BIG

BACTERIA IMPLEMENTATION GROUP

Research Workgroup
Meeting Agenda
Thursday, March 20, 2014
1:00 PM to 3:00 PM
H-GAC Conference Room B, Second Floor

Call to Order/Welcome/Introductions

Review Notes from Last Year's Meeting

Discussion: Preparing BIG 2014 Annual Report – I-Plan Strategy 10.0 Research

Workgroup will review data source availability and past year BIG implementation activities related to I-Plan Strategy 10.0:

Research Priority 10.1: Evaluate the Effectiveness of Stormwater Implementation Activities
Research Priority 10.2: Further Evaluate Bacteria Persistence and Regrowth
Research Priority 10.3: Determine Appropriate Indicators
Research Priority 10.4: Additional Research Topics

Discussion: Review I-Plan Strategy 10.0 Research

Workgroup will review approved I-Plan wording. Workgroup will discuss potential editorial changes. Workgroup will agree on any updates and develop recommendations that will be presented at the annual BIG meeting for approval.
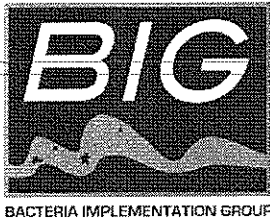
Adjourn

Upcoming Meeting Schedule
May 27, 2014: BIG Annual Meeting
March 20, 2014: Monitoring and Plan Revision | Research
March 25, 2014: Coordination and Policy

Joint Work Group Meeting:
Research, Monitoring, and Watershed Outreach
DRAFT Meeting Notes
Thursday, March 7, 2013
10:00 AM to noon
H-GAC Conference Room C, Second Floor

BACTERIA IMPLEMENTATION GROUP

Attendees

Linda Broach (TCEQ), Danielle Cioce (Harris County POD), Jonathan Holly (Harris County FCD), Tom Ivy (Texas Stream Team), Marty Kelly (TCEQ), Kim Laird (TCEQ), Linda Pechacek (LDP Consultants), Rachel Powers (H-GAC), Jean Wright (H-GAC)

Call to Order/Welcome/Introductions

Rachel called the meeting to order and initiated self-introductions.

Review Notes from Last Year

Rachel provided the notes from last year in case they were needed for reference.

Update on I-Plan Approval Process

The TCEQ unanimously approved the BIG I-Plan on January 30, 2013. The approved version included the changes to the I-Plan that had been discussed at previous BIG meetings. None of the changes were in the references sections.

Review Annual Report format

Rachel explained that the conceptual format for the annual report was developed in collaboration by the BIG and agreed to at the BIG mid-year meeting in October 2012. The report will consist of three main components:

1) At-a-Glance: The At-a-Glance section will be one 11x17 paper that includes cover page with a photo; a table of implementation activities, proposed milestones, and an evaluation of progress; and a sheet with background information, a map, and high-level review of progress overall.
2) A printed report: In addition to a narrative overview, the printed report will include information about progress and goals for each of the strategies in the plan. Each strategy will be described by a narrative description preceded by a tabular summary sheet, which will include recommendations from the workgroup to the BIG regarding progress, achievements, focus for the coming year, and revisions to the I-Plan.
3) Web-based support documents: If additional information, such as lengthy tables, are necessary, these will be provided in an on-line format.

Review Implementation Progress-- The workgroup reviewed progress for each of the implementation activities, as follows.

Implementation Strategy 9.0: Monitoring and I-Plan Revision

- 9.1: Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

  Jean Wright reported that H-GAC's Clean Rivers Program, including partners, has continued monitoring in the BIG project area. The Basin Highlights Report will be available for the BIG annual meeting on May 14, 2013, and will include information about water quality impairments and trends.

  Enterrococci were added as an additional parameter in September 2011, in part as a result of recommendations from the BIG. In non-tidal areas, about 1/3 of enterococci results exceed E. coli results, defying expectations. These discordant results do not appear to be random; a breakdown by segment shows that some segments have a greater frequency of discordant results than would be attributable to chance alone. The TCEQ indicated that their results were discordant, too, but that sometimes dilution seemed to correct the problem. Meeting participants asked that H-GAC look into the relationship to nutrients.

  In September 2012, CRP monitors began recording evidence of contact recreation when they were sampling. There is not yet enough information to analyze, but by next year, more information should be available.

