

Fecal Indicator Bacteria Toolkit

Guidance for the Implementation of Fecal Indicator Bacteria Total Maximum Daily Loads

**developed by the
Water Quality Restoration Program
Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection**

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**2600 Blair Stone Road
Tallahassee, FL 32399-2400
www.dep.state.fl.us**



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List of Acronyms

ARV	Air Release Valve
BMAP	Basin Management Action Plan
BMP	Best Management Practice
BPCP	Bacterial Pollution Control Plan
CAD	Computer-Aided Drafting
cm	Centimeter
DBPR	Florida Department of Business and Professional Regulation
DEP	Florida Department of Environmental Protection
DMR	Discharge Monitoring Report
EDIS	Electronic Data Information Source
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
FIB	Fecal Indicator Bacteria
FOG	Fats, Oils, and Grease
F.S.	Florida Statutes
FWCC	Florida Fish and Wildlife Conservation Commission
GIS	Geographic Information System
GPS	Global Positioning System
IDDE	Illicit Discharge Detection and Elimination
IWR	Impaired Surface Waters Rule
MEP	Maximum Extent Practicable
MOT	Maps on the Table
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NEP	National Estuary Program
NHD	National Hydrography Dataset
NNC	Numeric Nutrient Criteria
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
OAWP	FDACS Office of Agricultural Water Policy
OSTDS	On-Site Sewage Treatment and Disposal System
PIC	Potential Illicit Connection
PSA	Public Service Announcement
SOP	Standard Operating Procedure
SSO	Sanitary Sewer Overflow
STORET	STorage and RETrieval (Database)
TMDL	Total Maximum Daily Load
UF–IFAS	University of Florida–Institute of Food and Agricultural Sciences

UCF	University of Central Florida
USGS	U.S. Geological Survey
UV	Ultraviolet
WBID	Waterbody Identification (Name and Number)
WCD	Water Control District
WIN	Watershed Information Network
WMD	Water Management District
WTW	Walk the Waterbody/Watershed/WBID
WQRP	Water Quality Restoration Program

1.0 Context

1.1 Purpose

The purpose of this guidance document is to assist local stakeholders with the development of a restoration plan for fecal indicator bacteria (FIB) in impaired waters. Prepared by the Florida Department of Environmental Protection (DEP) and written for the lead restoration coordinator, it provides options and guidance to navigate the challenge of implementing total maximum daily loads (TMDLs) for FIB. FIB are used to indicate the potential level of pathogens in surface waters. Protecting human health by remediating fecal waste and conditions that increase bacteria and pathogen levels in Florida's waterbodies as a result of human activity is the underlying principle for all guidance in this document. The main objectives include understanding how to identify and eliminate FIB sources in order to prepare a TMDL implementation plan.

Reference documents are listed as appendices, and electronic copies of the documents can be obtained by contacting the Water Quality Restoration Program (WQRP) of the DEP Division of Environmental Assessment and Restoration (at anita.nash@dep.state.fl.us). Hyperlinks are embedded throughout the document to provide fast access to supportive information and email addresses. This document and the references should be considered optional guidance and not as an interpretation of the rules and regulations that DEP promulgates. Although some guidance documents in the appendices refer to fecal coliform, many of the concepts are also applicable to *Enterococci* and *Escherichia coli* bacteria.

This is the second version of this document. It and the appendices will be updated from time to time. Check the [DEP website](#) for the most recent version.

1.2 Document Outline

The sources of bacteria tend to vary in mixed-use landscapes and are often difficult to identify. For FIB-impaired waterbodies, additional analysis is usually needed before a restoration plan is developed. **Section 2.0, Understanding the Basin**, provides guidance on the kinds of information about the basin that should be reviewed, considerations for prioritizing waterbodies and resources, and suggestions about the stakeholders who should be involved in preparing the TMDL implementation plan and carrying out restoration activities. Watershed analysis and evaluation should involve local stakeholders who have knowledge of their watershed and detailed understanding of its infrastructure and potential sources of FIB (**Section 2.3, Identifying Restoration Partners**). **Section 2.0** also outlines some of the tools available for further information gathering. One or more of these tools can be used to identify FIB sources. **Section 3.0, Management Actions**, describes various management actions that stakeholders can use to address or remove potential sources once these have been identified. **Section 4.0, Implementation Plan and Documentation**, provides an example of implementation plan elements. **Section 5.0, Appendices**, lists the electronic documents and supporting information available as appendices upon request from DEP (at anita.nash@dep.state.fl.us).

1.3 Causes of FIB Impairments

FIB commonly originate in the enteric (intestinal) systems of warm-blooded animals and are indicative of the possible presence of pathogens. Human waste is the carrier of the highest number of pathogens contractible by humans and is, therefore, the greatest human health risk. Human waste can potentially be transmitted to waterbodies from degraded sewer infrastructure, failing on-site sewage treatment and disposal systems (OSTDS) (septic tanks and drain fields), homeless camps, and direct illicit connections from homes or businesses to stormwater conveyances and then to waters of the state.

Cattle and other livestock waste also contains pathogens harmful to humans. Waste from dogs and other domestic animals and livestock is not a natural part of the environment and, like most fecal sources, may cause an imbalance in nature, pose health risks to swimmers, and pollute seafood.

Balanced populations of wildlife and natural densities of native wildlife, such as bird rookeries, should not be altered because of TMDL implementation. While these should be noted when explaining all potential contributors to the impairment of a waterbody, the TMDL focuses on remediating the anthropogenic causes of FIB in excess of the state criterion.

Trash and litter contribute to bacteria impairments by transporting waste; impeding flow, which creates shaded, stagnant pockets of water; and increasing surface areas. Each of these factors promotes bacteria proliferation. Litter and trash should be frequently removed until effective social marketing efforts and well-placed and properly designed trash receptacles help to eliminate trash buildup in streams and stormwater conveyances. Poorly managed dumpsters can contribute to pollutants in stormwater runoff. Open dumpster lids and missing drain plugs allow rain to wash over the trash inside the dumpster. Rainwater then flows from the dumpster, carrying bacteria and food sources to the stormwater conveyance system. Closed lids and careful disposal practices prevent litter and food waste from lying around dumpsters and blowing or flowing into stormwater ponds and ditches.

Ultraviolet (UV) rays from the sun kill bacteria and pathogens suspended in the water column, providing natural treatment. Constructed stormwater infrastructure laden with litter or shaded by overgrown and excess plants creates conditions that reduce the effectiveness of the treatment and conveyance design. These areas should be identified and maintenance carried out more frequently. Additionally, siltation and debris may impede flow and prevent the stormwater system from flushing, creating stagnant conditions in which bacteria can proliferate. Overgrown man-made conveyances and stormwater ponds should be managed to provide maximum UV treatment while maintaining structural integrity, flood attenuation, and nutrient treatment capabilities, as designed.

1.4 Summary of Steps in the DEP Watershed Management Approach

What is a TMDL, and how did this waterbody get a TMDL? Does assessment occur before or after a waterbody is determined to be impaired? The following is a simplified summary of the steps in the DEP watershed management approach:

- It is important to know whether a waterbody meets water quality standards ([Surface Water Quality Standards – Chapter 62-302, Florida Administrative Code \[F.A.C.\]](#)). DEP uses a cyclical rotating basin approach to assess the quality of surface waters and determine which waters are impaired—meaning that they do not meet water quality standards for a particular pollutant or pollutants ([Impaired Surface Waters Rule \(IWR\) – Chapter 62-303, F.A.C.](#)). Contact [DEP](#) for more information about impaired waters and water quality standards and assessments.
- DEP establishes and adopts TMDLs by rule for waters that do not meet water quality standards. A [TMDL](#) establishes the maximum amount of a specific pollutant a waterbody can assimilate while maintaining water quality standards and designated uses ([TMDLs – Chapter 62-304, F.A.C.](#)).
- Stakeholders in each basin then collaboratively develop restoration plans for individual waterbodies to meet water quality criteria. These plans, also called TMDL implementation plans, can be initiated by local stakeholders or DEP. Enforceable TMDL implementation plans adopted by DEP Secretarial Order are called [basin management action plans \(BMAPs\)](#). Similarly, Phase 1 municipal separate storm sewer system (MS4) permittees can prioritize WBIDs with FIB TMDLs and develop bacterial pollution control plans (BPCPs), which include restoration plans.
- Next, stakeholders implement the strategies and actions in the restoration plan.
- Stakeholders measure the effectiveness of the specific goals detailed in the restoration plan.
- Stakeholders adapt, changing the plan and the actions as necessary based on results.
- Stakeholders continuously reassess the quality of surface waters.

1.5 Coordinating with DEP

DEP recommends that the lead person for the restoration plan contact the DEP [MS4 Phase 1 regional coordinator](#) at the beginning of the process so that DEP is aware that a restoration plan is being developed for the watershed. Entities can also contact Anita Nash, Environmental Consultant, in the Water Quality Restoration Program (at anita.nash@dep.state.fl.us), for assistance with the development of FIB TMDL implementation plans, Walk the

Waterbody/Watershed/WBID (WTW) exercises, monitoring plans, and more throughout the source identification and elimination process.

