



Approved

Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay

Segments 2481CB_03 and 2481CB_04

Distributed by the
Total Maximum Daily Load Section
Texas Commission on Environmental Quality
MC-203
P.O. Box 13087
Austin, Texas 78711-3087

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- Implementation Plan for Eight Total Maximum Daily Loads for Indicator Bacteria in Dickinson Bayou and Three Tidal Tributaries
- Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region

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List of Commonly Used Acronyms

| | |
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| A/E | Architectural and Engineering |
| AU | Assessment Unit |
| BEACH | Beaches Environmental Assessment, Closure, and Health |
| BMP | Best Management Practice |
| CA | Control Action |
| CARP | Cole and Ropes Parks |
| CBBEP | Coastal Bend Bays & Estuaries Program |
| CBBF | Coastal Bend Bays Foundation |
| CBCOG | Coastal Bend Council of Governments |
| CCNCPHD | Corpus Christi Nueces County Public Health District |
| CCS | Center for Coastal Studies |
| CCTV | Closed Circuit Televising |
| CFU | Colony-forming units |
| CFS | Cubic Feet Per Second |
| CIP | Capital Improvements Program |
| CITY | City of Corpus Christi |
| CMOM | Capacity Assurance, Management, Operation and Maintenance |
| CMP | Coastal Management Program |
| DNA | Deoxyribonucleic Acid |
| DWL | Dry Weather Loading |
| EC | Event Concentration |
| EMC | Event Mean Concentration |
| EPA | Environmental Protection Agency |
| FG | Future Growth |
| FOG | Fats, Oil & Grease |
| FSE | Food Service Establishments |
| ft. | Feet |
| GIS | Geographic Information System |
| GLO | General Land Office |
| HEM | Hexane Extractible Material |
| I&I | Inflow and Infiltration |
| IA | Implementation Activity |
| I-Plan | Implementation Plan |
| LA | Load Allocation |
| LID | Low Impact Development |
| LDC | Load Duration Curve |
| LF | Linear Feet |
| MM | Management Measure |
| mL | Milliliter |
| MGD | Million Gallons Per Day |
| MOS | Margin of Safety |

| | |
|--------|--|
| MPN | Most Probable Number |
| MS4 | Municipal Separate Storm Sewer System |
| MST | Microbial Source Tracking |
| NELAC | National Environmental Laboratory Accreditation Conference |
| NPDES | National Pollutant Discharge Elimination System |
| NPS | Nonpoint Source |
| NRA | Nueces River Authority |
| PCR | Polymerase Chain Reaction |
| OSSF | On-Site Sewage Facility |
| PSA | Public Service Announcements |
| QAPP | Quality Assurance Project Plan |
| qPCR | Quantitative Polymerase Chain Reaction |
| RDII | Rainfall Dependent Inflow/Infiltration |
| SEA | Saltwater Fisheries Enhancement Association |
| SEP | Supplemental Environmental Project |
| SSMD | Single Sample Maximum Density |
| SSO | Sanitary Sewer Overflow |
| SWMP | Stormwater Management Plan |
| SWQMIS | Surface Water Quality Monitoring Information System |
| TAC | Texas Administrative Code |
| TAMUCC | Texas A&M University-Corpus Christi |
| TBD | To Be Determined |
| TBWP | Texas Beach Watch Program |
| TCEQ | Texas Commission on Environmental Quality |
| TIDRC | Texas Illegal Dumping Resource Center |
| TMDL | Total Maximum Daily Load |
| TPDES | Texas Pollutant Discharge Elimination System |
| TPWD | Texas Parks and Wildlife Department |
| TX | Texas |
| UDC | Unified Development Code |
| USEPA | United States Environmental Protection Agency |
| USFWS | United States Fish and Wildlife Service |
| WLA | Waste Load Allocation |
| WQMP | Water Quality Management Plan |
| WWTF | Wastewater Treatment Facility |

Acknowledgements

CARP Members

Luz Lumb, Chair,
Recreation

Philippe Tissot,
Recreation

Kori Ellien,
City of Corpus Christi

Sharon Lewis,
City of Corpus Christi

Temple Williamson,
City of Corpus Christi Wastewater

Rosario Martinez
Environmental, Coastal Bend Bays &
Estuary Program

Sally Farris, Co-Chair
Home Owners

James Klein,
Environmental

Meredith Darden,
Tourism, Convention and Visitors Bureau

Craig Thompson,
Business & Industry

Kelly White,
Academia

Dr. William Burgin,
Public Health

CARP Alternates

Adriana Leiva,
Recreation

Leo Treviño,
Environmental, Coastal Bend Bays &
Estuary Program

Gabriel Ramirez,
City of Corpus Christi

Daniel McGinn,
City of Corpus Christi

Jay Reining,
Environmental

Gerald Sansing,
Home Owners

Preeti Shrestha,
City of Corpus Christi

Chris Tweedle,
Academia

Florence Tissot,
Recreation

Rae Mooney,
Environmental, Coastal Bend Bays &
Estuary Program

T.J. Carpenter,
Visitors Bureau

Ashleigh Higson,
Tourism, Convention and Visitors Bureau

Sandra Heatherley,
Home Owners

Lillian Bass,
Academia

Donna Rosson,
Public Health

Annette Rodriguez,
Public Health

Past CARP Members

Jace Tunnell, Environmental,
Coastal Bend Bays & Estuary Program

Danielle Converse,
City of Corpus Christi

Bill Green,
City of Corpus Christi

Bob Blair,
Business & Industry

Past CARP Alternates

Valerie Gray,
City of Corpus Christi

Tim Stephens,
Business & Industry

CARP Support

Teresa Carrillo,
Center for Coastal Studies,
Texas A&M University-Corpus Christi

Lauren Young,
Texas Commission on
Environmental Quality

Brien Nicolau,
Center for Coastal Studies,
Texas A&M University-Corpus Christi

Chris Loft,
Texas Commission on
Environmental Quality

Erin Hill,
Center for Coastal Studies,
Texas A&M University-Corpus Christi

Ron Stein,
Texas Commission on
Environmental Quality

Roger Miranda,
Texas Commission on
Environmental Quality

Past CARP Support

Ismael Nava,
Coastal Bend Bays Foundation

Debbie Grimaldi,
Coastal Bend Bays Foundation

Daniel Ryne Lucio,
Coastal Bend Bays Foundation

In Memory of Peggy Sumner, 1955-2013, First CARP Chair





Implementation Plan for Two Total Maximum Daily Loads for Bacteria at Cole and Ropes Parks Beaches in Corpus Christi Bay

Executive Summary

On *date*, the Texas Commission on Environmental Quality adopted Two Total Maximum Daily Loads for Bacteria (TMDL) on Cole and Ropes Parks Beaches in Corpus Christi Bay (Segment 2481). The TMDL was approved by the U.S. Environmental Protection Agency (USEPA) on *month, day, year*. Implementation activities within this plan specifically target beaches at Cole Park (Segment 2481CB_03) and Ropes Park (Segment 2481CB_04) beaches located along the southern shoreline of Corpus Christi Bay.

The Cole and Ropes Park Coordination Committee (CARP) is a group of interested citizens, private organizations, local businesses and federal, state, and local governments who work together to protect the health of Corpus Christi Bay at Cole and Ropes Park. The CARP Bacteria Reduction Implementation Plan Committee stakeholder group directing the I-Plan formed four work groups to determine appropriate activities and schedules to accomplish the Management Measures (MM) and Control Activities (CA) described in the plan.

Management Measures refer to strategies for reducing unregulated pollutants, generally through voluntary Best Management Practices (BMPs), while Control Actions refer to regulated source reduction strategies, generally through Municipal Separate Storm Sewer System (MS4) permits.

The work groups formed were (1) City Infrastructure, (2) Education and Outreach, (3) Ordinances and Regulations, and (4) Monitoring and Research. Collectively, the CARP stakeholder group and work groups held 61 meetings to develop this I-Plan.

The CARP Committee has identified Management Measure 3.2: Bacterial Source Tracking as the first priority activity for implementation. Because many of the Management Measures and Control Actions recommended in this I-Plan address specific potential bacterial sources, results from bacterial source tracking will guide the prioritization and implementation of subsequent activities and allow for wise allocation of limited resources throughout the implementation of the I-Plan.

The ultimate goal of this I-Plan is to restore the contact recreation uses in Segments 2481 CB_03 and CB_04 of the Cole and Ropes Parks beaches by reducing concentrations of bacteria to levels established in the TMDL. The TMDL identified potential regulated and unregulated sources of the indicator bacteria *Enterococcus*.

This Implementation Plan, or I-Plan:

- describes the Management Measures and Control Actions the watershed stakeholders and the TCEQ propose to implement with the ultimate goal of the bacteria pollutant reductions necessary to restore and protect water quality,
- identifies the means by which these activities may be implemented,
- proposes a schedule for implementation of these activities, and
- describes how stakeholders and the TCEQ propose to track implementation of these activities and monitor improvements in water quality.

This I-Plan includes 33 Management Measures with 6 Control Actions that may be used to reduce bacteria in the Cole and Ropes Park watershed. Management Measures are related to managing nonpoint sources (unregulated), such as working to identify On Site Sewage Facilities (OSSFs) in the watershed. Control Actions are related to point sources (regulated discharges), such as industrial or domestic wastewater treatment facilities and permitted stormwater discharges.

Discharges from the City of Corpus Christi's Municipal Separate Storm Sewer System (MS4) into Corpus Christi Bay at Cole and Ropes Parks beaches are regulated under a Texas Pollutant Discharge Elimination System (TPDES) permit.

Unregulated sources that could contribute to the bacteria load in the Cole and Ropes Park watershed include nesting and loafing birds at the sample site and beaches, and unmanaged pet and wildlife animal waste.

The TCEQ will track the progress of this voluntary I-Plan in restoring the affected Recreational Beach use. Water quality data will continue to be collected by the Texas General Land Office (GLO) who administers the Texas Beach Watch Program (TBWP) and is responsible for notifying the public when water quality standards for pathogens or pathogen indicators are exceeded. TCEQ is provided with a compilation of all beach data collected and analyzed by GLO under the TBWP and will continue to identify trends and compliance with the water quality standard in order to protect human health by identifying beaches with persistent advisories. If persistent advisories continue, and standards are not attained, the

TCEQ and watershed stakeholders should reevaluate the TMDL and the I-Plan and take appropriate action. The TCEQ will report the results of implementation tracking and evaluation in its biennial program status report and at regional forums.

Management Measures (Voluntary Activities)

1. *General Awareness*
2. *Leave It Better Than You Found It*
3. *Pet Waste Disposal*
4. *Prevent Intentional Dumping and Disposal*
5. *Slow the Flow (Low Impact Development) Initiative*
6. *Continue Sampling Enterococcus levels at Cole and Ropes Parks*
7. *Collect Rainfall Data Near Cole and Ropes Parks*
8. *Conduct Stormwater Outfall Flow Sampling*
9. *Evaluate Methods to Remove Bacteria with Green Infrastructure*
10. *Bacterial Source Tracking*
11. *Evaluate the Effectiveness of Public Utilities Programs and Projects in Bacteria Reductions*
12. *Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303 (d) List*
13. *Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes Parks by the use of Dye Testing*
14. *Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health*
15. *Enhance Existing Fats, Oil & Grease (FOG) Program*
16. *Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSOs)*
17. *Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation*
18. *Implement an Ongoing Inflow and Infiltration Study*
19. *Conduct Hydraulic Modeling of Collection System*
20. *Determine Effectiveness of Stormwater Retrofits to Remove Bacteria*
21. *Continue the Major Outfall Assessment and Repair Program as Funding Allows*
22. *Support and Encourage the Adoption of Stormwater Master Plan*
23. *Residential Leaking/ Broken Private Sewer Laterals Pre-Sale Inspection/ Testing Program*

24. *Commercial Cross-Connection Inspection Program*
25. *Commercial Leaking/ Broken Sewer Laterals Pilot Inspection/ Testing Program*
26. *Improved Grease Trap Standards*
27. *Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes*
28. *Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals*
29. *Install Additional Signage*
30. *Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall*
31. *Restrict Access to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks*
32. *Adopt and Enforce Additional Ordinances*
33. *Explore Adoption of Additional “Low Impact Development” Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff From Areas of New Development or Significant Redevelopment*

Control Actions (Regulatory Activities)

1. *Continue Existing Fats, Oil & Grease (FOG) Program*
2. *Continue Monitoring Sanitary Sewer Overflows (SSOs)*
3. *Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation*
4. *Continue Existing Stormwater Programs*
5. *Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation*
6. *Eliminate Residential Cross-connections*

For each of the measures and actions, this plan identifies the responsible parties, technical and financial needs, monitoring and outreach efforts, and a schedule of activities. The time line for activities is by tiers; Tier 1 (1-5 years), Tier 2 (5-10 years), and Tier 3 (10-15 years). Implementation of the Management Measures will largely be dependent upon the availability of funding.

The stakeholders and TCEQ will review progress under the TCEQ’s adaptive management process. The plan may be adjusted periodically as a result of progress reviews.

Introduction

To keep Texas' commitment to restore and maintain water quality in impaired rivers, lakes, and bays, the TCEQ works with stakeholders to develop an I-Plan for each adopted TMDL. A TMDL is a technical analysis that:

- determines the amount of a particular pollutant that a water body can receive and still meet applicable water quality standards, and
- sets limits on categories of sources that will result in achieving standards.
- TMDLs are the best possible estimates of the assimilative capacity of the water body for a pollutant under consideration.

This I-Plan is designed to propose activities that may achieve the water quality goals for the Cole and Ropes Parks beaches watershed as defined in the TMDL. It is a voluntary, flexible tool that governmental and nongovernmental organizations involved in implementation may use to guide their activities to improve water quality. The participating partners may accomplish the activities described in the plan through rule, order, guidance, or other appropriate formal or informal action.

The Cole and Ropes Park Coordination Committee (CARP) is a group of interested citizens, private organizations, local businesses and federal, state, and local governments who work together to protect the health of Corpus Christi Bay at Cole and Ropes Park. The CARP advised the TCEQ on the development of the bacteria TMDL and continued to advise the TCEQ during development of this I-Plan.

This I-Plan contains the following components:

- 1) A description of proposed Management Measures and Control Actions that may be implemented to achieve the water quality standards.
- 2) A recommended schedule for implementing activities (Appendix A).
- 3) The responsible organization under which the participating agencies may require implementation of the Control Actions.
- 4) A follow-up tracking and monitoring plan to determine the effectiveness of the Control Actions and Management Measures undertaken.
- 5) Identification of measurable outcomes the TCEQ and stakeholders will use to determine whether the I-Plan has been properly executed, water quality standards are being achieved, or the plan needs to be modified.
- 6) Identification of the communication strategies the TCEQ will use to disseminate information to stakeholders.

- 7) A review strategy that stakeholders will use to periodically review and revise the plan to ensure there is continued progress in improving water quality.

This I-Plan also includes possible causes and sources of the bacteria impairment, Management Measure and Control Action descriptions, estimated potential load reductions, technical and financial assistance needed, educational components for each measure and action, schedule of implementation, measurable milestones, indicators to measure progress, monitoring components, and responsible organization outlined in the *Nonpoint Source Program Grants Guidelines for States and Territories* (EPA, 2004). Consequently, projects developed to implement nonpoint source (unregulated) elements of this plan that also meet the grant program conditions may be eligible for funding under the EPA's Section 319(h) incremental grant program.

Watershed Overview

In 2008, based on data collected under the Texas Beach Watch Program, EPA took action to list Corpus Christi Bay (Segment 2481) on the 303(d) List of Impaired Waters for bacteria and subsequently listed the entire water body in Category 5a, meaning a TMDL will be scheduled. Upon request by TCEQ, EPA reconsidered listing the entire Corpus Christi Bay segment and changed the listing to include only beaches at Cole Park and Ropes Park, and designated them into separate assessment units (Segment 2481CB_03 and 2481CB_04, respectively) (Figure 1). In addition, the listing category changed to 5c, meaning additional bacteria data were needed before a TMDL is conducted. These actions resulted in establishment and TCEQ funding for the project: "TMDL Investigation for Bacteria in Corpus Christi Bay Beaches". This I-Plan addresses the impaired Assessment Units (AUs) and the watershed of the main area of those AUs. There are twelve main sub-watersheds that affect Cole and Ropes Park AU's, totaling 4415 acres of urban land that discharges to Corpus Christi Bay.



Figure 1. Location of Cole and Ropes Parks.

Cole Park

Cole Park, Segment 2481CB_03, is 43 acres in size and is owned and operated as a public park by the City of Corpus Christi. The park sits on the edge of Corpus Christi Bay (Figure 2). The park's facilities include 3 separate parking lots, totaling approximately 250 parking spots, a skate park, new children's playground, fishing pier, amphitheater, restroom facilities, and numerous park benches and picnic tables. The shoreline consists of approximately 1,800 ft. of rock rubble, 300 ft. of sandy beach, and the remainder consists of concrete bulkhead with large rocks and obstructions with little to no access to the water. There is one large (9.5 ft. high by 11 ft. wide) stormwater outfall located in Cole Park that serves the Baldwin-Louisiana drainage basin. Three other stormwater outfalls are present along the shoreline within the boundaries of the park. Windsurfers and kite boarders utilize Oleander Point (south end) part of Cole Park for bay access.

Ropes Park

Ropes park, Segment 2481CB_04, is 3.5 acres in size and is owned and operated as a public park by the City of Corpus Christi. This park also sits on the edge of Corpus Christi Bay (Figure 3). The park's facilities include 6 parking spaces. The park hosts a stairway down to the water and park benches for sitting. There is almost 1,000 ft. of shoreline, including 260 ft. of sand with the remainder comprised of large pieces of concrete rubble. The park sits on top of an

approximately 30 ft. bluff overlooking the water. There are two small stormwater outfalls located at this park. There is also a large (12 ft. high by 11 ft. wide) stormwater outfall located approximately 850 ft. south of Ropes Park which serves the Horne-Brawner Drainage Basin. Ropes Park is commonly used by windsurfers for bay access to launch their equipment.



Figure 2. Cole Park with Louisiana Parkway stormwater outfall and the Oleander Point location.



Figure 3. Ropes Park and the location of the Brawner Parkway stormwater outfall.

Texas Beach Watch Program Bacteria Sampling

Currently, the Texas General Land Office (GLO) administers the Texas Beach Watch Program (TBWP) and collects water samples through contract, from 164 stations at 62 recreational beaches along the Texas coast in Aransas, Brazoria, Cameron, Galveston, Jefferson, Kleberg, Matagorda, Nueces, and San Patricio Counties. Sample collection occurs weekly (one time at each station) during the peak beach season from May through September and bi-weekly from October through April with water samples collected at approximately 0.6 m (2 ft.), or knee depth. The GLO maintains a website at <http://texasbeachwatch.com/> where maps and bacteria water quality information are available. Bacteria results are updated each time sample data are entered into the TBWP database. Local government entities typically post Beach Watch advisory signs at beach access points and issue advisories that warn the public not to swim in affected waters when bacterial levels are exceeded.

TBWP advisories are recommended when a single sample exceeds EPA's recommended Single Sample Maximum Density (SSMD) criteria of 104 colony-forming units (CFU) or most probable number (MPN)/100 ml. Once issued, that beach is subject to continued monitoring every 24 hours until bacteria levels fall to <104 CFU or MPN/100 ml. Advisories last for 24 hours, and are extended if bacteria levels continue to exceed SSMD recommended levels. All samples are collected under a quality assurance project plan (QAPP) consistent with TCEQ bacteria collection and analysis protocols and analyzed for enterococci bacteria using EPA's Method 1600 or the IDEXX Enterolert® system.

TCEQ is provided with a compilation of all beach data collected and analyzed by GLO under the TBWP. Based on total number of samples for each beach and the number of days each beach is under an advisory, TCEQ assesses each individual year within the multi-year assessment period of record. For all available data, the total number of advisory days is divided by the total number of samples collected. If there are numerous sites monitored at one beach area, only one advisory is counted per beach per day. All impairments identified using this method are categorized as 5a (available data and/or information indicate at least one designated or existing use is not being supported and necessary TMDLs are underway or scheduled) due to human health considerations.

TCEQ proposes including the TBWP information in the 303(d)/305(b) assessment process in order to protect human health by identifying beaches with persistent advisories. Assessment would consist of identifying the percentage of days each beach has an advisory. The recreation use is not supported if the geometric mean of the samples collected over the assessment period exceeds the criterion (35 CFU or MPN/100 ml) or if the criteria for individual samples (104

CFU or MPN/100 ml) are exceeded greater than 25 percent of the time. TCEQ then categorizes the data according to the following scale;

Beach advisories <25% of the time—Fully Supporting

Beach advisories 20-25% of the time—Concern and Fully Supporting.

Beach advisories < 20% of the time—Delisted and Fully Supporting.

Beach advisories \geq 25% of the time—Not Supporting.

Summary of TMDLs

This section summarizes sections of the Corpus Christi Bay Beaches Bacteria TMDL. Additional background information, including the problem definition, endpoint identification, source analysis, linkages between sources and receiving waters, and seasonal variation can be found in the Corpus Christi Bay Beaches Bacteria TMDL (TCEQ, 2016). Table 1 provides a summary of the water quality inventory assessment data for bacteria in Corpus Christi Bay at Coles and Ropes Parks.

