/10.1016/B978-0-12-817495-1.00001-3.

Amy Bennett Williams. (2019, June 11). Billy's Creek dredging project may relieve flooding on the troubled tributary, but fecal pollution remains a worry. NewsPress. Retrieved from https://www.news-press.com/story/tech/science/environment/2019/06/11/fecal-pollution-remains-worry-billys-creek/1379375001/

CDM Smith Progress Report; prepared for the City of Fort Myers in response to FDEP Consent Order OGC Case No. 18-0043; March 6, 2018; 31.5 Infrastructure Condition.

City of Fort Myers. (2020, October 13). *Fort Myers regains top spot as 2020's fastest growing city in America. https://cityftmyers.com/CivicAlerts.aspx?AID=1179*

Dean Park Historic District. (n.d.). The Story of Dean Park. https://deanpark.org/about/history/

EPA (2005). Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems. Retrieved from https://www3.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf

Florida Department of Environmental Protection (2018). *Restoring Bacteria-Impaired Waters* Version 3.0. Retrieved from https://floridadep.gov/sites/default/files/Restoring_Bacteria-Impaired_Waters_Toolkit_082018.pdf

Fullilove, M. T., & Merrifield, A. (2020). *Main street: How a city's heart connects us all*. NY, NY: New Village Press.

LaPointe et al. 2004. Lower Florida Keys: discrimination of local versus regional nitrogen sources. Journal of Experimental Marine Biology and Ecology, Volume 308, Issue 1, 8 September 2004, Pages 23-58.

Merriam-Webster. (n.d.). Coalition. In Merriam-Webster.com dictionary. Retrieved December 9, 2020, from https://www.merriam-webster.com/dictionary/coalition

Moya-Latorre, Antonio (2019). The Sparking Cycle (Master's Thesis). Massachusetts Institute of Technology, Cambridge, MA.

Stearns, P. N., & McDowell, C. (2019). *Peacebuilding Through Dialogue: Education, Human Transformation, and Conflict Resolution*. Mason Publishing.

Swart, et al. 2013. Sources of dissolved inorganic nitrogen in a coastal lagoon adjacent to a major metropolitan area, Miami Florida (USA). Applied Geochemistry 38 (2013) 134–146.

U.S. Census Bureau, Census 2010 Summary File 1. Esri converted Census 2000 data into 2010 geography.

Williams. C.A. (2017). Hidden History of Fort Myer. (pp. 15) Charleston, SC. The History Press.

IX. APPENDECIES

Appendix A - Chapter III Graphs and Charts

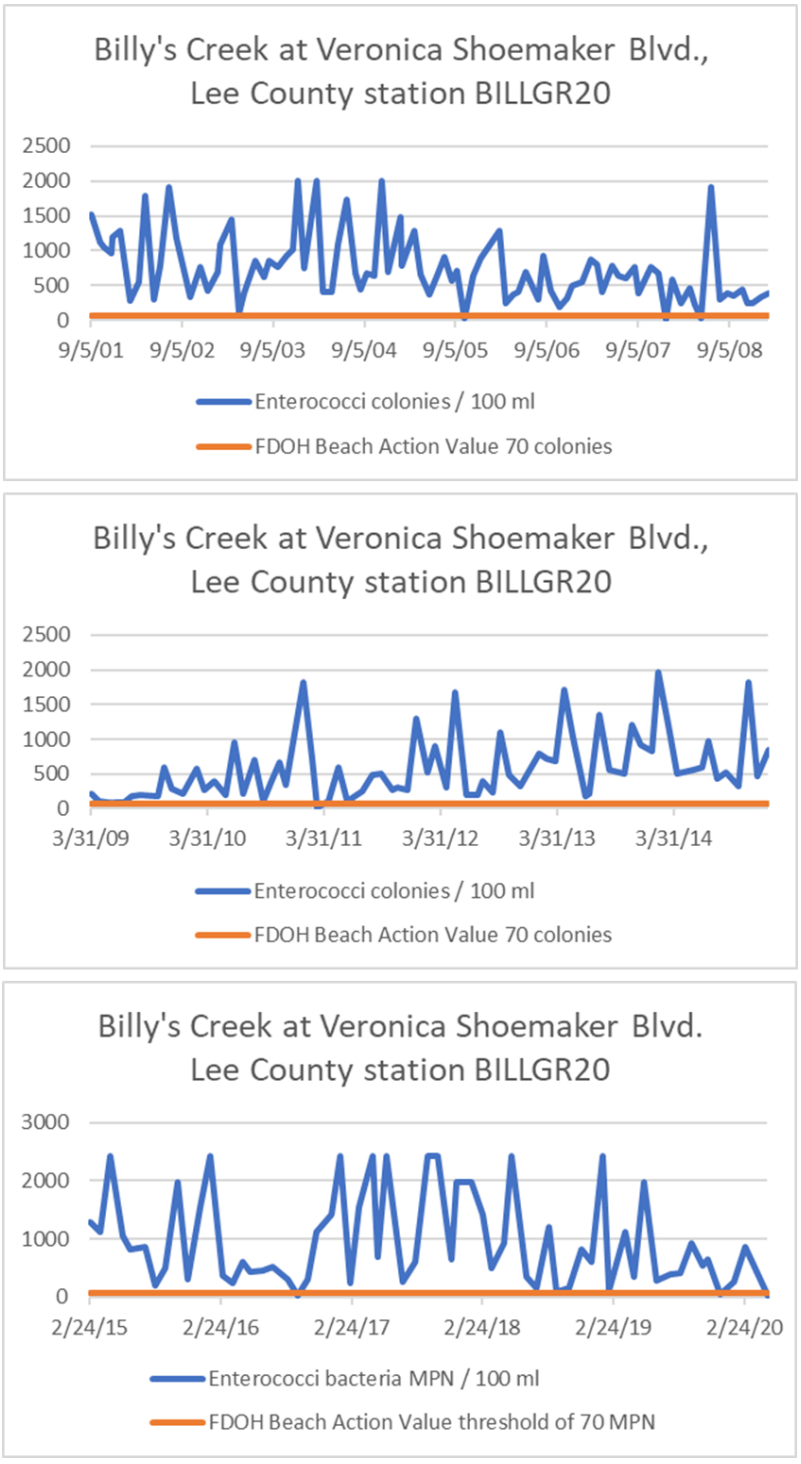


Figure 1. Enterococci levels at BILLGR20, 2001-2020

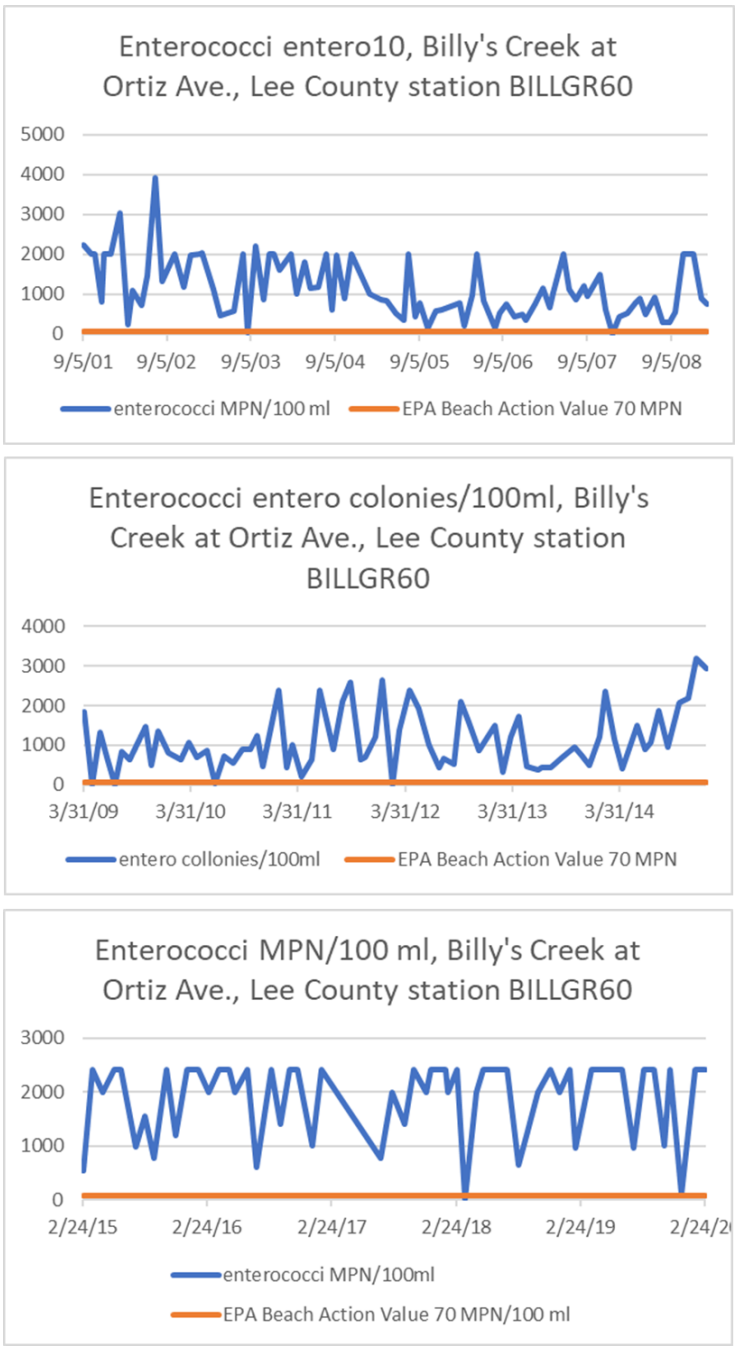


Figure 2. Enterococci levels at BILLGR60 2001-2020.

