Draft

Fecal Indicator Bacteria TMDLs for the Everglades West Coast Basin

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Executive Summary

Florida classifies its surface waters into seven categories, each with specific water quality criteria to protect various designated uses such as potable water supplies, shellfish harvesting, recreation, and fish and wildlife maintenance. The most stringent criteria apply to Class I waters, while Class V has the least. Waters may be classified as marine or freshwater based on chloride concentration or specific conductance. Florida sets fecal indicator bacteria (FIB) criteria to protect recreational uses, with separate standards for freshwater (*Escherichia coli* [*E. coli*]) and marine waters (enterococci). These criteria include both monthly geometric means and ten-percent threshold values to account for long-term water quality and short-term spikes. Class II waters also have a criterion for fecal coliform bacteria to protect shellfish harvesting uses in marine waters. If waters fail to meet these criteria, they are considered impaired, triggering the need for Total Maximum Daily Loads (TMDLs) to restore water quality. TMDLs address both components of the FIB criteria, and stakeholders can propose alternative restoration plans if they demonstrate the necessary capabilities to implement them. The report identifies impaired waterbody segments, in the Everglades West Coast Basin, that require TMDLs for FIB.

FIB Total Maximum Daily Loads (TMDLs) establish the maximum allowable pollutant levels to surface waters to ensure water quality standards are met. For FIB impairments, the TMDLs are based on the achievement of the applicable FIB water quality criteria, which include specific limits for *E. coli*, enterococci, or fecal coliform bacteria (**Table EX-1**). The TMDLs assigned to each impaired water segment are provided in **Table 5.1**. The TMDL allocations are expressed as daily and monthly allowable loads for each source category, and the TMDL is achieved when waterbodies consistently meet the specified FIB criterion.

The report also provides general information on common bacteria sources. This information serves as an aid for developing TMDL implementation strategies to control pollution.

Table EX-1. Expression of TMDL components for impaired FIB parameters in the Everglades West Coast Basin.

[1] F = Fresh; M = Marine

[2]The concentration-based fecal indicator bacteria TMDLs can be converted into a daily load expression by multiplying the applicable water quality criterion by the daily average volumetric flow representative of the water segment and the appropriate conversion factor. In this equation, flows may be determined from direct measurements or derived from calculation methods following generally accepted scientific procedures.

[3]Daily Q_{WLASW} = Total daily runoff from all MS4 urban areas conveyed through permitted storm water structures; MonthlyQ_{WLASW} = Total monthly runoff from all MS4 urban areas conveyed through permitted storm water structures

[4]DailyQ_{LA} = Total daily flow from all nonpoint sources; MonthlyQ_{LA} = Total monthly flow from all nonpoint sources.

Water-body Class[1]	FIB Parameter	$TMDL_{ind}$ (TPTV of MPN or MF counts/100mL) [2]	$TMDL_{geo}$ (Monthly Geometric Mean of MPN or MF counts/100mL) [2]	WLA for Waste-water (counts)	WLA for NPDES Storm-water (counts/day) [3]	LA (counts/day) [4]
III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
II, III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
II	Fecal Coliform	43 MPN	NA	Meet Permit Limits	43 x Daily Q_{WLASW}	43 x Daily Q_{LA}

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List of Abbreviations and Acronyms

µmhos/cm	Micromhos Per Centimeter
BPCP	Bacteria Pollution Control Plan
BMAP	Basin Management Action Plan
BMP	Best Management Practice
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
Counts/100mL	Counts Per 100 Milliliters
CWA	Clean Water Act
DEP	Florida Department of Environmental Protection
E. coli	*Escherichia coli*
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
DACS	Florida Department of Agriculture and Consumer Services
FIB	Fecal Indicator Bacteria
F.S.	Florida Statutes
FWRA	Florida Watershed Restoration Act
GIS	Geographic Information System
HUC	Hydrologic Unit Code
IWR	Impaired Surface Waters Rule
LA	Load Allocation
MF	Membrane Filter
mg/L	Milligrams Per Liter
MPN	Most Probable Number
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
OSTDS	Onsite Sewage Treatment and Disposal System
PLRG	Pollutant Load Reduction Goal
PRP	Pollutant Reduction Plan
SSAC	Site Specific Alternative Criteria
SSO	Sanitary Sewer Overflow
SWIM	Surface Water Improvement and Management (Program)
TPTV	Ten Percent Threshold Value
TMDL	Total Maximum Daily Load
USGS	U.S. Geological Survey
WBID	Waterbody Identification (Number)
WLA	Wasteload Allocation
WWTF	Wastewater Treatment Facility

Chapter 1: Introduction

1.1 Purpose of Report

This report presents the total maximum daily loads (TMDLs) for individual waterbody segments, identified by waterbody identification numbers (WBIDs) that are impaired for fecal indicator bacteria (FIB). These WBIDs do not meet the applicable water quality criteria for *Escherichia coli* (*E. coli*), enterococci, or fecal coliform bacteria. The state uses *E. coli* bacteria in fresh waters, enterococci bacteria in estuarine or marine waters, and fecal coliform bacteria in marine waters designated for shellfish harvesting (Class II) waters as indicator organisms for the presence of potentially harmful pathogens.

In addition to the adopted load allocations, for informational purposes each FIB TMDL analysis includes an overall percent reduction in bacteria counts for the impaired WBID needed to achieve the applicable criteria (the TMDL restoration target), found in the state's Surface Water Quality Standards (paragraphs 62-302.530(11)(a)–(d), Florida Administrative Code [F.A.C]). The needed percent reduction to achieve the target concentration is calculated for each impaired waterbody to show the difference between the existing FIB concentrations and the applicable target concentrations for verified impaired waters. Percent reductions are not part of the proposed TMDLs and presented for information purposes only. This report includes information to help identify potential sources contributing to the impairments.

1.2 Statutory Requirements and Rulemaking History

Section 303(d) of the federal Clean Water Act (CWA) requires states to submit to the U.S. Environmental Protection Agency (EPA) lists of surface waters that do not meet applicable water quality standards (impaired or threatened waters) and establish a TMDL for each pollutant causing the impairment of listed waters on a schedule. DEP has developed such lists, commonly referred to as the 303(d) list, since 1992.

The Florida Watershed Restoration Act (FWRA) (Section 403.067, Florida Statutes [F.S.]) directed DEP to develop, and adopt by rule, a science-based methodology to identify impaired waters. DEP adopted the methodology in Chapter 62-303, F.A.C. (the Impaired Surface Waters Rule [IWR]), in 2001. The rule was last amended in 2016. The list of impaired waters in each basin, referred to as the Verified List, is also required by the FWRA (subsection 403.067(4), F.S.). The state's 303(d) list is amended biennially to include updates from the basin Verified Lists.

For assessment purposes, DEP has divided the state into major hydrologic basins that generally conform to the U.S. Geological Survey's 8-digit hydrologic unit codes (HUC). Within each 8-

digit HUC basin, the surface waters are divided into assessment polygons with a unique WBID number for each waterbody segment. The surface water quality data in each WBID are evaluated following the IWR assessment methodology to identify waters that do not meet applicable water quality standards and are designated as impaired. The bacteria impaired waters, which are the subject of this report, are in the Everglades West Coast Basin (HUC 8 – 03090204).

Chapter 2: Description of Applicable Water Quality Standards

2.1 Classification of the Waterbodies and Criteria Applicable to the TMDL

Florida's surface waters are protected for seven designated use classifications, as follows:

Class	Designated Use
Class I	Potable Water Supplies
Class I-Treated	Treated Potable Water Supplies
Class II	Shellfish Propagation or Harvesting
Class III	Fish Consumption; Recreation, Propagation and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife
Class III-Limited	Fish Consumption; Recreation or Limited Recreation; and/or Propagation and Maintenance of a Limited Population of Fish and Wildlife
Class IV	Agricultural Water Supplies
Class V	Navigation, Utility, and Industrial Use

Water quality classifications are arranged in order of the degree of protection required, with Class I waters having generally the most stringent water quality criteria and Class V the least. Class I, I-Treated, II, and III surface waters share water quality criteria established to protect fish consumption, recreation, and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (i.e., aquatic life use).

Class III and III-Limited waters may be additionally classified as either marine or freshwater based on the waterbody's chloride concentration or specific conductance. "Predominately marine waters" are defined in Subsection 62-302.200(30), F.A.C., as surface waters in which the chloride concentration is greater than or equal to 1,500 milligrams per liter (mg/L), or specific conductance is greater than or equal to 4,580 micromhos per centimeter (µmhos/cm). "Predominately fresh waters" are waters with chloride or specific conductance less than 1,500 mg/L or 4,580 µmhos/cm, respectively.

2.2 Applicable Water Quality Standards

Florida has adopted numeric bacteriological criteria to protect recreational uses (swimming) in Class I, I-Treated, II, III, and III-Limited waters. These criteria are based on the use of two bacterial indicators of fecal contamination, *E. coli* and enterococci. The criteria are designed to protect primary contact recreation, including swimming, bathing, surfing, water skiing, tubing, water play by children, and similar water contact activities where a high degree of bodily contact with the water and immersion and ingestion are likely.

The applicable fecal indicator bacteria (FIB) criterion depends on whether the waterbody is predominantly marine (i.e., Class II or Class III Marine) or predominantly fresh (i.e., Class I or

Class III-Fresh). The *E. coli* criterion applies to freshwater, while the enterococci criterion applies to marine waters. Each criterion consists of two components: a monthly geometric mean and a ten-percent threshold value. These two criterion components are designed to regulate the data distribution of FIB in a waterbody over a month, ensuring full protection of the designated uses. EPA has approved Florida's FIB criteria as being protective of the applicable designated uses and thus, being consistent with the federal Clean Water Act.

In addition to the enterococci criterion to protect recreational uses, Class II waters also have a criterion for fecal coliform bacteria to protect shellfishing uses, consistent with the indicator used by the Florida Department of Agriculture and Consumer Services (DACS) to open and close designated shellfish harvesting areas.

Subsection 62-302.530(6), F.A.C., provides the bacteriological criteria applicable to Florida waters, and **Table 2.1** lists these criteria by surface water classification. The FIB sample requirements are implementing provisions and not considered components of the criteria.

Table 2.1. Summary of FIB criteria applicable to Florida waters by surface water classification and associated sampling requirements.

Bacteriological Parameter	Surface Water Classification	Criterion	Sample Requirements (Implementation Provisions)
Enterococci	Class II and Class III Marine	Most probable number (MPN) or membrane filter (MF) counts (number/100 milliliters [ml]) 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.	Monthly geometric means shall be based on a minimum of 10 samples taken on 10 different days over a 30-day period. If there are fewer than 10 samples in a month for a given location, the TPTV is assessed as a single-sample maximum.
E. coli	Class III Fresh	MPN or MF counts (number/100 ml) shall not exceed a monthly geometric mean of 126 nor exceed the 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 on 10 different days over a 30-day period. If there are fewer than 10 samples in a month for a given location, the TPTV is assessed as a single-sample maximum.
E. coli	Class I	MPN or MF counts (number/100 ml) shall not exceed a monthly geometric mean of 126 nor exceed the 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 5 samples taken on 5 different days over a 30-day period. If there are fewer than 5 samples in a month for a given location, the TPTV is assessed as a single-sample maximum.
Fecal Coliform	Class II	MPN or MF counts shall not exceed a median value of 14 with not more than 10% of the samples exceeding 43 (for MPN) or 31 (for MF).	To determine the percentage of samples exceeding the criteria when there are both MPN and MF samples for a waterbody, the percent shall be calculated as 100*(nmpn+nmf)/N, where nmpn is the number of MPN samples greater than 43, nmf is the number of MF samples greater than 31, and N is the total number of MPN and MF samples.

Chapter 3: Water Quality Assessment and Identification of Pollutants of Concern

3.1 Listing Process for FIB Criteria

DEP follows the methodology outlined in the IWR, Chapter 62-303, F.A.C., to evaluate water quality and verify impairments related to fecal coliform, enterococci and *E. coli* bacteria. This assessment process considers the designated uses and waterbody type of individual waterbody segments. Waterbodies or waterbody segments (WBIDs) are placed on the Verified List when they meet the data sufficiency and listing requirements set forth in subsection 62-303.460(3), F.A.C., for primary contact and recreation use support, subsection 62-303.470(3), F.A.C., for shellfish consumption use support, or subsection 62-303.480(3), F.A.C., for drinking water use support (see **Table 2.1** for more information).

When a Class I, II, or III waterbody fails to meet its applicable bacteriological water quality criterion, the waterbody is assessed as impaired under the IWR. If data sufficiency and quality requirements are met, exceedances of the criteria indicate that the waterbody is not supporting uses such as shellfish harvesting and recreational activities.

In the assessment process to identify impairment the potential influence of land use, chemical tracers, or molecular markers indicating anthropogenic sources of bacteria are also considered in addition to the data sufficiency requirements of the IWR.

DEP uses this assessment process to identify FIB impaired waters and determine which waterbodies require total maximum daily loads (TMDLs) to address the impairments.

3.2 Waterbodies Identified for TMDL Development

This report focuses on waterbody segments within the Everglades West Coast Basin, listed in **Table 3.1**. The locations of these impaired segments are shown in **Figure 3.1.** . The sampling stations for each segment with bacteria results used in this evaluation are displayed in **Appendix A**. These waterbodies have sufficient bacteria data to assess current conditions (2013-2022 period) and determine the necessary reductions to meet water quality criteria. The data sufficiency method used in this evaluation is described in Appendix **G**.

The proposed TMDLs are based on available bacteria data, reflecting current conditions. Additional details, including sampling stations and boundaries for TMDL development, are documented in the IWR Run 65 data layer coverages.

In the Everglades West Coast Basin, DEP is also updating the existing FIB TMDL for Hendry Creek (WBID 3258B2), a Class III Marine waterbody. A fecal coliform bacteria TMDL for Hendry Creek was previously adopted in 2008; however, DEP no longer uses fecal coliform as the applicable bacteriological parameter for the Class III designated use of recreation. Therefore, an enterococci bacteria TMDL will replace the existing fecal coliform TMDL for Hendry Creek.

Table 3.1. Classification, applicable bacteriological quality criteria (fecal indicator bacteria) and bacteria data summaries for waterbodies addressed in this TMDL development document. Table sorted by waterbody name.

Notes: The existing condition information provided in the table are for those water segments that meet the data sufficiency requirements, described in Appendix **G**, based on bacteria results in the IWR Run 65 Database. Mullock Creek (WBID 3258C2), Mullock Creek - Marine (WBID 3258C4), Estero River – Marine (WBID 3258D1), Imperial River – Marine (WBID 3258EB), and Spring Creek – Marine (WBID 3258H2) were adopted as additions to the Verified List through a Secretarial Order signed on October 2, 2019. Cocohatchee (Inland Segment) (WBID 3278D) was adopted as an addition to the Verified List through a Secretarial Order signed on July 11, 2022.
HUC = Hydrologic unit code; F = Fresh; M = Marine

[1] Waterbody classifications are defined as follows:
I – Potable water supplies.
II – Shellfish propagation or harvesting.
III-F – Recreation; propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in fresh water.
III-M – Recreation; propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in marine water.
F = Fresh; M = Marine
[2] Exceedance counts are based on exceedance of the applicable TPTV. The existing condition is represented by the data collected in the last 10 years, defined as the 2013-2022 period.
[3] GM means geometric mean.

WBID	Waterbody Segment Name	Water-body Type	Water-body Class[1]	FIB	Applicable FIB Criterion (Counts/100 ml)[3]	Existing Condition: Number of Exceedances/ Number of Samples[2]	Existing Condition Bacteria Count Median (counts/100ml)	Existing Condition Bacteria Count Mean (counts/100 mL)	Maximum Average Month Geometric Mean (counts/ 100 mL)	Maximum Upper 90% C.I. Monthly Geometric Mean
3278D	Cocohatchee (Inland Segment)	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: ≤126	123/779	70	243	108	153
3259A	Cocohatchee River	Estuary	II	Enterococci	TPTV: ≤130; Monthly GM: 35	146/1062	10	98	73	154
3278E	Cow Slough	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 126	22/63	248	547	879	2814
3258D1	Estero River (Marine Segment)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 35	187/267	249	543	384	696
3278R5	Gordon River (Marine Segment)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 35	56/194	74	169	97	286
3278K	Gordon River Extension	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 35	28/163	123	365	294	696
3278R1	Haldeman Creek (Lower)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 35	81/196	88	247	100	177

WBID	Waterbody Segment Name	Water-body Type	Water-body Class[1]	FIB	Applicable FIB Criterion (Counts/100 ml)[3]	Existing Condition: Number of Exceedances/ Number of Samples[2]	Existing Condition Bacteria Count Median (counts/100ml)	Existing Condition Bacteria Count Mean (counts/100 mL)	Maximum Average Month Geometric Mean (counts/ 100 mL)	Maximum Upper 90% C.I. Monthly Geometric Mean
3278R2	Haldeman Creek (Upper)	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 126	45/153	166	427	272	827
3258B2	Hendry Creek	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 126	349/543	306	746	362	851
3258EB	Imperial River (Marine Segment)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 35	175/296	209	588	291	606
3258ED	Leitner Creek	Stream	III-F	*E. coli*	TPTV: ≤130; Monthly GM: 126	66/77	921	1132	2063	2694
3258C2	Mullock Creek	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 35	44/139	272	616	398	1620
3258C4	Mullock Creek (Marine Segment)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 126	31/159	42	212	155	840
3278R4	Naples Bay (Coastal Segment)	Estuary	II	Enterococci	TPTV: ≤130; Monthly GM: 126	68/512	10	80	42	81
3278R4	Naples Bay (Coastal Segment)	Estuary	II	Fecal Coliform	TPTV: ≤43; Median: 14	85/274	19	68	N/A	N/A
3258F	Oak Creek	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 35	19/31	579	771	2420	6184
3278R3	Rock Creek	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 35	97/192	134	504	205	447
3278U	Rookery Bay (Coastal Segment)	Estuary	II	Fecal Coliform	TPTV: ≤43; Median: 14	11/32	8	578	N/A	N/A
3258H3	Spring Creek	Stream	III-F	*E. coli*	TPTV: ≤410; Monthly GM: 35	12/76	172	356	591	1351
3258H2	Spring Creek (Marine Segment)	Estuary	III-M	Enterococci	TPTV: ≤130; Monthly GM: 126	144/285	131	447	257	664

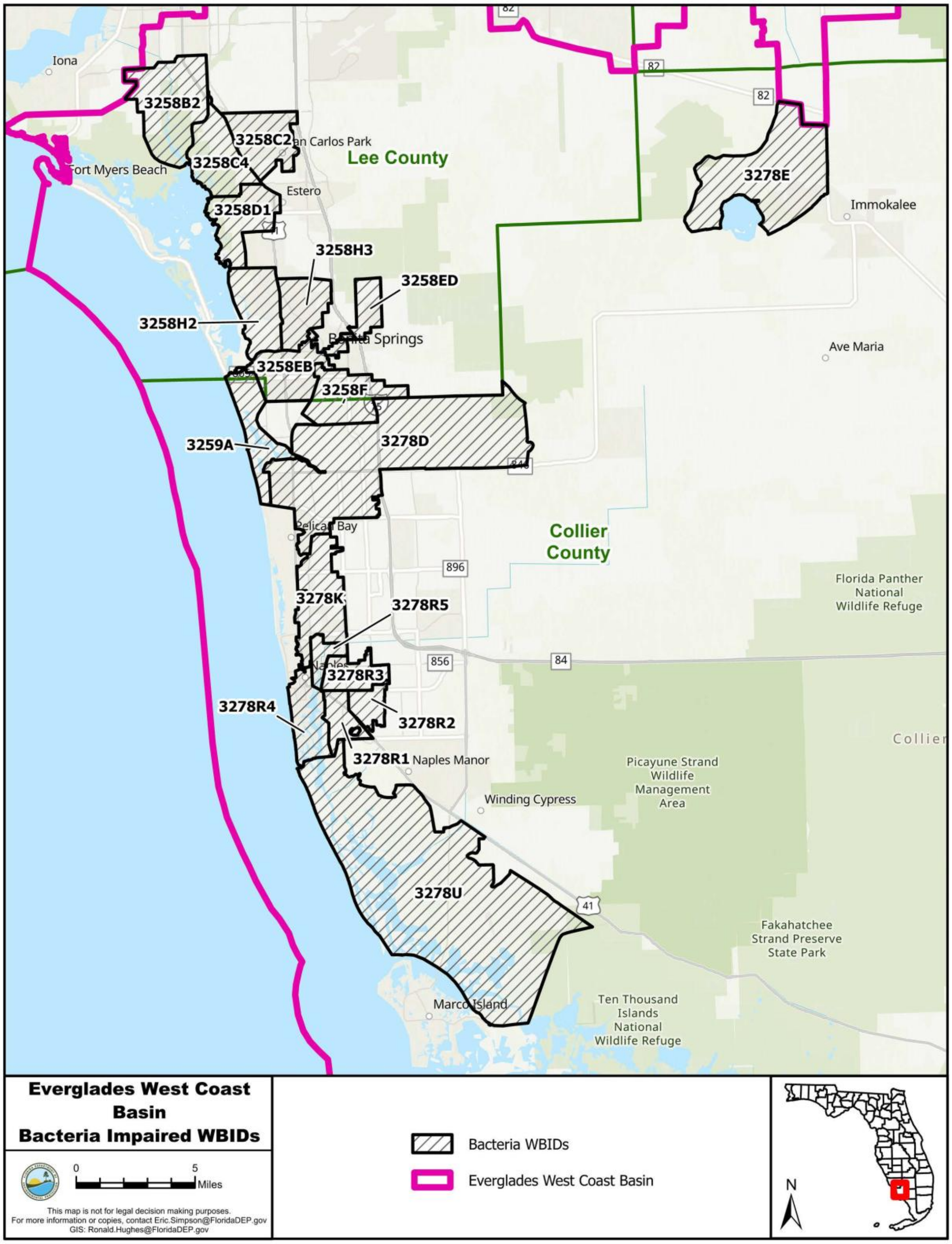

Figure 3.1. FIB Impaired Waterbodies in the Everglades West Coast Basin.