Table 1. Water Quality Inventory Assessment Data.

| Description | Segment | AU | Indicator Bacteria | Geometric Mean Criterion (mpn/100mL) | Single Sample Maximum Criterion (mpn/100mL) | % Single Sample Exceeded |
|-------------|---------|-----------|--------------------|--------------------------------------|---|--------------------------|
| Cole Park | 2481 | 2481CB_03 | Enterococci | 35 | 104 | 25 |
| Ropes Park | 2481 | 2481CB_04 | Enterococci | 35 | 104 | 25 |

Pollutant Sources and Loads

Potential Pollutant Sources

Pollutants may come from several sources, both point and nonpoint. Point source pollution comes from a single definable point, such as a pipe, and is regulated by permit under the TPDES. Wastewater and stormwater discharges from industries, construction, and municipal separate storm sewer systems are considered point sources of pollution. Nonpoint source (NPS) pollution originates from multiple locations, usually carried into surface waters by rainfall runoff. Nonpoint sources are not regulated by permit.

1. Construction site discharges

Mobilized sediment associated with construction sites in the Cole and Ropes Park watershed may be deposited in Corpus Christi Bay via surface runoff or from stormwater runoff. Increased suspended solids in the form of sediment have been correlated to increased bacteria levels in receiving water bodies (Sawyer et al. 2010).

2. Bacteria regrowth

Studies have shown biofilm regrowth of enterococci does occur in street gutters and storm drains and are contributors to elevated bacteria levels during surface runoff events (Skinner et al. 2010).

3. Sediment re-suspension

Bacteria in natural waters exist in two forms, (1) free-living or (2) attached and adsorbed to sediment particles (Yang, L et al. 2008). Bacteria in bottom sediments can reenter the water column via perturbations that cause sediment resuspension resulting in the reabsorption of bacteria onto the surface of available suspended sediments. Perturbation that can cause sediment resuspension in Corpus Christi Bay at Cole and Ropes Park include wave conditions (i.e. calm conditions resulting in low bacteria levels and rough wave conditions resulting in high levels), stormwater inflow through drain pipes, surface runoff, human recreation, and animals.

4. Dry weather discharges/illicit discharges into and from storm sewers

Illicit dry weather flows originate from many sources and may include wastewater, industrial and commercial discharges, cross-connections between stormwater and sanitary sewer systems, irrigation practices from landscaping, illegal dumping, failing septic tanks, and vehicle maintenance activities (i.e. car washing, waste oil).

5. Sanitary Sewer Overflows (SSOs)

SSOs are releases of untreated wastewater, including domestic, commercial, and industrial wastewater. They are permit violations that must be addressed by the responsible TPDES permittee. SSOs usually occur as the result of a break, blockage, or exceedance of capacity in the sanitary sewer conveyance system. SSOs have the potential to enter the stormwater conveyance system and may be transported to Corpus Christi Bay.

6. Stormwater Sources

Stormwater is regulated by the state and federal government only in areas designated by the EPA as “Urbanized Areas” (UAs) belonging to organizations regulated as Municipal Separate Storm Sewer Systems

(MS4s). Best management practices (BMPs) and participation in existing conservation and cost-share management programs is the most feasible option to control these sources of pollution.

Promoting the use of BMPs and expanding participation in management programs in Corpus Christi can help lower bacteria levels in waterways.

Promotion of BMPs could also help lower bacteria levels in the Cole and Ropes Parks drainage basins where commercial and residential development has occurred, as the density of pets (dogs and cats) is directly linked to population and urbanization.

7. Animal Sources (Wildlife)

Bacteria loads from animal sources (birds, livestock, wildlife, etc.) are identified in the Corpus Christi Bay Beaches TMDL report as nonpoint sources of concern. Failure to properly manage these sources may increase bacterial loads to Corpus Christi Bay in the future. Areas of concern include the potential for bacteria to attach to sediments in stormwater runoff, and animals' direct deposition of fecal waste on the beaches or in the watershed.

8. Domestic Pets

The most common domestic pets are dogs and cats; however, there are many other types of animals that are also kept as pets in the Coles and Ropes Park watersheds. There are over 9052 dogs, 10,301 cats and numerous other animals (goats, sheep, rabbits, ponies, etc.) in the CARP watersheds. Pet waste contributes substantial amounts of bacteria to surface waters. Feces left in parks, yards or on sidewalks gets washed off by rain water and carried into storm drains. These storm drains lead directly to Corpus Christi Bay and associated beaches. Water carried through these drains may deposit feces, bacteria and other harmful pollutants into the water where people recreate on the beaches at Coles and Ropes Park.

9. Domestic and Industrial Wastewater Treatment Facilities

In most cases, domestic and industrial wastewater treatment facilities may be potential sources of pollutants. In this case, the watershed has been serviced by a municipal sanitary sewer system since the 1940's and all sanitary waste water is conveyed out of the watershed and is not discharged to the beaches. The City of Corpus Christi has no plans to change this system and the limited space within the watershed precludes the possibility that a WWTF will be constructed within the watershed and sanitary wastewater will be discharged to the beaches.

Pollutant Load Allocation

The TMDL represents the maximum amount of a pollutant that the bay can receive in a single day without exceeding water quality standards. The pollutant load allocations for the selected scenarios were calculated using the following equation:

$$\text{TMDL} = \Sigma \text{WLA} + \Sigma \text{LA} + \text{MOS}$$

Where:

ΣWLA = Sum of waste load allocation, the amount of pollutant allowed by permitted or regulated dischargers

ΣLA = Sum of load allocation, the amount of pollutant allowed by unregulated or unregulated sources

MOS = margin of safety

The equation is used to allocate loads among different sources of a pollutant. Waste load allocations are determined for point sources. These point sources include permitted stormwater runoff and other point sources. Load allocations for nonpoint sources generally include background loads, upstream loads, any stormwater runoff not subject to permit, on-site sewage facility loads, and other nonpoint sources such as animal deposition and leaking wastewater infrastructure. Allocated loads for all TMDLs covered by this document can be found in Appendix B.

The MOS is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis for assigning an MOS.

Waste Load Allocation (WLA)

The waste load allocation is the sum of loads from regulated sources.

WWTFs

TPDES-permitted wastewater treatment facilities within the TMDL watershed are allocated a daily waste load (WLA_{WWTF}) based on the full permitted flow of each facility. The TMDL watershed has been serviced by a municipal sanitary sewer system since the 1940's. All sanitary waste water is conveyed out of the watershed and is not discharged to the beaches. The City of Corpus Christi has no plans to change this system and the limited space within the watershed precludes the possibility that a WWTF will be constructed within the watershed and sanitary wastewater will be discharged to the beaches. Because of this the waste load allocation for each impaired beach will be:

$$\text{WLA}_{\text{WWTF}} = 0$$

Table 2. Percentages of Each AU Designated as an Urbanized Area.

| AU | Total watershed area under MS4 (acres) | Percentage AU Permitted for Stormwater |
|-----------------------------|---|---|
| 2481CB_03 | 2041 | 100 |
| 2481CB_04 | 7 | 100 |
| Sub-basins Influencing AU's | 2367 | 100 |
| Total | 4415 | 100 |

Table 3. MS4 Permittees in Corpus Christi Bay at Coles and Ropes Park.

| AU | Permit Number | Permittee | AU Feet |
|-----------|---|------------------------|----------------|
| 2481CB_03 | NPDES No. TXS00601; TPDES Permit No. WQ0004200000 | City of Corpus Christi | 5897 |
| 2481CB_04 | NPDES No. TXS00601; TPDES Permit No. WQ0004200000 | City of Corpus Christi | 987 |

Regulated Stormwater

The absence of WWTF discharges limits the TMDL allocations to regulated stormwater (WLA_{SW}) for MS4, industrial, and construction permits, unregulated sources (LA), and the MOS. The WLA_{SW} is calculated by subtracting the MOS and LA from the TMDL:

$$WLA_{SW} = TMDL - MOS - LA$$

The entire watershed for both impaired beaches, or AU, is covered under the City of Corpus Christi's MS4 permit (NPDES No. TXS00601; TPDES Permit No. WQ0004200000). The LA is the result of bacteria loading and fate and transport within the receiving water at the beaches and is estimated by using the watershed loading model created for this TMDL.

In urbanized areas currently regulated by an MS4 permit, development and/or re-development of land in urbanized areas must implement the control measures/programs outlined in an approved Stormwater Management Program SWMP. Although additional flow may occur from development or re-development, loading of the pollutant of concern should be controlled and/or reduced through the implementation BMPs as specified in both the National Pollutant Discharge Elimination System (NPDES) or TPDES permit and the SWMP.

An iterative, adaptive management approach will be used to address stormwater discharges. This approach encourages the implementation of structural or non-structural controls, implementation of mechanisms to evaluate the performance

of the controls, and finally, allowance to make adjustments (e.g., more stringent controls or specific BMPs) as necessary to protect water quality.

Load Allocation (LA)

The LA is the sum of loads from unregulated sources. As has been shown in the TMDL, dry weather loading (DWL) is a significant contributor to water quality at both Cole and Ropes Parks. Although the sources of this loading are not well understood, they can be categorized as the non-permitted, non-point source components of the TMDL. As such, dry weather loading represents the LA portion of the TMDL calculation.

As shown in the TMDL (Appendix A, Step 5), DWL to the impaired beaches is estimated from the following factors:

1. Area influenced by the DWL,
2. The volume of water in the area of the dry weather load,
3. The median concentration of bacteria in that area, and
4. The decay rate for the bacteria.

Allowance for Future Growth (FG)

The future growth component addresses the requirement of TMDLs to account for future loadings that may occur as a result of population growth, changes in community infrastructure, and development. Allowance for future growth is not needed for these TMDLs because there are no permitted WWTF discharges to the impaired AUs and there will be none in the future.

Total Maximum Daily Load (TMDL)

To achieve water quality standards in effect at adoption of this TMDL, the following reduction in loads were calculated for both impaired beaches using the TMDL equation:

$$\text{TMDL} = \Sigma \text{WLA} + \Sigma \text{LA} + \text{MOS}.$$

Cole Park - 2481CB_03

The TMDL for this segment is estimated at 1.007×10^{12} MPN/day, which is the equivalent of a 95.9% reduction in *Enterococcus* load from runoff and an overall load reduction of 94.4%.

Ropes Park - 2481CB_04

The TMDL for this segment is estimated at 4.345×10^{12} , which is the equivalent of a reduction of a 74.0% in load from runoff and an overall load reduction of 73.1%.

Table 4. TMDL Allocation Summary Corpus Christi Bay at Coles and Ropes Parks (in Billions MPN/day.)

| Segment Name | AU | Indicator Bacteria | TMDL | WLA_{WWT} F | WLA_{Stor} mwater | LA | MOS | Future Growth (FG) |
|----------------------------|-----------|-------------------------------|-------------|--------------------------------|--------------------------------------|-----------|------------|-----------------------------------|
| Corpus Christi Bay 2481 | 2481CB_03 | Enterococci | 1007 | 0 | 555 | 273 | 179 | na |
| Corpus Christi Bay 2481 | 2481CB_04 | Enterococci | 4345 | 0 | 3537 | 146 | 662 | na |

Implementation Strategy

This voluntary I-Plan documents 33 Management Measures and 6 Control Actions to reduce bacteria levels. Management Measures are voluntary and Control Actions are regulated. Management Measures and Control Actions were selected based on feasibility, costs, support, and timing. Activities should be implemented in phases based on the needs of the stakeholders, availability of funding, and the progress made in improving water quality.

The Cole and Ropes Park (CARP) Bacteria Reduction Implementation Plan Committee (CARP Committee) formed 4 work groups that identified 4 broad categories of strategies to address reduction of bacteria levels at CARP beaches: (1) Education and Outreach, (2) Monitoring and Research, (3) Wastewater and Stormwater Infrastructure, and (4) Ordinances and Regulations. Voluntary and regulated activities are recommended within the framework of each strategy, but the CARP Committee recognizes that in order to be effective, activities across several strategies should be implemented simultaneously or in conjunction with each other. Some activities are necessary precursors to others, and the results from some activities will lead to decision making in the planning process for subsequent actions.

The CARP Committee has identified Management Measure 3.2: Bacterial Source Tracking as the first priority activity for implementation. Because many of the Management Measures and Control Actions recommended in this I-Plan address specific potential bacterial sources, results from bacterial source tracking will guide the prioritization and implementation of subsequent activities and allow for wise allocation of limited resources throughout the implementation of the I-Plan.

Adaptive Implementation

All I-Plans are implemented using an adaptive management approach in which measures are periodically assessed for efficiency and effectiveness. This adaptive management approach is one of the most important elements of the I-Plan. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals, and expresses stakeholder commitment to the process.

At annual meetings, TCEQ will direct an appropriate entity to facilitate stakeholders to periodically assess progress using the implementation timeline schedule, interim measurable milestones, water quality data, and the communication plan included in this document. If periodic assessments find that insufficient progress has been made or that implementation activities have not improved water quality, the implementation strategy will be adjusted.

Activities and Milestones

The Cole and Ropes Park (CARP) Bacteria Reduction Implementation Plan Committee stakeholders and work groups: (1) Education and Outreach, (2) Monitoring and Research, (3) Wastewater and Stormwater Infrastructure, and (4) Ordinances and Regulations, determined appropriate activities and schedules to accomplish the management and control activities in this I-Plan. Collectively, the CARP stakeholder group and work groups held a total of 61 meetings to develop this I-Plan.

This I-Plan includes surface water quality monitoring activities to identify unregulated sources of bacteria, technical analysis of Management Measures and Control Activities to predict efficiency of possible Best Management Practices (BMPs), and stakeholder guidance to review possible activities and provide recommendations to the TCEQ for future inclusion in the adopted I-Plan. In addition, the I-Plan outlines potential effective partnerships with local entities to implement the proposed Management Measures and control activities.

Each work group developed detailed, consensus-based action plans. The planned implementation activities are described in the following section.

Management Measures and Control Actions

The Cole and Ropes Park (CARP) Bacteria Reduction I-Plan includes [33] Management Measures and [6] Control Actions.

Management Measures (Voluntary Activities)

- 1.0) *Education and Outreach*
 - 1.1) *General Awareness*
 - 1.2) *Leave It Better Than You Found It*
 - 1.3) *Pet Waste Disposal*
 - 1.4) *Prevent Intentional Dumping and Disposal*
 - 1.5) *Slow the Flow (Low Impact Development) Initiative*
- 2.0) *Monitoring*
 - 2.1) *Continue Sampling Enterococcus Levels at Cole and Ropes Parks*
 - 2.2) *Collect Rainfall Data Near Cole and Ropes Parks*
 - 2.3) *Conduct Stormwater Outfall Flow Sampling*
- 3.0) *Research*
 - 3.1) *Evaluate Methods to Remove Bacteria with Green Infrastructure*
 - 3.2) *Bacterial Source Tracking*
 - 3.3) *Evaluate the Effectiveness of Public Utility Programs and Projects in Bacteria Reductions*
 - 3.4) *Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303 (d) List*
 - 3.5) *Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes Parks by the use of Dye Testing*
 - 3.6) *Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health*
- 4.0) *Wastewater Collection Systems*
 - 4.1) *Enhance Existing Fats, Oil & Grease (FOG) Program*
 - 4.2) *Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSOs)*
 - 4.3) *Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation*
 - 4.4) *Implement an Ongoing Inflow and Infiltration Study*

- 4.5) *Conduct Hydraulic Modeling of Collection System*
- 5.0) *Stormwater Drainage System*
 - 5.1) *Determine Effectiveness of Stormwater Retrofits to Remove Bacteria*
 - 5.2) *Continue the Major Outfall Assessment and Repair Program as Funding Allows*
 - 5.3) *Support and Encourage the Adoption of Stormwater Master Plan*
- 6.0) *Ordinances and Regulations*
 - 6.1) *Residential Leaking / Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program*
 - 6.2) *Commercial Cross-connection Inspection Program*
 - 6.3) *Commercial Leaking / Broken Sewer Laterals Pilot Inspection/Testing Program*
 - 6.4) *Improved Grease Trap Standards*
 - 6.5) *Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes*
 - 6.6) *Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals*
 - 6.7) *Install Additional Signage*
 - 6.8) *Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall*
 - 6.9) *Restrict Access to Bay Waters from City Parks and Other Bayfront City Properties during Periods of Public Health Risks*
 - 6.10) *Adopt and Enforce Additional Ordinances*
 - 6.11) *Explore Adoption of Additional "Low Impact Development" Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff From Areas of New Development or Significant Redevelopment*

Control Actions (Regulated Activities)

- 1.0) *Wastewater Collection Systems*
 - 1.1) *Continue Existing Fats, Oil & Grease (FOG) Program*
 - 1.2) *Continue Monitoring Sanitary Sewer Overflows (SSOs)*
 - 1.3) *Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation*

2.0) *Stormwater Drainage System*

2.1) *Continue Existing Stormwater Programs*

2.2) *Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation*

3.0) *Ordinances and Regulations*

3.1) *Eliminate Residential Cross-Connections*

Management Measure 1.0: Education and Outreach

Since its frontier beginnings in 1519 and incorporation in 1852, the City of Corpus Christi has always been a pathway to The Americas and is intrinsically linked to its bays, rivers, creeks, estuaries and waterways. The Port of Corpus Christi currently is the sixth largest U.S. port and deepest inshore port on the Gulf of Mexico. To this day these waters play an increasingly important role in the economic stability and success of the City of Corpus Christi. In 2005, it was ranked as the 47th largest in the world by cargo tonnage, principally handling oil and agricultural products. Corpus Christi Bay is also a significant draw for tourism, both on the north shore as well as the downtown recreational areas, particularly around Cole and Ropes Parks beaches.

In order to address the issue of excessive bacterial loading at Cole and Ropes Parks beaches, the CARP Committee will need to engage the City of Corpus Christi across all demographic aspects through sustained education and outreach programs that specifically target environmental stewardship, green thinking and cleanliness campaigns. These programs should address the critical aspects of education and outreach. Educational programs need to be created so they adhere to core learning objectives that reinforce knowledge and understanding of environmental stewardship. Outreach programs should be created and adopted to insure full coverage of the diverse demographic and socioeconomic background that the City of Corpus Christi represents. Through enduring City leadership, partnerships need to be established across government, public, business, industry, non-profit organizations, community associations and academic institutions that will strengthen and sustain commitment and involvement for this plan.

The Education and Outreach workgroup recommends five implementation activities with associated actions for the CARP implementation plan:

- 1.1) General Awareness
- 1.2) Leave It Better Than You Found It
- 1.3) Pet Waste Disposal
- 1.4) Prevent Intentional Dumping and Disposal

1.5) Slow the Flow (Low Impact Development) initiative

Management Measure 1.1: General Awareness

•**WHAT:** This activity is aimed at creating, implementing and sustaining educational programs within the community that increase awareness of the impact that human actions can have on the quality of local bodies of water.

•**WHO:** City leadership, CBBF, local environmental groups with support from educational institutions (TAMUCC, Delmar, CCISD), Surfrider Foundation - Texas Coastal Bend Chapter, Corpus Christi Convention and Visitors' Bureau, Texas State Aquarium, Corpus Christi Caller Times, KEDT, other media outlets.

•**WHERE:** City of Corpus Christi, focusing on Cole and Ropes parks stormwater outfall drainage area.

•**GOAL:** Improve community understanding of, "Where does the Water Go?", this includes wastewater effluent and stormwater runoff. Provide the community with an "Alert System" when beaches are safe or unsafe for contact recreation.

Create an introductory public education campaign about water quality in Corpus Christi Bay. Topics will include, "Where does the Water Go?" related to stormwater drainage and general information about the ways bacteria and other pollutants can enter waterways. Target practices that can ensure clean water and foster a sense of local pride related to quality of local waterways.

Produce a series of public service announcements educating the public about water quality in Corpus Christi Bay. The topics should be similar and align with the short-term milestone and strategy goals.

Develop community support system (funding, volunteers, partnerships with local organizations) for the sponsoring of water quality improvement projects such as clean-ups in affected stormwater drainage basins, "Beach to Bay Relay Marathon" interpretive signage at Cole and Ropes parks, mobile kiosks to be used at community events such as Earth Day Bay Day and others.

•**WHEN:** Tier 1 (1-5 Years).

•**HOW:** Media campaigns in the form of billboards, radio and TV advertising. Develop educational information to be used as City utility bill stuffers and website information. "Bay Walk" interpretive signage, water flow diorama, and other educational materials will be developed. Coordination will be maintained through existing partnerships.

•**COSTS/SOURCE OF FUNDS:** Costs to be determined/ various grant programs and non-profit agencies.

•**RESPONSIBLE ORGANIZATION(S):** None required.

•**ACTIONS AND SCHEDULE:**

Table 5. MM 1.1. General Awareness. Implementation timeline schedule.

| Activity | Tier 1 | Tier 2 | Tier 3 |
|------------------------------------|--------|--------|--------|
| Create Public Education Materials | x | x | x |
| Public Service Announcements (PSA) | x | x | x |
| Public presentations | x | x | x |

Management Measure 1.2: Leave It Better Than You Found It

•**WHAT:** A specific campaign targeted at reducing litter in the community. Principle focus will be on reducing and discouraging litter from vehicles and by individuals around restaurants, shopping areas, parks, beaches and all other public use spaces.

•**WHO:** Possible partners include Beautify Corpus Christi Association, Coastal Bend Council of Governments, Corpus Christi Convention and Visitors' Bureau, City of Corpus Christi, Coastal Bend Bays Foundation, Coastal Bend Bays and Estuaries Program, TCEQ.

•**WHERE:** Target areas should include all drainage basins which directly affect the Cole and Ropes Parks.

•**GOAL:** Support the "Leave It Better Than You Found It" and "Don't Mess With Texas Water" campaigns and increase community ownership for a clean and healthy City.

•**WHEN:** Tier 1 (1-5 Years).

•**HOW:** Adopt educational programs for all age groups that target anti-litter and environmental awareness. Develop outreach programs to engage local businesses and residents to support and participate in the "Leave It Better Than You Found It" campaign.

•**COSTS/SOURCE OF FUNDS:** Costs to be determined/ various grant programs and non-profit foundations.

