

# Little River Monitoring and Assessment: Final Report and Data

Authored and prepared by:

Ed Rhodes, Stephanie deVilleneuve, Shaylynn Postma, and Amanda Tague, Texas Water Resources Institute.

Prepared for the Texas State Soil and Water Conservation Board.

**TSSWCB Project MPG-02**

December 2022

Funding provided by Environmental Protection Agency Clean Water Act §319(h) Multipurpose Nonpoint Source Grant through the Texas State Soil and Water Conservation Board.



## Table of Contents

List of Figures.....	ii
List of Tables.....	iii
List of Acronyms .....	iv
<b>Executive Summary</b> .....	5
<b>Project Description</b> .....	6
Station 11887.....	6
Station 13546.....	7
<b>Task 1: Project Administration</b> .....	7
Subtask 1.1: QPRs .....	7
Subtask 1.2: Reimbursement Forms .....	7
Subtask 1.3: Project Coordination.....	7
Subtask 1.4: Final Report.....	7
<b>Task 2: Quality Assurance</b> .....	7
Subtask 2.1: QAPP Development.....	7
Subtask 2.2: QAPP Implementation.....	8
<b>Task 3: Supplemental Monitoring for Watershed Characterization</b> .....	8
Subtask 3.1: Water Quality Monitoring .....	8
Subtask 3.2: Water Quality Data Submission .....	8
<b>Task 4: Final Project Report</b> .....	8
Subtask 4.1: Draft Final Project Report .....	8
Subtask 4.1: Final Project Report.....	8
<b>Conclusion</b> .....	8
<b>Appendix A: Data Summary Report</b> .....	9
Bacteria.....	10
Dissolved Oxygen.....	13
Flow .....	16
<b>Data Conclusions</b> .....	20
<b>References</b> .....	21

## List of Figures

Figure 1. Overview of Little River watershed and TCEQ monitoring stations 13546 and 11887.....	6
Figure 2. Another view of the Little River Watershed with AUs displayed.....	10
Figure 3. Historical <i>E. coli</i> concentrations along Little River AUs at several monitoring stations. AU 1213_04 is the only AU with an established impairment, although the others also surpass the 126 MPN/100mL. Other AU's have bacteria, nitrate, and chlorophyll-a concerns.....	11
Figure 4. <i>E. coli</i> concentrations over the project monitoring period at TCEQ stations 11887 and 13546.....	12
Figure 5. Historical DO concentrations along Little River at several monitoring stations.....	14
Figure 6. DO over the project monitoring period at TCEQ stations 11887 and 13546.....	15
Figure 7. Instantaneous flow in cubic feet per second for SWQM station 11887 throughout Little River monitoring project. ....	17
Figure 8. Daily discharge in cubic feet per second from USGS gauge for AU 1213_04 over the course of the Little River monitoring project.....	18
Figure 9. Instantaneous flow in cubic feet per second for SWQM station 11887 throughout Little River monitoring project. ....	19

## List of Tables

Table 1. <i>E. coli</i> results over the course of the project at TCEQ monitoring stations 11887 and 13546. All highlighted points are exceeding 126 MPN/100mL, the maximum criterion for recreational bacteria.....	12
Table 2. DO concentrations over the course of the TWRI-led Little River monitoring at TCEQ monitoring stations 11887 and 13546. There is no exceedance of grab screening level criterion for DO. ....	15
Table 3. Flow over the course of the TWRI led Little River monitoring at TCEQ monitoring stations 11887 and 13546. ....	19

## List of Acronyms

AU	Assessment Unit
<i>E. coli</i>	<i>Escherichia coli</i>
EPA	Environmental Protection Agency
DO	Dissolved Oxygen
LDC	Load Duration Curve
NELAC	National Environmental Laboratory Accreditation Conference
OSSFs	On-site Sewage Facilities
QA	Quality Assurance
QAPP	Quality Assurance Protection Plan
QC	Quality Control
QPR	Quarterly Progress Report
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TSSWCB	Texas State Soil and Water Conservation
TWRI	Texas Water Resources Institute
USGS	United States Geological Survey
WWTFs	Wastewater Treatment Facilities

## Executive Summary

TCEQ conducts a water body assessment on a biennial basis to satisfy requirements of the federal Clean Water Act (CWA) Sections 305(b) and 303(d). The resulting *Texas Integrated Report of Surface Water Quality (Texas Integrated Report)* describes the status of water bodies throughout the state of Texas. The most recent report, the *2022 Texas Integrated Report*, includes an assessment of water quality data collected from December 1, 2013, to November 30, 2020.

The *Texas Integrated Report* assesses water bodies at the assessment unit (AU) level. An AU is a sub-area of a segment, defined as the smallest geographic area of use support reported in the assessment (TCEQ 2020). Each AU is intended to have relatively homogeneous chemical, physical, and hydrological characteristics, which allows assignment of site-specific standards (TCEQ 2020). A segment identification number and AUs are combined and assigned to each water body in a segment.

The Leon and Lampasas Rivers below Belton Lake and Stillhouse Hollow Lake, respectively, transect the urban areas of Temple, TX and Belton, TX, flowing downstream where they merge to form the Little River. The Little River flows southeast where it ultimately reaches the Brazos River. Major tributaries of the Little River are the San Gabriel River and Big Elm Creek. Currently, one assessment unit of the Little River is impaired for excessive levels of bacteria, and another has a concern for elevated bacteria. Additionally, concerns about excessive amounts of nitrate and chlorophyll-a along the length of the river also exist. Potential sources of these contaminants are various non-point agriculture and municipal point source discharges.

Water quality monitoring in the watershed currently occurs quarterly at three locations and monthly at a fourth location. However, the distribution of these sampling sites and the frequency of data collected may not adequately represent water quality conditions in the bulk of the watershed. For example, assessment unit 1213\_01, which extends from the Brazos River upstream to Cameron, TX, is evaluated on samples collected at two sites very near the City of Cameron. These sites are influenced by wastewater inflows to the river and may not adequately represent instream water quality condition farther downstream where more primary contact recreation is known to occur. Upstream, assessment unit 1213\_04 is considered impaired due to an insufficient data set; however, recent data indicates improved water from earlier monitored conditions, but a sufficient amount of sampling has not been completed to fully assess this portion of the water body.

This project increased the spatial and temporal distribution of water quality monitoring activity in this watershed to better define current instream water quality conditions, thus providing an increase in the quantity of water quality data available for future water body assessments. This will help to build a more robust data set for future planning purposes should remedial action be needed. Additionally, expanded data will aid in identifying potential cases and sources of pollution. It is

through monitoring and adequate data that watershed managers will be able to get a true assessment of water quality and water quality inhibitors.

