La Nana Bayou Watershed Protection Plan

Draft Chapter 3 - Water Quality

Surface water quality throughout the state is monitored to ensure that the waterbody meets the criteria for its specific designated use as defined in the Texas Surface Water Quality Standards (TSWQS). These uses and their associated standards are implemented by the TCEQ to ensure the state complies with requirements established under the federal Clean Water Act (CWA). Under the CWA (33 USC § 1251.303), administered by the EPA (40 CFR § 130.7), Texas is required to set standards that: (1) maintain and restore biological integrity in the waters, (2) protect fish, wildlife, and recreation in and on the water (must be fishable/swimmable) and (3) consider the use and value of state waters for public supplies, wildlife, recreation, agricultural and industrial purposes.

The CWA also requires states to publish a list that describes all impaired waterbodies not meeting their respective use standards. This is commonly referred to as the "303(d) list" in reference to the Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d). La Nana Bayou is currently included in Category 5b of the 303(d) list for impairment due to excessive bacteria. Concerns for elevated nitrate and total phosphorus concentrations are also noted (**Table 1**).

Table 1 *Watershed impairments listed in the 2020 Texas Integrated Report.*

Parameter	Category	AU ID	Criteria
Bacteria	5b*	0611B_01	126 MPN/100mL
		0611B_02	
		0611B_03	
Nitrate	CS**	0611B_01	>20% exceedance (1.95 mg/L Standard Screening Level)
Total Phosphorus	CS**	0611B_01	>20% exceedance (0.69 mg/L Standard Screening Level)

* Category 5b - A review of the standards for one or more parameters will be conducted before a management strategy is selected, including a possible revision to the Texas Surface Water Quality Standards (TSWQSs).

** CS - Concern for water quality based on screening levels

Water Body Assessments

To satisfy commitments to the CWA sections 305(d) and 303(d), TCEQ conducts biennial waterbody assessments and publishes the Texas Integrated Report for Surface Water Quality. The most recent assessment, the 2020 Integrated Report, includes water quality assessment data collected from December 1, 2011 – November 30, 2018.

Impaired waterbodies are evaluated at the Assessment Unit (AU) level. An AU is a sub-area of a stream segment, defined as the smallest geographic area of use support reported in the assessment (TCEQ 2020a). Streams are divided into relatively homogeneous hydrological and chemical characteristics, allowing each AU to be monitored for any site-specific standards. AUs are listed after the stream segment identification number to show

Figure 1 A map of the La Nana Bayou Watershed

which sub-area each represents. La Nana Bayou is stream segment 0611B, and its AUs are 0611B_01, 0611B_02, and 0611B_03 (**Figure 1**).

