Pond Creek Watershed Monitoring and Assessment: Final Report and Data

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List of Acronyms

AU	Assessment Unit
E. coli	*Escherichia coli*
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
SLOC	Station Location
SWQM	Surface Water Quality Monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
TSSWCB	Texas State Soil and Water Conservation
TWRI	Texas Water Resources Institute
WPP	Watershed Protection Plan
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 a way to assign site-specific standards (TCEQ 2020). A segment identification number and AUs are combined and assigned to each water body to divide into a segment. This report will focus on the previously impaired Pond Creek AU, 1242F_01, which was first listed in the 2010 *Texas Integrated Report*.

Water quality in Pond Creek currently exceeds recreational use standards for bacteria concentrations from the confluence with the Brazos River in Milam County upstream to the headwaters 0.18 kilometers north of FM 935 in Bell County. As a result, a Recreational Use Attainability Analysis was conducted in 2012. The report shows that primary contact recreation occurs "frequently" on the waterbody (Tables 4 & 7: https://www.tceq.texas.gov/assets/public/waterquality/standards/ruaa/brazos5/Brazos5Report.pdf) indicating that standards will not change.

Efforts to address this impairment are needed and can include additional water quality monitoring data collection or watershed-based plan development. No water quality data was collected on this water body between 2008 and 2015. Data collection resumed in 2016, but only at a single location; however, sufficient data to fully assess the bacteria impairment will not be available until the *2024 Texas Integrated Report* is developed. If the impaired status is confirmed with recently collected *E. coli* concentrations, remedial action through development of a watershed-based plan will be necessary.

Additionally, flow volume was not historically collected on this stream, making load duration curve (LDC) development more difficult. LDCs are a cornerstone of watershed-based plans in this type of watershed and acquiring actual flow data to base them on is vital. Subsequently, expanded data collection (including flow) from this project allows for more accurate assessment of waterbody conditions and 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. To fully understand and appreciate the scope of the impairment, ambient monthly sampling was conducted at more two locations within the watershed.