  The Basin Steering Committee for H-GAC's Clean Rivers Program will hold its annual meeting on April 18, 2013, from 1:30 to 4:30 in H-GAC's Conference Room A, second floor. The committee serves as the primary forum for discussion of various water quality issues raised through the assessment process and it advises staff on all administrative matters related to the Clean Rivers Program, including work plan and budget development, monitoring of progress toward project milestones, and review of the draft and final basin reports and other work items. The committee helps set area-wide priorities based on its deliberations of water quality issues.

  The regional monitoring workgroup continues to meet quarterly. At the spring meeting, scheduled for April 22, 2013, individual CRP monitoring partners meet one-on-one with H-GAC and TCEQ to review the partner monitoring plan for the coming year.

- 9.2: Conduct and Coordinate Non-Ambient Water Quality Monitoring

  H-GAC submitted a draft non-ambient water quality monitoring QAPP to the TCEQ in 2011 and has been awaiting comments since then. In the meantime, H-GAC is continuing to try to identify alternatives to monitoring under a TCEQ-approved QAPP that would adequately validate the data.

  The Harris County Flood Control District has developed a Regional BMP database, modeled on the International Stormwater BMP database. Currently, the database includes monitoring information for stormwater BMP projects developed by the HCFCD for its facilities. It has

been designed to accommodate information about other BMP projects in the region. More information is available at http://www.bmpbase.org/LandingPage.aspx/.

- 9.3: Create and Maintain a Regional Implementation Activity Database

  Rachel reported that H-GAC has developed a preliminary Regional Implementation Activity Database. The preliminary version has been tested using information from MS4 annual reports. Many bugs have been identified, and the database will be improved for next year.

- 9.4: Assess Monitoring Results and Modify I-Plan

  This activity will be discussed in-depth at the Coordination & Policy workgroup meeting on March 28, 2013.

- Highlights for annual report:

  With only minor typographical changes, the participants agreed with the description of progress, achievements in the past year, focus for the coming year, and revisions recommended by H-GAC for the I-Plan Strategy Cover Sheet for the annual report.

Implementation Strategy 10.0: Research

- 10.1: Evaluate the Effectiveness of Stormwater Implementation Activities
- 10.2: Further Evaluate Bacteria Persistence and Regrowth
- 10.3: Determine Appropriate Indicators
- 10.4: Additional Research Topics

  Bill Hoffman of H-GAC prepared a list of 29 articles with abstracts relating to BIG issues. The list included articles about predicting bacteria levels from other water quality parameters, bacteria in stormwater, microbial source tracking and alternative indicators, and naturalized fecal indicator bacteria.

  Meeting participants indicated interest in the relationship between bacteria and biofilms, colloidal particles, TSS, and turbidity. The group discussed wet sieve analysis, sample dilution, and the use of filters smaller than .45.

  The group also referenced research by Terry Gentry and work done by TCB/AECOM relating to testing sludge blankets from wastewater treatment facilities. Rachel will try to identify these articles.

- Highlights for annual report:

  With only minor typographical changes, the participants agreed with the description of progress, achievements in the past year, and revisions recommended by H-GAC for the I-Plan Strategy Cover Sheet for the annual report. It did recommend changes to the description of focus for the coming year, adding that *the relationship between bacteria and the supernatant and colloidal sediment that pass through a .45 micron filter should be a research focus in the coming year.*

- <u>11.1: Consider Recommended Criteria When Selecting Geographic Locations for Projects</u>

Rachel provided a table showing both 2012 and 2011 lists of the "Most wanted" and "Most Likely to Succeed" assessment units. These lists are based on the seven-year geometric mean for the monitoring stations with the ten highest bacteria levels—for the most wanted list—and the lowest bacteria levels that are still considered impaired.

Most Wanted: The good news is that all but one of the assessment units on last year's top 10 lists showed decreased bacteria levels, sometime substantial. For example:

- o Schramm Gully (1007R_01) at station 15869 went from a geomean of 35 times the standard to 20 times the standard, and dropped from 4th on the list to 9th. (It once had the highest bacteria level.)
- o Little White Oak Bayou (1013A_01) at station 11148 went from a geomean of 28 times the standard to 19 times the standard, and dropped off the top-ten list from 7th place.

While these changes cannot be directly attributed to stakeholder efforts, anecdotal information suggests that identification of problems and actions to address those problems resulted in improvements.

Participants asked that H-GAC look into to new additions to the top ten list. Berry Bayou (station 16661 on 1007F_01) and Plum Creek (station 16658 on 1007I_01) are both in the vicinity of Pine Gully, and the area has been subject to attention for problems for many years. They indicated that there might be 15 years of data that might be of interest.