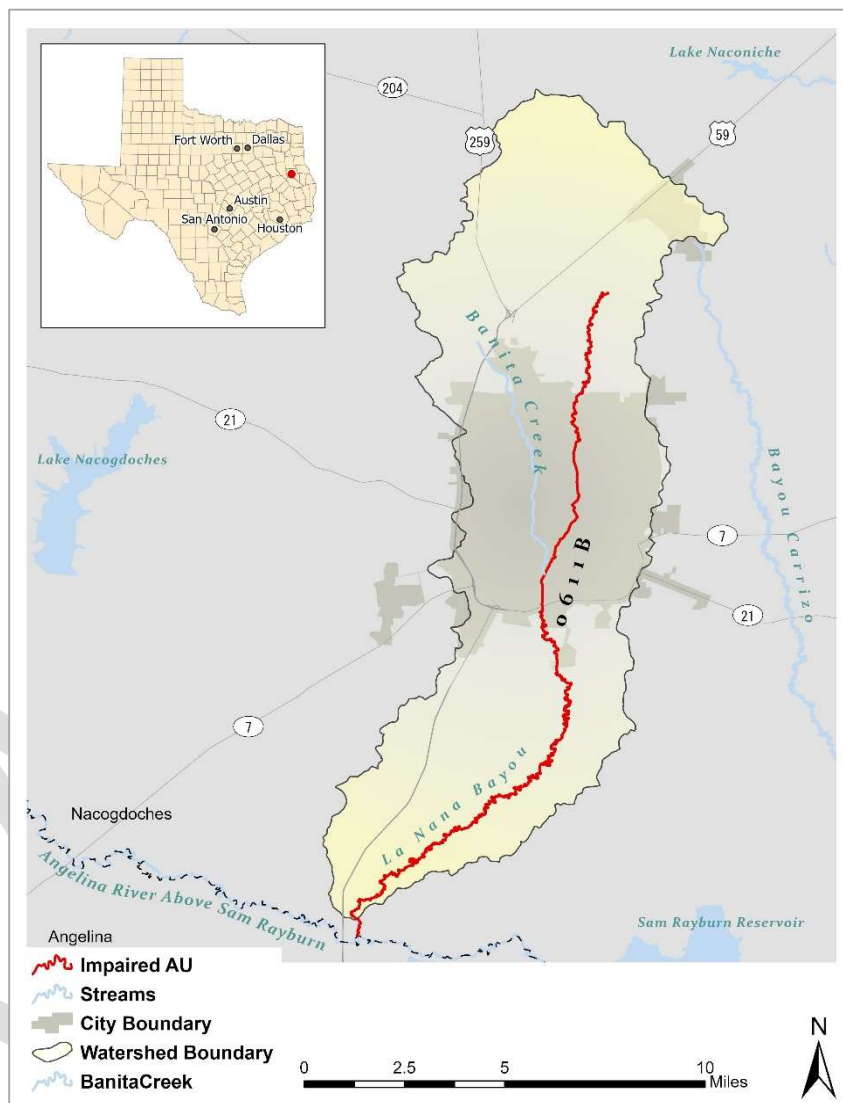For AUs to be included in the 303(d) list (and considered for WPP development), each corresponding station is required to have a minimum of 20 bacteria samples taken within seven years (TCEQ 2020a). In La Nana Bayou, routine water quality data monitoring is performed by the Angelina & Neches River Authority (ANRA) at the three currently active stations. At this time, ANRA collects conventional, field, and bacteria parameters and flow measurements on a quarterly basis.

Texas Surface Water Standards

Surface water quality standards in Texas are set to achieve specific goals for the state's many streams, rivers, lakes, and bays. These standards are set by the TCEQ under the authority of the CWA (33 USC § 1251.303) and are approved by the EPA. TCEQ implements these standards to ensure surface water resources remain high quality and may continue to provide for the sustainable economic development of Texas. Designated uses for the state's surface water includes supporting aquatic life, recreation, and public water supply sources. Water quality indicators for these uses include DO (aquatic life use), *E. coli* (contact recreation), pH, temperature, total dissolved solids, sulfate, and chloride (general uses) and a variety of toxins (fish consumption and public water supply) (TCEQ, 2020b). La Nana Bayou is designated as a primary contact recreation waterbody and must support intermediate aquatic life use.

Bacteria

 To assess potential risk of illness from contact recreation, concentrations of fecal indicator bacteria such as *E. coli* in water bodies are measured. The presence of these bacteria can indicate increased potential for related pathogens present in the intestinal tract of warm-blooded animals to be in surface waters. Common sources of *E. coli* include wildlife, livestock, pets, failing OSSFs, urban/agricultural runoff, sewage overflow, and WWTFs. Currently the TCEQ sets the water quality standard for primary contact recreation as a geometric mean of 126 MPN/100 mL of *E. coli* from at least 20 water samples collected within a 7-year period. The three AUs that make up La Nana Bayou have *E. coli* concentrations above the acceptable primary contact recreation water quality standard (**Table 2**). **Figure 1Figure 2** plots the *E. coli* results from sampling in La Nana Bayou since 2000 and the 7-year rolling geomean.

Table 2 *Water quality monitoring station summary from December 2011 – November 2018.*

