# 2015 BASIN SUMMARY REPORT

## LOWER NECHES RIVER BASIN

THE TEXAS CLEAN RIVERS PROGRAM

## NECHES-TRINITY COASTAL BASIN



# EXECUTIVE SUMMARY

In 1991, the Texas Legislature passed the Texas Clean Rivers Act in response to growing concerns that water resource issues were not being addressed in a holistic manner. The Texas Clean Rivers Program was created under this act. The Lower Neches Valley Authority (LNVA) is responsible for monitoring and assessing the surface water quality in the Lower Neches River Basin and the Neches-Trinity Coastal Basin, an area approximately 3,318 square miles. The LNVA assessment area extends from the Sam Rayburn Reservoir southward to the Texas Gulf Coast. The upper portion of the Neches River Basin is monitored and assessed by the Angelina & Neches River Authority (ANRA) based in Lufkin, Texas. The Texas Clean Rivers Program is funded by water rights fees and wastewater permit fees and the program is administered by the Texas Commission on Environmental Quality (TCEQ).

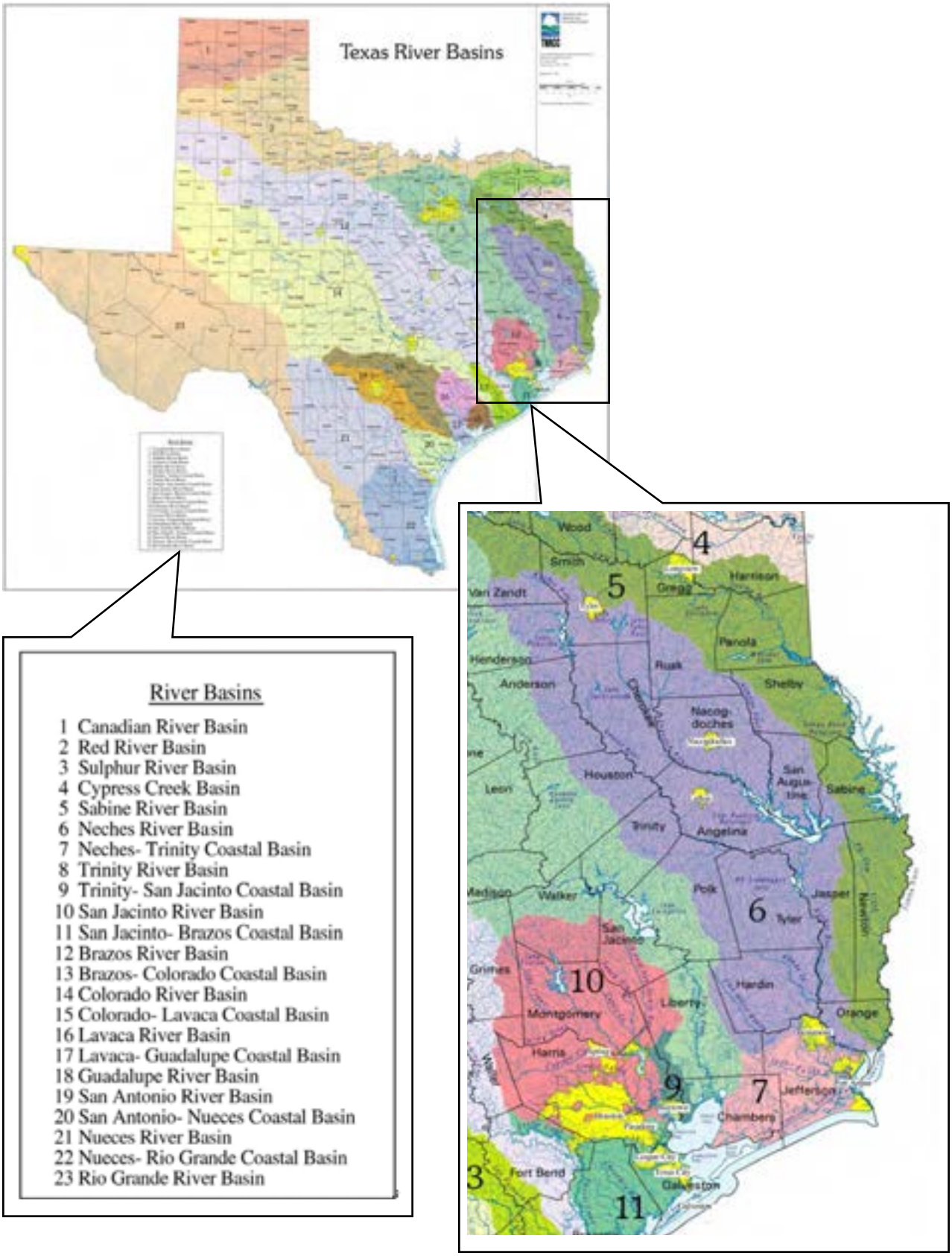
## *Activities and Accomplishments*

Since 1991, LNVA has continuously worked with a Clean Rivers Program (CRP) Steering Committee, a diverse group of basin stakeholders, representing a variety of interests in the basin. Steering Committee meetings are held annually to discuss the status of current CRP contracts/budgets, address state/local water quality issues, review basin studies/reports and establish basin water quality monitoring priorities. This group of basin stakeholders consistently provides meaningful input and practical ideas to improve water quality monitoring and assessments in the basin.

Public education and outreach through the Clean Rivers Program has continued to be a priority for LNVA. Over the years, thousands of water quality book covers, water conservation materials, and water education programs have been funded and distributed to schools, organizations, and the general public by LNVA in the basin. This effort has continued despite CRP budget cuts and diminished fee allocations to the basin. LNVA is currently supporting volunteer water quality monitors in the basin through the Texas Stream Team Program and provides the Major Rivers educational curriculum to participating schools in the basin through the Texas Water Development Board. Both of these programs continue to build on our efforts to educate and involve the public in the protection of our valuable water resources.

The Surface Water Quality Monitoring (SWQM) Program continues to be the primary focus of CRP in the basin. LNVA routinely monitors surface water quality at 25 stations in the basin. SWQM data collected by LNVA provides most of the quality assured data in the Lower Neches River Basin for TCEQ's Texas Integrated Report of Surface Water Quality. The Texas Integrated Report is a requirement of the federal Clean Water Act, Sections 305(b) and 303(d). The LNVA SWB Environmental Laboratory located in Beaumont provides the analyses on the CRP samples which requires laboratory accreditation (NELAP) from the TCEQ.

The Continuous Water Quality Monitoring Network (CWQMN) Station on Pine Island Bayou (CAMS 749), proposed and operated by LNVA, was installed in 2008 by the TCEQ. The real-time surface water quality data (pH, Temperature, Dissolved Oxygen, Conductivity, Turbidity) collected at this CWQMN station is available online 24-hours a day at the following website: http://www.tceq.state.tx.us/cgi-bin/compliance/monops/water_site_photo.pl?cams=749

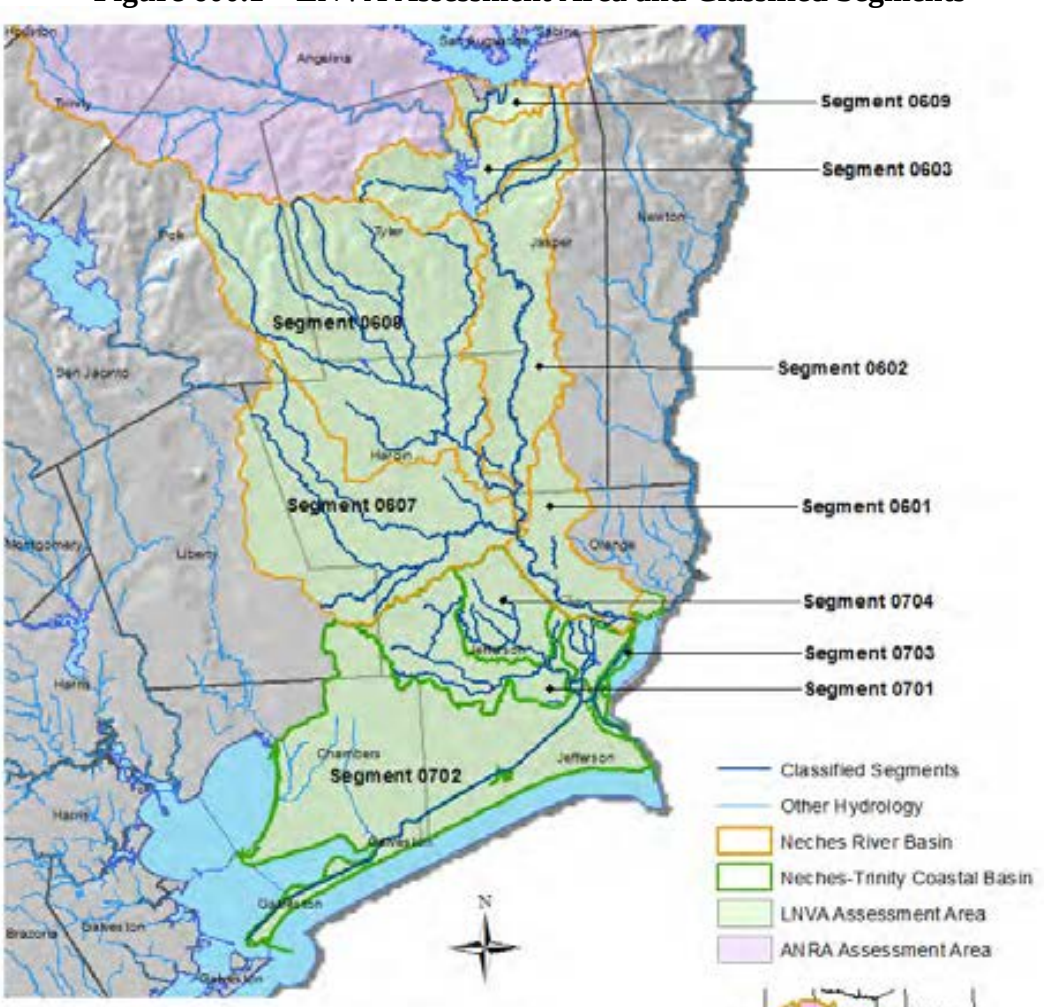



*Executive Summary II*

***Significant Findings***

The water quality in the Lower Neches River Basin and Neches-Trinity Coastal Basin does not meet all state water quality standards and/or assessment criteria. There are ten classified segments (Figure 600.1) between the two basins, and all segments have listed water quality impairments and/or concerns.

**Figure 600.1—LNVA Assessment Area and Classified Segments**




| Segment Number | Segment Name |
|---|---|
| 0601 | Neches River Tidal |
| 0602 | Neches River below B. A. Steinhagen Lake |
| 0603 | B. A. Steinhagen Lake |
| 0607 | Pine Island Bayou |
| 0608 | Village Creek |
| 0609 | Angelina River below Sam Rayburn Reservoir |
| 0701 | Taylor Bayou above Tidal |
| 0702 | Intracoastal Waterway Tidal |
| 0703 | Sabine/Neches Canal Tidal |
| 0704 | Hillebrandt Bayou |

The following water quality conditions, listed by segment, are based on the Draft 2014 Texas Integrated Report and Texas 303(d) List issued and adopted by the TCEQ on June 3, 2015.

## *Lower Neches River Basin*

**Segment 0601: Neches River Tidal (below LNVA Saltwater Barrier)**

- Fully supports the general use criteria
- Fully supports the public water supply use
- Not supporting the contact recreation use (*Enterococcus* bacteria)
- Not supporting the fish consumption use (PCBs in edible tissue)
- Aquatic life use concern for Malathion (lower segment)
- No concern for nutrients in the segment
- Not supporting the contact recreation use (0601A: Star Lake Canal)

**Segment 0602: Neches River below B.A. Steinhagen Lake**

- Fully supports the general use criteria
- Fully supports the contact recreation use
- Fully supports the public water supply use
- Not supporting the fish consumption use (mercury, dioxin)
- Aquatic life use concern for depressed dissolved oxygen (screening level)
- No concerns for nutrients in the segment

**Segment 0603: B.A. Steinhagen Lake**

- Fully supports the aquatic life use
- Fully support the general use criteria
- Fully supports the public water supply use
- No concerns for nutrients in the segment
- Not supporting the fish consumption use (mercury, dioxin)
- Not supporting the contact recreation use (0603A: Sandy Creek, 0603B: Wolf Creek)

**Segment 0607: Pine Island Bayou**

- Fully supports the general use criteria
- Fully supports the public water supply use
- Fully supports the fish consumption use
- No concerns for nutrients in the segment
- Not supporting the aquatic life use due to depressed dissolved oxygen (0607: Pine Island Bayou, 0607A: Boggy Creek, 0607B: Little Pine Island Bayou, 0607C: Willow Creek)
- Not supporting the contact recreation use
- Aquatic life use concern for impaired habitat (0607A: Boggy Creek)

**Segment 0608: Village Creek**

- General use concern for low pH (criteria not based on current *TSWQS*)
- Fully supports the public water supply use
- Not supporting the aquatic life use, depressed DO (0608C: Cypress Creek, 0608E: Mill Creek)
- Not supporting the aquatic life use, copper in water (0608A: Beech Creek)
- Not supporting the contact recreation use (0608B: Big Sandy Creek, 0608F: Turkey Creek)
- Not supporting the fish consumption use, mercury in tissue (0608: Village Creek, 0608G: Lake Kimball
- Aquatic life use concern for impaired habitat (0608A: Beech Creek, 0608C: Cypress Creek)
- No concerns for nutrients in the segment

**Segment 0609: Angelina River below Sam Rayburn Reservoir**

- Fully supports the aquatic life use
- Fully supports the contact recreation use
- Not supporting the fish consumption use (mercury, dioxin)
- Fully supports the general use criteria
- Fully supports the public water supply use
- No concerns for nutrients in this segment

## *Neches-Trinity Coastal Basin*

**Segment 0701: Taylor Bayou above Tidal**

- Fully supports the contact recreation use
- Fully supports the general use criteria
- Not supporting the aquatic life use, depressed DO
- Aquatic life use concern for depressed DO (screening level)
- General use concern for chlorophyll *a* (nutrient screening level)
- Fish consumption use concern for arsenic in edible tissue (0701D: Shallow Prong Lake)

**Segment 0702: Intracoastal Waterway Tidal**

- Not supporting the contact recreation use (*Enterococcus*)
- Not supporting the fish consumption use (PCBs, dioxin)
- General use concern for chlorophyll *a,* nutrient screening level (0702: Intracoastal Waterway, 0702A: Alligator Bayou)
- Not supporting the aquatic life use, acute toxicity in water, toxicity in sediment (0702A: Alligator Bayou)
- Aquatic life use concern for lead in sediment (0702A: Alligator Bayou)

**Segment 0703: Sabine-Neches Canal Tidal**

- Fully supports the aquatic life use
- Not supporting the contact recreation use (*Enterococcus*)
- Fully supports the general use criteria
- Fully supports the fish consumption use
- No concerns for nutrients in the segment

**Segment 0704: Hillebrandt Bayou**

- Fully supports the fish consumption use
- Not supporting the aquatic life use, depressed DO
- Aquatic life use concern for depressed DO (screening level, minimum)
- General use concern for chlorophyll *a*, ammonia (nutrient screening levels)
- Not supporting the contact recreation use

***Recommendations and Conclusions***

The following recommendations to address water quality impairments and concerns (see Table 4.1-1) are provided by LNVA to protect and improve water quality throughout the basin.

Overall, water quality in the Lower Neches River Basin and Neches-Trinity Coastal Basin is improving. However, it does not meet all state water quality standards and assessment criteria. All of the segments have listed impairments and/or concerns. Significant progress has been made to address these issues, but additional resources will be required to continue our efforts in the basin that is expected by stakeholders and the general public. LNVA is committed to this effort and will work closely with TCEQ and other agencies to identify additional funding and resources for the basin.

*The Neches River Saltwater Barrier includes a laboratory, public boat ramps and public restrooms.*

**Table 4.1-1: Recommendations for Water Quality Impairments and Concerns**

| Watershed/ Segment | Use Impairment/Concern | Identified Parameters | Explanation of Impairment/ Concern | Actions Taken | Recommended Actions |
|---|---|---|---|---|---|
| Segment 0601: Neches River Tidal | Aquatic Life Use<br><br>Contact Recreation Use<br><br>Fish Consumption Use | Malathion AU_01<br>*Enterococcus*<br><br>PCBs in Edible Tissue | Aerial pesticide applications<br>Non-Point Source Pollution<br><br>Unknown Industrial Sources | TCEQ organics in water monitoring<br>LNVA & TCEQ routine monitoring<br><br>Advisory issued by DSHS (Dec. 29, 2011) | Routine monitoring for organics in water<br>Routine monitoring to include bacteria<br><br>Fish Tissue Sampling in Segment 0601 |
| Segment 0601A: Star Lake Canal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ Region 10 routine monitoring | Re-evaluate Primary Contact Recreation Use for Star Lake Canal |
| Segment 0602: Lower Neches River above Tidal | Fish Consumption Use<br><br>Aquatic Life Use | Mercury/Dioxin in fish tissue<br><br>DO grab screening level | Atmospheric Deposition/Unknown<br><br>Natural due to seasonal fluctuations | Advisory issued by DSHS (Jan. 24, 2014)<br><br>LNVA & TCEQ routine monitoring | Routine Fish Tissue Sampling per DSHS<br><br>Continue routine monitoring in the segment |
| Segment 0603: B.A. Steinhagen Reservoir | Fish Consumption Use | Mercury/Dioxin in fish tissue | Atmospheric Deposition/Unknown | Advisory issued by DSHS (Jan. 24, 2014) | Routine Fish Tissue Sampling per DSHS |
| Segment 0603A: Sandy Creek<br>Segment 0603B: Wolf Creek | Contact Recreation Use | *E. coli* | Non-point Source Pollution | Planned East Texas Recreational Use Attainability Analysis (RUAA) Projects | Re-evaluate Primary Contact Recreation Use for these unclassified segments |
| Segment 0607: Pine Island Bayou | Aquatic Life Use<br><br>Contact Recreation Use | Depressed DO<br><br>*E. coli* | Natural, seasonal fluctuations and low flow conditions<br><br>Non-point Source Pollution | TCEQ Proposed Intermediate ALU in 2014 TSWQS (AU_04) CWQMN Real-Time Monitoring Station<br>LNVA routine monitoring in the segment | Implement lower DO standard (3.0 mg/L) pending EPA approval of 2014 TSWQS<br><br>Conduct RUAA in AU_03; Continue routine monitoring |
| Segment 0607A: Boggy Creek<br>Segment 0607B: Little Pine Island Bayou<br>Segment 0607C: Willow Creek | Aquatic Life Use | Depressed DO<br><br>Impaired Habitat 0607A | Natural, seasonal fluctuations and low flow conditions<br><br>Unknown | TCEQ Proposed Lower DO Standards in the 2014 TSWQS<br><br>TCEQ Biological Assessment | Implement revised DO standards based on intermittent streams with perennial pools Lower DO standards pending EPA approval of 2014 TSWQS |
| Segment 0608: Village Creek<br><br>Segment 0608A: Beech Creek<br>Segment 0608B: Big Sandy Creek<br>Segment 0608C: Cypress Creek<br>Segment 0608E: Mill Creek<br>Segment 0608F: Turkey Creek<br>Segment 0608G: Lake Kimble | General Use 0608<br>Contact Recreation Use 0608B, 0608F<br>Aquatic Life Use 0608C, 0608E<br><br>Aquatic Life Use 0608A<br><br>Fish Consumption Use 0608, 0608G | Low pH<br>*E. coli*<br><br>Depressed DO<br><br>Impaired Habitat Copper<br><br>Mercury in fish tissue | Natural Conditions<br>Non-Point Source Pollution<br><br>Natural, low flow conditions<br><br>Unknown Criteria Changed<br><br>Atmospheric Deposition | Revised pH range in 2010 TSWQS<br>LNVA Routine Monitoring<br><br>TCEQ Proposed Intermediate ALU for Cypress Creek in 2014 TSWQS<br>Acute Criteria is 1.89 vs. 2.46 in 2012 IR<br><br>Advisories issued by the DSHS on Sept. 21, 2009; April 23, 1999 | Implement TSWQS pH Range (5.5-8.0)<br>Conduct RUAA on Big Sandy Creek<br><br>Implement revised DO standard based on intermittent streams with perennial pools<br>Aquatic Life Assessment on Beech Creek<br><br>Update advisory using current fish tissue sampling results |

*Continued on Next Page*

**Table 4.1-1: Recommendations for Water Quality Impairments and Concerns (continued)**

| Watershed/ Segment | Use Impairment/ Concern | Identified Parameters | Explanation of Impairment/Concern | Actions Taken | Recommended Actions |
|---|---|---|---|---|---|
| Segment 0609: Angelina River below Sam Rayburn Reservoir | Fish Consumption Use | Mercury & Dioxin in Fish Tissue | Atmospheric Deposition/Unknown | Advisory issued by DSHS on Jan. 24, 2014 | Routine Fish Tissue Sampling per DSHS |
| Segment 0701: Taylor Bayou above Tidal | Aquatic Life Use | Depressed DO | Natural, low flow conditions | Completed UAA on Taylor Bayou | Collect new 24-hour DO measurements |
| | General Use/ Nutrients | Chlorophyll *a* | Excessive Nutrients | LNVA & TCEQ routine monitoring for nutrients | Continue routine monitoring; develop nutrient standards for segment |
| Segment 0701D: Shallow Prong Lake | Fish Consumption Use | Arsenic in fish tissue | Unknown | TCEQ Fish Tissue Sampling | DSHS issue a fish consumption advisory to warn public |
| Segment 0702: Intracoastal Waterway Tidal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ Routine Monitoring | Consider Secondary Contact Recreation Use Standards |
| | General Use/ Nutrients | Chlorophyll *a* | Excessive Nutrients | TCEQ routine monitoring for nutrients | Continue routine monitoring; develop nutrient standards |
| | Fish Consumption Use from East Bay to Port Bolivar | Dioxin & PCBs in fish tissue | Unknown Industrial Sources | Advisory issued by DSHS on June 26, 2013; TMDL Galveston Bay System Dioxin & PCBs Survey | Routine Fish Tissue Sampling per DSHS |
| Segment 0702A: Alligator Bayou and Main Canals A, B, C, and D | Aquatic Life Use | Lead in Sediment; Sediment Toxicity<br>Water Acute Toxicity | Industrial Legacy Pollutants<br>Unknown Industrial Sources | Ambient Toxicity TMDL in Alligator Bayou, 0702A Intermediate ALU for Main Canal D, Canal A, B, C in TSWQS | Complete TMDL Implementation; Continue monitoring for metals in sediment, ambient toxicity to determine source(s) of toxicity |
| Segment 0703: Sabine-Neches Canal Tidal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ routine monitoring for bacteria in the segment | Consider Secondary or Noncontact Recreation Use Standards |
| Segment 0704: Hillebrandt Bayou | Aquatic Life Use | Depressed DO | Natural, seasonal fluctuations and low flow conditions | Completed UAA on Hillebrandt Bayou; Revised 24-hr. minimum DO criterion | Collect new 24-hour DO measurements; Apply 2014 TSWQS pending EPA approval |
| | General Use/ Nutrients | Ammonia-N & Chlorophyll *a* | Excessive nutrients due to urban runoff, stormwater | TCEQ routine monitoring for nutrients in the segment | Continue routine monitoring; develop nutrient standards for segment |
| | Contact Recreation Use | *E. coli* | Non-Point Source Pollution | TCEQ routine monitoring for bacteria | Consider Secondary Contact Recreation Use Standards |

# 2015 BASIN SUMMARY REPORT

## LOWER NECHES RIVER BASIN & NECHES-TRINITY COASTAL BASIN

The preparation of this report by the

**Lower Neches Valley Authority**

was financed through grants from and
in cooperation with the

**Texas Commission on Environmental Quality**

**July 2015**

# TABLE OF CONTENTS

# LIST OF FIGURES

# LIST OF FIGURES

# LIST OF FIGURES

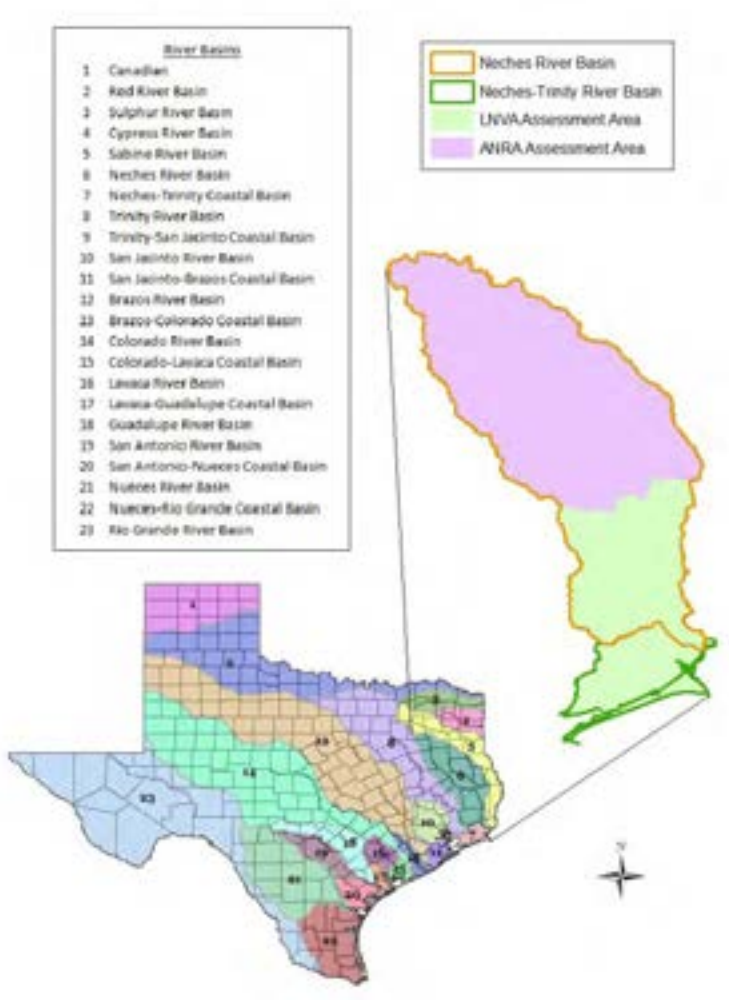
# LIST OF TABLES

# 1.0 INTRODUCTION

This Basin Summary Report assesses water quality and summarizes the Clean Rivers Program (CRP) activities in the Lower Neches River and Neches-Trinity Coastal Basins. It is provided to the Texas Commission on Environmental Quality (TCEQ) and other interested parties in fulfillment of the requirements of the Texas Clean Rivers Act.

The CRP was enacted in 1991 by the 72nd Legislature to insure the comprehensive assessment of water quality in each watershed and river basin in the state of Texas. In response to this legislation, the TCEQ adopted permanent rules establishing the CRP. These rules allow for river authorities and other designated local authorities, under the supervision of the TCEQ, to conduct regional assessments of the watersheds in their jurisdiction. This assessment process is made possible from the participation of public institutions, private industry, and individuals helping to determine how best to protect Texas' water resources. The Lower Neches Valley Authority (LNVA) is the planning agency for all CRP activities in the Lower Neches River Basin/ Neches-Trinity Coastal Basin. The LNVA CRP staff is responsible for collecting and analyzing water quality data to identify and prioritize water quality impairments.

***Location of the Neches River Basin & Neches-Trinity Coastal Basin***




## *Clean Rivers Program and Basin Goals/Objectives*

The long-term goal of the Clean Rivers Program is to maintain and improve the quality of water within each river basin in Texas through an ongoing partnership involving the Texas Commission on Environmental Quality (TCEQ), river authorities, other agencies, regional entities, local governments, industry and citizens. The program uses a watershed management approach to identify and evaluate water quality issues, establish priorities for corrective action, work to implement those actions, and adapt to changing priorities. The CRP has outlined six objectives in its long term plan. These objectives are to provide quality-assured data to the commission for use in water quality decision-making, to identify and evaluate water quality issues, to promote cooperative watershed planning, to inform and engage

stakeholders, to maintain efficient use of public funds, and to adapt the program to emerging water quality issues.

The surface water quality monitoring program is the primary focus in the basin to obtain information on the physical, chemical, and biological characteristics of the watershed. LNVA is responsible for CRP monitoring activities within the Lower Neches River and Neches-Trinity Coastal Basins. LNVA has increased monitoring efforts over the years and maintained a routine monitoring program in the basin. Additional monitoring stations are incorporated to provide important water quality data on impaired segments and/or improve spatial coverage in the basin as funding is available. All CRP monitoring is conducted in accordance with a TCEQ approved Quality Assurance Project Plan (QAPP) and TCEQ's *Surface Water Quality Monitoring Procedures Manual*.

*Coordination and Cooperation in the Basin*

In order to insure the most cost effective monitoring of the Neches River Basin and Neches-Trinity Coastal Basin, the CRP program relies on a cooperative effort between agencies within the basin. LNVA coordinates monitoring activities in the lower portion of the Neches River Basin with the United States Geological Survey (USGS), TCEQ's Surface Water Quality Monitoring (SWQM) program, and TCEQ's Region 10 Field Office located in Beaumont. LNVA participates in the annual Coordinated Monitoring Meeting for the Neches River Basin which is attended by all water quality monitoring agencies in the basin.

*Lower Neches River Basin Physical Characteristics*

The Neches River Basin extends for 210 miles in eastern Texas where it is geographically oriented between the Sabine River to the east and the Trinity River to the west. The Lower Neches River Basin encompasses approximately 3,318 square miles which consists of Hardin County and portions of Tyler, Jasper, Jefferson, Liberty, Polk, and Orange Counties. Cities include Jasper, Silsbee, Kountze, Lumberton, Sour Lake, Port Neches and portions of Beaumont/Port Arthur.

*Bladderworts (Utricularia spp.) blooming along the lower Neches River near the LNVA Saltwater Barrier.*

The entire basin is located in the Level III ecoregion called South Central Plains (35), commonly known as the "piney woods", as much of this region now consists of loblolly and shortleaf pine plantations. About two thirds of this region is in forests and woodland in-

cluding bottomland hardwoods which are fragmented. Several Level IV ecoregions are included in the lower basin including Floodplains and Low Terraces (35b), Southern Tertiary Uplands (35e), and Flatwoods (35f). The lower basin has a variety of trees, shrubs, and vines that grow together in assemblages based on soil type, flood duration, and water depth. This region is heavily forested with loblolly and shortleaf pine (*Pinus taeda* and *Pinus echinata*), oaks (*Quercus* spp.), magnolias (*Magnolia* spp.), elms (*Ulmus* spp.), water tupelo (*N.yssa aquatica*), bald cypress (*Taxodium distichum*) and sweet gum (*Liquidamber styraciflua*). Shrubs and vines are thick in this part of Texas and common species are American beautyberry (*Callicarpa* americana), southern wax-myrtle (*Myrica cerifera*), wild grapes (*Vitis* sp.), and greenbriars (*Smilax* sp.).

Mixed pine-hardwood forests are present in upland areas while hardwood forests are primarily in the lowland areas. Along the lower Neches River corridor are the floodplains and low terraces (35b). Within these floodplains, water levels fluctuate in pools, sloughs, and oxbows due to high precipitation, overbank flooding, and subsurface groundwater. Several Big Thicket National Preserve Units are located in this portion of the basin.

*Alligator Snapping Turtle (Macrochelys temminckii) observed near the Lower Neches River in Beaumont.*

Bottomland hardwood forests are one of the most severely altered ecosystems in the United States. This ecosystem is altered due to urban development, pollution, logging, timber production, mining, and petroleum extraction. Longleaf-pine savannas and beech-magnolia forests are now rare in the lower basin. This is crucial because several endangered and rare animals call these forests home locally. Among these are the highly endangered Golden cheeked Warbler (*Dendroica chrysoparia*), the endangered Black-capped Vireo (*Vireo atricappillus*), and the endangered Red-cockaded Woodpecker (*Picoides borealis*). Rare plants that thrive in the Piney Woods are the southern lady's slipper orchid, golden glade cress, white bladderpod, and the Texas traling phlox.

Major tributaries in the Lower Neches River Basin include Village Creek (Segment 0608) and Pine Island Bayou (Segment 0607). Additional tributaries monitored by LNVA include Wolf Creek, Sandy Creek, Big Sandy Creek, Turkey Creek, Hickory Creek, Beech Creek, Cypress Creek, Little Pine Island Bayou, and Willow Creek.

*Lower Neches River Basin Water Quality Characteristics*

The quality of surface water tends to reflect the characteristics of the watershed. The streams in the Lower Neches River Basin meander through forested areas, acidic soils, and sandy loams.

Soils consist of sand, silt, and large deposits of colloidal clay that drain poorly. Many area streams are low gradient and sluggish and course through low-lying "swampy" areas where depressed levels of dissolved oxygen and low pH develop naturally. Periods of low stream flow and warm weather further contribute to low dissolved oxygen levels. While nature accounts for some of the water quality shortcomings, other water quality problems cannot be attributed to the environment. Impairments to surface water are generally attributed to point and non-point source pollution. While point sources are regulated, such as discharge from a municipal or industrial wastewater treatment plant, non-point sources are largely unregulated. Non-point source pollution occurs when rainfall runoff transports contaminants over the land surface into adjacent water bodies. Not only can pollutants on land be washed into waterways, airborne contamination can precipitate out or be deposited directly in the water bodies or land and then washed into the water bodies. Examples of non-point source pollution include runoff from agricultural fields, soaps or fertilizers washed down storm drains, pet or animal waste, and physical trash such as old tires, used motor oil, and scrap metal.

According to EPA's *Nonpoint Source Program and Grants Guidelines for States and Territories, Issued April 12, 2013*, "NPS pollution continues to dominate water quality impairments throughout the United States. The most recent Clean Water Act § 305(b) data estimate that 53% of the nation's assessed rivers and streams, 66% of the nation's estuaries and bays, and 69% of the nation's lakes are impaired (www.epa.gov/waters/ir). EPA estimates that more than half of the waters identified on states' § 303(d) list of impaired or threatened waters are impacted primarily by nonpoint sources. Furthermore, an estimated 94% of the nation's TMDLs address waters that are either completely or partially listed for NPS pollution."

*Neches-Trinity Coastal Basin Physical Characteristics*

The Neches-Trinity Coastal Basin is situated in southeast Texas within the Western Gulf Coastal Plain. This coastal basin includes four classified segments with a drainage area of 769 square miles. Ecoregions include the Northern Humid Gulf Coastal Prairies (34a) and Texas-Louisiana Coastal Marshes (34g). Low gradient streams, dredged waterways, and estuaries adjacent to the Gulf of Mexico characterize the water bodies in the coastal basin. The land is relatively flat and dominated by prairie grasslands with small stands of oak in the south and some loblolly pines in the north. This region is dissected by rivers and streams that flow into the Gulf of Mexico, and bands of marsh border the coast. Soils are fine textured and made up of dark clay, clay loam, and sandy clay loam which drain poorly, therefore much of the soils remain wet for parts of the year.

The southern most portion of this basin is comprised of coastal marshes that receive the bulk of their nutrients and sediments from the Neches and Trinity Rivers to the north. Several bayous, streams, tidal channels, and canals flow through this coastal basin and common vegetation includes oaks, sweetgum, common reed (*Phragmites australis*), cordgrasses (*Spartina* spp.), sedges (*Carex* sp.and *Cyperus* sp.), bulrushes (*Scirpus* spp.), and rushes (*Juncus* spp.). The historical vegetation was mostly tallgrass prairies and Post Oak savannas, but due to fire suppression, agriculture, and urban development this has resulted in invasive species and various types of oak becoming more common. Large areas of the coastal basin have been converted to na-

tional wildlife refuges. Animals that are native to the coastal basin include Roseate Spoonbills (*Ajaja ajaja*), Laughing Gulls (*Larus atricilla*), River Otters (*Lutra Canadensis*), the endangered Houston Toad (*Bufo houstonensis*), and the American alligator (*Alligator mississippiensis*).

The Neches-Trinity Coastal Basin consists of four segments which are routinely monitored by the TCEQ Region 10 Field Office. Taylor Bayou (Segment 0701) and Hillebrandt Bayou (Segment 0704) are the primary inland drainage ways. The headwaters of Taylor and Hillebrandt Bayous originate in the northern and western parts of Jefferson County and southeast Liberty County. From here, the bayous meander south and southeasterly, before emptying into the Intracoastal Waterway, Sabine Lake, and Sabine Pass. Other tributaries and waterbodies in the coastal basin monitored by TCEQ include Taylor Bayou North Fork, Shallow Prong Lake, Bayou Din, and Alligator Bayou.

*Neches-Trinity Coastal Basin Water Quality Characteristics*

Water bodies in the Neches-Trinity Coastal Basin are tidally influenced and tend to be brackish in all segments. Area water bodies with low dissolved oxygen have sluggish flow and/or low atmospheric aeration capabilities, which can be further aggravated by point and non-point sources pollution. These conditions contribute to depressed dissolved oxygen concentrations in the basin. Non-point sources of pollution due to municipal, agricultural and industrial uses may also contribute to the water quality impairments and concerns for bacteria and nutrients.

## 2.0 PUBLIC INVOLVEMENT

The Lower Neches Valley Authority's Clean Rivers Program (CRP) stakeholder participation and public outreach program includes a number of activities and events that insures the public understands the role they play in protecting our valuable water resources. These activities target audiences of all ages. Public involvement is essential to LNVA meeting the goals of the Clean Rivers Program.

LNVA's stakeholder participation process includes the CRP Steering Committee. The basin Steering Committee consists of stakeholders representing local industry and municipalities, state and federal agencies, tribal groups, environmental groups, and the general public. A diverse basin-wide committee insures that the different interests, concerns, and priorities of each watershed are represented. The main objectives of the committee are to assist with creation of realistic water quality objectives and basin priorities, the review and development of work plans and allocation of resources, and the establishment of monitoring priorities. Members are encouraged to voice any local or regional concerns they may have as well as to consider the interests of the basin as a whole.

The CRP Steering Committee meets publicly at least once a year to discuss water quality issues in the basin. For more information on LNVA's CRP Steering Committee, how to become involved, or when the meetings are scheduled, please contact LNVA at (409) 892-4011.

*LNVA Web Page,* http://www.lnva.dst.tx.us

LNVA is the water quality data clearinghouse for the Lower Neches River Basin and Neches-Trinity Coastal Basin and maintains a web page for easy public access. The web page includes information about LNVA and our projects, but it is a source of information for the Clean Rivers Program as well.

Surface water quality monitoring (SWQM) data is available on the Clean Rivers Program section of the LNVA website. A link to TCEQ's Surface Water Quality Data Viewer is provided and water quality monitoring stations can be selected by basin or segment. By selecting a particular station ID number, the user can access data collected for the station and waterbody.

In addition to monitoring data, the LNVA web page includes a CRP overview, LNVA basin reports, Quality Assurance Project Plan (QAPP), CRP workplan summary, Coordinated Monitoring Schedule (CMS), CRP meeting announcements, and links to other websites including other CRP planning agencies, Texas Stream Team volunteer monitoring program, and the Major Rivers program.

*Public Education Materials and Programs*

*LNVA staff delivers the Major Rivers curriculum to elementary schools in the basin.*

Since 2009, LNVA has been a partner in the Texas Stream Team program. The Texas Stream Team, previously called Texas Watch, is a statewide volunteer network that began in 1991 and operates out of Texas State University in San Marcos. Volunteers are trained to monitor water bodies they select on a monthly basis for parameters such as *E. coli*, dissolved oxygen, pH, water temperature, and conductivity. LNVA provides volunteer monitors with water quality test kits, supplies and refill reagents for monitoring activities in the basin. Current volunteer monitoring stations include the Neches River at LNVA's Saltwater Barrier in Beaumont, Village Creek at Hwy. 96 north of Lumberton and Village Creek State Park, Neches River at Port Neches Park, and Adams Bayou at the Shangri-La Gardens in Orange. For additional information please visit the following website: http://www.meadowscenter.txstate.edu/Service/TexasStreamTeam.html

LNVA also sponsors the Major Rivers curriculum which is designed to help 4th and 5th grade students learn about Texas' major water resources, how water is treated and delivered to their homes and schools, and how to care for their water resources and use them wisely. This popular educational tool sponsored by the Texas Water Development Board supplies students and teachers with an introductory video, student workbooks, and teachers' guides. Major Rivers and his horse Aquifer cover topics in eight lessons that include a variety of activities in science, math, language arts, social studies and other subjects. Major Rivers cover topics such as defining a watershed, Texas' water supply, water use, water treatment and water conservation. This is a valuable tool serving not only to educate students about water but also reaching their families as well. LNVA continues providing Major Rivers free of charge to area schools, teachers, and students which over the years has included over 50 schools and 300 classrooms.

# 3.0 WATER QUALITY REVIEW

## 3.1 Water Quality Terminology

***Chloride***

Chloride is an essential element for maintaining normal physiological functions in all organisms. Concentrations can vary due to natural weathering and leaching of sedimentary rocks, soils, and salt deposits that release chloride into the environment. Other sources can be attributed to oil exploration and storage, sewage and industrial discharges, runoff from dumps and landfills, and saltwater intrusion. However, elevated chloride concentrations can disrupt osmotic pressure, water balance, and acid/base balances in aquatic organisms which can adversely affect survival, growth and/or reproduction. Small amounts are required for normal cell functions in plants and animal life, but high levels will corrode metals and contaminate irrigation water. Therefore, industrial and municipal water that is processed and agricultural water will have permissible chloride limits.

***Dissolved Oxygen (DO)***

Dissolved oxygen is necessary to support a healthy biological community, and is measured to determine support of the aquatic life use. DO is usually a good overall indicator of water quality. Water obtains oxygen by diffusion from atmospheric oxygen and as a result of photosynthesis. The stream standard for DO may vary across the state, but a high aquatic life use standard is 5.0 mg/L based on a 24-hour average and 3.0 mg/L is the minimum allowed at any one time.

***Bacteria***

The presence of high levels of bacteria indicates contamination from the waste of warm-blooded animals. This contamination could come from improperly treated wastewater, faulty septic systems or wildlife. Regardless of the source, elevated bacteria levels can indicate a possible health risk to those coming into contact with the water. The indicator bacteria is *E. coli* (freshwater) and *Enterococcus* (tidal/saltwater) for the contact recreation use support in accordance with the *Texas Surface Water Quality Standards*.

***Nutrients***

The nutrients routinely monitored are compounds of nitrogen and phosphorous. All animals produce nitrogenous wastes after proteins are digested and metabolized in the body. In aquatic animals, ammonia is the primary waste product. Ammonia also comes from the degradation of proteins from dead plant or animal matter. Some algae and bacteria use ammonia for growth and reproduction, and breakdown ammonia into nitrite which is ultimately converted into nitrate through a process called nitrification.

Nitrogen present in the form of ammonia-nitrogen and total nitrate-nitrite can identify that pollutants are being introduced to a stream. Nitrogen compounds can be lethal to the aquatic community in high concentrations. High ammonia levels can occur at any time of the year, but are more likely in the summer months due to higher metabolic rates.

Phosphorus is an essential element for plant growth and often primary productivity in the water is determined by the amount of phosphorus present. This nutrient can enter streams through runoff from fertilizer or from the dissolution of rocks. Most phosphorus ultimately ends up being absorbed by mud in an aquatic environment. In elemental form, phosphorus is very toxic and subject to bioaccumulation.

Phosphate will stimulate the growth of plankton and aquatic plants which provide food for fish. This may cause an increase in the fish population and improve the overall water quality. However, if an excess of phosphate enters the waterway, algae and aquatic plants will grow wildly, choke up the waterway and use up large amounts of oxygen. This condition is known as eutrophication or over-fertilization of receiving waters. This rapid growth of aquatic vegetation eventually dies and as it decays it uses up oxygen. This process in turn causes the death of aquatic life because of the lowering of dissolved oxygen levels.

Chlorophyll is the photosynthetic, green pigment found in most plants, algae, and cyanobacteria. The concentration of chlorophyll *a* is used to estimate phytoplankton biomass in surface water. In aquatic environments, enhanced growth of choking aquatic vegetation or phytoplankton (e.g. algal blooms) disrupts normal functioning of the ecosystem, causing a variety of problems such as a lack of oxygen in the water.

Surface Water Quality Standards have not been approved for the nutrient parameters in Texas. Concerns for general uses are identified with screening levels for nutrients and chlorophyll *a* (see Table 3.2-2) for both classified and unclassified segments or water bodies.

***pH***

The term pH is used universally to express the intensity of the acid or alkaline condition of a solution. The pH scale is represented as a range from 0 to 14, with 7 being neutral. Streams located in southeast Texas are typically characterized by low pH (mildly acidic) due to tannic acids produced from the decay of rotting forest material. The stream standard for pH is expressed as a range, typically 6.0 to 8.5 pH units. Levels outside of the stream standard range can adversely affect the aquatic life, and cause significant problems when considering water and wastewater treatment activities. pH cycles can vary on a daily basis due to the processes of respiration and photosynthesis. The type of rock and soil in a body of water affect pH, as well as the amount of dead organic matter present.