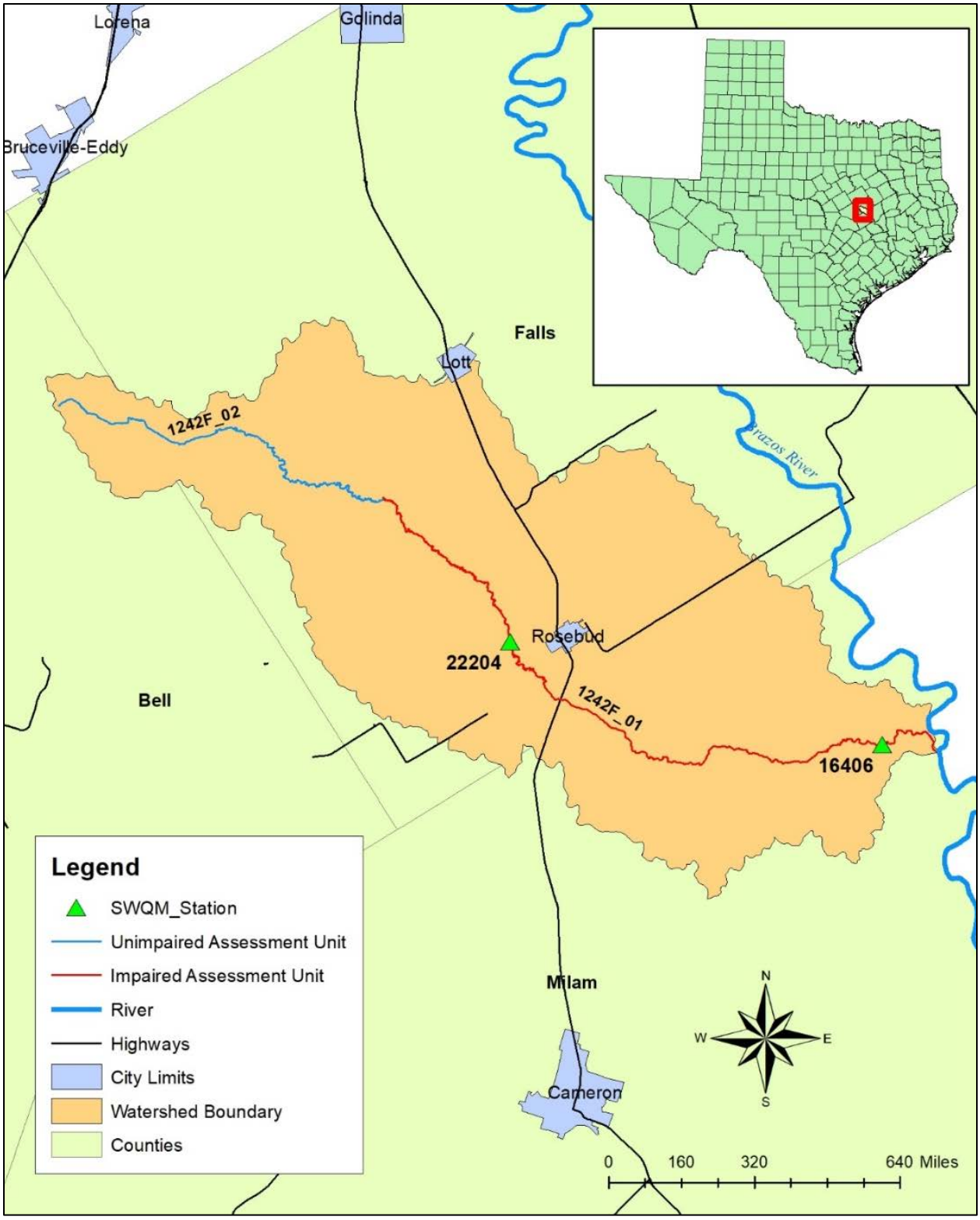

Figure 1. Overview of Pond Creek Watershed and the two Pond Creek AUs. SWQM monitoring stations 16406 and 22204 were used for sampling in this project.

Project Description

The primary objectives of this project were to collect additional surface water quality data in Pond Creek and to use that data to update existing water quality analysis within the watershed. Through this project, supplemental water quality monitoring was conducted with a focus on collecting paired flow rate and *E. coli* concentration data. Data was collected at two sites monthly at SWQM monitoring station 16406 and station 22204. Ambient monthly sampling allows data gaps to be filled and improves watershed analysis.

Additionally, existing water quality data collected through the Texas Clean Rivers Program was retrieved and summarized in conjunction with data generated through this project. Collecting additional data and synthesizing it with preexisting data results in a more accurate description of the watershed. Existing water quality findings and trends are discussed. These combined data are crucial in understanding bacterial loads throughout the watershed and can be used in future LDC development and loading reduction estimates.

Station 22204

This station is along Pond Creek, 30m Upstream of SH 53 Bridge 2.7 KM West of the City of Rosebud. Specifically, it is located on segment 1242F_01, and is upstream of the city of Rogers and the Rogers WWTF.

Station 16406

This station is along Pond Creek at FM 2027 4.0 Kilometers South of Baileyville. Specifically, it is located on segment 1242F_01, and it is the furthest downstream publicly accessible location before the confluence with the Brazos River.

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 discussing 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 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, was 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: Summary of Existing Data

Existing data was collected and summarized by TWRI and can be found in Appendix A.

Subtask 3.1: Gathering Existing Data

TWRI gathered existing surface water quality data for the Pond Creek watershed. Any additional information pertaining to surface water quality within the watershed was also collected.

Subtask 3.2: Inventory and Summarizing Data

Data collected during subtask 3.1 was inventoried by the TWRI and summarized to be used in the Surface Water Quality Monitoring Information System (SWQMIS).

Task 4: Supplemental Monitoring for Watershed Characterization

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

Subtask 4.1: Site Selection

TWRI conducted sampling site reconnaissance to determine the suitability of sample collection that will best help characterize the watershed. Once site selection was finalized, a Station Location request (SLOC request) was submitted to the TCEQ for official station numbers.

Subtask 4.2: Water Quality Monitoring

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

Subtask 4.3: 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.

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 Pond Creek watershed.

The additional surface water quality data 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 two AUs for the Pond Creek 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 1242F_01 along Pond Creek was first listed as impaired due to elevated levels of bacteria in 2010, according to the *2022 Texas Integrated Report* and *303(d) List* (TCEQ 2020). The AU 1242F_02 is not impaired and currently does not have any concerns listed in the *Texas Integrated Report.*

There are two monitoring stations within the Pond Creek watershed that are used in this project. Surface water quality monitoring (SWQM) stations 22204 and 16406 (Figure 1). Both stations are located in the impaired AU. There is only historical water quality data for station 16406 (Figure 2). The two stations used in this project were monitored monthly for field parameters such as temperature, dissolved oxygen [DO], specific conductance, and pH. Additionally, flow rate was monitored, and water samples from stations were analyzed for *E. coli* concentration data.