2.0 Understanding the Basin

The first step in preparing a restoration plan is to gain an understanding of the basin. This section outlines the types of information and data that should be reviewed by the stakeholders to familiarize themselves with the basin and to begin identifying potential FIB sources. It also discusses the types of stakeholders typically involved in a plan to reduce FIB.

2.1 Prioritizing FIB-Impaired Watersheds

All Florida counties and many cities extend into multiple watersheds. If multiple waterbodies are not meeting the FIB criterion, then watersheds may need to be prioritized to focus the use of limited financial and staff resources. Of course, some bacteria-reducing actions bring about change across the entire municipality and therefore may benefit all the watersheds within the municipality. In this case, the prioritization of watersheds is not necessary. However, typically site-specific restoration activities are also needed to address all anthropogenic sources of bacteria. Multiple considerations may guide the prioritization of watersheds. **Figure 1** describes one optional method of prioritizing waterbodies.

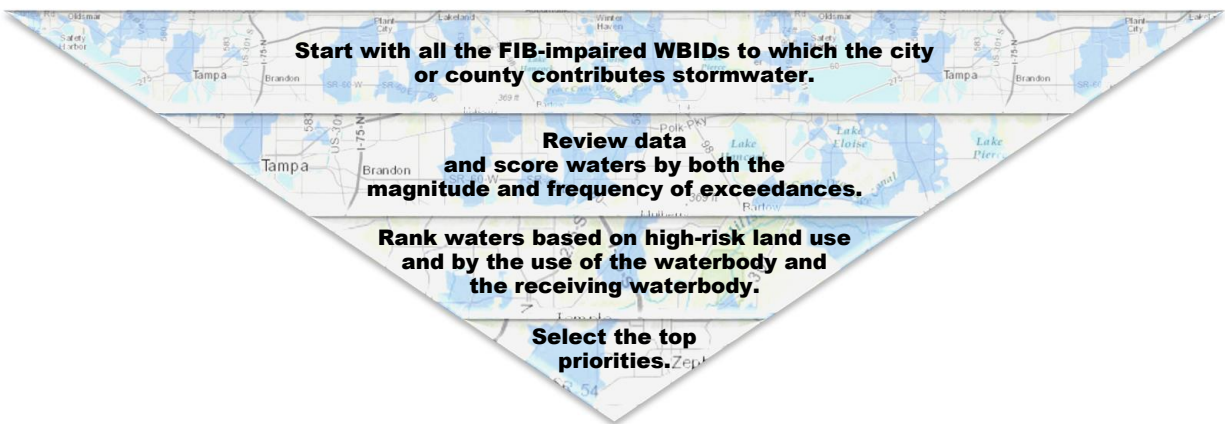


Figure 1: Example of method to prioritize FIB-impaired waterbodies

Start with all the waterbodies to which the city or county contributes stormwater that are not meeting the FIB criterion. Next, review the available data and score them by the magnitude of exceedances and by the frequency of exceedances. **Appendix B, Prioritization and Decision Matrix**, contains an Excel workbook that you can use to perform the following scoring method. **Figure 2** provides a visual aid to accompany the description below.

A simple way of scoring the magnitude of exceedances on a scale of 1 to 100 is by calculating the median of exceedances for the past 7.5 years (the length of DEP's verified period for assessment), subtracting the criterion, dividing by the median of exceedances, and multiplying by 100.

To calculate the exceedance frequency score, divide the number of exceedances by the total number of data points for the same period of record used above, and multiply by 100.

Average the two scores, and then multiply by the following confidence intervals (this applies more weight to the WBIDs with more data):

- For 5 to 10 total samples, multiply by 0.65.
- For 11 to 19 total samples, multiply by 0.75.
- For 20 to 29 total samples, multiply by 0.8.
- For 30 or more samples, multiply by 1.0.

Now you have a score for the waterbody. Waterbodies such as a tributary or segment of a waterbody are identified with a waterbody identification (WBID) number by DEP. Score all the WBIDs. The highest priority WBIDs in the second tier are those with the highest scores. You may see a natural break point from which to continue. If many or all of the waters score similarly, the next step may help differentiate them.

Consider the land uses and the age of the infrastructure in the watersheds. Those with the highest risk land uses should be scored or ranked as a high priority. This type of evaluation is not necessarily a numerical evaluation. A drive through the watersheds and a quick look at the aerial photos of each watershed may provide enough information to perform this part of the evaluation. Additionally, waterbodies where humans come in contact with the water directly should score high because of the potential risk to human health. Similarly, waterbodies that contribute to receiving waters with which humans come in contact should also score high. Sort the top-ranking WBIDs according to the potential sources (for example, based on land use, the age of sewer systems and OSTDS, and the behavior of residents) and the potential for human contact (for example, swimming beaches, kayaking, and fishing).

Remember, don't delay restoration by attempting to prioritize with 100 % confidence. Just begin restoration (on any impaired WBID) as soon as possible. Waterbodies shared by multiple municipalities are best served when all parties collaborate. For example, if a watershed's neighbors are developing a restoration plan on your second-worst WBID, you may strongly consider bumping your second-place WBID to first place and work with them to develop a restoration plan at the same time. Or, if you are already working on reducing nutrients in a watershed, then it may make sense to continue with the same watershed and consider FIB reductions simultaneously.

Waterbody name

WBID **WBID Class**

Data period
(Insert dates. 7.5 years of data is recommended.)

Applicable FIB criterion: **A**

Total Number of Samples: **B**

Median of exceedances: **C**

Total number of exceedances: **D**

Magnitude of exceedances indicator calculation:

$C - A = \text{} \div C = \text{}$ **E**

$E \times 100 = \text{}$ **F**
(Round F to whole number)

Frequency of exceedances indicator calculation:

$D \div B = \text{} \times 100 = \text{}$ **G**
(Round G to whole number)

Average the indicators:

$F + G = \text{} \div 2 = \text{}$ **H**
(Round H to whole number)

Calculate the WBID's weighted score:

Number of samples	Confidence compensation weight (I)
5 - 10	0.65
11 - 19	0.75
20 - 29	0.8
30 or more	1.0

$H \times I = \text{}$ **J**
(Round J to whole number)

Figure 2: Visual representation of mathematical calculations described above

2.2 Compiling and Evaluating Data

To gain a better understanding of the watershed, it is useful to compile existing data from all stakeholders in the basin. Stakeholders should become familiar with the adopted TMDL report before developing a restoration plan. The TMDL report provides a good starting point toward understanding the extent of the impairment, potential sources, and required reductions needed to meet the water quality criterion. Keep in mind that additional local investigations will be needed to understand the issues and sources of the impairment (see **Section 3.0, Management Actions**). [Final DEP TMDL reports](#) sorted by basin group and waterbody are available online.

Next, initiate discussions with stakeholders informing them of the bacteria impairment and the need for their assistance during the restoration process. Ask them what they know about problematic areas, what they suggest, and what types of data they possess. Build a geographic information system (GIS) database to create an informative map project. Computer-aided drafting (CAD) files, paper maps, prior studies, existing water quality data, and word of mouth can be very informative as well.

View all available data together in one place to begin identifying potential sources such as areas with repetitive and persistent problems. It is a good idea to host a Maps on the Table meeting (see **Section 2.4.1, WTW Process**) to bring stakeholders together, make notations on the maps, and discuss the potential sources of the FIB impairment. DEP has found that many departments and municipalities have not previously viewed stormwater maintenance areas, sanitary sewer lines, and OSTDS failure areas on the same map as water quality monitoring hot spots. Interesting discoveries are made through this effort. For instance, a ditch may not be on the maintenance maps because each municipality mistakenly thinks it belongs to the neighboring municipality. Or perhaps the Florida Department of Health (FDOH) knows there is a neighborhood with frequent OSTDS repair permit requests and the city knows there is a water quality hot spot just downstream, but they have not previously discussed these related items with one another.

Continue to update the mapping database and use it to track information throughout the investigative and implementation process. The GIS database is a valuable tool that will help decision makers select appropriate projects to address sources. DEP recognizes that putting all these layers on a single map can create a cluttered map and that it is time consuming to create a symbology that works. Thus DEP is including its GIS symbology package and recommended transparency levels as part of **Appendix C, Source Identification**. The following types of data should be added to the GIS database, as available:

- GIS information and associated useful attributes, as follows:
 - **Sanitary sewer infrastructure** – Location of pipes, pipe material, manholes, lift stations, valves, and wastewater treatment facilities; information on any recent past problems and upgrades. Include public and private sanitary sewer components.