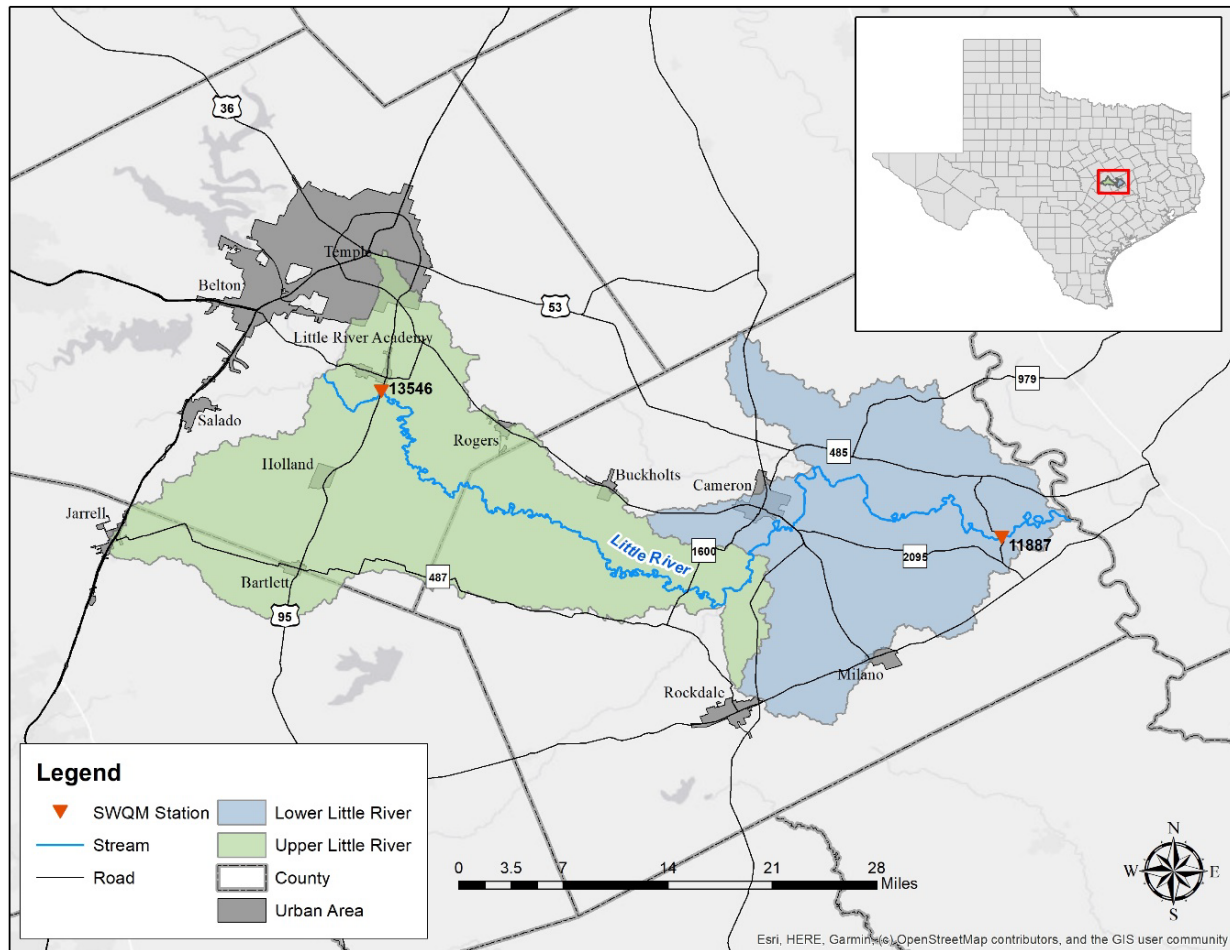


Figure 1. Overview of Little River watershed and TCEQ monitoring stations 13546 and 11887.

## Project Description

Throughout this project, supplemental water quality monitoring was conducted with a focus on collecting paired flow rate and *E. coli* concentration data. Data was collected monthly for 14 months at two TCEQ monitoring stations 11877 and 13546 (Figure 1). Both stations are along the Little River in assessment units with impairments or concerns for bacteria. Monthly sampling included monitoring field parameters and collecting grab samples. Ambient monthly sampling allows data gaps to be filled and improves watershed analysis. This improved dataset may help water managers identify potential sources of contamination for remediation. Collecting additional data and synthesizing it with preexisting data results in a more accurate characterization of the watershed. Existing water quality findings and trends will be discussed.

### Station 11887

This station is along Little River at CR 264 on segment 1213. It is north of the town of Gause and is the most downstream publicly accessible point before the confluence with the Brazos River.

## Station 13546

Also located on segment 1213 along Little River, this station is south of Little River Academy. It is the first accessible point downstream of the confluence of the Lampasas and Leon Rivers, and Salado Creek.

## Task 1: Project Administration

TWRI has effectively administered, coordinated, and monitored all work performed under this project including technical and financial supervision and preparation of status reports.

### Subtask 1.1: QPRs

To track project progress, TWRI submitted quarterly progress reports (QPRs) to the Texas State Soil and Water Conservation Board (TSSWCB). QPRs contained an overview of project activities completed during each quarter, an overview of activities to be completed in the next quarter, and highlighted related issues or problems associated with the project. The QPRs were submitted by the 1st of January, April, July, and October, and distributed to all Project Partners.

### Subtask 1.2: Reimbursement Forms

TWRI provided financial supervision to ensure tasks and deliverables were acceptable and completed within budget. Financial supervision consisted of submitting appropriate reimbursement forms at least quarterly to TSSWCB and submitting necessary budget revisions.

### Subtask 1.3: Project Coordination

TWRI hosted quarterly coordination meetings or conference calls with Project Partners to discuss project activities, the project schedule, communication needs, deliverables, and other requirements. TWRI developed lists of action items needed following each project coordination meeting and distributed them to project personnel.

### Subtask 1.4: Final Report

TWRI developed a Final Report that summarizes activities completed during the duration of the project as well as the conclusions reached. The Final Report also discusses the extent to which the project goals and measures of success were achieved.

## Task 2: Quality Assurance

TWRI developed data quality objectives and quality assurance/control (QA/QC) activities to ensure data generated through this project were of known and acceptable quality.

### Subtask 2.1: QAPP Development

TWRI developed a QAPP for activities in Tasks 3 and 4 consistent with the most recent versions of *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* and the *TSSWCB Environmental Data Quality Management Plan*. All monitoring procedures and methods prescribed in the QAPP were to be consistent with the guidelines detailed in the *TCEQ Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods for Water, Sediment, and Tissue (RG-415)* and *Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data (RG-416)*. [Consistency with



Title 30, Chapter 25 of the Texas Administrative Code, *Environmental Testing Laboratory Accreditation and Certification*, which describes Texas' approach to implementing the National Environmental Laboratory Accreditation Conference (NELAC) standards, were required where applicable.] After developing the QAPP, TWRI sent draft and final versions to TSSWCB, and a final document was approved.

### Subtask 2.2: QAPP Implementation

TWRI implemented the approved QAPP. TWRI submitted revisions and amendments of the QAPP to TSSWCB when necessary.

## Task 3: Supplemental Monitoring for Watershed Characterization

TWRI collected water quality data and flow data for future watershed planning efforts.

### Subtask 3.1: Water Quality Monitoring

TWRI conducted monthly ambient water quality monitoring at two sites for 14 months (28 total samples). Sampling included basic field parameters (temperature, pH, DO, conductivity, and flow where conditions allow) and grab sample collection (analyzed for E. coli). Water samples were delivered to a NELAP accredited laboratory with the appropriate holding time for bacterial analysis. Sampling events were documented in QPRs.

### Subtask 3.2: Water Quality Data Submission

The TWRI maintained a master database of all collected water quality data from this project. Collected data was submitted to the TSSWCB by TWRI for submission to SWQMIS quarterly.