Texas Surface Water Quality Standards

Water quality standards are established by the state and approved by the U.S. Environmental Protection Agency (EPA) to define a water body's ability to support its designated uses, which may include aquatic life use (fish, shellfish, and wildlife protection and propagation), primary contact recreation (swimming), public water supply, and fish consumption. Water quality indicators for these uses include DO (aquatic life use), *Escherichia coli* (primary contact recreation), pH, temperature, and total dissolved solids; Table 7; TCEQ 2022).

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 1242F_01 along Pond Creek is listed in the *2022 Texas Integrated Report* due to elevated indicator bacteria (TCEQ 2022). This listing is based on the geometric mean value from bacteria samples collected at monitoring stations. The AU was first listed in 2010 and remains listed in the most recent report. It contains both SWQM monitoring stations 16406 and 22204. Although there was a pause data collection at station 16406 from 2008-2105, bacteria levels remain consistent throughout the last two decades (Figure 2). There is no historical data for station 22204 before the TWRI-led project was conducted because this site was selected for this project to help better characterize the watershed.

For water quality data collected over the course of the TWRI-led Pond Creek watershed monitoring project, the rolling geomean calculated shows that bacteria levels at station 16406 and 22204 remain over the recreation standards (Figure 3: Table 1). However, station 22204 has a geomean slightly closer to meeting the standards but still over the desired criterion.

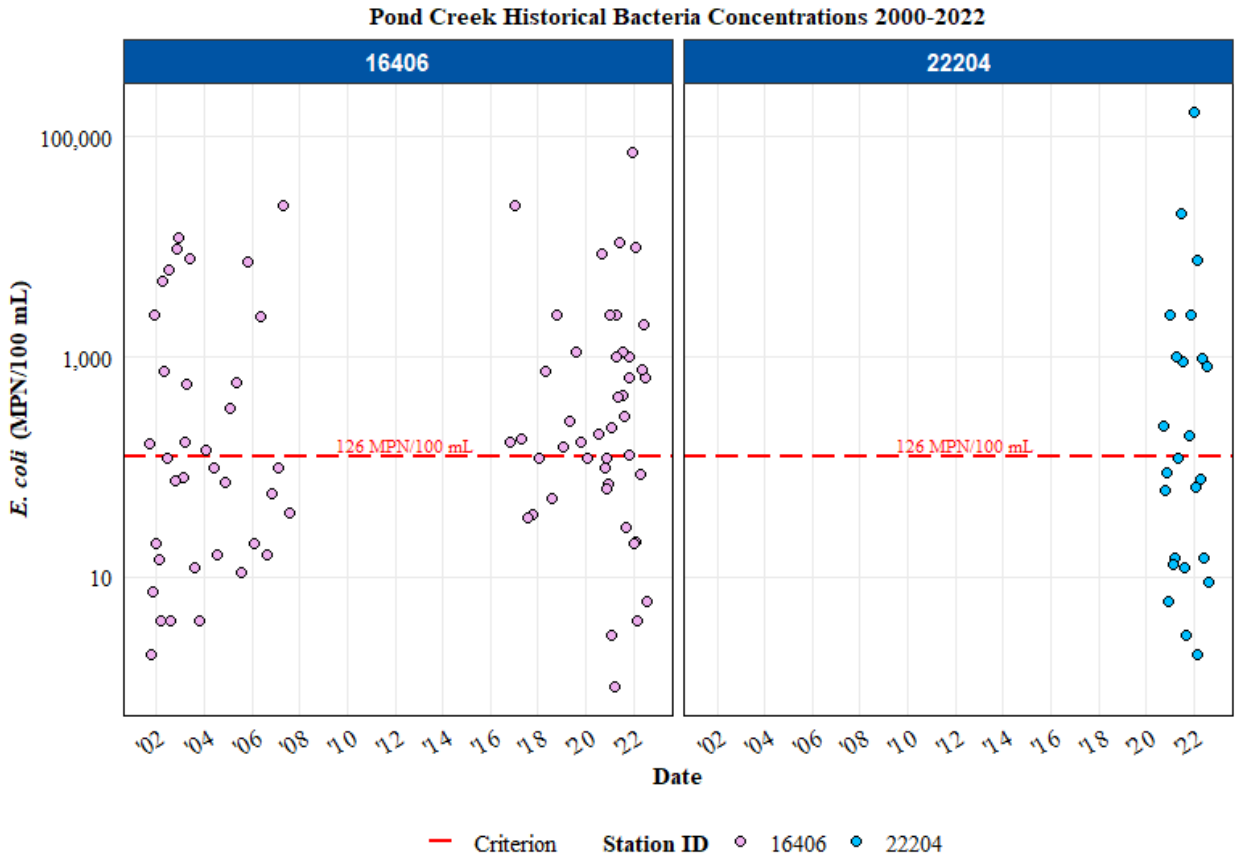

Figure 2. Historical *E. coli* concentrations at SWQM monitoring stations along Pond Creek. Monitoring was halted from 2008 to 2015 in station 16406 and continued again in 2016. Monitoring at station 22204 began with this project in 2020.