- **Sanitary sewer overflow (SSO) database** – Location of SSO, impact to surface waters, the amount of sewage spilled, the cause of the overflow, and the correction of the root cause.
- **Private sanitary sewer lift stations and conveyances** – Any available information on private sewer infrastructure such as lift stations and package plants.
- **Septic tanks** – Location of tanks and areas with repair permits.
- **Stormwater infrastructure** – Canals, ditches, treatment ponds, outfalls, inlets, and control structures.
- **Water quality sampling stations** – Location of stations and associated water quality data.
- **Livestock operations and hobby farms.**
- **Food service businesses, fruit processing facilities, seafood processing facilities, bait shops, and restaurants.**
- **Swimming beaches and recreational use areas** – Include official and unofficial uses.
- **Dog walks (official and unofficial)** – Include rights-of-way along ditches, empty lots, green areas in apartment complexes, and dog parks.
- **Businesses servicing animals** – Include veterinarians, pet boarding and grooming facilities, and pet supply stores.
- **Mobile home parks.**
- **Age of developments, neighborhoods, and mobile home parks** – This tells us the likely age of private sanitary sewer components such as laterals and conveyances between buildings and from buildings to private lift stations. It also indicates the age of OSTDS, barring any replacements.
- **Location of water quality monitoring stations.**
- **WBID boundaries per DEP and local studies.**
- **National Hydrography Dataset (NHD) or similar waterbody layers.**
- **A base map with aerial photos and street names.**

As you identify potential sources and eliminate them, it's helpful to create a layer of these locations and in the attributes notate dates and descriptions about what was found and when, and what was done to remediate the source. This will help you track sources and remediation activities.

If GIS resources are not available in your municipality, you may be able to find useful free web-based GIS tools to help you. They are not as comprehensive as ArcMap, but

you can at least use them to assist you with field navigation and capture points and notes. Others have used the following resources during source identification efforts:

- DEP's [Numeric Nutrient Criteria \(NNC\) Tracker](#) is a web-based map. You can turn off the NNC layers and add and download WBIDs and other state GIS layers. You can place markers on the map and upload your own GIS layers. The map can be bookmarked and saved including your changes, but DEP recommends backing up your GIS layers in case the system goes down.
- Create a [Google](#) account and generate maps. You can upload GIS KMZ and KML files with fewer than 1,000 features (sanitary sewer and stormwater conveyances cannot be uploaded here, but you can track many other things!). You can upload a WBID boundary, log in with a smart phone, and navigate around the basin and determine whether you are inside or outside the watershed. You can capture notes and create a layer from points, lines, and polygons you create in the field or on your computer and then download the files for your records.
- [CommunityWalk](#) allows users to create points, upload notes, photos, and audio and share the map with others.

2.3 Identifying Restoration Partners

When creating a plan to eliminate FIB sources, it is important to identify and engage all appropriate stakeholders with the authority to address sources, such as state and local municipalities. Include neighboring cities, counties, and other jurisdictional entities in the watershed as much as possible. It is also helpful to invite participation from citizens who have interest in and knowledge of basin activities. After all, watershed restoration is most successful when all parties understand the impairment and how they can contribute to restoration through simple and practical actions.

When building a list of restoration partners, it is important to consider the types of potential sources in the waterbody. **Section 2.3** is provided as a guide, a starting point, to help the watershed evaluation and implementation plan organizer, referred to here as “the lead coordinator” or simply “the lead.” Each category is accompanied by a list of potential stakeholders and the benefit of involving them. This list also includes the types of data they may possess.

Section 2.3 is written in a way that directly relates to the WTW process (**Section 2.4.1**) but can be useful to anyone in the watershed restoration business. Generally, state government responsibilities are designated uniformly across the state, but there are certainly variations on how local jurisdictional responsibilities are divided in each watershed. The lead coordinator will need to research the division of responsibilities in the watershed to identify appropriate parties. DEP suggests that the lead update this list for future stormwater managers to use. Programs and inspections are mentioned here because some problems can be improved by increasing the frequency of maintenance. MS4 coordinators may prescribe these increases accompanied by

supporting evidence (notes about observations and photos) demonstrating the need. Additional information can be obtained by contacting the Water Quality Restoration Program and MS4 Phase 1 regional coordinators at DEP (at anita.nash@dep.state.fl.us or NPDES-stormwater@dep.state.fl.us).

2.3.1 Phase 1 MS4 Conveyances

The entity to involve: Phase 1 MS4 permit coordinators for all counties and cities in the watershed.

Jurisdictional authority: MS4 coordinators are responsible for managing the quality of stormwater conveyed to waters of the state, which must meet water quality criteria. They are also responsible for reporting on the activities of multiple divisions in the municipality. They have the authority to address violations of local and state regulations pertaining to stormwater by initiating warnings and, if necessary, fines.

Information and data they may possess: GIS shapefiles illustrating the location of stormwater conveyances, maintenance schedules and the frequencies of trash removal from conveyances, sediment removal, illicit discharge detection and elimination (IDDE) inspection schedules, knowledge of local and state regulations to protect water quality, and private lift station inspection inventories and inspection frequencies.

When to engage in the implementation process: From beginning to end.

How the entity can help: Lead the implementation process and coordinate public education efforts where observations indicate it may be beneficial.

2.3.2 Roadway Stormwater Conveyances

The entities to involve: Public works departments of counties and cities, Florida Department of Transportation (FDOT).

Jurisdictional authority: Maintenance and management of stormwater conveyances.

Information and data they may possess: GIS layers of conveyances, stormwater manholes, inlets, and outfalls. Knowledge of the flow direction and connectedness of stormwater conveyances above ground and underground. Maintenance schedules and frequencies of trash removal from conveyances, sediment removal, plant removal along and inside stormwater infrastructure, and street sweeping. IDDE inspection schedules and areas. Knowledge of problem sites, such as recurring potholes indicative of broken underground pipes, areas with excessive litter, areas with flooding problems, areas with siltation build-up and erosion, and nuisance odor areas indicating the degradation of biological waste.

When to engage in the implementation process: Information gathering. Staff who mow rights-of-way, maintain conveyances, and sweep streets are beneficial to the Maps on the Table (MOT)

process. Managers and staff who mow rights-of-way, maintain conveyances, or are contract managers for these practices are beneficial at the MOT event and in the field.

How the entities can help: Per the MS4 Phase 1 permit, maintenance frequency may be increased in areas demonstrating the need for more frequent activities. Local roadway departments and FDOT may be well suited to provide assistance with watershed-focused IDDE efforts before or after the WTW field event.

2.3.3 Restaurants, Hotels, and Apartment Complexes

The entity to involve: Florida Department of Business and Professional Regulation (DBPR), Division of Hotels and Restaurants.

Jurisdictional authority: The Division of Hotels and Restaurants issues permits to hotels, most restaurants, and multi-unit housing such as apartment complexes. These permits, in part, address health and safety. The DBPR will work with permit holders to remediate and prevent future issues for the following situations: trash and litter around dumpsters and anywhere on site, food waste exposed to rain (rodent attractants), grease recycle containers with grease drips on the outside or spills on the ground, private lift stations, and missing sewer clean-out caps and privately owned sanitary conveyances.

Information and data they may possess: Knowledge of restaurants, hotels, and apartment complexes with a history of problems.

When to engage in the implementation process: MOT and WTW field event.

How the entity can help: When observations of concern are made at hotels, restaurants, and apartment complexes, assign follow-up activities to the DBPR.

2.3.4 Gas Stations that Sell Hot Food, Roadside Food Trucks, Donut Shops, and Coffee Shops

The entity to involve: Florida Department of Agriculture and Consumer Services (FDACS), Division of Food Services.

Jurisdictional authority: The Division of Food Services issues permits to some food service providers that do not have a DBPR Division of Hotels and Restaurants permit, such as gas stations with a small hot bar (such as pizza or fried chicken), food trucks, some coffee shops, and some donut shops. These permits are less environmentally comprehensive than DBPR permits for restaurants. For instance, they do not address sanitary sewer components. However, they do cover rodent attractants near dumpsters and in the general vicinity, such as grease spills and dumped food.

Information and data they may possess: Knowledge of areas of concern with a history of problems.

When to engage in the implementation process: MOT and WTW field event.

How the entity can help: When issues of concern are observed, assign follow-up activities to the Division of Food Services. If you are unsure if the facility has a permit from the FDACS Division of Food Services or the DBPR Division of Hotels and Restaurants, report the observation to either of the two agencies and they will forward it to the other if necessary.

2.3.5 Production Agriculture (agricultural operations operated as a business)

The entities to involve: FDACS Office of Agricultural Water Policy (OAWP) and University of Florida–Institute of Food and Agricultural Sciences (UF–IFAS) Extension Offices.

Jurisdictional authority: Both the OAWP and UF–IFAS may work directly with producers to identify appropriate best management practices (BMPs) and cost-share to implement BMPs. Outside of BMAPs or springs priority focus areas, participation in the BMP Program is voluntary because there are no requirements for producers to implement BMPs.

Information and data they may possess: FDACS maintains a GIS database of production agricultural operations enrolled in the BMP Program.

When to engage in the implementation process: MOT and WTW field event.

How the entities can help: If livestock or manure are observed near waterbodies or conveyances on production agricultural operations (businesses), the OAWP may work with producers after the WTW field event to educate them on the benefits of enrolling in the BMP Program. The goal is for producers to sign a notice of intent (NOI) to implement BMPs. The OAWP will assist producers by prescribing appropriate BMPs, finding cost-share funds, and following up once BMPs are in place.

In some regions, UF–IFAS Extension Offices are available to team up with the OAWP for this task. These agencies may also work together to host public education events. Please note, producers are not required to participate in the BMP Program outside of BMAPs and springs protection zones but may sign up voluntarily.