Chapter 4: Assessment of Sources

4.1 Types of Sources

An important part of the TMDL analysis is the identification of pollutant source categories, source subcategories, or individual sources of pollutants in the impaired waterbody and the amount of pollutant loadings contributed by each of these sources. Sources are broadly classified as either "point sources" or "nonpoint sources." Historically, the term "point sources" has meant discharges to surface waters that typically are regulated through the NPDES program, which have a continuous flow via a discernable, confined and discrete conveyance, such as a pipe. Domestic and industrial wastewater treatment facilities (WWTFs) surface water outfalls are examples of traditional point sources. Point sources also include certain urban stormwater discharges, such as those from local government stormwater systems, construction sites, and a wide variety of industries. In contrast, the term "nonpoint sources" was used to describe everything that was not a point source. Nonpoint sources are commonly regarded as intermittent, rainfall-driven, diffuse sources of pollution associated with everyday human activities, including runoff from urban land uses and agriculture; discharges from septic systems; and atmospheric deposition.

The term "point source" will be used to describe traditional NPDES-regulated sources (such as domestic and industrial wastewater discharges) and stormwater systems requiring a NPDES stormwater permit when allocating pollutant load reductions required by a TMDL. Stormwater systems, commonly referred to as municipal separate storm sewer systems (MS4s), may be required to have a NPDES permit depending on the population and discharge locations. However, the methodologies used to estimate nonpoint source loads do not distinguish between NPDES stormwater discharges and non-NPDES stormwater discharges, and as such, this source assessment section does not make any distinction between the two types of stormwater. The responsibilities for bacteria source reductions in stormwater discharges within and outside of MS4 areas are determined in the TMDL implementation phase. MS4 permittees are responsible for source reductions in the areas serviced by stormwater infrastructure it owns or has responsible control over.

FIB impairments are commonly caused by fecal contamination originating from humans, livestock, pets and wildlife. The bacteria are typically found in the intestinal systems of warm-blooded animals and are indicative of the possible presence of pathogens. Human waste can enter surface waters from such activities as degraded sewer infrastructure, failing onsite sewage treatment and disposal systems (OSTDS) (septic tanks and drain fields), homeless camps, and direct illicit connections from homes or businesses. Contamination ends up in local stormwater systems, where it is conveyed and discharged to surface waters. In agricultural areas, animal waste that is not managed properly can migrate into surface waters via runoff. Cattle manure and other livestock waste also contains pathogens harmful to humans (EPA 2010; 2012). Wastes from dogs and other domestic animals and livestock are not a natural part of the environment and waters contaminated by their feces also pose health risks to humans.

The following are general descriptions of potential point and nonpoint sources that can contribute to elevated levels of FIB in surface waters throughout the state. The potential sources of bacteria to individual waterbodies are thoroughly investigated when developing implementation plans to address bacteria impairments, as described in **Chapter 6**.

4.2 Potential Sources of FIB

4.2.1 Point Sources

PERMITTED WASTEWATER POINT SOURCES

Point sources include domestic and industrial WWTFs where effluent is discharged through outfall pipes to surface waters that are permitted under the NPDES program. Elevated bacteria counts at levels above permit limits may be found in domestic WWTF discharges to surface waters because of malfunctioning or poorly maintained treatment systems. **Appendix B** lists the permitted wastewater facility surface water outfalls, by WBID, along with a map displaying the outfall locations.

In agricultural areas, point source discharges from concentrated animal feeding operations (CAFOs) can potentially contribute to elevated bacteria counts if animal wastes are not managed properly. CAFOs are generally defined as farms with 700 or more head of livestock confined for more than 45 days. These facilities generally congregate and feed animals, manage their manure, and operate on a small land area.

SANITARY SEWER OVERFLOWS (SSOS)

Discharge of untreated wastewater from SSOs are unpermitted discharges which can contribute to bacteria contamination of surface waters. SSOs result from failures in wastewater collection/transmission systems where raw sewage enters the environment. SSOs can occur for a number of reasons, including pipe obstructions, leaking sewer lines, pump station failures, and the infiltration of groundwater or inflow of stormwater into defective piping systems. Chapter 62-604, F.A.C., stipulates operation and maintenance regulations pertaining to collection/transmission systems and the reporting requirements of unauthorized releases or spills of wastewater from such systems.

MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4S)

An MS4 is a system of stormwater conveyances like roads, streets, catch basins, curbs, gutters, ditches, swales, channels, or storm drains that is designed or used for collecting or conveying stormwater; discharges to surface waters of the state; and is publicly owned by governmental entities such as municipalities, counties, community development districts, universities, military bases and federal correctional facilities.

MS4s may be regulated by the department through NPDES permits. Regulated MS4 operators are required to develop and implement a Stormwater Management Program (SWMP) to reduce pollutant discharges to and from the MS4. The SWMP must include measures to educate the public on the impacts of illicit discharges to the MS4 and waterbodies, and control stormwater discharges through regulations, inspections and enforcement. Additionally, the MS4 permit requires operators that discharge to WBIDs with DEP-adopted and/or EPA established TMDLs to address wasteload allocations through participation in basin management action plans and/or development of TMDL implementation plans, including bacteria pollution control plans.

Stormwater is runoff generated from rain events that flow over land or impervious surfaces such as streets, parking lots, and rooftops. Contamination of stormwater by bacteria sources can occur as runoff picks up pollutants on the land surface which flows into local stormwater systems that ultimately discharge to surface waters. Stormwater contamination can occur due to illicit discharges, illicit connections, illegal dumping and improper garbage disposal, or contact with industrial materials and human or pet waste. Sanitary wastewater can also contaminate stormwater systems through infiltration of contaminated groundwater caused by damaged wastewater collection pipes, failing laterals and septic systems.

4.2.2 Land Uses and Nonpoint Sources

Obtaining an accurate accounting of bacteria contributions from nonpoint sources requires identifying nonpoint source categories, locating the sources, determining the intensity and frequency with which these sources create high bacteria loadings, and specifying the relative contributions from each source. Nonpoint sources include onsite sewage treatment and disposal systems (OSTDS) (septic tanks and drainfields), pets, livestock, the land application of sewage sludge and manure, solid waste, marina pumpout facilities, boat anchorages, waterbody sediments, and wildlife. These sources are associated with particular land use activities. While detailed source information is not always available for accurately quantifying the bacteria loadings from different sources, land use information can provide a useful starting point about potential sources of observed FIB impairments. Land uses associated with urban and agricultural activities typically include bacteria sources that can pose a greater human health risk compared to less developed areas.

LAND USES

The spatial distribution and acreage of different land use categories can be obtained from land use/land cover layers available in geographic information system (GIS) libraries. The spatial distribution of land uses in the verified impaired WBIDs, obtained from the data layer in the DEP's GIS library, are shown in the maps in **Appendix C**.

NONPOINT SOURCES

The following are descriptions of common nonpoint sources that can contribute to bacteria contamination of surface waters.

> ***OSTDS*** – Properly functioning septic systems result in retention and die-off of most fecal and pathogenic bacteria (EPA 2002). Septic systems are expected to remove 99.999% of fecal coliform bacteria 24 inches below the bottom of drain fields (Chapter 62-6, F.A.C.). However, failing OSTDS can be a source of bacteria contamination in surface waters. Failing systems result in the discharge of untreated or partially treated wastewater onto the ground surface or into stormwater systems, surface water, or groundwater.
>
> The risk of contamination from failing systems is greater in areas with a relatively high groundwater table where the drain field can be flooded during the rainy season, resulting in ponding, and bacteria can pollute surface waters through stormwater runoff. Additionally, in these circumstances, a high water table can result in bacteria pollution reaching the receiving waters through baseflow, which is the portion of flow derived from precipitation that infiltrates into the ground and is conveyed to surface waters through the shallow ground sub-surface.

The physical properties of an aquifer, such as thickness; proportion of sand, silt, and clay; and location play a large part in determining whether contaminants from the land surface will reach groundwater (U.S. Geological Survey [USGS] 2010). The risk of contamination is greater for unconfined (water table) aquifers than for confined aquifers because they usually are nearer to the land surface and lack an overlying confining layer to impede the movement of contaminants (USGS 2010).

Septic systems may also cause pollution when they are built too close to irrigation wells. Any well that is installed in the surficial aquifer system will cause a drawdown. If the septic system is built too close to the well (e.g., less than 75 feet), the septic system discharge will be situated within the cone of influence of the well. As a result, septic system effluent may enter the well, and once the polluted water is used for irrigation, fecal bacteria may reach the land surface and wash into surface waters through runoff.

Appendix D shows the locations of OSTDS in each impaired segment in 2024 based on centroids of parcels for households with known, likely, or somewhat likely septic systems.

Pet Waste – Pet waste can be a significant source of bacteria pollution through surface runoff to waterbodies. Studies report that up to 95% of the fecal coliform bacteria found in urban stormwater can have nonhuman origins (Alderiso et al. 1996; Trial et al. 1993).

The most important nonhuman contributors of fecal coliform bacteria are dogs and cats. In a highly urbanized Baltimore catchment, Lim and Olivieri (1982) found that dog feces were the single greatest source of fecal coliform and fecal strep bacteria. Trial et al. (1993) also reported that cats and dogs were the primary source of fecal coliform bacteria in urban subwatersheds.

Solid Waste Storage and Disposal - Poorly managed dumpsters can contribute to pollutants in stormwater runoff. Improper garbage disposal, such as open, overflowing, or leaking dumpsters is an attractant to rodents, especially where food waste is stored. 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 stormwater conveyance systems.

Stormwater systems associated with waste management facilities may be at risk for FIB contamination, including landfills, trash incinerators, and parking lots for recycling and garbage hauling trucks. The open land and food opportunities at landfills can attract nuisance wildlife, such as large flocks of seagulls, and refuse hauling facilities occasionally have issues with leaking storage (Michigan EGLE, 2019).

***Agricultural Animals* -** Livestock and other agricultural animals are a potentially important source of bacteria in agricultural areas. Runoff from pastureland and rangeland along with agricultural animals having access to surface waters can affect water quality. Agricultural animal waste is associated with various pathogens in streams, including *E. coli, Salmonella, Giardia, Campylobacter, Shigella,* and *Cryptosporidium parvum* (Landry and Wolfe 1999). Research conducted by EPA indicates that fecal waste originating from cattle may pose human health risks comparable to the risks from human sources (EPA 2010; 2012).

Biosolids and Manure - Properly treated biosolids and manure are applied on land as a fertilizer supplement and a soil conditioner. Biosolids, also referred to as sewage sludge, is the solid byproduct generated when domestic wastewater is treated. The sludge, which is removed routinely from treatment plants, has a high organic content and contains moderate amounts of nutrients. Regulatory requirements are in place to protect public health and the environment, including treatment to destroy harmful microorganisms and management practices for land application sites. Biosolids may be applied in farming and ranching operations, to forest lands, and in public areas such as parks, or in land reclamation projects such as the restoration of mined properties. As with biosolids, animal manure can be a source of bacteria to surface waters if regulations are not followed. The likelihood of contamination is increased if manure or biosolids are applied to fields in excess of agronomic rates or under wet weather conditions (DACS 2015).

***Boats* -** Boats have the potential to discharge bacteria in sewage from installed toilets and graywater from sinks, baths, and showers. Waterbodies and marinas that are heavily used for recreational boating have been shown to have elevated levels of FIB (EPA 2001). Areas where discharges from boats can be a bacteria source are marinas and vessel anchorage locations. Vessel anchorage areas are displayed in the map provided in **Appendix E**.

Wildlife - In urban areas, wildlife can typically be found in city parks and corridors along waterways and thus can potentially be a source of bacteria. Pristine forested lands might appear to be unlikely candidates for pathogen sources; however, wildlife can contribute fecal bacteria in these areas. Many wildlife species are reservoirs of microorganisms that are potentially pathogenic to themselves, other wildlife, and humans (EPA 2001). In addition to warm-blooded animals, FIB have been isolated from the feces of cold-blooded vertebrates including the American alligator (Johnston et al. 2010) and the Diamondback terrapin (Harwood et al. 1999). Streams draining largely undeveloped watersheds with extensive riparian wetlands can be important natural sources of bacteria. Animal bacteria from saturated wetland surfaces is a known mechanism for bacterial transport to the streams draining them, as was observed in a wetland-dominated watershed free of bacteria sources related to development (Weiskel et al. 1996).

Wildlife such as deer, bear, and feral hogs deposit their feces onto land surfaces, where the bacteria can be transported during storm events to nearby waterbodies. In addition, waterfowl such as geese, ducks, and herons can contaminate surface water with microbial pathogens by directly depositing feces into waterbodies (EPA 2001), especially in wetlands, lakes, ponds, and rivers.

Chapter 5: TMDL Development

5.1 Expression and Allocation of the TMDL

A TMDL identifies the amount of a pollutant that a surface water can assimilate without exceeding the water quality criteria or impairing the designated uses. TMDLs represent the loading capacity of a waterbody including a margin of safety (MOS) to account for uncertainty in target-setting. The TMDLs allocate pollutant loads among permitted point source discharges through WLAs, and nonpoint source discharges through LAs. The WLA is broken into separate subcategories for wastewater discharges and stormwater discharges regulated under the NPDES Program. The LAs identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background. Nonpoint sources typically result from land runoff, precipitation, drainage, or hydrologic modification and are often associated with land use activities which typically discharge contaminants to surface waters in response to rainfall. Bacteria contamination of surface waters from nonpoint sources which are not associated with rainfall events can also occur, for example, from failing septic systems and seepage from land application of biosolids.

In the case of waters impaired for FIB, the TMDLs are equal to the allowable bacteria loadings discharged to an impaired segment. For FIB TMDLs, the allowable loads for sources included in the WLA and LA can be expressed in an equation as follows:

$$\textbf{Allowable Load} = \textbf{Q} \times \textbf{WQC}$$

Where:

Q = the flow that is contributed by a source to receiving waters, and

WQC = the applicable water quality criterion for a bacteria indicator.

The allowable loads for both MS4 WLA and LA sources, as expressed in **Table 5.1,** are readily captured as an equation because the actual source loads are typically associated with runoff from diffuse sources that are difficult to quantify. For NPDES permitted wastewater facility discharges, the allowable bacteria loads are defined in permits through the assignment of outfall effluent limitations for flow and bacteriological counts equal to the criteria applicable to the receiving water. Therefore, wastewater facility discharges will be in compliance with the NPDES wastewater WLA as long as the permitted effluent limitations are met. Loads based on the water quality criteria accordingly incorporate all the elements included in the criteria. If a source does not contribute to an impaired segment, that component does not apply in **Table 5.1**. The allowable loads from all sources apply to bacteria loadings from WLA and LA sources discharged directly to impaired segments as well as bacteria contributions from surface waters that flow into impaired segments. For adjacent surface waters that contribute bacteria to impaired segments, a lumped sum allowable bacteria load applies to all WLA and LA sources entering those waters.

The TMDLs for waters verified impaired for FIB are expressed as concentration-based restoration targets, in terms of bacteria counts per 100 milliliters (counts/100 mL), (**Table 5.1**) that are consistent with the expression and derivation of the bacteriological criteria in section 62-302.530, F.A.C. Therefore, the TMDLs are based on both the TPTV and geometric mean components of the *E. coli* and enterococci bacteria criteria, **Table 5.1**. The State's FIB criteria include both TPTV and geometric mean components to protect primary and secondary contact recreational uses. Both criteria components are necessary to control the frequency and duration of high FIB levels that increase the risk of gastrointestinal illness in humans.

In addition to the adopted load allocations, **Appendix F** presents estimated percent reductions in bacteria counts for the impaired WBIDs to achieve the applicable TPTV (**Table F.1.**) and geometric mean (**Table F.2.**) components of the criteria. The percent reductions to achieve the target concentrations are calculated for each impaired waterbody to show the difference between the existing FIB concentrations and the applicable target concentrations. Percent reductions are not part of the TMDLs and are presented for information purposes only.

Table 5.1. TMDL components for FIB impairments

[1] F = Fresh; M = Marine

[2]The concentration-based fecal indicator bacteria TMDLs can be converted into a daily load expression by multiplying the applicable water quality criterion by the daily average volumetric flow representative of the water segment and the appropriate conversion factor. In this equation, flows may be determined from direct measurements or derived from calculation methods following generally accepted scientific procedures.

[3] Q_{WLASW} = Total daily runoff from all MS4 urban areas conveyed through permitted storm water structures; Monthly Q_{WLASW} = Total monthly runoff from all MS4 urban areas conveyed through permitted storm water structures.

[4] DailyQ_{LA} = Total daily flow from all nonpoint sources; Monthly Q_{LA} = Total Monthly flow from all nonpoint sources

WBID	Waterbody Segment Name	Water-body Class[1]	Parameter	$TMDL_{ind}$ (TPTV of MPN or MF counts/ 100mL) [2]	$TMDL_{geo}$ (Monthly Geometric Mean of MPN or MF counts/ 100mL) [2]	WLA for Waste-water (counts)	WLA for NPDES Storm-water (counts/day)[3]	LA (counts/day)[4]
3278D	Cocohatchee (Inland Segment)	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3278E	Cow Slough	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3278K	Gordon River Extension	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3278R2	Haldeman Creek (Upper)	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3258ED	Leitner Creek	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3258C2	Mullock Creek	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3258F	Oak Creek	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}
3258H3	Spring Creek	III-F	*E. coli*	410	126	Meet Permit Limits	410 x Daily Q_{WLASW}, and 126 x Monthly Q_{WLASW}	410 x Daily Q_{LA}, and 126 x Monthly Q_{LA}

WBID	Waterbody Segment Name	Water-body Class[1]	Parameter	$TMDL_{ind}$ (TPTV of MPN or MF counts/ 100mL)[2]	$TMDL_{geo}$ (Monthly Geometric Mean of MPN or MF counts/ 100mL)[2]	WLA for Waste-water (counts)	WLA for NPDES Storm-water (counts/day)[3]	LA (counts/day)[4]
3259A	Cocohatchee River	II	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3258D1	Estero River (Marine Segment)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3278R5	Gordon River (Marine Segment)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3278R1	Haldeman Creek (Lower)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3258B2	Hendry Creek	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3258EB	Imperial River (Marine Segment)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3258C4	Mullock Creek (Marine Segment)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3278R4	Naples Bay (Coastal Segment)	II	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3278R3	Rock Creek	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}

WBID	Waterbody Segment Name	Water-body Class[1]	Parameter	$TMDL_{ind}$ (TPTV of MPN or MF counts/ 100mL) [2]	$TMDL_{geo}$ (Monthly Geometric Mean of MPN or MF counts/ 100mL) [2]	WLA for Waste-water (counts)	WLA for NPDES Storm-water (counts/day)[3]	LA (counts/day)[4]
3258H2	Spring Creek (Marine Segment)	III-M	Enterococci	130	35	Meet Permit Limits	130 x Daily Q_{WLASW}, and 35 x Monthly Q_{WLASW}	130 x Daily Q_{LA}, and 35 x Monthly Q_{LA}
3278R4	Naples Bay (Coastal Segment)	II	Fecal Coliform	43 MPN	NA	Meet Permit Limits	43 x Daily Q_{WLASW}	43 x Daily Q_{LA}
3278U	Rookery Bay (Coastal Segment)	II	Fecal Coliform	43 MPN	NA	Meet Permit Limits	43 x Daily Q_{WLASW}	43 x Daily Q_{LA}

5.2 Load Allocation

There are two types of load allocations for nonpoint sources. One type are loads to surface waters independent of precipitation, including sources such as failing septic systems, seepage from land application of biosolids and manure, leachate from landfills, animals with access to waterways, and background loads. The other type are loads associated with bacteria accumulation on land surfaces that is washed off during rain events. Currently, it is not possible to quantify and partition the various sources of load allocations necessary to achieve the applicable TMDL targets. However, all bacteria sources contributing to impairment of individual water segments are required to meet the applicable concentration-based restoration targets listed in **Table 5.1**.