## Task 4: Final Project Report

TWRI prepared a final project report outlining surface water quality trends utilizing data collected under this project, as well as other available SWQMIS data.

### Subtask 4.1: Draft Final Project Report

Collaborated with TWRI project managers to draft an initial project report, summarizing data collected and analyzing results of monitoring. The draft was sent to project partners for input.

### Subtask 4.1: Final Project Report

After all input from project partners was addressed, the project report was finalized.

## Conclusion

TWRI worked diligently to complete all project tasks and turn in deliverables on time to the TSSWCB through the two-year project time period. Analysis of existing data created a solid foundation for additional, targeted information. As a result, more water quality data was collected for the watershed and made accessible for future planning within the Little River watershed. The additional 14 monthly ambient water quality data samples will be a great tool for stakeholders to determine a path forward for improving the water quality in the watershed.

Projects such as this are why accomplishments are being made toward restoring water quality. The need for such projects statewide in the future is crucial for continued success.

## Appendix A: Data Summary Report

TCEQ conducts a water body assessment on a biennial basis to satisfy requirements of the federal Clean Water Act (CWA) Sections 305(b) and 303(d). The resulting *Texas Integrated Report of Surface Water Quality (Texas Integrated Report)* describes the status of water bodies throughout the state of Texas. The most recent report, the *2022 Texas Integrated Report*, includes an assessment of water quality data collected from December 1, 2013, to November 30, 2020.

The *Texas Integrated Report* assesses water bodies at the assessment unit (AU) level. An AU is a sub-area of a segment, defined as the smallest geographic area of use support reported in the assessment (TCEQ 2022). Each AU is intended to have relatively homogeneous chemical, physical, and hydrological characteristics, which allows a way to assign site-specific standards (TCEQ 2022). A segment identification number and AUs are combined and assigned to each water body to divide into a segment.

In total, there are four AUs for the Little River watershed, but only one is listed as impaired. Most AUs have monitoring stations that allow independent water quality analysis for each AU within a segment. At least 10 data points within the most recent 7 years of available data are required for all water quality parameters except bacteria, which requires a minimum of 20 samples. The AU 1213\_04 along Little River was first listed as impaired due to elevated levels of bacteria in 2006, according to the *2022 Texas Integrated Report* and *303(d) List* (TCEQ 2020). Of the other AUs, 1213\_01 also has bacteria concerns along with screening levels concerns of chlorophyll-a and nitrate. Both AUs 1213-02 and 1213\_03 have screening level concerns for nitrate.

There are currently two active monitoring stations within the Little River watershed that are used in this project. Surface water quality monitoring (SWQM) stations 11877 and 13546 (Figure 1). These stations are in AUs 1213\_04 and 1213\_01, respectively (Figure 2). There is historical water quality data for stations 11887, 11888, 13544, 13546, 16409, 17499, 22084 along all four AUs (Figure 3; Figure 5). The two stations used in this project were monitored monthly for field parameters such as temperature, dissolved oxygen [DO], specific conductance, and pH. This type of monitoring is considered routine monitoring because all data and parameters are collected for each site routinely every month. Additionally, flow rate was monitored, and water samples from stations were analyzed for *E. coli* concentration data.

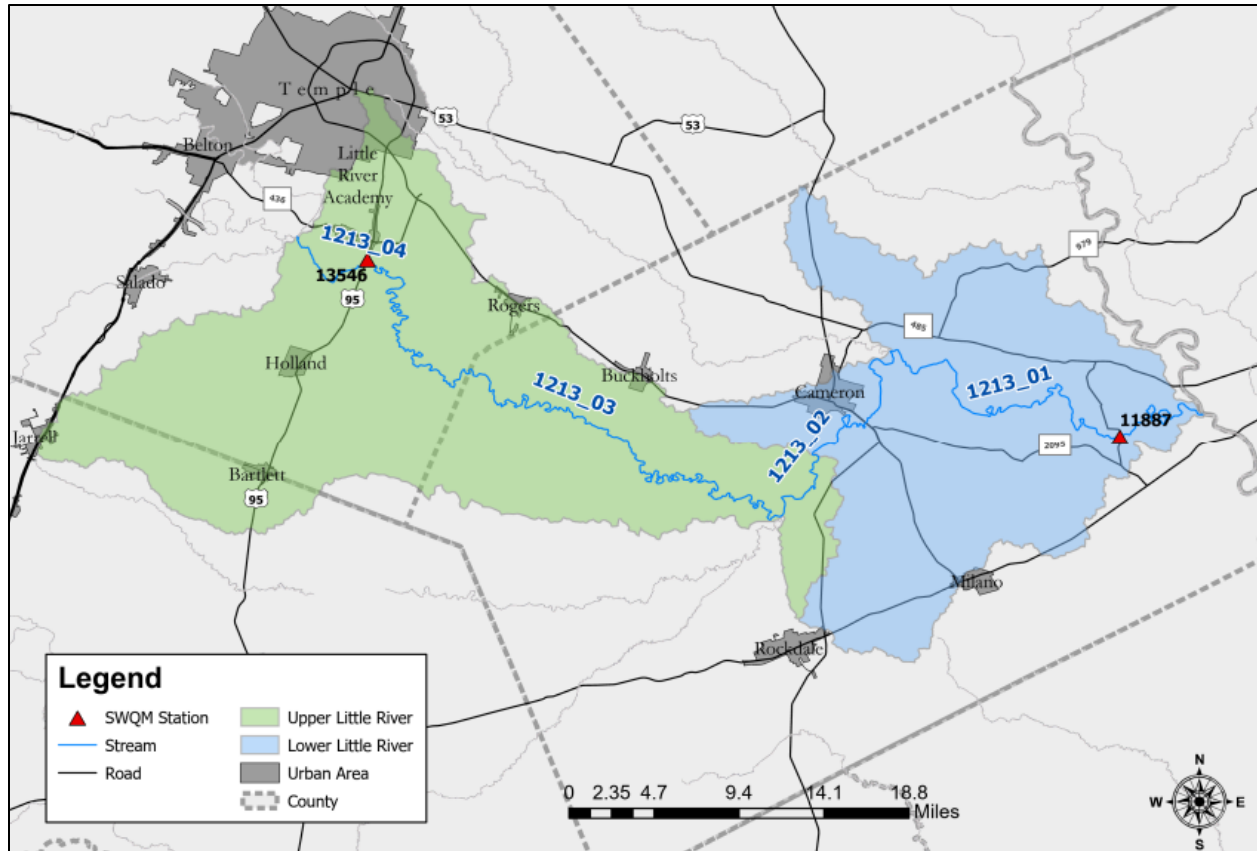


Figure 2. Another view of the Little River Watershed with AUs displayed.

## Bacteria

Concentrations of fecal indicator bacteria are evaluated to assess the risk of illness during contact recreation. In freshwater environments, concentrations of *Escherichia coli* (*E. coli*) are measured to evaluate the presence of fecal contamination in water bodies from warm-blooded animals and other sources. The presence of fecal indicator bacteria, like *E. coli*, suggests that associated pathogens from the intestinal tracts of warm-blooded animals could be reaching water bodies and may cause illness in people that recreate in them. Common sources that indicator bacteria can originate from include wildlife, domestic livestock, pets, malfunctioning on-site sewage facilities (OSSFs), urban and agricultural runoff, sewage system overflows, and direct discharges from wastewater treatment facilities (WWTFs). There is a specific standard for *E. coli* in freshwater for water bodies that are used for primary contact recreation. The standard for primary contact recreation is a geometric mean of 126 most probable number (MPN) of *E. coli* per 100 mL of water from at least 20 samples (30 TAC § 307.7 2014).