***Total Dissolved Solids (TDS)***

Solids that are dissolved in the water column consist mainly of carbonates, bicarbonates, chlo-

rides, and sulfates. TDS is sometimes referred to as the total salinity and is measured or expressed in parts per million (ppm) or in the equivalent units of milligrams per liter (mg/L). High TDS or total salinity in the environment can affect the permeability of ions in aquatic organisms, and it will have negative impacts on the industrial, agricultural and domestic uses of water. It affects the aesthetic quality of water, corrodes plumbing fixtures, reduces crop yields. Generally, forage crops are the most resistant to salinity, followed by field crops, vegetable crops, and fruit crops which are generally the most sensitive.

Mineral springs, carbonate deposits, salt deposits, and seawater intrusion are sources for naturally occurring high concentrations of TDS. Other sources may include oil and natural gas exploration, drinking water treatment chemicals, storm water and agricultural runoff, and wastewater discharges. In the lower Neches River Basin, TDS levels are generally less than 200 mg/L, whereas in the Neches-Trinity Coastal Basin concentrations can range from 300 to 5,000 mg/L. However, TDS water quality standards will vary from segment to segment (see Table 3.2-1).

***Sulfate***

Sulfate can be dissolved in any natural waters. Concentrations of this ion usually varies greatly from one watershed to another due to the natural availability in rocks and soils. Sulfate is collected during routine monitoring and data results compared to general use criteria. Excessive amounts of sulfate can cause taste and odor problems in water treatment, and scaling in boilers and heat exchangers used for industrial purposes. Typical sulfate levels range from 15 to 20 mg/L in the lower Neches River Basin and 30 to 55 mg/L in the Neches-Trinity Coastal Basin. The sulfate stream standard varies from segment to segment (see Table 3.2-1).

***Metals***

The effects of metals in water and wastewater range from beneficial through troublesome to dangerously toxic. Some metals are essential to plant and animal growth while others may adversely affect water consumers, wastewater treatment systems, and receiving waters. The benefits versus toxicity of some metals depend on their concentrations in waters (22nd Edition, Standard Methods, 2012).

The primary mechanism for toxicity to organisms that live in the water column is by absorption to or uptake across the gills: this physiological process requires metal to be in a dissolved form. This is not to say that particulate metal is nontoxic, only that particulate metal appears to exhibit substantially less toxicity than does dissolved metal (U.S. EPA).

Dissolved metals are un-acidified samples that pass through a 0.45 micrometer membrane filter which better represent the bioavailable fraction of metal in the water column. Total recoverable metals are not tightly bound and are biologically available to aquatic organisms. Total metals includes all metals, inorganically and organically bound, both dissolved and particulate that will give an unrealistic high value of those metals that are biologically available to aquat-

ic organisms.

Not all metals are acutely toxic in small concentrations. The "heavy metals" include copper (Cu), iron (Fe), cadmium (Cd), zinc (Zn), mercury (Hg), and lead (Pb) which are the most toxic to aquatic organisms. Some water quality characteristics which affect metal toxicity include temperature, pH, hardness, alkalinity, suspended solids, redox potential and dissolved organic carbon. Metals can bind to many organic and inorganic compounds which reduces the toxicity of the metal. High concentrations of metals can be a health threat to both humans and aquatic life. Metals can affect drinking water supplies and will accumulate in fish tissue to levels not suitable for human consumption. Dangerous levels of metals can be identified through the chemical analysis of water, sediment, and fish tissue. Dissolved metals in water are routinely analyzed by TCEQ to determine support of the aquatic life use. The freshwater acute and chronic criteria for metals such as Cd, Cu, Pb, Nickel, and Zn are based on site specific hardness data collected during metals sampling and surface water quality monitoring.

***Surface Water Quality Monitoring (SWQM)***

The Surface Water Quality Monitoring (SWQM) Program monitors and evaluates physical, chemical, and biological characteristics of aquatic systems as a basis for effective policy. The SWQM program coordinates the collection of physical, chemical, and biological samples from more than 1,800 surface water sites statewide. This data may be used by TCEQ to characterize existing conditions or identify emerging problems, evaluate the effectiveness of water quality control programs, or identify trends. This data may also be used to determine compliance with the Texas Surface Water Quality Standards through the Texas Integrated Report.

SWQM data and assessment results provide a basis for effective policies that promote the protection, restoration, and wise use of surface water in Texas. It is implemented by the TCEQ central office, TCEQ regional offices, river authorities, state contractors, researchers, universities, and other units of government involved in the Texas Clean Rivers Program.

***Quality Assurance Project Plan (QAPP)***

A QAPP is a legally defensible plan that clearly outlines quality assurance (QA) policy, management structure, and procedures which are used to implement the QA requirements necessary to verify and validate surface water quality data collected. Every contractor with the TCEQ and Clean Rivers Program must follow an approved QAPP to collect data for the SWQM program. The QAPP is reviewed and updated annually to insure all field, laboratory, and data management procedures are included. QAPPs are developed and implemented in accordance with provisions of the Quality Management Plan for the Clean Rivers Program.

***Texas Surface Water Quality Standards (TSWQS)***

Texas Surface Water Quality Standards are state rules (Texas Administrative Code, Title 30, Chapter 307) written and adopted by the TCEQ under the authority of the Clean Water Act

and Texas Water Code. The Standards establish explicit goals for the quality of streams, lakes, and bays throughout the state. They also identify appropriate uses for the state's surface waters, including aquatic life, contact or non-contact recreation, and source of public water supply (or drinking water). Statewide standards may be revised on a site-specific basis when sufficient information is available.

***Texas Integrated Report (IR)***

Formerly called the "Texas Water Quality Inventory and 303(d) List," the TCEQ's Texas Integrated Report of Surface Water Quality evaluates the quality of surface waters in Texas, and provides resource managers with a tool for making informed decisions when directing agency programs. The Texas Integrated Report is a requirement of the federal Clean Water Act Sections 305(b) and 303(d). The Texas Integrated Report describes the status of Texas' natural waters based on historical data. It assigns waterways to various categories depending on the extent to which they attain the Texas Surface Water Quality Standards (TSWQS), which were developed to define water quality and the criteria for which that quality is measured. The TCEQ produces a new report every two years in even-numbered years, as required by law. The 303(d) List must be approved by the EPA before it is final. Each river basin in Texas is assigned a TCEQ assessor who works closely with CRP planning agencies and other data collectors to insure adequate water quality data for assessment.

***Total Maximum Daily Load (TMDL)***

A scientific model or study which determines the maximum amount of a pollutant that a water body can receive and still both attain and maintain its water quality standards. A TMDL allocates this allowable amount, or load, to point and non-point sources in the watershed. A Category 5 water body may require a TMDL which is usually prepared for one or more parameters on the Texas 303(d) List of Impaired Waters. TMDLs must be submitted to the Environmental Protection Agency (EPA) for review and approval.

***Use Attainability Analysis (UAA)***

A UAA addresses possible and existing uses for a body of water, and uses historical, biological, physiochemical, and habitat data to evaluate the specific body of water. This consists of a multi-step assessment of the physical, chemical, biological, and economic factors affecting the attainment of a use. UAAs are used to determine if existing criteria and uses described in the TSWQS are appropriate.

***Ambient Water Reporting Limit (AWRL)***

For surface water to be evaluated for compliance with Texas Surface Water Quality Standards (TSWQS) and screening levels, data must be reported at or below specified levels. To insure data are collected at or below these levels, required ambient water reporting limits (AWRL), previously known as minimum analytical levels (MAL), were established early in the Clean

Rivers Program. These reporting limits adopted by CRP apply to all data collected and submitted to the program. A full listing of current AWRLs is available on the TCEQ web page at: http://www.tceq.state.tx.us/waterquality/clean-rivers/qa/index.html

***Segment (Classified & Unclassified)***

A classified segment is a water body or portion of a water body which is individually defined in Appendix A of the *Texas Surface Water Quality Standards*. These segments have designated uses and water quality criteria. Each segment is given a number which identifies the river basin and segment. For example, the Neches River Tidal segment number is 0601. The next upstream most segment is 0602. A segment is intended to have relatively homogenous chemical, physical, and hydrological characteristics. A segment provides a basic unit for assigning site-specific standards and water quality management programs in Texas. Classified segments may include streams, rivers, bays, estuaries, lakes, or reservoirs.

Unclassified streams are water bodies not defined in Appendix A of the TSWQS. For assessment purposes, unclassified segments not in the TSWQS will be referenced to the classified segments described in the Appendix A. These smaller tributaries are often assumed to meet the same criteria as the larger classified segments. Each unclassified water body is given a number which ties it to the classified segment with a letter designation. For example, 0601A, is a small stream which flows into Segment 0601 of the Neches River. This also applies to certain unclassified water bodies given site specific descriptions and criteria and listed in Appendix D of the TSWQS.

***Assessment Unit (AU)***

Segments are divided into what is known as assessment units (AU). AU is defined as the smallest geographic area of use support for the 305(b) assessment in the Texas Integrated Report. Support of criteria and uses are examined for each AU. An AU ID is a unique assessment unit code and is a six or seven-digit identifier (e.g. 0601A_01) that describes the location of the specific area assessed. A segment may consist of one or more AU's, and an AU may contain multiple station ID's or sampling stations.

***Seven-day, two-year low-flow (7Q2)***

The 7Q2 value is the lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data. Some water quality standards do not apply at stream flows which are less than the 7Q2 flow.

***Geometric mean (Geomean)***

Geomean is a mathematical term that is defined as an average that indicates the central tendency or typical value of a set of numbers. The TSWQS uses the geomean of bacteria samples in freshwater and saltwater to determine compliance with the contact recreation use criteria.

***Contact Recreation Use (PCR, SCR, NCR)***

Defined in the TSWQS for each segment, primary contact recreation (PCR) uses are activities that are presumed to involve a significant risk of ingestion of water (e.g. wading by children, swimming, water skiing, diving, tubing, surfing, and the following whitewater activities: kayaking, canoeing, and rafting). Secondary contact recreation (SCR) uses are activities that commonly occur but have limited body contact incidental to shoreline activity (e.g. fishing, canoeing, kayaking, rafting and motor boating). These activities are presumed to pose a less significant risk of water ingestion than primary contact recreation. Non-contact recreation (NCR) uses are activities that do not involve a significant risk of water ingestion, such as those with limited body contact incidental to shoreline activity, including birding, hiking, and biking. Non-contact recreation use may also be assigned where primary and secondary contact recreation activities should not occur because of unsafe conditions, such as ship and barge traffic.

***Aquatic Life Use (ALU)***

Each classified segment in the TSWQS is assigned an aquatic life use, based on physical, chemical, and biological characteristics of the water body. The five aquatic life use (ALU) categories are exceptional, high, intermediate, limited, or minimal (no significant) aquatic life use. Support of the ALU is based on the assessment of dissolved oxygen criteria, toxic substances in water criteria, ambient water and sediment toxicity test results, and indices for habitat, benthic macroinvertebrate and fish community, provided that the minimum number of samples are available.

For freshwater streams not classified in the TSWQS, the ALU and criteria are presumed based on the stream flow type. Stream flow type; perennial, intermittent with pools, or intermittent; is established from flow data associated with SWQM samples. Unclassified perennial streams are presumed to have a high ALU and corresponding DO criterion of 5.0 mg/L for average DO. Unclassified intermittent streams with significant ALU created by perennial pools are presumed to have limited ALUs (protected by a 3.0 mg/L criterion for average dissolved oxygen). Intermittent streams without perennial pools are presumed to have minimal ALUs (protected by a 2.0 mg/L average criterion).

***General Use***

Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for protection of one specific use. The general use criteria are established for each segment to insure healthy conditions and aesthetics. Parameters include water temperature, pH range, chloride, sulfate, TDS, and nutrients. Suitability for use as a public water supply is also assessed based on the water quality conditions and concentrations of parameters listed above. However, criteria developed for classified segments do not apply to unclassified water bodies. Concerns for general uses are identified with screening levels for nutrients and chlorophyll *a* (see Table 3.2-2) for both classified and unclassified water bodies. Although other concerns are reported for general use, attainment of the general use for unclassified water bodies is not assessed and therefore not reported.

## 3.2 Data Review Methodology

The data analysis and review methods used to evaluate water quality conditions in this report are based on the TCEQ's *Guidance for Assessing and Reporting Surface Water Quality in Texas* which is available at http://www.tceq.state.tx.us/waterquality/assessment/305_303.html.

The 2012 Texas Integrated Report of Surface Water Quality was approved by the EPA on May 9, 2013. The Draft 2014 Texas Integrated Report was issued by the TCEQ on December 19, 2014 for public comment. The TCEQ has addressed all comments submitted during the comment period that ended on February 2, 2015. The Commission adopted the Draft 2014 Texas 303(d) List on June 3, 2015.

The Draft 2014 Texas Integrated Report was primarily used in completing the Basin Summary Report, and the period of record used in the 2014 Draft Texas Integrated Report is a seven year period from December 1, 2005 to November 30, 2012. Samples from those seven years were evaluated, and if necessary, the most recent samples collected in the preceding three years (December 1, 2002 to November 30, 2005) may also be used to meet the requirements for minimum sample number. At least ten samples over the ten-year period are required for assessment of use attainment (listing and delisting). However, less than the required number of samples can be used to identify nonsupport for use attainment purposes if the threshold number of exceedances for these parameters is met when using the binomial method.

The Texas 303(d) List of impaired waters is submitted by the TCEQ to EPA every two years in even-numbered years as required by law, and it must be approved by the EPA before it is considered final. The 2012 Texas 303(d) List has been approved by EPA, and it was used as a reference tool in this report, as well as the Draft 2014 Texas 303(d) List. The segment specific criteria established in the 2014 Texas Surface Water Quality Standards (TSWQS), which are summarized in Table 3.2-1 for the classified segments in the Lower Neches River and Neches-Trinity Coastal Basins, were used to determine designated use support. Each segment is assigned a water quality category by the TCEQ, and each category indicates the status of water quality in the segment. Categories 4 and 5 are further subdivided to communicate the plans TCEQ has for addressing a particular water quality impairment.

LNVA's data review process utilized surface water quality monitoring data collected by LNVA and TCEQ stored in the Surface Water Quality Monitoring Information System (SWQMIS) database for Basin 6 (Neches) and Basin 7 (Neches-Trinity), which was downloaded from the TCEQ's SWQMIS website. The database tables were imported into Microsoft Excel where they were queried by segment, station ID, end depth, end date, time collected, parameter code, and value. Ten years of data was queried (2004-2014) to determine if any trends existed for certain parameters. In cases where additional data was available and the period of record did not meet the minimum number of samples required (20), more recent data was included in the data review process to complete the dataset. The tributaries or unclassified water bodies in each segment were assessed using the same criteria established for the associated classified segment. The parameters queried in this report included pH, temperature, specific conductance, flow, dissolved oxygen, turbidity, dissolved metals in water, ammonia-nitrogen, total nitrate plus nitrite,

total phosphorus, *E. coli*, *Enterococcus* and chlorophyll *a*.

Appropriate water uses, such as aquatic life use, contact recreation use, and general use, are designated for each classified segment. TCEQ has established screening levels to provide a quantitative basis for evaluating water quality concerns. Support of the aquatic life use is based on the dissolved oxygen criteria, toxic substances in water (metals and organics) and sediment, and biological screening levels for habitat, macrobenthos, and fish. Each criteria set is evaluated independently of the others, and the use support level identified when any of the individual criteria are not attained. Support of designated uses and water quality criteria are classified as fully supporting (FS), no concern (NC), use concern (CN), screening level concern (CS), and not supporting (NS).

The contact recreation use is designated for most water bodies in Texas, except where primary and secondary contact recreation should not occur because of unsafe conditions. Full support of the contact recreation use is not a guarantee that the water is completely safe of disease-causing organisms. Samples collected for *E. coli* bacteria are used to determine support of the contact recreation use for non-tidal segments and *Enterococcus* bacteria are used in tidal segments. Use support is determined based on the geometric mean or geomean. The geomean of *E. coli* should not exceed 126 colonies per 100 ml and *Enterococcus* should not exceed 35 colonies per 100 ml. Water bodies either fully support or do not support the contact recreation use based on the above criteria.

Nutrients and chlorophyll *a* stream standards have not been adopted by TCEQ for Texas water bodies. Therefore, screening levels were statistically derived from long-term SWQM monitoring data. The 85$^{th}$ percentile values for each parameter in freshwater streams, tidal streams, reservoirs, and estuaries are listed in Table 3.2-2. A concern for water quality is identified if the screening level is exceeded greater than 20 percent of the time using the binomial method, based on the number of exceedances for a given sample size.

General use criteria are established in the TSWQS to safeguard water quality conditions in each segment. Parameters include water temperature, pH, chloride, sulfate, and total dissolved solids (TDS). Criteria for each parameter are assigned to the classified segment based on physical, chemical, and biological characteristics. Although other concerns are reported for general use, attainment of the general use for unclassified water bodies is not assessed and therefore not reported. Support of general use water quality criteria based on water temperature and pH can be classified as fully supporting or not supporting. Criteria established in the TSWQS for chloride, sulfate and TDS represent annual averages (see Table 3.2-1).

*Trend Analysis*

Simple linear regression analysis and correlation techniques along with best professional judgment were used to illustrate and determine if water quality trends existed. Trend lines were incorporated into graphs using Microsoft Excel software. If available, monitoring sites were also analyzed versus flow to produce a better understanding of the water quality conditions. Trends were considered significant with t-ratios $\geq |2|$ and p-values $< 0.1$.

# Table 3.2-1: Segment Specific Surface Water Quality Standards

| SEGMENT NUMBER | SEGMENT NAME | USES | | | CRITERIA | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 601 | Neches River Tidal | PCR | I | | | | | 3.0 | 6.0-8.5 | 35 | 95 |
| 602 | Neches River below B.A. Steinhagen Lake | PCR | H | PS | 50 | 50 | 200 | 5.0 | 6.0-8.5 | 126 | 91 |
| 603 | B.A. Steinhagen Lake | PCR | H | PS | 50 | 50 | 200 | 5.0 | 6.0-8.5 | 126 | 93 |
| 607 | Pine Island Bayou | PCR | H | PS | 150 | 50 | 300 | 3.0 | 6.0-8.5 | 126 | 95 |
| 608 | Village Creek | PCR | H | PS | 150 | 75 | 300 | 5.0 | 5.5-8.0 | 126 | 90 |
| 609 | Angelina River below Sam Rayburn Reservoir | PCR | H | PS | 70 | 50 | 250 | 5.0 | 6.0-8.5 | 126 | 90 |
| 701 | Taylor Bayou above Tidal | PCR | I | | 400 | 100 | 1100 | 4.0 | 6.5-9.0 | 126 | 95 |
| 702 | Intracoastal Waterway Tidal | PCR | H | | | | | 4.0 | 6.5-9.0 | 35 | 95 |
| 703 | Sabine-Neches Canal Tidal | PCR | H | | | | | 4.0 | 6.5-9.0 | 35 | 95 |
| 704 | Hillebrandt Bayou | PCR | I | | 250 | 100 | 600 | 4.0 | 6.5-9.0 | 126 | 95 |

Source: 30 TAC Rule §307.10(1) Appendix A - Site-specific Uses and Crieria for Classified Segments, effective March 6, 2014.

**USES**

1. Recreation*
   - PCR - Primary Contact Recreation
2. Aquatic Life
   - E - Exceptional
   - H - High
   - I - Intermediate
   - L - Limited
   - M - Minimal
3. Domestic Water Supply
   - PS - Public Supply

**CRITERIA**

4. Chloride (mg/L) — Annual Average - Not to exceed
5. Sulfate (mg/L) — Annual Average - Not to exceed
6. Total Dissolved Solids (mg/L) — Annual Average - Not to exceed
7. Dissolved Oxygen (mg/L) — 24 hour average - Not to exceed
8. pH Range (standard units) — Absolute minima and maxima
9. Indicator Bacteria* (#/100mL) — Geometric mean - Not to exceed
   - *E. coli* (freshwater)
   - *Enterococci* (saltwater)
10. Temperature (°F) — Absolute maxima

*Standards for recreation use and indicator bacteria criteria from 2010 Texas Water Quality Standards remain in effect until EPA approves 2014 Standards.

**Table 3.2-2: TCEQ Screening Levels for Nutrient Parameters**

| Water Body Type | Nutrients | Screening Level |
|---|---|---|
| Freshwater Stream | $NH_3$-N | 0.33 mg/L |
| | $NO_3$-N | 1.95 mg/L |
| | OP | 0.37 mg/L |
| | TP | 0.69 mg/L |
| | Chl *a* | 14.1 mg/L |
| Reservoir | $NH_3$-N | 0.11 mg/L |
| | $NO_3$-N | 0.37 mg/L |
| | OP | 0.05 mg/L |
| | TP | 0.20 mg/L |
| | Chl *a* | 26.7 mg/L |
| Tidal Stream | $NH_3$-N | 0.46 mg/L |
| | $NO_3$-N | 1.10 mg/L |
| | OP | 0.46 mg/L |
| | TP | 0.66 mg/L |
| | Chl *a* | 21.0 mg/L |
| Estuary | $NH_3$-N | 0.10 mg/L |
| | $NO_3$-N | 0.17 mg/L |
| | OP | 0.19 mg/L |
| | TP | 0.21 mg/L |
| | Chl *a* | 11.6 mg/L |

Table Reference: *2014 Draft Guidance for Assessing and Reporting Surface Water Quality in Texas, June 3, 2015.*

## 3.3 Watershed Summaries

The purpose of this section is to provide a review of water quality data and watershed characteristics for each classified segment in the Neches River and Neches-Trinity Coastal Basins. Each summary includes watershed maps showing the classified segments, hydrology, surface water quality monitoring stations, cities, highways, recreation areas, and land use coverages. A comprehensive review of the water quality data based on trend analysis results and TCEQ's Draft 2014 Texas Integrated Report will identify and explain water quality issues, determine possible effects, and make recommendations to address water quality impairments and concerns.

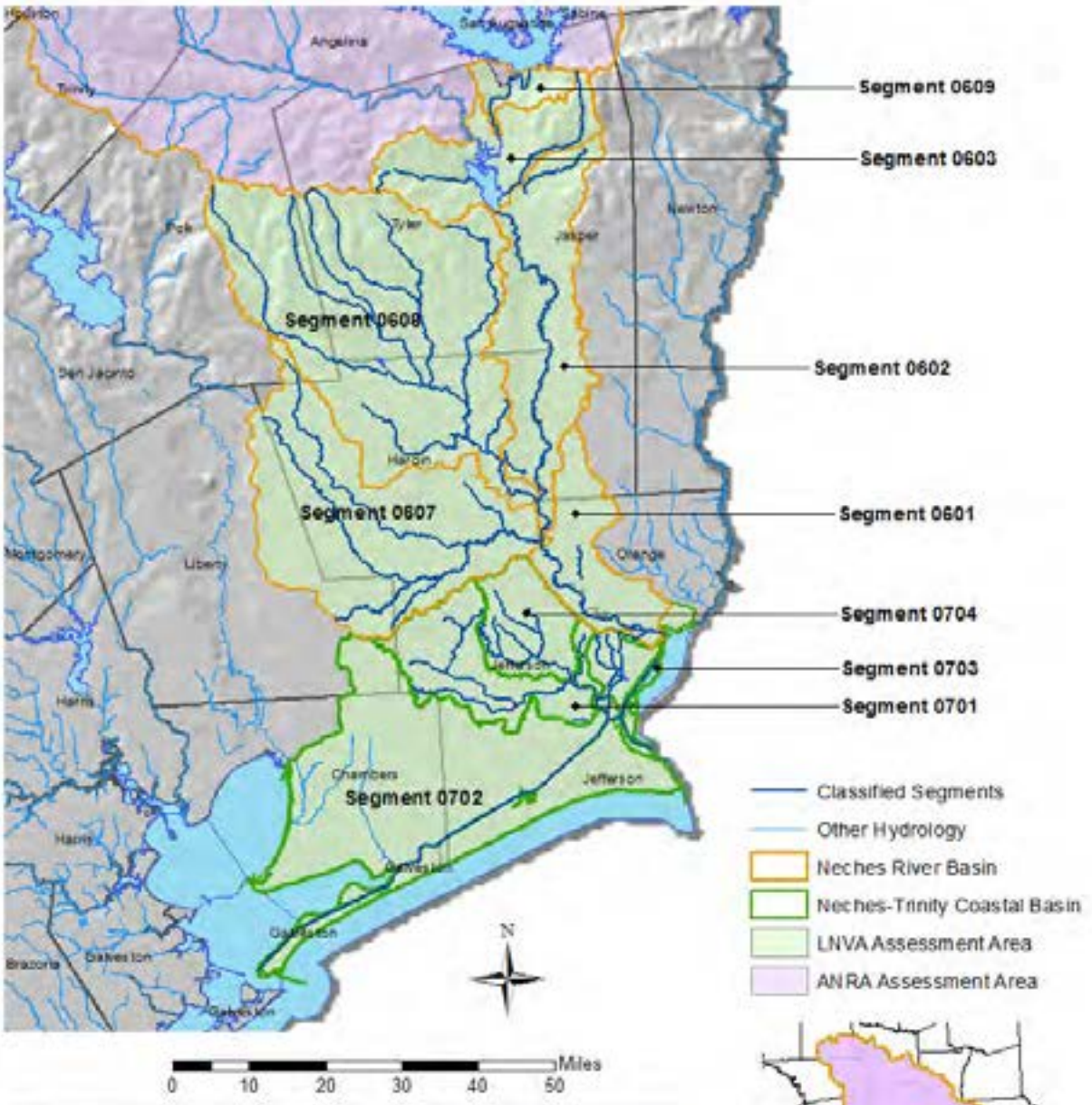
For this report, a watershed is defined by a classified segment and the land/tributaries that drain to it. This allows for the grouping of monitoring stations and water quality data in close geographic proximity with similar watershed characteristics. The watersheds are based on the TSWQS classified segments in the LNVA assessment area and their associated tributaries. All active and some historical surface water quality monitoring (SWQM) stations for both LNVA and TCEQ are included on the watershed maps for each segment. The SWQM stations are identified by unique Station ID numbers assigned by the TCEQ.

The LNVA assessment area consists of the Lower Neches River Basin and the Neches-Trinity Coastal Basin, encompassing ten classified segments as shown in Figure 600.1. The watershed summaries are presented in the order listed on the embedded table in Figure 600.1.

The goal of this section is to identify, describe, and analyze water quality impairments and concerns, determine causes and possible sources, and finally to make recommendations on what should be done to address any water quality issues.

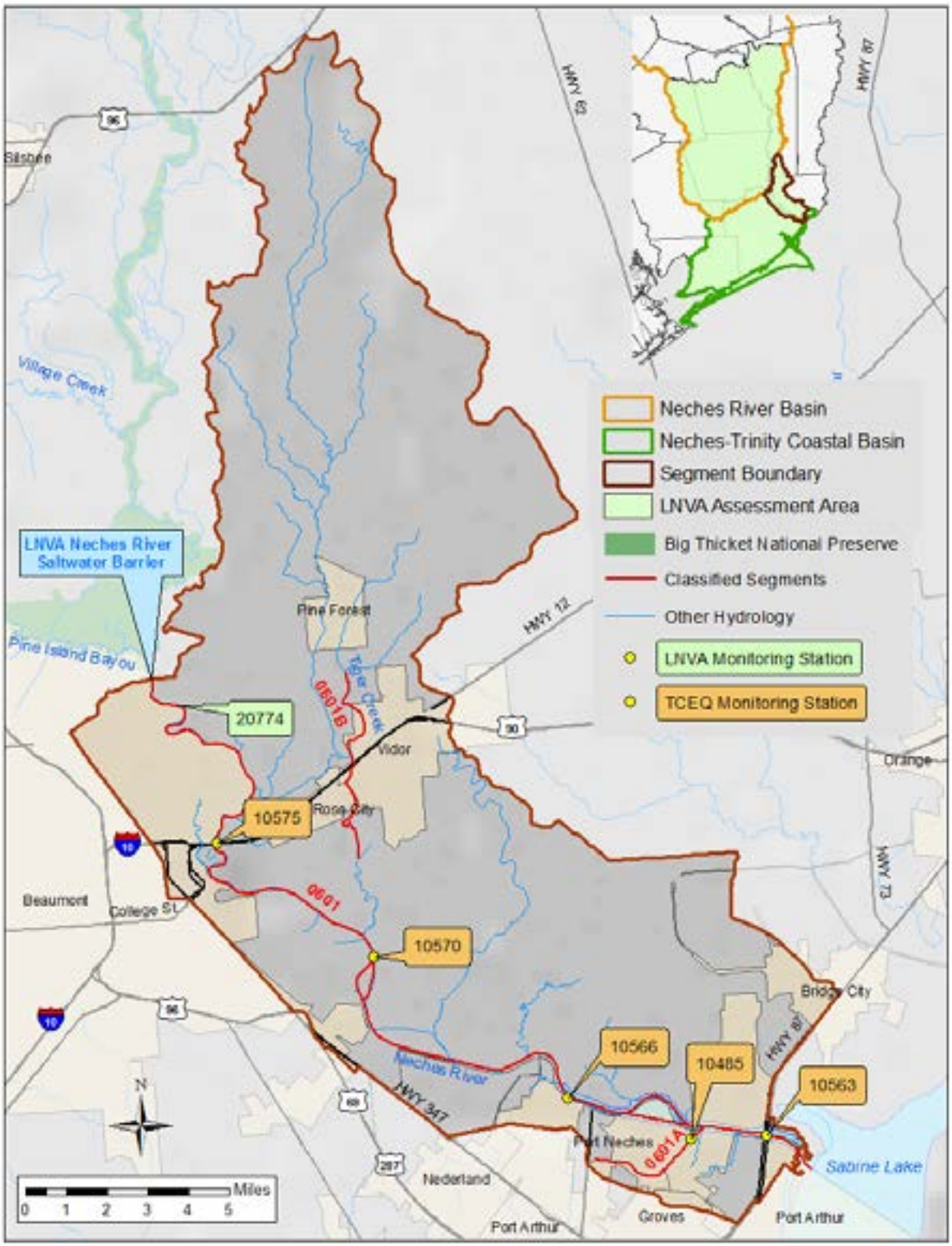
*Aerial view of the Neches River Saltwater Barrier located in Beaumont, Texas*

**Figure 600.1—LNVA Assessment Area and Classified Segments**



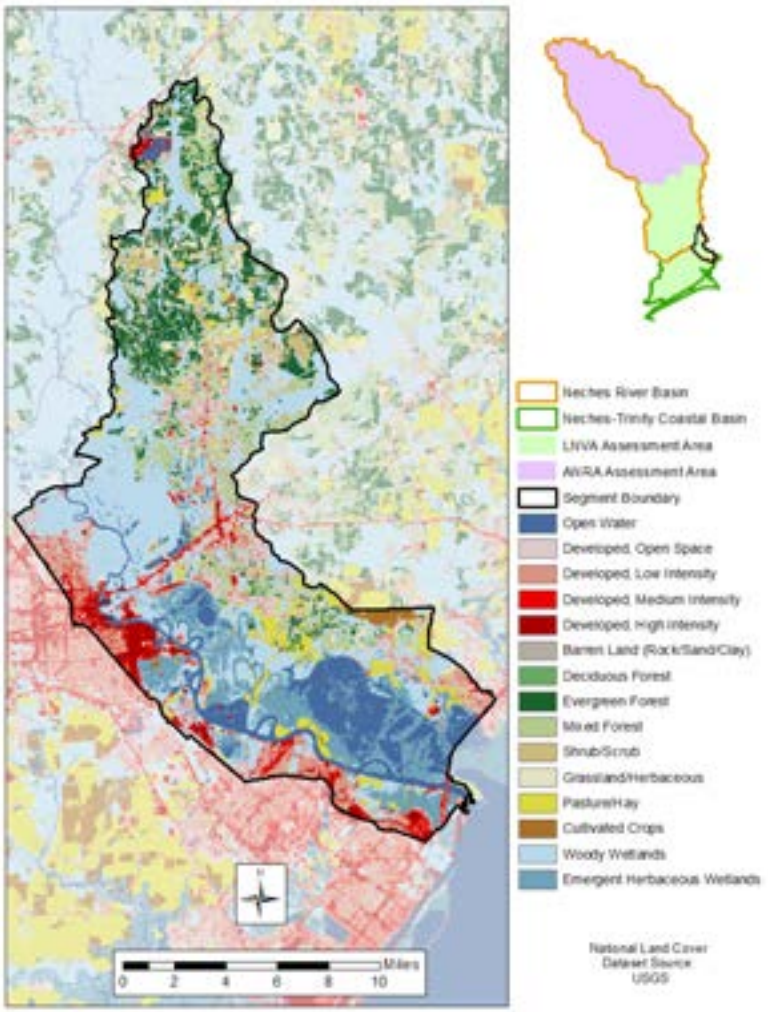

| Segment Number | Segment Name |
|---|---|
| 0601 | Neches River Tidal |
| 0602 | Neches River below B. A. Steinhagen Lake |
| 0603 | B. A. Steinhagen Lake |
| 0607 | Pine Island Bayou |
| 0608 | Village Creek |
| 0609 | Angelina River below Sam Rayburn Reservoir |
| 0701 | Taylor Bayou above Tidal |
| 0702 | Intracoastal Waterway Tidal |
| 0703 | Sabine/Neches Canal Tidal |
| 0704 | Hillebrandt Bayou |

# Segment 0601 – Neches River Tidal



*Watershed Characteristics*

**Figure 601.1: Land Use Map for Segment 0601**




The Neches River Tidal (0601) is defined in the TSWQS as a river segment from the confluence with Sabine Lake in Orange County to the Neches River Saltwater Barrier, which is at a point 0.8 kilometers (0.5 miles) downstream of the confluence of Pine Island Bayou, [a point 11.3 kilometers (7.0 miles) upstream of IH 10] in Orange County. Below the I-10 bridge crossing in Beaumont, the segment is highly industrialized, consisting primarily of a navigation channel from the mouth of the river to the Port of Beaumont, which is maintained by the U.S. Army Corps of Engineers (USACE). This navigation channel has been dredged to 40 feet deep and widened to 400 feet in order to accommodate marine traffic and large vessels. A proposed USACE project would deepen this channel from 40 feet to 48 feet to accommodate larger ships that will be traveling through the Panama Canal, allowing them to reach local ports and critical industry along the waterway.

Segment 0601 is classified as a tidal stream segment with aquatic life use and contact recreation use designations. Located on the most southerly end of the Neches River, hydrologic influences on this segment include tidal exchange and freshwater inflows. This segment is where Level IV Ecoregions Northern Humid Gulf Coastal Prairies (34a) and Texas-Louisiana Coastal Marshes (34g) converge. The area has sandy, silty, and clayey substrates, and consists of low, flat plains with some of the area being tidal marshes with bayous. The mean annual precipitation here ranges from 37-58 inches and the mean temperature is 42/62 °F. Grasses and common reed (*Phragmites communis*) are fairly common in the lower part of Segment 0601, and grasses consist of little bluestem, yellow Indiangrass, switchgrass, and salt meadow cord grass. Few to no trees are present in the lower portion of this segment, although further upstream near the Saltwater Barrier the vegetation is dominated by water tolerant trees such as water tupelo (*Nyssa aquatica*), bald cypress (*Taxodium distichum*), willow (*Salix nigra*), and oaks (*Quercus* spp.).

*Boat Pass at the LNVA Saltwater Barrier*

The Neches River Saltwater Barrier was designed and constructed by the U.S. Army Corps of Engineers to protect critical freshwater intakes on the Neches River and Pine Island Bayou. The saltwater intrusion from the Gulf of Mexico and Sabine Lake to the Neches River Tidal segment can be substantial during periods of drought and low-flow conditions. Since 2003, this permanent Saltwater Barrier (SWB) which is operated and controlled by the local sponsor, LNVA, has conserved billions of gallons of freshwater previously used to remove saltwater from the lower Neches River channel. During the record drought of 2011, Neches River salinity levels immediately below the SWB were over 20 parts per thousand (ppt) and conductivity was approaching 35,000 µS/cm. However, Neches River specific conductance measurements were less than 185 µS/cm immediately above the SWB.

The Neches River SWB also improves navigation, provides additional access to the river and enhances fishing and recreational activities. The $32 million project includes a 4,500-square-foot administration building with a water quality laboratory, control room, and conference room; a 2,000-square-foot boathouse; public boat ramps; public restrooms; access road and parking lots.

Land use in Segment 0601 is primarily oil and gas production, along with marshland, wildlife and waterfowl habitat, cropland, and urban and industrial uses. Populated areas located in the watershed include the Cities of Beaumont, Nederland, Port Neches, and Groves.

The segment boundary is 27 miles long with an unclassified water body within this segment called Star Lake Canal (0601A) which is only three miles in length. TCEQ Region 10 currently monitors four stations on Segment 0601 and one station on Segment 0601A, and LNVA monitors one station on Segment 0601.

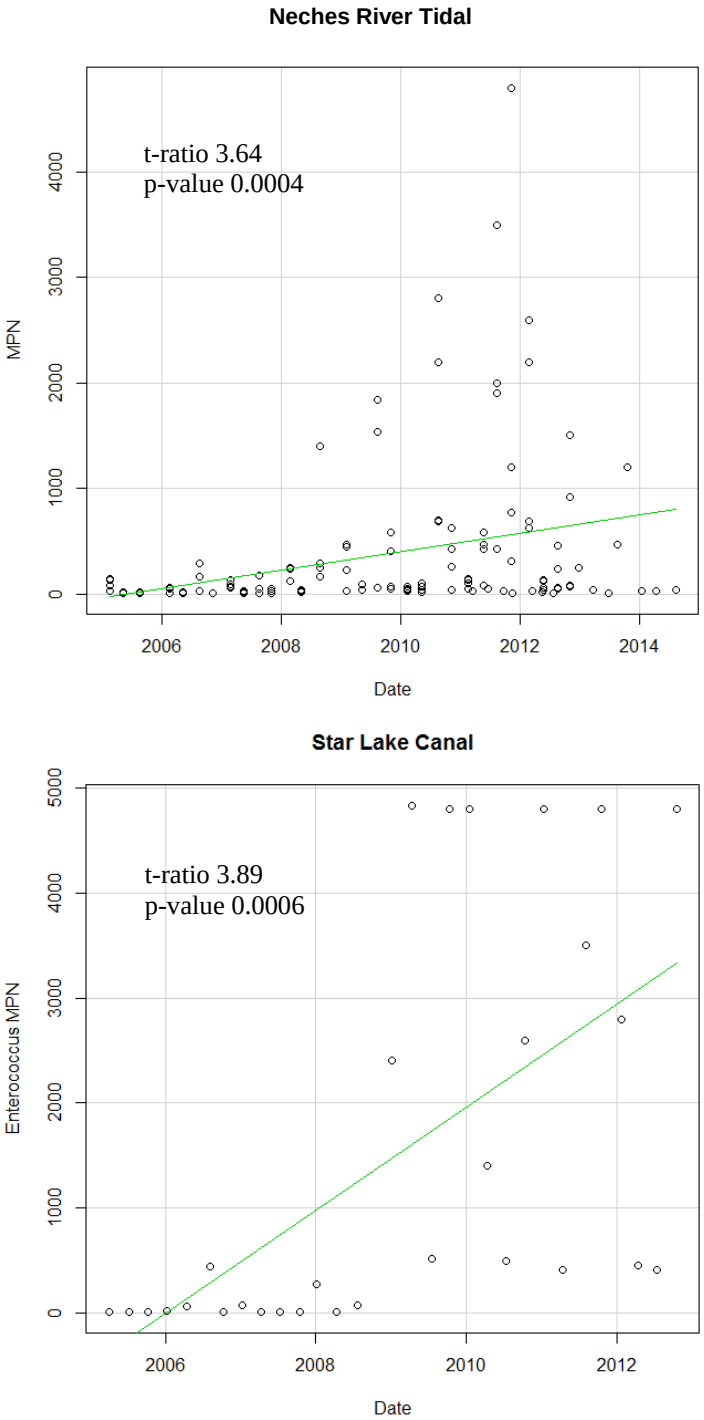
**Table 601.1—Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Neches River Tidal | 0601_01 | Aquatic Life | Malathion | CN |
| | | Recreation | Enterococcus | NS |
| | | Fish Consumption | DSHS Advisory (PCBs) | NS |
| | 0601_02 | Recreation | Enterococcus | NS |
| | | Fish Consumption | DSHS Advisory (PCBs) | NS |
| | 0601_03 | Recreation | Enterococcus | NS |
| | | Fish Consumption | DSHS Advisory (PCBs) | NS |
| | 0601_04 | Recreation | Enterococcus | NS |
| | | Fish Consumption | DSHS Advisory (PCBs) | NS |
| Star Lake Canal | 0601A_01 | Recreation | Enterococcus | NS |

*Background*

Historically, the Neches River Tidal segment had major water quality issues due to pollution impacts and waste loads discharged to the Neches River from numerous industrial and petrochemical plants located along the waterway. In 1968, it was considered by many to be the second most polluted waterway in Texas. However, since the 1970's, major improvements in water quality have been well documented by Dr. Richard Harrel with Lamar University.

Figure 601.2: Enterococcus vs. Time in Segment 0601




The Neches River water quality studies were funded in part by LNVA and the ExxonMobil Corporation. In 2007, LNVA staff participated in Dr. Harrel's last *Survey of Water Quality and Macrobenthic Community Structure in the Tidal Neches River* which showed similar results to previous studies in 1984-1985, but with little to no improvement in water quality since 1999.

*Current Assessment Results*

Segment 0601 is designated in the current TSWQS with intermediate aquatic life use and primary contact recreation. Table 601.1 includes those assessment units within the segment that are not supporting (NS) the designated use or have a use concern (CN) based on the Draft 2014 Texas Integrated Report.

The water quality impairments for bacteria in this segment are based on *Enterococcus* samples collected at five stations on the Neches River Tidal and one station on Star Lake Canal. The significant increasing trends (t-ratios $\geq |2|$ and p-values $< 0.1$) in the scatter plots at left are based on ten years of data collected at the six routine monitoring stations in the segment.

*Molasses Bayou is located near Star Lake Canal in Segment 0601A*

Enterococcus water quality standards for primary contact recreation are based on the geometric mean of bacteria sample results that must not exceed 35 MPN/100mL. The geomean of samples collected in the segment from Dec. 1, 2005 to Nov. 30, 2012 were all considerably above this criterion. For example, the lowest geomean in the segment (71.57) was calculated from bacteria samples collected at or above the I-10 bridge in the upper assessment unit (AU_04) at stations 20774 and 10575, and the highest geomean (352.05) was calculated from samples collected in Star Lake Canal at station 10485.

Star Lake Canal (Segment 0601A) is a tidally influenced, dredged canal that receives industrial wastewater and stormwater discharges from industrial facilities. The primary flow in Star Lake Canal is due to tidal fluctuations from the Neches River Tidal, industrial discharges (wastewater/stormwater outfalls) and the Jefferson Canal. Land use around Star Lake Canal includes residential, industrial, and recreational activities.

In July 2000, Star Lake Canal, along with Jefferson Canal and Molasses Bayou, was declared a Superfund Site by the U.S. EPA. The Site is currently defined as the lengths of two industrial canals, the Star Lake Canal and the Jefferson Canal, from their origins to the Neches River. The Star Lake Canal joins the Jefferson Canal in an area between State Highway 366 and Sara Jane Road (a.k.a. Atlantic Highway). The Jefferson Canal was constructed in the late 1940's as an industrial wastewater and stormwater outfall. The Star Lake Canal was constructed after 1948 for the same purpose. Both canals are currently being utilized for industrial and storm water purposes. They were added to the National Priorities List based on evidence that hazardous

substances, including chromium, copper, polynuclear aromatic hydrocarbons (PNAs), and polychlorinated biphenyls (PCBs) have migrated or could potentially migrate to Molasses Bayou, Star Lake Canal, Neches River, Sabine Lake, and their associated wetlands. Pentachlorophenol and toxaphene have been found in the sediments of the Jefferson Canal.

EPA is currently preparing an agreement to implement the remedy selected in the Record of Decision (ROD). The selected remedy for the seven areas of the Site include excavation and disposal of soil/sediment, containment with soil, clay, and/or armor caps, and monitored natural recovery. The EPA issued the ROD for the Site in September 2013. The Site Status Summary can be found on the internet at the following site: http://www.epa.gov/earth1r6/6sf/6sf-tx.htm

Current assessment results indicate an aquatic life use concern for chronic malathion in water based on the freshwater/saltwater chronic criteria (0.01 µg/L) for both the Neches River Tidal and Star Lake Canal. Station 10563 on the Neches River Tidal at SH 87 includes 17 samples collected during the seven year assessment period. Only one sample collected during this period was not reported as < 0.5 µg/L. This sample was collected on 10/4/12 and the concentration was 0.96 µg/L. Since 1977, numerous malathion samples (43) have been collected and only one other sample result, 0.34 µg/L on 7/8/98, was reported above the analytical reporting limit. These reporting limits must be lowered in order to truly assess the malathion in water concern. The assessment results are similar for Star Lake Canal where ten samples were collected during the assessment period and only one sample was above the reporting limit (0.51 µg/L) at station 10485.