The aggregated allocated nonpoint source loads are expressed as equations in **Table 5.1**. In the future, after additional data have been collected, it may be possible to partition the load allocation by source. The allocations to anthropogenic nonpoint sources may be calculated based on more detailed source information conducted as part of a restoration plan, such as a bacteria pollution control plan (BPCP).

Implementation of TMDLs and their load allocations is conducted through various regulatory programs and the requirements of those programs. Aggregated allocations for a category of sources are not intended to be applied uniformly to individual sources in that category, unless otherwise specified. The LA includes loading from stormwater discharges regulated by DEP and the water management districts that are not part of the NPDES stormwater program (see **Appendix G**). Resources are available to facilitate achievement of the reductions necessary to meet the applicable bacteriological water quality criteria concentrations. DEP created an implementation guidance document with a focus on controlling urban sources of bacteria and the DACS has prepared manuals with adopted BMPs that identify measures for reducing pollutants to surface waters from agricultural activities. These resources are described further in **Chapter 6.**

5.3 Wasteload Allocation

5.3.1 NPDES Wastewater Discharges

NPDES-permitted wastewater facility outfall locations are displayed in the map located in **Appendix B** along with a list identifying the wastewater facility outfalls associated with the impaired WBIDs. The state requires all NPDES-permitted wastewater point source dischargers to meet bacteria criteria contained in subsection 62-302.530(6), F.A.C., and the disinfection requirements of section 62-600.440, F.A.C. Permit effluent limitations for bacteria serve as the WLA for wastewater discharges. DEP does not allow mixing zones for bacteria.

5.3.2 NPDES Stormwater Discharges

MS4 permittees are responsible for addressing the reductions necessary to meet the applicable bacteriological water quality criteria concentrations in the areas serviced by stormwater infrastructure it owns or operates. State and Federal Rules define stormwater discharges covered by NPDES permits as point sources. However, stormwater discharges are from diffuse sources and there are multiple stormwater discharge points which are difficult to quantify.

Regulated MS4 operators are required to develop and implement a Stormwater Management Program (SWMP) to reduce pollutant discharges to and from the MS4 area. Additionally, MS4 operators that discharge to impaired waters with TMDLs are required to address reductions through participation in basin management action plans and/or development of TMDL implementation plans, including BPCPs. The intent of stormwater NPDES permits is not to treat the water after collection, but to reduce the exposure of stormwater to pollutants by implementing various controls. Therefore, stormwater NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment.

Aggregated allocations for a category of sources are not intended to be applied uniformly to individual sources in that category. Pollutant reductions to attain a TMDL can come from many sources, and the DEP implementation guidance document, described in **Chapter 6**, is valuable in facilitating the achievement of reductions necessary to meet the applicable bacteriological criteria in urban areas.

5.4 Seasonal Variation

Florida's bacteriological criteria are consistent year-round, with a single set of numeric criteria applying throughout the calendar year. Organizations collecting surface water samples typically monitor conditions regularly to account for seasonal variability. The FIB TMDLs include both the TPTV and monthly geometric mean components, which must be met every month. As a result, the TMDLs inherently account for seasonal variation and protect against exceedances in any month.

5.5 Margin of Safety

The MOS is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving waterbody. The MOS can either be implicitly accounted for by choosing conservative assumptions about loading or water quality response, or explicitly accounted for during the allocation of loadings. The explicit MOS usually takes the form of setting a TMDL target at a certain percentage below the protective target. An implicit MOS can be achieved by making conservative assumptions or using conservative approaches when developing a TMDL. For these TMDLs, an implicit MOS is applied, based on the following conservative assumptions:

a. the bacteria concentrations from adjacent waters, such as upstream and tributary inflows, are at the maximum allowable limit (i.e., criterion); there is no dilution capacity from these areas,
b. although all sources are provided an allocation at the applicable water quality criterion, not all sources discharge at this maximum allocation at the same time,
c. there is no bacteria die-off accounted for, when in reality bacteria concentrations diminish downstream from their source and,
d. all wastewater sources must meet both the applicable TPTV and geometric mean (as single sample maxima) at all times.

Chapter 6: Next Steps: Implementation Plan Development

6.1 Implementation Mechanisms

Following the adoption of a TMDL, implementation takes place through various measures. The implementation of TMDLs may occur through specific requirements in NPDES wastewater and stormwater permits, and, as appropriate, through local or regional water quality initiatives or basin management action plans (BMAPs).

Mechanisms to most efficiently address bacteria loading within impaired watersheds can be found in the department's document entitled "Restoring Bacteria-Impaired Waters A Toolkit to Help Local Stakeholders Identify and Eliminate Potential Pathogen Problems" (toolkit). Appropriate activities apply to a wide variety of stakeholders such as local governments, wastewater utilities, agriculture, the Florida Department of Health, the Florida Department of Transportation, and other federal, state and local governmental entities. The toolkit assists stakeholders by providing a range of potential activities, from the simple (such as Walk the WBIDs and GIS mapping) to the complex (such as bacteria source tracking). DEP may be available to provide technical assistance, guidance, and oversight of local efforts to identify and minimize bacteria sources of pollution.

Wastewater facilities must continue to meet applicable FIB criteria and effluent limitations in NPDES permits authorizing discharge to waters of the state that are issued under the provisions of Chapter 403, Florida Statutes (F.S.), and applicable rules in the F.A.C. Additionally, collection and transmission systems must be maintained and operated in accordance with Section 62-604.500, F.A.C., so that sanitary overflows or leaks do not cause or contribute to violations of the applicable FIB criteria.

6.2 Basin Management Action Plans

Information on the development and implementation of BMAPs is contained in Section 403.067, F.S. DEP may initiate and develop a BMAP that addresses some or all the contributing areas to the TMDL waterbody. BMAPs are adopted by the DEP Secretary and are legally enforceable.

BMAPs describe the fair and equitable allocations of pollution reduction responsibilities to the sources in the watershed, as well as the management strategies that will be implemented to meet those responsibilities, funding strategies, mechanisms to track progress, and water quality monitoring. Local entities, such as wastewater facilities, industrial sources, agricultural producers, county and city stormwater systems, military bases, water control districts, state agencies, and individual property owners usually implement these strategies. BMAPs can also identify mechanisms to address potential pollutant loading from future growth and development.

An Everglades West Coast Basin BMAP is in place to implement load reductions to achieve the dissolved oxygen (DO) TMDLs for Hendry Creek and the Imperial River. Projects designed to reduce pollutants to meet the DO TMDLs may have indirect benefits that may control sources of bacteria contamination to these impaired segments.

6.3 Other Water Quality Initiatives

The Surface Water Improvement and Management (SWIM) Program is implemented by Florida's water management districts, by working cooperatively with DEP, other state and federal agencies, local governments, and private stakeholders. SWIM plans outline initiatives to accomplish watershed protection and restoration.

Additionally, DACS develops and adopts BMP manuals specific to different agricultural commodities, such as row crops or cow-calf operations. Each manual is the result of research, field testing, and expert review, and each contains effective and practical means for improving water quality in agricultural and urban discharges. Many BMP manuals explicitly address techniques and practices for reducing sources of bacterial pollution, such as using buffers, setbacks, and swales to reduce or prevent the transport of pollutants from production areas to waterbodies.

6.4 Implementation Considerations

FIB impairments result from the cumulative effects of a multitude of potential sources, both natural and anthropogenic. Implementation of TMDLs and their allocations is conducted through various regulatory programs and the requirements of those programs. Reductions required of individual sources may be adjusted through these other programs as long as the reductions are consistent with achieving the overall allocations set forth in the TMDL. Aggregated allocations for a category of sources are not intended to be applied uniformly to individual sources in that category, unless otherwise specified.

Restoration of FIB impairments often relies on holistic approaches to address point and nonpoint sources. Plans need to include sufficient monitoring to identify the sources of the FIB impairment and appropriate remedial actions to address those sources. The combined active participation of state, county, and city authorities will be necessary to identify, reduce, eliminate, and prevent anthropogenic sources of FIB from reaching stormwater and receiving waterbodies.

Information on identifying urban and agricultural sources of bacteria—and best practices for involving stakeholders to address the sources is available at Restoring Bacteria Impaired Waters Toolkit.

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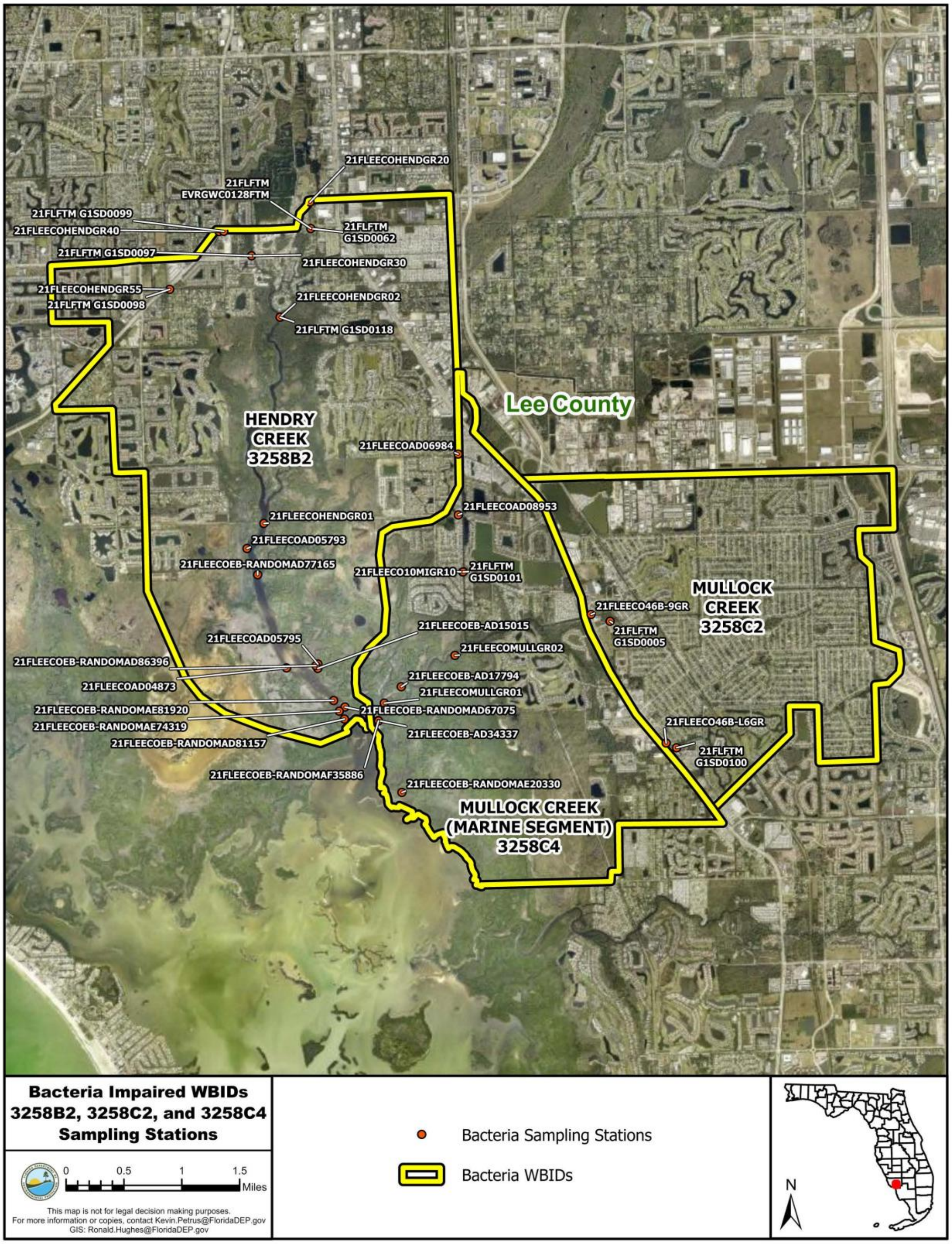
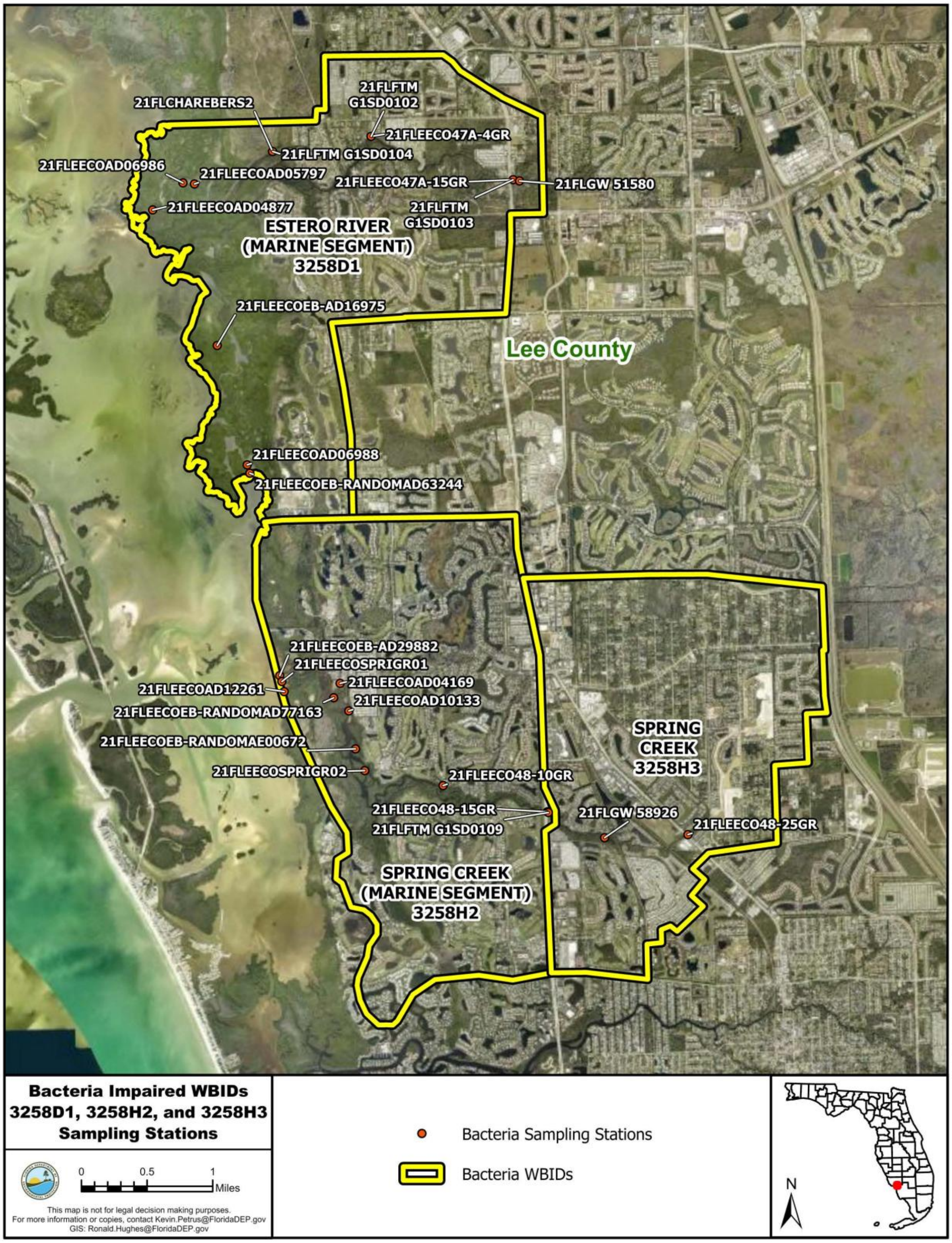
Appendices

Appendix A: Maps of Sampling Stations with Bacteria Results Used to Characterize Current Conditions