Most Likely to Succeed: Unfortunately, news from the "Most Likely to Succeed List" is not as good. While four of the assessment units on last year's most wanted list showed almost no change, the other six saw increases, albeit relatively minimal increases ranging from 0.1 to 0.8 times the standard (up to 2.2 times the standard).

Harris County provided a brief report on their project to prioritize waterways in the unincorporated portion of the county. They are moving forward with their analysis that addresses more of the prioritization criteria identified in the I-Plan. They indicated that they had not figured out a way to include recreational use in their analysis. Jean Wright indicated that CRP monitoring partners had started to record information about recreational use at monitoring sites, and HC might be able to include that information in their analysis. H-GAC said they would look into it.

- Highlights for annual report:

With only minor typographical changes, the participants agreed with the description of progress, achievements in the past year, and revisions recommended by H-GAC for the I-Plan Strategy Cover Sheet for the annual report. Participants recommended changes to the description of focus for the coming year, adding that ***Harris County will continue***

Confirm Recommendations to the BIG for Annual Report

The work group reviewed the draft Implementation Strategy Cover Sheets for the three strategies: Monitoring & Plan Revision, Research, and Geographic Priorities. There were 9 attendees including 2 BIG members and 2 alternates.

Changes to the draft coversheets are as follows:

- Research—area of focus—add the following: *"the relationship between bacteria and the supernatant and colloidal sediment that pass through a .45 micron filter should be a research focus in the coming year."*
- Geographic Priorities—area of focus—add the following: *"Harris County will continue developing analytical capabilities to geographically prioritize waterways based in part of BIG recommendations for geographic priorities."*

No changes to the I-Plan were recommended.

Rachel will send meeting notes and a draft section for the annual report as soon as they are available, and workgroup members will be able to provide comments. Workgroup recommendations will be reviewed by the Coordination and Policy and Plan Revision Workgroups at the meeting on March 28, 2013.

Adjourn

BIG Annual Meeting: Tuesday, May 14, 2013
Coordination & Policy work group meeting: March 28, 2013, 10:00 AM

[Tentative next meeting date: December 10, 2013, 1:00 PM to 3:00 PM, to coincide with the quarterly meeting of H-GAC's regional monitoring workgroup, which is held that morning.]

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Main Summary

BIG stakeholders support new research initiatives that result in useful findings and recommendations. Total daily maximum load (TDML) studies provide a general overview of the extent and character of the presence of bacteria. However, these studies are not sufficient to determine the most cost-effective courses of action to achieve water quality standards for contact recreation. The BIG has identified three top research priorities: (1) effectiveness of stormwater management activities, (2) bacteria persistence and regrowth, and (3) appropriate indicators to identify health risks presented by contact recreation in impaired waters.

These topics are pertinent to the entire project area. However, research is often driven by the availability of resources. While some research is being conducted within the region, BIG's active participation and advocacy at the state and national levels will help to ensure regional priorities are addressed. Local participation will also help to ensure findings and recommendations produced elsewhere are transferrable to the project area. Efforts to date have focused on compiling informational resources.

Work Group Activities

Meeting March 7, 2013. Nine attendees, including two BIG members and two alternates.

Progress

Progress has been adequate. Activity has begun or is ongoing for each of the research priorities.

Achievements

- H-GAC and BIG stakeholders:
  - Began analyzing local water quality data to determine the relationship between *E. coli* and *Enterococcus*.
  - Began the grant application process for funding research on bacteria persistence and regrowth in local streams.
- The Harris County Flood Control District's (HCFCD) best management practice (BMP) database showed promise as a tool for evaluating stormwater BMP effectiveness.

Focus

- H-GAC and BIG stakeholders aim to:
  - Continue researching existing programs and projects.
  - Secure funding for additional projects.
  - Research the relationship between bacteria and the supernatant and colloidal sediment that passes through a 0.45 micron filter.

Revisions

The work group does not recommend changes to the I-Plan.

10.1 Evaluate the Effectiveness of Stormwater Implementation Activities

– *BIG stakeholders will monitor current and future stormwater projects and analyze their effectiveness.*

☐ Not Started
☑ **Initiated**
☐ In Progress
☐ Completed

☐ Behind Schedule
☑ **On Schedule**
☐ Ahead of Schedule

Annual Progress and Applicable Programming:

☑ ***No Progress Reported.*** Eventual monitoring of current and future stormwater projects in the planning area will help provide an area-specific set of data on the relative effectiveness of different management practices. These studies should include both structural measures and behavioral measures.