Malathion is an organophosphate insecticide that has been used in the United States since 1956. It is applied very commonly in Southeast Texas for the eradication of mosquitoes, and poses little risk to human health as long as it is applied in accordance with the rates of application and safety precautions. Malathion is very toxic to insects, including honeybees, and that is why the EPA has placed specific restrictions on malathion. The occasional high value of malathion in water is likely caused by aircraft spraying applications made by the Jefferson County Mosquito Control District along drainage canals and waterways near the Neches River Tidal and Star Lake Canal.

On December 29, 2011, the Texas Department of State Health Services (DSHS) issued an advisory limiting the consumption of gafftopsail catfish from Texas waters of Sabine Lake in Jefferson and Orange counties (see Figure 601.3). Laboratory testing showed levels of polychlorinated biphenyls, or PCBs, that exceed standards in samples of gafftopsail catfish collected from the lake. The advisory also covers contiguous Texas waters, including Sabine Pass and portions of the Sabine and Neches rivers. Therefore, the Neches River Tidal segment is not supporting the fish consumption use due to PCBs in edible tissue. DSHS did not find elevated levels of contaminants in samples of alligator gar, black and red drum, sand trout, southern flounder, spotted seatrout or striped bass.

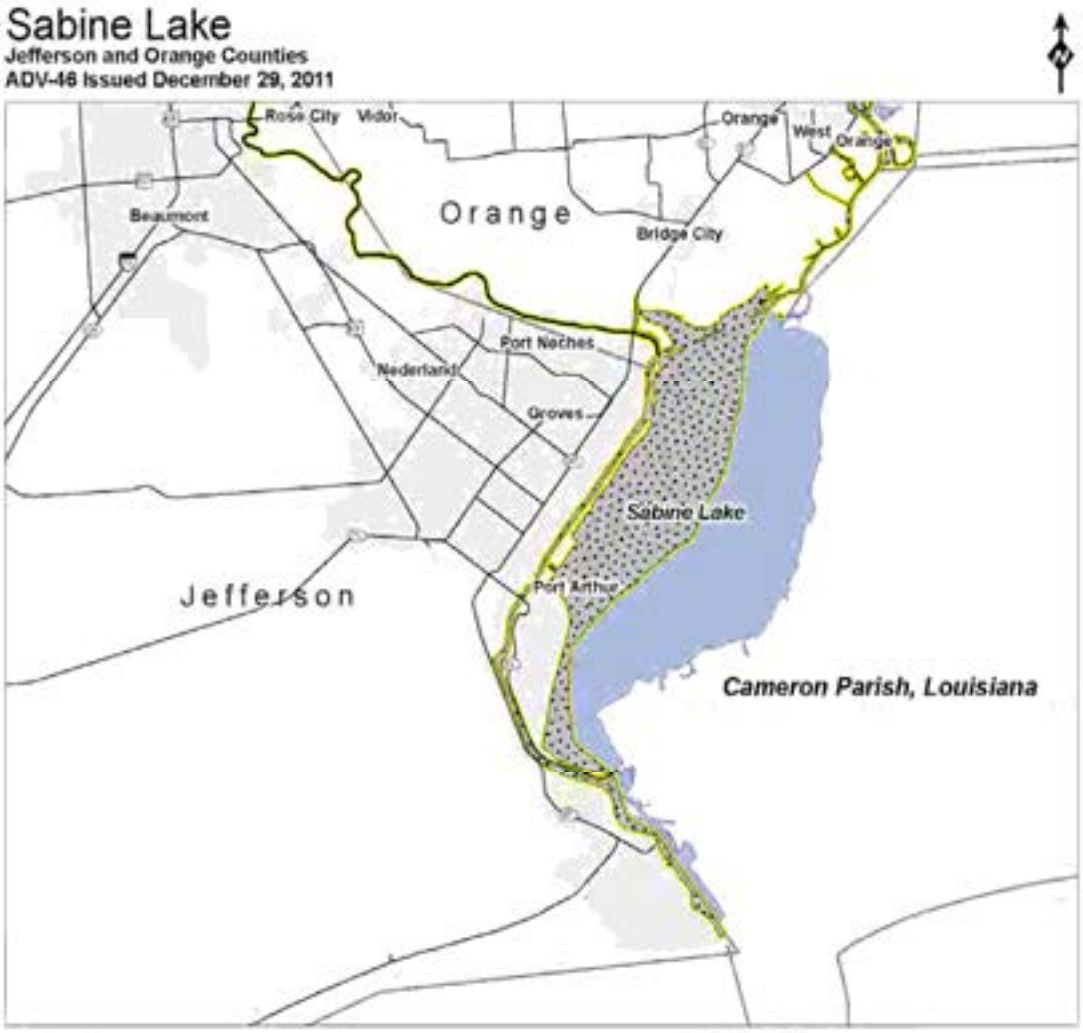
PCBs are industrial chemicals once used as coolants and lubricants in electrical equipment and for other industrial purposes. The U.S. EPA banned PCBs in 1979, but equipment containing PCBs did not have to be replaced. PCBs break down very slowly in the environment and can

accumulate in animals such as fish. Long-term consumption of PCBs may cause cancer as well as reproductive, immune system, developmental and liver problems in humans. Elevated levels of PCBs in fish do not pose a health risk for people participating in recreational activities on Sabine Lake or the Neches River Tidal.

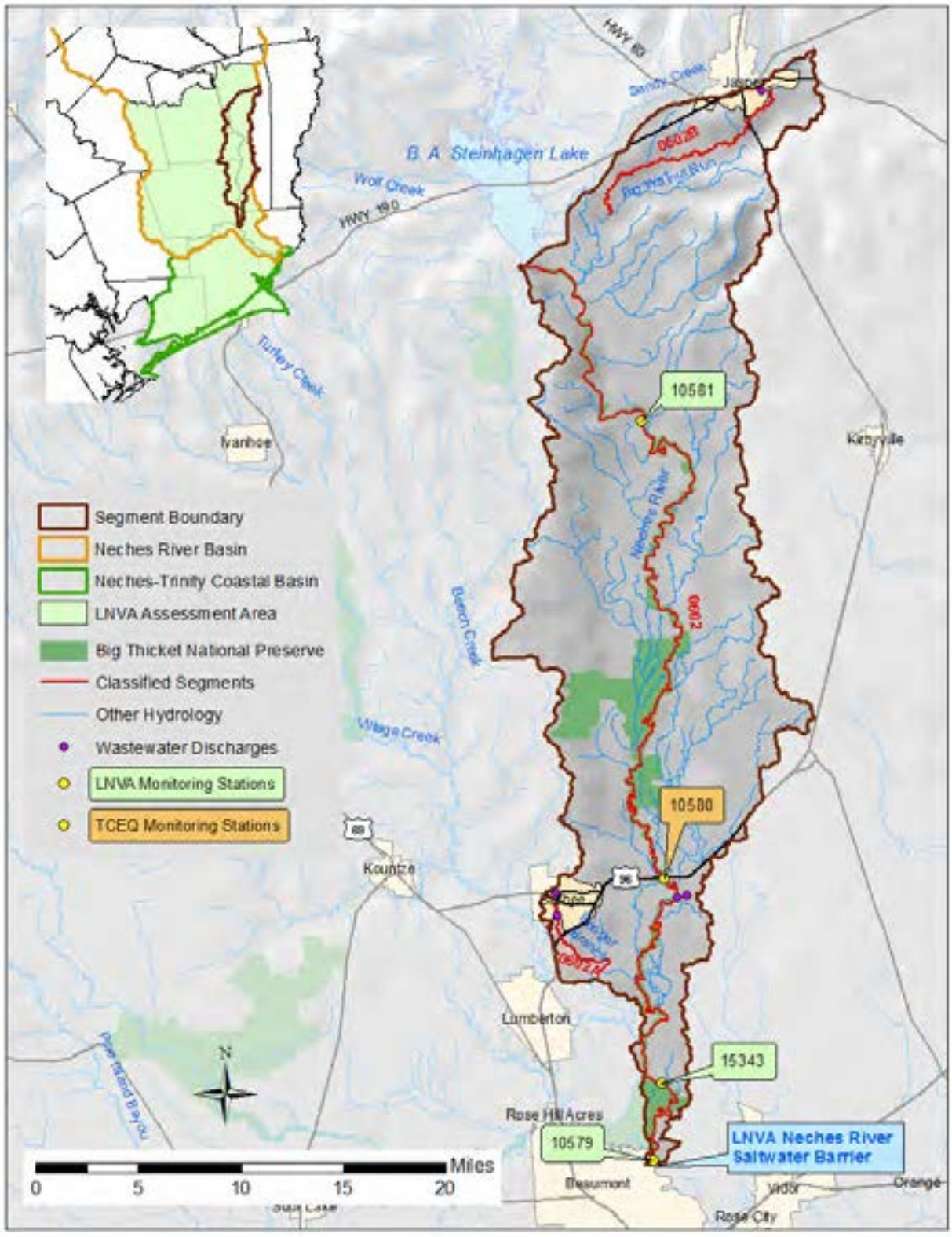
*Recommendations*

To address the malathion in water concerns, the analytical reporting limits must be reduced to meet the chronic criteria established by the TCEQ. A special study to collect organics in water at all routine stations on the Neches River Tidal and Star Lake Canal should be initiated once the reporting limits are adjusted. Water quality impairments due to elevated bacteria should continue to be monitored by LNVA and TCEQ Region 10. The DSHS should continue to monitor fish from Sabine Lake for changes or trends in contaminants or contaminant concentrations that would necessitate a change in the fish consumption advice.

**Figure 601.3: Texas DSHS Fish Consumption Advisory for Sabine Lake**

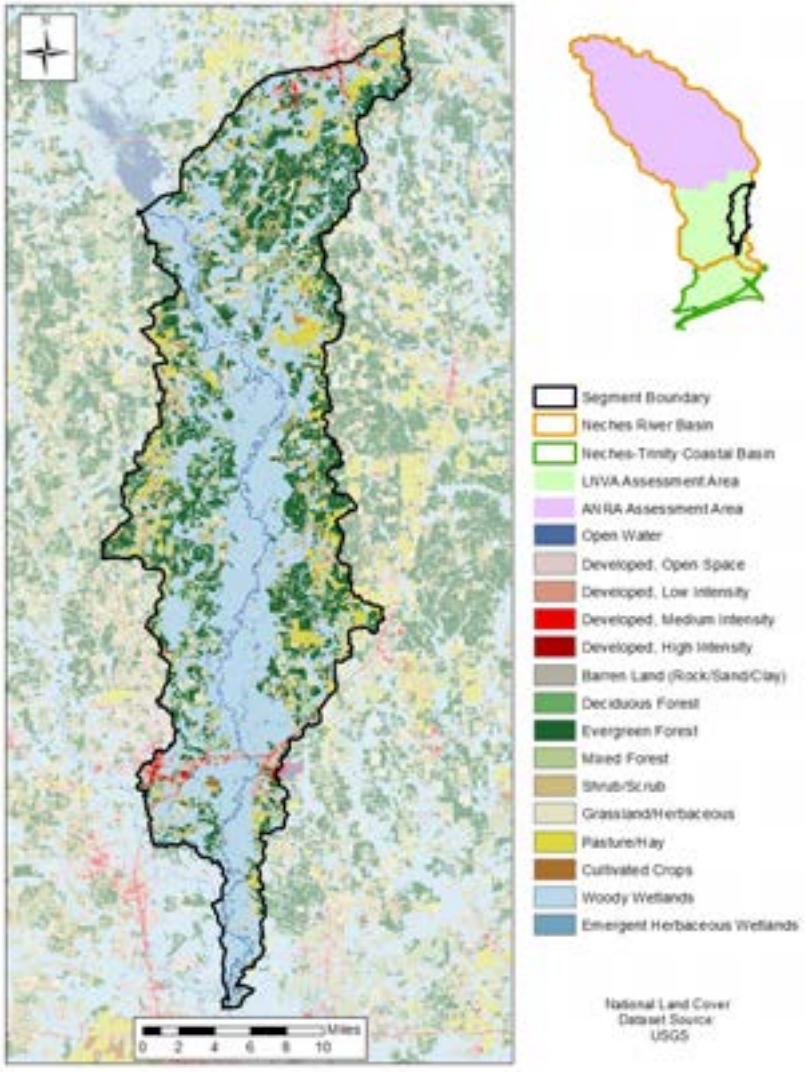


## Segment 0602 – Neches River below B. A. Steinhagen Lake



*Watershed Characteristics*

**Figure 602.1: Land Use Map for Segment 0602**



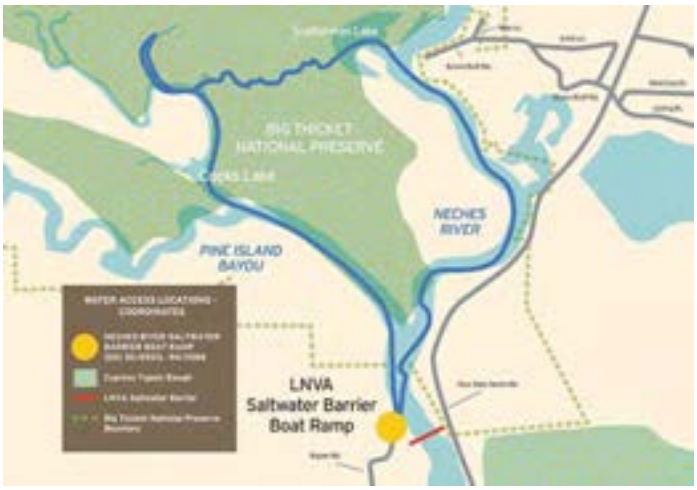

The Neches River below B. A. Steinhagen Lake is defined in the TSWQS as a river segment from the Neches River Saltwater Barrier, which is at a point 0.8 kilometers (0.5 miles) downstream of the confluence of Pine Island Bayou, [a point 11.3 kilometers (7.0 miles) upstream of IH 10] in Orange County to Town Bluff Dam in Jasper/Tyler County. Situated in a broad flood plain, the segment is 84 miles long and major tributaries include Village Creek and Pine Island Bayou. Stream discharge is regulated by Town Bluff Dam at B.A. Steinhagen Lake and the Neches River Saltwater Barrier.

Segment 0602 is situated in the Level III Ecoregion known as South Central Plains, also termed the "piney woods". The segment is dominated by loblolly and shortleaf pines, but several oak species, sweetgum, flowering dogwood, and longleaf pine are present throughout. In the floodplains, which includes sections of the Neches River, additional kinds of trees thrive well in frequently flooded areas and include bald cypress, water tupelo, water hickory (*Carya aquatica*), and red maple (*Acer rubrum*). A thick understory grows in forested areas and includes vegetation like American beautyberry, greenbriars, sumac, hawthorns, and some grass species. Soils are sandy loams, acidic sands, and some silty substrates, with poorly drained soils in the floodplains, flatwoods, and low terraces. Bottomland forests provide a lot of wildlife habitat to a diversity of animals. The Louisiana pine snake is found in the piney woods and listed as threatened in Texas. Historically, its range extended through the piney woods in west Louisiana to east Texas, but today the range of the Louisiana Pine Snake is the southern parts of the Sabine and Angelina National Forests.

Mean annual precipitation ranges from 42-58 inches, and mean temperature is 34/61°F (Jan. min/max) and 71/94°F (July min/max). Land use is livestock grazing, hunting, timber production, pasture production, recreation, wildlife habitat, oil and gas production, and some public

land (Big Thicket National Preserve). Land cover includes mixed forest, evergreen forest, deciduous forest, pine plantations, and forested wetlands.

Three routine stations are monitored quarterly by LNVA for the basic field parameters, conventional lab parameters, bacteria and flow.




*Map of the Cooks Lake to Scatterman Lake Paddling Trail on the Lower Neches River (TPWD)*

*Background*

The Big Thicket National Preserve manages a total of 106,684 acres (gross area acreage) and includes the following five units in Segment 0602: the Beaumont Unit, Lower Neches River Corridor Unit, Neches Bottom, Jack Gore Baygall Unit, and the Upper Neches River Corridor Unit.

During the past 10 years, Segment 0602 has been noted for some water quality problems. Previously identified concerns for various metals in water have been dropped due to uncertainty with the accuracy of the data, and improved sampling techniques and analytical methods have been implemented. In September 1990, the Texas Department of Health (TDH) issued a fish consumption advisory for the lower reaches of the segment due to dioxins in fish tissue. However, this fish consumption advisory was rescinded in December 1995.

*Current Assessment Results*

Segment 0602 is designated in the current TSWQS with high aquatic life use, primary contact recreation and public water supply. Table 602.1 includes those assessment units within the seg-

**Table 602.1—Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Neches River below B.A. Steinhagen Lake | 0602_01 | Fish Consumption | DSHS Advisory (mercury) | NS |
| | | Fish Consumption | Mercury | CS |
| | 0602_02 | Aquatic Life | DO grab screening level | CS |
| | | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| | | Fish Consumption | Mercury | CS |
| | 0602_03 | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| | 0602_04 | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| | | Fish Consumption | Mercury | CS |

ment that are not supporting (NS) the designated use or have a screening level concern (CS) based on the Draft 2014 Texas Integrated Report.

Current assessment results show the contact recreation use is fully supporting for *E. coli* bacteria in the segment, and the general use criteria are fully supporting for the following parameters: pH, temperature, chloride, sulfate and total dissolved solids. The aquatic life use as measured by dissolved oxygen is fully supporting, and there are no water quality concerns due to nutrients or chlorophyll *a*.

Some trends were identified for *E. coli* in this segment. Station 10580: Neches River at US 96 and Station 15343: Neches River near Lakeview both had decreasing trends over time. (Figures 602.2 and 602.3). A trend between *E. coli* and flow was also found at Station 15343 (Figure 602.3). In general, *E. coli* counts in water are greater after rain events due to runoff from soil and the re-suspension of bacteria in sediment due to turbulence in the water.

Figure 602.4 shows the dissolved oxygen (DO) concentrations over ten years at three stations on the Neches River. The fluctuations in dissolved oxygen occur seasonally, and most values are above the 5.0 mg/L criteria for DO grab screening level. However, one sampling event in September 2008 at Station 15343: Neches River near Lakeview, and one sampling event in July 2007 at Station 10580: Neches River at US 96 are below the criteria, but the DO grab minimum criteria is 3.0 mg/L and both values are above this criteria.

Figure 602.2: *E. coli* and Flow vs. Time at Station 10580

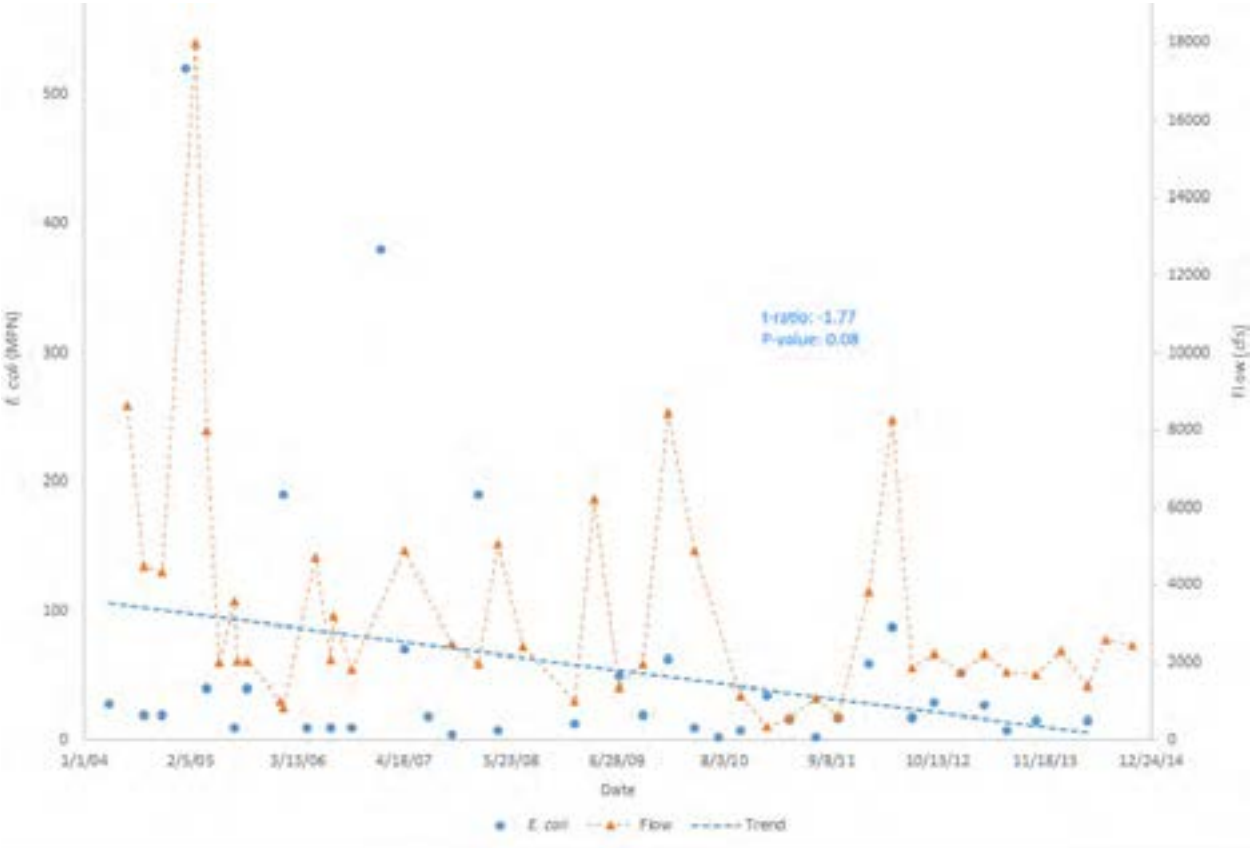


Figure 602.3: *E. coli* and Flow vs. Time at Station 15343

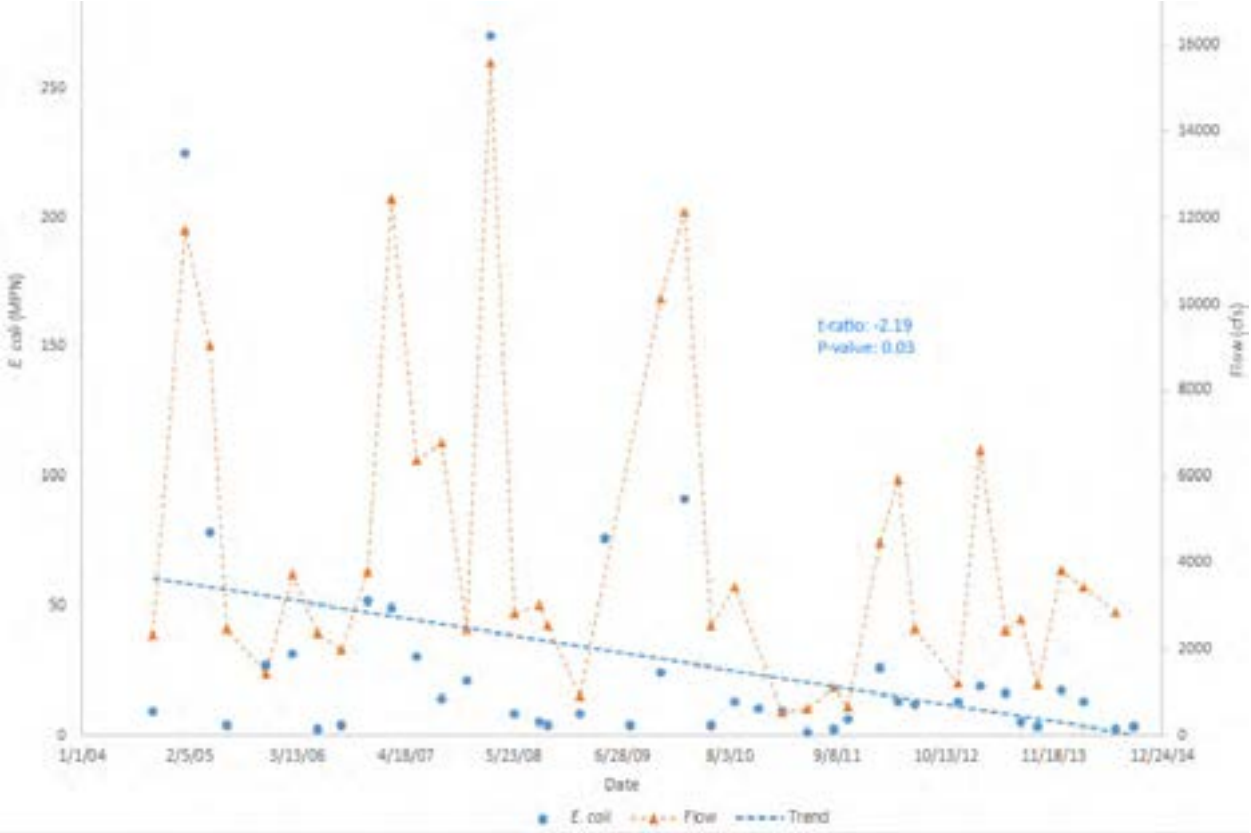



Figure 602.4: *E. coli* vs. Flow at Station 15343

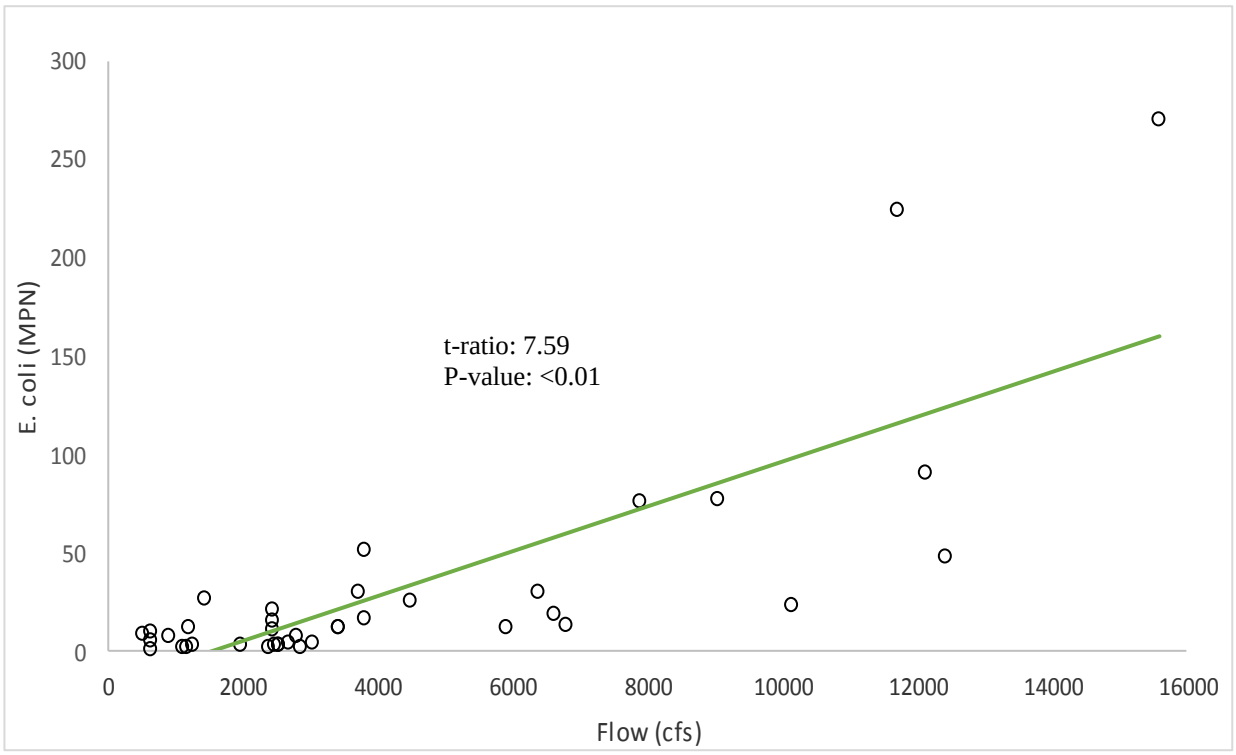
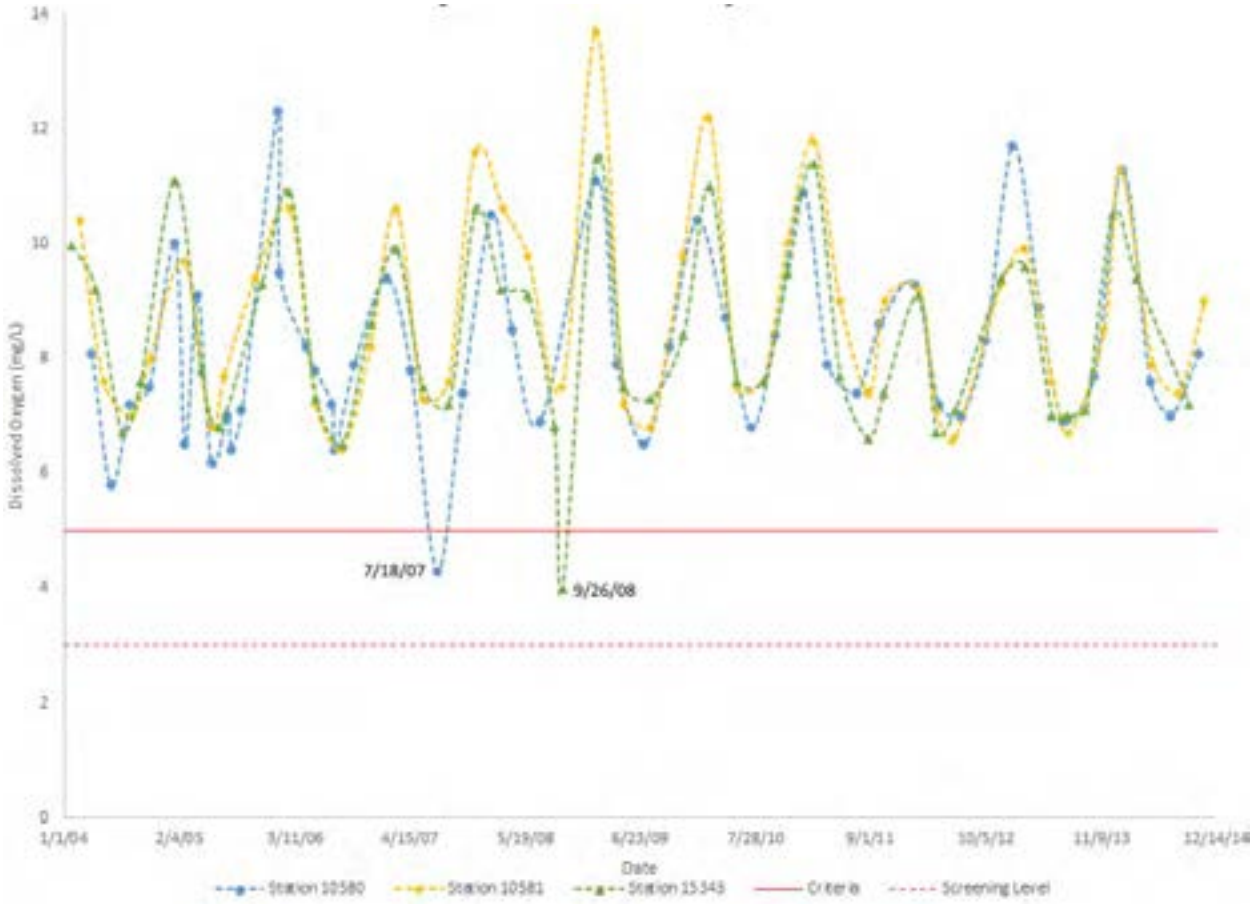


Figure 602.5: Dissolved Oxygen vs. Time in Segment 0602




The DO value for the event in 2008 at Station 15343 was 4.0 mg/L, which occurred about two weeks after Hurricane Ike made landfall on the Gulf Coast. Fallen leaves and debris in the river segment after strong hurricane winds moved through the area might explain the low dissolved oxygen during this time period. Bacteria will begin to break down this organic matter and consume dissolved oxygen in the process of respiration. This segment also experienced major flooding during 2006, so the depressed dissolved oxygen in 2007 could be due to the summertime decomposition of organic matter deposited in the river during the previous year. Overall, temporal plots of Stations 10580, 10581, and 15343 indicate expected seasonal fluctuations with the lowest DO values during the hot summer months and the highest values in the cold winter months.

On January 24, 2014, the Texas Dept. of State Health Services (DSHS) issued a fish consumption advisory for portions of the Neches River (Figure 602.5). This new advisory warns the public to limit their consumption of blue catfish greater than 30 inches long, flathead catfish, gar, largemouth bass greater than 16 inches long, spotted bass greater than 16 inches long, and smallmouth buffalo due to elevated levels of mercury and dioxins in fish tissue samples taken from these six species. The advisory area includes the Neches River and all contiguous waters from the SH 7 bridge west of Lufkin downstream to the U.S. Hwy. 96 bridge near Evadale which is located in Segment 0602.

Mercury is a naturally occurring element in the environment and is released into the air when rocks erode, soils decompose, and volcanoes erupt. Mercury may also be released into surface waters by pulp and paper mills, leather tanning, chemical manufacturing, and wastewater treatment facilities. Microorganisms in the aquatic environment convert inorganic mercury to methyl mercury, which happens more readily in acidic waters with a high amount of organic matter. Methyl mercury accumulates in fish and is passed through the food chain. Mercury bioaccumulation in East Texas is common among fish that are the highest in the food chain, in which methyl mercury is biomagnified through each trophic level. Examples of freshwater fish which are more likely to build up mercury are largemouth bass, freshwater drum, white bass, striped bass, gar species, walleye, and flathead catfish. Freshwater fish which are less likely to build up mercury are channel catfish, perch (sunfish species), and crappie.

A likely source of elevated mercury in fish tissue affecting water bodies in East Texas is atmospheric deposition from fossil fuel combustion and other industrial practices such as coal burning power plants. Gulf Coast lignite and sub-bituminous coal from the Powder River Basin (PRB) in Wyoming are both widely used in Texas as fuel for steam-electric power generation. The elemental form of mercury dominates emissions from Texas power plants burning lignite and PRB coal and is more difficult to control. Divalent mercury tends to deposit close to its source, whereas elemental mercury tends to become part of the global pool of mercury that can travel great distances before it is deposited. Stringent mercury controls on lignite and PRB coal-fired power plants may require switching to bituminous coals, reducing the use of available coal reserves in Texas and increasing the use of natural gas and renewable fuels, or implementing mercury-specific control technologies. Other non-air deposition contributions, including sources such as soil erosion, tributaries, and waste streams, and factors influencing methylation of mercury to methyl mercury concentrations in fish tissue are not well understood. In addition, basin water quality data shows no mercury in water or sediment exists in water bodies with mercury in fish tissue concerns or impairments.

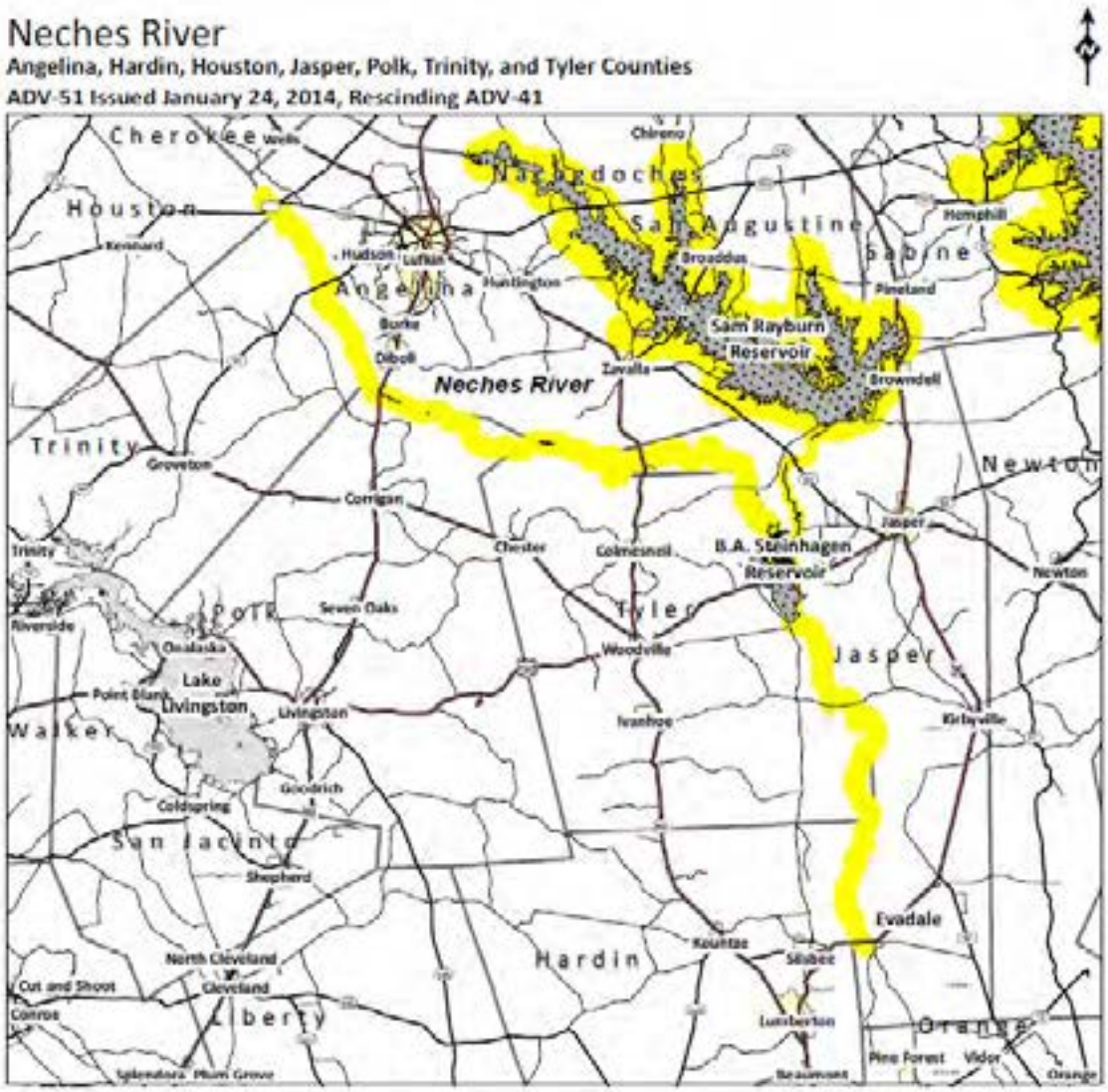
*Recommendations*

It is recommended that TCEQ continue to work closely with a Mercury-Impaired Waters Advisory Group. The purpose of this work group is to provide advice to the Commission on the best course of action to address the state's surface water bodies that are listed as impaired because of elevated mercury in fish tissue. LNVA will closely follow the actions of the TCEQ on this ongoing issue involving mercury in fish tissue in the basin.

Information on the fish consumption advisories in Texas can be found on the DSHS website at https://www.dshs.state.tx.us/seafood/advisories-bans.aspx

Surface water quality monitoring of the routine stations in Segment 0602 should be continued by the TCEQ and LNVA to maintain baseline water quality data collection, and insure stream standards and nutrient screening levels are being met.

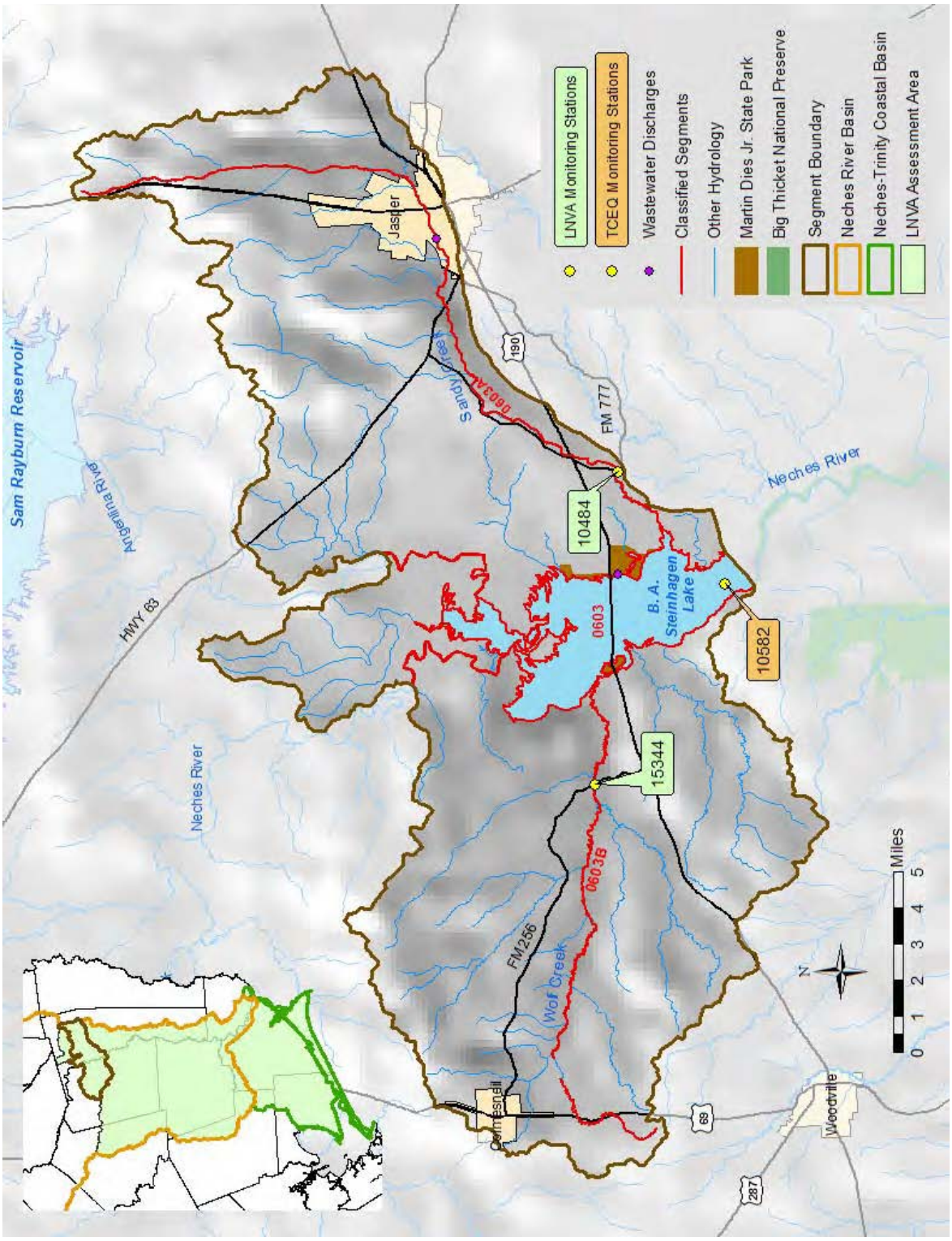
**Figure 602.6: Texas DSHS Fish Consumption Advisory for the Neches River**




| Species Affected | Women of Childbearing Age and Children < 12 | Women Past Childbearing Age and Adult Men[1] |
|---|---|---|
| Blue catfish > 30 inches | DO NOT EAT | 2 meals/month |
| Flathead catfish | DO NOT EAT | 1 meal/month |
| Gar (all species) | DO NOT EAT | 1 meal/month |
| Largemouth bass > 16 inches | DO NOT EAT | 2 meals/month |
| Smallmouth buffalo | DO NOT EAT | DO NOT EAT |
| Spotted bass > 16 inches | DO NOT EAT | 2 meals/month |

[1] A meal is eight ounces of fish.

## Segment 0603 – B. A. Steinhagen Lake



*Watershed Characteristics*

*B.A. Steinhagen Lake at Martin Dies Jr. State Park*

B.A. Steinhagen Lake is a reservoir managed by the U.S. Army Corps of Engineers that covers over 13,000 acres and is situated in the piney woods region. The reservoir was designed to assist Lake Sam Rayburn in flood control, supply water to LNVA in the lower basin, and generate hydroelectric power on the Neches River. The segment is defined as from Town Bluff Dam in Jasper/Tyler county to a point immediately upstream of the confluence of Hopson Mill Creek on the Neches River Arm in Jasper/Tyler county and to a point immediately upstream of the confluence of Indian Creek on the Angelina River arm in Jasper County, up to the normal pool elevation of 83 feet.