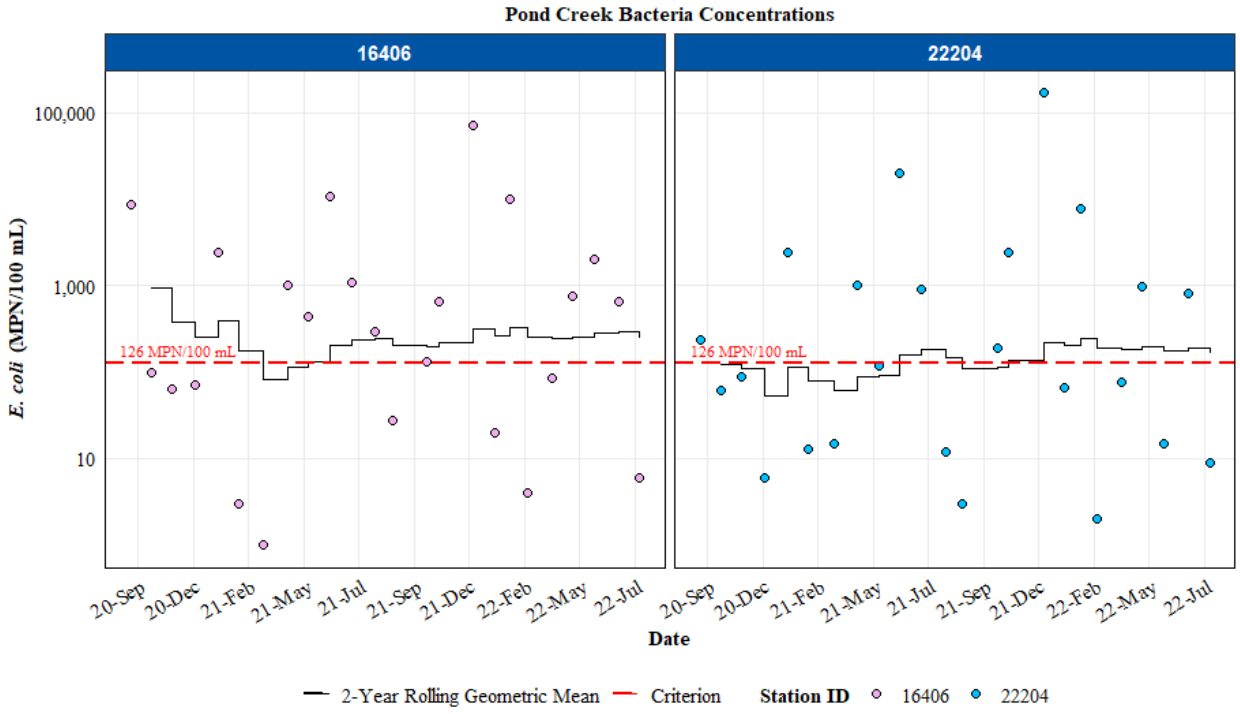

Figure 3. *E. coli* concentrations over the project monitoring period at SWQM stations 16406 and 22204.

Table 1. *E. coli* results over the course of the project at SWQM monitoring stations 22204 and 16406. All highlighted cells are exceeding 126 MPN/100mL, the maximum criterion for recreational bacteria.

Date	Station 16406 [MPN/100 mL]	Station 22204 [MPN/100 mL]
2020-09-10	8700	240
2020-10-08	99	61
2020-11-05	64	88
2020-12-07	71	6
2021-01-07	2400	2400
2021-02-03	3	13
2021-03-10	<1	15
2021-04-12	1000	1000
2021-05-10	440	120
2021-06-08	11000	20000
2021-07-07	1100	920
2021-08-09	290	12
2021-09-01	28	3
2021-10-18	130	190
2021-11-03	650	2400

Date	Station 16406 [MPN/100 mL]	Station 22204 [MPN/100 mL]
2021-12-20	73000	170000
2022-01-18	20	66
2022-02-08	9900	7700
2022-03-03	4	2
2022-04-05	86	77
2022-05-03	770	980
2022-06-02	2000	15
2022-07-06	650	820
2022-08-03	6	9

Dissolved Oxygen

Dissolved oxygen (DO) is used to determine a water body's aquatic life uses. This is a metric used to 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 plants 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*, Pond Creek lists no concerns for DO because measured DO is fully supporting water quality standards. All historical data from ambient field monitoring are shown in Figure 4. While sampling for station 16406 was halted from 2008 to 2015, there are at least twelve years of water quality data at this station. Out of this historical data, only one point in 2019 approached the grab screening level of 3 mg/L. Similarly, in station 22204 all collected DO values are consistently over the criterion.