10.2 Further Evaluate Bacteria Persistence and Regrowth

– *BIG stakeholders will conduct special studies to better understand the extent of human contributions to bacterial loading. Data from these studies should be included in monitoring databases.*

☐ Not Started
☑ **Initiated**
☐ In Progress
☐ Completed

☐ Behind Schedule
☑ **On Schedule**
☐ Ahead of Schedule

Annual Progress and Applicable Programming:

☑ ***Research Funding.*** H-GAC sought grant funding to investigate naturalized populations of *E. coli* in local waterways. If funded, H-GAC would work with a team at the Georgia Institute of Technology headed by Dr. Konstantin Konstantinidis. Along with other researchers, he has sequenced the genomes of many naturalized strains of *E. coli* and is developing a molecular assay to quantify the relative contributions of environmental and fecal sources.

10.3 Determine Appropriate Indicators

– *H-GAC and BIG stakeholders should help determine the need for alternative, supplemental, or multiple bacteria indicators to refine the I-Plan.*

☐ Not Started
☑ **Initiated**
☐ In Progress
☐ Completed

☐ Behind Schedule
☑ **On Schedule**
☐ Ahead of Schedule

Annual Progress and Applicable Programming:

☑ ***Initial Research.*** Ongoing and future research by the following agencies and organizations indicates promising indicators in the coming years:

– The U.S. Environmental Protection Agency continued developing recreational water quality standards based on new analytical techniques involving quantitative polymerase chain reactions, new statistical terminology, predictive modeling, sanitary surveys, epidemiological studies, and the development of quantitative microbial risk assessment.

– Harris County and the HCFCD continued to analyze the Clean Rivers Program's (CRP) water quality data to identify possible correlations between bacteria levels and other water quality parameters such as total suspended solids or nutrients.

– The CRP continued collecting *Enterococci* samples to supplement *E. coli* samples in freshwater.

– The HCFCD, in cooperation with H-GAC and the City of Houston Public Works Department, continued to conduct sampling to better describe diurnal patterns in bacteria levels.

10.4　Additional Research Topics

– *H-GAC and BIG stakeholders should conduct additional research on WWTFs, health risks, recreational use, land use modeling, unimpaired waterways, nutrients, and other constituents as funds are available.*

☐ Not Started

◪ **Initiated**

☐ In Progress

☐ Completed

☐ Behind Schedule

◪ **On Schedule**

☐ Ahead of Schedule

Annual Progress and Applicable Programming:

◪ *Research Abstracts.* H-GAC staff prepared 29 article abstracts relating to BIG issues. The collection included articles about:

– Predicting bacteria levels from other water quality parameters;

– Bacteria in stormwater;

– Microbial source tracking and alternative indicators; and

– Naturalized fecal indicator bacteria.

◪ *New Research Topics.* BIG members recommended new research initiatives that study the relationship between bacteria and biofilms, colloidal particles, total suspended solids, and turbidity. The group discussed:

– Wet sieve analysis;

– Sample dilution;