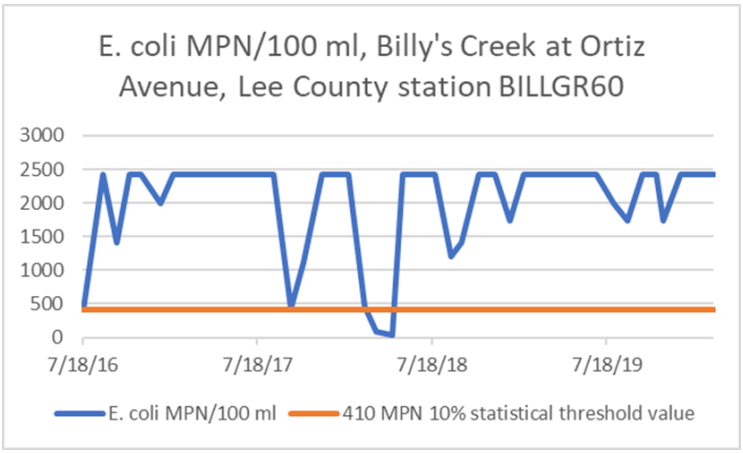


Figure 3. E. coli levels at BILLGR60, 2001-2020.

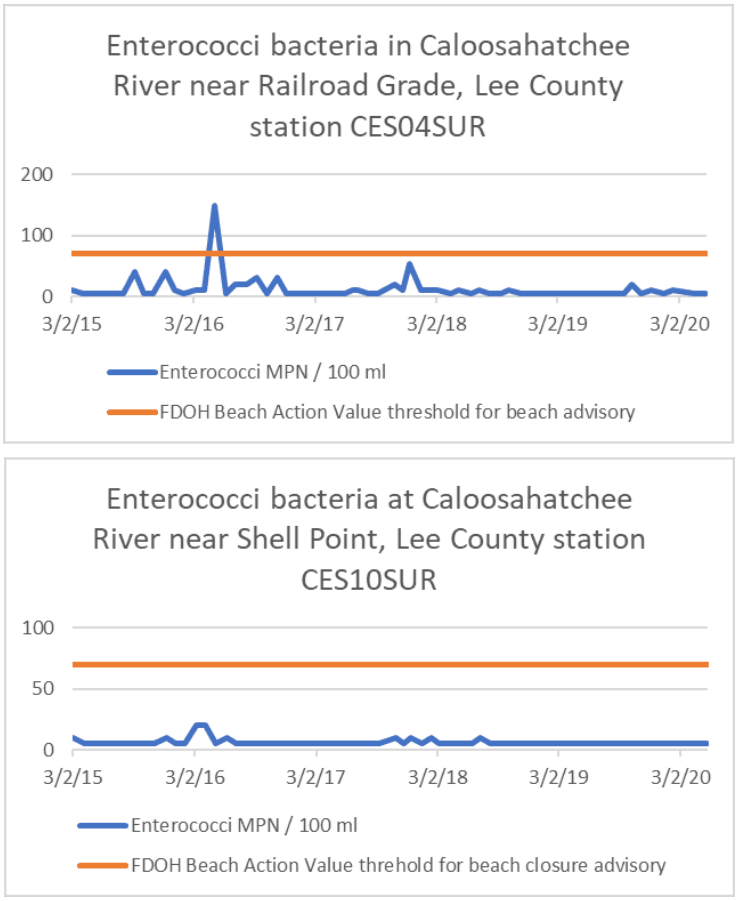
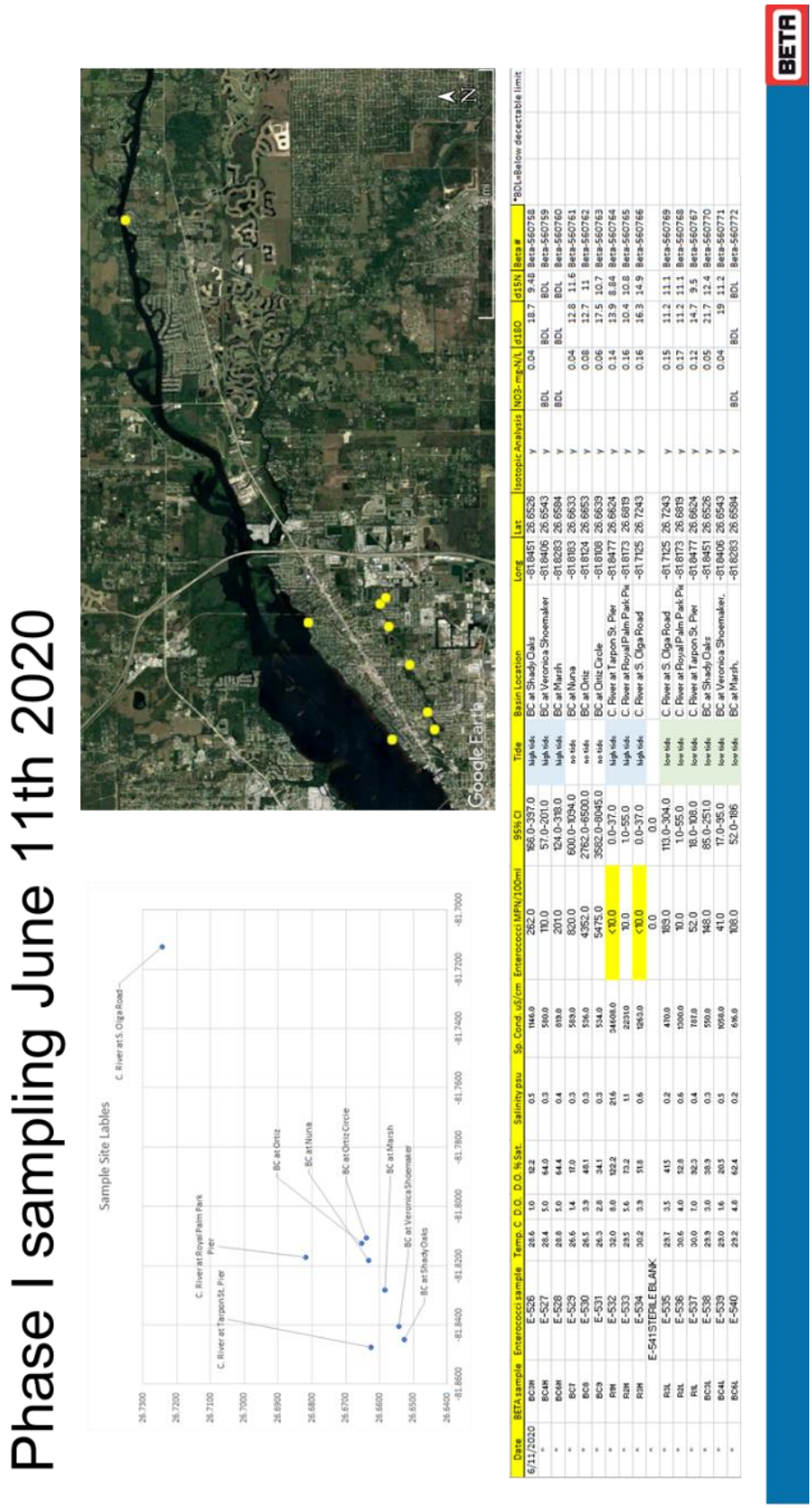


Figure 4. Enterococci levels at CES04SUR, 2015-2020.

