UPPER TRINITY RIVER WATER QUALITY REPORT CARD

Shedding Light on an Underutilized Regional Resource

ACKNOWLEDGMENTS

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Disclaimer: The data in this report is previously collected for the Upper Trinity River Basin for the time period between 2013 to 2019. It does not reflect the water quality of the sampled waterbodies at realtime. Users are advised to use real-time data relevant for recreational use of waterbodies.

1. EXECUTIVE SUMMARY

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This report presents the state of water quality within the Upper Trinity watershed to help users to be aware of their local conditions while experiencing the river. The report presents the analysis conducted by the Institute of Urban Studies (IUS) at UT Arlington to evaluate indicator bacteria levels in the Upper Trinity River Basin within the Dallas Fort Worth Region.

Trinity River segments, creeks and lakes within the Upper Trinity River Basin are gaining popularity for recreational activities like paddling, swimming, birding, volunteering, fishing and hiking. Yet there is no single platform that provides users information regarding the safety of the several freshwater recreational areas (river, creeks and lakes) the region offers. Given the increasing number of kayakers and paddlers, information about the water quality and its relationship to health risks is required. E. coli is considered as the primary indicator of the potential presence of pathogens in water, as per the Environmental Planning Agency (EPA). It is considered as the primary indicator for permitting and grading of recreational use within natural water systems in the state of Texas. The aim of the report is to understand the current state of the water quality within DFW region using existing data from the Texas Commission of Environmental Quality (TCEQ) and other local agencies.

- Perform initial analysis to study and represent E. coli data availability, gaps and geographic distribution of data within the DFW region.
- Upper Trinity Watershed Grades and Compliance Rates maps and tables for short term (2019-2013) like the Mystic River Watershed Report Card.
- Upper Trinity River E. coli analysis for Geometric Mean and Median for the short term (2019-2013) for the monitoring stations with the DFW region.
- Comparison of the grades and compliance rates with Recreational Use analysis done by other agencies for the study area

To analyze and present the current state of the water quality, this report has developed a methodology similar to the EPA Mystic River Report Card. The EPA Mystic River report card has a single goal, to understand the safety of the river for recreational use. Using E. coli as the parameter for measuring recreational use suitability of a water-body, this report card presents the results as a compliance rate as percentage of days that a water-body is swimmable and a grade system for major water-bodies in the study area.

A total of 98 monitoring stations located in water-bodies across the study area were analyzed for this report card. Instead of a single grade for the entire watershed, the resulting map in Figure 1 issues grades for each segment of the Trinity river, individual lakes and creek segments. The water quality in the Upper Trinity River is comparable to other urbanized watersheds, including the Mystic River and Charles River. Most of the Upper Trinity River is performing better than the Mystic River. The data shows us that the water in the lake systems across the DFW metroplex is clean for swimming and boating, throughout the year. Parts of the main Trinity River which includes the Elm Fork and the West Fork segments are swimmable for 75 to 80 percent of the times, in a year. Though, many areas of the region, including parts of the Trinity river and creeks, do not support swimming, boating or fishing as required by the Clean Water Act, due to high levels of bacteria. This report aims to present complex data in an easy-to-understand, user-friendly metric to help create a road map for improving the water quality and increasing the involvement of local, regional entities as well as everyday users, to make Trinity River system an integral part of our region's outdoor experience.