As previously mentioned, AU 1213\_01 has concerns for bacteria levels and AU 1213\_04 is listed as impaired due to elevated bacteria according to the 2022 *Texas Integrated Report* (TCEQ 2022). AU 1213\_04 was first listed as impaired in 2006 and has remained listed due to insufficient new data. Historically, the geomean of bacteria levels at several monitoring stations in each of the four Little River AUs is just below the criterion (Figure 3). Data collected from this TWRI-led monitoring project indicates both AUs have relatively stable bacteria levels with a geomean consistently underneath the maximum *E. coli* criterion for recreational use at 126 MPN/100 mL (Figure 4). This

indicates that water quality has improved from earlier monitoring conditions that resulted in listing Little River as impaired.

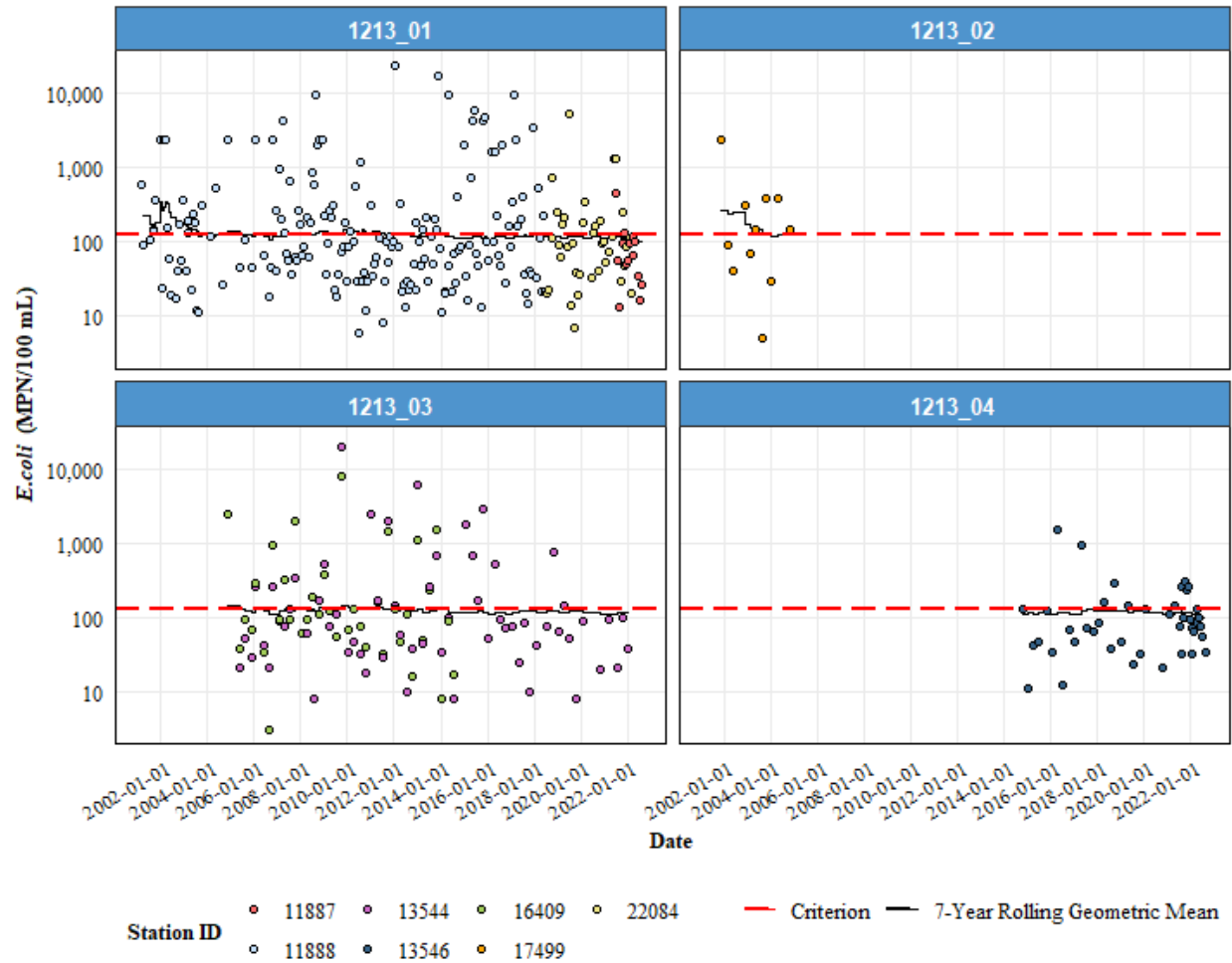


Figure 3. Historical *E. coli* concentrations along Little River AUs at several monitoring stations. AU 1213\_04 is the only AU with an established impairment, although the others also surpass the 126 MPN/100mL. Other AU's have bacteria, nitrate, and chlorophyll-a concerns.