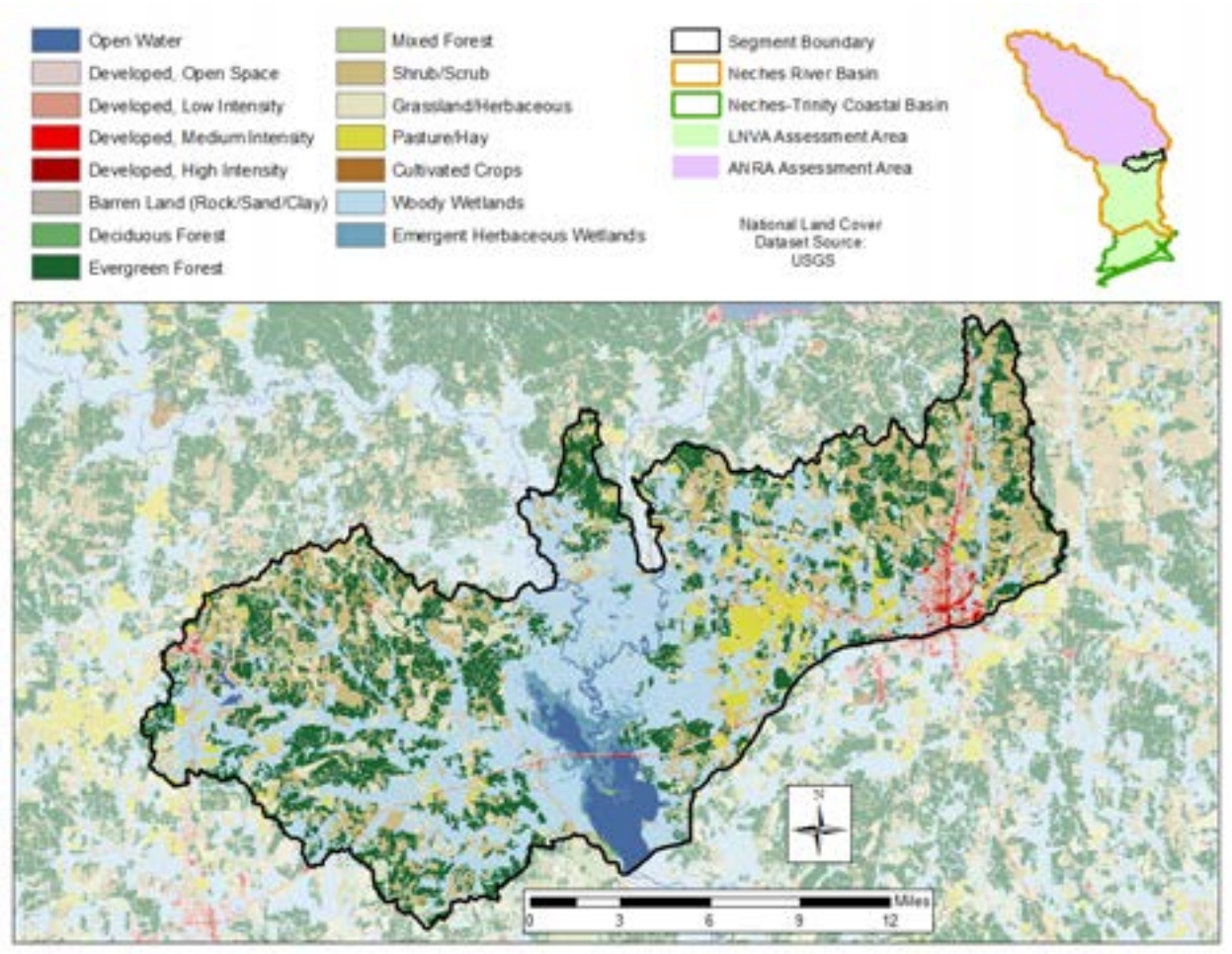
B.A. Steinhagen Lake is located off of Hwy 190 between Woodville and Jasper where it impounds the Neches River. Major tributaries include the Angelina River (Segment 0609), Sandy Creek (Segment 0603A) and Wolf Creek (Segment 0603B). The Sandy Creek segment (23 miles) is from the confluence of B.A. Steinhagen Lake southwest of Jasper County to the confluence of Big and Little Sandy Creeks in the City of Jasper. The Wolf Creek segment (12 miles) is from the confluence of B.A. Steinhagen Lake southeast of Colmesneil in Tyler County to the upstream perennial portion of the stream south of Colmesneil in Tyler County. LNVA performs routine water quality monitoring on Sandy Creek at Station 10484 and Wolf Creek at Station 15344. TCEQ Region 10 monitors B.A. Steinhagen Lake on the main pool near the dam at Station 10582.

Segment 0603 mainly has pine-hardwood forests and includes large expanses of loblolly and shortleaf pine. Soils are acidic and sandy and support upland longleaf pine woodlands, longleaf pine savannas, and hardwood slope forests. Segment 0603 is largely represented by Level IV Ecoregion 35e called Southern Tertiary Uplands, which is more hilly and dissected than the Flatwoods (35f) to the south in Segment 0602. The soils are generally better drained over the more permeable sediments. The geology contains a variety of siltstones, sandstones, and acidic clays. Mean annual precipitation is 44-54 inches/year, and the mean temperature is 38/59 °F (Jan. min/max) and 71/94 °F (July min/max). Land use is primarily for timber production, public land use, pasture and livestock production, recreation and wildlife habitat. The land is covered by mixed forest, evergreen forest, deciduous forest, and pine plantations.

*Background*

Historically, this segment has good water quality for parameters such as dissolved oxygen, chlorides, sulfates, chlorophyll *a*, and nutrients. Tributaries in this segment, other than the

**Figure 603.1: Land Use Map for Segment 0603**




Neches and Angelina Rivers, are Wolf and Sandy Creeks. Wolf Creek drains areas of pine forest and pastureland, while Sandy Creek is a forested sub-watershed with pasturelands and its upper reaches drain the City of Jasper. Sandy Creek and Wolf Creek historically have elevated bacteria levels.

*Current Assessment Results*

Table 603.1 includes those assessment units within the segment that are not supporting (NS) the designated uses based on the Draft 2014 Texas Integrated Report. Segment 0603 is designated for high aquatic life use, primary contact recreation, and public water supply. This segment fully supports the high aquatic life use for dissolved oxygen and the general use criteria for the following parameters: pH, temperature, chloride, sulfate and total dissolved solids. The primary contract recreation use is fully supporting for *E. coli* in B.A. Steinhagen Lake, and there are no general use concerns for nutrients or chlorophyll *a*. However, the primary contact recreation use is not supporting due to elevated bacteria in Segment 0603A (Sandy Creek) and 0603B (Wolf Creek).

**Table 603.1 – Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| B.A. Steinhagen Lake | 0603_01 | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| | 0603_02 | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| Sandy Creek | 0603A_01 | Recreation | E. coli | NS |
| Wolf Creek | 0603B_01 | Recreation | E. coli | NS |

According to the Draft 2014 Texas Integrated Report, the primary contact recreation use is not supporting for Sandy Creek at FM 777 (Station 10484) due to high levels of *E. coli*. Twenty-eight samples were assessed for bacteria and the geometric mean was 154 colonies per 100 milliliters (mL); the criterion for bacteria is 126 colonies per 100mL. In addition, Wolf Creek at FM 256 (Station 15344) does not support the primary contact recreation use because of twenty-eight samples assessed for bacteria with the geomean at 207 colonies per 100mL.

Figures 603.1 and 603.2 are graphs depicting the historical levels of *E. coli* and flow at Sandy Creek at FM 777 and Wolf Creek at FM 256, respectively. Generally, bacteria counts seem to be influenced by periods of high flow after rainfall events. Each location had one very high *E. coli* count in April of 2012. This is likely due to the buildup of *E. coli* in soils and sediments during the 2011 drought being washed into the streams after a major rain event when the drought was ending. In addition, Wolf Creek and Sandy Creek are both located in watersheds with large forested areas with an abundance of wildlife which contribute to bacteria levels in the soils and sediment. Sandy Creek also flows through the City of Jasper which discharges wastewater effluent and stormwater runoff to the segment.

Figures 603.3 and 603.4 are scatter plots of *E. coli* data plotted against stream flow recorded at the time of sampling for Sandy Creek and Wolf Creek, respectively. The graph only includes bacteria samples collected with an associated flow. Factors that influence high *E. coli* counts are urban runoff/storm sewers, manure runoff, sewage discharges in unsewered areas, failing on-site sewage facilities, and wildlife. There is a positive correlation to flow with the highest values occurring at stream flow conditions above 50 cubic feet per second (cfs).

The fish consumption advisory issued in January 2014 for portions of the Neches River (Figure 602.5) includes Segment 0603. This new advisory warns the public to limit their consumption of blue catfish greater than 30 inches long, flathead catfish, gar, largemouth bass greater than 16 inches long, spotted bass greater than 16 inches long, and smallmouth buffalo due to elevated levels of mercury and dioxins in fish tissue samples taken from these six species.

The advisory area includes the Neches River and all contiguous waters from the SH 7 bridge west of Lufkin downstream to the U.S. Hwy. 96 bridge near Evadale which is located in Segment 0602. Mercury in edible fish tissue is a concern in fish at the main pool by the dam and also in the remainder of the reservoir. The issue of mercury in fish tissue is regional, encompassing other water bodies in East Texas in addition to B.A. Steinhagen Lake and Sam Rayburn

Figure 603.2: Historical *E. coli* and Flow at Sandy Creek

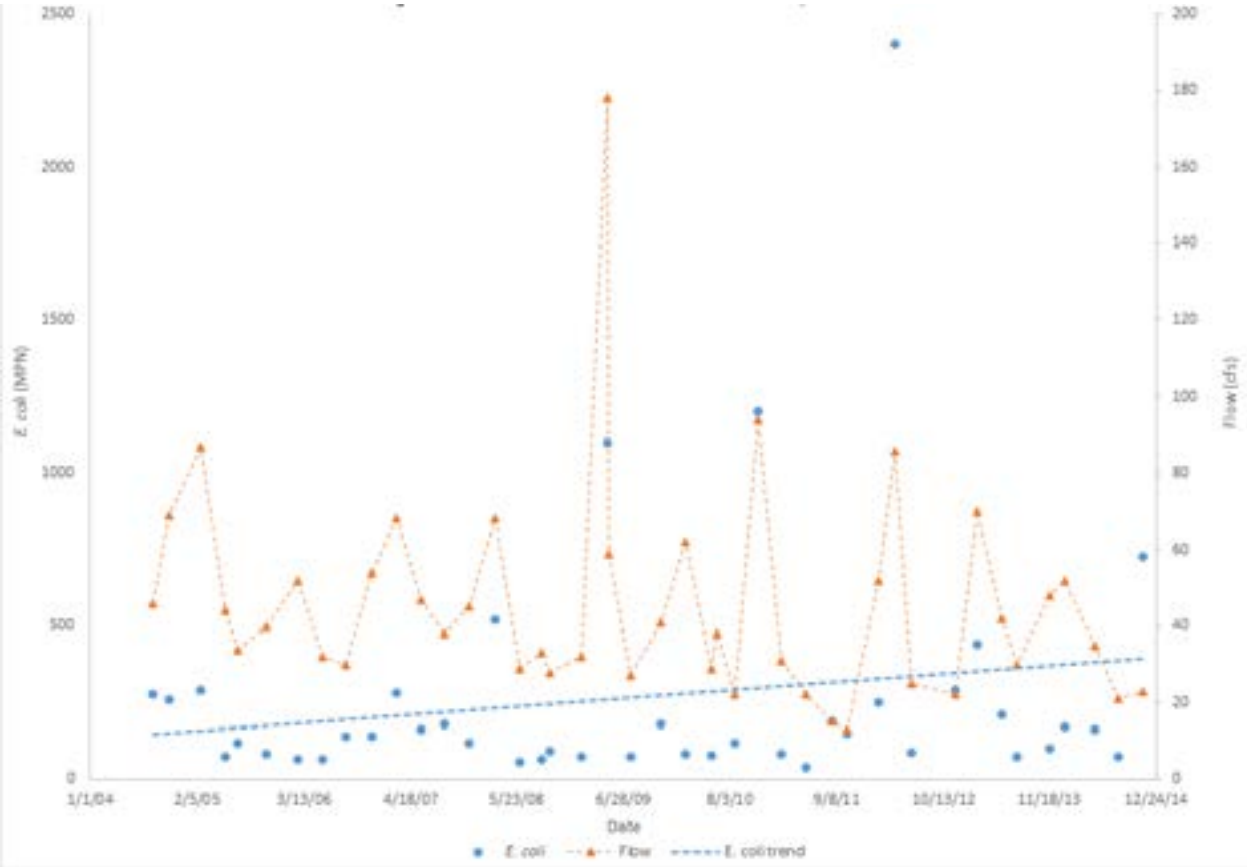



Figure 603.3: Historical *E. coli* and Flow at Wolf Creek

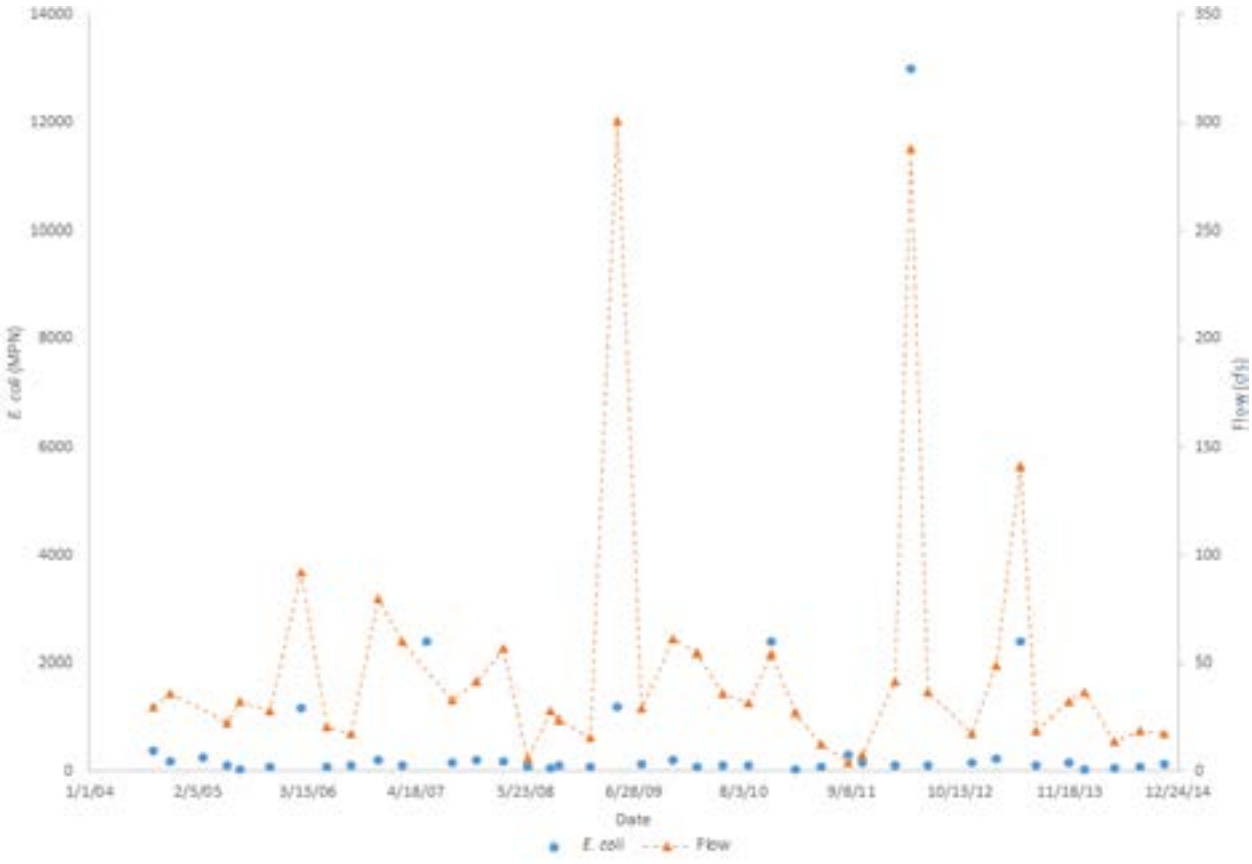


Figure 603.4: *E. coli* vs. Flow at Station 10484 on Sandy Creek

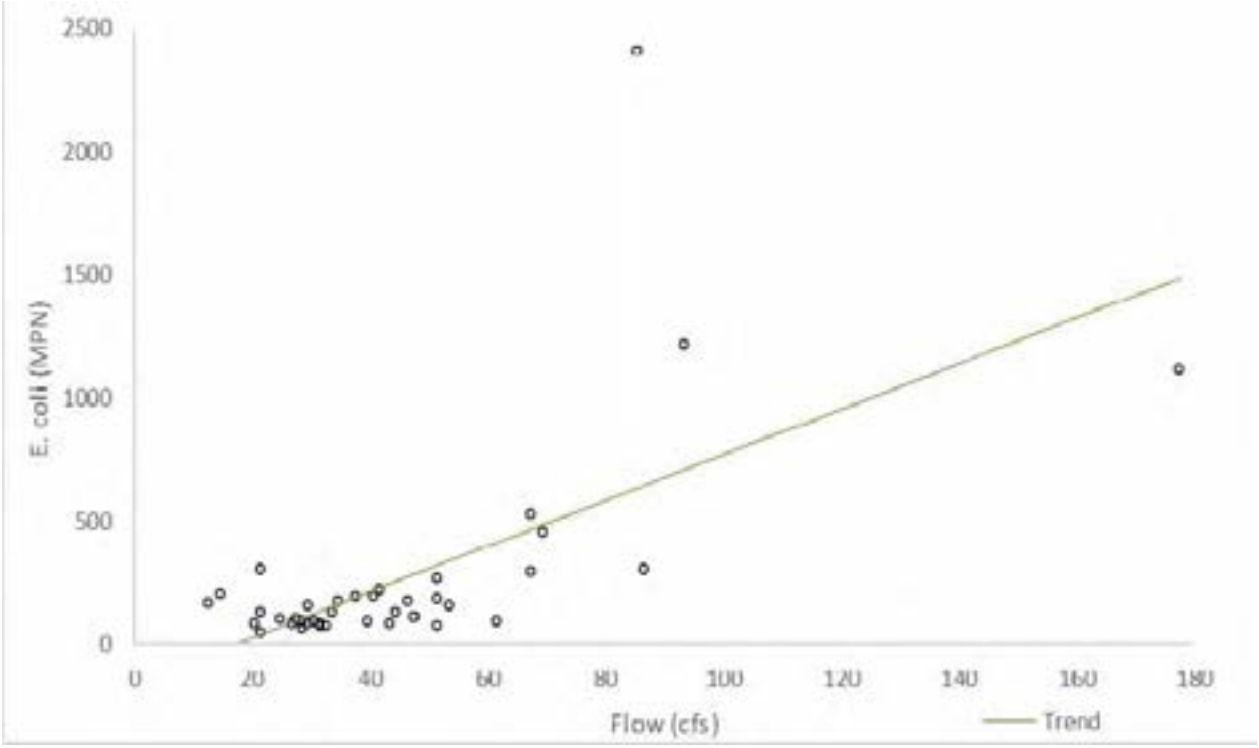
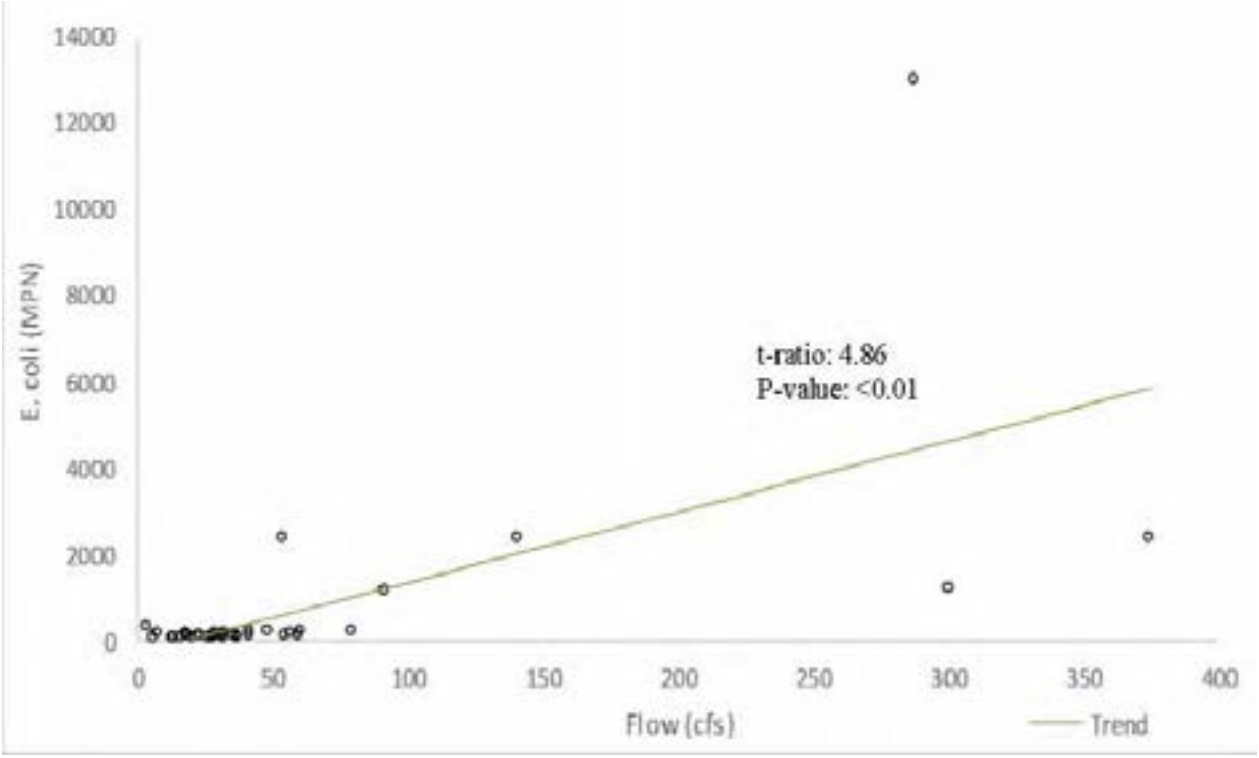



Figure 603.5: *E. coli* vs. Flow at Station 15344 on Wolf Creek



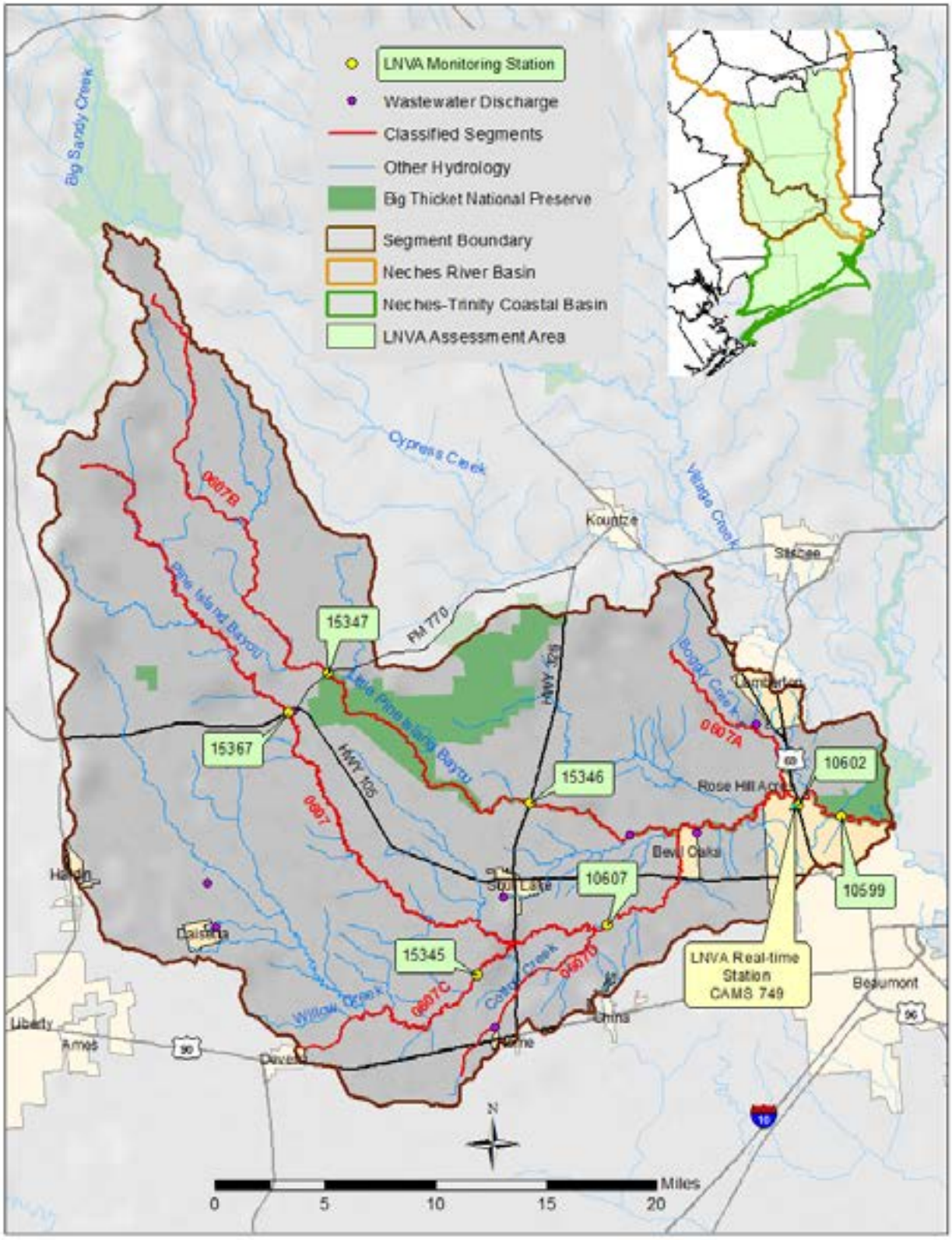
Reservoir. The level of mercury contamination in fish tissue is the result of bioaccumulation, and there are no risks to the public in other recreational activities. Segment 0603 is listed on the Texas 303(d) List as a category 5c impaired water body, therefore, additional data and information will be collected before a management strategy is selected.

*Recommendations*

LNVA and TCEQ Region 10 will continue to coordinate routine monitoring in the segment. In addition, both Wolf and Sandy Creeks are recommended to be included in any Recreational Use Attainability Analyses (RUAA) projects in the basin. RUAA projects are designed to document the occurrence and frequency of recreational activities in stream segments which are considered impaired for primary contact recreation use. The purpose is to determine if the primary contact recreation use standards are appropriate considering pending revisions in the 2014 TSWQS.

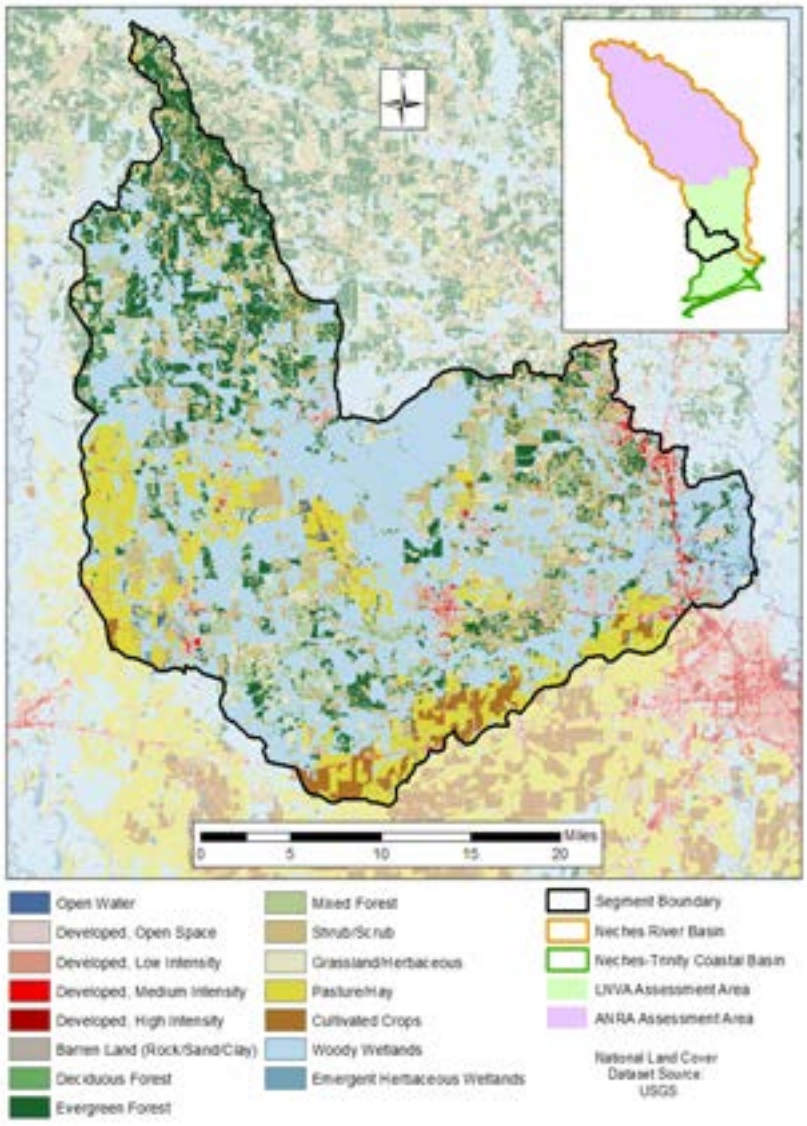
LNVA recommends routine monitoring to include stream flow measurements continue in the segment to better define the flow-to-concentration relationship. Mercury and dioxins in fish tissue sampling should continue in B.A. Steinhagen Lake and updates to current advisories issued promptly by the Texas DSHS.

# Segment 0607 – Pine Island Bayou



*Watershed Characteristics*

**Figure 607.1: Land Use Map for Segment 0607**




Pine Island Bayou is defined in the TSWQS, as from the confluence with the Neches River in Hardin/Jefferson County to FM 787 in Hardin County and is 81 miles in length. Major tributaries include Little Pine Island Bayou (50 miles long) and Willow Creek (15 miles long) (Figure 607.1 and Figure 607.2). Streams are low gradient and sluggish in this segment with sandy and silty substrates. Pine Island Bayou has a drainage area of 657 square miles, and the segment is a natural streambed with sand and clay substrate from its headwaters to its confluence with the Neches River. Little Pine Island Bayou and Willow Creek are the only major tributaries to the segment. The upper reaches of Pine Island Bayou bisect mainly forestland through approximately 71% of the watershed. The lower reaches drain the communities of Sour Lake, Pinewood Estates, Bevil Oaks and the northern section of the City of Beaumont.

Soils are acidic and drain poorly after high rainfall events in Segment 0607. The Level IV ecoregion in the Segment 0607 is Flatwoods (35f), and physiography consists of flat plains, irregular plains, small, undrained depressions, and a few surface mounds from salt domes. Seven sites are monitored quarterly, two of which are considered off segment. Mean annual precipitation here is 47-58 inches/year and mean temperature is 40/61 °F (Jan. min/max) and 73/92 °F (July min/max). Historically, longleaf pine flatwoods and savannas with bluestem grasses were present, but now it is mixed pine-hardwood forests. Common vegetation in this segment is longleaf pine, loblolly pine, sweetgum, oak species, southern magnolia, and an understory of holly, yaupon, sweetbay, wax myrtle, and American beautyberry. Land use is timber production, pastureland, cattle production, and oil and gas production. Land cover is mixed forest, evergreen forest, deciduous forest, and forested wetlands.

*Background*

Since June 2008, TCEQ's Continuous Water Quality Monitoring Network (CWQMN) station on Pine Island Bayou has collected real-time water quality data. Located just above the LNVA BI Canal Pump Station in Beaumont, LNVA operates and maintains this CWQMN station to monitor and assess the water quality conditions in the bayou. The station (CAMS 749) uses YSI 6-Series Multiparameter Sondes equipped with four probes including optical DO and Turbidity. The station collects and transmits real-time data at 15 minute intervals for the following parameters: dissolved oxygen, pH, water temperature, specific conductance, calculated TDS, turbidity, and water depth. The station uses solar power and includes a 12V battery, data logger, and modem to transmit real-time data across a cellular network to the TCEQ headquarters in Austin. This real-time water quality data can be viewed 24-hours a day on the TCEQ web page at: http://www.tceq.state.tx.us/cgi-bin/compliance/monops/water_daily_summary.pl?cams=749

**Table 607.1 – Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Pine Island Bayou | 0607_01 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO Grab Minimum | NS |
| | 0607_02 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | 0607_03 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Recreation | E. coli | NS |
| | 0607_04 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO Grab Minimum | NS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| Boggy Creek | 0607A_02 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO Grab Minimum | NS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | | Aquatic Life | Habitat | CS |
| Little Pine Island Bayou | 0607B_01 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | 0607B_02 | Aquatic Life | DO Grab Screening Level | CS |
| Willow Creek | 0607C_01 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO Grab Minimum | NS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |

Figure 607.2 - Historical DO in Segment 0607

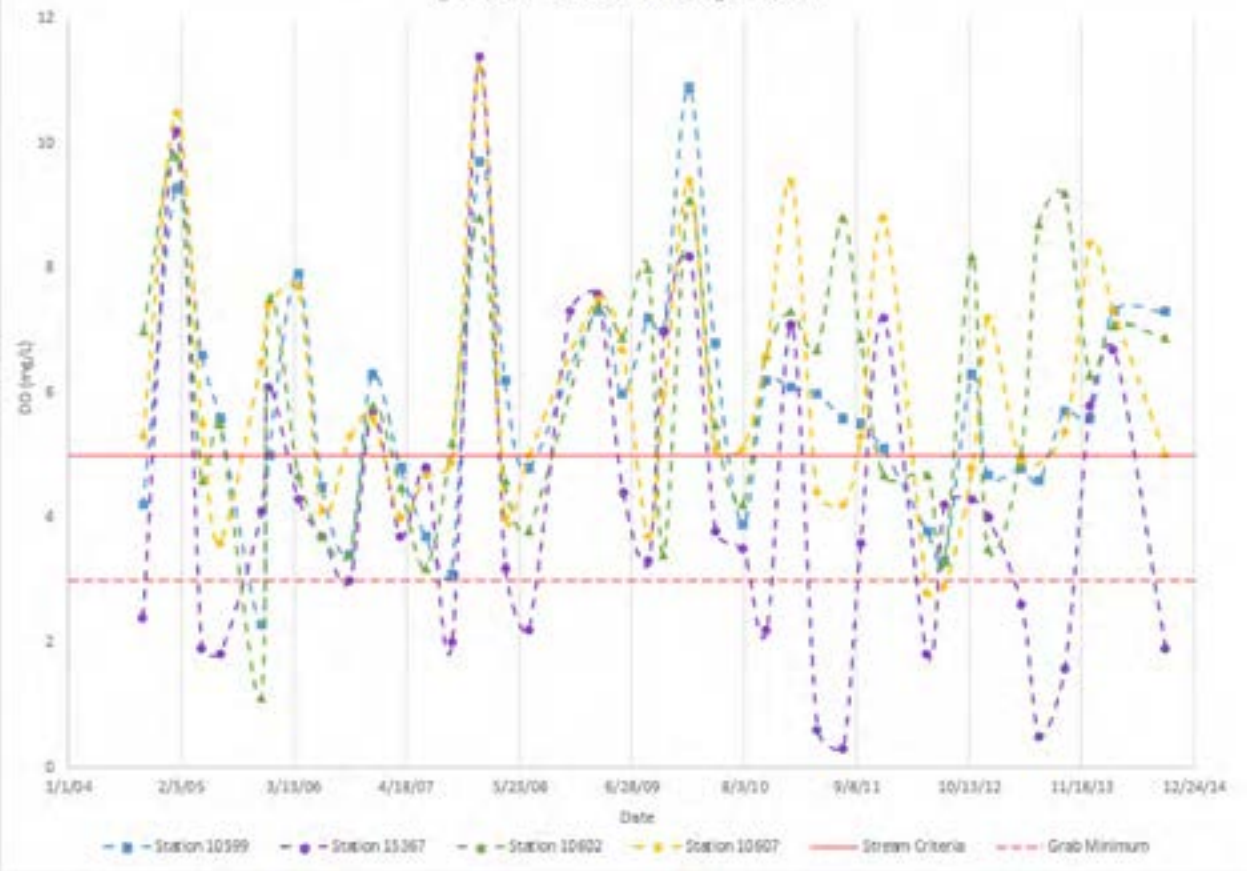



Figure 607.3 - Historical Flow in Segment 0607

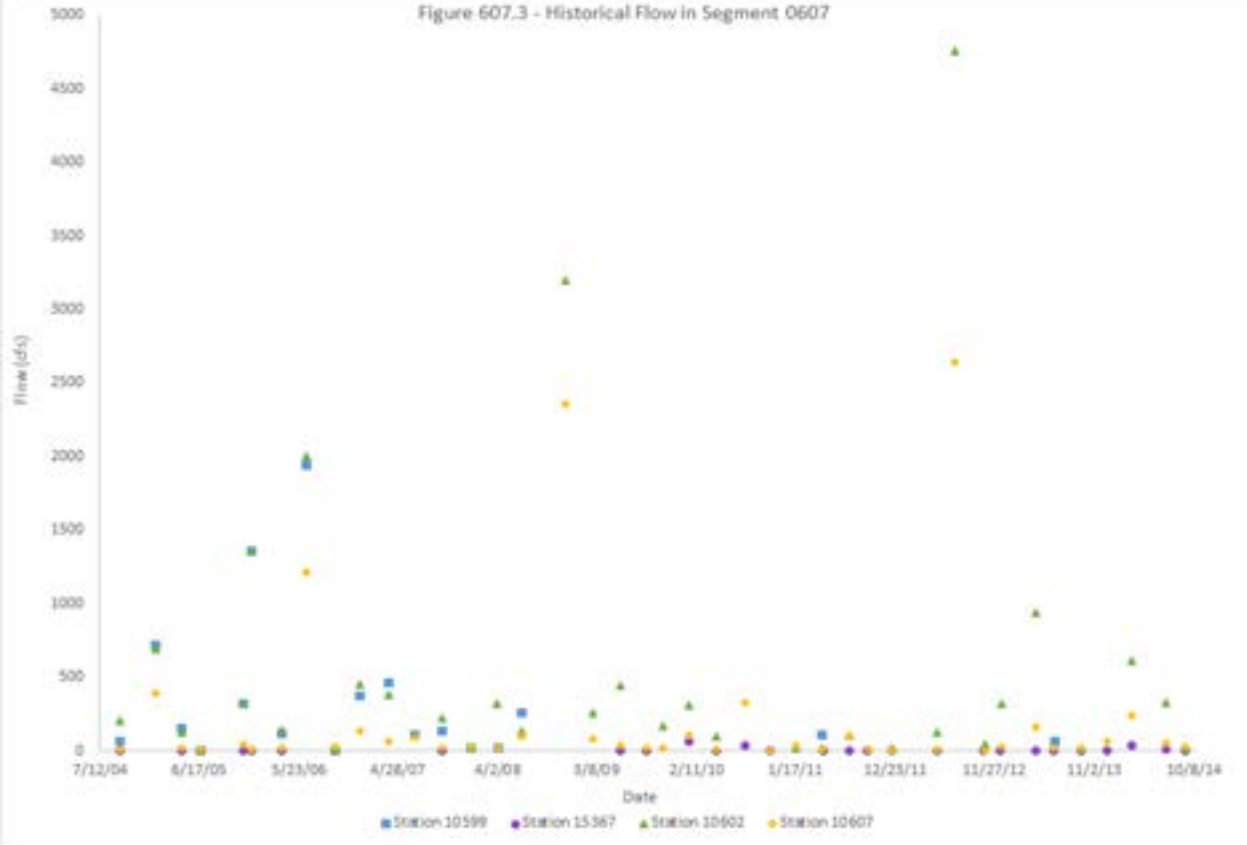


Figure 607.4 - Historical DO in tributaries of Pine Island Bayou

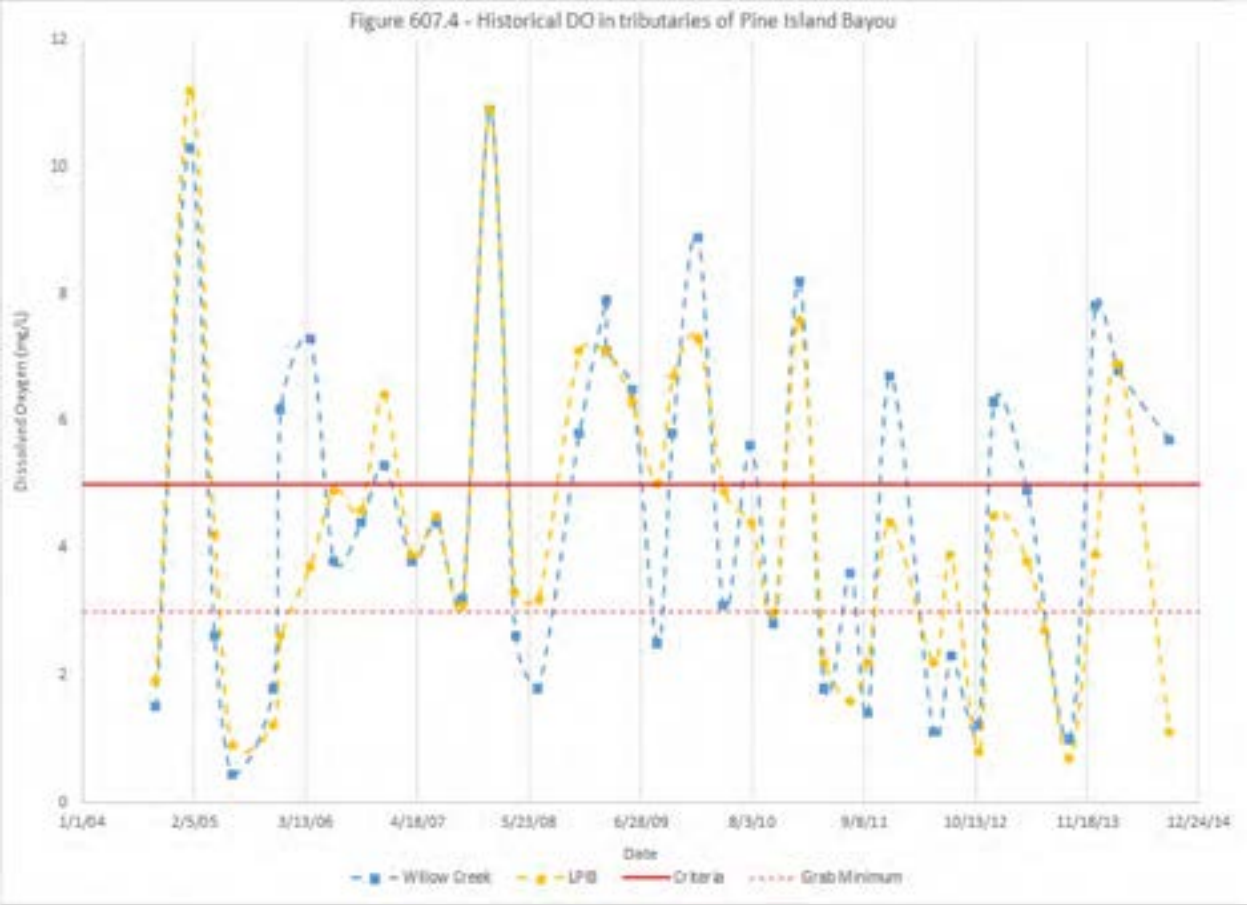
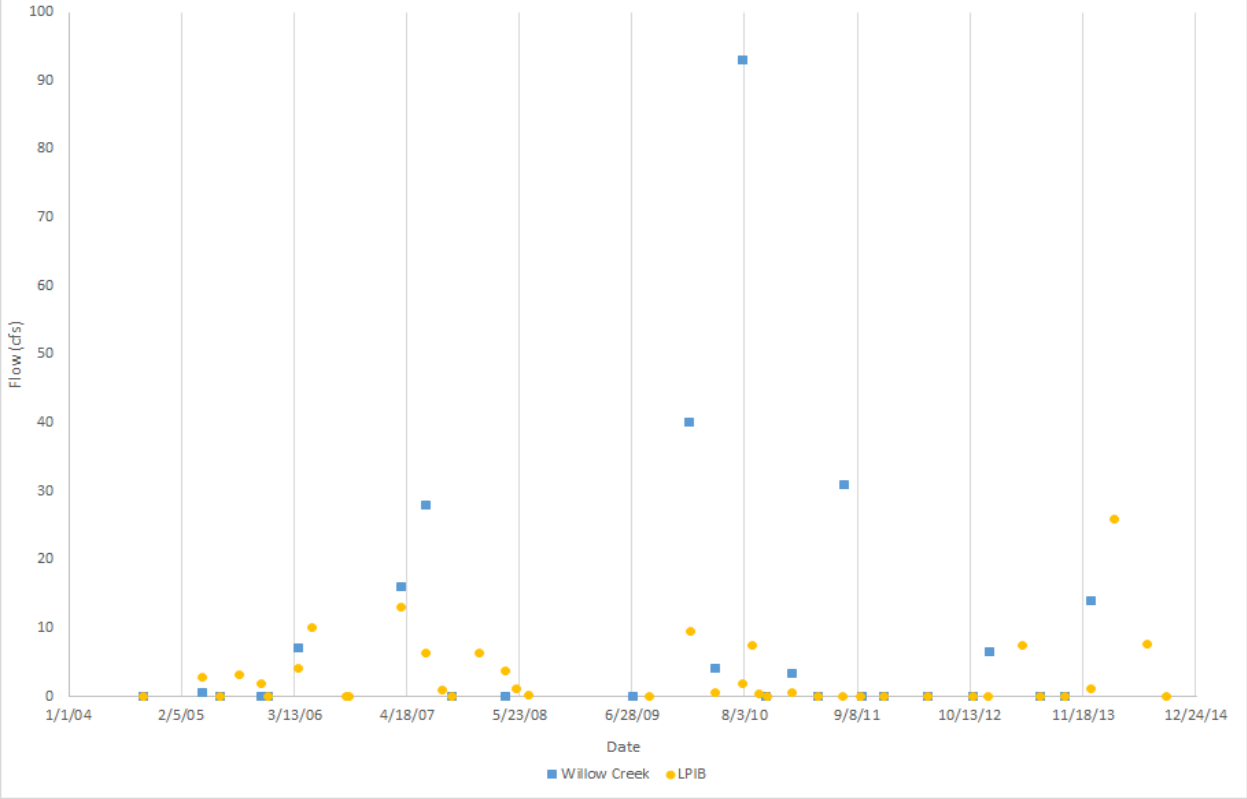



Figure 607.5 - Historical flow in tributaries of Pine Island Bayou

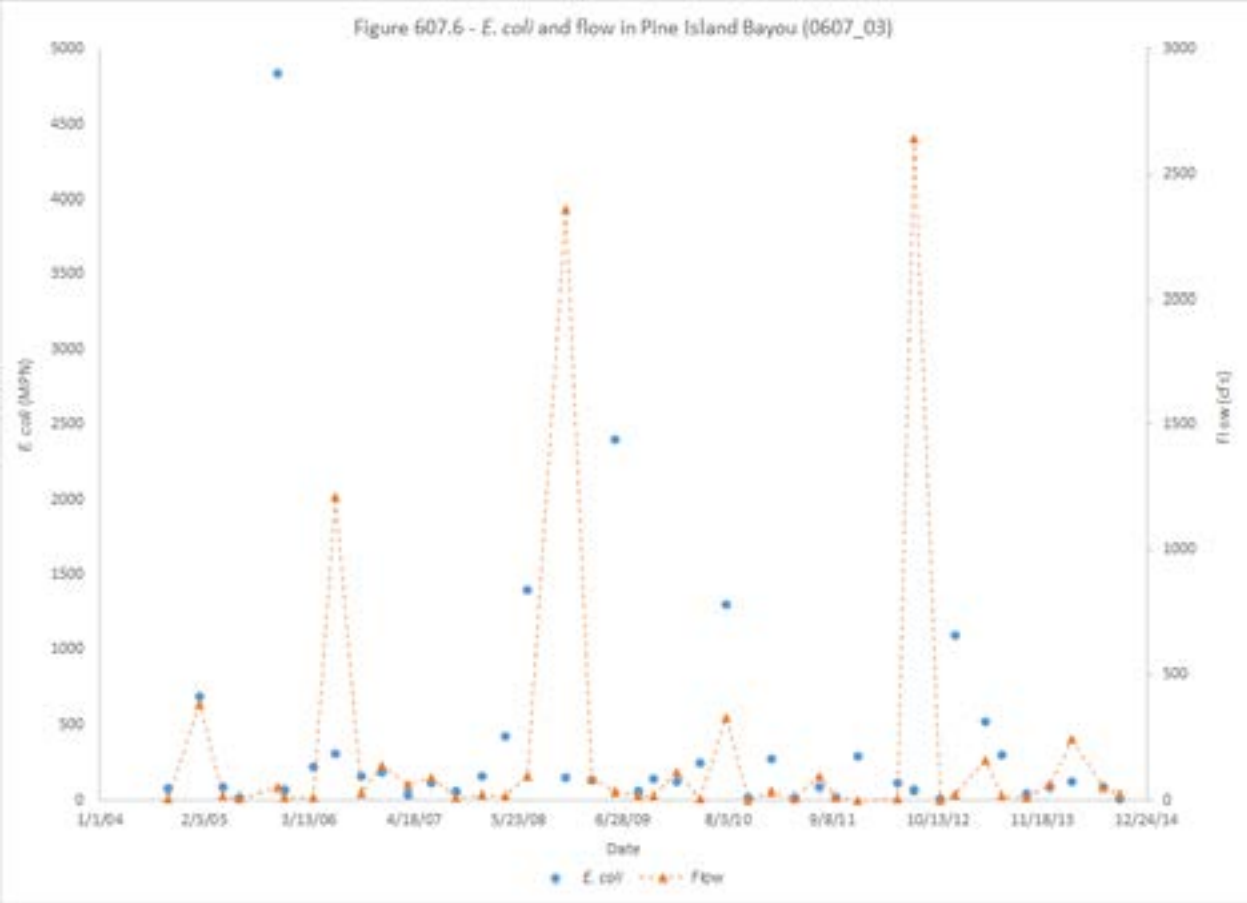


*Current Assessment Results*

Table 607.1 includes those assessment units within the segment that are not supporting (NS) the designated uses or have a screening level concern (CS) based on the Draft 2014 Texas Integrated Report. Segment 0607 is designated for high aquatic life use, primary contact recreation, and public water supply. Segment 0607 is fully supporting the general use, fish consumption use and public water supply in all assessment units. Also, the segment is fully supporting the primary contact recreation use in all assessment units except for AU 0607_03.