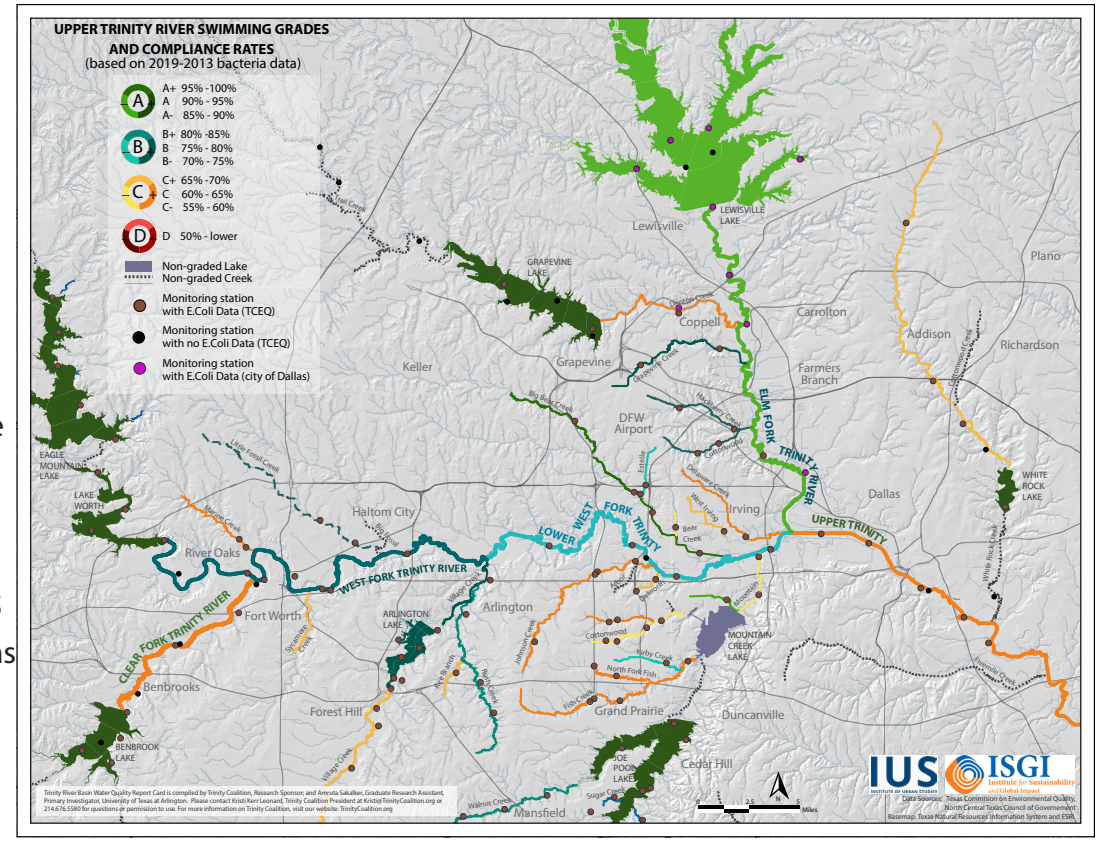


Figure 1 : Map of the Upper Trinity River swimming grades and compliance rates as per E. coli counts for 2013 to 2019 data.

The future steps beyond this report card are, to understand and present the seasonality of the water quality in the Upper Trinity River system. Analyzing the seasonality of E. coli numbers in the water will help to present the best and safest times of the year for swimmers, kayakers and other users to interact with the water-bodies. It will also help to analyze the relationship of non-point pollutants locations and the built-environment' with the water quality. The development of the report card, as a dependable metric for users and stewards, rests upon the collaborations between local and regional agencies. Collaborations will help inform the current state of the upper Trinity watershed as well as address and inform the future of this important natural asset within our region.

2. INTRODUCTION

2. Introduction

2.1 Trinity River and the Dallas Fort Worth Region

Trinity River is one of the main rivers in the North Texas region. It is 710 miles long and has its entire watershed within the State of Texas. The river originates in the far North Texas from the Red River into four segments which spread across the North Texas region, joining into a single stream, few miles south of the Dallas County. The West Fork, the Clear Fork and the Elm Fork flow mainly through the Dallas Fort Worth Metroplex and confluence into a single stream near downtown Dallas. The fourth segment, the East Fork joins the river south of the Dallas County.

As indicated in figure 2, the Dallas Fort Worth (DFW) Metroplex located in the northern parts of the State, falls within the Upper Trinity River Basin and is the first dense urban region that the river encounters. The West Fork enters the region flowing through Eagle Mountain Lake, through Lake Worth and through the city of Fort Worth. It joins the Clear fork branch in Fort Worth, which flows from southeast through the Benbrook Lake toward downtown Fort Worth. These two segments join and flow from Fort Worth to Dallas, converging with the Elm Fork of the river near downtown Dallas. The Elm Fork branch originates in the east of Montague County, and flows south, entering the DFW Metroplex through Lewisville Lake to a confluence with the West Fork west of downtown Dallas. Ultimately merging as Trinity River, it flows south towards Houston, entering the Trinity Bay, west of the city of Anahuac.

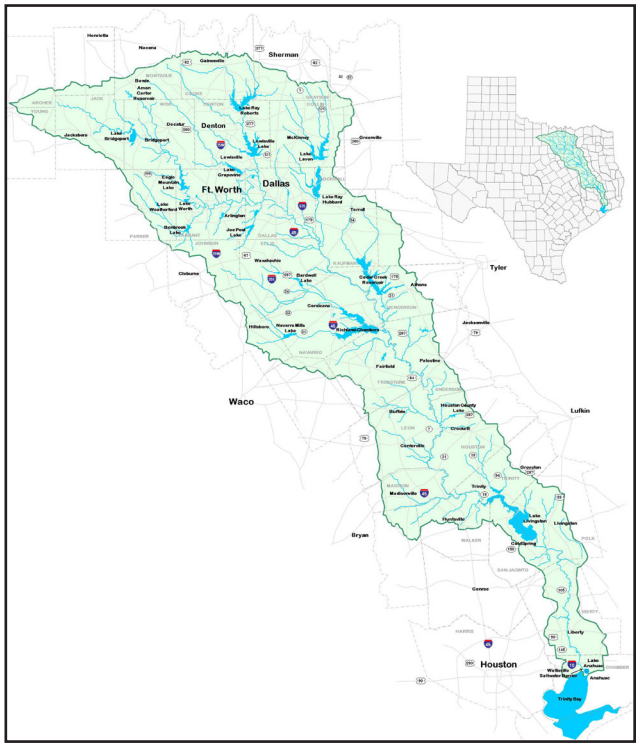


Figure 2 : Location of DFW Metroplex within the Trinity River Basin and watershed within the region.
Source: Trinity Coalition

The Dallas Fort Worth Metroplex encompasses 11 Counties and 10 principal cities. Trinity River, the creeks and the lakes within the DFW metroplex form an important ecological breather for the rapidly growing and urbanizing metroplex. The Upper Trinity River mainly flows through a densely-populated rapidly urbanizing area, which negatively impacts the water quality and the environmental balance of the river. Also, as the river

flows through an urban area, it also becomes an important recreational outdoor oasis for the residents of the region to escape the urban densities and experience nature. This has resulted in an increasing number of residents accessing the river and its adjacent spaces for recreation. Parks, trails, nature preserves, and paddling trails are few of the ways in which residents continue to interact with the river. Considering the growing importance of the river within the region, stewards of all the water bodies within the region are important people and organizations to help understand the best ways to interact with the river and the land around it.

2.2 Study Partnership

Trinity Coalition in Dallas has partnered with the Institute of Urban Studies (IUS)and the Office of Sustainability at the University of Texas at Arlington to create a water quality report card for Trinity River within the DFW region. IUS is an urban research and service organization within the University of Texas at Arlington (UTA) that consists of graduate and doctoral students with diverse backgrounds within the College of Architecture, Planning, and Public Administration (CAPPA), as well as other university departments. This report responds to Trinity Coalition's intent to better understand the current state of the water quality within DFW using existing data available with Texas Commission of Environmental Quality (TCEQ), North Central Texas Council of Governments (NCTCOG) and the Texas River Authority (TRA).