2.3.6 Nonproduction Agriculture such as Hobby Farms

The entities to involve: UF–IFAS Extension Offices and MS4 Phase 1 permit coordinators for counties and cities.

Jurisdictional authority: UF–IFAS and MS4 permit coordinators may work with the owners of hobby farms to reduce impacts to a waterbody through public education.

Information and data they may possess: Knowledge of areas with hobby farms.

When to engage in the implementation process: MOT and WTW field event.

How the entities can help: May host public outreach events for small parcels with livestock, such as ranchettes, to discuss hobby farm BMPs, including manure management and waterbody impairments.

2.3.7 Pathogen Transporters such as Sharps (hypodermic needles), Blood (vials of blood samples), Medical Waste, and Numerous Houseflies

The entities to involve: FDOH and local code enforcement.

Jurisdictional authority: FDOH and code enforcement are concerned with any uncontained human medical waste and evidence of drug use. Medical waste containing animal blood, such as from a veterinarian's office, is a code enforcement issue, not an FDOH issue. FDOH should be called when animal manure or another biological waste is drawing numerous houseflies. If the fly nuisance originates from a farm business, FDACS OAWP should also be called to assist the owner with BMP planning.

Information and data they may possess: Knowledge of areas of concern with a history of problems.

When to engage in the implementation process: MOT and WTW field event.

How the entities can help: They will work with property owners to remediate the immediate problem and develop a plan to prevent it in the future. Many times, after initial remediation is completed, staff will add the site to their periodic inspection schedule until a clean history is noted.

2.3.8 OSTDS such as Septic Tanks or Cluster Systems

The entity to involve: FDOH.

Jurisdictional authority: If sewage is observed or smelled, or if a drain field is suspected of failing on a parcel serviced by an OSTDS or cluster system, report the problem to the county FDOH environmental division. It is very helpful to have a representative attend the WTW field event because their authority to investigate if sewage is smelled or directly observed is great for on-the-spot answers. If problems are suspected rather than confirmed, FDOH must first gain permission from the property owner to access private property.

Information and data they may possess: GIS layer of septic tanks. However, the county or city may maintain a more up-to-date layer. FDOH may also possess knowledge of areas with a history of septic system failures or repair permits.

When to engage in the implementation process: MOT and WTW field event.

How the entity can help: FDOH may conduct an OSTDS inspection on a site where failure is suspected with the permission of the owner.

2.3.9 Sanitary Sewer Utility–Owned Conveyances and Components

The entity to involve: Sanitary sewer utility (or utilities).

Jurisdictional authority: Responsible for the sanitary sewer conveyances and components owned by the utility.

Information and data they may possess: Many utilities have a GIS layer of their infrastructure. These professionals can share their knowledge of the age of the infrastructure and the conveyance and manhole construction materials in each neighborhood, conveyance inspection schedules, inspection methods, repair and replacement plans, causes of SSOs, and common locations of SSOs. Sanitary sewer representatives can provide information about utility-owned lift stations such as inspection frequency, what happens if an overflow is impending, whether they are equipped with back-up generators to prevent SSOs during power outages, the means by which staff are notified (telemetry is fast) when there is a problem, and how quickly they respond once notified.

When to engage in the implementation process: MOT and WTW field event.

How the entity can help: Whether the utility is owned by a municipality or a private company, or is a co-operative, sanitary sewer utility leaders and field staff are invaluable. They are most familiar with the industry and can identify a sewage problem faster and more accurately than most stormwater staff.

In the field, the utility is usually willing to pop manhole covers for staff to observe the inside. The construction materials used in manholes and conveyances can indicate their age and potential for structural degradation. The depth of conveyances varies depending on many factors. Therefore, stormwater conveyances may be higher or lower or at similar elevations as the sanitary sewer conveyances. This knowledge helps everyone think through the possibility of cross-contamination.

After the field event, especially if monitoring results suggest a leak, the utility may be willing and able to inspect a portion of its conveyance system using smoke testing and remote television camera technology.

2.3.10 Any Anthropogenic Sources

The entity to involve: County and city code enforcement.

Jurisdictional authority: Enforcement of county or city ordinances.

Information and data they may possess: Code enforcement staff are trained to make observations beneficial to the WTW field event, and they know local and state regulations.

When to engage in the implementation process: WTW field event.

How the entity can help: Staff are rarely available to participate but should be notified in advance of the WTW field event date and its purpose. Carry code enforcement's phone number and call them from the field if something urgent is observed. Often, the MS4 coordinator is also familiar with county and city codes and can stand in for code enforcement during the field event.

2.3.11 Watershed Protection Agencies

The entities to involve: Water management district (WMD), DEP, water control district (WCD), National Estuary Program (NEP).

Jurisdictional authority: WMD – Water consumption, water treatment projects and initiatives, irrigation schedules, flood control; DEP – Water quality assessments, permits regulating stormwater discharges to waters of the state; WCD – Flood control, water quality in stormwater conveyances; maintenance of stormwater conveyances; NEP – Restoring and maintaining healthy estuaries and bays; water treatment projects and initiatives.

Information and data they may possess: Knowledge of some history of the watershed and modifications to the waterbody; laws and regulations on waters of the state and federal waters; may suggest participants and partners who can assist in the restoration effort; knowledge of hydrology and water quality–related subjects.

When to engage in the implementation process: From the very beginning.

How the entity can help: During the MOT and WTW events, staff will ask valuable questions from a watershed management perspective. DEP may be able to assist with monitoring plan development, monitoring efforts, data analysis, minor GIS support, and WTW planning. All the entities in this category may be able to provide outreach assistance and assistance with public education materials.

2.3.12 Watershed Protection Activists and Others

The entities to involve: Environmental concern groups and citizens such as The Nature Conservancy, Audubon Society, River Keeper, Friends of (insert waterbody name), Bream Fishermen's Association, local politicians, universities, citizens, homeowners' associations, and neighborhood outreach coordinators employed by municipalities.

Jurisdictional authority: Not applicable.

Information and data they may possess: Environmental concern groups and citizens, both organized and unorganized, are often very observant and can provide information about site-specific issues and concerns.

When to engage in the implementation process: MOT and post-WTW field event.

How the entity can help: They may provide support with public education, litter pick-up events, and dog waste campaigns. Universities may be able to assist with a portion of the water quality

monitoring, laboratory analysis, and data interpretation. They may also assist in organizing and running think tanks for specific problems.

2.3.13 Potentially Dangerous Neighborhoods

The entity to involve: Florida Fish and Wildlife Conservation Commission (FWCC) officers or another law enforcement entity.

Jurisdictional authority: Environmental and standard law enforcement.

Information and data they may possess: Seek a law enforcement officer who is also trained in environmental law, such as FWCC officers.

When to engage in the implementation process: In advance of the WTW field event.

How the entity can help: If an area of the watershed is known for prolific illegal activity and is potentially dangerous, remember, the safety of the field team is the highest priority. With advance request, law enforcement will sometimes escort and accompany the team.

2.3.14 Military Bases

The entity to involve: Military base.

Jurisdictional authority: Military base stormwater and sanitary sewer management.

Information and data they may possess: Knowledge of base operations and history of the area.

When to engage in the implementation process: MOT and WTW field event.

How the entity can help: Notify and invite participation from military base stormwater and sanitary sewer system managers. The event will inform them about the FIB impairment and associated concerns. If allowed, they may choose to invite a select group of participants to come on base to make observations.

2.4 Tools for Source Identification

The following subsections summarize source identification tools that DEP and stakeholders have found useful. This information is provided to help stakeholders select the tools that work best in their basin. There is no single measure that can be used to identify FIB sources, and an implementation plan should use multiple tools to determine the likely sources in the basin. The results of these assessment methods will provide the basis for selecting management actions (**Section 3.0**) and developing the restoration plan (**Section 4.0**). The data collected using the tools in this section should be compiled and analyzed with the previously gathered GIS data to determine the completeness of the database.

As you read this section, keep in mind that new tools are continually being developed to identify bacteria sources in waterbodies. A few options are described here, but there may be many other

excellent alternatives. Please write to us and let us know about methods you have used so we can share them in the next version of this document. Feel free to contact DEP (at anita.nash@dep.state.fl.us, kevin.coyne@dep.state.fl.us, or daisys.matthews@dep.state.fl.us) to discuss any of the tools you are considering.

2.4.1 WTW Process

The WTW is an informed field reconnaissance effort to gain a better understanding of a watershed, including the hydrology of the basin and its contributing branches, where infrastructure (sewer and stormwater) is located, and what potential sources are contributing bacteria to the waterbody. This activity is a useful tool for impaired waterbodies where the source (or sources) of the FIB loading is not readily apparent. **Appendix C, Source Identification**, contains detailed information on the WTW process. Feel free to contact DEP (at anita.nash@dep.state.fl.us or kevin.coyne@dep.state.fl.us) for guidance about the process as needed. The WTW steps are as follows:

- A representative from the entity leading the WTW, referred to here as the lead, will identify stakeholders with jurisdictional authority in the watershed. For additional information, see the TMDL report for a specific waterbody and **Section 2.3** above.
- The lead will gather and review available data. See **Section 2.2** for a list of the types of data that may be helpful.
 - The lead will compile a GIS database and then create large-format maps in preparation for the MOT meeting. See **Appendix C, Source Identification**, for a GIS symbology package and guidance on which components of the stormwater and sanitary sewer to show for this exercise.
 - The lead will review the available monitoring data and determine whether more data are needed to identify hot spots.
 - The lead will review recent SSO information.
- The lead will host an MOT meeting, as follows:
 - To ensure interested parties attend, notice the public meeting. Call and send invitations directly to the staff of necessary divisions and departments requesting confirmation of their participation. See **Section 2.3** for guidance on participants to include in the meeting.
 - All jurisdictional entities should be represented. Other stakeholders and citizens should be given the opportunity to provide input at this meeting or at a second MOT meeting geared toward citizen participation. The impairment and WTW process are introduced, and a review of existing data is presented. Participants are then strategically broken into groups of six or less per table.