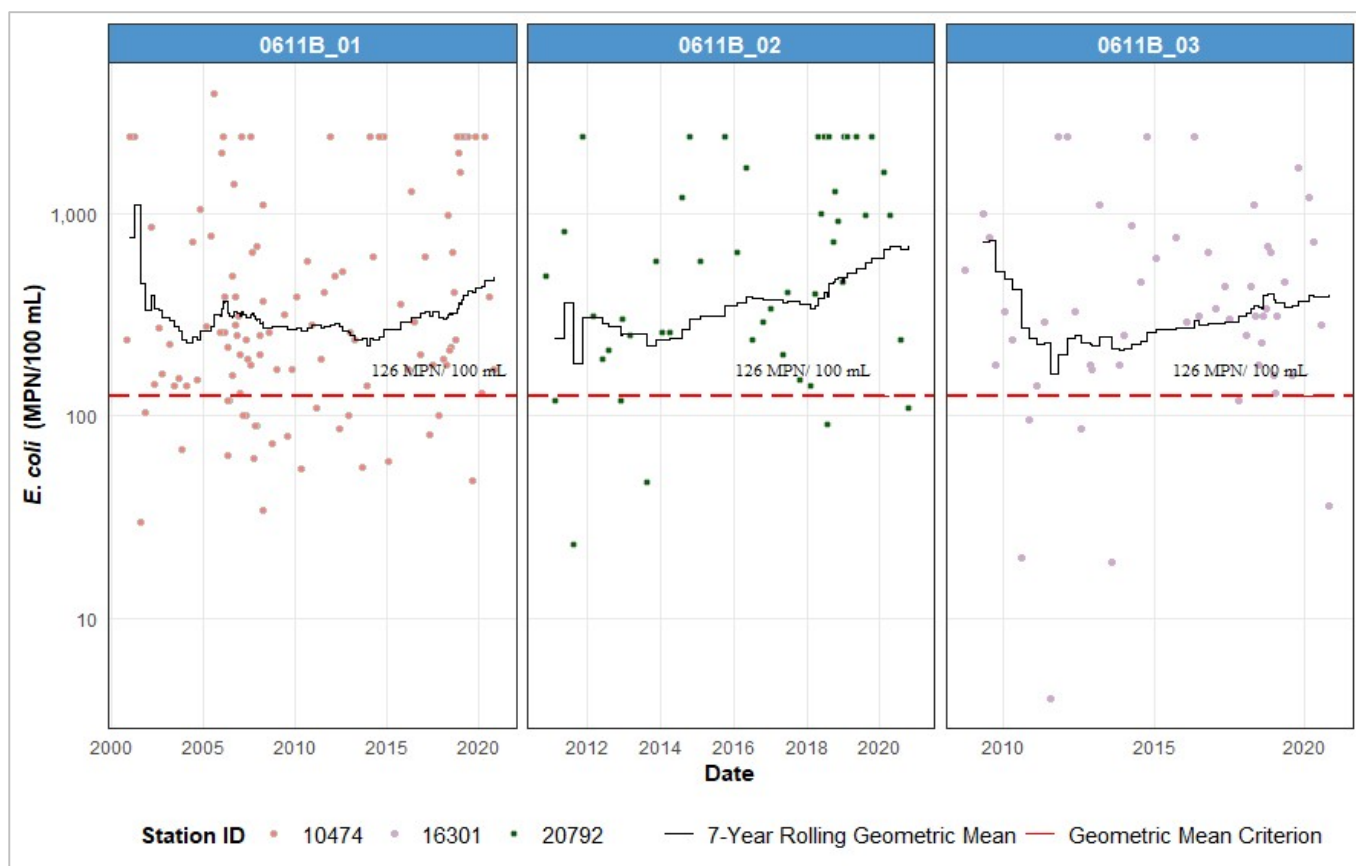| AU Description	AU ID	Station ID	# Of samples	7-year *E. coli* geomean (MPN/100mL)
From confluence of Angelina River, upstream to Loop 224	0611B_01	10474	26	279.46
Upstream from Loop 224 to FM 1878 in Nacogdoches	0611B_02	20792	35	576.58
Upstream side of FM 1878 to confluence with Banita Creek	0611B_03	16301	20	443.93

Figure 2 *Individual E. coli measurements and the seven-year rolling geometric mean since 2000.*

Nutrients

Elevated nutrient concentrations, specifically nitrate and total phosphorus, were found in AU 0611B_01 (**Figure 3** and **Figure 4**). Both nitrogen and total phosphorus are used by aquatic plants and algae to grow and excessive concentrations can lead to algae blooms which will reduce DO in stream and can affect fish respiration. The main nutrient sources in watersheds are typically WWTF effluent and fertilizer application in urban yards or agricultural fields that are then introduced into the surface water as runoff. Runoff can also carry newly eroded sediment particles that have nutrients bound to them, further increasing the nutrient concentrations in streams.