•**RESPONSIBLE ORGANIZATION(S):** None required

•ACTIONS AND SCHEDULE:

Table 6. MM 1.2. Leave It Better Than You Found It. Implementation timeline schedule.

| Activity | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Media campaign reinforcing “Leave It Better Than You Found It” | x | | |
| Increase support for GLO Adopt-A-Beach. Create: Adopt-A-Bay, Watershed, etc. | x | | |
| Engage local leaders to address City wide litter problem | x | | |
| Engage local businesses to support clean initiatives and post “Leave It Better Than You Found It” campaign signs | | x | |

Management Measure 1.3: Pet Waste Disposal

•**WHAT:** Establish coordination with key stakeholders to facilitate the reduction and eventual elimination of improper pet waste disposal. This will be accomplished through the continued installation of pet waste disposal stations as funding is secured, implementation of a public service announcement (PSA) and other education initiatives including utilization of information booths or kiosks at local events.

•**WHO:** City of Corpus Christi with support from CARP, Local Animal Businesses, Local Veterinarian Clinics and Animal Rescue/Adoption Centers, City Parks and Recreation (doggie pool day), other etc.

•**WHERE:** Local businesses and events. Specific locations for pet waste disposal stations as identified and prioritized by City in the drainage basins that impact Cole and Ropes parks.

•**GOAL:** Continue installation of pet waste disposal stations in affected drainage basins as funding is secured. Develop and establish an information booth or table at community events. Distribute educational materials and pet waste disposal kits to pet associated businesses and service providers.

Complete dog waste pickup PSA with celebrity endorsement and video.

Example - Seattle PSA: <http://www.youtube.com/watch?v=jDh12w-jcfs>

2018: Complete implementation activities and continue monitoring education and outreach initiatives.

2020: Strive for 100% compliance with pet waste disposal ordinances.

•**WHEN:** Tier 1 (1-5 Years).

•**HOW:** Install additional pet waste disposal stations as funding is available. Provide educational handout material to residents about pet waste at local events. Create PSA using a local celebrity to engage pet owner population to take responsibility for good water quality in the CARP watershed areas and throughout the community. Technical assistance will be needed with production of a short commercial video to capture essence and vitality, which may be provided by a local TV station or production company.

•**COSTS/SOURCE OF FUNDS:** Various grant programs and non-profit foundations.

•**RESPONSIBLE ORGANIZATION(S):** None required

•**ACTIONS AND SCHEDULE:**

Table 7. MM 1.3. Pet Waste Disposal. Implementation timeline schedule.

| Activity | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Pet waste stations | x | x | x |
| Public service announcement (PSA) | x | x | x |
| Create info booth for local events | x | | |
| Distribute educational materials & kits to pet business and services | x | x | x |

Management Measure 1.4: Prevent Intentional Dumping and Disposal

•**WHAT:** Establish coordination with key stakeholders to develop education and outreach programs to facilitate the reduction of improper waste disposal and dumping. This strategy is aimed at educating the community on the effects of illegal dumping. Illegal dumping and disposal harms watersheds, habitat and creates unhealthy and unsafe conditions for people that work, live or recreate in impacted areas. Intentional dumping and disposal are illegal and a crime.

•**WHO:** CARP, community partners and stakeholders.

•**WHERE:** Cole and Ropes Park watersheds.

•**GOAL:** Increase awareness and education on the harm that illegal dumping and disposal causes to our environmental health and economy. A greater understanding of this is necessary so that commercial businesses and the public will begin to take pride in their environment and watersheds. Create an extensive awareness campaign to educate all ages and socioeconomic backgrounds on illegal dumping and disposal.

•**WHEN:** Tier 1 (1-5 Years).

•**HOW:** Establish education and outreach programs targeted towards community involvement with commercial business support to identify and report instances of illegal dumping and disposal. Reference “General Awareness” and “Keep It Clean” strategies (Appendix A). Encourage applicable stakeholders to attend training workshops provided by the Texas Illegal Dumping Resource Center (TIDRC) on illegal dumping regulations and how to address these issues. The training is provided through grants from TCEQ to the Coastal Bend Council of Governments (CBCOG).

•**COSTS/SOURCE OF FUNDS:** Various grant programs and non-profit foundations.

•**RESPONSIBLE ORGANIZATION(S):** None required

•**ACTIONS AND SCHEDULE:**

Table 8. MM 1.4. Prevent Intentional Dumping and Disposal. Implementation timeline schedule.

| Activity | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Sponsor TIDRC workshop in Corpus Christi | x | x | x |
| Hunting and fishing organization education and outreach | x | x | x |
| Coordination with City Solid Waste Department activities | x | x | x |

Management Measure 1.5: Slow the Flow (Low Impact Development) Initiative

•**WHAT:** Educate and promote Low Impact Development (LID) by focusing on practices that improve environmental conditions and water quality.

•**WHO:** Various professional, non-profit, academic and government organizations, local gardening/landscaping centers and gardeners’ community organizations.

•**WHERE:** Within the City of Corpus Christi

•**GOAL:** Provide training workshop to the design community demonstrating LID techniques and benefits; promote LID on individual properties by demonstrating the benefits through social media and educational presentations upon I-Plan adoption. Incorporate LID techniques into City projects where feasible and funding allows as demonstration projects.

•**WHEN:** Within one year of I-Plan adoption provide training workshop; upon adoption of the I-Plan, begin promoting LID benefits through social media sites; incorporate LID techniques into presentations to adult audiences within one year of I-Plan adoption.

•**HOW:** Using existing materials such as those provided by the Ladybird Johnson Wildflower Center promoting LID, create a half day workshop for design community.

•**COSTS/SOURCE OF FUNDS:** Training workshop for designers and engineers approximately \$2500.00, source of funds to be determined.

•**RESPONSIBLE ORGANIZATION(S):** None required

•**ACTIONS AND SCHEDULE:**

Table 9. MM 1.5. Slow the Flow (Low Impact Development) Initiative. Implementation timeline schedule.

| Activity | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Provide LID workshop for local designers & engineers | x | | |
| Promote benefits of LID through social media | x | | |
| Incorporate LID into presentations | x | | |

Table 10. Summary of Management Measure 1.0: Education and Outreach

Management Measure: *Education and Outreach*

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Organization(s) |
|--|---------------------------------|--|---|-----------------------------------|--|--|---|------------------------------------|
| Education and Outreach | | | | | | | | |
| 1.1.) General Awareness | TBD | TBD as funding becomes available | Create an introductory public education campaign about water quality in Corpus Christi Bay. | Tier 1- (years 1-5) on going | Create Public Education Materials. | Public Service Announcements. | Track public presentations and PSA's given and number of attendees and conduct surveys on their effectiveness | TBD |
| | | | Produce a series of public service announcements educating the public on water quality in Corpus Christi Bay. | Tier 1- (years 1-5) on going | Public Service Announcements. | Count: number of classes/outreach. | | |
| | | | Develop community support system for water quality improvement at Cole and Ropes Park. | Tier 1- (years 1-5) on going | Public Presentation Create Public Education Materials. | Public Presentations | | |
| 1.2) Leave It Better than You Found It | TBD | TBD as funding becomes available | Adopt educational programs for all age groups that target anti-litter and environmental awareness. Develop outreach programs to | Tier 1- (years 1-5) on going | Track and measure number of citizens reached (all media). Measure hours and individual involvement in community cleanup events. | Media campaign reinforcing "Leave It Better Than You Found It". Increase support for TGLO Adopt-A-Beach. Create: Adopt-A-Bay, Watershed, etc. | Track public presentations and PSA's given and number of attendees and conduct surveys on their effectiveness | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Organization(s) |
|---------------------------|---------------------------------|--|---|-----------------------------------|--|--|---|------------------------------------|
| | | | engage local businesses and residents to support and participate in the “Leave It Better than You Found It” campaign. | | Measure number of businesses supporting “Leave It Better than You Found It” campaign initiatives and increase or adjust outreach campaign goals and targets. | Engage local leaders to address City wide litter problems. Engage local businesses to support clean initiatives and post “Leave It Better than you Found It” campaign signs. | | |
| 1.3) Pet Waste Disposal | TBD | TBD as funding becomes available | Distribute educational material and pet waste disposal kits to pet associated businesses and service providers. | Tier 1- (years 1-5) | Continue installation of Pet Waste disposal stations in Cole and Ropes Park drainage basins. Develop and establish an information booth or table at community events. Complete dog waste pickup PSA with celebrity endorsement and video (Tier 3). | Count number of pet waste stations installed and count number of bags used. Survey the public for the effectiveness of public service announcements and informational booths at local events. For PSA and informational booths track times aired or used at events | Track public presentations and PSA’s given and number of attendees and conduct surveys on their effectiveness | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Organization(s) |
|--|---------------------------------|--|--|--|---|---|---|------------------------------------|
| 1.4) Prevent Intentional Dumping and Disposal | TBD | TBD as funding becomes available | <p>Establish education and outreach programs targeted towards community involvement i.e. “General Awareness” and “Keep It Clean” strategies.</p> <p>Provide training and workshops provided by the Texas Illegal Dumping Resource Center (TIDRC) on illegal dumping regulations.</p> | <p>Tier 1.</p> <p>Workshops will be provided annually.</p> <p>Coordination with the City Solid Waste Department will be conducted quarterly.</p> | <p>Track attendance at TIDRC events.</p> <p>Track attendance at education and outreach events.</p> <p>Track number of meetings stakeholders attend with solid waste advisory boards/committees.</p> | <p>Sponsor TIDRC workshops in Corpus Christi on an annual basis.</p> <p>Sponsor hunting and fishing organization education and outreach.</p> <p>Coordination with City Solid Waste Department activities.</p> | Track public presentations and PSA’s given and number of attendees and conduct surveys on their effectiveness | TBD |
| 1.5) Slow the Flow (Low Impact Development) Initiative | TBD | TBD as funding becomes available | Provide training workshops to promote low impact development initiatives. | Tier 1. | <p>Survey participants to determine low impact development support and survey for positive feedback from social media sites.</p> | <p>Provide low impact development workshops for local designers and engineers.</p> <p>Promote benefits of low impact development through social media.</p> <p>Incorporate LID into presentations.</p> | Track public presentations and PSA’s given and number of attendees and conduct surveys on their effectiveness | TBD |

Management Measure 2.0: Monitoring

In order to assess progress towards reducing bacterial loading at Cole and Ropes Parks beaches, the CARP Committee will need to evaluate the results of monitoring on a regular basis. Evaluation of monitoring results will be used to identify potential changes that could improve effectiveness of the I-Plan.

Monitoring and annual evaluation will determine if the I-Plan or any of its parts are complete, must address a longer time frame, or require revision. Every five years, as resources are available and with stakeholder participation, a more in-depth evaluation will be completed.

Two types of monitoring are proposed:

- 1) Bacteria baseline (pre-event) water quality monitoring
- 2) Stormwater event (during/post-event) rainfall and flow of water quality monitoring

These monitoring measures will form the basis for potential research projects related to understanding the causes, sources, and solutions to high bacteria levels at Cole and Ropes Park beaches. Conclusions derived from post-implementation water quality monitoring data will be an important indicator of whether implementation activities are resulting in the desired reduction of bacteria loading. The results of this research will provide essential information to determine strategic modifications to management actions and control measures outlined in this plan.

Management Measure 2.1: Continue Sampling Enterococcus Levels at Cole and Ropes Parks

The purpose of this Management Measure is to identify improvements or degradation of bacteria levels at these beaches and help in meeting the TCEQ standard. Current program for sampling is the Texas Beach Watch Program that is administered by the Texas General Land Office and funded through the U.S. Environmental Protection Agency.

•**WHAT:** Growing concerns about the health risks posed by polluted bathing beaches, increased beach closures, and scientific evidence indicating an increase in infectious diseases caused by microbial organisms in recreational waters prompted the EPA to create the National Beaches Environmental Assessment, Closure, and Health (BEACH) Program. The goals of the BEACH Program are to protect public health at the nation's beaches and to ensure the public is notified when the risk for potential illness and disease is present. The GLO Office secured

and allocated Texas Coastal Management Program (CMP) funds for water quality monitoring at beaches in six counties along the Texas coast. The project is the Texas Beach Watch Program.

•**WHO:** For Nueces, Aransas, and San Patricio counties, the current grant is administered by the laboratory at the Corpus Christi-Nueces County Public Health District.

•**WHERE:** Samples are taken at 52 sites along the coast in San Patricio, Nueces, and Aransas counties. Four sites are located at Cole Park and two at Ropes Park.

•**GOAL:** The goal of this water quality monitoring project is to provide the public with information about water quality at recreational beaches.

•**WHEN:** Water samples are collected weekly during the beach season (currently May-September) and biweekly during the off-season (October-April). Samples at Cole and Ropes Parks are currently being collected on Tuesdays.

•**HOW:** This project involves the collection and testing of water quality samples for the presence of *Enterococcus* bacteria and compared to EPA's recommended Single Sample Maximum Density (SSMD) criteria of 104 colony forming units (cfu)/100 ml. If sample results exceed EPA's recommended criteria, the GLO will notify local government representatives immediately and the required signs warning of elevated bacteria levels will be posted at the affected beaches. In addition, bacteria levels for each sample are posted in real time on the Texas Beach Watch Program's public Internet site at www.TexasBeachWatch.com.

•**COSTS/SOURCE OF FUNDS:** EPA

•**RESPONSIBLE ORGANIZATION(S):** The local Beach Watch grant was awarded to Nueces County and operated by the Corpus Christi-Nueces County Public Health District. Local government representatives make the necessary beach notifications upon receipt utilizing the provided signage.

•ACTIONS AND SCHEDULE:

Table 11. MM 2.1. Continue sampling *Enterococcus* levels at Cole and Ropes Parks. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|----------------------------|--------|--------|--------|
| Texas Beach Watch Sampling | x | x | x |

Management Measure 2.2: Collect Rainfall Data Near Cole and Ropes Parks

•**WHAT:** The main sources of bacteria at Cole and Ropes Parks beaches may be coming from non-point source runoff. The non-point source runoff may be (1) from stormwater flowing into the stormwater collection system and through the pipes into Corpus Christi Bay, (2) surface runoff from the land that flows directly into Corpus Christi Bay, or (3) a combination of both (TMDL 2016).

Collecting accurate rainfall data within the Cole and Ropes Parks stormwater basins and in close proximity to stormwater outfalls in Corpus Christi Bay may provide better information to determine the relationship between stormwater flows and bacteria exceedances at these beaches.

•**WHO:** The CARP envisions a cooperative effort including the City, local universities, residents, and local research and data collections organizations (e.g. Center for Coastal Studies, Coastal Bend Bays and Estuaries Program and others to be determined).

•**WHERE:** Three major stormwater drainage channels should be the focus for this monitoring effort: Louisiana Parkway, Brawner Parkway, and Carmel Parkway. Real-time rain gauges should be installed at residences centrally located along these drainage channels.

•**GOAL:** To develop a long term time series of rainfall information at Cole and Ropes Parks. Data should be made available for use by researchers to correlate rainfall levels with stormwater pipe flow and *Enterococcus* levels, to determine the effect of varying amounts of rainfall with bacteria development in the bay. Stormwater flow methodology will be decided prior to project development. There are, however, many factors that affect bacteria development and growth.

•**WHEN:** Planning and implementation on a smaller sub-basin within the CARP drainage basin to begin in Tier 1, continuing through the life of the I-Plan.

•**HOW:** Methods of data collection could include Doppler radar data analysis, conventional rain gauges, and weather stations. Specific implementation proposals should be developed by entities such as those listed in “WHO” section above or other as appropriate.

•**COSTS/SOURCE OF FUNDS:** Will vary depending on data collection methods, funding sources, and responsible parties.

•**RESPONSIBLE ORGANIZATION(S):** None required

•ACTIONS AND SCHEDULE:

Table 12. MM 2.2. Collecting Rainfall Data Near Cole and Ropes Parks. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Planning and implementation in smaller pilot project area | x | | |
| Data Management and Maintenance | x | x | x |

Management Measure 2.3: Conduct Stormwater Outfall Flow Sampling

•**WHAT:** The main sources of bacteria at Cole and Ropes Parks beaches may be coming from non-point source runoff. The non-point source runoff may be (1) from stormwater flowing into the stormwater collection system and through the pipes into Corpus Christi Bay, (2) surface runoff from the land that flows into Corpus Christi Bay, or (3) a combination of both (TMDL 2016).

Measuring flow within the main stormwater pipes and correlating the flows with bacteria levels in the bay might give the CARP Committee better information to help develop timely public safety notifications at these beaches. Additionally, along with rainfall data, stormwater flow data may be useful to better understand the causes and sources of high bacteria levels at Cole and Ropes Parks, and for implementing strategies to ultimately prevent further water quality degradation. Data collected may also be used to help measure success of Management Measures and Control Actions proposed elsewhere in the I-Plan.

•**WHO:** The CARP Committee envisions a cooperative effort including the City, local universities, residents, and local research and data collection organizations (i.e. Center for Coastal Studies, Coastal Bend Bays and Estuaries Program and others to be determined).

•**WHERE:** The CARP Committee suggests a pilot project be installed within a smaller sub-basin of the study area first, and then expanded to the Louisiana and Brawner Parkway basins.

•**GOAL:** To collect stormwater flow data in order to correlate stormwater pipe flow in cubic feet per second (cfs) with *Enterococcus* levels (cfu) to see if there are any significant relationships. Ultimately, if a correlation is found, flow in the stormwater system could be used as a proxy for alerting the public when to avoid the water at Cole and Ropes Parks.

•**WHEN:** Planning and implementation within a pilot area could start upon approval of the I-Plan and should be completed within Tier 1; evaluation of the pilot project and application of methods the larger area should begin within Tier 1 to begin implementation in Tier 2. Data collection should continue throughout the life of the I-Plan.

•**HOW:** Methods of data collection could include in-pipe laser flow meters, Parshall Flumes, automated water flow meters, and other flow data collection technology. Specific implementation proposals should be developed by entities such as those listed in “WHO” section above or other as appropriate. The influence of flow within the stormwater system should be taken into account regardless of method of flow data collection. Detailed models of the effect of tides on water levels through Corpus Christi Bay are available, and should be used in conjunction with stormwater flow data to determine non-tidal portion of flow within the system.

•**COSTS/SOURCE OF FUNDS:** Will vary depending on data collection methods, funding sources, and responsible parties. Some equipment for this purpose could be borrowed from the Center for Coastal Studies at no cost.

•**RESPONSIBLE ORGANIZATION(S):** To be determined

•**ACTIONS AND SCHEDULE:**

Table 13. MM 2.3. Conduct Stormwater Outfall Flow Sampling. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Planning and Implementation of Pilot Project | x | | |
| Planning for entire Cole and Ropes Parks basins | x | | |
| Project Implementation for Entire Cole and Ropes Parks Basins | x | x | |
| Data Management and Maintenance | x | x | x |

Table 14. Summary of Management Measure 2.0: Monitoring

Management Measure: *Monitoring*

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|--------------------------|---|--|-----------------------------|---|---|---|--------------------|
| Monitoring | | | | | | | | |
| 2.1) Continue Sampling <i>Enterococcus</i> Levels at Cole and Ropes Parks | TBD | Grants administered by the laboratory at the Corpus Christi-Nueces County Public Health District. | Provide the public with information about water quality at recreational beaches. | Tier 1 (1-5 years). | Number of samples collected. | Continue current Texas Beach Watch Sampling Program. | Continue bacterial monitoring at Cole and Ropes Park. | EPA and TGLO |
| 2.2) Collect Rainfall Data Near Cole and Ropes Parks | TBD | Will vary depending on data collection methods, funding sources, and responsible parties. | Public Service Announcements and create public education material. | Tier 1 (1-5 years)-ongoing. | Develop a database with rainfall and bacteria data. | Planning and implementation of rainfall collection program in a small pilot project area to begin with and then expand. Data Management and Maintenance. | Collect accurate rainfall data in close proximity to stormwater outfalls/ drainage areas to provide better information on the relationship between bacteria exceedances and stormwater flows. | TCEQ |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|---------------------------------|--|---|---|--|---|---|---------------------------|
| 2.3) Conduct Stormwater Outfall Flow Sampling | TBD | TBD | Use data to alert public when bacteria levels may be high at Cole and Ropes Park. | Tier 1 (1-5 years). After pilot project plan and implement program for entire Cole and Ropes Parks basins. | Non-tidal flow data time series developed. | Data is being collected and reported (i.e. weekly, monthly, quarterly) Data management and maintenance | Collect stormwater flow data in a pilot project area within Cole and Ropes Parks. | TBD |

Management Measure 3.0: Research

Bacteria levels at Cole and Ropes Parks (CARP) beaches are a concern for our area, as reflected in the TMDL studies this I-Plan addresses. The TMDL study provides a general description of the extent and character of bacteria exceedances in the CARP area. Alone, however, this is not a sufficient basis for determining the most cost-effective courses of action to achieve contact recreation standards at these two beaches. This will undoubtedly be a dynamic process where we continually expand our knowledge of the sources and effects of bacteria at these beaches and where various management approaches are tested and refined. This section identifies potential research topics that will be critical to this undertaking.

These topics are pertinent to the entire Corpus Christi Bay area, and are intended to be implemented as resources become available. Research would be conducted using appropriate methodology and quality assurance that have been developed in consultation with TCEQ and EPA.

A variety of funding sources should be pursued, with a wide spectrum of partners. It is unlikely that any one local entity will find it feasible to conduct this research alone. Given the large-scale character of the undertakings, entities should look to coordinate efforts with the various academic institutions in the area, federal and state agencies like the EPA, Texas Department of State Health Services, water and environmental research groups, and similar potential partners. A shared project, the result of an inter-local agreement or similar instrument, may allow local entities to feasibly investigate these issues. Parts of, or entire projects described below could be undertaken by graduate students or researchers at local universities and research institutions. Results of the following projects are intended to be used for evaluation of the effectiveness of current and future I-Plan Management Measures and Control Actions, as well as other measures currently being undertaken by the City and other entities to reduce bacteria loading in Corpus Christi Bay.

