2013 Rio Grande Basin Summary Report

Texas Clean Rivers Program
International Boundary and Water Commission,
United States Section

August 2013

PREPARED IN COOPERATION WITH THE

Texas Commission on Environmental Quality

The preparation of this report was financed through grants from the Texas Commission on Environmental Quality.

Cover Photo: The Rio Grande in Big Bend National Park

2013 Rio Grande Basin Summary Report

Texas Clean Rivers Program
International Boundary and Water Commission,
United States Section

August 2013

THIS PAGE INTENTIONALLY LEFT BLANK

Participating Agencies

Federal

International Boundary and Water Commission, United States Section

Big Bend National Park

Natural Resources Conservation Service

U.S. Fish and Wildlife Service

U.S. Geological Survey

State

Big Bend Ranch State Park

Texas Commission on Environmental Quality

Texas Parks and Wildlife Department

Texas State Soil and Water Conservation Board

Local

El Paso Community College

Pecos Basin Watershed Protection Plan

Sabal Palm Sanctuary

Sul Ross State University

Texas A&M Agrilife Extension

The City of Brownsville Public Utilities Board

The City of El Paso Public Service Board

The City of Laredo Environmental Services Division

The City of Laredo Health Department

The Rio Grande International Study Center

The University of Texas at El Paso

The University of Texas at Brownsville

THIS PAGE INTENTIONALLY LEFT BLANK

Executive Summary

This report provides a summary of important information relevant to the Texas Clean Rivers Program (CRP). The goal of this program is to maintain and improve the quality of water in the Rio Grande Basin. The Texas CRP is a partnership between the Texas Commission on Environmental Quality (TCEQ) and regional water authorities established by the Texas Clean Rivers Act in 1991. This mutual working relationship was established to coordinate and conduct water quality monitoring, assessment, and stakeholder participation to improve the quality of surface water within each river basin of Texas. The TCEQ and its regional water quality partners work together to implement the program as laid out in Texas Water Code, Section 26.0135 and in the Clean Rivers Program Rule, Texas Administrative Code, Chapter 220. The International Boundary and Water Commission (IBWC) is a bi-national commission, established to apply boundary and water treaties and agreements between the United States (U.S.) and Mexico, and to settle disputes that arise in the application of these agreements. The IBWC is committed to exercising this authority in an environmentally sound manner that benefits the social and economic welfare of both countries, and improves their relations. The IBWC consists of the United States Section (USIBWC) and the Mexican Section (MXIBWC), with each Section headed by a commissioner appointed by that country's respective president. Originally administered by the TCEQ's Border Environment Assessment team, the State of Texas contracted with the USIBWC in 1998 to administer and implement the CRP in the Rio Grande Basin in Texas. The USIBWC CRP is responsible for collecting water quality data throughout the Texas portion of the Rio Grande Basin.

The Rio Grande at the Webb-Zapata County Line

Activities and Accomplishments

In Texas, the USIBWC has continued its efforts to improve and sustain the water quality of the Rio Grande, a trans-boundary river, by collaborating with stakeholders to monitor, compile, and exchange water quality data on the Rio Grande. Additionally, the USIBWC has drafted a capital plan with Mexico for improvement of the El Morillo Drain. This diversion canal prevents the discharge of highly saline irrigation waters originating in Mexico into the lower Rio Grande near McAllen by diverting these inflows directly into the Gulf of Mexico. The USIBWC also continues to provide technical assistance and financial support to the MXIBWC to ensure the proper operation and maintenance of the Nuevo Laredo International Wastewater Treatment Plant, which discharges into the international reach of the Rio Grande.

Several factors have been identified by the USIBWC as having a potential or real impact on existing water quality. These factors have the potential to influence future water demand, treatment, and uses along the 1,254-mile (2,018-kilometer [km]) international dividing line of the Rio Grande Basin between the U.S. and Mexico:

- Increased water pollution and a lack of adequate trans-boundary wastewater treatment infrastructure
- Increased utilization and depletion of scarce trans-boundary water resources (surface water and groundwater), and associated water quality and quantity implications for the bilateral relationship with Mexico
- Redistribution of water resources from agricultural uses to municipal and industrial uses
- Aging flood-control infrastructure that helps secure the health, safety, and well-being of border communities
- An increase in border region populations leading to increased competition for water resources that will require additional water strategies.

The USIBWC is one of 15 partner agencies that collaborate with the TCEQ to administer the Texas CRP in the 24 river and coastal basins in Texas. The TCEQ has made great strides at both the national and international level through the Border Initiative agreement with Mexico to maximize efforts to improve the environment, including protection of water quality, along the international border. Between 2010 and 2012, TCEQ was involved in projects dealing with water quality and emergency water management, air quality and emergency management, environmental education, and multi-media efforts. The TCEQ Surface Water Quality Monitoring (SWQM) Program recently developed their new Monitoring and Assessment Strategy Fiscal Years (FYs) 2012–2017, which is designed to achieve the agency's long-range vision as required by the Clean Water Act of 1972 (CWA). This document lists 17 major accomplishments achieved during the FY 2005–2011 period.

The CRP uses a watershed management approach to identify and evaluate water quality issues, establishes priorities for corrective actions, and works to implement those actions. All water quality data employed in this report are included in the TCEQ Surface Water Quality Monitoring Information System (SWQMIS), an electronic database maintained by TCEQ. This information has been collected, analyzed, and managed using a statewide set of uniform procedures established in a Quality Assurance Project Plan (QAPP) to ensure comparability of these results over the period of record and among river basins.

The USIBWC is implementing a new data management system that will improve agency-wide data management and distribution. Two different databases will complement each other to house data from multiple divisions within the agency, including water quality and quantity data, and spatial data for levees and other USIBWC infrastructure. CRP data will be included in this system that will make data submissions to the State of Texas more efficient. With this system, the USIBWC will be able to track electronically all flow and water data, which will allow a more efficient use of network resources. The two databases will also facilitate data distribution, allowing the public to review, query, and download information from the USIBWC Web site.

The water quality and quantity of the discharge from two major river systems, the Rio Grande and Pecos River, is affected by many different anthropogenic factors and processes taking place in that part of the river catchment found within New Mexico and Mexico. Increasing dissolved solids concentrations (also expressed as salinity), especially during drought conditions, has become a major water quality issue for the Rio Grande Basin. River flows received at El Paso and at Red Bluff Reservoir consist of a substantial amount of salinity resulting from irrigation return flow and municipal wastewater returns from outside state and international boundaries.

Long-term drought experienced throughout northern Mexico, the desert southwest, and the southern Rockies in the U.S. has put pressure on an already over-appropriated basin. The lack of consistent flow, fulfillment of water treaty obligations, and the subsequent impacts on water quality in the Rio Grande is one of the big issues in the region and at the national and international levels. Water quality conditions due to excessive bacteria, dissolved solids, nutrient contaminants, and dissolved oxygen (DO) will continue to impact the health of fish and wildlife in the Rio Grande ecosystem.

The USIBWC CRP's overall goals for the Rio Grande are as follows:

1. Protect and improve water quality by reducing direct and indirect sewage inputs and illegal discharges and by increasing natural treatment of storm water through infiltration, thus reducing direct releases from combined sewer outflows.
2. Protect and improve aquatic and riparian plant and animal biological diversity though targeted removal of invasive vegetation increasing the area of native vegetation and restoring healthy soil conditions, and restore habitat through ecologically sound riparian management techniques, improved hydrology and water quality, and restorative channel alteration.
3. Reduce environmental stresses on the river ecosystem by increasing connectivity between river reaches to facilitate the passage of fish and restore natural sediment flows. This will entail the improvement of hydrological conditions to reduce erosion, sedimentation and habitat disturbance and increase base flow through storm water infiltration.

The USIBWC, TCEQ, and other state and Federal entities are addressing problems identified in multiple projects that include educational programs on river ecology, biological control of saltcedar, monitoring of metals in water, and bacteria, nutrient and total dissolved solids (TDS) loadings in the upper Rio Grande including the Big Bend area; evaluation of salinity, creation of a watershed protection plan, managing saltcedar, and extensive aquatic life and habitat monitoring assessments in the Pecos River; bacteria source tracking and nutrient and heavy metals assessment in the middle Rio Grande; and monitoring and managing bacteria and TDS levels in the lower Rio Grande to mitigate agricultural return flows. In the Rio Grande Basin, landform features, stream morphology, and vegetation patterns have been so heavily altered that most of the characteristics of a healthy river might never be completely restored. Ecosystem conditions have been modified based on economic, social, and political constraints. It will be difficult to change existing conditions at the watershed level, because many of the preferred changes will require large-scale capital improvements, interstate and bi-national jurisdictional boundary policy and land use changes, and widespread changes in human behavior.

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Appendices

Figures

Tables

Acronym List

7Q2	7-day, 2-year low flow
ALU	Aquatic Life Use
ARS	U.S. Department of Agricultural Research Service
AU	Assessment Unit
BAC	Basin Advisory Committee
CAFO	Concentrated Animal Feeding Operation
cfu	colony forming unit
CRP	Texas Clean Rivers Program
CWA	Clean Water Act
CWQMN	Continuous Water Quality Monitoring Network
DO	Dissolved Oxygen
DSHS	Department of State Health Services
E. coli	*Escherichia coli*
EPCC	El Paso Community College
FY	Fiscal Year
H_2S	Hydrogen Sulfide
IBWC	International Boundary and Water Commission
IR	2012 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)
IWA	Initial Watershed Assessment
km	kilometer(s)
µg/L	micrograms per liter
mg/L	milligrams per liter
ml	milliliter(s)
MXIBWC	International Boundary and Water Commission, Mexican Section
NELAP	National Environmental Laboratory Accreditation Program
NMED	New Mexico Environment Department
OWIR	Office of Water Integrated Reporting
PCB	polychlorinated biphenyl
PCR	primary contact recreation
ppm	part(s) per million
QAPP	Quality Assurance Project Plan
RGACE	Rio Grande American Canal Extension
RGISC	Rio Grande International Study Center
RISE	Research Initiative Scientific Enhancement
RR	Ranch Road
SH	State Highway
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TPWD	Texas Parks and Wildlife Department
TST	Texas Stream Team
TSWQS	Texas Surface Water Quality Standards
TWC	Texas Water Code
TWDB	Texas Water Development Board
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USIBWC	International Boundary and Water Commission, United States Section
UTEP	University of Texas at El Paso
WA	Watershed Assessment
WPP	Watershed Protection Plan
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

THIS PAGE INTENTIONALLY LEFT BLANK

1. Introduction

The Rio Grande Basin drains an area of more than 330,000 square miles (800,000 square kilometers [km]) in Colorado, New Mexico, and Texas in the United States (U.S.) and Chihuahua, Durango, Coahuila, Nuevo Leon, and Tamaulipas in Mexico. The Rio Grande Basin in Texas drains an area of 86,720 square miles (224,600 square km). The Texas portion of the Rio Grande forms the international border with Mexico for 1,254 miles (2,020 km). Protecting the lakes and streams of the Basin is a complex process, not only in terms of the number of sources of pollution and the variety of water body types and interactions, but also in the coordination of people and activities that must be involved in achieving the goal of clean water.

The Rio Grande in Big Bend National Park

Background

The Texas Legislature passed the Texas Clean Rivers Act (Senate Bill 818) and established the Texas Clean Rivers Program (CRP) in 1991. The goal of this 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 (program partners), other agencies, regional entities, local and state governments, industry, and citizens. The CRP is coordinated by the TCEQ Monitoring and Assessment Section in the Water Quality Planning Division. The CRP also coordinates with TCEQ's Surface Water Quality Monitoring (SWQM) team to guarantee consistency in water quality sampling, assessment, and data reporting protocols. The CRP uses a holistic watershed management approach to identify and evaluate water quality issues, establish priorities for corrective actions, and works to implement those actions. The term "watershed" as used in this context is broadly defined as the land area that drains to a given point in a river, stream, or lake, and is defined by natural rather than political boundaries.

The main goals of the CRP as contained within their long-term plan are as follows:

- Maintain a basin-wide routine water quality monitoring program and maintain a water quality database
- Provide quality-assured data to TCEQ for use in water quality decisionmaking
- Identify and evaluate water quality issues and summarize in reports

- Promote cooperative watershed planning (i.e., conducting Coordinated Monitoring Meetings and collaborating on watershed plans and water quality initiatives)
- Inform and engage stakeholders (e.g., conducting basin advisory meetings and watershed education activities, maintain an updated Web site, and print annual reports)
- Maintain an efficient use of public funds
- Adapt the program to address emerging water quality issues.

USIBWC's Clean Rivers Program

In 1998, the State of Texas contracted with the International Boundary and Water Commission, United States Section (USIBWC) to implement the CRP for the Rio Grande Basin, and to monitor and address water quality issues unique to the international water boundary. The USIBWC CRP monitors and assesses the Texas portion of the Rio Grande Basin from the point that it enters the state to its end at the Gulf of Mexico (see Figure 1). This action has resulted in better coverage within the basin and more comprehensive information, which is then used to advance the resolution of issues along the border. The USIBWC has expanded the program to include numerous sampling partners and water quality monitoring stations, and provides support for special projects. Special projects can be developed to address water quality issues identified by CRP Partners and Steering Committees as priority issues for the Basin. These special projects can take place within either the U.S. or Mexico.

The USIBWC conducts chemical, physical, and biological stream surveys and monitoring to assess the quality of receiving streams and document water quality problem sources and improvements. Water samples are collected and analyzed to provide baseline data for the determination of potential effects of point and nonpoint sources of water pollution. Pollution from point sources can be traced to a specific location and point of discharge, such as a regulated industrial operation or a wastewater treatment facility. Pollution from most point sources is controlled through regulations that require treatment of a facility's wastewater before it is discharged into a nearby water body. Pollution from nonpoint sources are wastes not released at one specific, identifiable point-of-entry into receiving water bodies but from a number of points that are spread out and difficult to identify and control. Irrespective of source, there are growing apprehensions related to watershed contributions through overland transport and soil infiltration of nutrient, sediment, and bacterial pollution, and increasing presence of aquatic invasive species. Identified pollutants in the Rio Grande Basin include bacteria and other disease-causing organisms, suspended sediments and salts, excess nutrients, and decaying organic matter responsible for low levels of oxygen. Common sources of pollutants include city streets, construction sites, runoff and erosion from agricultural fields, stream banks and stream channel scouring, feedlot runoff, and effluent discharge from wastewater treatment plants and septic systems. Typically, these pollutants, in the form of sediment and chemical loads carried by rivers and their tributaries, ultimately find their way into lakes, wetlands, groundwater, and, eventually, the oceans.

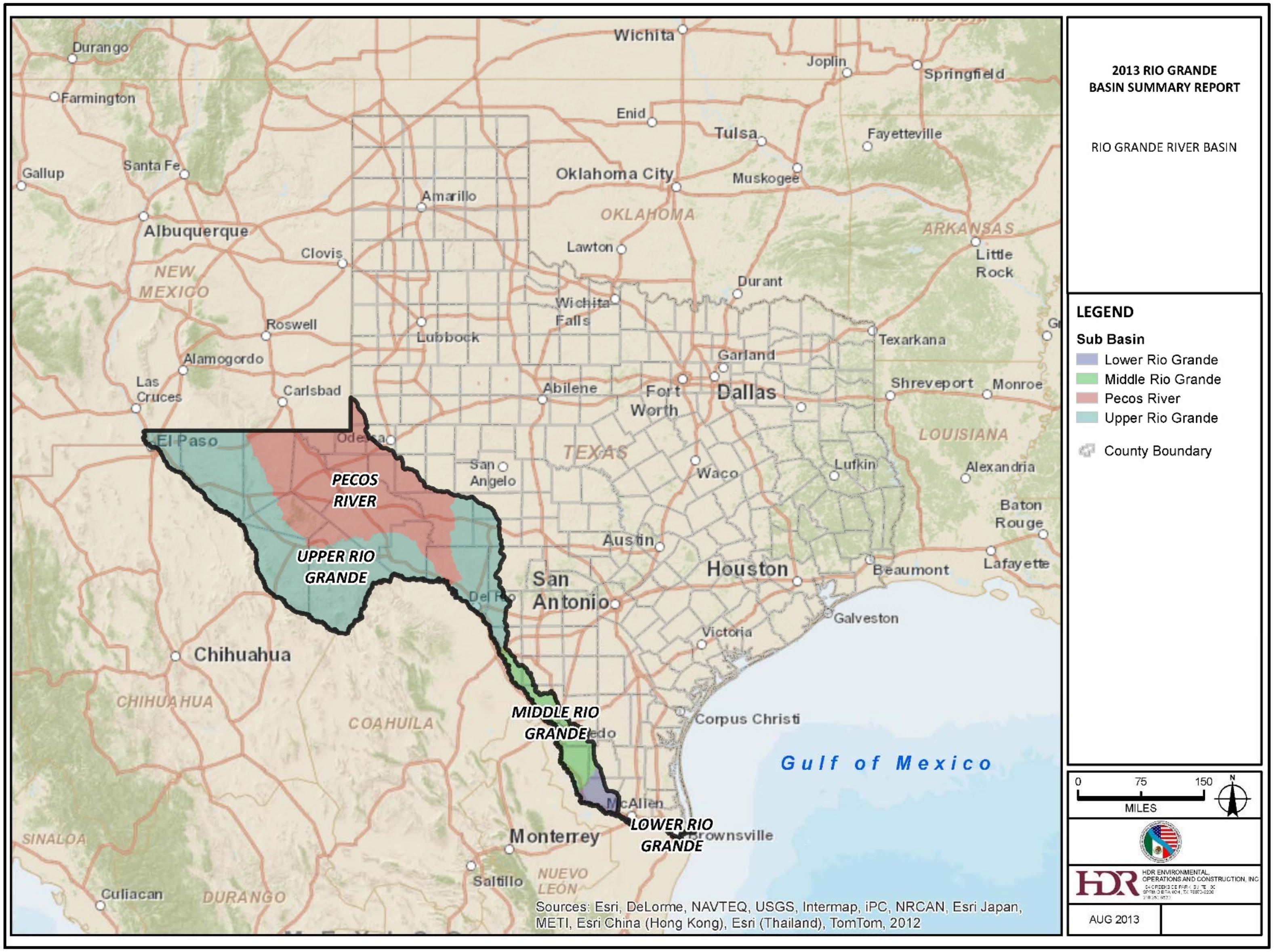


Figure 1. Rio Grande Basin and Sub Basins

Water Quality Monitoring

Sampling stations are located at sites which have high-quality beneficial use classifications, are above and below municipal/industrial discharges, or are within watersheds having water quality issues. The sampling site needs to be safe, accessible, and easily located by others using field descriptions, and ensure good geographic representation of monitoring and temporal coverage of the same water quality parameters within that part of the lake or stream of interest. Sampling locations in streams, including inflows and outflows of lakes, should be in areas of significant flow and little possible effect from tributaries, stagnant flow areas, or point sources and structures that could introduce their own chemistry. Reservoirs are sampled away from shore, by boat, and preferably in the deepest portions which are typically found near dams. The USIBWC CRP water quality monitoring network for Fiscal Year (FY) 2013 currently includes a total of 91 stations: 67 are located on the main river channel, 2 on the Devils River, 7 on the Pecos River, 7 at reservoir sites, and 8 on six creeks within the Basin. The number of stations monitored each year might vary depending on the need and the resources available. Occasionally, new locations are selected based on recommendations and data needs to augment the information collected from routine station monitoring. These additional stations allow more extensive observation of specific regions and increase geographic coverage of the station network. For the trend analysis conducted as part of this report and described in Section 3, a total of 156 stations over a period of 10 years from 2002–2011 were used.

Due to the vast expanse of water resources, the USIBWC CRP receives significant support from many other state and Federal agencies, offices, state universities, and other involved organizations in its efforts to monitor water quality of the Rio Grande Basin. This support comes in the form of sample collection, visual inspection of sites, recommendations about problems or special areas of distress, recommendations for new locations, and assistance with special studies. The USIBWC CRP sampling partners have agreed to the long-term collection (and analysis) of water quality samples and environmental data at designated monitoring stations on a prescribed schedule. The types of samples and data collected by each partner can vary in time, commitment, and geography. Sampling protocol requires all program participants to have water samples analyzed by the new CRP National Environmental Laboratory Accreditation Program (NELAP) laboratory, A&B Environmental Service, Inc., or at any other state-accredited laboratory. Following is a list of CRP partners and key participants involved in the CRP sampling efforts:

USIBWC CRP Sampling Partners

- A&B Environmental Services, Inc. (as of April 2013)
- Big Bend National Park
- Big Bend Ranch State Park
- The City of Brownsville Public Utilities Board
- The City of El Paso, Public Service Board
- The City of Laredo Environmental Services Department
- The City of Laredo Health Department
- El Paso Community College (EPCC) Research Initiative for Scientific Enhancement (RISE) Program
- Rio Grande International Study Center (RGISC)
- Sabal Palm Sanctuary

- Sul Ross State University Rio Grande Research Center
- University of Texas at Brownsville
- University of Texas at El Paso (UTEP)
- USIBWC American Dam Office
- USIBWC International Amistad Dam Office
- USIBWC International Falcon Dam Office
- USIBWC Laredo Field Office
- USIBWC Mercedes Office
- USIBWC Presidio Office.

Key Agency Participants

- National Resources Conservation Service
- Texas A&M Cooperative Extension
- Texas A&M University at Kingsville
- TCEQ Region 6
- TCEQ Region 7
- TCEQ Region 15
- TCEQ Region 16
- Texas State Soil and Water Conservation Board
- Texas Parks and Wildlife Department (TPWD), Natural Resources Program
- Barton Warnock Education Center
- U.S. Geological Survey (USGS).

An Overview of the Rio Grande Basin

International Falcon Dam
Release of Floodwaters after Hurricane Alex in 2010

The USIBWC CRP international reach associated with the Rio Grande Basin encompasses an immense area from the arid Chihuahuan Desert region around El Paso, Texas, downstream to the subtropical coastal region near Brownsville, Texas, and ultimately the Gulf of Mexico (see Figure 1). The Rio Grande Basin includes three ecological regions of Texas (i.e., Trans-Pecos, Edwards Plateau, and South Texas Plains) that are characterized by their similarity of climate, landform, geology, soil, potential natural vegetation, hydrology, and other ecologically relevant variables. The Rio Grande forms the international border between Texas in the U.S. and four states in Mexico (i.e., Chihuahua, Tamaulipas, Nuevo Leon, and Coahuila). The river-dominated estuary of the Rio Grande is different from the typical bar-built estuaries of Texas that are characterized by large open bays in that it drains directly into the Gulf of Mexico. Turbulent weather conditions persisted in July and August 2010 with the development of Hurricane Alex, a Category 2 storm, and Tropical Depression #2. The combined impacts of these two storms produced more than 50 inches of rainfall across the Mexican tributaries of the Rio Grande Basin through July 2, 2010. The result was a massive river flood requiring the opening of the many floodways in the Basin, which continued through the end of August 2010. Since then, abnormally dry to exceptional drought conditions have affected many of the counties in the Rio Grande Basin.

International treaties and interstate compacts govern the distribution and allocation of water in the upper Rio Grande from southern Colorado downstream to just below Fort Hancock, Texas, near the USIBWC gage at Fort Quitman and then from Fort Quitman to the Gulf of Mexico. Two major agreements between the U.S. and Mexico, in 1906 and 1944, regulate the water allocation of the Rio Grande. The International Boundary and Water Commission (IBWC) administers these agreements, implements the orders, and generally manages the operation of the Rio Grande system. The Rio Grande Project**,** an interstate compact signed in 1938**,** allocates the waters of the Rio Grande between the states of Colorado, New Mexico, Texas, and Chihuahua (Mexico). The Project was approved by the U.S. Congress to equitably apportion the waters of the Rio Grande Basin. The agricultural community receives the majority of the water allocated through the Elephant Butte Irrigation District in New Mexico, and the El Paso County Water Improvement District #1 in Texas. The El Paso County Water Improvement District #1 also supplies up to 50 percent of El Paso's water supply needs when resources are available.

Although not under the jurisdiction of the IBWC, the New Mexico Interstate Stream Commission is responsible for compliance with the accounting and measurement provisions to meet New Mexico's water delivery obligations to Texas as specified in the Pecos River Compact and the 1988 U.S. Supreme Court decision governing water allocations of the Pecos River between Texas and New Mexico. This Compact establishes New Mexico's obligation to ensure certain deliveries of water to the Red Bluff Reservoir at the Texas state line specifically to meet the terms of appropriated downstream uses within the Pecos River. However, this Compact did not address the quality of water delivered from New Mexico to Texas and is based only on water quantity. This could impact water deliveries for downstream water users within Texas for the subsequent execution of USIBWC's water quality management goals in the portion of the Pecos River between New Mexico and the Rio Grande. Such impacts could be more pronounced during severe drought weather.

For the purposes of coordination and planning, the USIBWC has divided the Rio Grande Basin into four sub-basins based on river length and ecosystem types (see Figure 1): (1) the Upper Rio Grande Sub-basin extends from the New Mexico-Texas state line downstream to the International Amistad Dam (including the Devils River), (2) the Pecos River Sub-basin extends from the Red Bluff Reservoir at the New Mexico/Texas state line to the confluence with the Rio Grande, (3) the Middle Rio Grande Sub-basin extends downstream of International Amistad Dam to International Falcon Dam, and (4) the Lower Rio Grande Sub-basin extends from downstream of International Falcon Dam to the Rio Grande Tidal area. The major tributaries to the Rio Grande and the Pecos River in Texas include the following:

- The Rio Conchos, in the Upper Rio Grande Sub-basin near Presidio, Texas
- Independence Creek in the Lower Pecos River Sub-basin
- The Devils River, in the Upper Rio Grande Sub-basin, which forms an arm of the International Amistad Reservoir

- San Felipe Creek in the Middle Rio Grande Sub-basin in Del Rio, Texas
- The Rio Salado, in the Lower Rio Grande Sub-basin downstream of Laredo, Texas, which forms an arm of International Falcon Reservoir
- The Rio San Juan, in the Lower Rio Grande Sub-basin upstream of McAllen, Texas
- Many other smaller tributaries and springs contribute to the Rio Grande Basin from the U.S. and Mexico.

Since the passage of the North American Free Trade Agreement in 1994, economic growth along the border cities of El Paso, Eagle Pass, Laredo, McAllen, and Brownsville has been partially driven by more than 3,000 maquiladora (product assembly) industrial plants built in the northern Mexico border urban areas. These facilities increase the potential for water quality degradation and toxic chemical contamination in the Rio Grande.

The rapid increases in population along the Texas-Mexico border are resulting in additional stress on the environment by producing more waste water discharge, septic system discharge, roadway and parking lot runoff, and construction site erosion. The Rio Grande flows through communities known as sister cities, which are metropolitan areas divided by the international border. A total of seven pairs of sister cities are found along the Texas-Mexico border. The first of these communities, the cities of El Paso and Ciudad Juárez, form the largest population group found along the border in Texas, with an estimated population of more than 2 million people. Laredo and McAllen are two of the ten largest growing metropolitan areas in the U.S. In addition, approximately 432,000 people live in 1,200 colonias in Texas and New Mexico. Colonias are unincorporated, semi-rural communities characterized by substandard housing and unsafe public drinking water or wastewater systems.

This rapid industrialization has also placed a burden on the communities located on the Mexican side of the border that now have less access to an adequate water supply for safe drinking and sanitation needs. Many water sources impacted by industry and agriculture over the years could contain a number of heavy metals, pesticides, and other agricultural chemicals. A number of these compounds remain in the environment over a considerable length of time and bio-accumulate in the food cycle, causing many acute and chronic risks to human health. In addition, the high economic growth and consequent increase in population have put the focus back on ambient water conditions. The impact of agricultural land use within the Rio Grande Basin also increases nutrient loadings into streams. Increasing agricultural operations, such as confined cattle operations and manure fertilization, are commonly associated with excess phosphorus and nitrogen in the soils and streams of the region. All of these sources contribute to water quality degradation due to nutrient enrichment.

The Upper Rio Grande Sub-basin

The Upper Rio Grande Sub-basin extends from the New Mexico-Texas state line downstream to the International Amistad Reservoir, a length of 650 miles (1,045 km) (see Figure 1). Due to historical changes in the channel, the Rio Grande meanders in and out of Texas and New Mexico with some sections forming the boundary between the two states. Proceeding downstream, the Rio Grande forms the international boundary between the U.S. and Mexico. The economy of this region is based on agriculture, agribusiness, manufacturing, tourism, wholesale and retail trade, and government including the Fort Bliss Army installation in El Paso, Texas.

The Upper Rio Grande Sub-basin lies entirely in the Trans-Pecos region. The upper portion of the river traverses the mountains of the Chihuahuan desert, flowing through arid mountains, high hills, and rock outcrops as it passes through Big Bend National Park. This region depends largely on groundwater sources for its water supply. Two major aquifers, the Edwards-Trinity (Plateau) and the Hueco-Mesilla Bolsons, combined with six minor aquifers contribute to the majority of the region's water supply.

During irrigation season, the water in the Rio Grande is used for agriculture by New Mexico, Texas, and Mexico. The City of El Paso also uses the river to provide half of its drinking water supply. The sister cities of El Paso, Texas, and Ciudad Juárez, Chihuahua, have a combined population of more than 2 million, and lands surrounding the cities are used primarily for agriculture. These agricultural uses significantly reduce the quantity and the quality of water within the river. Water in the river downstream of these cities is primarily composed of agricultural return flows, wastewater effluent, and raw or partially treated sewage. As a result, the upper Rio Grande downstream of El Paso and Ciudad Juárez contains very high levels of salts and bacteria. As the river traverses the sister cities of Presidio, Texas, and Ojinaga, Chihuahua, the Rio Conchos joins with the Rio Grande, improving the water quality and significantly increasing water quantity. The blended water from both rivers then flows through Big Bend Ranch State Park, Big Bend National Park, and the Rio Grande Wild and Scenic Area, where tourism and wildlife depend greatly on water quality and quantity.

Benefits created by the International Amistad Reservoir include flood prevention for downstream communities, improved water quality, water supply, and steady, continuous flow in the river below the dam, in addition to fishing and recreation. The dam also contains two hydroelectric plants that produce electricity for communities on both sides of the border.

The Pecos River Sub-basin

The Pecos River is the largest U.S. tributary in the Rio Grande Basin. It enters Texas from New Mexico and joins the Rio Grande at the upstream arm of the International Amistad Reservoir. The Pecos River is 926 miles (1,490 km) long and drains approximately 38,300 square miles (99,200 square km). The headwaters originate in the mountains of north-central New Mexico and flow along the western portion of Texas. The Pecos River's Sub-basin is bounded by the Rio Grande to the south and west (International Amistad Reservoir), the New Mexico portion of the basin to the north and the Colorado River and Edwards Plateau to the east (see Figure 1). Shortly after crossing the Texas-New Mexico state line, the Pecos River is impounded by Red Bluff Dam, creating Red Bluff Reservoir. Releases from Red Bluff are made in accordance with the Pecos River Compact for distribution to several irrigation districts in the basin. The river then flows southeast across Texas for 409 miles (658 km) until it empties into the Rio Grande upstream of the International Amistad Dam.

The Pecos River Sub-basin lies mostly within the Trans-Pecos region in the western section of the state, with a small portion of the eastern edge lying in the Edwards Plateau region. The topography of this Sub-basin generally consists of plains with high hills to high mountains. High mountainous terrain surrounds the river along the Permian Basin and empties into the Rio Grande downstream of Big Bend

National Park, forming an arm of International Amistad Reservoir. This region relies heavily on groundwater from four major aquifers (Ogallala, Edwards-Trinity [Plateau], Trinity, and Pecos Valley) and seven minor aquifers to meet water supply needs. Reservoirs, run-of-river supplies, desalination, and wastewater reuse also contribute to the existing supply. Population centers along the Pecos River are relatively few and the entire area has seen a general decline in population. The major economic sectors of this area include healthcare and social assistance, mining, manufacturing, agriculture, and oil and gas. Irrigation and municipal needs account for the two largest water consumers.

The Middle Rio Grande Sub-basin

The Middle Rio Grande Sub-basin consists of the portion of the Rio Grande flowing from just below International Amistad Reservoir to just above International Falcon Reservoir (see Figure 1). The 303-mile (487-km) stretch of the Middle Rio Grande spans five counties in Texas and the Mexican states of Coahuila, Nuevo Leon, and Tamaulipas. Del Rio, Eagle Pass and Laredo, Texas, along with Mexican sister cities Ciudad Acuña, Coahuila, Piedras Negras, Coahuila, and Nuevo Laredo, Tamaulipas, compose the majority of the population living along the Rio Grande in this reach. Laredo, in particular, is one of the fastest growing cities in Texas. Increases in trade with Mexico, manufacturing growth, and tourism have all contributed to the population increases in the area.

The northernmost and easternmost portions of the Middle Rio Grande Sub-basin lie in the Edwards Plateau region with the remainder of the Sub-basin occurring in the South Texas Brush Country. Within areas located downstream of the International Amistad Reservoir, where the river flows into the Middle Rio Grande Sub-basin, the terrain transitions to form rolling, irregular plains and continues with this pattern until it turns into coastal plains as the river approaches the Gulf of Mexico in the Lower Rio Grande Sub-basin. Water impounded behind International Amistad Dam slows in velocity and much of the suspended solids carried from the Upper Rio Grande Sub-basin sinks within this area. Most municipalities along this portion of the Rio Grande are dependent on surface water for domestic, agricultural, and industrial use. Del Rio is the only major city in this Sub-basin that relies on groundwater for its water needs. San Felipe Creek, a major spring-fed tributary located within Del Rio, enters the Rio Grande in Val Verde County, downstream of the International Amistad Dam. Groundwater is primarily provided by the Edwards-Trinity (Plateau) that underlies most of this region. The largest economic sectors are based primarily on tourism, hunting, ranching, and government (e.g., Laughlin Air Force Base in Del Rio).

The Lower Rio Grande Sub-basin

The Lower Rio Grande Sub-basin stretches from just below International Falcon Dam to its confluence with the Gulf of Mexico (see Figure 1). This 280-mile (451-km) stretch of the Rio Grande runs through Starr, Hidalgo, and Cameron counties of Texas, and forms the border between those counties and the Mexican State of Tamaulipas. Population centers along the Lower Rio Grande have grown tremendously in the past 10 years. Agriculture, trade, services, manufacturing, and hydrocarbon production are the primary economic activities in this region. Major cities in the sub-basin include McAllen, Harlingen, and Brownsville, Texas, on the U.S. side of the river, and Matamoros and Reynosa, Tamaulipas, on the Mexican side. Drinking water requirements of the Lower Rio Grande Sub-basin depend entirely on the Rio Grande. Anticipated increases in municipal and industrial demands resulting from rapid population growth will only further strain a limited resource already taxed by previous drought conditions and high agricultural use.

The Lower Rio Grande Sub-basin occupies the southeastern portion of the South Texas Brush Country region. There are two major aquifers that lie beneath a major portion of this region—the Carrizo-Wilcox and Gulf Coast Aquifers. Groundwater in the area is brackish, requiring construction of a desalinization plant and the possible construction of more plants in the future. Studies are being conducted on the desalinization of groundwater and ocean water to supplement drinking water supplies in the Lower Rio Grande Valley. Currently, research is also being done on potential water storage solutions, such as construction of a weir near Brownsville. Most agricultural and urban discharges do not enter the Rio Grande in this reach, as they are diverted to canals that ultimately empty into the Gulf of Mexico; however, excessive flows that exceed the capacity of the canals can be routed to the Rio Grande.

Infestations of invasive aquatic weeds such as hydrilla (*Hydrilla verticillata*) and water hyacinth (*Eichhornia crassipe*) have been problematic in the Lower Rio Grande Sub-basin. These aquatic plants obstruct long sections of the river, preventing boat navigation, impeding water flow, and increasing water loss through consumption and evapotranspiration. However, control methods including mechanical removal and biological control using triploid grass carp have helped to reduce the problem.

Summary of Water Quality Issues

TCEQ groups river segments into classified (e.g., 2302) or unclassified (e.g., 2302A) segments. The letter at the end of the segment number is an indicator that the segment is unclassified. Classified segments, also referred to as designated segments, refer to water bodies that are protected by site-specific criteria. The classified segments are listed and described in Appendix A and C of TSWQS Chapter 307.10. Classified waters include most rivers and their major tributaries, major reservoirs, and estuaries. Unclassified waters are those smaller water bodies that do not have site-specific water quality standards assigned to them, but instead are protected by general standards that apply to all surface waters in the state. The water quality impairments and concerns identified by TCEQ for the 14 classified segments and 5 unclassified segments of the Rio Grande Basin during its latest assessment cycle of water quality testing results are presented in Table 1. If the data assessed by TCEQ indicates poor water quality, the water body may be classified as "impaired" since it is not supporting its designated use(s). A "concern" may be identified if a limited amount of data indicates elevated levels of pollutants or if a screening level is exceeded. The primary water quality impairments in the Rio Grande Basin are elevated levels of bacteria and unacceptable dissolved solids levels. Impairments are based on the high constituent concentrations of chloride, sulfate, and total dissolved solids (TDS) which account for the greatest number of elevated concentrations in the Basin. Other water quality issues involve screening level concerns for "nutrient-related" situations, which include ambient and public supply waters impacted by nutrients (ammonia, nitrates, phosphorus, and chlorophyll-*a*), golden algal growth, and oxygen depletion.

Table 1. Water Quality Impairments and Concerns in the Rio Grande Basin

Segment	Segment Name	Parameter(s) Impaired	Year First Listed	Assessment Category[1]	Parameter (s) of Concern	Level of Concern[2]
2301	Rio Grande Tidal	No Impairments	--	--	*Enterococci* Chlorophyll-*a*	CN CS
2302	Below International Falcon Reservoir	*E. coli*	1996	5c	Ammonia Chlorophyll-*a* DO grab screening level Mercury in Edible Tissue	CS CS CS CS
2302A	Los Olmos Arroyo	*E. coli*	2004	5b	Chlorophyll-*a*	CS
2303	International Falcon Reservoir	No Impairments	--	--	Ammonia Nitrate Ortho-phosphorus Total Phosphorus Toxicity in Water	CS CS CS CS CN
2304	Below International Amistad Reservoir	*E. coli*	1996	5c	Toxicity in Water	CN
2304B	Manadas Creek	No Impairments	--	--	*E. coli* Chlorophyll-*a*	CN CS
2305	International Amistad Reservoir	No Impairments	--	--	Nitrate	CS
2306	Above International Amistad Reservoir	Total Dissolved Solids Chloride Sulfate	2010 2010 2010	5c	Chlorophyll-*a* Fish Kill Report Total Phosphorus	CS CN CS
2306A	Alamito Creek	No Impairments	--	--	No Concerns	--
2307	Below Riverside Diversion Dam	*E. coli* Total Dissolved Solids Chloride	2002 1996 1996	5c	Ammonia Chlorophyll-*a* DO grab screening level Nitrate Ortho-phosphorus Total Phosphorus	CS CS CS CS CS CS
2308	Below International Dam	No Impairments	--	--	Chlorophyll-*a* Nitrate Ortho-phosphorus Total Phosphorus	CS CS CS CS
2309	Devils River	No Impairments	--	--	No Concerns	--
2309A	Dolan Creek	No Impairments	--	--	No Concerns	--
2310	Lower Pecos River	No Impairments	--	--	Golden Algae	CN
2310A	Independence Creek	No Impairments	--	--	No Concerns	--
2311	Upper Pecos River	24-Hr DO minimum	2006	5c	*Enterococci* Chlorophyll-*a* DO grab screening level Golden Algae	CN CS CS CN
2312	Red Bluff Reservoir	No Impairments	--	--	Chlorophyll-*a* Golden Algae	CS CN
2313	San Felipe Creek	No Impairments	--	--	*E. coli*	CN
2314	Above International Dam	*E. coli*	2002	5c	Chlorophyll-*a*	CS

[1] 5b – A review of the water quality standards will be conducted before a TMDL is scheduled.
5c – Additional information will be collected before a TMDL is scheduled.
[2] CN – Concern for near-nonattainment of the Texas Water Quality Standards.
CS – Concern for water quality based on screening levels.

The portion of the Rio Grande (**Segment 2314**) found upstream of International Dam, in El Paso, Texas, and into New Mexico is listed with a bacteria impairment and has a screening level concern for chlorophyll-*a*. In El Paso, a 4.34-mile (6.9-km) length of river in **Segment 2308**, adjacent the Chamizal National Memorial, is an urban concrete-lined channel located downstream of International Dam. Within this channel, water quality standards are less stringent for all designated uses, including a noncontact recreation classification. Downstream of **Segment 2308**, the river areas of Del Rio and Eagle Pass between the Riverside Diversion Dam, including El Paso's lower valley downstream to Presidio (**Segment 2307**), is impaired for bacteria, chloride, and TDS, and has concerns for ammonia, chlorophyll-*a*, nitrate, ortho-phosphorus, total phosphorus, and dissolved oxygen (DO). The length of Rio Grande (**Segment 2306**) extending from the Mexican Rio Conchos entering near Presidio, Texas, and Ojinaga, Chihuahua, and ending upstream of the International Amistad Reservoir is impaired for chloride, sulfate, and TDS, and has concerns for total phosphorus, chlorophyll-*a*, and fish kill report. International Amistad Reservoir (**Segment 2305**) has a concern for only nitrate. Devils River (**Segment 2309**) is distinguished by its nearly pristine waters that meet all criteria standards and beneficial designated uses, thus providing high-quality water to International Amistad Reservoir. Downstream of this reservoir, there is a bacteria impairment with concerns for water toxicity and chlorophyll-*a* in the urban river areas flowing through Del Rio, Eagle Pass, and Laredo (**Segment 2304**). The International Falcon Reservoir (**Segment 2303**) has nutrient screening level concerns for ammonia, nitrate, total phosphorus, ortho-phosphorus, and a concern for near-nonattainment for water toxicity. In the lower Rio Grande downstream of International Falcon Dam (**Segment 2302**) water has a bacteria impairment, and concerns for ammonia, chlorophyll-*a*, DO, and mercury in edible tissue in the urban areas of Rio Grande City, Hidalgo, and Brownsville, Texas. Arroyo Los Olmos (**Segment 2302A**) in Rio Grande City is impaired for bacteria, and has a concern for chlorophyll-*a*. The tidal section of the river beginning approximately 7 miles (11 km) downstream of the International Bridge (**Segment 2301**) has concerns for bacteria and chlorophyll-*a*. Additionally, a phenomena known as red tide caused a number of fish kills in the Gulf of Mexico, including a 7-mile (11-km) length of coastal shoreline near Brownsville in October 2011.

Water in the Pecos River watershed is naturally high in salts as levels increase markedly in New Mexico from the Chain Lakes and Bottomless Lakes near Carlsbad and through a hydrological connection to a highly saline aquifer near Malaga Bend approximately 20 miles upstream of Red Bluff Reservoir. Salinity levels are commonly above 6,000 milligrams per liter (mg/L) at the Texas-New Mexico state line.[1] Red Bluff Reservoir (**Segment 2312**) receives surface inflow largely of poor quality from the Pecos River in New Mexico and has concerns for chlorophyll-*a* and harmful golden algae. The Pecos River is an important source of surface water in the arid western portion of Texas and is one of the main U.S. tributaries flowing into the Rio Grande. Natural geologic deposits in the watershed increase the concentrations of chloride, sulfate, and dissolved solids to levels typically higher than 6,000 mg/L that are as much as ten times higher than typical surface waters. This drainage contributes approximately

[1] Gregory, L. and W. Hatler. 2008. A watershed protection plan for the Pecos River in Texas. Texas AgriLife Extension Service, Texas AgriLife Research, International Boundary and Water Commission, U.S. Section, and Texas Water Resources Institute.

29.5 percent of the salt loading into the International Amistad Reservoir while contributing only 11 percent of the stream flow. The Upper Pecos River (**Segment 2311**) has an impairment for the minimum value for 24-hour DO and concerns for harmful golden algae, *Enterococci*, chlorophyll-*a*, and instantaneous DO minimum. Naturally high salinity, extreme drought conditions, and invasive saltcedar (*Tamarix ramosissima*) are other issues having an impact on water quality. The Lower Pecos River (**Segment 2310**) improves in water quality and biological diversity as freshwater inflows received from Independence Creek and other numerous freshwater springs lower the salt concentration before it converges with the Rio Grande upstream of the International Amistad Reservoir.

THIS PAGE INTENTIONALLY LEFT BLANK

2. Public Involvement

Public involvement is a major portion of the CRP and includes a number of different approaches. CRP staff participate in meetings across the basin where they receive information related to river basin issues that need attention, make presentations to groups concerning the CRP goals and efforts in the basin, ensure that water quality data are readily available, and prevent any duplication of monitoring efforts.

Internet technology provides the public with an effective and efficient way to access and share information about the CRP, including meeting schedules, studies and reports, sampling data, and other information. The USIBWC has made it their focus to provide a Web site which includes a directly usable format, good site navigation, and practical content organization. USIBWC's presence on the Internet has been enhanced by incorporating continual upgrades and technology improvements to the Web site. The USIBWC CRP Web page, shown here, is available at:

http://www.ibwc.state.gov/CRP/about.htm.

Providing a forum for water quality issues is an important aspect of the CRP public involvement. As a result of this program citizens and organizations within the basin are presented with opportunities to comment on the program, and provide information regarding local issues. A number of public meetings are held each year focusing on updating stakeholders within the basin about the progress of current projects and presenting the results of recent water quality monitoring. Maintaining local support is a critical part of the success the CRP has had when addressing water quality issues. Some of the various organizations that are included in public involvement activities are discussed in more detail in the following paragraphs.

Basin Advisory Committee

A primary component of the CRP includes the involvement of stakeholders, or anyone who might be affected in a significant way by the implementation of recommendations either economically, in quality of life, or otherwise. Stakeholders assist TCEQ in developing an understanding of the needs of their river basin and the identification of specific areas for water quality improvement. The Basin Advisory Committee (BAC) plays a major part in these public involvement activities. As part of the advisory committee process, the USIBWC coordinates closely with the TCEQ and other participants to ensure the development of a comprehensive water monitoring strategy within the watershed.

Representatives from municipalities, state and Federal agencies, industrial and agricultural interests, environmental organizations and individual citizens, are included in the BAC. The BAC serves as the hub for public input; assisting with the creation of specific achievable water quality objectives and basin priorities; work plan review and development; allocation of resources; development, review, and approval of major reports; the establishment of monitoring priorities; and the development of monitoring plans. An important aspect of the BAC is helping to identify priority problem areas and associated mitigative actions to address these problems, including pollutant sources.

The USIBWC CRP holds annual BAC meetings during the spring and fall along the Rio Grande Basin to discuss water quality and other related issues and to gather ideas for possible program improvements. These meetings are informal and open to public participation. BAC meetings are generally held in conjunction with the USIBWC Rio Grande Citizen's Forum or a similar gathering of stakeholders. Input from these public meetings assists the CRP in determining changes to the monitoring schedule, the development of new monitoring sites, initiation of special studies, and dissemination of information. In addition, the CRP uses information derived from these meetings to develop and update their existing program. These meetings also provide an opportunity for CRP personnel to apprise the committee about any special studies performed by the CRP, changes in program policies, program updates, new partnerships, new laws and regulations, and current concerns and impairments within the basin.

Rio Grande Citizens' Forum

The Rio Grande Citizens' Forum was established to facilitate the early exchange of information between the USIBWC and community members on USIBWC activities and projects. This outreach effort is accomplished with the assistance of volunteer board members. Forum boards have been developed within the Lower and Upper Rio Grande areas with several public meetings held each year. These meetings provide information to stakeholders while simultaneously gathering information about the community's interests, needs, and any issues they could have with respect to current USIBWC activities and future plans.

Coordinated Monitoring Meetings

The USIBWC CRP is responsible for the development and implementation of a basin-wide monitoring program. Qualified monitoring organizations and sampling entities are invited to attend the annual USIBWC CRP coordinated monitoring meetings. During these meetings, monitoring objectives and data needs of the basin are discussed both segment by segment, and station by station for each of the four USIBWC-defined Rio Grande sub-basins. The information obtained from participants and stakeholders is then used to select stations and parameters that will improve overall water quality monitoring coverage, eliminate duplication of effort, and address river basin priorities. Monitoring changes are made as resources allow and as monitoring priorities are identified. Any resulting changes to the basin monitoring schedule are then entered into the statewide CRP database found at http://cms.lcra.org and communicated to meeting attendees. TCEQ's Watershed Action Planning process is also being integrated into the Coordinated Monitoring Meetings. This process helps coordinate, document, and track strategies and activities that are designed to protect and improve water quality. In addition, the USIBWC CRP normally hosts sampling training for basin partners in conjunction with these meetings.

Public Information and Education Activities

The USIBWC and partner organizations continue to make the implementation of CRP objectives a focus of their annual and long-range strategies by participating in a number of outreach activities. These activities are designed to disseminate information about the Rio Grande, the CRP, and water quality.

El Paso Community College Service Learning Program

El Paso Community College Field Event

The USIBWC CRP is collaborating with the EPCC Service Learning Program to develop hands-on learning experiences for participating students in science, technology, engineering, and math. The USIBWC provides opportunities for these students to be involved in water quality monitoring, provides outreach presentations, creates watershed education materials, generates summary reports of journal articles and scientific reports, and allows students to participate in river cleanups through the Adopt-a-River Program. This partnership also involves faculty training that integrates student field experiences with classroom curriculum to meet specific objectives. The USIBWC CRP also participated in the EPCC Early College Program, which provides high school students the opportunity to take college-level courses. CRP staff provided a presentation for this program that outlined their duties and job opportunities, then escorted the students to a river site where they presented a water sampling demonstration. The students learned about the CRP and gained exposure to the importance of good water quality and careers in the environmental science field.

Rio Grande CRP Calendar and World Water Day Student Art Contest

A new outreach calendar was produced by the USIBWC CRP in 2012 to promote awareness of the issues associated with the Rio Grande Basin. The calendar featured the winners from a student art contest. Almost 2,000 calendars were distributed to the public throughout the Texas border region.

2012 Rio Grande Basin Calendar Drawing by Jennifer Zamudio

A drawing contest created in honor of the 2011 World Water Day was held by the USIBWC CRP. Information was provided to school districts in the Rio Grande Basin that specified the contest rules. The drawings were required to focus on the Rio Grande and how water was important to the students, or how they enjoy the water. Drawings could be submitted from any grade and winning entries were used in the 2012 CRP calendar. More than 365 entries were received; selected drawings from the contest can be viewed on the CRP Web site's media gallery at http://www.ibwc.gov/crp/gallery.htm.

Pecos River Watershed Protection Plan 2012 Spring Field Day

A 2-day field event was held in April 2012 for all interested Pecos River landowners to highlight current status and progress being made toward implementing the Pecos River Watershed Protection Plan. Topics included DO modeling, guidance for comprehensive management plan development, chemical and biological control of saltcedar, prescribed burning of dead saltcedar, drought and tree mortality, best management practices, and a schedule for future plan implementation. The TPWD provided a discussion of the health of the fish community within the Rio Grande Basin.

El Paso Water Utilities Water Festival

The USIBWC CRP has hosted a booth to educate children about water quality in the annual El Paso Water Utilities Water Festival since 2008. USIBWC conducted water quality experiments with 3rd, 4th, and 5th grade students from El Paso County, Texas, in 2011. The experiments included information about DO, pH, and turbidity and how these factors can affect water quality and aquatic organisms.

Adopt-a-River Program

USIBWC Adopt-a-River Program Participants

The USIBWC Adopt-a-River Program was developed to promote a litter-free Rio Grande by encouraging citizens to adopt a section of the river and periodically remove trash and debris from its banks. The Upper Rio Grande project area is currently the only active area within the basin. Within the program community, groups sign a contract to adopt a section of the river and commit to conducting several river cleanups each year. The USIBWC participates by picking up the filled trash bags after each cleanup and posting signs that include the name of the community group that has adopted that section of the river. Nine groups are currently active in this program.

Other Outreach Activities

USIBWC CRP staff has distributed information about the Rio Grande, the CRP, and water quality during numerous additional outreach activities, including an education booth at the El Paso Earth Day Fair and water quality experiments with middle school children at the Drinking Water Summit. Staff also participated and assisted in sessions at the Healthy Water, Healthy People and Project WET workshops, and sponsored a presentation and field trip with a local high school.

Outreach Materials

In addition to public outreach activities, outreach and awareness materials have been developed to assist in the distribution of information associated with basin issues and activities. Outreach materials for the Rio Grande Basin include two brochures, a factsheet, and an annual calendar. Descriptions of each of these resources are presented in the following paragraphs.

Brochure: Water Quality in the Rio Grande Basin

This brochure describes the condition of rivers, lakes, estuaries, and coastal waters within the Rio Grande Basin and discusses their ability to protect the health of humans and aquatic organisms. Water quality issues in the Rio Grande are addressed, including pollutants and their effects, and links are provided which help people find out more about what is being done or what can be done to improve water quality within the Basin.

Brochure: Drinking Water and the Rio Grande

This brochure is available in both English and Spanish and provides an overview of the origin of drinking water used in the Rio Grande Basin area. It explains how important the water from the Rio Grande is to the region and how pollutants, including trash bags, fertilizers, pesticides, and other materials can contaminate the drinking water and lead to public health impacts. Suggestions are included to help protect and conserve the Rio Grande, including limiting fertilizer and pesticide use, and picking up pet waste.

Factsheet: Bacteria in the Rio Grande Basin

This factsheet includes information about bacteria, with emphasis on *Escherichia coli (E. coli)*, in the Rio Grande Basin. Included are a discussion of sources and pathways of *E. coli* entering the Rio Grande, potential health effects, indications of presence in water, how it is monitored, and what is considered a "safe" level. Additionally, suggestions are provided in this factsheet for citizen and community engagement on helping to protect Rio Grande from bacteria.

Calendar: Rio Grande Basin Calendar

The Rio Grande Basin Calendar has been produced since 2010. It includes a range of information about the Rio Grande Basin, including water quality, invasive species, and the CRP programs, in addition to other information. For the 2010–2011 calendar years, photos of the basin were used; however, beginning in 2011 it also included drawings from winners of the calendar competition.

Volunteer Environmental Monitoring

Texas Stream Team

The Texas Stream Team (TST) is a program of the Meadows Center for Water and the Environment at Texas State University. The program was established in 1991 through a cooperative partnership between Texas State University, the TCEQ, and the U.S. Environmental Protection Agency (USEPA). As one of the state's leading citizen science water quality monitoring programs, a major focus of this organization is working with partners to train citizens as certified water quality monitors. The environmental data collected by the TST are made publically available via an online data viewer. The TST program also educates the public and schools about nonpoint source pollution and how it impacts drinking water supplies, recreation, fisheries, and wildlife.

The mission of this organization is to facilitate environmental stewardship by enabling a statewide network of concerned citizen monitors, partners, and institutions working in a collaborative effort; and promote a healthy and safe environment through the use of environmental education, data collection, and community action. Program goals include the production of quality-assured, usable information to determine environmentally sound decisions, the improvement of communication to facilitate knowledge of the state's natural resources, and conflict resolution of environmental impacts through positive cooperation.

Nearly half of the TST monitoring groups include teachers and their students. Educators view the program as a valuable teaching tool that lends itself to cross disciplinary instruction. Within the Rio Grande Basin, the Iraan Independent School District is using the Pecos River as an outdoor classroom through an ecology class. Science teachers from Iraan High School participated in water quality monitoring training provided by the TST. They are collecting water quality information at several sites in and around Iraan, Texas.

Texas Stream Team Field Event

THIS PAGE INTENTIONALLY LEFT BLANK

3. Water Quality Review

Existing Conditions Affecting Water Quality

Water supply across the state is a major issue as the statewide conservation storage percentage has dropped steadily since mid-summer 2012. Abnormally dry to exceptional drought conditions are affecting much of the Rio Grande Basin. Available water from the two major surface water supply sources, the Rio Grande and Pecos River, is limited by river systems operations, water quality, and precipitation. International Amistad Reservoir and International Falcon Reservoir are two large reservoirs built on the international reach of the Rio Grande constructed mostly for flood control and water storage for the benefit of the U.S. and Mexico. Both are presently at very low levels due to prolonged drought conditions. The likelihood of expected below average rainfall and increasing temperatures will contribute to the Basin's current persistent drought condition, especially in the areas where short-term deficits continue to occur.

Factors Influencing Surface Water Quality

The water quality parameters discussed in this report address constituents that can affect water quality, limit the intended uses of water, or harm aquatic life. A list of the more common parameters analyzed for potential changes in water quality is found in Appendix A. Water samples are analyzed for physical, chemical, biological, and bacteriological parameters to provide baseline data for the determination of potential effects of point and nonpoint sources of pollution. Stressors, or the processes that degrade water, include habitat modification (removal of riparian vegetation), fragmentation (spatial alteration of habitat), and hydrologic modification (dams).

Stream Flow

Stream flow measurements are necessary to calibrate watershed and water quality models, calculate loadings of pollutants from point and nonpoint sources, characterize transport processes, and evaluate impacts of pollutant loadings. The USGS surface water collection network in Texas is primarily established to monitor stream flow continuously at many of TCEQ's permanent water collection locations.

In 2007, Senate Bill 3 of the 80th Texas Legislature established a process for developing and implementing environmental flow standards applicable to new appropriations for surface water use in each of the major river basins and estuarine systems across the State of Texas. The legislation identified seven basin and bay systems in Texas to be given priority for completion under Senate Bill 3. Schedules were established for the selection of stakeholder and science teams to represent these basin and bay systems, and for the completion of environmental flow recommendations and flow standards. The Rio Grande/Rio Grande Estuary, and Lower Laguna Madre Area were identified as one of these priority basin and bay systems. The final TCEQ decision to adopt environmental flow standards for the river basin is scheduled for September 2013.

Bacteria

Bacterial standards were first established to protect human health at public swimming areas. These standards have subsequently been extended to public waters throughout the nation to be protective of human health during contact recreation, which includes all activities in which there is a substantial probability of ingesting water. A variety of bacterial groups and individual species were used in these studies to select the most reliable and sensitive indicators and to determine appropriate protective bacterial concentrations.

E. coli is a predictive indicator for water borne pathogens in fresh water that could limit beneficial uses and pose human health issues. *E. coli* replaced fecal coliform as a more reliable indicator of fecal contamination and subsequent risk for gastrointestinal illness. In addition, *Enterococci* bacteria are used as an indicator for the saline Rio Grande tidal water and Pecos River environments (**Segments 2301, 2311, and 2312**). Review of the water quality data shows bacteria contamination continues to occur in communities that border the Rio Grande.

Assessment concerns remain upstream and within El Paso, Texas, and the Laredo, Texas/Nuevo Laredo, Tamaulipas, area where bacterial levels exceed the Texas Surface Water Quality Standards (TSWQS) use standard for primary contact recreation (PCR). A 16-mile (26-km) length of the river near the Texas-New Mexico state line is monitored by each state for reporting purposes. In 2007, New Mexico designated their area of the river as impaired for bacteria and a total maximum daily load (TMDL) was developed and approved by the USEPA. As a result, New Mexico lowered their geometric mean criteria for coliform bacteria to adhere to the same protective Texas bacteria standards for *E. coli* of a monthly geometric mean not to exceed 126 colony forming units (cfu)/100 milliliters (ml) in the downstream segment of the main channel. In the El Paso area, high bacteria counts remain problematic especially where irrigation canals discharge into the Rio Grande. Bacteria levels in the Laredo/Nuevo Laredo area of the Rio Grande have been high for decades.

One of the primary source issues is the lack of, or the inability of, existing wastewater infrastructure to meet local sanitation needs and consequently the TSWQS. The development and expansion of unincorporated subdivisions and growing municipalities have not been providing the level of treatment of municipal sewage necessary to prevent bacterial contamination of the river. Border communities are upgrading their existing wastewater treatment plants (WWTPs) to meet the demands from increasing population and to protect public health or have applied for assistance to improve infrastructure and construct WWTPs. The CRP funded a bacteria characterization special study in the Rio Grande near the Laredo/Nuevo Laredo area. The findings were significant in identifying several untreated point source discharges that are in the process of being remediated.

Elevated bacteria levels can have adverse economic impacts on areas downstream of the major metropolitan areas that rely heavily on tourism and recreation. For example, communities near the Big Bend Ranch State Park and Big Bend National Park, and within the park boundaries, are dependent on bacterial standards compliance to maintain the quality of recreation along this portion of the Rio Grande. The USIBWC CRP monitors *E. coli* concentration at all of its routine sampling stations to gage the degree of bacterial loading and help determine whether the many sanitation infrastructure projects underway in both countries are improving river conditions.

Total Dissolved Solids, Chloride, and Sulfate

The Upper Rio Grande has been affected by drastic hydrological modifications developed to divert water for irrigation and drinking water. In the recent past, little water remains after irrigation withdrawal in the upper part of the Rio Grande Basin in Texas. The end result is increasing TDS and chloride. TDS is a measure of all constituents, or elements, dissolved in water, including carbonates, nitrates, chlorides, and sulfates. Chloride is a major ion commonly found in streams and wastewater and levels are regulated because of their role in contributing to the salinity of a system. Sulfate is a constituent of TDS and is widely found in nature and in many industrial wastes. Under anaerobic conditions it can form hydrogen sulfide (H_2S). Sources of these dissolved salts can include agricultural and urban runoff, discharges from wastewater treatment plants, groundwater inflows, or naturally saline conditions resulting from the local geology and arid climate.

Elevated salt content in the Rio Grande, extending from above Elephant Butte Reservoir in New Mexico downstream to Fort Quitman, Texas, has long been documented. Salt accumulates from the soil after repeated shared usage for irrigation by various communities. The dissolved salt content eventually reaches a level that does not meet public water supply standards. For example, conventional water treatment not able to produce finished water meeting all health and aesthetic guidelines could require advanced treatment technologies to meet drinking water standards resulting in higher costs of supplying better quality water to customers. Levels in the Big Bend area have increased and are variable with questions about the current water quality criterion for TDS. Combined with reduced downstream river discharge, high salt content is presenting challenges for cultivating crops in both the U.S. and Mexico.

Water with high salt levels emanating from New Mexico has caused a decline in the water quality of the Pecos River from the Red Bluff Reservoir to the Rio Grande confluence. Over time, groundwater pumping has lowered the water table, which affects the quantity and quality of groundwater discharge to local springs, the lower river reaches, and major tributaries. The largest issue within the Pecos River Sub-basin is the amount of water for irrigation. Since water quality is too saline for use as potable drinking water, the primary source of drinking water comes from brackish groundwater sources. Residents in this region use water purification systems in their homes and businesses. Although the Pecos River is not listed as impaired for TDS due to naturally high levels, the water in the river enters Texas with constituents that far exceed drinking water standards; therefore, water use is solely for crop irrigation.

A major water quality issue posed by the elevated chloride and associated TDS concentrations in the Rio Grande Basin is the potential lethal effect of golden alga (*Prymnesium parvum*) on the aquatic environment. Golden algae-related fish kills have been reported since 1985 when this organism was first confirmed in North America with a fish kill in the Pecos River in the Rio Grande Basin.[2] Other kill events have since been reported in the Pecos River and in the Big Bend portion of the Rio Grande.

[2] James, T.L., and A. De La Cruz. 1989. Prymnesium parvum *Carter (Chrysophyceae) as a suspect of mass mortalities of fish and shellfish communities in western Texas*. The Texas Journal of Science, 41: 429–430.

Harmful algal blooms, including golden algae, are monitored by the TPWD. It is important to note that harmful algae are always naturally present within the water column, just not in concentrations that are intolerable. Although not yet fully understood, toxin production is believed to be triggered by several physical and chemical factors. A recently published study seems to indicate that exposure to sunlight can reduce the acute toxicity potential to fish.[3]

The general results of water samples currently collected by TPWD within the seven major Texas river basins (Canadian River, Red River, Brazos River, Colorado River, San Jacinto, Rio Grande, and Nueces-Rio Grande Coastal) include a brief narrative regarding concentrations of golden algae cells, toxicity levels, and overall algal densities by collection date, water body, and any associated fish kills. Stressed or dying fish attributed to golden algae toxicity or other pollution incidents have not been reported in the Rio Grande Basin since late 2007. Golden algae bloom status reports by river basin are available at the following Web site:

http://www.tpwd.state.tx.us/landwater/water/environconcerns/hab/ga/status.phtml.

Nutrients

Elevated levels of nutrients in the form of nitrates and phosphorus usually lead back to discharges from municipal/industrial sources or agricultural sources in general. Elevated levels of nitrates can be the result of a WWTP improperly operating by not converting ammonia to nitrate. Ammonia is highly soluble in water and when left unchecked, is lethal to aquatic organisms at 1 part per million (ppm). Nitrite, produced during the first stage of the nitrification process, is also dangerous to aquatic life. Ammonia can be toxic to certain aquatic species and, as stated, could be an indicator that other pollutants are present in the water associated with the source. Phosphorus travels unchanged through the treatment process and is used in many types of fertilizer. High nitrogen and phosphorus levels can lead to algal blooms particularly during summer, which accelerate the natural enrichment process known as eutrophication. Chlorophyll-*a* is directly involved with all impairments for excessive algal growth or to the consequences of soluble nutrient loading. With respect to the latter, the issue manifests itself as (for example) reduced DO, increased turbidity, surface scums, taste and odor problems, or as widespread aquatic weeds; excessive plant biomass and metabolic activity is the proximate factor mediating all these impacts.