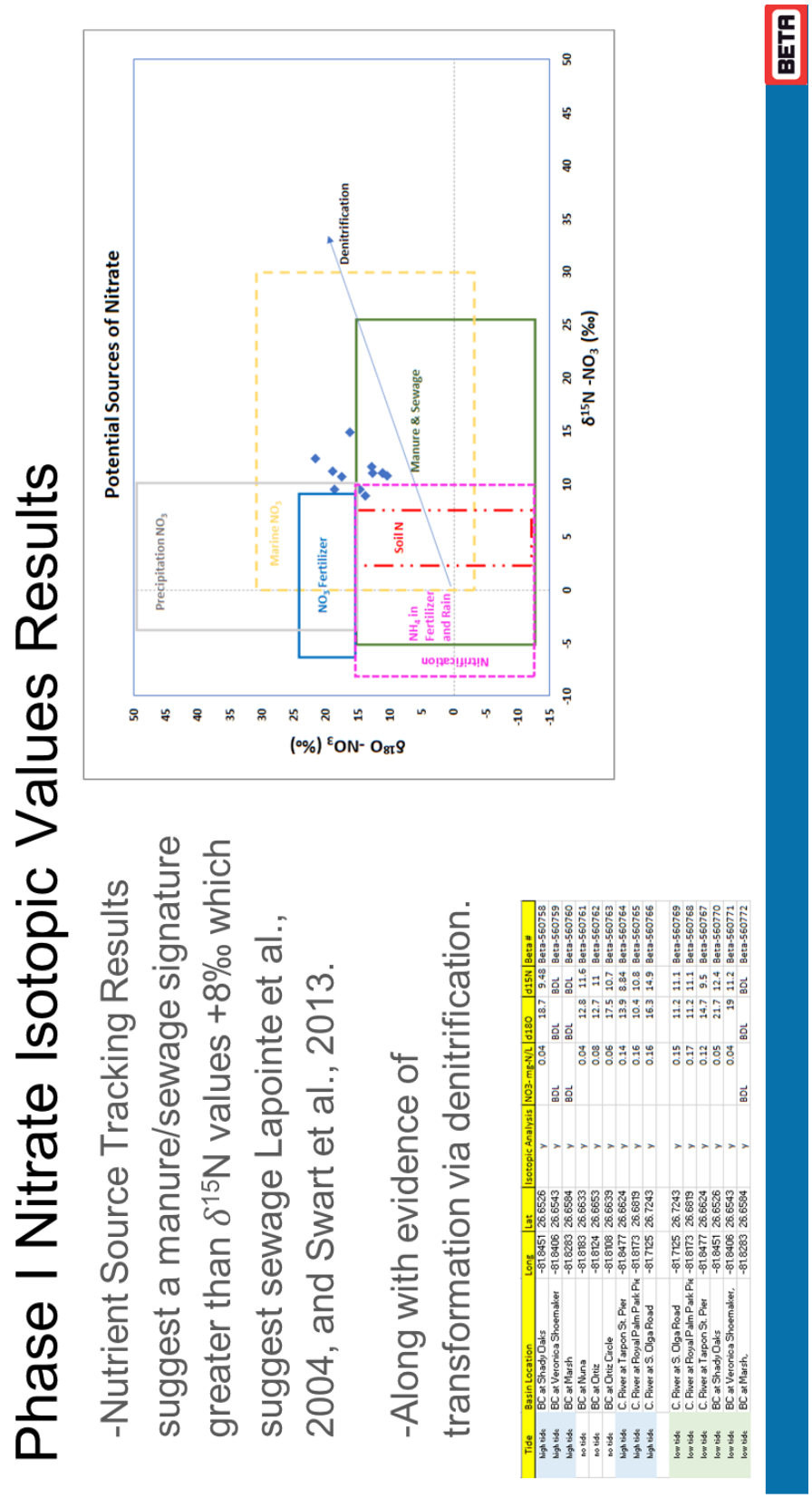
	Note: Watershed wide, the strong inverse relationship between sucralose and enterococci suggesting the elevated bacteria levels are not being driven by a sewage source.			Sucralose is present in both treated and untreated effluent.	U means not present.	Acetaminophen is usually only present in untreated waste.	U means not present. The "I" qualified analytes were detected, but not at concentration	Naproxen is usually only present in untreated waste.	U means not present.	Ibuprofen is usually only present in untreated waste.	U means not present.	FIB TPTV is 130	U means not present.		U means not present.		U means not present.		U means not present.		U means not present.		U means not present.		U means not present.
Sampling Date RQ-2018-06-18-55	Site	Time of collection	Dave and Anita's summaries 8-10-18	Sucralose	Sucralose Qualifier	Acetaminophen	Acetaminophen Qualifier	Naproxen	Naproxen Qualifier	Ibuprofen	Ibuprofen Qualifier	Enterococci	Enterococci Qualifier	HF-183-PMA treated-qPCR	HF-183-PMA treated-qPCR Qualifier	HF-183-purified-untreated-qPCR	HF-183-purified-untreated-qPCR Qualifier	Gull2-qPCR	Gull2-qPCR Qualifier	GFD-Purified-PCR	GFD-Purified-PCR Qualifier	BacR-qPCR	BacR-qPCR Qualifier	DG3-qPCR	DG3-qPCR Qualifier
6/28/2018	SR 80 Seaboard St	8:45AM	*Human: Very low levels of untreated waste indicators*	0.16		0.065			I		I	122.3	Q		UJ	47	IJ		U	120	I	2.10E+03	I		U
6/28/2018	BLANK_06282018	9:00AM	*Blank was clean. That's great!*		U		U		U		U		U		UJ		UJ		U		U		U		U
6/28/2018	Ford Canal Gallee Way	9:20AM	*Bird waste present at very low level. Entero at TPTV.*	0.1			U		U		U	129.6	Q		UJ		UJ		U	390	I		UJ		U
6/28/2018	Ver ShoemakeBrookhill	9:35AM	*Ruminant present, low level. However, bacteria level v*	0.066			U		U		U	24.9	Q		UJ		UJ		UJ		U	2.90E+03	I		U
6/28/2018	Zapato CanalMarkland	09:52AM	*Bird waste present at very low level. Entero very low.*	0.19			U		U		UJ	24.7	Q		UJ		UJ		U	280	I		UJ		U
6/28/2018	BillyCreek ab fltrmrsh	10:25AM	*HF-183 purified is present at a very low level. No other*		U		U		U		U	307.6	Q		UJ	31	IJ		UJ		UJ		UJ		U
6/28/2018	Nuna AVE Billy Creek	10:55AM	*HF-183 purified is present at a very low level. No other*	0.035	I		U		U		U	547.5	Q		UJ	77	IJ		U	610	I		U		U
6/28/2018	Ortiz Circ Billy Creek	11:10AM	*HF-183, purified and crude, present at very low levels.*	0.052			U		U		U	1732.9	Q	38	IJ	84	IJ		UJ	420	I		U		U
6/28/2018	EBilly Creek DR S Gary	11:25am	*HF-183, purified and crude, present at very low levels.*	0.035	I		U		U		U	1732.9	Q		UJ		UJ		UJ		U		U		U
				Human Waste Indicators. (Sucralose does not differentiate between treated and untreated)(I qualified Hf-183 could be from reuse)(Enterococci can be from any fecal matter, not just human waste)														Gulls and wading birds.				Cattle, ruminants, other grazing animals.		Dogs.	

Figure 5. Results of FDEP source tracing on 6-28-18



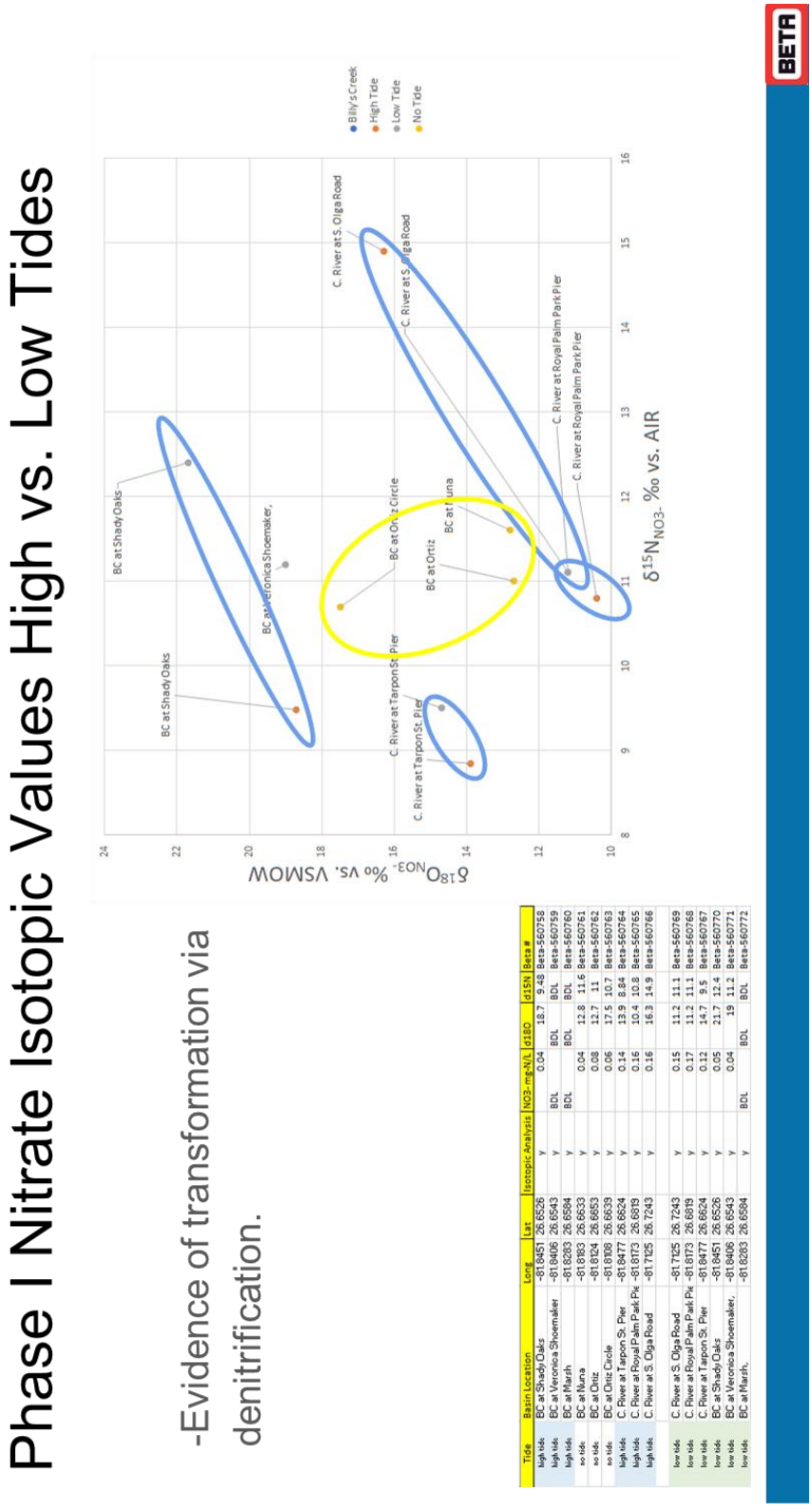
Date	BETA sample	Enterococci sample	Temp. C	D.O.	D.O. % Sat.	Salinity psu	Sp. Cond. uS/cm	Enterococci MPN/100ml	95% CI	Tide	Basin Location	Long.	Lat.	Isotopic Analysis	N03-mg-N/L	d18O	d15N	Beta #	*BDL=Below decectable limit
6/11/2020	BC0M	E-526	28.6	1.0	12.2	0.5	1146.0	262.0	108.0–337.0	high tide.	BC at Shady Oaks	-81.8451	26.6526	y	0.04	18.7	9.48	Beta-560758	
"	BC4M	E-527	28.4	5.0	64.0	0.3	580.0	110.0	57.0–201.0	high tide.	BC at Veronica Shoemaker	-81.8406	26.6543	y	BDL	BDL	BDL	Beta-560759	
"	BC6M	E-528	28.0	5.0	64.4	0.4	619.0	201.0	124.0–318.0	high tide.	BC at Marsh	-81.8283	26.6584	y	BDL	BDL	BDL	Beta-560760	
"	BC7	E-529	26.6	1.4	17.0	0.3	583.0	820.0	600.0–1094.0	no tide.	BC at Nuna	-81.8183	26.6633	y		0.04	12.8	11.6	Beta-560761
"	BC8	E-530	26.5	3.9	48.1	0.3	556.0	4352.0	2762.0–6500.0	no tide.	BC at Ortiz	-81.8124	26.6853	y		0.08	12.7	11	Beta-560762
"	BC9	E-531	26.3	2.8	34.1	0.3	534.0	5475.0	3682.0–8045.0	no tide.	BC at Ortiz Circle	-81.8108	26.6839	y		0.06	17.5	10.7	Beta-560763
"	RIM	E-532	32.0	8.0	122.2	21.6	34698.0	<10.0	0.0–37.0	high tide.	C. River at Tarpon St. Pier	-81.8477	26.6624	y		0.14	13.9	8.84	Beta-560764
"	R2M	E-533	23.5	5.6	73.2	1.1	2210.0	10.0	1.0–55.0	high tide.	C. River at Royal Palm Park Pie	-81.8173	26.6819	y		0.16	10.4	10.8	Beta-560765
"	R3M	E-534	30.2	3.3	51.8	0.6	1263.0	<10.0	0.0–37.0	high tide.	C. River at S. Olga Road	-81.7125	26.7243	y		0.16	16.3	14.9	Beta-560766
"		E-541STEPALEBLANK						0.0	0.0										
"	R3L	E-535	28.7	3.5	41.5	0.2	470.0	169.0	113.0–304.0	low tide.	C. River at S. Olga Road	-81.7125	26.7243	y		0.15	11.2	11.1	Beta-560769
"	R2L	E-536	30.6	4.0	52.8	0.6	1060.0	10.0	1.0–55.0	low tide.	C. River at Royal Palm Park Pie	-81.8173	26.6819	y		0.17	11.2	11.1	Beta-560768
"	R1L	E-537	30.0	7.0	92.3	0.4	781.0	52.0	18.0–108.0	low tide.	C. River at Tarpon St. Pier	-81.8477	26.6624	y		0.12	14.7	9.5	Beta-560767
"	BC3L	E-538	29.9	3.0	38.9	0.3	550.0	148.0	65.0–251.0	low tide.	BC at Shady Oaks	-81.8451	26.6526	y		0.05	21.7	12.4	Beta-560770
"	BC4L	E-539	29.0	1.6	20.5	0.5	1058.0	41.0	17.0–95.0	low tide.	BC at Veronica Shoemaker.	-81.8406	26.6543	y		0.04	19	11.2	Beta-560771
"	BC5L	E-540	29.2	4.8	62.4	0.2	696.0	108.0	52.0–186	low tide.	BC at Marsh.	-81.8283	26.6584	y	BDL	BDL	BDL	BDL	Beta-560772