Because the results of the following research project will be instrumental in the “adaptive-management” nature of this I-Plan, all research activities should begin implementation as soon as possible in Tier 1. Results should be shared with the CARP to be integrated into I-Plan revisions at the five-year review. The applicability of this section for academic researchers’ and graduate students’ research projects should not be overlooked.

The I-Plan’s stakeholders identified six priority research topics which are listed below:

Management Measure 3.1: Evaluate Methods to Remove Bacteria with Green Infrastructure

•**WHAT:** Green infrastructure is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits and support sustainable communities. Unlike single-purpose gray stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, air quality management, bay debris management, and much more. A green infrastructure feasibility study should be completed for Cole and Ropes Parks to determine the impact of bacteria load reduction at these beaches. Alternatives could include large and small scale options from greenway redesign to rain gardens and rain water harvesting by residents in single family homes.

•**WHO:** The City of Corpus Christi is the owner of the stormwater pipes, Cole and Ropes Parks, Louisiana Parkway, Brawner Parkway, and should lead the effort for initiating a green infrastructure feasibility study within these areas. An engineering firm familiar with green infrastructure planning should be hired to conduct the feasibility study.

•**WHERE:** A feasibility study looking at implementing green infrastructure could be completed for the area surrounding Cole and Ropes Parks, including at the major outfalls contributing flows at these beaches. Upstream areas (Louisiana and Brawner Parkways) and possibly Brawner Parkway should also be included in the study, as well as any small scale modifications and other viable concepts.

•**GOAL:** Complete a feasibility study in the Cole and Ropes Parks drainage basins to implement green infrastructure concepts to reduce bacteria loading at the beaches. Ultimately, if the study indicates to be cost-effective and significant reduction in bacteria loads can be achieved through green infrastructure, then the activities may be pursued for full construction implementation at appropriate measures.

•**WHEN:** A feasibility study could be initiated and completed in Tier 1.

•**HOW:** Steps involved in this study could include the City of Corpus Christi working with a contractor or researcher familiar with implementing green infrastructure projects to conduct a feasibility study for Cole and Ropes Parks, with the main goal of determining whether green infrastructure could be effective at reducing bacteria loads at these beaches. The researcher should develop a list of alternatives that could be implemented with an estimated percentage of bacteria load reduction for each alternative and a cost associated with each. The

CARP Committee could suggest next steps to the City staff and council based on results from the feasibility study.

•**COSTS/SOURCE OF FUNDS:** Will vary depending on data collection methods, funding sources, and responsible parties.

•**RESPONSIBLE ORGANIZATION(S):** None required

•**ACTIONS AND SCHEDULE:**

Table 15. MM 3.1. Evaluate Methods to Remove Bacteria with Green Infrastructure. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|----------------------------|--------------------------------|--------|--------|
| Initiate Feasibility Study | x | | |
| Develop Recommendations | x at completion of study | | |

Management Measure 3.2: Bacterial Source Tracking

•**WHAT:** Further evaluate bacteria sources, persistence, and re-growth. To fully comprehend the extent of contributions to bacterial loading at these beaches and to focus future management actions targeting the largest sources of bacteria, studies could use bacteria source tracking as a way to identify sources within the CARP area.

•**WHO:** Personnel will collect the samples and ship them to an approved Research and Testing Laboratory.

•**WHERE:** Sample the six TBWP sites pre and post rain events.

•**GOAL:** The goal of the study is to characterize the microbiome of the bay water at the Cole and Ropes Parks locations and then compare the original samples with samples collected after rain run-off to determine the biota of the organisms and origin of the increased bacterial load. Results from this study will guide implementation of subsequent bacteria reduction efforts.

•**WHEN:** Before a rain event and immediately post rain event. To be implemented immediately upon approval of the I-Plan pending funding availability; Tier 1.

•**HOW:** With use of the latest technology. To be determined.

•**COSTS/SOURCE OF FUNDS:** Funding is to be determined.

•**RESPONSIBLE ORGANIZATION(S):** None required

•**ACTIONS AND SCHEDULE:**

Table 16. MM 3.2. Bacterial Source Tracking. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|------------------------------------|--------|--------|--------|
| Sample collection; pre-rain event | x | | |
| Sample collection; post-rain event | x | | |

Management Measure 3.3: Evaluate the Effectiveness of Public Utilities Programs and Projects in Bacteria Reductions

•**WHAT:** Evaluation of the effectiveness of current and future public utility programs and projects in the planning area will help demonstrate the relative success of different management practices. This effort would draw from current and proposed activities undertaken by the City of Corpus Christi's Phase 1 MS4 permit. The effectiveness studies would include both structural measures and behavioral measures. Structural measures might be based on both traditional drainage engineering, such as specifications for stormwater outfalls; and sustainable infrastructure design methodologies, such as Green Infrastructure and Low Impact Development. Behavioral measures might include, scope and impact of public outreach, public reporting of illicit discharges, and other efforts aimed at changing behaviors. The data collected and the results from the comparative evaluations should be made available to all stakeholders.

•**WHO:** Researchers and/or consultants.

•**WHERE:** Within the watersheds of Cole Park, Ropes Park, and Brawner Parkway.

•**GOAL:** To identify the effects of City programs on bacteria levels in the watershed: Which City programs are the most and least effective in improving water quality?

•**WHEN:** Tier 2.

•**HOW:** Record effectiveness of current stormwater programs and future projects being implemented by using a list of success criteria for both structural and behavioral measures.

•**COSTS/SOURCE OF FUNDS:** Will vary depending on data collection methods, funding sources, and responsible parties.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi.

•**ACTIONS AND SCHEDULE:**

Table 17. MM 3.3. Evaluate the effectiveness of Public Utilities programs and projects in bacteria reductions. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Evaluate program and project effectiveness through monitoring | | x | |

Management Measure 3.4: Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303(d) List

Elevated bacteria levels at Cole and Ropes Parks during certain times of the year (i.e. after rainfall events, etc.) pose a health risk to recreational users. For regulatory use, a better methodology to justify the listing of these beaches on the 303(d) list should be considered rather than the current process of 25% of days sampled. This Management Measure will provide two alternative methods for analyzing data other than what is currently being implemented and should provide better justification with regards to regulatory scrutiny.

•**WHAT:** Growing concerns about the health risks posed by polluted bathing beaches, increased beach closures, and scientific evidence indicating an increase in infectious diseases caused by microbial organisms in recreational waters prompted the EPA to create the National BEACH Program. The goals of the BEACH Program are to protect public health at the nation's beaches and to ensure the public is notified when the risk for potential illness and disease is present.

For regulatory purposes, (i.e. listing on the 303(d) list) the current sampling regime is biased towards having higher days of elevated bacteria due to the continuous return of daily sampling after bacteria levels are elevated until levels have decreased below the threshold. For public safety this is a good sampling method, but for listing beaches on the 303(d) list it is insufficient. There are a couple of ways to address this: 1) more sampling to account for “good” days when bacteria levels are below the criteria or 2) count the series of sampling days in row as an event, rather than separate days sampled. This would depict a more accurate data set of high vs. low bacteria levels based on the current sampling methodology.

•**WHO:** Cole and Ropes Parks Coordination Committee

•**WHERE:** State-wide

•**GOAL:** The goal is to improve and standardize listing methodology for regulatory justification in listing beaches on the 303(d) list.

•**WHEN:** Tier 1 upon approval of the I-Plan.

•**HOW:** The CARP will request a review of statistical merit to the current data analysis process of Texas Beach Watch Data for listing beaches on the 303(d) list. Amendments to the way the TCEQ evaluates the listing of 303(d) beaches based on TBWP data would need to be discussed and approved by both TCEQ and the EPA. This change would affect the entire state of Texas and not just Cole and Ropes Parks.

•**COSTS/SOURCE OF FUNDS:** Technical and legal assistance may be required. Funding to be determined

•**RESPONSIBLE ORGANIZATION(S):** EPA, TCEQ, GLO, City of Corpus Christi.

•**ACTIONS AND SCHEDULE:**

Table 18. MM 3.4. Promote new data analysis method for regulatory justification for listing beaches on the 303(d) list. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Change data review methodology for regulatory purposes | x | | |

Management Measure 3.5: Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes Parks by the Use of Dye Testing

Water flow patterns within Corpus Christi Bay may have a significant effect on the bacterial occurrence at Ropes and Cole Parks. Stormwater loading from the Brawner and Louisiana Parkway outfalls may be the largest contributors of bacteria to Corpus Christi Bay due to watershed size and geographic extent, and location and size of their ultimate outfalls.

•**WHAT:** Rhodamine dyes have been used over the years in water flow and particle research. By placing probes that can detect this dye north of the Brawner drainage outfalls and adding this dye to the Brawner Parkway drainage system prior to rain events.

•**WHO:** Texas A&M University-Corpus Christi has several departments and divisions with researchers that have equipment and expertise to conduct a water flow study using dye methods.

- WHERE:** Two to four areas between Brawner Parkway outfall and Ropes Park.
- GOAL:** The goal is to understand the impact of the Brawner Parkway outfall discharges at Ropes Park on bacteria levels and ultimately focus resources toward the area of most influence.
- WHEN:** Ideally, the dye testing could be conducted during or immediately following several rain events within the study area. The data required to establish a correlation between the Brawner discharges and the sampling taken at Ropes Park should determine the spatial and temporal criteria.
- HOW:** Research contractors would develop a monitoring regime that should be able to discern whether the large outfalls have a direct impact on the sampling conducted at Ropes Park. Two to four probes could be placed within the study area until data could be collected from rain events. These may need to be moved at various times to provide a better picture of the water flow.
- COSTS/SOURCE OF FUNDS:** Since there is not an abundance of public or private funds, grant funding would be required. A project through the Coastal Bend Bays & Estuaries Program (CBBEP) or CMP could be applied for to fund the research conducted by an appropriate group from TAMUCC. Purchase and install two to four probes that can be used with Rhodamine dye (approximately \$3.7K each), Collect data and move probes as needed to develop a good concept of water flow during rain events (\$10K), develop report with conclusions on impact of Brawner drainage outfall on GLO sampling locations at Ropes Park. Total cost is estimated at \$32K for the entire project.
- RESPONSIBLE ORGANIZATION(S):** Dependent upon the organization that conducts this study and if the grant or project funding requires approval of a QAPP or similar plan.
- ACTIONS AND SCHEDULE:**

Table 19. MM 3.5. Identify water flow patterns in Corpus Christi Bay at Cole and Ropes Parks by the use of dye testing. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Planning and Implementation of Dye Testing Procedure | x | | |

Management Measure 3.6: Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health

Elevated bacteria levels at Cole and Ropes Parks during certain times of the year (i.e. after rainfall events, etc.) pose a health risk to recreational users. The public

health issue that needs to be addressed is the time of week the beaches are sampled for public health safety. Sampling of Cole and Ropes Parks needs to occur closer to the weekend when the public will be using these beaches, rather than on a Tuesday as is the current sampling protocol. This will help ensure public safety.

•**WHAT:** Growing concerns about the health risks posed by polluted bathing beaches, increased beach closures, and scientific evidence indicating an increase in infectious diseases caused by microbial organisms in recreational waters prompted the EPA to create the National BEACH Program. The goals of the BEACH Program are to protect public health at the nation's beaches and to ensure the public is notified when the risk for potential illness and disease is present. The Texas Beach Watch Program currently samples Cole and Ropes Parks beaches on Tuesday, when public use of these beaches is likely the lowest. Changing the sampling of these beaches closer to the weekend (i.e. Thursday or Friday) when the public is more likely to be utilizing these areas would ensure more timely notification of elevated bacteria levels to the public.

•**WHO:** For Cole and Ropes Parks, the Texas Beach Watch Program is administered by the laboratory at the Corpus Christi-Nueces County Public Health District (CCNCPHD). The GLO would need to agree to changing sampling days closer to the weekend for these beaches.

•**WHERE:** Four sites are located at Cole Park and two at Ropes Park.

•**GOAL:** The goal is to provide the public with better timed information about water quality at the recreational beaches of Cole and Ropes Parks.

•**WHEN:** Water samples are collected weekly during the beach season (currently May-September) and biweekly during the off-season (October-April). Samples at Cole and Ropes Parks beaches are currently being collected on Tuesday. Change the sampling days to Thursday or Friday.

•**HOW:** For Cole and Ropes Parks, the Texas Beach Watch Program is administered by the laboratory at the CCNCPHD. The GLO would need to agree to changing sampling days closer to the weekend for these beaches.

•**COSTS/SOURCE OF FUNDS:** Will vary depending on data collection methods, funding sources, and responsible parties.

If collection days were changed to Thursday, then the results would be out on Friday and would reflect the levels on Thursday and may better reflect weekend values unless it rained after Thursday collection. This is important only after an accurate analysis is conducted and documented that the primary contact recreational users increase on weekends to a level for that site to remain as a primary recreational water site.

•**RESPONSIBLE ORGANIZATION(S):** The local Beach Watch grant was awarded to Nueces County and operated by the Corpus Christi-Nueces County Public Health District. Local government representatives make the necessary beach notifications upon receipt utilizing the provided signage.

•**ACTIONS AND SCHEDULE:**

Table 20. MM 3.6. Change sampling date of current TX Beach Watch Program to be more protective of public health. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---------------------------------------|--------|--------|--------|
| Texas Beach Watch sampling day change | x | | |

Table 21. Summary of Management Measure Research

Management Measure: *Research*

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|---|--|----------------------------|---|---|--|------------------------------|
| Research | | | | | | | | |
| 3.1) Evaluate Methods to Remove Bacteria with Green Infrastructure | TBD | TBD | Provide public with activities they can implement at home to reduce bacteria. | Tier 1 (1-5 Years). | After study is complete CARP will recommend green infrastructure alternatives to City. City will implement green infrastructure within the City. | Initiate Feasibility Study Develop Recommendations | No monitoring Modeling exercise | City of Corpus Christi, CARP |
| 3.2) Bacterial Source Tracking | TBD | TBD | Provide public with sources of bacteria and information on they can help reduce bacteria | Tier 1 (1-5 Years) | Utilize results to identify possible contamination sources. | Identify the microbiome of bay water samples. | Use identified source tracking methods to evaluate sources of bacteria | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|---------------------------------|--|--|-----------------------------------|--|--|---|---------------------------|
| 3.3) Evaluate the Effectiveness of Public Utilities Programs and Projects in Bacteria Reductions | TBD | TBD | Notify public of successful programs the City is implementing. | Tier 1-2 (1-10 Years). | Measure the effectiveness of program and project and modify management practices and projects to improve effectiveness. | Evaluate program and project effectiveness through monitoring. | Gather pertinent information on activities for programs that could help reduce bacteria. | City of Corpus Christi, |
| 3.4) Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303 (d) List | TBD | EPA | Notify public of methods for evaluating beaches water quality. | Tier 1-2 (1-10 Years). | Date review changed. Fewer beaches and water bodies listed for bacteria on the 303d list due to more accurate characterization of conditions of water body. | Change data review methodology for regulatory purposes. | Review data analyzing method for better justification for characterizing beach water quality. | TCEQ, EPA, CARP |
| 3.5) Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes Parks by the use of Dye Testing | TBD | TBD | Show visual maps of where water flows along the beach, especially after rain events. | Tier 1 (1-5 Years). | Identify focus for future action by City if Brawner outfall can be shown to have large influence on Ropes Park sampling. | Identification of water flow patterns. | Implement dye testing during rain events and monitor flow. | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|---------------------------------|--|--|-----------------------------------|---|--|-----------------------------|---|
| 3.6) Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health | TBD | TBD | Already incorporated into the TBWP which is the TBWP website | Tier 1 (1-5 Years) | Sampling days changed so notifications are more protective on weekends. | Texas Beach Watch sampling day change. | None | City of Corpus Christi, Texas Beach Watch Program and Corpus Christi Nueces County Public Health District |

Management Measure 4.0: Wastewater Collection Systems

Sanitary sewers can fail to function properly due to blockages, line breaks, defects that allow stormwater and groundwater to overload the system, lapses in operation and maintenance, inadequate design and construction, power failures, deferred replacement, and vandalism. The EPA has concluded that sanitary sewer overflows (SSOs) contribute to bacteria loading in almost all impaired streams, but may or may not be a primary source of loading. EPA acknowledges that SSO data is difficult to assess.

In general, implementation actions consist of encouraging improvements to sanitary sewers through hydraulic modeling and completing an inflow and infiltration study; reducing the amount of fats, oils, and grease entering the system; continuing sanitary sewer line cleaning; and reporting of SSOs to the TCEQ. These reports are public information and are available from the TCEQ.

Management Measure 4.1: Enhance Existing Fats, Oil & Grease Program

Fats, oil, and grease (FOG) are considered to be a leading cause of blockages in sanitary sewers, and the EPA estimates that blockages account for nearly 50 percent of all SSOs nationwide. This Management Measure enables the City of Corpus Christi to determine the proper size and design for grease interceptors, to inspect traps regularly, and to require grease interceptors be effectively maintained by businesses.

•**WHAT:** Almost all of the City's Food Service Establishments (FSE) are required to have a grease interceptor and this is initially enforced by Development Services through the building permit process. Thereafter, FSEs are inspected annually by the City's Pretreatment staff. Inspections include reviewing manifests for grease interceptor cleaning frequency and analyzing Hexane Extractible Material (HEM) levels, which cannot exceed 200 mg/l. The hexane solvent methodology is used to measure total oils and grease. A Notice of Violation is sent to FSEs where exceedance is observed, with a requirement to increase the interceptor cleaning frequency. Continued exceedances may result in a requirement for a larger or more effective interceptor.

On inserts included in City utility bills, at Earth Day Bay Day and similar events throughout the City, residents receive information on problems associated with disposing of grease down drains and are advised to avoid this practice. The City provides fat trapper containers and bags at no charge to attendees at public events.

•**WHO:** City of Corpus Christi Public Utilities, Corpus Christi- Nueces County Health Department, Food Service Establishments (FSE Program).

•**WHERE:** All FSEs in the Cole and Ropes Parks contributing drainage areas.

•**GOAL:** Reduce or eliminate SSOs resulting from blockages caused by FOG through monitoring and enforcement of the City's ordinances prohibiting grease input into the wastewater collection system

•**WHEN:** Implementation beginning in Tier 1 and continuing.

•**HOW:** Through continuing efforts in the City's FOG program, enhanced by increased enforcement.

•**COSTS/SOURCE OF FUNDS:** Approximately \$400,000 annually, in the range of Public Utilities operating budget.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi Public Utilities Department

•**ACTIONS AND SCHEDULE:**

Table 22. MM 4.1. Enhance existing Fats, Oil & Grease (FOG) program. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Continue Food Service HEM Monitoring | x | x | x |
| Continue Food Service Grease Interceptor Maintenance Enforcement | x | x | x |

Management Measure 4.2: Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSOs)

•**WHAT:** All SSOs are reported by the City's Public Utilities Department to the TCEQ. It is City policy that all reported overflows are repaired or addressed. The intent of this Control Action is to continue the SSO reporting and notification by the City of Corpus Christi to TCEQ. Other interested groups could be included in the future.

•**WHO:** The City of Corpus Christi Public Utilities Department

•**WHERE:** The main priority area would be within the Cole and Ropes Park drainage basin and include Brawner Parkway drainage basin.

•**GOAL:** Continue reporting of SSOs.

•**WHEN:** Implementation beginning in Tier 1 and ongoing.

•**HOW:** Continue reporting SSOs as is currently being done to date.

•**COSTS/SOURCE OF FUNDS:** The costs associated with SSO reporting to the TCEQ by the City are included in the Public Utilities Department's annual operating budget.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution; TCEQ implementation of federally delegated TPDES permitting authority under Texas Clean Water Act; USEPA, National Pollutant Disposal Elimination System program, implementing the federal Clean Water Act.

•**ACTIONS AND SCHEDULE:**

Table 23. MM 4.2. Continue and Expand the Notification System for Monitoring Sanitary Sewer Overflows (SSOs). Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|------------------------|--------|--------|--------|
| Continue SSO Reporting | x | x | x |

Management Measure 4.3: Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation

The City of Corpus Christi has an on-going program of cleaning and televised inspecting its wastewater collection system. This is part of the Wastewater Department's maintenance and operation plan for improved performance. Through cleaning and televising, the City can optimize repairs/rehabilitation efforts to meet TCEQ permit requirements. In addition to continuing this program, the CARP Committee recommends developing additional monitoring techniques that may be more accurate or cost effective such as smoke detection.

•**WHAT:** Maintenance of lines is a Public Utilities Department function to assure improved performance to its 83,000 customers who depend on this service every day.

•**WHO:** The Public Utilities Department, along with competitively bid contracts, provides the forces to maintain the City's collection system. Additional projects (e.g. such as a smoke detection pilot project) could be undertaken by research entities such as graduate students or local environmental groups.

•**WHERE:** Annually, the Public Utilities Department assesses areas of the City to determine need for improved maintenance and repairs. Areas needing replacement are placed on the Capital Improvements Program (CIP) plan for bid

solicitation. Also, database reviews occur to resolve problematic areas in the system. Pilot projects or expansion of the current program should be focused on the Cole and Ropes Parks drainage basins.

•**GOAL:** Prevent overflows and increase system capacity.

•**WHEN:** Implementation beginning in Tier 1 and continuing.

•**HOW:** Generally, through cleaning and closed circuit televising (CCTV), smoke detection surveys, and customer complaints of affected areas, resolution of problems and improvements of the systems are accomplished.

•**COSTS/SOURCE OF FUNDS:** Corpus Christi Public Utilities Department.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution.