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21FLGW 51580
21FLEECOAD04877
21FLFTM G1SD0103
ESTERO RIVER (MARINE SEGMENT) 3258D1
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Lee County
21FLEECOAD06988
21FLEECOEB-RANDOMAD63244
21FLEECOEB-AD29882
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21FLEECOAD04169
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SPRING CREEK 3258H3
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21FLEECO48-10GR
21FLEECO48-15GR
21FLGW 58926
21FLEECO48-25GR
21FLFTM G1SD0109
SPRING CREEK (MARINE SEGMENT) 3258H2
Bacteria Impaired WBIDs 3258D1, 3258H2, and 3258H3 Sampling Stations
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This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
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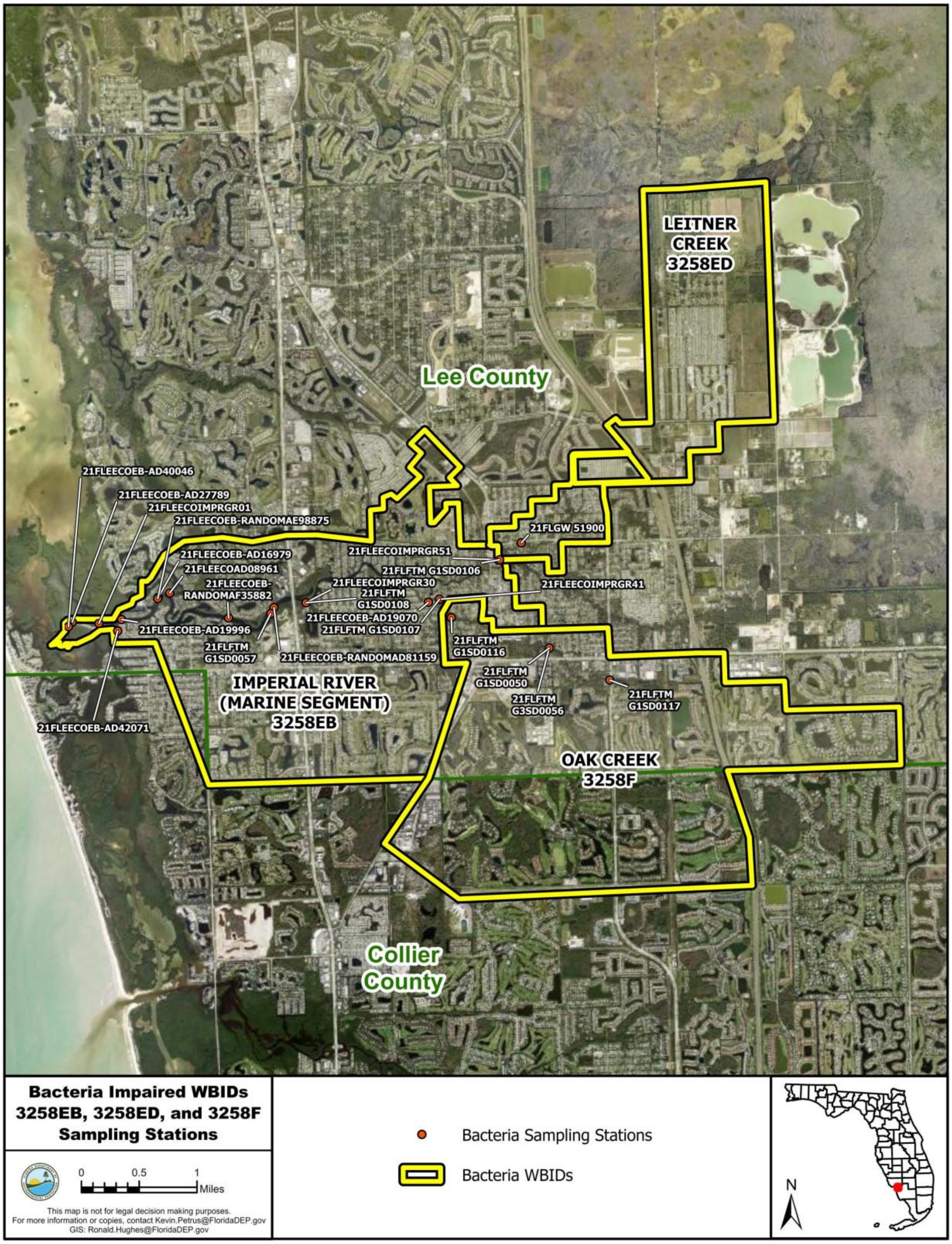
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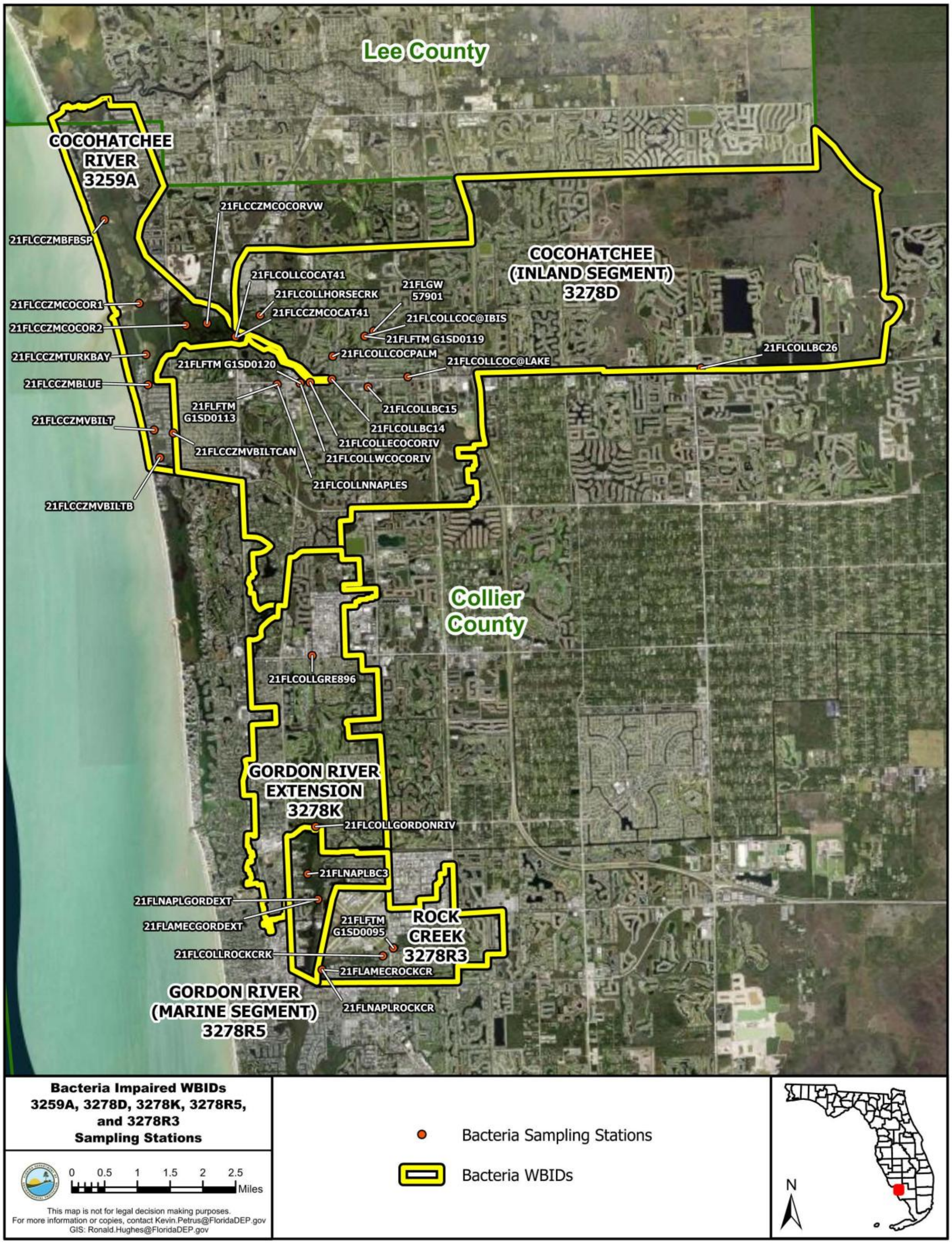
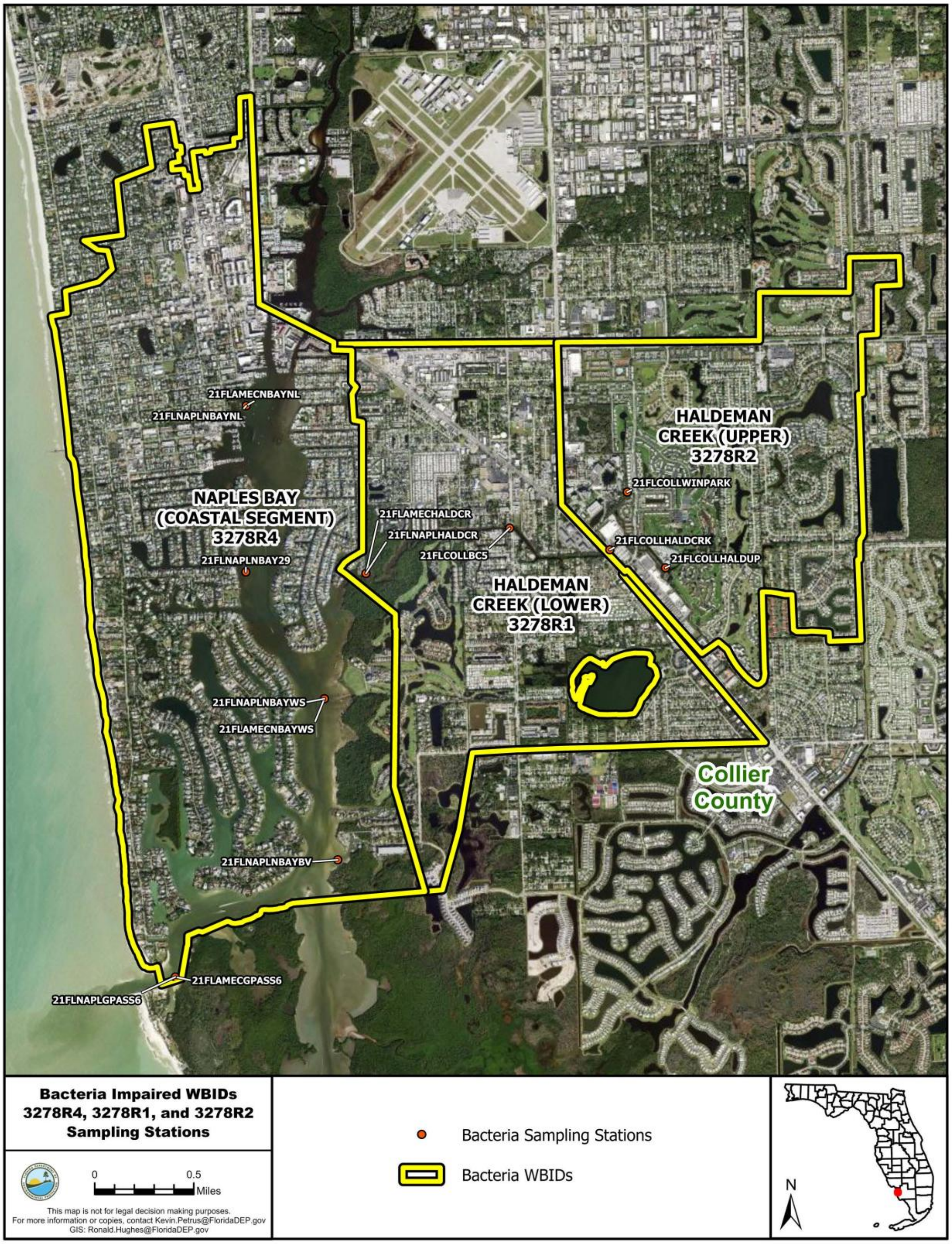
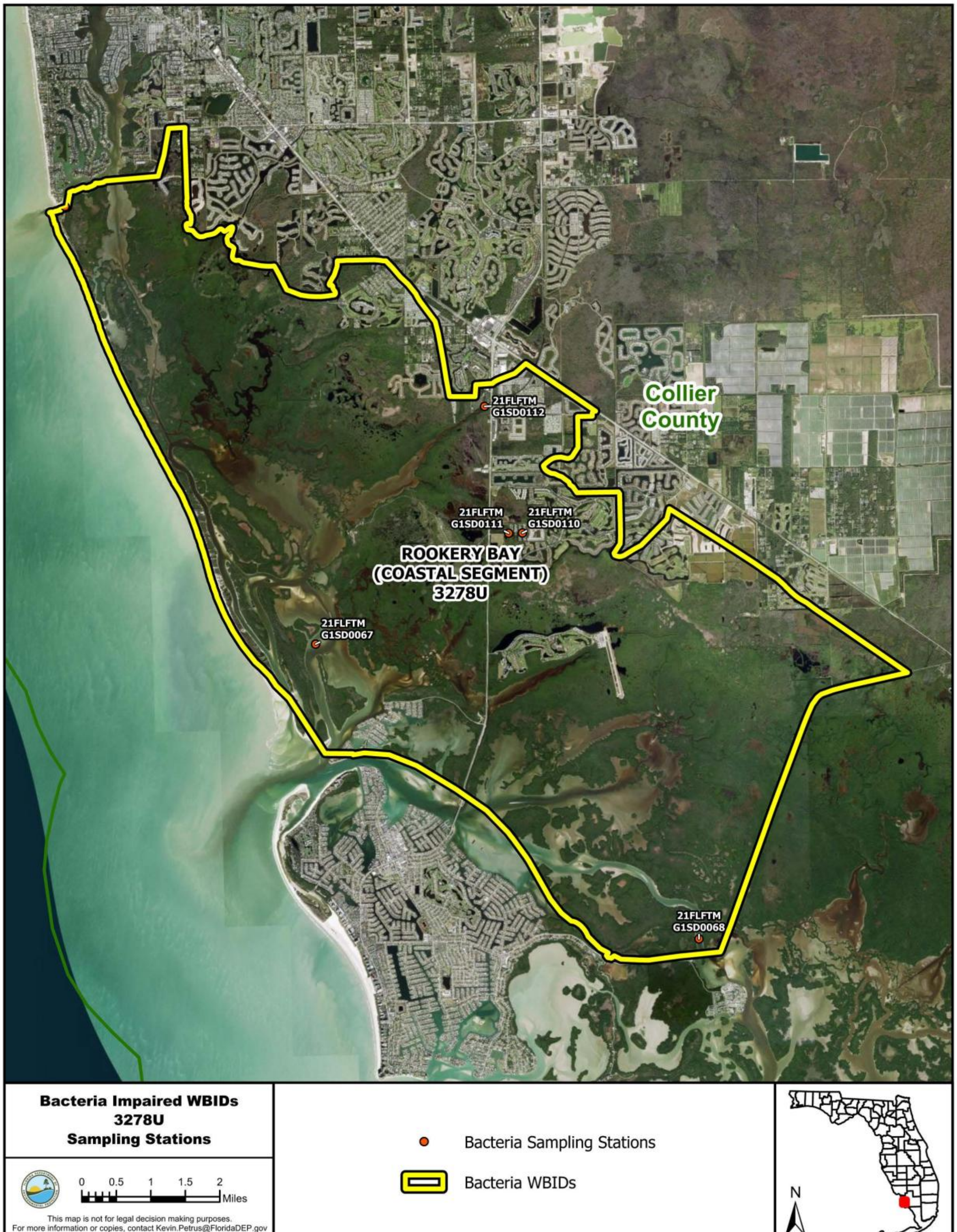
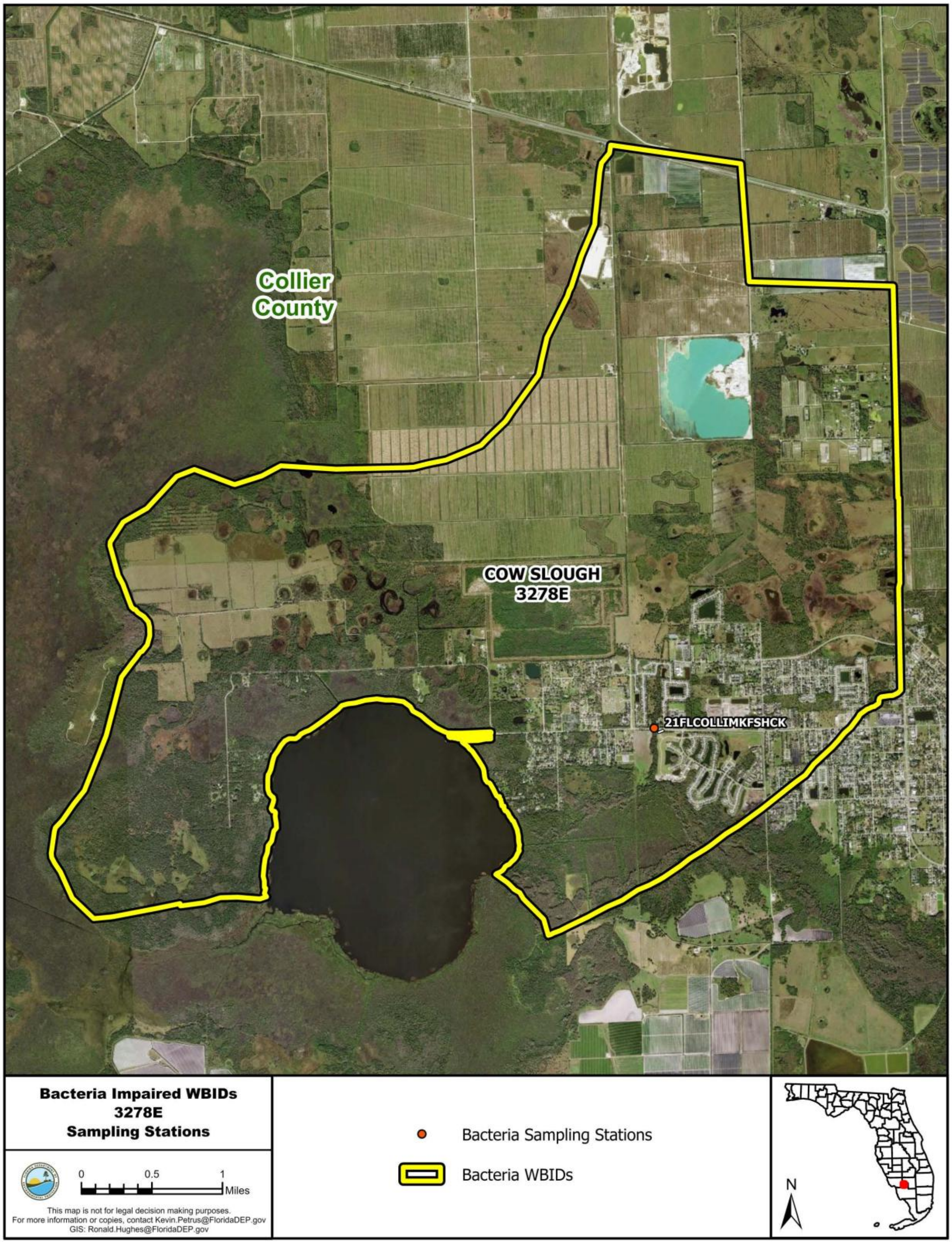
IMPERIAL RIVER (MARINE SEGMENT) 3258EB
OAK CREEK 3258F
Collier County
Bacteria Impaired WBIDs 3258EB, 3258ED, and 3258F Sampling Stations
0 0.5 1 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
Bacteria WBIDs
N


Lee County
Collier County
COCOHATCHEE RIVER 3259A
COCOHATCHEE (INLAND SEGMENT) 3278D
GORDON RIVER EXTENSION 3278K
ROCK CREEK 3278R3
GORDON RIVER (MARINE SEGMENT) 3278R5
21FLCCZMBFBSP
21FLCCZMCOCORVW
21FLCOLLCOCAT41
21FLCOLLHORSECRK
21FLGW 57901
21FLCCZMCOCOR1
21FLCCZMCOCAT41
21FLCOLLCOC@IBIS
21FLCCZMCOCOR2
21FLFTM G1SD0119
21FLCOLLCOCPALM
21FLCCZMTURKBAY
21FLFTM G1SD0120
21FLCOLLCOC@LAKE
21FLCOLLBC26
21FLCCZMBLUE
21FLFTM G1SD0113
21FLCOLLBC15
21FLCOLLBC14
21FLCCZMVBILT
21FLCOLLECOCORIV
21FLCCZMVBILTCAN
21FLCOLLWCOCORIV
21FLCOLLNNAPLES
21FLCCZMVBILTB
21FLCOLLGRE896
21FLCOLLGORDONRIV
21FLNAPLBC3
21FLNAPLGORDEXT
21FLAMECGORDEXT
21FLFTM G1SD0095
21FLCOLLROCKCRK
21FLAMECROCKCR
21FLNAPLROCKCR
Bacteria Impaired WBIDs
3259A, 3278D, 3278K, 3278R5, and 3278R3
Sampling Stations
0 0.5 1 1.5 2 2.5 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
Bacteria WBIDs
N



21FLAMECNBAYNL
21FLNAPLNBAYNL
NAPLES BAY
(COASTAL SEGMENT)
3278R4
21FLNAPLNBAY29
21FLAMECHALDCR
21FLNAPLHALDCR
21FLCOLLBC5
HALDEMAN
CREEK (UPPER)
3278R2
21FLCOLLWINPARK
21FLCOLLHALDCRK
21FLCOLLHALDUP
HALDEMAN
CREEK (LOWER)
3278R1
21FLNAPLNBAYWS
21FLAMECNBAYWS
Collier
County
21FLNAPLNBAYBV
21FLAMECGPASS6
21FLNAPLGPASS6
Bacteria Impaired WBIDs
3278R4, 3278R1, and 3278R2
Sampling Stations
0
0.5
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
Bacteria WBIDs
N


21FLFTM
G1SD0112
21FLFTM
G1SD0111
21FLFTM
G1SD0110
ROOKERY BAY
(COASTAL SEGMENT)
3278U
21FLFTM
G1SD0067
21FLFTM
G1SD0068
Collier
County
Bacteria Impaired WBIDs
3278U
Sampling Stations
0 0.5 1 1.5 2
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
Bacteria WBIDs
N

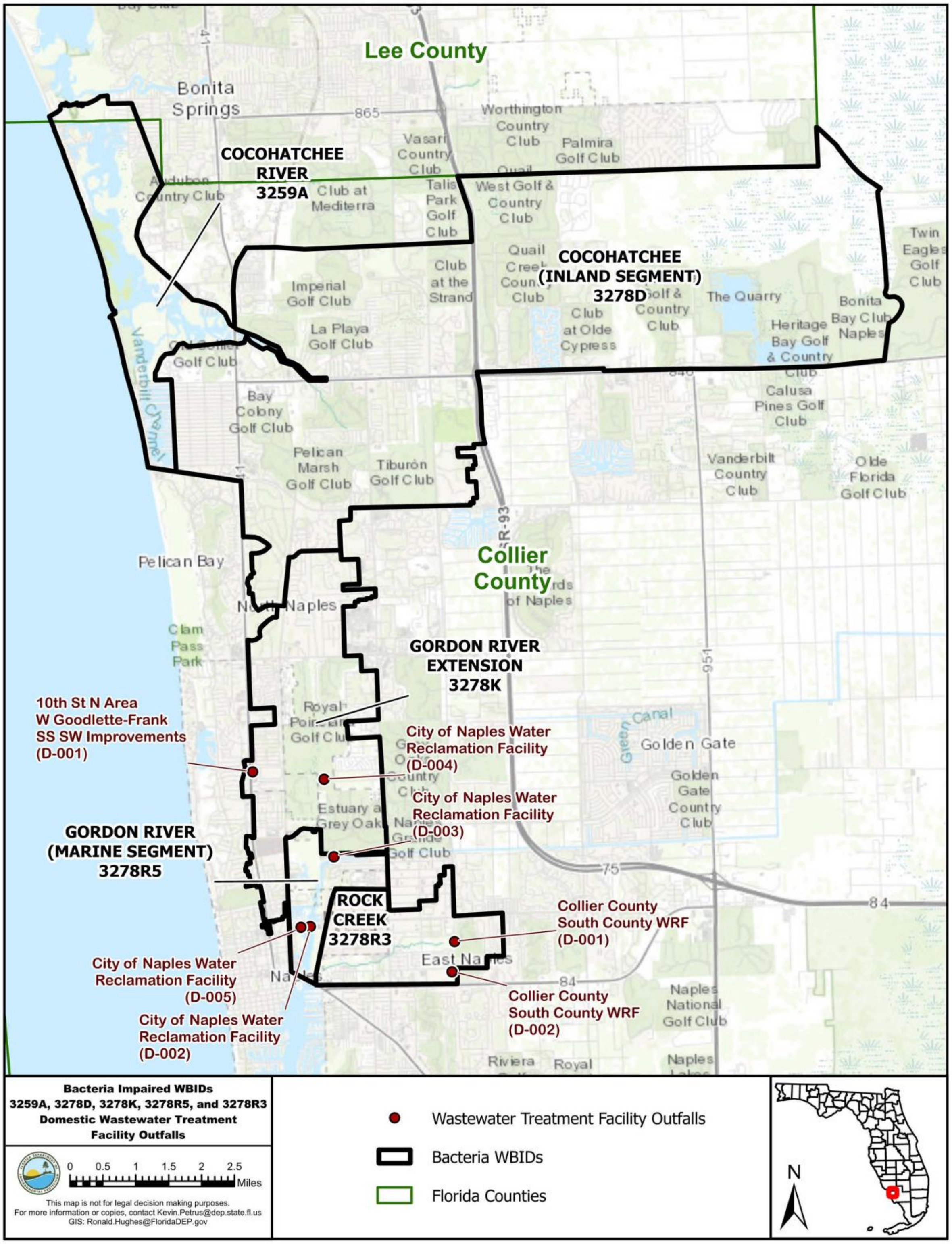

Collier County
COW SLOUGH 3278E
21FLCOLLIMKFSHCK
Bacteria Impaired WBIDs
3278E
Sampling Stations
0 0.5 1 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Bacteria Sampling Stations
Bacteria WBIDs
N

Appendix B: Permitted Wastewater Facility Outfalls for Bacteria-Impaired WBIDs. Table sorted by waterbody name.