Figure 6. Phase I CWK nitrate source tracing, sampling location and results



Tide	Basin Location	Long	Lat	Isotopic Analysis	NO3-mg-N/L	d18O	d15N	Beta #
high tide	BC at Shady Oaks	-81.8451	26.6526	y	0.04	18.7	9.48	Beta-560758
high tide	BC at Veronica Shoemaker	-81.8406	26.6543	y	BDL	BDL	BDL	Beta-560759
high tide	BC at Marsh	-81.8283	26.6584	y	BDL	BDL	BDL	Beta-560760
no tide	BC at Nuna	-81.8163	26.6633	y	0.04	12.8	11.6	Beta-560761
no tide	BC at Ortiz	-81.8124	26.6653	y	0.08	12.7	11	Beta-560762
no tide	BC at Ortiz Circle	-81.8108	26.6639	y	0.06	17.5	10.7	Beta-560763
high tide	C. River at Tarpon St. Pier	-81.8477	26.6624	y	0.14	13.9	8.84	Beta-560764
high tide	C. River at Royal Palm Park Pie	-81.8173	26.6819	y	0.16	10.4	10.8	Beta-560765
high tide	C. River at S. Olga Road	-81.7125	26.7243	y	0.16	16.3	14.9	Beta-560766
low tide	C. River at S. Olga Road	-81.7125	26.7243	y	0.15	11.2	11.1	Beta-560769
low tide	C. River at Royal Palm Park Pie	-81.8173	26.6819	y	0.17	11.2	11.1	Beta-560768
low tide	C. River at Tarpon St. Pier	-81.8477	26.6624	y	0.12	14.7	9.5	Beta-560767
low tide	BC at Shady Oaks	-81.8451	26.6526	y	0.05	21.7	12.4	Beta-560770
low tide	BC at Veronica Shoemaker,	-81.8406	26.6543	y	0.04	19	11.2	Beta-560771
low tide	BC at Marsh,	-81.8283	26.6584	y	BDL	BDL	BDL	Beta-560772

Figure 7. Phase I CWK nitrate source tracing, categorization of sources.



Tide	Basin Location	Long	Lat	Isotopic Analysis	NO3-mg-N/L	d18O	d15N	Beta #
high tide	BC at Shady Oaks	-81.8451	26.6526	y	0.04	18.7	9.48	Beta-560758
high tide	BC at Veronica Shoemaker	-81.8406	26.6543	y	BDL	BDL	BDL	Beta-560759
high tide	BC at Marsh	-81.8283	26.6584	y	BDL	BDL	BDL	Beta-560760
no tide	BC at Nuna	-81.8183	26.6633	y	0.04	12.8	11.6	Beta-560761
no tide	BC at Ortiz	-81.8124	26.6653	y	0.08	12.7	11	Beta-560762
no tide	BC at Ortiz Circle	-81.8108	26.6639	y	0.06	17.5	10.7	Beta-560763
high tide	C. River at Tarpon St. Pier	-81.8477	26.6624	y	0.14	13.9	8.84	Beta-560764
high tide	C. River at Royal Palm Park Pie	-81.8173	26.6819	y	0.16	10.4	10.8	Beta-560765
high tide	C. River at S. Olga Road	-81.7125	26.7243	y	0.16	16.3	14.9	Beta-560766
low tide	C. River at S. Olga Road	-81.7125	26.7243	y	0.15	11.2	11.1	Beta-560769
low tide	C. River at Royal Palm Park Pie	-81.8173	26.6819	y	0.17	11.2	11.1	Beta-560768
low tide	C. River at Tarpon St. Pier	-81.8477	26.6624	y	0.12	14.7	9.5	Beta-560767
low tide	BC at Shady Oaks	-81.8451	26.6526	y	0.05	21.7	12.4	Beta-560770
low tide	BC at Veronica Shoemaker,	-81.8406	26.6543	y	0.04	19	11.2	Beta-560771
low tide	BC at Marsh,	-81.8283	26.6584	y	BDL	BDL	BDL	Beta-560772

Figure 8. Phase I CWK nitrate source tracing, high vs. low tide.

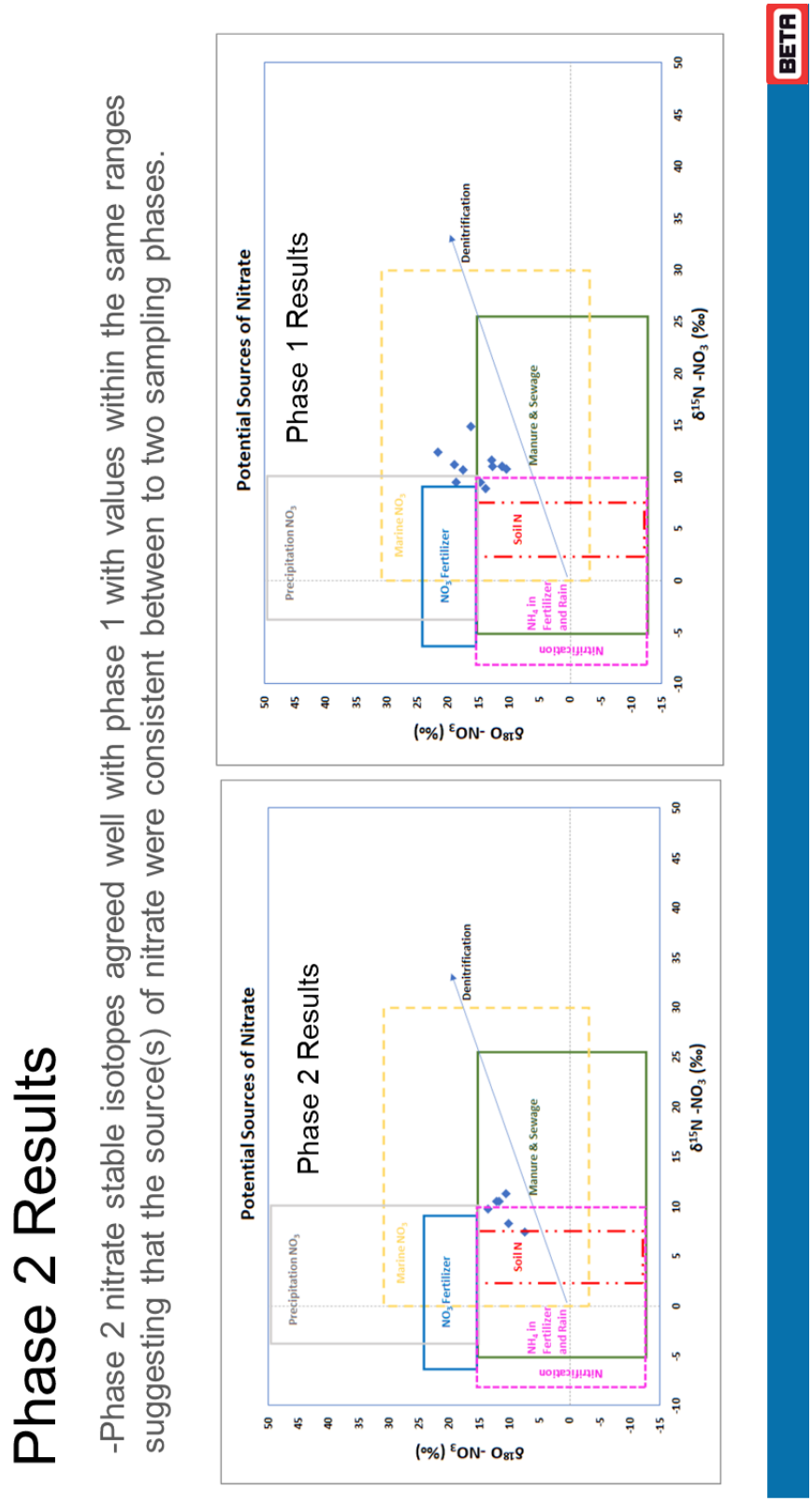


Figure 9. Phase II CWK nitrate source tracing results and categorization of sources.