---

[3] James, S.V., T.W. Valenti, Jr., K.N. Prosser, J.P. Grover, D.L. Roelke, and B.W. Brooks. 2011. *Sunlight amelioration of* Prymnesium parvum *acute toxicity to fish.* J. Plankton Res. 33 (2): 265-272.

Protection from Aquatic Nuisance Species

River Invasion of Water Hyacinth near the El Jardin Intake Structure

Species that demonstrate rapid growth and development, invade native habitats, and displace other species are considered invasive. Invasive species can arrive through many different pathways and vectors, but most species considered nonnative to North America have arrived as a direct result of human activity. When these species invade semi-aquatic and riparian areas, they aggressively compete and displace native species, reduce wildlife habitat potential, alter natural ecosystem processes, limit overall biodiversity, interfere with navigation and recreation, and clog water systems of power plants and water treatment facilities. Coordination with existing local, state, and Federal agencies is recommended to prevent or reduce the spread of damaging invasive species.

Following are a few preventative measures to consider for aquatic nuisance species management:

- Do not release plants, animals, or fish into the river, unless they originally came from that particular body of water
- Introduce interstate and bi-national legislation plans to help prevent the spread of aquatic invasive species
- Clean and inspect boats and equipment before and after use as a precaution to prevent the transport and introduction of exotic plant and mussel species into the Rio Grande
- Incorporate the use of biological and mechanical control methods, where appropriate, into the control/eradication of invasive species along with chemical treatment
- Educate the public about the importance of preventing incidental introductions, and how the harmful impacts can be reduced.

The Texas State Comprehensive Management Plan for Aquatic Nuisance Species addresses several of the state's most problematic nonindigenous species including those found in the Rio Grande Basin. Information on the fish, shellfish, and aquatic plants considered harmful or potentially harmful, and the use of physical, biological, and chemical control of these species is found at the following Web sites:

http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_t3200_1066_1.pdf.
http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_t3200_1066_2.pdf.

Several problem species impacting water quality in the basin, or that have the potential to impact water quality in the future, include saltcedar, giant reed (*Arundo donax*), water hyacinth, hydrilla, Eurasian water milfoil (*Myriophyllum spicatum*), zebra mussel (*Dreissena polymorpha*), and quagga mussel (*Dreissena bugensis*).

Saltcedar is an exotic, scale-leafed tree or shrub that occupies the banks of the Upper Rio Grande from El Paso to the Big Bend area. This species is also found in the Pecos River watershed. Saltcedar is a hardy plant characteristic of high water usage, which contributes to significant reductions in stream flow, growing in dense thickets along waterways, lakes, and wetlands. It is tolerant of drought and wet-weather conditions. This aggressive plant excretes excess salt through leaf glands inhibiting establishment of native saline intolerant species. The alteration of the soil salt concentrations due to the presence of saltcedar in turn contributes to elevated surface water salinity during periods of wet weather which result in increased runoff and soil erosion. The U.S. Department of Agriculture's Agricultural Research Service (ARS) has been studying the saltcedar leaf beetle (*Diorhabda elongata*) in various ecotypes as a means of biological control.

Another invasive plant, the giant reed, has infested the riparian corridor of the Middle Rio Grande between Del Rio and Zapata. This species can grow in both wetland and upland environments, but prefers access to abundant water sources such as riparian areas and stream channels. A thick fibrous root system enables this species to create large monocultures and consume large volumes of water. The plant quickly forms dense colonies and is rapidly able to displace native riparian vegetation. The ARS has developed a biological control program that evaluates the effectiveness of the Arundo wasp, (*Tetramesa romana*), the Arundo scale (*Rhizaspidiotis donacis*), and the Arundo fly (*Cryptonevra* spp.) to target eradication of the giant reed. Petitions are currently being reviewed for the release of these insects into the wild for biological control.

The unrestricted growth of water hyacinth and hydrilla in the Lower Rio Grande from International Amistad Reservoir to the Gulf of Mexico has been linked to the large economic loss of irrigation water, public water supply in Matamoros, Mexico, and reduction in the amount of river discharge entering the Gulf of Mexico. The water hyacinth is a chronic problem posing a significant challenge. This species has a tremendous growth and reproductive rate, and quickly colonizes large areas of water bodies. Hydrilla forms dense stands from the river bottom to the water surface. TPWD, with assistance from several state, Federal, and international agencies, has been reasonably successful in removing water hyacinth blockages from key areas on the river over the past few years. Part of the removal effort is mechanical, but the TPWD is working with Mexico on a Memorandum of Understanding to use herbicides as another method for the removal of water hyacinth.

Eurasian water milfoil is an invasive submergent aquatic plant accidently introduced through the aquarium trade. This species easily colonizes in shallow water no more than 20 feet deep, as dense infestations in the water column. An inhabitant of a wide variety of habitats and conditions, this species is capable of rapid dispersal through a reproductive mechanism known as autofragmentation whereby plant fragments will set root and grow quickly into a new plant. This plant invades in several ways, including impeding water circulation, DO depletion, increasing water temperatures, clogging residential or industrial water intakes, interfering with recreation and drinking water supplies, and blocking native species from sunlight, threatening the survival of native plants and animals.

Zebra and quagga mussels are the most well-known invasive aquatic species in the U.S. Water intake facilities are most vulnerable to these destructive mussels because they are capable of attaching to most submerged hard surfaces. They have a tendency to clog source water transmission systems, including valves, screens, and meters; damage centrifugal pumps; and cause taste and odor problems. Although these mussel species have yet to be reported in the Rio Grande Basin, they have invaded north Texas and New Mexico. The occurrence of exotic species in nearby waters presents an early warning of a potential problem.

Sediment

Eroded soil particles can impact surface water quality in many ways including stream and lake turbidity and sedimentation, accelerated lake eutrophication, impairment of the quality of fisheries through feeding interference, habitat degradation, behavior modifications, degradation of food supplies through the impairment of the macroinvertebrate community, and increases in water treatment costs for municipal and industrial users. The many physical and chemical properties of sediment are important factors to consider in the transport and distribution of nutrients, metals (e.g., arsenic, cadmium, chromium, lead, zinc, and mercury), organics, pesticides, and pathogenic organisms, all of which can significantly influence surface water quality. These materials can be released slowly from sediment deposits and lead to impaired water quality conditions over an extended period of time. Presently, regulatory criteria do not exist for the majority of sediment contaminants.

Climatic Effects on Water Quality

According to the USEPA,[4] several environmental changes can contribute to climate change, such as changes in the sun's intensity, changes in ocean circulation, deforestation, urbanization, and burning fossil fuels. Global climate was not analyzed in detail for this report, since climate change has only recently been identified as a potential threat to the environment, economy, and population. Scientific evidence suggests that many climatic conditions are already changing and will continue to change in the future. Addressing climate change at the national, state, and local levels will be complex and evolving.

The strong relationship of the El Niño Southern Oscillation, the weaker La Niña weather patterns, and below normal rainfall in the Southwest has contributed to the extreme dryness in Texas. The two most severe droughts each lasted 14 years and occurred between 1943 and 1956, and from 1993 through 2006. In the past 3 years, the Rio Grande has seen two extreme weather conditions: flooding in 2010 after Hurricane Alex and a major tropical depression, and severe drought since 2011. The Lower Rio Grande Valley experienced the worst flooding in years following Hurricane Alex. The International Amistad and

---

[4] U.S. Environmental Protection Agency (USEPA). 2010. Climate Change – Basic Information. Web site: http://www.epa.gov/climatechange/basicinfo.html.

International Falcon reservoirs reached record levels after being inundated with floodwater from Mexico. As of 2011, the current drought is the one of the worst in the state since the drought of record in the early 1950s.

Multi-year drought, compounded with human water use in the absence of normal rainfall, has a major impact on the hydrology where connectivity within watersheds is disrupted. Flow is highly dependent on upper watershed inflow and the rate of evaporation/transpiration during dry periods. Such disruptions can range from flow reduction to a complete loss of surface water and connectivity. The longitudinal patterns along streams where flow ceases and dries up can differ between streams. Pools are usually the only stable habitats that provide living space as a refuge for aquatic life. Therefore, it would be reasonable to expect influence of pronounced drought on surface and ground water quality and to the aquatic community.

Salt Deposits from Water Evaporation at the Courchesne Bridge in El Paso, Texas

Surface water quality in pool habitats remaining during periods of drought is directly impacted by the increase of the concentration of pollutants including salts, inorganic elements and compounds, total organic carbon, turbidity, nutrients, and microbes. Groundwater quality is affected by increased infiltration from higher concentration surface water flows and increased pumping of lower quality water due to higher concentrations of minerals from lower depths. As prolonged drought persists, and reservoir levels continue to drop, municipal water treatment plants will be processing lower quality raw water from the Rio Grande.

Extremely low water levels for long periods of time also present unfavorable conditions that can be very damaging to the local freshwater biota, including freshwater mussels. Unlike highly mobile fishes that can rapidly disperse into new habitats, freshwater mussels are not so adaptable in their response to habitat modification. The TCEQ SWQM Team introduced new interim guidance in 2011 for conducting routine monitoring events under extended drought conditions. This information can be found online at:

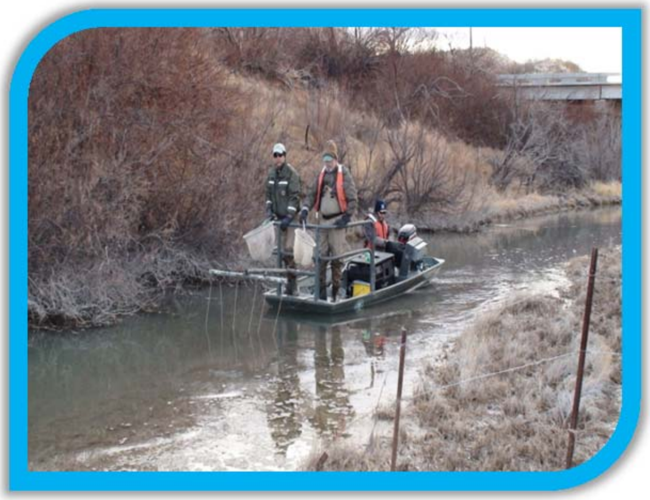
http://www.tceq.texas.gov/assets/public/compliance/monops/water/wqm/interim_droughtguidance.pdf.

Long-Term Water Quality Planning and Protection

Senate Bill 1 enacted by the 75th Session of the Texas Legislature in 1997 specified that water plans be developed for regions of Texas and authorized the future regulatory and financing decisions to the TCEQ and the Texas Water Development Board (TWDB). The TWDB is the state agency designated to coordinate the overall statewide planning effort. The Rio Grande Basin crosses many political, jurisdictional, and geographical boundaries, and includes a highly complex environment of groundwater and surface water interactions. The Far West Texas (Region E), Pecos River (Region F), Plateau (Region J), and Rio Grande (Region M) are 4 of the 16 planning regions established by the TWDB. These 4 planning groups can include recommendations for the designation of ecologically unique river and stream segments within their adopted regional water plans. This designation is supported by a recommendation package that includes criteria pertaining to the biological, hydrological, aesthetic, and unique communities contained within each segment.

Water Quality Monitoring and Sample Collection

As part of the statewide monitoring program strategy, core and supplemental water quality indicators are critical components of the TCEQ's ability to assess overall ambient water quality. Consistency is particularly important in long-term monitoring programs. A standard set of parameters is used during routine monitoring by both SWQM and CRP. The core or baseline indicators are based on those with corresponding uses and criteria in the TSWQS (with the exception of the public water supply use) and those with screening levels defined in the Texas Integrated Report guidance. Supplemental indicators are monitored to evaluate local factors (such as point or nonpoint source contributions). These indicators are used to help identify causes and sources of impairments, and appropriate source controls.



Aquatic Life Monitoring
Electrofishing in the Pecos River near Coyanosa

The sample design is based on the legislative intent of the CRP. Under the legislation, the Basin Planning Agencies, including USIBWC, have been tasked with providing timely data to characterize the stream ambient water quality conditions in support of the Texas Water Quality Integrated Report, and periodic data analysis to identify long-term water quality trends. Based on Steering Committee input, achievable water quality objectives and priorities and the identification of water quality issues are used to develop work plans that are in accord with available resources. As part of the Steering Committee process, the USIBWC works closely with TCEQ and other participants to ensure comprehensive water monitoring strategies within the watershed. TCEQ's 2010 Integrated Report, SWQM team guidance, past and present conditions and changes (trend analysis), results of Coordinated Monitoring Meetings, and steering committee input were all used to evaluate and determine current monitoring sites and schedules. A historical perspective, which only long-term records can provide, is necessary to make informed decisions regarding TMDL development, water quality assessments, or the effects of regulatory actions on water quality.

Water Quality Parameters

There are many different parameters that can be used to measure water quality. Water quality parameters for surface water monitoring are selected (1) to represent environmental water quality regulated by the TSWQS, (2) for the evaluation of the five designated water body uses (i.e., aquatic life, contact recreation, general, fish consumption, and public water supply), (3) to be representative of water quality as related to irrigation uses, and (4) to be representative of conditions that could impact the treatability of municipal or industrial supplies.

The selection of the specific core routine water quality and field parameters is based primarily on TSWQS Chapter 307, Exhibit 3C of the FY 2012–2013 CRP Guidance, and the current water quality concerns identified in the TCEQ's 2012 Texas Integrated Report approved by the USEPA on May 9, 2013. Additional sources include previous USIBWC CRP Basin Summary and Highlights Reports, water user issues expressed in the 2012 State Water Plan, and regional water quality studies.

The most commonly sampled field parameters include instantaneous measurements of water temperature, pH, DO, conductivity, secchi depth, and flow status. Conventional inorganic and nutrient parameters include alkalinity, TDS, chloride, sulfate, nitrate, ammonia, ortho-phosphorus, total phosphorus, chlorophyll-*a*, and bacteria (*E. coli* and *Enterococci*). Water and sediment at several locations are sampled for pesticides during the irrigation season. Stations located along the main channel that receive inflows from historic Big Bend mining areas or entry points to and within a public water supply are analyzed for metals-in-water or -in-sediment, semi-volatile and volatile organics in water and sediment, and fish tissue analysis for heavy metals, complex organic compounds, and pesticides as an early warning indicator of sediment contamination or related water quality problems.

Water Quality Standards and Classification

In Texas, the USEPA and TCEQ are responsible for water quality protection. The CWA (33 United States Code [U.S.C] §1251–1387), as amended, was enacted to maintain and restore the chemical, physical, and biological integrity of waters of the U.S. The TSWQS, as specified in Title 30, Chapter 307 of the Texas Administrative Code, is the primary basis for water quality protection in Texas. This document contains all the water quality standards applicable to the state's surface waters and administered by the TCEQ. The TCEQ sets and implements standards for surface water quality in an effort to improve and maintain the quality of water in the state. Water quality standards apply to ambient waters, as opposed to point source discharges.

The CWA requires each state to designate uses of their waters and to develop water quality standards to protect those uses. TCEQ identifies surface water quality standards and appropriate designated water uses for each classified river segment in Texas. For each classified segment, specific water quality criteria (i.e., numeric levels and narrative statements) protective of the use designations, or beneficial use designations, has been assigned by the state based on the TSWQS (Appendix A, 31 Texas Administrative Code §307.10).

2010 Texas Surface Water Quality Standards Revisions

The TCEQ adopted proposed revisions to the TSWQS in August 2010 (Segment Criteria are included in Appendix B) but are considered draft until approved by the USEPA. Major changes from the 2000 TSWQS include the subdivision of the PCR designation, changes to *Enterococci* bacteria indicator for the saline Rio Grande tidal water and Pecos River environments (**Segments 2301, 2311, and 2312**), removal of fecal coliform as an alternate indicator, removal of grab sample bacteria standard, and removal of public supply designation for the Rio Grande at **Segment 2308** (below International Dam). Additionally, the Lower Rio Grande Valley **Segments 2302** (below International Falcon Reservoir), **Segment 2303** (International Falcon Reservoir), and **Segment 2304** (below International Amistad Reservoir) have been designated in the 2010 TSWQS as a sole-source surface drinking water supply, as provided by the TCEQ Drinking Water Protection Team. Numeric criteria for chlorophyll-*a* (25.14 micrograms per lit [µg/L]) was assigned to Red Bluff Reservoir in the Pecos River Sub-basin. The next round of revisions is scheduled for FY 2013.

In the 2010 revisions to the TSWQS, two new categories for secondary contact recreation (secondary contact 1 and secondary contact 2) were proposed as an expansion of the two current contact and noncontact recreational use classifications with corresponding criteria. This new revision is in an effort to characterize better the different levels of water recreation activities that can occur in Texas.

Nutrient Criteria Development

Currently, Texas has no numerical criteria for nutrients in the TSWQS. Nutrient controls do exist in the form of narrative criteria, watershed rules, and anti-degradation considerations. Since 1998, the USEPA has provided technical guidance and collaboration for the development of numeric nutrient criteria for all water body types including lakes and reservoirs, rivers and streams, estuaries, and wetlands. TCEQ initially created a Nutrient Criteria Development Plan in 2001, which was revised in 2004 and 2006. The updated 2006 nutrient development plan has met the USEPA's approval. This plan outlines the process and timeline the state intends to develop assigned numeric criteria. Nutrient criteria will be sequentially assigned based on the following water body types: (1) reservoirs, (2) rivers, and (3) estuaries. In June 2010, TCEQ adopted site-specific numeric nutrient criteria, currently awaiting USEPA approval, for 75 reservoirs, including Red Bluff Reservoir. Although no numeric stream criteria for nutrients have yet been stipulated, these parameters provide valuable information for assessing water quality. TCEQ screens phosphorus, nitrate nitrogen, and chlorophyll-*a* monitoring data as preliminary indication of areas of possible concern that are not meeting standards set for their use in a section called the 303(d) list.

Assessment of Water Quality Data

Data Quality Assurance

Routine station and special study monitoring are important facets of the CRP and are conducted by contractors (primarily river authorities) in each of the 24 major river and coastal basins. Routine monitoring is structured to provide long-term water quality data at locations draining major Sub-basins and important subwatersheds within the Rio Grande Basin. The primary objective of collecting comparable water quality data over a substantial period of time under all weather and flow conditions is to facilitate the identification of temporal trends in water quality and to differentiate water quality characteristics, impairments, and possible causes.

All monitoring procedures and methods for data collection follow the guidelines prescribed in the USIBWC CRP Quality Assurance Project Plan (QAPP), which establishes acceptable collection and analysis methods and parameter-specific measurement performance specifications. Data management procedures have been developed to screen and digitally store data, convert the data to a format suitable for analysis, apply quality control and assurance procedures, provide data access for current and future users of the data, and support assessments of water quality conditions within the basin. An additional layer of quality assurance was created when the Texas Legislature enacted Texas Water Code (TWC), Section 5.134(a) to ensure the quality of laboratory data for use in commission decisions conform to standards established by the NELAP.

Once the field and laboratory data have been entered, screened, and quality-checked, the data set(s) are uploaded to the Surface Water Quality Monitoring Information System (SWQMIS) database. This process ensures the data collected under the approved QAPP and submitted to SWQMIS have been collected and managed in a way that guarantees its reliability and, therefore, can be used in water quality assessments, TMDL development, establishing water quality standards, making permit decisions, and by other programs deemed appropriate by the TCEQ.

Assessment Methodology

Water bodies in Texas are divided into defined segments (referred to as classified segments) based on a number of factors including water body characteristics, land use, habitat, and water quality. Further evaluation of each segment identifies the quality of the water and the habitat for the segment, and results in the assignment of appropriate designated uses. Water quality criteria include both numerical and narrative requirements necessary to protect five general categories for designated water uses, including aquatic life use, general use, contact recreation, public water supply, and fish consumption. Each use defined in the standards is linked to measurements for specific conditions or pollutants. These measurements are used to evaluate whether water quality is high enough to maintain designated uses.

Most water bodies are assessed in increments, such as the upper third, middle third, and lower third of a stream or reservoir to allow for more accurate and site-specific evaluations of the effects on the water body. These "portions" of a particular water body are defined as assessment units (AUs). One of five Integrated Report categories is assigned to each AU, or area assessed, to provide more information to the public, USEPA, and internal agency programs about water quality management. Water bodies are listed in Categories 1 through 5. All stream, reservoir, and tidal sites are evaluated if there is sufficient water quality data to assess at least one designated beneficial use or criterion.

TCEQ assesses all data in the state's SWQMIS database for a 7-year period, and a new 7-year data set is assessed every 2 years. The TCEQ made an assessment of the data collected during the 7-year period of December 1, 2003, through November 30, 2010. A range of water quality conditions and assessment status is expressed by a level of support established for each parameter, and for the use in each assessment unit and in some instances for each station. Support status reflects (1) that data are not sufficient to allow assessment, (2) when only a concern can be established from limited data, and (3) when the assessment can confidently establish the level of support. The following is a description of the level of support categories used when assigning waters/pollutants to the assessment categories in the 2012 assessment:

- **Fully Supporting (FS):** There are no known violations of state water quality standards as all designated uses are fully supported.
- **No Concern (NC):** Situation where there is not a concern for screening level parameters.

- **Not Assessed (NA):** Situation where a parameter was either not assessed or not enough data were available for assessment.
- **Non-Supporting (NS):** Situation where there are known violations of state water quality standards where one or more designated uses are not supported if any narrative or numeric criteria are exceeded.
- **Concern for Screening Level (CS):** A concern when screening levels indicate marginal water quality for parameter by concern assessment methods.
- **Concern for Near Non-Attainment (CN)**: Situation where an area is currently meeting its standard but is at risk of violating set standards.

Designated Uses

Water quality standards define the goals for a water body by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water bodies from pollutants. The numerical criteria for the individual segments of the Rio Grande are provided in Appendix B. The five designated use categories established by TCEQ are based on how the water within each segment is used and are described in the following paragraphs.

Aquatic Life Use

Standards associated with the aquatic life use (ALU) are designed to protect plant and animal species that live in and around the water. ALU support is based on the assessment of DO criteria, toxic substances in water criteria, ambient water and sediment toxicity test results, and indices for physical aquatic habitat and biological integrity based on macroinvertebrate and fish assemblages. Each of these sets of criteria is evaluated independently of each other to provide initial estimates of aquatic life use support. Impairment of the ALU occurs when any of the individual criteria are not attained.

Physical stream habitat and aquatic biota (benthic macroinvertebrates and fish) are collected from all available microhabitats to evaluate ALU through the use of comparative statistical parameters and available trophic structure data to provide a rating for each stream investigated. A Habitat Quality Index is an evaluation tool that consists of a number of key stream habitat features, or attributes, to assess stream habitat quality and characterize the aquatic life potential of a stream. An Index of Biotic Integrity is a scored evaluation of biotic components using benthic macroinvertebrate and fish community composition and structure to evaluate the quality of an aquatic ecosystem.

The overall habitat condition (Habitat Quality Index) is determined to evaluate the suitability of the habitat for occupancy by aquatic organisms, and the cumulative invertebrate and vertebrate community baseline Index of Biotic Integrity values are determined by matching the final tabulated scores of each index to one of four defined subcategories (i.e., limited, intermediate, high, and exceptional) of ALU.

Contact Recreation Use

The standard associated with the contact recreation use is designed to ensure that water is safe for swimming or other water sports that involve direct contact with the water. Contact recreation use categories and criteria are assigned to all water bodies. Water samples collected to determine support of the recreation use are routinely analyzed with the use of two organisms, *E. coli* in freshwater, and *Enterococci* in tidal water bodies and certain inland water bodies. Recreation uses are defined as (1) PCR, which involves a significant risk of ingestion of water; (2) secondary contact recreation 1, which does not involve a significant risk of water ingestion; (3) secondary contact recreation 2, which does not involve a significant risk of water ingestion and includes limiting factors; and (4) noncontact recreation, where primary and secondary contact recreation should not occur because of unsafe conditions.

For bacteria data, the following long-term geometric averages established as criteria are *E. coli includes* 126 colonies/100 ml, and *Enterococci* includes 35 colonies/100 ml. The contact recreation use is not supported if the geometric average of the samples collected exceeds the mean criterion. For noncontact recreation, an *E. coli* geometric average of 605 colonies/100 ml are assigned to protect the designated non-contact recreation use in Segment 2308 of the Rio Grande near El Paso where bacteria densities are recurrent and elevated.

General Use

To safeguard general water quality rather than protect one specific use, water quality criteria have been established for several constituents. Water temperature, pH, chloride, sulfate, TDS, and chlorophyll-*a* are parameters which protect aquatic life, recreation, public water supply and other beneficial uses of water resources. These criteria, which protect multiple uses, are evaluated for attainment as “general use.”

Fish Consumption Use

Standards associated with fish consumption use are designed to protect people from eating fish or shellfish that might be contaminated. As part of its overall monitoring efforts, the TCEQ investigates edible fish tissues for the presence of contaminants that can be harmful to humans if ingested. Whether a commercial or recreational species, fish are monitored because of the ability of certain chemicals to accumulate in fish tissue and organs. Support of fish consumption use is determined by two assessment methods. The first is by the designation of the human health criteria in the TSWQS. For each toxicant parameter at each site, the average of all values for water samples collected during a 5-year period is computed. The averages are compared to human health criteria. The second is assessed by the Texas Department of State Health Services (DSHS), Seafood and Aquatic Life Group for fish consumption advisories, possession bans, and aquatic life closures. A DSHS risk assessment or advisory is required for a full assessment of use attainment criteria for fish consumption and a determination that the criteria is fully supported. Due to cost, risk assessments are only conducted on water bodies where the assessment has indicated a risk from consumption.

The DSHS surveyed four areas in the Rio Grande Basin between 1999 and 2001. Fish were tested for metals, pesticides, polychlorinated biphenyls (PCBs), semi-volatile organic compounds, and volatile organic compounds from collections in Red Bluff Reservoir and at three river locations in Webb, Brewster, Presidio, Hidalgo, and Cameron counties. No consumption advisories or possession bans were issued. In the Rio Grande Valley, the Donna Reservoir and interconnecting canal system in Hidalgo County were issued a ban on fish consumption on February 4, 1994, for PCBs, thereby prohibiting possession of any fish species captured from this water body.

Public Water Supply Use

Standards associated with public water supply use indicate whether water from a lake or river is suitable for use as a source for a public water supply system. Many communities depend on surface water for their drinking water supply. Standards are in place to ensure water quality meets both the TSWQS and secondary drinking water standards. Public water supply use is evaluated for surface water bodies by comparing the average of constituents included in the human health criteria. The human health criteria are partly based on the primary maximum contaminant level adopted for water bodies designated for public water supply use. Data from all sites in the segment are averaged and used with the exception of very long stream segments where water may be taken from hydrologically isolated assessment units.

Texas Integrated Report for Clean Water Acts Sections 305(b) and 303(d)

The provisions of Sections 305(b) and 303(d) of the CWA require that Congress receive a biennial accounting of the water quality for each state. Every 2 years, TCEQ assesses status of the waters of Texas through an inventory of each river segment using relevant current and historical monitoring station information found in the TCEQ SWQMIS database. The TSWQS most recently adopted by the TCEQ and approved by the USEPA are used for the assessment. This information is used to identify water bodies that do not meet applicable water quality standards by analyzing collected data against established indicators of water quality set for each designated use assigned to a specific river segment and the pollutants and conditions responsible. These data in turn are used to generate the 303(d) that lists only segments that are not meeting water quality standards.

The intent of the biennial Integrated Report (IR) informs the citizens of Texas and the USEPA of the condition of state surface water resources and to serve as the basis for management decisions by government and other entities for the protection of surface water quality. A database is used to evaluate water quality over a period of years to determine if waterways in Texas are being protected and to develop a plan to correct any identified problems. USEPA will use the information from the IR to document the State's progress in meeting and maintaining CWA goals for the ecological health of the nation's surface waters and their domestic, commercial, and recreation uses. The TCEQ has identified 47 water quality impairments in 23 AUs of six stream segments of the Rio Grande Basin during its latest assessment cycle of water quality testing results. Appendix C provides the 2012 IR list of segments with use concerns and impairments. The full version of the 2012 IR is available at the TCEQ Web site: http://www.tceq.texas.gov/waterquality/assessment/305_303.html.

Water Quality Trend Analysis

Analyzing water quality for trends helps in gaining a better understanding of water quality issues and subsequently identifies areas that are improving or degrading, and providing information on areas that might need additional monitoring. This exercise helps to demonstrate if water quality improvement projects and other changes are making a difference. This information can be presented to steering committees to provide input and help to prioritize issues that are of importance to the community. When evaluated in conjunction with water quality improvement projects either being planned for a future date or currently undertaken they can provide an idea about their impacts. In short, trend analysis can be used to facilitate the decision making process and prioritize projects/issues that are critical within a basin.

Data for the trend analysis was obtained from TCEQ's SWQMIS database that stores data collected under a TCEQ-approved CRP QAPP by several partners in supporting the CRP including USIBWC, USGS, and other entities. Data spanning a 10-year time frame from 2002 to 2011 consisted of 165,527 observations across 156 stations and 761 water quality parameters. In accordance with the CRP 2012–2013 Task 5: Data Analysis and Reporting Guidance, the trend analyses were conducted in the AUs of 14 river segments throughout the Rio Grande Basin for priority core parameters that had at least 10 years of data, regular sampling, and a minimum of 20 to 30 data points.

Based on TCEQ's 2012 assessment of water quality within the Rio Grande Basin, eligible stations within each segment AU were evaluated for trends and compared against the assessment. Some stations where TCEQ's assessment used less than 20 samples were not included as part of the trend analysis. Many statistical procedures, particularly those computing confidence limits, do not perform well when using substitution methods (e.g., one half the detection limit) for non-detect values (right-censored) as low as 5 to 10 percent.[5] For screening purposes in this analysis a proportion of non-detects as high as 25 percent was allowed, but care must be exercised in interpreting the confidence intervals and significance levels for any sample containing values below the minimum detection limit. Further, stations with a sampling data time frame of at least two-thirds of the entire 10-year period were included in the trend analysis. Appendix D provides a list of all the segments and parameters included in the trend analysis, and Appendix E provides the statistical trend analysis data for evaluated parameters at the stations assessed in the Rio Grande Basin. Graphs generated for the parameters for each segment during the trend analysis are available under separate cover, and supplemental information is available upon request from the USIBWC CRP.

Watershed Summary Overview

The bi-national IBWC monitors the 1944 Water Treaty allocations through a system of gaging stations on the Rio Grande and Rio Conchos. The USIBWC operates and maintains 14 gaging stations on the main channel of the Rio Grande, and operates and maintains 12 gaging stations on the measured tributaries in the U.S. The IBWC, Mexican Section (MXIBWC) operates and maintains four gaging stations on the main channel of the river, eight gaging stations on measured tributaries in Mexico, and several gaging stations on diversion and return flow channels. Both the USIBWC and MXIBWC operate and maintain several diversion and return flow channels on their respective sides of the international border. Each Section gages the spring inflows from its side to the river downstream of the International Amistad Dam on the Rio Grande. In addition, the USIBWC operates 13 gaging stations for flood warning and operation of the flood regulation storage in the International Amistad and International Falcon Reservoirs on the Rio Grande. The exchange and review of the stream flow data collected forms the basis for joint

---

[5] Gibbons, R.D. 1994. Statistical Methods for Groundwater Monitoring. John Wiley & Sons, Inc.;
Singh, Anita, et al. 2010. ProUCL. Version 4.00.05 Technical Guide U.S. Environmental Protection Agency, EPA/600/R-07/038

accounting by these two sections of the waters belonging to each nation. The national ownership of waters was established in 1953.

A Continuous Water Quality Monitoring Network (CWQMN) effort was initiated in 2001 by TCEQ and CRP to create a more precise picture of water quality conditions in the state and selected watersheds in the Rio Grande (i.e., Pecos River and Lower Rio Grande). The installation of monitoring stations at key locations to collect data 24 hours a day was a part of this effort. Plans are pending to reinstall the CWQMN stations on the Devils River near Baker's Crossing, the Rio Grande upstream of Rio Conchos, and the Rio Grande near Rio Grande City; relocate a station at the Rio Grande near Castolon; install two new stations on the Rio Grande near Eagle Pass and near Laredo; and remove the Fort Quitman station. The benefits of continuous monitoring are providing an early warning of water quality issues, allowing for adaptive water use, and increasing public awareness. Each data point is verified and validated by TCEQ Data Management staff or contracted data validators. To view data for the individual real-time stations in the Rio Grande basin and throughout the State of Texas, visit www.texaswaterdata.org.

The analysis of water quality data is one of the most important aspects of the CRP. The CRP staff has attempted to take technical analyses and reports and present them in a user-friendly format. Each level of analysis performed on the water quality data provides information that by itself explains one or more aspects of either water quality or the overall health of the river. When coordinated with other analyses, it provides a better understanding of the data and can be presented to planning agencies or interested individuals in various forms depending on the desired format, such as a graph, report, table, or map. It is still important to explain the technical aspect of the creation of the reports because it is an important part of the data quality and could be important to end-users of the data as a point of reference. The following section provides a discussion of the data by assessment station within each of the four sub-basins. Any impairments or concerns that have been identified in the *2012 TCEQ Integrated Report* (IR) have been tabulated by each segment and associated AUs.

The available data and locations were compared against the corresponding water quality standards to provide insights into the levels of impacts. This analysis, combined with statistical estimates such as minimums, maximums, means, and medians, helped identify the areas or sub-basins of concern within the watershed. Further, this information will help guide the subsequent task of stakeholder coordination.

The Upper Rio Grande Sub-basin

The Upper Rio Grande Sub-basin extends from the New Mexico-Texas state line downstream to the International Amistad Reservoir. The Rio Grande forms the international border between Texas in the U.S. and four states in Mexico (i.e., Chihuahua, Tamaulipas, Nuevo Leon, and Coahuila). Along this border the Rio Grande flows through communities known as sister cities, or cities located on both sides of the border. The first of these sister city communities, El Paso and Ciudad Juárez, form the largest population along the border in Texas with an estimated population of more than 2 million.

The Rio Grande below El Paso generally experienced biannual seasonal flows prior to the Rio Grande Project in south-central New Mexico and westernmost Texas near El Paso that resulted in the construction of storage and diversion dams followed by intensive irrigation of land. Apportionment of water of the Rio Grande between the U.S. and Mexico is determined by various agreements and treaties made between

1904 and 1944. Presently, irrigation systems that serve three irrigation districts are composed of an extensive array of canals, laterals, and drains.

The Rio Grande serves as a drinking water supply for El Paso and a major water source for agriculture irrigation in the El Paso/Juárez valley. Portions of the water stored in Elephant Butte and Caballo Dam in New Mexico are used to meet the water needs in the El Paso area. Downstream of El Paso/Ciudad Juárez, river water is composed mostly of return flows from the irrigated lands upstream and municipal wastewater effluent. Assessment of river water from El Paso to International Amistad Reservoir has shown constant non-compliance with the TSWQS bacterial criteria for PCR and recent data continue to support the impairment designation. Downstream of El Paso is an approximately 200-mile (322-km) length of river channel between Fort Quitman and Presidio known as the Forgotten River reach of the Rio Grande. This area is aptly named for the lack of unimpeded stream flow created by upstream apportionment of water. The volume of flows of the Rio Grande observed after 1915 is approximately one-quarter of the annual volume of flows recorded previous to dam construction and water distribution.

Upstream control of flows in the Rio Grande and its tributaries present a special problem for Big Bend National Park, the Rio Grande Wild and Scenic River Area, Amistad National Recreation Area, and the protected areas in the neighboring states of Coahuila and Chihuahua, Mexico. Lower flows have resulted in elevated water temperatures and higher TDS concentrations. Occurrences of golden algae under optimal conditions can be deadly to the fish population. The absence of scouring flows has allowed several invasive plant species, including tamarisk and giant cane, to proliferate, thus contributing to the alteration of bank stability and morphology.

The Rio Grande Upstream of the American Dam Station 17040 in Segment 2314

The Rio Conchos in Mexico flows into the Rio Grande just upstream of Presidio, Texas and Ojinaga, Chihuahua. Currently, the Rio Conchos provides almost 50 percent of the surface inflow to the Rio Grande at this point. Surface water to the river downstream of the Rio Conchos confluence is supplemented by contributory tributary and spring flows in the vicinity of the Big Bend National Park. Upstream of Del Rio, Texas, and Ciudad Acuña, Coahuila, the Pecos River joins the Rio Grande providing additional surface flows to the river before emptying into the International Amistad Reservoir.

There are 99 permitted dischargers in the Upper Rio Grande Sub-basin: 2 superfund sites, 26 wastewater outfalls, 5 hazardous waste sites, 40 landfills, 11 concentrated animal feeding operations (CAFOs), 3 industrial permits, and 15 solid waste disposal facilities (see Figure 2). The Sub-basin is composed of six stream assessment segments (i.e., **Segments 2314, 2308, 2307, 2306, 2305, and 2309**) divided further by 25 AUs.

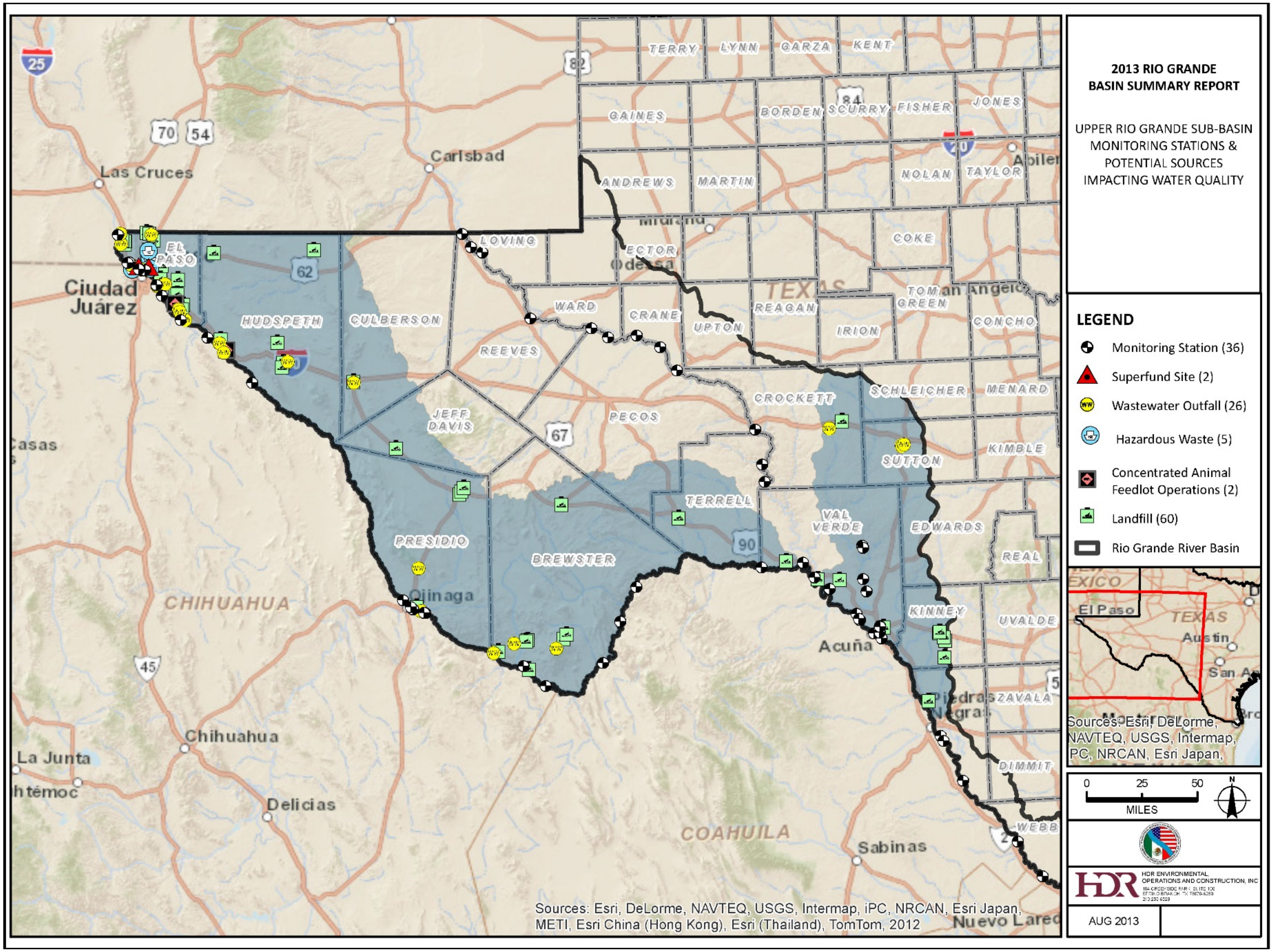


Figure 2. Upper Rio Grande Sub-basin Monitoring Stations and Permitted Dischargers

Segment 2314: Rio Grande above International Dam

The Rio Grande extends for 21 river miles (34 km) from the New Mexico-Texas state line downstream to the International Dam in El Paso County. The amount of water available in the river depends largely on the needs of water rights holders as a majority of stream flow is contractually delivered between March and October. Water diversion for irrigation use in the U.S. occurs at the American Diversion Dam that enters the Rio Grande American Canal Extension (RGACE) and then to far west Texas. Approximately 2 miles (3 km) downstream, water delivery for agricultural use exits to the Juárez Valley in Mexico at the International Diversion Dam. The designated uses for this river segment include high aquatic life, public water supply, fish consumption, and PCR. **Segment 2314** is not attaining its designated use due to bacteria impairment. Primary impacts are from CAFOs, irrigated agriculture, some industry, and municipal wastewater treatment plant effluent. There is a concern for high chlorophyll-*a* values, largely created by large and dense phytoplankton blooms. Parameter assessments for the TCEQ 2012 Integrated Report were made from 4 monitoring stations in **Segment 2314** (see Table 2). A total of 25 parameters among **Stations 13272, 17040, and 13276** (see Figure 3) were analyzed for parameter trends along this segment. Significant trends were noted for nitrates, chlorophyll-*a*, and *E. coli*. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-1).

Table 2. Water Bodies Evaluated by TCEQ along Segment 2314

Rio Grande Above International Dam					
Water Body Name and Location	**Water Body ID**	**ID**	**Parameter**	**Designated Use**	**2012 Status**
From the International Dam upstream to the Anthony Drain confluence	2314_01	13272 13275 17040	*E. coli*	Recreation	***Impairment***
			Chlorophyll-*a*	General	Concern
From the Anthony Drain confluence upstream to the New Mexico/Texas state line	2314_02	13276	Chlorophyll-*a*	General	Concern

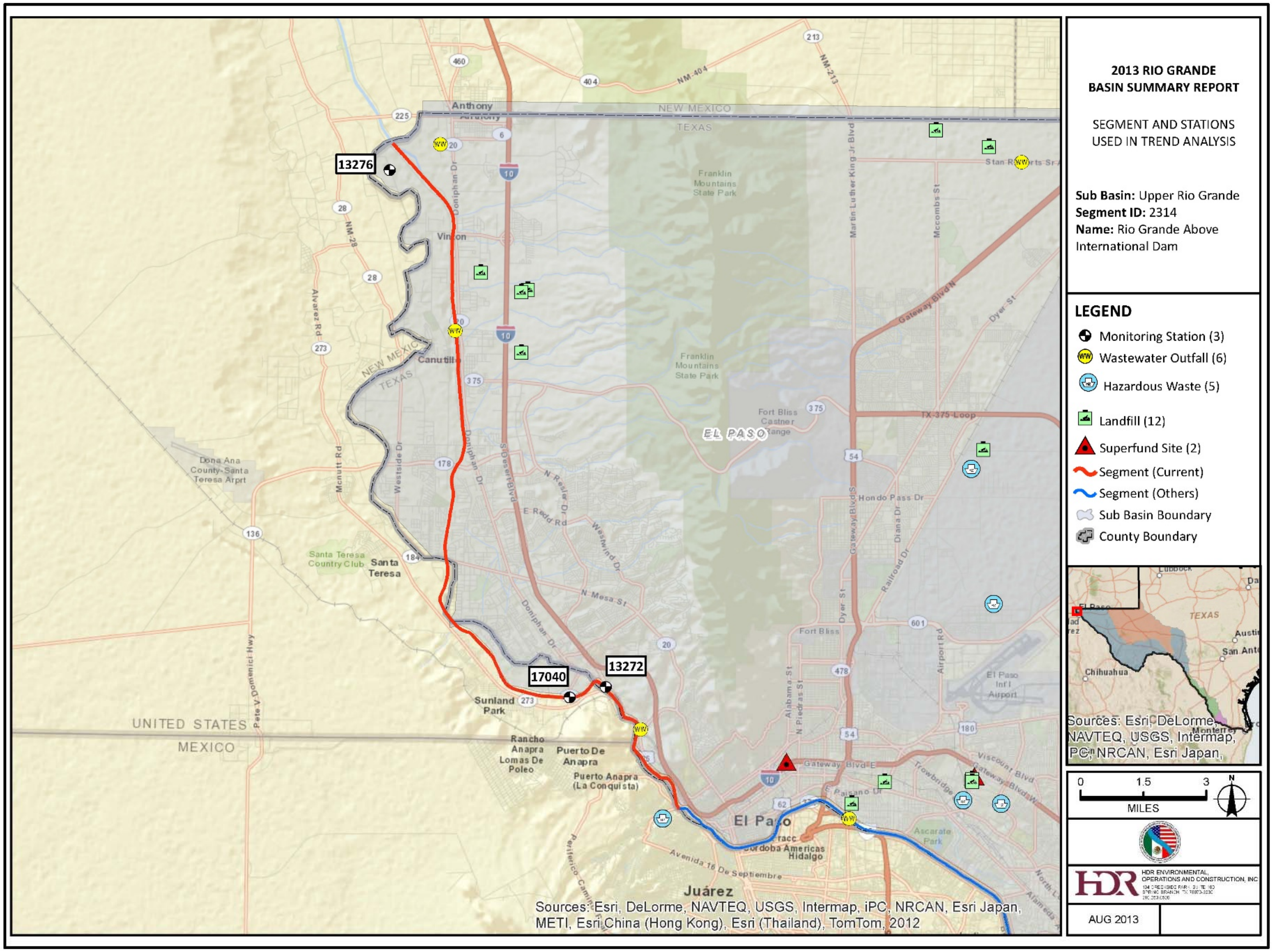


Figure 3. Monitoring Stations along Segment 2314

Assessment Unit 2314_01 is monitored at three stations with the bulk of the collected data available for trend analysis being found at **Station 13272**. The 2012 assessment for this AU continues to show impairment for elevated bacteria levels and a concern for chlorophyll-*a*. **Station 13272** is located on the Rio Grande at the Courchesne Bridge. This site historically has shown increased bacterial levels as the river here is the receiving water for the majority of localized irrigation returns and wastewater discharge. Upstream enhancements to wastewater infrastructure, as noted in 2008,[6] appear to have contributed toward the reduction of bacteria levels in surface samples collected from this area. A statistically decreasing trend for *E. coli* concentrations at **Station 13272** supports this observation as shown in Figure 4.

The Rio Grande at the Courchesne Bridge
Station 13272 in Assessment Unit 2314_01

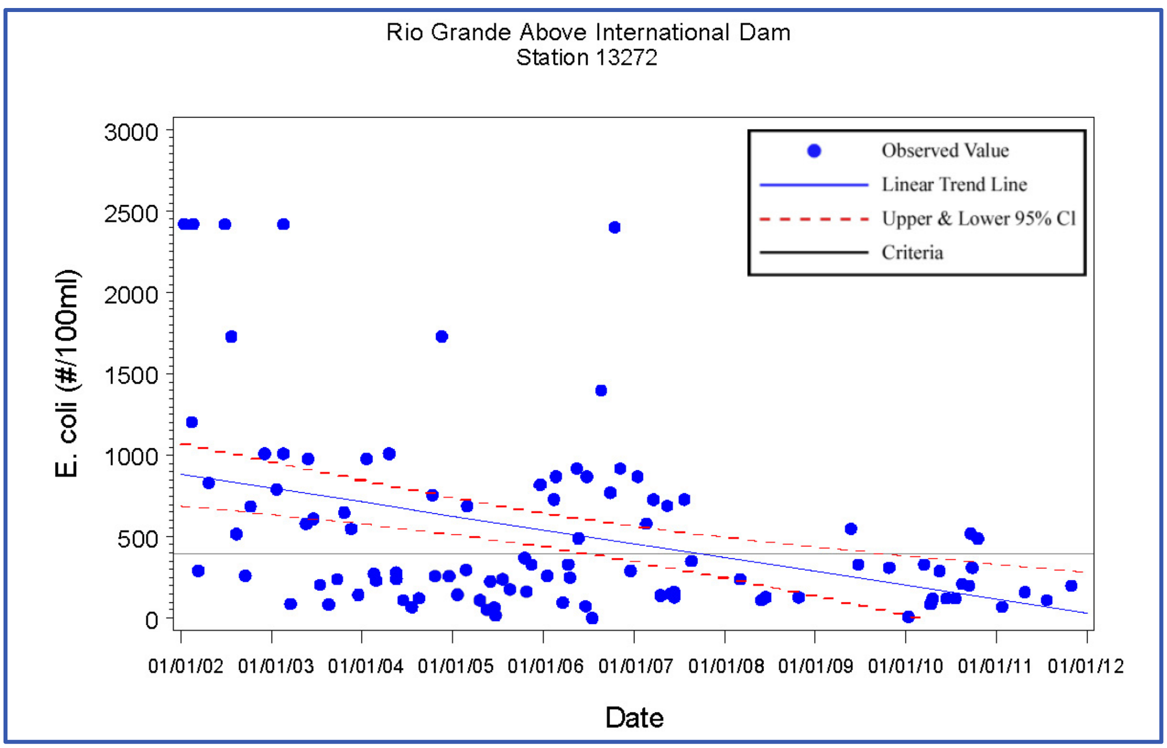


Figure 4. Decreasing *E. coli* Trend at Station 13272

[6] International Boundary and Water Commission, United States Section. 2008. Regional assessment of water quality in the Rio Grande, 2008. Texas Clean Rivers Program.

Although chlorophyll-*a* is identified as a concern, the trend is gradually decreasing (see Figure 5) possibly due also to the 2008 wastewater infrastructure improvements referenced above. The average value of 20.8 µg/L is above the screening level of 14.1 µg/L and the median at 13.0 µg/L is slightly below the screening level. Due to the inadequate data at **Stations 13275** and **17040** no trend analysis was performed. **Station 13275** is located on the Rio Grande near the Vinton Bridge approximately 2.5 miles (4 km) south of Anthony, Texas. **Station 17040** is located on the Rio Grande at the Anapra Bridge, which is 2.6 miles (4.2 km) upstream of the American Dam in New Mexico.

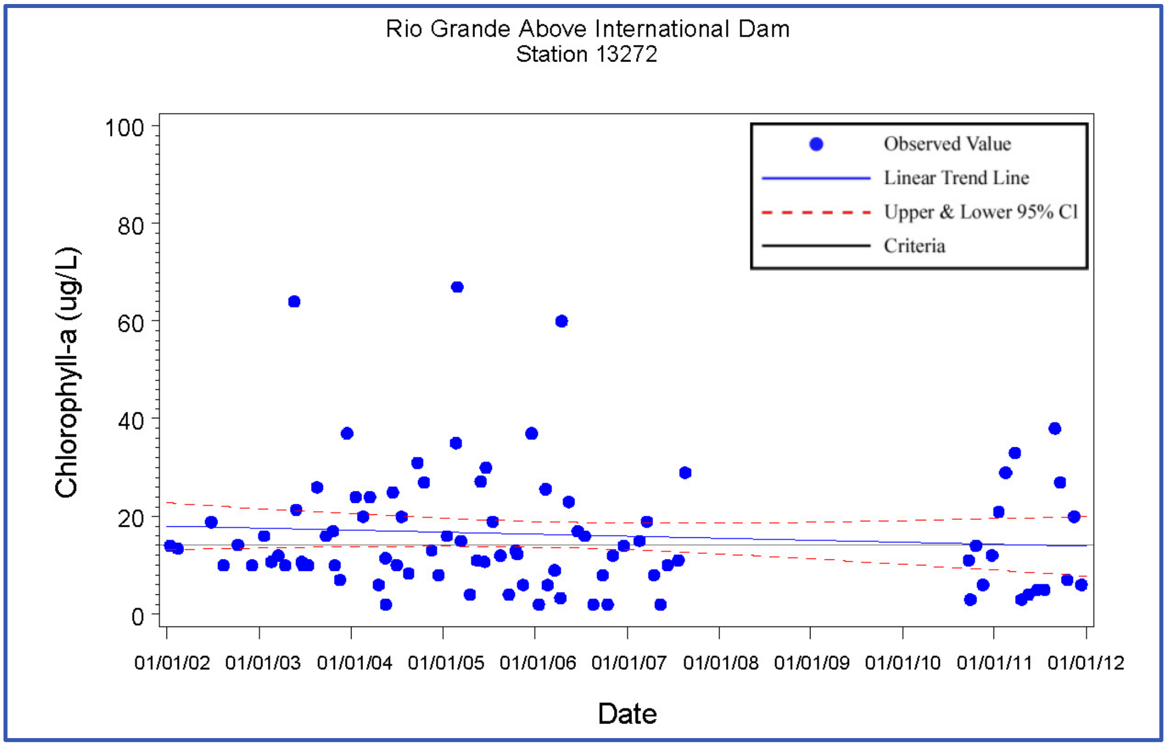


Figure 5. Decreasing Chlorophyll-*a* Trend at Station 13272

Flow variations appear to have no effect on the E. *coli* concentrations as demonstrated by the relatively flat trend line shown on the graph in Figure 6.

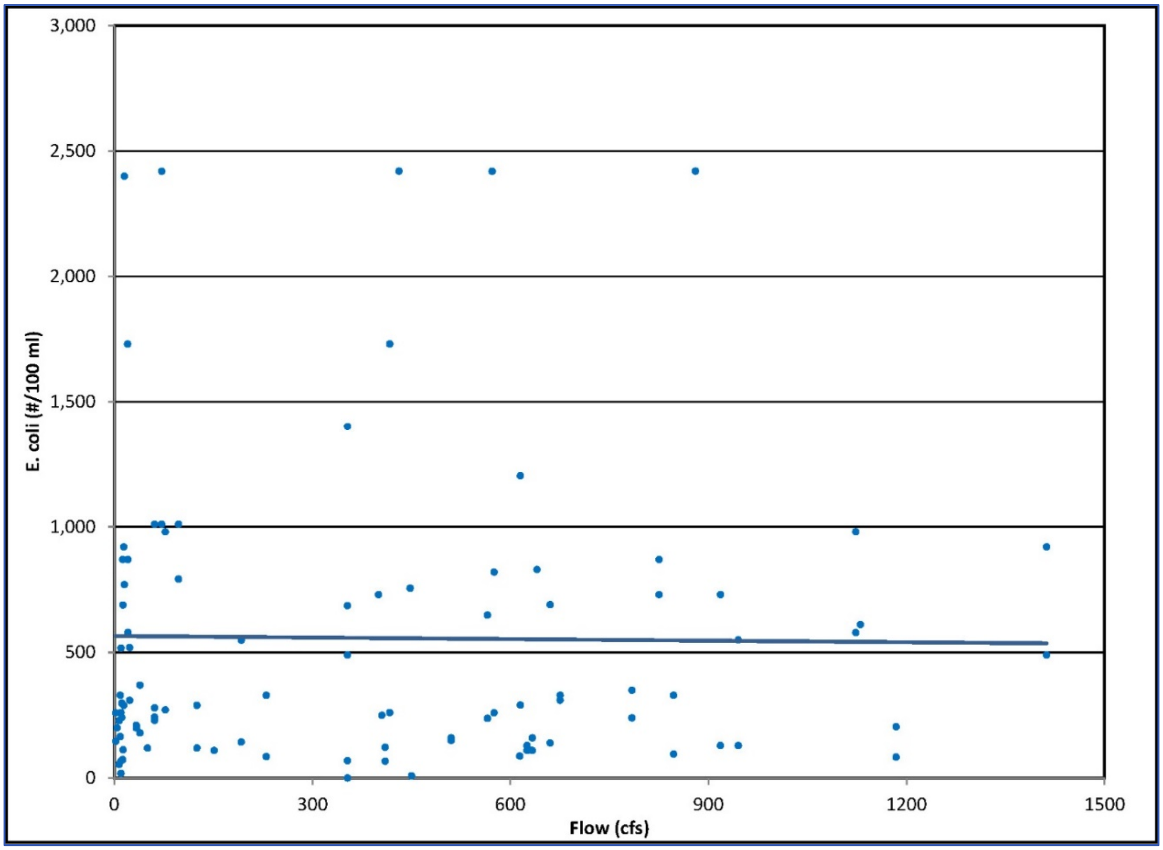


Figure 6. ***E. coli*** **vs Flow at Station 13272**

Assessment Unit 2314_02 at **Station 13276** is in the uppermost portion of **Segment 2314** upstream of the East Drain located near the City of Anthony wastewater outfall. This area is currently meeting the water quality criteria for all designated uses except for a concern for chlorophyll-*a*, an indicator of algal biomass. The presence of elevated concentrations of chlorophyll-*a* in the river could be associated with algae present in the treated wastewater discharge, or from algal growth in the river, or a combination of both. Ammonia nitrogen (see Figure 7) showed an upward trend suggesting that the algal community has sufficient nutrients for growth and a potential impact of the wastewater on phytoplankton photosynthesis.

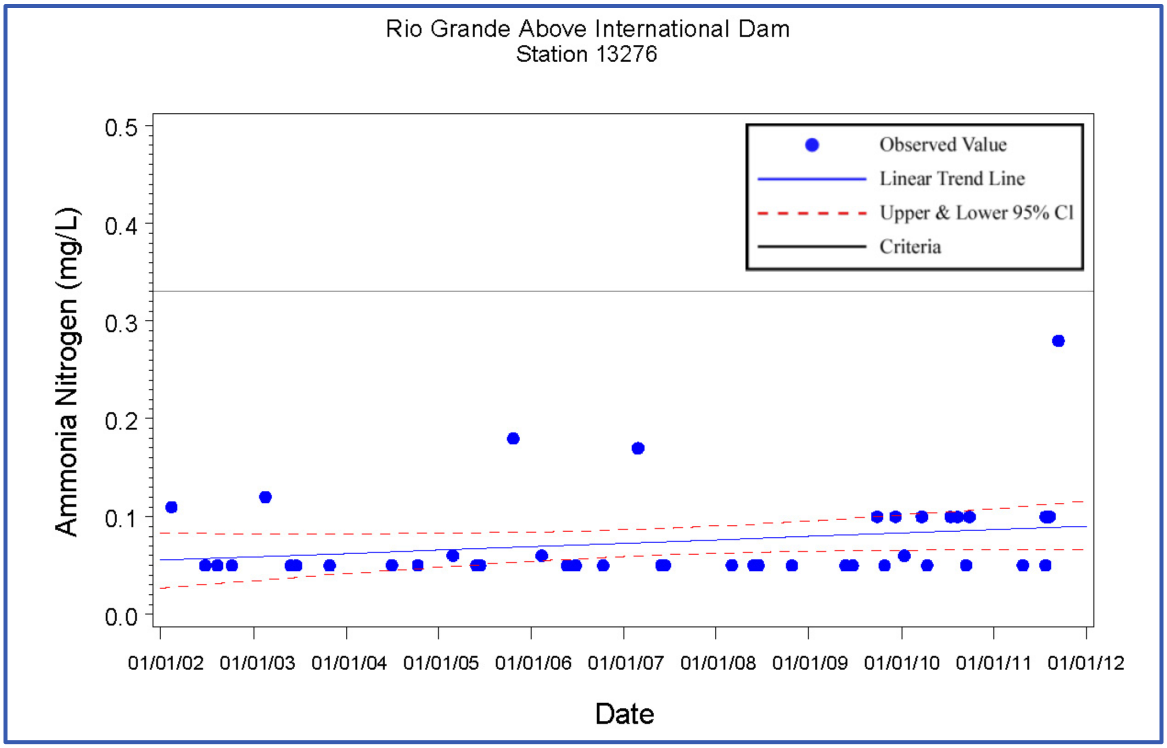


Figure 7. Increasing Ammonia Nitrogen Trend at Station 13276

Segment 2308: Rio Grande below International Dam

Segment 2308 is defined as the river in El Paso County from the Riverside Diversion Dam to the International Dam, which runs for 15 miles (24 km) through El Paso and Ciudad Juárez. Because of water diversions upstream in **Segment 2314**, this section of river channel rarely contains water and should be considered for reclassification as intermittent. Wastewater effluent is released into the RGACE which carries water to the American Diversion Dam to Riverside Canal to the lower El Paso Valley as part of the City of El Paso's drinking water supply. This has caused the Rio Grande in this area to be dry most of the time and is essentially intermittent in nature with the emergence of water periodically from storm waters and seepage past the diversion dam.

Because a portion of the river channel within this segment is concrete-lined with access blocked by fencing, the area has been assigned with a noncontact recreation designation. The artificial channel was built to prevent meandering of the international boundary and is usually dry except immediately during and after rainfall events. This section currently meets all of its non-recreation use standards, which are less stringent than the other segments. Other designated uses are a limited aquatic life and general use. There are general use concerns for nutrients (phosphorus, nitrate, and chlorophyll-*a*), probably from urban runoff. There are three established TCEQ stations along this AU (see Table 3). A total of 24 parameters among 3 stations (see Figure 8) were analyzed for trends along this segment where *E. coli* showed a statistically significant trend upstream and downstream of a wastewater outfall. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-3).

Table 3. Water Bodies Evaluated by TCEQ along Segment 2308

Rio Grande Below International Dam					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
From the Riverside Diversion Dam to the International Dam in El Paso County	2308_01	15529 15528 14465	Chlorophyll-*a*	General	Concern
			Total Phosphorus		
			Ortho-Phosphorus		
			Nitrate		

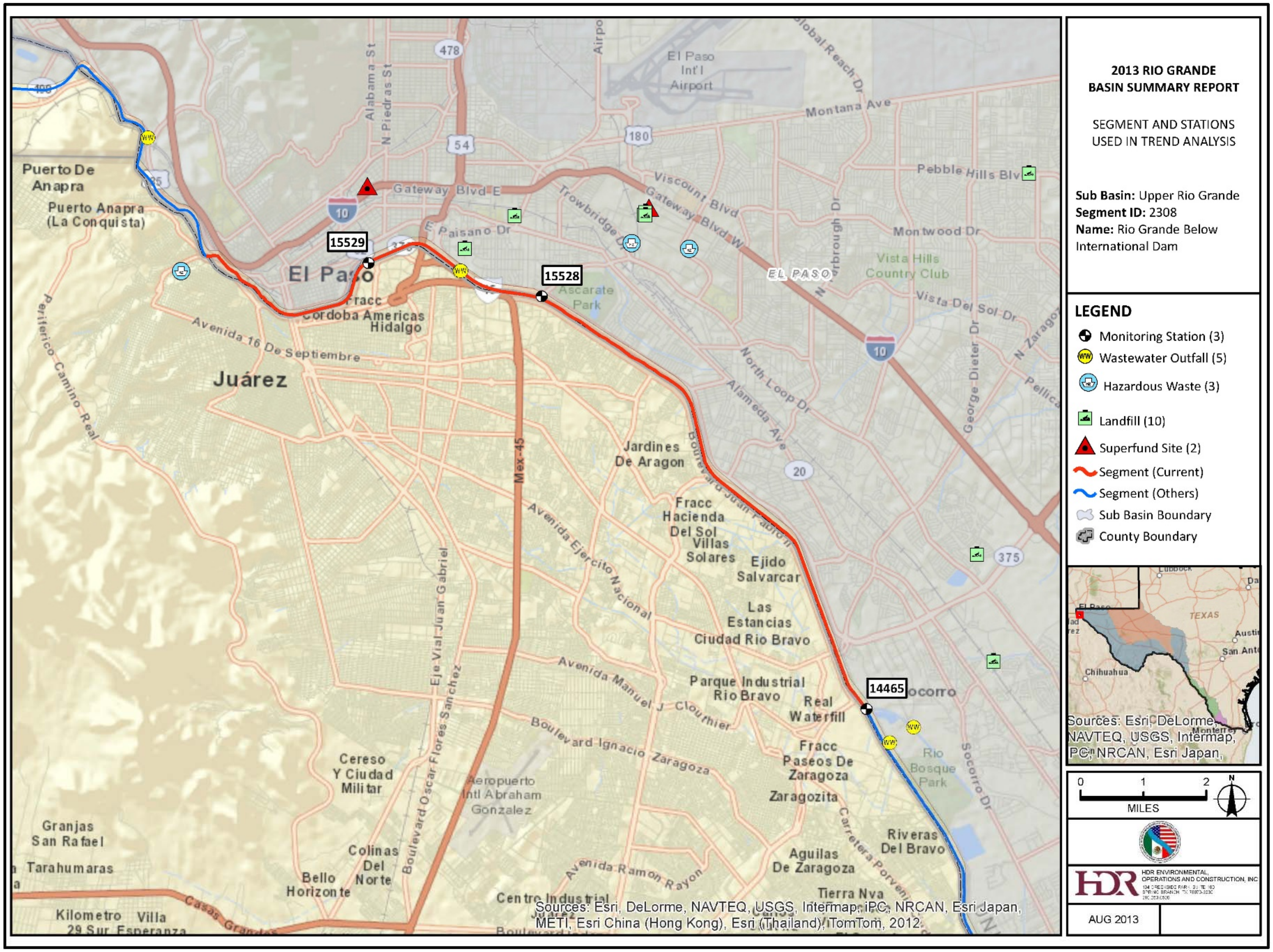


Figure 8. Monitoring Stations along Segment 2308

Assessment Unit 2308_01 includes the following three monitoring locations in an area of minimal flow due to water diversion. **Station 15529** is on the Rio Grande 1.5 miles (2.4 km) upstream from the Haskell R. Street WWTP outfall and south of the Bowie High School football stadium in El Paso. Sampling is located within the concrete-lined portion of the river upstream of the Haskell R. Street WWTP. The majority of flow is seepage from the International Dam and occasional releases from the RGACE diversion structure located upstream. **Station 15528**, located on the Rio Grande 0.8 miles (1.3 km) downstream from the Haskell R. Street WWTP outfall, is very similar to the concrete-lined habitat represented at **Station 15529**. This area receives minimal flow where the river is mostly dominated by effluent as water continues to be diverted away from this location by the RGACE. Both of these locations showed an upward trend for *E. coli* (see Figures 9 and 10).