[1] M = Marine; F = Fresh

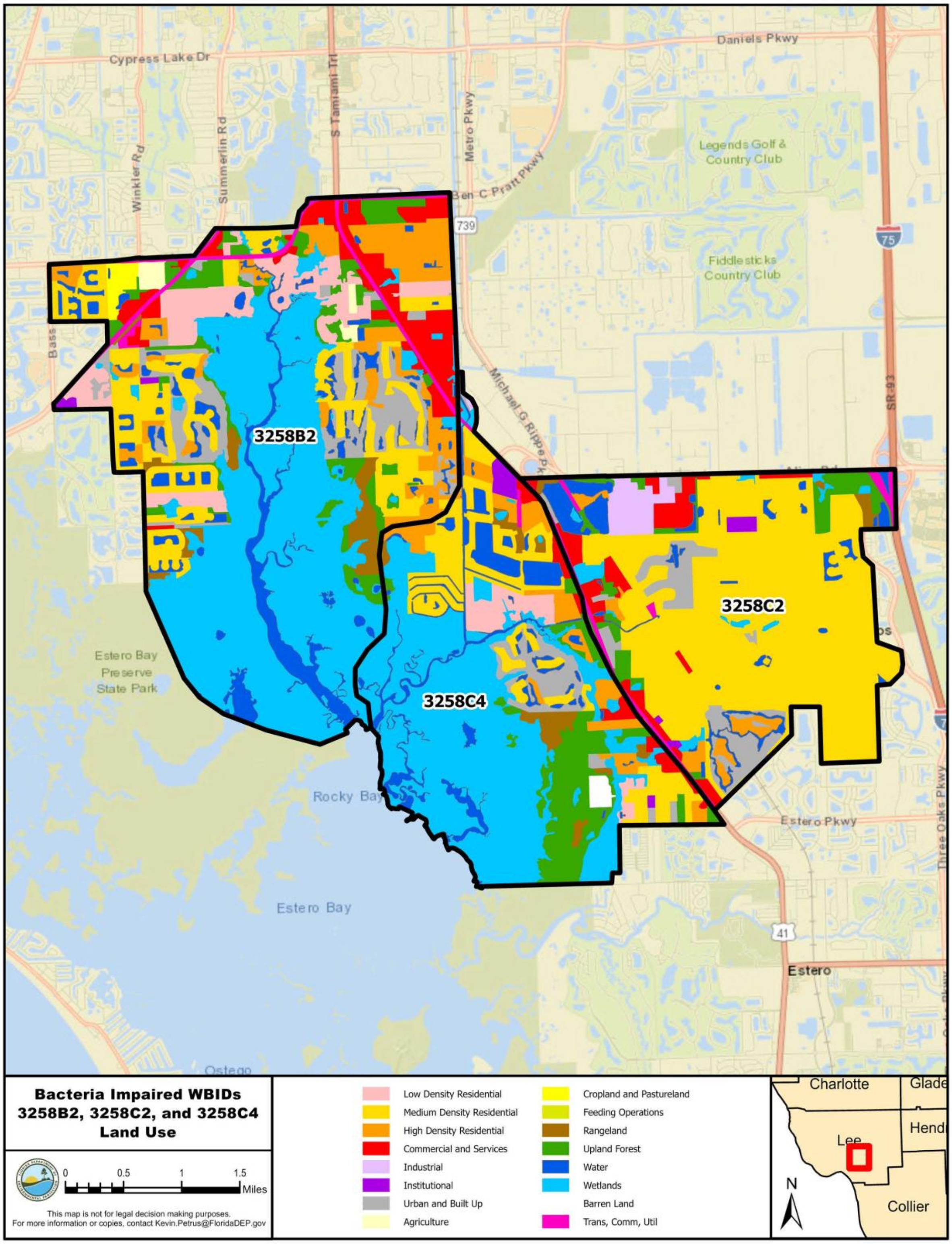
[2] (Permit number: Outfall designation)

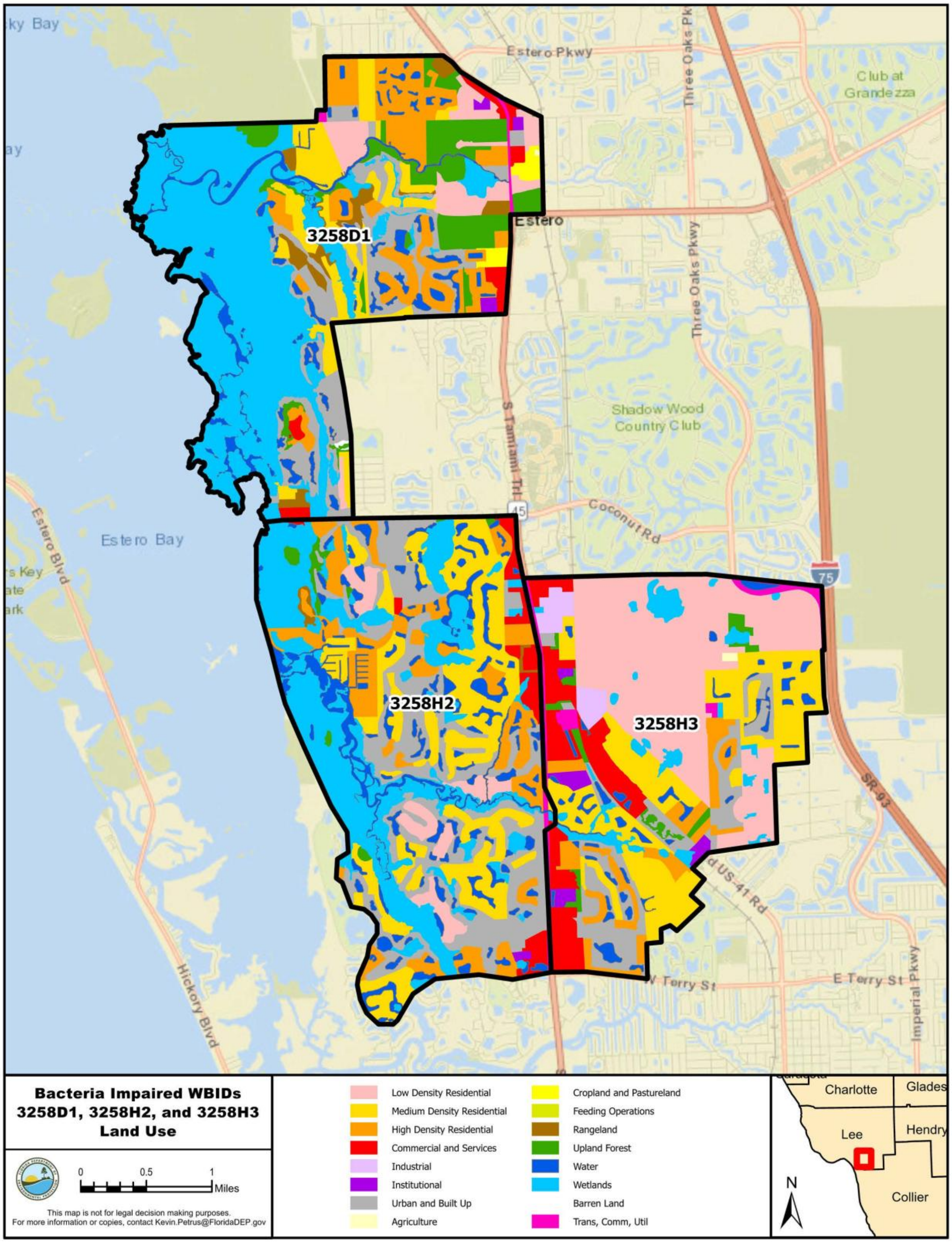
Waterbody Name	WBID	Classification[1]	FIB Impairment	NPDES Wastewater Facility Outfalls[2]
Gordon River (Marine Segment)	3278R5	III-M	Enterococci	City of Naples Water Reclamation Facility (FL0026271: D-002, D-003, D-005)
Gordon River Extension	3278K	III-F	*E. coli*	10th St N Area W Goodlette-Frank SS SW Improvements (FLG914741: D-001), City of Naples Water Reclamation Facility (FL0026271: D-004)
Rock Creek	3278R3	III-M	Enterococci	Collier County South County WRF (FL0141356: D-001, D-002)

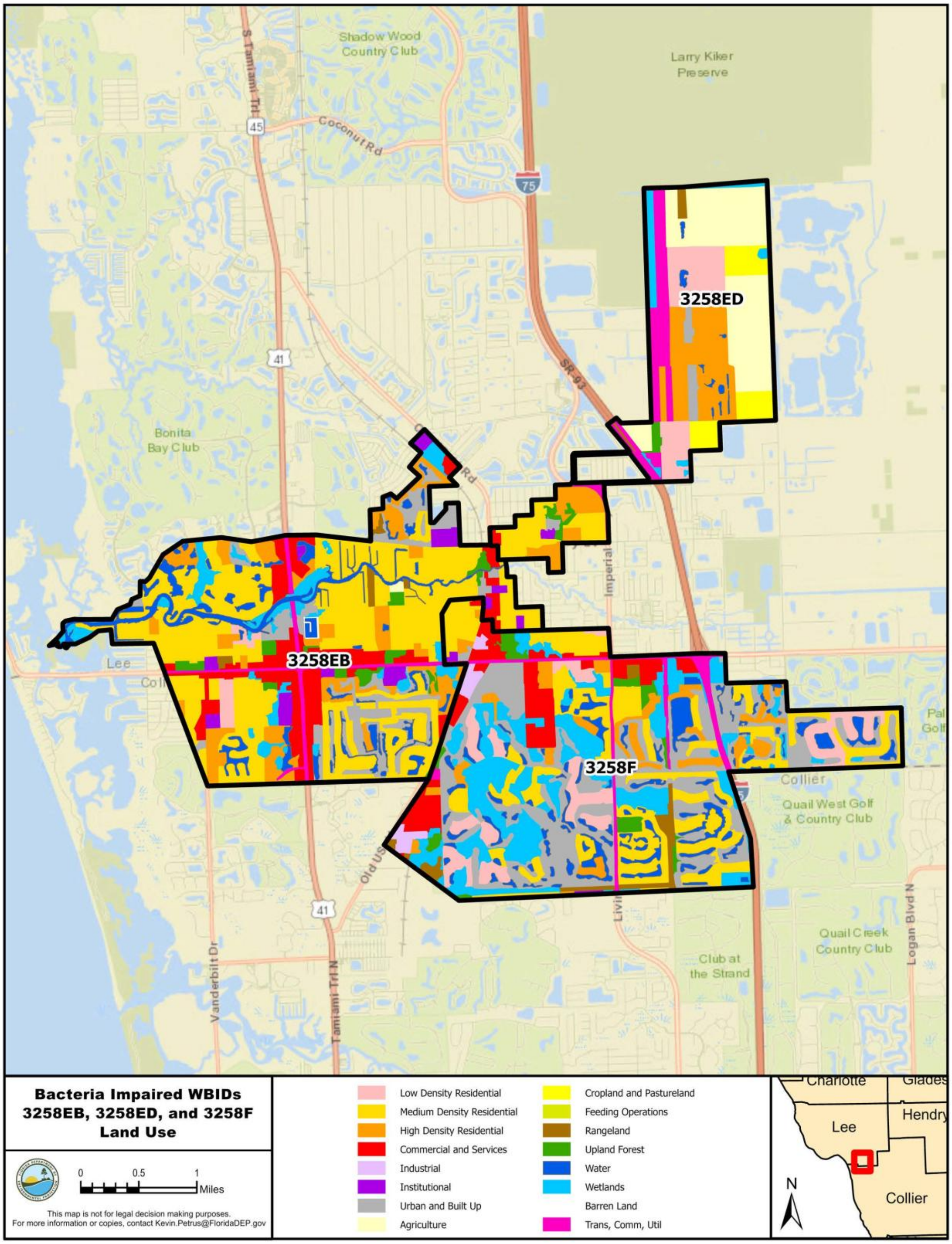


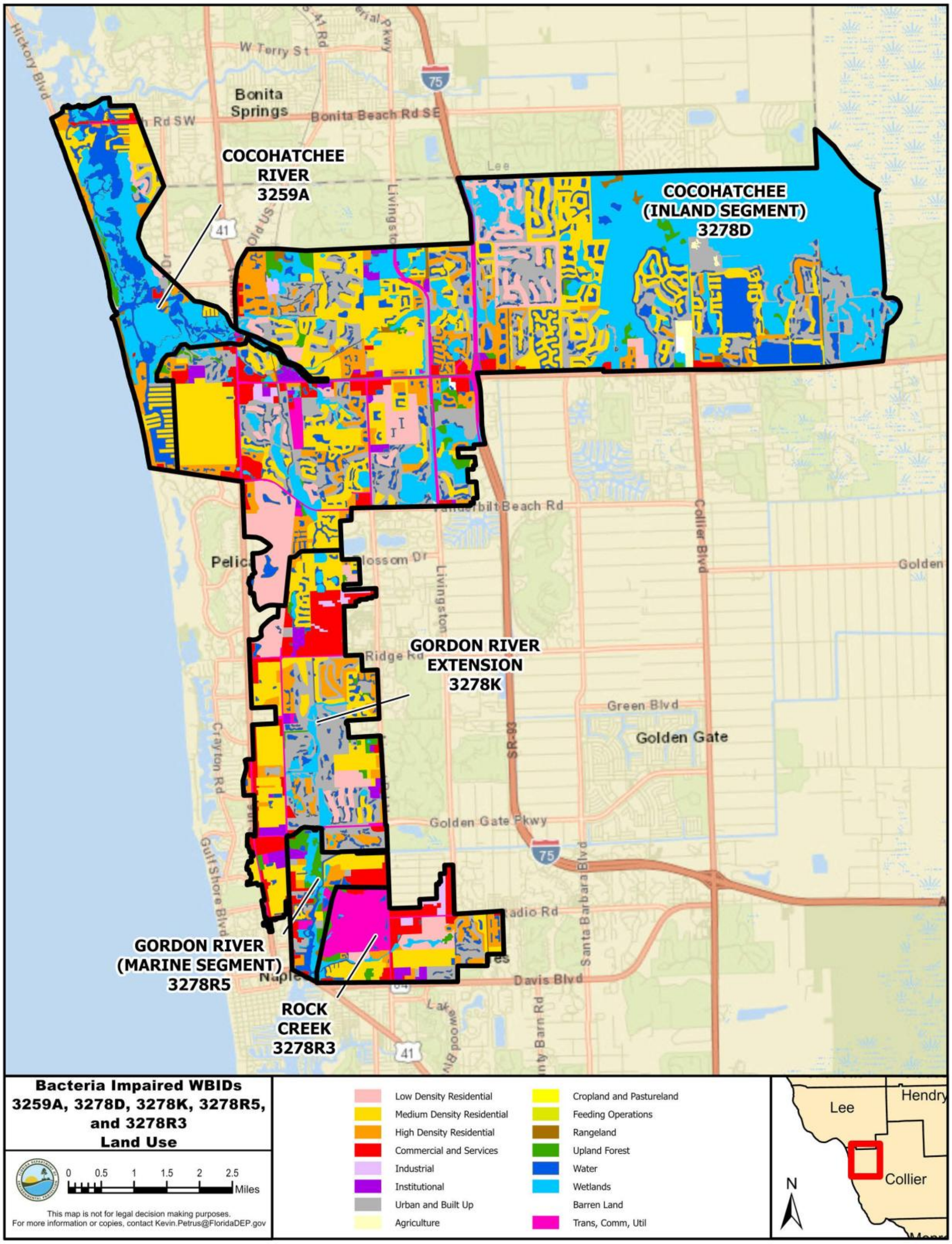
Lee County
Collier County
COCOHATCHEE RIVER 3259A
COCOHATCHEE (INLAND SEGMENT) 3278D
GORDON RIVER EXTENSION 3278K
GORDON RIVER (MARINE SEGMENT) 3278R5
ROCK CREEK 3278R3
10th St N Area W Goodlette-Frank SS SW Improvements (D-001)
City of Naples Water Reclamation Facility (D-004)
City of Naples Water Reclamation Facility (D-003)
City of Naples Water Reclamation Facility (D-005)
City of Naples Water Reclamation Facility (D-002)
Collier County South County WRF (D-001)
Collier County South County WRF (D-002)
Bonita Springs
Pelican Bay
Golden Gate
Bacteria Impaired WBIDs 3259A, 3278D, 3278K, 3278R5, and 3278R3 Domestic Wastewater Treatment Facility Outfalls
0 0.5 1 1.5 2 2.5 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@dep.state.fl.us
GIS: Ronald.Hughes@FloridaDEP.gov
Wastewater Treatment Facility Outfalls
Bacteria WBIDs
Florida Counties
N

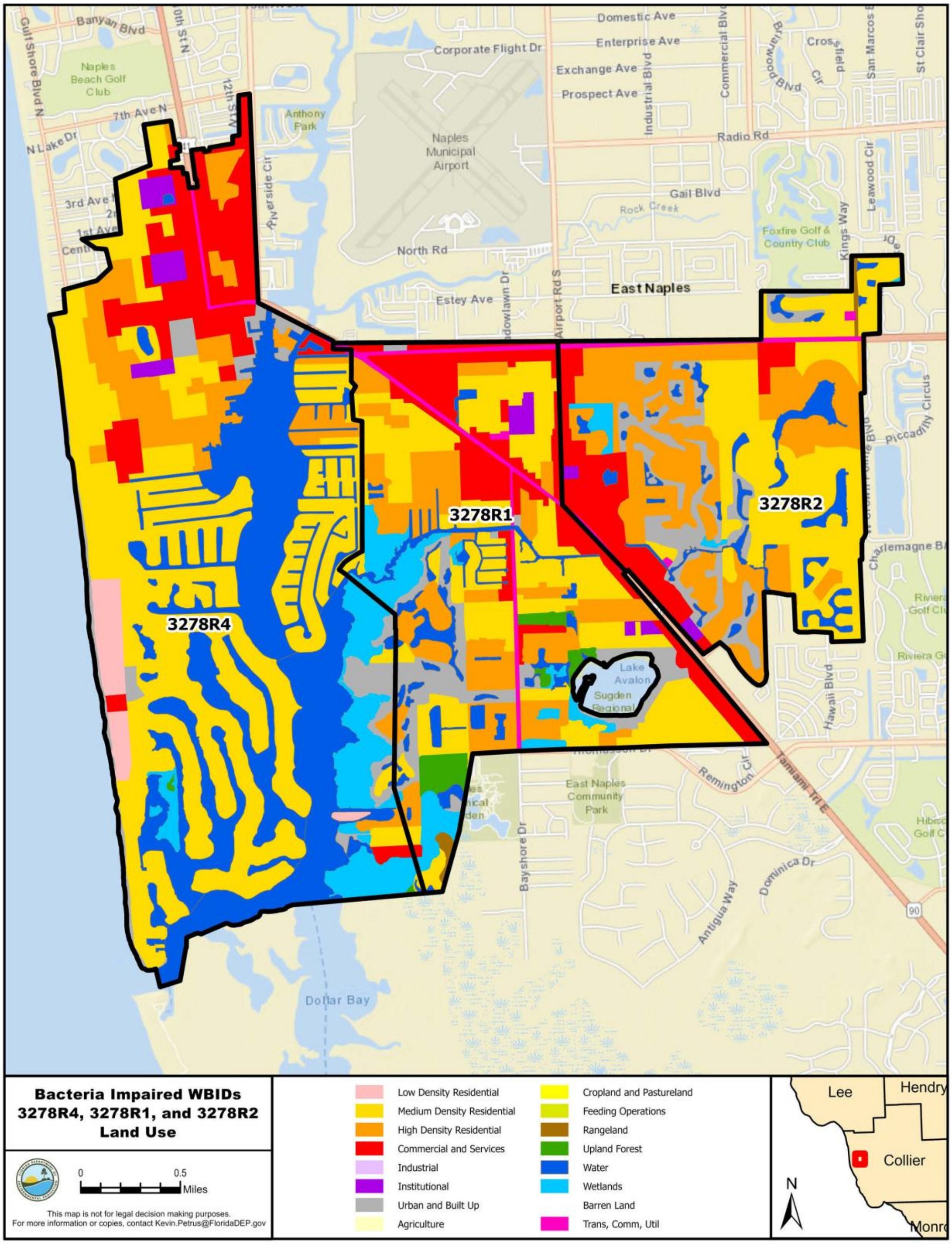
Appendix C: Maps of Land Use in the Verified Impaired WBIDs