Low dissolved oxygen (DO) measurements have historically been collected in the segment which has remained on the Texas 303(d) List since 2000. The 2014 TSWQS proposed changes to the DO criteria (5.0 mg/L to 3.0 mg/L) in Segment 0607 which is still under review by the EPA. In the Draft 2014 Texas Integrated Report, Segment 0607 is listed as not supporting aquatic life use for 24 hour average DO, 24 hour minimum DO, and grab sample minimum DO. Persistent low DO levels in the watershed are likely due to natural causes which are influenced by high ambient summer temperatures, low-flow conditions, and decaying organic material.

In Figures 607.2 and 607.4, the temporal plots show that dissolved oxygen grab values are seasonally influenced. Pine Island Bayou stations tend to have higher dissolved oxygen values than stations located on tributaries upstream (i.e. Willow Creek & Little Pine Island Bayou). Stations 10599 and 10602 (AUs 0607_01 and 0607_02, respectively) are located on the downstream portion of Pine Island Bayou which is a much wider channel and receives much more



*Above: Pine Island Bayou at Station 15367 is located at the FM 770/SH 105 bridge crossing near Batson. Seasonal or intermittent flow conditions with perennial pools are normal in this upper segment, AU 0607_04.*

*Right: The USGS Flow Station 08041749 and TCEQ's Continuous Water Quality Monitoring Network (CWQMN) Station CAMS 749 are located on the Pine Island Bayou above the US 69 bridge at LNVA's BI Canal Pump Station.*

flow than the upstream sites (Figures 607.3 and 607.5), which allows for better aeration and higher dissolved oxygen levels.

Little Pine Island Bayou (LPIB) at SH 326 and Willow Creek generally have measurable flows only after substantial rain events. When these two sites do have measureable flow it is often low and results in a shallow, slow moving stream. Because of low-flow conditions, Little Pine Island Bayou and Willow Creek frequently have low dissolved oxygen. TCEQ has performed an Aquatic Life Assessment (ALA) on Little Pine Island Bayou, and Use Attainability Analyses (UAAs) on Willow Creek and Pine Island Bayou to determine if the presumed high aquatic life use standards are appropriate for these segments.

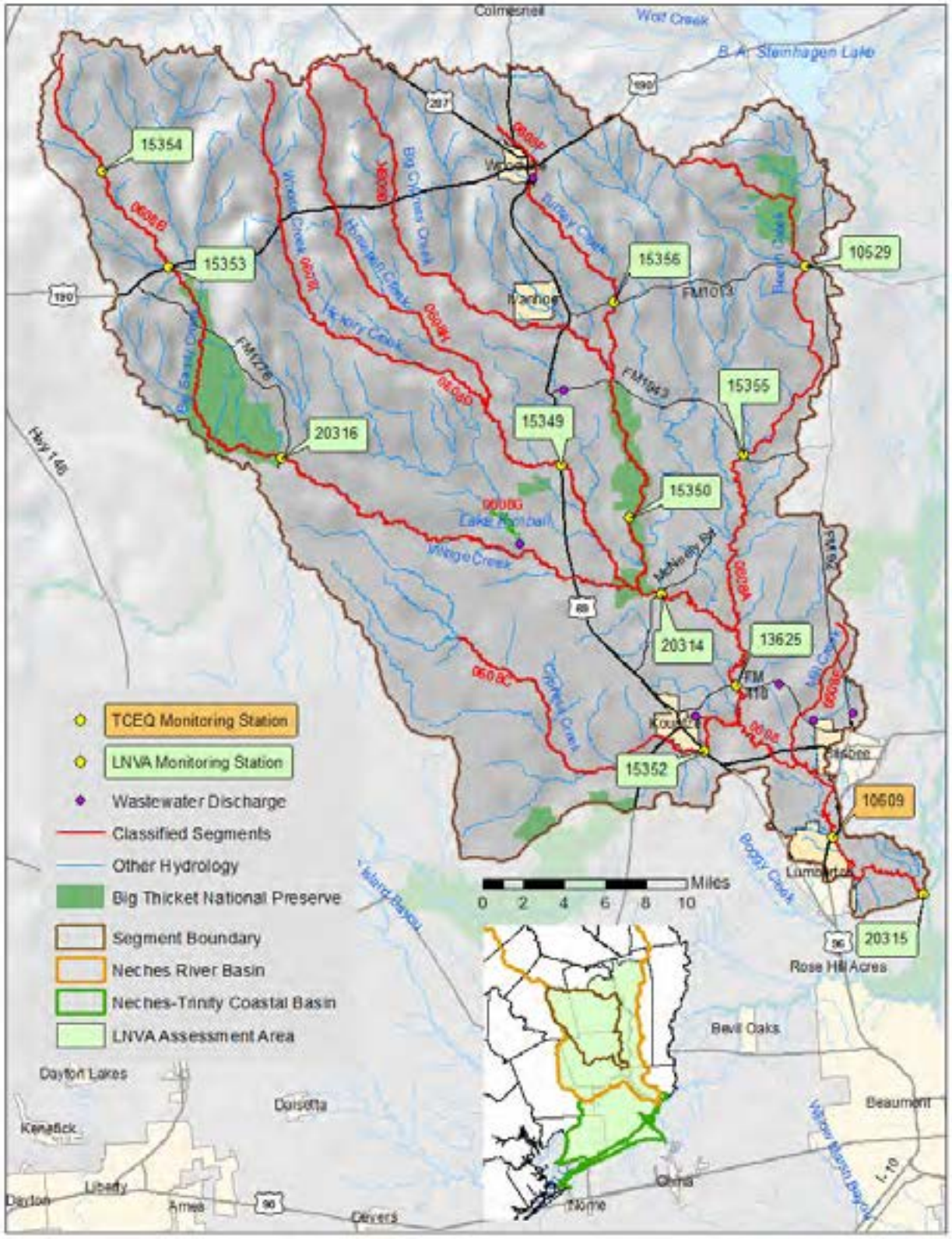
The 2014 TSWQS include site-specific ALU and DO criteria for Willow Creek and Pine Island Bayou in the upper segment (AUs 0607_04, 0607_05). The proposed intermediate aquatic life use (ALU) standard applies to both waterbodies classified as intermittent streams with perennial pools. For Pine Island Bayou, the proposed 24-hour average DO criterion is 1.5 mg/L, which includes a site-specific 24-hour minimum DO criterion of 1.0 mg/L. For Willow Creek, the proposed 24-hour average DO criterion is 3.0 mg/L. However, a site-specific 24-hour average DO criterion of 2.0 mg/L and a 24-hour minimum DO criterion of 1.5 mg/L apply for the months of June through September. These proposed changes to the 2014 TSWQS are still under review by the EPA.

Segment 0607_03 is not supporting the primary contact recreation use designation due to elevated *E. coli* since 2008. The geometric mean of the samples assessed was 128.7 MPN/100mL. *E. coli* over time can be seen in Figure 607.6. The source of the elevated *E. coli* counts in this segment is unknown and the upstream and downstream assessment units are not exceeding the criteria for bacteria. Additionally, unlike many of the other segments that are not supporting due to *E. coli*, the elevated *E. coli* counts in this segment do not appear to correlate strongly with periods of high flow. There are two permitted wastewater outfalls close to the assessment unit that may be contributing to *E. coli* levels as well as wildlife and other non-point sources. More bacteria data should be collected in this segment to determine the cause of the elevated *E. coli* counts.

*Recommendations*

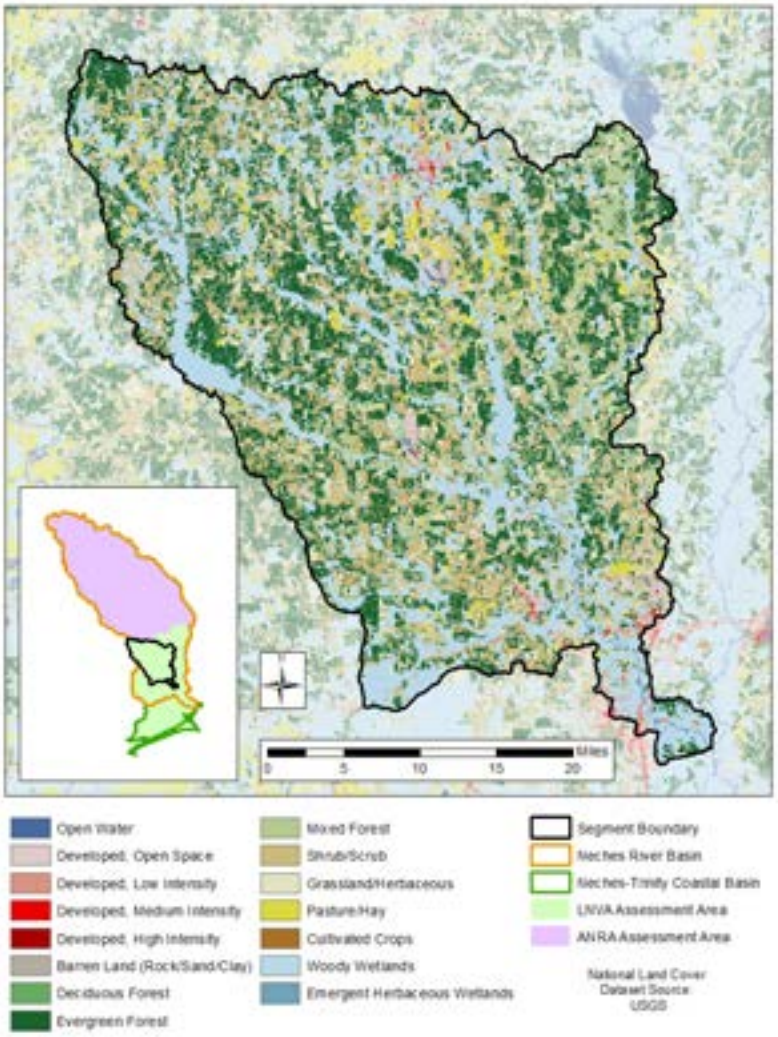
TCEQ special projects and proposed changes in the 2014 TSWQS are addressing the aquatic life use concerns and impairments in Segment 0607. LNVA will continue to operate and maintain the real-time CWQMN station (CAMS 749) on Pine Island Bayou to monitor and collect real-time water quality data and provide additional 24-hour DO measurements. In addition, LNVA will continue routine water quality monitoring in the segment which includes flow data and provide *E. coli* bacteria results at all stations to assess the primary contact recreation use.

# Segment 0608 – Village Creek



*Watershed Characteristics*

**Figure 608.1: Land Use Map for Segment 0608**




The Village Creek watershed has many tributaries draining approximately 1,113 square miles as it flows southeasterly to its confluence with the Neches River. Village Creek is defined in the TSWQS as from the confluence with the Neches River in Hardin County to the confluence of Lake Kimball Dam in Hardin County (Figure 608.1 and Figure 608.2). Unclassified water bodies include Beech Creek (0608A), Big Sandy Creek (0608B), Cypress Creek (0608C), Mill Creek (0608E), Turkey Creek (0608F), and Lake Kimball (0608G). This segment is broad and covers over 200 miles in stream length.

Segment 0608 is similar to Segment 0602 and 0603, in that it falls under the same South Central Plains, or "Piney Woods" ecoregion. This region represents the western edge of the southern coniferous forest belt. Species of pine, oak, gum, and magnolia cover large expanses in this segment, in addition to large tracts of pastureland. Once thickly blanketed in pine and hardwood forests, now most of the area is covered by loblolly and shortleaf pine plantations. Village Creek State Park is included in Segment 0608 in Hardin County at Lumberton, Texas, and covers more than 1,000 acres of thick forests. The Village Creek watershed lies entirely within the region of southeast Texas known as the Big Thicket. Forests include cypress swamps, baygalls, blackwater sloughs, yaupon, water tupelo, and mayhaw trees. Average rainfall is approximately 50 inches/year and Village Creek will flood severely every 3 to 4 years. Temperatures range from an average low of 38 °F in January to an average high of 93°F in July. Land use in Segment 0608 is oil and gas extraction, timber production, pastureland, cattle production, and public land (Village Creek State Park and Big Thicket National Preserve).

*Background*

Since 2007, LNVA has monitored 12 routine stations in this segment. Due to various changes in LNVA's monitoring program, there are currently eight routine monitoring stations that are

active. TCEQ continues monitoring on a quarterly basis at Station 10609: Village Creek at US 96.

*Rope Swing on Village Creek*

Previous assessments of the segment identified water quality concerns for fecal coliform bacteria, pH, and dissolved oxygen. Earlier basin reports identified a correlation between these water quality concerns and streamflow. pH levels tended to decrease as streamflow increased, while bacteria levels increased. Low dissolved oxygen concentrations were correlated with low streamflow during the summer months.

The 2010 TSWQS were revised to adjust the pH range for this segment (5.5 to 8.0) due to the natural, acidic conditions that are present in the watershed. For example, very low pH levels are common in tributaries such as Beech Creek where dark, stained water color indicates tannins are present. Tannins are natural organic matter that can result from nature's fermentation process as water passes through the ground in peaty areas or through levels of decaying vegetation. Tannins are typically found in swampy or marshy areas where the decomposition of trees around bodies of water often leads to the direct colorization of the water. The solution of tannic acid and water reduces the pH level below 7, leading to a far more acidic environment.

**Table 608.1 – Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Village Creek | 0608_01 | Fish Consumption | DSHS Advisory (mercury) | NS |
| | | Fish Consumption | Mercury | CS |
| | 0608_02 | General | pH | CN |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |
| | | Fish Consumption | Mercury | CS |
| | 0608_03 | Fish Consumption | DSHS Advisory (mercury) | NS |
| Beech Creek | 0608A_01 | Aquatic Life | Copper | NS |
| | 0608A_02 | Aquatic Life | Habitat | CS |
| Big Sandy Creek | 0608B_04 | Recreation | E. coli | NS |
| Cypress Creek | 0608C_01 | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | | Aquatic Life | Habitat | CS |
| Mill Creek | 0608E_01 | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| Turkey Creek | 0608F_02 | Recreation | E. coli | NS |
| Lake Kimball | 0608G_01 | Fish Consumption | DSHS Advisory (mercury) | NS |

Figure 608.2 - *E. coli* and flow over time in Big Sandy Creek at US 190 (Station 15353)

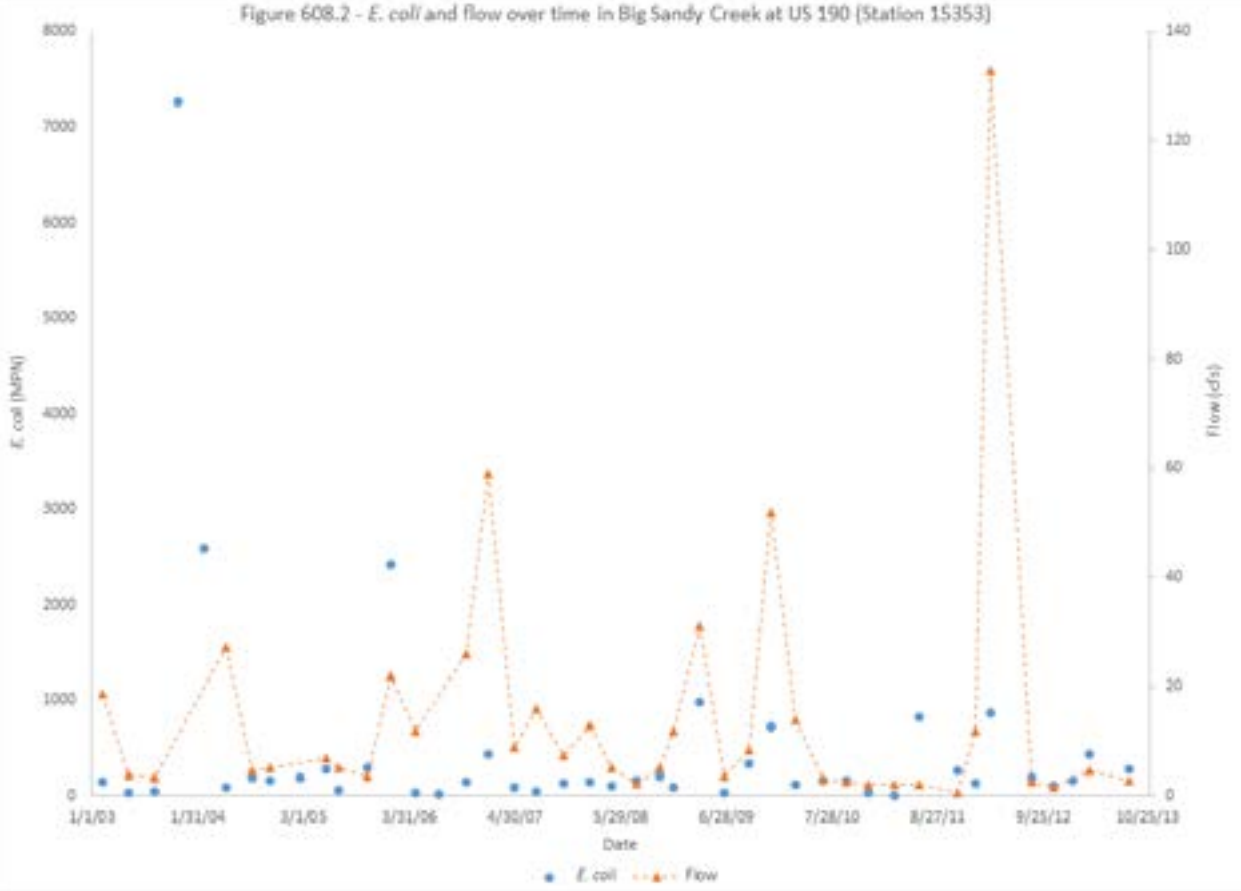
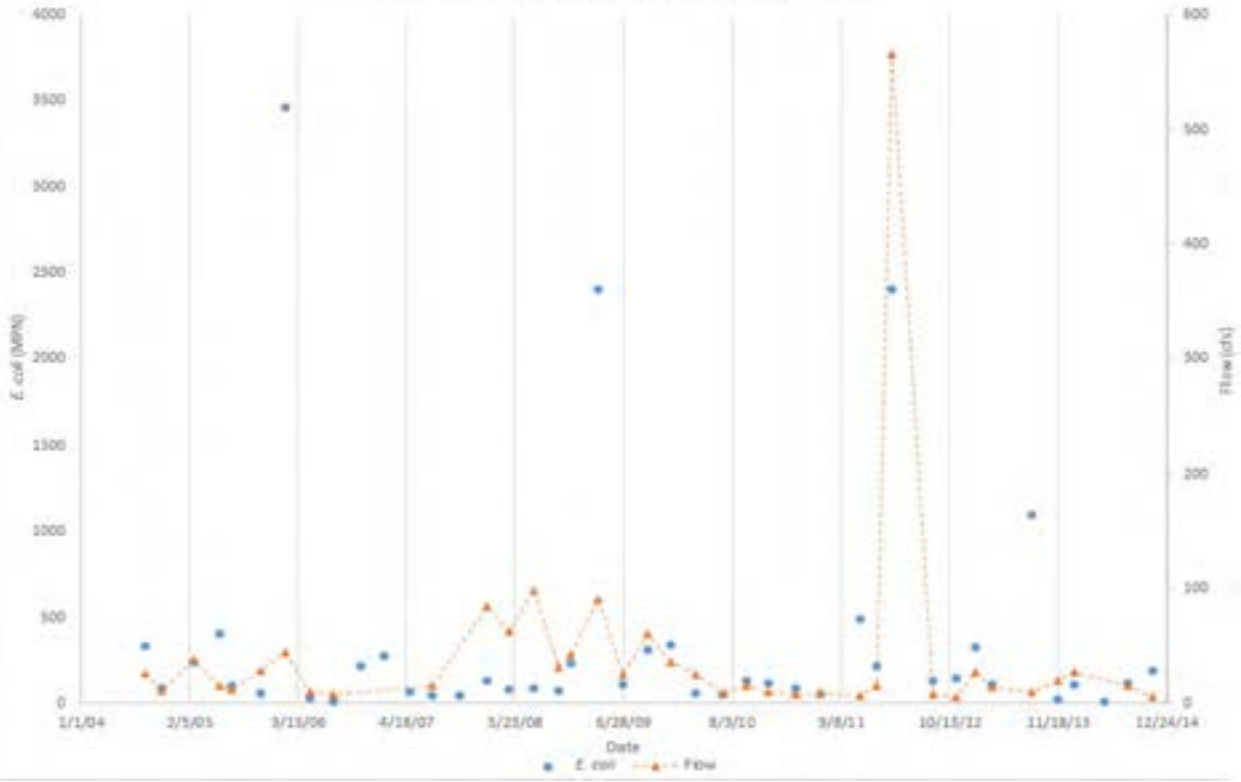



Figure 608.3 - *E. coli* and flow in Turkey Creek at FM 1013



*Current Assessment Results*

Table 608.1 includes those assessment units within the segment that are not supporting (NS) the designated uses, have a screening level concern (CS) or have a use concern (CN) based on the Draft 2014 Texas Integrated Report. Segment 0608 is designated for high aquatic life use, primary contact recreation, and public water supply. The primary contact recreation use is not supported due to elevated levels of *E. coli* bacteria in Big Sandy Creek and Turkey Creek. According to the Draft 2014 Texas Integrated Report, the geometric mean of the 28 samples assessed from Big Sandy Creek was 153.8 MPN/100mL. In Turkey Creek, the geomean of the 28 samples assessed was 146.9 MPN/100mL.

In Figures 608.2 and 608.3, *E. coli* grab data and instantaneous flow are plotted over time for Big Sandy Creek and Turkey Creek, respectively. Big Sandy Creek (Station 15353) and Turkey Creek (Station 15356) drain large areas of forest and agricultural land that is used for timber and cattle production, with some residential areas scattered throughout. The spikes in *E. coli* counts could be due to increased stream flow (see Figures 608.4 and 608.5) as a result of high rainfall events that occurred during those times and runoff from municipal areas, agricultural fields, and storm sewers. The sources of the bacteria are likely non-point sources such as wildlife, livestock (manure runoff), and failing onsite sewage facilities located upstream.

In Figure 608.6, dissolved oxygen in Cypress Creek is plotted over time to show the seasonal fluctuations. During the cool months in East Texas and while the rainfall is

Figure 608.4—*E. coli* vs. Flow in Big Sandy Creek at US 190

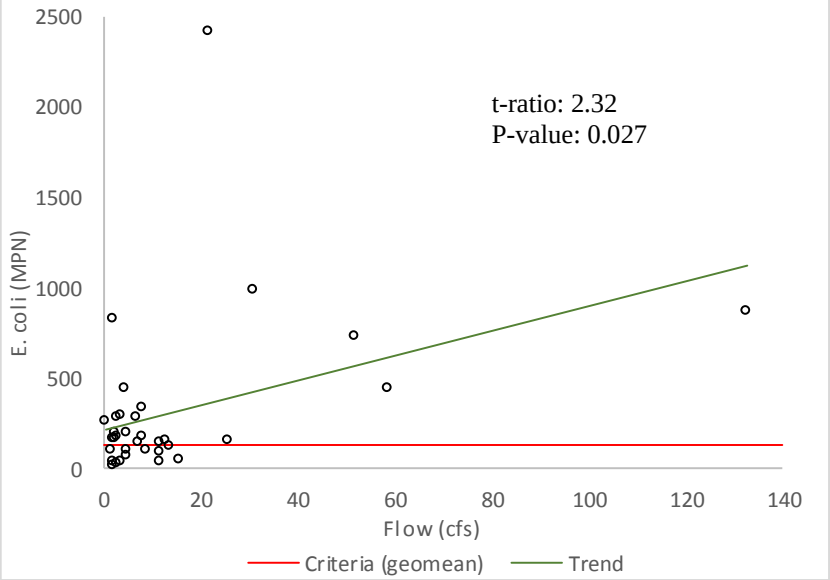
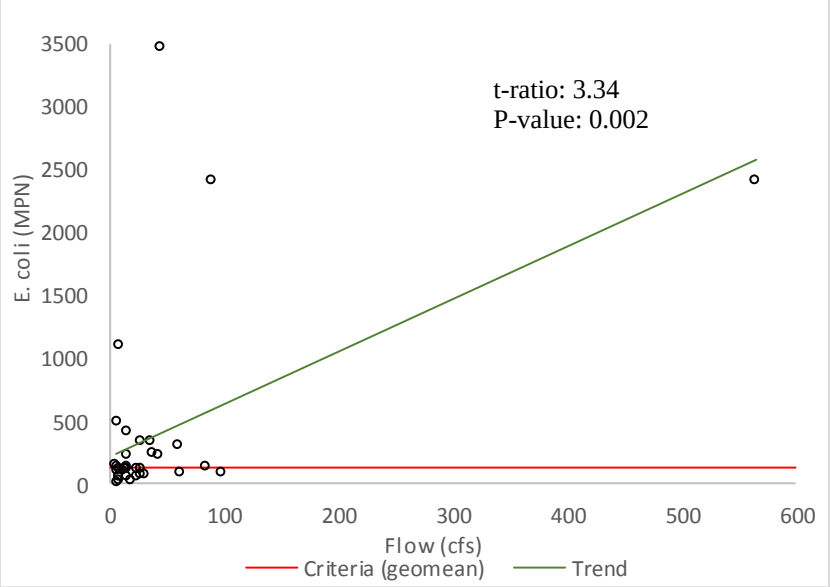
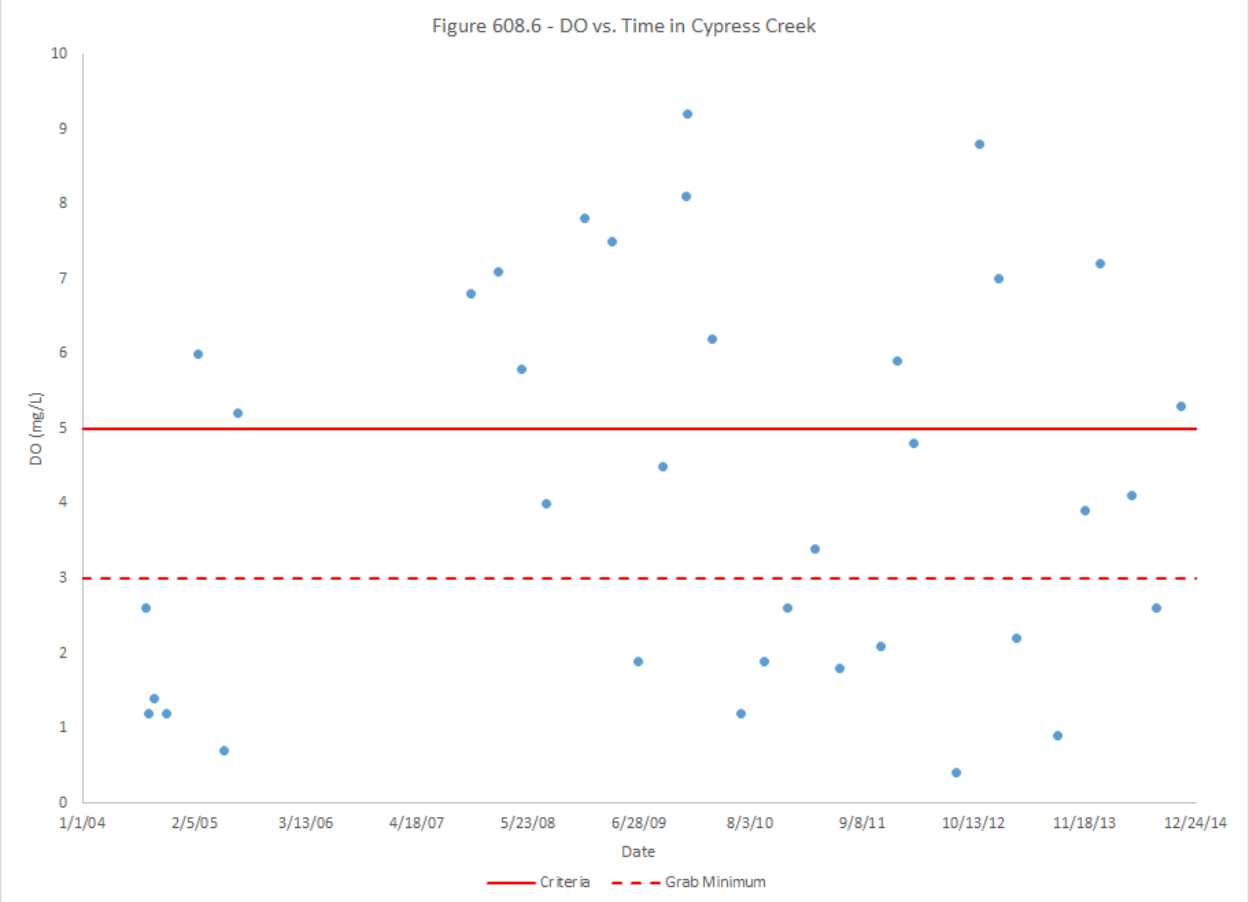
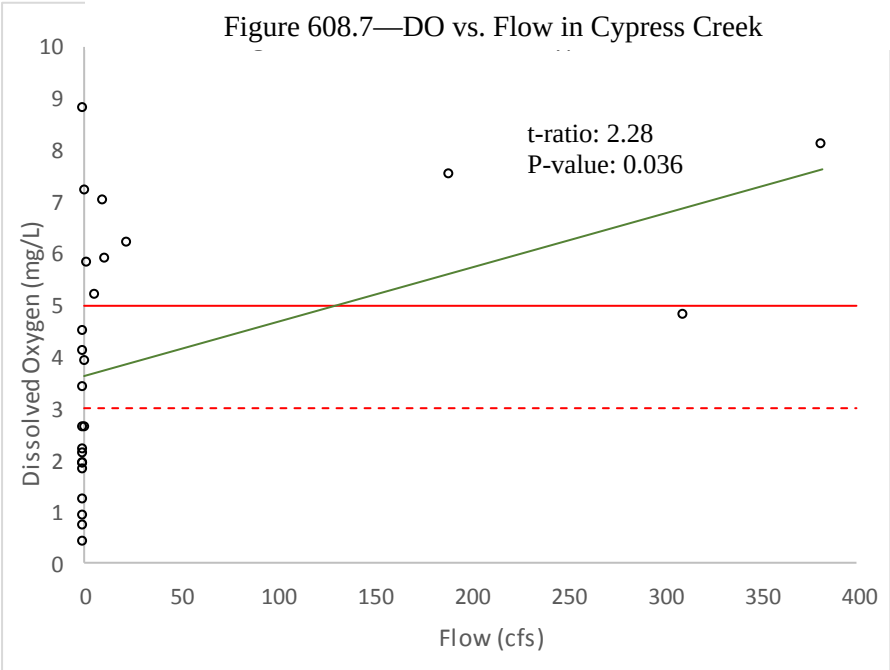



Figure 608.5—*E. coli* vs. Flow in Turkey Creek at FM 1013

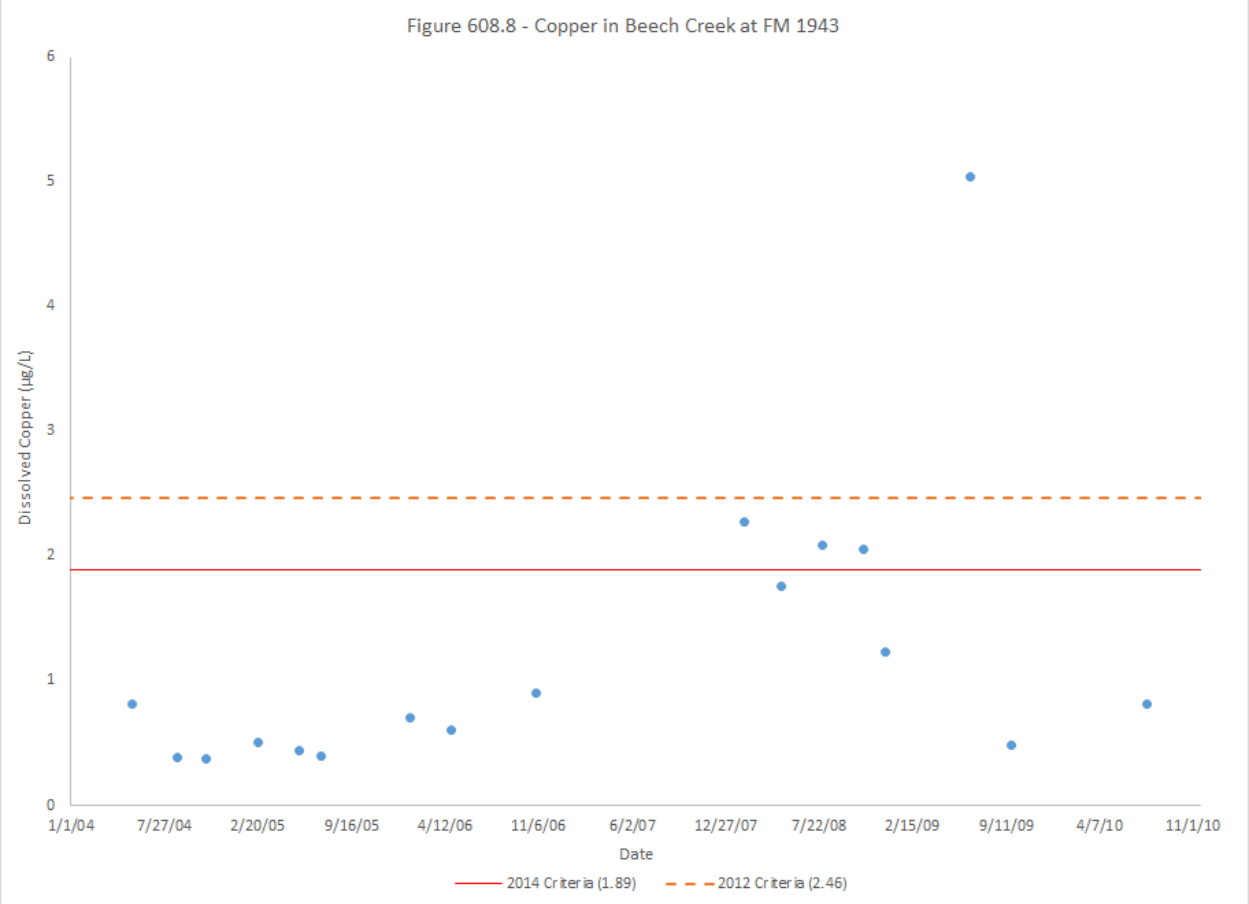





greater, the dissolved oxygen concentration tends to increase. In fact, during the winter months, the dissolved oxygen can be so saturated in water that levels reach over 100% saturation (>10 mg/L) which is a good indicator of unstable DO from excess algal growth. As temperatures elevate, the amount of oxygen water can hold is reduced. For example, at 0°C water can hold about 14.6 mg/L of oxygen, while at 30 °C the amount decreases by almost half to 7.7 mg/L.



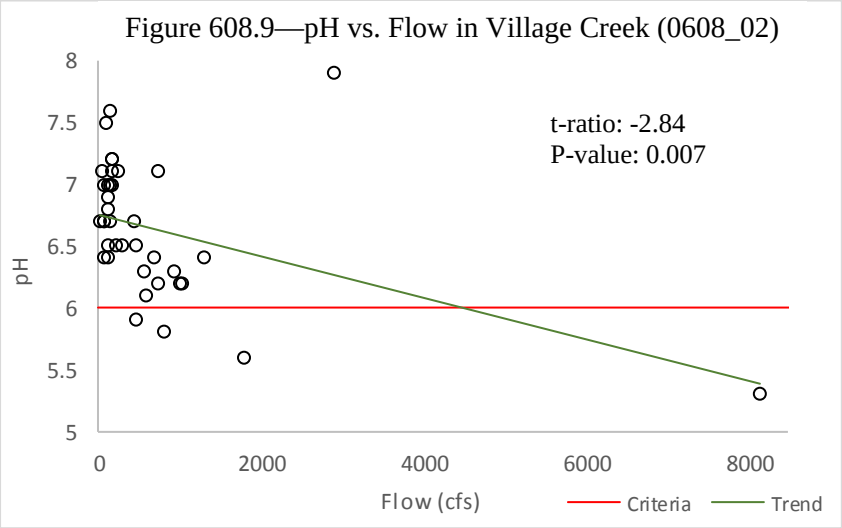

Mill Creek in Hardin County is also not supporting the aquatic life use due to depressed dissolved oxygen. However, no recent monitoring data is available on this segment and the NS status is a carry forward




from previous assessments. Cypress Creek and Mill Creek in Hardin County are both low gradient streams with perennial pools when not flowing, which explains many of the low DO results.

Metals in water assessments are based on dissolved freshwater or saltwater acute and chronic criteria for aquatic life protection established in the TSWQS. The criteria for cadmium, copper, lead, nickel, and zinc are calculated based on the hardness concentrations from the segment. Hardness values in the segment and river basin are much lower compared to hardness values statewide, ranging from <10 mg/L to 30 mg/L, therefore calculated criteria values are lower. Acute criteria apply to all waters of the state and at all flows above one-fourth the 7Q2. The chronic criteria apply outside of mixing zones in unclassified perennial streams when the stream flow is greater than the 7Q2, and in intermittent streams that support significant aquatic life. For purposes of monitoring instream compliance with standards, the individual measurements are compared against acute criteria and the averages for each parameter are compared to the chronic criteria to determine aquatic life use support.

Beech Creek is not supporting the aquatic life use due to elevated dissolved copper in water (Figure 608.8) which was added to the Draft 2014 303(d) List. According to the Draft 2014 Texas Integrated Report, three samples exceed the acute criterion of 1.89 µg/L which is lower than the acute criterion used in the 2012 Texas Integrated Report (2.46 µg/L). However, if the 2012 acute copper criterion is applied, then only 1 out of 14 or 7.1% of samples exceed the




aquatic life use standard. Copper is a naturally abundant element in nature and an essential micronutrient for the lifecycles of plants and animals, but in large amounts copper can be toxic to both plants and animals. One elevated sample result for dissolved copper does not indicate a water quality impairment, therefore additional metals data should be collected to determine the validity of this new 303(d) listing.

Village Creek from the confluence with Cypress Creek (0608C) upstream to the confluence with Beech Creek (0608A) has a concern for aquatic life use due to low pH. The pH range is important to organisms in the water because the ability of an aquatic organism to complete a life cycle becomes threatened when pH is greater than 9.0 or less than 5.0. However, the mean (5.65) of the 4 out of 28 samples that are below the listed criteria (6.0) according to the Draft 2014 Integrated Report is still above the current TSWQS for low pH (5.5).

The likely source of this low pH in Village Creek is the Beech Creek watershed or segment upstream. Very low pH results are common due to the tannic acids formed during the decomposition of trees and woody debris in the watershed. The most common occurrence of tannic acid is in the twigs of certain trees, specifically Chestnut and Oak trees. Although pH changes may be common in highly wooded areas, a sudden drop in the pH has adverse consequences. This may be the case following a collapse of a tree into the water which lowers pH and stains the water a dark tea color. Another factor that influences pH in a body of water is stream flow. Generally, an inverse relationship exists between pH and stream flow, as depicted in Figure 608.9, where the highest flow measurement coincided with the lowest pH. This indicates a flushing of backwater, swampy areas where organic decay of forest litter lowers the pH, thus impacting the stream's pH.

On Sept. 21, 2009, the Texas DSHS issued a fish consumption advisory for Village Creek (Figure 608.10). The advisory warns the public to limit their consumption of crappie, gar, and largemouth bass due to elevated levels of mercury in fish tissue samples taken from these three species. This advisory applies to the entire stream segment (0608). On April 23, 1999, the Texas DSHS issued a fish consumption advisory for Lake Kimball (segment 0608G) warning that consumption of all species of fish from the lake should be limited. Therefore, the fish consumption use is not supported in Village Creek and Lake Kimball due to mercury in fish tissue and both segments are on the 303(d) list in the Draft 2014 Integrated Report.