For water quality data collected over the course of the TWRI-led Pond Creek watershed monitoring project, the rolling geomean calculated shows that DO levels at station 16406 and 22204 are significantly higher than the grab screening criterion (Figure 5). Both stations show DO levels at satisfactory levels, indicating a potentially healthy aquatic ecosystem.

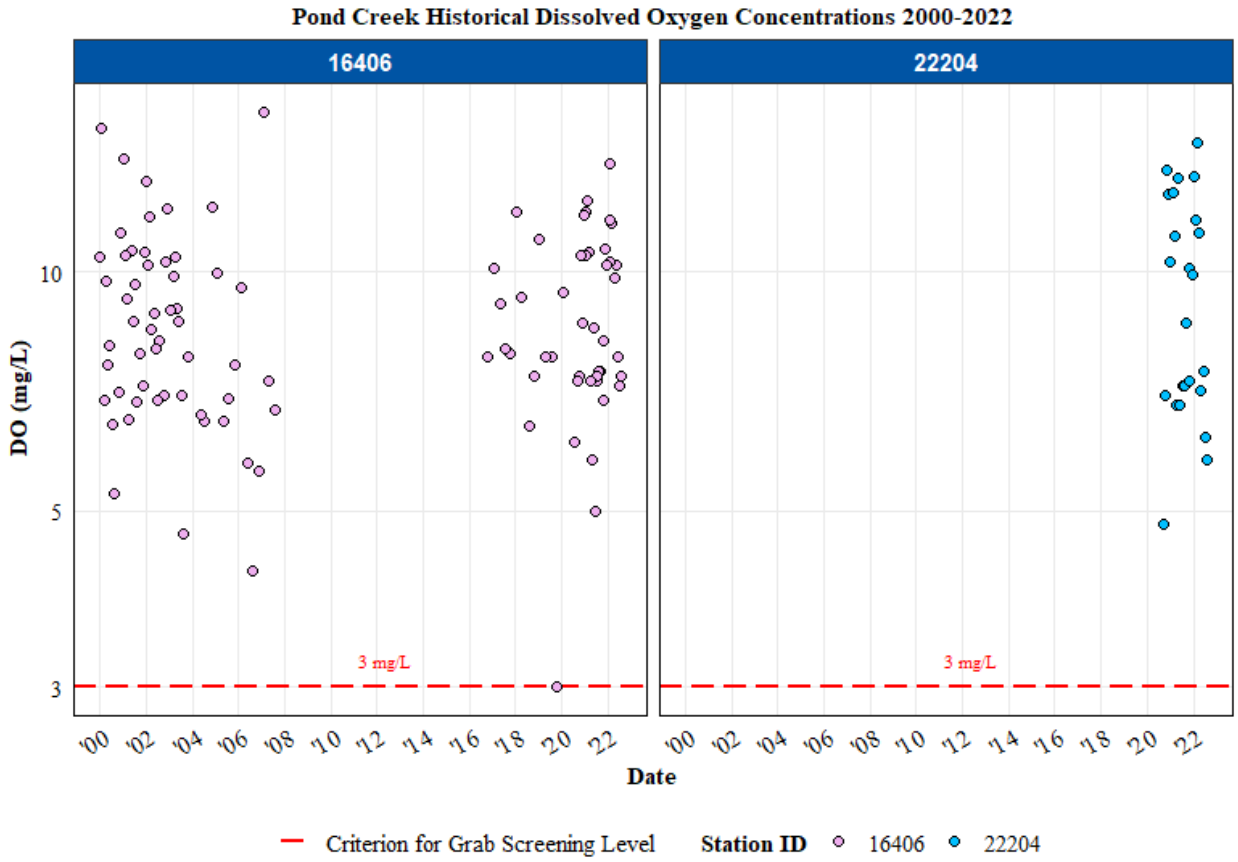

Figure 4. Historical DO concentrations at SWQM monitoring stations along Pond Creek. Monitoring was halted from 2008 to 2015 in station 16406 and continued again in 2016. Monitoring at station 22204 began with this project in 2020.