•**ACTIONS AND SCHEDULE:**

Table 24. MM 4.3. Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|------------------------------------|--------|--------|--------|
| Continue Customer Response | x | x | x |
| Review Funding for Line Cleaning | x | x | x |
| Increase Funding for Smoke Testing | x | x | x |

Management Measure 4.4: Implement an Ongoing Inflow and Infiltration Study

The City of Corpus Christi has an on-going City-wide flow monitoring program to prioritize ranking of sub-basins based on various factors such as Rainfall Dependent Inflow/Infiltration (RDII), SSOs, and maintenance history. The monitoring program is intended to address issues which may cause a negative impact on human health and safety or the environment. The City is further developing a program to determine needed wastewater infrastructure modifications/improvements to ensure adequate collection system conveyance capacity.

•**WHAT:** Rainfall Distribution analysis and recorded wet weather flow data, the gallons of RDII and other variables will establish the magnitude of wet weather inflow in order to prioritize sub-basins for future testing and rehabilitation.

•**WHO:** The Public Utilities Department, along with competitively bid contract services, provides the forces to maintain the City's collection system.

•**WHERE:** All areas of the City to determine need for improved maintenance and repairs.

•**GOAL:** Development of long-term Infiltration/Inflow (I/I) program to find and fix system defects.

•**WHEN:** The I/I study is part of the CMOM (Capacity Assurance, Management, Operation and Maintenance) self-audit, following EPA guidance criteria, an ongoing SSO initiative project. It will precede and be incorporated into the hydraulic modeling project.

•**HOW:** I/I studies will be conducted by the City.

•**COSTS/SOURCE OF FUNDS:** Funding for the I/I studies will be provided by the City.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution; TCEQ implementation of federally delegated TPDES permitting authority under Texas CWA; USEPA, NPDES program, implementing the federal CWA; state and federal Solid Waste Acts to regulate wastewater collection, treatment, and disposal.

•**ACTIONS AND SCHEDULE:**

Table 25. MM 4.4. Implement an Ongoing Inflow and Infiltration Study. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Identify Flow Monitoring Site Locations | x | x | x |
| Conduct Flow Monitoring | x | x | x |
| Data Collection and Analysis | x | x | x |

Management Measure 4.5: Conduct Hydraulic Modeling of Collection System

The City of Corpus Christi has an on-going Capacity Assurance, Management, Operation and Maintenance (CMOM- a self-audit process developed and recommended for use by the EPA) program to address issues which may cause a negative impact on human health and safety or the environment and is developing a comprehensive City-wide hydraulic model of the wastewater collection system. The hydraulic model will facilitate understanding the root

causes of factors contributing to bacteria in the bay, aid in development of system improvements, produce informational maps/exhibits, and will recommend the system's response to future improvements.

•**WHAT:** A hydraulic wastewater system model will equip the wastewater department with the tool for analyzing system conveyance capacities, bottlenecks, and potential overflow locations.

•**WHO:** The Public Utilities Department, along with a competitively bid contract provide the forces to maintain the City's wastewater collection system.

•**WHERE:** The modeling project will be broken into two phases based on the treatment plant service areas of greatest priority. Phase 1 will consist of Oso, Greenwood, and Broadway Wastewater Treatment Plants (WWTP) service areas.

•**GOAL:** The Goal is to prevent overflows and increase system capacity

•**WHEN:** The project is to be performed in a timely manner consistent with sound professional practices. Both phases are anticipated to be complete in future years.

•**HOW:** The hydraulic model will enable the City to assess any potential capacity constraints and to develop strategies to optimize system performance to meet TCEQ permit requirements. The professional engineering consultant, if needed, should be chosen on the basis of competency rather than low bid.

•**COSTS/SOURCE OF FUNDS:** Funding Implementation for the Citywide hydraulic model will be through A/E (Architecture/Engineer) professional services engineering contracts in the amount of \$2,000,000. Funding for this Control Action is to be determined but may be provided by a grant from TCEQ or EPA.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution; TCEQ implementation of federally delegated Texas Pollutant Disposal Elimination System permitting authority under Texas Clean Water Act; USEPA, National Pollutant Disposal Elimination System program, implementing the federal Clean Water Act; state and federal Solid Waste Acts to regulate wastewater collection, treatment, and disposal.

•**ACTIONS AND SCHEDULE:**

Table 26. MM 4.5. Conduct Hydraulic Modeling of Collection System. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---------|--------|--------|--------|
|---------|--------|--------|--------|

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| | | | |
|--|----------|----------|--|
| Phase 1 Modeling- Oso, Greenwood, and Broadway WWTP Basins | x | | |
| Data Analysis, Reporting, and Recommendations | x | x | |

Table 27. Summary of Management Measure: Wastewater Collection Systems**Management Measure:** *Wastewater Collection System*

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|--|---|--|-------------------------------------|--|--|---|
| Wastewater Collection System | | | | | | | | |
| 4.1.) Enhance Existing Fats, Oil & Grease (FOG) Program | TBD | City of Corpus Christi Public Utilities operating budget | Continue generator education directed to permittees and citizens. | Tier 1 - ongoing. Continue current program | Decreased FOG associated overflows. | Increased Food Service Grease Interceptor Maintenance Enforcement. | Continue to monitor FSE's. Food Service HEM Monitoring. | Partnership among City of Corpus Christi Public Utilities, Corpus Christi-Nueces County Health Department, Food Service Establishments (FSE Program). |
| 4.2) Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSOs) | TBD | City of Corpus Christi Public Utilities operating budget | Notification to TCEQ; this entity may choose further outreach/education activities. | Tier 1- ongoing. | TCEQ compliance. | Continue reporting SSOs to TCEQ | Monitor number of reported SSO's to TCEQ | City of Corpus Christi Public Utilities Department |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|---------------------------------|--|--|-----------------------------------|---|---|-----------------------------------|---------------------------|
| 4.3) Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | City of Corpus Christi Public Utilities operating budget | Notify public on collection system line cleaning. | Tier 1- ongoing | Continued customer response. Funding for line cleaning reviewed. Funding for smoke testing increased. Number of repaired broken lines. | Reduced number of overflow events. | Continue monitoring and response. | City of Corpus Christi |
| 4.4) Implement an Ongoing Inflow and Infiltration Study | TBD | City of Corpus Christi Public Utilities operating budget | Provide data results from I/I study to the public. | Tier 1- ongoing. | Ranking of meter sub-basins. Preparation of sanitary sewer evaluation survey. I/I study report completed. | Determine flow monitoring site locations. Conduct flow monitoring. Data collection and analysis. Analyze Flow and Infiltration Data to determine where wastewater infrastructure modifications/improvements to ensure adequate collection system conveyance capacity are needed. | Conduct flow monitoring | City of Corpus Christi |

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|--|--|----------------------------|---|--|-------------------------|--|
| 4.5) Conduct Hydraulic Modeling of Collection System | TBD | City of Corpus Christi Public Utilities operating budget | Provide data results from hydraulic modeling study to the public | Tier 1. | Reduction in sanitary sewer overflows. Collection system capacity assurance Ranking of sub-basins based on I/I. | Data collection and analysis. TCEQ compliance. Development of prioritized system improvement programs. | Conduct Flow Monitoring | Public Utilities Department and contractors. |

Management Measure 5.0: Stormwater Drainage System

Existing requirements of Municipal Separate Storm Sewer System (MS4) permits address some important elements of bacteria loading in stormwater, offering an adaptive rather than prescriptive approach to bacteria reduction. Although not required under the MS4, Structural Best Management Practices (BMPs), such as modifications to stormwater outfalls may reduce bacteria through aeration, treatment by sunlight, or physical removal of contaminants, and have the potential to reduce bacteria loading into waterways. However, there is limited data regarding how well such BMPs (i.e. green infrastructure) might reduce bacteria loading. Therefore, the CARP Committee has identified the evaluation of the effectiveness of green infrastructure as one of its priorities.

Management Measure 5.1: Determine Effectiveness of Stormwater Retrofits* to Remove Bacteria

Fecal indicator bacteria such as *Enterococcus* in urban stormwater originate from feces of warm blooded animals deposited in the watershed. These bacteria may be directly deposited into the receiving water or carried to the receiving water by stormwater runoff. Bacteria may persist for extended periods of time outside of a warm-blooded host in sediments, biofilms, and organic litter in stormwater facilities, pipes and media. Understanding sources of bacteria is important in selecting appropriate BMPs targeted to these sources. Managing the source should be the first strategy implemented. A variety of guidance and techniques exist for conducting bacteria source tracking, ranging from relatively straight forward illicit discharge screening to complex microbial source tracking (MST) studies.

As funding is identified and becomes available the City of Corpus Christi should perform a small scale pilot program on a public improvement project using a site-specific engineered stormwater retrofit in Cole and Ropes Park Stormwater drainage basin. (*Retrofits are defined as “stormwater treatment practices in stream corridors or upland areas to capture and treat stormwater runoff before it flows into the receiving water”).

(EPA 2007; www.cwp.org; www.stormwatercenter.net).

As part of this small scale pilot program, the City should undertake a detailed survey of the stormwater collection system in one or two of the small drainage basins in the study area, including either smoke testing or televising the stormwater sewer lines, to determine whether illegal cross connections or leaking/broken private sewer laterals are contributing sewage to the stormwater collection system. Retrofits which may assist in reducing bacteria concentrations

in stormwater include diverting flows through constructed wetlands, exposing previously underground flows to sunlight, or diverting runoff to wet ponds. There is a need for additional research into the effectiveness of removing bacteria from stormwater runoff with retrofits to existing infrastructure in urban environments. The results of this pilot project should be used to determine if retrofits to existing infrastructure are effective in reducing *Enterococcus* levels in stormwater runoff.

•**WHAT:** The purpose of this implementation activity is to determine the feasibility of reducing bacteria concentrations from urban runoff by retrofitting existing infrastructure and evaluating the level of bacteria removal. When a funding source becomes available, the City may perform a small scale pilot program on a public improvement project using a site specific engineered stormwater retrofit to determine if such retrofit is effective at reducing *Enterococcus* bacteria.

•**WHO:** The City of Corpus Christi

•**WHERE:** Cole and Ropes Parks Stormwater drainage basin. The pilot project should be developed on City-owned property. Site specific pilot project location to be determined with assistance of an engineering consulting firm.

•**GOAL:** Determine if stormwater retrofit(s) can effectively reduce bacteria in stormwater runoff.

•**WHEN:** Tier 1.

•**HOW:** The City of Corpus Christi should hire an engineer experienced in designing stormwater retrofits for pollutant reduction. The City or the City's designee will monitor the bacteria levels at the inflow and outflow of the retrofit and report findings to the CARP committee.

•**COSTS/SOURCE OF FUNDS:** Estimated cost (\$75,000). Source of funding to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi

•**ACTIONS AND SCHEDULE:**

Table 28. MM 5.1. Determine Effectiveness of Stormwater Retrofits to Remove Bacteria. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|---|--------|--------|
| Conduct Pilot Project | x | | |
| Develop Recommendations for Further Stormwater Retrofits | x at completion of pilot study | x | |

Management Measure 5.2: Continue the Major Outfall Assessment and Repair Program as Funding Allows

There are eight major stormwater outfalls and more than 80 other outfalls that allow stormwater runoff to flow into Corpus Christi Bay. In 2003, 13.5 miles of these outfall structures were inspected and improvements and repairs were made to four outfalls.

•**WHAT:** Continue the ongoing Major Outfall Assessment and Repair program instituted by the City of Corpus Christi, as funding allows.

•**WHO:** The City of Corpus Christi

•**WHERE:** First priority should be outfalls in Cole and Ropes parks.

•**GOAL:** To continue the ongoing maintenance and repair, as needed, of stormwater outfalls which may influence segments of Corpus Christi Bay at Cole and Ropes Parks. Verifying the integrity and function of such outfall structures will ensure the carrying capacity of the system is protected, while minimizing sediment deposition due to physical defects and system failures. As funding and technological advances become available, the City should evaluate the feasibility of retrofitting structurally unsound outfalls to incorporate water quality improvements.

•**WHEN:** As voters and City Council approve funding for the program.

•**HOW:** Continue existing Capital Improvement Program to assess the condition of major outfalls. Condition assessments should rank and prioritize outfall repairs or replacements needed. When major repairs or replacement are warranted, the project should be evaluated to determine the feasibility of retrofits for water quality improvements. The engineer should develop a list of alternatives that could be implemented to project water quality improvements.

•**COSTS/SOURCE OF FUNDS:** To be determined by infrastructure condition monitoring, source of funding for retrofits to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution.

•ACTIONS AND SCHEDULE:

Table 29. MM 5.2. Continue the Major Outfall Assessment and Repair Program as Funding Allows. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Assess Outfalls Within CARP Area | x | | |
| Develop Repair/Retrofit Recommendations | x | | |

Management Measure 5.3: Support and Encourage the Adoption of Stormwater Master Plan

The City is proceeding with adoption of a stormwater master plan. In April 2013, the Level of Service for the SWMP was presented and approved by Corpus Christi City Council. The Level of Service, which is the first step in adopting the SWMP and is a Council level policy approval item, allows City Departments the ability to proceed with developing design standards and updating maps. The approved Level of Service and the SWMP are predicates to amending existing development and construction codes to reflect adopted changes. The City will be re-engaging with a design consultant to assess the impact of the revised level of service and feasibility of incorporating stormwater quality criteria in the master plan.

•**WHAT:** Encourage City leadership and staff to adopt the Stormwater Master Plan, develop design standards and modify City Code of Ordinances as needed.

•**WHO:** The City of Corpus Christi's Development Services, Capital Programs and Public Utilities Departments.

•**WHERE:** Within the corporate boundaries of the City of Corpus Christi

•**GOAL:** Adoption of a SWMP that incorporates water quality protection incentives.

•**WHEN:** Tier 1. Within 5 years of the approval of this I-Plan and securing funding for this activity.

•**HOW:** With the engagement of community groups and support of interested stakeholders to be involved in Plan CC and other long-term City planning efforts.

•**COSTS/SOURCE OF FUNDS:** To be determined.

•**RESPONSIBLE ORGANIZATION(S):** CARP, CBBF, CBBEP, and other similar interested organizations.

•**ACTIONS AND SCHEDULE:**

Table 30. MM 5.3. Support and Encourage the Adoption of Stormwater Master Plan. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|---------------|---------------|---------------|
| Support and Encourage Stakeholder Activity Leading to the Adoption of the Stormwater Master Plan | x | x | x |
| Hold Community-wide Workshop for Developing Stormwater Master Plan Support | x | x | x |
| Create a Stakeholder Master Plan Support Team | x | | |

Table 31. Summary of Management Measure: Stormwater Drainage System]

Management Measure: Stormwater Drainage System

| Management | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|--------------------------|---|--|----------------------------|--|---|---|------------------------|
| Stormwater Drainage System | | | | | | | | |
| 5.1) Determine Effectiveness of Stormwater Retrofits to Remove Bacteria | TBD | TBD | Educate public on Stormwater Retrofits | Tier 1 | CARP will develop recommendations based on the data collected in the pilot study. Effective bacteria removal. | Initiate a pilot study for outfall assessments. | Assess retrofits annually to determine if repairs are needed | City of Corpus Christi |
| 5.2) Continue the Major Outfall Assessment and Repair Program as Funding Allows | TBD | TBD | Notify public about the repair program and provide results from the assessment | Tier 1 | Assessments completed. | Outfall assessment program. Engineer recommends alternatives to City | Continue the assessment program as funding permits to other basins affecting the CARP area. | City of Corpus Christi |
| 5.3) Support and Encourage the Adoption of Stormwater Master Plan | TBD | City of Corpus Christi | Make the Stormwater Master Plan available to public once adopted | Tier 1 | Adoption of a Stormwater Master Plan Evaluate the effectiveness from a water quality and cost perspective | Improved Stormwater management within the watershed | Review Stormwater Master Plan annually and determine if revisions are needed | City of Corpus Christi |

Management Measure 6.0: Ordinance and Regulation

Source tracking should be the FIRST implementation activity before any other engineering solutions, etc. to determine how to order/prioritize further activities.

The information obtained in the pilot program described in 5.1 should be utilized to determine whether illegal cross connections or broken or leaking wastewater laterals are providing a source of bacteria within the target basins and whether Management Measures 6.1-6.3 are needed.

Management Measure 6.1: Residential Leaking / Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program

•**WHAT:** Residential properties have been identified as a potential source of wastewater and other wastes materials that could result in bacteria into the City's MS4. Old, leaking, broken, or improperly installed or maintained private wastewater sewer lines on the property that allow wastewater to infiltrate into the MS4 are a primary concern.

Establish a targeted inspection program for private sewer lines, within the drainage basins contributing flows to the TMDL program area, to test private sewer lines to make sure they do not have any leaks or breaks, and require by law the repair of substandard private sewer lines, also known as private laterals. Lateral failures are often latent defects, not seen, until raw sewage reaches premises surfaces or floods the interior of a home. Sellers can mask such problems or fail to disclose.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Within 10 years, reduce or eliminate all leaking or broken private sewer lines within the drainage basins that discharge within the TMDL.

•**WHEN:** Develop, adopt and implement a targeted private sewer line inspection program within five years of adoption of the I-Plan. Undertake and complete review of City's Technical Construction Codes and Housing Standards Code, identify sections that need to be amended to further the stated goal and prepare and present for adoption the ordinances necessary to amend the codes during the next technical construction codes update process.

• **HOW:** see a.) and b.) below

a. Leaking Private Sewer Line Inspection Program using Hydrostatic or Televised Testing. Pilot Project. Utilizing the information obtained in the

pilot program described in 5.1, determine whether broken or leaking private wastewater lateral systems are providing a source of bacteria by infiltration into stormwater collection systems in the target basins.

Establish an enhanced, targeted inspection program for private sewer lines, within the drainage basins contributing flows to the TMDL program area, to test private sewer lines to make sure they do not have any leaks or broken sewer lines, and mandate repair of substandard private sewer lines, also known as private laterals. (Note: Inspection program could be conducted by licensed plumbers or other certified entities. This is an appropriate requirement prior to a change of house ownership, to enable a new owner to be aware of an actual problem and not be misled into an expensive surprise to correct failed plumbing. Often, plumbing problems are ignored after a purchase because the new owner has no budget to fund expensive corrections. The current system allows “latent” defects to be passed on to a new owner. There is no leverage or requirement for plumbing inspections.)

b. Code Updates. Update City's Building and Housing Standards Code, especially, as they relate to the issue of leaking / broken underground sewer lines.

•COSTS/SOURCE OF FUNDS: Costs to the City of Corpus Christi are to be determined. (Adopt by ordinance the necessary regulatory fees, to be charged to the customer for costs of inspections, identification of needed repairs, and needed lateral replacements, at rates designed to cover the total costs to the City to administer the program. The City could also explore funding/tax abatement/incentives programs to assist the City with program cost overruns as well as seek grants to cover costs of inspections, needed repairs, and lateral replacements, especially for low income property owners. Private inspections of residential lateral lines, accompanying a sale, can likely be accomplished for under \$100.00 to the parties involved, or for free if additional plumbing work is scheduled by a seller or buyer. The City would need to establish a disclosure filing fee to record inspection results associated with a sale.

•RESPONSIBLE ORGANIZATION(S): City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•ACTIONS AND SCHEDULE:

Table 32. MM 6.1. Residential Leaking / Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|---------------------------------|--------|--------|
| Prepare and Present to Council Ordinances Necessary to Establish Targeted Inspection Program Within CARP Area | x at completion of 5.1 | x | |
| Prepare and Present to Council Ordinances Necessary to Update City's Technical | x at | x | |

| | | | |
|---|-------------------|--|--|
| Construction Codes to Address Illegal Cross-connections | completion of 5.1 | | |
|---|-------------------|--|--|

Management Measure 6.2: Commercial Cross-Connection Inspection Program

•**WHAT:** Commercial properties (including multi-family rental property, large condominiums, retail establishments, and industrial properties) may be identified as potential sources of wastewater and other waste materials that could result in introduction of bacteria into the City's MS4. The primary concerns involve illegal cross-connections between the private stormwater and wastewater sewer lines on the property that allow wastewater to infiltrate into the MS4.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce or eliminate all illegal cross-connections within the drainage basins that discharge within the TMDL within 10 years.

•**WHEN:** Develop, adopt and execute an enhanced, targeted illegal cross-connection inspection program in Tier1. Undertake and complete review of City's Technical Construction Codes and Housing Standards Code, including unpermitted work by homeowners within two years, which codes and amendments are intended for adoption during the next technical construction codes update process.

•**HOW:** see a.) and b.) below

a. Illegal Cross-connections Pilot Inspection Program. Utilizing the information obtained in the pilot program described in 5.1, determine whether illegal cross connections between private wastewater systems and the stormwater collection system are providing a source of bacteria within the Cole and Ropes Parks stormwater basins.

Expand City's current inspection programs within drainage basins, contributing flows into the TMDL program area, to locate unauthorized cross-connections on commercial properties. This may include smoke testing wastewater and stormwater lines.

b. Code Updates. Update City's Technical Construction Codes, especially as they relate to the issue of cross-connections.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees, to be charged to the customer for costs of inspections, identification of needed repairs, and needed lateral

replacements, at rates designed to cover the total costs to the City to administer the program. The City could also explore funding/tax abatement/incentives programs to assist with program cost overruns.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•**ACTIONS AND SCHEDULE:**

Table 33. MM 6.2 Commercial Cross-connection Inspection Program. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--|--------|--------|
| Illegal Cross-connections Pilot Inspection Program | x | | |
| Code Updates | x at completion of Pilot Project | | |

Management Measure 6.3: Commercial Leaking / Broken Sewer Laterals Pilot Inspection/Testing Program

•**WHAT:** Commercial properties have been identified as a potential source of wastewater and other waste materials that could result in the infiltration of bacteria into the City's MS4. The primary concerns involve old, leaking, broken, or improperly installed or maintained private wastewater lines on the property that allow wastewater to infiltrate into the MS4.