The Rio Grande Upstream of the Haskell R. Street WWTP Station 15529 in Assessment Unit 2308_01

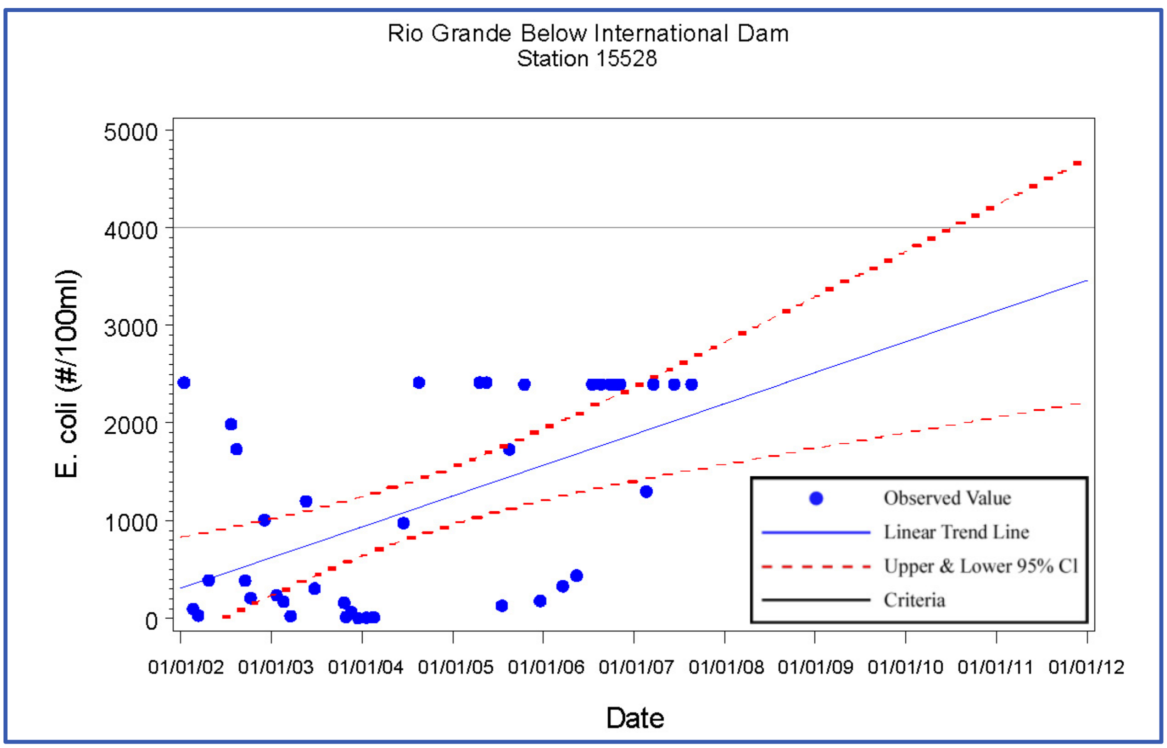


Figure 9. Increasing *E. coli* Trend at Station 15528

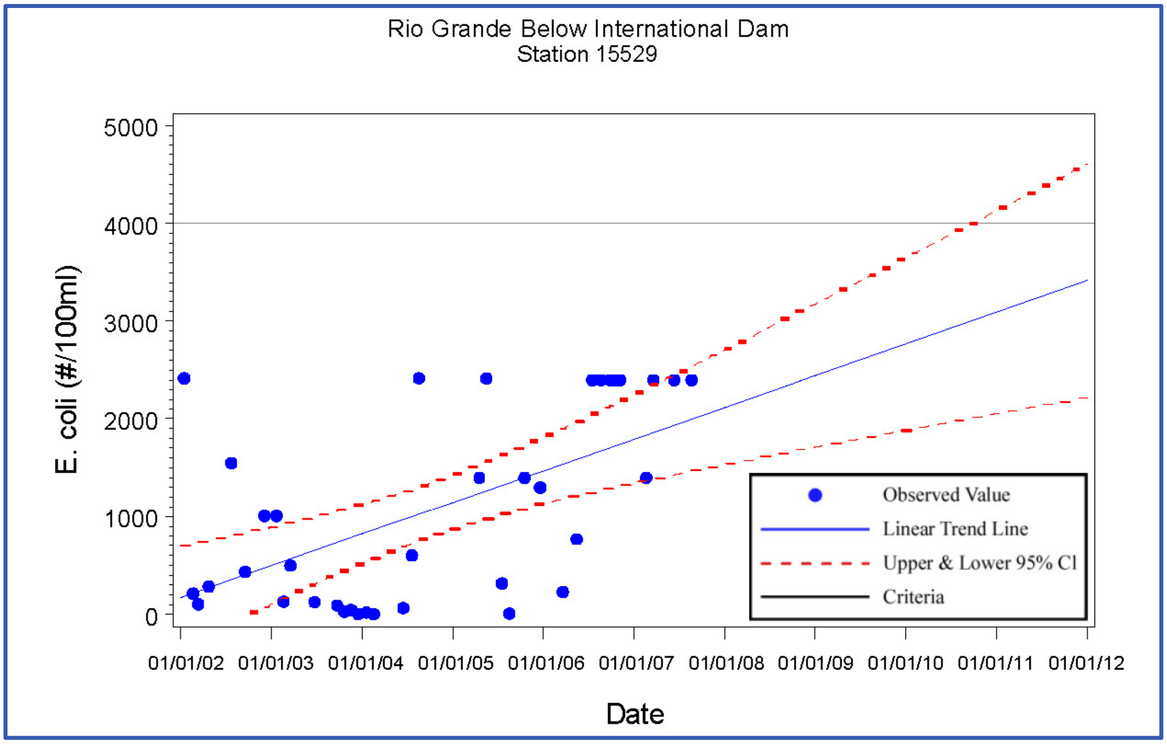


Figure 10. Increasing *E. coli* Trend at Station 15529

Potential instream bacteria concentrations at both locations could result from urban nonpoint sources associated with rainfall events and possibly from ineffective wastewater treatment at **Station 15528**. The most likely cause contributing to the concern for total phosphorus, ortho-phosphorus, nitrate, and chlorophyll-*a* is point source municipal discharges from the Haskell R. Street WWTP and periodic storm water runoff. None of these three parameters showed any statistically significant trends. The **Station 14465** is found on the Rio Grande at the Riverside Canal 1.1 miles (1.8 km) downstream of the Zaragosa International Bridge. This site is located downstream of the concrete channel but water continues to be diverted away from this portion of river by the RGACE.

Segment 2307: Rio Grande below Riverside Diversion Dam

Segment 2307 extends from below Riverside Diversion Dam in El Paso County 222 river miles (357 km) downstream to the confluence with the Rio Conchos (Mexico) in Presidio County (see Figure 11). This portion of the Rio Grande is designated for PCR, public water supply, high aquatic life use, and fish consumption. The general uses and contact PCR were not fully supported throughout this reach due to high TDS, chloride, and high bacteria levels. The portion of the Rio Grande extending downstream from Riverside Diversion Dam to Little Box Canyon has been identified as having concerns for chlorophyll-*a*,

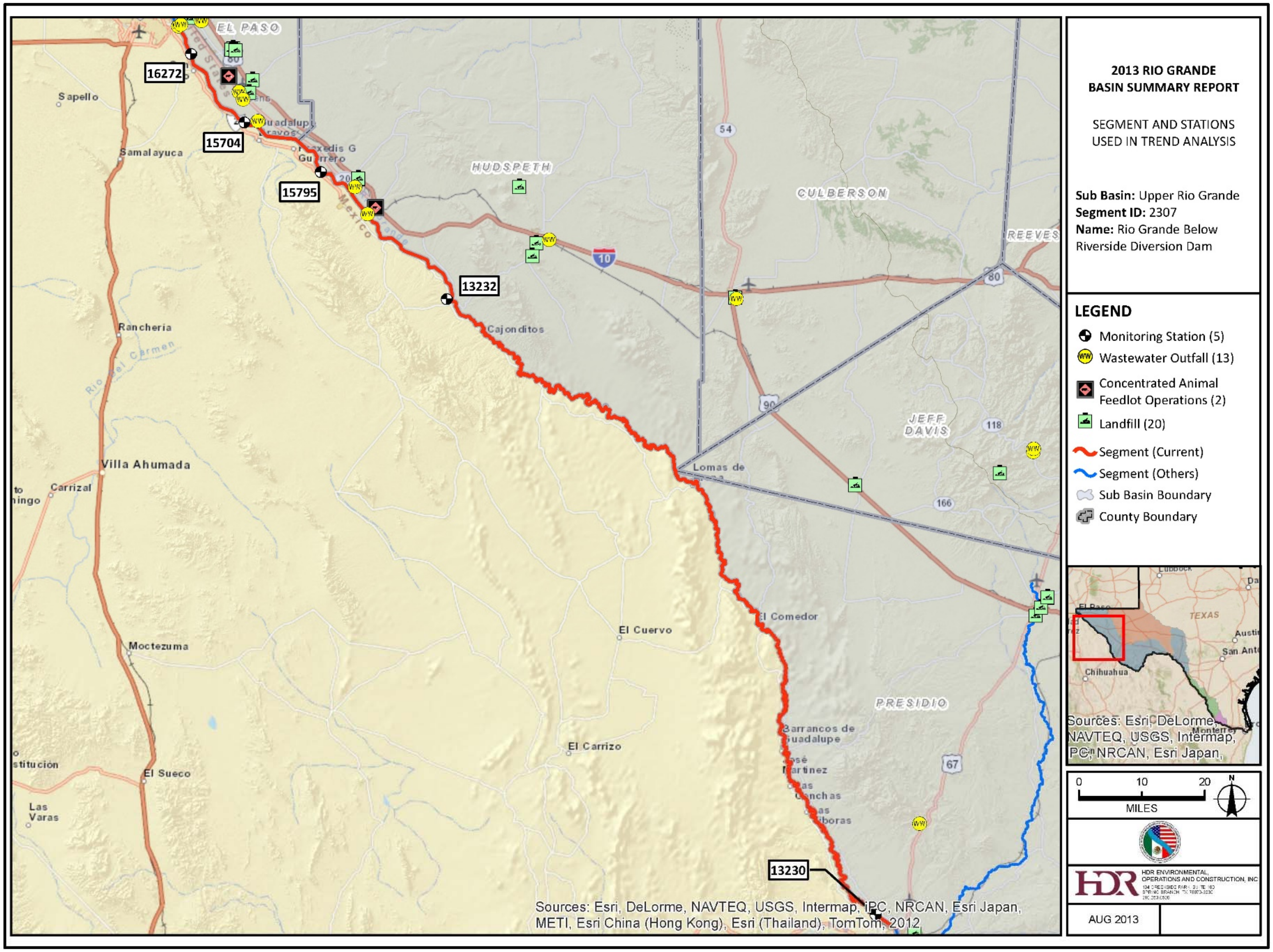


Figure 11. Monitoring Stations along Segment 2307

ammonia, nitrate nitrogen, ortho-phosphorus, and total phosphorous. There are nine monitoring stations among 5 AUs in this segment that were evaluated by TCEQ for the 2012 Integrated Report (see Table 4). A total of 29 parameters from five stations (see Figure 11) were analyzed for trends along this segment. Analyses of phosphorus, TDS, and chlorophyll-*a* all showed significant statistical trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (starting on page E-5).

Table 4. Water Bodies Evaluated by TCEQ along Segment 2307

<table>
<tr><th colspan="6">Rio Grande Below Riverside Diversion Dam</th></tr>
<tr><th>Water Body Name and Location</th><th>Water Body ID</th><th>Assessment Station ID</th><th>Parameter</th><th>Designated Use</th><th>2012 Status</th></tr>
<tr><td rowspan="3">From immediately upstream of the Rio Conchos confluence to a point 40.2 km (25 miles) upstream</td><td rowspan="3">2307_01</td><td rowspan="3">13230
13231</td><td>Chloride</td><td rowspan="2">General</td><td rowspan="2">Impairment</td></tr>
<tr><td>TDS</td></tr>
<tr><td>Chlorophyll-a</td><td>General</td><td>Concern</td></tr>
<tr><td rowspan="3">From a point 40.2 km (25 miles) upstream of the Rio Conchos confluence to Little Box Canyon</td><td rowspan="3">2307_02</td><td rowspan="3">20648</td><td>Chloride</td><td rowspan="2">General</td><td rowspan="2">Impairment</td></tr>
<tr><td>TDS</td></tr>
<tr><td>Chlorophyll-a</td><td>General</td><td>Concern</td></tr>
<tr><td rowspan="7">From Little Box Canyon upstream to the Alamo Grade Structure</td><td rowspan="7">2307_03</td><td rowspan="7">17408
13232
13233</td><td>E. coli Bacteria</td><td>Recreation</td><td rowspan="3">Impairment</td></tr>
<tr><td>Chloride</td><td rowspan="2">General</td></tr>
<tr><td>TDS</td></tr>
<tr><td>Chlorophyll-a</td><td rowspan="4">General</td><td rowspan="4">Concern</td></tr>
<tr><td>Total Phosphorus</td></tr>
<tr><td>Ortho-Phosphorus</td></tr>
<tr><td>Ammonia</td></tr>
<tr><td rowspan="9">From the Alamo Grade Structure upstream to the Guadalupe Bridge</td><td rowspan="9">2307_04</td><td rowspan="9">15795</td><td>E. coli Bacteria</td><td>Recreation</td><td rowspan="3">Impairment</td></tr>
<tr><td>Chloride</td><td rowspan="2">General</td></tr>
<tr><td>TDS</td></tr>
<tr><td>DO grab</td><td>Aquatic Life</td><td rowspan="6">Concern</td></tr>
<tr><td>Chlorophyll-a</td><td rowspan="5">General</td></tr>
<tr><td>Total Phosphorus</td></tr>
<tr><td>Ortho-Phosphorus</td></tr>
<tr><td>Nitrate</td></tr>
<tr><td>Ammonia</td></tr>
<tr><td rowspan="8">From the Guadalupe Bridge to downstream of the Riverside Diversion Dam</td><td rowspan="8">2307_05</td><td rowspan="8">15704
16272</td><td>E. coli Bacteria</td><td>Recreation</td><td rowspan="3">Impairment</td></tr>
<tr><td>Chloride</td><td rowspan="2">General</td></tr>
<tr><td>TDS</td></tr>
<tr><td>Chlorophyll-a</td><td rowspan="5">General</td><td rowspan="5">Concern</td></tr>
<tr><td>Total Phosphorus</td></tr>
<tr><td>Ortho-Phosphorus</td></tr>
<tr><td>Nitrate</td></tr>
<tr><td>Ammonia</td></tr>
</table>

The stream flow within the entire length of **Segment 2307** is composed mostly of irrigation flow returns, wastewater discharge, and some groundwater seepage that all contribute to potential elevated levels of TDS, chloride, nutrients, and bacteria. Effluent from two major WWTPs in Ciudad Juárez is mixed with untreated sewage collected southeast of the South Plant[7] and diverted to the Juárez Valley and blended with river and well water for farmland irrigation use. All return flows are diverted back to the Rio Grande near Fort Quitman. Since the current discharge quality from Ciudad Juárez is inadequate for direct river discharge, both of these facilities would need to be upgraded to secondary treatment. Additionally, an approximately 200-mile (322-km) length of river channel downstream of the El Paso Valley extending from Fort Quitman to the Rio Conchos confluence near Presidio is known as the Forgotten River reach. This area has been altered by intense upstream hydraulic modifications significantly reducing river flows with a progressive aggradation of the channel. Only a small amount of water from the upper Rio Grande Basin actually flows below Fort Quitman and is primarily the result of local summer rainfall runoff and industrial and municipal wastewater effluent discharges in the El Paso/Ciudad Juárez area. Fluctuating flow conditions affect water quality by increasing dissolved solids, nutrients, bacteria, and low DO levels due to flow alterations from upstream diversions, irrigated crop production, nonpoint sources, and natural causes. Recurrent bacterial contamination can be attributed to local rural runoff during drought and from urban runoff and municipal discharges during high-flow events.

Assessment Unit 2307_01 is monitored at two stations: **Station 13230** located on the Rio Grande 2.4 miles (3.4 km) upstream from the Rio Conchos confluence and **Station 13231** located on the Rio Grande 6.4 miles (10.2 km) upstream from the Rio Conchos confluence. In 2008, this section of the river was reported as impaired for TDS and chloride and identified as a concern with elevated amounts of chlorophyll-*a*. The samples collected for the 2012 assessment continue to support impairments for chloride and TDS, currently listed as 5c, and indicate that additional data and information will be collected before a TMDL is scheduled. Trend analysis for total phosphorus at the most downstream **Station 13230** showed a downward trend (see Figure 12). Greater flow at this station appears to have a diluting effect on the total phosphorus concentrations as demonstrated by decreasing concentrations with increasing flows (see Figure 13).

The Rio Grande Upstream of the Rio Conchos Confluence Station 13230 in Assessment Unit 2307_01

[7] Turner, C.C. Rio Grande/Rio Bravo restoration through El Paso/Ciudad Juárez. Project Number NR-05-02. University of Texas at El Paso.

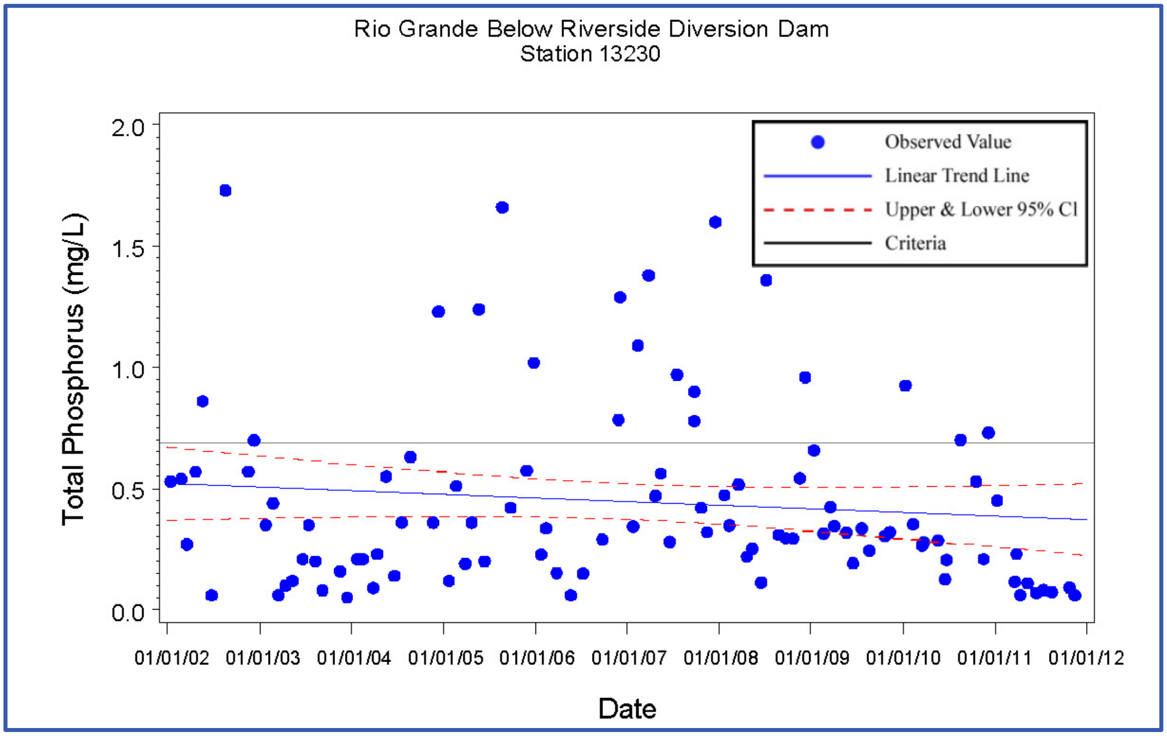


Figure 12. Decreasing Total Phosphorus Trend at Station 13230

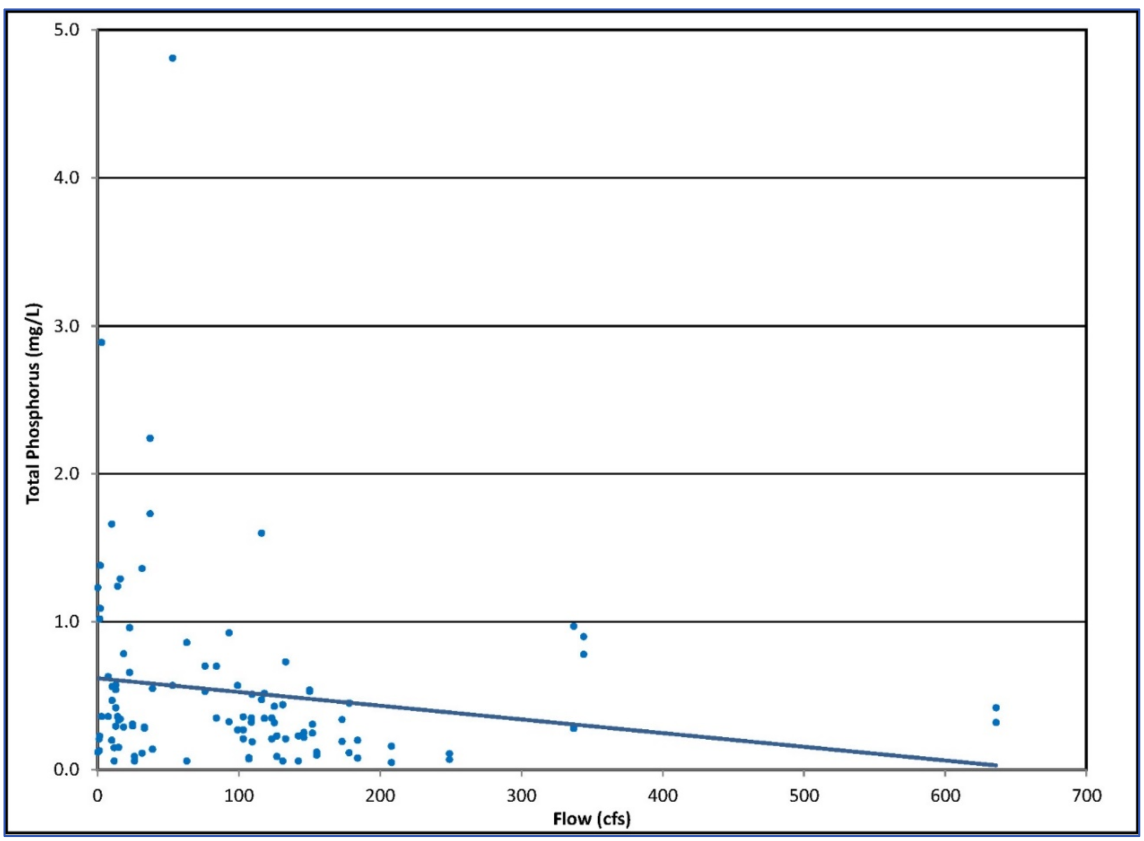


Figure 13. Total Phosphorus vs Flow at Station 13230

Based on the 2012 assessment period, **Assessment Unit 2307_02** has impairments for chloride and TDS and a general use concern for chlorophyll-*a*. **Station 20648** is located on the Rio Grande 0.9 miles (1.47 km) upstream of the confluence with the Green River at Indio Mountain Research Station. Trend analysis was not performed at this location due to inadequate data.

Assessment Unit 2307_03, monitored at three locations, is listed as impaired due to bacteria, TDS, and chlorides. These impairments are classified as 5c, meaning that additional data and information will be collected before a TMDL is scheduled. Parameters identified as having a concern include ammonia, chlorophyll-*a*, and phosphorus. **Station 17408** is located on the Rio Grande at Little Box Canyon downstream of Fort Quitman. **Station 13232** is established on the Rio Grande at Neely, south of Fort Quitman. This area receives highly saline water from a combination of irrigation return flows and wastewater discharges from urban areas from both countries that empty into agricultural drains. This site continues to exhibit non-attainment of TDS and chloride and repeated high bacteria levels have failed to meet standards compliance. **Station 13233** is located on the Rio Grande at Foster Ranch. Trend analysis was not performed at this location due to inadequate data.

Assessment Unit 2307_04 at Station 15795 is located at the Alamo Grade Control Structure, 6 miles (9.7 km) upstream of the Fort Hancock port-of-entry. This location is currently on the 2012 Index of Water Quality Impairments list for TDS, chloride, and *E. coli* with screening level concerns for ammonia, nitrate, chlorophyll-*a*, grab DO, and phosphorus. The Rio Grande at this point begins to become more heavily influenced by irrigation and wastewater return flows from each nation. Collectively, inadequate municipal treatment and the lack of phosphorus restrictions present difficulties in the capability to remove nutrients. Several parameters including DO, chloride, sulfate, and TDS were analyzed at this location but no significant trends were detected.

Assessment Unit 2307_05 is monitored at two TCEQ stations: **Stations 15704** and **16272**. Both locations at the uppermost portion of **Segment 2307** are listed as impaired for TDS and chloride general use standards and bacteria for PCR use. Since 2008, concerns have expanded from ammonia to include nitrate, phosphorus, and chlorophyll-*a* in 2012. At **Station 16272** located on the Rio Grande at San Elizario, 1,640 feet (500 meters) upstream of Capomo Road and 6.3 miles (10.2 km) downstream of the Zaragosa International Bridge, TDS and chloride showed a downward trend (see Figures 14 and 15). Mexico does not ban phosphorus in their cleaning products; therefore nutrient-laden water returns to the river. Agricultural runoff in this area also introduces nutrients and dissolved solids into the river and could affect the entire segment. No significant trends were found at **Station 15704** located on the Rio Grande at the Guadalupe port-of-entry bridge at FM 1109 west of Tornillo, Texas.

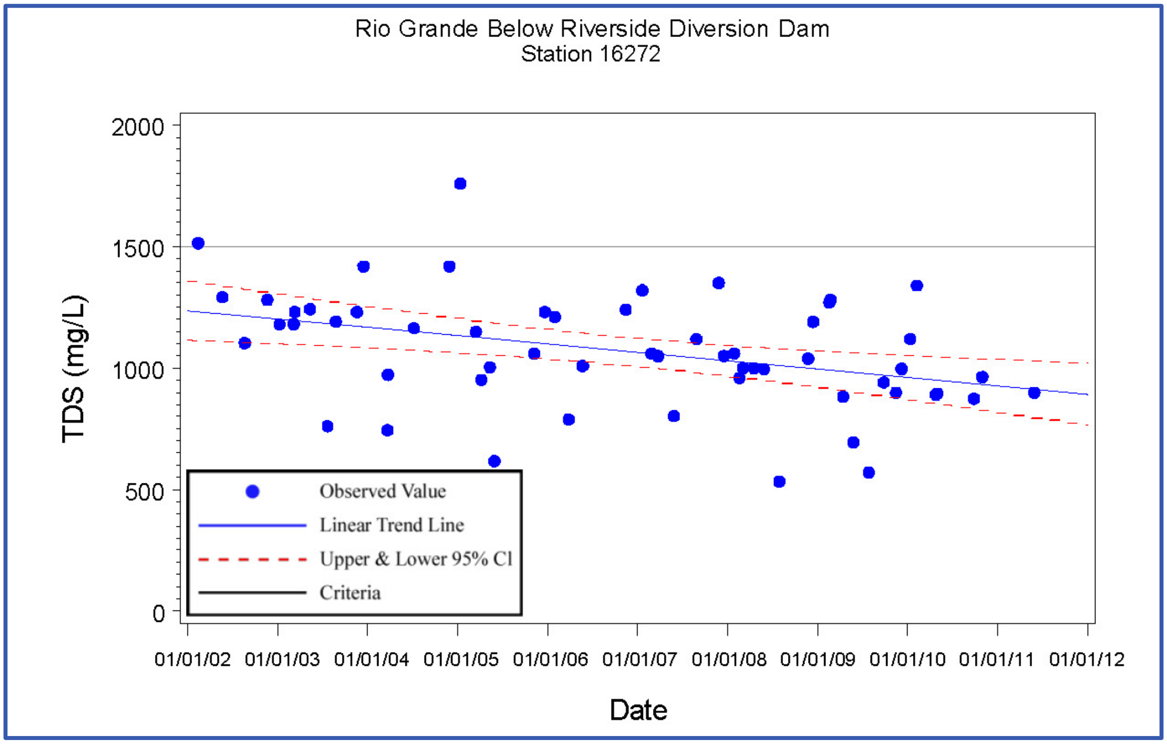


Figure 14. Decreasing TDS Trend at Station 16272

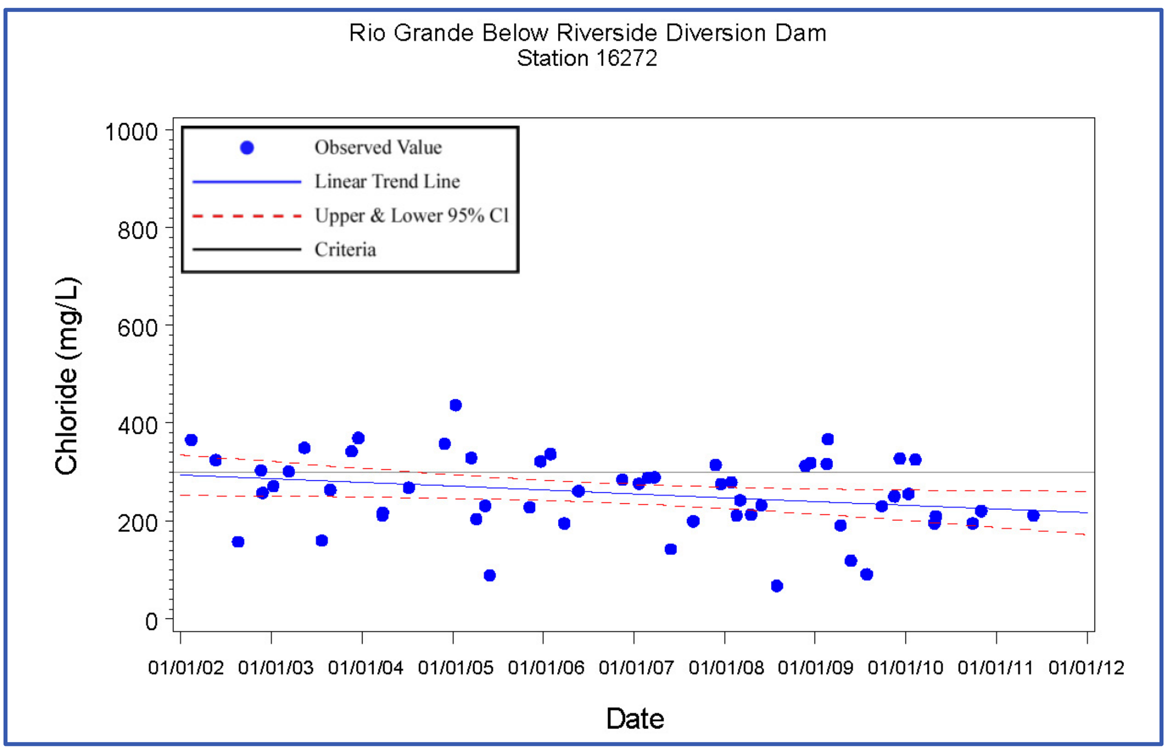


Figure 15. Decreasing Chloride Trend at Station 16272

Segment 2306: Rio Grande above International Amistad Dam

Segment 2306, approximately 313 river miles (503 km) long, begins just downstream of the confluence with the Rio Conchos (Mexico) in Presidio County, traverses through the Big Bend Ranch State Park and Big Bend National Park, and ends at a point 1.1 miles (1.8 km) downstream of the confluence of Ramsey Canyon in Val Verde County and upstream of the International Amistad Reservoir. Due to the extensive network of water diversions and dams controlling flow upstream, a high percentage of water in the Rio Grande downstream of Presidio is being supplied by the Mexican Rio Conchos. Large and small communities use the river for farming and ranching.

Because of decreasing freshwater inflows from the Rio Conchos, increasing dissolved solids (also expressed as salinity) in the river are becoming more problematic for native plant and wildlife species. Saltcedar is a major fire hazard along the Rio Grande riparian corridor where large monoculture stands have formed upstream of Presidio, Texas, displacing native species of cottonwood and willow. Additionally, elevated levels of *E. coli* have been measured during high-flow events commonly followed by fish die-offs and the development of algal blooms. Higher salinities and the occurrence and distribution of nutrients in the Rio Grande could play a central role in the development of toxic algal blooms.

The designated uses assigned to this segment are high aquatic life, PCR, fish consumption, and public water supply. The TCEQ's 2012 Integrated Report identifies several AUs of **Segment 2306** that do not meet the general use designation due to elevated levels of TDS, chloride, and sulfate. There are 29 established monitoring stations within this very long river segment (see Table 5). The river is monitored for heavy metals including silver, chromium, aluminum, and lead. A total of 27 parameters among 10 stations (see Figure 16) were analyzed for trends along this segment. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-9).

The nutrients, phosphorus, and nitrogen, along with several metals including lead, arsenic, chromium, copper, and silver showed statistically significant trends. Upward trends were identified for ammonia, Total Kjeldahl Nitrogen (TKN), and lead. Downward trends were identified for silver and chromium.

Table 5. Water Bodies Evaluated by TCEQ along Segment 2306

Rio Grande Above International Amistad Reservoir and Alamito Creek (unclassified water body)					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Rio Grande from the lower segment boundary at Ramsey Canyon upstream to the confluence of Panther Gulch	2306_01	13223 20182 20628 26031 20629 20632	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Total Phosphorus	General	Concern
Rio Grande from the confluence of Panther Gulch upstream to FM 2627	2306_02	20626 20625 20623	Chloride	General	***Impairment***
			Sulfate		
			TDS		
Rio Grande from FM 2627 upstream to Boquillas Canyon	2306_03	13225	Chloride		
			Sulfate		
			TDS		
			Chlorophyll-*a*	General	Concern
Rio Grande from Boquillas Canyon upstream to Mariscal Canyon	2306_04	20619 16730 18483 20199 18535	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Chlorophyll-*a*	General	Concern
			Fish Kill Report	Fish Consumption	
Rio Grande from Mariscal Canyon to a point upstream of the USIBWC gage at Johnson Ranch	2306_05	20616 13227	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Fish Kill Report	Fish Consumption	Concern
Rio Grande from a point upstream of the USIBWC gage at Johnson Ranch to the mouth of Santa Elena Canyon at the Terlingua Creek confluence.	2306_06	17621 18482 13228 16274 20671	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Chlorophyll-*a*	General	Concern
			Fish Kill Report	Fish Consumption	
Rio Grande from the Terlingua Creek confluence at Santa Elena Canyon upstream to the Alamito Creek confluence	2306_07	18441 16862 20615	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Fish Kill Report	Fish Consumption	Concern
Rio Grande from Alamito Creek confluence upstream to the Rio Conchos confluence	2306_08	13229 17000 17001	Chloride	General	***Impairment***
			Sulfate		
			TDS		
			Chlorophyll-*a*	General	Concern
Alamito Creek from confluence of the Rio Grande upstream to RR 169 crossing	2306A_01	13108	NO IMPAIRMENTS OR CONCERNS		

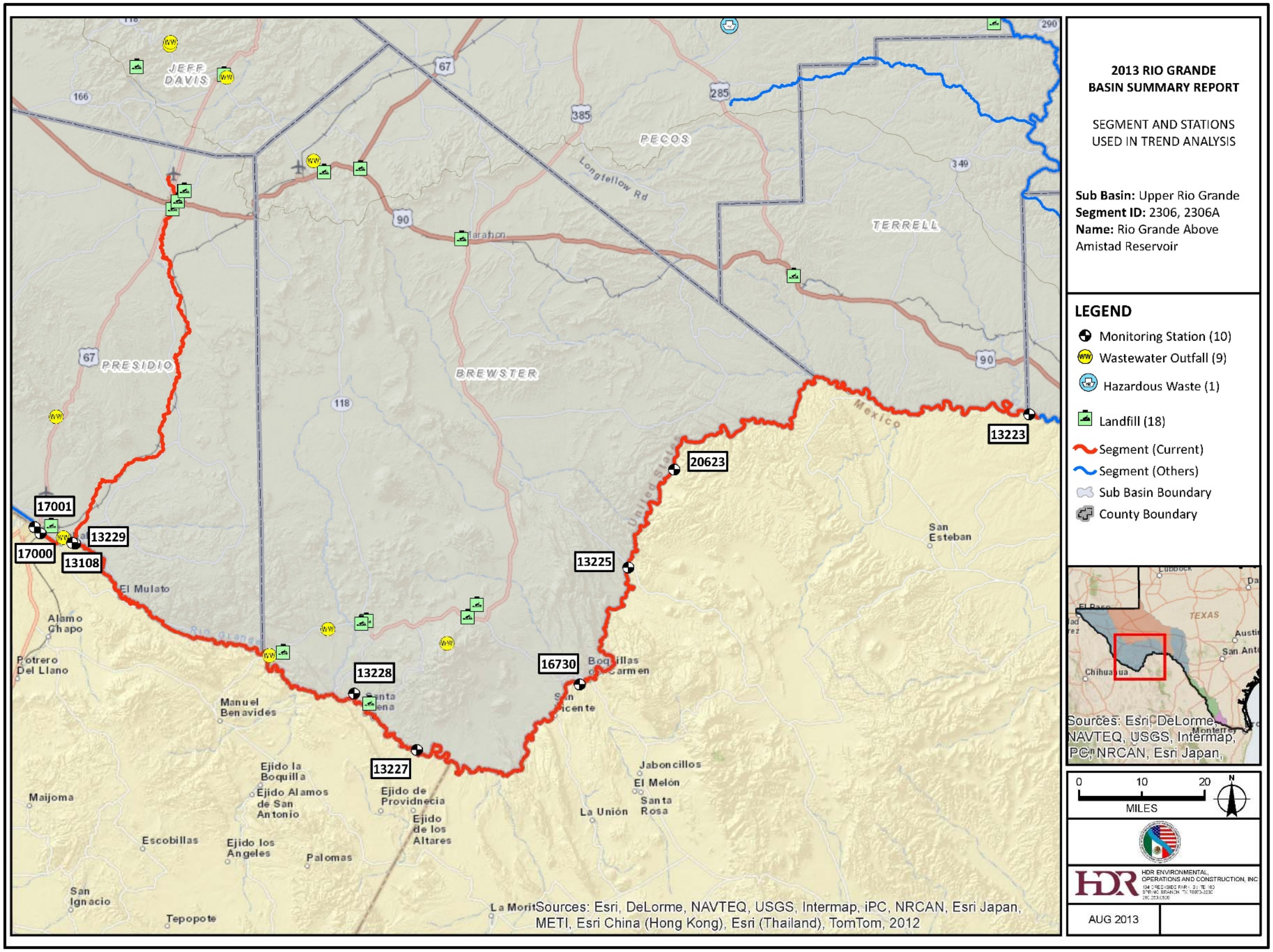


Figure 16. Monitoring Stations along Segment 2306

Assessment Unit 2306_01 is represented by six TCEQ-designated monitoring stations. All parameters assessed in the 2012 Texas IR shows impairment for dissolved solids and a screening level concern for total phosphorus. **Station 13223** is on the Rio Grande at Foster Ranch west of Langtry off U.S. Hwy 90. Lead concentrations showed an upward trend at **Station 13223** (see Figure 17). Runoff from several mining areas upstream of this location including the San Carlos Mine, Tres Marias Mine, and Boquillas Mine have the potential to contribute lead and other trace elements in flow and sediments to the Rio Grande.

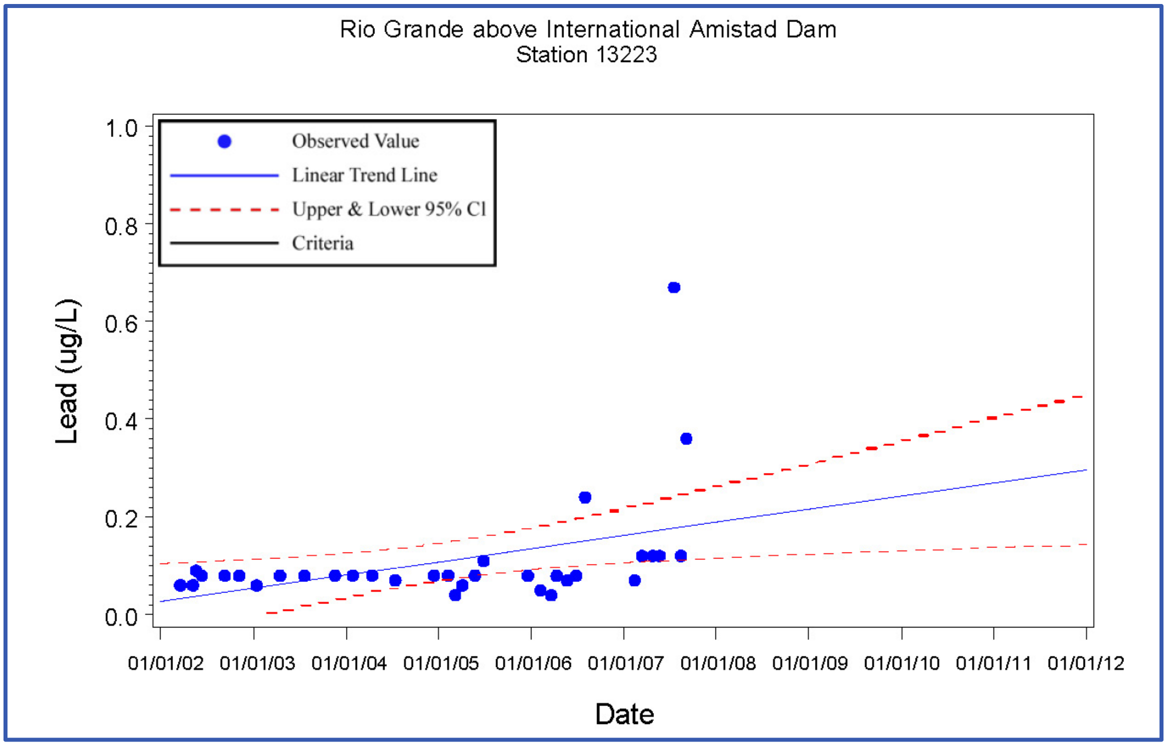


Figure 17. Increasing Lead Trend at Station 13223

Station 20182 is located on the Rio Grande, 2.2 miles (3.6 km) downstream from the confluence with Lozier Canyon Creek near Dryden, Texas. **Station 20628** is on the Rio Grande 0.8 miles (1.3 km) downstream of Bear Canyon and approximately 5.8 miles (9.3 km) downstream from Cook Creek in Terrell County. **Station 26031** is on the Rio Grande at the confluence with Indian Creek in Terrell County. **Station 20629** is on the Rio Grande 570 meters (1,871 feet) north and 605 meters (1,985 feet) west from the south end of Shafter Crossing Road and 1.2 miles (1.9 km) downstream from Britton Canyon in Terrell County. **Station 20632** is on the Rio Grande 4.7 miles (7.5 km) upstream from the confluence with San Francisco Creek in Brewster County.

Assessment Unit 2306_02 is represented by the three monitoring stations. The 2012 assessment of this AU also shows TDS/chloride/sulfate impairment based on adequate data and assessor judgment. These include **Station 20626** found downstream from Rodeo Rapids south of Sanderson in Brewster County, **Station 20625** on the river 164 feet (50 meters) upstream from Silber Canyon south of Sanderson in Brewster County, and **Station 20623** established at Taylors Farm southwest of Sanderson.

Assessment Unit 2306_03 at Station 13225 is on the Rio Grande at FM 2627 (Gerstacker Bridge) below Big Bend. Though no impairments or concerns for screening levels or near non-attainment were identified at this location, the lack of recent steady flows has possibly contributed to the 2012 listing of TDS, chloride, and sulfate as impaired and chlorophyll-*a* as a screening level concern.

Assessment Unit 2306_04 is monitored within the Big Bend National Park at five locations. **Station 16730** is on the Rio Grande at the Rio Grande Village boat ramp in Big Bend National Park. This area is influenced in part by tributary and natural spring flows as the river travels through the Big Bend National Park in Texas and the Canyon de Santa Elena and Maderas del Carmen in Mexico. Though not previously listed for any impairments or concerns, the elevated dissolved solids listed as impaired in 2012 could be associated with the lack of flowing water caused by pronounced drought. Concerns for a potentially impaired fish community subject to kill events due to depressed DO levels and the presence of chlorophyll-*a* were also identified in this AU. Ammonia nitrogen showed an upward trend at **Station 16730** (see Figure 18).

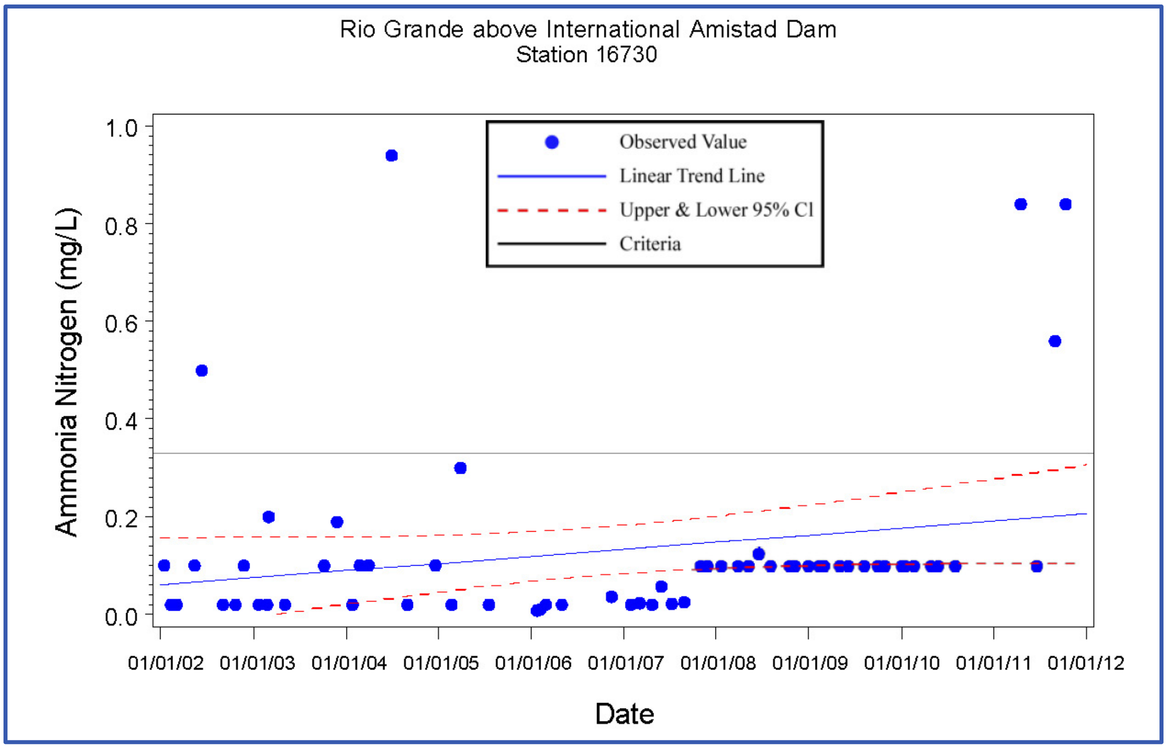


Figure 18. Increasing Ammonia Nitrogen Trend at Station 16730

Greater flow at this station appears to have a diluting effect on the ammonia nitrogen concentrations as demonstrated by decreasing concentrations with increasing flows (see Figure 19).

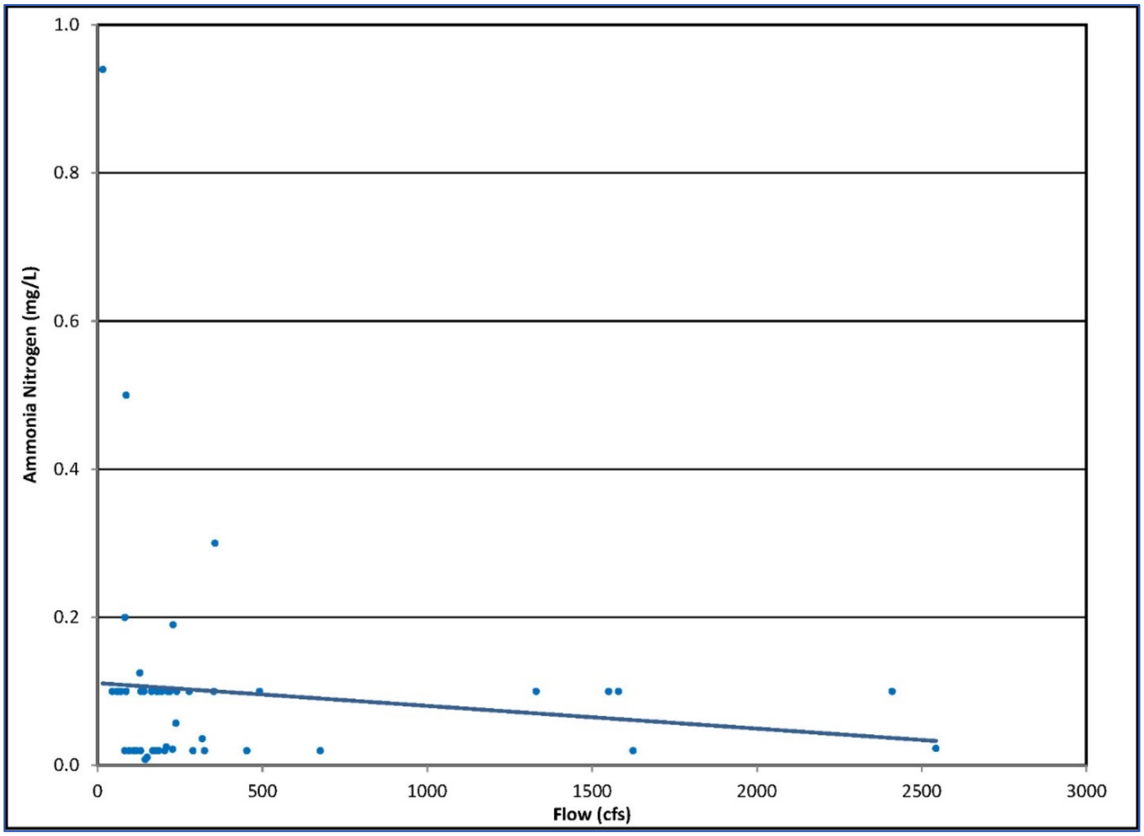


Figure 19. Ammonia Nitrogen vs Flow at Station 16730

The remaining four stations include **Station 20619**, which monitors the river conditions at Boquillas Crossing in Big Bend National Park; **Station 18483** at Rio Grande Village next to the pump house at Daniels Ranch picnic area; **Station 20199** at the confluence of Tornillo Creek upstream of the hot springs in the National Park; and at **Station 18535** on the north bank at La Clocha Campground in the National Park (USGS Station 290855103002800).

Assessment Unit 2306_05, represented by two monitoring stations, has similar impairments and concerns as listed for **Assessment Unit 2306_04**. This area is sampled at **Station 20616,** on the Rio Grande at Talley Campground in Big Bend National Park, and by **Station 13277** at the gaging station camp approximately 2 miles upstream of Johnson Ranch near Santa Elena East of Castolon.

Assessment Unit 2306_06 is monitored by five stations. **Station 13228** is the portion of the Rio Grande at the mouth of Santa Elena Canyon. This site is located downstream of Presidio/Ojinaga where the river receives tributary flow form Terlingua Creek and San Carlos Creek. This older sampling site had no identified impairments with a concern for chlorophyll-*a* in 2008. The increasing trends calculated for TDS, conductivity, and salts speculated future conditions for these parameters now listed as impaired. Diminishing flows from prolonged drought conditions have resulted in dissolved solids levels becoming even more concentrated than normal due to evaporation and reduced water levels. Concern for episodic fish kills and chlorophyll-*a* were also identified by TCEQ for this AU.

The remaining four AU representatives are **Station 17621** located 5 miles (8 km) downstream of the mouth of Santa Elena Canyon southwest of Castolon, **Station 18482** at Castolon 15 miles west of Cottonwood Campground Road, **Station 16274** found west of the Santa Elena Canyon public boat ramp road and downstream of the Terlingua Creek confluence, and **Station 20617** at the confluence with Terlingua Creek at Santa Elena Canyon in Big Bend National Park.

Assessment Unit 2306_07, impaired for dissolved solids with a concern for fish kills, is monitored for assessment at three stations. **Station 18441** at the Lajitas Resort FM 170 boat ramp upstream of the Black Hills confluence near Lajitas; **Station 16862** at Colorado Canyon approximately 18.6 miles (30 km) southeast of Redford on Ranch Road 170 in Presidio County; and **Station 20615** at Hoodoos Rapids in Big Bend Ranch State Park approximately 9.1 miles (14.65 km) south of Redford on Ranch Road 170.

The Rio Grande at FM 170 near Lajitas Station 18441 in Assessment Unit 2306_07

Assessment Unit 2306_08 is monitored at three stations: **Stations 13229, 17000,** and **17001**. **Station 13229** is situated on the Rio Grande near the intersection of Ranch Road (RR) 170 and RR 169 below the Rio Conchos confluence near Presidio. This site captures the combined flows of the Rio Grande and Rio Conchos in the river upstream of Presidio, Texas, and Ojinaga, Chihuahua. This area, listed in 2008 for non-compliance for bacteria, was not listed as an impairment or concern in 2012. The 2008 analyses showed steadily increasing trends for chloride, sulfate, and TDS. These salts are all now identified as impairments. The current condition can be attributed partly to diminished flow within this reach. **Station 17000** is located on the Rio Grande at the Presidio Railroad Bridge, and **Station 17001** is located nearby on the Rio Grande at Presidio/Ojinaga International Toll Bridge. Both locations were selected in 2008 for water collection to monitor the impacts of each city and infrastructure improvements upon ambient water quality. According to the 2012 TCEQ assessment, these two stations show no concern for bacteria but do not support the general use because of high TDS, chloride, and sulfate levels. Chlorophyll-*a* has been listed as a parameter of concern. Trend analysis for TKN showed an upward trend (see Figure 20).

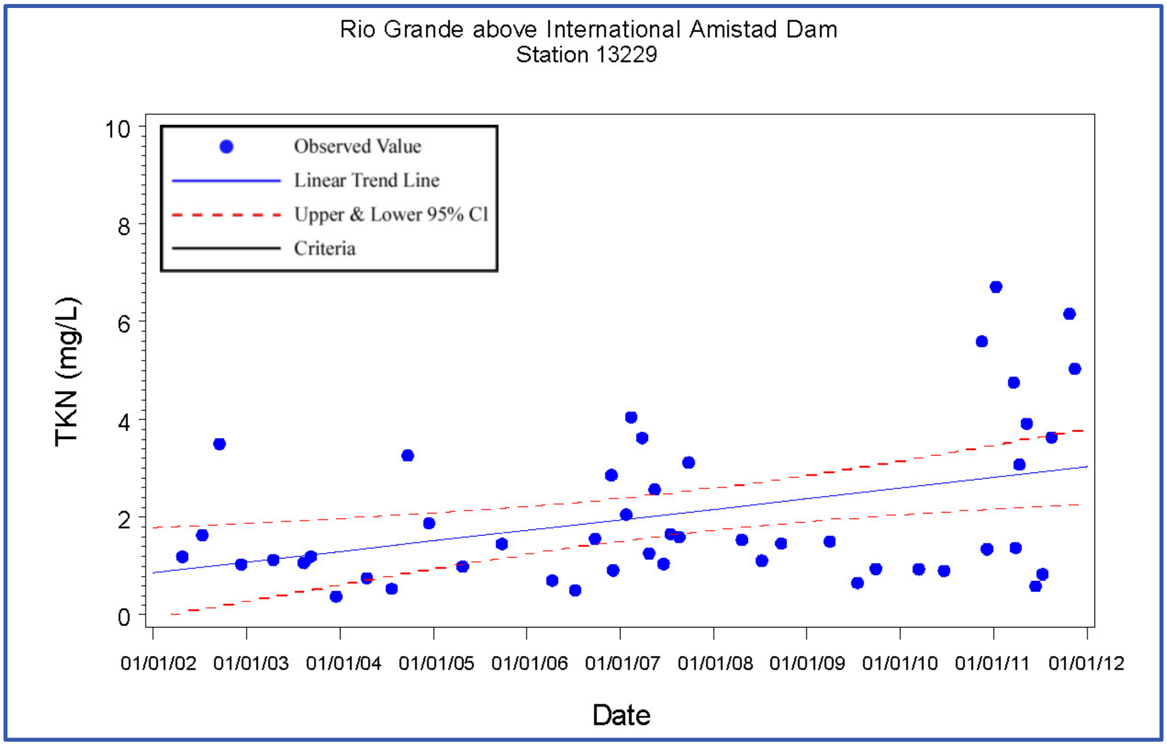


Figure 20. Increasing TKN Trend at Station 13229

Almost the entire length of the segment is listed as impaired for chloride, TDS, and sulfate. There are no use concerns or listed impairments for any metals in this segment. However, the analyzed data did not show statistically significant trends for dissolved solids and most metals.

Segment 2306A: Alamito Creek

Alamito Creek, an unclassified stream located at **Station 13108**, is fully supporting and has no identified impaired parameters or concerns for screening levels or near non-attainment. No significant trends were identified from the assessed data collected from this location.

Segment 2305: International Amistad Reservoir

The Rio Grande in Val Verde County is impounded by the International Amistad Reservoir. **Segment 2305** is defined by TCEQ as the portion of the Rio Grande from International Amistad Dam in Val Verde County to a point 1.1 miles (1.8 km) downstream of the confluence of Ramsey Canyon in Val Verde County, which runs for 75 miles (120 km). The lake was built for flood control, conservation, irrigation, power,

Low Water Level at the Diablo East Boat Ramp in May 2013

and recreation. The area of the reservoir encompasses 64,900 acres (26,265 hectares) with a normal pool elevation of 1,117 feet (341 meters). In July 2013, water level was almost 57 feet below normal conservation pool and at only 39 percent of conservation capacity. The majority of water, which flows into International Amistad Reservoir from the Rio Grande, originates either in the Rio Conchos in Mexico or results from rainfall runoff along the river between Presidio and International Amistad Reservoir. Surface flows from the Pecos River enter the Rio Grande upstream of International Amistad Reservoir near Del Rio. The Devils River empties directly into the Devils River Arm on the northern end of the lake. International Amistad Reservoir is a popular attraction for boating, fishing, and picnicking. Hydroelectric power is generated at the dam by both the U.S. and Mexico. The deep area nearest the dam acts as a settling basin for the heavy sediment loading entering the shallow upper end resulting in clearer water available for downstream releases. Water stored at the reservoir belongs to both the U.S. and Mexico based on the allocation of waters outlined in the 1944 Water Treaty. Water is released from International Amistad Reservoir to downstream water rights holders in the U.S. and Mexico and the storage of water at International Falcon Reservoir for usage further downstream. The designated uses for the reservoir include high aquatic life, PCR, general uses, fish consumption, and public water supply. The reservoir is meeting its high aquatic life and PCR uses; nitrate is a concern in the Rio Grande and Devils River arms but the exact sources are not known. High salt input from the Pecos River is potentially a pollutant of concern for the reservoir's natural water quality cycles. There are seven monitoring stations available for TCEQ surface water assessment at four separate AUs on the reservoir (see Table 6). A total of 14 parameters among 3 stations (see Figure 21) were analyzed for trends along this segment. TDS, chloride, and sulfate showed statistically significant trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-13).

Table 6. Water Bodies Evaluated by TCEQ along Segment 2305

International Amistad Reservoir					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Rio Grande Arm	2305_01	20627 20624 20174 20630 15892	Nitrate	General	Concern
Devils River Arm	2305_02	15893			
Area around International Boundary Buoy 1	2305_03	13835	NO IMPAIRMENTS OR CONCERNS		
Remainder of Reservoir	2605_04	No stations			

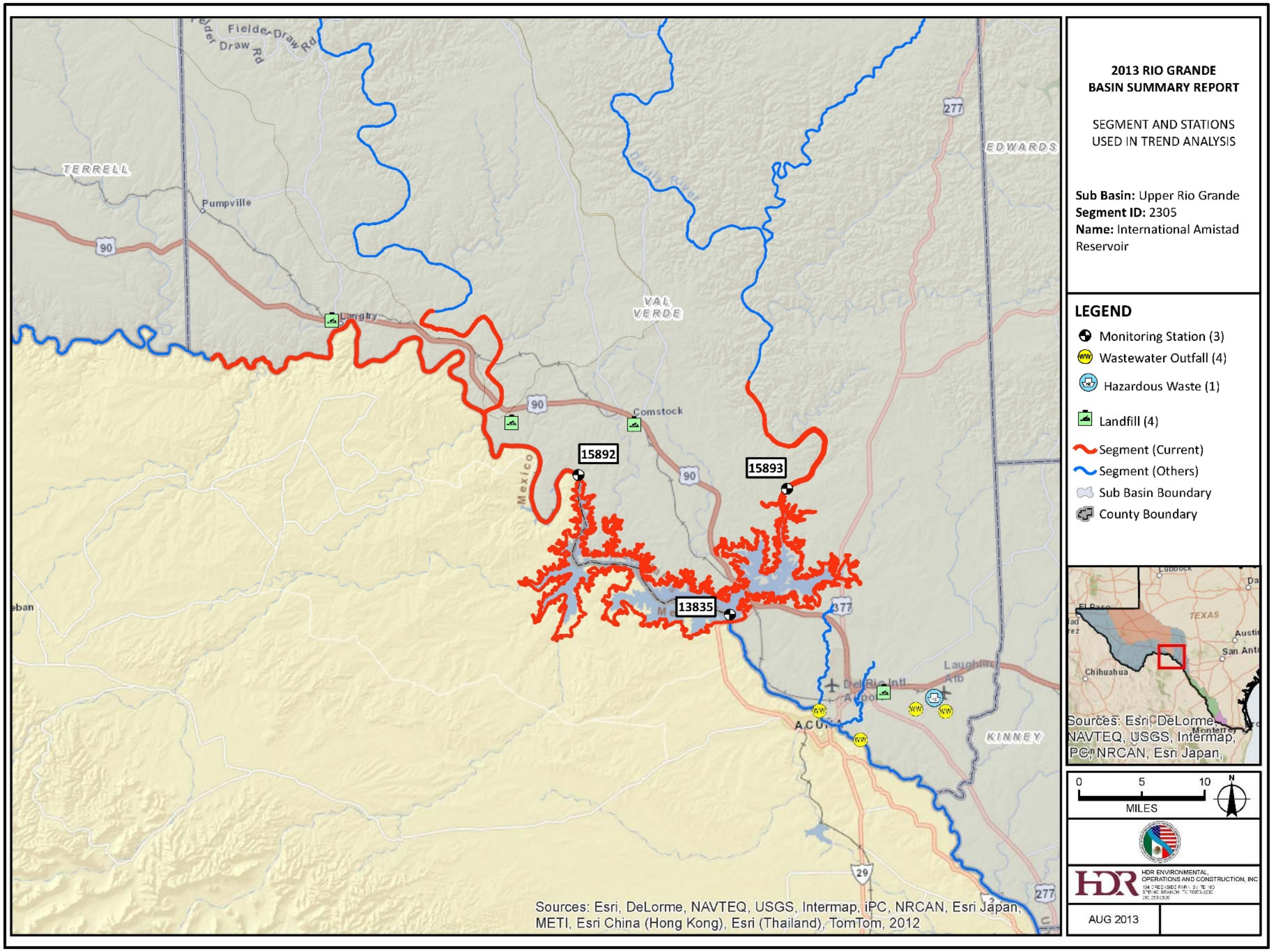


Figure 21. Monitoring Stations along Segment 2305

Assessment Unit 2305_01 is monitored at **Stations 20627**, **20624**, **20174**, **20630**, and **15892**. The first four locations are sampled upstream of the Pecos River confluence. The Rio Grande Arm currently meets all of its designated use standards except for a General Use concern for nitrate. Locations monitored for the 2012 assessment include **Station 20627** found on the Rio Grande east and south of Fosters Ranch Road in Val Verde County, **Station 20624** on the river upstream of Rattlesnake Canyon southwest of Langtry, **Station 20174** at the confluence with an unnamed tributary downstream from Rattlesnake Canyon near Langtry, **Station 20630** in the stream channel downstream from Langtry Creek and Pump Canyon in Val Verde County, and **Station 15892** within the Rio Grande Arm at Buoy 28.