Figure 3 : Trinity Coalition Paddling Trail Map with locations of launch sites, Trinity River and parks adjacent to the river. Source: Trinity Coalition

Trinity Coalition is a nature-oriented not-for-profit, based in Dallas, Texas and is registered as a Texas corporation. Its mission is "to transform the Trinity River corridor into a nationally-recognized conservation and recreation area" (Trinity Coalition, n.d.). As indicated in the Figure 3, there are 21 existing canoe launches, within the 130-mil-long Trinity River Paddling Trail, under Trinity Coalition. Other parties involved in creating this project were, NCTCOG, TCEQ and TRA. NCTCOG helped in reaching out to other regional and local entities for data and inputs during various stages of the project.

2.3 Significance of creating the Upper Trinity Report Card

Trinity River segments, creeks and lakes within the Upper Trinity River Basin are gaining popularity for recreational activities like paddling, swimming, birding, volunteering, fishing and hiking. Yet there is no single platform that provides users information regarding the safety of the several freshwater recreational areas (Trinity river, creeks and lakes) the region offers. There is also a deficiency of water quality data for few of the critical freshwater areas within the watershed. These deficiencies have resulted in limiting information about the potential public health risks associated with recreating in the region's water bodies. Given the increasing number of kayakers and paddlers in the river, information about the water quality and its relationship to the health risks is required. While also providing the details about when the river is safe for performing such activities.

Figure 4 : Images of kayakers paddling in the Trinity River across DFW Metroplex. Source: Trinity Coalition

To ensure that users are made aware of the water quality, an easy-to-understand, user-friendly metric that can be regularly communicated to the public will be helpful. Currently, users must look for water quality data at various places, ranging from local municipalities to regional agencies, who may choose to not share relevant water quality stats consistently. This report synthesizes complex, un-edited water quality data, currently available for the regional fresh water-bodies, in a user-friendly grades and compliance percentage metric.

E. coli data as tables and charts are available for major water bodies in the study area. Under Sections 305(b) and 303(d) of the federal Clean Water Act, Texas Commission on Environmental Quality (TCEQ) recently completed the 2020 Texas Integrated Report for Surface Water Quality (Texas Commission for Environmental Quality, 2019). The report evaluates the status of water bodies within the Trinity River

Basin for multiple surface water quality parameters. Fitness of the water body for recreational use, use by aquatic life and other attributes, at the segment level of each water body. Though this report provides the details at the appropriate scale of each water-body, it does not provide the ease-to-understand, graphical and locational details, necessary for communicating these details to all users.

Whereas, the Upper Trinity River Water Quality Report Card presents the geographic and temporal details of individual water bodies while making it comprehensible for users. It also shows which parts of the rivers, creeks and lakes are safe places to swim, as per data. While demonstrating the need for much work that lies ahead to meet the Clean Water Act Standards for the water bodies within the DFW region.

Thus, this report card is significant for presenting water quality data that is critical for recreational use of the Upper Trinity River in a user-friendly metric, at the desegregated scale of each water body. This will help understand the presence of geographic and temporal gaps in water quality data within the study area. It will provide a road-map to develop the necessary tools and data, to improve water quality data, increase the awareness about the river and increase involvement of local and regional entities.

2.4 Project Scope and Deliverables

The scope of the project is to create a water quality report card for the Upper Trinity River Basin within the DFW region. It aims to understand the current state of the water quality within DFW region using existing data with the Texas Commission of Environmental Quality (TCEQ). To achieve scope, following deliverables are submitted in this report:

- Perform initial analysis to study & represent E. coli data availability, gaps and geographic distribution of data within the DFW region.
- Upper Trinity River Grades and Compliance Rates maps and tables for short term (2019-2013) like the Mystic River Watershed Report.
- Upper Trinity River E.coli analysis for Geometric Mean and Median for the short term (2019-2013) for the monitoring stations with the DFW region.
- Comparison of the grades and compliance rates with Recreational Use analysis done by other agencies for the study area.

2.5 Recreational use of the river and what matters

Rivers have been and continue to be extensively used for recreational activities. Examples of activities that take place within water-bodies

are swimming, boating, fishing and kayaking. Whereas, there are other activities that take place within the vicinity of a water body like, hiking, bird watching, volunteering and biking. These activities make natural water bodies important places for people to gather, socialize and indulge in outdoor activities (ORD US EPA, n.d.). Even without being aware of the water quality, people tend to participate in one or many of the above-mentioned recreational activities, making it necessary to understand the attributes of a water body that are critical for safe and healthy recreational use.

EPA has determined that pathogens and chemical contaminants that are harmful to human health. Recreational use of any water body is permitted based on the standards set for those pathogens. People can get mildly or fatally effected by exposure to the pathogens through skin contact or swallowing the water. The amount of bacteria in the surface water tends to increase due to non-point source runoff. While waterfowl and habitats can contribute to the bacterial runoff, freshwater outlets through storm drains have been studied as high bacterial contaminators. The level on fecal coliform and enterococcal bacteria are used as indicator of the likelihood of presence of pathogenic organisms in the water. The level of such pathogens has been correlated to illness incidences in swimmers. Users exposed to these pathogens can contract stomach flu and other infections. Escherichia coli or E. coli is a subgroup of fecal coliform bacteria that is present in the intestinal tracts and feces of warm blooded animals. It is used as an indicator of the potential presence of pathogens (Texas Administrative Code, 30, §307.3). This demonstrates the need to measure E. coli in the water bodies that are used for swimming and kayaking is necessary.