Although Texas does not currently have nutrient standards set for creeks, screening concentrations have been developed to evaluate nutrient loading. Screening concentrations are set as the 85th percentile of average nutrient concentration of similar waterbodies. If 20% of samples exceed this value, then the waterbody meets the TCEQ criteria for concern of elevated nutrient concentration(s). The screening

concentration for nitrate is 1.95 mg/L and total phosphorus is 0.69 mg/L. Only the downstream station 10474 consistently exceed the TCEQ standards for nitrate and total phosphorus (**Table 3**).

Table 3 *TCEQ screening levels for Nitrate and Total Phosphorus.*

Parameter	Standard Screening Level	Criteria	Assessment Results from the 2020 IR
Nitrate	1.95 mg/L	> 20% exceedance	4.71 mg/L
Total Phosphorus	0.69 mg/L		2.36
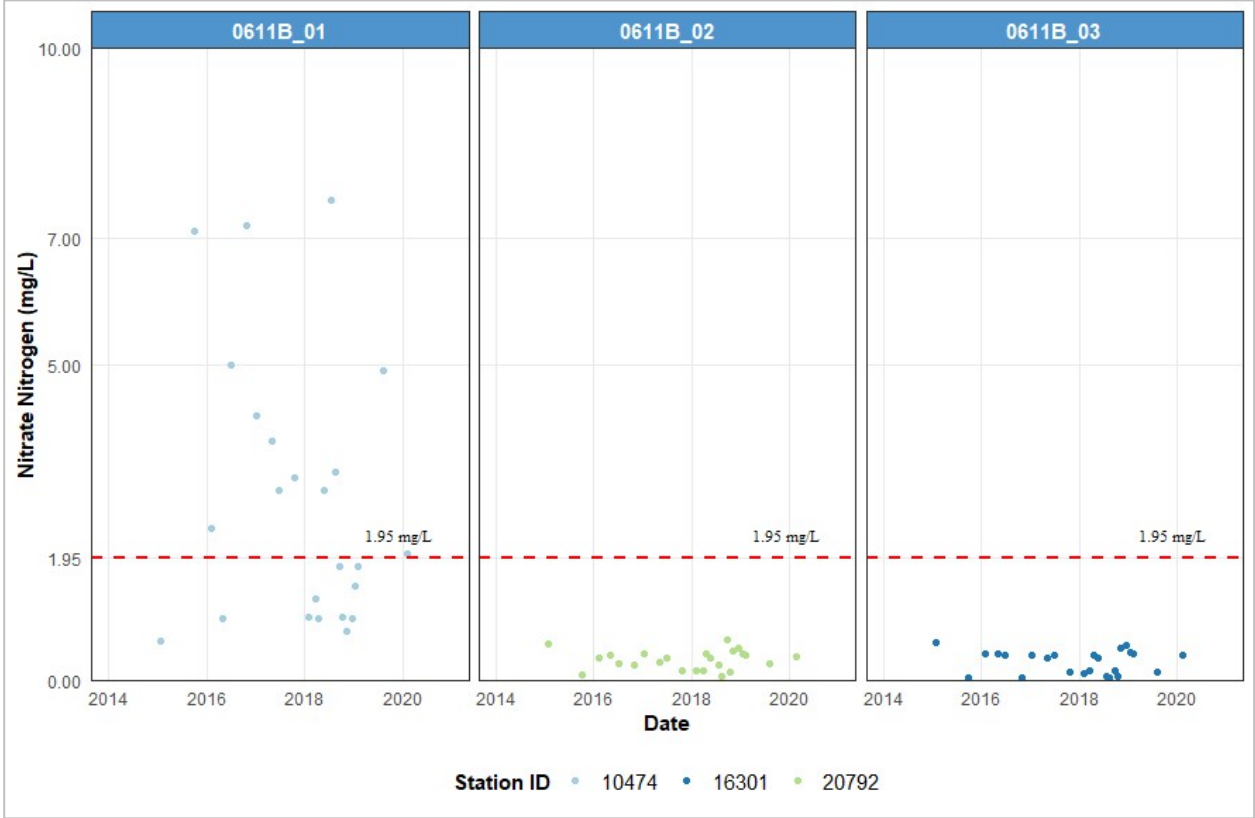
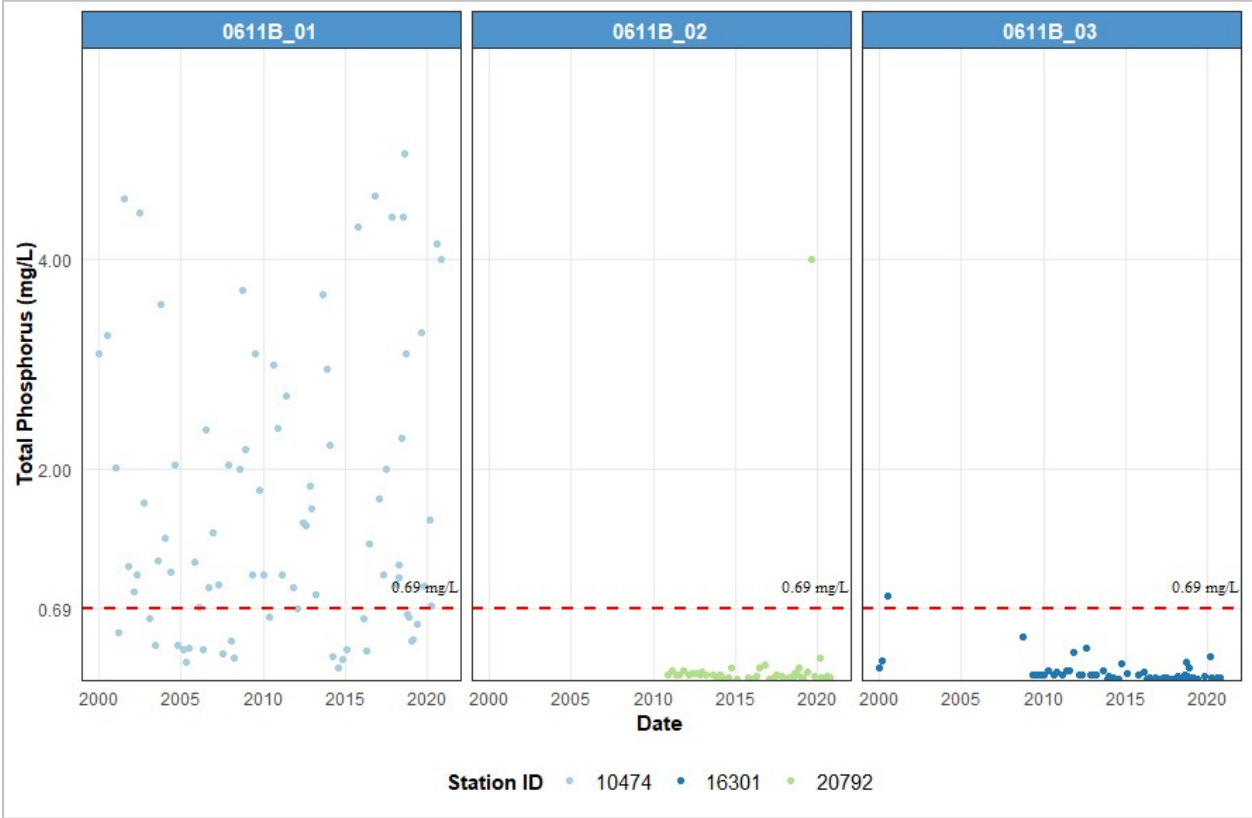**Figure 3** *Nitrate Nitrogen measurements since 2014.*