- Next, the lead calls out potential sources, and all participants are asked to mark the maps to document the locations of these potential sources based on recent observations. For example, this may include areas where storm sewer and sanitary sewer lines may be close to each other, areas of homeless activity, routes used intensively for dog walking, large stormwater culverts and ponds discharging to surface water, areas where businesses may be releasing waste, etc.
- A note taker at each table is asked to capture the information on a notepad in such a way to tie the notes to the locations marked on the map by participants.
- Each table presents its notes and locations to the room to further discussion and to share knowledge. This process results in the identification of specific areas for field investigation.
- The meeting concludes with a discussion of logistics for the WTW field event.
- After the meeting is a good time for key representatives to choose monitoring locations for a one-time watershedwide monitoring effort to precede the WTW field event.
- The lead will combine the notes from the MOT meeting into one list and will transfer locations to one map.
- Reconnaissance is carried out as follows:
 - The lead will take the compiled MOT documentation into the field to conduct a preliminary reconnaissance of the watershed before the group field investigation. Unless the watershed is too large, the entire watershed and waterbody should be covered during the one-day group field event. Therefore, a lot of planning is essential.
 - Determine whether areas noted during the MOT may or may not warrant investigation during the group field event. Investigate locations from the MOT that are difficult to access or where more information is needed before taking the group to the site.
 - Choose a route for the field event.
 - Choose a lunch break location with shade and restrooms. Because of time constraints (30 minutes for lunch is ideal), restaurants may not be the best option for a lunch stop. Parks along the waterbody are ideal to continue participant focus on the FIB issue.
- A one-time water quality monitoring event throughout the watershed, approximately 11 sites per WBID, is recommended approximately 2 weeks before the WTW field event. These results (preliminary results are acceptable)

should be used in conjunction with past results to help focus activities on the WTW field day. Monitor for *E. coli* bacteria in Class 3 fresh waters and *Enterococci* in Class 3 marine waters. Monitoring for more specific analytes can be helpful but is more expensive. It is okay to reserve the use of these analytes for a more targeted monitoring event later.

- The WTW field day!
 - The field day is a single all-day event.
 - All key jurisdictional stakeholders need to be represented. Typically, field staff with local knowledge participate, and in the case of public works the supervisors also usually come along.
 - All representatives will ride in one vehicle (usually a 12-passenger van). We've used trolleys, too. The vehicle will stop frequently, participants will get out, walk, make observations, take notes and photos, and note locations on the maps.
 - Collaboration, stronger relationships, and a better understanding of each other's needs and abilities occur between participating agencies. This happens primarily in the van and to a certain extent in the field, making it vital for entities to be represented and riding **in the van for the entire day**. Staff on call often follow the van in a utility work truck, but their supervisors ride along in the van to participate in conversation.
 - Citizens are rarely encouraged or allowed to participate in the field event for safety and insurance reasons. However, citizen input is invaluable. Citizens will have the opportunity to attend a follow-up meeting. The team will drive and walk the watershed and waterbody making observations, taking photographs, documenting global positioning system (GPS) points, and making notes about problems that may be potential or confirmed FIB sources. The team should investigate any potential sources. This can include identifying sewer infrastructure (such as manholes and pump stations, and sewer lines crossing creeks) and inspecting for signs of recent overflows, MS4 conveyances that need cleaning, failing septic tanks, evidence of wildlife, heavy tree cover or vegetated ditches, evidence of homeless populations, and pet and livestock sources. Recommended locations to be added to the monitoring plan should also be noted. Care should be taken to ensure that only appropriate representatives access private property, unless the property owner has offered access to the entire team.
 - While in the field, participants will call and report problems to appropriate agencies if immediate responses are needed to address problematic observations such as an illicit connection, SSO, or dangerous substance

spill. This provides immediate responses while allowing the team to continue investigating the watershed.

- Following the event, the lead will draft a report to summarize the WTW efforts and findings. Near the end of the report is a table of action items to address anthropogenic potential and confirmed sources. Responsible entities are noted for each action item. Sometimes the lead is unsure of the responsible entity, and so one should be delegated. If the issue is later determined to fall under the jurisdiction of another entity, the table should be updated and comments should be used to explain the update. Follow-up activities often include the need for further field investigations, sometimes by boat, of areas that could not be explored during the big field event. Follow-up investigations can usually be carried out by one or two people. Sometimes follow-up actions include additional monitoring targeting an area of concern. Many follow-up activities consist of two parts. The first addresses an immediate need, such as removing trash that impedes flow or removing an illicit connection. The second part consists of long-term programmatic improvements, such as prescribing an increased frequency of trash removal at a specific location or increasing the frequency of illicit connection investigations in an area.
- Participating entities have the opportunity to review and edit or correct the report before it is finalized.
- The lead should track action items as problems are fixed and as programs are enhanced or developed, noting the date the action item was completed or initiated and the magnitude of the change, such as increasing street sweeping from monthly to weekly.
- A follow-up meeting is recommended to present the results of this effort. Citizens are encouraged to participate in the meeting and provide feedback.

Collaboration and the exchange of information will continue to occur long after the field event as a result of these efforts. Participants generally report stronger relationships and experience a shared understanding and ownership of the bacteria problem and the restoration efforts. Many recommend WTW for all their impaired creeks, and they often remark that this exercise should be repeated at least every five years or more often.

2.4.2 Pollution Assessment Monitoring and Field Work

The assessment and direct identification of FIB sources are complicated by many variables inherent in the use of indicator organisms and by the dynamic nature of microbial populations in various substrates and environmental conditions. **Appendix C, Source Identification** (Lower St. Johns Tributaries Pollution Assessment Manual), outlines methods for assessing, tracking, and mitigating fecal microbial contaminants in surface waters. It also presents the results of research in microbial source tracking (MST) in the context of guidelines for assessing and developing corrective actions for FIB-impaired waterbodies. Information on using chemical analytes such as

sucralose and acetaminophen that are specific to human waste is also provided in separate documents in **Appendix C**.

2.4.2.1 Developing a Monitoring Plan

The water quality monitoring plan is an important component of the restoration plan because it is used to measure progress towards meeting the TMDL and water quality targets. The first step in preparing a monitoring plan should be to gather information on existing sampling from the stakeholders conducting the monitoring in the watershed. Important monitoring information includes the station name, station location, parameters sampled, frequency of sampling, period of record, and responsible entity.

When developing the monitoring plan, several key items should be considered, including the following:

- The parameter(s) addressed in the TMDL implementation plan. Florida no longer assesses waterbodies for fecal coliform. For fecal coliform TMDLs, it is almost always more useful to monitor instead for the applicable FIB described in the current state rule (**Appendix A, Fecal Indicator Bacteria Criteria**).
- Goals and objectives for the monitoring, such as the following:
 - To identify sources.
 - To determine the success of the TMDL implementation plan core (such as *E. coli* or *Enterococci*) and supplemental parameters that should be assessed related to the impairment.
- Monitoring frequency (monthly is ideal for repetitive monitoring).
- Any important assumptions made in the development of the TMDL.
- DEP has learned over time that some previously monitored stations are not ideal for bacteria monitoring. Assess the monitoring stations before committing to them for the monitoring plan. Ideal stations to represent the waterbody should have the following conditions:
 - Steady flow.
 - Regular flushing.
 - Deeper than 10 centimeters (cm).
 - Open without floating, emergent, and submergent plants.
- The sampler should be able to acquire the water sample without disturbing the sediment, seawall, culvert, plant life, and trash. Biofilms form on objects in the water. Disturbing them can disturb the biofilm and suspend bacteria in the sample water, thus inflating the results. The results would not be

representative of the water column in the waterbody, which is what the water quality criterion is written to address.

- Strategies for any monitoring plan should consider the following concepts:
 - Seasonal human use of the watershed or waterbody such as colleges, vacation homes, retiree neighborhoods, and parks.
 - Seasonal bird populations, such as nesting rookeries, or animals that are fed by seasonal vacationers (for example, Muscovy ducks, seagulls, and geese).
 - Part-time livestock populations on farms or at fairgrounds and other arenas.
- The time of day you plan to monitor may need to correspond with the following:
 - The end of an outgoing tide to represent upstream water quality.
 - Times when bathrooms are being used heavily, such as mornings before work and school, evenings after work, weekends, etc.
 - The placement of monitoring stations so that if high results come back, the location of the source can be easily narrowed down.
- Consider how to include all responsible entities.