The Texas Surface Water Quality Standards are codified in Title 30, Chapter 307 of the Texas Administrative Code, as per the Clean Water Act and the Texas Water Code. The state standards specify the recreational use attainability on the basis of physical, biological and chemical characteristics of a water body. The number of E. coli in the water sample is used as the chemical determinant for recreational use attainability. Section 3.1 of the report provides the details for the specified E. coli standards as the State of Texas.

2.6 The Study Area

The study area for this report consists of water-bodies within the DFW metroplex. The Upper Trinity River Basin is the river system flows through this region. As shown in figure XX, Trinity River in this region is formed through four main segments. The Clear Fork segment flows between downtown Fort Worth and the Benbrook Dam. The West Fork segment runs east-west between Dallas and Fort Worth and consists of the Lower West Fork Trinity segment and the West Fork Trinity segment. The Elm Fork segment flows between downtown Dallas to the north towards the Lewisville Lake. Lastly, the main Upper Trinity segment converges in downtown Dallas with the other

segments and flows downstream towards Houston, Texas.

Apart from the Trinity river segments, the Upper Trinity River Basin consists of nine big and small lakes within the study area. Lewisville lake and Grapevine lake are in the north of the Elm Fork branch and north of Dallas. Mountain Creek and Joe Pool Lake are in the south-west of Dallas. White Rock Lake is in the eastern parts of the city of Dallas. Arlington Lake is in the city of Arlington. Eagle Mountain Lake and Lake Worth are located north-west of the city of Fort Worth and Benbrook Lake is in its south-west. The Upper Trinity River Basin consists of multiple creeks. All creeks are freshwater streams within the region.

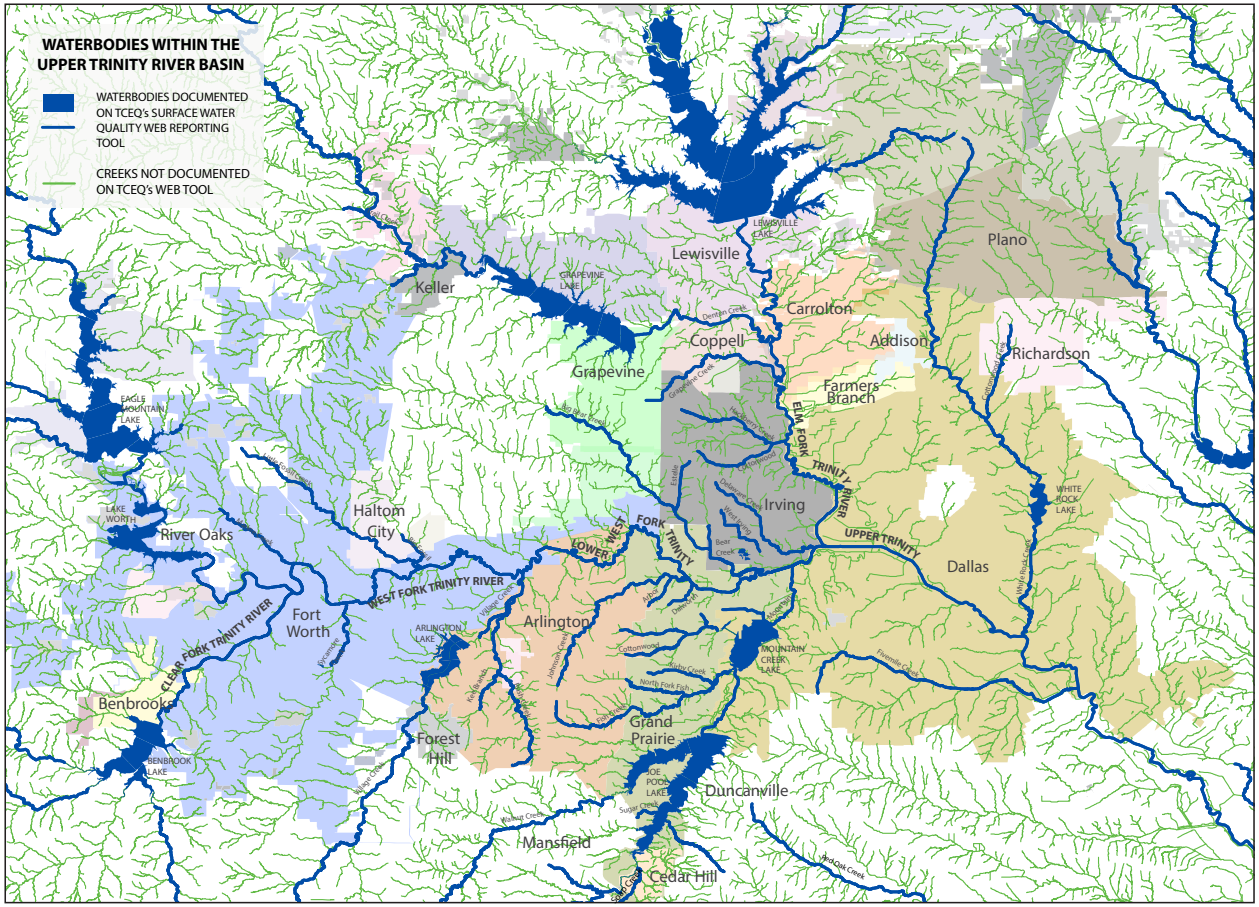
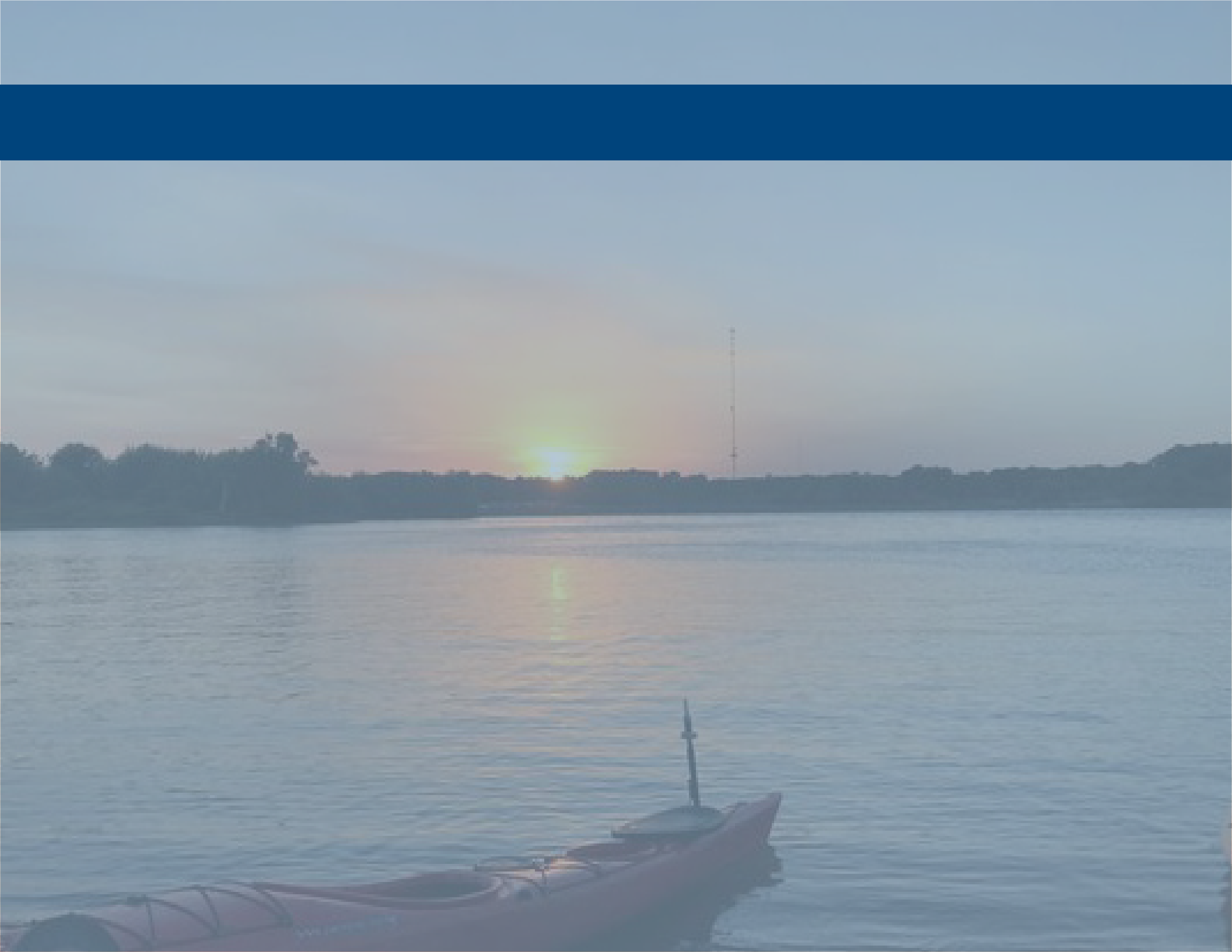