*Recommendations*

The source of impairments in the Village Creek watershed can be attributed to either natural conditions or non-point source pollution. Low pH and dissolved oxygen are influenced by the low gradient streams, decaying organic matter, and acidic soils in Segment 0608. The current TSWQS for low pH criteria should be applied to this segment in the Draft 2014 Texas Integrated Report. Recreational Use Attainability Analyses (RUAAs) to address the primary contact recreation use designation is recommended for Big Sandy Creek (0608B) and Turkey Creek (0608F). In addition, the TDSHS should update the fish consumption advisories in the segment, and LNVA and TCEQ should continue routine water quality monitoring in the segment to address water quality issues and concerns.

**Figure 608.10 - Texas DSHS Fish Consumption Advisory for Village Creek**

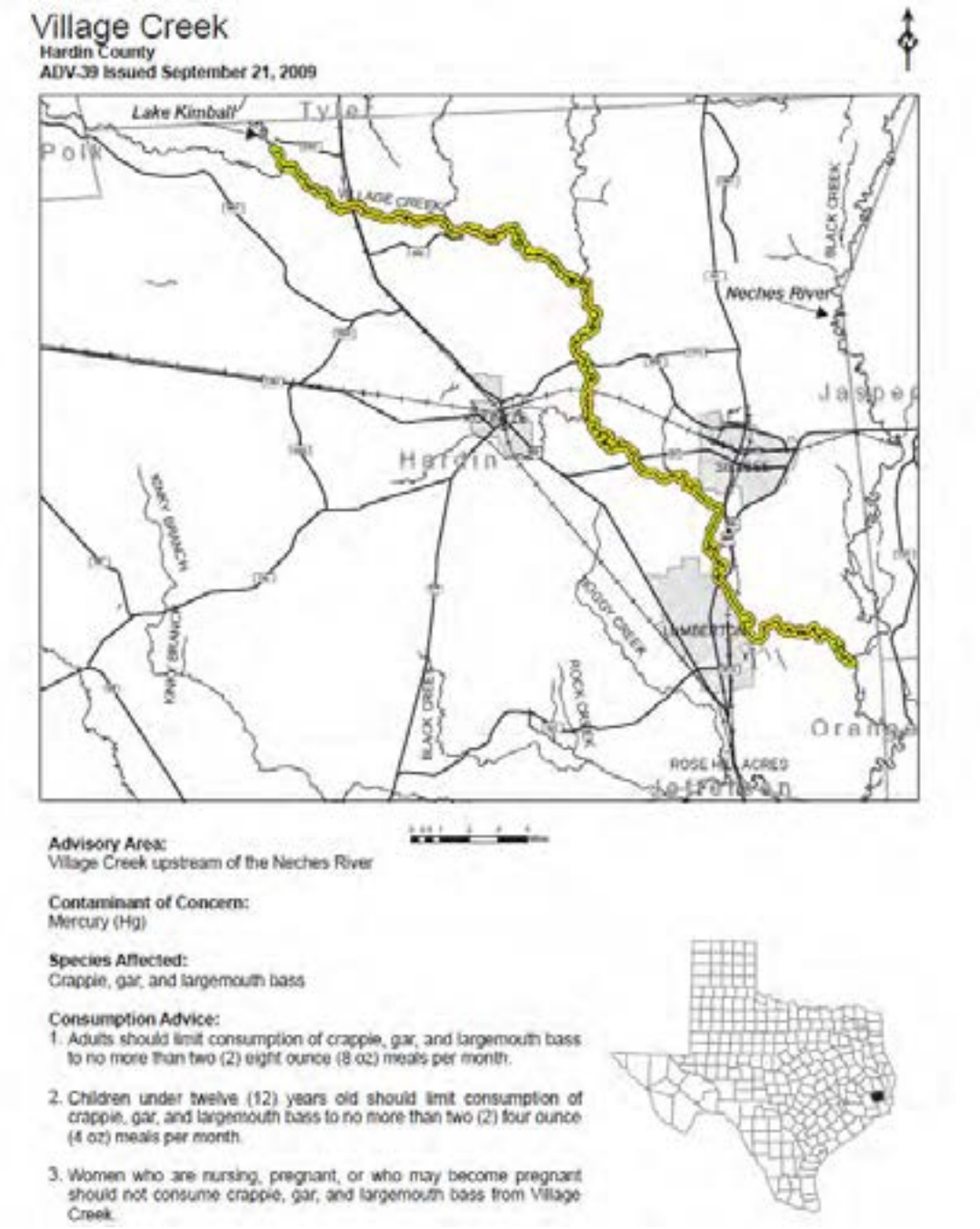
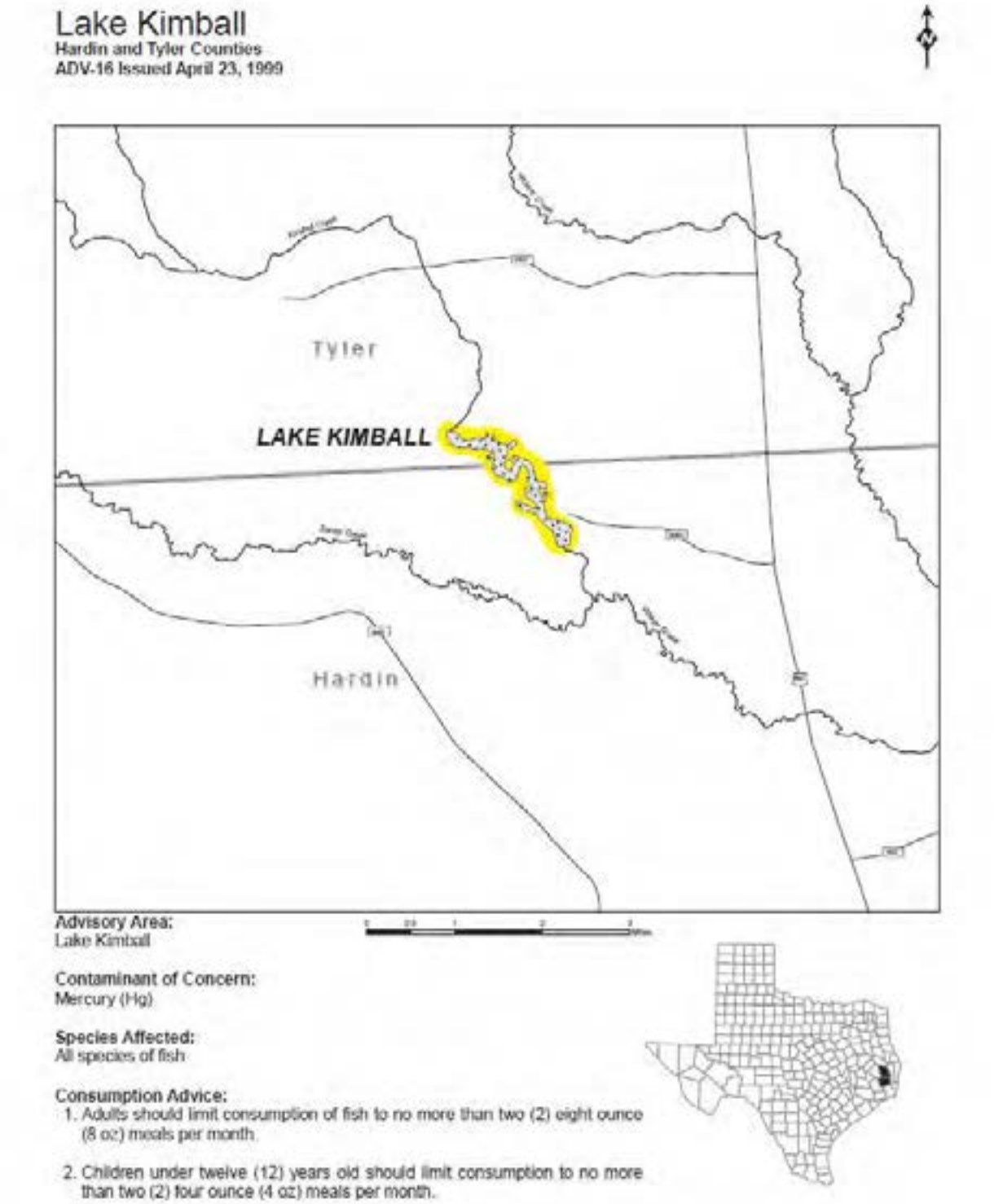


**Figure 608.11 - Texas DSHS Fish Consumption Advisory for Lake Kimball**



**Segment 0609 – Angelina River below Sam Rayburn Reservoir**

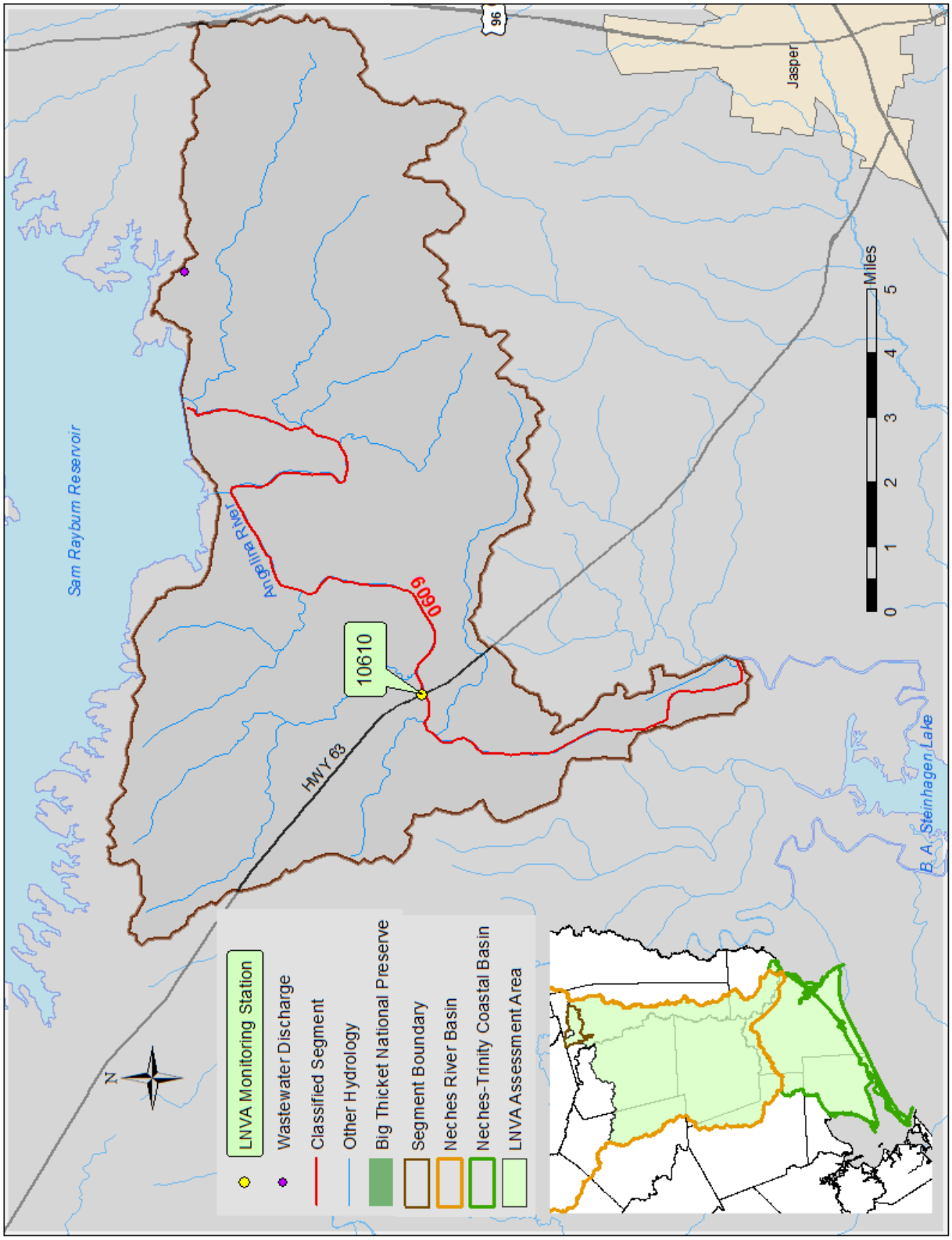
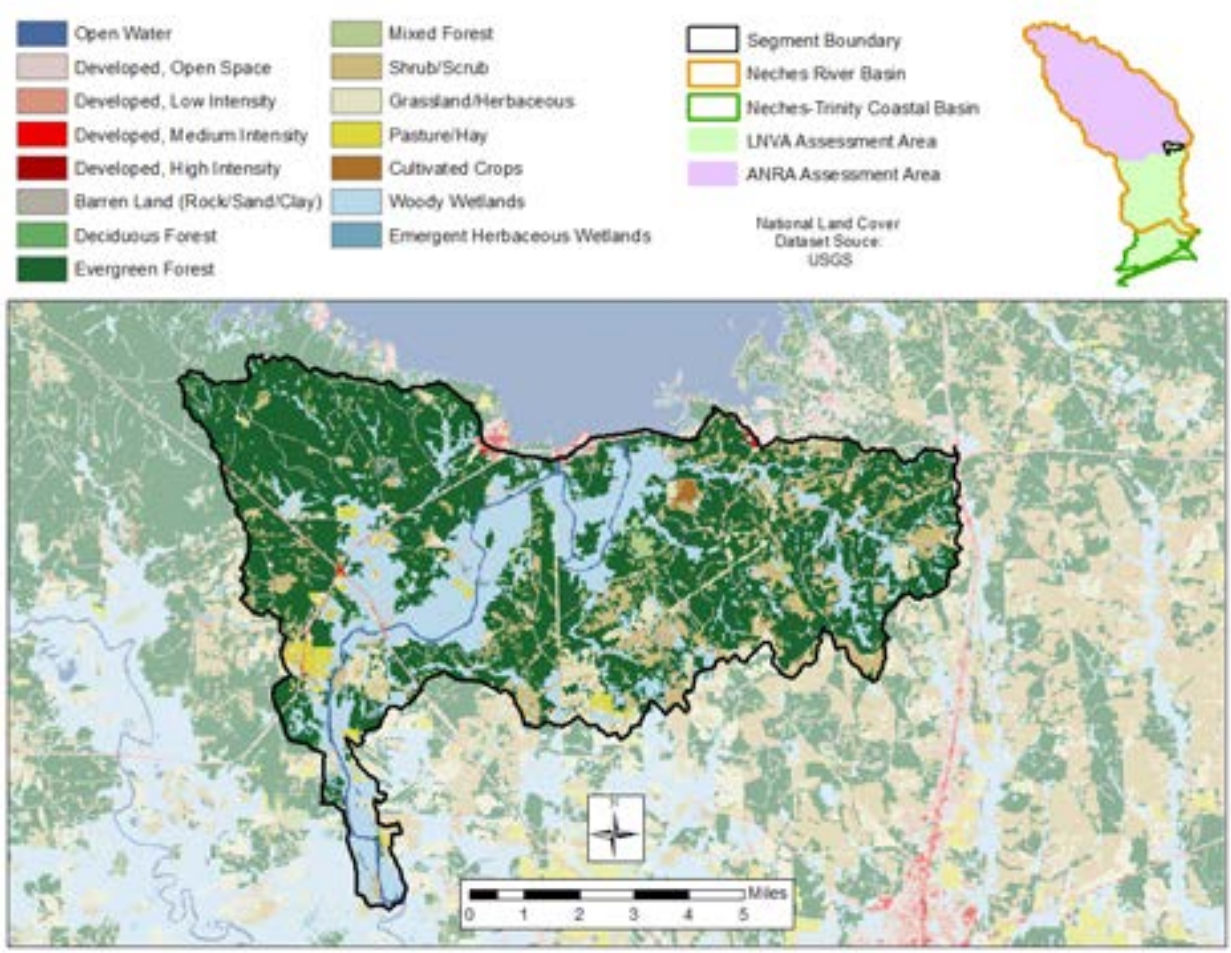


**Figure 609.1: Land Use Map for Segment 0609**




*Watershed Characteristics*

Angelina River below Sam Rayburn Reservoir is defined in the *Texas Surface Water Quality Standards* as from a point immediately upstream of its confluence of Indian Creek in Jasper County to Sam Rayburn Dam in Jasper County. The Angelina River has very clear waters as compared to Segments 0607 and 0608, and ranges from 75-150 feet in width. This river meanders through the rolling hills of the heart of the East Texas Piney Woods (Level III Ecoregion 35), through forested bottomlands that contain bald cypress, pine, and hardwood trees. Common wildlife to the area is whitetail deer, squirrel, wild turkey, quail, dove, and duck. The 153,000-acre Angelina National Forest borders the upper part of Segment 0609, and land use includes recreational use and public property near the national forest. Longleaf pine is the dominant tree type in the southern part of the segment, while loblolly and shortleaf pine are dominant in the northern section. Flow is generally high as compared to other segments in the basin, because of the Sam Rayburn Reservoir dam releases.

*Background*

Segment 0609 lies within Jasper County approximately ten miles northwest of the City of Jasper. The segment extends 13 river miles from the tailrace below Sam Rayburn Reservoir dam towards the headwaters of B.A. Steinhagen Lake. Another 5.2 miles of old riverbed exists along the lower side of the dam upstream from the confluence with the tailrace. The drainage area of Segment 0609 is 107 square miles, with land use characterized as sparsely populated and heavily forested with minimal area of non-irrigated cropland located in the southeast quadrant of the watershed. The LNVA monitors one station on this segment.

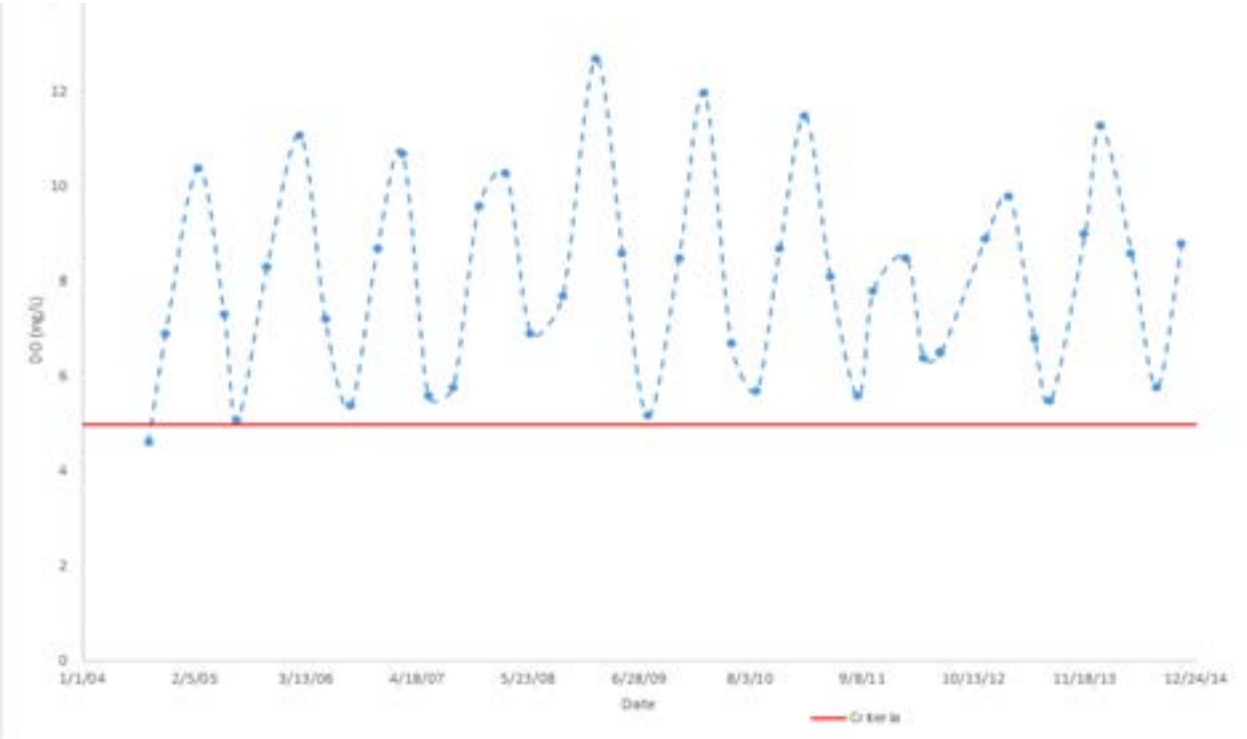
**Table 609.1 – Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Angelina River below Sam Rayburn Reservoir | 0609_01 | Fish Consumption | DSHS Advisory (dioxin) | NS |
| | | Fish Consumption | DSHS Advisory (mercury) | NS |

*Current Assessment Results*

Table 609.1 includes the assessment unit within the segment that is not supporting (NS) the designated uses based on the Draft 2014 Texas Integrated Report. Segment 0609 is designated for primary contact recreation use, high aquatic life use, and public water supply. Overall, water quality in the segment is very good. The contact recreation use, aquatic life use, general use, and public water supply are fully supported in the segment. There are no concerns due to nutrients. However, the segment is not supporting the fish consumption use due to dioxins and mer-

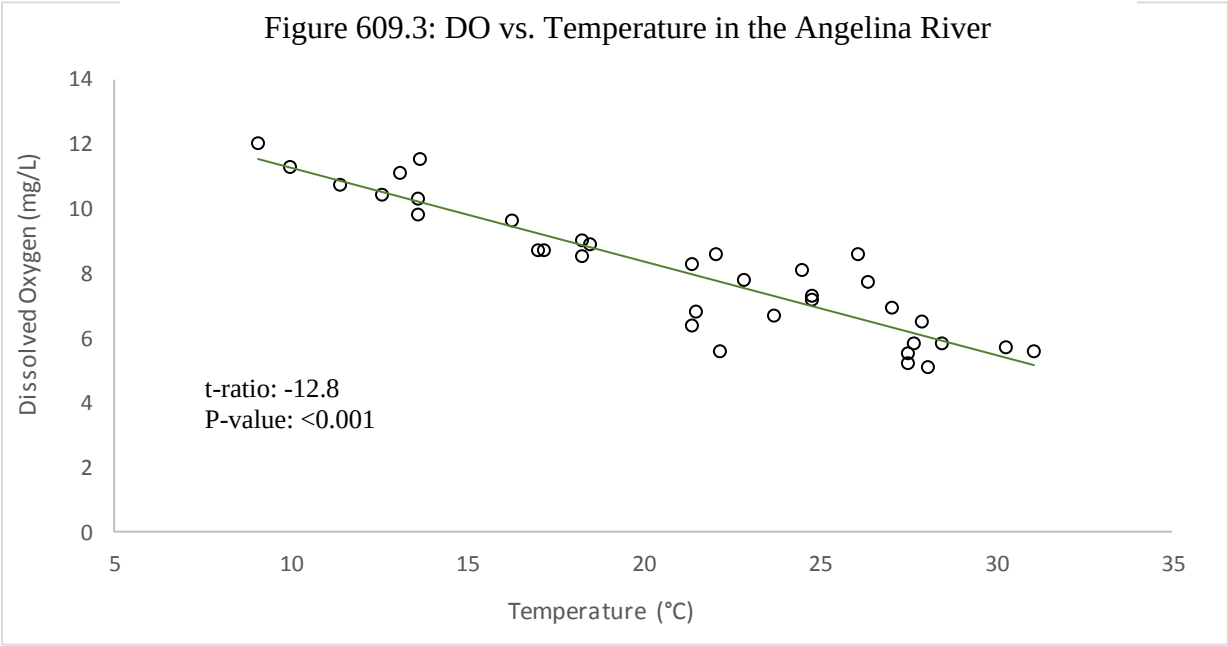
Figure 609.2: Seasonal Variation of DO in the Angelina River



cury in fish tissue, therefore it was added to the Texas 303(d) List for this reason.

Figure 609.2 shows dissolved oxygen concentrations peak during winter months and lower concentrations occur during summer months when the reservoir is stratified. During summer lake stratification, colder water sinks to the bottom while the warmer waters rise to the surface. At this time circulation is limited to the upper lake level, and the colder water near the bottom is depleted of oxygen. The situation is reversed during the winter when the entire water column is at or near the same temperature, therefore allowing full circulation and replenishment of oxygen.

Figure 609.3: DO vs. Temperature in the Angelina River

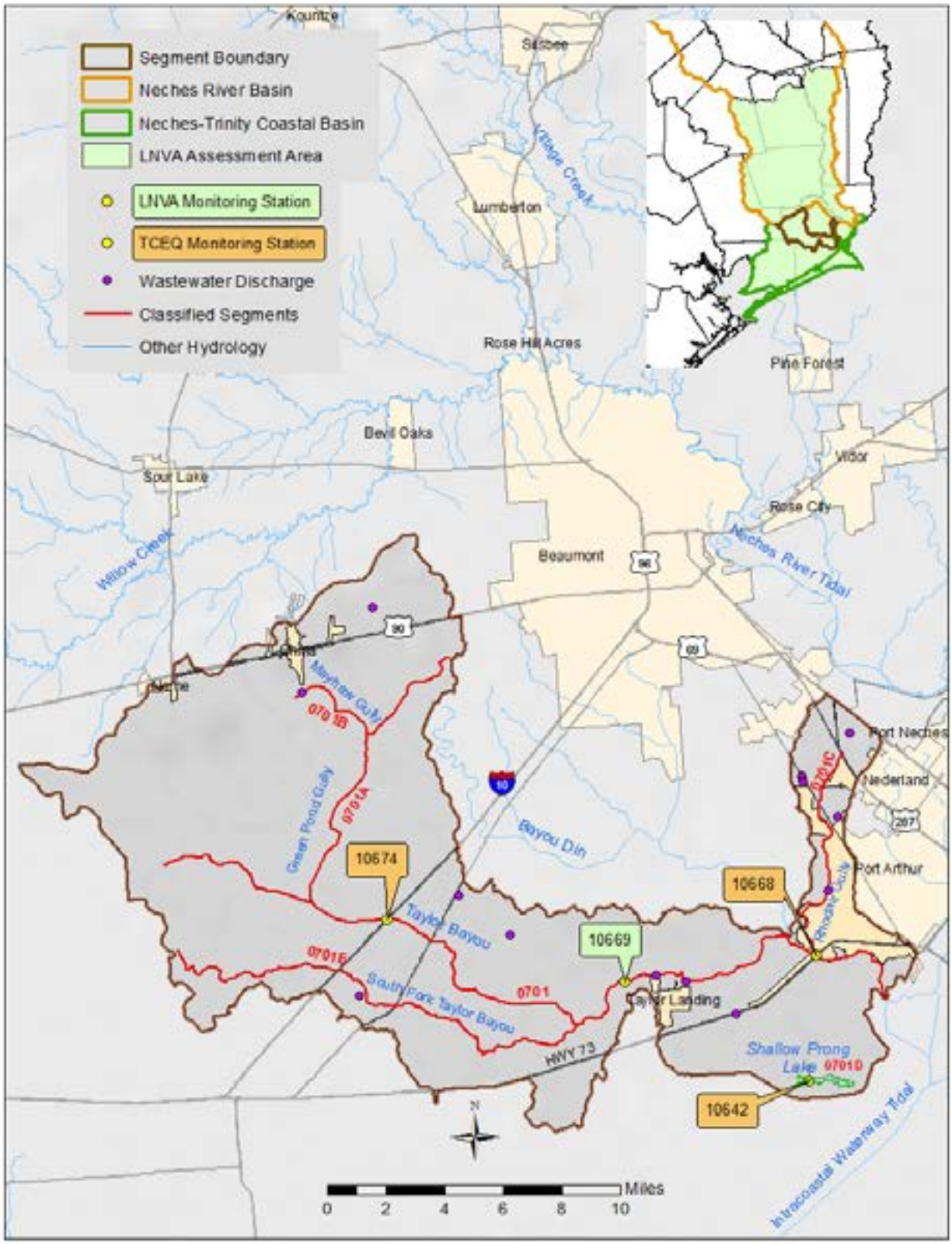



Flow is controlled by the U.S. Army Corps of Engineers, Ft. Worth District from the powerhouse (turbine/gated) at the Sam Rayburn Reservoir dam located just upstream. Since the LNVA Neches River Saltwater Barrier went into operation in 2003, additional releases from the Sam Rayburn Reservoir are no longer required to prevent saltwater intrusion in the lower Neches River channel. This has resulted in an atypical flow regime in this river segment. In other segments, dissolved oxygen is most strongly influenced by flow patterns, but due to the artificial flow in this segment, the fluctuations in dissolved oxygen are much more correlated with water temperature (Figure 609.3).

*Recommendations*

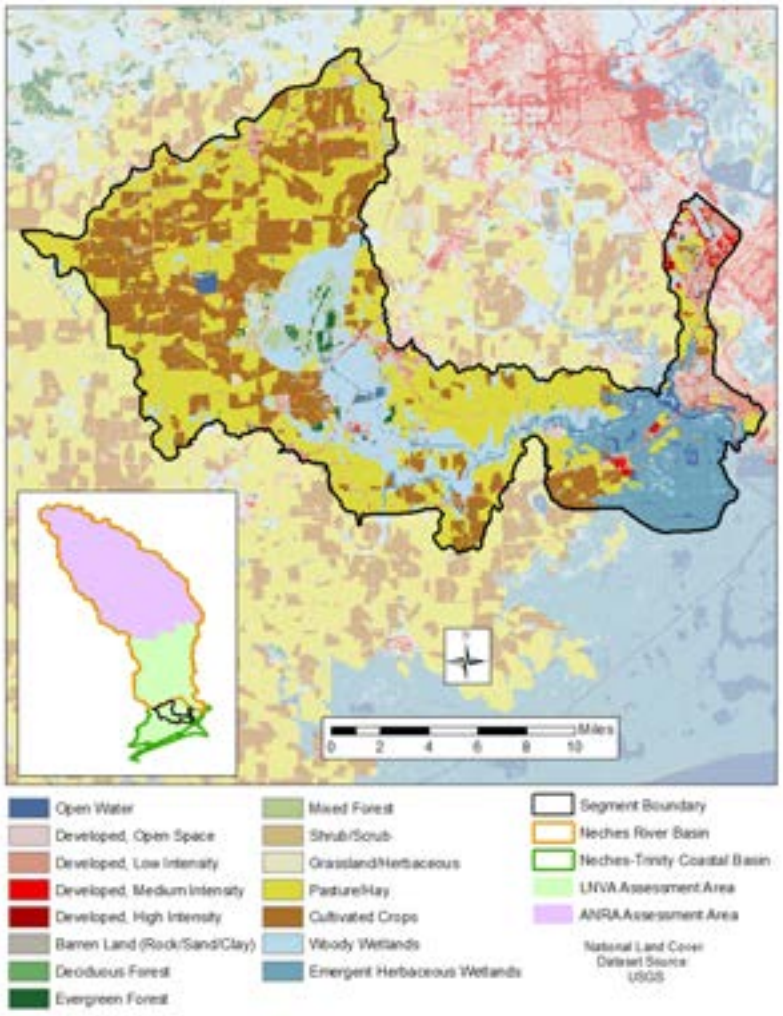
LNVA should continue routine monitoring on the segment to maintain baseline water quality data to insure stream standards are being met. TDSHS should routinely update the fish consumption advisories affecting this segment and both reservoirs located upstream and downstream.

# Segment 0701 – Taylor Bayou above Tidal



*Watershed Characteristics*

**Figure 701.1: Land Use Map for Segment 0701**




Taylor Bayou above Tidal is defined in the *Texas Surface Water Quality Standards* as from the salt water lock 7.7 kilometers (4.8 miles) downstream of SH 73 in Jefferson County to the confluence with Hillebrandt Bayou, and includes Shallow Prong Lake on Big Hill Bayou. Taylor Bayou is 34 feet long, ranges from 8 feet to 13 feet in depth, and is characterized as low gradient with sluggish flow. Shallow Prong Lake is a reservoir that is 150 acres large.

Segment 0701 is located in the Level III ecoregion known as the Western Gulf Coastal Plain (34) and has a mix of two Level IV ecoregions present: the Northern Humid Gulf Coastal Prairies (34a) and the Texas-Louisiana Coastal Marshes (34g). The Western Gulf Coastal Plain is generally about 50 to 90 miles wide, relatively flat, and adjacent to the Gulf of Mexico. The natural dominant vegetation in this segment is grasslands, but further inland are some forest and savanna-type vegetation. Soils drain poorly and much of the segment stays wet for most of the year. Soils are fine textured and made up of sands, silts, and clays, and even some salt domes. Historically, tall grass covered the area with some oak stands in the southern part of the ecoregions. Some loblolly pines still exist today in the northern part of the Northern Humid Gulf Coastal Prairies. Vegetation in the northern part of Segment 0701 is similar to the floodplain forests of Ecoregion 35, but in the south there are different types of trees such as pecan (*Carya illionensis*), southern live oak (*Quercus virginiana*), cedar elm (*Ulmus crassifolia*), and ash (*Fraxinus* sp.). Even closer to the coast freshwater and saltwater coastal marsh vegetation is very abundant, like at Shallow Prong Lake on Big Hill Bayou. Cordgrass marshes (*Spartina* sp.) are extensive, in addition to rushes, sedges, bulrushes, and cattails. In the coastal marshes, few to no trees are present. Historically, animal populations included bison (*Bison bison*), pronghorn (*Antilocarpa americana*), and red wolves (*Canis rufus*).

Segment 0701 is generally flat plains with much of the area covered by wetlands and tidal marshes with bayous, lakes, and canals. Land use is primarily pasture/hay and cultivated crops

of rice, grain, sorghum, cotton, and soybeans. There is also urban/industrial uses, oil and gas production, waterfowl and wildlife habitat throughout Segment 0701. The mean annual precipitation is 37-58 inches per year, and mean temperature is 42/62 °F (Jan. min/max) and 74/92 °F (July min/max).

An industrial hazardous waste incinerator operated by Veolia Environmental Services is located about 3.5 miles west of Taylor Bayou at SH 73. The Veolia facility is located on 3,300-rural acres of which only 450-acres are involved in waste activity approximately ten miles west of Port Arthur, TX. The 150 million BTU/hr rotary kiln based incinerator occupies 16-acres. Veolia's Port Arthur Treatment Complex is permitted to handle all six RCRA hazardous waste code categories (ignitable, toxic, corrosive, acute hazardous, extraction procedure (EP) toxic, and reactive) as well as most PCB wastes. Veolia ES-Port Arthur accepts waste solvents, solvent/oil mixtures, organic and inorganic chemical wastes, pesticide wastes, petroleum wastes, aqueous wastes, contaminated soils and sludges, PCBs and capacitors, as well as other wastes.

*Background*

This segment is designated for primary contact recreation use and intermediate aquatic life use. Irrigation return flows from rice fields, storm water runoff and municipal and industrial discharges are the principle sources of flow in the segment and its major tributary, Hillebrandt Bayou. A saltwater lock near the mouth of the bayou minimizes tidal impact and saltwater intrusion, but the segment is still highly tidally influenced.

**Table 701.1 - Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Taylor Bayou Above Tidal | 0701_01 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | | General | Chlorophyll-α | CS |
| | 0701_02 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | | General | Chlorophyll-α | CS |
| Shallow Prong Lake | 0701D_01 | Fish Consumption | Arsenic | CS |

Historical water quality reports indicated a partial support of the aquatic life use due to low dissolved oxygen levels, a non-support of aquatic life use due to dissolved metals in water on Taylor Bayou at LaBelle Road (Station 10669), and a concern for nutrients (chlorophyll *a*) on Taylor Bayou at SH 73 (Station 10668).

Two stations (10674, 10668) on Taylor Bayou above Tidal and one station on Shallow Prong Lake (10642) are routinely monitored by TCEQ for field parameters, conventional, and bacteria. Station 10669 is included in this assessment, but the LNVA station is currently not being monitored due to changes in the CRP monitoring schedule.

Figure 701.2 - DO vs. Time in Taylor Bayou above Tidal

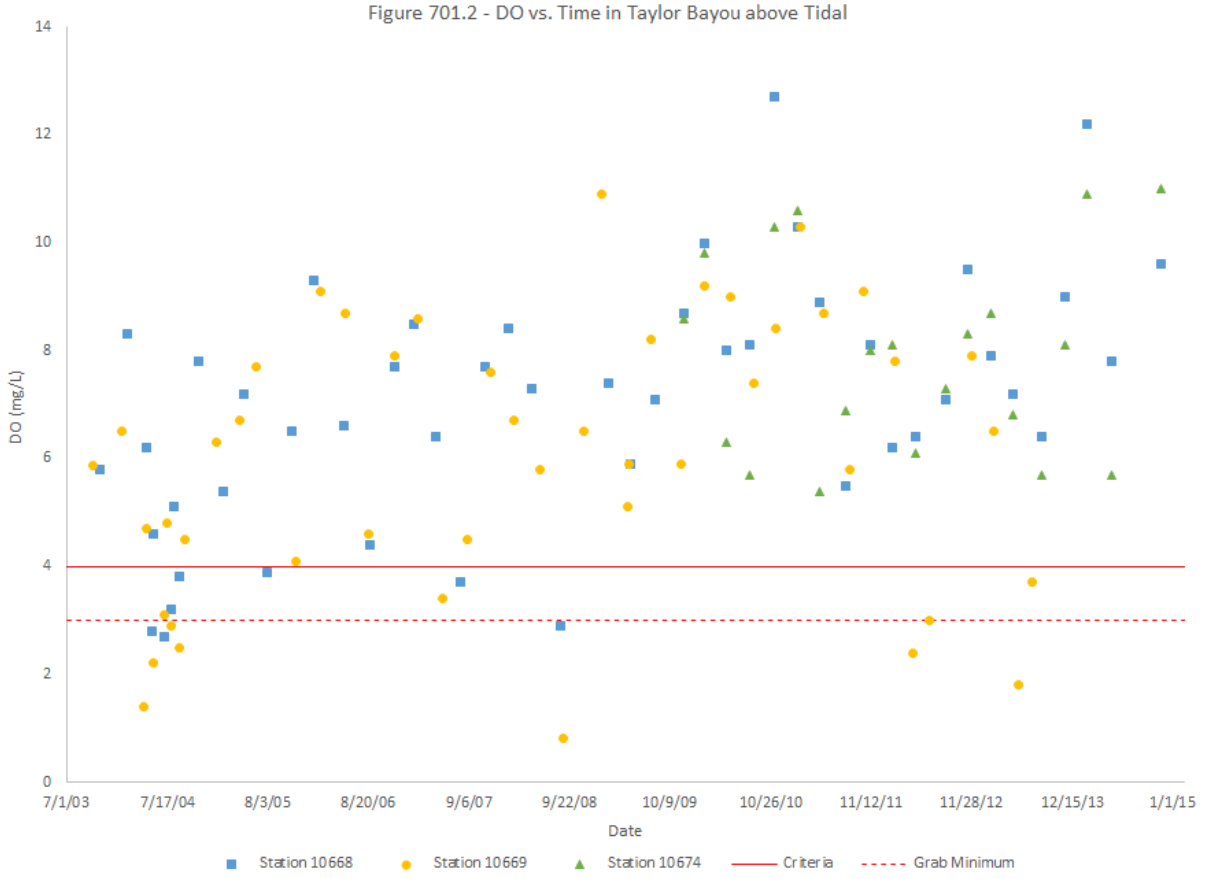
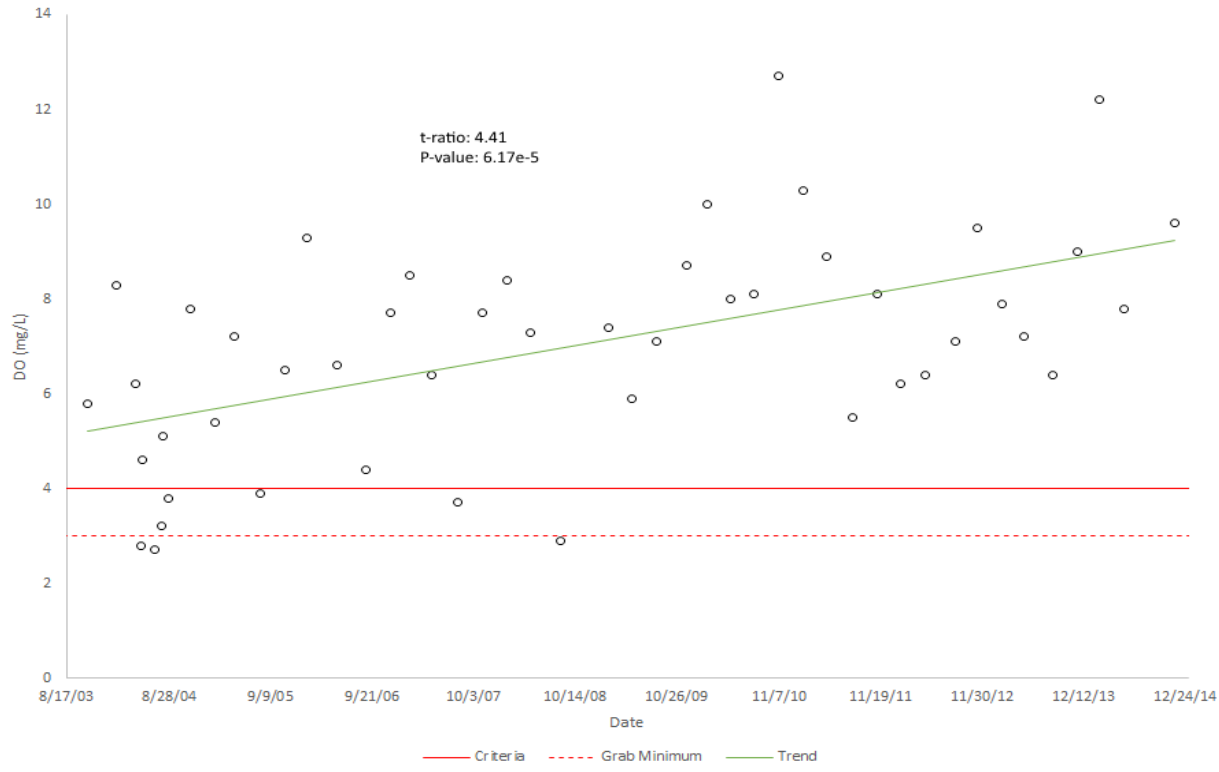



Figure 701.3 - DO vs. Time in Taylor Bayou at SH 73 (Station 10668)

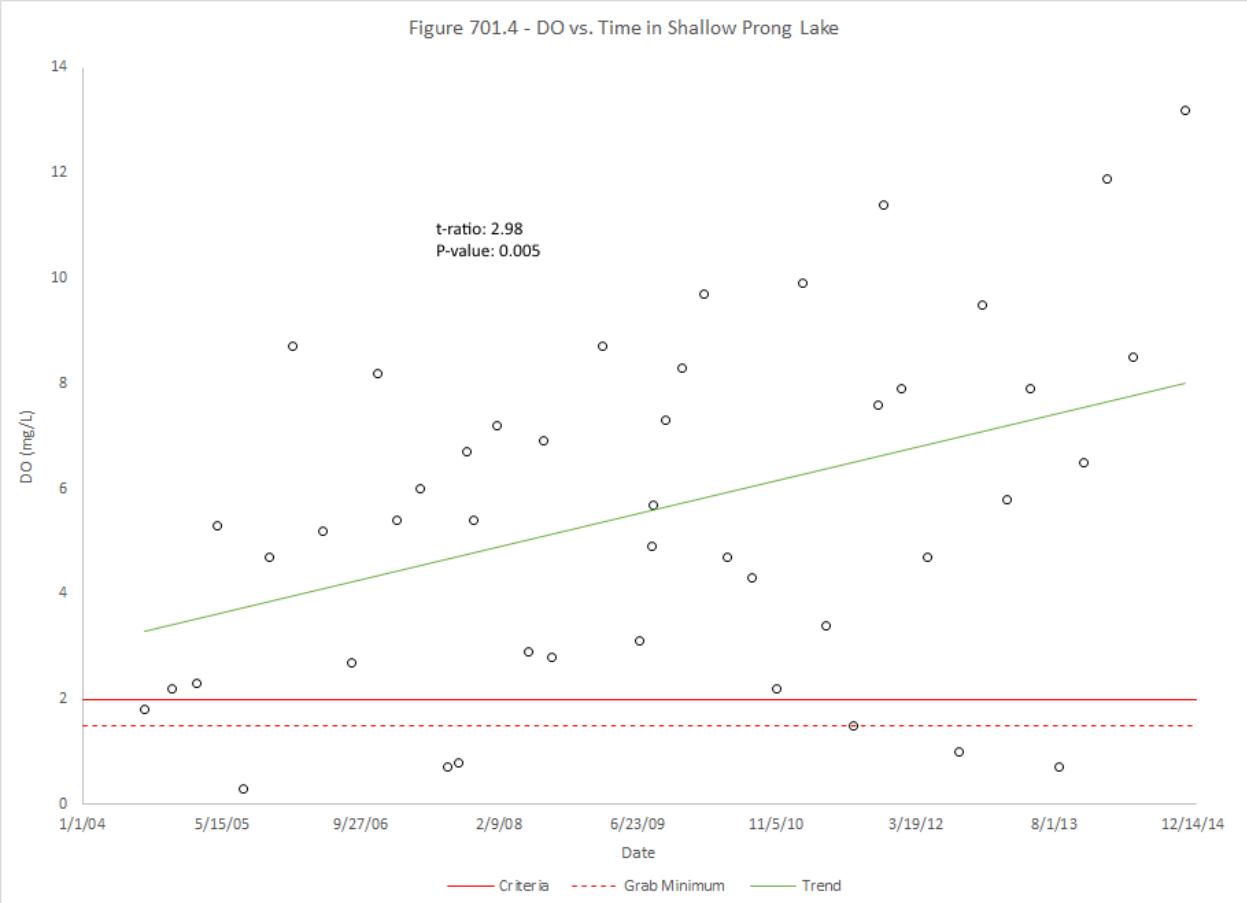


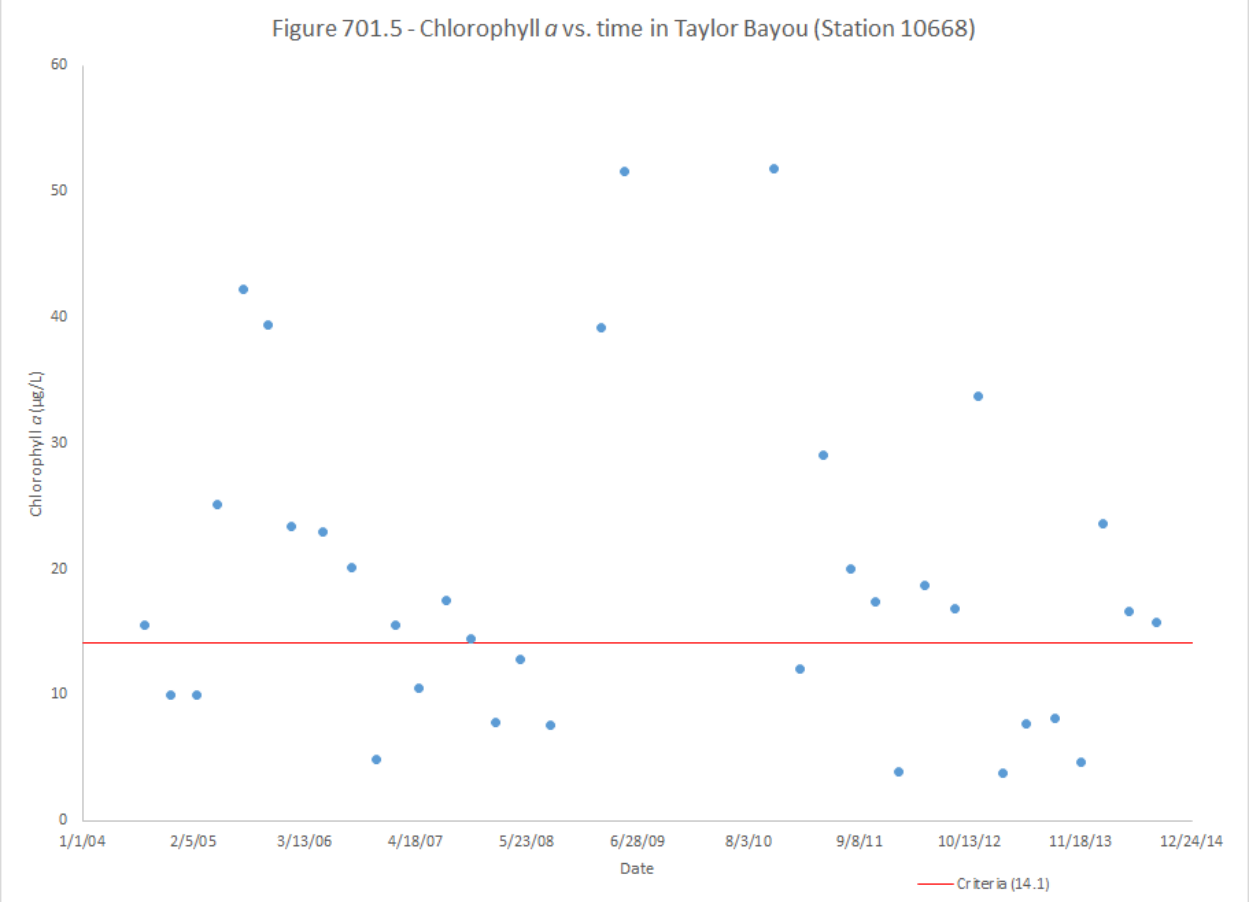
*Current Assessment Results*

Table 701.1 includes those assessment units within the segment that are not supporting (NS) the designated uses or have a screening level concern (CS) based on the Draft 2014 Texas Integrated Report. For Taylor Bayou above Tidal, assessment units 0701_01 and 0701_02 are carry forwards from previous assessments as not supporting the intermediate aquatic life use due to 24-hour dissolved oxygen average and minimum values. According to the Draft 2014 Texas Integrated Report, TCEQ is currently reviewing the standard for this segment to assess if a change is warranted.