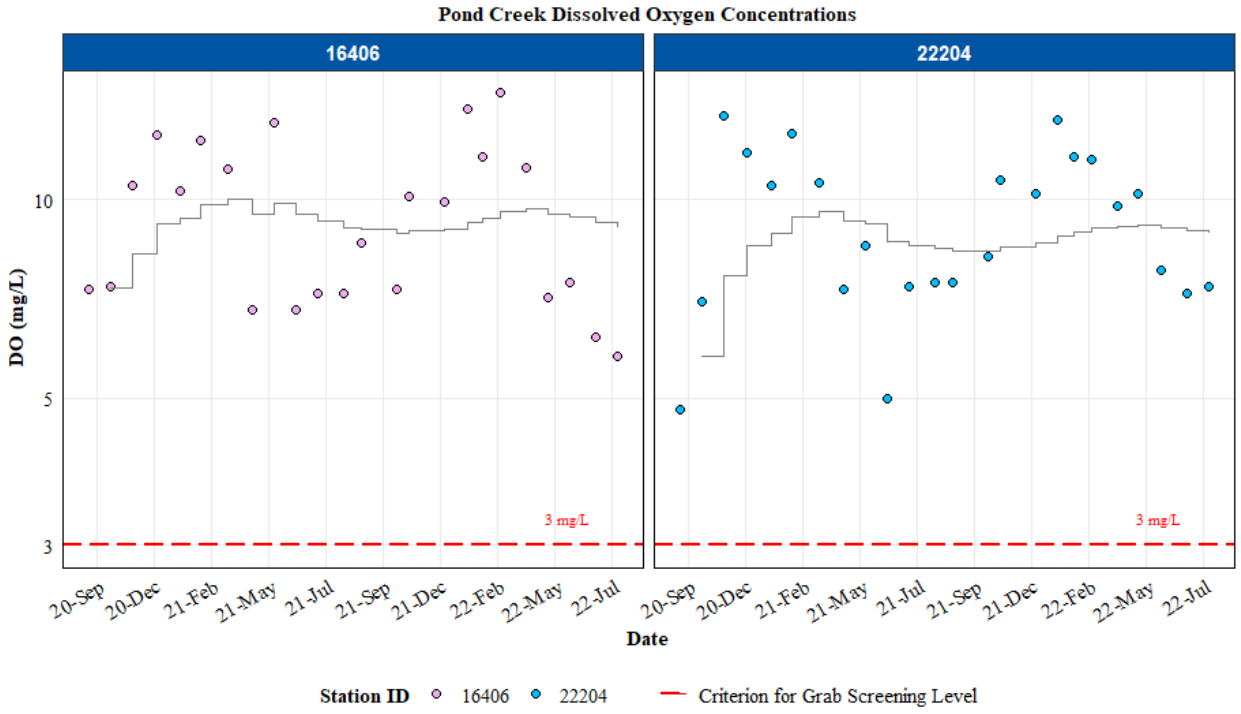

Figure 5. Dissolved Oxygen over the project monitoring period at SWQM stations 16406 and 22204.

Table 2. DO concentrations over the course of the TWRI led Pond Creek monitoring at SWQM monitoring stations 22204 and 16406. There is no exceedance of grab screening level criterion for DO.

Date	Station 16406 [mg/L]	Station 22204 [mg/L]
2020-09-10	7.3	4.8
2020-10-08	7.4	7
2020-11-05	10.5	13.4
2020-12-07	11.8	12.5
2021-01-07	10.5	10.3
2021-02-03	12.3	12.6
2021-03-10	10.6	11.1
2021-04-12	7.3	6.8
2021-05-10	8.5	13.1
2021-06-08	5	6.8
2021-07-07	7.4	7.2
2021-08-09	7.5	7.2
2021-09-01	7.5	8.6
2021-10-18	8.2	7.3
2021-11-03	10.7	10.1
2021-12-20	10.2	9.9

Date	Station 16406 [mg/L]	Station 22204 [mg/L]
2022-01-18	13.7	13.2
2022-02-08	11.6	11.6
2022-03-03	11.5	14.5
2022-04-05	9.8	11.2
2022-05-03	10.2	7.1
2022-06-02	7.8	7.5
2022-07-06	7.2	6.2
2022-08-03	7.4	5.8

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.

For water quality data collected over the course of the TWRI-led Pond Creek watershed monitoring project instantaneous flow was collected at SWQM sites 16406 and 22204 (Table 3). This data was then averaged by month (Figure 7). The calculated monthly averages demonstrate a variable flow over the course of the project, with the highest flows occurring during June and December.