The data collected as part of the monitoring plan are required to meet DEP standard operating procedure (SOP) requirements for quality assurance/quality control (QA/QC). The [most current version](#) of these procedures is available online. DEP will determine the usability of the data received following the guidelines in [Process for Assessing Data Usability \(DEP-EA 001/07\)](#). A QA plan and calibration logs should also accompany records of the monitoring program. Ambient water quality data should be uploaded to the state's water quality [Storage and Retrieval \(STORET\) Database](#), soon to be replaced by the DEP Watershed Information Network (WIN). Data collected from monitoring performed to trace hits to a source should be flagged as such.

Table 1: Example of sampling parameters for a FIB monitoring plan

Water Quality Indicators	Field Parameters
<i>Enterococci</i> , <i>E. coli</i> , or fecal coliform (see water quality criteria to determine what parameters will be assessed) Example of additional parameters: Human waste indicators: Sucralose, acetaminophen, qPCR HF-183 (MST marker)	Dissolved oxygen Dissolved oxygen saturation pH Conductance or salinity Temperature Turbidity Air temperature Cloud cover Rainfall Tide stage Canopy cover Water flow condition Wind

A useful document to consult while preparing the monitoring plan is the U.S. Environmental Protection Agency (EPA) document, [Elements of a State Water Monitoring and Assessment Program](#), which includes the following 10 essential elements for a monitoring plan:

- Monitoring program strategy.
- Monitoring objectives.
- Monitoring design.
- Core and supplemental indicators of water quality.
- Quality assurance.
- Data management.
- Data analysis/assessment.
- Reporting.
- Programmatic evaluation.
- General support and infrastructure.

An example of a water quality monitoring plan can be found in Section 4.2 of the [Lower St. Johns River Tributaries BMAP](#).

2.4.2.2 Repetitive Monitoring

Many sampling entities monitor ambient water quality monthly or quarterly year after year. Think of it as checking the pulse of the waterbody. This repetitive sampling can be plotted to determine the general range of bacteria levels. Statistically significant trends can be determined using a very large amount of data, but statistical trends are not necessary to gain a sense of recent

conditions. Water quality may spike occasionally while remaining low around the criterion on a regular basis.

If results remain high or continue to climb, there may be a persistent problem. The high results may be source related or caused by poor sampling conditions or techniques. For instance, if plants or sediment are disturbed, biofilms from these surfaces may come loose and become suspended in the sample water. Thus, it is important to review monitoring stations and techniques and determine if improvements can be made. Once this concern is satisfied and if high results persist, further source identification efforts are necessary to restore the waterbody.

2.4.2.3 Triggered Follow-Up Monitoring

One option for gathering additional data is to adopt responsive monitoring protocols. For example, conduct immediate follow-up sampling and field investigations triggered by high FIB monitoring results. This technique is used in the [Lower St. Johns River Tributaries BMAP](#) and follows the protocol outlined in the Lower St. Johns Tributaries Pollution Assessment Manual in **Appendix C, Source Identification**, discussed above. In this protocol, fecal coliform samples are collected monthly at set stations in the tributaries, and if the preliminary results of the samples are greater than 5,000 counts per 100 milliliters (mL) (assumed to be mainly from human sources), crews return to the field immediately and collect additional samples upstream and downstream of the location of the recent high-count station in an effort to locate the source. This responsive targeted monitoring continues until the source is identified or the high results no longer persist.

DEP is looking for documentation to support the development of response thresholds for *E. coli* and *Enterococci* and will update this document as they are identified. Meanwhile, a general rule of thumb is that if you know the typical levels of bacteria and a recent sample is two magnitudes above the typical levels, an immediate field investigation and investigative follow-up sampling are an appropriate response.

2.4.2.4 Human Waste–Specific Chemical Analytes

Sucralose and acetaminophen are very effective in indicating the presence of human waste in ambient water samples. Entities are adding these analyses to their TMDL implementation monitoring plans. **Appendix C, Source Identification**, contains more information.

2.4.2.5 MST

If you suspect that human or animal waste is contributing to the FIB impairment, MST can be very useful in confirming a source. MST has been used in the Hillsborough River and Lower St. Johns River Tributaries Basins. Studies in these basins used human, ruminant, and horse indicators. **Appendix C, Source Identification**, contains examples of MST studies used in BMAP documents.

Users of MST analysis should be aware that a lack of hits for bacteria from a specific animal in a few samples does not rule out that species as a source. A lot of data is needed to draw conclusions to rule out sources. Rather, MST is best used to confirm a source. Because it is

expensive, managers may consider using MST monitoring at identified hot spots. Additional information on MST may be found at websites for laboratories who offer this analysis, the [U.S. Geological Survey \(USGS\) website](#), and vendor laboratories.

2.4.2.6 Thermal Imaging

Also, in the Lower St. Johns River Tributaries Basin (see **Appendix C, Source Identification**), thermal imaging was used to identify inputs that could be FIB sources to several creeks. This process uses the differences in temperatures between the warmer inputs and the cooler creeks in winter. The warmer inputs to the creeks can come from a variety of sources, including natural sources, such as groundwater; residential sources, such as water from heat pumps; and illicit connections conveying pollutants. In association with the thermal imagery, it is helpful to conduct sampling before and after the flyover to help correlate FIB counts to the anomalies found through the imaging.

2.4.2.7 Optical Brighteners

Optical brighteners such as those found in laundry detergents fluoresce under UV light. There are methods for deploying a material, such as cotton, for a period and later testing it for brighteners that cling to cotton. Optical brighteners may not be the best option in Florida's dark-colored rivers because humic and tannic acids overshadow the fluorescing brightener, interfering with the results.

2.4.2.8 Sewage-Sniffing Dogs

Yes, you read that correctly. At least one [company trains dogs to sniff out sewage sources](#). They walk the dogs along creeks and ditches to identify problem locations. Alternatively, water samples can be gathered from multiple locations, each in a separate container, and then brought to a parking lot. The samples are placed on the ground, lids off, and the dogs signal which samples contain sewage. The latter option may be safer for the dogs because Florida waterbodies can contain dangerous reptiles. Using the dogs for this purpose also makes for interesting press stories and brings awareness to the community about the impairment and restoration efforts.

2.4.3 Decision Matrix and Ranking Tool

A decision matrix and ranking tool assists local stakeholders in determining the level of impairment in a waterbody and guides management actions to address FIB impairments. This decision-support tool incorporates fecal coliform levels, the presence and relative magnitude of human fecal contamination, and other potential sources of human pathogens. **Appendix B, Prioritization and Decision Matrix**, provides more detailed information on the tool and how to develop a site-specific matrix.

2.4.4 Wildlife Surveys

In some areas, wildlife can be a significant FIB source, especially in watersheds with significant acreages of wetlands, upland forest, or wooded corridors. While wildlife is a contributing source of FIB loading to a waterbody, this is considered a background concentration. Stakeholders are not asked to remove or discourage native wildlife in and near waterbodies. However, it is helpful

to record instances or indicators of wildlife to help correlate potential sources with FIB concentrations.

Wildlife surveys can be used to help determine what portion of the FIB impairment might be attributed to natural conditions. Information on and methods for conducting these surveys are provided at the following websites:

- [UF–IFAS Extension Electronic Data Information Source \(EDIS\), Wildlife Conservation and Ecology website.](#)
- [Florida Monitoring Program: Point Count Method To Survey Birds](#) (M.E. Hostetler and M.B. Main).
- [Breeding Season Survey Techniques for Seabirds and Colonial Waterbirds throughout North America](#) (M. Steinkamp, B. Peterjohn, V. Byrd, H. Carter, and R. Lowe).

3.0 Management Actions

Once the watershed has been evaluated using one or more of the tools described in **Section 2.0** to identify potential sources, the responsible stakeholders must implement management actions to address these sources. If an assessment of existing efforts by stakeholders in the basin demonstrates that current practices are sufficient to address the potential sources, then this should be documented and monitoring begun to ensure that the necessary FIB reductions are occurring.

However, if additional work is needed to address the impairment, the stakeholders should develop a restoration plan that describes the additional management actions that will be implemented and timelines for completion. The sections below include examples of the projects and programs that have been used in other basins to reduce FIB loading. The identified FIB source guides the most appropriate management actions to be taken.

3.1 Projects and Activities

Many different types of activities can be implemented to address potential FIB sources. Once the potential sources have been evaluated, the appropriate projects to address those sources can be identified. The following sections discuss examples of management actions to address FIB.

3.1.1 Structural Activities

Several types of stormwater and sanitary sewer structural projects can help to reduce FIB loading. Flood control projects are one option. Not only do these projects reduce the amount of nonpoint source pollution to a waterbody after a rain event, they also prevent flooding in septic tank areas, alleviating conditions that can cause septic tank failures. In addition, flooding can cause infiltration of the sanitary sewer system, leading to overflows. Therefore, controlling flooding also benefits the sewer system.

Several types of standard stormwater treatment BMPs, such as wet ponds and swales, can reduce FIB loading. These projects capture and treat stormwater before it is discharged to surface waters.