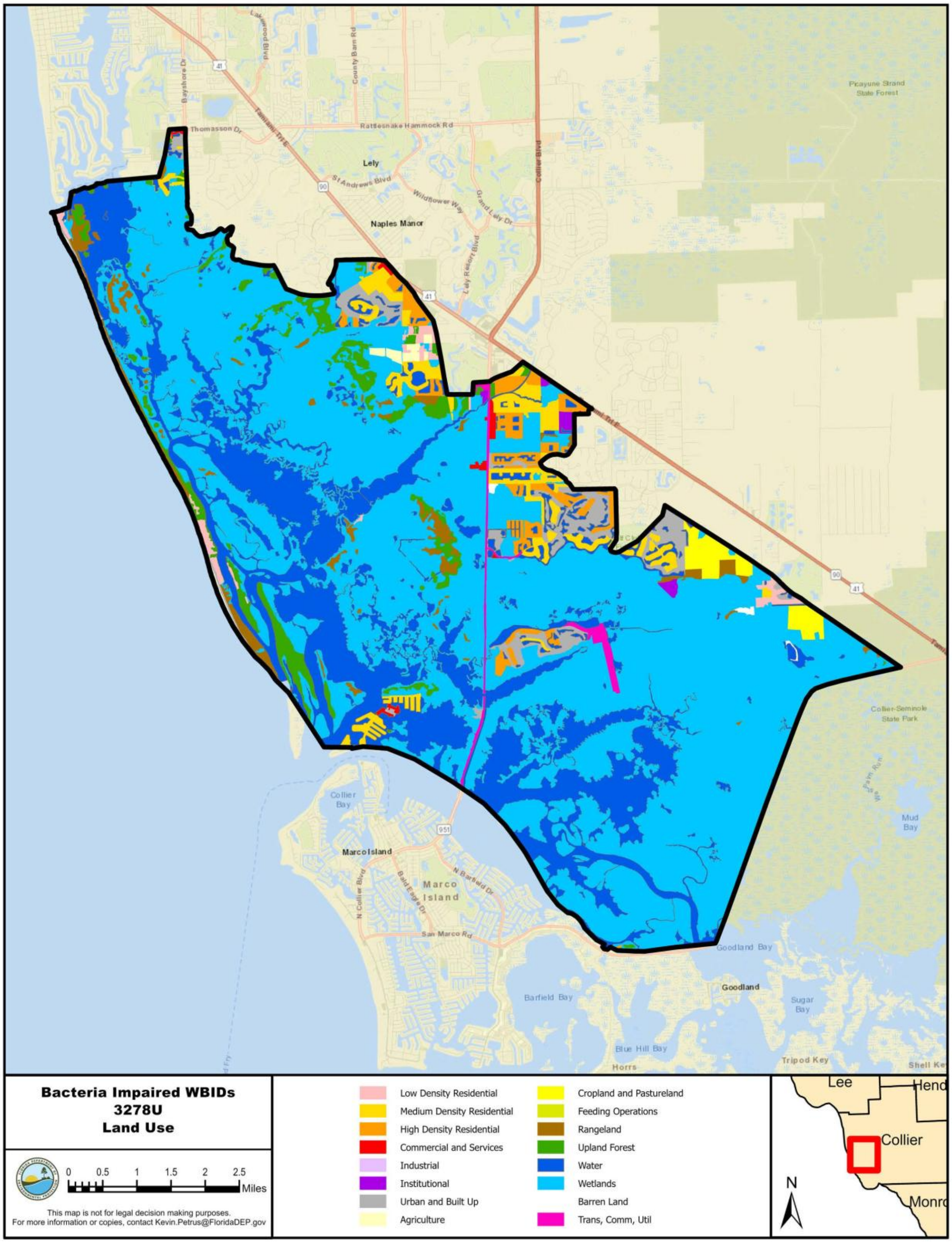


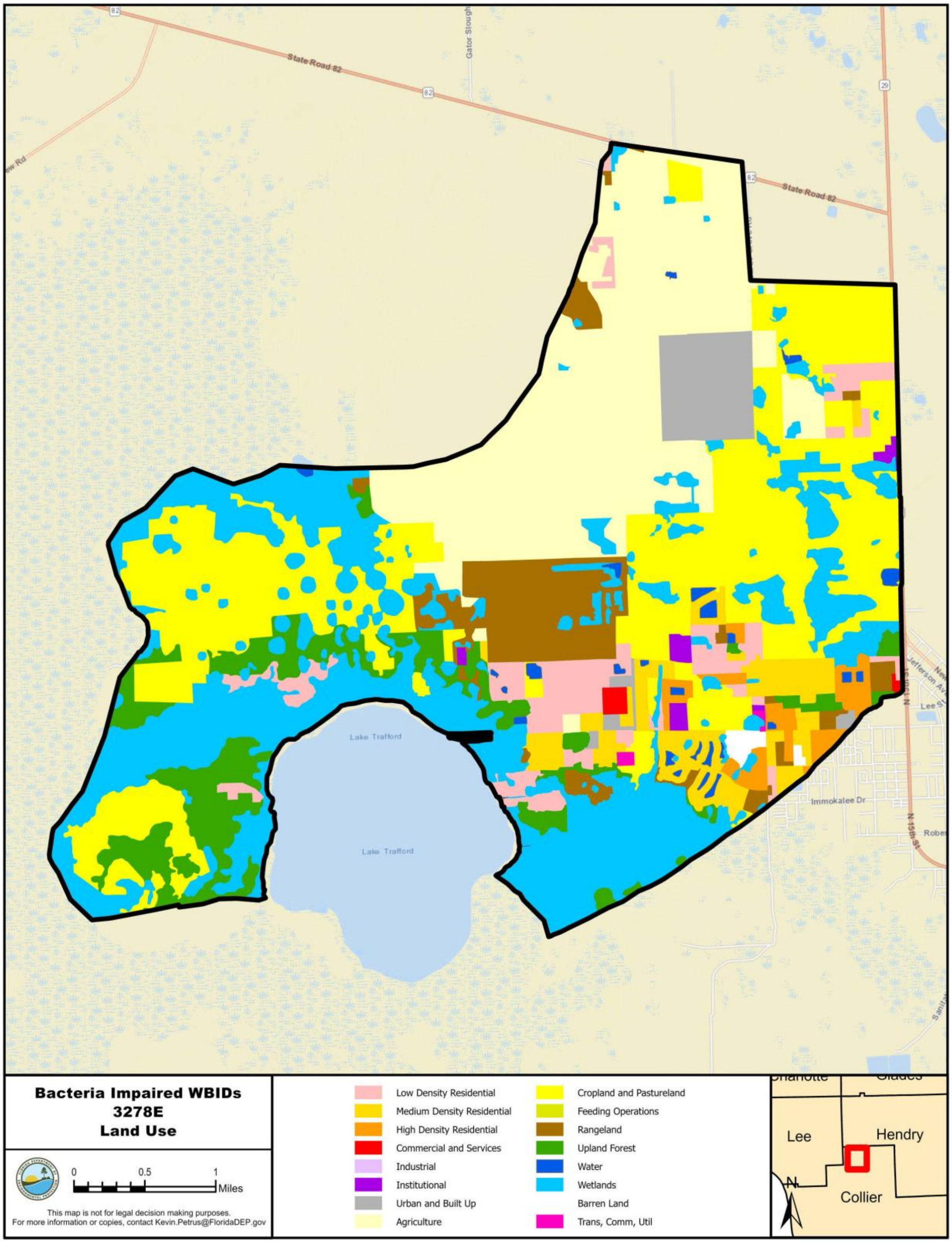

Estero Pkwy
Three Oaks Pkwy
Club at Grandezza
Estero
3258D1
Three Oaks Pkwy
Shadow Wood Country Club
S Tamiami Trl
45
Coconut Rd
75
Estero Blvd
Estero Bay
3258H2
3258H3
SR-93
US-41 Rd
W Terry St
E Terry St
Imperial Pkwy
Hickory Blvd
Bacteria Impaired WBIDs 3258D1, 3258H2, and 3258H3 Land Use
0 0.5 1 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
Charlotte
Glades
Lee
Hendry
Collier
N


Shadow Wood
Country Club
Larry Kiker
Preserve
S Tamiami Trl
45
Coconut Rd
75
3258ED
41
SR-93
Bonita
Bay Club
Imperial
3258EB
Lee
3258F
Collier
Quail West Golf
& Country Club
41
Old US
Vanderbilt Dr
Tamiami Trl N
Quail Creek
Country Club
Club at
the Strand
Logan Blvd N
Bacteria Impaired WBIDs
3258EB, 3258ED, and 3258F
Land Use
0
0.5
1
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
Charlotte
Glades
Lee
Hendry
Collier
N

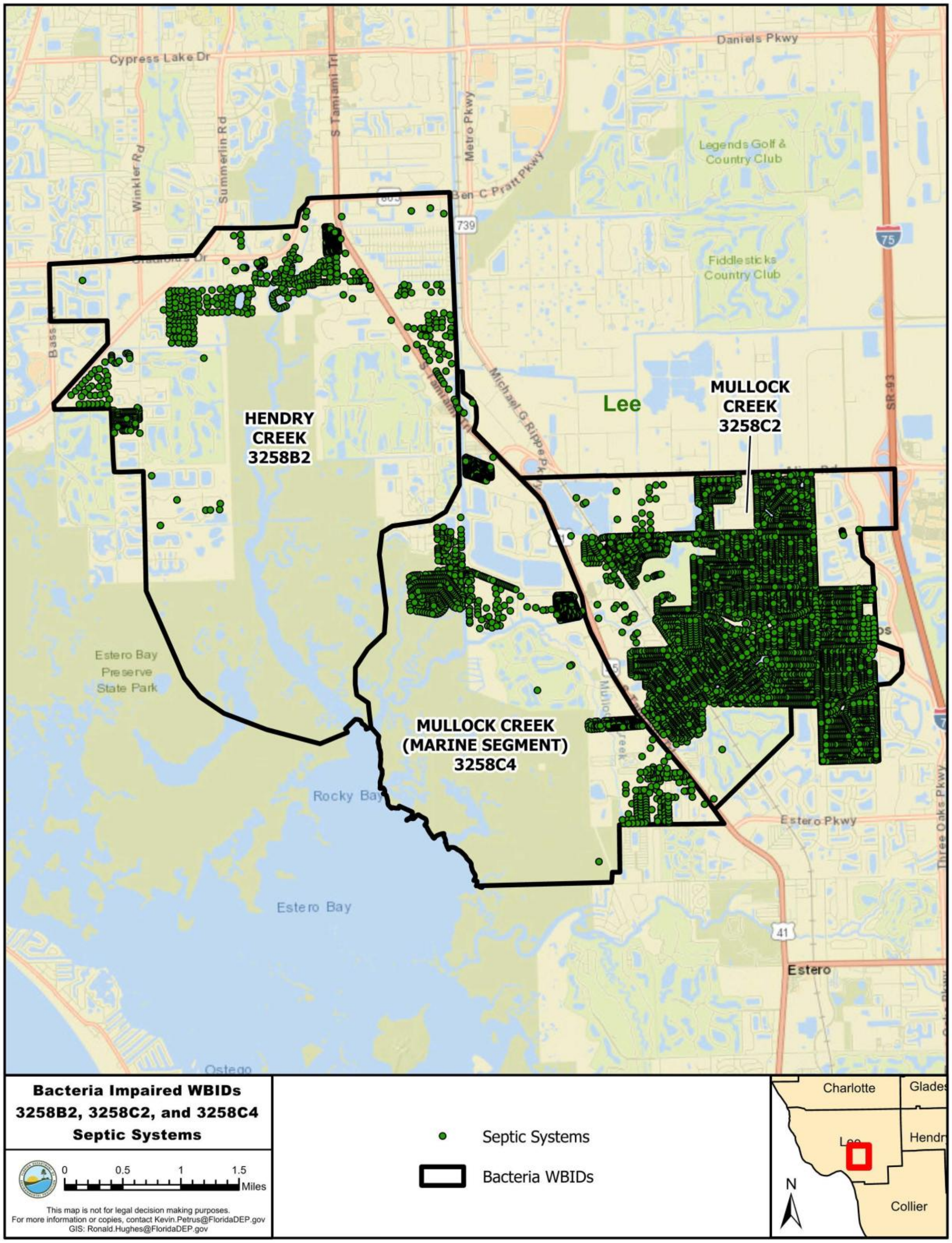

COCOHATCHEE
RIVER
3259A
COCOHATCHEE
(INLAND SEGMENT)
3278D
GORDON RIVER
EXTENSION
3278K
GORDON RIVER
(MARINE SEGMENT)
3278R5
ROCK
CREEK
3278R3
Bonita
Springs
W Terry St
Bonita Beach Rd SE
Hickory Blvd
Vanderbilt Beach Rd
Collier Blvd
Golden Gate
Green Blvd
Golden Gate Pkwy
Radio Rd
Davis Blvd
Santa Barbara Blvd
SR-93
Livingston
Crayton Rd
Gulf Shore Blvd
75
41
Bacteria Impaired WBIDs
3259A, 3278D, 3278K, 3278R5,
and 3278R3
Land Use
0 0.5 1 1.5 2 2.5
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
Lee
Hendry
Collier
N

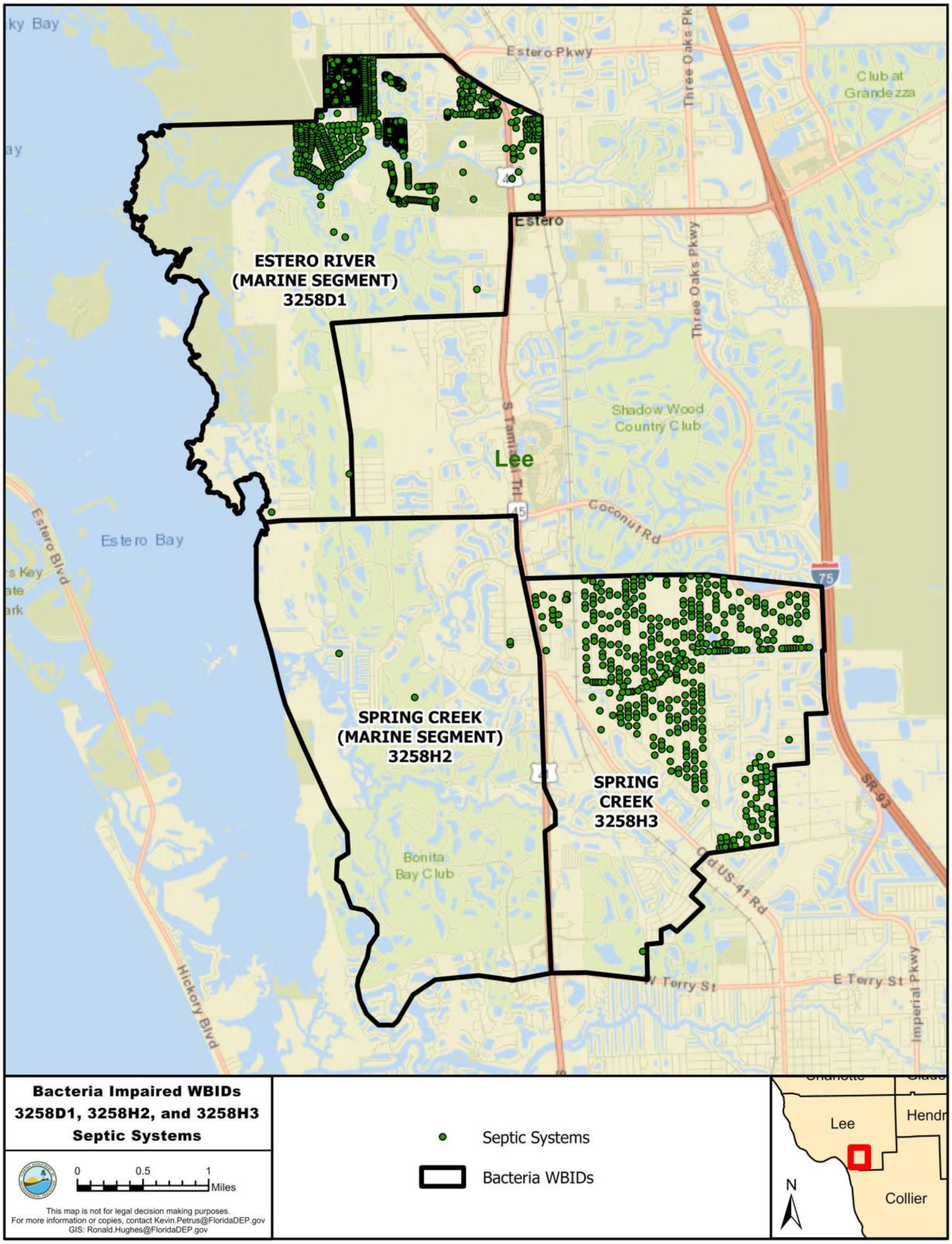

Bacteria Impaired WBIDs
3278R4, 3278R1, and 3278R2
Land Use
0
0.5
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
Lee
Hendry
Collier
N
3278R4
3278R1
3278R2
Naples Municipal Airport
East Naples
Lake Avalon
Sugden Regional
East Naples Community Park
Naples Beach Golf Club
Anthony Park
Foxfire Golf & Country Club
Dollar Bay
Banyan Blvd
Corporate Flight Dr
Domestic Ave
Enterprise Ave
Exchange Ave
Prospect Ave
Radio Rd
Gail Blvd
Rock Creek
North Rd
Estey Ave
Airport Rd S
Industrial Blvd
Commercial Blvd
Briarwood Blvd
Kings Way
Leawood Cir
San Marcos Blvd
St Clair Shores Rd
Gulf Shore Blvd N
7th Ave N
N Lake Dr
3rd Ave N
1st Ave
Riverside Cir
12th St
10th St N
Bayshore Dr
Tamiami Trl E
Remington Cir
Hawaii Blvd
Antigua Way
Dominica Dr
Piccadilly Circus
Charlemagne Blvd
90


Bacteria Impaired WBIDs
3278U
Land Use
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
0 0.5 1 1.5 2 2.5 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Lee
Collier
N
Lely
Naples Manor
Rattlesnake Hammock Rd
Thomasson Dr
Picayune Strand State Forest
Collier-Seminole State Park
Collier Bay
Marco Island
Mud Bay
Goodland Bay
Goodland
Barfield Bay
Sugar Bay
Blue Hill Bay
Tripod Key
San Marco Rd