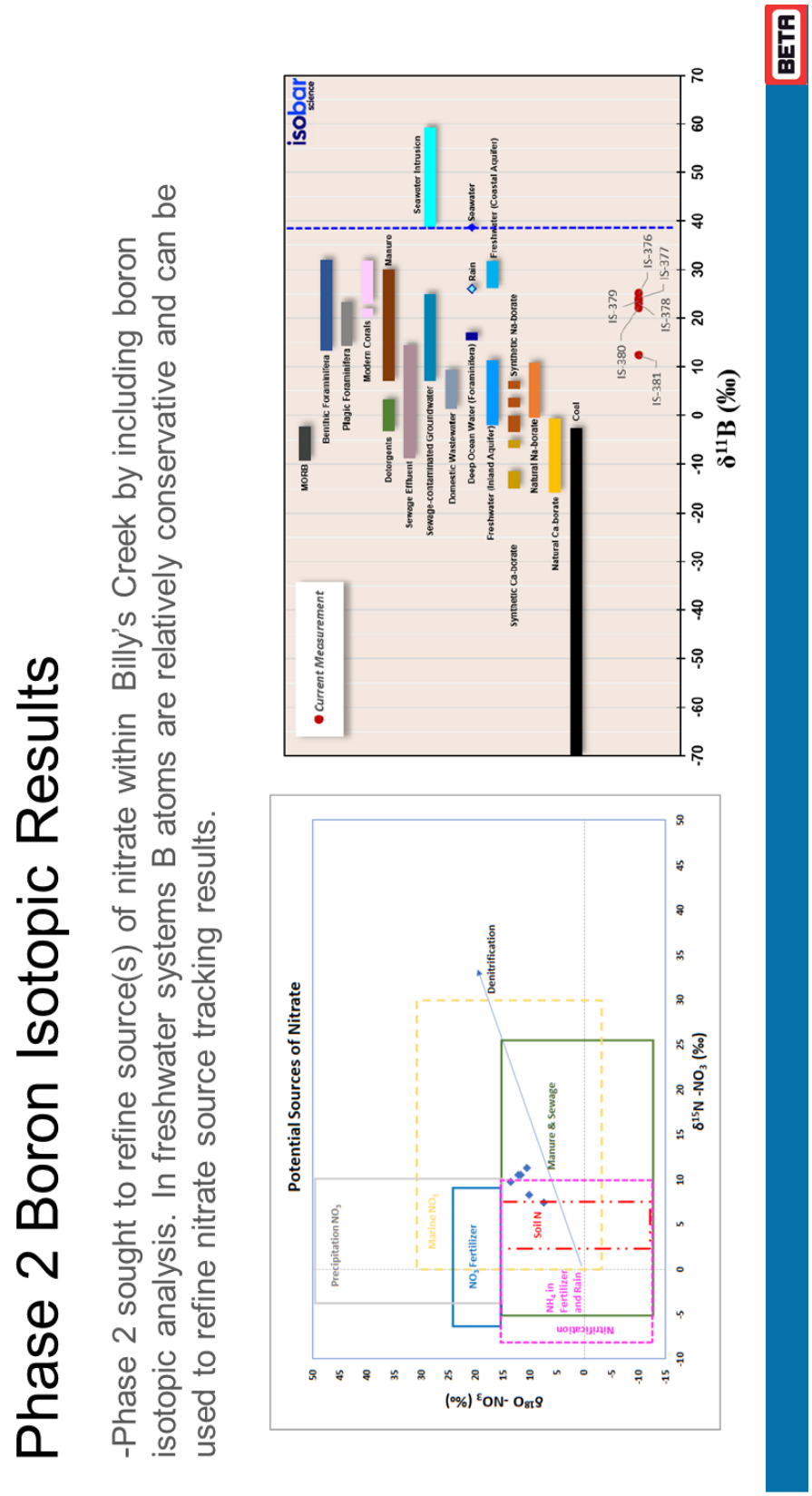


Figure 10. Phase II CWK boron isotope results and categorization of sources.

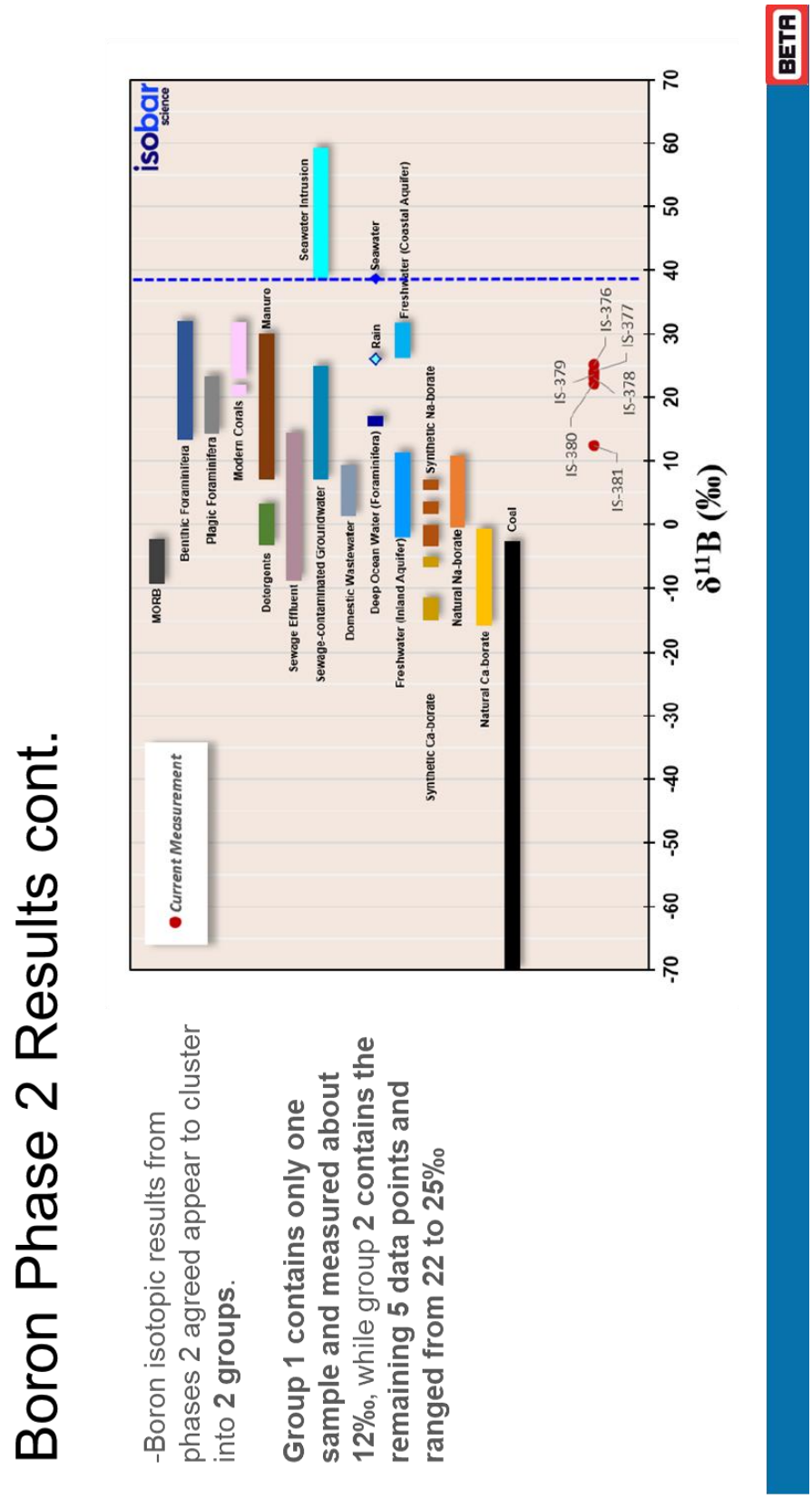


Figure 11. Phase II boron isotope results and explanation of sources indicated.