Assessment Unit 2305_02 at Station 15893 is found in the Devils River Arm at Buoy DRP. This site is located at the confluence of the Devils River and the reservoir. This site is not listed for any use impairments but has a concern for nitrate. Trend analysis showed an upward trend for chloride, TDS, and sulfate (see Figures 22, 23, and 24).

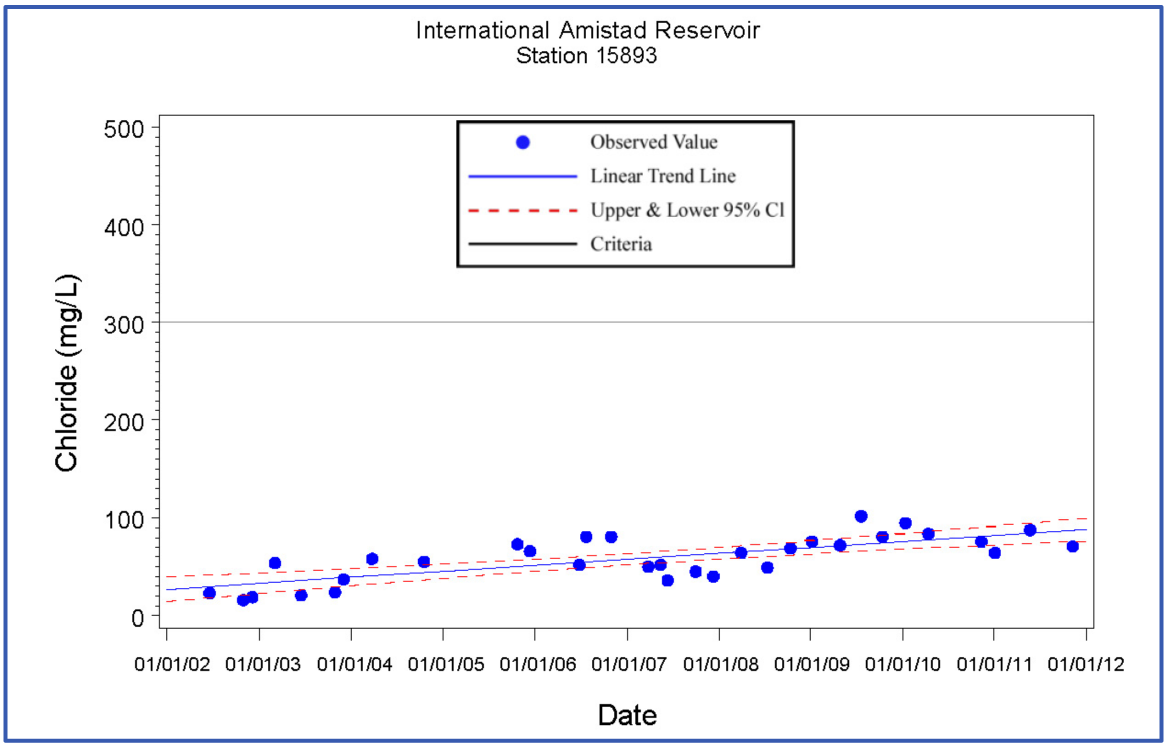


Figure 22. Increasing Chloride Trend at Station 15893

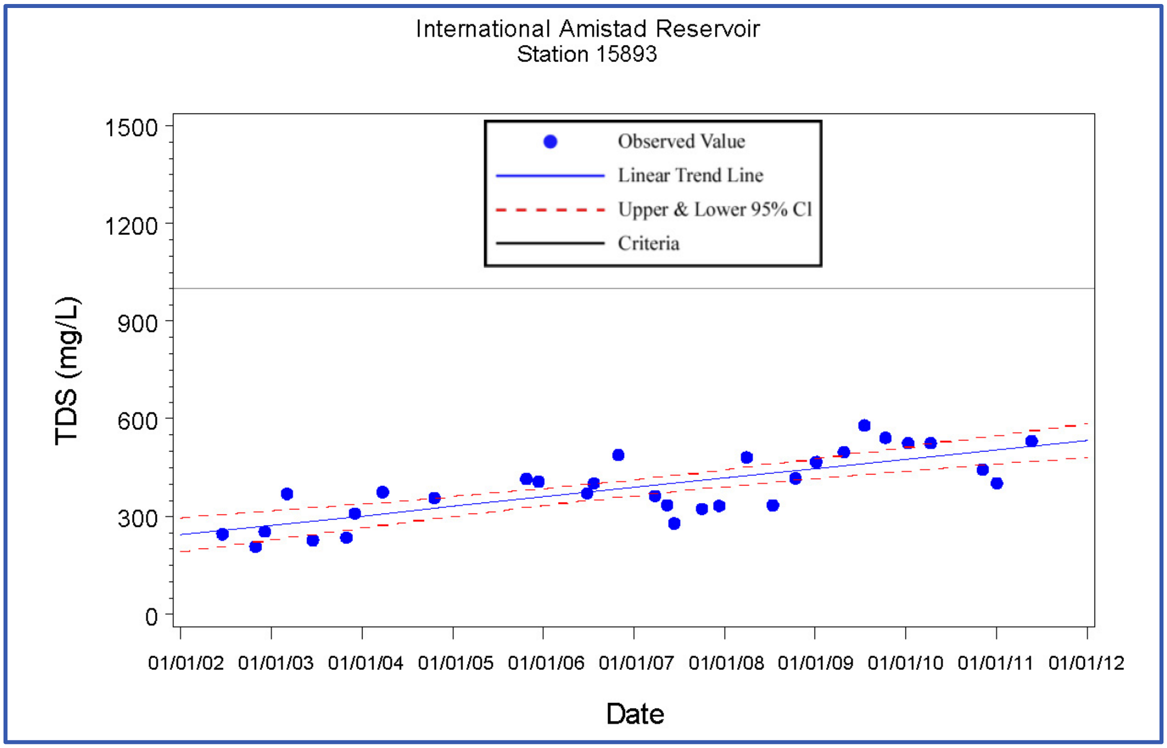


Figure 23. Increasing TDS Trend at Station 15893

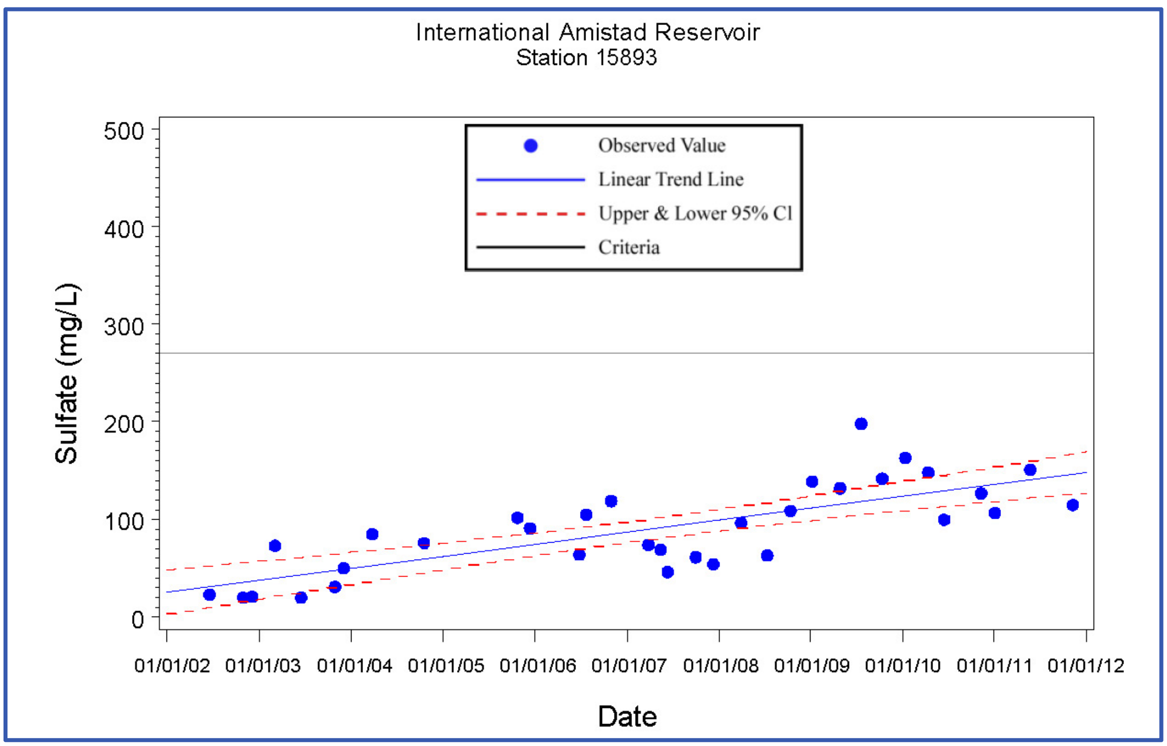


Figure 24. Increasing Sulfate Trend at Station 15893

Assessment Unit 2305_03 at Station 13835 is at Buoy 1. There were no impairments or concerns for screening levels or near non-attainment identified by TCEQ in 2012 for this area of the lake. The 2013 trend analysis shows a decrease in DO and an increase in pH, total phosphorus, sulfate, and conductivity all indicative of water quality degradation. Potential sources are unknown. The combined factors of low precipitation, quality of water received from upstream sources, the reduction in reservoir water level, and evapotranspiration could likely increase algal growth and concentrate pollutants resulting in an overall reduction in water quality. **Assessment Unit 2305_04** is considered the remaining portion of the lake and no TCEQ stations were specified for the 2012 data assessment; however data from other sources including three General Use parameters (TDS, chloride, sulfate) and two public water supply use parameters (fluoride, and nitrate) were assessed by TCEQ with none exceeding their TSWQS criteria.

Segment 2309: Devils River

The Devils River Downtream of Dolan Falls

Segment 2309 is defined from a point 0.4 miles (0.6 km) downstream of the confluence of Little Satan Creek in Val Verde County to the confluence of Dry Devils River in Sutton County. It is 67 river miles (107.8 km) in length and empties into the International Amistad Reservoir. This area of the Basin is mostly undisturbed and remains in pristine condition characterized by excellent water quality with low salinity content, typically less than 500 mg/L. The Devils River is a high quality stream with an average TDS concentration of 380 mg/L compared to 700 mg/L in the Rio Grande in the same area. Designated uses include exceptional aquatic life use, PCR, public water supply, fish consumption and general uses. All uses are fully supporting with no impairments or concerns for screening levels or near non-attainment at any station. There are four established monitoring stations in two of the three river AUs and one unclassified stream (Dolan Creek) from which available data were assessed by TCEQ in this segment (see Table 7). The 2012 assessment did not identify any impairments or concerns in **Segment 2309** and unclassified Segment 2309A. A total of 16 parameters among 3 stations (see Figure 25) were analyzed for trends along this segment. Chloride and TDS showed statistically significant upward trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-15).

Table 7. Water Bodies Evaluated by TCEQ along Segment 2309

Devils River and Dolan Creek (unclassified water body)					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Devils River from the Devils River Arm of International Amistad Reservoir upstream to Falls Canyon just below the Dolan Creek confluence	2309_01	13237	NO IMPAIRMENTS OR CONCERNS		
Devils River from Falls Canyon just below the Dolan Creek confluence upstream to Wallace Canyon	2309_02	13239 18387			
Devils River from Wallace Canyon to the upper segment boundary of the Dry Devils River confluence	2309_03	No Stations			
Dolan Creek from Yellow Bluff upstream to a point 4.7 km (29 miles) south of Sonora and 4.8 km (3 miles) west of U.S. Hwy 277 in Val Verde County	2309A_02	14942	NO IMPAIRMENTS OR CONCERNS		

Assessment Unit 2309_01 at Station 13237 is located on the Devils River at Pafford Crossing near Comstock. Trend analysis conducted for this location shows a decrease in stream flow and DO whereas an increase in chloride was observed (see Figure 26).

Assessment Unit 2309_02 locations at **Station 13239,** situated in the Devils River State Natural Area 1.1 miles (1.7 km) upstream of Dolan Creek and **Station 18387**, located on the Devils River at the Nix Ranch Crossing upstream of Harland Canyon Creek confluence, have no impairments or concerns.

Although no TCEQ monitoring stations are specified in the 2012 Texas IR for **Assessment Unit 2309_03**, assessments were made in 2012 by TCEQ from data collected by others for TDS, chloride, sulfate, fluoride, and nitrate.

Unclassified **Segment 2309A_02** at **Station 14942** monitors a 29-mile (47-km) length of Dolan Springs from Yellow Bluff to Sonora. The 2012 assessment did not identify any impairments or concerns for screening levels or near non-attainment in this unclassified segment. The 2013 trend analysis for sulfate, chloride, conductivity, ammonia, and phosphorus indicated an upward trend (see Figure 27). Since there are few sources of pristine water sources remaining in Texas, further research will be required to understand better the processes associated with these parameters. The disturbance of surface areas due to recent oil and gas exploration in the region along with produced water from these activities and the reuse or disposal of drilling waste are highly visible issues involving industry stewardship and regulatory oversight.

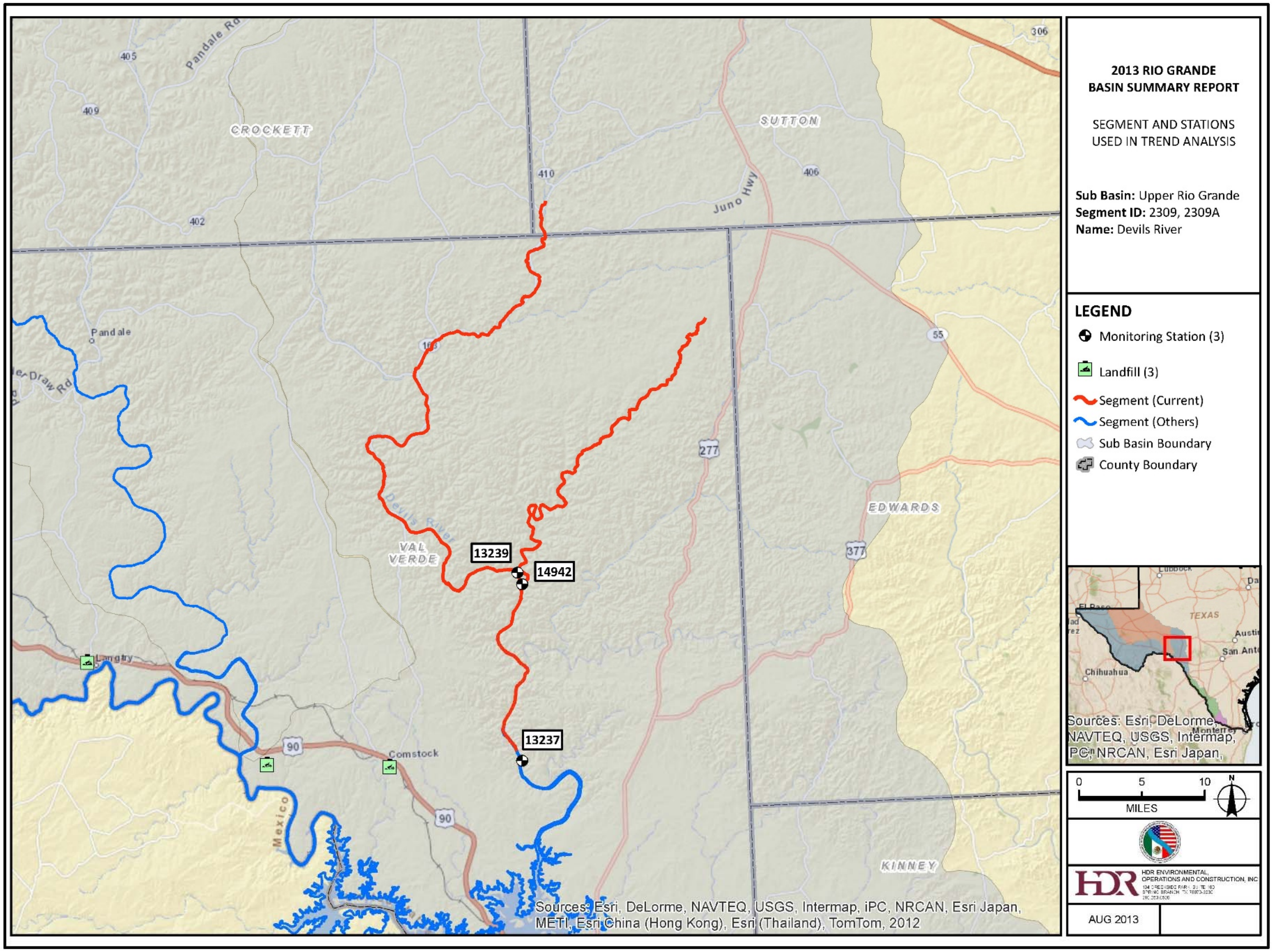


Figure 25. Monitoring Stations along Segment 2309

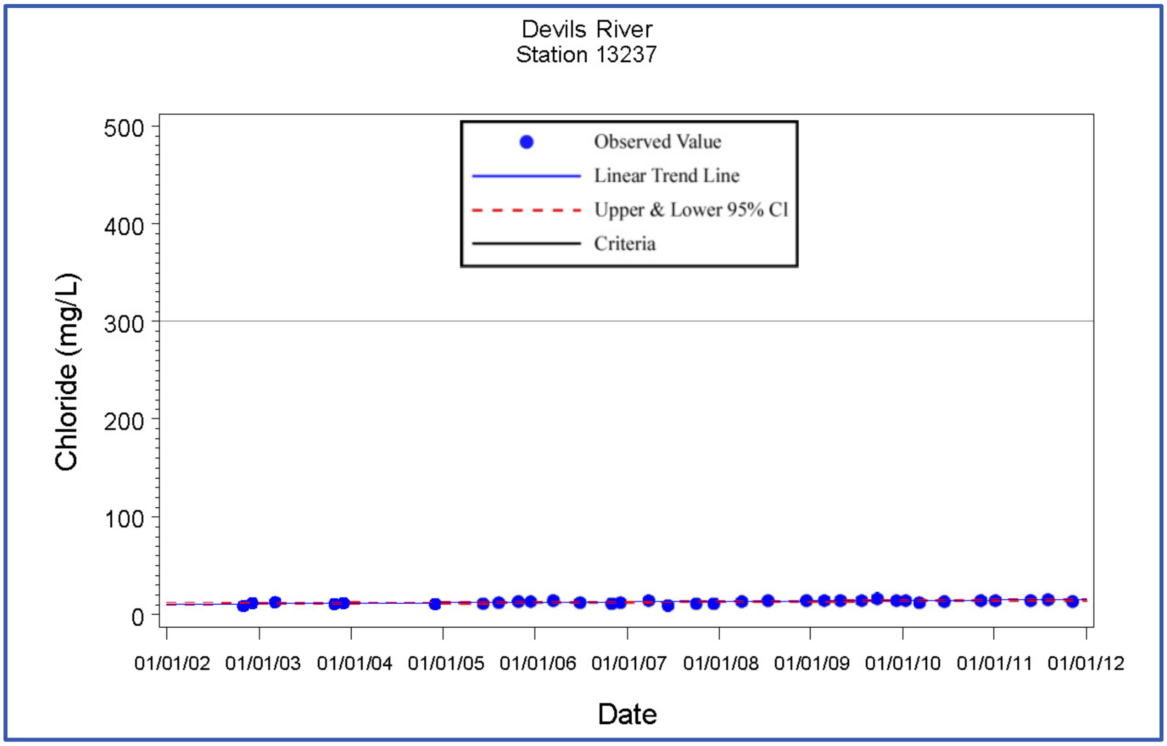


Figure 26. Increasing Chloride Trend at Station 13237

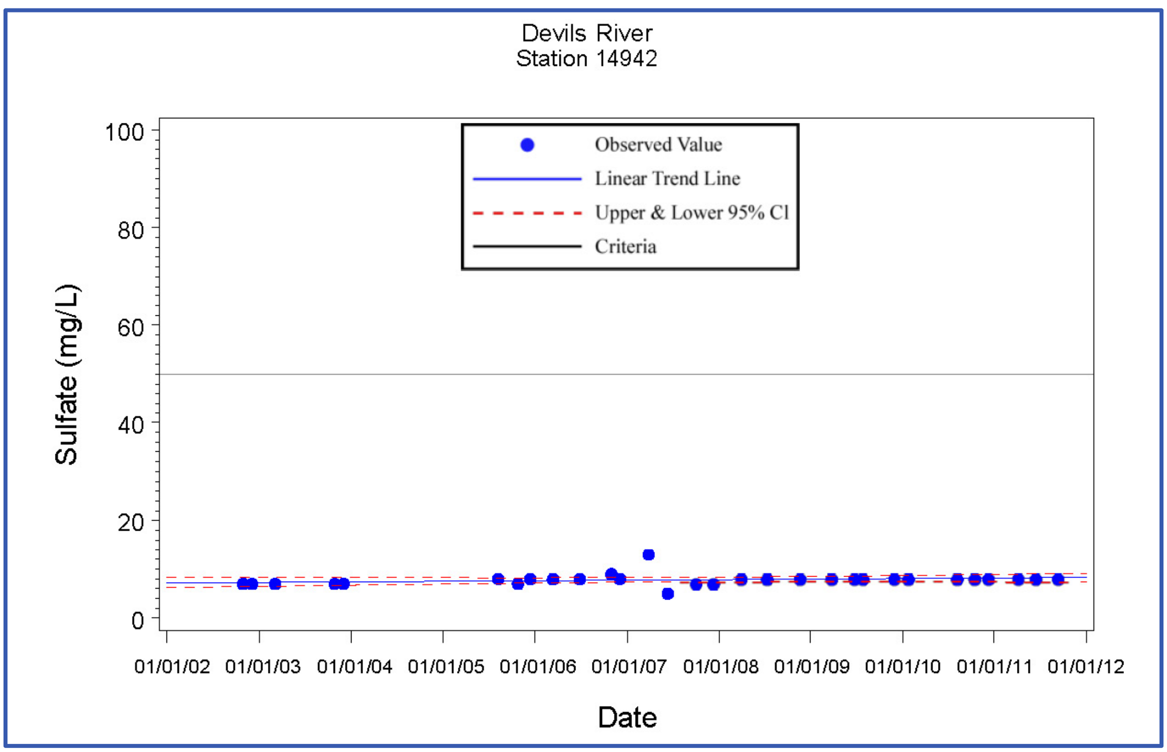


Figure 27. Increasing Sulfate Trend at Station 14942

Projects and Studies of Relevance to the Upper Rio Grande Sub-basin

Segment Standards Review - The TCEQ is currently undergoing a Standards Review for **Segments 2307** and **2306**. If this reclassification occurs, segments would not be renamed but rather designated as **Segment 2315**.

Bacteria Study - The Paso del Norte Watershed Council is receiving 319(h) grant funding from USEPA and New Mexico Environment Department (NMED) to develop a Watershed Restoration Action Strategy to address bacteria impairment in the Lower Rio Grande of New Mexico. The efforts to address bacteria contamination are unique because they cross jurisdictional boundaries. This section of the Rio Grande meanders for a distance of almost 16 miles (26 km). The Texas **Segment 2314,** which overlaps three separate New Mexico AUs throughout this shared portion of monitored river, is also impaired for bacteria. USIBWC CRP will support the monitoring efforts and provide assistance for the Watershed Restoration Action Strategy.

Bacteria Source Tracking - The EPCC RISERISE program has been collecting water samples with USIBWC Clean Rivers Program since 2000 for ongoing research, including bacteria source tracking and other pathogen analysis.

The Forgotten River – Fort Quitman to Presidio - Rapid and extensive development in the trans-boundary portion of the Rio Grande means that very little water flows past El Paso and the water that does flow downstream is lost in the Forgotten River reach. Various environmental organizations, including the World Wildlife Fund, the Environmental Defense Fund and the American Heritage Rivers group have focused attention on this 200-mile (322-km) riparian corridor. Flows in the Sub-basin have diminished to such an extent that the biological, cultural, and geological resources of the area have been severely impacted and are threatened even further by impacted water quality. The spatial distribution of gaining/losing reaches of fresh water and saline water throughout the region is poorly documented.

Biological Control of Saltcedar - The ARS has been studying means of controlling the aggressive, exotic saltcedar (*Tamarix* sp.) by introducing a biological control agent, the *Diorhabda* spp. beetle. USIBWC has participated in bi-national discussions of the trans-boundary effects of the biological control projects.

Salinity and Nutrients - Diminished flow, high salinity and the occurrence and distribution of nutrients in the Rio Grande from Presidio to International Amistad Reservoir have been indirectly implicated in the development of toxic algal blooms. Objectives of the study included quantifying flow, characterizing salinity and nutrient concentrations, determining possible nutrient-loading sources, and developing recommendations for long-term monitoring. The USGS, the National Park Service, USIBWC, TCEQ, and Mexican agencies collaborated on the research.

Mine Tailings – In 2002, the USGS, TCEQ, USIBWC, and Mexican agencies participated in a study of historic mercury, silver, lead, and gold mines upstream of and within Big Bend National Park. Drainage from the mines was a suspected source of contaminants affecting the quality of the Rio Grande in the area. Sediment and water samples were collected from the Rio Grande (above and below tributary confluences) and from tributaries identified as transporters of mine runoff. The study, published in 2009, discusses the sample results which showed elevated concentrations of trace elements and metals, some exceeding TCEQ standards. The report is available at this Web site:

http://www.ibwc.state.gov/CRP/documents/BigBendMines_USGSsir2008-5032.pdf.

Water Toxicity Assessment - The TCEQ has completed a project to assess the potential, extent, and severity of toxicity to aquatic life in ambient water and sediment in seven Texas water bodies, including the Rio Grande main channel upstream (**Segment 2306**) and downstream of International Amistad Reservoir (**Segment 2304**). The study, entitled *Assessment of the Presence and Causes of Ambient Water Toxicity in the Rio Grande above Amistad Reservoir, Segment 2306*, focused on the upper 25 miles (40 km) near Presidio. Samples were collected from TCEQ **Stations 13228** and **17621** (**Assessment Unit 2306_06**) and **Station 13229** (**Assessment Unit 2306_08**) during flow rates below the 7-day, 2-year low flow (7Q2). The findings were inconclusive for attainment of aquatic life uses based on ambient toxicity. Recommendations indicated that more data were needed to determine whether a TMDL is required for **Segment 2306**. This report is available to the public for online viewing at:

http://www.tceq.texas.gov/waterquality/tmdl/30-toxicity_project.html.

The Pecos River Sub-basin

The headwaters of the Pecos River originate in the Sangre de Cristo Mountains of north-central New Mexico. The Pecos River Sub-basin is the portion of the Pecos River from the point it enters Texas at Red Bluff Reservoir in Loving County to its confluence with the Rio Grande in Val Verde County. Population centers along the river are relatively few and the region has experienced a general decline in population. Water in the Pecos River is naturally high in dissolved solids and salt concentrations. The high salinity levels are aggravated by low flows and the prevalence of saltcedar, a nonnative invasive species that is an enormous water consumer. The introduction of high quality fresh water from natural springs feeding Independence Creek creates significant changes to the aquatic community in the Pecos River.

The Pecos River is one of the saltiest rivers in the western U.S. and contributes almost 10 percent of the stream inflow into International Amistad Reservoir and 26 percent of the total salt loading.[8] As the major contributor of salt to the reservoir, lake salinities exceeded 1,000 ppm for one month in 1988, and can fluctuate with the changing flow and salt content of the Pecos River. Therefore, it is important to control the variable salt loading to ensure salinity levels are maintained below the 1,000 ppm drinking water standard.

Watershed data evaluations have revealed issues relating to water quality and quantity. Currently in the Pecos River Basin, there are eight CWQMN water data collecting stations in Texas, and one near Red

---

[8] Miyamoto S., F. Yuan, S. Anand. 2006. *Influence of Tributaries on Salinity of Amistad International Reservoir.* Texas Water Resources Institute. TR-292.

Bluff, New Mexico, to monitor conditions and changes in water quality to support the Pecos River Watershed Protection Plan and the Pecos River Interstate Compact Commission. These stations measure DO, pH, temperature, and conductivity. There are 71 permitted dischargers in the Sub-basin including 6 hazardous waste sites, 10 wastewater outfalls, 32 active landfills, 18 CAFOs, and 5 solid waste disposal facilities. The Pecos River Sub-basin is divided into three sections (**Segments 2312, 2311**, and **2310**) and 14 AUs (see Figure 28).

Segment 2312: Red Bluff Reservoir

Segment 2312 is the Texas portion of Red Bluff Reservoir, an on-channel impoundment encompassing 11,700 acres. The Red Bluff Dam, constructed in 1936 for irrigation and hydroelectric power, impounds the waters of the Pecos River entering from New Mexico. Naturally occurring salt springs situated upstream of the reservoir in New Mexico contribute to the very high levels of TDS and chlorides. Salinity values are typically greater than 6,000 mg/L. The high salinity prohibits its use as public water supply and limits agriculture to salt-tolerant crops. Current availability of water from Red Bluff Reservoir is low with the reservoir level less than 16 percent of full capacity. This level is a result of the current drought, high evaporation rates, and high infiltration rates of the bed and banks of the Pecos River and irrigation canal systems. Stored water at the dam operated by Red Bluff Water Control District is released based on requests from downstream municipalities and irrigation districts. Designated uses for this segment are assessed for high aquatic life use, PCR, general use, and fish consumption. The reservoir is represented by two monitoring stations that indicate full support for all uses, but two areas of concern were identified by TCEQ (see Table 8). This lake has a concern for golden algae blooms, nitrate, and chlorophyll-*a*. Fish kill reports are also identified by TCEQ as a concern for **Segment 2312**, with the exact causes unknown. A total of 11 parameters between the two representative stations for **Segment 2312** (see Figure 29) were analyzed for trends. DO, TKN, and transparency (secchi depth) showed statistically significant trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-17).

Table 8. Water Bodies Evaluated by TCEQ along Segment 2312

Red Bluff Reservoir					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
From the Red Bluff Dam to mid-lake	2312_01	13267	Golden Algae	Fish Consumption	Concern
			Chlorophyll-*a*	General	
From mid-lake to the Texas/New Mexico state line	2312_02	13269	Golden Algae	Fish Consumption	
			Chlorophyll-*a*	General	

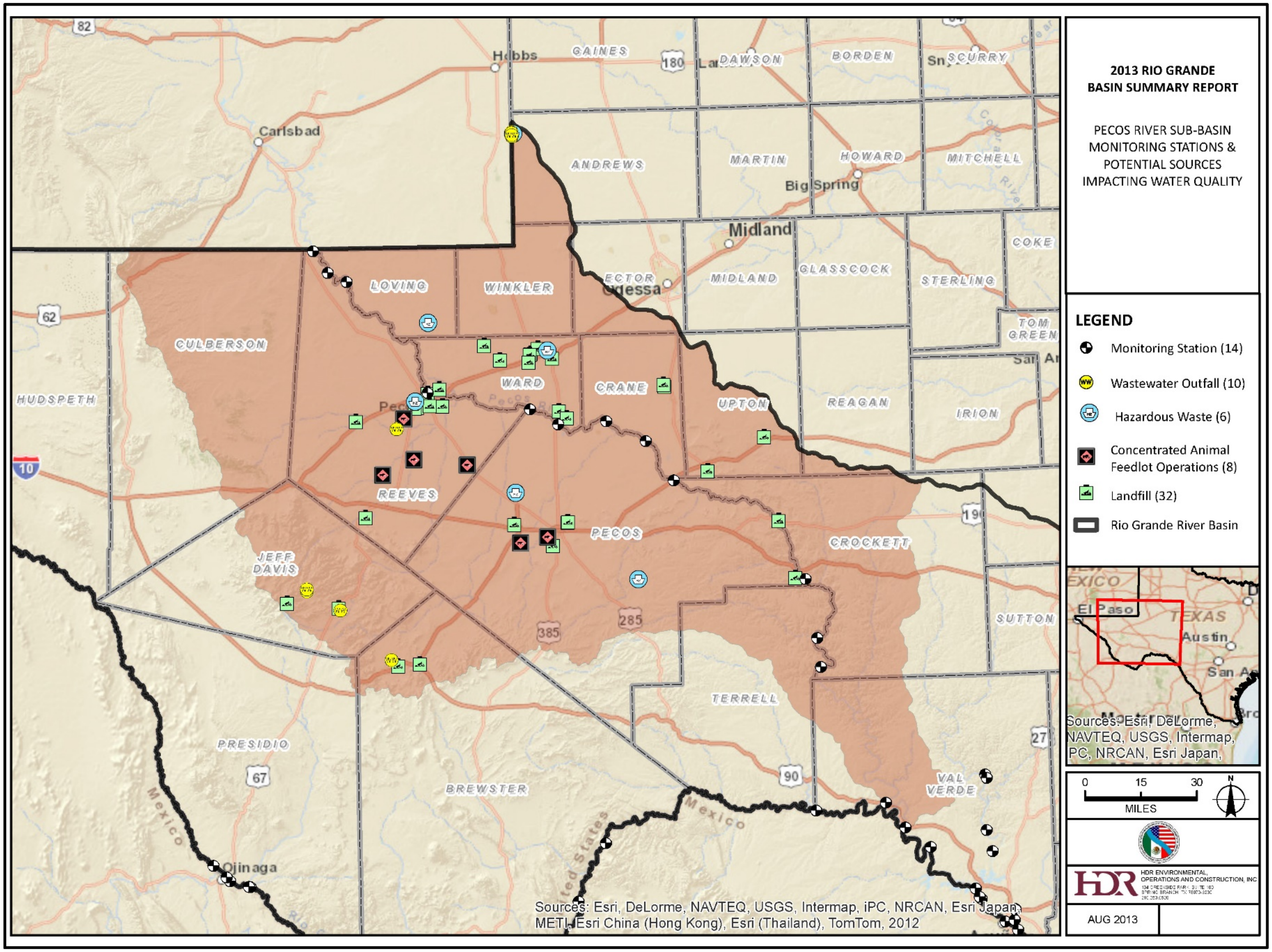


Figure 28. Pecos River Sub-basin Monitoring Stations and Permitted Dischargers

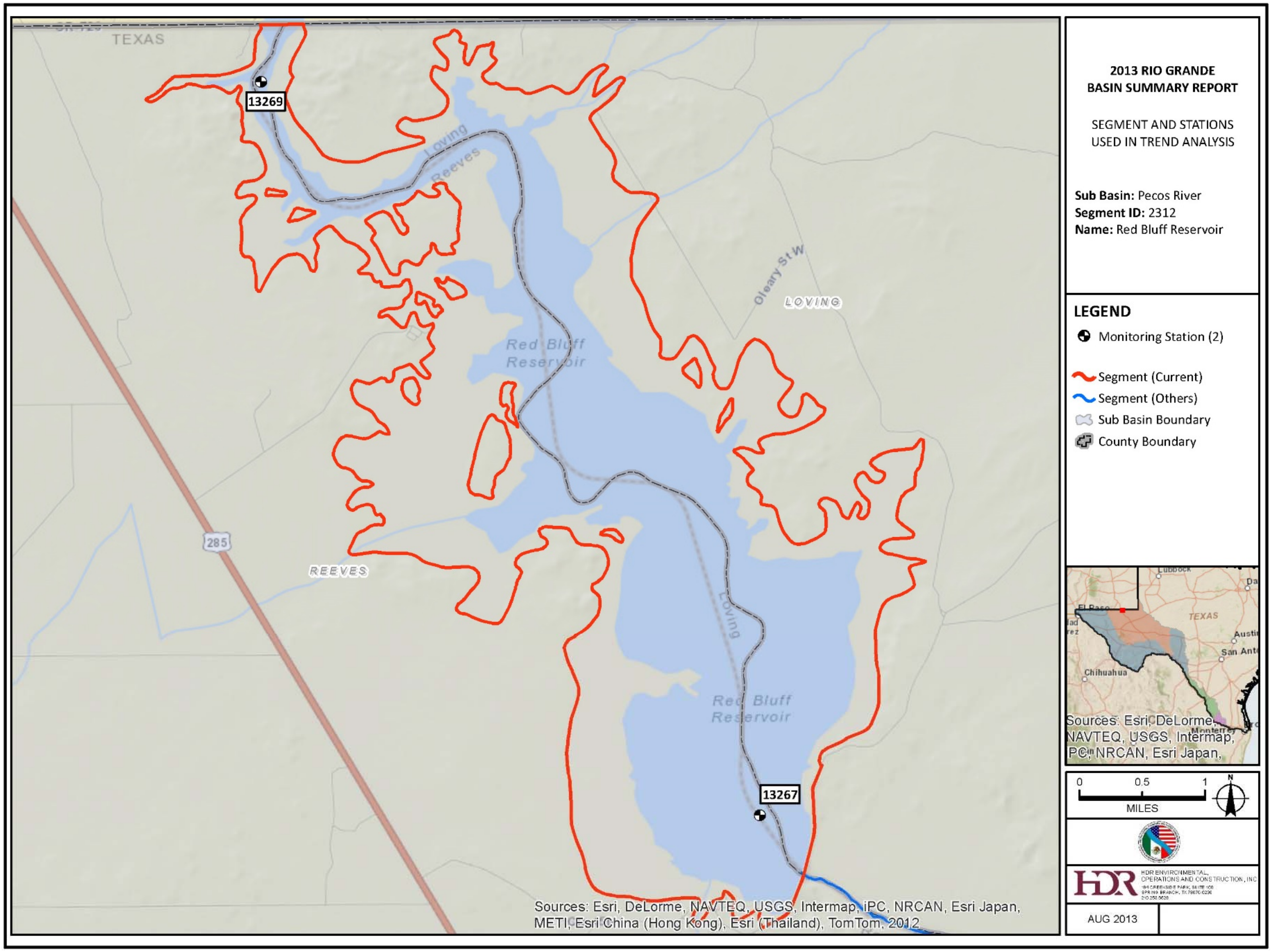


Figure 29. Monitoring Stations along Segment 2312

Assessment Unit 2312_01 at Station 13269 – This station, located on Red Bluff Reservoir 0.5 miles (0.8 km) south of the Texas-New Mexico border, is identified as having concerns for fish kill events and chlorophyll-*a*. This location has had previous concerns for golden algae, nitrates, and nitrites. Most of the documented golden algae bloom events have occurred either in Red Bluff Reservoir or the upper Pecos River where the water is highly saline. Widespread fish kills created by golden algae have occurred upstream in the Pecos River at Brantley, Bataan, and Carlsbad municipal reservoirs in New Mexico between 2002 and 2007. The majority of golden algae-related fish kills occur during the winter and spring months when the water temperatures are cold. TPWD collects water samples year round on the Pecos River at Coyanosa and at the Brotherton Ranch. No fish kills have been reported on the Texas portion of the reservoir or river channel since 2007.

Assessment Unit 2312_02 at **Station 13267** – This station is on Red Bluff Reservoir above the dam, north of Orla. The reservoir at this location also has a concern for increasing chlorophyll-*a* levels and potential fish kills. The last reported fish kill attributed to golden algae took place in October 2007. Not all golden algae blooms are toxic, but because these blooms can become harmful quickly and can vary in toxicity and frequency, all are potentially dangerous and a threat to all aquatic ecosystems. During the 2008 assessment cycle, this station was inventoried as having a concern for ammonia, ortho-phosphorus, and DO with an increasing trend in total phosphorus. Conductivity is primarily used to indicate the levels of TDS in the water. Additionally, salinity is often considered equivalent to TDS. Bad taste in tap water is often attributed to salinity. Due to inadequate data, chlorophyll-*a* was not included in the trend analysis; however, results for transparency (secchi depth) at **Station 13267** showed an downward trend in TKN (see Figure 30) whereas water clarity showed a upward trend (see Figure 31), suggesting that conditions of lower flow allow suspended solids to settle and a possible decline in photosynthetic pigments **in the upper shallow end of the reservoir. There were no statistical indications or future concerns for nutrients and low DO levels.**

Segment 2311: Upper Pecos River

Segment 2311 is classified as a freshwater stream extending for 349 miles (562 km). This reach of the Pecos River is naturally high in salts due to groundwater passing through salt-bearing geologic formations. Water is not drinkable due to the high salinity content. Salinity progressively increases downstream climbing to an average of 21,000 mg/L at Girvin. A complex inter-relationship of natural processes involving the seasonal nature of precipitation within the region, the exchange of surface water and groundwater, variability of seasonal flow, and evaporation influence changes in TDS, chloride, and sulfate concentrations. This segment contains 11 monitoring stations that were assessed by TCEQ for 8 AUs (see Table 9). A total of 11 parameters among 8 stations (see Figure 32) were analyzed for trends along this segment. The 2012 analyses for sulfate, chloride, TDS, nitrogen, and phosphorus showed statistically significant trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-18).

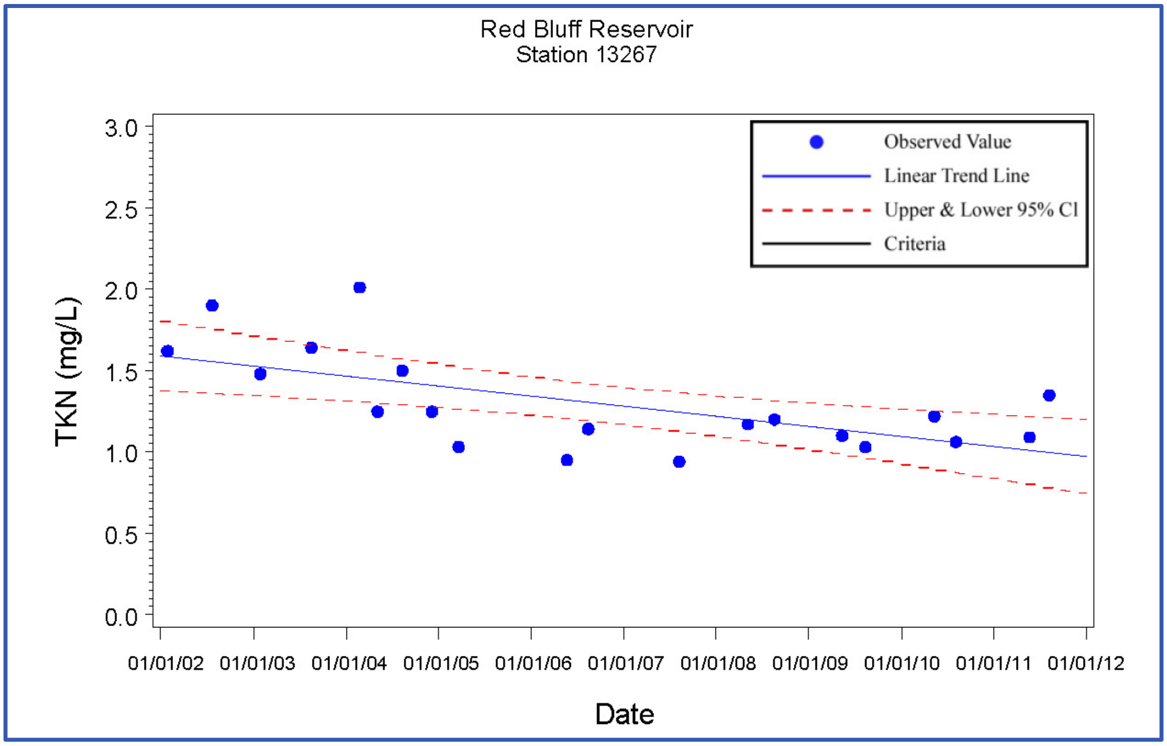


Figure 30. Decreasing TKN Trend at Station 13267

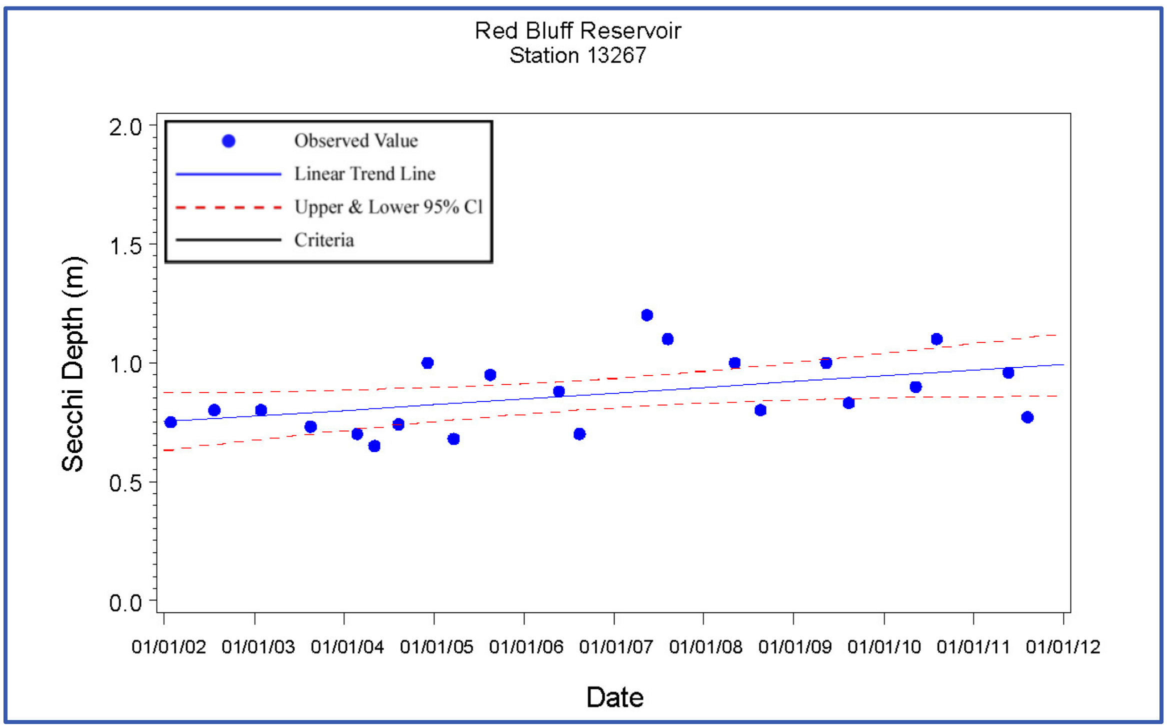


Figure 31. Increasing Transparency (Secchi Depth) Trend at Station 13267

Table 9. Water Bodies Evaluated by TCEQ along Segment 2311

Upper Pecos River					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
From just upstream of the Independence Creek confluence upstream to U.S. Hwy 290	2311_01	No Stations	Golden Algae	Fish Consumption	Concern
From U.S. Hwy 290 upstream to U.S. Hwy 67	2311_02	13249 13255 15114	*Enterococci*	Recreation	
			Golden Algae	Fish Consumption	
			Chlorophyll-*a*	General	
From U.S. Hwy 67 upstream to the Ward Two Irrigation Turnout	2311_03	13257 13258 13260 20399	*Enterococci*	Recreation	
			DO grab screening level	Aquatic Life	
			24-Hour DO minimum	Aquatic Life	***Impairment***
			Golden Algae	Fish Consumption	Concern
			Chlorophyll-*a*	General	
From the Ward Two Irrigation Turnout upstream to U.S. Hwy 80 (Bus 20)	2311_04	13259	Golden Algae	Fish Consumption	
From U.S. Hwy 80 (Bus 20) upstream to the Barstow Dam	2311_05	13261			
From the Barstow Dam upstream to SH 302	2311_06	No Stations			
From SH 302 upstream to FM 652	2311_07	13264			
From FM 652 upstream to the Red Bluff Dam	2311_08	13265	DO grab screening level	Aquatic Life	
			Golden Algae	Fish Consumption	
			Chlorophyll-*a*	General	

The entire segment has a concern for golden algae as fish kills have occurred several times in the past. The levels of chlorophyll-*a* have caused a concern but the exact causes are unknown. Because the salt concentrations have been historically high, the standard is also set high but only when the source is believed to be natural.[9] The segment standard for TDS in the upper Pecos River is 15,000 mg/L. The source of chloride causing impairment throughout the upper Pecos River is the extensive dissolution of salts from underlying geologic formations in New Mexico.

[9] Texas Clean River Program. 2011. *April 28, 2011 meeting notes for the Pecos River Coordinated Monitoring Meeting for the Rio Grande Basin*. Midland, Texas.

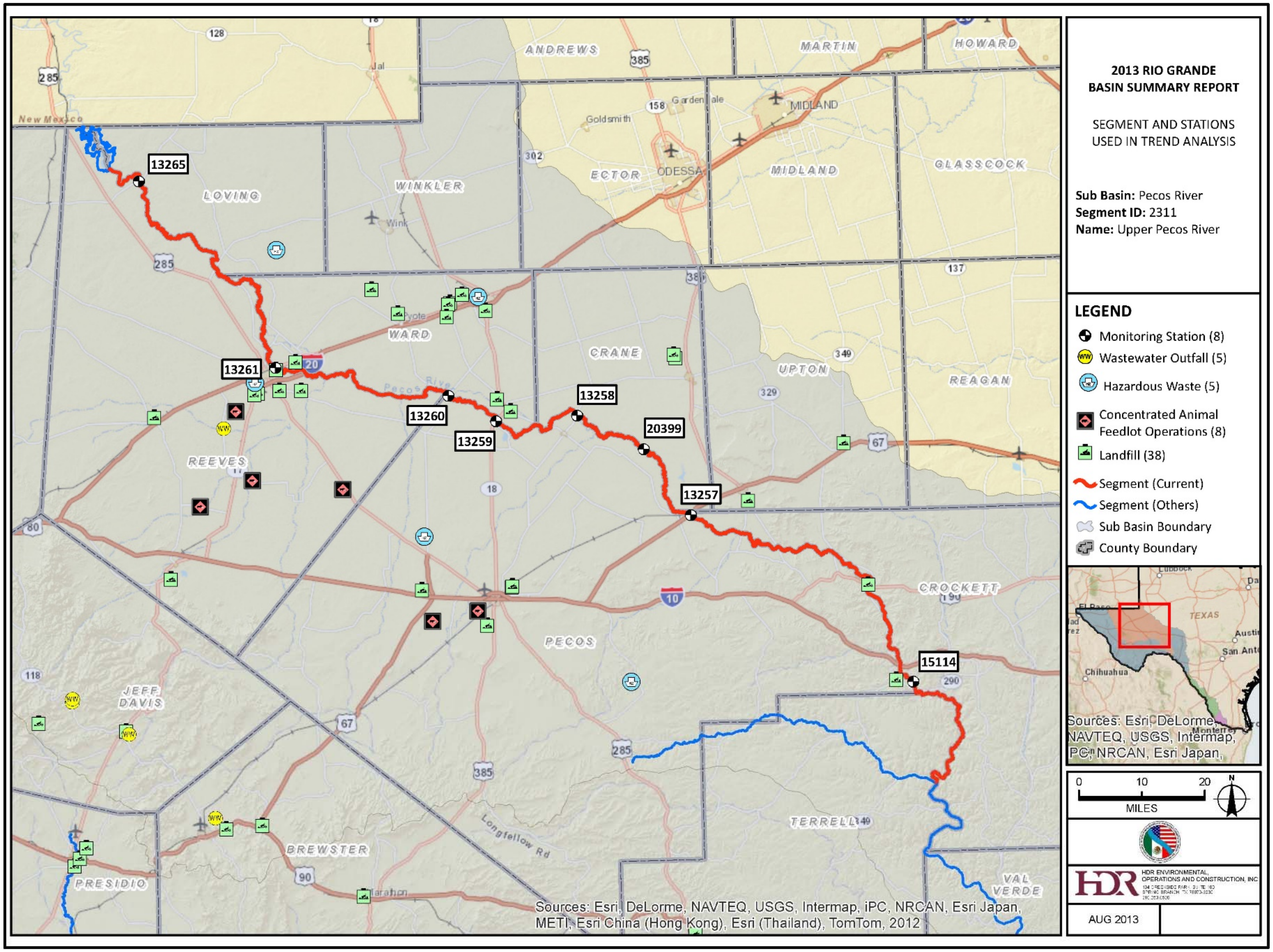


Figure 32. Monitoring Stations along Segment 2311

The stream monitoring locations contained in Table 9 are listed in a downstream-to-upstream orientation. The **Segment 2311** assigned uses are high aquatic life, PCR, general, and fish consumption, all of which are fully supported except for an impairment for high aquatic life (minimum 24-hour DO values) at **Assessment Unit 2311_03** and DO concerns at **Assessment Unit 2311_03** and **Assessment Unit 2311_08** where high aquatic life use appears to be negatively affected by depressed *in situ* DO.

Although the 2012 Texas IR indicates that no monitoring stations are found in **Assessment Units 2311_01 and 2311_06**, other sources were used by TCEQ to evaluate TDS, chloride, sulfate, lead, and chromium in 2012. Both areas indicate a concern only for potential golden algae-related fish kills similar to the contiguous AUs within **Segment 2311**.

Assessment Unit 2311_02 - The 2012 assessment based on the data collected at three stations continues to show a concern for golden algae toxicity, chlorophyll-*a*, and for *Enterococci* bacteria values. **Station 15114** is located on the Pecos River 1.6 miles (2.6 km) upstream of U.S. Hwy 290 and southeast of Sheffield. In 2008, this site displayed a sharp increase in chlorophyll-*a*, which now has become a concern. Stimulation of algal growth from nutrient loading is most likely elevating the amount of chlorophyll-*a*, which can lead to dense blooms, decreased water clarity, and DO fluctuations through photosynthesis. **Station 13249** is situated on the Upper Pecos River at the State Highway (SH) 290 Bridge southeast of Sheffield and **Station 13255** is found on the Pecos River at FM 1901 southwest of McCamey.

Assessment Unit 2311_03 – This AU is monitored at the following four locations: **Stations 13257, 13258, 13260,** and **20399**. Twelve of the 24-hour period DO samples assessed failed to meet the criteria for 24-hour minimum DO levels resulting in an impaired aquatic life use with adequate data to make a determination. This impairment is classified as 5c meaning that additional data or information are needed before a final management strategy is selected. Additionally, five concerns were identified including *Enterococci* bacteria, harmful golden algae, chlorophyll-*a*, and depressed DO instantaneous measurements. **Station 13257** is established on the Pecos River at U.S. Hwy 67 northeast of Girvin. The data analysis conducted for chlorophyll-*a* shows an upward trend with no statistical significance (see Figure 33).

The 2012 assessment continues to show an aquatic life use concern for depressed DO levels and for *Enterococci* bacteria values. Some of the highest values of TDS have been recorded at this site which is influenced by variable concentrations of dissolved solids from groundwater springs that pass through subsurface salt formations. This validated the 2008 trend analysis which observed increasing trends for TDS, chlorides, and sulfates. An increase in bacteria levels projected in 2008 has now become a concern for recreational use.

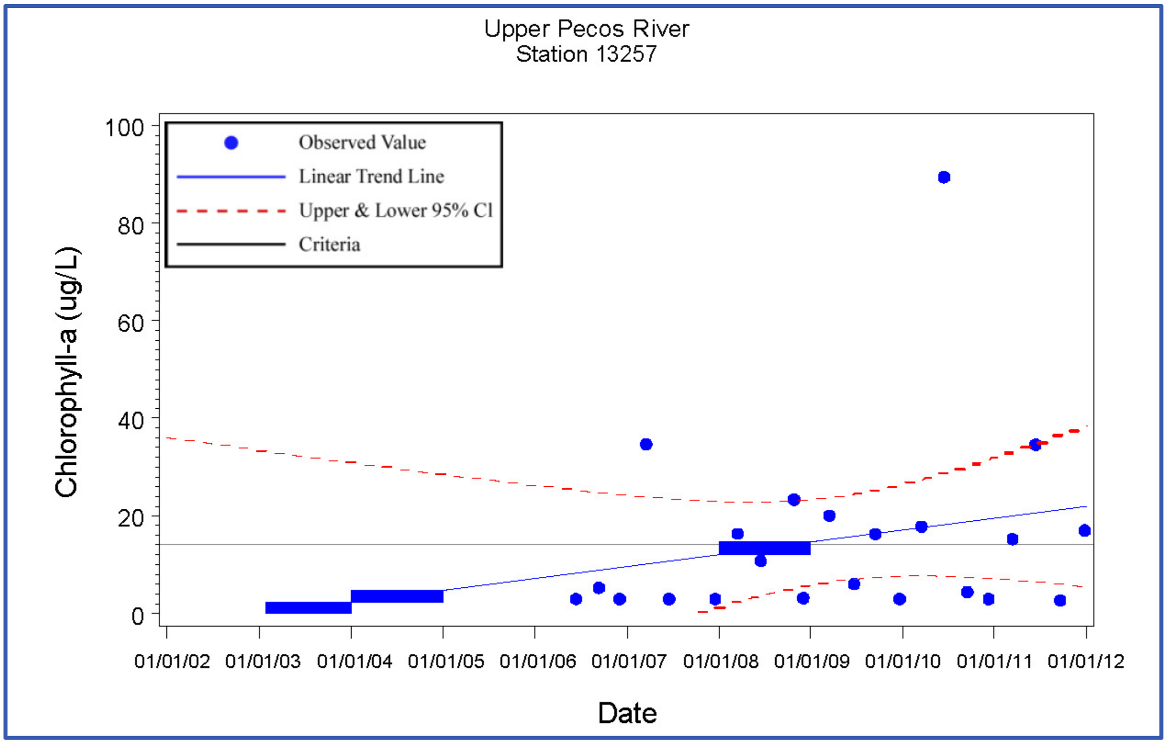


Figure 33. Increasing Chlorophyll-*a* Trend at Station 13257

Station 13258 is on the Pecos River at FM 1053 northeast of Imperial. This location has concerns for DO grab screening level and 24-hour DO minimum values, bacteria, chlorophyll-*a*, and fish consumption. **Station 13260,** located at the Pecos River at FM 1776 southwest of Monahans continues to exhibit aquatic life use concerns for 24-hour DO values, in addition to new concerns regarding the screening level for low DO grab samples. This location has concern for high chlorophyll-*a* levels. The 2008 trend analyses showed an increase in this parameter along with a slight increase in bacterial contamination with a decline in levels of chloride and conductivity. The results of *Enterococci* samples analyzed since 2008 have shown a concern for non-support of the PCR use. **Station 20399** is on the Pecos River near the intersection of RR 11 and Horse Head Road. This site has been included for concerns of bacteria, low DO levels, fish consumption, and chlorophyll-*a*.

The Pecos River at Monahans
Station 13260 in Assessment Unit 2311_03

Assessment Unit 2311_04 at Station 13259, located on the Pecos River at SH 18 south-southwest of Grandfalls, **Assessment Unit 2311_05 at Station 13264,** located on the Pecos River at SH 302 near Mentone, Texas, and **Assessment Unit 2311_07** at **Station 13261,** found on the Pecos River at U.S. Hwy 80 near Pecos, Texas, have no identified impairments but are all recognized as having fish kill concerns over the potential presence and toxic effects of golden algae. These three sites had limited data for the 2012 assessment. Sulfate at **Station 13261** showed an upward trend (see Figure 34).

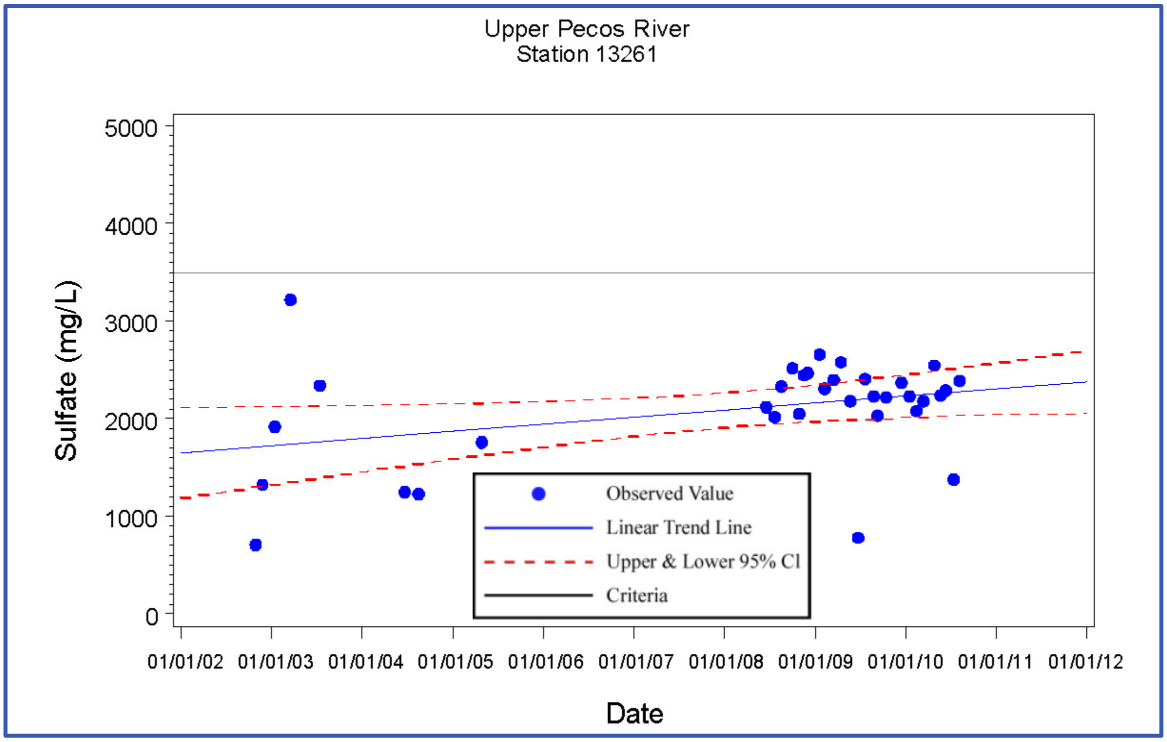


Figure 34. Increasing Sulfate Trend at Station 13261

Assessment Unit 2311_08 at **Station 13265** is found at FM 652 bridge northeast of Orla and downstream of the Red Bluff Dam. In times of drought, releases from reservoirs are often reduced or curtailed. Storage in the reservoir is affected by the delivery of water from New Mexico. Since this region is perennially under drought or near drought conditions, releases from the dam are infrequent; therefore flow in this portion of the river is highly intermittent. TCEQ has reported that periodic flow variations from irrigation releases at the dam were reducing downstream habitat through scouring of the streambed. A 2008 assessment yielded no concerns for screening levels, near non-attainment, or impairments. However, a 2012 assessment identified concerns for aquatic life (*in situ* DO), fish consumption (fish kills associated with golden algae blooms), and general (chlorophyll-*a*) designated uses. These concerns are likely a function of low to no flows, seasonal air temperature and associated DO values, and high evaporation rates.

Segment 2310: Lower Pecos River

The lower reach of the Pecos River is classified as a freshwater stream with a length of 89 miles (143 km). Its designated uses are high aquatic life use, PCR, general use, fish consumption, and public water supply. Waters from Independence Creek in the past have brought dissolved solids values down to treatable drinking water levels, but recent data show abnormally high values of chloride, sulfate, and TDS. The current assessment cycle for the two Pecos River AUs have identified a concern for golden algae blooms and associated fish kills. The potential for fish kills increase especially during stressful drought conditions. As the water levels in the river decrease through evaporation and lack of runoff, fish become stressed as they are confined into smaller areas of water, thus less DO is available for the aquatic community as they crowd into smaller volumes of water. Metabolic wastes or excretes (e.g., ammonia, carbon dioxide, nitrates) become more concentrated with a link to an increase in nuisance aquatic vegetation, and algae begin to develop as nutrient levels become more concentrated.