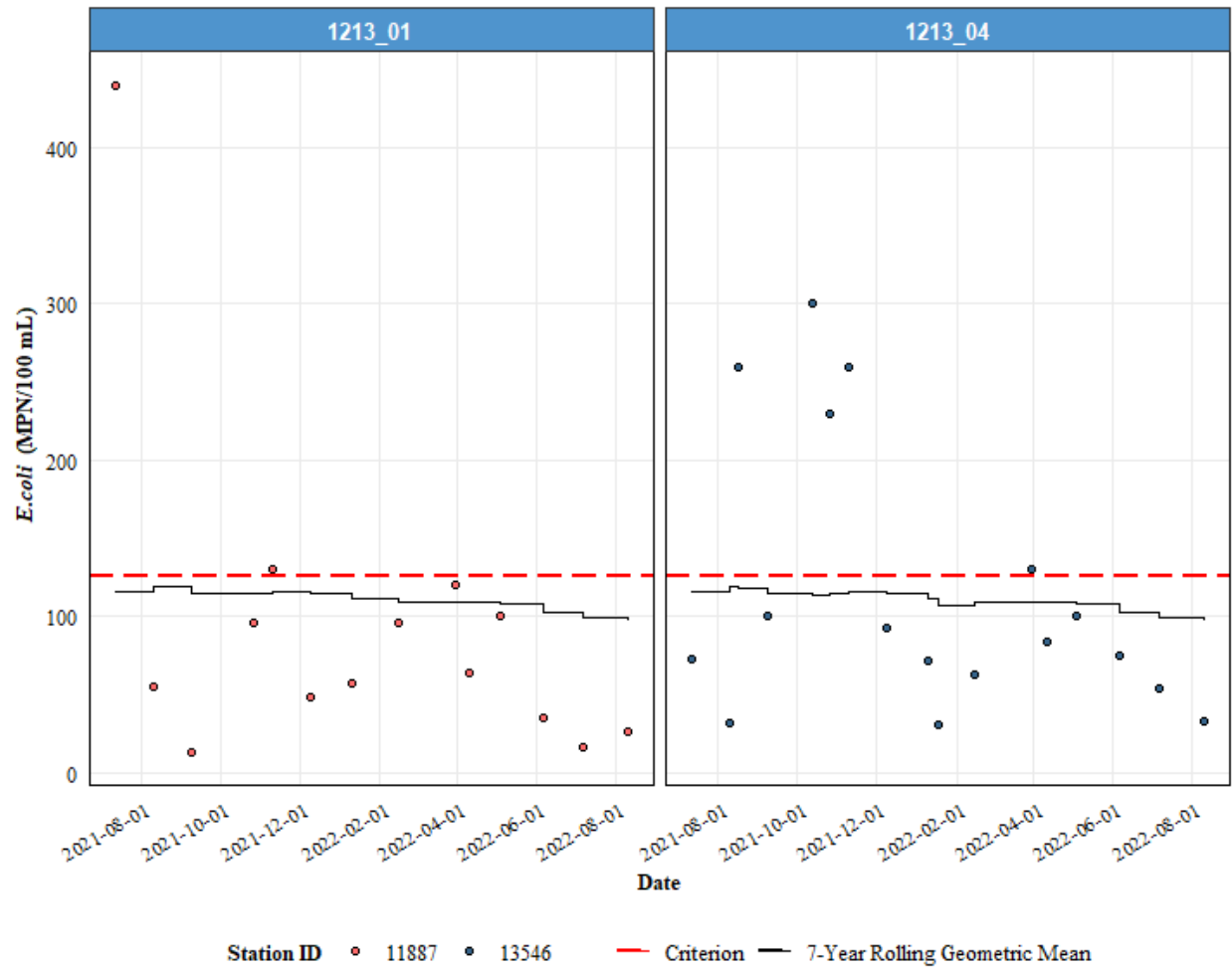


Figure 4. *E. coli* concentrations over the project monitoring period at TCEQ stations 11887 and 13546.

Table 1. *E. coli* results over the course of the project at TCEQ monitoring stations 11887 and 13546. All highlighted points are exceeding 126 MPN/100mL, the maximum criterion for recreational bacteria.

Date	Station 11887 [MPN/100 mL]	Station 13546 [MPN/100 mL]
2021-07-12	435	72.8
2021-08-10	55.4	31.5
2021-09-08	13.4	104
2021-10-26	95.9	228
2021-11-10	126	261
2021-12-09	48.7	93.2
2022-01-10	56.5	72.3
2022-02-15	96	63.3
2022-03-31	115	133
2022-04-11	64.4	83.6

Date	Station 11887 [MPN/100 mL]	Station 13546 [MPN/100 mL]
2022-05-04	101	101
2022-06-07	35	75.4
2022-07-07	435	53.8
2022-08-11	26.9	32.7

## Dissolved Oxygen

Dissolved oxygen (DO) is used to determine a water body's aquatic life uses. Aquatic life uses measure whether a water body can support and maintain a healthy aquatic ecosystem. If DO levels drop too low, fish and other aquatic species will not survive. Typically, DO will fluctuate throughout the day, with the highest levels occurring in the mid to late afternoon due to photosynthesis. DO levels are usually at their lowest just before dawn as both plants and animals in the water consume oxygen through respiration. Furthermore, seasonal fluctuations in DO are common because of decreased oxygen solubility in water as temperature increases; therefore, DO levels are typically lower during the summer and higher in the winter months. While DO can fluctuate naturally, human activities can also cause abnormally low DO levels. Excessive organic matter (vegetative material, untreated wastewater, etc.) can result in depressed DO levels as bacteria break down the materials and consume oxygen. Excessive nutrients from fertilizers and manures can also depress DO as aquatic plant and algae growth increase in response. More respiration from plants and the decay of organic matter as plants die off can also decrease DO concentrations.

On the *2022 Texas Integrated Report*, Little River has no concerns for depressed DO. All historical data from ambient field monitoring is shown in Figure 5. There are very few isolated points where DO drops below the criterion, therefore, they are likely due to warmer temperatures. The data collected by the TWRI during this project are shown in Figure 6 and are presented with the current rolling geomean. There are no violations of the criterion, and the DO rolling geomean for these samples remain well above the criterion for both AU 1213\_01 and 1213\_04. Figure 6 demonstrates that DO in both areas along Little River have a normal pattern of increasing during the winter months and decreasing during summer months. However, AU 1213\_04 may be more sensitive to warmer temperatures due to its greater differences in high and low values during the summer. Table 2 demonstrates the data collected during this project that will be added to the historical dataset to fill in any gaps and create a robust dataset for decision making. Overall, the DO concentration indicates a potentially healthy aquatic ecosystem throughout the TWRI-led monitoring project and beyond.