Figure 5 : Map documenting the water-bodies (river segments, lakes and creeks) within the Upper Trinity River Basin. Data sources for the map: TNRIS and TCEQ

The study area and the water-bodies for this report are outlined based on the kayak launch site locations provided by Trinity Coalition. It is also dependent on the E. coli Data availability for the water-bodies in the region. TCEQ's Surface Water Quality Web Reporting Tool provides E. coli data for some of the water bodies in the region. For this report, only those water-bodies that have data on the TCEQ tool have been analyzed. In Figure 4, the water-bodies in blue are those river segments, lakes and creeks with data available on the TCEQ website. Whereas, the water-bodies in green are not documented under the TCEQ's tool. The creeks are mainly the water-bodies without data on the TCEQ website.



3. BACKGROUND

3. Background

3.1 Upper Trinity Watershed and Recreational Use Standards

The Trinity river, creeks and lakes in the study area fall within the Upper Trinity Watershed. Upper Trinity Watershed is completely within the State of Texas and follows the statutory Texas Water Codes of the State of Texas defined through the Texas Surface Water Quality Standards Code (Texas Surface Water Quality Standards, 2016).

Water quality standards for evaluating samples are based on the state of Texas, water quality criteria and designated Recreational Use category for water-bodies. Water-bodies are categorized as, Primary Contact Recreation 1 (PCR1), Primary Contact Recreation 2 (PCR 2), Secondary Contact Recreation 1 (SCR 1) and Secondary Contact Recreation 2 (SCR 2). TCEQ assigns each sampled water-body within the Upper Trinity River basin,a designated recreational use. All water quality standards must be followed as per the designated use of that water-body (Texas Surface Water Quality Standards, 2016). Appendix A of the same document also provides the list of all water-bodies within the Upper Trinity River Basin. As per this list, all river segments, creeks and lakes in the DFW Metroplex have the designated recreational use as PCR1.

Primary contact recreation (PCR1) is defined by the EPA and TCEQ as "1--Activities that are presumed to involve a significant risk of ingestion of water (e.g., wading by children, swimming, water skiing, diving, tubing, surfing, hand-fishing as defined by Texas Parks and Wildlife Code, §66.115, and the following whitewater activities: kayaking, canoing, and rafting)"(Texas Surface Water Quality Standards, 2016). Under this definition, all water-bodies within the DFW region must adhere to PCR1 water quality standards for fresh water type.