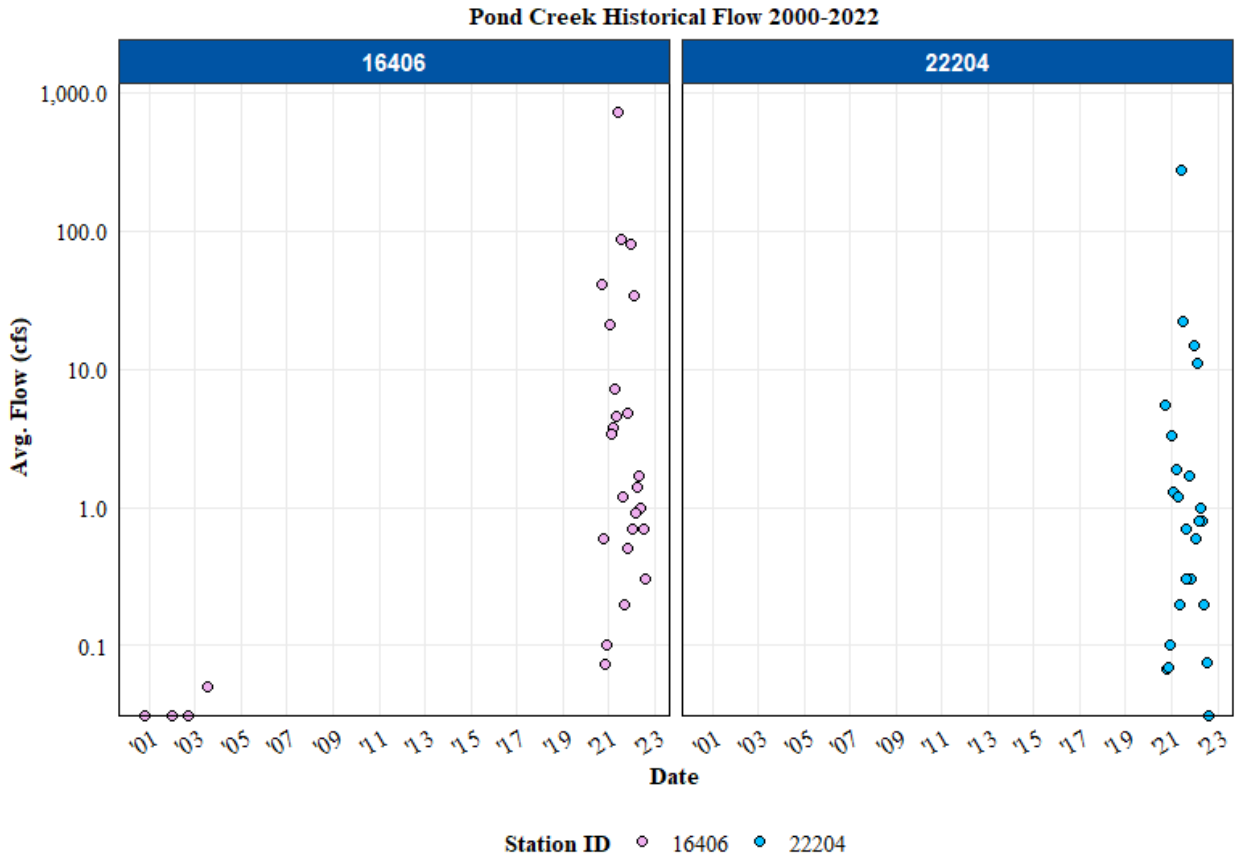

Figure 6. Historical flow in cubic feet per second at SWQM monitoring stations along Pond Creek. Monitoring was halted from 2008 to 2015 in station 16406 and continued again in 2016. Monitoring at station 22204 began with TWRI monitoring project in 2020.