Upgrades to the sanitary sewer system can reduce FIB levels. Replacing and upgrading old sewer lines, rehabilitating or relining manholes, rebuilding pump stations, and replacing air release valves (ARVs) are types of projects that make the system more efficient and reduce the likelihood of an SSO from faulty infrastructure.

If large numbers of OSTDS are failing, a solution may be developed that is more effective than individual repairs. For example, drain field enhancements, such as adding treatment tanks or supplementing the drain field media, can be done to improve treatment. Mounding drain fields removes them from the surficial groundwater table and potentially flooded areas. A passive [nitrogen reduction study by FDOH](#), available online, describes a few affordable options for enhancing OSTDS. Work closely with FDOH to ensure the proposed OSTDS modifications can be permitted before constructing. Experts at the [Florida Onsite Wastewater Association, Inc.](#) can

assist with OSTDS-friendly solutions. If improvement is not possible, consider replacement with a better system. If necessary, phasing out septic tanks may be an option if sanitary sewer is available.

3.1.2 Nonstructural Activities

The following sections outline several types of nonstructural activities that address FIB loading.

3.1.2.1 Inspection and Maintenance Programs

Implementing inspection and maintenance programs can proactively identify and prevent problems with infrastructure before the problems result in water quality issues. If these programs already exist, it may be beneficial to shift inspection schedules to target the impaired watershed as soon as possible.

Private lift stations can be a significant source of FIB loadings and should be identified, an inventory should be developed, and an inspection program should be implemented. Many WTW processes around the state have identified neglected private lift stations as sources. A private lift station inspection program is an effective way to ensure the stations are maintained and operating correctly. Entities can adopt local ordinances requiring certified operators to maintain private lift stations.

For sanitary sewer systems, inspections should include the pipes, manholes, ARVs, and lift stations. These important components of the collection system all need to be inspected and maintained regularly to prevent breaks and overflows of sewage. Any part of the system identified as compromised (i.e., tuberculated pipe, leaking ARVs, broken lift station components) should be rehabilitated, repaired, or replaced to prevent failures.

Stormwater conveyance systems should also be inspected regularly to ensure they are free of trash and debris. All ditches, canals, ponds, pipes, inlets, catch basins, and outfall structures that make up the stormwater system should be maintained regularly. During the inspection and maintenance efforts, any potential illicit discharges should be identified and followed up on to ensure that the connection is not contributing FIB to the conveyance system. Entities can add natural creeks to their IDDE inspection schedules if it is deemed necessary based on field investigations.

An inspection and maintenance program is also important for septic tanks to ensure they are functioning properly and to identify any repairs needed on the systems. FDOH–Duval County has been inspecting OSTDS in FIB-impaired WBIDs for many years.

Increasing collaboration with inspection entities will strengthen the plan’s effectiveness. This can be done through frequent discussions initiated by the lead coordinator. Code enforcement, FDOH, and DBPR should be made aware of the impairment and restoration efforts for the watershed. Frequent communication about the issues they are seeing in the field may provide

insight to the lead coordinator. Likewise, discussions with wastewater managers may also continue progress. [FDACS](#) and UF–IFAS make frequent field visits and may provide insight.

3.1.2.2 Social Marketing

Public education and outreach inform the public about FIB sources and how to prevent these sources from impacting waters in their area. Social marketing is a combination of public education and other messaging and strategies to change behavior. These efforts could help to reduce FIB loading to a waterbody. Examples of these efforts include the following:

- Public service announcements (PSAs) on local cable or commercial television and radio stations. PSAs can be developed locally—for example, the [Think About Personal Pollution Campaign](#) by the city of Tallahassee. PSAs are available through the University of Central Florida (UCF) [Stormwater Management Academy](#). One example of a [PSA about dog waste](#) was developed by the City of Dunedin after a WTW on Cedar Creek.
- Informational pamphlets and/or presentations on pollution prevention, septic tank maintenance, and pet waste management. The *Stormwater Education Tool Box* is available online from the UCF [Stormwater Management Academy](#).
- Websites to provide information on reducing FIB pollution for homeowners and businesses.

Be sure to research effective and audience-sensitive social marketing before choosing a strategy.

3.1.2.3 Ordinances

Adopting and implementing rules or ordinances can give local governments the additional authority needed to achieve FIB reductions.

A septic tank ordinance to address FIB loading involves several different measures. It could require inspections on a set schedule, and a requirement that the tanks must be pumped out every five years with a notice to the local government that this maintenance occurred. The ordinance could require a greater distance between the septic system drain field and the groundwater table and/or surface waters to reduce the loading of bacteria that travel directly from the septic system to groundwater or surface water. The ordinance might also require septic tanks in certain areas to be advanced treatment systems, which provide a higher level of wastewater treatment. Another option is to require septic tanks to be connected to the sanitary sewer system, where the sewer lines are available. This can occur when a septic tank has failed, when a property with a septic tank has changed ownership, or in areas near impaired waterbodies where the sewer system would provide better treatment.

A pet waste management ordinance is another important step to address FIB pollution. It requires residents to pick up and properly dispose of pet waste. To help implement this ordinance, local

governments could provide pet waste stations with bags and trash cans in areas where residents typically walk their dogs. The local government could also implement a fine for not complying with the ordinance as an incentive for residents to pick up after their pets.

3.1.2.4 Fats, Oils, and Grease (FOG) Program

FOG generated during food preparation builds up in sanitary sewer lines. Without proper maintenance, these lines clog, eventually leading to the occurrence of SSOs. Creating a FOG Program can help to reduce the amount of commercial grease dumped into the sewer system, preventing clogs and reducing the number of SSOs and FIB discharges to the watershed. This program would be required for food service establishments, and they would need to pump out their systems regularly. Failure to meet the pump-out requirement would result in enforcement actions, such as an initial notice of violation, followed by a cease and desist order, and finally the emergency suspension of service for establishments that fail to comply with previous actions.

3.1.2.5 Root Cause Program

When an SSO is reported, the assumption made about the cause of the overflow may be incorrect. To properly address the problem and prevent future issues, it is important to identify the root (actual) cause of the SSO. A root cause program would allow the utility to determine the best short- and long-term corrective actions to prevent the problem from reoccurring. In areas where this program has been established, a committee should be formed to meet periodically to determine the root cause of the SSOs. The purpose of this committee is to identify key issues across the system to better prioritize resources for the maintenance, repair, and replacement of sewer infrastructure and to prevent future issues with the system.

3.2 Project Selection Process

While all of the management actions described above are useful to reduce FIB loading, the stakeholders will need to choose a combination of these activities based on the conditions in the watershed. Management actions must be selected to address the potential sources identified during the basin evaluation process. Projects can be most effective in areas that do not already have stormwater treatment and in areas with older sewer or septic tank infrastructure that could be upgraded or replaced. Adding stormwater treatment to flood-prone areas would help to reduce FIB loading from stormwater runoff and any septic tanks in the area, while also reducing the amount of infiltration in the sanitary sewer system. The stakeholders should analyze the costs and benefits of the projects to select the most cost-effective options. Once the projects have been selected, a timeline for project implementation should be determined, in coordination with DEP, to provide a reasonable schedule to achieve water quality benefits.

Chapter 11 of the [Lower St. Johns River Tributaries BMAP](#) provides a good example of how all of the above considerations come together to form a plan for restoration activities.

3.2.1 Summary of Potential Sources and Management Actions

To determine if the identified management actions are sufficient to address the potential FIB sources in the watershed, the information on sources and actions should be summarized in a format that aids in evaluation. Each stakeholder should provide information on past and current projects and programs, as well as any planned projects and programs that could reduce FIB loading. These efforts should be matched to the potential FIB source(s) addressed. Summarizing the existing and planned management actions compared with the confirmed and potential sources in the watershed is helpful in identifying any sources that are not adequately addressed.

Tables 1a through **1e**, based on those in the Lower St. Johns River Tributaries BMAP, illustrate how the efforts in the basin can be summarized. These tables include the responsible entities, as well as the potential sources and types of management actions to address those sources. Under each entity, the following symbols can be placed in the tables to explain the level of effort:

- A check mark ("√") denotes an activity that the entity currently implements or plans to implement in the near future.
- A dash ("-") denotes an activity that the entity currently does not implement in the basin but could be an option for that entity to implement if additional actions are needed.
- An "X" denotes an activity that is not the responsibility of that entity (note those boxes can also be shaded to help illustrate what activities are and are not the responsibility of that entity).