Type of Recreational Use Criteria	Parameter	Geometric Mean Criterion per 100 mL	Single Sample Criterion per 100 mL
Primary Contact Recreation 1 (PCR 1)	E. coli	126	399
Secondary Contact Recreation 1 (SCR1)	E. coli	630	____
Secondary Contact Recreation 2 (SCR2)	E. coli	1030	___

Table 1: The numeric criteria for each standard and parameter as defined by the State of Texas

Hence, the boating and swimming standards for all water-bodies in the study area have to follow the PCR1 category. As documented in Table 1, the E. coli geometric mean criterion is 126 counts per 100 ml. The single sample criterion for PCR1 water-bodies is 399 per 100 ml. This standard is used through this report to analyze what percentage of samples of a water-body for the given time period is below the single sample criterion. The examples in the next section demonstrate the methodologies that use single sample criterion standard to calculate percentage of days the monitoring station samples are within the acceptable standards for primary contact use like swimming.

3.2 Examples of Watershed Report Cards and their methodologies to study the health of rivers

Watershed stewards nationally have been using report card formats to represent complex data into easily comprehensible grades. Complex data that evaluates the state of water-bodies for topics ranging from health of ecosystem, water supply, flood control and risk reduction, transportation, economy and recreational use, are represented through report-card-based grading systems. Here are a few important examples of such report cards, on what they reported and how their reporting is used by various stakeholders.

America's Watershed Report Card is developed by the America's Watershed Initiative to measure and represent the state of watersheds in 31 states nationally. It measures the watersheds for six broad goals, using data and relevant information recommended by a panel of experts. The scoring from each goal is synthesized and represented through a grade wheel, as shown in the figure 6 example of the Arkansas River and Red River Report. The report grades a total of 17 indicators related to the health of a watershed under the larger 6 goals. For example, Ecosystem well-being is graded through water quality, living resources, stream side habitat and wetland area change. The goals of the project and the grading system is to find solutions for the

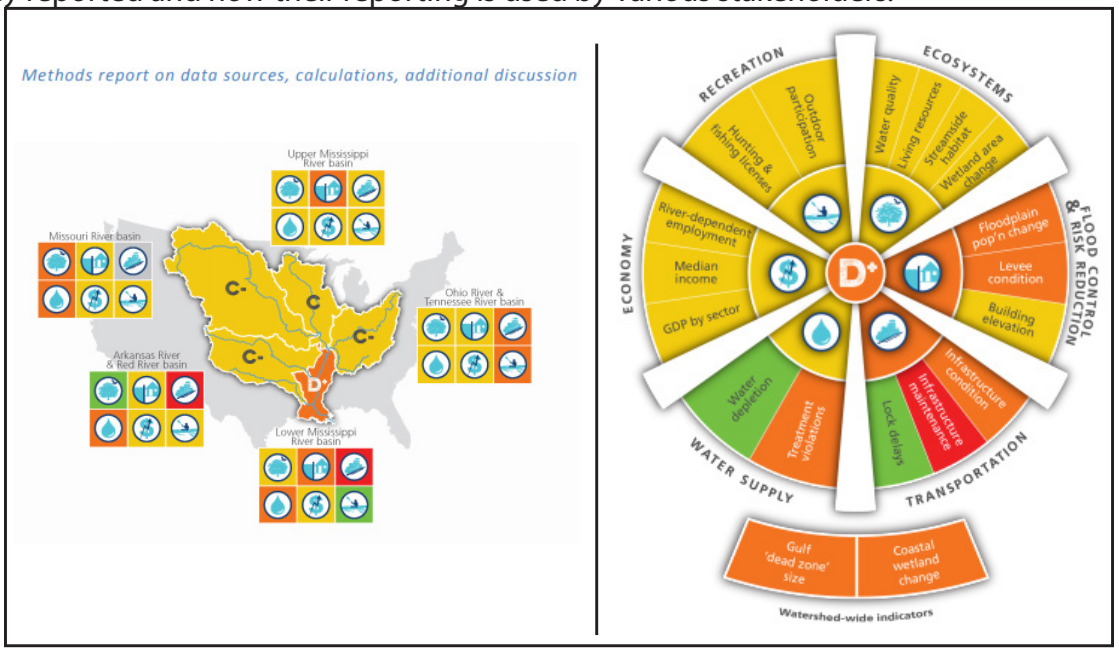


Figure 6 : America's Watershed Initiative Report Card, examples of the grading indicators and graphics. Source: www.americaswatershed.org

issues and sources that lower the grades of the watershed. It also aims to create a shared vision. The graded system helps to visualize the different parameters of each indicator on the same platform, making it easier to evaluate multiple aspects that affect water quality.

Similarly, the 2018 Galveston Bay Report Card created by the Houston Advanced Research Center (HARC) and the Galveston Bay Foundation, grades scientific data related to 22 unique indicators. The report card provides information regarding recreation, food and storm protection to be able to inform users' everyday decisions and activities. The report addresses issues ranging from blue crab population to waterway trash and litter. As this report card has been made every year from 2015 to 2018, it also shows which indicators have been able to improve scores, through the increased involvement of local and regional entities.