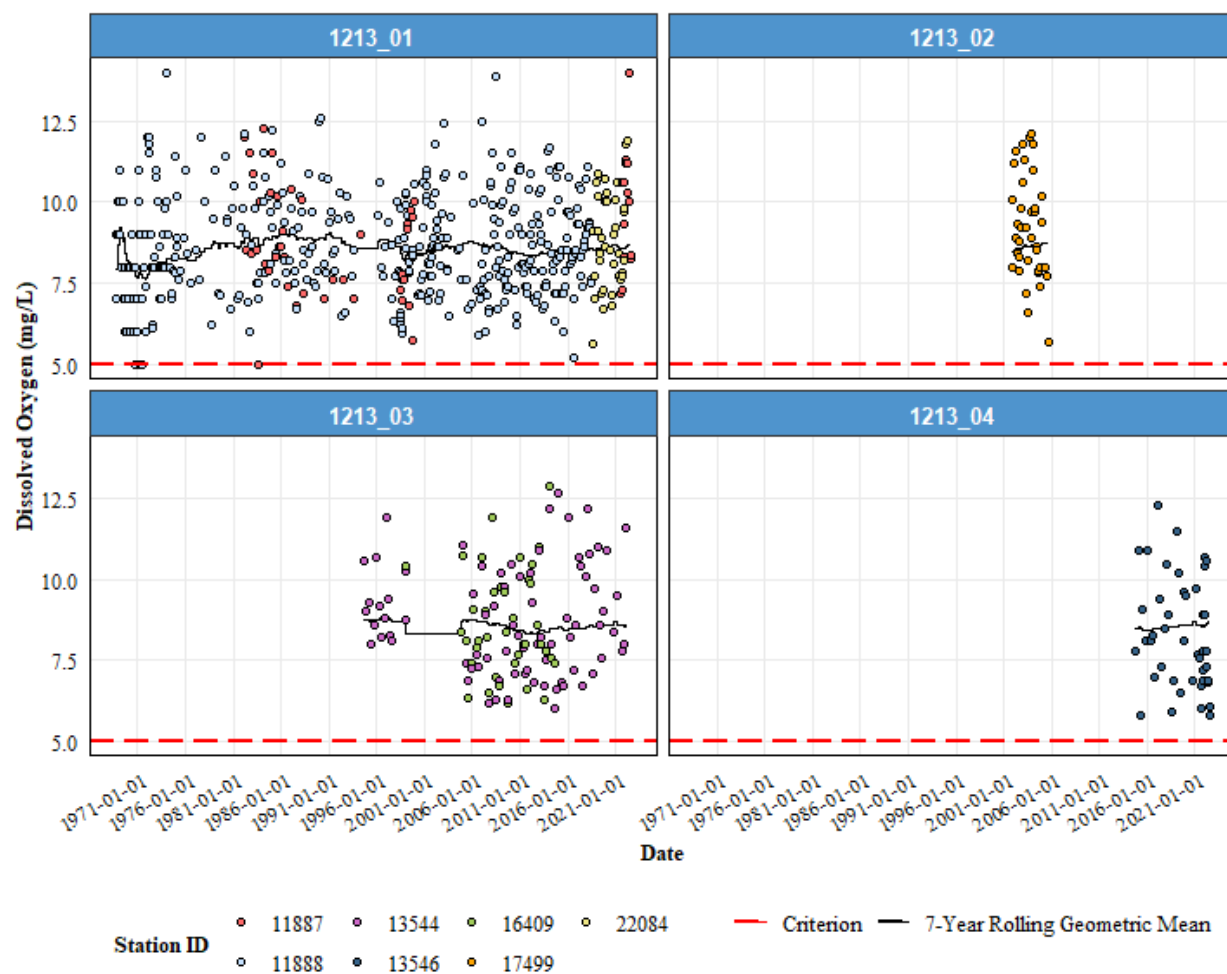


Figure 5. Historical DO concentrations along Little River at several monitoring stations.

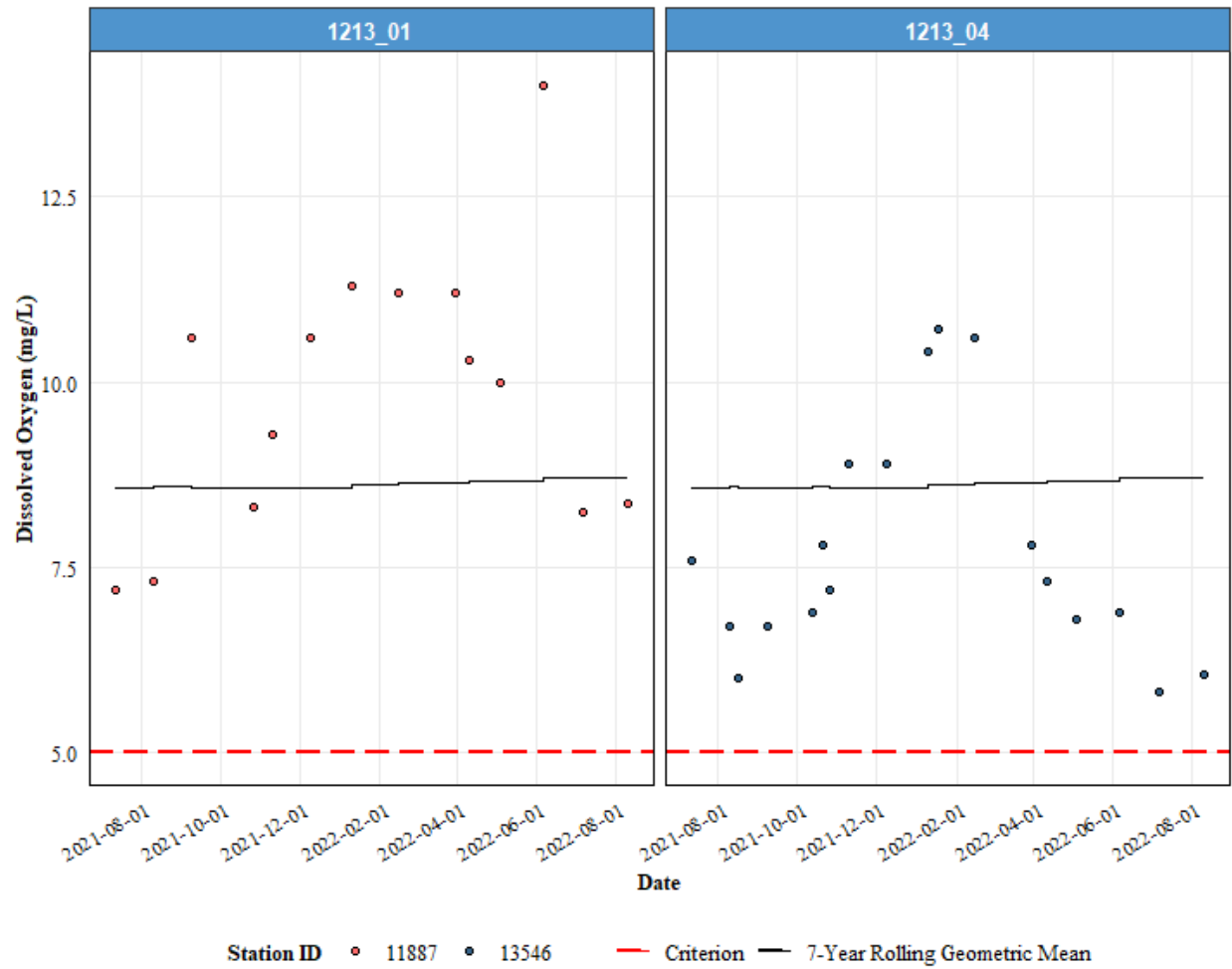


Figure 6. DO over the project monitoring period at TCEQ stations 11887 and 13546.

Table 2. DO concentrations over the course of the TWRI-led Little River monitoring at TCEQ monitoring stations 11887 and 13546. There is no exceedance of grab screening level criterion for DO.

Date	Station 11887 [mg/L]	Station 13546 [mg/L]
2021-07-12	7.15	7.6
2021-08-10	7.27	6.72
2021-09-08	10.63	6.68
2021-10-26	8.3	7.18
2021-11-10	9.29	8.87
2021-12-09	10.61	8.86
2022-01-10	11.26	10.39
2022-02-15	11.16	10.59
2022-03-31	11.18	7.75
2022-04-11	10.28	7.32



Date	Station 11887 [mg/L]	Station 13546 [mg/L]
2022-05-04	10.05	6.77
2022-06-07	14.02	6.89
2022-07-07	8.25	5.82
2022-08-11	8.35	6.06

## Flow

Generally, streamflow (the amount of water flowing in a river/creek at a given time) is dynamic and always changing in response to both natural (e.g. precipitation events) and anthropogenic (e.g. changes in land cover) factors. From a water quality perspective, streamflow is important because it influences the ability of a water body to assimilate pollutants.

Flow data is useful in creating flow duration curves (FDC) and load data curves (LDC). The LDC method is widely used to characterize water quality data across different flow conditions in a watershed. An LDC provides visual display of streamflow, load capacity, and water quality exceedance by first developing a FDC using flow measurements.

Figure 6 shows that station 11887 has a highly variable flow that is significantly greater than station 13546. This influx of water is most likely due to the influence of wastewater inflows, further evidence that AU 1213\_01 cannot adequately represent water quality conditions further downstream. Both AUs 1213\_01 and 1213\_4 show a large influx of water that coincides with high bacteria measurements in Figure 4 for 1213\_01 (Figure 7: Figure 9). However, AU 1213\_04 does not reflect the expected high bacteria measurement immediately, it shows elevated bacteria for several months before returning to normal levels.

Instantaneous flow data collected by the TWRI for along AU 1213\_04 and USGS discharge data can be analyzed to fill gaps in data (Figure 8: Figure 9). The USGS gauge shows that the influx in water in July 2021 is even greater than TWRI monitoring data shows. Once enough data has been collected, these combined data can be used to create a FDC and LDC for Little River.