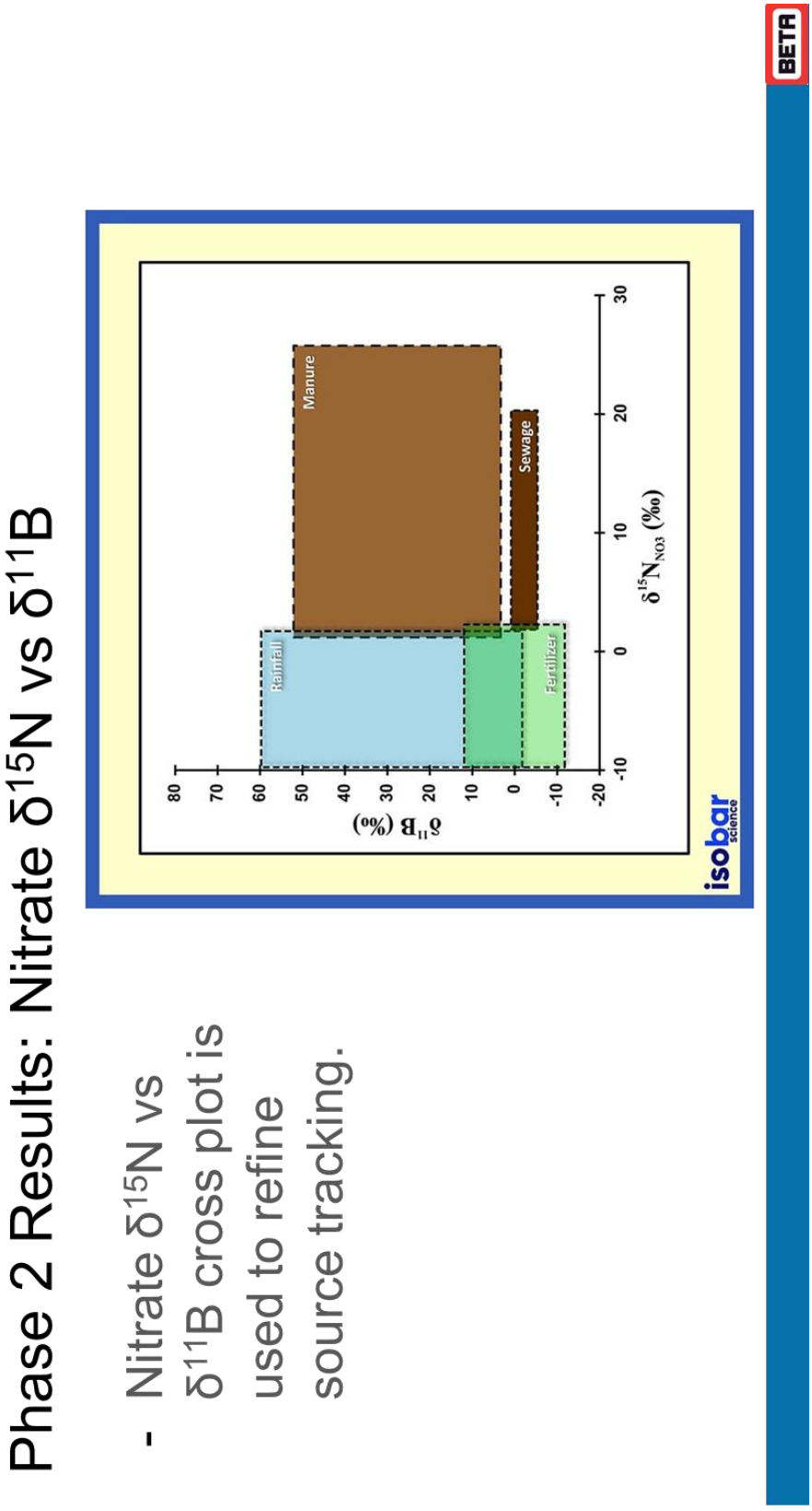


Figure 12. Phase II CWK boron isotope explanation of cross-plot with ^{15}N.

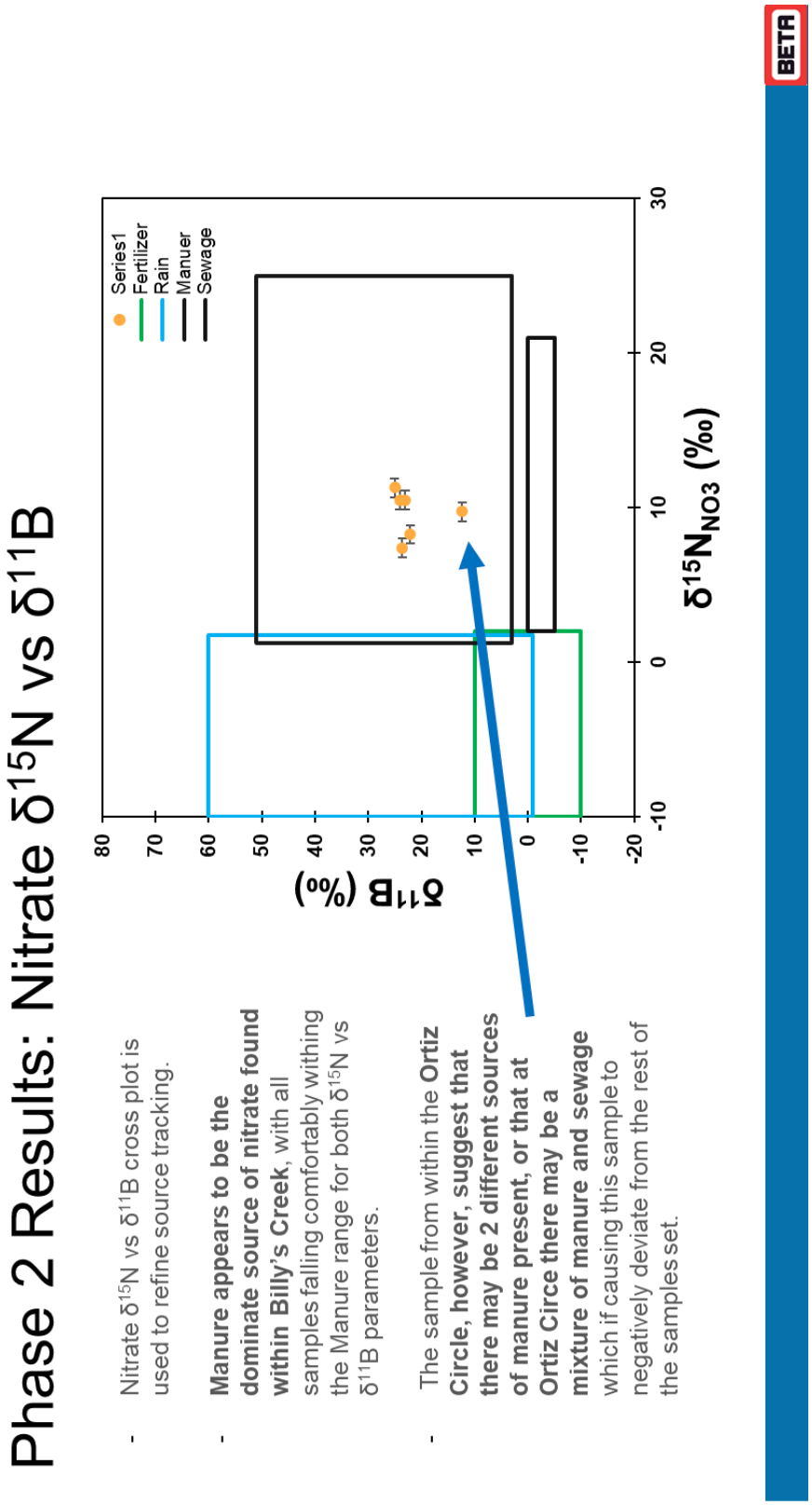


Figure 13. Phase II CWK boron isotope cross plot with ^{15}N results and explanation of sources indicated.

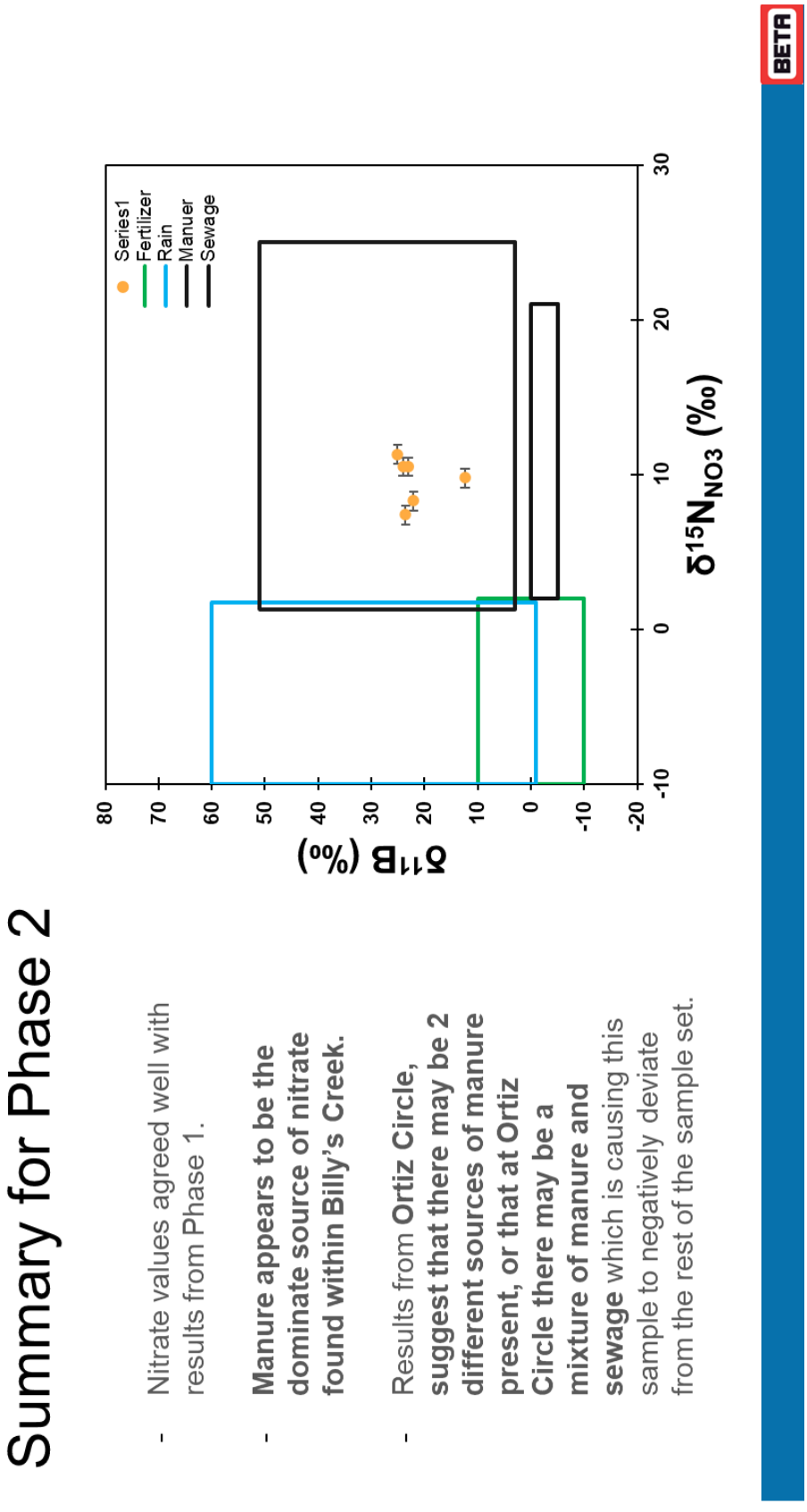


Figure 14. Phase II CWK boron isotope assessment summary.