Lastly, the results and indicators used in the Upper Trinity River Report Card document are similar to the third example, the EPA Mystic River Report Card. Like the Trinity River, the Mystic River watershed is also an urban water-body system of the main river, lakes and streams. The EPA Mystic River Report Card is created by the Mystic River Watershed Association, in collaboration with the US Environmental Protection Agency (EPA). The grades of the report are based on the frequency of the number of times the water-bodies in the Mystic river watershed meet bacteria standards for swimming and boating (Mystic River Watershed Association, n.d.). The

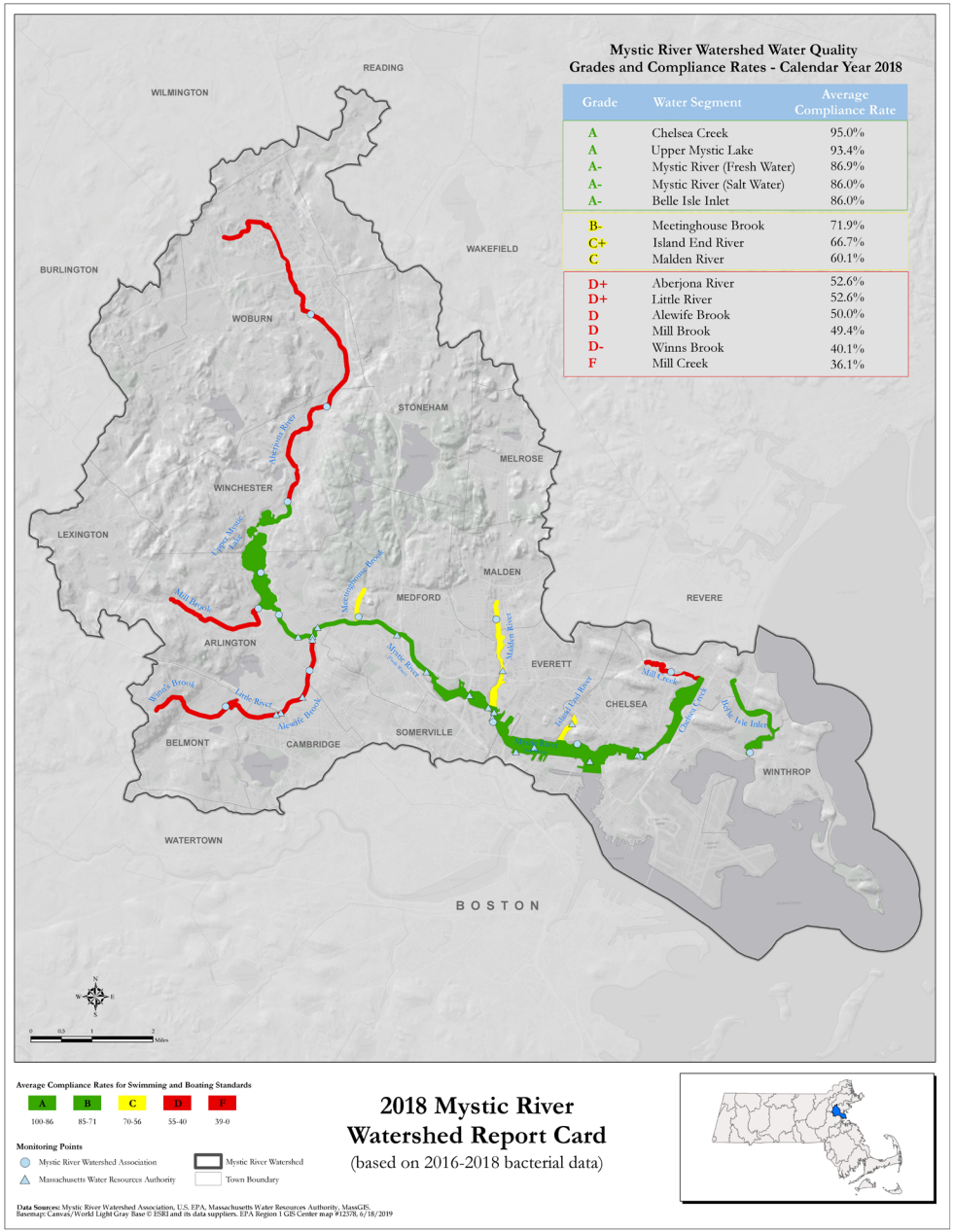


Figure 7: Mystic River Report Card Map with river graded as per the recreational use
Source: www.mysticriver.org/epa-grade

report uses the grade system to demonstrate that the Mystic River fairs well for boating, and the lakes fair well for swimming. Whereas the streams and creeks have high bacteria levels and mostly do not meet the water quality standard. The EPA press release of the report highlights the role of the report card to make people aware of the state of their local watershed, while bringing important governmental and environmental entities together to work towards the water quality improvement (OA US EPA, 2018). Stating the report card, the MassDEP Deputy Commissioner states that, "the work of local, state and federal governments and regional advocacy groups continues to have a positive impact on ester quality within the Mystic River system".

The three examples of watershed, bay and river report cards cited above were created by local and regional water stewards to provide scientific data to the public in more comparable and relatable system. They help to encourage people to further engage with the natural resource in their vicinity through an informed decision. Thus, ensuring that people are more aware of their everyday decisions and activities, as it impacts the water-bodies around them.

The Mystic River report card's methodology has a single goal to understand the safety of the river for recreational use. Similarly, the Upper Trinity River report card documented in this report has a similar goal. Only a single variable, E. coli counts in the surface water are studied in both report cards. The next section provides the description of the methodology developed for this report card.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4. DATA & METHODOLOGY

4. Data and Methodology

The state of Texas mandated E. coli standards are applied in this report card to evaluate the water-bodies for recreational use. TCEQ's Surface Water Quality Web Reporting Tool was the data source for all the data points in the report card. TCEQ's tool provides downloadable data made available at the monitoring stations levels, located within water-bodies across the state. Each monitoring station has data on multiple surface water quality indicators including, E. coli, Alkalinity, Carbon, Chloride, Nitrogen, and many others. For this report, only E. coli data was extracted, cleaned and analyzed. Figure 8 provides the geographic location of the monitoring stations located within the study area. All the monitoring stations in yellow have E. coli data on the TCEQ tool. Whereas the monitoring stations in red with an "x" symbology do not have E. coli data, but have data on other surface water quality indicators. As documented in the map, the TCEQ data is most inconsistent and missing in the northern parts of Elm Fork, near Lewisville lake. Though there are monitoring stations in this area, they do not sample for E.coli.