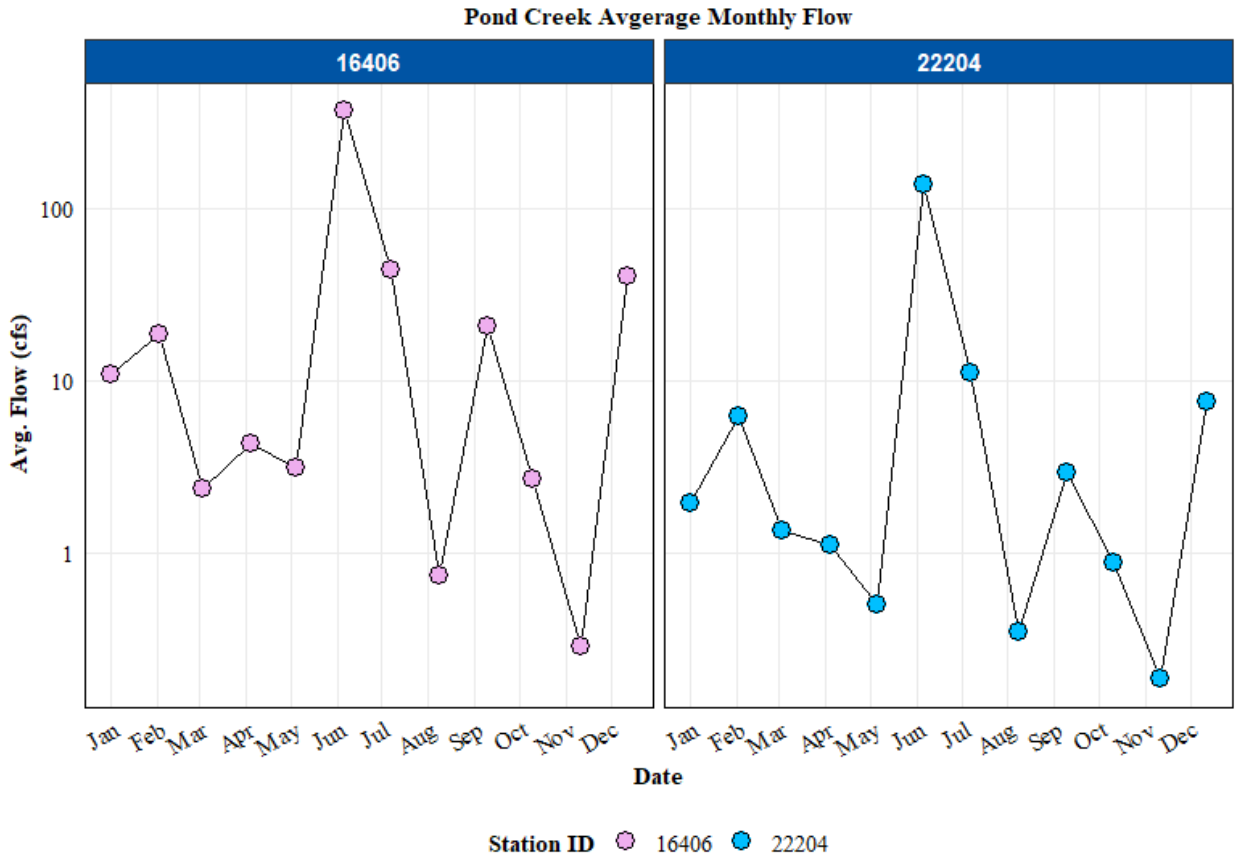

Figure 7. Flow in cubic feet per second at SWQM monitoring stations along Pond Creek throughout TWRI-led water monitoring from 2020 to 2022.

Table 3. Instantaneous stream flow over the course of the TWRI-led Pond Creek monitoring at SWQM stations 22204 and 16406

Date	Station 22204 [cfs]	Station 16406 [cfs]
2020-09-10	5.5	41
2020-10-08	0.068	0.6
2020-11-05	0.069	0.074
2020-12-07	0.1	0.1
2021-01-07	3.3	21
2021-02-03	1.3	3.4
2021-03-10	1.9	3.8
2021-04-12	1.2	7.2
2021-05-10	0.2	4.5
2021-06-08	274	731
2021-07-07	22	88
2021-08-09	0.7	1.2

Date	Station 22204 [cfs]	Station 16406 [cfs]
2021-09-01	0.3	0.2
2021-10-18	1.7	4.8
2021-11-03	0.3	0.5
2021-12-20	15	81
2022-01-18	0.6	0.7
2022-02-08	11	34
2022-03-03	0.8	0.9
2022-04-05	1	1.4
2022-05-03	0.8	1.7
2022-06-02	0.2	1
2022-07-06	0.076	0.705
2022-08-03	0	0.278

Data Conclusions

Continued monitoring of the Pond Creek 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 above the standard for impaired Pond Creek AU. The rolling geometric mean between 2020 and 2022 demonstrates that *E. coli* concentrations have been consistent in the last two years. Additional data may help pinpoint what is causing the elevated bacteria levels. In contrast, the DO concentration has remained above the criterion. The DO follows the historical data trend of satisfactory concentrations indicating a healthy aquatic ecosystem. Flow data collected is variable, as expected. With continued monitoring and data collection FDC s and LDCs can be built to better characterize the watershed.

References

TCEQ. 2019. Surface Water Quality Monitoring Data Management Reference Guide. July 2019. 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

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)