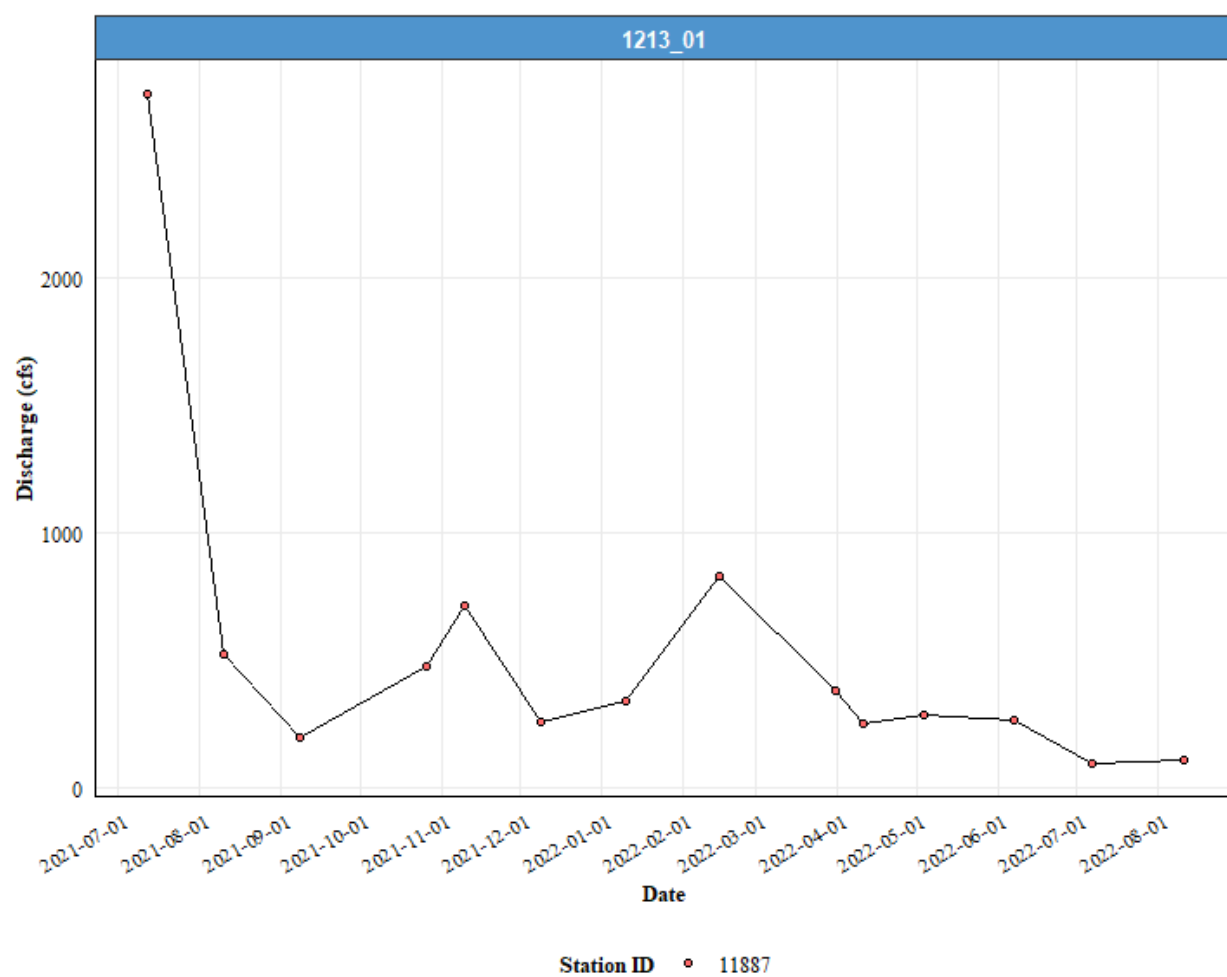


Figure 7. Instantaneous flow in cubic feet per second for SWQM station 11887 throughout Little River monitoring project.

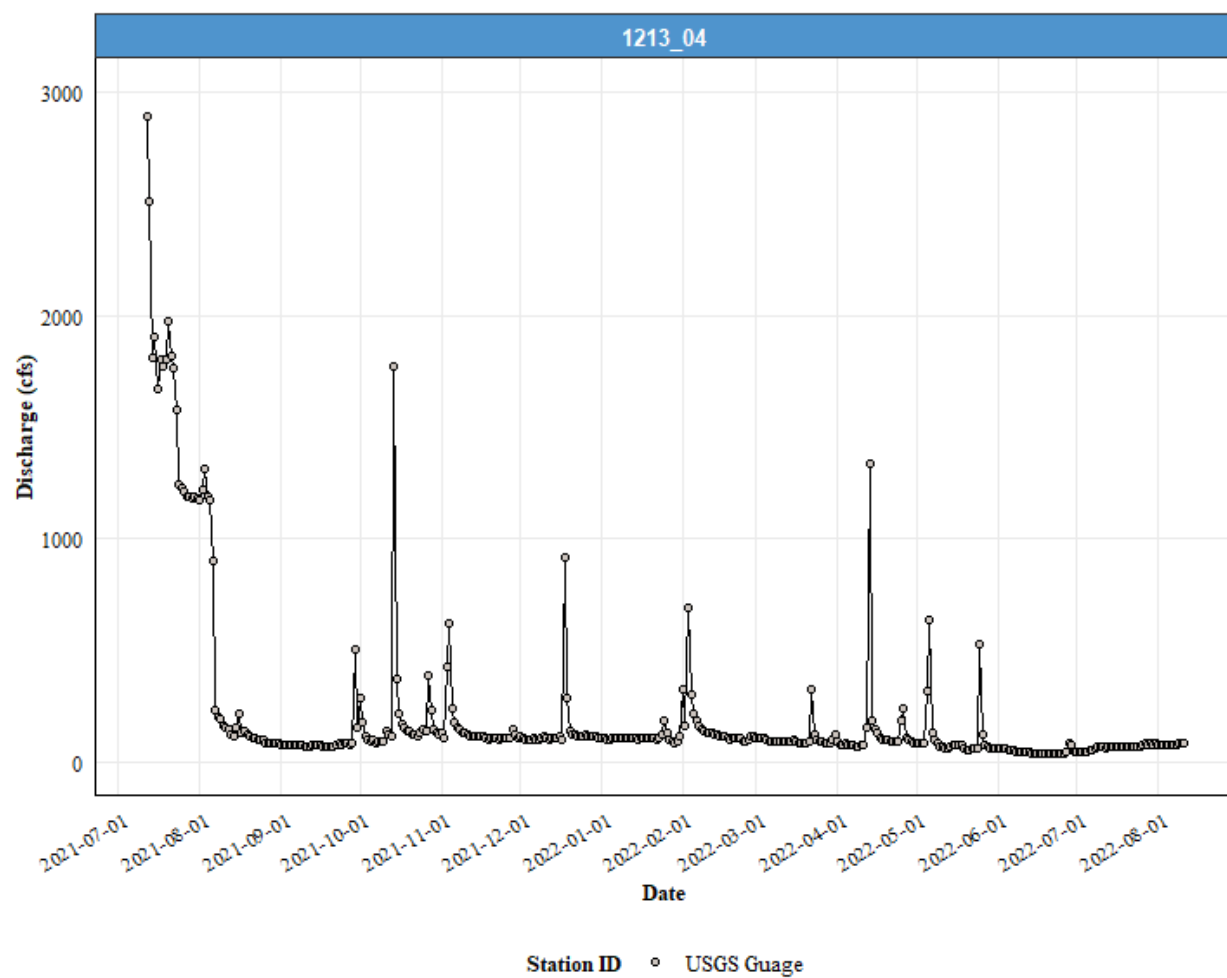


Figure 8. Daily discharge in cubic feet per second from USGS gauge for AU 1213\_04 over the course of the Little River monitoring project.