– Use of filters smaller than 0.45; and

– Testing sludge blankets from wastewater treatment facilities.
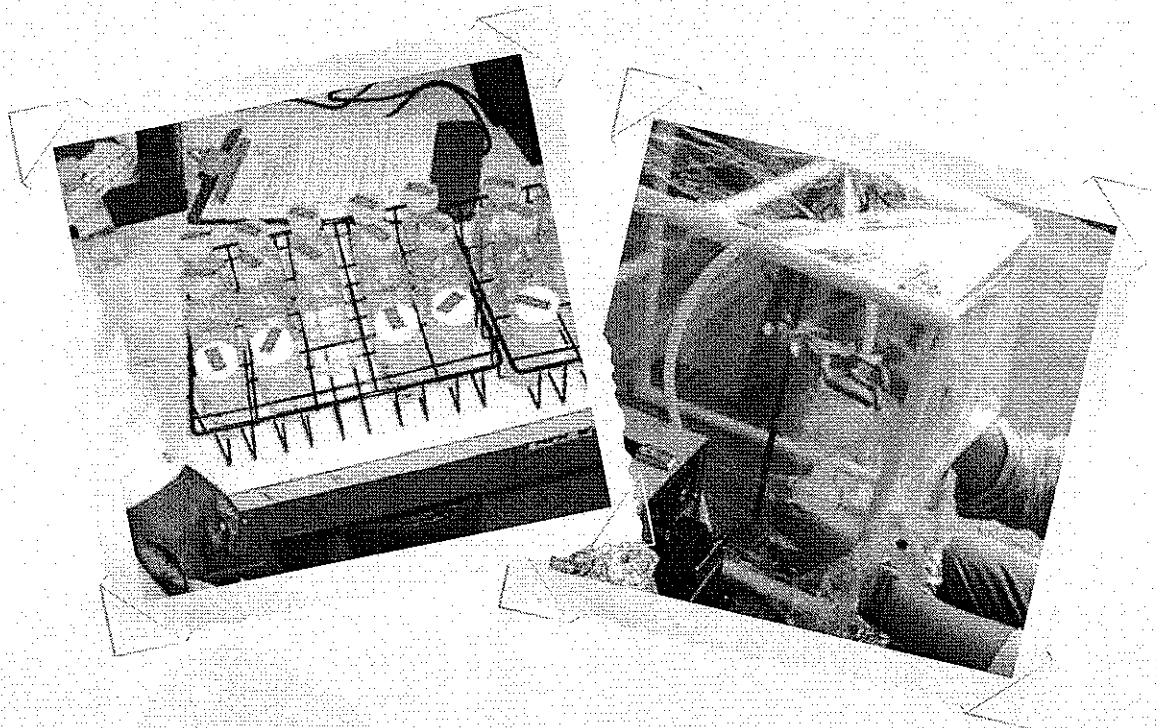
Implementation Strategy 10.0: Research

Bacterial contamination of waterways is a concern for the BIG project area, as reflected in the TMDL studies that this I-Plan addresses. The studies provide a general overview of the extent and character of the presence of bacteria, but they are not sufficient to determine the most cost-effective courses of action to achieve contact recreation standards. A dynamic process is required where affected entities continually expand their knowledge of bacteria sources and effects and where various management approaches are tested and refined. This section identifies potential research topics that will be critical to this undertaking.

Recognizing that many of these topics would be area-specific, the BIG was asked to prioritize those which would have the greatest impact on management actions across the area. Three topics emerged. These topics are pertinent to the entire BIG area, are intended to be implemented as resources are available, and may be superseded as necessary for research needs that are specific to individual stakeholders. Research would be conducted using appropriate methodology and quality assurance that have been developed in consultation with the TCEQ and the EPA. In the following text, although the research priorities are presented in a numerical order, this is not a rank order.

The I-Plan's stakeholders identified three priority research topics which address the following:

- Effectiveness of stormwater activities
- Bacteria persistence and regrowth
- Appropriate indicators

Additional topics were identified and, although important, were not identified as top priorities. Many of these topics are related to the three research priorities. As funding is available, these additional research topics should be considered.

A variety of funding sources should be pursued, with a variety of partners. It is unlikely that any one local entity will find it appropriate to conduct this research. Given the large-scale character of the undertakings, entities should look to coordinate efforts with the various academic institutions of the greater Houston area, federal and state agencies like the EPA, Center for Disease Control and Prevention, and Department of State Health Services, water and environmental research groups like Water Environment Research Foundation and Water Environment Association of Texas, 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. However, the more practical avenue is likely to be the BIG group as a whole advocating for a national or state-level entity to address research priorities.

Research Priority 10.1: Evaluate the Effectiveness of Stormwater Implementation Activities

Additional monitoring of current and future stormwater projects in the planning area will help provide an area-specific set of data on the relative effectiveness of different management practices. This effort would draw from current and proposed activities undertaken by Phase I MS4 permitted entities. 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, such as public outreach, public reporting of illicit discharges, and efforts aimed at changing behaviors. The data collected and the results from the comparative evaluations should be made available to all stakeholders through the monitoring databases described in Implementation Strategy 9.0.