Figure 4 *Total Phosphorus measurements since 2000.*

Flow

Streamflow is the main driver behind assimilating and diluting pollutants. This is critical to the health of the stream as streamflow fluxes in response to precipitation and anthropogenic changes. Streamflow in La Nana Bayou is consistent as the region experiences above average precipitation for Texas, the exception being the upstream AU 0611B_03 which exhibits some intermittent flow patterns as measured at station 16301. Downstream at station 10474 the median value for low-flow periods was 9.3 cfs, while the median high-flow value was 134 cfs. **Figure 5** shows how the average flow changes in La Nana Bayou throughout the year by averaging the monthly measurements.
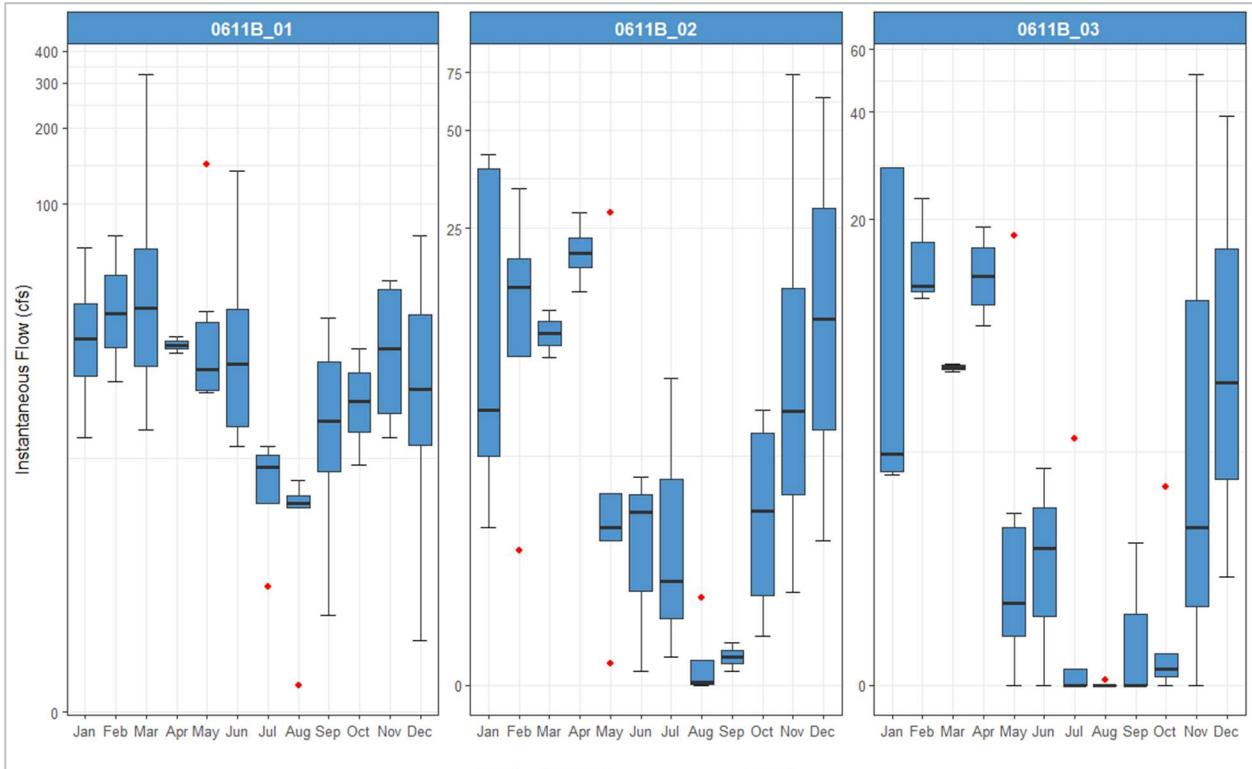
Figure 5 *Monthly average instantaneous flow measurements (cfs) by station.*

Dissolved Oxygen

Dissolved Oxygen (DO) is the primary measurement used to determine a water body's ability to support and maintain aquatic life and related activities. If DO levels in a water body drop too low (or are "depressed"), fish and other aquatic species will not survive due to low oxygen availability. Under the 2020 Texas Integrated Report, none of the AUs in La Nana Bayou were listed as impaired for depressed DO, though levels continue to be monitored.

DO concentrations fluctuate throughout the day depending on environmental factors. The lowest levels occur just before dawn as both plants and animals in the water consume oxygen through respiration, with the highest levels of DO occurring in mid to late afternoon, due to increased photosynthesis activity. Seasonal fluctuations in DO are common due to decreased oxygen solubility in water as temperature increases and it is common to see lower DO levels during the summer.