Due to depressed dissolved oxygen, there is a concern for DO grab screening level (assessment units 0701_01 and 0701_02) where 8 out of 56 samples exceeded the criteria. A concern for Chlorophyll *a* screening level is also present in assessment units 0701_01 and 0702_02. General use for total dissolved solids (TDS), pH, and water temperature is fully supporting, as well as the contact recreation use for bacteria. In Shallow Prong Lake (0701D), there is a concern for fish consumption use due to arsenic in edible tissue.

Figure 701.2 displays the seasonal variation of dissolved oxygen in Taylor Bayou above Tidal. Although the non-support in this segment was carried over, the values causing a screening level concern can be seen in the graph. A trend of increasing dissolved oxygen was identified at one of the stations in this segment and the trend is shown in Figure 701.3.

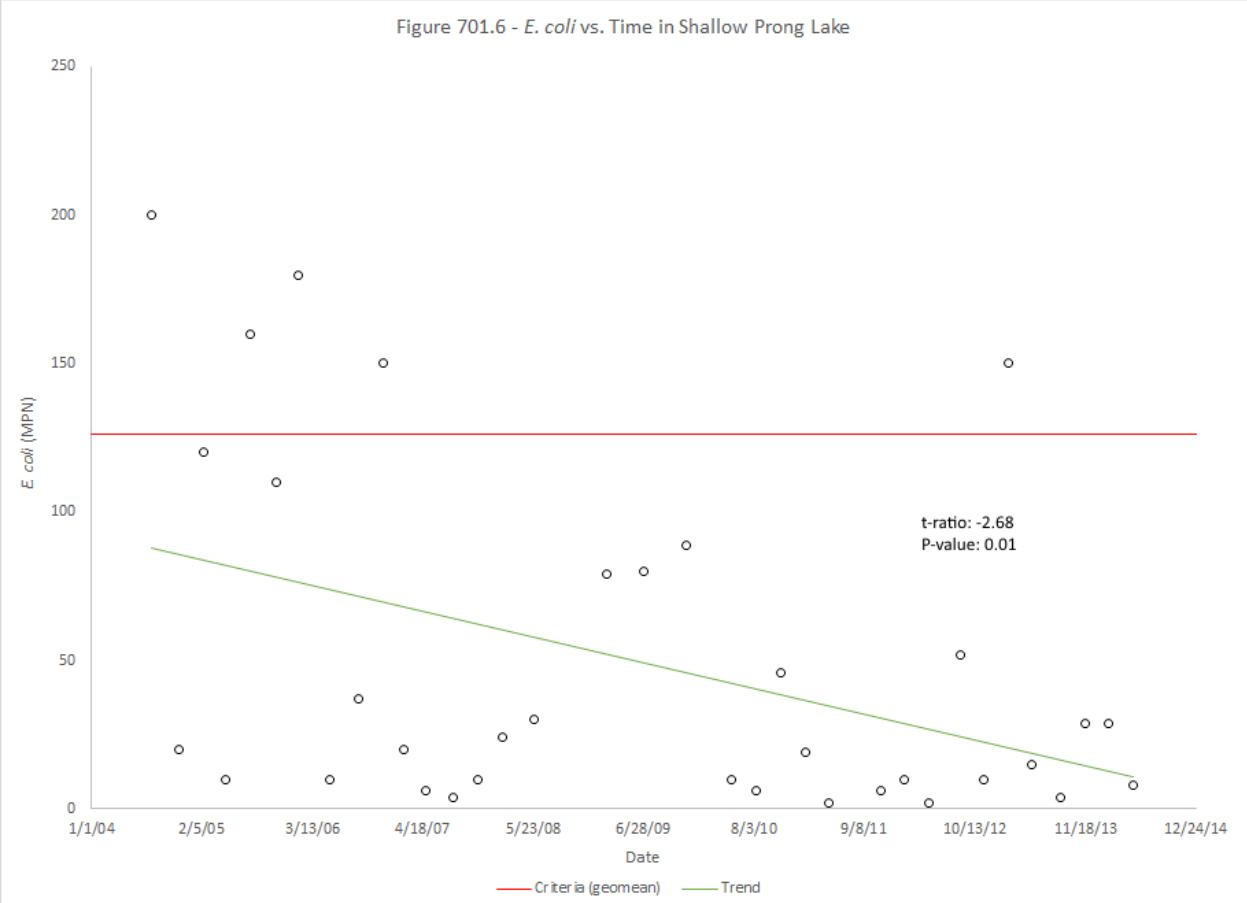





Shallow Prong Lake has historically had issues with low dissolved oxygen levels. The waterbody is a shallow marsh lake receiving little water exchange with the surrounding environment and no direct discharges into the system, which contribute to the low dissolved oxygen levels. These conditions coupled with high temperatures will lower DO, however current water quality standards indicate this segment is supporting the aquatic life use. Figure 701.4 shows the increasing trend of dissolved oxygen in Shallow Prong Lake.

Figure 701.5 is a scatter plot of historical chlorophyll *a* values in Taylor Bayou above tidal. In the Draft 2014 Texas Integrated Report, 26 samples were assessed for chlorophyll *a* and 15 exceeded criteria overall (0701_01 and 0701_02). Chlorophyll *a* is the green pigment that absorbs sunlight and converts it into chemical energy needed to fix $CO_2$ into carbohydrates. Nutrients such as ammonia-nitrogen and total phosphorus feed algae, thus increased nutrient levels in the watershed will contribute to chlorophyll *a* concentrations. Flow values were not measured during these sampling events, however low-flow, pooled conditions similar to ponds and lakes is commonly observed in the segment, which contributes to increased algae growth and chlorophyll *a*.

Chlorophyll *a* can be detrimental to water bodies if algal blooms are present. An algal bloom is a rapid increase or accumulation in the population of algae in an aquatic system. Algal blooms may occur in freshwater as well as marine environments. Typically, only one or a small number of phytoplankton species are involved, and some blooms may be recognized by discoloration of




the water resulting from the high density of pigmented cells. Algal blooms consume a high amount of oxygen in the water during respiration, which affects the viability of aquatic life.

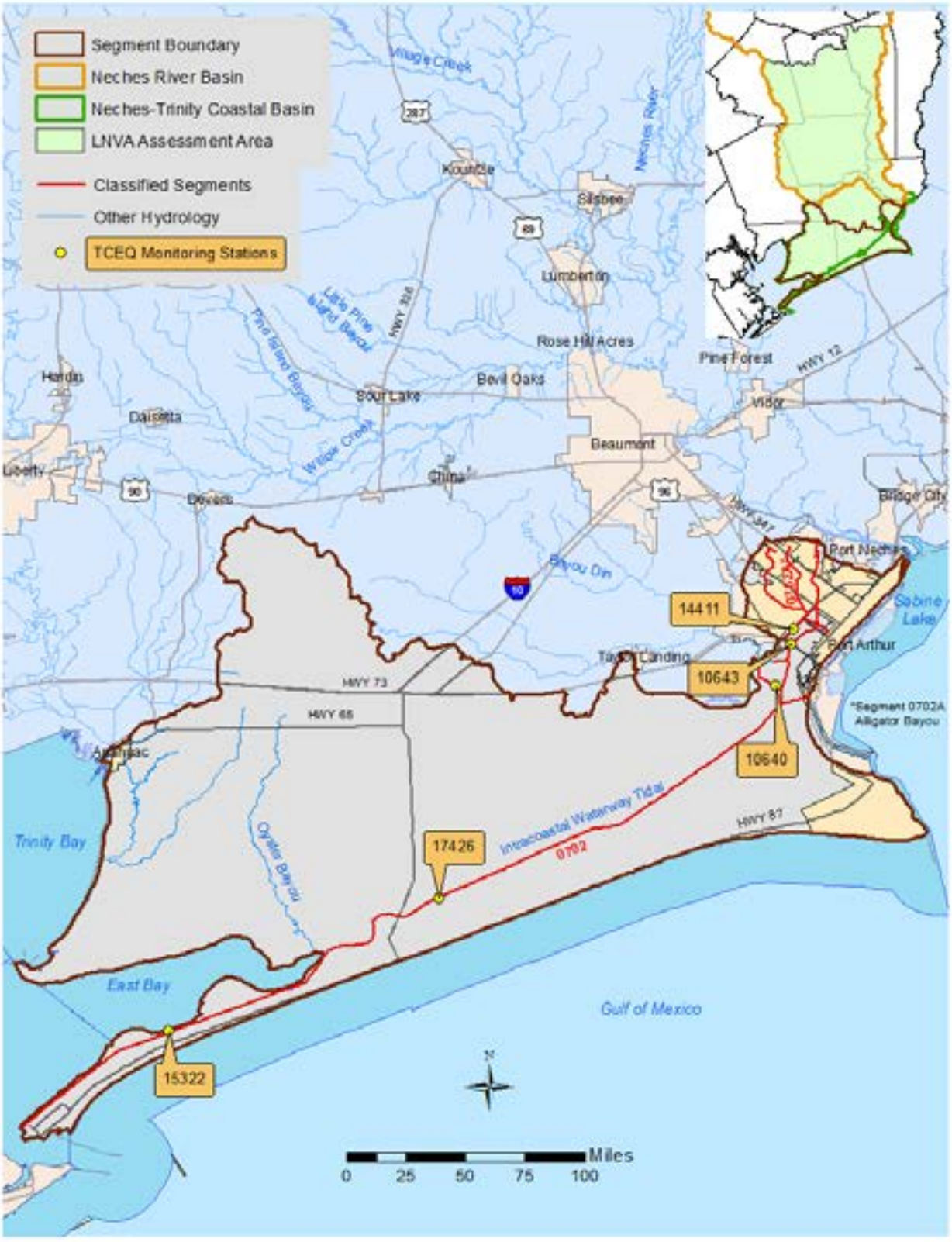
Generally, high levels of chlorophyll *a* indicate poor water quality, but low to moderate amounts of algae and nutrients in a waterbody can enhance aquatic life and fish populations. However, Segment 0701 chlorophyll *a* is present in excessive amounts and the long-term persistence of chlorophyll *a* is a problem.

Shallow Prong Lake is fully supporting for *E. coli*, and a significant trend was identified. Figure 701.6 shows a decrease in the overall *E. coli* values in the segment over the last ten years.

*Recommendations*

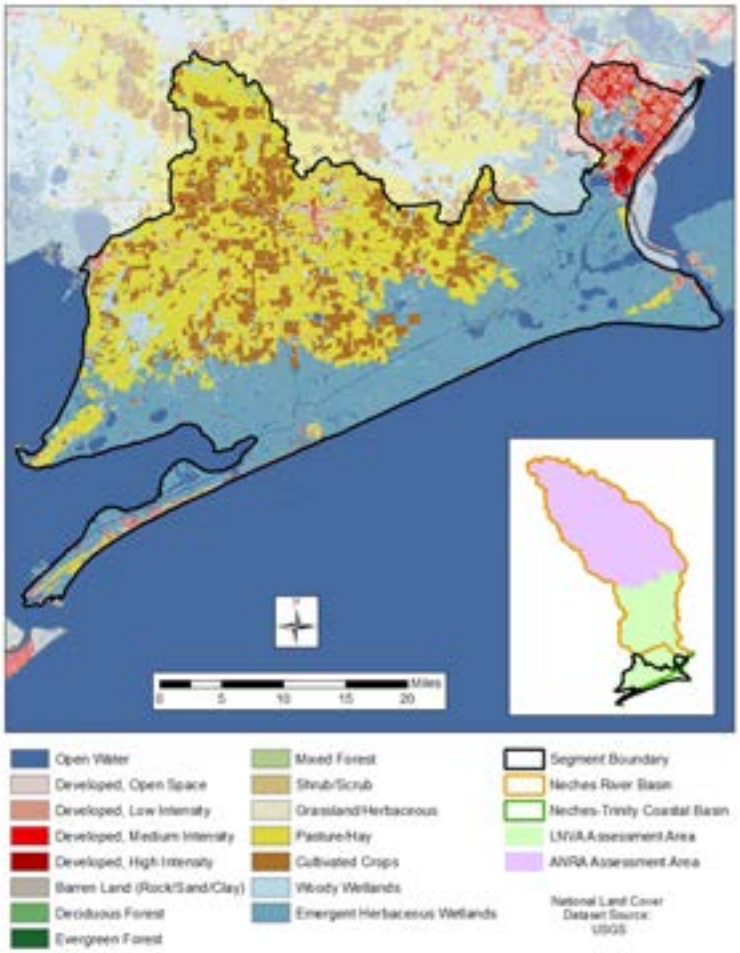
Chlorophyll *a* and nutrients should be routinely monitored in the segment to continue baseline data collection for the development of nutrient standards. As part of the ongoing monitoring coordination, LNVA will work closely with TCEQ to develop a monitoring strategy that may help identify the source(s) of chlorophyll *a* due to excessive nutrients.

# Segment 0702 – Intracoastal Waterway Tidal



*Watershed Characteristics*

**Figure 702.1: Land Use Map for Segment 0702**




As defined in the *Texas Surface Water Quality Standards*, Segment 0702 is from the confluence with Galveston Bay at Port Bolivar in Galveston County to the confluence with the Sabine-Neches/Port Arthur Canal in Jefferson County (including Taylor Bayou Tidal from the confluence with the Intracoastal Waterway up to the saltwater lock 7.7 kilometers (4.8 miles) downstream of SH 73 in Jefferson County). The segment is 63 miles long and includes the unclassified segment Alligator Bayou (0702A). Discharges to the segment, including Alligator Bayou, are primarily from municipal and industrial facilities (31 permitted outfalls) with a smaller amount from agricultural runoff.

Segment 0702 is primarily located in the Level IV Ecoregion known as Texas-Louisiana Coastal Marshes (34g). This ecoregion is 539 square miles, and is comprised of flat plains with most of the land covered in standing water, beach ridges, cheniers, canals, and tidal marshes with bayous meandering through. Elevation is anywhere from sea level to 30 feet, and soil is made up of clay and silt with some shell fragments and sand on cheniers/beach ridges. The highest point in the segment is at High Island (30 feet) which is situated atop an old salt dome. This ecoregion has many freshwater and saltwater coastal marshes, and a wetter, more humid climate than Ecoregion 35 to the northeast.

Dominant vegetation is cordgrass marshes, bulrushes, spikesedges, maidencane, and cattails in freshwater marshes; saltgrass, seashore paspalum, Olney bulrush, and marshhay cordgrass in brackish places; and smooth cordgrass, black needlerush, and saltmarsh bulrush in the more saline marsh areas. The marshes in this segment provide wintering grounds for ducks and geese and breeding and rearing grounds for fish and shrimp such as Brown shrimp (*Penaeus aztecus*), white shrimp (*P. setiferus*), blue crabs (*Callinectes sapidus*), red drum (*Sciaenops ocellatus*), southern flounder (*Paralichthys lethostigma*), and spotted seatrout (*Cynoscion nebulosus*). Due to the ecologically rich areas in Segment 0702, fishing is both recreationally popular as well as commercially important.

Mean annual precipitation ranges from 47-57 inches/year and mean temperature is 42/61 °F (Jan. min/max) and 72/91 °F (July min/max). Land use includes extensive agricultural land for cultivated crops and pasture/hay, marshland, wildlife and waterfowl habitat, oil and gas production, and intensive urban/industrial development in the easternmost portion of the watershed.

Three stations in the segment are routinely monitored by the TCEQ Region 10 office in Beaumont. Station 17426 is located on the Intracoastal Waterway at the Jefferson/Chambers County line east of the Bolivar Peninsula, Station 10643 is located on Alligator Bayou at SH 82, and Station 10640 is located on Taylor Bayou 420 meters upstream of the confluence with Intracoastal Waterway Tidal.

*Intracoastal Waterway looking northeast from Galveston Bay (U.S. Army Corps of Engineers)*

*Background*

In the 2010 Basin Summary Report, aquatic life use was not supported due to water acute toxicity, impaired fish community, and sediment toxicity. Also, in Alligator Bayou there was a concern for nutrients due to chlorophyll *a* and aquatic life use because of the following toxins in sediment: chrysene, lead, phenanthrene, and pyrene.

Historically, segment 0702 has been included on the state's CWA 303(d) List for bacteria impairments, ambient toxicity in water, toxicity in sediment, and impaired fish community. TCEQ conducted a dioxin and PCBs survey from September 2009 to April 2014 in the Galveston Bay System which includes segment 0702 to characterize the extent of dioxin and PCB contamination.

*Current Assessment Results*

Table 702.1 includes those assessment units within the segment that are not supporting (NS) the designated uses or have a screening level concern (CS) based on the Draft 2014 Texas Integrated Report. Segment 0702 is designated for primary contact recreation use and high aquatic life use. The aquatic life use for dissolved oxygen grab samples (minimum value) is fully supporting and the general use criteria are fully supporting for pH and water temperature throughout the segment. Water quality standards for chloride, sulfate and total dissolved solids are not applicable to tidal segments.

In the Draft 2014 Integrated Report, the high aquatic life use is fully supported in the Intracoastal Waterway Tidal assessment units (0702_01, 0702_02, 0702_03) but is not supporting in Alligator Bayou (0702A_01) due to lead in sediment, impaired fish community, and sediment toxicity. Main Canal D was carried forward as not supporting aquatic life use due to water acute toxicity. Also, in Taylor Bayou Tidal (0702_02) and Alligator Bayou there is a concern for nutrients due to chlorophyll *a*. Alligator Bayou is classified as Category 5c on the 303(d)

**Table 702.1 — Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Intracoastal Waterway Tidal | 0702_01 | Recreation | Enterococcus | NS |
| | 0702_02 | Recreation | Enterococcus | NS |
| | | General | Chlorophyll-α | CS |
| | 0702_03 | Fish Consumption | DSHS Advisory (PCBs) | NS |
| | | Fish Consumption | DSHS Advisory (dioxin) | NS |
| Alligator Bayou | 0702A_01 | Aquatic Life | Lead (in sediment) | CS |
| | | Aquatic Life | Sediment Toxicity | NS |
| | | General | Chlorophyll-α | CS |
| | 0702A_03 | Aquatic Life | Water Acute Toxicity | NS |

list for toxicity in sediment, therefore additional data and information will be collected before a TMDL is scheduled. Two assessment units in segment 0702 (0702_01 and 0702_02) are not supporting the contact recreation use due to *Enterococcus* and were added to the 303(d) list in 2012.

In Figure 702.2, historical chlorophyll *a* values are plotted against time for Taylor Bayou Tidal (Station 10640). In the Draft 2014 Texas Integrated Report, Taylor Bayou Tidal had 10 out of 25 samples assessed exceeding the criteria of 21.0 µg/L with a mean exceed of 31.8 µg/L. Chlo-

Figure 702.2 - Chlorophyll *a* vs. time in Taylor Bayou Tidal

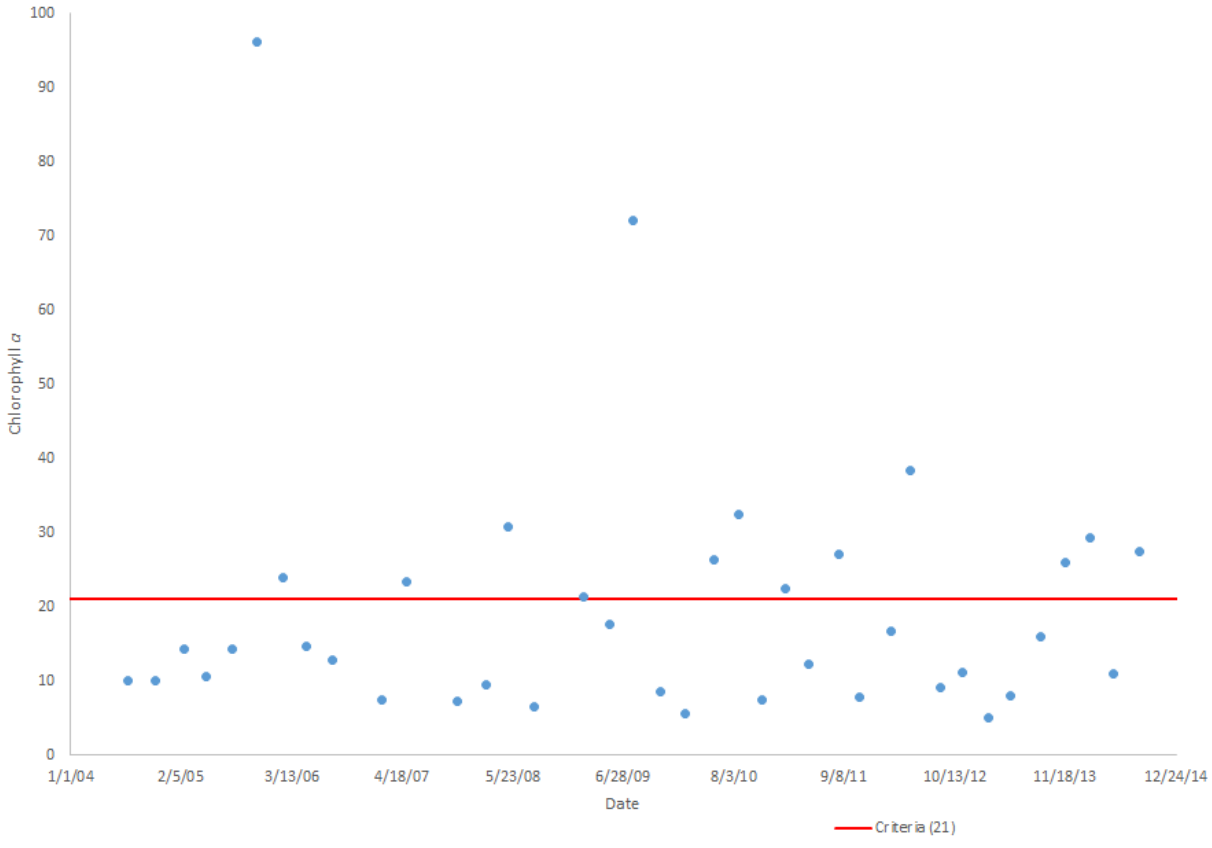
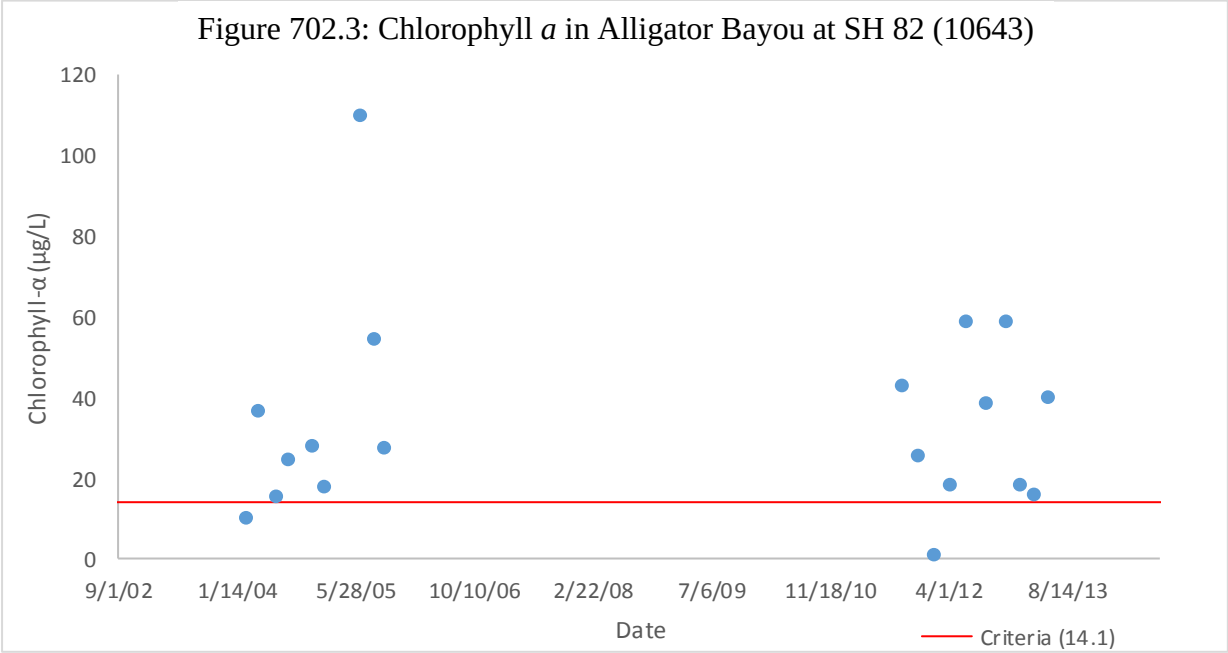


Figure 702.3: Chlorophyll *a* in Alligator Bayou at SH 82 (10643)




rophyll *a* tends to be found in high numbers when conditions are warm, sunlight is abundant, and nutrients are plentiful. Station 10643, Alligator Bayou at SH 82 (0702A), exceeded the chlorophyll *a* screening level in 13 out of 15 samples assessed with a mean exceed of 38.4. Figure 702.3 is a plot of chlorophyll *a* at Station 10643. Due to the number of exceedances of the freshwater nutrient screening level (14.1 µg/L), this waterbody has a concern for chlorophyll *a*. No flow measurements were reported during sampling events in Segment 0702.

There has been a significant increase in recent years in the *Enterococcus* counts in Taylor Bayou Tidal and the Intracoastal Waterway (ICWW). According to the Draft 2014 Texas Integrated Report, assessment units 0702_01 and 0702_02 are not supporting the contact recreation use due to *Enterococcus*. In the Intracoastal Waterway (0702_01) the geomean of the samples assessed was 140.9 MPN/100 mL which exceeded the criteria of 35 MPN/100mL. The geomean for Taylor Bayou Tidal was 69.9 MPN/100mL. Figures 702.4 and 702.5 show the *Enterococcus* counts over time for the Intracoastal Waterway and Taylor Bayou Tidal, respectively.

There are currently two fish consumption advisories in place that include the portion of the Intracoastal Waterway from the eastern most boundary of East Bay to Port Bolivar. On June 26, 2013 the Texas DSHS issued a fish consumption advisory for Galveston Bay that warns the public to limit their consumption of spotted sea trout, catfish, and blue crab due to elevated levels of dioxins and polychlorinated biphenyls (PCBs) in the three species. On March 27, 2014, the Texas DSHS issued another fish consumption advisory for Galveston Bay due to the presence of oil in the water. The advisory warns the public to discard fish, shrimp or crabs that have oil on them or have a hydrocarbon smell or taste. The fish consumption use is not supported in the Draft 2014 Texas Integrated Report due to dioxins and PCBs in fish tissue.

*Recommendations*

Nutrient and chlorophyll *a* screening levels for both freshwater and tidal streams apply to waterbodies in the segment. Taylor Bayou/Intracoastal Waterway are considered tidal streams. A concern for nutrients due to high chlorophyll *a* is an ongoing issue in the segment. More intensive sampling for nutrients is recommended to determine possible sources of the chlorophyll *a* and nutrient screening levels should be re-evaluated for this segment. Continue routine monitoring in the segment to include *Enterococcus* bacteria samples.

Figure 702.4: *Enterococcus* vs. Time in the Intracoastal Waterway Tidal

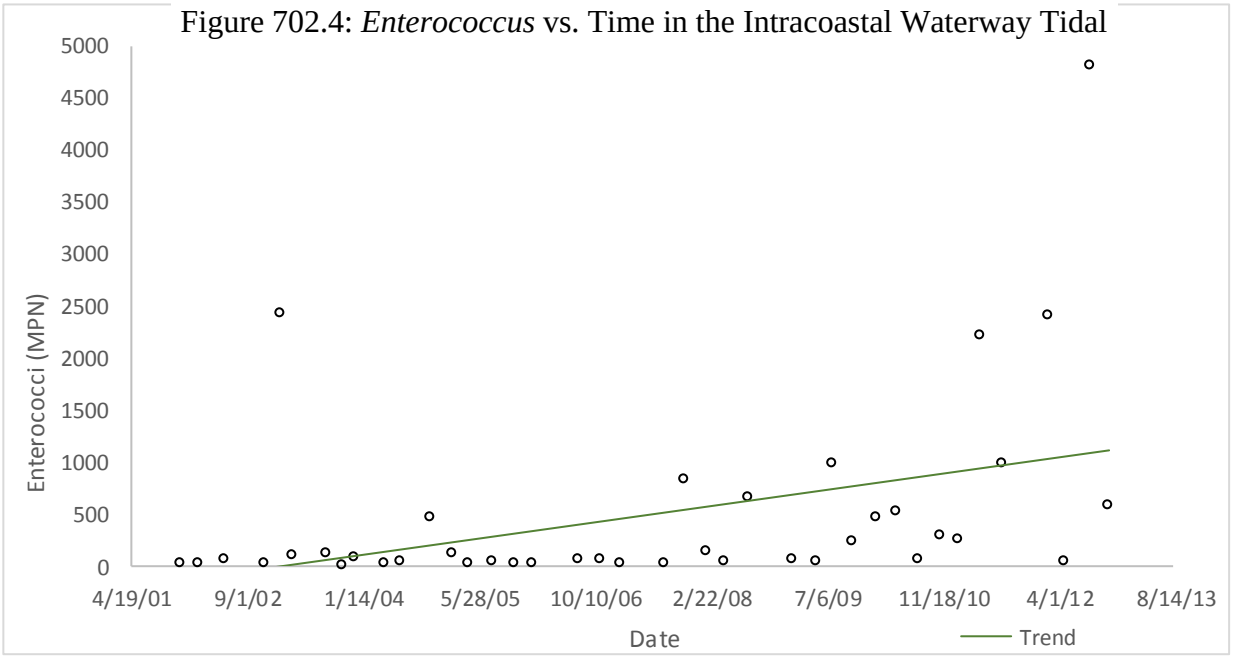
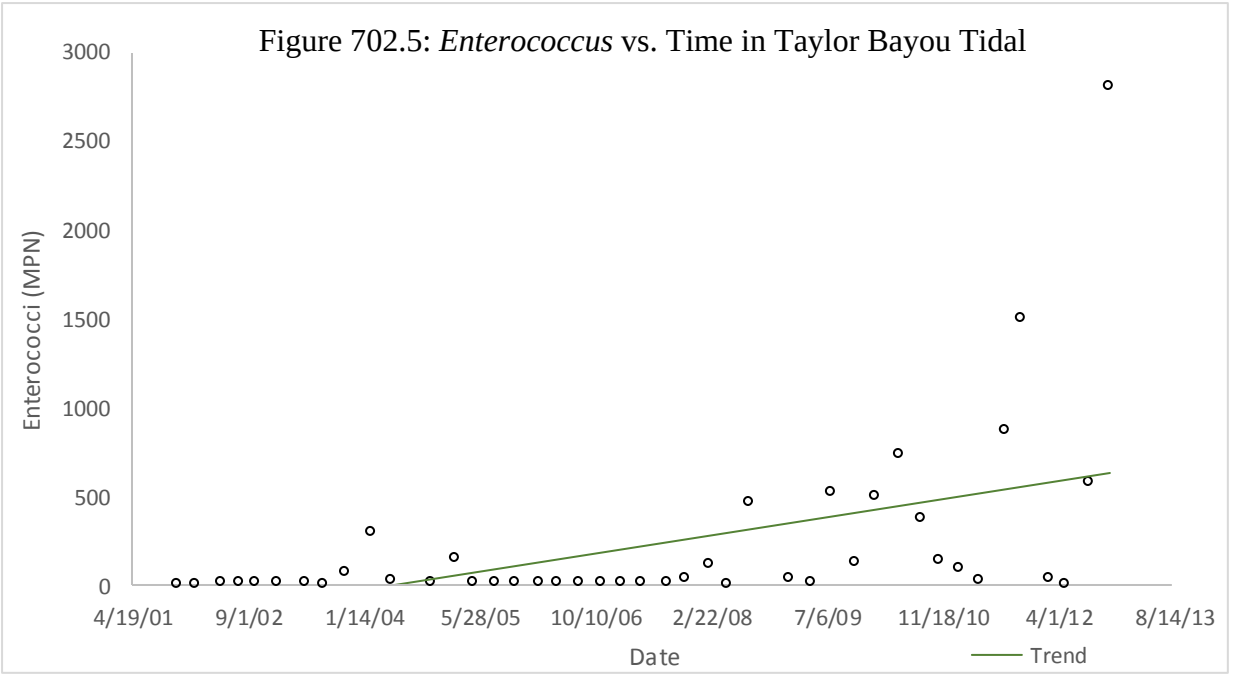
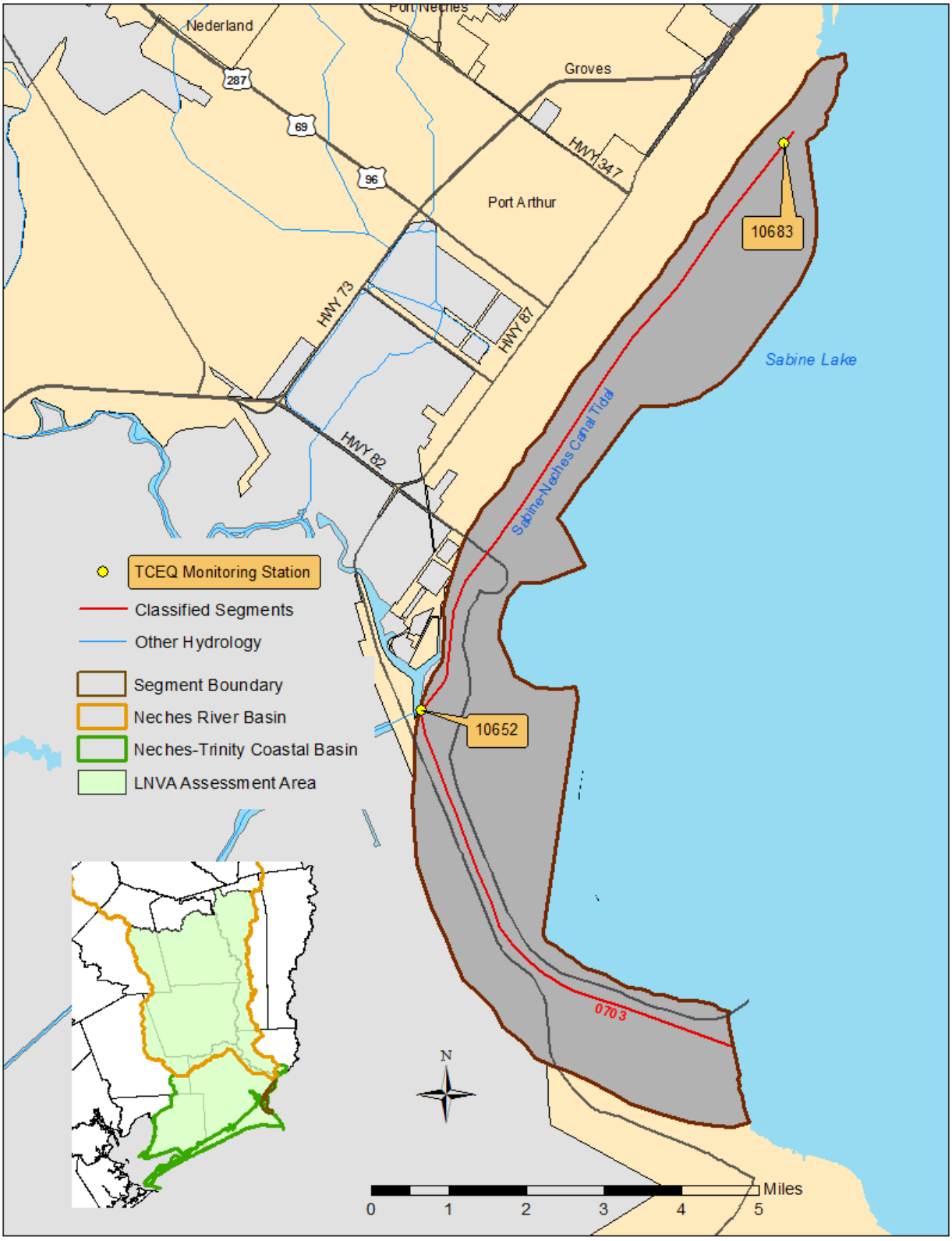



Figure 702.5: *Enterococcus* vs. Time in Taylor Bayou Tidal

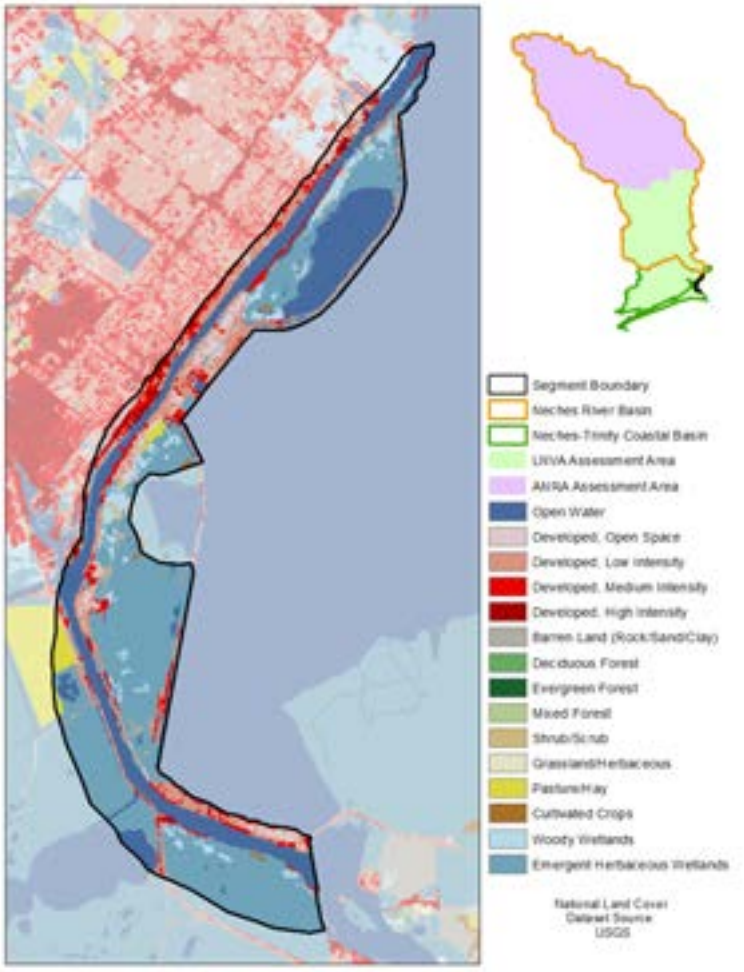


# Segment 0703 – Sabine-Neches Canal Tidal



*Watershed Characteristics*

**Figure 703.1: Land Use Map for Segment 0703**




Segment 0703 is defined in the *Texas Surface Water Quality Standards* as from the confluence with Sabine Pass at the southern tip of Pleasure Island in Jefferson County to the Sabine Lake seawall at the northern tip of Pleasure Island in Jefferson County. This water body is considered a tidal stream and is 16 miles in length. The ecoregion encompassing Segment 0703 is Western Gulf Coastal Plain (34), and more specifically Ecoregion IV known as Texas Louisiana Coastal Marshes (34g). There is extensive freshwater and saltwater coastal marshes consisting of grasses, sedges, and rushes. Very little trees are found in this segment, and soils consist of clay and silt, with sand and shell fragments on cheniers or beach ridges. Most of the area is covered by standing water, and bayous, lakes, and canal course through low lying areas. Annual precipitation ranges from 48-54 inches/year, and mean temperature is 42/61 °F in January (min/max) and 72/91 °F in July (min/max). The piney woods area of Ecoregion 35 (Segments 0602, 0603, 0607, 0609) supply nutrients and flow to Segment 0703.

The Sabine-Neches Canal exchanges water with Sabine Lake, and a large amount of marine traffic navigates between the Port of Houston and Port Arthur, including both large vessels and smaller recreational boats. Land use includes urban/industrial development, oil and gas production, as well as marshland, wildlife, and waterfowl habitat. Pleasure Island, a local fishing and recreational hotspot, lies adjacent to the east side of Segment 0703. This island is 18 miles long and was constructed in 1899 by the U.S. Army Corps of Engineers using dredge spoils from the creation of the Sabine-Neches Intracoastal Waterway. Stations 10683 and 10652 are routinely monitored by TCEQ Region 10 for field, conventional parameters, bacteria and metals in water.