This segment contains five monitoring stations divided between three AUs that were assessed by TCEQ for water quality concerns and impairments (see Table 10). A total of 23 parameters among 3 stations (see Figure 35) were analyzed for trends along this segment. No significant parameter trends were analyzed for **Segment 2310** and unclassified Segment 2310A. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-21).

Table 10. Water Bodies Evaluated by TCEQ along Segment 2310

Lower Pecos River and Independence Creek (unclassified water body)					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Pecos River from the Devils River Arm of International Amistad Reservoir confluence upstream to FM 2083 near Pandale	2310_01	13240 16379	Golden Algae	Fish Consumption	Concern
Pecos River from FM 2083 near Pandale upstream to just upstream of the Independence Creek confluence	2310_02	13246 18801			
Independence Creek from the Pecos River confluence to the unnamed tributary 0.23 (0.7 km) upstream of SH 349	2310A	13109	NO IMPAIRMENTS OR CONCERNS		

Assessment Unit 2310_01 is monitored at two stations. **Station 13240** monitors the river conditions at USGS gage station No. 08447410 7.4 miles (11.9 km) east of Langtry and 15 miles (24.1 km) upstream of confluence with Rio Grande. **Station 16379** is on the Pecos River at a point 0.7 miles (1.1 km) downstream from U.S. Hwy 90 in Val Verde County and usually shows similar water quality conditions due to its proximity to **Stations 13240** and **16379**. This location is not listed as having concerns for screening levels or near non-attainment or impairments for its designated uses except for the potential of a fish kill due to events such as the current drought that could contribute to less than optimal conditions (e.g., low flow, high temperature, low DO).

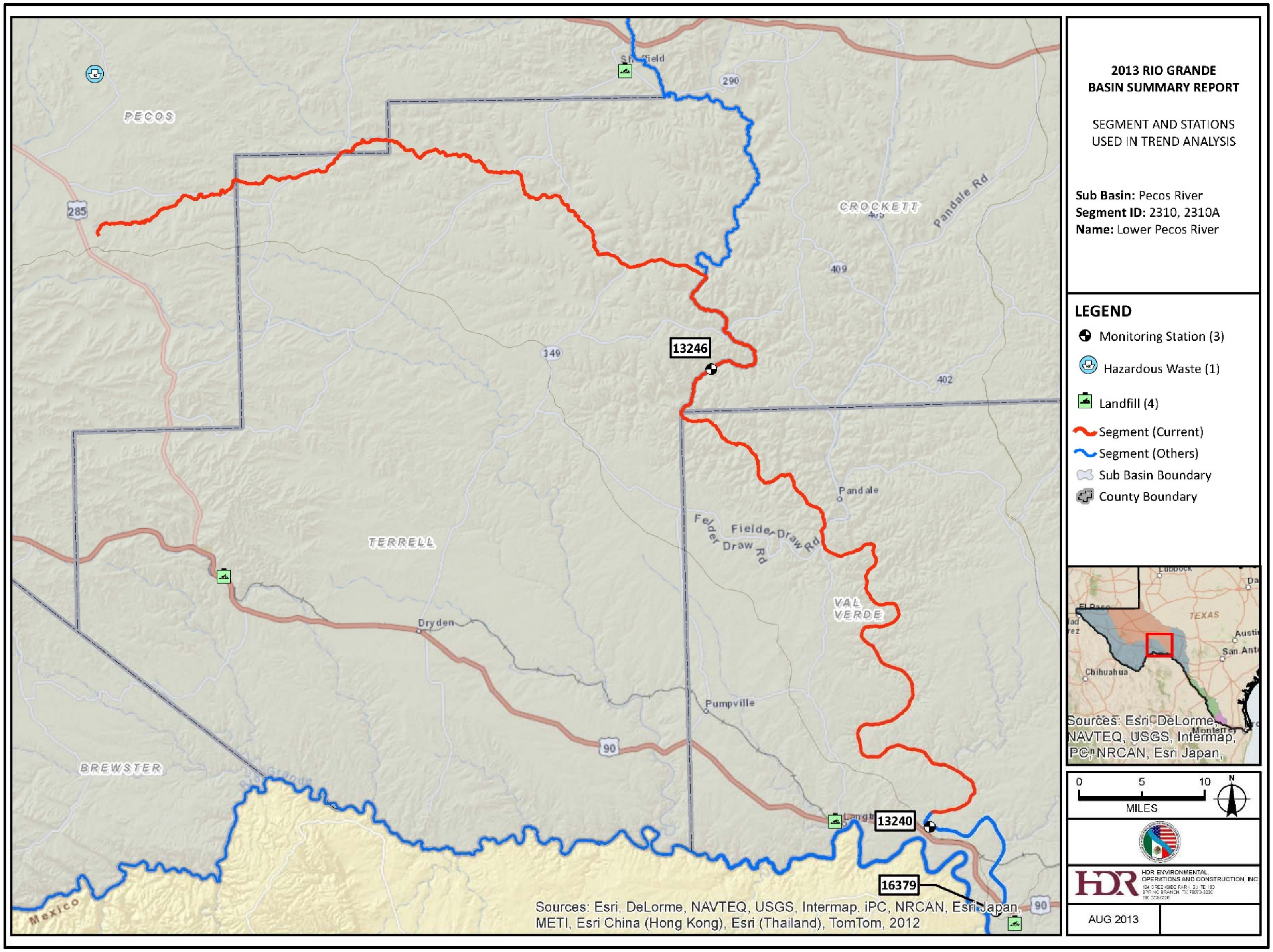


Figure 35. Monitoring Stations along Segment 2310

Assessment Unit 2310_02 is monitored at **Stations 13246** and **18801**. **Station 13246** is located on the Pecos River 4.67 miles (7.52 km) upstream of the Val Verde/Crockett/Terrell county line. **Station 18801** is a recently established location on the Lower Pecos River on the Brotherton Ranch upstream of the Terrell/Val Verde/Crockett County Line. Similar to the entire length of river segment, this area is subject to harsh low flow conditions that become stressful to the aquatic life, especially fish, when the river has lower assimilative capacities for metabolic waste inputs from point and nonpoint sources reducing the available DO content in the water. Reduced flows in this segment raises uncertainty over the availability of water for aquatic life. Concern remains for the potential effects of golden algae on the fish community at this location is another issue.

Assessment Unit 2310A at **Station 13109** is located on Independence Creek 0.5 miles (0.8 km) downstream of the John Chandler Ranch headquarters. This location has no reported impairments or concerns for screening levels or near non-attainment in 2012, fully supporting all of its designated uses.

Projects and Studies of Relevance to the Pecos River Sub-basin

Watershed Protection Plan - Texas A&M University, along with the USIBWC, TCEQ, the Texas Water Resources Institute, and the Texas State Soil and Water Conservation Board completed a 3-year USEPA-funded project to develop *A Watershed Protection Plan for the Pecos River in Texas*. Completed in 2009 after approval by stakeholders, the Watershed Protection Plan (WPP) is a collective guideline that addresses watershed concerns, impairments, and resource management issues to help determine the appropriate future management measures to implement for protection and improvement of water quality and quantity in the river basin. Two separate projects: (1) *Implementing the Pecos River Watershed Protection Plan through Invasive Species Control (Saltcedar) and by Providing Technical and Financial Assistance to Reduce Agricultural Nonpoint Source Pollution*, and (2) *Implementing the Pecos River Watershed Protection Plan through Continuous Water Quality Monitoring and Dissolved Oxygen Modeling* have been initiated for implementation of portions of the WPP to facilitate restoration of water quality in the river.

This plan is vital to the future of the Pecos River ecosystem as past changes in river hydrology, riparian community destruction, oil and gas activities, irrigation demands, long- and short-term droughts, damming of the river and the desertification of the upland watershed due to grazing mismanagement have negatively affected aquatic biodiversity. For more information on the project and to view reports developed from the research conducted by the various partnering agencies, visit the project Web site at http://pecosbasin.tamu.edu.

Aquatic Life Monitoring - The TCEQ is currently conducting aquatic life monitoring in the Sheffield area to document the biological response to a transition in the river between turbid high salinity water and spring-fed freshwater conditions between the communities of Orla and Girvin. The *Pecos River Aquatic Life Monitoring – Segments 2310 and 2311* project will supplement TCEQ's Use Attainability Analysis data to help demonstrate whether or not a water classification involving the removal of a use designation or site-specific adjustment to the applicable water quality criteria is appropriate. The results of this study will be available in FY 2014.

Arsenic - A group of researchers at the University of Texas at El Paso published a paper that focused on arsenic concentrations in groundwater and soil.[10] The review focuses on the occurrence and treatment of arsenic in northern Mexico, specifically Chihuahua and Coahuila, and the bordering southwestern states in the U.S., which include New Mexico, Arizona, and Texas, all of which are known historically for containing high concentrations of natural and anthropogenic sources of arsenic.

Salinity Special Study - TCEQ, USIBWC CRP, and Texas AgriLife Research are conducting a special study in the Pecos River to determine possible sources contributing to the increasing salinity in the upper Pecos River. TCEQ collected monthly samples at six stations from 2008 to 2010 between the communities of Girvin and Imperial where recorded salinity is highest. Texas AgriLife is currently evaluating the data to help determine the salt load and source of salinity in the river. TDS values greater than 5,000 mg/L enter Texas in the Pecos River and climb to an average value of 20,000 mg/L as the water continues movement downstream to Girvin.

Pecos River Water Quality Coalition - The coalition's goal is to reduce salinity concentrations and impacts to increase usable water supplies for agricultural, urban, and environmental purposes. This coalition is working in both the Texas and New Mexico portions of the watershed along with the Pecos River WPP. Authored by State Senator Carlos Uresti and State Representative Pete Gallego, this resolution passed to reauthorize appropriate funding to the U.S. Army Corps of Engineers to solve the salinity problems in the Rio Grande Basin, including the Pecos River watershed.

Initial Watershed Assessment of the Pecos River Watershed - The USGS, in cooperation with the U.S. Army Corps of Engineers, is conducting an Initial Watershed Assessment (IWA) of the Pecos River watershed in New Mexico and Texas. An IWA is the initial phase in the development of the Corps watershed assessment which will be used to achieve integrated water resources management in the basin and address watershed issues such as elevated salinity. The purpose of an IWA is to determine if there is Federal interest in pursuing a Watershed Assessment (WA) of the basin, and more detailed studies of watershed problems.

Water Quality Strategy Plan - In New Mexico, the Lower Pecos River Watershed Alliance Strategy Plan was developed as a guide to protect and improve the watershed area from Santa Rosa Dam to the Texas state line that will prove beneficial for Red Bluff Reservoir and the Pecos River Sub-basin over time.

Middle Rio Grande Sub-basin

The Middle Rio Grande Sub-basin is the portion of the Rio Grande from downstream of the International Amistad Dam to International Falcon Reservoir. The pristine spring waters of San Felipe Creek in the southeastern tip of Val Verde County flow directly into the Rio Grande downstream of the International

[10] Camacho, L.M., M. Gutierrez, M.T. Alarcon-Herrera, M.L. Villalba, and S. Deng. 2011. *Occurrence and Treatment of Arsenic in Groundwater and Soil in Northern Mexico and Southwestern USA.* Chemosphere 83(3): 211-225.

Amistad Dam that help mitigate Rio Grande water quality through groundwater contributions. The City of Del Rio, Texas, is the only large city along this section of river that uses the groundwater from the San Felipe Springs as its principal water supply. The downstream communities of Eagle Pass, Texas, and Laredo, Texas, rely on the river as their principal domestic and agricultural use water supply. Water for irrigation is directed through the Maverick Irrigation District canal system that starts above Eagle Pass, Texas, and continues for more than 100 miles (161 km) to a point immediately south of Laredo, Texas.

The discharge of water from International Amistad Dam is based on the allocation of water rights in the U.S. and Mexico and releases are passed on to International Falcon Dam for further downstream distribution. As is the case along the international border throughout Texas, sister cities located along this reach struggle to stay ahead of development to provide the infrastructure to minimize pollution entering the Rio Grande. There are 57 permitted dischargers to the Sub-basin: 1 hazardous waste site, 20 landfills, 27 wastewater outfalls, 2 CAFOs, and 7 solid waste disposal facilities. The Sub-basin contains 3 segments and 16 AUs (see Figure 36).

Segment 2313: San Felipe Creek

San Felipe Creek is a pristine water source that originates in the Del Rio area in Val Verde County, Texas. A series of 10 springs collectively known as the San Felipe Springs arise to form the headwaters of San Felipe Creek. This spring-fed stream flows through portions of Del Rio while providing a high-quality water supply source for drinking, fishing, and swimming. The West Spring and East Spring provide the public water supply for Del Rio and Laughlin Air Force Base. Surrounding urban parks with high scenic and recreational value and continued growth are under scrutiny for potential impacts on this creek, especially regarding bacteria. Irrigation water is also removed from the creek before it enters the Rio Grande.

Segment 2313 is designated for high aquatic life, PCR, general use, fish consumption, and public water supply use. All uses were fully supported and no sites in this segment are listed as impaired. The latest data assessed show a concern for bacteria. This creek has a positive effect on the water quality of the Rio Grande at its confluence as it proceeds downstream to other communities. There are three monitoring stations available for TCEQ assessment (see Table 11), which all show a concern for *E. coli*. A total of 10 parameters among three stations were analyzed for trends (see Figure 37). Sulfate showed a statistically significant upward trend at **Station 15821** (see Figure 38) while no significant trends were observed upstream of U.S. Hwy 90 or downstream of the Del Rio WWTP. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-23).

Table 11. Water Bodies Evaluated by TCEQ along Segment 2313

San Felipe Creek					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
From the Rio Grande confluence to the San Felipe Springs upstream of U.S. Hwy 90	2313_01	15820 15821 13270	*E. coli*	Recreation	Concern

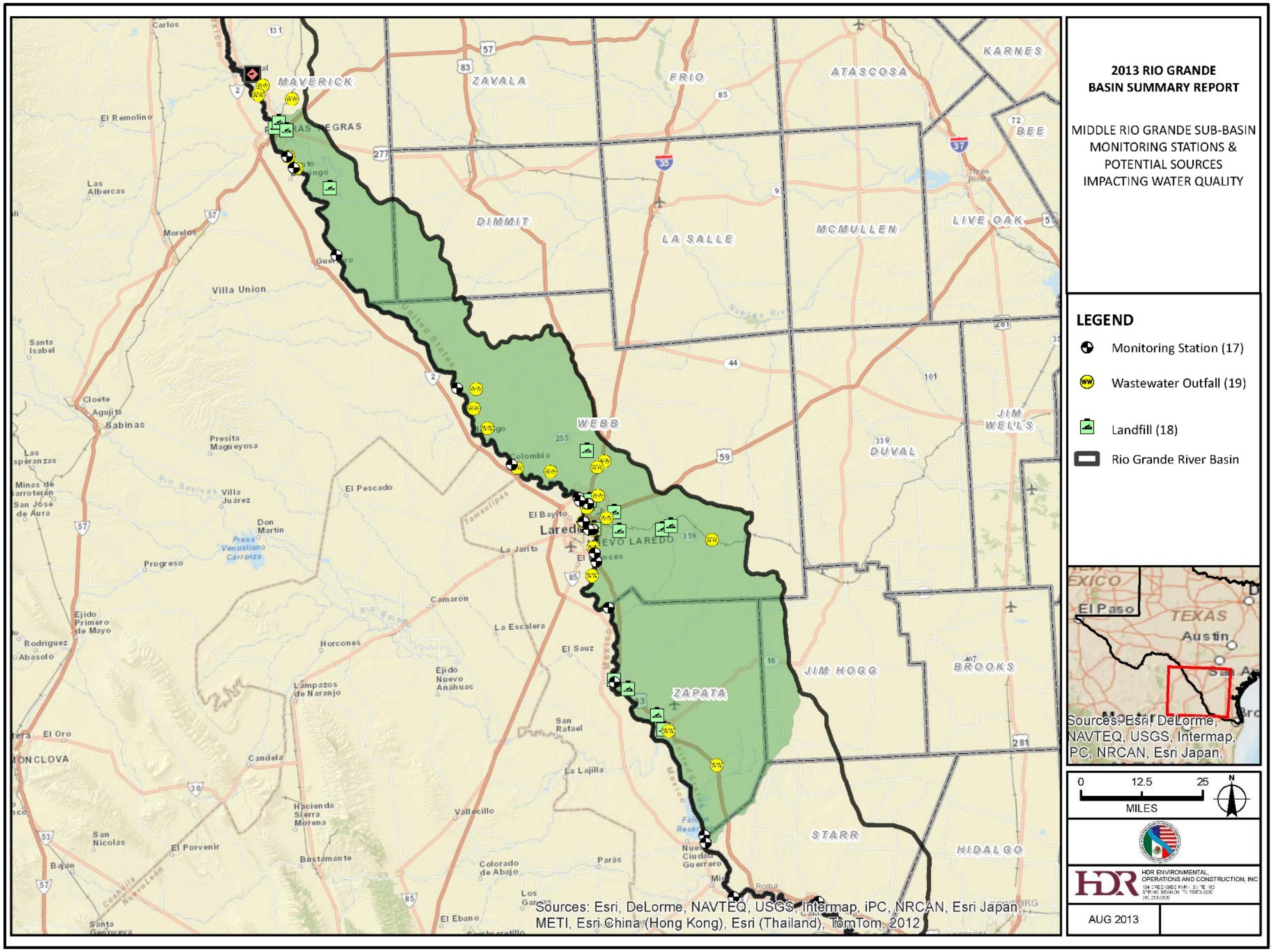


Figure 36. Middle Rio Grande Sub-basin Monitoring Stations and Permitted Dischargers

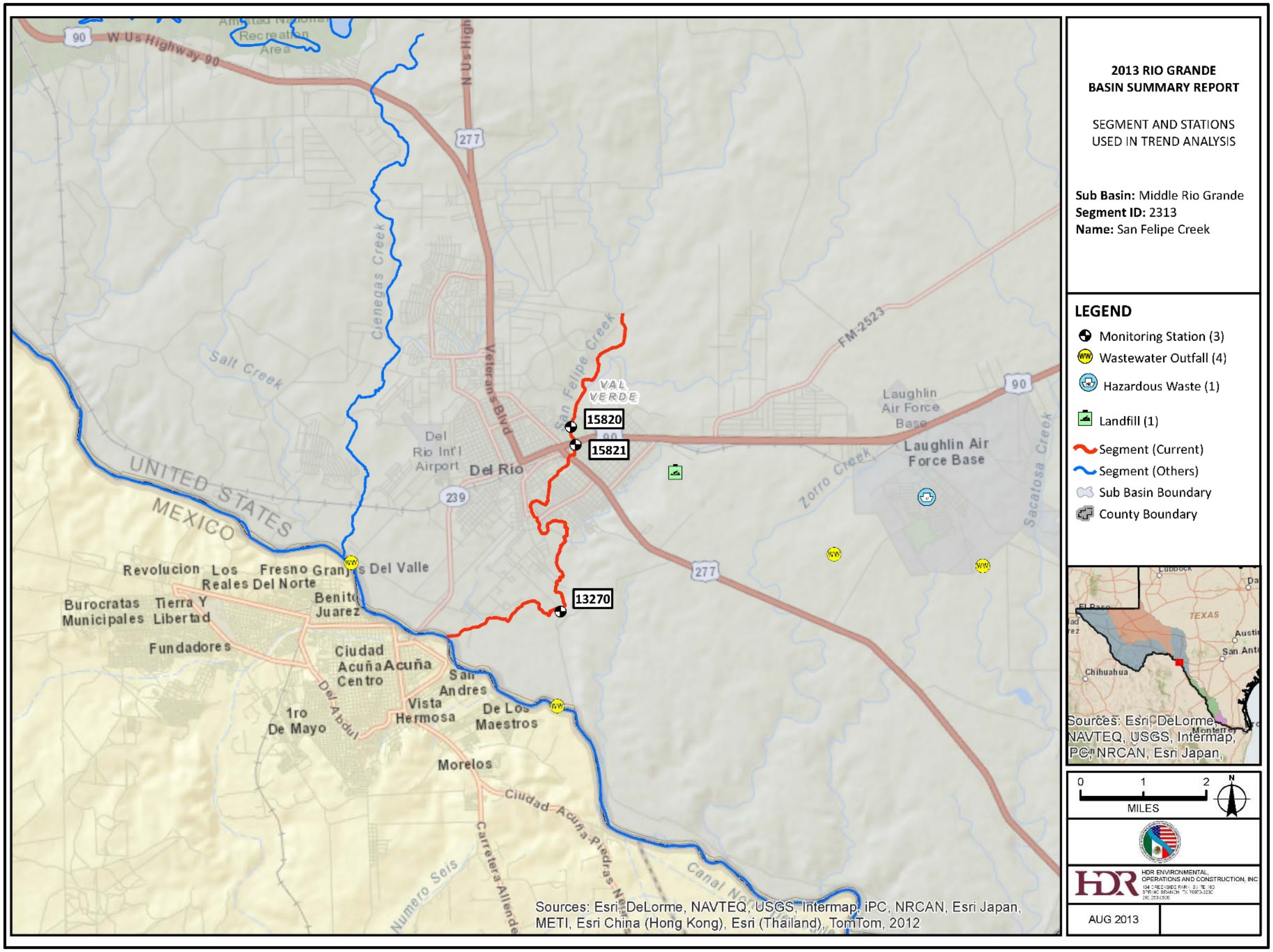


Figure 37. Monitoring Stations along Segment 2313

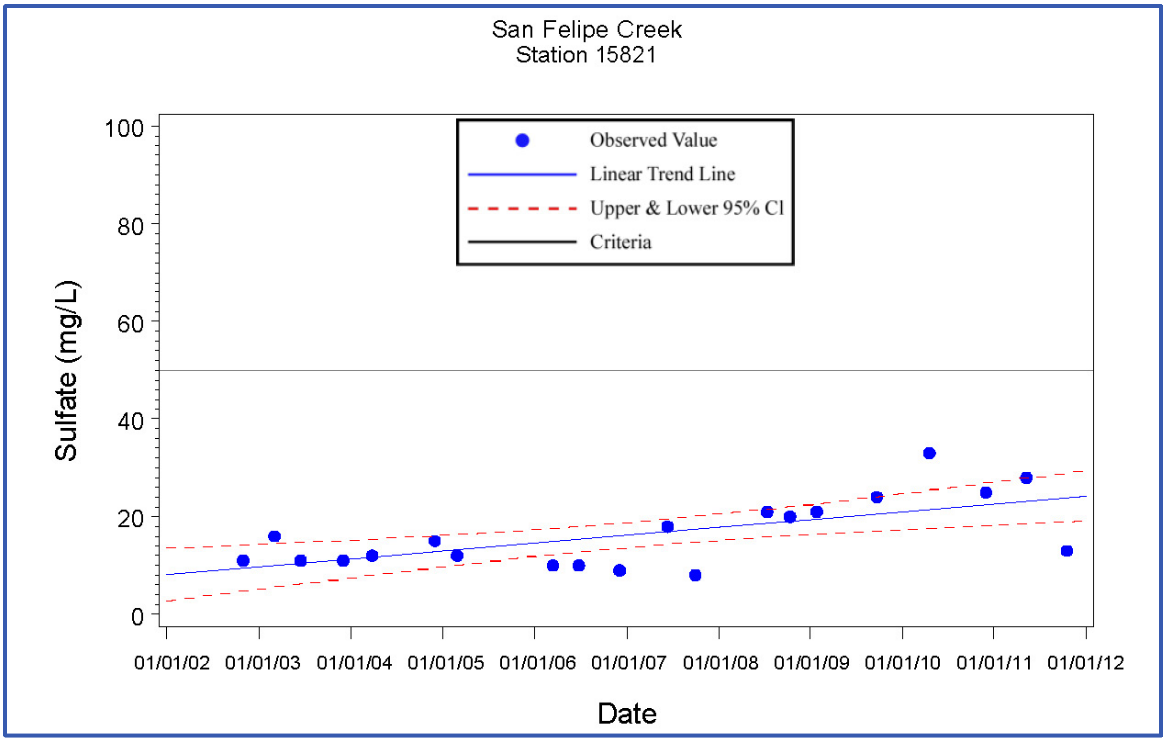


Figure 38. Increasing Sulfate Trend at Station 15821

Assessment Unit 2313_01 is monitored from upstream to downstream on San Felipe Creek at **Stations 15820**, **15821**, and **13270**. **Station 15820** is found at West Springs, near West Wells upstream of the U.S. Hwy 90 Bridge in Del Rio. Data collected from this location show a concern for *E. coli*. West Springs is a steady flowing spring that provides a source of water supply for Del Rio. Parkland surrounding the creek offers several recreational opportunities to locals and tourists. No trends were established for the five water quality constituents meeting the 20 minimum data point criteria (DO, pH, conductivity, water temperature, and transparency). **Station 15821** is immediately downstream of **Station 15820** at the Blue Hole flood gates, in Lions Park between the U.S. Hwy 90 Bridge and the Southern Pacific Railroad Bridge in Del Rio, Texas. Generally increasing trends for pH, chloride, sulfate, and conductivity were all noted at this location. Higher concentrations of major ions including chloride and sulfate affect the measured specific conductance. Since West Springs is grouped with several other springs that supply water to San Felipe Creek, downstream water quality could be affected by high sediment loads created by rainfall-induced runoff to the aquifer's recharge zone. The presence of various domestic wildlife wastes and associated coliform bacteria in Lions Park could pose a health hazard to swimmers at the Blue Hole and contribute to higher bacteria levels downstream, especially after rainfall events. **Station 13270** is on San Felipe Creek near Guyler Avenue approximately 2 miles upstream of its confluence with the Rio Grande. No significant trends were identified for *E. coli*, nutrients, or dissolved solids for the area downstream of the Del Rio WWTP.

Segment 2304: Rio Grande below International Amistad Reservoir

Segment 2304 is defined as the Rio Grande just downstream of International Amistad Reservoir to the confluence of the Arroyo Salado in Zapata County. The segment is 226 river miles (364 km) in length. The sister cities of Del Rio, Texas, and Ciudad Acuña, Coahuila; Eagle Pass, Texas, and Piedras Negras, Coahuila; Laredo, and Nuevo Laredo, Tamaulipas, are located in this part of the Rio Grande Basin. This area has experienced rapid urban growth during the past 10 years. The designated uses for this segment are high aquatic life, PCR, general uses, fish consumption, and public water supply.

Segment 2304 was placed on the 2012 Texas Index of Water Quality Impairments for *E. coli* bacteria. This segment is impaired for PCR due to high bacteria counts below Del Rio and near Laredo. Concerns along this segment include nitrate and DO depletion from below the dam to the confluence with San Felipe Creek and toxicity in ambient water near Laredo. There are 23 established monitoring stations available for TCEQ assessment in this segment that are subdivided further into 10 AUs and are located primarily within the populated areas along the river. A total of 26 parameters were considered for trend analysis from 18 eligible stations (see Figure 39) assessed by TCEQ along this segment (see Table 12). Several parameters including nitrogen, phosphorus, *E. coli*, chloride, sulfate and TDS showed statistically significant trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-24).

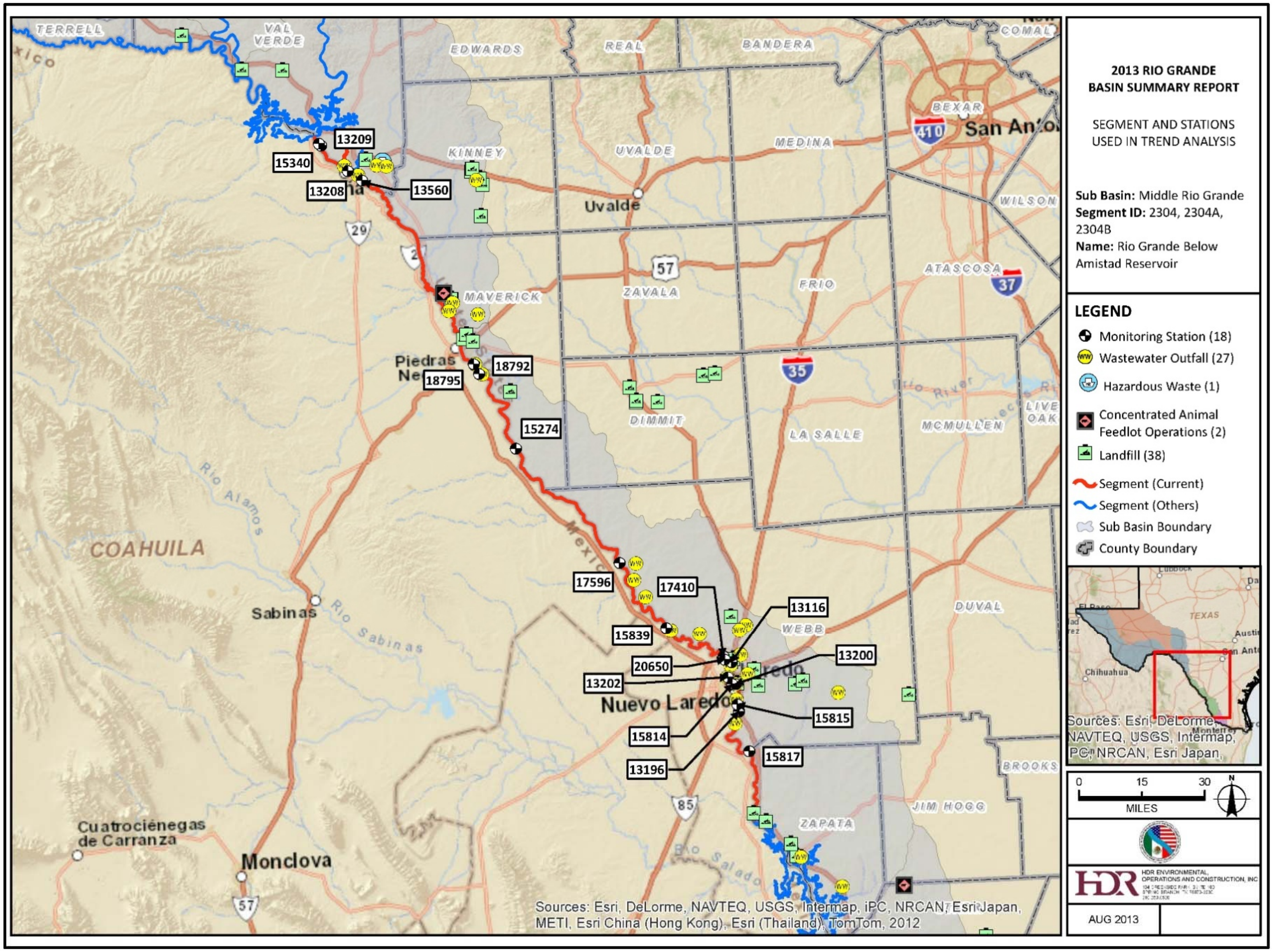


Figure 39. Monitoring Stations along Segment 2304

Table 12. Water Bodies Evaluated by TCEQ along Segment 2304

Rio Grande Below International Amistad Reservoir and Manadas Creek (unclassified water body)					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Rio Grande from the Arroyo Salado confluence upstream to the San Idelfonso Creek confluence	2304_01	15817 15816 13196	*E. coli*	Recreation	***Impairment***
Rio Grande from the San Idelfonso Creek confluence upstream to International Bridge #2	2304_02	15815 13200			
Rio Grande from the International Bridge #2 upstream to the City of Laredo water treatment plant intake	2304_03	13201 15814	*E. coli* Water Toxicity		***Impairment*** Concern
Rio Grande from the City of Laredo water treatment plant intake upstream to the World Trade Center Bridge	2304_04	13202 15813 20650	Water Toxicity		Concern
Rio Grande from the World Trade Center Bridge upstream to the Columbia Bridge	2304_05	17410 13204	NO IMPAIRMENTS OR CONCERNS		
Rio Grande from the Columbia Bridge upstream to El Indio	2304_06	15839 17596 15274			
Rio Grande from El Indio upstream to downstream of U.S. Hwy 277 (Eagle Pass)	2304_07	18792 18795	*E. coli*	Recreation	***Impairment***
Rio Grande from downstream of U.S. Hwy 277 in Eagle Pass upstream to the Las Moras Creek confluence	2304_08	13205 13206	NO IMPAIRMENTS OR CONCERNS		
Rio Grande from the Las Moras Creek confluence upstream to the San Felipe Creek confluence	2304_09	13560	*E. coli*	Recreation	***Impairment***
Rio Grande from the San Felipe confluence upstream to International Amistad Dam	2304_10	13208 13209 14092 15340	NO IMPAIRMENTS OR CONCERNS		
Manadas Creek from the Rio Grande confluence in Laredo to a point 0.8 miles (1.3 km) upstream of Bob Bullock Loop	2304B_01	13116	*E. coli* Chlorophyll-*a*	Recreation General	Concern

Assessment Unit 2304_01 has three monitoring stations where the *E. coli* geometric mean of 279.48 MPN/100 mL resulting from 139 observed samples within the cities of Laredo and Nuevo Laredo exceeded the stream standard of 126 MPN/100 mL. All stations have shown a trend for bacteria. High nutrient levels, notably ammonia, have been indicative of poorly treated municipal wastewater. **Station 13196** is at the Pipeline Crossing, 8.6 miles (13.9 km) below Laredo, and is heavily influenced by source pollutants. The trend analysis showed an increase in bacteria over time (see Figure 40).

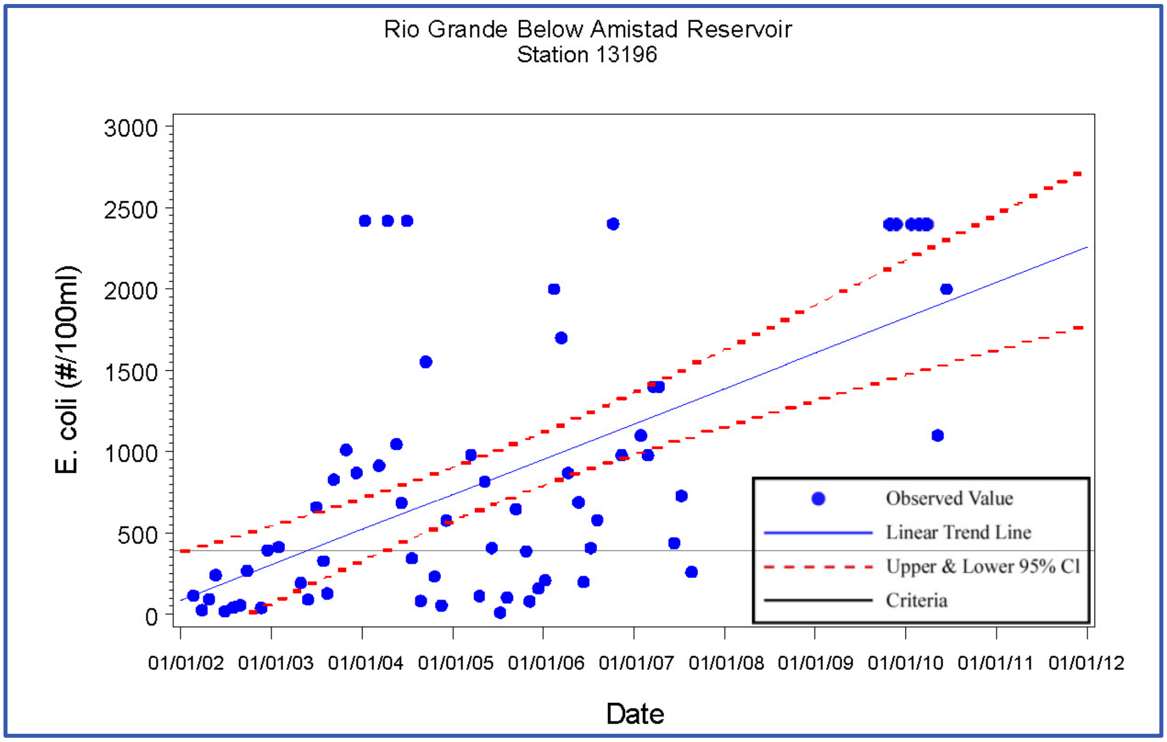


Figure 40. Increasing *E. coli* Trend at Station 13196

Station 15816 at Rio Bravo downstream of the community of El Cenizo, has a history of standards violations for fecal coliform bacteria. This station is located downstream of the highly urbanized portion of river. **Station 15817**, located on the Rio Grande at the Webb/Zapata County line, is impaired for bacteria.

Assessment Unit 2304_02 is represented by two stations in Laredo. **Station 15815** is at Masterson Road 6.2 miles (9.9 km) downstream of the International Bridge #1. **Station 13200**, historically reported as **Station 13201**, is in Azteca Park upstream of the confluence with Zacata Creek. These two locations have a history of being impaired for bacteria levels exceeding the water quality standards.

Water quality for **Assessment Unit 2304_03** is monitored at two stations downstream of the Laredo WTP. **Station 15814** is established at the Juárez-Lincoln International Bridge #2. This location continues to show impairment for high bacteria levels and concern for water toxicity. High nutrient and chlorophyll-*a* levels are common as well. The Laredo WTP appears as the prime point source for bacteria and nutrient loading to the immediate downstream reaches. The other sampling point is at **Station 13201** located upstream of the U.S. Hwy 81 bridge in Laredo.

Assessment Unit 2304_04 is monitored by **Stations 13202**, **15813**, and **20650.** The entire AU has been identified by TCEQ as having an ambient water toxicity concern. Bacteria levels according to the 2012 assessment are meeting the TSWQS standards. **Station 13202** is located at the Laredo Water Treatment Plant pump intake; **Station 15813** is fixed at the CP&L Power Plant Intake, and **Station 20650** is situated in Father McNaboe City Park. The data at **Station 13202** met criteria for trend analysis and an increase in chloride was observed (see Figure 41).

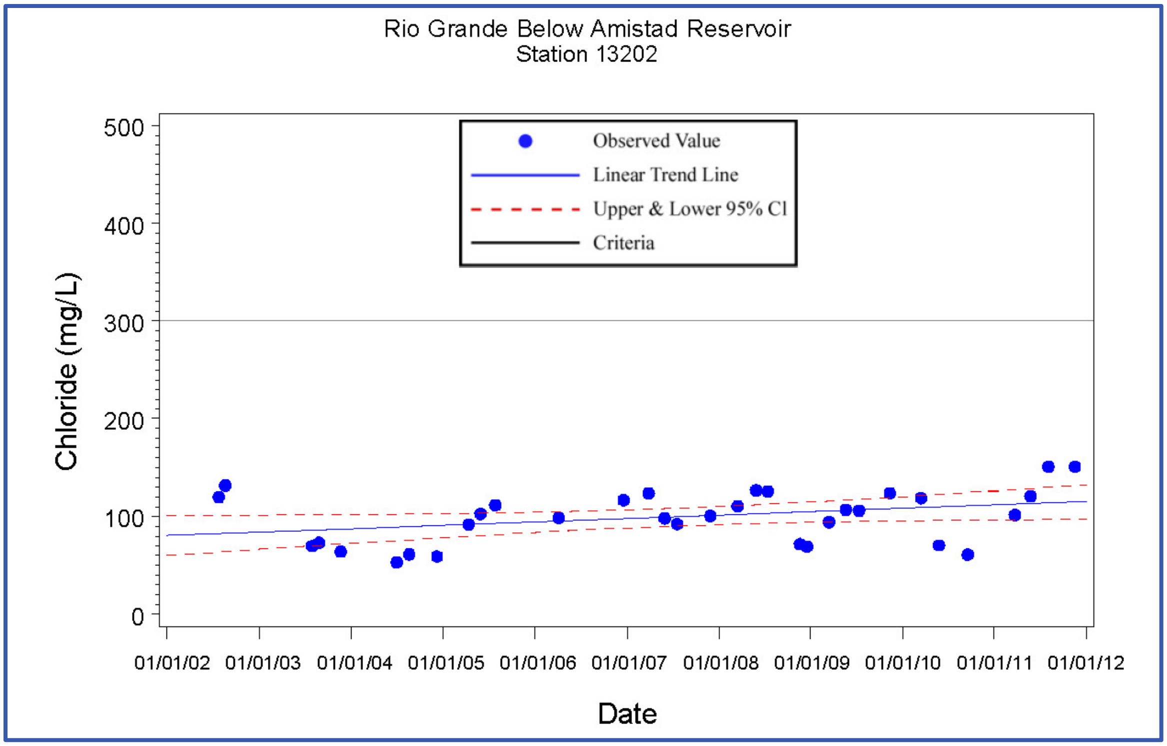


Figure 41. Increasing Chloride Trend at Station 13202

Assessment Unit 2304_05 is monitored by two stations between two international bridges, the World Trade Center Bridge and the Columbia Bridge. **Assessment Unit 2304_06** is monitored in three distinct areas from Columbia Bridge upstream to El Indio. Water quality within this river reach show no impairments or concerns for screening levels or near non-attainment. Representative areas sampled for assessment include the Rio Grande at World Trade Bridge on FM 3484 (**Station 17410**); at Dolores Ranch 26.3 mi (42.4 km) upstream of the Laredo WTP intake (**Station 13204**); the Colombia Bridge upstream of the Dolores Pump Station and upstream of Laredo/Nuevo Laredo (**Station 15839**); Apache Ranch (**Station 17596**); and the USIBWC Weir Dam 6 miles (10 km) south of El Indio, 0.6 miles (1 km) downstream of Cuervo Creek (**Station 15274**). Trend analysis revealed an overall increase in TDS at **Station 17596** (see Figure 42).

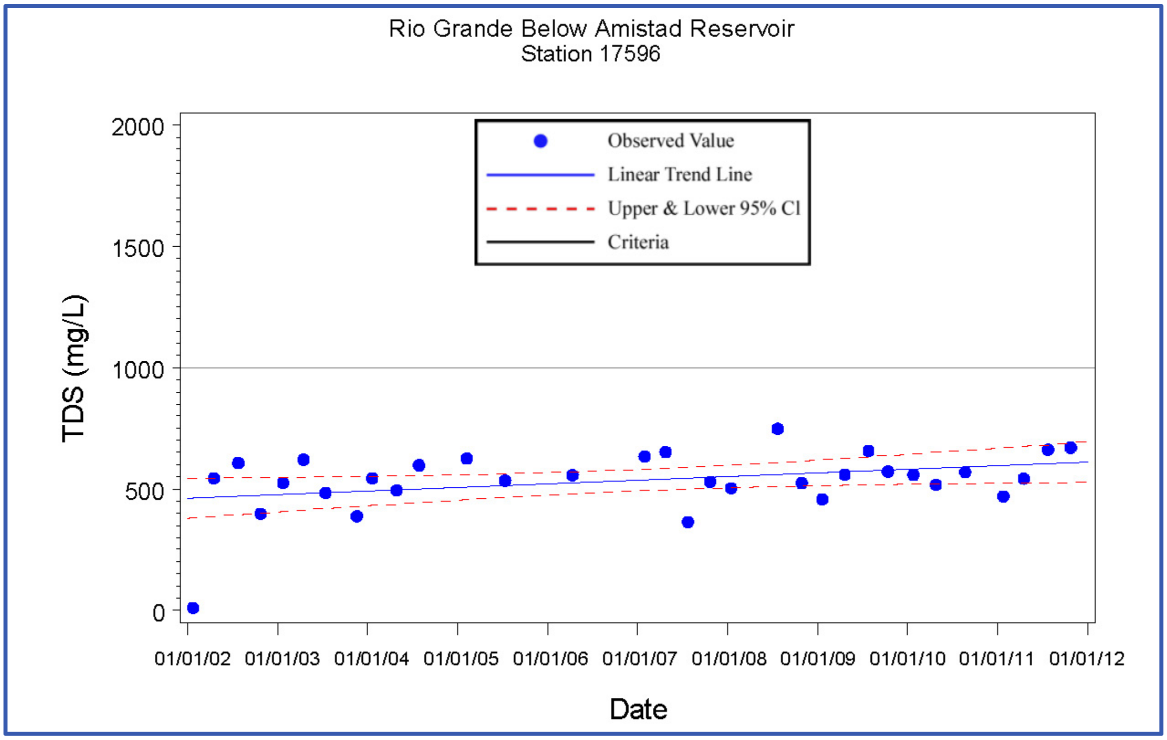


Figure 42. Increasing TDS Trend at Station 17596

The water quality of **Assessment Unit 2304_07** is monitored at four described locations in the Eagle Pass area. As the river flows through Eagle Pass, bacteria levels begin to increase. This AU is listed for not meeting its designated recreation use as the geometric mean of 56 samples of *E. coli* bacteria assessed was 543 MPN, exceeding the criteria of 126 MPN for PCR. Formerly **Station 13205, Station 18792** is found at the Kickapoo Casino on Riverside Drive south of Eagle Pass and downstream of municipal discharges. Access to **Station 18795** is on Maverick County Hwy 523 to the Kickapoo Reservation south of Eagle Pass.

Assessment Unit 2304_08 is monitored in Eagle Pass at **Stations 13205** and **13206** and neither location is listed for any impairments or concerns for screening levels or near non-attainment. **Station 13205** is located near irrigation canal lateral 50 at the U.S. Hwy 277 Bridge and **Station 13206** is at U.S. Hwy 277.

Assessment Unit 2304_09 is in the upper limit of this river segment, which is monitored by **Station 13560** at the Moody Ranch 4.5 miles (7.2 km) downstream of Del Rio. This area is located on the Rio Grande just below the confluence of San Felipe Creek where spring-fed water enters the river. Historically, this site is listed for impairment caused by high bacteria levels. A park surrounding a spring-fed pool attracts groups of people for swimming and fishing.

The Rio Grande Upstream of U.S. Hwy 277 near Del Rio Station 13208 in Assessment Unit 2304_10

Assessment Unit 2304_10 covers the area between the San Felipe Creek confluence with the Rio Grande upstream of the International Amistad Dam. This area is not listed for any impairments or concerns for screening levels or near non-attainment. The four sampling areas are at **Station 13208** found downstream of International Amistad Dam on the Rio Grande and upstream of U.S. Hwy 277 Bridge in Del Rio; at **Station 13209** established downstream of the International Amistad Dam and northwest of Del Rio; at **Station 15340** located downstream of International Amistad Dam and upstream of the weir dam at USIBWC gage #08-4509.00; and at **Station 14092** and Weir 1 Station 131.00 situated on the Rio Grande downstream of the International Amistad Dam. Trend analysis revealed a statistically significant increase in *E. coli* at **Station 13208** (see Figure 43).

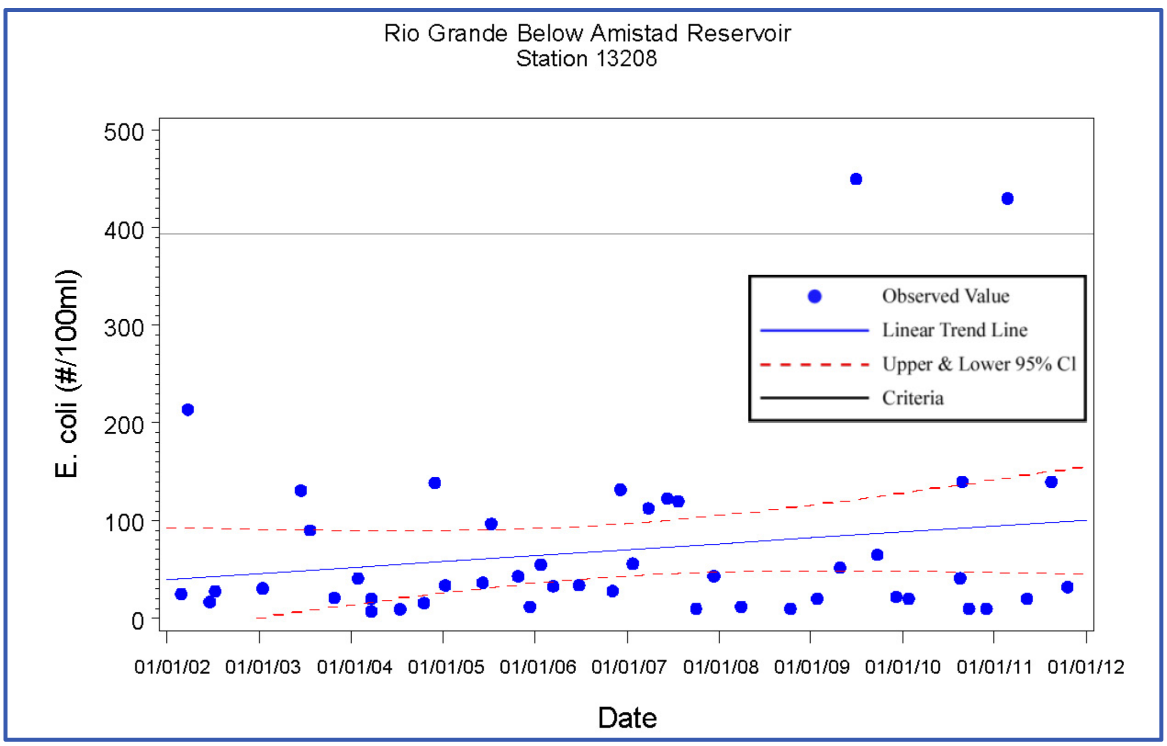


Figure 43. Increasing *E. coli* Trend at Station 13208

Assessment Unit 2304B_01 is monitored at **Station 13116** on Manadas Creek, an unclassified small perennial stream at FM 1472 in northwest Laredo. Assessment of the available data shows concerns for near non-attainment of *E. coli* and chlorophyll-*a* screening levels. It has not been uncommon for bacteria values to exceed the standards set for this creek, which is located adjacent to recent urban and industrial developments where their sources are likely due to runoff from urban areas. A special study has previously been conducted at this location to survey impacts from potential industrial pollutants. Although not officially listed, the special study results show detection of dissolved metals due to previous industrial activity.

Most of the stations in **Segment 2304** are concentrated near Laredo and receive discharges from several wastewater outfalls resulting in significantly increased *E. coli* concentrations. Other contributing sources of high bacteria are likely due to urban runoff and discharges outside of U.S. jurisdiction.

Segment 2303: International Falcon Reservoir

Segment 2303 is defined as the length of the Rio Grande impounded by the International Falcon Dam at a normal pool elevation of 301 feet (91.7 meters). The area of the lake varies from 87,000 acres at elevation 301.2 feet to 115,400 acres at the maximum elevation of 314.2 feet. The dam and reservoir provide for water conservation, flood control, hydroelectric energy, and recreation. The water level is almost 44 feet below conservation level or 18.5 percent of total capacity. Water stored by the reservoir is released based on downstream requests from municipalities and irrigation districts. Long-term fluctuations in nitrate and ammonia levels have shown a wide range of values prompting recurring apprehensions that have again resurfaced in 2012. The designated uses for the reservoir include PCR, high aquatic life, fish consumption, and public water supply use. Three TCEQ monitoring locations have been established for reservoir sampling (see Table 13). The majority of water quality data used for TCEQ water quality assessment of **Segment 2303** is collected near the Zapata Water Treatment Plant (WTP) intake. A total of 14 parameters among 2 stations (see Figure 44) were analyzed for potential trends. All data available to perform trend analysis for each parameter assessed as a concern in 2012 showed that no significant trends were found in this segment. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-30).

Table 13. Water Bodies Evaluated by TCEQ along Segment 2303

<table>
<tr><th colspan="6">International Falcon Reservoir</th></tr>
<tr><th>Water Body Name and Location</th><th>Water Body ID</th><th>Assessment Station ID</th><th>Parameter</th><th>Designated Use</th><th>2012 Status</th></tr>
<tr><td>Area around International Monument XIV</td><td>2303_01</td><td>No Stations</td><td colspan="3">NO IMPAIRMENTS OR CONCERNS</td></tr>
<tr><td rowspan="5">Area around Zapata WTP intake</td><td rowspan="5">2303_02</td><td rowspan="5">15818</td><td>Ammonia</td><td rowspan="4">General</td><td rowspan="5">Concern</td></tr>
<tr><td>Nitrate</td></tr>
<tr><td>Total Phosphorus</td></tr>
<tr><td>Ortho-Phosphorus</td></tr>
<tr><td>Water Toxicity</td><td>Aquatic Life</td></tr>
<tr><td>Area around Monument I</td><td>2303_03</td><td>13189</td><td colspan="3" rowspan="2">NO IMPAIRMENTS OR CONCERNS</td></tr>
<tr><td>Remainder of segment</td><td>2303_04</td><td>15819</td></tr>
</table>

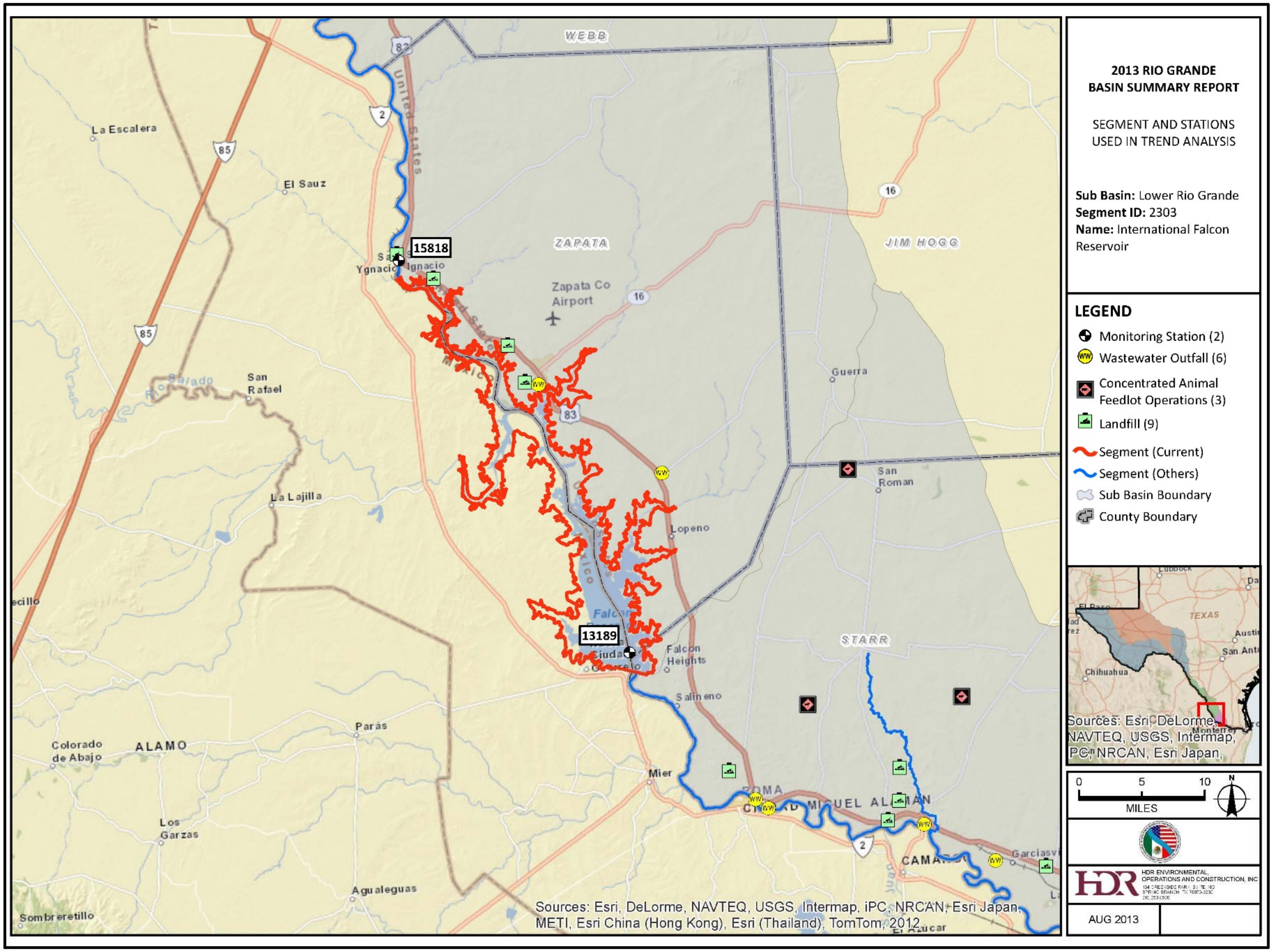


Figure 44. Monitoring Stations along Segment 2303

Although no TCEQ monitoring stations were specified in the 2012 Texas IR for **Assessment Unit 2303_01**, assessments were made by TCEQ in 2012 from other data sources for TDS, chloride, sulfate, fluoride, and nitrate.

Assessment Unit 2303_02 at Station 15818 is found on the International Falcon Reservoir at the San Ygnacio WTP intake west of the U.S. Hwy 83/FM 3169 intersection. The 2012 assessment showed general use screening level concerns for nitrate, total phosphorus, and ortho-phosphorus; and an aquatic life use concern for water toxicity. Otherwise, the remaining data were found to fully support the assessed public water supply and recreation uses.

Assessment Unit 2303_03 at Station 13189 is on the International Falcon Reservoir at the International Boundary Monument #1. Trend analysis conducted at this location indicates an upward trend in sulfate (see Figure 45) and chlorophyll-*a* (see Figure 46). **Assessment Unit 2303_04 at Station 15819** is found on the International Falcon Reservoir at the Zapata WTP intake just offshore and midway between the international boundary markers 12 and 13. These two reservoir AUs were not listed for any impairments or concerns in 2012.

International Falcon Reservoir at Dam
Assessment Unit 2303_03

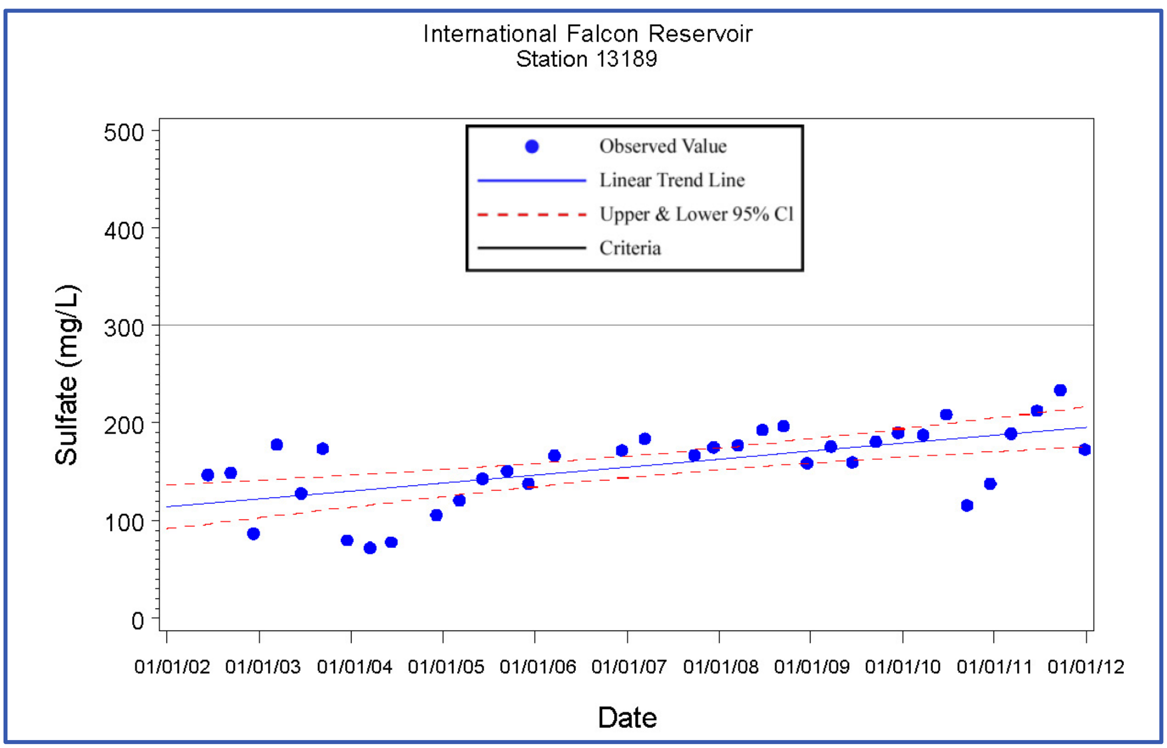


Figure 45. Increasing Sulfate Trend at Station 13189

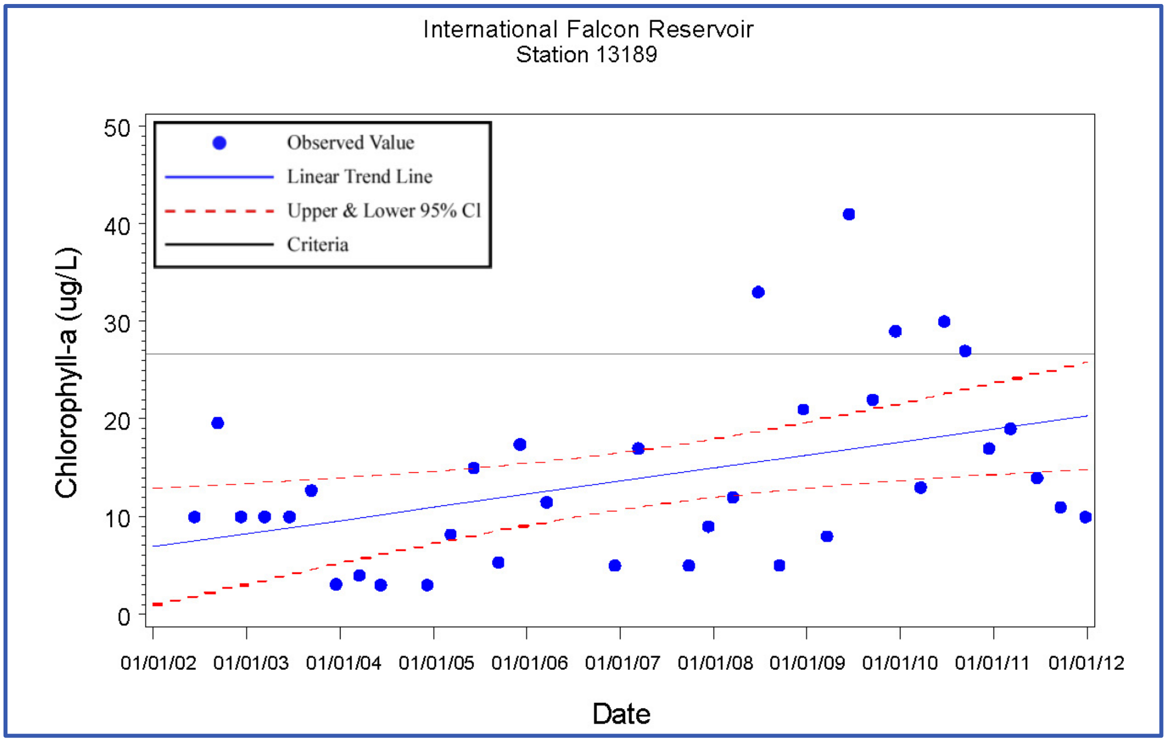


Figure 46. Increasing Chlorophyll-*a* Trend at Station 13189

Projects and Studies of Relevance to the Middle Rio Grande Sub-basin

Bacteria Special Study - A review of the 2012 water quality data assessment demonstrates that bacteria contamination continues to occur within and below communities that border the Rio Grande. Bacteria levels in the Laredo/Nuevo Laredo stretch of the Rio Grande have been high for decades. The increases typically occur below irrigation return drains and tributaries, which are thought to be the main source of contamination due to wastewater discharges. Both cities are working to address this problem by constructing new WWTP plant facilities and upgrading existing collection systems. On the U.S. side, the Laredo area has four major wastewater treatment facilities with increasing efforts for infrastructure expansion and improvements. On the Mexico side, Nuevo Laredo also has several wastewater treatment facilities, including the Nuevo Laredo International WTP constructed in the 1990s. While the combined infrastructure on both sides of the border has decreased bacteria levels in the river, bacteria levels still remain above the U.S. and Mexican acceptable standards.

The USIBWC's Texas CRP, along with participating entities (City of Laredo Health Department Laboratory, Texas A&M International University, Rio Grande International Study Center, Laredo Community College, and TCEQ Laredo Regional Office) conducted a special investigation of the bacteria levels. Historical U.S.-collected data have shown that bacteria levels spike between routine monitoring **Station 13202** at the Jefferson Plant Intake and **Station 15814** at the International Bridge #2. Monitoring was conducted in May and August 2011 to characterize the bacteria contamination through intensive monitoring and to survey possible sources of contamination. The Target Area was between the two routine stations where bacteria levels are problematic. A total of 118 water samples were collected and tested for *E. coli* and fecal coliform bacteria at 49 stations along a 27-mile (43-km) stretch of the river.