Establishment of an inspection program to test private sewer lines to make sure they do not have any leaks or breaks, and mandate repair of substandard private sewer lines, also known as private laterals. (Note: Inspection program could be conducted by licensed plumbers or other certified entities.) The problem seems more prevalent in areas with older clay pipe, installed in the 30's, 40's, and 50's, and with cast iron pipes, installed in 60's and 70's, all before widespread use of PVC piping.

There should be an evaluation of the adequacy of the City's current certificate of occupancy program to determine if necessary changes in a property's infrastructure are being correctly installed and properly maintained, especially upon a change of ownership or a change in tenants. This might necessitate the adoption of a business permit system within the City.

•**WHO:** City of Corpus Christi.

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Within 10 years, reduce or eliminate leaking or broken private sewer lines within the drainage basins that discharge within the TMDL area.

•**WHEN:** Propose to City Council to consider for approval and adoption a leaking and broken private sewer inspection program. Undertake and complete review of City's Technical Construction Codes, for adoption during the next technical construction codes update process.

•**HOW:** see a.) and b.) below

a. Leaking or Broken Private Sewer Lateral Pilot Inspection Program.

Utilizing the information obtained in the pilot program described in 5.1, determine whether broken or leaking commercial wastewater lateral systems are providing a source of bacteria by infiltration into stormwater collection systems in the target basins.

Establish an inspection program to test private sewer lines to make sure they do not have any leaks or breaks, and mandate repair of substandard private sewer lines, also known as private laterals, especially upon a change of ownership and/or a change in tenants. (Note: Inspection program could be conducted by licensed plumbers or other certified entities.)

b. Certificate of Occupancy. Evaluate the adequacy of the City's current certificate of occupancy program to determine if necessary changes in a property's infrastructure are being correctly installed and properly maintained, especially upon a change of ownership and/or a change in tenants. This might necessitate the adoption of a business permit system within the City.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees, to be charged to the customer at rates designed to cover the program costs of inspections, identification of needed repairs, and needed lateral replacements. The City could explore funding/tax abatement/incentives programs to assist the City with program cost overruns.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•ACTIONS AND SCHEDULE:

Table 34. MM 6.3 Commercial Leaking / Broken Sewer Laterals Pilot Inspection/Testing Program. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--|--------|--------|
| Leaking or Broken Private Sewer Lateral Pilot Inspection Program | x | | |
| Evaluate the Adequacy of the City's Current Certificate of Occupancy Program | x at completion of Pilot Project | | |

Management Measure 6.4: Improved Grease Trap Standards

•**WHAT:** Clogged, overloaded grease and grit traps and improperly operating oil/water separators may result in contaminated runoff entering the City's MS4, encouraging the growth of bacteria with the underground stormwater sewers. There is a need to review the standards for oil, grease, and grit traps in City's current Technical Construction Codes to verify they have adopted the best available technology, and to adopt new standards for new and existing commercial properties.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Within 10 years, reduce or eliminate introduction of wastewater contributed by undersized or malfunctioning grease interceptors and /or oil-water separators into the MS4 from commercial properties within the drainage basins that discharge within the TMDL area.

•**WHEN:** Undertake and complete review of City's Technical Construction Codes, intended for adoption and amendment during the next technical construction codes update process.

•**HOW:** Review the standards for grease interceptors and /or oil-water separators in City's current Technical Construction Codes to verify they have adopted the best available technology, and adopt new standards for new and existing commercial properties. Existing installations should not be grandfathered, if they fail to meet the current pre-treatment requirements, they should be afforded the opportunity to come into compliance with new requirements after a reasonable amortization period.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined Adopt by ordinance the necessary regulatory fees, to be charged to the

customer for costs of inspections, to identify needed repairs, and grease trap, grit trap, and oil/water separator replacements, at rates designed to cover the total costs to the City to administer the inspection program. The City could also explore funding/tax abatement/incentives programs to assist the City with any program cost overruns.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi

•**ACTIONS AND SCHEDULE:**

Table 35. MM 6.4 Improved Grease Trap Standards. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Continue Grease Trap, Grit Trap, and Oil/Water Separator Inspection Program | x | | |
| Undertake and Complete Review of City's Technical Construction Code Provisions Related to Grease Traps, Grit Traps, and Oil/Water Separators. | x | | |

Management Measure 6.5: Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes

•**WHAT:** Develop and present for adoption code amendments to strengthen current ordinances that require pet owners to remove and properly dispose of pet wastes, such as the "pooper scooper" requirements and the requirement to remove waste that has accumulated on the ground from animals that are harbored on the property (premises). This should also apply to free range chickens and livestock that are not related to a commercial agriculture operation. Ordinance amendments would include, at a minimum, new enforcement measures, stricter fines, and enhancements to improve enforceability.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce amount of pet wastes running off of private property and into the City's MS4.

•**WHEN:** Adopt amendments to the animal control ordinances within two years.

•**HOW:** City staff should review animal control ordinances adopted in other communities, draft appropriate proposed amendments to the Code of Ordinances, submit the proposal to the City's Animal Control Board for review and recommendation, and refer to City Council for adoption. Amendments should provide for enhanced

enforcement capabilities, fines or increased fines, and consider fees and other consequences for violating the law.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees, to be charged to the violator for code enforcement costs, at rates designed to cover the total costs to the City to administer the program

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•**ACTIONS AND SCHEDULE:**

Table 36. MM 6.5. Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Review Animal Control Ordinances Adopted in Other Communities and Draft Appropriate Amendments to City's Animal Control Ordinances | x | | |

Management Measure 6.6: Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals

•**WHAT:** Consider adoption of measures to control feral cats, rodents, and nuisance animals, such as possums, that property owners allow to take up residence on their property.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce amount of animal wastes running off of public and private property and into the City's MS4.

•**WHEN:** Adopt amendments to the animal control ordinances within two years.

•**HOW:** City staff should review animal control ordinances adopted in other communities, draft appropriate proposed amendments to the Code of Ordinances, submit the proposal to the City's Animal Control Board for review and recommendation, and refer to City Council for adoption. The City's police department, as well as code compliance department, ought to be engaged in animal waste control enforcement. Officers on bicycles are optimal contacts to warn the public of pet waste obligations. Police department engagement will require a policy shift. Amendments should provide

for enhanced enforcement capabilities, fines or increased fines, and consider administration fees and other consequences for violating the law.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees, to be charged to the customer for costs of any inspections and code enforcement costs, at rates designed to cover the total costs to the City to administer the program.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi

•**ACTIONS AND SCHEDULE:**

Table 37. MM 6.6. Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Review Animal Control Ordinances Adopted in Other Communities, and Present for Adoption Appropriate Amendments to the Code of Ordinances | x | | |

Management Measure 6.7: Install Additional Signage

•**WHAT:** Install appropriate signage to warn the public of potential public health risks associated with contact recreation in bay waters when bacteria levels exceed state water quality standards for contact recreation, which normally occur during and immediately following heavy rain events.

•**WHO:** City of Corpus Christi

•**WHERE:** At access points in City parks and public areas, adjacent to the TMDL study area; which are used to access bay waters for contact recreation.

•**GOAL:** Until such time as engineering solutions to the elevated bacteria levels in the bay at Cole and Ropes Parks are implemented, reduce public health risks associated with contact recreational use of bay waters adjacent to City stormwater outfalls, which have elevated bacteria levels during and immediately following heavy rain events.

•**WHEN:** Within two years of adoption of the plan.

•**HOW:** In the interest of the economy, install permanent signage, which may or may not be related to the Texas General Land Office Beach Watch Program, which advises public of general risk of using bay waters for contact recreation during and immediately after heavy rain events.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•**ACTIONS AND SCHEDULE:**

Table 38. MM 6.7. Install Additional Signage. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|-----------------------------|---|--------|--------|
| Install Additional Signage. | x Within one year of adoption of this plan | | |

Management Measure 6.8: Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall

•**WHAT:** Prepare and present to Council for adoption the ordinances that would devise an advisement protocol to warn the public of periodically elevated bacteria levels, as anticipated by weather forecasts for rain, as well as warnings during and immediately after rainfall, and an advisement protocol to notify the public when elevated bacteria levels are assumed to have fallen to permissible levels.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Until such time as implementation of an engineering solution to the bacterial contamination created in the “first flush” of a heavy rainfall event, reduce public health risks associated with contact recreational use of bay waters adjacent to City stormwater outfalls, which have elevated bacteria levels during and immediately following heavy rain events.

•**WHEN:** Within one year of adoption of the plan.

•**HOW:** By adoption of an ordinance, establish the standards for issuing general and specific public health safety advisories on the contact recreational use of subject bay waters when bacteria levels exceed contact recreation water quality standards.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi.

•**ACTIONS AND SCHEDULE:**

Table 39. MM 6.8. Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings and Immediately After Rainfall. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--|--------|--------|
| Prepare and Present to Council for Adoption Ordinances Setting Standards for Issuing General and Specific Public Health Safety Advisories on the Contact Recreational Use of Bay Waters with Bacterial Contamination Following Major Rain Events | x Prepare ordinance within one year of adoption of implementation plan and obtaining support of affected stakeholders | | |

Management Measure 6.9: *Restrict Access to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks*

•**WHAT:** Prepare and present to Council for adoption an ordinance that authorizes the City Manager to close or deny contact access to recreational waters from City parks and public spaces during periods when there is a risk to public health from elevated bacteria levels in the bay. This ordinance proposal will be held in active abeyance during the first implementation cycle of the I-Plan. During this abeyance period, recognized stakeholder work groups, Ordinances/Regulations; Education/Outreach; and Monitoring/Research, will meet to create specific language or elements for a proposed ordinance to direct closure or direct advisories pertaining to the subject beaches during periods of risk to the public health or safety. The goal of the ordinance will be to regulate or manage beach access during periods of risk to public health or safety. The work groups will explore conditions and progress made under the I-Plan that may affect the efficacy and appropriateness of a beach access ordinance. Elements for work group consideration, include, but are not limited to, creation of an exempted class of recreational user; the use/non-use of the City's police powers in managing access; potential for penalties and non-penal approaches to enforcement; education and outreach in lieu of enforcement or to supplement enforcement; progress or new approaches to testing and evaluation; and

any legal and scientific avenues appropriate to managing access to affected beaches for benefit of the public health and safety. The participating work groups will, at their discretion, as individual groups or a consolidated work group, vote a proposed ordinance draft, or the elements of such, to the CARP committee for further action, which committee may incorporate the ordinance draft or its elements as an adjunct to the current I-Plan at any time the CARP committee may deem appropriate to accept or decline the proposal. The ordinance will include language to **exempt activities of organized and individual windsurf/sailboard/kiteboard users, that rely upon the launch site at Oleander Point within Cole Park, predicated upon informed assumption of risk for this class of recreation user.**

•**WHO:** City of Corpus Christi.

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Until such time as an implemented engineering solution to the elevated bacteria levels in the bay waters adjacent to Cole and Ropes Park, reduce public health risks associated with contact recreational use of bay waters adjacent to City stormwater outfalls, which have excessive bacteria levels during and immediately following heavy rain events.

•**WHEN:** Within two years of adoption of the plan.

•**HOW:** Adopt ordinance to authorize the City Manager to close or deny access to bay waters for contact recreation from City parks and public spaces during periods when there is a significant public health risk associated with the use of the subject bay area for recreational contact when bay waters exceed state water quality standards for contact recreation, which normally occur during and immediately following heavy rain events. Closure or denial of access would be accomplished by posting appropriate signage and installing barriers on physical access points, such as steps or pathways.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws, as applicable.

•ACTIONS AND SCHEDULE:

Table 40. MM 6.9. Restrict Access to Bay Waters from City Parks and Other Bay Front City Properties During Periods of Significant Public Health Risks. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|---|--------|--------|
| Adopt Ordinance Authorizing City Manager to Restrict Access to Targeted Bay Waters for Contact Recreation When There is a Significant Public Health Risk. | x Propose ordinance within two years of adoption of I-Plan and based on stakeholder input. | | |

Management Measure 6.10: Adopt and Enforce Additional Ordinances

•**WHAT:** Solid waste, especially litter that contains or was associated with food and beverages, that gets into the City's MS4, can contribute to the growth of bacteria within the stormwater system. While the City currently has some ordinances to address litter at food establishments, the current ordinances do not provide adequate requirement related to the number and maintenance of outdoor trash receptacles in commercial parking lots and public access areas to allow the public to properly dispose of waste that has been generated as a result of the commercial activities on the property. Responsible landlords and commercial owners, who invest in clean premises costs, are at a competitive disadvantage against operators who ignore cleanliness to enjoy higher profit margins. New and amended ordinances should provide:

a. More Receptacles. Increase the required number of waste receptacles on commercial properties and public areas.

b. More Commercial Waste Service. Enhance a commercial owner's maintenance obligations to service waste receptacles and clear parking lots of loose debris, particularly, discarded used diapers and animal carcasses, with special attention to dead birds and discarded food that attracts birds and bird feces.

c. Dumpsters. Enhanced ordinance obligations requiring contractors who provide dumpsters to keep dumpster areas free of deleterious materials and leakage. (Generally, sanitation obligations pertaining to dumpsters are not being observed. More enforcement is needed).

d. Plastic. Support the current efforts to reduce plastic bag usage.

e. Relief from Fugitive Waste on City Service Routes. Updated and enforceable secondary containment requirements for both automated and manual routes, which secondary requirements are already in Chapter 21, Garbage, Trash, and Other Refuse, but lack standards for required plastic and paper container bags, and which regulations are further without enforcement capability for lack of statement of offense. Enforcement of secondary containment puts the citizen customer where he or she ought to be, in a responsible position to assist the City in controlling fugitive wastes.

•**WHO:** City of Corpus Christi.

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce volume of solid wastes that runoff or blow into the MS4 from commercial properties.

•**WHEN:** Within two years of adoption of the implementation plan.

•**HOW:** City staff should review litter and property maintenance ordinances adopted in other communities, draft appropriate proposed amendments to the Code of Ordinances, submit the proposal to the City Council for adoption.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees, to be charged to the customer for costs of any inspections and code enforcement costs, at rates designed to cover the total costs to the City to administer the program.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi's Charter, the Texas State Constitution, and other state, local and federal laws.

•**ACTIONS AND SCHEDULE:**

Table 41. MM 6.10. Adopt and Enforce Additional Ordinances. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|-------------------------------|--|--------|--------|
| Adopt Appropriate Ordinances. | X Throughout the life of the I-Plan | | |

Management Measure 6.11: Explore Adoption of Additional "Low Impact Development" Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff From Areas of New Development or Significant Redevelopment

•**WHAT:** Review "low impact development" standards adopted by other communities that will reduce volumes of stormwater runoff from areas of new development or significant redevelopment.

•**WHO:** City of Corpus Christi.

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce the volume of runoff generated from areas of new development or significant redevelopment.

•**WHEN:** Target adoption of amendments to the Unified Development Code (UDC) within three calendar years.

•**HOW:** Establish a special advisory committee to study issues and make recommendations to the Planning Commission and City Council. Committee should have broad public membership, and should include developers, residential and commercial builders, consulting engineers, neighborhood homeowner association representatives, and environmental interest.

•**COSTS/SOURCE OF FUNDS:** Costs to the City of Corpus Christi are to be determined.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi.

•**ACTIONS AND SCHEDULE:**

Table 42. MM 6.11. Explore Adoption of Additional "Low Impact Development" Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff From Areas of New Development or Significant Redevelopment. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--|--------|--------|
| Establish Special Advisory Committee | x within three years | | |
| Amend UDC to Encourage "Low Impact" Development. | x throughout the life of the I-Plan | x | x |

Table 43. Summary of Management Measure: Ordinance and Regulation

Management Measure: *Ordinance and Regulation*

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|---|---|----------------------------|--|---|--|------------------------|
| Ordinance and Regulation | | | | | | | | |
| 6.1) Residential Leaking/Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program | TBD | TBD | Public will be educated on sewer lateral inspection/testing program | Tier 1. | <p>Complete review of current technical construction codes and adopt necessary amendments during next code revision process.</p> <p>Take appropriate enforcement action, if property owners do not make necessary repairs to private sewer lines.</p> <p>Determine # of broken/leaking private sewer lines identified vs. # of broken/leaking private sewer lines corrected.</p> | <p>Prepare and present to Council ordinances necessary to establish an enhanced, targeted inspection program of private sewer lines within the drainage basins contributing flows to the TMDL program area to test private sewer lines to make sure they do not have leaks or broken sewer lines</p> <p>Prepare and present to Council for adoption the ordinances that would update City's technical construction codes to address illegal cross connections</p> | Determine number of illegal cross-connections identified vs. number of illegal cross-connections corrected | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|---------------------------------|--|--|-----------------------------------|--|--|---|---------------------------|
| 6.2) Commercial Cross-connection Inspection Program | TBD | TBD | Educated public on Cross-connection Inspection Program | Tier 1. | <p>Establish an enhanced, targeted inspection program within the drainage basins contributing flows to the TMDL program area to locate unauthorized cross-connections on private property, which may include smoke testing wastewater collection lines and stormwater lines.</p> <p>Update City's technical construction codes to address illegal cross-connections.</p> | <p>Complete ordinance review and amendment adoption process</p> <p>Complete inspection of target drainage basins within 10 years</p> <p>Complete review of current technical construction codes and adopt any necessary amendments during the next code revision process.</p> <p>Take appropriate enforcement action, if property owners do not make necessary repairs to private sewer lines.</p> | Determine number of illegal cross-connections identified vs. number of illegal cross-connections corrected. | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|---------------------------------|--|---|-----------------------------------|--|---|---|---------------------------|
| 6.3) Commercial Leaking/ Broken Private Sewer Laterals Pilot Inspection/ Testing Program | TBD | TBD | Educate public on Sewer Lateral Inspection Program | Tier 1. | <p>Establish an enhanced, targeted pilot inspection program of private sewer lines within the drainage basins contributing flows to the TMDL program area to test private sewer lines to make sure they do not have any leaks or broken sewer lines.</p> <p>Update City's technical construction codes to address illegal cross-connections.</p> | <p>Complete ordinance review and amendment adoption process within two years of adoption of this implementation plan.</p> <p>Complete review of current technical construction codes and adopt any necessary amendments during the next code revision process.</p> <p>Take appropriate enforcement action, if property owners do not make necessary repairs to private sewer lines.</p> | Determine number of broken/leaking private sewer lines identified vs. number of broken/leaking private sewer lines corrected. | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|-------------------------------------|---------------------------------|--|--|-----------------------------------|--|--|---|---------------------------|
| 6.4) Improved Grease Trap Standards | TBD | TBD | Notify Public of new Grease Trap Standards | Tier 1. | <p>Continue and Improve grease trap, grit trap, and oil/water separator inspection program.</p> <p>Undertake and complete review of City's Technical Construction Code provisions related to grease traps, grit traps, and oil/water separators.</p> | <p>Implement inspection program within two years of adoption of the implementation plan.</p> <p>Adopt any necessary changes during the next technical construction codes update process.</p> <p>Take appropriate enforcement action, if property owners do not replace or make necessary repairs to improperly operating grease traps, grit traps, and oil/water separators.</p> | Determine number of grease traps, grit traps, and oil/water separators that do not operate at appropriate levels vs. number of grease traps, grit traps, and oil/water separators repaired or replaced. | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|---------------------------------|--|---|-----------------------------------|---|--|--|---------------------------|
| 6.5) Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes | TBD | TBD | Educate public on new animal control ordinances | Tier 1. | Review animal control ordinances adopted in other communities and draft appropriate amendments to City's animal control ordinances. Evaluate number of complaints investigated | Complete ordinance review and amendment adoption process within two years of adoption of this implementation plan. | Number of complaints investigated. Number of enforcement actions taken (includes issuance of warnings, notices of violation, and citations). | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|---------------------------------|--|---|-----------------------------------|--|---|---|---------------------------|
| 6.6) Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals | TBD | TBD | Educate public on measures they could help control feral cats, rodents, and nuisance animals. | Tier 1. | Review animal control ordinances adopted in other communities, and present for adoption appropriate amendments to the Code of Ordinances. Make pet waste enforcement a policy priority, or at least a function, within the City's police department, not limited to code compliance department. | Complete ordinance review and amendment adoption process within two years of adoption of this implementation plan. Complete policy change within one year of adoption of I-Plan. | Number of complaints investigated. Number of enforcement actions taken (includes issuance of warnings, notices of violation, and citations). | City of Corpus Christi |
| 6.7) Install Additional Signage | TBD | TBD | Educate via signage | Tier 1. | Install additional signage. | Signs are installed | Maintain signage | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|---|---------------------------------|--|---|-----------------------------------|--|---|--|---------------------------|
| 6.8) Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall | TBD | TBD | Public health safety advisories are issued as directed in the ordinance. | Tier 1. | Ordinances adopted within one year of adoption of I-Plan | Prepare and present to Council for adoption ordinances setting standards for issuing general and specific public health safety advisories on the contact recreational use of bay waters with bacterial contamination following major rain events. | Evaluate how many public health safety advisories were issued as directed in the ordinance(s). | City of Corpus Christi |
| 6.9) Restrict Access to Bay Waters from City Parks and Other Bayfront City Properties During Periods of Public Health Risks | TBD | TBD | Notify public of new beach/water restrictions when bacteria levels are or can be a health risk. | Tier 1 | Adopted within one year of adoption of I-Plan | Number of Restrictions advised. | Evaluate how many public health safety advisories/res trictions were issued. | City of Corpus Christi |
| 6.10) Adopt and Enforce Additional Ordinances | TBD | TBD | Notify public of new ordinances. | Tier 1. | Propose ordinances for adoption within 2 years of adoption of implementation plan. | Adopt appropriate ordinances. | Evaluate the effectiveness of appropriate ordinances that have been adopted. | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|---------------------------------|--|--|-----------------------------------|--|--|--|---------------------------|
| 6.11) Explore Adoption of Additional “Low Impact Development” Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff From Areas of New Development or Significant Redevelopment | TBD | TBD | Educate public of LID standards in unified development code. | Tier 1. | Adopt necessary ordinances within 3 years of adoption of this implementation plan. | Amend UDC to encourage "low impact" development. | Evaluate the effectiveness of new developments utilizing LIDs. | City of Corpus Christi |

Control Actions 1.0: Wastewater Collection Systems

Sanitary sewers can fail to function properly due to blockages, line breaks, defects that allow stormwater and groundwater to overload the system, lapses in operation and maintenance, inadequate design and construction, power failures, deferred replacement, and vandalism. The EPA has concluded that sanitary sewer overflows (SSOs) contribute to bacteria loading in almost all impaired streams, but may or may not be a primary source of loading. EPA acknowledges that SSO data is difficult to assess.