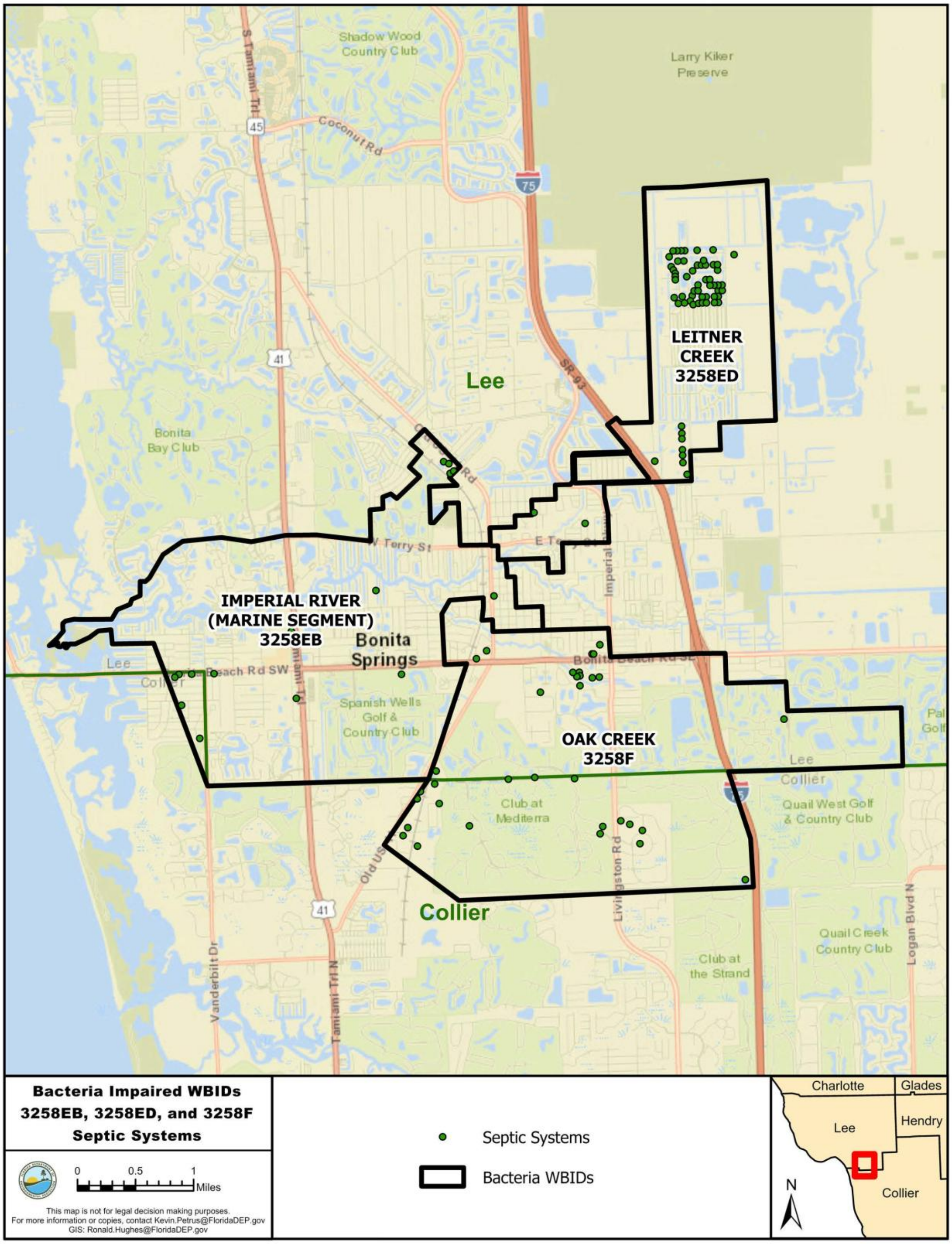

State Road 82
Gator Slough
Lake Trafford
Immokalee Dr
Bacteria Impaired WBIDs
3278E
Land Use
0
0.5
1
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
Low Density Residential
Medium Density Residential
High Density Residential
Commercial and Services
Industrial
Institutional
Urban and Built Up
Agriculture
Cropland and Pastureland
Feeding Operations
Rangeland
Upland Forest
Water
Wetlands
Barren Land
Trans, Comm, Util
Lee
Hendry
Collier
N

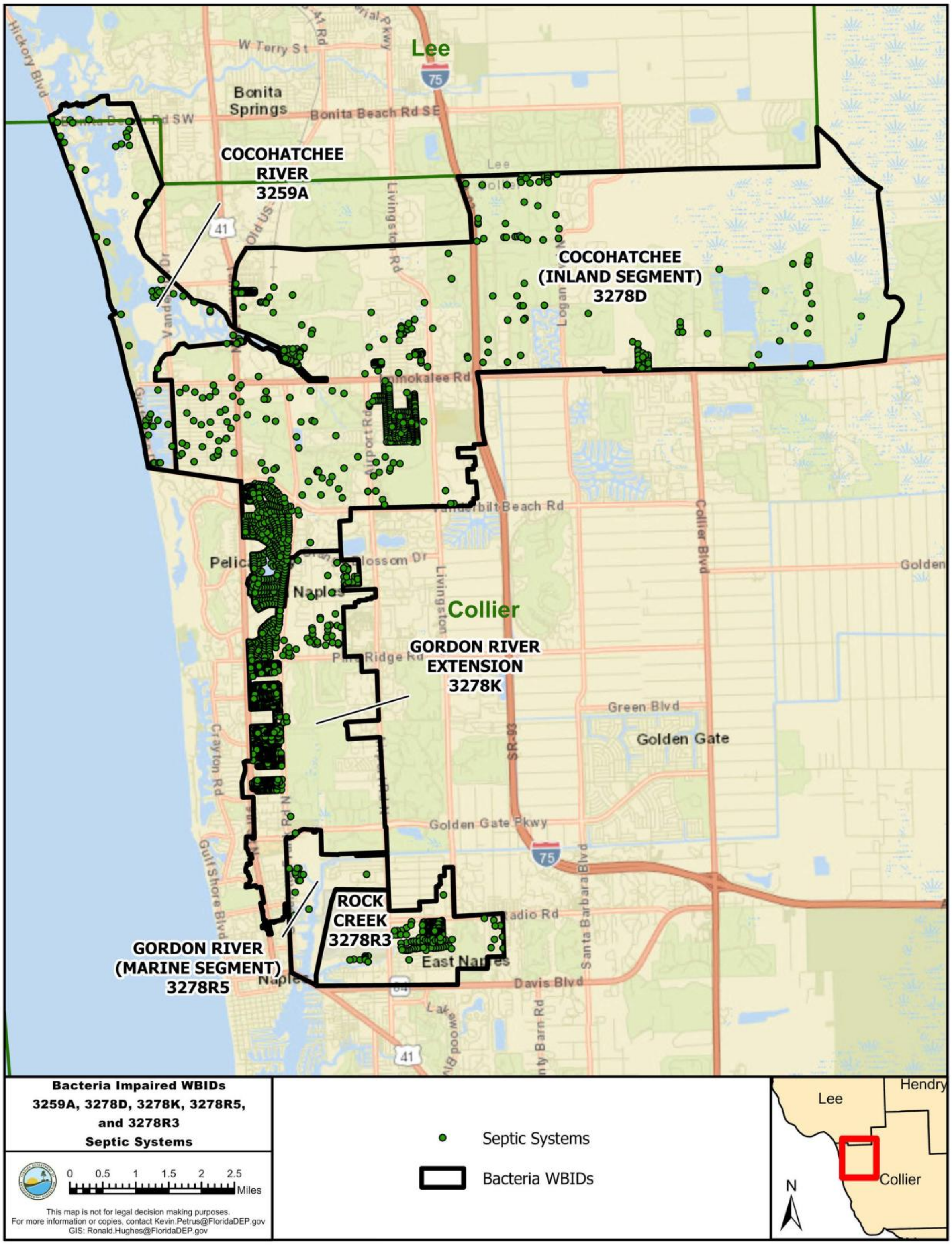
Appendix D: Maps of Septic Systems (OSTDS) Located in the Impaired Water Segments

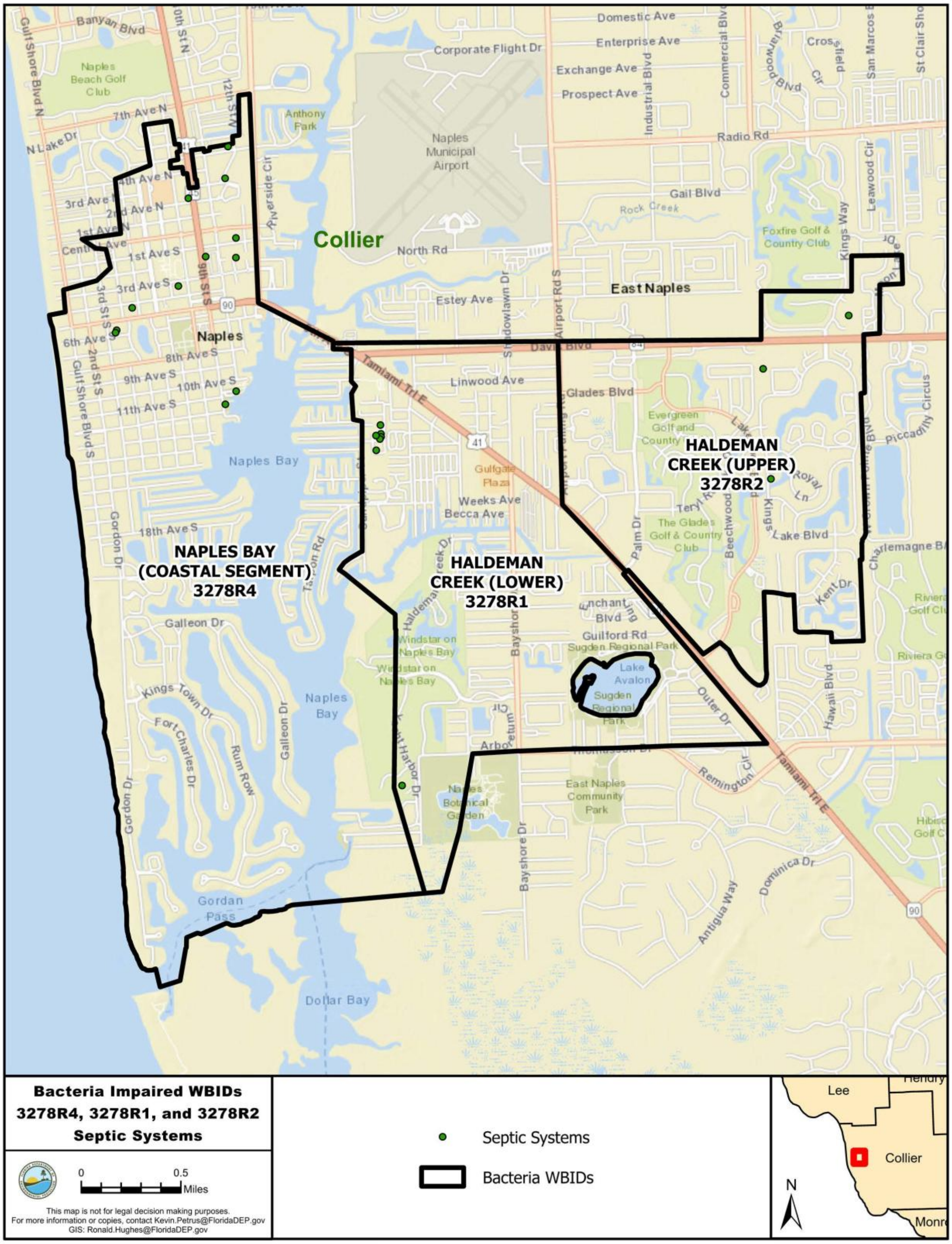


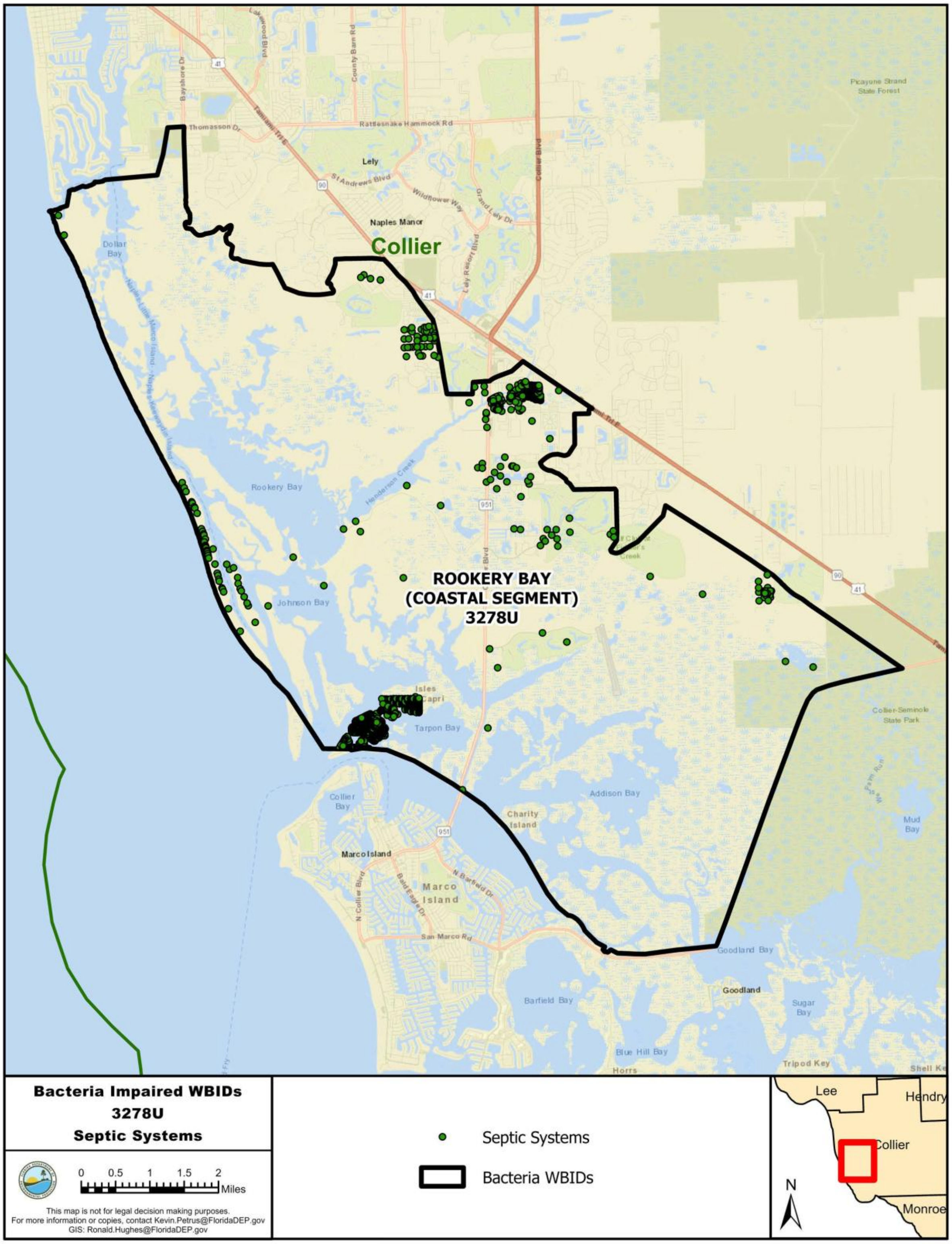


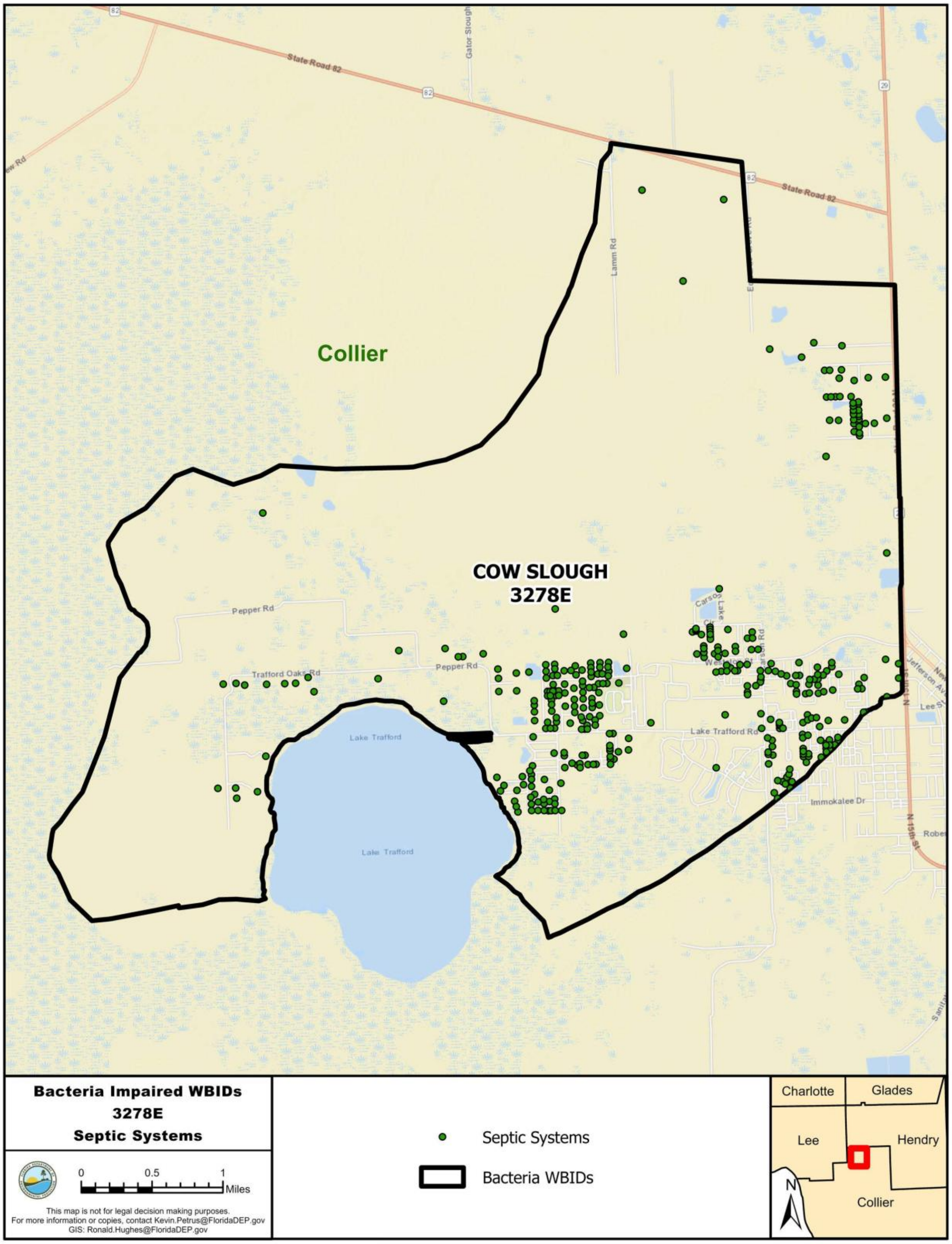
Estero Pkwy
Three Oaks Pkwy
Club at Grandezza
Estero
ESTERO RIVER (MARINE SEGMENT) 3258D1
Shadow Wood Country Club
Lee
S Tamiami Trl
Coconut Rd
Estero Bay
Estero Blvd
75
SPRING CREEK (MARINE SEGMENT) 3258H2
SPRING CREEK 3258H3
SR-93
Bonita Bay Club
Old US-41 Rd
W Terry St
E Terry St
Hickory Blvd
Imperial Pkwy
Bacteria Impaired WBIDs 3258D1, 3258H2, and 3258H3 Septic Systems
0
0.5
1
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Lee
Collier
N


Shadow Wood
Country Club
Larry Kiker
Preserve
Coconut Rd
S Tamiami Trl
LEITNER
CREEK
3258ED
Lee
SR 93
Bonita
Bay Club
W Terry St
E Terry St
Imperial
IMPERIAL RIVER
(MARINE SEGMENT)
3258EB
Bonita
Springs
Lee
Collier
Beach Rd SW
Bonita Beach Rd SE
Spanish Wells
Golf &
Country Club
OAK CREEK
3258F
Lee
Collier
Club at
Mediterra
Quail West Golf
& Country Club
Livingston Rd
Old US 41
Collier
Quail Creek
Country Club
Logan Blvd N
Club at
the Strand
Vanderbilt Dr
Tamiami Trl N
Bacteria Impaired WBIDs
3258EB, 3258ED, and 3258F
Septic Systems
0
0.5
1
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Charlotte
Glades
Lee
Hendry
Collier
N