Samples were collected at or near the point of discharge for 10 identified features, or at the confluence of tributaries with the Rio Grande. The study results confirmed very high levels of bacteria in a high percentage of samples that exceeded Texas and Mexico standards by documenting 13 point source discharges, all of which originate in Mexico. The report mentions several current projects in both countries, either in planning or construction phases, which will result in improved conditions on the river. More than $280 million has been allotted for improvement and expansion of water and wastewater plants in Laredo, improvements to the storm water and wastewater drainage network in Nuevo Laredo and four shared infrastructure projects. This collaborative effort will help reduce untreated discharges from both countries into the Rio Grande and improve the wastewater collection system in Nuevo Laredo.

Water Toxicity Assessment - *Assessment of the Presence and Causes of Ambient Water Toxicity in the Rio Grande below International Amistad Reservoir, Segment 2304* focused on the upper two-thirds of the segment that was not supporting aquatic life uses due to water toxicity. Samples were collected from TCEQ **Stations 13205** (**Assessment Unit 2304_08**), **13208** (**Assessment Unit 2304B_01**), **13560** (**Assessment Unit 2304_09**), and at **13196** and **15817** in the lower third of the segment (**Assessment Unit 2304_01**). The data results indicated the aquatic life uses in the upper two-thirds this segment are fully supported with respect to ambient water toxicity.

Nutrients and Heavy Metals - Texas A&M University at Kingsville, with cooperation from CRP and the RGISC in Laredo, completed an assessment of nutrients and heavy metals in Manadas Creek, an unclassified tributary to the Rio Grande, and its potential impacts on the river in Laredo. The study showed heavy metals (i.e., arsenic and antimony) exceeded TSWQS and phosphorus values were periodically higher than the acceptable criteria. Impacts on the river were measured in the Rio Grande over a fairly long distance away from the confluence. The nutrient and metals contamination originating in Manadas Creek were found to be absent in the river.

Lower Rio Grande Sub-basin

The Lower Rio Grande Sub-basin is the section of the Rio Grande from a point just below International Falcon Reservoir to the mouth of the Rio Grande at the Gulf of Mexico. Population centers along the Lower Rio Grande have grown tremendously over the past 20 years. The entire stretch of the segment is bounded by urban growth. Drinking water needs of the Lower Rio Grande are completely dependent upon the river. Most agricultural and urban discharges do not enter the Rio Grande in this reach because this water is diverted to canals that ultimately empty into the Gulf of Mexico; however, excessive flows that surpass the capacity of the canals are allowed entry to the Rio Grande. The TCEQ and the Rio Grande Watermaster's Office maintain and operate a network of seven real-time monitoring locations downstream of the International Falcon Reservoir in the Lower Rio Grande Basin to facilitate management of TDS levels from upstream agricultural return flows.

Many areas of the river are infested with non-indigenous aquatic plants, including hydrilla and water hyacinth, which pose a threat to navigation, recreation, and flood control. Dense, floating masses can wield immense pressure on transportation infrastructure. Canals and floodways can enable the spread of invasive aquatic plant species outside of their native range. Excessive populations can reduce DO levels, aquatic and wildlife habitat degradation, and increase the accumulation of sediments. There are

26 permitted dischargers to the Sub-basin; 15 wastewater outfalls, 6 landfills, and 5 CAFOs (see Figure 47). This Sub-basin contains two segments that are subdivided into 10 AUs.

Segment 2302: Rio Grande below International Falcon Reservoir

Segment 2302 is classified as a freshwater stream that flows from International Falcon Reservoir through the Lower Rio Grande Valley, an area exhibiting high growth rates. The river segment has a length of 231 miles (371.8 km) that has been sub-divided for TCEQ watershed assessment efforts into 8 AUs monitored by 11 stations (see Table 14). This region of the Rio Grande is primarily agricultural and municipal. The designated uses for this segment are high aquatic life, PCR, general, fish consumption, and public water supply. **Segment 2302** is meeting all of its uses, except for *E. coli* impairments at the upper and lower end of the segment. An increase for *E. coli* observed in Arroyo Los Olmos, the Rio Grande from Arroyo Los Olmos upstream to International Falcon Dam, and downstream of the El Jardin Pump Station intake structure has led to the impairment of these three areas during the 2012 assessment cycle. Other concerns have been identified for chlorophyll-*a*, DO grab screening level, and ammonia. The entire segment is identified for having an aquatic life concern for mercury concentration in edible fish tissue. Sources and amounts of mercury, a trace metal, are unknown but could fluctuate based on the amount and distribution of rainfall, and variable emissions from local and distant atmospheric sources.

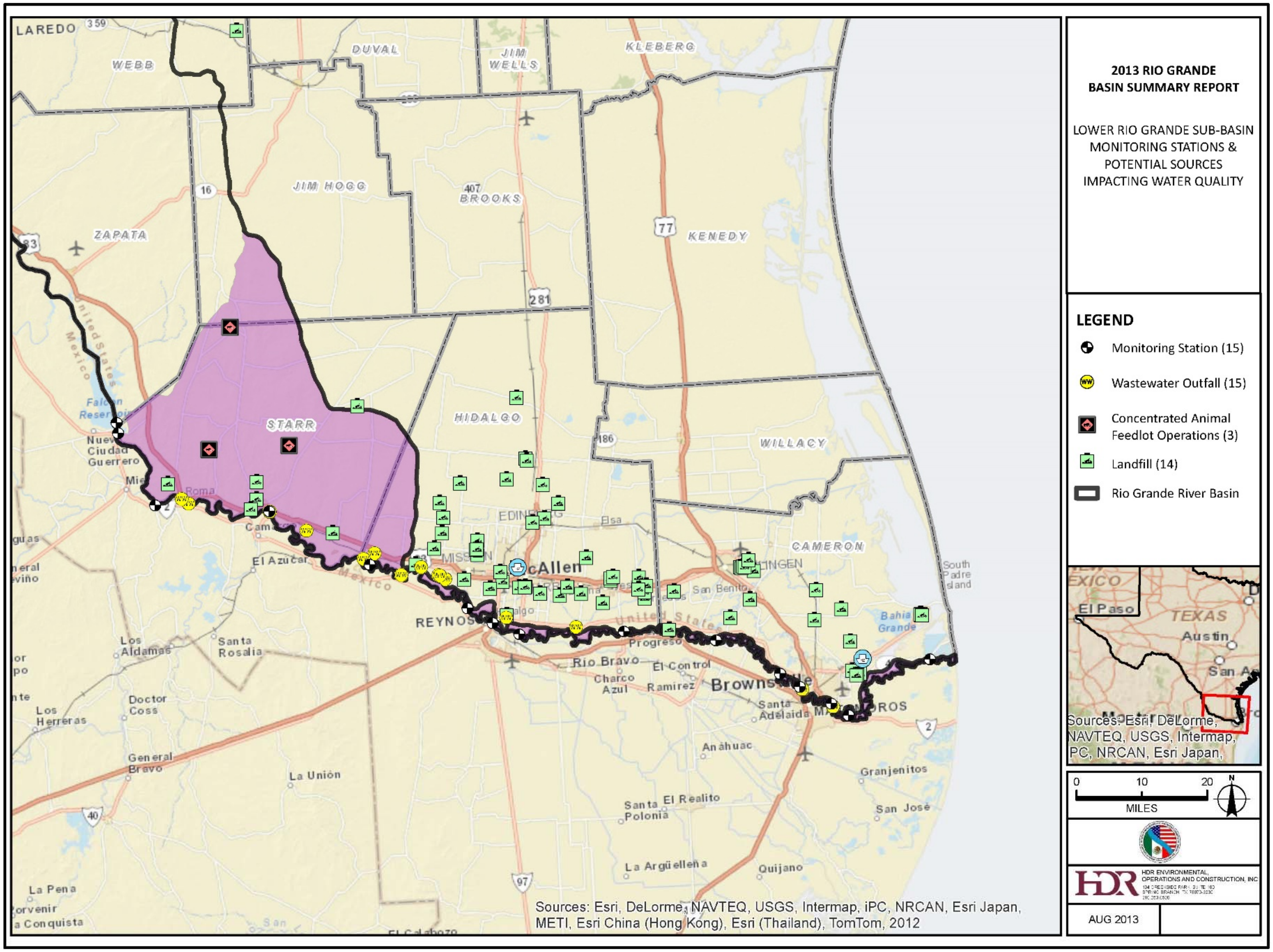


Figure 47. Lower Rio Grande Sub-basin Monitoring Stations and Permitted Dischargers

Table 14. Water Bodies Evaluated by TCEQ along Segment 2302

Rio Grande Below International Falcon Reservoir and Arroyo Los Olmos (unclassified water body)					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
Rio Grande from the El Jardin Pump Station upstream to the Rancho Viejo Floodway	2302_01	13177 13178 20449 13179	*E. coli*	Recreation	***Impairment***
			Mercury in edible tissue	Fish Consumption	Concern
			DO grab screening level	Aquatic Life	
			Chlorophyll-*a*	General	
Rio Grande from the Rancho Viejo Floodway upstream to the Progresso International Bridge	2302_02	10249	Mercury in edible tissue	Fish Consumption	
			Ammonia	General	
Rio Grande from the Progresso International Bridge (FM 1015) upstream to the McAllen International Bridge (U.S. Hwy 281)	2302_03	17247 15808 13180	Mercury in edible tissue	Fish Consumption	
			DO grab screening level	Aquatic Life	
Rio Grande from the McAllen International Bridge (U.S. Hwy 281) upstream to Anzalduas Dam	2302_04	13181 13664	Mercury in edible tissue	Fish Consumption	
Rio Grande from Anzalduas Dam upstream to the Los Ebanos Ferry Crossing	2302_05	20696			
Rio Grande from the Los Ebanos Ferry Crossing upstream to the Arroyo Los Olmos confluence	2302_06	13184			
Rio Grande from the Arroyo Los Olmos confluence upstream to the International Falcon Dam	2302_07	13185 13186 13188	*E. coli*	Recreation	***Impairment***
			Mercury in edible tissue	Fish Consumption	Concern
			Ammonia	General	
Arroyo Los Olmos from the Rio Grande confluence near Rio Grande City upstream to a point 39.4 km (24.5 miles) near El Sauz	2302A_01	13103	*E. coli*	Recreation	***Impairment***
			Chlorophyll-*a*	General	Concern

A total of 20 parameters from 12 stations were analyzed for trends in **Segment 2302** (see Figure 48). Previous trends for bacteria showed a marked increase for *E. coli*, which has led to the current impairment status for three areas assessed by TCEQ in 2012. Statistical analysis alerted to low DO potential, an aquatic life use concern confirmed by the 2012 assessment (see Table 14). Other parameters examined for trend analysis including chloride, nitrogen, phosphorus, chlorophyll-*a*, TDS, salinity, and sulfate showed statistically significant trends. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-31).

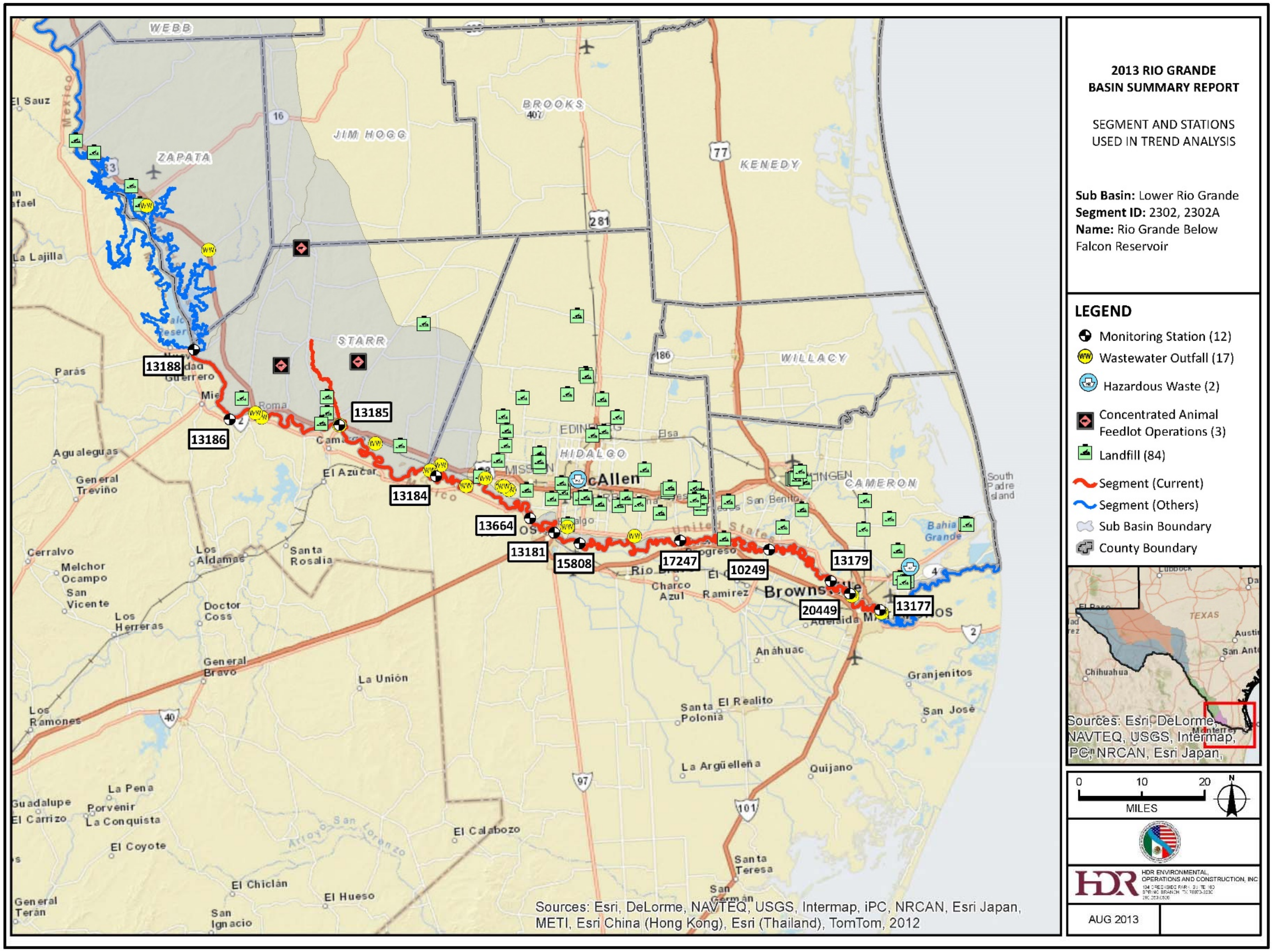


Figure 48. Monitoring Stations along Segment 2302

Assessment Unit 2302_01 is monitored by four stations. **Station 13177** is found 300 feet (91 meters) downstream of the intake structure at the El Jardin Pump Station. **Station 13179** is near the River Bend boat ramp, an area invaded by noxious aquatic weeds approximately 5 miles (8 km) west of Brownsville on U.S. Hwy 281. **Station 13178** is located on the river at the International Bridge on U.S. Hwy 77 in Brownsville and **Station 20449** is found at the Brownsville WTP Intake No. 1 between the WTP reservoir and the Rio Grande levee. TCEQ identified *E. coli* as impaired with concerns for edible fish, screening of low DO grab samples, and chlorophyll-*a*. It appears this segment is likely influenced by the water quality observed at the pump station and boat ramp.

The Rio Grande at the International Bridge in Brownsville Station 13178 in Assessment Unit 2302_01

Assessment Unit 2302_02 is represented by **Station 10249** is on the Rio Grande 3.9 miles (6.3 km) downstream from the San Benito pumping plant, 9.5 miles (15.3 km) southwest of San Benito. This station has no listed impairments but has concerns for mercury in fish tissue and ammonia.

Assessment Unit 2302_03 is monitored by **Station**s **13180**, **15808**, and **17247**. The 2012 assessment shows this area currently has no identified impairments with concerns for mercury accumulation in fish tissue and screening level for grab DO. **Station 13180** is on the Rio Grande below the El Anhelo drain south of Las Milpas; **Station 15808** is found upstream of the Pharr International Bridge at U.S. Hwy 281 and **Station 17247** is upstream from the FM 1015 Bridge at Progresso. Trend analysis revealed a statistically significant decreasing DO (see Figure 49) at **Station 15808**, decreasing total phosphorus (see Figure 50) levels at **Station 13185** and an increasing trend for TDS (see Figure 51) at **Station 15808**. These three trends were also observed throughout the entire segment. Greater flow at **Station 15808** appears to have a diluting effect on the total phosphorus concentrations as demonstrated by decreasing concentrations with increasing flows (see Figure 52).

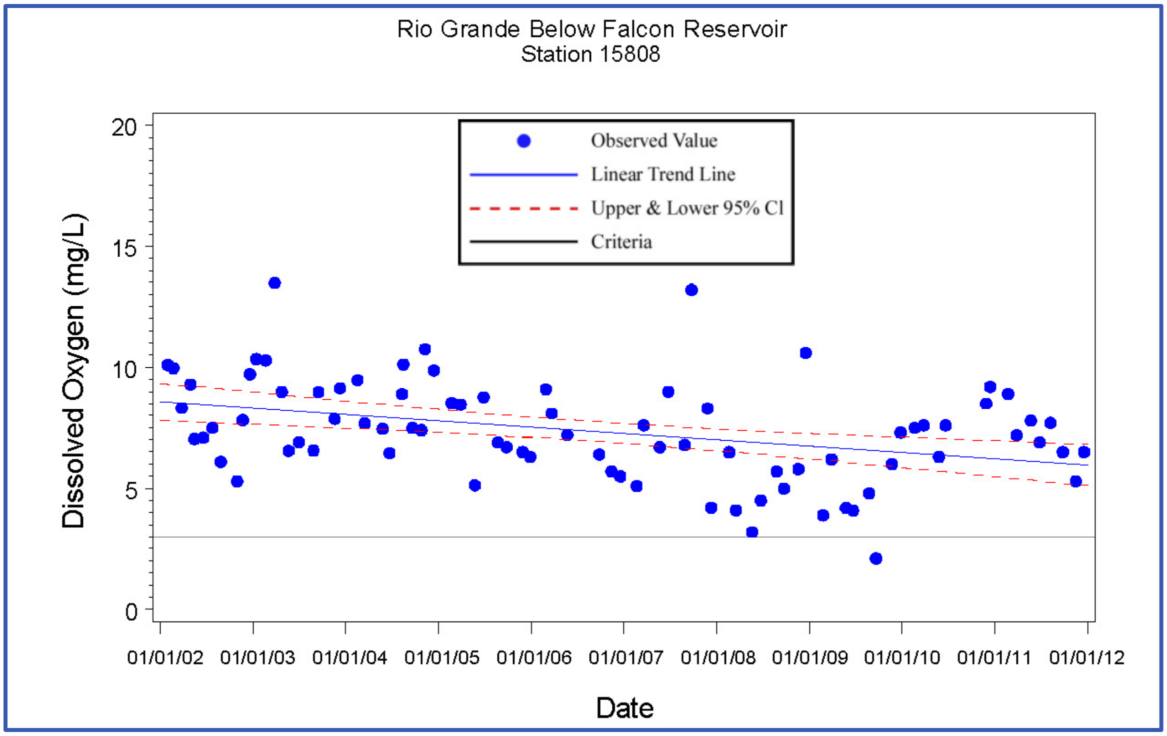


Figure 49. Decreasing DO Trend at Station 15808

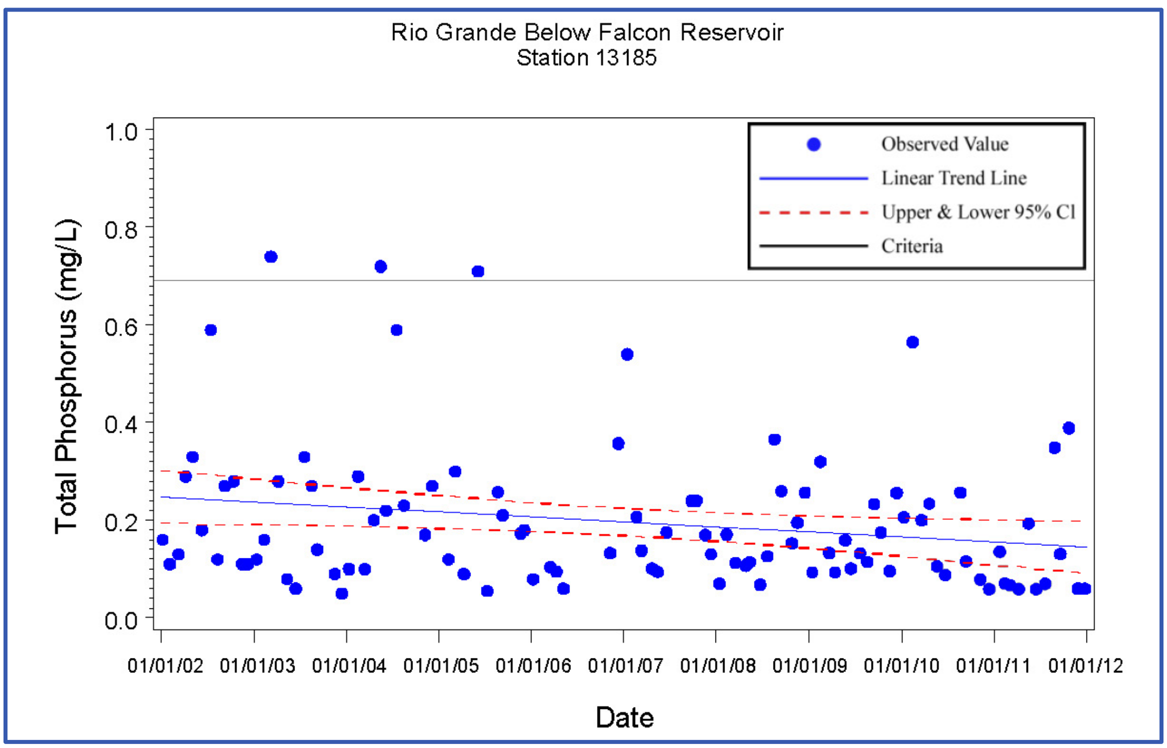


Figure 50. Decreasing Total Phosphorus Trend at Station 13185

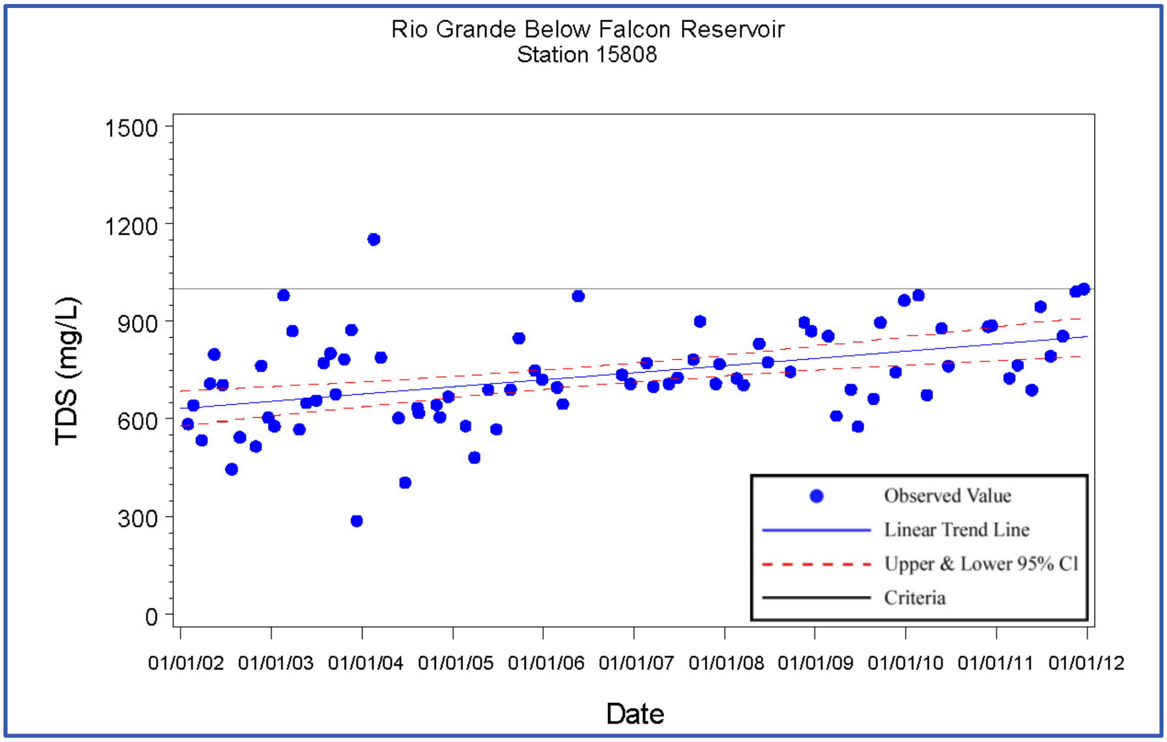


Figure 51. Increasing TDS Trend at Station 15808

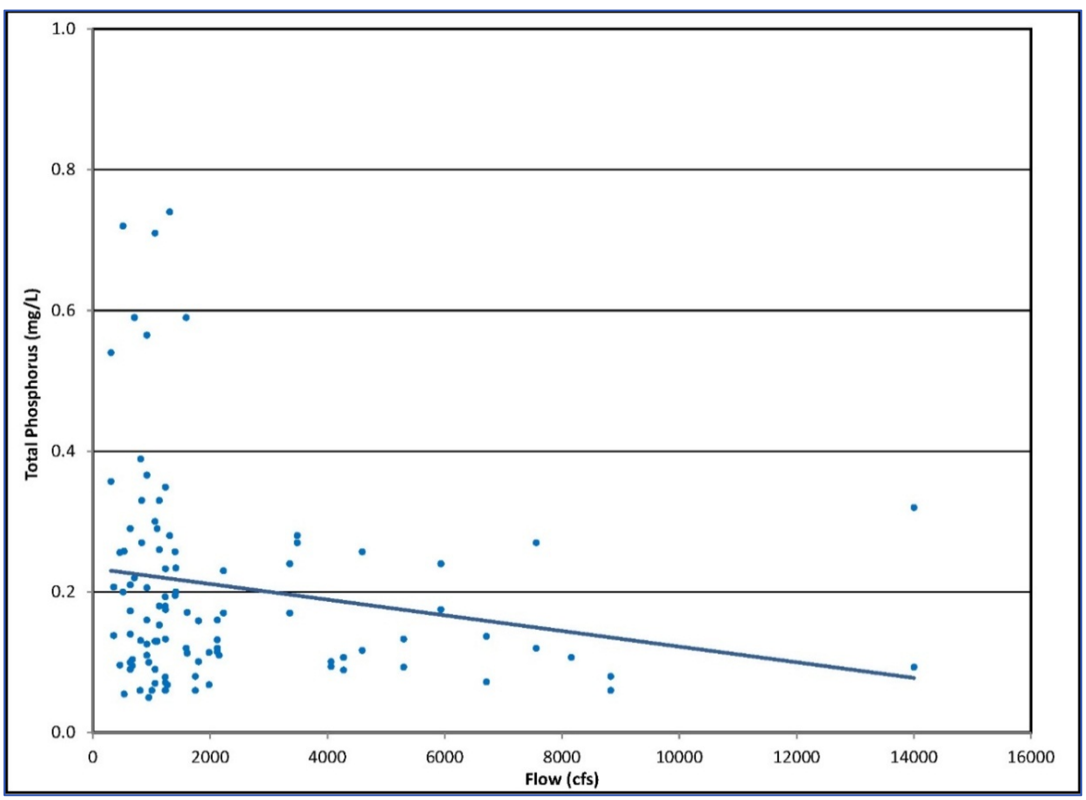


Figure 52. Total Phosphorus vs Flow at Station 13185

At **Station 17247**, an increasing trend was identified for chlorophyll-*a* (see Figure 53).

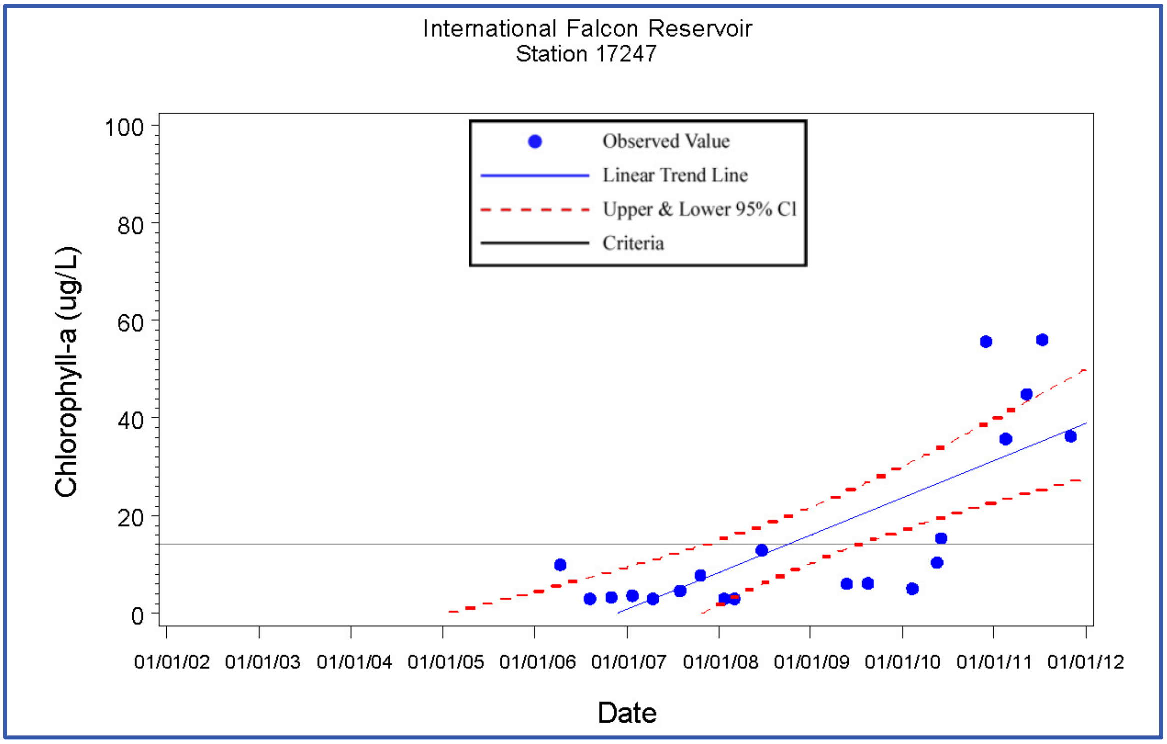


Figure 53. Increasing Chlorophyll-*a* Trend at Station 17247

Assessment Units 2302_04, 2302_05, and 2302_06 are monitored by five stations that include a length of 76 miles (122 km) between the McAllen International Bridge and upstream of the Arroyo Los Olmos confluence. **Station 13181** is located under the International Bridge (U.S. Hwy 281) in Hidalgo. **Station 13664** is found in the downstream area near the Anzalduas Dam 12.2 miles (19.6 km) from Hidalgo. **Station 20696** is on the El Morillo Tract within the Lower Rio Grande Valley National Wildlife Refuge and **Station 13184** is located at FM 886 near Los Ebanos. Based on the 2012 assessment, all five locations currently have no listed impairments but have a concern for mercury in edible fish tissue.

Assessment Unit 2302_07 is represented by three sampling stations covering the river from the Arroyo Los Olmos confluence upstream to the International Falcon Dam. **Station 13185** is on the Rio Grande at Fort Ringgold 1 mile (1.6 km) downstream of Rio Grande City. **Station 13186** is found on the Rio Grande downstream of Rio Alamo near Fronton. A third sampling station found at **Station 13188,** located on the Rio Grande in the tailrace of International Falcon Reservoir near FM 2098. The data results for the 2012 assessment period verified the failure of bacteria to meet its TSWQS criteria. The assessment also begins to show a nutrient concern for increasing chlorophyll-*a* and ammonia levels. *E. coli* showed an increasing trend in 2013 at **Station 13185** (see Figure 54) but was not statistically significant in the river upstream or downstream of this location.

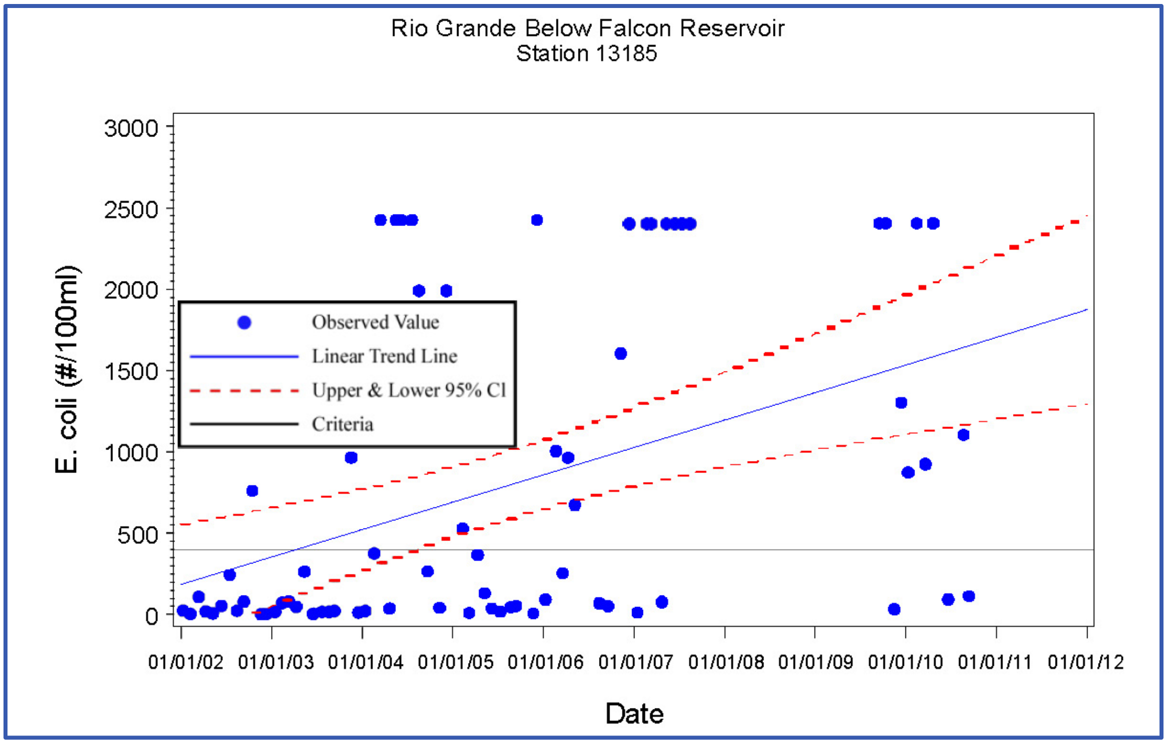


Figure 54. Increasing *E. coli* Trend at Station 13185

Assessment Unit 2302A_02 includes **Station 13103**, which is located on Arroyo Los Olmos at the U.S. Hwy 83 Bridge south of Rio Grande City. This unclassified stream is listed as impaired for non-attainment of its recreation use criteria for bacteria with a screening level concern for chlorophyll-*a*. This stream has been listed as Category 5b water since 2004. This assessment category requires a review of the water quality standards before a TMDL is scheduled. All data available for analysis were examined for trends. None of the parameters, including *E. coli* and chlorophyll-*a*, revealed any significant patterns.

Segment 2302 is listed as Category 5c in 2012 as the latest assessment determined this water body's contact recreation beneficial use is impaired for *E. coli*. This segment flows past several water treatment intake and pump station structures and irrigation drains, which all can influence the local water quality. Mercury in edible tissue remains a concern throughout **Segment 2302** although no recent information has been collected to reassess this parameter. The area west of Brownsville has a history of severe problems with invasive aquatic weeds, which could contribute to the accumulation of chlorophyll-*a*, sediments to the water, and reduced DO levels. Three significant trends were observed throughout the entire segment. DO grab and total phosphorus levels appear to be decreasing over time. These two downward trends are likely due to the drought conditions and reduced freshwater inflows. A statistically significant increasing trend was identified for TDS indicating turbid waters characteristic of suspended solids in the water column.

Segment 2301: Rio Grande Tidal

Segment 2301 is classified as a tidal stream with a length of 49 miles (79 km). Its designated uses are exceptional aquatic life, PCR, general, and fish consumption. The Rio Grande tidal segment differs from the rest of the Basin in that the Gulf of Mexico can have an effect on the water quality of that portion of the river. This segment does not have any water quality impairments, yet has a concern for *Enterococci* bacteria and chlorophyll-*a*. Historically, this segment has experienced increasing levels in chlorophyll-*a*, nutrients, and pH. **Segment 2301** contains two monitoring stations representing two AUs, which are assessed by TCEQ for ambient water quality conditions (see Table 15). A total of 11 parameters with adequate data for analysis were examined for trends at these two locations (see Figure 55). Decreasing trends were identified for total phosphorus and DO; no upward trends were found, and no change was detected for chloride, TDS, or pH. Detailed trend analysis tables for stations analyzed along this segment are provided in Appendix E (page E-36).

Table 15. Water Bodies Evaluated by TCEQ along Segment 2301

Rio Grande Tidal					
Water Body Name and Location	**Water Body ID**	**Assessment Station ID**	**Parameter**	**Designated Use**	**2012 Status**
From the mouth of the Rio Grande to a point 71.7 km (44.6 mi) upstream	2301_01	13176	Chlorophyll-*a*	General	Concern
From a point 71.7 km (44.6 mi) upstream of the mouth the Rio Grande to the upper segment boundary 10.8 km (6.7 mi) downstream of the International Bridge	2301_02	16288	*Enterococci*	Recreation	
			Chlorophyll-*a*	General	

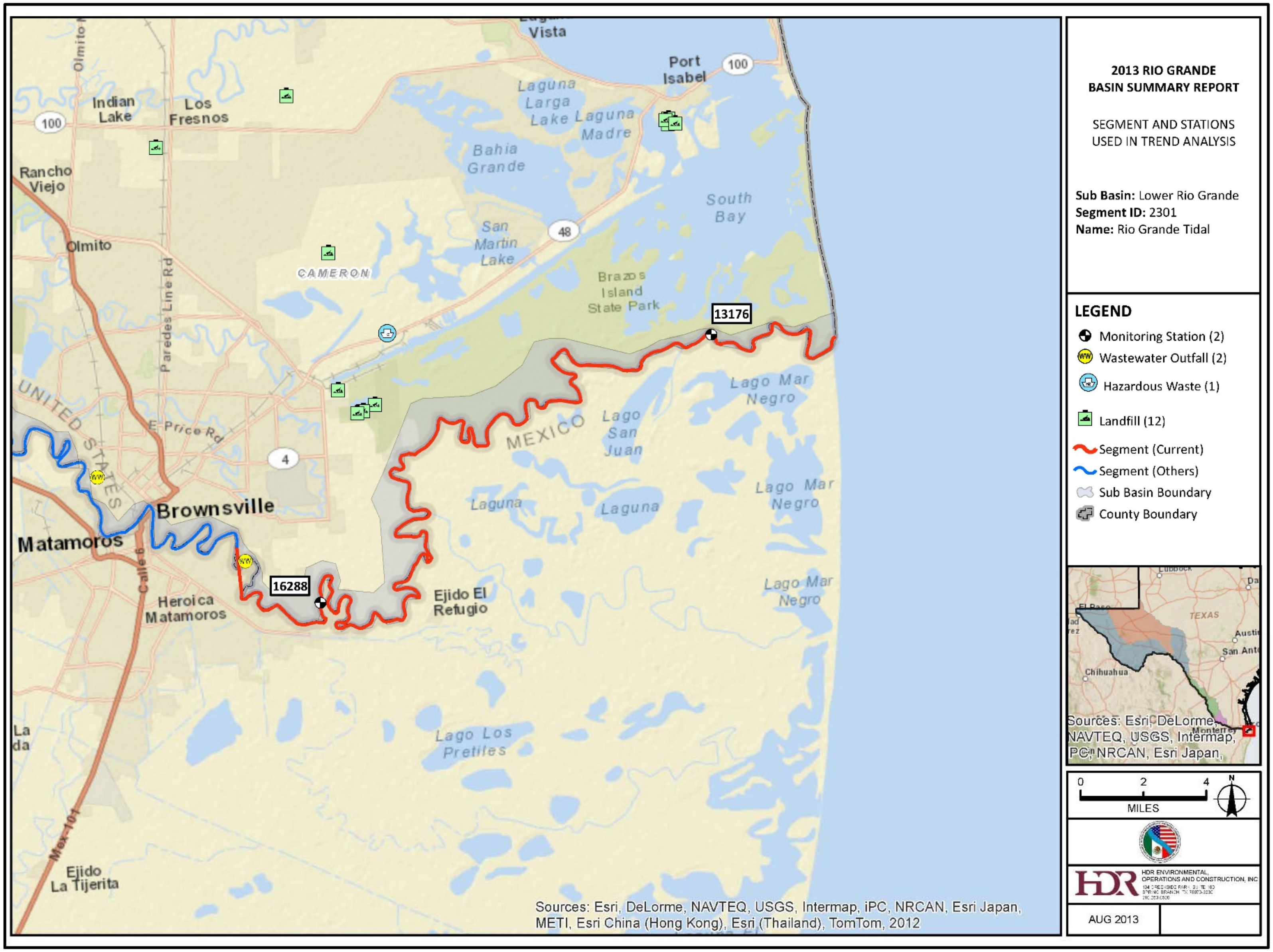


Figure 55. Monitoring Stations along Segment 2301

Assessment Unit 2301_01 at Station 13176 is located on the Rio Grande tidal segment at SH 4 near Boca Chica. Currently, this station has an algal growth concern for excessive algae as represented by high chlorophyll-*a* levels. Previous analyses showed increasing chlorophyll-*a* and other nutrient levels with an indicated rise in pH values. A statistically significant decrease in grab sample values for DO (see Figure 56) and total phosphorus (see Figure 57) was noticed at **Station 13176**. Increases to water temperature due to infrequent freshwater inflows, increases in organic matter, bacteria, and algae could cause a reduction in DO concentrations.

The Rio Grande Entering the Gulf of Mexico Assessment Unit 2301_01

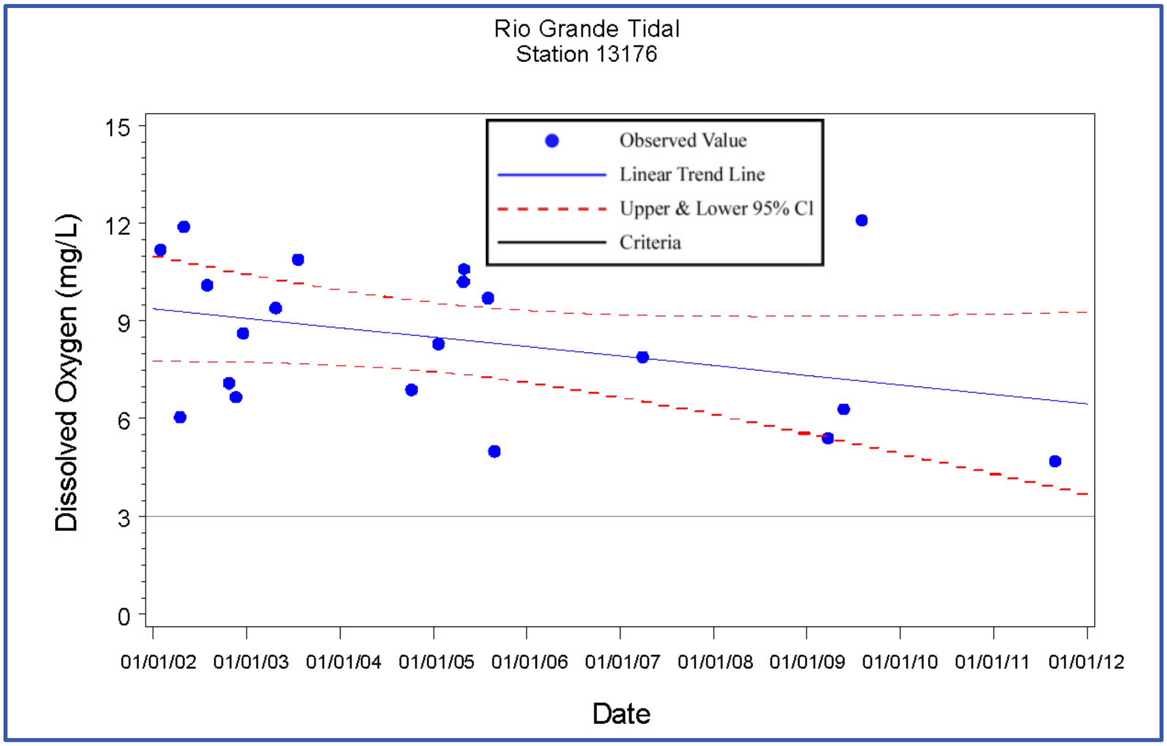


Figure 56. Decreasing DO Trend at Station 13176

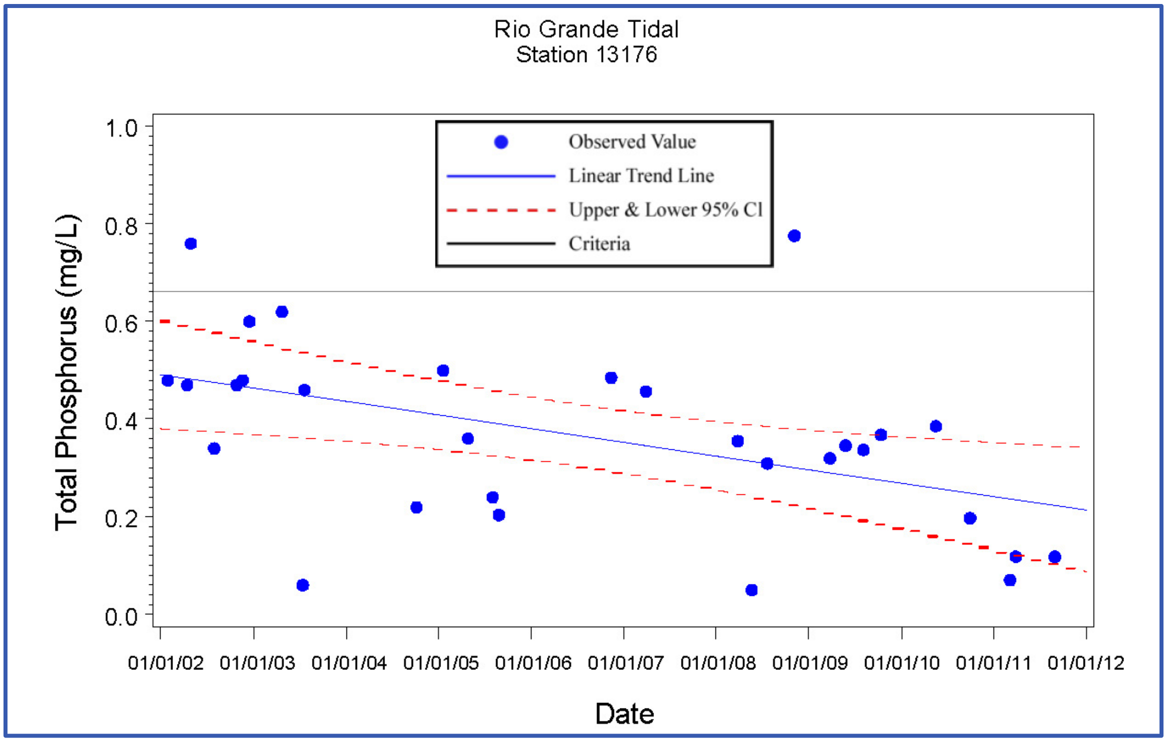


Figure 57. Decreasing Total Phosphorus Trend at Station 13176

Assessment Unit 2301_02 at **Station 16288** is located on the Rio Grande tidal segment at the Sabal Palm Sanctuary approximately 1 mile (1.6 km) south of FM 1419 near Palm Grove. This is a relatively new location that has only recently shown concerns for *Enterococci* and chlorophyll-*a*.

Projects and Studies of Relevance to the Lower Rio Grande Sub-basin

Water quality in the region has seen many improvements with slight problems with bacterial and phosphorus contamination. The sources for these water quality issues can be traced back to municipal wastewater effluent. They can also be associated with the main issue in the Sub-basin, lack of substantial infrastructure to handle high growth rates and increased amounts of municipal waste.

Groundwater in this region is too brackish to use for public consumption, so municipalities rely solely on surface water as their drinking water source. Several initiatives are in place to build groundwater desalination plants in this region to supplement water demands for municipal growth.

El Jardin Pump Station Facing Upstream at Station 13177 in Assessment Unit 2302_01

Bacteria - In 2010, The USIBWC Texas CRP and the University of Texas at Brownsville, Chemistry and Environmental Science Department conducted an extensive bacteria special study to characterize the contamination at various intervals within a 20-mile (32-km) river length designated as Segment 2302_01. A total of 63 bacteria samples from 33 stations were collected over a 3-day period in March and April 2010 on the river between River Bend upstream of Brownsville to the El Jardin Pump Station downstream of Brownsville. A total of 37 potential sources of contamination (including drains, pumps, boat ramps, outfalls, trash dumps, wildlife trails) were identified on both sides of the river. The study area boundary was delineated based on the results taken from a previous bacteria source tracking study in Segment 2302_07 where the likely source of contamination was thought to originate downstream of the Brownsville Public Utilities Board water intake structure since bacteria impairments were not occurring immediately upstream or downstream of this AU. Bacteria values were all relatively low during both sampling events, with peaks much lower than historical bacteria spike values which had initially caused this stretch of river to be listed as impaired. The report concluded that improvements in bacterial water quality were attributable to the completion of the first WWTP in Matamoros, funded by NADBank in 2003 and in operation by late 2009.

The report mentioned the drastic change in bacteria levels generally coincided with plant operation and preliminarily linked it to the low bacteria values collected during the special study and subsequent routine monitoring events. USIBWC CRP and its sampling partners will continue to collect routine monitoring in Brownsville for determination of the continuation of declining values to support a delisting of AU 2302_01 in the near future. This report can be accessed at:

http://www.ibwc.state.gov/CRP/documents/LaredoBacteriaSpecialStudyFinalRptwhole.pdf

THIS PAGE INTENTIONALLY LEFT BLANK

4. Conclusions and Recommendations

Conclusions

The availability of water has always, and will continue to, impose constraints on development in the Rio Grande Basin. Less than 20 percent of the Rio Grande's historical flow now reaches the Gulf of Mexico. The explosive growth over the past 30 years in the region has resulted in an increased demand for the river water. Combined with the recent drought conditions, the potential for the river to go dry is ever increasing. The rapid economic development has also contributed towards deterioration of river water quality along with an increased concentration of various pollutants in the water. Revision and update of the current international agreement with Mexico could be required to help resolve this problem

Some of the challenges that still exist include improving access to clean water and sanitation for both urban and rural populations, improving public participation and knowledge and strengthening river basin management. The common perception of the stakeholders is that the problem sources within the Rio Grande are fairly well understood and significant resources have already being targeted towards nonpoint source control programs. However, it was recognized that the preparation of a comprehensive management plan for each sub-basin (similar to the Pecos Watershed Protection Plan) might be what is required in the Rio Grande to help direct existing resources more efficiently and also increase the likelihood of securing additional resources as necessary. A lack of data describing natural processes in the watershed highlights the need for more widespread monitoring that will improve ecological and wildlife assessments.

While economic development is beyond the scope of this summary report, maintaining a healthy agricultural industry is a desirable goal for areas in the vicinity of the Rio Grande. The recent drought combined with the competing demands for limited water resources and the resulting impacts on water quality makes it necessary to pursue regional prosperity in concert with conservation efforts.

Recommendations

Based on the field work, research, and experience of the Rio Grande experts and stakeholders, there are many methods that USIBWC can use in meeting and maintaining the Rio Grande's water quality goals. These include storm water capture and infiltration, aquatic habitat improvement, sediment control, native vegetation reintroduction and establishment, and channel/floodplain improvements. The significant flow variations that can occur in river discharges throughout the years are caused by climatic induced conditions, such as precipitation amounts, evaporation rates and snow pack conditions. Flow in all streams is seasonally quite variable. Runoff is often the greatest in early spring as a result of snowmelt water and spring rainfall. Many of the smaller streams experience little or no flow for extended periods during the drier summer months.

A streambank-riparian protection and restoration program, coordinated with targeted watershed/land-use management improvements, would require careful planning, design, and sustained management of grasslands, livestock waste, onsite wastewater systems, cropland conversion, nutrients, pesticides, wetland installation, and urban growth. Developing a complete perspective on protecting and managing water resources through the application of a natural channel design approach to previously impacted river reaches would seem likely to be very challenging given the geological nature of the setting, the amount of watershed manipulation, and the intense agricultural land use. Over time, actions taken to implement these recommendations could lead to measured decreases in bacteria, sediment, nitrogen, phosphorus, and chlorophyll-*a* concentrations, to achieve water quality objectives.

Targeting these opportunity areas will involve the following types of recommended actions:

- **Projects:** Large- and small-scale restoration activities that restore the river corridor and surrounding landscape to improve the health of the watershed.
    - Pursue grant funding through the Environmental Exchange Network to support more effective and efficient exchange of water quality data and water quality assessment results via the Water Quality Exchange and the Clean Water Act Integrated Reporting, Water Quality Assessment, and the Office of Water Integrated Reporting (OWIR) Impaired Waters Data Exchange.
    - Incentives and financial assistance should be targeted to address the highest priority AUs in a systematic restoration and protection program.
- **Management and maintenance:** Structure activities to ensure proper care of resources within the Rio Grande watershed.
    - The CWQMN stream gaging network, critical to water quantity and quality management, permitting, and monitoring and assessment in the Rio Grande and Pecos River, should be supported, enhanced, and maintained. Partnerships (with USGS and others) should be extended to improve efficiency and effectiveness of the stream gaging program, and support associated costs.
    - While the TSWQS provide effective tools for managing water quality, they provide little guidance for managing sediment quality. The river system has lost extensive native vegetation resulting in unstable banks and loss of habitat. Streambank and riparian restoration efforts and land treatment are important factors to manage the rate of sediment deposition effectively. Working with the U.S. Fish and Wildlife Service, the USIBWC currently has ongoing efforts to maintain vegetation corridors along the lower Rio Grande for the two cat species: jaguarundi (*Herpailurus yaguarondi*) and ocelot (*Leopardus pardalis*). USIBWC also implements a vegetation maintenance program to maintain flood capacity.
    - A substantial commitment must be made by municipalities to water conservation, drought management, and emergency contingency through the adoption of aggressive water conservation water management strategies. These actions would reduce projected water

shortages effectively, thereby delaying or eliminating the need for implementation of other water management strategies with greater associated environmental impacts.

- **Regulatory enforcement:** Involve citizens to act as river stewards by reporting pollution and environmentally hazardous activities to the proper authorities.
    - Laws that prevent environmental damage should be enforced. Illegal discharge of untreated sewage, pesticides, and other pollutants into the Rio Grande cause severe detriment to the water quality.
    - Dedicated actions against polluters will help to clean and restore the Rio Grande through enforcement, which provides a necessary complement to the ongoing physical restoration plans and current water quality standards.
    - Improvement in water quality will only be successful if enforcement is employed along both sides of the river. USIBWC should continue to work with the TCEQ Standards Team on the development of nutrient standards for water bodies throughout the Basin.
- **Planning and design review:** Review of all planning processes and project designs of the relevant agencies to ensure partner coordination, community input, and use of ecological design principles.
    - Work as a partnership for the development of an overall "Restoration and Management Plan" that conveys a collective vision on both sides of the Rio Grande and a framework to guide its realization. This plan should describe elements of current projects and successes to move forward and identify all issues that remain to be resolved to create a complete and continuous direction. The Plan should set out guidelines for ecological performance intended to ensure that all future development enhances and protects the ecological functioning of the Rio Grande.
    - Develop a long-term plan for sustainable management for the Forgotten River reach of the Rio Grande. Planning constraints have been provided by the U.S. Army Corps of Engineers in a 2007 study investigation conducted at a level of detail adequate for making resource assessments and recommendations.
- **Policy/Agency coordination:** Work with local city, state, Federal, and international agencies to improve policies affecting the health of the Rio Grande Basin. Identify information deficiencies that are pertinent to future planning efforts, and develop a research strategy for obtaining needed data.
    - Begin to move forward toward the development and implementation of numeric nutrient criteria, particularly for phosphorus, nitrogen, and chlorophyll-*a* for all water bodies.
    - Monitoring chlorophyll-*a* levels is a direct way of tracking algal growth. Surface waters that have high chlorophyll-*a* conditions are usually high in nutrients, typically phosphorus and nitrogen. Chlorophyll-*a* is the most valuable biological criterion for trophic assessment in that it provides not only an estimate of overall lake productivity, but also information regarding recreational desirability, water treatment cost, and suitability of water for livestock and irrigation.

- Complete the standards review to make a final determination on whether a new segment is warranted in the Upper Rio Grande Sub-basin.
- Freshwater mussel decontamination locations similar to those in the Pacific Northwest should be seriously considered and installed at the two international reservoirs and possibly at other gateway reservoirs. Funding and future direction for design and implementation shall determine if these facilities are built.

- **Monitoring and research:** Continue to engage in and encourage continued monitoring and research of ecological parameters in the Rio Grande Basin.
  - Increase multi-assemblage biological monitoring to characterize fish, benthic macroinvertebrates, freshwater mussels, and algal communities; and increase and provide more detailed characterization of in-stream and riparian area habitat characteristics, and land use and land cover.
  - Sediment contamination with toxic chemicals due to the irrigation-induced discharges of a wide variety of metals (e.g., arsenic, cadmium, chromium, lead, zinc), and organic substances (e.g., PCBs, organochlorine pesticides) impacts surface water and biota. None of these parameters were found in surface water at concentrations exceeding acute and chronic criteria. Since many chemicals potentially impacting water quality are hydrophobic (i.e., not easily dissolved into solution), they will quickly bind to sediments, where the contaminants are frequently redistributed by biological activity and by resuspension of sediments during flushing events. Contaminants that accumulate in the sediments during drought conditions can result in the impairment of the water column due to the resuspension of contaminated sediments. Sampling for these parameters should continue to be monitored closely.
  - Pesticides with low risk to water quality should be used when possible.
  - Efforts should be made to continue and expand ambient monitoring by adding new local agencies to the USIBWC CRP Monitoring QAPP.
  - Using the 303(d) list, TCEQ develops a schedule to establish TMDLs for priority impaired waters in Texas. To date, it does not appear that any TMDL projects have been developed or implemented in the Rio Grande Basin. The goal of a TMDL is to restore the impaired water body to full use. The TMDL defines an environmental target and, based on that target, the state develops an implementation plan to mitigate pollution within the watershed to restore full use of the water body.
  - Update the sample August 2002 collection results taken at 23 locations in the Big Bend area for comparative analysis of stream water quality, streambed sediment, and mine tailings relating to abandoned mines and mine-processing activities.
  - Update monitoring of fish tissue contamination to enable the state to detect concentrations of toxic chemicals in fish that might be harmful to consumers, and take appropriate action to protect public health and the environment.
- **Outreach:** Citizens are a crucial component of all water monitoring programs.

- Encourage and facilitate community education and involvement in all matters affecting the ecological health of the Rio Grande Basin.
- Continue to devote staff time to coordinate and support all volunteer groups.
- Expand the monitoring participation of the TST and other citizen volunteer monitoring into priority areas.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A

Constituents With Potential Impacts on Water Quality

THIS PAGE INTENTIONALLY LEFT BLANK

Parameter Definition	Potential Impacts to Water
Alkalinity	
A measure of the acid-neutralizing capacity of water Alkalinity is not a specific substance but rather combination of substances. Bicarbonate, carbonate and hydroxide are the primary forms of alkalinity in natural waters.	Alkalinity varies in water bodies depending of many numerous conditions including groundwater recharge, geology, pollutant influences and urban/agricultural pollution. The presence of borates, phosphates, and silicates may increase the concentration of alkalinity.
Ammonia Nitrogen	
Naturally occurring in surface and wastewaters, it is produced by the breakdown of compounds containing organic nitrogen.	High levels can be lethal to certain fish species. Possible sources of ammonia are from animal waste from CAFO's or from urban wastewater that is not treated for ammonia removal.
Arsenic	
Arsenic is a highly toxic element that occurs naturally in soils, rocks, and minerals and also from past use in pesticides.	It is also used in paints, dyes, metals, drugs, soaps, and semiconductors. Alkaline pH will increase arsenic mobility.
Biochemical Oxygen Demand (BOD)	
A measure of the amount of oxygen consumed in the biological processes that break down organic matter in water.	High BOD levels are an indicator of increased pollution in the water, usually from untreated sewage, which may result in decreased oxygen levels in the receiving stream.
Chloride	
One of the many naturally occurring salts. One of the major inorganic ions in water and wastewater. Industrial and agricultural processes can increase concentrations.	High levels can affect plant growth and the use of the water for agricultural or municipal purposes. Chloride ions that enter ground water can ultimately be expected to reach surface water and, therefore, influence aquatic environments and humans.
Chlorophyll-*a*	
A photosynthetic pigment that is found in all green plants.	Chlorophyll *a* is an excellent measure of water column algae/phytoplankton concentrations and an indicator of the water bodies eutrophic tendencies.
Conductivity and Specific Conductance (Temperature Corrected Conductivity)	
These two parameters are measures of the ability of an aqueous solution to conduct electrical current and both are directly related to the concentration of free ions in solution.	Generally, higher values indicate urban or agricultural pollution in the form of nitrogen and phosphorous. It is commonly measured as part of stream surveys. Conductivity is a measure of how salty the water is; salty water has high conductivity.
Dissolved Oxygen (DO)	
The oxygen freely available in water. DO is measured as both temperature corrected concentration in mg/l and % air saturation.	DO is vital to fish and other aquatic life and for the prevention of odors. Low DO can occur in stagnant waters and from waters polluted with chemicals that deplete the oxygen or from water high in BOD.

Parameter Definition	Potential Impacts to Water
Fecal coliform, *Escherichia coli* (*E. coli*), *Enterococci*	
Bacteria found in the intestinal tracts of warm-blooded animals. These organisms are used as indicators of bacterial pollution and possible presence of waterborne pathogens. Starting after January 1, 2002, Texas began to use *E. coli* and *Enterococci* bacteria for water quality monitoring compliance. By testing for *E. coli* one can better confirm the extent of bacterial contamination associated with fecal matter. *Enterococci* bacteria have a higher survival rates in the environment and are better public health indicators than fecal coliform bacteria.	Sources of high bacteria are wastewater that has not been treated for bacteria, concentrations of animals, and application of animal based fertilizers. Although fecal coliform can also be present in soils, high concentrations in water can be attributed to recent fecal contamination from septic systems, mammal feces and bird feces.
Metals (Total and Dissolved)	
Metals occur naturally in the watershed and may increase when used for anthropogenic processes. Metals in dissolved form are generally more toxic than metals in the particulate form.	High levels can result in bioaccumulation within aquatic species causing short or long-term effects and may pose health issues with regards to fish consumption, agriculture, or public water supply. Sources of metals can be naturally occurring in the water, like arsenic, or deposited from industrial processes. Wastewater effluent that has not been treated for metals can also introduce high levels of metals. To prevent potential contamination of samples collected for trace metals analyses and to ensure reliable results, the use of "clean techniques" is becoming more and more frequent when sampling for dissolved metals.
Nitrate-Nitrogen	
A nutrient required by plants that can exist as a dissolved solid in water.	Excessive amounts can have harmful effects on humans and animals. Potential sources of nitrates are agricultural fertilizers, feed lot discharges, septic tanks, and wastewater treatment plants converting ammonia and organic nitrogen to nitrates.
Organic Compounds	
(Volatile and Semi-volatile) Compounds used in industry (commercial or agriculture	When present in water they could potentially affect aquatic life and human health. Examples are herbicides and pesticides.
Orthophosphate as Phosphorus	
Nearly all phosphorus exists in water as phosphate also an essential nutrient for plants. Orthophosphate can be directly utilized by plants and organisms but is usually the least abundant nutrient. Because of this, orthophosphate is commonly the limiting factor meaning aquatic plant growth is limited by the amount of orthophosphate in the water.	Excessive amounts of phosphorus can contribute to the eutrophication (growth of aquatic vegetation because of excess nutrients resulting in depressed DO levels) of lakes and rivers.
pH	
The hydrogen ion activity of water caused by the breakdown of water molecules and presence of dissolved acids and bases.	The pH affects many chemical and biological processes in the water and is influenced by geology, soils, decaying leaves and human-induced acids from acid rains.