In general, implementation actions consist of encouraging improvements to sanitary sewers through hydraulic modeling and completing an inflow and infiltration study; reducing the amount of fats, oils, and grease entering the system; continuing sanitary sewer line cleaning; and reporting of SSOs to the TCEQ. These reports are public information and are available from the TCEQ.

Control Action 1.1: Continue Existing Fats, Oil & Grease (FOG) Program

Fats, oil, and grease (FOG) are considered to be a leading cause of blockages in sanitary sewers, and the EPA estimates that blockages account for nearly 50 percent of all SSOs nationwide. This Control Action enables the City of Corpus Christi to determine the proper size and design for grease interceptors, to inspect traps regularly, and to require grease interceptors be effectively maintained by businesses.

•**WHAT:** Almost all of the City's Food Service Establishments (FSE) are required to have a grease interceptor and this is initially enforced by Development Services through the building permit process. Thereafter, FSEs are inspected annually by the City's Pretreatment staff. Inspections include reviewing manifests for grease interceptor cleaning frequency and analyzing Hexane Extractable Material (HEM) levels, which cannot exceed 200 mg/l. The hexane solvent methodology is used to measure total oils and grease. A Notice of Violation is sent to FSEs where exceedances are observed, with a requirement to increase the interceptor cleaning frequency. Continued exceedances may result in a requirement for a larger or more effective interceptor. In addition to notices in utility bills, residents are advised to avoid putting grease in the drains at the annual World of Water event at the Corpus Christi Museum of Science and History. The City provides fat trapper containers and bags at no charge to attendees.

•**WHO:** City of Corpus Christi Public Utilities, Corpus Christi- Nueces County Health Department, Food Service Establishments (FSE Program).

•**WHERE:** All FSEs in the Cole and Ropes Parks contributing drainage areas.

•**GOAL:** Reduce or eliminate SSOs resulting from blockages caused by FOG through monitoring and enforcement of the City's ordinances prohibiting grease input into the wastewater collection system

•**WHEN:** Implementation beginning in Tier 1 and continuing.

•**HOW:** Through continuing efforts in the City's FOG program.

•**COSTS/SOURCE OF FUNDS:** Approximately \$400,000 annually, in the range of Public Utilities operating budget.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi Public Utilities Department

•**ACTIONS AND SCHEDULE:**

Table 44. CA 1.1. Continue existing Fats, Oil & Grease (FOG) program. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|--------|--------|--------|
| Food Service HEM Monitoring | x | x | x |
| Food Service Grease Interceptor Maintenance Enforcement. | x | x | x |

Control Action 1.2: Continue Monitoring Sanitary Sewer Overflows (SSOs)

•**WHAT:** Sanitary Sewer Overflows are accurately reported by the City's Public Utilities Department to the TCEQ. It is City policy that all reported overflows are repaired or addressed. The intent of this Control Action is to continue the SSO reporting by the City of Corpus Christi.

•**WHO:** The City of Corpus Christi Public Utilities Department

•**WHERE:** The main priority area will be within the Cole and Ropes Park drainage basin and include Brawner Parkway drainage basin.

•**GOAL:** Continue reporting SSOs.

•**WHEN:** Implementation beginning in Tier 1 and continuing.

•**HOW:** Continue reporting SSOs as is currently being done to date.

•**COSTS/SOURCE OF FUNDS:** The costs associated with SSO reporting to the TCEQ by the City are included in the Public Utilities Department's annual operating budget.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution; TCEQ implementation of federally delegated Texas Pollutant Disposal Elimination System permitting authority under Texas Clean Water Act; USEPA, National Pollutant Disposal Elimination System program, implementing the federal Clean Water Act.

•**ACTIONS AND SCHEDULE:**

Table 45. CA 1.2. Continue Monitoring Sanitary Sewer Overflows (SSOs). Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|------------------------|--------|--------|--------|
| Continue SSO reporting | x | x | x |

Control Action 1.3: Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation

The City of Corpus Christi has an on-going program of cleaning and televised inspecting its wastewater collection system. This is part of the Wastewater Department's maintenance and operation plan for improved performance. Through cleaning and televising, the City can optimize repairs/rehabilitation efforts to meet TCEQ permit requirements.

•**WHAT:** Maintenance of lines is a Public Utilities Department function to assure improved performance to its 83,000 customers who depend on this service every day.

•**WHO:** The Public Utilities Department, along with competitively bid contracts, provides the forces to maintain the City's collection system.

•**WHERE:** Annually, the Public Utilities Department assesses all areas of the City to determine need for improved maintenance and repairs. Areas needing replacement are placed on the Capital Improvements Program (CIP) plan for bid solicitation. Also, database reviews occur to resolve problematic areas in the system.

•**GOAL:** Prevent overflows and increase system capacity.

•**WHEN:** Implementation beginning in Tier 1 and continuing.

•**HOW:** Generally, through cleaning and closed circuit televising (CCTV), smoke detection surveys, and customer complaints of affected areas, resolution of problems and improvements of the systems are accomplished.

•**COSTS/SOURCE OF FUNDS:** The Public Utilities Department.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution.

•**ACTIONS AND SCHEDULE:**

Table 46. CA 1.3. Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|--------|--------|--------|
| Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation | x | x | x |

Table 47. Summary of Control Action Wastewater Collection Systems**Control Action:** *Wastewater Collection Systems*

| Control Action | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|--|--|----------------------------------|--|--|---|---|
| Wastewater Collection Systems | | | | | | | | |
| 1.1.) Continue Existing Fats, Oil & Grease (FOG) Program | TBD | City of Corpus Christi Public Utilities operating budget | Continue generator education directed to permittees and domestics. | Tier 1. Continue current program | Decreased FOG associated with overflows | Food Service Grease Interceptor Maintenance Enforcement. | Continue to monitor FSE's. Food Service HEM Monitoring. | Code of Ordinances of the City of Corpus Christi Ordinances |
| 1.2) Continue Monitoring Sanitary Sewer Overflows (SSOs) | TBD | City of Corpus Christi Public Utilities operating budget | Educate public on how they can help reduce SSOs. | Tier 1- ongoing | TCEQ compliance. Public notification for public health and safety | Report SSOs to TCEQ | Evaluate the effectiveness of and continue public notification for public health and safety. TCEQ compliance | City of Corpus Christi |
| 1.3) Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | City of Corpus Christi Public Utilities operating budget | Educate public on collection system line cleaning, inspection, repair and rehabilitation program | Tier 1- ongoing | Prevent overflows and increase system capacity. | Reduced number of overflow events. | Continue monitoring and response. | City of Corpus Christi |

Control Actions 2.0: Stormwater Drainage System

Existing requirements of Municipal Separate Storm Sewer System (MS4) permits address some important elements of bacteria loading in stormwater, offering an adaptive rather than prescriptive approach to bacteria reduction. Structural Best Management Practices (BMPs), such as modifications to stormwater infrastructure that may reduce bacteria through aeration, treatment by sunlight, or physical removal of contaminants, have the potential to reduce bacteria loading into waterways. However, there is limited data regarding how well such BMPs (i.e. green infrastructure) might reduce bacteria loading. Therefore, the CARP Committee has identified the evaluation of the effectiveness of green infrastructure as one of its priorities.

Control Action 2.1: Continue Existing Stormwater Programs

The City of Corpus Christi is permitted to discharge stormwater runoff by a Texas Pollutant Discharge Elimination System (TPDES) Phase I Municipal Separate Storm Sewer (MS4) Permit. To comply with this permit, the City employs extensive stormwater pollution prevention programs, as well as land development programs, some of which address bacteria sources identified in this I-Plan. These programs shall be continued and modified as deemed appropriate by the City. Examples of current programs are provided at <http://www.ccparkandrec.com/government/storm-water/index>.

•**WHAT:** Continuation of existing Stormwater Management Programs throughout the City will ensure the introduction of pollutants into the MS4 is minimized to the maximum extent practicable.

•**WHO:** The City of Corpus Christi

•**WHERE:** Cole and Ropes Parks drainage basins.

•**GOAL:** Continue existing TPDES Permit Programs to reduce introduction of pollutants into the MS4.

•**WHEN:** Continue the efforts of implementing TPDES Permit Programs.

•**HOW:** Utilize adaptive management techniques to adjust and modify changes to existing programs.

•**COSTS/SOURCE OF FUNDS:** Public Utilities Department operating budget; some programs by other City departments, included in their respective operating budgets.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, TCEQ, EPA

•ACTIONS AND SCHEDULE:

Table 48. CA 2.1. Continue Existing Stormwater Programs. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---------------------------------------|--------|--------|--------|
| Continue Existing Stormwater Programs | x | x | x |

Control Action 2.2: Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation

The City of Corpus Christi employs preventive maintenance of drainage lines as stormwater best management practice to avoid or mitigate clogging of lines to ensure operational effectiveness. On a periodic basis, as well as an on-going basis, the City employs two vacuum crews to inspect and service inlets, manholes, lateral lines and main lines on a planned and emergency schedule. Each of the 18,000+ inlets in the inventory is scheduled for servicing at least once every three years; some areas, based on condition, are serviced more frequently. For example, inlets in the downtown and uptown areas are serviced on a quarterly basis. Additionally, inlets within a special events footprint, i.e., Buccaneer Days, are cleaned as soon as practical after the conclusion of the event. This inlet, manhole, and line servicing program, coupled with earthen and concrete-lined drainage channels cleaning, prevents flooding, maintains drainage system reliability, improves performance, as well as minimizes the discharge of debris and other pollutants into the receiving waters.

•**WHAT:** Inlet cleaning, manhole, lateral line, and main line cleaning; and open-channel maintenance

•**WHO:** The Public Utilities Department employs force account and contract to maintain the City's stormwater drainage infrastructure.

•**WHERE:** The department routinely performs condition assessments of the drainage infrastructure. Deficiencies, noted by the condition assessments and repeated systems failures, but whose replacement/repair scope is outside Operations and Maintenance funding ability, are placed on the Capital Improvements Program (CIP) list to compete for Capital funding.

•**GOAL:** Maintain drainage system capacity and minimize the introduction of pollutants into the drainage system

•**WHEN:** Continuously

•**HOW:** Through vacuum truck operations, lateral line cleaning, channel grading and debris removal

•**COSTS/SOURCE OF FUNDS:** The Department currently operates two (2) vacuum trucks for cleaning inlets, manholes, lateral lines, and main lines.

•**RESPONSIBLE ORGANIZATION(S):** City of Corpus Christi, a Municipal Corporation with Home Rule Authority to act in all ways not specifically prohibited by the State of Texas and State Constitution; TCEQ implementation of federally delegated Texas Pollutant Disposal Elimination System permitting authority under Texas Clean Water Act; USEPA, National Pollutant Disposal Elimination System program, implementing the federal Clean Water Act.

•**ACTIONS AND SCHEDULE:**

Table 49. CA 2.2. Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|---|---------------|---------------|---------------|
| Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation | x | x | x |

Table 50. Summary of Control Action: Stormwater Drainage System]

Control Action: Stormwater Drainage System

| Control Action | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|--|---|----------------------------|--|--|--|------------------------|
| Stormwater Drainage System | | | | | | | | |
| 2.1) Continue Existing Stormwater Programs | TBD | City of Corpus Christi Public Utilities Department | Educate public on the City's stormwater programs | Tier 1- ongoing. | City of Corpus Christi's Stormwater Programs are continued. Once programs are evaluated by TCEQ, implement recommendation(s) given by the TCEQ. | Continue existing TPDES Permit Programs to reduce introduction of pollutants into the MS4. | City stormwater programs are evaluated annually by TCEQ through the MS4 permitting process | City of Corpus Christi |
| 2.2) Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | City of Corpus Christi Public Utilities Department | Educate public on drainage system line cleaning, inspection, repair and rehabilitation program. | Tier 1- ongoing | Improved flow capacity and minimize introduction of pollutants | Maintain funding for line cleaning | Monitor, inspect, and repair | City of Corpus Christi |

Control Actions 3.0: Ordinance and Regulation

Source tracking should be the FIRST implementation activity before any other engineering solutions, etc. to determine how to order/prioritize further activities.

Control Action 3.1: Eliminate Residential Cross-Connections

•**WHAT:** Conduct a pilot project to determine if residential properties (including duplexes, townhouses, and similar small multi-family residential units under individual ownership with common areas) are sources of wastewater and other wastes materials that result in the introduction of bacteria into the City's MS4 (Municipal Separate Stormwater Sewer System, e.g., the stormwater sewer lines, drainage ditches, and street curbs and gutters). A primary concern involves illegal cross-connections between the private stormwater and wastewater sewer lines on the property that allow wastewater to infiltrate into the MS4. If the pilot project determines there is a cross-connection problem with residential homes the project should expand to other basins.

•**WHO:** City of Corpus Christi

•**WHERE:** Within drainage basins that discharge into the TMDL study area, and any immediately adjoining drainage basins.

•**GOAL:** Reduce or eliminate all illegal cross-connections within the drainage basins that discharge within the TMDL within 10 years.

•**WHEN:** Develop, adopt and institute a targeted inspection program for wastewater and stormwater lines in the TMDL drainage basins in Tier 1. Undertake and complete review of City's Technical Construction Codes and Housing Standards Code, identifying all code sections relating to unpermitted work by homeowners. Identify which codes are intended for adoption or amendment during the next technical construction codes update process, and prepare and present for adoption ordinances required to update the code to meet these goals.

• **HOW:**

a. Illegal Cross-connection Inspection Program. Establish an enhanced, targeted inspection program, within the drainage basins contributing flows to the TMDL program area, to locate unauthorized cross-connections on private property to include smoke testing wastewater collection lines and stormwater lines. Problem appears to occur more frequently during repairs, replacement of underground piping, and homeowner repairs, rather than new installations subject to more rigid inspections.

b. Code Updates. Review the City's technical construction codes and housing standards codes, identifying all sections that pertain or relate to the issue of

cross-connections. Prepare and propose to Council any ordinances necessary to update the City's Technical Construction Codes and Housing Standards Code. Amendments should provide for enhanced enforcement capabilities, fines or increased fines, and consider fees and other consequences for violating the law.

c. Unpermitted Work. Review and identify all codes and criteria that allow a homeowner to do work on on-site underground piping systems without a plumbing permit. Determine how best to inform homeowners about plumbing work standards for both permitted and unpermitted work. Reconsider, if deemed appropriate, conditions under which unpermitted plumbing work is allowed.

•COSTS/SOURCE OF FUNDS: Costs to the City of Corpus Christi are to be determined. Adopt by ordinance the necessary regulatory fees to be charged to the customer for costs of inspections to determine needed repairs, and needed lateral replacements at rates designed to cover the total costs to the City to administer the program. The City should explore funding/tax abatement/incentives programs to assist the City with program cost overruns in addition to grant funding of inspections, needed repairs, and lateral replacements, especially for low income property owners. (Funding issues concerning unpermitted homeowner work could be resolved by the fee being charged through the City's plumbing inspections process.)

•RESPONSIBLE ORGANIZATION(S): City of Corpus Christi's Charter, the Texas State Constitution and other federal, state and local laws, as applicable.

•ACTIONS AND SCHEDULE:

Table 51. CA 3.1. Eliminate Residential Cross-connections. Implementation timeline schedule.

| Actions | Tier 1 | Tier 2 | Tier 3 |
|--|---------------|---------------|---------------|
| Conduct a Pilot Project to Determine if Residential Properties (Including Duplexes, Townhouses, and Similar Small Multi-Family Residential Units Under Individual Ownership with Common Areas) Are Sources of Wastewater and Other Wastes Materials that Result in the Introduction of Bacteria into the City's MS4 (Municipal Separate Stormwater Sewer System) | x | | |
| Establish an Illegal Cross-connection Inspection Program | x | x | x |
| Code Updates | | x | x |

Table 52. Summary of Control Action: Ordinance and Regulation

Control Action: *Ordinance and Regulation*

| Control Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|--|--------------------------|---|---|----------------------------|---|--|---|------------------------|
| Ordinance and Regulation | | | | | | | | |
| 3.1) Eliminate Residential Cross-Connections | TBD | TBD | Educate public on residential cross-connections | Tier 1. | <p>Conduct a pilot project to determine if residential properties (including duplexes, townhouses, and similar small multi-family residential units under individual ownership with common areas) are sources of wastewater and other wastes materials that result in the introduction of bacteria into the City's MS4.</p> <p>Establish an enhanced, targeted inspection program</p> | <p>Establish an enhanced, targeted inspection program within the CARP drainage basins.</p> <p>Prepare and present to Council for adoption the ordinances that would update City's technical construction codes to address illegal cross-connections and unpermitted plumbing work</p> <p>Illegal cross-connection inspection program established</p> | Determine number of illegal cross-connections identified vs. number of illegal cross-connections corrected. | City of Corpus Christi |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Control Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|------------------------|---------------------------------|--|----------------------------|-----------------------------------|---|-------------------------------|-----------------------------|---------------------------|
| | | | | | <p>within the drainage basins contributing flows to the TMDL program area to locate unauthorized cross-connections on private property, this may include smoke testing wastewater collection lines and stormwater lines in pilot or targeted areas</p> <p>Establish an illegal cross-connection inspection program</p> <p>Implement the enhanced, targeted program.</p> <p>Complete review of current technical</p> | Code updates | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Control Measure | Potential Load Reduction | Technical and Financial Assistance Needed | Education Component | Schedule of Implementation | Interim, Measurable Milestones | Indicators of Progress | Monitoring Component | Responsible Entity |
|------------------------|---------------------------------|--|----------------------------|-----------------------------------|--|-------------------------------|-----------------------------|---------------------------|
| | | | | | <p>construction codes.</p> <p>Take appropriate enforcement action if property owners do not make necessary repairs to private sewer lines.</p> | | | |

Sustainability

The TCEQ and stakeholders in TMDL implementation projects periodically assess the results of the planned activities, along with other information, to evaluate the effectiveness of the I-Plan. Stakeholders evaluate several factors, such as the pace of implementation, the effectiveness of BMPs, load reductions, and progress toward meeting water quality standards. The TCEQ will document the results of these evaluations and the rationale for maintaining or revising elements of the I-Plan.

The TCEQ and stakeholders will track progress using both implementation milestones and water quality indicators. These terms are defined as:

- **Water Quality Indicator** – A measure of water quality conditions for comparison to pre-existing conditions, constituent loadings, and water quality standards.
- **Implementation Milestones** – A measure of administrative actions undertaken to affect improvement in water quality.

Water Quality Indicators

The Texas General Land Office Texas Beach Watch Program will continue sampling for bacteria in water at Cole and Ropes Park during implementation. Additional funding will be sought to conduct supplemental monitoring in the watershed.

The indicators that will be used to measure improvement in water quality are improvements in bacteria levels at Cole and Ropes Park

Follow-up monitoring will be conducted within the watershed throughout the implementation schedule. The monitoring strategy will consider the spatial and temporal aspects necessary to characterize trends in water quality that result from implementing the activities in this plan. Follow-up monitoring through the Texas Beach Watch Program will also provide water quality data for evaluation of standards attainment. The monitoring program is expected to consist of routine sampling exercises that emphasize historical monitoring locations, with some potential modifications as needed. Water quality monitoring and data collection will occur routinely throughout the year. As stated in the TMDL report, the summer season represents the critical condition, during which time the study area has the highest levels of contact recreation. The TMDL and respective reductions are based on the critical condition.

CCS, with support from the TCEQ, began a three-year monitoring regime in May 2011. The objective of this monitoring was to provide data for characterizing *Enterococcus*

bacteria loads at the impaired beaches. The project goals required the collection of supplementary *Enterococcus* data in Corpus Christi Bay. Data collection specifically targeted beaches at Cole Park (Segment 2481CB_03), Ropes Park (Segment 2481CB_04), Emerald Beach (Segment 2481CB_07), McGee Beach (Segment 2481CB_05), Poenisch Park (Segment 2481CB_06), Corpus Christi Beach (Segment 2481CB_02), and University Beach (Segment 2481CB_08). Monitoring plan included routine bacteria sampling, rain event sampling, rainfall data collection, sediment cores, and beach use surveys.

(<https://www.tceq.texas.gov/waterquality/tmdl/97-corpusbeachesbacteria.html>)

The CCS was responsible for coordinating the monitoring activities for the TCEQ at these beaches. The data from these activities are included in the TCEQ's Surface Water Quality Monitoring database (SWQMIS), which houses the primary data used for the state's biennial assessment of water quality. The CCS collected water samples as described in the Quality Assurance Project Plan for the study area. The data was analyzed by CCS and the TCEQ.