Research Priority 10.2: Further Evaluate Bacteria Persistence and Regrowth

To better understand the extent of human contributions to bacterial loading in waterways, the underlying base layer of background or endemic bacteria should be studied in greater detail. Previous studies of water bodies in the region, including evaluations of Buffalo and Whiteoak bayous in Harris County,[112] indicated that naturally occurring bacteria are prevalent and persistent in our slow-moving waterways. While these naturally occurring bacteria are certainly supplemented with bacteria from human activities and other sources, the relationship and relative percentages of each should be studied in greater detail. Additionally, the character and cycle of bacteria in the waterway pertaining to regrowth potential requires further evaluation. More realistic and comprehensive simulations are required to more fully grasp the nature of bacterial behavior in the waterways. Implementing agencies that choose to conduct these studies for specific projects will make their data available for the rest of the stakeholders through the monitoring databases (or through H-GAC as a facilitator). The results could be used to provide more precise predictions of bacterial loading by following the impact of loading over time within the waterway.

Research Priority 10.3: Determine Appropriate Indicators

An indicator species is an organism whose presence is highly correlated to the presence of another organism (or group of organisms). *E. coli* or *Enterococcus* are used as indicator bacteria based on their pervasiveness and correlation between their presence and the presence of a wide range of potential microbial pathogens. However, that general correlation may not be precise enough to justify their exclusive use in monitoring for this I-Plan. While these indicators are generally accepted nationwide,

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[112] (Brinkmeyer, Amon and Schwarz 2008) and (NSF International Engineering & Research Services 2007)

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they may not reflect the unique balance of microbial pathogens and water quality characteristics of the region's semi-tropical urban bayous and local water bodies. Many studies, including the data used to formulate the 1986 EPA guidance on bacteria limits for recreational waters,[113] were conducted in areas and water bodies greatly different from the BIG area. The potential need for alternate, supplemental, or multiple indicators should be determined to refine the I-Plan's monitoring approach and further assist stakeholders in identifying sources.

The EPA is currently studying the question of appropriate indicators. The results of their inquiry, due in October of 2012,[114] should be incorporated into future revisions of this I-Plan. Additional consideration of the best indicator(s) for the area could help supplement their findings by providing a more specific understanding of local correlations between indicators and pathogens. Stakeholders are encouraged to participate in EPA's discussion of indicators and to encourage the EPA to consider environments similar to those in the Houston region.

Research Priority 10.4: Additional Research Topics

A variety of additional research topics were identified by stakeholders. The following list gives a brief description of broad groups of research topics and some possible research questions. Research addressing these topics should be conducted as resources are available.

- *WWTFs:* Studies should examine the correlation between bacteria levels in effluent and in-stream bacteria levels. Have in-stream bacteria levels changed as a result of the TCEQ's new rules that limit bacteria levels in effluent? Research may also be conducted to identify how other constituents in wastewater effluent may influence in-stream bacteria levels. How are in-stream bacteria levels influenced by sludge discharges, nutrients, and stormwater discharges from WWTFs?
- *Health risks:* The studies should include cumulative review of epidemiological studies, collection of new epidemiological data, and/or microbial risk assessment efforts aimed at determining human health risks from recreational activities in, on, or near bayous in the BIG region. What is the relationship between the levels of pathogens and indicators in different watersheds?
- *Recreational use:* Generally, eight or more illnesses above the background level are considered problematic. Does the rate of illness from contact recreation in impaired waterways in the project area exceed this threshold? What is the level of recreation on the waterways?
- *Land use:* Research could analyze the correlations between land use, turbidity, and in-stream bacteria levels. Some land use types may lead to increased turbidity, and may be associated with increased bacteria levels. Consideration should be given to evaluating the per-capita

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[113] (U.S. Environmental Protection Agency 1986)

[114] (U.S. Environmental Protection Agency 2010c)

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contribution of bacteria in relative compact mixed use developments versus lower density developments. Historical land use prior to development may also influence in-stream bacteria levels. Is there a correlation between impervious surfaces and in-stream bacteria levels?

- *Modeling:* The document, "Bacteria Total Maximum Daily Load Task Force Final Report,"[115] contains summary information about the selection and application of various water quality models for use in Texas. However, many questions were raised by the authors regarding how well the models work, how they can be improved to be more accurate, and how well they function as predictive models. Research could be done to provide answers to the questions raised in the report. One particular input for which further information could be done is to improve the flow data available for classified stream sections.

- *Unimpaired waterways:* A minority of sampled waterways in the project area are *not* considered impaired for bacteria. Why do these assessment units have relatively low bacteria levels? How could this information be applied to lower bacteria levels in impaired waterways?

- *Nutrients and other constituents:* Waterways in the project area contain constituents such as nutrients, fine particles, sediment, soil, and other solid materials. Studies and research should examine how such constituents influence instream bacteria levels.

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[115] (Jones, et al. 2007)