Parameter Definition	Potential Impacts to Water
Radionuclides	
Any man-made or natural element that emits radiation and are found in air, water, soil, plants, and the human body.	Indirect contamination of a drinking water supply source could occur from runoff from contaminated land, contaminated discharge from a WWTP, and contaminated discharge directly from a storm water collection system that is untreated. Concentration in a water source would depend on the amount of activity of activity entering the water.
Salinity	
The amount of dissolved salts in a given volume of water. Salinity measurements are made in reference to a standard seawater (corrected to S= 35) at a temperature of 15 ºC and a gauge pressure of zero.	Evaporation causes an increase in salinity, and this affects salt-sensitive plants and animals. Intrusion of saline groundwater can increase as surface water levels drop. Groundwater intrusion can cause stratification in pools, leading to deterioration of water quality and a higher chance of algal blooms.
Sulfate	
Sulfate is derived from rocks and soils containing gypsum, iron sulfides and other sulfur compounds.	Industrial discharges may contain high levels of sulfate and can affect conveyance systems, under anaerobic conditions, due to bacterial activity that converts sulfate to hydrogen sulfide, subsequently forming sulfuric acid.
Temperature	
Temperature is the degree of heat (warmth or coldness of a substance) measured on a definite scale referenced to some physical phenomenon such as expansion of mercury (liquid thermometer), change of electrical resistance (thermistor), or intensity of radiation.	A critical parameter for aquatic life and has an impact on other water quality parameters such as DO concentrations, and bacteria activity in water. Variation may be from a variety of anthropogenic and natural causes.
Total Dissolved Solids (TDS)	
The amount of material, often a diverse mix of various salts and small amounts of organic material, dissolved in water.	High TDS concentrations can limit the use of water for agriculture, drinking water, and industrial use.
Total Hardness	
Hardness is an indicator of mineral content (i.e., the sum of calcium and magnesium concentrations) expressed as calcium carbonate in mg/L.	Although not a significant eutrophic indicator, elevated hardness values can indicate pollution influences and is an acceptable contaminant for most water uses in low concentrations. Both are essential elements for plants and animals.
Total Kjeldahl Nitrogen (TKN)	
TKN is a measure of organic nitrogen and ammonia in a water body.	High nitrogen levels can increase algae and chlorophyll-*a* levels in the river, but is generally less of an issue in fresh water than phosphorus. Nitrogen can indicate the presence of sewage, animal waste, fertilizer, erosion, or other types of pollution.
Total Organic Carbon (TOC)	
Method used to determine the amount of organic carbon present in water and wastewater.	Sources of TOC are decaying organic matter, pesticides, fertilizers, herbicides, and detergents.

Parameter Definition	Potential Impacts to Water
Total Phosphorus	
A measure of all forms of phosphorus in the water, including inorganic and organic forms. Phosphorus is found in surface water and waste streams almost exclusively in the form of phosphates.	In most freshwater systems, phosphorus is typically the limiting nutrient which controls aquatic plant productivity. It is found in solution, particulates, detritus, or in living aquatic organisms. Other sources of phosphates include decomposition of organic material and erosion of rock.
Total Suspended Solids (TSS)	
A measure of the total suspended particles in water, both organic and inorganic.	Another parameter that helps to define the extent of algae associated with high turbidity.
Turbidity	
Turbidity is the laboratory equivalent of field secchi disk readings.	As turbidity increases, the ability for light to penetrate the water column decreases resulting in lower secchi disk readings.
Volatile Suspended Solids (VSS)	
A measure of the inorganic component of TSS. VSS are the organic (biotic) solids, derived from algae, decaying plant and animal material, and organic wastes from sewage and industrial discharges.	Analyzed with other parameters to determine the quality of treated water from septic systems and permitted dischargers.
7Q2	
The 7Q2 (low flow) is defined as the seven-day, two-year low flow. The lowest average stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data.	For perennial freshwater streams, the only parameters that are applicable below 7Q2 are chloride, sulfate, TDS, acute toxics, and toxicity.

Appendix B

NUMERIC CRITERIA AND DESIGNATED USES FOR INDIVIDUAL SEGMENTS OF THE RIO GRANDE

THIS PAGE INTENTIONALLY LEFT BLANK

RIO GRANDE BASIN		DESIGNATED USE			CRITERIA						
Seg. No.	**Segment Name**	**Recreation**	**Aquatic Life**	**Domestic Water Supply**	**Chloride (mg/L)**	**Sulfate (mg/L)**	**TDS (mg/L)**	**Dissolved Oxygen (mg/L)**	**pH Range (SU)**	**Indicator Bacteria[a] #/100ml**	**Temperature (°F)**
2301	Rio Grande Tidal	PCR	E					5.0	6.5-9.0	35	95
2302	Rio Grande Below International Falcon Reservoir	PCR	H	PS	270	350	880	5.0	6.5-9.0	126	90
2303	International Falcon Reservoir	PCR	H	PS	200	300	1,000	5.0	6.5-9.0	126	93
2304	Rio Grande Below International Amistad Reservoir	PCR	H	PS	200	300	1,000	5.0	6.5-9.0	126	95
2305	International Amistad Reservoir	PCR	H	PS	150	270	800	5.0	6.5-9.0	126	88
2306	Rio Grande Above International Amistad Reservoir	PCR	H	PS	300	570	1,550	5.0	6.5-9.0	126	93
2307	Rio Grande Below Riverside Diversion Dam	PCR	H	PS	300	550	1,500	5.0[b]	6.5-9.0	126	93
2308	Rio Grande Below International Dam	NCR	L		250	450	1,400	3.0	6.5-9.0	605	95
2309	Devils River[c]	PCR	E	PS	50	50	300	6.0	6.5-9.0	126	90
2310	Lower Pecos River	PCR	H	PS	1,700	1,000	4,000	5.0	6.5-9.0	126	92
2311	Upper Pecos River	PCR	H		7,000	3,500	15,000	5.0	6.5-9.0	33	92
2312	Red Bluff Reservoir	PCR	H		3,200	2,200	9,400	5.0	6.5-9.0	33	90
2313	San Felipe Creek[c]	PCR	H	PS	50	50	400	5.0	6.5-9.0	126	90
2314	Rio Grande Above International Dam	PCR	H	PS	340	600	1,800	5.0	6.5-9.0	126	92

[a] The indicator bacteria for freshwater is *E. coli* and *Enterococci* for saltwater. The indicator bacteria and alternate indicator for Segments 2311 and 2312 are *Enterococci* and fecal coliform, respectively.

[b] The DO criterion in the upper reach of Segment 2307 (Riverside Diversion Dam to the end of the rectified channel below Fort Quitman) is 3.0 mg/L when headwater flow over the Riverside Diversion Dam is less than 35 ft3/s.

[c] The critical low-flow for Segments 2309 and 2313 is calculated according to §307.8(a)(2)(A) of this title.

Source: Texas Administrative Code 307.10; Appendix A - Site-specific Uses and Criteria for Classified Segments: http://info.sos.state.tx.us/fids/201003720-6.pdf.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix C

2012 IR List of Segments with Use Concerns and Impairments

THIS PAGE INTENTIONALLY LEFT BLANK

Segment/Assessment Unit	Parameter	Concern Type	Level of Concern
Segment 2301			
2301_01	Chlorophyll-*a*	Use Attainment	CS
2301_02	Bacteria	Use Attainment	CN
2301_02	Chlorophyll-*a*	Use Attainment	CS
Segment 2302			
2302_01	Chlorophyll-*a*	Use Attainment	CS
2302_01	Dissolved Oxygen	Use Attainment	CS
2302_01	Mercury in edible tissue	Use Attainment	CS
2302_01	Bacteria	Impairment	NS
2302_02	Ammonia Nitrogen	Use Attainment	CS
2302_02	Mercury in edible tissue	Use Attainment	CS
2302_03	Dissolved Oxygen	Use Attainment	CS
2302_03	Mercury in edible tissue	Use Attainment	CS
2302_04	Mercury in edible tissue	Use Attainment	CS
2302_05	Mercury in edible tissue	Use Attainment	CS
2302_06	Mercury in edible tissue	Use Attainment	CS
2302_07	Ammonia Nitrogen	Use Attainment	CS
2302_07	Mercury in edible tissue	Use Attainment	CS
2302_07	Bacteria	Impairment	NS
2302A_01	Bacteria	Impairment	NS
2302A_01	Chlorophyll-*a*	Use Attainment	CS
Segment 2303			
2303_02	Ammonia Nitrogen	Use Attainment	CS
2303_02	Nitrate Nitrogen	Use Attainment	CS
2303_02	Orthophosphorus	Use Attainment	CS
2303_02	Total Phosphorus	Use Attainment	CS
2303_02	Toxicity in water	Use Attainment	CN
Segment 2304			
2304_01	Bacteria	Impairment	NS
2304_02	Bacteria	Impairment	NS
2304_03	Toxicity in water	Use Attainment	CN
2304_03	Bacteria	Impairment	NS
2304_04	Toxicity in water	Use Attainment	CN
2304_07	Bacteria	Impairment	NS
2304_09	Bacteria	Impairment	NS
2304B_01	Bacteria	Use Attainment	CN
2304B_01	Chlorophyll-*a*	Use Attainment	CS
Segment 2305			
2305_01	Nitrate Nitrogen	Use Attainment	CS
2305_02	Nitrate Nitrogen	Use Attainment	CS
Segment 2306			
2306_01	Total Phosphorus	Use Attainment	CS
2306_01	Sulfate	Impairment	NS
2306_01	Total Dissolved Solids	Impairment	NS
2306_01	Chloride	Impairment	NS
2306_02	Sulfate	Impairment	NS
2306_02	Total Dissolved Solids	Impairment	NS
2306_02	Chloride	Impairment	NS
2306_03	Chlorophyll-*a*	Use Attainment	CS

Segment/Assessment Unit	Parameter	Concern Type	Level of Concern
Segment 2306 (continued)			
2306_03	Sulfate	Impairment	NS
2306_03	Total Dissolved Solids	Impairment	NS
2306_03	Chloride	Impairment	NS
2306_04	Chlorophyll-*a*	Use Attainment	CS
2306_04	Sulfate	Impairment	NS
2306_04	Total Dissolved Solids	Impairment	NS
2306_04	Chloride	Impairment	NS
2306_05	Sulfate	Impairment	NS
2306_05	Total Dissolved Solids	Impairment	NS
2306_05	Chloride	Impairment	NS
2306_06	Chlorophyll-*a*	Use Attainment	CS
2306_06	Sulfate	Impairment	NS
2306_06	Total Dissolved Solids	Impairment	NS
2306_06	Chloride	Impairment	NS
2306_07	Sulfate	Impairment	NS
2306_07	Total Dissolved Solids	Impairment	NS
2306_07	Chloride	Impairment	NS
2306_08	Chlorophyll-*a*	Use Attainment	CS
2306_08	Chloride	Impairment	NS
2306_08	Sulfate	Impairment	NS
2306_08	Total Dissolved Solids	Impairment	NS
Segment 2307			
2307_01	Chloride	Impairment	NS
2307_01	Total Dissolved Solids	Impairment	NS
2307_01	Chlorophyll-*a*	Use Attainment	CS
2307_02	Chloride	Impairment	NS
2307_02	Total Dissolved Solids	Impairment	NS
2307_02	Orthophosphorus	Use Attainment	CS
2307_03	Ammonia Nitrogen	Use Attainment	CS
2307_03	Bacteria	Impairment	NS
2307_03	Chloride	Impairment	NS
2307_03	Total Dissolved Solids	Impairment	NS
2307_03	Chlorophyll-*a*	Use Attainment	CS
2307_03	Orthophosphorus	Use Attainment	CS
2307_03	Total Phosphorus	Use Attainment	CS
2307_04	Ammonia Nitrogen	Use Attainment	CS
2307_04	Bacteria	Impairment	NS
2307_04	Chloride	Impairment	NS
2307_04	Total Dissolved Solids	Impairment	NS
2307_04	Chlorophyll-*a*	Use Attainment	CS
2307_04	Dissolved Oxygen	Use Attainment	CS
2307_04	Nitrate Nitrogen	Use Attainment	CS
2307_04	Orthophosphorus	Use Attainment	CS
2307_04	Total Phosphorus	Use Attainment	CS
2307_05	Ammonia Nitrogen	Use Attainment	CS
2307_05	Bacteria	Impairment	NS
2307_05	Chloride	Impairment	NS
2307_05	Total Dissolved Solids	Impairment	NS

Segment/Assessment Unit	Parameter	Concern Type	Level of Concern
Segment 2307 (continued)			
2307_05	Chlorophyll-*a*	Use Attainment	CS
2307_05	Nitrate Nitrogen	Use Attainment	CS
2307_05	Orthophosphorus	Use Attainment	CS
2307_05	Total Phosphorus	Use Attainment	CS
Segment 2308			
2308_01	Chlorophyll-*a*	Use Attainment	CS
2308_01	Nitrate Nitrogen	Use Attainment	CS
2308_01	Orthophosphorus	Use Attainment	CS
2308_01	Total Phosphorus	Use Attainment	CS
Segment 2310			
2310_01	Algal bloom	Use Attainment	CN
2310_02	Algal bloom	Use Attainment	CN
Segment 2311			
2311_01	Algal bloom	Use Attainment	CN
2311_02	Bacteria	Use Attainment	CN
2311_02	Chlorophyll-*a*	Use Attainment	CS
2311_02	Algal bloom	Use Attainment	CN
2311_03	Dissolved Oxygen	Impairment	NS
2311_03	Bacteria	Use Attainment	CN
2311_03	Chlorophyll-*a*	Use Attainment	CS
2311_03	Dissolved Oxygen	Use Attainment	CS
2311_03	Algal bloom	Use Attainment	CN
2311_04	Algal bloom	Use Attainment	CN
2311_05	Algal bloom	Use Attainment	CN
2311_06	Algal bloom	Use Attainment	CN
2311_07	Algal bloom	Use Attainment	CN
2311_08	Chlorophyll-*a*	Use Attainment	CS
2311_08	Dissolved Oxygen	Use Attainment	CS
2311_08	Algal bloom	Use Attainment	CN
Segment 2312			
2312_01	Chlorophyll-*a*	Use Attainment	CS
2312_01	Algal bloom	Use Attainment	CN
2312_02	Chlorophyll-*a*	Use Attainment	CS
2312_02	Algal bloom	Use Attainment	CN
Segment 2313			
2313_01	Bacteria	Use Attainment	CN
Segment 2314			
2314_01	Bacteria	Impairment	NS
2314_01	Chlorophyll-*a*	Use Attainment	CS
2314_02	Chlorophyll-*a*	Use Attainment	CS

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D

Segments and Core Parameters Evaluated for Trend Analysis

THIS PAGE INTENTIONALLT LEFT BLANK

Parameter Type	Parameter Name/Reporting Units
Upper Rio Grande	
Segment 2314	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	NITRITE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Organics in Water - Pesticides	ALACHLOR, WHOLE WATER (µg/L)
Organics in Water - Pesticides	SIMAZINE IN WHOLE WATER (µg/L)
Organics in Water - Volatile	METHYL-TERT-BUTYL ETHER (MTBE) WATER, TOTAL (µg/L)
Segment 2308	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	NITRITE NITROGEN, (mg/L as N)

Parameter Type	Parameter Name/Reporting Units
Upper Rio Grande	
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Organics in Water - Pesticides	ALACHLOR, WHOLE WATER (µg/L)
Organics in Water - Pesticides	SIMAZINE IN WHOLE WATER (µg/L)
Organics in Water - Volatile	METHYL-TERT-BUTYL ETHER (MTBE) WATER, TOTAL (µg/L)
Segment 2307	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CADMIUM, DISSOLVED (µg/L as Cd)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	COPPER, DISSOLVED (µg/L as Cu)
Metals - Dissolved	LEAD, DISSOLVED (µg/L as Pb)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Metals - Dissolved	SILVER, DISSOLVED (µg/L as Ag)
Metals - Dissolved	ZINC, DISSOLVED (µg/L as Zn)
Metals - Total	SELENIUM, TOTAL (µg/L as Se)
Metals - Total	TOTAL HARDNESS, (mg/L as $CaCO_3$)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Organics in Water - Volatile	METHYL-TERT-BUTYL ETHER (MTBE) WATER, TOTAL (µg/L)
Unclassified Segment 2306A	
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)

Parameter Type	Parameter Name/Reporting Units
Upper Rio Grande	
Metals - Dissolved	CADMIUM, DISSOLVED (µg/L as Cd)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	COPPER, DISSOLVED (µg/L as Cu)
Metals - Dissolved	LEAD, DISSOLVED (µg/L as Pb)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Metals - Dissolved	SILVER, DISSOLVED (µg/L as Ag)
Metals - Dissolved	ZINC, DISSOLVED (µg/L as Zn)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Nutrients	TOTAL NITROGEN (MG/L AS N)
Segment 2306	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CADMIUM, DISSOLVED (µg/L as Cd)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	COPPER, DISSOLVED (µg/L as Cu)
Metals - Dissolved	LEAD, DISSOLVED (µg/L as Pb)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Metals - Dissolved	SILVER, DISSOLVED (µg/L as Ag)
Metals - Dissolved	ZINC, DISSOLVED (µg/L as Zn)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Nutrients	TOTAL NITROGEN (mg/L as N)

Parameter Type	Parameter Name/Reporting Units
Pecos River	
Segment 2312	
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)

Parameter Type	Parameter Name/Reporting Units
Pecos River	
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Segment 2311	
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CADMIUM, DISSOLVED (µg/L as Cd)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	LEAD, DISSOLVED (µg/L as Pb)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Metals - Dissolved	SILVER, DISSOLVED (µg/L as Ag)
Metals - Dissolved	ZINC, DISSOLVED (µg/L as Zn)
Metals - Total	SELENIUM, TOTAL (µg/L as Se)
Metals - Total	TOTAL HARDNESS, (mg/L as $CaCO_3$)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Unclassified Segment 2310A	
24 HR - DO	DISSOLVED OXYGEN, # MEASUREMENTS DURING 24-HR
24 HR - DO	DISSOLVED OXYGEN, 24-HOUR AVG (mg/L)
24 HR - DO	DISSOLVED OXYGEN, 24-HOUR MAX. (mg/L)
24 HR - DO	DISSOLVED OXYGEN, 24-HOUR MIN. (mg/L)
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)

Parameter Type	Parameter Name/Reporting Units
Pecos River	
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Segment 2310	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Nutrients	TOTAL NITROGEN (mg/L as N)

Parameter Type	Parameter Name/Reporting Units
Middle Rio Grande	
Segment 2313	
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Unclassified Segment 2309A	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)

Parameter Type	Parameter Name/Reporting Units
Middle Rio Grande	
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Segment 2309	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Segment 2305	
Bacteria	*E. coli*, MPN/100 ml
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Segment 2304	
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry

Parameter Type	Parameter Name/Reporting Units
Middle Rio Grande	
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ALUMINUM, DISSOLVED (µg/L as Al)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Metals - Dissolved	CADMIUM, DISSOLVED (µg/L as Cd)
Metals - Dissolved	CHROMIUM, DISSOLVED (µg/L as Cr)
Metals - Dissolved	COPPER, DISSOLVED (µg/L as Cu)
Metals - Dissolved	LEAD, DISSOLVED (µg/L as Pb)
Metals - Dissolved	NICKEL, DISSOLVED (µg/L as Ni)
Metals - Dissolved	SILVER, DISSOLVED (µg/L as Ag)
Metals - Dissolved	ZINC, DISSOLVED (µg/L as Zn)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Nutrients	TOTAL NITROGEN (mg/L as N)

Parameter Type	Parameter Name/Reporting Units
Lower Rio Grande	
Segment 2303	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)

Parameter Type	Parameter Name/Reporting Units
Lower Rio Grande	
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Segment 2302	
Bacteria	*E. coli*, MPN/100 ml
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
Flow	FLOW STREAM, INSTANTANEOUS (cfs, ft^3/s)
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SALINITY - PARTS PER THOUSAND (ppt)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
General	TRANSPARENCY, SECCHI DISC (meters)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Metals - Dissolved	ARSENIC, DISSOLVED (µg/L as As)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	NITRATE NITROGEN, (mg/L as N)
Nutrients	ORTHOPHOSPHATE PHOSPHORUS (mg/L as P)
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)
Nutrients	TOTAL KJELDAHL NITROGEN (mg/L as N)
Nutrients	TOTAL NITROGEN (mg/L as N)
Segment 2301	
Flow	FLOW SEVERITY 1=No Flow, 2=Low, 3=Normal, 4=Flood, 5=High, 6=Dry
General	OXYGEN, DISSOLVED (mg/L)
General	pH (standard units)
General	SPECIFIC CONDUCTANCE,FIELD (µmhos/cm @ 25°C)
General	TEMPERATURE, WATER (Degrees Centigrade)
Inorganics	CHLORIDE (mg/L as Cl)
Inorganics	SULFATE (mg/L as SO_4)
Inorganics	TOTAL DISSOLVED SOLIDS (mg/L)
Nutrients	AMMONIA NITROGEN, (mg/L as N)
Nutrients	CHLOROPHYLL-A, µg/L
Nutrients	PHOSPHORUS, TOTAL, WET METHOD (mg/L as P)

Source: Texas Commission on Environmental Quality. FY2012-2013 Guidance. Exhibit 3C: Surface Water Quality Monitoring Core Parameters.

Appendix E

Statistical Trend Analysis for Evaluated Parameters

THIS PAGE INTENTIONALLY LEFT BLANK

Upper Rio Grande

Segment 2314 Rio Grande Above International Dam

Station 13272

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	152	8.68	4.70	7.30	8.31	9.82	15.07	0.00%	0.43	0.67	
pH	156	8.21	6.70	7.94	8.2	8.47	9.85	0.00%	-4.04	0.00	Downward
Conductivity	158	2012.39	511.00	1033.00	1421	2770	8490.00	0.00%	0.00	1.00	
Temperature	163	17.27	4.63	11.50	16.8	22.9	28.00	0.00%	0.25	0.80	
Secchi Depth	60	0.2	0.01	0.09	0.15	0.24	1.20	7.00%	-2.68	0.01	Downward
E. Coli	101	557.74	1.00	147.00	291	730	3800.00	3.00%	-2.38	0.02	Downward
Chloride	99	255.15	50.00	95.80	147	363	862.00	0.00%	-0.91	0.37	
Sulfate	102	358.87	90.70	175.00	233	507	1030.00	0.00%	-0.62	0.53	
Total Dissolved Solids	101	1191.12	21.00	624.00	846	1560	3090.00	0.00%	-1.96	0.05	
Ammonia	98	0.36	0.02	0.05	0.1	0.31	5.30	22.00%	-2.26	0.03	Downward
Chlorophyll-a	92	20.84	2.00	8.15	13	23.5	210.00	12.00%	-1.62	0.11	
Nitrate	87	0.54	0.05	0.27	0.49	0.72	1.94	3.00%	2.47	0.02	Upward
Orthophosphate	79	0.19	0.04	0.06	0.09	0.2	1.55	22.00%	-0.38	0.71	
Nitrite	53	0.06	0.05	0.05	0.05	0.05	0.25	83.00%	0.39	0.70	
Total Phosphorus	77	0.54	0.06	0.22	0.3	0.6	2.34	1.00%	-1.89	0.06	
Total Kjeldahl Nitrogen	59	1.74	0.46	0.86	1.84	2	6.12	27.00%	-1.67	0.10	
Alachlor	44	0.5	0.50	0.50	0.5	0.5	0.50	100.00%	-99.00	-99.00	
Aluminum	58	216.1	20.00	20.00	68	248	2580.00	41.00%	-0.58	0.57	
Arsenic	61	8.25	2.00	5.00	6.3	8	68.00	11.00%	1.15	0.26	
Chromium	63	6.56	5.00	5.00	5	10	28.00	95.00%	-6.01	0.00	Downward
Nickel	46	18	10.00	10.00	10	10	325.00	93.00%	-0.39	0.70	
Simazine	44	0.5	0.50	0.50	0.5	0.5	0.50	100.00%	-99.00	-99.00	

Station 13276

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	44	8.34	4.60	6.80	7.8	9.74	14.10	0.00%	-0.34	0.73	
pH	45	8.24	7.45	8.10	8.3	8.4	8.70	0.00%	-0.01	0.99	
Conductivity	48	1218.29	606.00	777.50	960	1495	6770.00	0.00%	-0.16	0.88	
Temperature	50	18.8	5.05	12.00	20.1	25.39	29.40	0.00%	0.61	0.54	
Secchi Depth	42	0.42	0.01	0.08	0.1	0.3	9.50	12.00%	-1.35	0.19	
E. Coli	36	137.23	20.00	50.20	71.5	145	920.80	0.00%	-2.16	0.04	Downward
Chloride	45	107.81	1.00	59.00	89.4	142	241.00	2.00%	-0.29	0.78	
Sulfate	45	188.12	1.00	120.00	157	258	387.00	2.00%	-1.12	0.27	
Total Dissolved Solids	42	646.74	10.00	492.00	580	840	1140.00	2.00%	-0.88	0.39	
Ammonia	46	0.2	0.05	0.05	0.05	0.1	2.56	76.00%	2.04	0.05	Upward
Chlorophyll-a	26	15.97	3.00	10.00	10	16.6	69.40	54.00%	0.20	0.84	
Nitrate	35	0.96	0.13	0.30	0.48	1.08	5.05	0.00%	1.76	0.09	
Total Phosphorus	45	0.25	0.05	0.13	0.22	0.31	1.46	7.00%	-0.01	0.99	
Total Kjeldahl Nitrogen	37	1.27	0.07	0.60	0.8	1.06	6.72	3.00%	2.74	0.01	Upward

Station 17040

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	24	8.95	4.40	7.60	8.7	9.85	15.30	0.00%	-2.31	0.03	Downward
pH	20	8.17	6.90	8.05	8.25	8.5	8.90	0.00%	-1.04	0.31	
Conductivity	24	1122.17	615.00	724.00	849.5	1615	2010.00	0.00%	0.49	0.63	
Temperature	25	17.1	6.10	13.00	16.2	21.4	27.30	0.00%	1.90	0.07	

Segment 2308 Rio Grande Below International Dam

Station 14465

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	43	8.85	2.50	7.50	8.8	10.8	12.30	0.00%	0.44	0.66	
pH	45	8.45	7.30	8.15	8.5	8.75	9.75	0.00%	-1.74	0.09	
Conductivity	46	1785.04	508.00	1115.00	1535	2380	4780.00	0.00%	3.01	0.00	Upward
Temperature	49	18.82	9.46	14.00	17.7	24.3	29.40	0.00%	-2.39	0.02	Downward
E. Coli	26	654.6	7.00	58.00	185.5	830	2420.00	0.00%	1.08	0.29	
Chloride	27	181.05	45.60	92.70	135	241	443.00	0.00%	1.14	0.26	
Sulfate	30	252.82	82.10	171.00	218.5	340	525.00	0.00%	0.56	0.58	
Total Dissolved Solids	30	955.6	344.00	598.00	754	1250	2600.00	0.00%	0.46	0.65	
Ammonia	27	0.24	0.02	0.05	0.06	0.2	2.50	11.00%	-1.35	0.19	
Chlorophyll-a	29	20.75	2.00	9.00	10	23	110.00	17.00%	-0.38	0.71	
Nitrate	21	2.96	0.05	0.73	1.35	5.58	8.97	5.00%	-0.45	0.66	
Nitrite	23	0.07	0.05	0.05	0.05	0.06	0.16	70.00%	1.01	0.33	
Total Phosphorus	22	0.86	0.08	0.30	0.68	1.2	2.50	0.00%	-0.62	0.54	
Aluminum	25	84.12	20.00	20.00	40	144	313.00	48.00%	-1.14	0.27	
Arsenic	28	9.46	4.20	6.10	8.05	12.1	18.70	7.00%	0.59	0.56	
Chromium	27	6.15	5.00	5.00	5	6	10.00	93.00%	-5.15	0.00	Downward
Nickel	20	10	10.00	10.00	10	10	10.00	100.00%	-99.00	-99.00	

Station 15528

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	51	9.74	5.30	8.00	9.07	11.7	17.80	0.00%	-0.89	0.38	
pH	53	8.66	7.57	8.30	8.57	9	9.97	0.00%	0.59	0.56	
Conductivity	54	1860.54	357.00	1060.00	1480	2440	5120.00	0.00%	-1.41	0.16	
Temperature	56	17.82	2.81	10.85	18.45	21.85	37.61	0.00%	1.26	0.21	
Secchi Depth	21	0.22	0.05	0.10	0.15	0.2	1.20	76.00%	-0.16	0.87	
E. Coli	39	1139.47	5.00	162.00	980	2400	2420.00	3.00%	3.88	0.00	Upward
Chloride	40	208	50.70	100.00	148.5	327.5	603.00	0.00%	-0.09	0.93	
Sulfate	44	324.19	91.20	181.50	221.5	488.5	809.00	0.00%	-0.66	0.51	
Total Dissolved Solids	46	1148.15	374.00	626.00	847	1600	2540.00	0.00%	-0.73	0.47	
Ammonia	34	0.79	0.02	0.05	0.14	0.5	9.80	6.00%	1.98	0.06	
Chlorophyll-a	39	27.9	2.00	8.00	11	25	310.00	21.00%	-1.03	0.31	
Nitrate	30	1.83	0.05	0.55	1.06	2.35	8.48	10.00%	-0.63	0.53	
Orthophosphate	25	0.2	0.05	0.05	0.06	0.19	1.90	44.00%	0.12	0.90	
Nitrite	34	0.1	0.05	0.05	0.05	0.08	0.50	71.00%	1.73	0.09	
Total Phosphorus	28	0.97	0.06	0.25	0.72	1.75	2.88	4.00%	-0.51	0.61	
Alachlor	25	0.5	0.50	0.50	0.5	0.5	0.60	100.00%	-1.08	0.29	
Aluminum	36	136.92	20.00	20.00	83	200	622.00	58.00%	-0.43	0.67	
Arsenic	39	12.04	2.70	6.60	9.2	14.3	45.00	8.00%	0.52	0.60	
Chromium	40	6.98	5.00	5.00	5	10	19.00	98.00%	-6.70	0.00	Downward
Nickel	26	10	10.00	10.00	10	10	10.00	96.00%	-99.00	-99.00	
Simazine	25	0.5	0.50	0.50	0.5	0.5	0.60	100.00%	-1.08	0.29	

Station 15529

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	46	9.17	5.17	7.60	8.9	10.7	14.40	0.00%	-1.01	0.32	
pH	48	8.55	7.39	8.15	8.4	8.9	9.90	0.00%	0.31	0.76	
Conductivity	49	1848	695.00	1040.00	1364	2430	5110.00	0.00%	-1.60	0.12	
Temperature	50	17.02	3.19	10.10	17.7	21.6	27.70	0.00%	2.27	0.03	Upward
E. Coli	37	1068.19	5.00	127.00	770	2400	2420.00	5.00%	4.10	0.00	Upward
Chloride	35	192.89	45.20	98.00	137	304	561.00	0.00%	0.20	0.84	
Sulfate	39	319.86	83.40	179.00	217	503	828.00	0.00%	-0.44	0.66	
Total Dissolved Solids	40	1106.7	352.00	599.00	826	1665	2540.00	0.00%	-0.62	0.54	
Ammonia	33	1.04	0.02	0.06	0.13	0.6	13.20	9.00%	1.67	0.10	
Chlorophyll-a	34	18.16	2.00	6.00	12.5	24	83.00	18.00%	0.82	0.42	
Nitrate	27	1.49	0.10	0.22	0.69	2.28	5.53	7.00%	-1.20	0.24	
Orthophosphate	20	0.12	0.05	0.05	0.06	0.14	0.37	45.00%	-1.07	0.30	
Nitrite	30	0.06	0.05	0.05	0.05	0.05	0.25	80.00%	0.82	0.42	
Total Phosphorus	22	1.05	0.06	0.30	0.82	1.7	3.01	5.00%	-0.72	0.48	
Alachlor	24	0.49	0.05	0.50	0.5	0.5	0.60	100.00%	-1.71	0.10	
Aluminum	36	132.97	20.00	20.00	96.5	200	589.00	53.00%	-0.36	0.72	
Arsenic	39	11.29	2.50	5.70	8.1	15.1	43.50	8.00%	0.56	0.58	
Chromium	40	6.62	5.00	5.00	5	10	10.00	100.00%	-8.13	0.00	Downward
Nickel	27	10	10.00	10.00	10	10	10.00	100.00%	-99.00	-99.00	
Simazine	24	0.5	0.50	0.50	0.5	0.5	0.60	100.00%	-1.11	0.28	

Segment 2307 Rio Grande Below Riverside Diversion Dam

Station 13230

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	100	7.83	3.76	6.40	7.65	9.2	13.80	0.00%	0.94	0.35	
pH	103	7.77	6.90	7.50	7.8	8	8.80	0.00%	7.78	0.00	Upward
Conductivity	101	3099.92	505.00	2590.00	3300	3660	5640.00	0.00%	0.05	0.96	
Temperature	106	18.29	3.40	11.00	19.15	25.6	30.30	0.00%	0.29	0.77	
Secchi Depth	106	0.15	0.01	0.08	0.14	0.21	0.50	1.00%	0.22	0.83	
E. Coli	73	171.94	7.20	19.50	32.7	125.9	2700.00	1.00%	1.22	0.23	
Chloride	107	563.16	18.00	356.00	603	746	1298.00	0.00%	0.83	0.41	
Sulfate	110	621.54	92.00	524.00	590.5	729	1985.00	0.00%	-0.16	0.87	
Total Dissolved Solids	104	1984.36	283.00	1435.50	2105	2420	4060.00	0.00%	0.79	0.43	
Ammonia	104	0.26	0.01	0.05	0.1	0.18	3.79	51.00%	1.64	0.10	
Chlorophyll-a	104	47.35	3.00	10.00	29.5	78.45	260.00	23.00%	3.57	0.00	Upward
Nitrate	88	1.64	0.02	0.04	0.3	1.53	35.60	33.00%	-0.56	0.58	
Orthophosphate	33	0.21	0.02	0.06	0.11	0.3	1.04	42.00%	1.63	0.11	
Total Phosphorus	106	0.53	0.05	0.20	0.34	0.57	4.81	6.00%	-2.41	0.02	Downward
Total Kjeldahl Nitrogen	46	2.34	0.58	1.27	1.7	3.24	8.45	0.00%	1.40	0.17	

Station 13232

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	30	8.89	4.90	7.20	9.05	11.13	13.90	0.00%	-0.80	0.43	
pH	32	7.95	7.31	7.78	7.93	8.18	8.70	0.00%	-0.50	0.62	
Conductivity	32	3700.94	1280.00	2895.00	3630	4345	6250.00	0.00%	-1.86	0.07	
Temperature	32	14.76	6.60	8.80	12.1	21.45	31.40	0.00%	1.16	0.26	
Secchi Depth	31	0.17	0.03	0.08	0.15	0.22	0.61	6.00%	-3.48	0.00	Downward
E. Coli	30	7169.64	10.00	48.10	86	629	200000.00	7.00%	1.45	0.16	
Chloride	35	729.54	112.00	525.00	674	915	1490.00	0.00%	-1.06	0.30	
Sulfate	35	612.66	74.00	484.00	575	721	1140.00	0.00%	-1.03	0.31	
Total Dissolved Solids	35	3804.57	1180.00	1920.00	2220	2900	50300.00	0.00%	0.22	0.82	
Ammonia	34	2.43	0.05	0.05	0.64	3.79	11.80	26.00%	0.46	0.65	
Nitrate	23	1.45	0.04	0.60	1.12	1.86	4.76	4.00%	1.35	0.19	
Total Phosphorus	33	1.05	0.29	0.46	0.73	1.24	3.05	0.00%	0.90	0.37	
Total Kjeldahl Nitrogen	32	3.91	1.14	1.48	2.1	4.54	12.90	0.00%	0.34	0.73	

Station 15704

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	56	9.1	3.80	7.12	8.95	10.7	15.05	0.00%	0.06	0.95	
pH	57	8.15	6.80	7.90	8.2	8.4	10.00	0.00%	0.06	0.95	
Conductivity	59	1718.49	750.00	1410.00	1640	2020	3300.00	0.00%	-2.72	0.01	Downward
Temperature	61	16.53	0.90	11.00	16.5	22.6	30.00	0.00%	1.75	0.09	
Secchi Depth	56	0.22	0.00	0.10	0.15	0.3	1.30	21.00%	-1.35	0.18	
E. Coli	41	676.84	10.00	170.00	310	870	2419.20	12.00%	-1.92	0.06	
Chloride	66	261.34	70.00	201.00	249.5	320	564.00	0.00%	-1.42	0.16	
Sulfate	66	286.47	126.00	220.00	290	337	530.00	0.00%	-0.98	0.33	
Total Dissolved Solids	65	1112.63	520.00	910.00	1140	1270	2120.00	0.00%	-2.03	0.05	Downward
Ammonia	65	0.84	0.01	0.10	0.21	0.73	8.00	20.00%	-1.88	0.06	
Chlorophyll-a	45	17.78	3.00	8.20	10	19	93.00	40.00%	0.86	0.40	
Nitrate	52	2.38	0.02	0.24	0.8	3.9	23.60	17.00%	1.19	0.24	
Orthophosphate	21	0.83	0.07	0.46	0.7	1.03	2.08	0.00%	-0.94	0.36	
Total Phosphorus	62	0.98	0.06	0.56	0.8	1.13	6.42	2.00%	-1.27	0.21	
Total Kjeldahl Nitrogen	37	2.78	0.63	1.07	1.62	3.36	10.00	0.00%	0.19	0.85	

Station 15795											
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value**	**Trend**
Dissolved Oxygen (Grab)	82	8.42	0.90	7.00	8.45	10.47	16.90	0.00%	1.13	0.26	
pH	84	8.14	7.10	7.90	8.2	8.35	9.10	0.00%	0.85	0.40	
Conductivity	84	2265.07	880.00	1740.00	2071	2530	6840.00	0.00%	-1.47	0.14	
Temperature	86	15.84	4.20	10.40	15.28	21.5	29.20	0.00%	0.56	0.58	
Secchi Depth	72	0.2	0.02	0.10	0.17	0.28	1.00	7.00%	-3.97	0.00	Downward
Total Hardness	24	386	265.00	345.00	378.5	400.5	580.00	0.00%	1.77	0.09	
E. Coli	50	5932.11	26.00	190.00	460.55	1553.07	240000.00	12.00%	1.54	0.13	
Chloride	64	367.75	1.00	222.00	319	401.5	1440.00	0.00%	-0.50	0.62	
Sulfate	67	378.52	1.00	267.00	356	415	1190.00	1.00%	-0.20	0.84	
Total Dissolved Solids	64	1423.59	5.00	1075.00	1315	1545	4400.00	3.00%	-0.29	0.78	
Ammonia	65	2.23	0.03	0.05	0.19	1.56	28.20	23.00%	-1.16	0.25	
Chlorophyll-a	59	49.2	1.00	13.00	29.3	50.6	384.00	12.00%	-1.55	0.13	
Nitrate	41	1.89	0.04	0.39	1.16	2.69	7.48	10.00%	0.91	0.37	
Orthophosphate	58	0.85	0.06	0.33	0.48	1.16	5.83	2.00%	-1.06	0.29	
Total Phosphorus	62	1.2	0.05	0.54	0.86	1.45	5.60	2.00%	-1.86	0.07	
Total Kjeldahl Nitrogen	53	3.98	0.12	1.17	1.73	3.93	37.50	4.00%	-1.10	0.28	
Aluminum	34	90.5	20.00	100.00	100	100	190.00	79.00%	1.26	0.22	
Arsenic	34	9.4	2.00	6.09	7.7	10.2	25.00	29.00%	1.56	0.13	
Chromium	34	4.15	3.00	4.00	4	4	5.00	100.00%	-0.35	0.73	
Nickel	34	7.5	5.00	5.00	5	10	17.00	94.00%	-5.19	0.00	Downward
Cadmium	29	1.14	0.10	0.10	0.4	1	7.00	93.00%	-2.91	0.01	Downward
Copper	20	3.54	1.60	2.22	3	5.08	6.00	55.00%	-4.71	0.00	Downward
Lead	28	0.52	0.05	0.20	0.5	1	1.11	57.00%	-1.52	0.14	
Selenium	26	0.56	0.13	0.25	0.26	0.34	5.00	50.00%	1.22	0.23	
Silver	26	1.25	0.25	0.40	0.5	2	4.00	96.00%	2.25	0.03	Upward
Zinc	28	5.41	4.00	4.00	4	7.25	12.50	82.00%	-1.70	0.10	

Station 16272

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	47	8.09	2.00	6.50	8.12	9.3	12.50	0.00%	-0.43	0.67	
pH	50	8.05	6.20	7.80	8.04	8.4	9.00	0.00%	0.01	0.99	
Conductivity	52	1646.06	758.00	1450.00	1592	1920	2760.00	0.00%	-3.23	0.00	Downward
Temperature	53	16.89	5.80	12.10	16.66	20.6	30.20	0.00%	1.07	0.29	
Secchi Depth	48	0.39	0.02	0.18	0.29	0.48	1.20	31.00%	0.50	0.62	
E. Coli	41	377.71	10.00	104.00	210	530	2300.00	0.00%	-0.87	0.39	
Chloride	57	256.83	67.70	212.00	262	317	438.00	0.00%	-2.04	0.05	Downward
Sulfate	57	279.98	141.00	236.00	267	329	502.00	0.00%	-1.91	0.06	
Total Dissolved Solids	57	1070.23	534.00	942.00	1060	1230	1760.00	0.00%	-3.11	0.00	Downward
Ammonia	56	0.4	0.02	0.11	0.3	0.57	2.82	11.00%	0.21	0.83	
Chlorophyll-a	39	11.96	3.00	7.00	10	12.3	73.00	46.00%	0.35	0.73	
Nitrate	44	1.68	0.04	0.04	0.32	2.74	8.90	30.00%	1.08	0.29	
Orthophosphate	23	0.52	0.04	0.22	0.47	0.65	1.50	9.00%	2.03	0.06	
Total Phosphorus	55	0.87	0.20	0.39	0.6	1	4.19	0.00%	1.73	0.09	
Total Kjeldahl Nitrogen	32	1.25	0.44	0.78	1.08	1.45	4.11	0.00%	-0.48	0.64	

Segment 2306 Rio Grande Above Amistad Reservoir

Station 13223

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	59	8.1	4.80	7.10	7.9	9.3	12.40	0.00%	-0.01	0.99	
pH	60	8.05	7.14	7.90	8.1	8.2	8.50	0.00%	0.71	0.48	
Conductivity	60	1221.67	644.00	907.00	1200	1450	2000.00	0.00%	0.75	0.46	
Temperature	59	21.73	11.40	17.00	23	26.7	29.00	0.00%	1.53	0.13	
Chloride	58	117.13	14.40	49.00	93.45	176	292.00	0.00%	-0.30	0.76	
Sulfate	58	302.79	113.00	238.00	292.5	361	501.00	0.00%	1.44	0.16	
Total Dissolved Solids	58	814.24	433.00	606.00	811	1010	1330.00	0.00%	1.09	0.28	
Orthophosphate	50	0.02	0.00	0.01	0.01	0.01	0.17	62.00%	3.50	0.00	Upward
Total Phosphorus	58	0.94	0.00	0.05	0.1	0.73	14.50	10.00%	-0.88	0.38	
Total Kjeldahl Nitrogen	55	1.8	0.16	0.33	0.54	1.4	23.00	0.00%	-0.74	0.46	
Total Nitrogen	39	2.51	0.61	0.87	1.2	2.2	25.00	0.00%	-1.65	0.11	
Aluminum	32	1.92	0.80	1.10	1.4	2.25	8.00	6.00%	1.26	0.22	
Arsenic	41	2.63	1.30	2.20	2.7	3.1	3.90	0.00%	0.89	0.38	
Chromium	32	0.5	0.04	0.11	0.8	0.8	0.80	66.00%	-8.78	0.00	Downward
Nickel	31	2.35	0.32	1.20	2.08	3.55	5.61	0.00%	-1.01	0.32	
Cadmium	33	0.03	0.02	0.02	0.03	0.04	0.16	24.00%	1.39	0.17	
Copper	32	1.96	0.41	1.40	1.8	2.5	5.70	0.00%	-0.76	0.45	
Lead	33	0.11	0.04	0.07	0.08	0.09	0.67	55.00%	2.54	0.02	Upward
Silver	33	0.31	0.10	0.20	0.2	0.2	1.00	97.00%	-5.05	0.00	Downward
Zinc	31	1.96	0.38	0.86	1.5	2.6	6.10	3.00%	0.47	0.64	

Station 13225

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	41	7.86	2.30	7.59	8	8.2	10.89	0.00%	-1.25	0.22	
pH	43	8.06	7.30	7.90	8.1	8.3	8.50	0.00%	-1.51	0.14	
Conductivity	43	1664.42	587.00	1380.00	1440	2110	2730.00	0.00%	1.00	0.32	
Temperature	43	24.77	12.20	22.10	26.9	29.5	31.80	0.00%	-1.07	0.29	
Secchi Depth	34	0.23	0.01	0.08	0.18	0.25	1.30	12.00%	-1.31	0.20	
E. Coli	23	270.36	1.00	10.00	15	26	2420.00	22.00%	-0.82	0.42	
Chloride	34	199.47	15.00	95.00	175.5	284	515.00	0.00%	1.13	0.27	
Sulfate	35	493.69	152.00	374.00	506	622	744.00	0.00%	1.28	0.21	
Total Dissolved Solids	32	1192.12	464.00	952.00	1175	1495	1750.00	0.00%	1.46	0.15	
Ammonia	33	0.06	0.02	0.05	0.05	0.05	0.28	82.00%	-1.47	0.15	
Nitrate	23	0.26	0.04	0.04	0.13	0.38	0.92	22.00%	0.17	0.86	
Total Phosphorus	32	1.51	0.02	0.06	0.08	0.24	14.00	31.00%	-1.30	0.20	
Total Kjeldahl Nitrogen	29	2.45	0.14	0.43	0.53	1.07	18.48	0.00%	-0.97	0.34	

Station 13227

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	10.52	9.70	10.45	10.6	10.6	10.70	0.00%	-99.00	-99.00	
pH	20	8.3	8.30	8.30	8.3	8.3	8.30	0.00%	-99.00	-99.00	
Conductivity	20	3473	3470.00	3470.00	3470	3480	3480.00	0.00%	-99.00	-99.00	
Temperature	20	13.02	12.90	13.00	13	13.1	13.10	0.00%	-99.00	-99.00	

Station 13228

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	95	9.13	5.00	7.10	8.7	10.92	17.20	0.00%	0.44	0.66	
pH	98	7.98	6.70	7.80	8	8.2	8.80	0.00%	-1.16	0.25	
Conductivity	96	2584.49	419.00	1870.00	2850	3285	3840.00	0.00%	0.27	0.79	
Temperature	98	20.34	8.40	13.70	21.22	26.5	32.98	0.00%	-0.22	0.82	
Secchi Depth	90	0.17	0.01	0.04	0.1	0.23	0.94	4.00%	2.12	0.04	Upward
E. Coli	66	195.73	1.00	10.00	28.5	72	2419.00	8.00%	-0.33	0.74	
Chloride	103	361.34	15.40	178.00	416	524	715.00	0.00%	0.23	0.82	
Sulfate	102	666.1	68.60	542.00	679.5	815	1100.00	0.00%	0.66	0.51	
Total Dissolved Solids	99	1725.74	525.00	1270.00	1900	2180	2720.00	0.00%	0.22	0.83	
Ammonia	98	0.24	0.01	0.05	0.05	0.1	4.14	70.00%	1.80	0.07	
Chlorophyll-a	74	29.68	3.00	7.00	10.85	36	366.00	41.00%	0.69	0.49	
Nitrate	74	0.49	0.01	0.04	0.14	0.42	8.40	38.00%	-1.54	0.13	
Orthophosphate	24	0.11	0.01	0.06	0.07	0.12	0.65	62.00%	1.42	0.17	
Total Phosphorus	101	0.61	0.02	0.08	0.17	0.29	15.50	13.00%	-2.67	0.01	Downward
Total Kjeldahl Nitrogen	44	1.98	0.20	0.64	1.07	2.45	6.72	2.00%	2.95	0.01	Upward

Station 13229

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	102	8.16	4.70	6.70	7.75	9.2	14.50	0.00%	1.75	0.08	
pH	105	7.77	6.90	7.50	7.8	8	8.80	0.00%	6.75	0.00	Upward
Conductivity	103	2719.62	163.00	2180.00	2910	3360	4420.00	0.00%	-0.03	0.98	
Temperature	108	19.48	6.30	13.00	20.36	25.8	32.20	0.00%	0.74	0.46	
Secchi Depth	108	0.17	0.02	0.09	0.18	0.24	0.50	1.00%	0.22	0.83	
E. Coli	74	344.37	3.00	30.00	72	403.4	2419.00	3.00%	-1.69	0.10	
Chloride	106	393.49	15.90	200.00	402.5	565	829.00	0.00%	-0.55	0.58	
Sulfate	109	711.69	73.80	557.00	746	881	1322.00	0.00%	0.78	0.44	
Total Dissolved Solids	102	1865.83	298.00	1509.00	2035	2320	3280.00	0.00%	-0.08	0.94	
Ammonia	103	0.21	0.01	0.05	0.1	0.16	2.80	51.00%	2.30	0.02	Upward
Chlorophyll-a	83	38.97	3.00	10.00	19	59	205.00	31.00%	2.61	0.01	Upward
Nitrate	86	1.2	0.02	0.05	0.3	1.35	28.00	27.00%	-1.22	0.22	
Orthophosphate	31	0.17	0.01	0.04	0.07	0.18	1.16	52.00%	-0.21	0.83	
Total Phosphorus	106	0.34	0.03	0.12	0.21	0.42	1.80	6.00%	-2.47	0.02	Downward
Total Kjeldahl Nitrogen	48	2.08	0.38	0.98	1.46	3.1	6.72	0.00%	2.99	0.00	Upward

Station 16730

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	64	7.92	2.40	6.55	7.54	8.95	13.00	0.00%	0.15	0.88	
pH	65	7.82	7.00	7.70	7.82	8	8.89	0.00%	-0.58	0.56	
Conductivity	65	2081.12	663.00	1610.00	2202	2740	3290.00	0.00%	1.41	0.16	
Temperature	66	21.76	11.54	17.30	21.7	26.5	33.11	0.00%	1.34	0.19	
Secchi Depth	58	0.16	0.01	0.03	0.06	0.28	0.85	0.00%	4.44	0.00	Upward
E. Coli	43	62.55	1.00	18.00	25.9	48	721.50	2.00%	-0.99	0.33	
Chloride	67	265.7	7.00	111.00	281	410	620.00	0.00%	0.46	0.65	
Sulfate	66	544.19	30.00	451.00	593	677	867.00	0.00%	1.00	0.32	
Total Dissolved Solids	67	1358.13	120.00	969.00	1430	1788	2140.00	0.00%	0.48	0.64	
Ammonia	64	0.26	0.01	0.02	0.1	0.1	4.76	58.00%	2.59	0.01	Upward
Chlorophyll-a	60	19.59	3.00	3.05	10	17.05	225.00	38.00%	0.86	0.40	
Nitrate	52	0.58	0.02	0.04	0.07	0.29	9.30	31.00%	-0.25	0.80	
Total Phosphorus	67	0.91	0.02	0.06	0.09	0.23	18.30	19.00%	-1.73	0.09	

Station 17000

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	64	8.02	5.90	6.80	7.75	9.1	13.20	0.00%	0.90	0.37	
pH	65	7.7	7.00	7.40	7.8	8	8.40	0.00%	10.09	0.00	Upward
Conductivity	65	2807.14	835.00	2290.00	3020	3410	4100.00	0.00%	-0.07	0.94	
Temperature	68	18.38	4.40	12.10	18.1	25.35	29.00	0.00%	0.81	0.42	
Secchi Depth	68	0.19	0.03	0.14	0.18	0.24	0.46	0.00%	1.49	0.14	
E. Coli	42	560.53	5.00	52.80	105.9	1000	2419.20	7.00%	-1.50	0.14	

Station 17001

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	65	7.94	5.10	6.80	7.8	8.9	13.60	0.00%	0.61	0.54	
pH	66	7.67	6.80	7.30	7.7	8	8.50	0.00%	8.41	0.00	Upward
Conductivity	66	2814.8	810.00	2310.00	3035	3410	4060.00	0.00%	-0.31	0.76	
Temperature	69	18.34	4.40	12.10	18.2	25	28.70	0.00%	0.54	0.59	
Secchi Depth	69	0.18	0.03	0.15	0.18	0.24	0.46	0.00%	1.49	0.14	
E. Coli	44	243.57	1.00	23.15	56.9	190	2419.20	5.00%	0.15	0.88	

Station 20623

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	23	9.87	8.80	9.50	9.5	9.9	14.10	0.00%	-0.01	0.99	
pH	23	8.07	8.00	8.00	8.1	8.1	8.30	0.00%	3.18	0.00	Upward
Conductivity	23	1509.78	995.00	1010.00	1960	1970	1970.00	0.00%	-612.69	0.00	Downward
Temperature	23	26.32	21.00	21.00	23	31.8	32.20	0.00%	57.75	0.00	Upward

Segment 2306A Alamito Creek (unclassified water body)

Station 13108

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	49	8.79	5.60	7.20	8.5	9.3	16.20	0.00%	-1.85	0.07	
pH	50	7.91	7.30	7.80	7.9	8	8.30	0.00%	0.74	0.47	
Conductivity	51	2799.02	1090.00	2040.00	3220	3310	4370.00	0.00%	-0.50	0.62	
Temperature	50	22.94	9.20	15.10	26.3	28.8	31.50	0.00%	1.56	0.13	
Chloride	41	349.61	44.00	144.00	320	539	722.00	0.00%	-1.95	0.06	
Sulfate	41	700.93	228.00	502.00	688	904	1080.00	0.00%	-0.12	0.91	
Total Dissolved Solids	41	1869.15	648.00	1330.00	2040	2420	3030.00	0.00%	-0.93	0.36	
Orthophosphate	37	0.08	0.01	0.02	0.02	0.02	0.76	57.00%	0.06	0.95	
Total Phosphorus	36	0.36	0.03	0.12	0.17	0.34	3.92	0.00%	1.49	0.15	
Total Kjeldahl Nitrogen	36	1.3	0.34	0.66	0.96	1.45	7.70	0.00%	1.02	0.32	
Total Nitrogen	28	2.04	0.56	1.00	1.35	2.25	8.20	0.00%	0.54	0.60	
Aluminum	31	2.45	1.00	1.60	2.3	3.2	5.00	32.00%	-0.89	0.38	
Arsenic	41	4.04	1.20	2.30	3	4.5	12.00	0.00%	3.37	0.00	Upward
Chromium	34	0.56	0.03	0.12	0.8	0.8	0.90	76.00%	-8.74	0.00	Downward
Nickel	32	3.76	0.06	1.68	2.76	4.89	10.80	3.00%	-0.80	0.43	
Cadmium	34	0.05	0.02	0.03	0.04	0.05	0.24	35.00%	1.08	0.29	
Copper	32	2.93	0.61	2.00	2.9	4	6.00	0.00%	-3.71	0.00	Downward
Lead	34	0.11	0.04	0.08	0.09	0.16	0.30	50.00%	2.50	0.02	Upward
Silver	34	0.5	0.10	0.20	0.2	0.4	2.00	100.00%	-4.73	0.00	Downward
Zinc	33	2.45	0.43	1.40	2	3.4	6.30	3.00%	-1.92	0.06	

Segment 2305 International Amistad Reservoir

Station 13835

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	602	7.16	0.10	6.20	7.6	8.9	12.40	1.00%	-2.12	0.03	Downward
pH	642	7.97	4.70	7.80	8	8.3	8.50	0.00%	5.64	0.00	Upward
Conductivity	642	969.35	792.00	913.00	973	1030	1230.00	0.00%	4.21	0.00	Upward
Temperature	642	19.31	10.80	15.20	18.5	23.2	28.50	0.00%	-1.40	0.16	
Secchi Depth	36	4.37	1.50	3.00	3.95	5.86	8.00	3.00%	0.19	0.85	
E. Coli	31	2.48	1.00	1.00	1	1	10.00	87.00%	2.32	0.03	Upward
Chloride	34	109.06	80.00	98.00	109.5	117	134.00	0.00%	-0.70	0.49	
Sulfate	35	176.83	115.00	159.00	176	186	375.00	0.00%	3.55	0.00	Upward
Total Dissolved Solids	33	570.52	464.00	530.00	574	604	652.00	0.00%	2.12	0.04	Upward
Ammonia	34	0.05	0.02	0.05	0.05	0.05	0.20	94.00%	-0.68	0.50	
Nitrate	26	0.17	0.04	0.09	0.14	0.19	0.48	15.00%	0.10	0.92	
Orthophosphate	20	0.04	0.01	0.04	0.04	0.04	0.04	100.00%	-0.94	0.36	
Total Phosphorus	34	0.06	0.02	0.05	0.06	0.06	0.40	97.00%	-1.34	0.19	
Total Kjeldahl Nitrogen	32	0.31	0.19	0.26	0.3	0.36	0.45	3.00%	1.22	0.23	

Station 15892

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	460	7.71	0.20	6.60	7.6	9	13.70	1.00%	-2.91	0.00	Downward
pH	473	8.09	7.10	7.90	8.1	8.3	8.60	0.00%	5.94	0.00	Upward
Conductivity	473	1067.12	587.00	990.00	1066	1122	1730.00	0.00%	0.46	0.64	
Temperature	474	21.6	10.90	17.40	22	26.8	29.10	0.00%	0.56	0.57	
Secchi Depth	31	3.23	0.30	2.00	2.8	4.7	7.00	0.00%	1.29	0.21	
E. Coli	26	2.74	1.00	1.00	1	3	10.00	54.00%	1.67	0.11	
Chloride	31	120.26	31.00	103.00	127	141	157.00	0.00%	-0.83	0.41	
Sulfate	31	197.87	106.00	187.00	201	216	265.00	0.00%	1.38	0.18	
Total Dissolved Solids	28	621	406.00	589.00	644	662	740.00	0.00%	-0.10	0.92	
Ammonia	30	0.05	0.05	0.05	0.05	0.05	0.06	93.00%	-1.16	0.26	
Nitrate	22	0.25	0.04	0.10	0.2	0.27	0.77	9.00%	0.07	0.94	
Total Phosphorus	30	0.05	0.02	0.05	0.06	0.06	0.06	97.00%	-1.32	0.20	
Total Kjeldahl Nitrogen	30	0.38	0.23	0.29	0.36	0.44	0.81	0.00%	-1.46	0.15	

Station 15893											
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value**	**Trend**
Dissolved Oxygen (Grab)	397	7.27	0.10	5.90	7.8	8.9	12.80	1.00%	-1.53	0.13	
pH	420	8.01	6.80	7.80	8.1	8.2	8.50	0.00%	6.62	0.00	Upward
Conductivity	420	723.27	166.00	556.00	753	877	1010.00	0.00%	11.39	0.00	Upward
Temperature	420	21.25	10.60	17.00	21.75	25.4	29.50	0.00%	-1.75	0.08	
Secchi Depth	33	3.01	0.25	2.50	2.8	3.8	6.40	0.00%	2.36	0.02	Upward
E. Coli	28	5.55	1.00	1.00	1	7.15	64.00	68.00%	0.45	0.66	
Chloride	32	58.56	16.00	42.50	61	76	102.00	0.00%	5.99	0.00	Upward
Sulfate	33	90.15	20.00	61.00	91	119	198.00	0.00%	6.56	0.00	Upward
Total Dissolved Solids	31	389.32	208.00	324.00	376	482	580.00	0.00%	6.41	0.00	Upward
Ammonia	32	0.05	0.05	0.05	0.05	0.05	0.11	84.00%	1.67	0.10	
Nitrate	24	0.42	0.11	0.28	0.42	0.54	0.92	0.00%	-1.00	0.33	
Orthophosphate	20	0.04	0.01	0.04	0.04	0.04	0.04	100.00%	-0.94	0.36	
Total Phosphorus	32	0.05	0.02	0.05	0.06	0.06	0.06	100.00%	-1.97	0.06	
Total Kjeldahl Nitrogen	31	0.34	0.19	0.28	0.34	0.39	0.53	0.00%	0.88	0.39	

Segment 2309 Devils River

Station 13237

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	33	9.76	6.71	8.30	10.2	11.1	13.20	0.00%	-2.14	0.04	Downward
pH	35	8.03	6.40	7.90	8.2	8.2	8.40	0.00%	1.39	0.17	
Conductivity	35	403	201.00	389.00	402	426	512.00	0.00%	0.81	0.42	
Temperature	35	20.79	10.90	15.20	21	25.5	29.54	0.00%	-0.30	0.77	
Secchi Depth	34	1.2	0.30	1.00	1.2	1.5	2.00	97.00%	0.53	0.60	
E. Coli	31	14.01	1.00	3.00	7	10	187.00	29.00%	-0.34	0.73	
Chloride	34	13.56	9.00	12.00	14	15	17.00	0.00%	5.36	0.00	Upward
Sulfate	34	8.53	8.00	8.00	8	9	12.00	0.00%	1.06	0.30	
Total Dissolved Solids	31	239.71	196.00	228.00	238	248	272.00	0.00%	1.11	0.28	
Ammonia	32	0.05	0.05	0.05	0.05	0.05	0.07	97.00%	-1.03	0.31	
Chlorophyll-a	22	2.66	0.23	3.00	3	3	3.00	86.00%	-3.40	0.00	Downward
Nitrate	27	1.17	0.61	0.92	1.2	1.37	1.64	0.00%	-0.95	0.35	
Total Phosphorus	34	0.05	0.02	0.05	0.06	0.06	0.06	100.00%	-2.56	0.02	Downward
Total Kjeldahl Nitrogen	32	0.26	0.14	0.20	0.22	0.29	0.55	28.00%	-0.82	0.42	

Station 13239

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	30	9.29	7.00	8.30	9.05	10.1	12.10	0.00%	-1.12	0.27	
pH	31	7.78	6.60	7.70	7.8	8	8.10	0.00%	1.14	0.27	
Conductivity	31	446.1	385.00	434.00	440	461	491.00	0.00%	0.15	0.88	
Temperature	31	21.53	15.00	18.30	21.2	25.6	27.80	0.00%	1.16	0.26	
Secchi Depth	30	1.24	0.30	1.20	1.2	1.5	2.00	97.00%	0.27	0.79	
E. Coli	25	16.37	2.00	6.00	10	13	104.00	4.00%	-0.26	0.80	
Chloride	28	18	9.00	14.00	15	16.5	105.00	0.00%	0.10	0.92	
Sulfate	30	14.47	7.00	9.00	9	10	164.00	0.00%	-0.33	0.74	
Total Dissolved Solids	27	271.3	229.00	244.00	258	276	608.00	0.00%	0.16	0.88	
Ammonia	28	0.05	0.05	0.05	0.05	0.05	0.14	96.00%	-0.32	0.75	
Nitrate	24	1.24	0.26	1.06	1.24	1.5	1.80	0.00%	-0.51	0.62	
Total Phosphorus	27	0.05	0.02	0.05	0.06	0.06	0.06	100.00%	-1.62	0.12	
Total Kjeldahl Nitrogen	27	0.24	0.17	0.20	0.2	0.27	0.51	22.00%	0.59	0.56	

Segment 2309A Dolan Creek (unclassified water body)

Station 14942

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	32	9.14	6.30	8.35	9.05	9.84	12.20	0.00%	-3.18	0.00	Downward
pH	33	7.84	6.00	7.70	7.9	8	9.00	0.00%	-0.04	0.97	
Conductivity	33	459.18	384.00	443.00	471	484	510.00	0.00%	2.31	0.03	Upward
Temperature	33	22.25	18.50	20.20	22	24	28.00	0.00%	1.10	0.28	
Secchi Depth	33	1.22	0.30	1.00	1.2	1.5	1.50	100.00%	1.49	0.15	
E. Coli	27	31.76	0.90	8.00	14	41	142.00	0.00%	0.51	0.61	
Chloride	29	14	7.00	13.00	15	16	17.00	0.00%	4.31	0.00	Upward
Sulfate	30	7.83	5.00	7.00	8	8	13.00	3.00%	1.23	0.23	
Total Dissolved Solids	27	265.96	220.00	244.00	271	284	310.00	0.00%	3.02	0.01	Upward
Ammonia	28	0.05	0.05	0.05	0.05	0.05	0.05	100.00%	-99.00	-99.00	Upward
Nitrate	24	1.63	0.98	1.50	1.65	1.79	2.00	0.00%	-0.57	0.57	
Total Phosphorus	27	0.05	0.02	0.05	0.06	0.06	0.06	96.00%	-1.62	0.12	
Total Kjeldahl Nitrogen	26	0.21	0.13	0.20	0.2	0.2	0.44	54.00%	1.33	0.20	