The TCEQ will assess Cole and Ropes Parks beaches every two years as part of updating the Integrated Report. If the Texas Surface Water Quality Standards criteria for contact recreation are revised or water quality changes at these beaches are observed, this plan will be modified. This management strategy allows stakeholders to learn and adapt the plan as progress is made. The ultimate goal is for the AUs of both Cole and Ropes Parks beaches is to meet water quality standards for contact recreation. If sufficient reductions in *Enterococcus* are not observed, the stakeholders will reevaluate the potential sources identified in the TMDL and adapt the I-Plan as appropriate.

Implementation Milestones

Implementation tracking provides information that can be used to determine if progress is being made toward meeting goals of the TMDL. Tracking also allows stakeholders to evaluate actions taken, identify those which may not be working, and make any changes that may be necessary to get the plan back on target. Schedules of implementation activities and milestones for this I-Plan are included in Appendix A.

Communication Strategy

Communication is necessary to ensure stakeholders understand the I-Plan and its progress in restoring water quality conditions. The TCEQ will disseminate the information derived from tracking I-Plan activities to all interested parties, organizations, and individuals.

The TCEQ will report results and evaluations from implementation tracking to stakeholders as needed. The TMDL Program will summarize all actions taken to address the impairment and will report trends observed in the water quality data collected to

track the progress of implementation as needed. Responsible parties are committed to providing appropriate information to the TCEQ to update these progress assessments and communicating information at annual meetings.

In accordance with the Clean Water Act §319, the state must annually report to USEPA on success in achieving the goals and objectives of the *Texas Nonpoint Source Management Program*, including progress in implementing the NPS portion of TMDLs. The TCEQ and TSSWCB jointly publish *Managing Nonpoint Source Water Pollution in Texas: Annual Report*, which highlights the state's efforts during each fiscal year to collect data, assess water quality, implement projects that reduce or prevent NPS pollution, and educate and involve the public to improve the quality of water resources. Information derived from tracking and review activities of this I-Plan will be reported in each annual report. Previously published annual reports are available at www.tceq.texas.gov/waterquality/nonpoint-source/mgmt-plan/annual-reports.html.

The TCEQ will host annual meetings for up to five years so stakeholders may evaluate their progress. Stakeholders and responsible parties will continue to take part in annual meetings over the five-year period to evaluate implementation efforts. At the completion of the scheduled I-Plan activities, stakeholders will assemble and evaluate the actions, overall impacts, and results of their implementation efforts.

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Appendix A. I-Plan Matrix

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

Table A-1. CARP Watershed Monitoring and Assessment — Implementation Schedule and Tasks

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|---|--|------------------------|----------------------|-----------------------|
| 1. Education and Outreach | | | | |
| 1.1 General Awareness | Create and Utilize Public Education Materials | | | |
| | Create and Utilize Appropriate Public Service Announcements (PSA) | | | |
| | Conduct Public presentations | | | |
| 1.2 Leave It Better Than you Found It | Reinforce and Support "Leave It Better Than You Found It" Media Campaign | | | |
| | Increase support for TGLO Adopt-A-Beach. Create Adopt-A-Bay, Watershed, etc. | | | |
| | Engage local leaders to address City wide litter problem | | | |
| | Engage local businesses to support clean initiatives and post "Leave It Better Than You Found It" campaign signs | | | |
| 1.3 Pet Waste Disposal Awareness | Pet Waste Stations | | | |
| | Public Service Announcements (PSA) | | | |
| | Create info both for local events | | | |
| | Distribute educational materials and kits to pet businesses and services | | | |
| 1.4 Prevent Intentional Dumping and Disposal | Sponsor TIDRC workshop in Corpus Christi | | annually | |
| | Hunting and fishing organization education and outreach | | annually | |
| | Coordination with City Solid Waste Department | | quarterly | |
| 1.5 Slow the Flow (Low Impact Development) Initiative | Provide LID workshop for local designers and engineers | | | |
| | Promote benefits of LID through Social Media | | | |
| | Incorporate LID into other outreach presentations | | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|---|---|------------------------|----------------------|-----------------------|
| 2. Monitoring | | | | |
| 2.1 Continue Sampling <i>Enterococcus</i> Levels at Cole and Ropes Parks | Texas Beach Watch Sampling | | | |
| 2.2 Collect Rainfall Data Near Cole and Ropes Parks | Planning and implementation in smaller pilot project area | | | |
| | Data management and maintenance | | | |
| 2.3 Conduct Stormwater Outfall Flow Sampling | Planning and implementation in smaller pilot project area | | | |
| | Planning for entire Cole and Ropes Parks basin | | | |
| | Project implementation for entire Cole and Ropes Parks basins | | | |
| | Data management and maintenance | | | |
| | | | | |
| 3. Research | | | | |
| 3.1 Evaluate Methods to Remove Bacteria With Green Infrastructure | Initiate feasibility study | | | |
| | Develop recommendations | at completion of study | | |
| | | | | |
| 3.2 Bacterial Source Tracking | Sample collection; pre-rain event | FIRST PRIORITY | | |
| | Sample collection; post-rain event | FIRST PRIORITY | | |
| | | | | |
| 3.3 Evaluate the Effectiveness of Public Utilities Programs and Projects in Reducing Bacteria | Evaluate program and project effectiveness through monitoring | | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|--|---|------------------------|----------------------|-------------------------------|
| 3.4 Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303(d) List | Recommend change to data review methodology for regulatory purposes | | | |
| 3.5 Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes Parks by Use of Dye Testing | Planning and implementation of dye testing procedure | | | |
| 3.6 Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health | TX Beach Watch sampling day change | | | |
| 4. Wastewater Collection Systems | | | | |
| 4.1 Enhance Existing Fats, Oil & Grease (FOG) Program | Food service HEM monitoring | | | |
| | Food service grease interceptor maintenance enforcement | | | |
| 4.2 Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSOs). | Continue SSO reporting | | | |
| | Develop list-serve | | | |
| | Create notification system | | | |
| 4.3 Expand Collection System Line Cleaning, Inspection, Repair, and Rehabilitation | Customer response | | | on-going |
| | Review funding for line cleaning | | | through annual budget process |
| | Increase funding for smoke testing | | | through annual budget process |
| 4.4 Implement an Ongoing Inflow and Infiltration Study | Determine flow monitoring site locations | | | on-going |
| | Conduct flow monitoring | | | on-going |
| | Perform data collection and analysis | | | on-going |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|---|--|-----------------------------------|----------------------|-----------------------|
| | | | | |
| 4.5 Conduct Hydraulic Modeling of Collection System | Rank sub-basins | | | |
| | Prepare sanitary sewer evaluation survey | | | |
| | Complete I/I study report | | | |
| | Phase 1: Oso, Greenwood, and Broadway WWTP basins: conduct flow monitoring | | | |
| | Phase 1: Oso, Greenwood, and Broadway WWTP basins: data collection and analysis | | | |
| 5. Stormwater Drainage System | Ranking of sub-basins based on I/I | | | |
| | Contract complete | | | |
| | Development of prioritized system improvement program | | | |
| 5.1 Determine Effectiveness of Stormwater Retrofits to Remove Bacteria | Pilot project | | | |
| | Develop recommendations | at completion of study | | |
| 5.2 Continue Major Outfall Assessment and Repair Program as Funding Allows | Focused outfall assessment program within CARP drainage basins | | | |
| | Develop recommendations | at completion of assessment | | |
| 5.3 Support and Encourage Adoption of Stormwater Master Plan | Adopt stormwater master plan | | | |
| 6. Ordinance and Regulation | | | | |
| 6.1 Residential Leaking/Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program | Prepare and present for adoption ordinances necessary to establish pre-sale inspection program for private sewer lines within CARP drainage basins | during next code revision process | | |
| | Complete review of current technical construction codes | | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|---|---|------------------------------------|----------------------|-----------------------|
| | Prepare and present for adoption ordinances to update City's technical construction codes to address illegal cross-connections | during next code revision process | | |
| | Implement program | | | |
| | Determine number of broken/ leaking private sewer lines identified vs number of broken/ leaking private sewer lines corrected | | | |
| 6.2 Commercial Cross-Connection Inspection Program | Complete ordinance review and amendment adoption process | | | |
| | Complete review of current technical construction codes | | | |
| | Prepare and present for adoption ordinances necessary to establish an enhanced, targeted inspection program to locate unauthorized cross-connections for private sewer lines within CARP drainage basins which may include smoke testing wastewater collection lines and stormwater lines | during next code revision process | | |
| | Prepare and present for adoption ordinances to update City's technical construction codes to address illegal cross-connections | during next code revision process | | |
| | Complete inspection of target drainage basins | | | |
| | Determine number of illegal cross-connections identified vs number of illegal cross-connections corrected | | | |
| 6.3 Commercial Leaking/ Broken Sewer Laterals Pilot Inspection/ Testing Program | Complete ordinance review and amendment adoption process | within 2 years of I-Plan adoption | | |
| | Complete review of current technical construction codes | during next code revision process | | |
| | Evaluate adequacy of City's current certificate of occupancy program to address property infrastructure issues, especially upon change of ownership or tenants; consider adoption of City business permit system | To begin with program commencement | | |
| | Prepare and present for adoption ordinances necessary to establish an enhanced, targeted pilot program to inspect for leaks and broken private sewer lines within CARP drainage basins | within 2 years of I-Plan adoption | | |
| | Prepare and present for adoption ordinances to update City's technical construction codes to address illegal cross-connections | during next code revision process | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|--|---|---|----------------------|-----------------------|
| | | Evaluation will take place after study is complete | | |
| 6.4 Improved Grease Trap Standards | Determine number of broken/ leaking private sewer lines identified vs number of broken/ leaking private sewer lines corrected | | | |
| | Continue grease trap, grit trap, and oil/water separator inspection program | on-going | | |
| | Complete review of City's technical construction code provisions related to grease traps, grit traps, and oil/water separators | | | |
| | Prepare and present for adoption any necessary changes to the City's technical construction code provisions related to grease traps, grit traps, and oil/water separators | during next technical construction codes update process | | |
| | Determine number of grease traps, grit traps, and oil/water separators that do not operate at appropriate levels vs number of grease traps, grit traps, and oil/water separators repaired or replaced | to begin with program commencement | | |
| 6.5 Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Waste | Review animal control ordinances adopted in other communities | within 2 years of I-Plan adoption | | |
| | Prepare and present for adoption appropriate amendments to City's animal control ordinances | within 2 years of I-Plan adoption | | |
| | Evaluate number of complaints investigated, number of enforcement actions taken | to begin with program commencement | | |
| 6.6 Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals | Review animal control ordinances adopted in other communities | within 2 years of I-Plan adoption | | |
| | Prepare and present for adoption appropriate amendments to City's animal control ordinances | within 2 years of I-Plan adoption | | |
| | Make pet waste enforcement a policy priority, or at least a function, within the City's police department, not limited to code compliance department | within 1 year of I-Plan adoption | | |
| | Evaluate number of complaints investigated, number of enforcement actions taken | to begin with program commencement | | |
| 6.7 Install Additional Signage | Install additional signage | within 1 year of I-Plan adoption | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|---|---|---|----------------------|-----------------------|
| 6.8 Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall. | Prepare and present for adoption ordinances setting standards for issuing general and specific public health safety advisories on the contact recreational use of bay waters with bacterial contamination following major rain events | within 1 year of I-Plan adoption and obtaining support of affected stakeholders | | |
| 6.9 Restrict Access to Bay Waters from City Parks and Other Bay Front City Properties During Periods of Public Health Risk | Prepare and present for adoption an ordinance authorizing City Manager to restrict access to targeted bay waters for contacts recreation when there is a significant public health risk | within 1 year of I-Plan adoption based on stakeholder input | | |
| 6.10 Adopt and Enforce Additional Ordinances | Prepare and present for adoption ordinances related to solid waste that address: increased receptacles on commercial and public properties, more commercial waste service, dumpster maintenance and sanitation, reduced plastic bag usage, and fugitive waste on City service routes. | within 2 years of adoption of I-Plan | | |
| 6.11 Explore Adoption of Additional "Low Impact Development" Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff from Areas of New Development or Significant Redevelopment | Review LID standards adopted by other communities. | within 3 years of adoption of 1-Plan | | |
| | Prepare and present for adoption ordinances to amend City's Unified Development Code to encourage LID. | within 3 years of adoption of 1-Plan | | |
| Control Action | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
| 1. Wastewater Collection Systems | | | | |
| 1.1 Continue Existing Fats, Oil & Grease (FOG) program | Continue current Food Service Hexane Extractible Material (HEM) monitoring program | on-going | | |
| | Continue current Food Service Grease Interceptor maintenance enforcement | on-going | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|-------------------------------|--|---|--|----------------------|-----------------------|
| 1.2 | Continue Monitoring Sanitary Sewer Overflows (SSOs) | Continue SSO reporting to TCEQ | on-going | | |
| | | Report SSOs to interested and affected groups | | | |
| 1.3 | Continue Collection System Line Cleaning, Inspection, Repair, and Rehabilitation | Respond to affected areas identified by cleaning, closed circuit television inspection, smoke detection surveys, and customer complaints | on-going | | |
| | | Review funding for line cleaning | through annual budget process | | |
| | | Increase funding for smoke testing | through annual budget process | | |
| | | | | | |
| 2. Stormwater Drainage System | | | | | |
| 2.1 | Continue Existing Stormwater Programs | Continue TPDES MS4 Programs | on-going | | |
| 2.2 | Continue Drainage System Line Cleaning, Inspection, Repair, and Rehabilitation | Continue maintenance stormwater inlets, manholes, lateral lines, and main lines, as well as open-channel maintenance according to service schedule, special events, emergency response, and customer response | on-going | | |
| | | Maintain funding for line cleaning | through annual budget process | | |
| | | | | | |
| 3. Ordinance and Regulation | | | | | |
| 3.1 | Eliminate Residential Cross-Connections | Complete ordinance review and amendment adoption process | | | |
| | | Complete review of current technical construction codes | | | |
| | | Prepare and present for adoption ordinances necessary to establish an enhanced, targeted inspection program to locate unauthorized cross-connections for private sewer lines within CARP drainage basins which may include smoke testing wastewater collection lines and stormwater lines | | | |
| | | Prepare and present for adoption ordinances to update City's technical construction codes to address illegal cross-connections and unpermitted plumbing work | during next code revision process or within 2 years of I-Plan adoption | | |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Management Measure | Activity | Tier 1 1-5 years | Tier 2 5-10 years | Tier 3 10-15 years |
|--------------------|--|------------------------|----------------------|-----------------------|
| | Conduct a pilot project to determine if residential properties (including duplexes, townhouses, and similar small multi-family residential units under individual ownership with common areas) are sources of wastewater and other wastes materials that result in the introduction of bacteria into the City's MS4 (Municipal Separate Stormwater Sewer System) | | | |
| | Establish an enhanced, targeted inspection program within the drainage basins contributing flows to the TMDL program area to locate unauthorized cross-connections on private property, this may include smoke testing wastewater collection lines and stormwater lines in pilot or targeted areas | | | |
| | Implement targeted program within CARP basins | | | |
| | Complete inspection of target drainage basins | | | |
| | Determine number of illegal cross-connections identified vs number of illegal cross-connections corrected | | | |

Appendix B. Load Reduction Estimates

Load Reduction Estimates

Table B-1. CARP Watershed Load Reduction Estimates

| | | Cole Park | | Ropes Park | |
|-----------------------------|---|------------|----------------|------------|----------------|
| Measure/Action | Description | Targeted # | Load Reduction | Targeted # | Load Reduction |
| 1.0. Education and Outreach | | | | | |
| Management Measure 1.1 | General Awareness | TBD | TBD | TBD | TBD |
| Management Measure 1.2 | Leave It Better Than You Found It | TBD | TBD | TBD | TBD |
| Management Measure 1.3 | Pet Waste Disposal | TBD | TBD | TBD | TBD |
| Management Measure 1.4 | Prevent Intentional Dumping and Disposal | TBD | TBD | TBD | TBD |
| Management Measure 1.5 | Slow the Flow (Low Impact Development) Initiative | TBD | TBD | TBD | TBD |
| 2.0. Monitoring | | | | | |
| Management Measure 2.1 | Continuing Sampling Enterococcus Levels at Cole and Ropes Park | NA | NA | NA | NA |
| Management Measure 2.2 | Collect Rainfall Data Near Cole and Ropes Parks | NA | NA | NA | NA |
| Management Measure 2.3 | Conduct Stormwater Outfall Flow Sampling | NA | NA | NA | NA |
| 3.0 Research | | | | | |
| Management Measure 3.1 | Evaluate Methods to Remove Bacteria with Green Infrastructure | TBD | TBD | TBD | TBD |
| Management Measure 3.2 | Bacterial Source Tracking | TBD | TBD | TBD | TBD |
| Management Measure 3.3 | Evaluate the Effectiveness of Public Utility Programs and Projects in Bacteria Reductions | TBD | TBD | TBD | TBD |
| Management Measure 3.4 | Promote New Data Analysis Method for Regulatory Justification for Listing Beaches on the 303 (d) List | TBD | TBD | TBD | TBD |
| Management Measure 3.5 | Identify Water Flow Patterns in Corpus Christi Bay at Cole and Ropes | TBD | TBD | TBD | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Measure/Action | Description | Cole Park | | Ropes Park | |
|---|--|------------|----------------|------------|----------------|
| | | Targeted # | Load Reduction | Targeted # | Load Reduction |
| | Pars by the use of Dye Testing | | | | |
| Management Measure 3.6 | Change Sampling Date of Current Texas Beach Watch Program to be More Protective of Public Health | TBD | TBD | TBD | TBD |
| 4.0. Wastewater Collection Systems | | | | | |
| Management Measure 4.1 | Enhance Existing Fats, Oil & Grease (FOG) Program | TBD | TBD | TBD | TBD |
| Management Measure 4.2 | Continue the Notification System for Monitoring Sanitary Sewer Overflows (SSO's) | TBD | TBD | TBD | TBD |
| Management Measure 4.3 | Expand Collection System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | TBD | TBD | TBD |
| Management Measure 4.4 | Implement an Ongoing Inflow and Infiltration Study | TBD | TBD | TBD | TBD |
| Management Measure 4.5 | Conduct Hydraulic Modeling of Collection System | TBD | TBD | TBD | TBD |
| 5.0. Stormwater Drainage System | | | | | |
| Management Measure 5.1 | Determine Effectiveness of Stormwater Retrofits to Remove Bacteria | TBD | TBD | TBD | TBD |
| Management Measure 5.2 | Continue the Major Outfall Assessment and Repair Program as Funding Allows | TBD | TBD | TBD | TBD |
| Management Measure 5.3 | Support and Encourage the Adoption of Stormwater Master Plan | TBD | TBD | TBD | TBD |
| 6.0. Ordinances and Regulations | | | | | |
| Management Measure 6.1 | Residential Leaking/Broken Private Sewer Laterals Pre-Sale Inspection/Testing Program | TBD | TBD | TBD | TBD |
| Management Measure 6.2 | Commercial Cross-connection Inspection Program | TBD | TBD | TBD | TBD |
| Management Measure 6.3 | Commercial Leaking/Broken Sewer Laterals Pilot Inspection/Testing Program | TBD | TBD | TBD | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| Measure/Action | Description | Cole Park | | Ropes Park | |
|---|--|------------|----------------|------------|----------------|
| | | Targeted # | Load Reduction | Targeted # | Load Reduction |
| Management Measure 6.4 | Improved Grease Trap Standards | TBD | TBD | TBD | TBD |
| Management Measure 6.5 | Strengthen Current Animal Control Ordinances Relating to Removal and Disposal of Pet Wastes | TBD | TBD | TBD | TBD |
| Management Measure 6.6 | Implement Measures to Control Feral Cats, Rodents, and Nuisance Animals | TBD | TBD | TBD | TBD |
| Management Measure 6.7 | Install Additional Signage | TBD | TBD | TBD | TBD |
| Management Measure 6.8 | Develop Advisement Protocol to Warn the Public of Periodically Elevated Bacteria Levels, as Anticipated by Weather Forecasts for Rain, as well as Warnings During and Immediately After Rainfall | TBD | TBD | TBD | TBD |
| Management Measure 6.9 | Restrict Access to Bay Waters from City Parks and Other Bayfront City Properties during Periods of Public Health Risks | TBD | TBD | TBD | TBD |
| Management Measure 6.10 | Adopt and Enforce Additional Ordinances | TBD | TBD | TBD | TBD |
| Management Measure 6.11 | Explore Adoption of Additional “Low Impact Development” Standards in Unified Development Code that will Reduce Volumes of Stormwater Runoff from Areas of New Development or Significant Redevelopment | TBD | TBD | TBD | TBD |
| 1.0. Wastewater Collection Systems | | | | | |
| Control Action 1.1 | Continue Existing Fats, Oil & Grease (FOG) Program | TBD | TBD | TBD | TBD |
| Control Action 1.2 | Continue Monitoring Sanitary Sewer Overflows (SSOs) | TBD | TBD | TBD | TBD |
| Control Action 1.3 | Continue Collection System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | TBD | TBD | TBD |
| 2.0. Stormwater Drainage System | | | | | |
| Control Action 2.1 | Continue Existing Stormwater Programs | TBD | TBD | TBD | TBD |
| Control Action 2.2 | Continue Drainage System Line Cleaning, Inspection, Repair and Rehabilitation | TBD | TBD | TBD | TBD |

Draft Implementation Plan for Cole and Ropes Parks Beaches in Corpus Christi Bay

| | | Cole Park | | Ropes Park | |
|---------------------------------|---|------------|----------------|------------|----------------|
| Measure/Action | Description | Targeted # | Load Reduction | Targeted # | Load Reduction |
| 3.0. Ordinances and Regulations | | | | | |
| Control Action 3.1 | Eliminate Residential Cross-Connections | TBD | TBD | TBD | TBD |

Appendix C. Formal Support for the I-Plan

Formal Support for the I-Plan

[Insert letters and resolutions]