While DO fluctuates naturally, human activities impact those levels as well. Excess fertilizers and manure in the water can lower DO as aquatic plant and algae grow in response to the additional nutrients. The increased respiration from plants and decaying organic matter as plants die off can also reduce DO concentrations as bacteria break down the materials and subsequently consume oxygen. The historical

data for DO concentrations in each AU and their respective grab minimums and screen levels can be seen below in **Figure 6**.
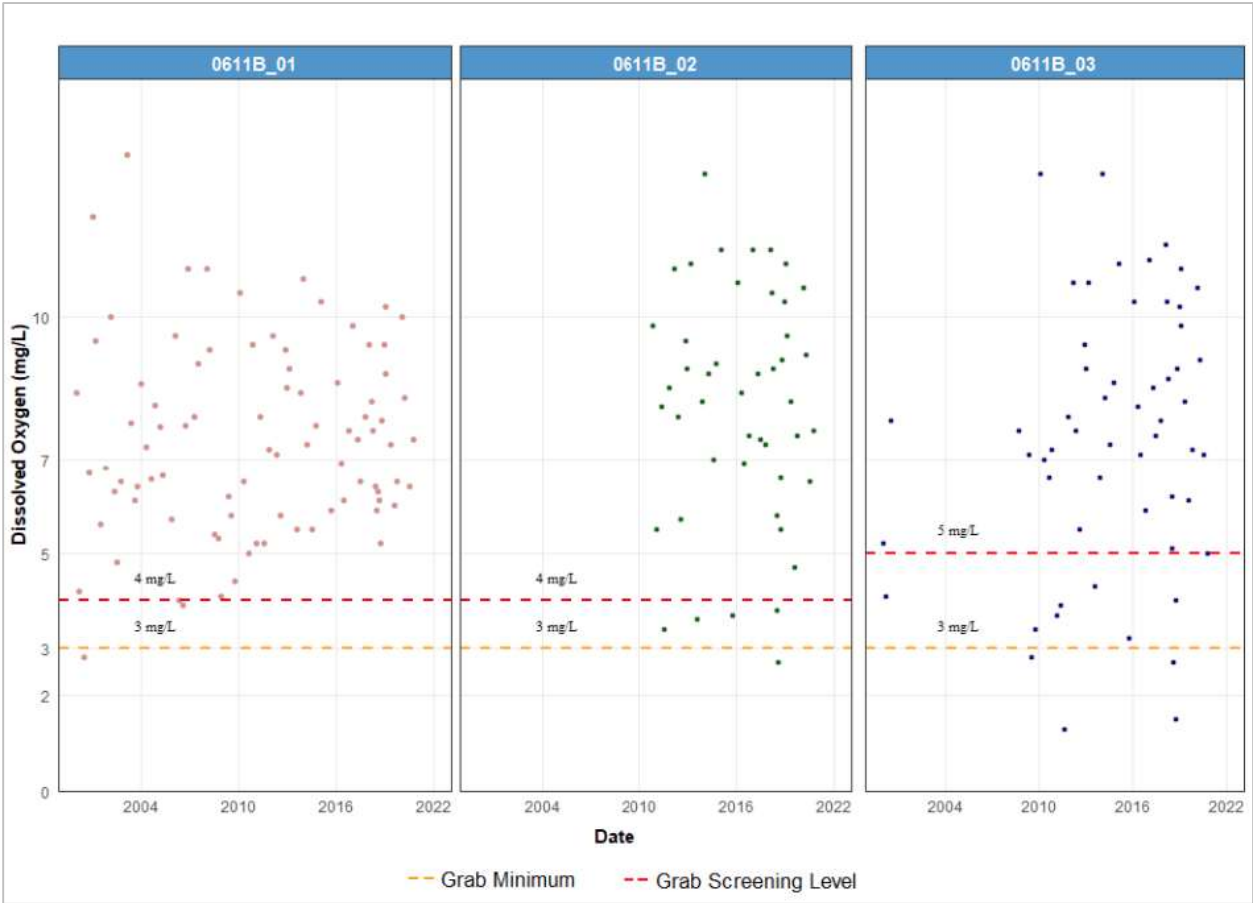

Figure 6 *Dissolved oxygen concentrations for La Nana Bayou since 2000.*

References

TCEQ. 2020a. 2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d). https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf

TCEQ. 2020b. 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas. Austin, TX: Texas Commission on Environmental Quality. https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/gawg/2020/2020_guidance.pdf