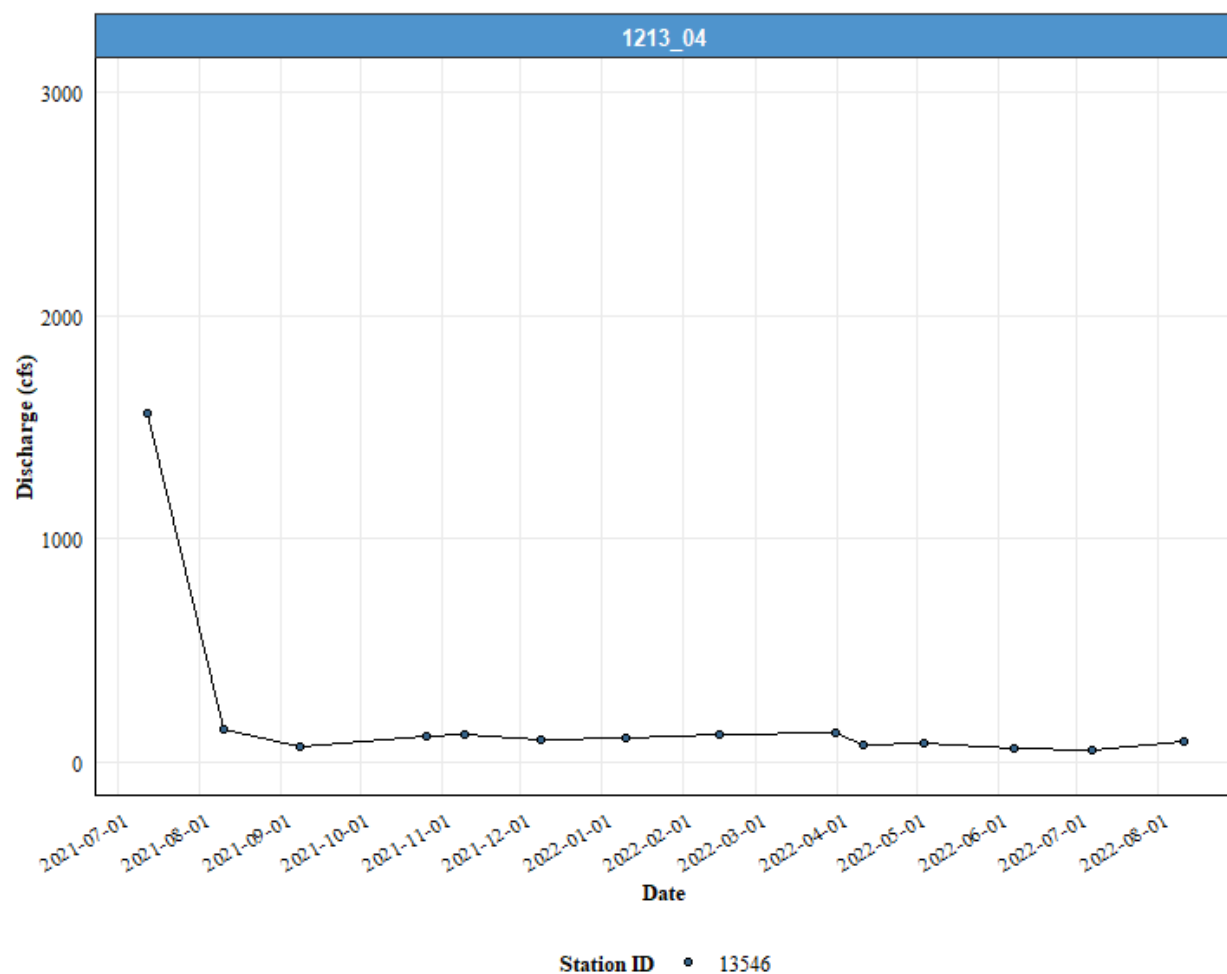


Figure 9. Instantaneous flow in cubic feet per second for SWQM station 13546 throughout Little River monitoring project.

Table 3. Flow over the course of the TWRI led Little River monitoring at TCEQ monitoring stations 11887 and 13546.

Date	Station 11887 [cfs]	Station 13546 [cfs]
2021-07-12	2723.59	1560
2021-08-10	527.032	152
2021-09-08	196.142	71.9
2021-10-26	477.779	118
2021-11-10	712.296	124
2021-12-09	257.88	104
2022-01-10	340.537	111
2022-02-15	833.191	128
2022-03-31	384.216	133
2022-04-11	253.327	80.7

Date	Station 11887 [cfs]	Station 13546 [cfs]
2022-05-04	283.9	82.7
2022-06-07	267.675	63.7
2022-07-07	94.23	57.2
2022-08-11	111.07	92

## Data Conclusions

Continued monitoring of the Little River watershed is essential to building a robust dataset for stakeholders to make informed choices. Analysis of the accumulated data shows that *E. coli* levels remain stable and below criterion for the Little River. The rolling geometric mean between 2021 and 2022 demonstrates that *E. coli* concentrations have been consistent in the last two years, aside from a few outliers. According to flow data these bacteria outliers coincide with high flow events. Similarly, DO follows the historical trend of satisfactory concentrations besides a few outliers during warm summer months. Additional data can confirm that Little River no longer exceeds standards that resulted in being listed as impaired on the 2022 Texas 303(d) list.

## References

- TCEQ. 2019. Surface Water Quality Monitoring Data Management Reference Guide. July 2019.  
[www.tceq.texas.gov/waterquality/data-management/dmrg\\_index.html](http://www.tceq.texas.gov/waterquality/data-management/dmrg_index.html).
- TCEQ. 2010. 2010 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d).  
[https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020\\_303d.pdf](https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/20txir/2020_303d.pdf)
- TCEQ. 2020. 2020 Guidance for Assessing and Reporting Surface Water Quality in Texas (May 2020): In Compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act.
- TCEQ. 2022. 2022 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d).  
<https://www.tceq.texas.gov/downloads/water-quality/assessment/integrated-report-2022/2022-303d.pdf>
- The NELAC Institute (TNI) Standard. 2016. Volume 1, Management and Technical Requirements for Laboratories Performing Environmental Analysis, Module 2, Quality Systems General Requirements. EL-V1M2- Rev. 2.1.
- USGS 2005. Oberg, K.A., Morlock, S.E., and Caldwell, W.S. Quality-Assurance Plan for Discharge Measurements Using Acoustic Doppler Current Profilers. Special Investigations Report 2005-5183.
- 30 Tex. Admin. Code §307.7 (2020)