Table 2: OSTDS sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Ordinances	√	X	X	X
Enforcement	√	√	X	X
Program Implementation	√	√	X	X
Permit Review (new and repair permits)	X	√	X	X
Failure Area Evaluation	√	√	X	X
Failure Area Ranking	√	√	X	X
Septic Tank Inspection	√	√	X	X
Septic Tank Phase-Out	√	√	X	X
Septic System Upgrade	√	√	X	X
Public Education (PSAs)	√	X	X	X
Surface Water Sampling for Conditions and Trends	√	X	X	X

Table 3: Sewer system sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Sewer Line Upgrades	X	X	X	√
Manhole Inspection and Rehab	X	X	X	√
Pump Station Inspection and Maintenance	X	X	X	√
Pump Station Rebuild	X	X	X	√
ARV Inspection and Rehab	X	X	X	√
Program Implementation	X	X	X	√
Private Lift Station Inspections and Enforcement	√	X	X	X
SSO Investigations	√	X	X	√
Surface Water Sampling for Conditions and Trends	X	X	X	√

Table 4: Stormwater sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Flood Control Capital Projects	√	X	√	X
Private Lift Station Inventory	√	X	√	X
Private Lift Station Inspection Program	X	X	X	X
Capital Projects/Stormwater Water Quality BMPs	√	X	-	X
Stormwater System Ditch and Canal Maintenance	√	X	√	X
Stormwater Pond Maintenance	√	X	-	X
Stormwater Pipe Cleaning and Maintenance	√	X	√	X
Potential Illicit Connection (PIC) Identification	√	X	√	X
Illicit Connection Detection and Removal	√	X	√	X
Public Education and Outreach	√	X	√	X
Surface Water Sampling for Conditions and Trends	√	X	√	X
Program Implementation	√	X	√	X

Table 5: Pet waste management sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Ordinances and Enforcement	√	X	X	X
Public Education and Outreach	√	X	X	X

Table 6: Special source assessment sample summary of efforts table

Source/Action	Entity 1	Entity 2	Entity 3	Entity 4
Intensive Water Quality Sampling To Track Sources	√	X	X	X
MST	√	X	X	√

3.2.2 State of Oregon Implementation Matrix Template

To organize source information and project information, the Oregon Implementation Matrix is a good example to follow. Oregon's guidance for developing TMDL implementation plans includes an implementation tracking matrix to assist in describing, tracking, and reporting on TMDL implementation efforts. The Oregon guidance document contains a fecal coliform example of the matrix that serves as another useful evaluation tool for stakeholders. The matrix includes columns for information on the pollutant sources, strategies to control the source, specific projects to address the source, expected resources needed, how implementation will be measured, timeline and milestones, and status of the activity. The matrix is found in Appendix D of the report [TMDL Implementation Guidance for State and Local Government-Designated Management Agencies](#).

3.2.3 Evaluation of Management Actions

Summarizing the existing and planned actions will help stakeholders identify what more needs to be done to address the FIB impairment. All of the stakeholder activities should be organized by the type of source the projects address. Data gaps or uncertainties related to the FIB sources should be identified, and studies planned to address these needs should be included in the TMDL implementation plan.

4.0 Implementation Plan and Documentation

Many people who will use this document are developing a BPCP. The specific elements required in these plans should be discussed with your MS4 permit contact at DEP.

The purpose of this section is to outline the elements that should be included in a TMDL implementation plan. This information will help stakeholders prepare a comprehensive plan to address the FIB impairment to meet the TMDL.

4.1 TMDL Implementation Plan Elements

To ensure that the restoration plan includes all the necessary information to show how FIB sources will be removed or reduced, data gaps will be filled, and the waterbody monitored to show progress towards the TMDL, certain elements must be included. A helpful tool for preparing a restoration plan is the EPA [*Handbook for Developing Watershed Plans To Restore and Protect Our Waters*](#), which outlines the elements essential for a watershed plan, as follows:

- Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan.
- Describe the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated, and identify the critical areas in which those measures will be needed to implement the plan.
- Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied on to implement the plan.
- Develop an information/education component to enhance public understanding of the project and encourage early and continued public participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
- Develop a reasonably expeditious schedule for implementing the nonpoint source management measures identified in the plan.
- Describe interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
- Develop a set of criteria to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the TMDL needs to be revised.

- Develop a monitoring component to evaluate the effectiveness of efforts over time, measured against the state's FIB criteria.

Developing a TMDL implementation plan takes time and dedication. Unlike nutrients and other nonpoint source pollutants, bacteria are very dynamic. A thorough investigation of the watershed, a strong understanding of potential sources, and programs developed to address each potential source are the essential ingredients for an initial restoration plan. Progress toward restoration must be evaluated, and plans must be updated and adapted to meet current needs. It can be overwhelming when one thinks of how many components in a watershed are in need of upgrades and inspections, but don't fret. Having a plan and moving step by step through it will lead to success. Contact DEP (at anita.nash@dep.state.fl.us and kevin.coyne@dep.state.fl.us) for more information.

5.0 Appendices

The following additional documents referenced in the above guidance may be useful to review when preparing a FIB watershed restoration plan. These documents can be obtained by contacting DEP.

- Appendix A – Fecal Indicator Bacteria Criteria.
- Appendix B – Prioritization and Decision Matrix:
 - Hillsborough Decision Matrix.
 - Prioritizing FIB-Impaired WBIDs.
- Appendix C – Source Identification:
 - Walk the WBID.
 - DEP Interpretation of HF-183 Human MST Marker, Sucralose, and Acetaminophen Results.
 - DEP Study Design and Unofficial SOPs for Source ID Monitoring.
 - Lower St. Johns Tributaries Pollution Assessment Manual 2006.
 - Mammalian Survey Techniques.
 - Point Count Bird Surveys.
 - Thermal Imaging Report.
 - EPA MST Guide.
 - GIS – MOT Layer List and Symbology Package.
- Appendix D – Management Strategies:
 - Pet Waste Ordinances.
 - Scoop the Poop Alachua County PSA Information.
 - HF-183 Human MST Marker.
- Appendix E – Evaluating Progress:
 - Annual BMAP Report Template Example.
 - Detailed Description of Statistical Analysis of Bacteria.
- Appendix F – Funding:
 - Creating a Sustainable Watershed Funding Plan 2008.
 - Sample Watershed Funding Plan.
 - Grant Sources: DEP Water Restoration Assistance Handout.

Appendix G: List of Complete Website Addresses

- *Breeding Season Survey Techniques for Seabirds and Colonial Waterbirds throughout North America* (M. Steinkamp, B. Peterjohn, V. Byrd, H. Carter, and R. Lowe):
<http://www.waterbirdconservation.org/pubs/PSGManual03.PDF>.
- City of Dunedin YouTube PSA about dog waste:
<https://www.youtube.com/watch?v=U9FxFBREISA>.
- City of Tallahassee Think about Personal Pollution Campaign website:
<http://www.tappwater.org/>.
- CommunityWalk website: <http://www.communitywalk.com/>.
- DEP websites:
 - BMAPs: <http://www.dep.state.fl.us/water/watersheds/bmap.htm>.
 - Final TMDL documents:
http://www.dep.state.fl.us/water/tmdl/final_tmdl.htm.
 - Florida STORET Database public access website:
<http://prodenv.dep.state.fl.us/DearSpa/public/welcome>.
 - Lower St. Johns River Tributaries BMAP:
<http://www.dep.state.fl.us/water/watersheds/bmap.htm>.
 - NNC Tracker:
<http://fdep.maps.arcgis.com/home/item.html?id=da661fe32e9d49b6a0c2706a42d4782c>.
 - QA/QC SOPs and quality manuals:
http://www.dep.state.fl.us/labs/library/lab_sops.htm.
 - *Process for Assessing Data Usability (DEP-EA 001/07)*:
http://mytest.sfwmd.gov/portal/page/portal/xrepository/pdf2/usability_doc.pdf.
 - Program for MS4s:
http://dep.state.fl.us/water/stormwater/npdes/ms4_1.htm.
 - Surface Water Quality Standards, Chapter 62-302, F.A.C.:
<https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-302>.
 - Impaired Surface Waters Rule, Chapter 62-303, F.A.C.:
<https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-303>.
 - TMDLs, Chapter 62-304, F.A.C.:
<https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62-304>.
 - TMDL Program: <http://www.dep.state.fl.us/water/tmdl/>.

- Environmental Canine Services, LLC website:
<http://www.ecsk9s.com/home.html>.
- EPA documents:
 - *Elements of a State Water Monitoring and Assessment Program*:
<https://archive.epa.gov/water/archive/web/html/statemonitoring.html>.
 - *Handbook for Developing Watershed Plans To Restore and Protect Our Waters*: <https://www.epa.gov/polluted-runoff-nonpoint-source-pollution/handbook-developing-watershed-plans-restore-and-protect>.
- FDACS OAWP website: <http://www.freshfromflorida.com/Divisions-Offices/Agricultural-Water-Policy>.
- FDOH nitrogen reduction study: <http://www.floridahealth.gov/environmental-health/onsite-sewage/index.html>.
- *Florida Monitoring Program: Point Count Method To Survey Birds* (M.E. Hostetler and M.B. Main): <http://edis.ifas.ufl.edu/uw140>.
- Florida Onsite Wastewater Association, Inc. website:
<http://www.fowaonsite.com/services>.
- Google: <https://accounts.google.com/SignUp?hl=en>.
- Oregon Department of Environmental Quality website on TMDL implementation guidance for state and local government-designated management agencies:
<http://www.deq.state.or.us/wq/tmdls/implementation.htm>.
- UCF Stormwater Management Academy website: <https://stormwater.ucf.edu/>.
- UF–IFAS Extension, Electronic Data Information Source (EDIS), Wildlife Conservation and Ecology website:
http://edis.ifas.ufl.edu/departments/wildlife_ecology_and_conservation.
- USGS Microbial Source-Tracking and Detection Techniques website:
<http://water.usgs.gov/owq/microbial.html>.