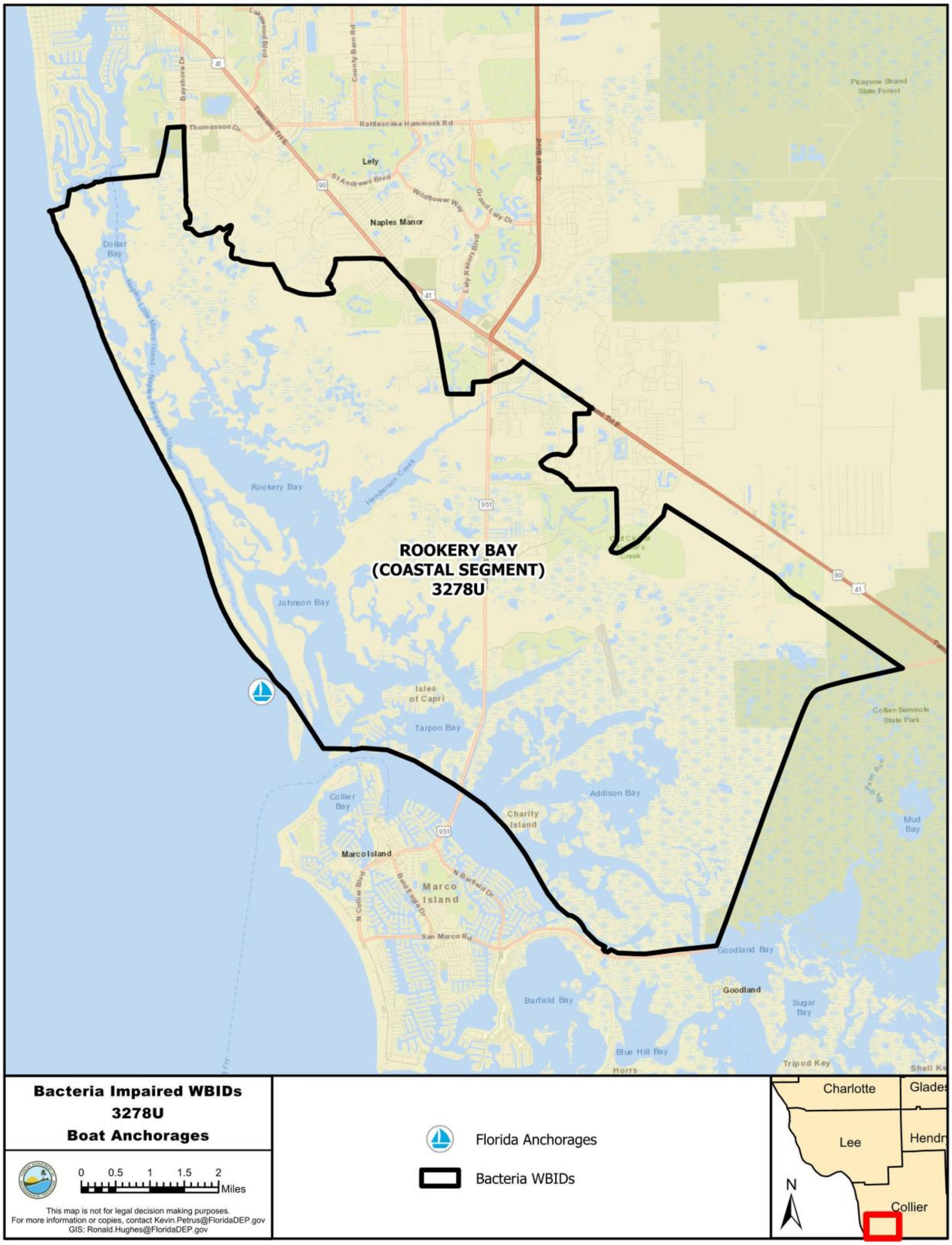

Lee
Collier
Bonita Springs
COCOHATCHEE RIVER 3259A
COCOHATCHEE (INLAND SEGMENT) 3278D
GORDON RIVER EXTENSION 3278K
ROCK CREEK 3278R3
GORDON RIVER (MARINE SEGMENT) 3278R5
Golden Gate
East Naples
Bonita Beach Rd SE
Vanderbilt Beach Rd
Golden Gate Pkwy
Green Blvd
Davis Blvd
Radio Rd
Collier Blvd
Livingston Rd
Santa Barbara Blvd
SR-93
Bacteria Impaired WBIDs
3259A, 3278D, 3278K, 3278R5, and 3278R3
Septic Systems
0 0.5 1 1.5 2 2.5 Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Lee
Hendry
Collier
N


NAPLES BAY
(COASTAL SEGMENT)
3278R4
HALDEMAN
CREEK (LOWER)
3278R1
HALDEMAN
CREEK (UPPER)
3278R2
Collier
Naples
East Naples
Naples Bay
Naples Municipal Airport
Gordan Pass
Dollar Bay
Lake Avalon
Sugden Regional Park
Naples Botanical Garden
East Naples Community Park
Tamiami Trl E
Davis Blvd
Radio Rd
North Rd
Airport Rd S
Bayshore Dr
Gulf Shore Blvd S
Gordon Dr
Bacteria Impaired WBIDs
3278R4, 3278R1, and 3278R2
Septic Systems
0
0.5
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Lee
Collier
N


Collier
Lely
Naples Manor
Rattlesnake Hammock Rd
Thomasson Dr
St Andrews Blvd
Wildflower Way
Grand Lely Dr
Lely Resort Blvd
Bayshore Dr
County Barn Rd
Collier Blvd
Picayune Strand State Forest
Dollar Bay
Rookery Bay
Henderson Creek
Johnson Bay
ROOKERY BAY
(COASTAL SEGMENT)
3278U
Isles of Capri
Tarpon Bay
Collier Bay
Charity Island
Addison Bay
Collier-Seminole State Park
Mud Bay
Marco Island
N Collier Blvd
N Barfield Dr
Bald Eagle Dr
San Marco Rd
Goodland Bay
Goodland
Barfield Bay
Sugar Bay
Blue Hill Bay
Horrs
Tripod Key
Bacteria Impaired WBIDs
3278U
Septic Systems
0 0.5 1 1.5 2
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Lee
Hendry
Collier
Monroe
N


State Road 82
Gator Slough
Lamm Rd
Collier
COW SLOUGH
3278E
Pepper Rd
Trafford Oaks Rd
Lake Trafford
Lake Trafford Rd
Immokalee Dr
N 15th St
Bacteria Impaired WBIDs
3278E
Septic Systems
0
0.5
1
Miles
This map is not for legal decision making purposes.
For more information or copies, contact Kevin.Petrus@FloridaDEP.gov
GIS: Ronald.Hughes@FloridaDEP.gov
Septic Systems
Bacteria WBIDs
Charlotte
Glades
Lee
Hendry
Collier
N

Appendix E: Map of Vessel Anchorage Areas



Appendix F: Supporting Information for TMDL Development

Analysis of Reduction Perecentages Needed to Meet the TMDL Targets

To facilitate restoration of the impaired waters, an analysis was performed to identify reductions from existing bacteria concentrations needed to meet the target concentrations for each impaired waterbody. These percent reductions represent the relative difference between existing and target concentrations and should not be interpreted as the reduction required in bacteria loads entering the impaired waters. Therefore, the percent reductions are presented for informational purposes only to document the general magnitude of each impairment and the potential level of effort necessary to attain the applicable criteria and to facilitate comparisons between the reductions necessary to meet the TPTV and geometric mean criteria components.

Prior to calculating percent reductions, a data sufficiency evaluation was performed for each impaired WBID to determine if the available data were adequate for characterizing existing conditions, which are based on data collected in the last 10 years (2013 to 2022 period). Minimum data requirements for calculation of needed reductions were waterbodies with at least three years of data and 20 samples taken in the last 10 years, with at least five samples collected between June and September. Bacteria sample results reported with the following qualifier codes are excluded from analysis: ?, G, H, N, O, V, and Y. For stations with multiple results collected on the same day, the median value of the results is counted as one sample. The bacteria results used for this analysis are in a spreadsheet available at the hyperlink found at the end of the appendix. The FIB impaired waters in the basin met the data sufficiency requirements, with all except five WBIDs (Cow Slough, Leitner Creek, Oak Creek and Spring Creek stream segments; and Rookery Bay (Coastal Segment)) having greater than 100 sample results in the last 10 years.

The percent reductions to meet the TPTV and geometric mean components of the criteria are presented in **Tables F.1. and F.2.**, respectively.

Percent Reductions Necessary to Meet the TPTV

To calculate the percent reduction needed to meet the TPTV, the existing condition was represented by the 90th percentile value of the measured concentrations in the 2013-2022 period. The 90th percentile is also referred to as the 10 percent exceedance event because it will be exceeded with the probability of 0.10, which is consistent with the 10 percent threshold value expression of the criteria. Considering a set of water quality data, 90 percent of the measured values are lower than the 90th percentile concentration and 10 percent are higher.

Because bacteriological counts in water are not normally distributed, a nonparametric method is more appropriate for the analysis of fecal indicator bacteria data (Hunter 2002). Nonparametric methods account for skewed data distributions that are often observed in bacteria results. For waters verified impaired for exceeding the FIB TPTV, the Hazen method, which uses a nonparametric formula, was used to determine the 90th percentile. The percent reduction needed to reduce the existing bacteria concentration was calculated by comparing the existing concentrations and allowable target concentrations using **Formula 1**:

$$Needed\ \%\ Reduction = \frac{Existing\ 90th\ Percentile\ Concentration - Allowable\ Concentration}{Existing\ 90th\ Percentile\ Concentration} \quad (1)$$

Using the Hazen method for estimating percentiles, as described in Hunter (2002), the existing condition concentration was defined as the 90th percentile of all the data collected during the last 10 years, defined as the 2013-2022 period. The 90th percentile is also called the 10% exceedance event. This will result in a target condition that is consistent with the state bacteriological water quality criteria TPTV and assessment thresholds for verified impaired waters. Additionally, because microbiological results are log-normally distributed, the following calculations were done on the log-transformed concentration values.

The Hazen equation for determining the rank equivalent to the 90th percentile in a data set is shown in **Formula 2** as follows:

$$Hazen\ (r) = ½ + P*n/100 \qquad (2)$$

Where:

- *r is the rank of the relevant percentile*
- *n is the number of data points in the data set*
- *P is the percentile value (90th in this case)*

To determine the 90th percentile value in a data set, all the available concentration results are ranked (ordered) from the lowest to the highest, and the result that equates to the Hazen rank identifies the 90th percentile.

If none of the results equate to the 90th percentile, the 90th percentile value is calculated by interpolation using the rank of results immediately below and above the 90th percentile rank using **Formula 3**:

$$90th\ Percentile\ Concentration = C_{lower} + \left(C_{higher} - C_{lower}\right) * (r - C_{lower}Rank) \quad (3)$$

Where:

- C_{lower} is the concentration corresponding to the percentile lower than the 90th percentile.
- C_{higher} is the concentration corresponding to the percentile higher than the 90th percentile
- r is the Hazen rank of the 90th percentile
- C_{lower} Rank is the rank of the concentration immediately below the 90th percentile

As an example, the hyperlink provided at the end of the appendix includes a spreadsheet of the calculations of summary statistics, including the 90th percentile value, and the percent reduction necessary to attain the applicable criterion for Rock Creek (WBID 3278R3). The required percent reductions necessary to meet the applicable TPTV criterion components for each impaired segment are provided in **Table F.1**.

Table F.1. WBID-specific summaries of reductions necessary to meet the applicable TPTV criterion component.

[1] Waterbody classifications are defined as follows:
I – Potable water supplies.
II – Shellfish propagation or harvesting.
III-F – Recreation; propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in fresh water.
III-M – Recreation; propagation, and maintenance of a healthy, well-balanced population of fish and wildlife in marine water.
[2] The existing condition is represented by the data collected in the last 10 years, defined as the 2013-2022 period.

WBID	Waterbody Segment Name	Water-body Type	Water-body Class[1]	FIB	Existing Condition: Number of Exceedances/ Number of Samples[2]	Existing Condition Bacteria Count 90th Percentile (counts/100ml)[2]	Applicable TPTV Criterion Component (Counts/100 mL)	Percent Reduction to Meet TMDL TPTV Target
3278D	Cocohatchee (Inland Segment)	Stream	III-F	*E. coli*	123/779	613	≤ 410	33
3259A	Cocohatchee River	Estuary	II	Enterococci	146/1062	184	≤ 130	29
3278E	Cow Slough	Stream	III-F	*E. coli*	22/63	1473	≤ 410	72
3258D1	Estero River (Marine Segment)	Estuary	III-M	Enterococci	187/267	1202	≤ 130	89
3278R5	Gordon River (Marine Segment)	Estuary	III-M	Enterococci	56/194	303	≤ 130	57
3278K	Gordon River Extension	Stream	III-F	*E. coli*	28/163	757	≤ 410	46

WBID	Waterbody Segment Name	Water-body Type	Water-body Class[1]	FIB	Existing Condition: Number of Exceedances/ Number of Samples[2]	Existing Condition Bacteria Count 90th Percentile (counts/100ml)[2]	Applicable TPTV Criterion Component (Counts/100 mL)	Percent Reduction to Meet TMDL TPTV Target
3278R1	Haldeman Creek (Lower)	Estuary	III-M	Enterococci	81/196	711	≤ 130	82
3278R2	Haldeman Creek (Upper)	Stream	III-F	*E. coli*	45/153	1036	≤ 410	60
3258B2	Hendry Creek	Estuary	III-M	Enterococci	349/543	2420	≤ 130	95
3258EB	Imperial River (Marine Segment)	Estuary	III-M	Enterococci	175/296	2420	≤ 130	95
3258ED	Leitner Creek	Stream	III-F	*E. coli*	66/77	2420	≤ 410	83
3258C2	Mullock Creek	Stream	III-F	*E. coli*	44/139	1019	≤ 410	60
3258C4	Mullock Creek (Marine Segment)	Estuary	III-M	Enterococci	31/159	412	≤ 130	68
3278R4	Naples Bay (Coastal Segment)	Estuary	II	Enterococci	68/512	190	≤ 130	32
3278R4	Naples Bay (Coastal Segment)	Estuary	II	Fecal Coliform	85/274	180	≤ 43	76
3258F	Oak Creek	Stream	III-F	*E. coli*	19/31	1830	≤ 410	78
3278R3	Rock Creek	Estuary	III-M	Enterococci	97/192	1209	≤ 130	89
3278U	Rookery Bay (Coastal Segment)	Estuary	II	Fecal Coliform	11/32	1522	≤ 43	97
3258H3	Spring Creek	Stream	III-F	*E. coli*	12/76	638	≤ 410	36
3258H2	Spring Creek (Marine Segment)	Estuary	III-M	Enterococci	144/285	1733	≤ 130	92

Percent Reductions Needed to Meet the Monthly Geometric Mean

The *E. coli* and enterococci criteria include monthly geometric mean components in addition to the TPTVs. Although no waters have been identified as exceeding the monthly geometric mean criteria component due to insufficient data, TMDLs must protect all criteria components year-round. Therefore, an estimate of the monthly geometric mean was included in the analysis. The percent reduction needed to reduce the existing monthly geometric mean bacteria concentration was calculated by comparing the existing concentration and target concentration using **Formula 4**:

$$\%\ Reduction = \frac{Existing\ Geometric\ Mean\ Concentration - Allowable\ Geometric\ Mean\ Concentration}{Existing\ Geometric\ Mean\ Concentration}$$

Percent reductions needed to meet the monthly geometric mean criteria were calculated for each segment based on the highest upper confidence interval (CI) presented in **Table F.2**. These calculations estimate the range of reductions required to fully meet the FIB criteria in each segment. Based on these estimates, most WBIDs likely need additional reductions beyond those calculated for the TPTV criteria. However, since these reductions are based on estimates of monthly geometric means, they are provided for informational purposes only. This information helps identify waterbodies with the greatest need for restoration. It also helps demonstrate the necessity of controlling both the geometric mean and upper percentile (TPTV) for purposes of protecting recreational uses.

The analysis of monthly geometric means emphasizes the importance of addressing both criteria components in the TMDL. Therefore, the *E. coli* and enterococci TMDL targets and allocations account for both the TPTV and the monthly geometric mean.

Table F.2. Monthly geometric mean, upper 90% confidence intervals FIB counts by WBID, and reductions necessary to meet the monthly geometric mean component of the applicable FIB criterion.

WBID	Waterbody Segment Name	FIB Parameter	Monthly Geometric Mean Criterion (counts/100 mL)	Maximum Monthly Geometric Mean (counts/ 100mL)	Maximum Upper 90% CI Monthly Geometric Mean	Percent Reduction based on the Upper 90% CI
3278D	Cocohatchee (Inland Segment)	*E. coli*	≤ 126	108	153	18
3259A	Cocohatchee River	Enterococci	≤ 35	73	154	77
3278E	Cow Slough	*E. coli*	≤126	879	2814	96
3258D1	Estero River (Marine Segment)	Enterococci	≤ 35	384	696	95
3278R5	Gordon River (Marine Segment)	Enterococci	≤ 35	97	286	88
3278K	Gordon River Extension	*E. coli*	≤126	294	696	82
3278R1	Haldeman Creek (Lower)	Enterococci	≤ 35	100	177	80
3278R2	Haldeman Creek (Upper)	*E. coli*	≤ 126	272	827	85
3258B2	Hendry Creek	Enterococci	≤ 35	362	851	96
3258EB	Imperial River (Marine Segment)	Enterococci	≤ 35	291	606	94
3258ED	Leitner Creek	*E. coli*	≤ 126	2063	2694	95
3258C2	Mullock Creek	*E. coli*	≤ 126	398	1620	92
3258C4	Mullock Creek (Marine Segment)	Enterococci	≤ 35	155	840	96
3278R4	Naples Bay (Coastal Segment)	Enterococci	≤ 35	42	81	57
3258F	Oak Creek	*E. coli*	≤ 126	2420	6184	98
3278R3	Rock Creek	Enterococci	≤ 35	205	447	92
3258H3	Spring Creek	*E. coli*	≤ 126	591	1351	91
3258H2	Spring Creek (Marine Segment)	Enterococci	≤ 35	257	664	95

Percent Reductions Needed to Meet the Class II Median Criterion

For Class II marine waters listed as verified impaired for median concentration values exceeding the applicable criterion of 14 counts/100 mL, the existing condition is expressed as the median value of the bacteria results collected in the last 10 years defined as the 2013-2022 period.

The percent reduction needed to reduce the existing median bacteria concentration was calculated by comparing the existing concentration and target concentration using **Formula 4**:

$$\% \, Reduction = \frac{Existing\ Median\ Concentration - Allowable\ Median\ Concentration}{Existing\ Median\ Concentration} \quad (4)$$

Only the Naples Bay Coastal Segment (WBID 3278R4) exceeded the median fecal coliform criterion of 14 MPN/100 ML. The median fecal coliform count for the segment, 19 MPN/100 mL, would require a 26% reduction.

The following hyperlinks include spreadsheets of supporting information:
1) the bacteria results for impaired WBIDs that were used to characterize existing conditions.
https://publicfiles.dep.state.fl.us/DEAR/DEARweb/TMDL/Bacteria_TMDLs/AppendixF_EWCBasin_TMDLBacteriaResults_IWRRun65.xlsx

2) an example of the TMDL percent reduction calculations for Rock Creek (WBID 3278R3).
https://publicfiles.dep.state.fl.us/DEAR/DEARweb/TMDL/Bacteria_TMDLs/AppendixF_RockCreek_3278R3_Encoc_2013-2022.xlsx

Appendix G: Background Information on Federal and State Stormwater Programs

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The Stormwater Rule, as authorized in Chapter 403, F.S., was established as a technology-based program that relies on the implementation of BMPs designed to achieve a specific level of treatment (i.e., performance standards) as set forth in Chapter 62-40, F.A.C. In 1994, the DEP stormwater treatment requirements were integrated with the stormwater flood control requirements of the water management districts, along with wetland protection requirements, into the Environmental Resource Permit regulations, as authorized under Part IV of Chapter 373, F.S.

Chapter 62-40, F.A.C., also requires the state's water management districts to establish stormwater pollutant load reduction goals (PLRGs) and adopt them as part of a SWIM Program plan, other watershed plan, or rule. Stormwater PLRGs are a major component of the load allocation part of a TMDL. Waterbodies where PLRGs have been established include Tampa Bay, Lake Thonotosassa, the Winter Haven Chain of Lakes, the Everglades, Lake Okeechobee, and Lake Apopka.

In 1987, the U.S. Congress established Section 402(p) as part of the federal CWA Reauthorization. This section of the law amended the scope of the federal NPDES permitting program to designate certain stormwater discharges as "point sources" of pollution. EPA promulgated regulations and began implementing the Phase I NPDES stormwater program in 1990 to address stormwater discharges associated with industrial activity, including 11 categories of industrial activity, construction activities disturbing five or more acres of land, and large and medium MS4s located in incorporated places and counties with populations of 100,000 or more.

However, because the master drainage systems of most local governments in Florida are physically interconnected, the EPA implemented Phase I of the MS4 permitting program on a countywide basis, which brought in all cities (incorporated areas), Chapter 298 special districts; community development districts, water control districts, and Florida Department of Transportation throughout the 14 counties meeting the population criteria. DEP received authorization to implement the NPDES stormwater program in 2000. The authority to administer the program is set forth in Section 403.0885, F.S.

The Phase II NPDES stormwater program, promulgated in 1999, addresses additional sources, including small MS4s and small construction activities disturbing between one and five acres, and urbanized areas serving a minimum resident population of at least 1,000 individuals. While these urban stormwater discharges are technically referred to as "point sources" for the purpose of regulation, they are still diffuse sources of pollution that cannot be easily collected and treated by a central treatment facility, as are other point sources of pollution such as domestic and industrial wastewater discharges. Phase I MS4 permits issued in Florida include a reopener clause that allows permit revisions to implement TMDLs when the implementation plan is formally adopted.