*Background*

Historically, there have been few concerns with water quality in Segment 0703. One concern did arise in 2001 for chlorophyll *a*, but since then chlorophyll *a* has been categorized as no concern. In the 2010 Basin Summary Report, aquatic life use was fully supporting for dissolved

oxygen, contact recreation use was fully supporting for bacteria, general use was fully supporting for water temperature and pH, and there were no concerns for nutrients in the segment.

**Table 703.1—Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Sabine-Neches Canal Tidal | 0703_01 | Recreation | Enterococcus | NS |

*Current Assessment Results*

Table 703.1 includes the assessment unit within the segment that is not supporting (NS) the designated uses based on the Draft 2014 Texas Integrated Report. Segment 0703 is designated for primary contact recreation use and high aquatic life use. According to the Draft 2014 Texas Integrated Report, this segment is not supporting the contact recreation use due to elevated levels of *Enterococcus*. The geomean of the 51 samples assessed was 70.8 MPN/100mL which exceeds the criteria of 35 MPN/100mL. Also, this segment was recently added to the Draft 2014 Texas 303(d) List due to the bacteria impairment. As a Category 5c waterbody, additional data or information will be collected and/or evaluated before a management strategy is selected. The *Enterococcus* is likely due to non-point sources, and increasing trends were identified for both stations in the segment (Figures 703.2 and 703.3).

The Draft 2014 Texas Integrated Report indicates the segment is fully supporting the aquatic life use for dissolved oxygen, and the general use criteria for pH and water temperature. In addition, there are no concerns for chlorophyll *a* and nutrients. Water quality standards for chloride, sulfate and total dissolved solids (TDS) are not applicable to the tidal segments.

*Recommendations*

It is recommended that TCEQ Region 10 continue routine monitoring in this segment to assess the source(s) of the recent increase in the *Enterococcus* bacteria levels and to insure stream standards and nutrient screening levels are being met.

*Taylor Bayou Saltwater Barriers and Navigational Locks are located near the Sabine-Neches Canal Tidal (SNND.org)*

Figure 703.2: *Enterococcus* vs. Time at Station 10652

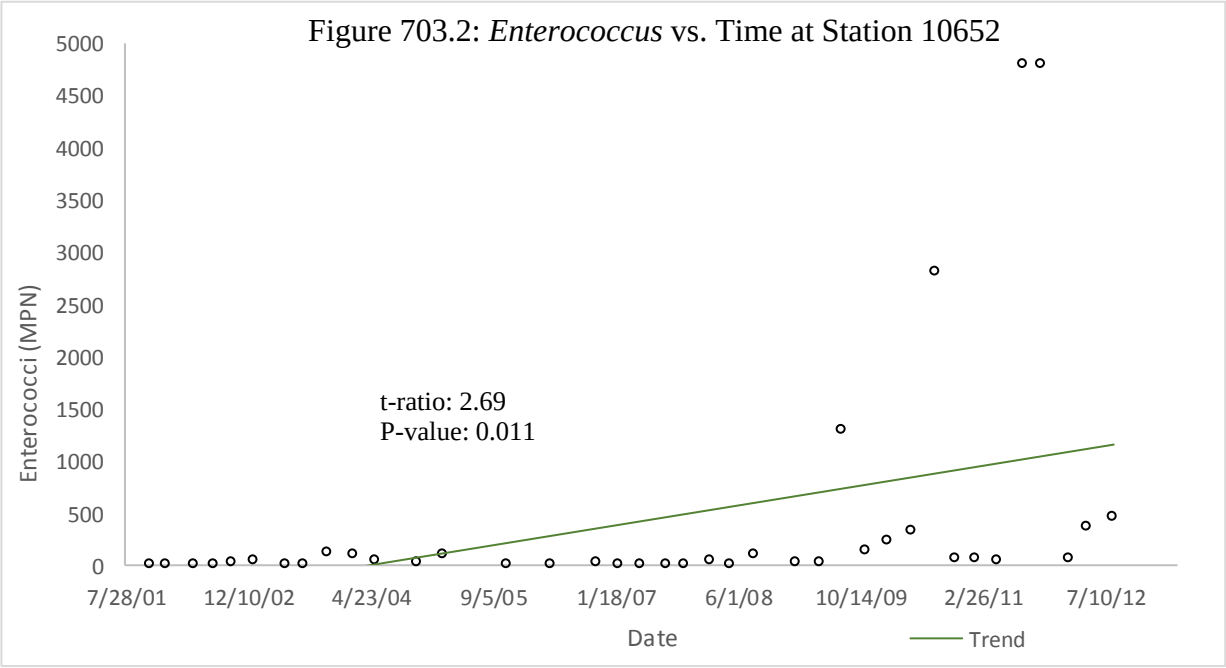
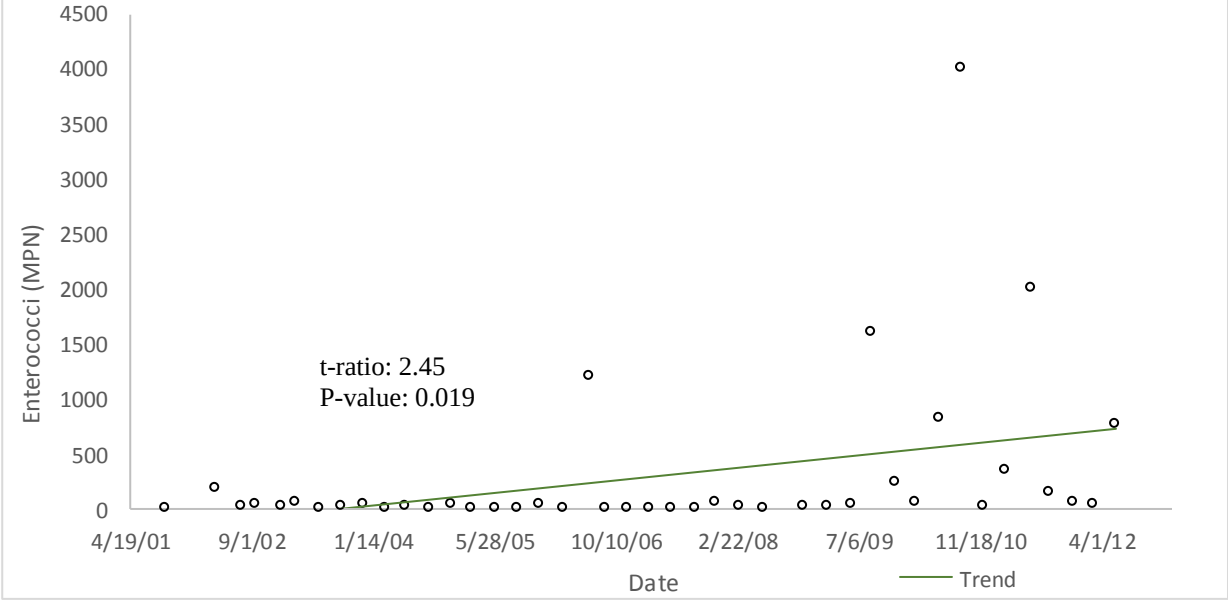
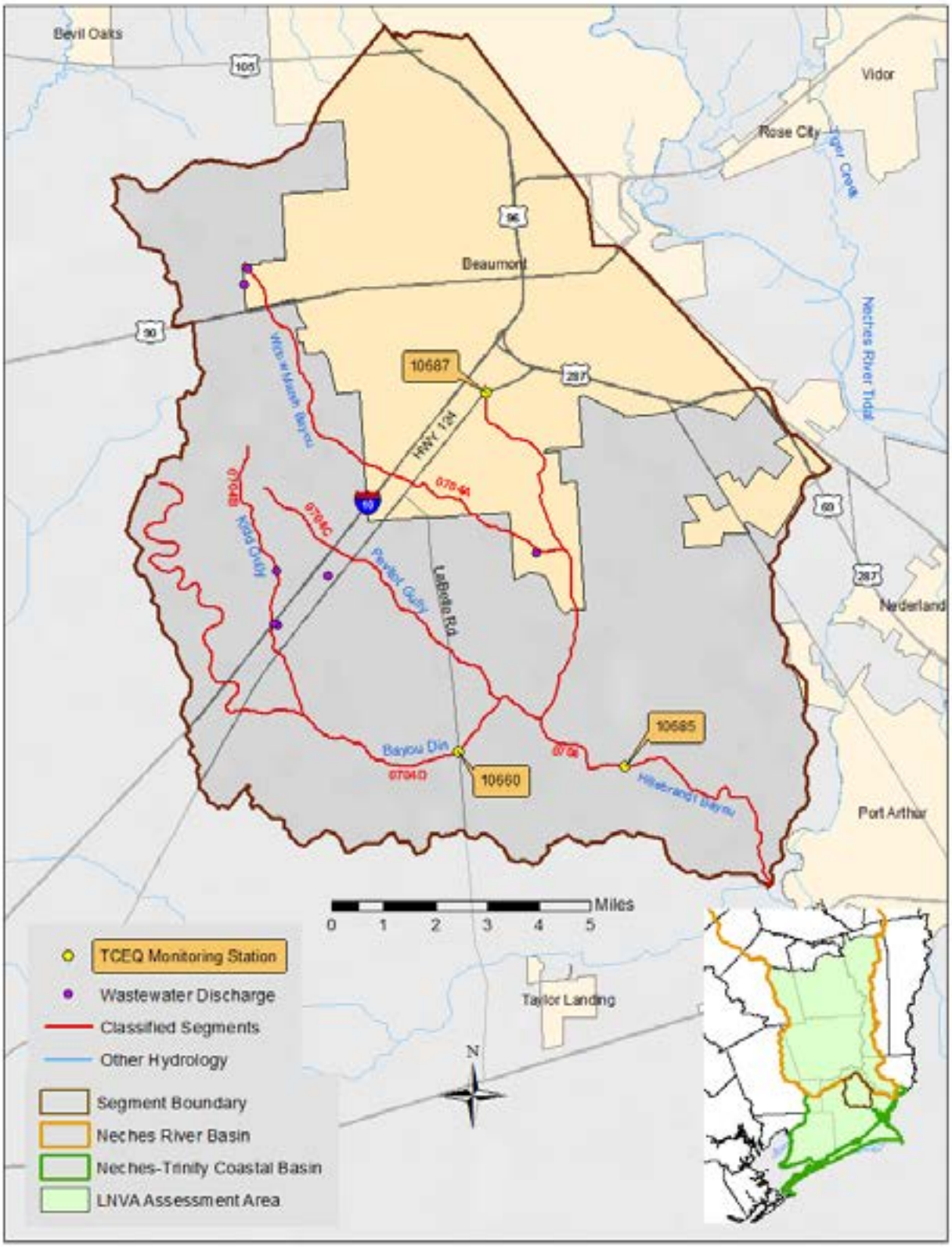



Figure 703.3: *Enterococcus* vs. Time at Station 10683

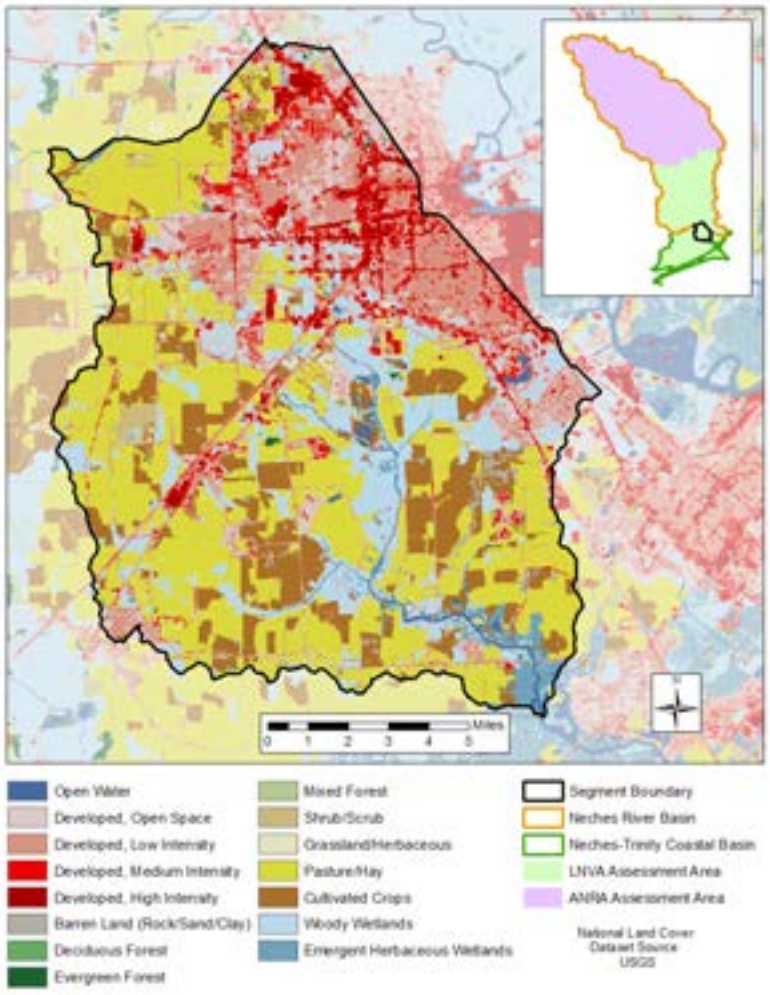


# Segment 0704 – Hillebrandt Bayou



*Watershed Characteristics*

**Figure 704.1: Land Use Map for Segment 0704**




Hillebrandt Bayou is defined in the *Texas Surface Water Quality Standards* as a freshwater stream from the confluence of Taylor Bayou in Jefferson County to a point 100 meters (110 yards) upstream of SH 124 in Jefferson County, and is 14 miles in length (Figure 704.1). Hillebrandt Bayou extends from the southern part of Level III Ecoregion South Central Plains (35) to Level IV Ecoregion Northern Humid Gulf Coastal Prairies (34a).

In the northern part of Segment 0704, trees are common and dominant types are water oak, pecan, southern live oak, American elm, and loblolly pine, much resembling the floodplain forests of Ecoregion 35. Lining the bayou is also water tolerant trees such as bald cypress and water tupelo. Prairie land is abundant in the southern section of Segment 0704, and as Hillebrandt Bayou converges with Taylor Bayou, low flat plains with freshwater and saltwater marsh grass is abundant. Soils consist of fine-textured sands, silt, and clayey substrates, and low gradient rivers, streams, and bayous are common. Drainage near Hillebrandt Bayou is generally poor due to the substrate types, and soils remain wet most of the year. Yearly rainfall averages between 37-58 inches/year, and mean temperature is 42/62 °F in January (min/max) and 74/92 °F in July (min/max).

Land use is pasture/hay, cultivated cropland, urban and industrial development, oil and gas production, and recreational parks/golf courses. Exotic species that are found near Hillebrandt Bayou are the Chinese tallow tree (*Sapium sebiferum*), Chinese privet (*Ligustrum sinense*) and fire ants (*Solenopsis invicta*). These species are of concern because they can eliminate or drastically reduce local wildlife and plant populations.

Hillebrandt Bayou serves as the primary receiving stream for the storm drainage system within the City of Beaumont, accepting runoff from approximately 70% of the city. The City of Beaumont's Wastewater Treatment System discharges into Hillebrandt Bayou below SH 124 after the final stage of treatment by a series of wetlands called Cattail Marsh. Cattail Marsh includes

900-acres of wetlands and offers a variety of recreational activities with more than eight miles of gravel levee roads for jogging, hiking, biking, horseback riding, bird watching, wildlife photography and picnicking along the banks of Hildebrandt Bayou and Willow Marsh Bayou. This natural and innovative process has attracted the interest of environmentalists and wildlife professionals from across the state.


*Cattail Marsh was originally constructed in 1993 by the Beaumont Public Utilities Department as the final phase of Beaumont's wastewater treatment system.*

In addition to Hillebrandt Bayou receiving effluent from the Cattail Marsh system, Willow Marsh Bayou, Kidd Gully, Pevitot Gully and Bayou Din are tributaries which convey additional flows from agricultural land and golf courses in the area. Flow in Hillebrandt Bayou is controlled by the Taylor Bayou saltwater barrier and navigational locks located in Port Arthur.

Three stations (10685, 10686, 10687) are routinely monitored by TCEQ Region 10 for field parameters, conventional lab parameters, bacteria and metals in water. Segment 0704 includes the following unclassified segments mentioned previously: Willow Marsh Bayou (0704A), Kidd Gully (0704B), Pevitot Gully (0704C), and Bayou Din (0704D).

*Background*

The TCEQ conducted an Aquatic Life Use Attainability Analysis on Hillebrandt Bayou to evaluate the chronically depressed dissolved oxygen in the segment from April 1, 2009 to March 31, 2010. Station 10687 is located above the City of Beaumont's wastewater treatment plant outfall and Stations 10686 and 10685 are located downstream from the WWTP outfall.

*Current Assessment Results*

Table 704.1 includes those assessment units within the segment that are not supporting (NS) the designated uses, have a screening level concern (CS) or have a use concern (CN) based on the Draft 2014 Texas Integrated Report. Segment 0704 is designated for primary contact recreation use and intermediate aquatic life use.

The not supporting status for 24-hour dissolved oxygen (DO) average and minimum was carried forward for assessment unit 0704_01 from previous assessments. The 2010 LNVA Basin Summary Report stated that out of 26 samples, six exceeded the criterion (4.0 mg/L) for 24

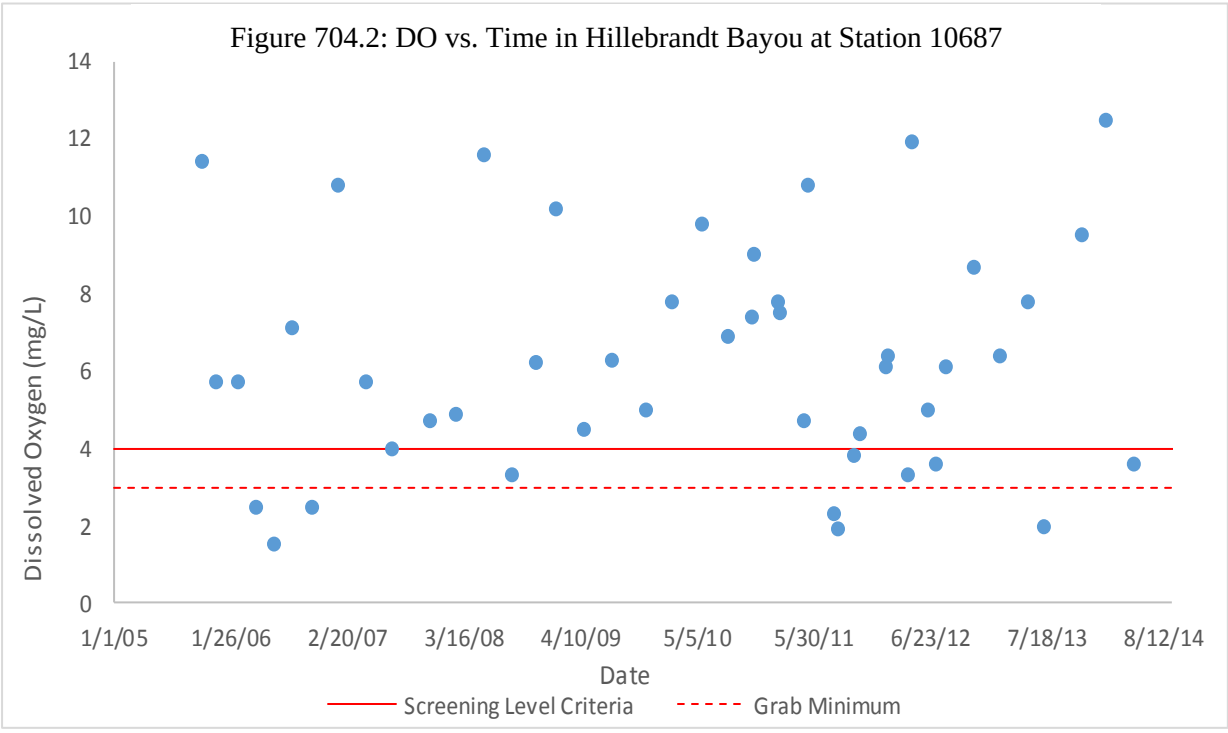
**Table 704.1—Summary of Water Quality Impairments and Concerns**

| Segment Name | AUID | Use | Parameter | Status |
|---|---|---|---|---|
| Hillebrandt Bayou | 0704_01 | Aquatic Life | DO 24hr Average | NS |
| | | Aquatic Life | DO 24hr Minimum | NS |
| | | General | Chlorophyll-α | CS |
| | | General | Ammonia | CS |
| | 0704_02 | Aquatic Life | DO Grab Screening Level | CS |
| | | Aquatic Life | DO Grab Minimum | CN |
| | | Recreation | E. coli | NS |
| | | General | Chlorophyll-α | CS |
| | | General | Ammonia | CS |

hour average and five samples exceeded the criterion (3.0 mg/L) for 24 hour minimum. There is also a concern for dissolved oxygen grabs in assessment unit 0704_02. Nine out of 39 samples assessed exceeded the grab screening level (4.0 mg/L) with a mean exceedance of 2.74 mg/L. Five out of 39 samples assessed exceeded the grab minimum (3.0 mg/L) with a mean exceedance of 2.14 mg/L. Figure 704.2 shows dissolved oxygen grabs over time at Station 10687. Several values fall below the screening level and minimum criteria established for the segment.

The aquatic life use in Segment 0704 is fully supporting for metals, and the general use is fully supporting for pH, water temperature, chloride, sulfate, and TDS in the entire segment. However, there is a screening level concern for ammonia-nitrogen and a screening level concern for chlorophyll *a* in the entire segment. In addition, the contact recreation use is not supporting in assessment unit 0704_02 due to elevated *E. coli* bacteria.

Figure 704.2: DO vs. Time in Hillebrandt Bayou at Station 10687



The bacteria impairment is from the confluence with Willow Marsh Bayou (0704A) upstream to a point 100 meters (110 yards) upstream of SH 124 in Jefferson County. The impairment is due to *E. coli* bacteria geometric mean exceedances and the segment was added to the 2010 Texas 303(d) List. In Figure 704.3, *E. coli* levels are plotted over time at Station 10687 excluding one sample result from February 1, 2012. The *E. coli* count for this outlier was 24,000 MPN/100mL. This sample was collected just after the drought of 2011 which could be due to excessive bacteria in soils and sediments being washed into the stream.

In the Draft 2014 Texas Integrated Report, 32 samples were assessed with a geomean of 384.5 MPN/100mL which exceeds the criterion of 126 MPN/100mL for Station 10687, Hillebrandt Bayou at SH 124. This upper station consists primarily of stormwater and urban runoff from the City of Beaumont. Non-point source pollution is the likely source of these high bacteria levels. In contrast, *E. coli* counts below the wastewater treatment facility are much lower. There is a significant difference in the downstream bacteria levels on Hillebrandt Bayou compared to upstream levels where non-point sources of bacteria exist.

Chlorophyll *a* was also identified as a concern for the screening level in this segment. In Figure 704.4, Stations 10685 and 10687 are plotted over time. According to the Draft 2014 Texas Integrated Report, the lower portion of Hillebrandt Bayou (0704_01) exceeded the chlorophyll *a* screening criteria in 18 out of 22 samples with a mean exceedance of 46.7 µg/L. In Sept. 2010, TCEQ started collecting and analyzing chlorophyll *a* samples at Station 10687 to assess the upper segment. Station 10687 (AU 0704_02) had five samples out of 12 that exceeded the criteria with a mean exceedance of 20.3 µg/L. The freshwater criterion for chlorophyll *a* is 14.1 µg/L.

Figure 704.3: *E. coli* vs. Time in Hillebrandt Bayou at Station 10687

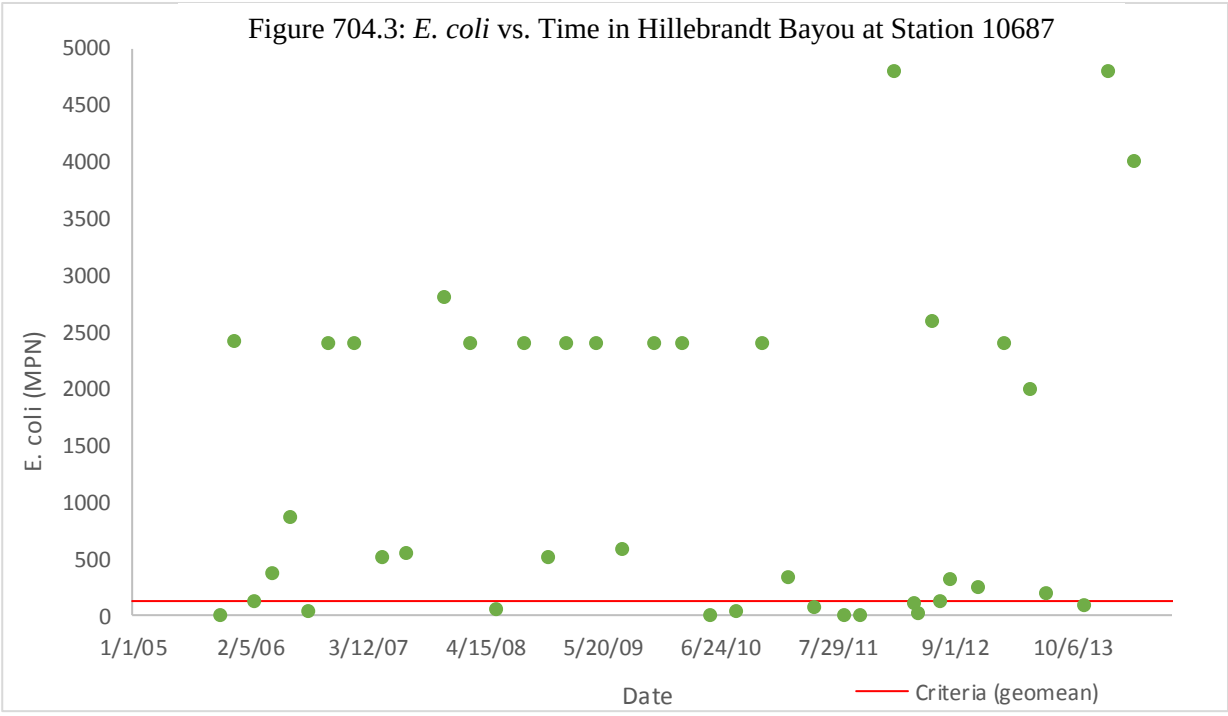


Figure 704.4 - Chlorophyll *a* vs. Time in Hillebrandt Bayou

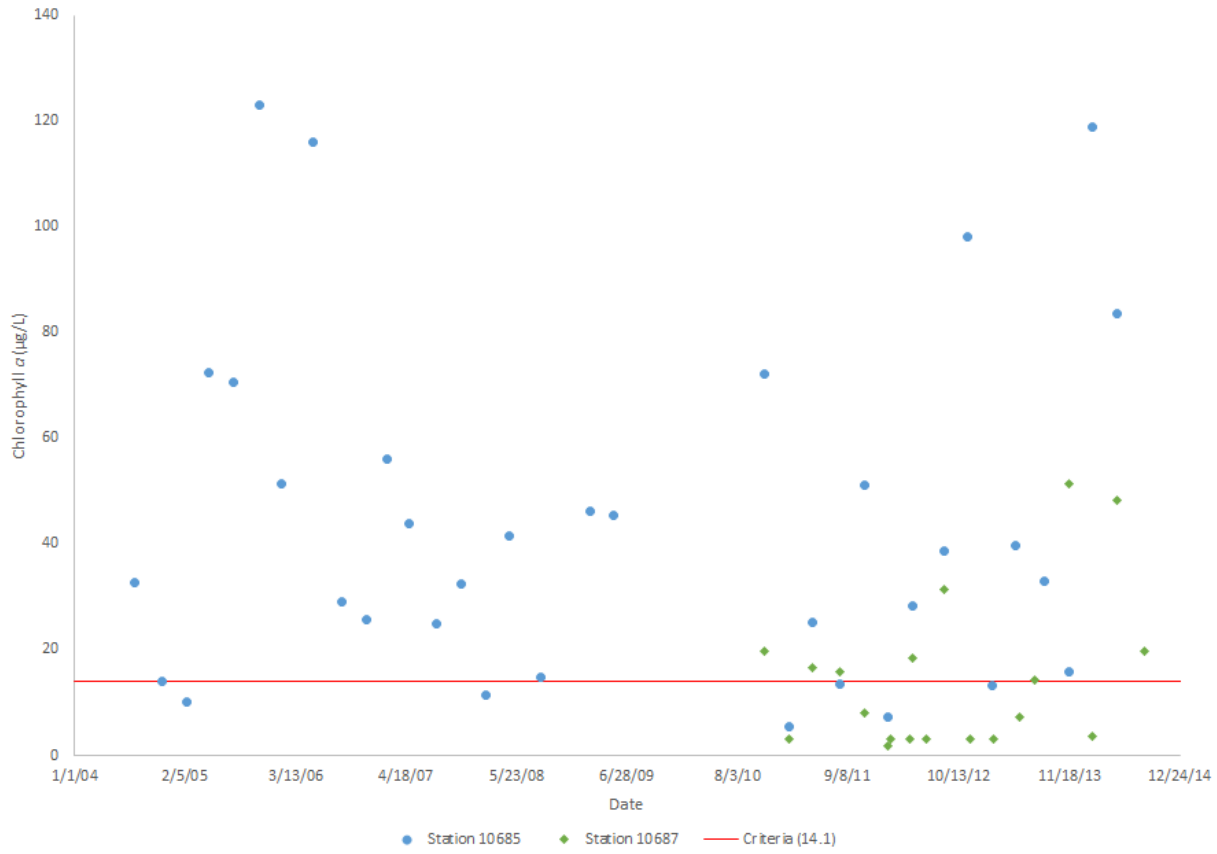
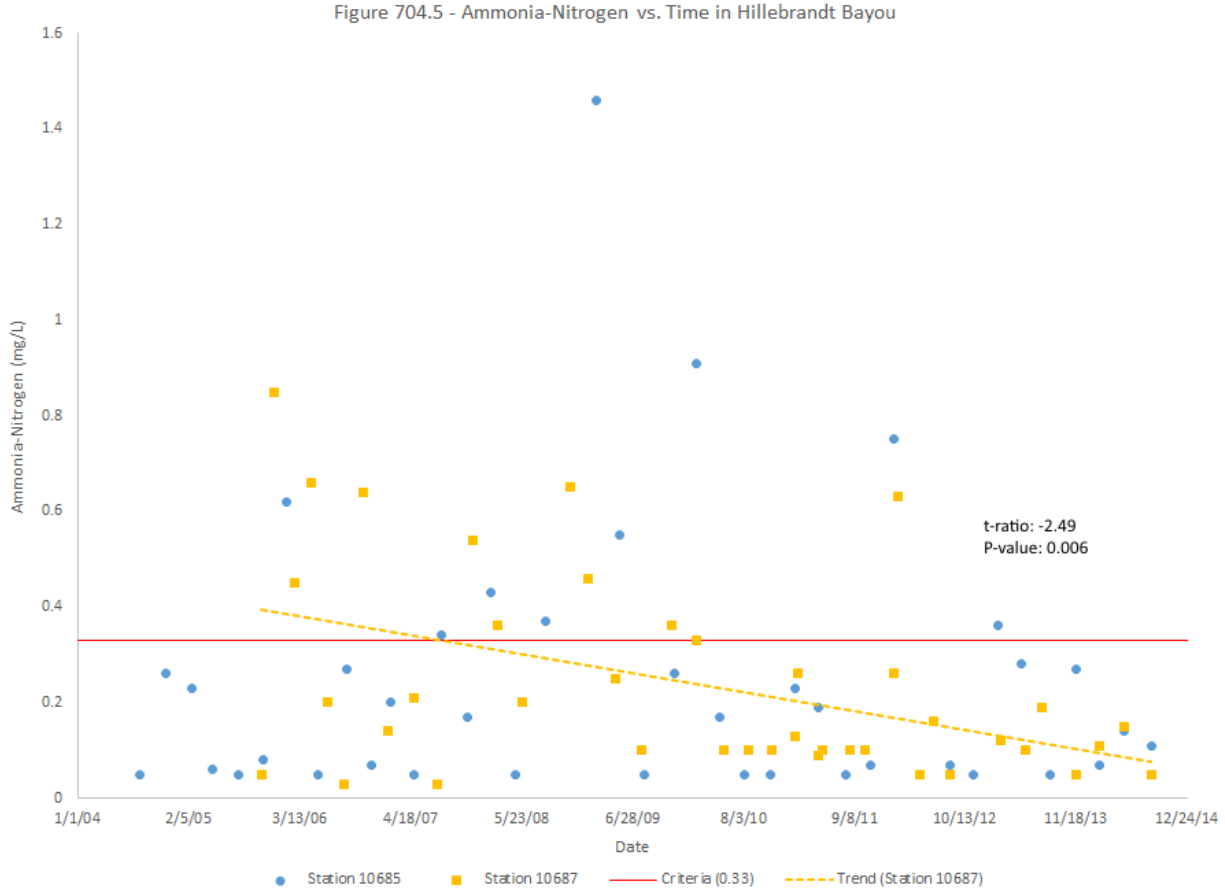



Figure 704.5 - Ammonia-Nitrogen vs. Time in Hillebrandt Bayou



In Segment 0704, there is a concern for ammonia-nitrogen in the entire segment (see Figure 704.5). At Station 10685 eight out of 27 samples exceeded the screening criteria with a mean exceedance of 0.68 mg/L and at Station 10687 ten out of 32 samples exceeded the criteria with a mean exceedance of 0.56 mg/L. The screening level criteria for the segment is 0.33 mg/L. Also, a decreasing trend was identified for Station 10687 as shown in Figure 704.5. Station 10687 is located above the City of Beaumont's wastewater treatment facility, while Station 10685 is located downstream of the wastewater treatment plant and wetland system. The downstream station is likely influenced by effluent ammonia levels, however the upstream station is more difficult to determine since Hillebrandt Bayou receives about 70% of the stormwater runoff from the City of Beaumont.

Sources of ammonia-nitrogen in surface waters are primarily from human/animal waste products. A large contributor to high ammonia-nitrogen levels in Hillebrandt Bayou is likely from non-point source pollution. Urban/stormwater runoff, sanitary sewer overflows, agriculture/livestock, and illegal dumping are possible sources. Ammonia is excreted by animals, produced when plants and animals decay, and is present in fertilizers. As a nutrient, ammonia-nitrogen is the food promoting the proliferation of algae common in Hillebrandt Bayou, thus increasing chlorophyll *a* levels.

*Recommendations*

TCEQ should continue routine monitoring on Hillebrandt Bayou. Increased monitoring in the segment and/or a special study is recommended to determine the locations and sources of ammonia-nitrogen in the watershed. The primary contact recreation use in assessment unit 0704_02 should be re-evaluated due to the persistently high *E. coli* counts that cannot be attributed to point sources.

*Cattail Marsh is a wildlife refuge for more than 350 species of birds annually, including: pelicans, egrets, roseate spoonbills, ducks, ibis, doves and red-winged blackbirds.*

# 4.0 RECOMMENDATIONS AND CONCLUSIONS

**Table 4.1-1: Recommendations for Water Quality Impairments and Concerns**

| Watershed/ Segment | Use Impairment/Concern | Identified Parameters | Explanation of Impairment/ Concern | Actions Taken | Recommended Actions |
|---|---|---|---|---|---|
| Segment 0601: Neches River Tidal | Aquatic Life Use | Malathion AU_01 | Aerial pesticide applications | TCEQ organics in water monitoring | Routine monitoring for organics in water |
| | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | LNVA & TCEQ routine monitoring | Routine monitoring to include bacteria |
| | Fish Consumption Use | PCBs in Edible Tissue | Unknown Industrial Sources | Advisory issued by DSHS (Dec. 29, 2011) | Fish Tissue Sampling in Segment 0601 |
| Segment 0601A: Star Lake Canal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ Region 10 routine monitoring | Re-evaluate Primary Contact Recreation Use for Star Lake Canal |
| Segment 0602: Lower Neches River above Tidal | Fish Consumption Use | Mercury/Dioxin in fish tissue | Atmospheric Deposition/Unknown | Advisory issued by DSHS (Jan. 24, 2014) | Routine Fish Tissue Sampling per DSHS |
| | Aquatic Life Use | DO grab screening level | Natural due to seasonal fluctuations | LNVA & TCEQ routine monitoring | Continue routine monitoring in the segment |
| Segment 0603: B.A. Steinhagen Reservoir | Fish Consumption Use | Mercury/Dioxin in fish tissue | Atmospheric Deposition/Unknown | Advisory issued by DSHS (Jan. 24, 2014) | Routine Fish Tissue Sampling per DSHS |
| Segment 0603A: Sandy Creek Segment 0603B: Wolf Creek | Contact Recreation Use | *E. coli* | Non-point Source Pollution | Planned East Texas Recreational Use Attainability Analysis (RUAA) Projects | Re-evaluate Primary Contact Recreation Use for these unclassified segments |
| Segment 0607: Pine Island Bayou | Aquatic Life Use | Depressed DO | Natural, seasonal fluctuations and low flow conditions | TCEQ Proposed Intermediate ALU in 2014 TSWQS (AU_04) CWQMN Real-Time Monitoring Station | Implement lower DO standard (3.0 mg/L) pending EPA approval of 2014 TSWQS |
| | Contact Recreation Use | *E. coli* | Non-point Source Pollution | LNVA routine monitoring in the segment | Conduct RUAA in AU_03; Continue routine monitoring |
| Segment 0607A: Boggy Creek Segment 0607B: Little Pine Island Bayou | Aquatic Life Use | Depressed DO | Natural, seasonal fluctuations and low flow conditions | TCEQ Proposed Lower DO Standards in the 2014 TSWQS | Implement revised DO standards based on intermittent streams with perennial pools Lower DO standards |
| Segment 0607C: Willow Creek | | Impaired Habitat 0607A | Unknown | TCEQ Biological Assessment | pending EPA approval of 2014 TSWQS |
| Segment 0608: Village Creek | General Use 0608 | Low pH | Natural Conditions | Revised pH range in 2010 TSWQS | Implement TSWQS pH Range (5.5-8.0) |
| Segment 0608A: Beech Creek | Contact Recreation Use 0608B, 0608F | *E. coli* | Non-Point Source Pollution | LNVA Routine Monitoring | Conduct RUAA on Big Sandy Creek |
| Segment 0608B: Big Sandy Creek | Aquatic Life Use 0608C, 0608E | Depressed DO | Natural, low flow conditions | TCEQ Proposed Intermediate ALU for Cypress Creek in 2014 TSWQS | Implement revised DO standard based on intermittent streams with perennial pools |
| Segment 0608C: Cypress Creek | | | | | |
| Segment 0608E: Mill Creek | Aquatic Life Use 0608A | Impaired Habitat Copper | Unknown Criteria Changed | Acute Criteria is 1.89 vs. 2.46 in 2012 IR | Aquatic Life Assessment on Beech Creek |
| Segment 0608F: Turkey Creek Segment 0608G: Lake Kimble | Fish Consumption Use 0608, 0608G | Mercury in fish tissue | Atmospheric Deposition | Advisories issued by the DSHS on Sept. 21, 2009; April 23, 1999 | Update advisory using current fish tissue sampling results |

**Table 4.1-1: Recommendations for Water Quality Impairments and Concerns (continued)**

| Watershed/ Segment | Use Impairment/ Concern | Identified Parameters | Explanation of Impairment/Concern | Actions Taken | Recommended Actions |
|---|---|---|---|---|---|
| Segment 0609: Angelina River below Sam Rayburn Reservoir | Fish Consumption Use | Mercury & Dioxin in Fish Tissue | Atmospheric Deposition/Unknown | Advisory issued by DSHS on Jan. 24, 2014 | Routine Fish Tissue Sampling per DSHS |
| Segment 0701: Taylor Bayou above Tidal | Aquatic Life Use | Depressed DO | Natural, low flow conditions | Completed UAA on Taylor Bayou | Collect new 24-hour DO measurements |
| | General Use/ Nutrients | Chlorophyll *a* | Excessive Nutrients | LNVA & TCEQ routine monitoring for nutrients | Continue routine monitoring; develop nutrient standards for segment |
| Segment 0701D: Shallow Prong Lake | Fish Consumption Use | Arsenic in fish tissue | Unknown | TCEQ Fish Tissue Sampling | DSHS issue a fish consumption advisory to warn public |
| Segment 0702: Intracoastal Waterway Tidal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ Routine Monitoring | Consider Secondary Contact Recreation Use Standards |
| | General Use/ Nutrients | Chlorophyll *a* | Excessive Nutrients | TCEQ routine monitoring for nutrients | Continue routine monitoring; develop nutrient standards |
| | Fish Consumption Use from East Bay to Port Bolivar | Dioxin & PCBs in fish tissue | Unknown Industrial Sources | Advisory issued by DSHS on June 26, 2013; TMDL Galveston Bay System Dioxin & PCBs Survey | Routine Fish Tissue Sampling per DSHS |
| Segment 0702A: Alligator Bayou and Main Canals A, B, C, and D | Aquatic Life Use | Lead in Sediment; Sediment Toxicity<br>Water Acute Toxicity | Industrial Legacy Pollutants<br>Unknown Industrial Sources | Ambient Toxicity TMDL in Alligator Bayou, 0702A Intermediate ALU for Main Canal D, Canal A, B, C in TSWQS | Complete TMDL Implementation; Continue monitoring for metals in sediment, ambient toxicity to determine source(s) of toxicity |
| Segment 0703: Sabine-Neches Canal Tidal | Contact Recreation Use | *Enterococcus* | Non-Point Source Pollution | TCEQ routine monitoring for bacteria in the segment | Consider Secondary or Noncontact Recreation Use Standards |
| Segment 0704: Hillebrandt Bayou | Aquatic Life Use | Depressed DO | Natural, seasonal fluctuations and low flow conditions | Completed UAA on Hillebrandt Bayou; Revised 24-hr. minimum DO criterion | Collect new 24-hour DO measurements; Apply 2014 TSWQS pending EPA approval |
| | General Use/ Nutrients | Ammonia-N & Chlorophyll *a* | Excessive nutrients due to urban runoff, stormwater | TCEQ routine monitoring for nutrients in the segment | Continue routine monitoring; develop nutrient standards for segment |
| | Contact Recreation Use | *E. coli* | Non-Point Source Pollution | TCEQ routine monitoring for bacteria | Consider Secondary Contact Recreation Use Standards |

## 4.1 Recommendations and Comments

The recommendations to address water quality impairments and concerns in Table 4.1-1 above are provided by LNVA to protect and improve water quality throughout the basin.

## 4.2 Conclusions

Since 1991, LNVA has been involved in the Texas Clean Rivers Program and worked closely with TCEQ and the CRP Steering Committee to address water quality issues in the Lower Neches River and Neches-Trinity Coastal Basins. The issues identified are well documented and CRP water quality data has been instrumental to this effort. The majority of the water quality issues in these two basins are currently being addressed. LNVA's role through the years has primarily been surface water quality monitoring, data management, data analysis, reporting, and public education/outreach.

LNVA's CRP Steering Committee is a diverse group of basin stakeholders, representing a variety of interests. Steering Committee meetings are hosted by LNVA to discuss the status of current CRP contracts/budgets, address state/local water quality issues, review basin reports and any special projects in the basin, and establish water quality monitoring priorities. This group of basin stakeholders has changed through the years, but they consistently provide meaningful input and practical ideas to improve water quality conditions throughout the basin.

Public education and outreach through CRP is a priority for LNVA. Basin water quality reports, water conservation materials, and the Major Rivers educational curriculum have been distributed to schools, organizations, and the general public throughout the basin. This effort has continued despite CRP budget issues and decreased fee allocations to the basin. The Volunteer Monitoring Program has enhanced our efforts to educate the public about the importance of water quality.

LNVA's Surface Water Quality Monitoring (SWQM) Program continues to be the primary focus of CRP in the basin. SWQM data collected and analyzed by LNVA's environmental staff provides quality assured data for the Texas Integrated Report prepared by the TCEQ and submitted biennially to the EPA. LNVA monitors surface water quality on a quarterly basis at 25 routine stations in the Lower Neches River Basin. LNVA's SWB Laboratory, located at the Neches River Saltwater Barrier in Beaumont, performs the routine water quality analyses on all samples collected. Since 2008, the SWB Laboratory has the NELAP accreditation from TCEQ.

Since June 2008, the Continuous Water Quality Monitoring Network (CWQMN) Station on Pine Island Bayou (CAMS 749) has been in operation by LNVA after it was installed by the TCEQ. The real-time surface water quality data (pH, Temperature, Dissolved Oxygen, Conductivity, Turbidity) collected at this station is available on-line, 24-hours a day at the URL: http://www.tceq.state.tx.us/cgi-bin/compliance/monops/water_daily_summary.pl?cams=749

Overall, water quality in the Lower Neches River and Neches-Trinity Coastal Basins is improving. However, it does not meet all state water quality standards and assessment criteria. All of the segments have listed impairments and/or concerns. Significant progress has been made to address these issues, but additional resources will be required to continue our efforts in the basin that is expected by stakeholders and the general public. LNVA is committed to this effort and will work closely with TCEQ and other agencies to identify additional funding and resources for the basin.