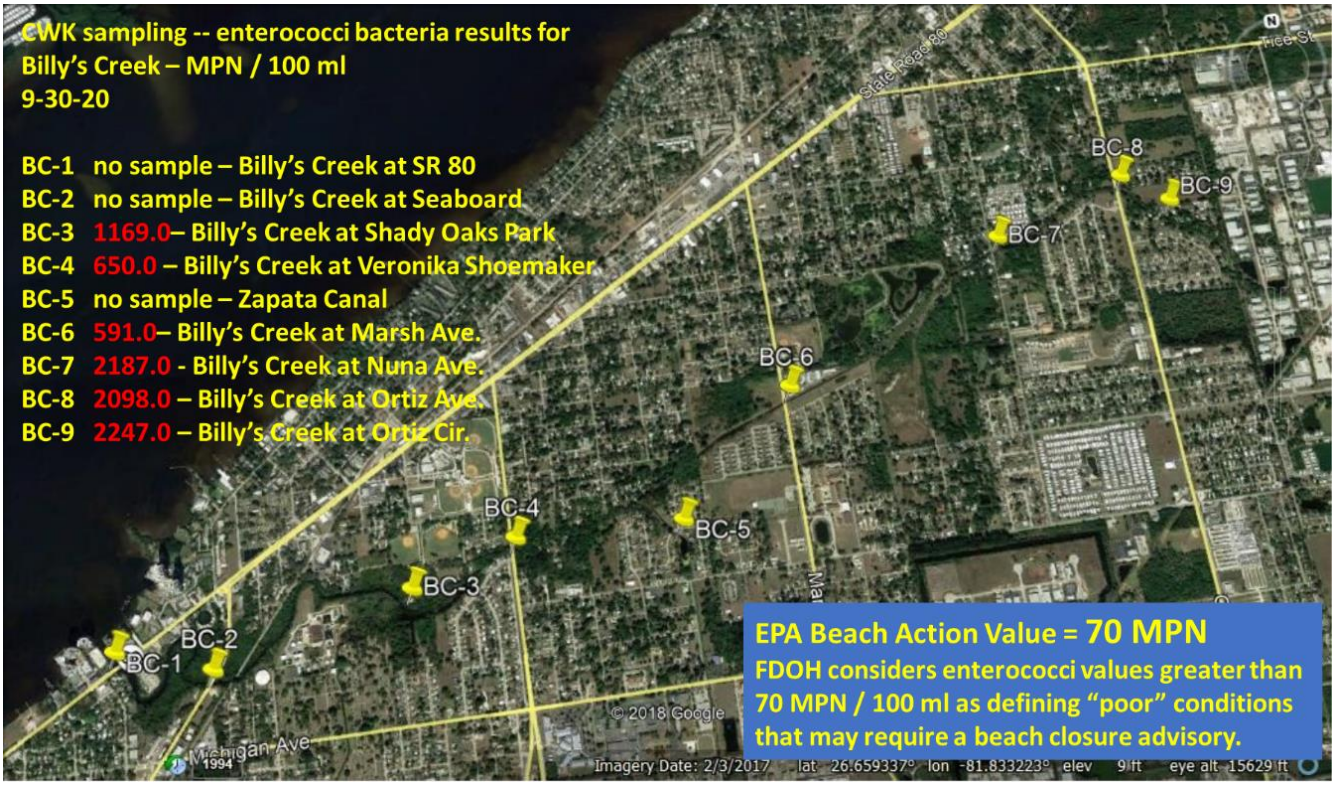


Figure B-15. Phase II CWK enterococci values at stations BC3, BC4, BC6, BC7, BC8, BC9.

Table 1. City of Fort Myers sampling record for enterococci bacteria in Billy's Creek, 2005-2010.

Station	Location	Period of Record	No. monthly samples	Enterococci bacteria mean monthly cfu/100ml
CFMBILLY1	26.65073N, -81.85287	2/8/05-6/17/10	67	556
CFMBILLY3	26.65400N, -81.83355	2/8/05-6/17/10	65	435
CFMBILLY4	26.65563N, -81.83437	2/8/05-6/17/10	68	750

CFMBILLY6	26.64980N, -81.84773	2/8/05-6/17/10	74	499

Table 2. Average Number of DNA Copies for Each Assay 9-30-20

This table provides data on the average number of DNA copies that were detected for each sample for each assay.

Columns represent the number of copies per filtered 100 mL of water (if data provided) for each assay averaged across internal replicates. The column name denotes the assay name.

SampleID	Bovine01	Dog01	E. coli01	Human01	Poultry01
1 1HQRV5LL **BC8, Ortiz**	0	0	138	26	0
2 28WTKT65 **BC6 Marsh**	0	18	0	34	0
3 B9RYSB8I **BC4 VS Blvd**.	16	0	16	181	10
4 HZOWVVK6 **BC3 Shady Oaks Pk**	0	12	105	24	0

Table 3. Percent of Replicates Above Detection Limit for Each Assay 9-30-20.

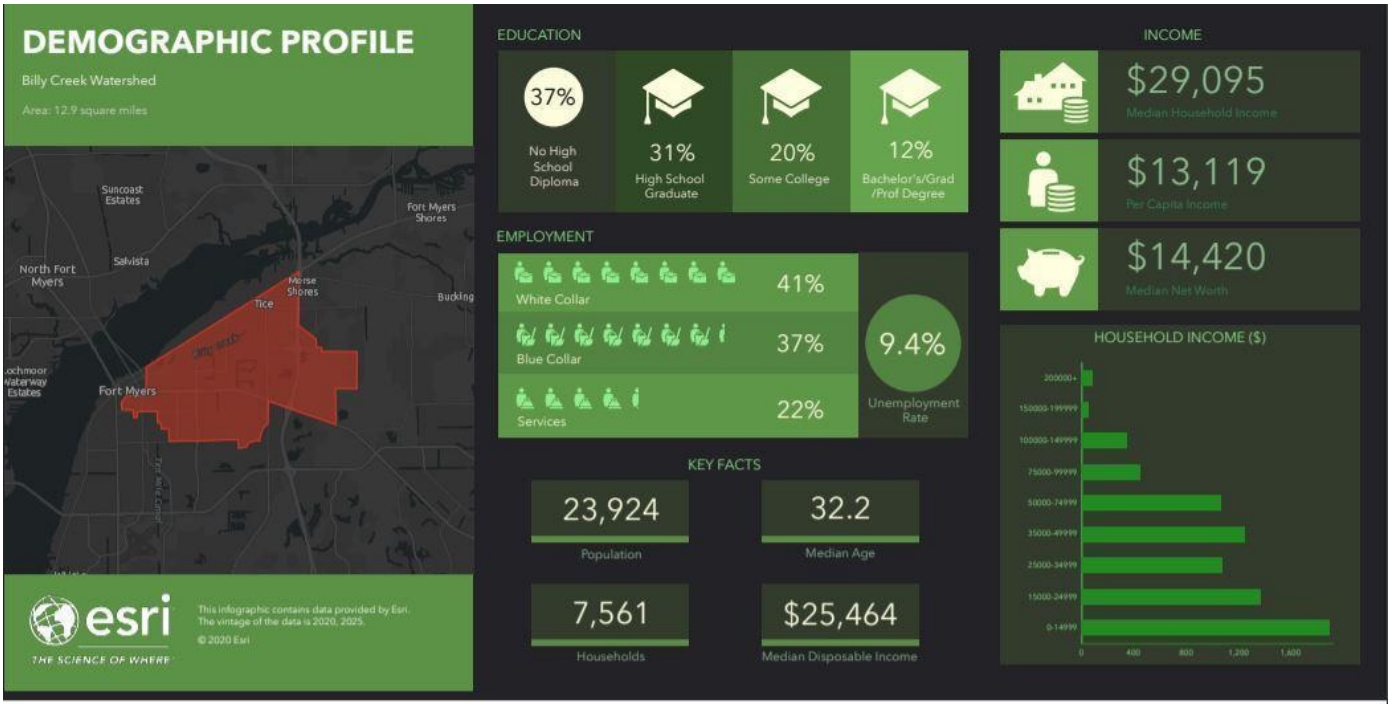
This table provides data on what percentage of the replicates that were run were above the detection limit. The detection limit is as high as the lowest positive on the calibration curve, but can be up to an order of magnitude lower. For example, a calibration curve might generate a positive at 100 copies and no positive for 10 copies, but the actual detection limit would be 11 copies. See Table 3 for the range of number of copies for each assay.

Columns show the percent of all replicates that were above detection limit for each assay. The column name denotes the assay name.

RunID	SampleID	Bovine01	Dog01	E.coli01	Human01	Poultry01
JVQ0119	1HQRV5LL BC8 Ortiz Ave.	0.0	0.0	0	100.0	0.0
JVQ0119	28WTKT65 BC6 Marsh Ave.	0.0	0.0	0	33.3	0.0
JVQ0119	B9RYSB8I BC4 VS Blvd.	33.3	0.0	0	100.0	0.0
JVQ0119	HZOWVVK6 Shady Oaks Pk	0.0	0.0	0	33.3	0.0
JVQ0120	1HQRV5LL BC8 Ortiz Ave.	0.0	0.0	0	0.0	0.0
JVQ0120	28WTKT65 BC6 Marsh Ave.	0.0	33.3	0	0.0	0.0
JVQ0120	B9RYSB8I BC4 VS Blvd.	0.0	0.0	0	0.0	33.3
JVQ0120	HZOWVVK6 Shady Oaks Pk	0.0	33.3	0	0.0	0.0
JVQ0121	1HQRV5LL BC8 Ortiz Ave.	0.0	0.0	100	0.0	0.0
JVQ0121	28WTKT65 BC6 Marsh Ave.	0.0	0.0	0	0.0	0.0
JVQ0121	B9RYSB8I BC4 VS Blvd	0.0	0.0	100	0.0	0.0
JVQ0121	HZOWVVK6 BC3 Shady Oaks Pk	0.0	0.0	100	0.0	0.0

Appendix B - Basin Demographics

The following figures offer further demographic information about the Billy's Creek hydraulic basin:


DEMOGRAPHIC PROFILE
Billy Creek Watershed
Area: 12.9 square miles
Suncoast Estates
Fort Myers Shores
North Fort Myers
Salvista
Morse Shores
Tice
Bucking
Fort Myers
esri
THE SCIENCE OF WHERE
This infographic contains data provided by Esri.
The vintage of the data is 2020, 2025.
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EDUCATION
37%
No High School Diploma
31%
High School Graduate
20%
Some College
12%
Bachelor's/Grad /Prof Degree
EMPLOYMENT
White Collar
41%
Blue Collar
37%
Services
22%
9.4%
Unemployment Rate
KEY FACTS
23,924
Population
32.2
Median Age
7,561
Households
$25,464
Median Disposable Income
INCOME
$29,095
Median Household Income
$13,119
Per Capita Income
$14,420
Median Net Worth
HOUSEHOLD INCOME ($)

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2010 Census Profile

Billy Creek Watershed
Area: 12.9 square miles

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Households by Type		
Total	6,474	100.0%
Households with 1 Person	1,535	23.7%
Households with 2+ People	4,939	76.3%
Family Households	4,436	68.5%
Husband-wife Families	1,973	30.5%
With Own Children	785	12.1%
Other Family (No Spouse Present)	2,463	38.0%
With Own Children	1,277	19.7%
Nonfamily Households	503	7.8%
All Households with Children	2,755	42.6%
Multigenerational Households	612	9.5%
Unmarried Partner Households	569	8.8%
Male-female	519	8.0%
Same-sex	50	0.8%
Average Household Size	3.08	
Family Households by Size		
Total	4,435	100.0%
2 People	1,304	29.4%
3 People	986	22.2%
4 People	850	19.2%
5 People	599	13.5%
6 People	342	7.7%
7+ People	354	8.0%
Average Family Size	3.56	
Nonfamily Households by Size		
Total	2,037	100.0%
1 Person	1,535	75.4%
2 People	295	14.5%
3 People	82	4.0%
4 People	42	2.1%
5 People	47	2.3%
6 People	19	0.9%
7+ People	17	0.8%
Average Nonfamily Size	1.49	
Population by Relationship and Household Type		
Total	20,317	100.0%
In Households	19,943	98.2%
In Family Households	16,915	83.3%
Householder	4,431	21.8%
Spouse	1,978	9.7%
Child	7,754	38.2%
Other relative	1,618	8.0%
Nonrelative	1,131	5.6%
In Nonfamily Households	3,028	14.9%
In Group Quarters	374	1.8%
Institutionalized Population	10	0.0%
Noninstitutionalized Population	364	1.8%

Data Note: Households with children include any households with people under age 18, related or not. **Multigenerational households** are families with 3 or more parent-child relationships. **Unmarried partner households** are usually classified as nonfamily households unless there is another member of the household related to the householder. Multigenerational and unmarried partner households are reported only to the tract level. Esri estimated block group data, which is used to estimate polygons or non-standard geography. **Average family size** excludes nonrelatives.
Source: U.S. Census Bureau, Census 2010 Summary File 1.

October 01, 2020

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	2000	2010	2000-2010 Annual Rate
Population	22,785	20,317	-1.14%
Households	7,484	6,474	-1.44%
Housing Units	8,463	8,300	-0.19%

Population by Race	**Number**	**Percent**
Total	20,317	100.0%
Population Reporting One Race	19,776	97.3%
White	5,080	25.0%
Black	11,010	54.2%
American Indian	233	1.1%
Asian	72	0.4%
Pacific Islander	17	0.1%
Some Other Race	3,364	16.6%
Population Reporting Two or More Races	541	2.7%
Total Hispanic Population	6,547	32.2%

Population by Sex		
Male	10,376	51.1%
Female	9,941	48.9%

Population by Age		
Total	20,317	100.0%
Age 0 - 4	1,932	9.5%
Age 5 - 9	1,681	8.3%
Age 10 - 14	1,522	7.5%
Age 15 - 19	1,682	8.3%
Age 20 - 24	1,705	8.4%
Age 25 - 29	1,490	7.3%
Age 30 - 34	1,379	6.8%
Age 35 - 39	1,218	6.0%
Age 40 - 44	1,120	5.5%
Age 45 - 49	1,255	6.2%
Age 50 - 54	1,203	5.9%
Age 55 - 59	1,068	5.3%
Age 60 - 64	925	4.6%
Age 65 - 69	723	3.6%
Age 70 - 74	569	2.8%
Age 75 - 79	390	1.9%
Age 80 - 84	278	1.4%
Age 85+	177	0.9%
Age 18+	14,204	69.9%
Age 65+	2,137	10.5%

Data Note: Hispanic population can be of any race. Census 2010 medians are computed from reported data distributions.
Source: U.S. Census Bureau, Census 2010 Summary File 1. Esri converted Census 2000 data into 2010 geography.

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Family Households by Age of Householder		
Total	4,436	100.0%
Householder Age 15 - 44	2,040	46.0%
Householder Age 45 - 54	884	19.9%
Householder Age 55 - 64	688	15.5%
Householder Age 65 - 74	512	11.5%
Householder Age 75+	312	7.0%
Nonfamily Households by Age of Householder		
Total	2,039	100.0%
Householder Age 15 - 44	494	24.2%
Householder Age 45 - 54	402	19.7%
Householder Age 55 - 64	483	23.7%
Householder Age 65 - 74	364	17.9%
Householder Age 75+	296	14.5%
Households by Race of Householder		
Total	6,472	100.0%
Householder is White Alone	1,812	28.0%
Householder is Black Alone	3,706	57.3%
Householder is American Indian Alone	55	0.8%
Householder is Asian Alone	19	0.3%
Householder is Pacific Islander Alone	4	0.1%
Householder is Some Other Race Alone	750	11.6%
Householder is Two or More Races	126	1.9%
Households with Hispanic Householder	1,508	23.3%
Husband-wife Families by Race of Householder		
Total	1,972	100.0%
Householder is White Alone	640	32.5%
Householder is Black Alone	963	48.8%
Householder is American Indian Alone	20	1.0%
Householder is Asian Alone	7	0.4%
Householder is Pacific Islander Alone	3	0.2%
Householder is Some Other Race Alone	302	15.3%
Householder is Two or More Races	37	1.9%
Husband-wife Families with Hispanic Householder	598	30.3%
Other Families (No Spouse) by Race of Householder		
Total	2,463	100.0%
Householder is White Alone	420	17.1%
Householder is Black Alone	1,710	69.4%
Householder is American Indian Alone	15	0.6%
Householder is Asian Alone	6	0.2%
Householder is Pacific Islander Alone	0	0.0%
Householder is Some Other Race Alone	261	10.6%
Householder is Two or More Races	51	2.1%
Other Families with Hispanic Householder	547	22.2%
Nonfamily Households by Race of Householder		
Total	2,039	100.0%
Householder is White Alone	752	36.9%
Householder is Black Alone	1,033	50.7%
Householder is American Indian Alone	20	1.0%
Householder is Asian Alone	6	0.3%
Householder is Pacific Islander Alone	1	0.0%
Householder is Some Other Race Alone	188	9.2%
Householder is Two or More Races	39	1.9%
Nonfamily Households with Hispanic Householder	363	17.8%

Source: U.S. Census Bureau, Census 2010 Summary File 1.

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Total Housing Units by Occupancy		
Total	8,344	100.0%
Occupied Housing Units	6,474	77.6%
Vacant Housing Units		
For Rent	838	10.0%
Rented, not Occupied	12	0.1%
For Sale Only	211	2.5%
Sold, not Occupied	21	0.3%
For Seasonal/Recreational/Occasional Use	185	2.2%
For Migrant Workers	8	0.1%
Other Vacant	595	7.1%
Total Vacancy Rate	22.0%	
Households by Tenure and Mortgage Status		
Total	6,474	100.0%
Owner Occupied	3,228	49.9%
Owned with a Mortgage/Loan	1,957	30.2%
Owned Free and Clear	1,271	19.6%
Average Household Size	2.94	
Renter Occupied	3,246	50.1%
Average Household Size	3.22	
Owner-occupied Housing Units by Race of Householder		
Total	3,228	100.0%
Householder is White Alone	1,071	33.2%
Householder is Black Alone	1,923	59.6%
Householder is American Indian Alone	8	0.2%
Householder is Asian Alone	11	0.3%
Householder is Pacific Islander Alone	1	0.0%
Householder is Some Other Race Alone	179	5.5%
Householder is Two or More Races	35	1.1%
Owner-occupied Housing Units with Hispanic Householder	465	14.4%
Renter-occupied Housing Units by Race of Householder		
Total	3,246	100.0%
Householder is White Alone	741	22.8%
Householder is Black Alone	1,783	54.9%
Householder is American Indian Alone	47	1.4%
Householder is Asian Alone	9	0.3%
Householder is Pacific Islander Alone	3	0.1%
Householder is Some Other Race Alone	572	17.6%
Householder is Two or More Races	91	2.8%
Renter-occupied Housing Units with Hispanic Householder	1,043	32.1%
Average Household Size by Race/Hispanic Origin of Householder		
Householder is White Alone	2.70	
Householder is Black Alone	2.94	
Householder is American Indian Alone	4.49	
Householder is Asian Alone	3.37	
Householder is Pacific Islander Alone	4.50	
Householder is Some Other Race Alone	4.48	
Householder is Two or More Races	3.67	
Householder is Hispanic	4.22	

Source: U.S. Census Bureau, Census 2010 Summary File 1.

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Appendix C - Dialog & Demographic Complexity

Double click on the icon below to read a PDF version of Dr. McDowell's chapter contribution on dialogue and demographic complexity:

McDowell (2019) - Dialogue and Demographic Complexity (3).pdf (Command Line)

Appendix D - FDEP Restoring Bacteria-Impaired Waters Toolkit

https://floridadep.gov/sites/default/files/Restoring_Bacteria-Impaired_Waters_Toolkit_082018.pdf

Appendix E - Guide for Evaluating Capacity, Management, Operation, and Maintenance (CMOM) Programs at Sanitary Sewer Collection Systems

https://www3.epa.gov/npdes/pubs/cmom_guide_for_collection_systems.pdf