Pecos River

Segment 2312 Red Bluff Reservoir

Station 13267

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	147	6.02	0.00	2.70	6.4	8.7	14.90	0.00%	-3.18	0.00	Downward
pH	138	7.94	7.10	7.70	8	8.2	8.60	0.00%	-1.60	0.11	
Conductivity	147	10222.65	5890.00	9230.00	10600	11200	13900.00	0.00%	2.29	0.02	Upward
Temperature	147	20.39	7.80	16.30	21.4	26.3	28.00	0.00%	8.20	0.00	Upward
Secchi Depth	22	0.87	0.65	0.74	0.82	1	1.20	9.00%	2.33	0.03	Upward
Chloride	20	2379.2	834.00	2010.00	2440	2815	3470.00	0.00%	1.29	0.21	
Sulfate	21	2043.33	1150.00	1820.00	2100	2300	2760.00	0.00%	0.79	0.44	
Total Dissolved Solids	20	6985	3830.00	6305.00	6980	8000	9570.00	0.00%	0.33	0.75	
Ammonia	21	0.07	0.05	0.05	0.05	0.06	0.26	71.00%	-2.09	0.05	
Total Phosphorus	20	0.05	0.03	0.05	0.06	0.06	0.07	75.00%	-1.48	0.16	
Total Kjeldahl Nitrogen	20	1.3	0.94	1.08	1.21	1.49	2.01	0.00%	-3.42	0.00	Downward

Station 13269

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	89	6.63	0.10	4.10	7.1	9.1	14.50	0.00%	-2.27	0.03	Downward
pH	81	7.93	7.10	7.70	8	8.2	8.60	0.00%	-1.71	0.09	
Conductivity	89	9587.64	3960.00	7780.00	9150	11000	18800.00	0.00%	3.20	0.00	Upward
Temperature	89	22.36	7.50	20.70	24.3	27.2	30.20	0.00%	5.37	0.00	Upward
Secchi Depth	20	0.5	0.28	0.42	0.5	0.58	0.75	0.00%	-0.17	0.87	

Segment 2311 Upper Pecos River

Station 13257

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	40	7.71	2.80	5.35	8	9.4	13.70	0.00%	0.41	0.69	
pH	39	7.94	6.90	7.70	7.9	8.2	8.80	0.00%	0.89	0.38	
Conductivity	40	21125	8700.00	16850.00	20100	24500	36900.00	0.00%	-1.40	0.17	
Temperature	39	17.85	3.60	9.40	16.9	25.3	32.10	0.00%	-0.09	0.93	
Secchi Depth	40	0.9	0.35	1.00	1	1	1.00	90.00%	-1.95	0.06	
Total Hardness	26	3676.58	1670.00	3110.00	3495	4000	6580.00	0.00%	3.26	0.00	Upward
Chloride	54	5923.52	2080.00	4540.00	5795	7030	10600.00	0.00%	-2.29	0.03	Downward
Sulfate	58	3648.28	1570.00	3020.00	3415	4360	6470.00	0.00%	-1.29	0.20	
Total Dissolved Solids	52	13994.81	5860.00	11450.00	13850	15800	29300.00	0.00%	-3.70	0.00	Downward
Ammonia	55	0.08	0.03	0.05	0.05	0.05	0.69	75.00%	-0.39	0.70	
Chlorophyll-a	22	15.25	2.73	3.00	8.46	17.9	89.40	27.00%	0.99	0.33	
Nitrate	70	0.07	0.02	0.02	0.04	0.04	0.50	96.00%	-6.94	0.00	Downward
Total Phosphorus	54	0.05	0.02	0.05	0.06	0.06	0.11	83.00%	-3.59	0.00	Downward
Total Kjeldahl Nitrogen	53	1.05	0.40	0.75	1.03	1.27	1.82	0.00%	-2.03	0.05	Downward
Aluminum	25	100	100.00	100.00	100	100	100.00	100.00%	-99.00	-99.00	
Arsenic	24	57.01	2.50	18.75	43.75	68.75	250.00	88.00%	-0.36	0.72	
Chromium	25	4	4.00	4.00	4	4	4.00	100.00%	-99.00	-99.00	
Nickel	25	5	5.00	5.00	5	5	5.00	100.00%	-99.00	-99.00	
Cadmium	24	2.39	0.10	1.00	1.75	2.75	10.00	100.00%	-0.27	0.79	
Lead	22	1.31	0.10	0.75	1	1.5	5.00	95.00%	-0.65	0.52	
Selenium	26	0.91	0.25	0.25	0.3	0.42	10.00	35.00%	1.64	0.11	
Silver	24	9.2	0.50	3.00	7	11	40.00	100.00%	-0.43	0.67	
Zinc	25	4	4.00	4.00	4	4	4.00	100.00%	-99.00	-99.00	

Station 13258

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Chloride	25	4406.4	1180.00	3760.00	4390	5300	6280.00	0.00%	0.25	0.80	
Sulfate	27	2836.7	881.00	2580.00	2800	3160	4700.00	0.00%	-0.36	0.72	
Total Dissolved Solids	24	11060.83	3240.00	9810.00	11150	13050	15700.00	0.00%	0.66	0.52	
Ammonia	26	0.09	0.04	0.05	0.05	0.05	0.52	73.00%	1.49	0.15	
Nitrate	24	0.03	0.02	0.02	0.02	0.04	0.10	75.00%	1.02	0.32	
Total Phosphorus	21	0.06	0.03	0.06	0.06	0.06	0.09	81.00%	-0.58	0.57	
Total Kjeldahl Nitrogen	25	0.95	0.59	0.90	0.94	1.04	1.35	4.00%	-0.51	0.61	

Station 13259										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Chloride	23	3940	2000.00	3350.00	4200	4520	4900.00	0.00%	2.20	0.04 Upward
Sulfate	26	2502.85	764.00	2510.00	2620	2790	3050.00	0.00%	-0.16	0.87
Total Dissolved Solids	22	9809.55	2810.00	8960.00	10450	11400	12700.00	0.00%	0.34	0.73
Ammonia	26	0.07	0.05	0.05	0.05	0.06	0.27	69.00%	0.36	0.72
Nitrate	21	0.02	0.02	0.02	0.02	0.02	0.03	95.00%	-1.27	0.22
Total Phosphorus	23	0.06	0.03	0.05	0.06	0.06	0.08	87.00%	-2.67	0.01 Downward
Total Kjeldahl Nitrogen	25	0.98	0.51	0.77	0.86	1.01	3.22	4.00%	-0.82	0.42

Station 13260										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Dissolved Oxygen (Grab)	40	8.91	2.30	7.35	9.2	10.6	12.30	0.00%	1.50	0.14
pH	39	7.81	7.00	7.70	7.8	7.9	8.70	0.00%	-0.49	0.63
Conductivity	40	15298.5	6630.00	11900.00	14050	18000	32200.00	0.00%	-2.96	0.01 Downward
Temperature	40	18.16	2.80	11.15	17.9	24.8	28.50	0.00%	0.04	0.97
Secchi Depth	40	0.82	0.43	0.60	1	1	1.00	78.00%	-1.28	0.21
Total Hardness	25	2787.6	1550.00	2460.00	2680	3020	4510.00	0.00%	4.35	0.00 Upward
Chloride	54	4271.67	2120.00	3170.00	4050	4830	9160.00	0.00%	-3.25	0.00 Downward
Sulfate	59	2631.19	1460.00	2350.00	2550	2900	4510.00	0.00%	-1.96	0.05
Total Dissolved Solids	51	10763.33	5740.00	8690.00	10200	11400	21200.00	0.00%	-4.03	0.00 Downward
Ammonia	56	0.1	0.05	0.05	0.05	0.07	0.46	68.00%	2.67	0.01 Upward
Chlorophyll-a	22	12.7	2.01	5.54	8.24	17.1	42.00	9.00%	-0.27	0.79
Nitrate	72	0.07	0.02	0.02	0.04	0.04	0.75	93.00%	-7.05	0.00 Downward
Orthophosphate	20	0.36	0.04	0.04	0.24	0.36	1.50	95.00%	-1.98	0.06
Total Phosphorus	56	0.05	0.02	0.05	0.06	0.06	0.08	77.00%	-1.05	0.30
Total Kjeldahl Nitrogen	56	0.87	0.45	0.68	0.88	1.02	1.57	2.00%	1.26	0.21
Aluminum	25	100	100.00	100.00	100	100	100.00	100.00%	-99.00	-99.00
Arsenic	25	50.63	2.20	17.50	25	50	250.00	88.00%	0.05	0.96
Chromium	25	4	4.00	4.00	4	4	4.00	100.00%	-99.00	-99.00
Nickel	25	5	5.00	5.00	5	5	5.00	100.00%	-99.00	-99.00
Cadmium	25	2.13	0.10	1.00	1	2	10.00	100.00%	0.16	0.87
Lead	24	1.28	0.25	0.50	0.88	1.25	5.10	83.00%	-0.62	0.54
Selenium	26	0.82	0.25	0.25	0.25	0.25	10.00	88.00%	1.73	0.10
Silver	25	8.51	0.50	4.00	4	10	40.00	100.00%	-0.26	0.80
Zinc	25	4	4.00	4.00	4	4	4.00	100.00%	-99.00	-99.00

Station 13261										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Chloride	32	2726.41	670.00	2575.50	2895	3175	3969.00	0.00%	2.16	0.04 Upward
Sulfate	34	2098.32	710.00	2020.00	2240	2400	3220.00	0.00%	2.13	0.04 Upward
Total Dissolved Solids	30	7868.27	2157.00	7140.00	7985	8660	20932.00	0.00%	-0.35	0.73
Ammonia	33	0.07	0.02	0.05	0.05	0.05	0.40	82.00%	-2.24	0.03 Downward
Nitrate	48	0.12	0.02	0.02	0.04	0.04	3.70	90.00%	-2.19	0.03 Downward
Total Phosphorus	31	0.08	0.04	0.06	0.06	0.06	0.31	71.00%	-2.31	0.03 Downward
Total Kjeldahl Nitrogen	25	0.96	0.61	0.80	0.91	1.12	1.69	4.00%	0.03	0.97

Station 13265										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Dissolved Oxygen (Grab)	40	8.68	3.30	6.30	9.15	10.7	12.70	0.00%	-0.57	0.57
pH	39	7.78	7.00	7.50	7.8	8.1	8.80	0.00%	0.00	1.00
Conductivity	40	11519.5	8010.00	9820.00	11300	12750	18100.00	0.00%	-1.43	0.16
Temperature	40	17.31	2.30	10.55	15.9	25.4	27.30	0.00%	0.00	1.00
Secchi Depth	39	0.86	0.58	0.60	1	1	1.00	92.00%	-1.12	0.27
Chloride	40	2928.8	492.00	2550.00	2845	3405	5350.00	0.00%	-1.10	0.28
Sulfate	39	2197.95	430.00	1940.00	2160	2570	3040.00	0.00%	-0.82	0.42
Total Dissolved Solids	36	8017.22	5670.00	7020.00	7815	8790	11700.00	0.00%	-3.00	0.01 Downward
Ammonia	38	0.14	0.05	0.05	0.08	0.22	0.53	42.00%	1.59	0.12
Nitrate	27	0.07	0.04	0.04	0.04	0.08	0.32	56.00%	-1.62	0.12
Orthophosphate	20	0.2	0.02	0.04	0.12	0.39	0.60	100.00%	-1.05	0.31
Total Phosphorus	37	0.06	0.02	0.05	0.06	0.06	0.08	76.00%	-1.33	0.19
Total Kjeldahl Nitrogen	38	1.2	0.68	1.02	1.17	1.32	1.84	0.00%	0.27	0.79

Station 15114										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Dissolved Oxygen (Grab)	27	8.26	4.40	7.20	8.2	9.6	11.60	0.00%	1.09	0.28
pH	28	7.84	7.60	7.70	7.85	7.9	8.10	0.00%	2.08	0.05 Upward
Conductivity	28	11620.43	4450.00	8071.00	12850	14700	17700.00	0.00%	-0.41	0.69
Temperature	28	20.39	9.80	15.85	20.6	25.6	30.00	0.00%	0.79	0.44
Secchi Depth	28	0.55	0.30	0.44	0.5	0.63	1.00	14.00%	0.46	0.65
Chloride	27	3328.04	927.00	2320.00	3740	4130	4950.00	0.00%	0.81	0.43
Sulfate	27	1885.37	847.00	1340.00	2130	2350	2680.00	0.00%	0.91	0.37
Total Dissolved Solids	27	8228.89	2820.00	5720.00	9430	10300	12000.00	0.00%	0.76	0.45
Ammonia	26	0.06	0.05	0.05	0.05	0.08	0.12	62.00%	1.34	0.19
Total Phosphorus	27	0.06	0.05	0.06	0.06	0.06	0.09	59.00%	0.38	0.71
Total Kjeldahl Nitrogen	26	0.89	0.46	0.66	0.81	0.97	1.92	0.00%	1.41	0.17

Station 20399										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Chloride	23	4913.48	2060.00	3780.00	5030	5880	7220.00	0.00%	0.07	0.94
Sulfate	26	3115.77	1360.00	2560.00	3075	3440	4960.00	0.00%	-0.30	0.76
Total Dissolved Solids	23	12023.91	5390.00	9860.00	12500	13800	17500.00	0.00%	0.28	0.78
Ammonia	25	0.09	0.04	0.05	0.05	0.09	0.65	60.00%	0.58	0.57
Nitrate	23	0.02	0.02	0.02	0.02	0.02	0.03	91.00%	-0.82	0.42
Total Phosphorus	21	0.06	0.02	0.06	0.06	0.06	0.14	86.00%	-1.66	0.11
Total Kjeldahl Nitrogen	24	1	0.50	0.86	0.99	1.14	1.44	0.00%	-1.23	0.23

Segment 2310 Lower Pecos River

Station 13240

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	43	8.56	6.50	7.40	8.4	9.3	11.60	0.00%	0.62	0.54	
pH	42	8.16	7.90	8.10	8.2	8.2	8.60	0.00%	0.90	0.37	
Conductivity	43	3069.07	1900.00	2440.00	3030	3600	4430.00	0.00%	0.77	0.44	
Temperature	43	22.34	9.80	17.00	23.5	28.1	31.50	0.00%	0.59	0.56	
Chloride	43	681.81	368.00	522.00	658	823	1240.00	0.00%	1.27	0.21	
Sulfate	43	401.28	234.00	306.00	386	472	621.00	0.00%	1.00	0.32	
Total Dissolved Solids	43	1888.84	1200.00	1470.00	1880	2250	2800.00	0.00%	1.20	0.24	
Orthophosphate	43	0.01	0.00	0.01	0.01	0.01	0.04	79.00%	1.08	0.29	
Total Phosphorus	42	0.01	0.00	0.00	0	0.01	0.06	19.00%	1.64	0.11	
Total Kjeldahl Nitrogen	42	0.26	0.14	0.20	0.25	0.32	0.53	2.00%	-1.89	0.07	
Total Nitrogen	37	0.8	0.30	0.48	0.78	1.1	1.70	0.00%	2.15	0.04	Upward
Arsenic	42	1.34	0.70	1.10	1.3	1.6	2.00	0.00%	-0.16	0.87	

Station 13246

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	27	7.88	5.60	7.10	7.8	8.8	10.20	0.00%	0.22	0.83	
pH	26	7.97	7.80	7.90	8	8	8.10	0.00%	-0.32	0.75	
Conductivity	27	4847.85	2700.00	3510.00	4860	6090	6680.00	0.00%	1.12	0.27	
Temperature	27	20.28	11.60	16.00	20.6	24.7	27.20	0.00%	0.46	0.65	
Secchi Depth	27	0.69	0.30	0.48	0.7	0.85	1.00	22.00%	2.39	0.02	Upward
E. Coli	24	65.08	4.00	19.00	31.5	66	517.00	0.00%	-0.39	0.70	
Chloride	27	1131.26	530.00	756.00	1120	1480	1690.00	0.00%	1.16	0.26	
Sulfate	27	689.78	397.00	486.00	652	881	997.00	0.00%	1.35	0.19	
Total Dissolved Solids	27	3574.81	1650.00	2160.00	2970	3980	18200.00	0.00%	0.73	0.47	
Ammonia	27	0.05	0.05	0.05	0.05	0.05	0.06	93.00%	-1.18	0.25	
Total Phosphorus	27	0.06	0.05	0.05	0.06	0.06	0.07	96.00%	3.57	0.00	Upward
Total Kjeldahl Nitrogen	26	0.38	0.20	0.32	0.34	0.4	0.88	4.00%	-0.10	0.92	

Station 16379

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	8.56	4.60	7.45	8.45	9.7	13.90	0.00%	-1.03	0.32	
pH	20	7.95	6.39	7.80	8.1	8.2	8.50	0.00%	1.45	0.16	
Temperature	20	21.73	11.20	15.05	21.95	27.65	29.50	0.00%	1.21	0.24	
Chloride	20	379.6	84.00	291.00	350	484	761.00	0.00%	-2.01	0.06	
Sulfate	20	311.6	192.00	261.50	316	344	471.00	0.00%	-0.37	0.72	

Segment 2310A Independence Creek (unclassified water body)

Station 13109

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	41	9.09	6.80	8.30	9	9.8	11.50	0.00%	0.97	0.34	
Dissolved Oxygen (24 hr Min)	50	7.93	4.60	6.70	7.85	9.3	10.40	0.00%	-0.30	0.76	
pH	40	8.04	7.80	8.00	8	8.1	8.20	0.00%	3.76	0.00	Upward
Conductivity	41	994.24	916.00	954.00	984	1010	1130.00	0.00%	-2.69	0.01	Downward
Temperature	41	20.79	10.90	16.70	20.9	25.2	28.90	0.00%	-0.16	0.88	
Secchi Depth	41	0.93	0.30	1.00	1	1	1.00	100.00%	-2.33	0.02	Downward
E. Coli	37	22.32	3.00	8.00	13	22	120.00	11.00%	1.02	0.32	
Chloride	39	102.9	36.00	98.00	103	111	131.00	0.00%	-3.06	0.00	Downward
Sulfate	39	148.72	60.00	141.00	152	161	184.00	0.00%	-2.21	0.03	Downward
Total Dissolved Solids	35	702.54	498.00	586.00	604	656	3450.00	0.00%	-1.64	0.11	
Ammonia	39	0.05	0.05	0.05	0.05	0.05	0.08	95.00%	-0.11	0.91	
Chlorophyll-a	22	2.81	0.46	3.00	3	3	3.01	86.00%	-2.42	0.02	Downward
Nitrate	27	0.91	0.55	0.79	0.94	1.02	1.28	0.00%	-1.34	0.19	
Total Phosphorus	37	0.05	0.02	0.05	0.06	0.06	0.06	100.00%	-1.13	0.27	
Total Kjeldahl Nitrogen	36	0.18	0.08	0.14	0.2	0.2	0.35	56.00%	4.73	0.00	Upward

Middle Rio Grande

Segment 2313 San Felipe Creek

Station 13270

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	8.59	7.40	8.20	8.7	9.05	9.30	0.00%	-0.09	0.93	
pH	20	7.92	7.40	7.90	7.9	8	8.10	0.00%	0.91	0.38	
Conductivity	20	512.45	451.00	475.50	484.5	494	979.00	0.00%	-0.78	0.44	
Temperature	20	22.94	20.60	21.85	22.8	23.95	26.30	0.00%	0.23	0.82	
Chloride	20	20.75	14.00	16.50	18	19	75.00	0.00%	0.11	0.91	
Sulfate	20	23.35	13.00	18.00	19.5	22	83.00	0.00%	0.21	0.83	

Station 15820

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	8.12	5.80	7.55	7.85	8.75	10.40	0.00%	-0.10	0.92	
pH	20	7.42	7.00	7.30	7.45	7.5	7.90	0.00%	1.94	0.07	
Conductivity	20	504.9	449.00	465.00	511	530.5	573.00	0.00%	-1.06	0.30	
Temperature	20	23.86	21.80	23.15	23.7	24.35	28.90	0.00%	-0.55	0.59	
Secchi Depth	20	1.27	0.30	1.00	1.5	1.5	1.50	90.00%	0.15	0.88	

Station 15821

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	7.84	5.50	7.25	8.15	8.5	8.90	0.00%	1.26	0.22	
pH	20	7.41	6.80	7.30	7.45	7.5	7.60	0.00%	2.48	0.02	Upward
Conductivity	20	483.95	433.00	452.00	468.5	514.5	593.00	0.00%	2.88	0.01	Upward
Temperature	20	23.02	12.70	22.65	23.5	24.2	25.40	0.00%	1.76	0.10	
Chloride	20	15.85	9.00	12.00	13.5	21	26.00	0.00%	3.95	0.00	Upward
Sulfate	20	16.4	8.00	11.00	14	21	33.00	0.00%	3.70	0.00	Upward
Ammonia	20	0.08	0.05	0.05	0.05	0.05	0.55	90.00%	-0.08	0.94	
Total Phosphorus	20	0.05	0.02	0.05	0.06	0.06	0.06	100.00%	-2.07	0.05	

Segment 2304 Rio Grande Below Amistad Reservoir

Station 13196

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	42	7.96	5.80	6.60	7.45	8.7	15.00	0.00%	-0.15	0.88	
pH	44	7.94	7.20	7.75	8	8.2	8.50	0.00%	1.67	0.10	
Conductivity	53	907.7	388.00	833.00	940	998	1170.00	0.00%	1.37	0.18	
Temperature	53	23.43	10.00	18.50	25.5	28.5	30.50	0.00%	-0.33	0.74	
E. Coli	66	850.83	12.00	195.10	614.4	1100	2419.20	15.00%	6.17	0.00	Upward
Chloride	44	101.65	20.10	83.85	107.5	120.5	145.00	0.00%	1.10	0.28	
Sulfate	44	158.01	39.40	140.00	163.5	183.5	220.00	0.00%	1.41	0.17	
Total Dissolved Solids	44	555	232.00	512.00	578.5	624.5	730.00	0.00%	1.79	0.08	
Orthophosphate	43	0.17	0.02	0.10	0.16	0.21	0.42	2.00%	-0.64	0.52	
Total Phosphorus	44	0.27	0.10	0.22	0.26	0.32	0.52	0.00%	-0.49	0.63	
Total Kjeldahl Nitrogen	43	0.72	0.36	0.52	0.62	0.79	1.70	0.00%	-0.25	0.81	
Total Nitrogen	43	1.44	0.67	1.10	1.4	1.6	2.50	0.00%	-0.46	0.65	
Aluminum	20	10.44	1.10	3.25	7.85	13.5	30.50	0.00%	-2.25	0.04	Downward
Arsenic	43	2.4	1.20	1.90	2.4	2.9	3.60	0.00%	0.82	0.42	
Chromium	20	0.66	0.07	0.80	0.8	0.8	0.80	90.00%	-6.78	0.00	Downward
Nickel	20	2	0.57	1.02	1.94	3.06	3.67	0.00%	-1.29	0.21	
Cadmium	20	0.03	0.02	0.02	0.04	0.04	0.04	70.00%	2.20	0.04	Upward
Copper	20	1.36	0.49	1.00	1.45	1.7	1.90	0.00%	-1.21	0.24	
Lead	20	0.08	0.04	0.08	0.08	0.08	0.12	80.00%	2.60	0.02	Upward
Silver	20	0.38	0.10	0.20	0.2	0.6	1.00	100.00%	-3.97	0.00	Downward
Zinc	20	1.67	0.30	0.85	1.5	2	4.60	0.00%	-1.85	0.08	

Station 13200

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Conductivity	22	924.05	655.00	789.00	945	994	1140.00	0.00%	0.04	0.97	
Temperature	22	22.52	12.30	18.30	22.95	27.9	29.30	0.00%	0.18	0.86	
E. Coli	77	805.4	11.00	200.00	456.9	1200	2419.20	8.00%	5.23	0.00	Upward

Station 13202

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	34	8.36	6.60	7.30	8	9.39	11.20	0.00%	-1.19	0.24	
pH	34	8.07	7.40	7.90	8.1	8.3	8.47	0.00%	-0.11	0.92	
Conductivity	54	846.02	9.22	759.00	838	992	1150.00	0.00%	1.93	0.06	
Temperature	53	23.26	12.30	18.10	24.4	28.4	30.80	0.00%	-1.24	0.22	
E. Coli	102	68.8	1.00	6.30	19	47.2	1203.00	2.00%	-1.16	0.25	
Chloride	33	99.48	53.00	71.90	102	120	151.00	0.00%	2.10	0.04	Upward
Sulfate	33	159.21	87.00	134.00	161	190	223.00	0.00%	2.69	0.01	Upward
Total Dissolved Solids	33	551.97	289.00	498.00	578	611	706.00	0.00%	1.68	0.10	
Ammonia	31	0.2	0.02	0.03	0.1	0.1	1.40	61.00%	2.68	0.01	Upward
Chlorophyll-a	33	5.31	1.00	3.00	4	7.1	14.00	73.00%	-1.15	0.26	
Nitrate	28	1.05	0.04	0.16	0.31	0.7	10.30	11.00%	-0.51	0.61	
Total Phosphorus	32	0.13	0.05	0.08	0.11	0.14	0.64	16.00%	-1.28	0.21	

Station 13208											
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value**	**Trend**
Dissolved Oxygen (Grab)	57	9.11	4.80	7.59	9.5	10.8	12.90	0.00%	-3.08	0.00	Downward
pH	59	7.99	6.45	7.80	8	8.2	8.80	0.00%	0.27	0.79	
Conductivity	58	941.1	753.00	891.00	939	994	1140.00	0.00%	-0.30	0.76	
Temperature	60	18.68	10.80	14.90	18.65	23.7	27.20	0.00%	0.15	0.88	
Secchi Depth	57	1.15	0.20	0.65	1.5	1.5	3.00	60.00%	1.12	0.27	
E. Coli	48	96.95	7.40	20.00	33.85	105.05	1400.00	0.00%	1.08	0.29	
Chloride	56	105.78	13.00	94.00	110.5	120	131.00	0.00%	-0.19	0.85	
Sulfate	56	170.39	8.00	158.50	177.5	189.5	224.00	0.00%	1.11	0.27	
Total Dissolved Solids	52	593.08	490.00	560.00	594	628	684.00	0.00%	0.38	0.70	
Ammonia	56	0.11	0.02	0.05	0.05	0.07	2.80	70.00%	1.58	0.12	
Chlorophyll-a	56	5.36	0.67	3.00	3	10	10.00	88.00%	-7.45	0.00	Downward
Nitrate	41	1.2	0.02	0.13	0.21	0.31	25.00	7.00%	-0.56	0.58	
Orthophosphate	45	0.05	0.02	0.04	0.04	0.06	0.22	93.00%	-2.28	0.03	Downward
Total Phosphorus	54	0.08	0.02	0.05	0.06	0.06	1.25	74.00%	-0.89	0.38	
Total Kjeldahl Nitrogen	35	0.54	0.20	0.31	0.35	0.44	5.04	3.00%	1.59	0.12	

Station 13209											
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value**	**Trend**
Dissolved Oxygen (Grab)	21	7.45	1.30	5.70	7.9	9.7	12.30	0.00%	1.11	0.28	
pH	22	7.9	7.30	7.60	8	8.2	8.30	0.00%	1.60	0.12	
Conductivity	22	930.23	811.00	851.00	947	1010	1100.00	0.00%	-2.18	0.04	Downward
Temperature	21	17.62	12.60	14.50	16.5	19.7	25.80	0.00%	-1.19	0.25	
Chloride	22	114.5	88.10	98.60	118.5	126	143.00	0.00%	-2.98	0.01	Downward
Sulfate	22	164.41	140.00	146.00	164	179	198.00	0.00%	-3.27	0.00	Downward
Total Dissolved Solids	22	584.64	506.00	539.00	590.5	620	695.00	0.00%	-2.69	0.01	Downward
Orthophosphate	21	0.01	0.00	0.01	0.01	0.01	0.01	95.00%	-3.44	0.00	Downward
Total Phosphorus	21	0.01	0.00	0.00	0.01	0.01	0.01	0.00%	-0.06	0.96	
Total Kjeldahl Nitrogen	21	0.23	0.16	0.21	0.22	0.26	0.32	0.00%	0.90	0.38	
Total Nitrogen	21	0.51	0.40	0.47	0.5	0.55	0.60	0.00%	0.60	0.56	
Arsenic	22	2.14	1.10	1.90	2.1	2.4	3.00	0.00%	0.11	0.92	

Station 13560

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	105	9.39	2.10	7.70	9.5	11	14.60	0.00%	-0.87	0.38	
pH	113	8.07	6.90	7.90	8.1	8.2	9.00	0.00%	0.57	0.57	
Conductivity	111	909.34	673.00	852.00	911	960	1090.00	0.00%	-0.42	0.68	
Temperature	115	19.44	1.80	16.30	19.4	22.9	31.00	0.00%	-0.13	0.89	
Secchi Depth	113	0.91	0.10	0.60	0.9	1.2	3.00	35.00%	2.48	0.01	Upward
E. Coli	83	1040.3	5.00	81.00	250	960	20000.00	7.00%	2.41	0.02	Upward
Chloride	107	101.94	40.00	88.00	101	112	169.00	0.00%	0.37	0.71	
Sulfate	107	159.06	17.30	143.00	160	174	342.00	0.00%	1.38	0.17	
Total Dissolved Solids	104	581.87	459.00	526.50	558	592.5	1840.00	0.00%	-0.47	0.64	
Ammonia	107	0.21	0.02	0.05	0.1	0.2	3.36	44.00%	2.60	0.01	Upward
Chlorophyll-a	107	5.61	0.77	3.00	3	10	40.00	80.00%	-3.16	0.00	Downward
Nitrate	87	1.17	0.02	0.29	0.38	0.49	28.00	10.00%	-1.37	0.18	
Orthophosphate	60	0.09	0.04	0.04	0.06	0.08	1.10	40.00%	-0.87	0.39	
Total Phosphorus	105	0.12	0.02	0.06	0.07	0.1	1.43	22.00%	-1.59	0.11	
Total Kjeldahl Nitrogen	47	1.28	0.20	0.44	0.55	1.21	8.12	2.00%	3.84	0.00	Upward

Station 15274

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	31	8.45	5.50	7.00	7.8	9.9	13.20	0.00%	-0.65	0.52	
pH	32	8.11	7.70	7.90	8.1	8.3	8.50	0.00%	0.24	0.81	
Conductivity	31	870.74	582.00	774.00	923	972	1041.00	0.00%	0.70	0.49	
Temperature	32	21.18	12.00	15.75	21.4	26.1	30.00	0.00%	-1.10	0.28	
Secchi Depth	32	0.52	0.18	0.30	0.51	0.72	1.00	3.00%	0.76	0.45	
E. Coli	30	50.77	2.00	8.00	15	32	490.00	3.00%	-0.96	0.35	
Chloride	34	92.32	48.00	74.00	99.5	110	141.00	0.00%	-0.33	0.74	
Sulfate	34	154.29	86.00	127.00	162.5	180	195.00	0.00%	1.71	0.10	
Total Dissolved Solids	32	533.03	370.00	483.00	552	587	642.00	0.00%	0.00	1.00	
Ammonia	34	0.08	0.04	0.05	0.05	0.08	0.29	59.00%	0.44	0.66	
Chlorophyll-a	21	3.43	0.78	3.00	3	3	9.21	62.00%	-0.42	0.68	
Nitrate	26	0.48	0.04	0.40	0.49	0.55	1.12	4.00%	-0.03	0.98	
Total Phosphorus	33	0.1	0.03	0.08	0.09	0.13	0.25	12.00%	-1.86	0.07	
Total Kjeldahl Nitrogen	29	0.47	0.17	0.34	0.48	0.55	0.93	0.00%	0.36	0.72	

Station 15814

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	34	8.46	6.90	7.30	8.4	8.8	11.40	0.00%	-2.20	0.04	Downward
pH	35	8.09	7.50	7.90	8.1	8.3	8.50	0.00%	-1.47	0.15	
Conductivity	57	865	565.00	768.00	850	975	1170.00	0.00%	1.67	0.10	
Temperature	57	23.59	12.20	18.87	24.3	28.4	33.20	0.00%	-1.57	0.12	
E. Coli	105	938.06	5.00	272.30	730	1400	2419.00	7.00%	5.80	0.00	Upward
Chloride	34	101.79	55.00	71.80	104	124	181.00	0.00%	2.43	0.02	Upward
Sulfate	34	157.47	89.00	130.00	161.5	187	219.00	0.00%	2.68	0.01	Upward
Total Dissolved Solids	34	593.5	338.00	485.00	582	649	1500.00	0.00%	2.10	0.04	Upward
Ammonia	32	0.2	0.02	0.06	0.1	0.22	1.40	50.00%	1.94	0.06	
Chlorophyll-a	33	5.06	0.10	3.00	3	6	12.00	70.00%	-2.19	0.04	Downward
Nitrate	29	1.15	0.04	0.16	0.28	0.75	8.80	14.00%	-1.03	0.31	
Total Phosphorus	33	0.19	0.05	0.09	0.11	0.14	1.96	12.00%	-0.81	0.42	

Station 15815

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Conductivity	21	877.38	617.00	771.00	908	950	1120.00	0.00%	-0.64	0.53	
Temperature	20	21.88	11.80	18.10	22.15	27.35	29.20	0.00%	0.02	0.99	
E. Coli	80	973.52	14.50	280.00	795	1600	2419.00	12.00%	6.70	0.00	Upward

Station 15816

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
E. Coli	70	752.12	8.40	120.00	547.5	1100	2419.00	9.00%	6.81	0.00	Upward

Station 15817

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	100	8.62	4.80	7.50	8.24	9.75	14.53	0.00%	-2.32	0.02	Downward
pH	102	8.07	7.40	7.80	8	8.3	9.10	0.00%	0.33	0.74	
Conductivity	102	906.43	337.00	797.00	898.5	1020	1560.00	0.00%	0.85	0.40	
Temperature	102	24.33	2.70	19.40	25.65	29.83	33.90	0.00%	0.04	0.97	
E. Coli	58	181.5	1.00	12.00	29.15	140	2419.17	5.00%	-0.16	0.87	
Chloride	98	105.3	48.00	84.60	108	123	170.00	0.00%	2.16	0.03	Upward
Sulfate	98	167.84	17.10	141.00	176	196	304.00	0.00%	2.16	0.03	Upward
Total Dissolved Solids	97	578.31	122.00	513.00	595	643	980.00	0.00%	1.24	0.22	
Ammonia	90	0.31	0.02	0.10	0.11	0.22	3.36	39.00%	4.47	0.00	Upward
Chlorophyll-a	96	6.51	2.56	3.00	5	10	35.00	64.00%	-1.10	0.28	
Nitrate	86	1.42	0.04	0.40	0.74	1.1	26.00	7.00%	-1.07	0.29	
Orthophosphate	29	0.23	0.04	0.15	0.23	0.28	0.48	10.00%	-0.95	0.35	
Total Phosphorus	97	0.27	0.06	0.17	0.22	0.3	2.31	1.00%	-2.32	0.02	Downward
Total Kjeldahl Nitrogen	21	3.85	0.20	1.50	4.2	5.32	9.52	5.00%	4.93	0.00	Upward

Station 15839

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Conductivity	32	835.62	529.00	746.50	818	924.5	1110.00	0.00%	0.45	0.65	
Temperature	32	24.16	12.40	18.55	25.2	28.7	38.87	0.00%	-2.09	0.05	Downward
E. Coli	93	47.81	1.00	5.20	10	22.8	2000.00	2.00%	1.63	0.11	

Station 17410

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value Trend
Dissolved Oxygen (Grab)	33	8.37	5.80	7.30	8.3	9.5	11.30	0.00%	-2.37	0.02 Downward
pH	33	8.08	7.20	8.00	8.1	8.23	8.50	0.00%	-1.51	0.14
Conductivity	33	863.97	567.00	761.00	853	958	1240.00	0.00%	1.52	0.14
Temperature	33	24.13	12.80	19.10	24.3	28.9	31.50	0.00%	-1.26	0.22
Chloride	32	101	52.00	73.05	104.5	121.5	172.00	0.00%	1.86	0.07
Sulfate	32	156.53	81.00	122.00	162.5	190	216.00	0.00%	2.22	0.03 Upward
Total Dissolved Solids	32	573.72	380.00	484.00	560	612	1500.00	0.00%	1.17	0.25
Ammonia	30	0.31	0.02	0.04	0.1	0.16	2.24	53.00%	3.11	0.00 Upward
Chlorophyll-a	31	4.99	1.00	3.00	3.4	6	10.00	71.00%	-1.79	0.08
Nitrate	27	0.95	0.04	0.16	0.24	0.78	6.80	11.00%	-0.47	0.65
Total Phosphorus	32	0.14	0.05	0.08	0.1	0.14	0.64	12.00%	-0.19	0.85

Station 17596

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value Trend
Dissolved Oxygen (Grab)	28	7.44	5.80	6.50	6.95	8.35	10.20	0.00%	0.66	0.51
pH	34	8.1	6.60	7.99	8.2	8.4	8.66	0.00%	-1.88	0.07
Conductivity	34	873.21	480.00	798.00	922.5	965	1120.00	0.00%	-0.12	0.91
Temperature	34	22.15	11.00	17.50	23	27.3	30.90	0.00%	0.45	0.66
Secchi Depth	23	0.45	0.06	0.30	0.4	0.5	1.00	17.00%	-3.17	0.00 Downward
E. Coli	22	122.99	3.10	6.30	10.95	16	2419.00	5.00%	-1.01	0.32
Chloride	32	97.87	36.90	71.75	99	118.5	168.00	0.00%	1.03	0.31
Sulfate	32	157.68	39.90	129.50	163.5	189.5	288.00	0.00%	1.57	0.13
Total Dissolved Solids	32	535.47	10.00	499.00	545	614	748.00	0.00%	2.15	0.04 Upward
Ammonia	32	0.38	0.02	0.02	0.1	0.1	5.60	59.00%	2.57	0.02 Upward
Chlorophyll-a	31	5.89	1.00	3.00	5	10	20.00	81.00%	-1.22	0.23
Nitrate	25	1.56	0.04	0.05	0.32	0.61	25.00	24.00%	-0.38	0.71
Total Phosphorus	31	3.28	0.05	0.06	0.1	0.2	96.00	23.00%	-0.76	0.46

Station 18792

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value Trend
Dissolved Oxygen (Grab)	34	9.05	6.50	7.50	8.25	10.6	15.80	0.00%	0.10	0.92
pH	35	8.11	7.60	8.00	8.1	8.3	8.50	0.00%	0.75	0.46
Conductivity	35	880.11	466.00	781.00	942	984	1050.00	0.00%	0.19	0.85
Temperature	35	21.55	13.00	16.60	22.5	25.5	30.10	0.00%	-1.45	0.16
Secchi Depth	33	0.57	0.20	0.34	0.6	0.75	1.00	3.00%	0.11	0.92
E. Coli	30	531.15	1.00	37.00	96	792	4600.00	3.00%	0.00	1.00
Chloride	35	89.26	28.00	64.00	100	112	133.00	0.00%	-0.34	0.74
Sulfate	35	150.46	52.00	121.00	165	177	196.00	0.00%	1.44	0.16
Total Dissolved Solids	33	527.33	286.00	472.00	558	592	638.00	0.00%	0.58	0.57
Ammonia	34	0.17	0.05	0.09	0.13	0.19	0.46	3.00%	-0.66	0.52
Chlorophyll-a	21	4.71	0.64	3.00	3	5.7	19.40	48.00%	-0.06	0.95
Nitrate	25	0.47	0.14	0.35	0.45	0.57	1.14	0.00%	-0.34	0.73
Total Phosphorus	34	0.11	0.06	0.08	0.1	0.14	0.25	6.00%	-2.00	0.05
Total Kjeldahl Nitrogen	31	0.64	0.24	0.50	0.62	0.78	1.20	0.00%	-0.78	0.44

Station 18795

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	60	7.43	4.07	6.15	6.8	8.74	15.40	0.00%	-1.33	0.19	
pH	64	7.95	6.96	7.84	8	8.1	8.60	0.00%	3.10	0.00	Upward
Conductivity	59	880.78	570.00	802.00	907	975	1150.00	0.00%	0.43	0.67	
Temperature	64	21.47	9.90	15.93	21.9	27.05	29.80	0.00%	0.02	0.98	
Secchi Depth	64	0.53	0.06	0.30	0.5	0.6	3.00	23.00%	1.87	0.07	
E. Coli	47	1717.96	1.00	299.00	1011.1	2419	24000.00	15.00%	1.95	0.06	
Chloride	60	94.32	31.00	81.00	98.25	114.5	164.00	0.00%	0.11	0.91	
Sulfate	59	162.25	22.00	133.00	161	187	507.00	0.00%	0.68	0.50	
Total Dissolved Solids	58	553.31	337.00	491.00	562.5	600	1500.00	0.00%	0.79	0.43	
Ammonia	58	0.15	0.02	0.09	0.13	0.21	0.40	28.00%	1.87	0.07	
Chlorophyll-a	58	7.33	3.00	3.00	5	10	37.00	64.00%	0.28	0.78	
Nitrate	51	1.97	0.02	0.23	0.4	0.68	32.00	8.00%	-0.92	0.36	
Orthophosphate	24	0.24	0.04	0.07	0.11	0.16	2.90	4.00%	0.93	0.36	
Total Phosphorus	59	0.22	0.06	0.11	0.15	0.18	3.00	2.00%	-0.94	0.35	

Station 20650

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Conductivity	21	852.67	621.00	744.00	824	950	1100.00	0.00%	-0.35	0.73	
Temperature	21	22.17	12.20	18.20	22	28.1	29.50	0.00%	0.51	0.62	
E. Coli	42	36.2	1.00	5.00	14	32	520.00	5.00%	1.39	0.17	

Segment 2304B Manadas Creek (unclassified water body)

Station 13116

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Secchi Depth	22	0.31	0.30	0.30	0.3	0.3	0.60	64.00%	-1.26	0.22	
Chloride	24	577.42	272.00	380.00	527.5	734	1110.00	0.00%	-1.27	0.22	
Sulfate	23	1631.22	32.00	749.00	1350	2350	3860.00	0.00%	-2.58	0.02	Downward
Total Dissolved Solids	23	3436.04	1260.00	1610.00	2760	4906	7550.00	0.00%	-1.60	0.13	
Ammonia	24	0.64	0.02	0.10	0.1	0.46	8.40	46.00%	1.60	0.12	
Chlorophyll-a	24	45.09	3.00	5.50	24.75	48.5	252.00	17.00%	0.35	0.73	
Total Phosphorus	23	0.63	0.05	0.14	0.33	0.62	2.71	4.00%	2.06	0.05	

Lower Rio Grande

Segment 2303 International Falcon Reservoir

Station 13189

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	30	7.71	5.80	6.70	7	8.8	13.90	0.00%	1.74	0.09	
pH	32	8.19	7.00	7.85	8.1	8.45	9.70	0.00%	2.00	0.05	
Conductivity	34	882.21	580.00	758.00	879	968	1180.00	0.00%	1.66	0.11	
Temperature	34	23.28	13.70	17.60	26.25	28.3	30.30	0.00%	-0.06	0.95	
Secchi Depth	22	0.67	0.30	0.40	0.4	0.6	1.50	0.00%	2.88	0.01	Upward
E. Coli	24	14.93	1.00	3.00	6.85	13.3	81.00	4.00%	0.30	0.77	
Chloride	35	103.19	47.50	89.00	106	118	162.00	0.00%	0.96	0.34	
Sulfate	35	157.43	72.00	138.00	167	184	234.00	0.00%	4.51	0.00	Upward
Total Dissolved Solids	34	535.44	349.00	468.00	534.5	588	785.00	0.00%	3.51	0.00	Upward
Ammonia	32	0.43	0.02	0.02	0.1	0.24	7.84	56.00%	1.64	0.11	
Chlorophyll-a	35	14.02	3.00	8.00	11.5	19	41.00	20.00%	2.75	0.01	Upward
Nitrate	30	0.71	0.02	0.04	0.05	0.12	15.10	47.00%	-0.49	0.63	
Total Phosphorus	34	0.08	0.02	0.05	0.06	0.06	0.64	50.00%	-0.51	0.61	

Station 15818

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	24	7.73	4.10	6.40	7.2	8.95	11.50	0.00%	-1.24	0.23	
pH	25	7.95	7.50	7.70	8	8.1	8.30	0.00%	-0.28	0.78	
Conductivity	25	934.12	581.00	854.00	946	1020	1240.00	0.00%	0.81	0.43	
Temperature	25	25.62	15.30	22.70	26.2	29.09	32.50	0.00%	-1.46	0.16	
Chloride	25	110.18	75.00	93.00	105	131	162.00	0.00%	1.71	0.10	
Sulfate	25	174.72	93.00	152.00	176	205	235.00	0.00%	2.38	0.03	Upward
Total Dissolved Solids	25	582.68	332.00	506.00	588	670	771.00	0.00%	1.32	0.20	
Ammonia	23	0.18	0.02	0.10	0.1	0.14	1.12	39.00%	1.90	0.07	
Chlorophyll-a	25	6.14	3.00	3.00	5	7	21.00	64.00%	-1.10	0.28	
Nitrate	21	1.04	0.04	0.24	0.65	0.95	6.07	14.00%	0.03	0.97	
Total Phosphorus	24	0.38	0.06	0.16	0.2	0.38	2.23	4.00%	-0.86	0.40	

Segment 2302 Rio Grande Below Falcon Reservoir

Station 10249

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	31	8.99	4.40	7.50	8.7	10.8	13.00	0.00%	1.64	0.11	
pH	31	7.8	7.20	7.60	7.8	8	8.90	0.00%	-1.14	0.26	
Conductivity	31	1331.16	915.00	1180.00	1300	1530	1800.00	0.00%	2.03	0.05	
Temperature	31	25.17	16.00	21.60	24.6	29.5	32.30	0.00%	-0.75	0.46	
Secchi Depth	30	0.52	0.10	0.40	0.4	0.8	1.00	23.00%	-1.56	0.13	
E. Coli	25	192.89	6.00	14.00	24	100	2400.00	12.00%	-0.45	0.66	
Chloride	30	179.9	107.00	144.00	164	217	306.00	0.00%	1.13	0.27	
Sulfate	32	250.47	159.00	209.00	243	285.5	407.00	0.00%	3.08	0.00	Upward
Total Dissolved Solids	30	820.1	568.00	740.00	777	912	1220.00	0.00%	2.44	0.02	Upward
Ammonia	31	0.29	0.05	0.05	0.15	0.38	1.79	35.00%	-0.33	0.74	
Nitrate	22	0.56	0.04	0.26	0.5	0.93	1.19	9.00%	-2.78	0.01	Downward
Orthophosphate	20	0.26	0.08	0.18	0.2	0.35	0.63	0.00%	1.77	0.09	
Total Phosphorus	28	0.28	0.12	0.21	0.24	0.31	0.66	0.00%	-0.29	0.77	
Total Kjeldahl Nitrogen	29	1.01	0.43	0.58	0.95	1.35	1.91	0.00%	1.48	0.15	

Station 13177

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	162	6.75	0.68	5.30	6.65	7.9	18.20	0.00%	0.77	0.44	
pH	162	7.83	6.45	7.60	7.82	8	9.00	0.00%	2.81	0.01	Upward
Conductivity	135	1316.76	653.00	1190.00	1310	1440	2230.00	0.00%	0.92	0.36	
Temperature	164	25.83	16.10	21.80	27	30.2	34.66	0.00%	0.74	0.46	
Secchi Depth	75	0.82	0.03	0.30	0.58	1.1	3.50	7.00%	0.98	0.33	
E. Coli	48	788.65	9.00	85.65	220	1410	2419.20	15.00%	-0.26	0.80	
Chloride	133	180.66	69.50	150.00	174	204	450.00	0.00%	1.54	0.13	
Sulfate	133	238.34	111.00	202.00	239	265	399.00	0.00%	3.80	0.00	Upward
Total Dissolved Solids	131	856.31	471.00	727.00	813	919	4275.00	0.00%	0.47	0.64	
Ammonia	87	0.27	0.02	0.08	0.1	0.32	2.24	40.00%	3.01	0.00	Upward
Chlorophyll-a	88	15.38	3.00	5.00	10	15.75	85.40	41.00%	2.19	0.03	Upward
Nitrate	70	1.49	0.02	0.18	0.53	1.46	16.00	17.00%	0.18	0.85	
Orthophosphate	76	0.21	0.01	0.12	0.18	0.28	0.74	5.00%	-2.45	0.02	Downward
Total Phosphorus	131	0.3	0.03	0.20	0.27	0.36	1.60	3.00%	-4.57	0.00	Downward
Total Kjeldahl Nitrogen	73	1.4	0.37	0.65	0.93	1.28	7.00	0.00%	7.10	0.00	Upward
Total Nitrogen	42	1.44	0.54	1.10	1.4	1.6	3.10	0.00%	0.81	0.42	
Arsenic	44	4.5	3.00	3.75	4.15	5.05	7.50	0.00%	0.90	0.37	

Station 13179

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Chloride	20	173.2	60.00	141.50	176	203	281.00	0.00%	0.42	0.68	
Sulfate	20	228.35	27.00	212.50	241	271	331.00	0.00%	0.45	0.66	
Total Dissolved Solids	21	801.14	449.00	723.00	781	864	1180.00	0.00%	0.06	0.95	
Ammonia	21	0.6	0.02	0.10	0.1	0.24	7.00	57.00%	1.61	0.12	
Chlorophyll-a	21	17.25	3.00	3.00	7	20	68.00	43.00%	0.53	0.60	

Station 13181

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	88	7.45	2.40	6.32	7.46	8.65	14.20	0.00%	-2.29	0.02	Downward
pH	89	7.86	6.38	7.78	8	8.1	8.50	0.00%	-0.81	0.42	
Conductivity	89	1202	787.00	1060.00	1160	1340	1870.00	0.00%	2.25	0.03	Upward
Temperature	89	24.37	14.89	20.20	24.7	29.4	32.10	0.00%	-0.83	0.41	
Secchi Depth	72	0.94	0.03	0.38	0.7	1.21	4.00	8.00%	1.56	0.12	
E. Coli	44	335.91	10.00	42.00	90	362.6	2400.00	2.00%	0.74	0.47	
Chloride	90	160.31	73.50	128.00	147	179	306.00	0.00%	3.17	0.00	Upward
Sulfate	90	218.99	25.00	183.00	222.5	248	357.00	0.00%	4.95	0.00	Upward
Total Dissolved Solids	89	749.37	462.00	634.00	714	838	1800.00	0.00%	2.57	0.01	Upward
Ammonia	84	0.21	0.02	0.04	0.1	0.1	2.52	56.00%	3.99	0.00	Upward
Chlorophyll-a	89	8.8	1.00	3.00	6	10	58.00	57.00%	0.84	0.41	
Nitrate	71	0.85	0.02	0.07	0.15	0.5	11.20	20.00%	0.29	0.77	
Orthophosphate	31	0.06	0.03	0.04	0.06	0.06	0.11	71.00%	0.08	0.94	
Total Phosphorus	87	0.1	0.02	0.06	0.07	0.1	0.78	29.00%	-0.67	0.50	
Total Kjeldahl Nitrogen	29	2.38	0.40	0.54	1.54	4.2	8.12	0.00%	6.69	0.00	Upward

Station 13184

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	64	7.02	1.50	6.08	7.02	7.96	11.97	0.00%	-2.22	0.03	Downward
pH	64	7.83	5.90	7.70	7.9	8.1	8.50	0.00%	1.96	0.05	
Conductivity	64	1091.75	774.00	973.00	1063.5	1189.5	1610.00	0.00%	3.45	0.00	Upward
Temperature	64	23.82	11.50	19.54	24.5	28.1	31.04	0.00%	-0.01	0.99	
Secchi Depth	37	1.16	0.09	0.61	1	1.5	3.00	5.00%	1.71	0.10	
Chloride	64	139.57	71.10	112.00	130	162	262.00	0.00%	1.51	0.14	
Sulfate	64	203.64	88.00	170.00	202.5	228	329.00	0.00%	3.23	0.00	Upward
Total Dissolved Solids	63	752.78	47.00	597.00	649	754	4961.00	0.00%	-0.50	0.62	
Ammonia	61	0.18	0.02	0.02	0.1	0.1	3.08	61.00%	3.02	0.00	Upward
Chlorophyll-a	61	8.37	3.00	3.00	5.3	10	32.00	48.00%	1.55	0.13	
Nitrate	54	1.02	0.02	0.08	0.13	0.39	20.00	15.00%	-0.70	0.49	
Total Phosphorus	63	0.12	0.03	0.06	0.08	0.11	1.10	21.00%	-1.96	0.05	

Station 13185										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Dissolved Oxygen (Grab)	92	7.28	4.20	6.50	6.9	7.55	18.60	0.00%	2.78	0.01 Upward
pH	101	7.94	6.40	7.70	7.9	8.1	9.00	0.00%	2.74	0.01 Upward
Conductivity	104	1006.96	479.00	917.00	998.5	1090	1337.00	0.00%	1.80	0.08
Temperature	105	23.08	12.50	18.70	23.5	28	30.30	0.00%	0.17	0.87
Secchi Depth	71	0.45	0.20	0.30	0.3	0.4	1.80	0.00%	-3.01	0.00 Downward
E. Coli	72	783.04	2.00	27.10	118.65	1793	2420.00	8.00%	4.00	0.00 Upward
Chloride	107	123.73	41.00	105.00	123	140	210.00	0.00%	2.26	0.03 Upward
Sulfate	107	180.48	22.70	153.80	186	208	285.00	0.00%	5.03	0.00 Upward
Total Dissolved Solids	106	623.31	274.00	537.00	598	676	1990.00	0.00%	3.67	0.00 Upward
Ammonia	106	0.89	0.02	0.30	0.56	1.2	8.40	2.00%	3.85	0.00 Upward
Chlorophyll-a	104	9.32	3.00	3.00	5	10	57.00	63.00%	0.22	0.83
Nitrate	90	0.87	0.02	0.05	0.12	0.33	27.00	28.00%	-0.84	0.41
Orthophosphate	30	0.15	0.03	0.06	0.1	0.23	0.49	20.00%	1.05	0.30
Total Phosphorus	105	0.21	0.05	0.10	0.15	0.26	1.54	7.00%	-2.02	0.05 Downward
Total Kjeldahl Nitrogen	24	4.9	0.80	2.43	4.92	6.67	12.30	0.00%	4.56	0.00 Upward

Station 13186										
Parameter	**N**	**Mean**	**P0**	**P25**	**P50**	**P75**	**P100**	**%Cnsrd**	**T-Ratio**	**P-Value Trend**
Dissolved Oxygen (Grab)	71	7.34	4.10	6.20	6.7	8.1	14.30	0.00%	0.69	0.50
pH	77	7.96	7.00	7.70	7.9	8.1	9.10	0.00%	1.72	0.09
Conductivity	81	882.6	651.00	805.00	874	941	1200.00	0.00%	3.40	0.00 Upward
Temperature	81	23.02	13.70	17.60	24.9	27.4	30.00	0.00%	-0.26	0.80
Secchi Depth	54	0.52	0.24	0.30	0.4	0.7	1.70	7.00%	-1.65	0.11
E. Coli	57	101.77	4.00	22.00	50	91	1119.85	0.00%	-1.23	0.23
Chloride	83	102.93	49.20	85.30	104	115	181.00	0.00%	1.55	0.13
Sulfate	83	155.87	22.20	125.00	158	185	276.00	0.00%	3.61	0.00 Upward
Total Dissolved Solids	82	536.01	332.00	461.00	520	587	1320.00	0.00%	4.20	0.00 Upward
Ammonia	79	0.26	0.02	0.04	0.1	0.14	4.48	52.00%	3.76	0.00 Upward
Chlorophyll-a	81	8.04	1.25	3.00	7	10	52.00	54.00%	0.89	0.38
Nitrate	65	0.28	0.02	0.04	0.05	0.13	6.90	35.00%	-1.16	0.25
Orthophosphate	27	0.07	0.03	0.04	0.04	0.06	0.38	74.00%	1.02	0.32
Total Phosphorus	80	0.12	0.01	0.05	0.06	0.09	1.36	38.00%	-1.84	0.07
Total Kjeldahl Nitrogen	24	2.89	0.39	0.88	2.24	4.9	8.40	0.00%	7.18	0.00 Upward

Station 13188

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	8.92	4.80	7.90	9.2	10.2	11.90	0.00%	-0.09	0.93	
pH	21	8.08	7.60	7.90	8.1	8.2	8.60	0.00%	-2.44	0.02	Downward
Conductivity	21	791.76	614.00	712.00	750	847	1120.00	0.00%	-2.56	0.02	Downward
Temperature	21	22.93	15.00	17.00	20	29	31.00	0.00%	0.34	0.73	
Chloride	21	87.92	58.20	73.50	79.2	107	133.00	0.00%	-2.59	0.02	Downward
Sulfate	21	130.39	87.20	110.00	119	152	197.00	0.00%	-2.74	0.01	Downward
Total Dissolved Solids	21	477.1	347.00	433.00	458	534	647.00	0.00%	-2.32	0.03	Downward
Orthophosphate	21	0.01	0.00	0.01	0.01	0.01	0.02	24.00%	-0.34	0.74	
Total Phosphorus	21	0.04	0.01	0.03	0.03	0.06	0.08	0.00%	-2.41	0.03	Downward
Total Kjeldahl Nitrogen	21	0.54	0.37	0.46	0.53	0.59	0.74	0.00%	-2.63	0.02	Downward
Arsenic	21	3.03	2.20	2.50	3.1	3.5	3.80	0.00%	-0.64	0.53	

Station 13664

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	71	8.16	3.80	6.70	7.89	9.23	16.60	0.00%	-3.05	0.00	Downward
pH	71	7.94	6.20	7.77	8	8.2	8.74	0.00%	0.80	0.42	
Conductivity	71	1200.27	597.00	1067.00	1160	1300	1830.00	0.00%	2.02	0.05	Upward
Temperature	71	24.8	11.50	19.30	26.3	29.63	35.00	0.00%	0.11	0.92	
Secchi Depth	44	1.14	0.21	0.60	1.05	1.4	4.50	14.00%	2.08	0.04	Upward
Chloride	70	171.19	74.10	135.00	152.5	180	919.00	0.00%	2.43	0.02	Upward
Sulfate	70	225.53	118.00	195.00	225	252	390.00	0.00%	3.91	0.00	Upward
Total Dissolved Solids	69	765.42	300.00	664.00	725	839	1690.00	0.00%	1.37	0.18	
Ammonia	67	0.22	0.02	0.02	0.1	0.1	5.04	57.00%	2.58	0.01	Upward
Chlorophyll-a	68	8.22	1.00	3.00	5	10	71.00	57.00%	1.21	0.23	
Nitrate	60	1.22	0.02	0.07	0.18	0.54	26.00	17.00%	-0.51	0.61	
Total Phosphorus	67	0.14	0.02	0.06	0.07	0.17	0.84	28.00%	-1.33	0.19	

Station 15808

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	84	7.34	2.10	6.15	7.25	8.84	13.48	0.00%	-3.70	0.00	Downward
pH	85	7.88	6.73	7.77	8	8.1	8.70	0.00%	-0.12	0.91	
Conductivity	85	1202.66	130.00	1070.00	1170	1345	1890.00	0.00%	2.86	0.01	Upward
Temperature	85	24.66	14.93	20.50	25.31	29	32.10	0.00%	-0.90	0.37	
Secchi Depth	71	0.9	0.03	0.37	0.61	1.2	3.50	6.00%	1.27	0.21	
E. Coli	40	208.01	2.00	26.60	52.2	203.4	2419.20	2.00%	-1.20	0.24	
Chloride	85	159.6	82.00	127.00	152	181	309.00	0.00%	4.72	0.00	Upward
Sulfate	85	223.66	117.00	189.00	226	252	383.00	0.00%	5.83	0.00	Upward
Total Dissolved Solids	84	745.88	288.00	645.00	726	852	1720.00	0.00%	3.10	0.00	Upward
Ammonia	79	0.29	0.02	0.05	0.1	0.13	8.96	47.00%	2.53	0.01	Upward
Chlorophyll-a	84	9.1	1.15	3.00	6.5	10	69.00	61.00%	0.69	0.49	
Nitrate	65	0.92	0.02	0.07	0.15	0.4	10.50	20.00%	0.19	0.85	
Orthophosphate	29	0.06	0.03	0.04	0.06	0.06	0.11	55.00%	0.08	0.94	
Total Phosphorus	81	0.13	0.02	0.06	0.09	0.13	0.86	14.00%	-1.81	0.07	
Total Kjeldahl Nitrogen	25	2.72	0.44	0.82	1.4	3.58	12.30	0.00%	4.33	0.00	Upward

Station 17247

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	37	6.95	2.00	5.30	6.9	8.5	13.20	0.00%	0.74	0.47	
pH	36	7.7	7.10	7.50	7.65	7.85	8.30	0.00%	0.16	0.87	
Conductivity	37	1476.16	700.00	1100.00	1220	1400	6010.00	0.00%	-0.36	0.72	
Temperature	37	24.34	11.50	22.00	25	28.4	31.60	0.00%	-0.38	0.70	
Secchi Depth	36	0.56	0.12	0.30	0.4	0.8	1.60	3.00%	-2.96	0.01	Downward
E. Coli	32	114.94	4.00	13.50	39.6	84	1700.00	3.00%	1.02	0.31	
Chloride	35	168.97	102.00	137.00	152	186	306.00	0.00%	1.67	0.10	
Sulfate	37	235.81	151.00	198.00	227	265	404.00	0.00%	2.96	0.01	Upward
Total Dissolved Solids	34	758.09	560.00	636.00	728	812	1100.00	0.00%	1.08	0.29	
Ammonia	34	0.38	0.05	0.11	0.24	0.46	1.64	12.00%	-0.68	0.50	
Chlorophyll-a	20	16.3	3.00	3.46	6.96	25.55	56.10	20.00%	4.98	0.00	Upward
Nitrate	24	0.42	0.04	0.28	0.44	0.6	0.79	8.00%	-1.97	0.06	
Orthophosphate	21	0.23	0.07	0.14	0.19	0.24	0.56	0.00%	1.19	0.25	
Total Phosphorus	30	0.27	0.11	0.19	0.25	0.34	0.58	0.00%	-0.96	0.35	
Total Kjeldahl Nitrogen	34	1.14	0.54	0.82	1.08	1.33	2.54	0.00%	0.14	0.89	

Station 20449

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
E. Coli	28	70.14	8.00	24.00	41.5	62.5	490.00	0.00%	-0.98	0.34	
Total Dissolved Solids	28	1148.64	520.00	775.00	925	1055	7800.00	0.00%	0.37	0.71	
Ammonia	28	0.15	0.10	0.10	0.1	0.1	0.76	75.00%	-1.30	0.21	

Segment 2301 Rio Grande Tidal

Station 13176

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	20	8.45	4.70	6.48	8.46	10.4	12.10	0.00%	-1.61	0.13	
pH	24	8.33	6.98	8.15	8.4	8.7	8.90	0.00%	-0.33	0.75	
Conductivity	24	2746.04	900.00	1352.50	1628	2251.5	15600.00	0.00%	-0.21	0.84	
Temperature	26	26.79	18.10	24.30	26.9	30.8	32.50	0.00%	1.48	0.15	
Chloride	30	697.61	73.20	200.00	241	557	4860.00	0.00%	-0.87	0.39	
Sulfate	30	284.15	8.49	208.00	247.5	315	861.00	0.00%	-0.30	0.77	
Total Dissolved Solids	31	1922.23	456.00	886.00	992	1670	10200.00	0.00%	-1.11	0.28	
Ammonia	31	0.36	0.02	0.05	0.1	0.1	7.10	61.00%	1.69	0.10	
Chlorophyll-a	32	36.45	3.00	11.50	21.5	39.2	192.00	25.00%	0.92	0.36	
Total Phosphorus	30	0.37	0.05	0.22	0.36	0.48	0.78	7.00%	-2.83	0.01	Downward

Station 16288

Parameter	N	Mean	P0	P25	P50	P75	P100	%Cnsrd	T-Ratio	P-Value	Trend
Dissolved Oxygen (Grab)	23	7.88	3.30	6.60	7.5	10.2	12.90	0.00%	-1.48	0.15	
pH	25	7.94	6.40	7.70	7.81	8.3	10.20	0.00%	-0.02	0.99	
Conductivity	25	1751.32	741.00	1140.00	1330	1490	11400.00	0.00%	-0.82	0.42	
Temperature	27	26.4	18.20	23.20	26.4	31.2	32.70	0.00%	0.72	0.48	
Chloride	28	209.59	64.40	161.50	186.5	223	794.00	0.00%	-0.32	0.75	
Sulfate	28	241.25	28.40	208.50	243.5	275	664.00	0.00%	0.57	0.57	
Total Dissolved Solids	27	888.11	483.00	752.00	832	927	1880.00	0.00%	0.57	0.57	
Ammonia	26	0.22	0.02	0.10	0.1	0.21	1.96	50.00%	1.40	0.18	
Chlorophyll-a	28	25.88	3.00	5.50	13.25	30.35	111.00	29.00%	-1.48	0.15	
Total Phosphorus	27	0.46	0.10	0.26	0.4	0.52	1.88	0.00%	-1.38	0.18	