4.1 Geographic and Temporal distribution of data from TCEQ

The E. coli data distribution across the study area is patchy. All locations do not have data for the same time period. There is also a large difference in the number of samples at each monitoring station. Considering the inconsistence of the data availability, this report focuses on data for the past 7 years. Data from 2013 to 2019 is analyzed, similar to methodologies followed by other similar reports. Figure 9 shows the geographic and temporal distribution of the monitoring stations, mainly located in the main Trinity River segments and lakes. It does not document the data distribution for all the creeks in the study area. The color and size of the dot indicate the year since when the data has been collected for that station. Dark green color dots are monitoring stations with data starting from 2019, the latest year. The Lower West Fork and the Upper Trinity segment which flow downstream from downtown Dallas have the maximum number of stations with the most current data. Clear Fork and West Fork also have more than one monitoring stations with the most current data. Whereas Elm Fork, between Lewisville Lake and downtown Dallas has only one monitoring station with the most current data. Accordingly, only part of the Elm Fork segment can be analyzed for recreational use. The orange color dots indicate stations with data from 2018 and before. The three lakes West of Fort Worth are the ones under this category. Lastly, monitoring stations with data since before 2011 are indicated with red and have not been analyzed for this report.

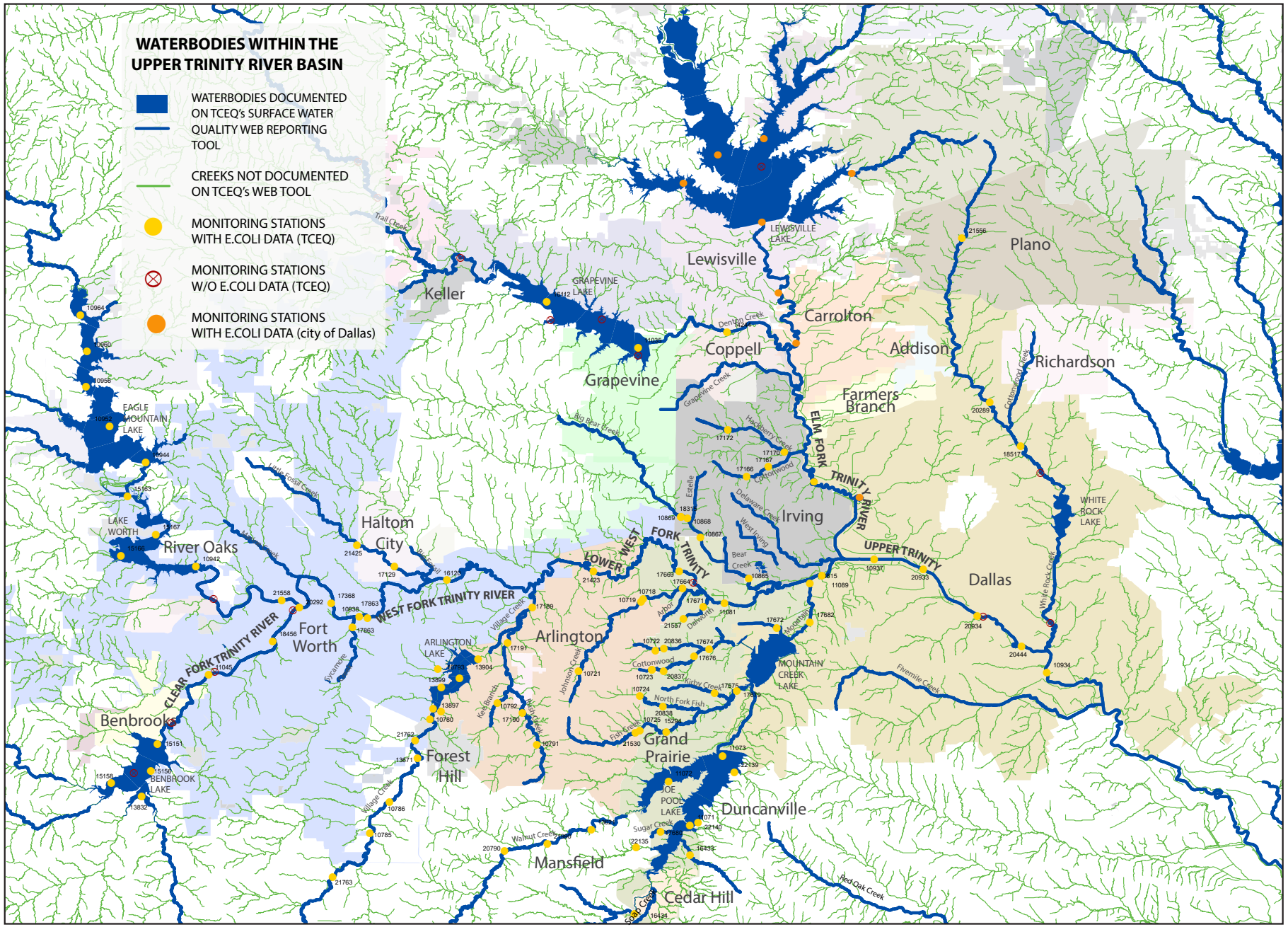
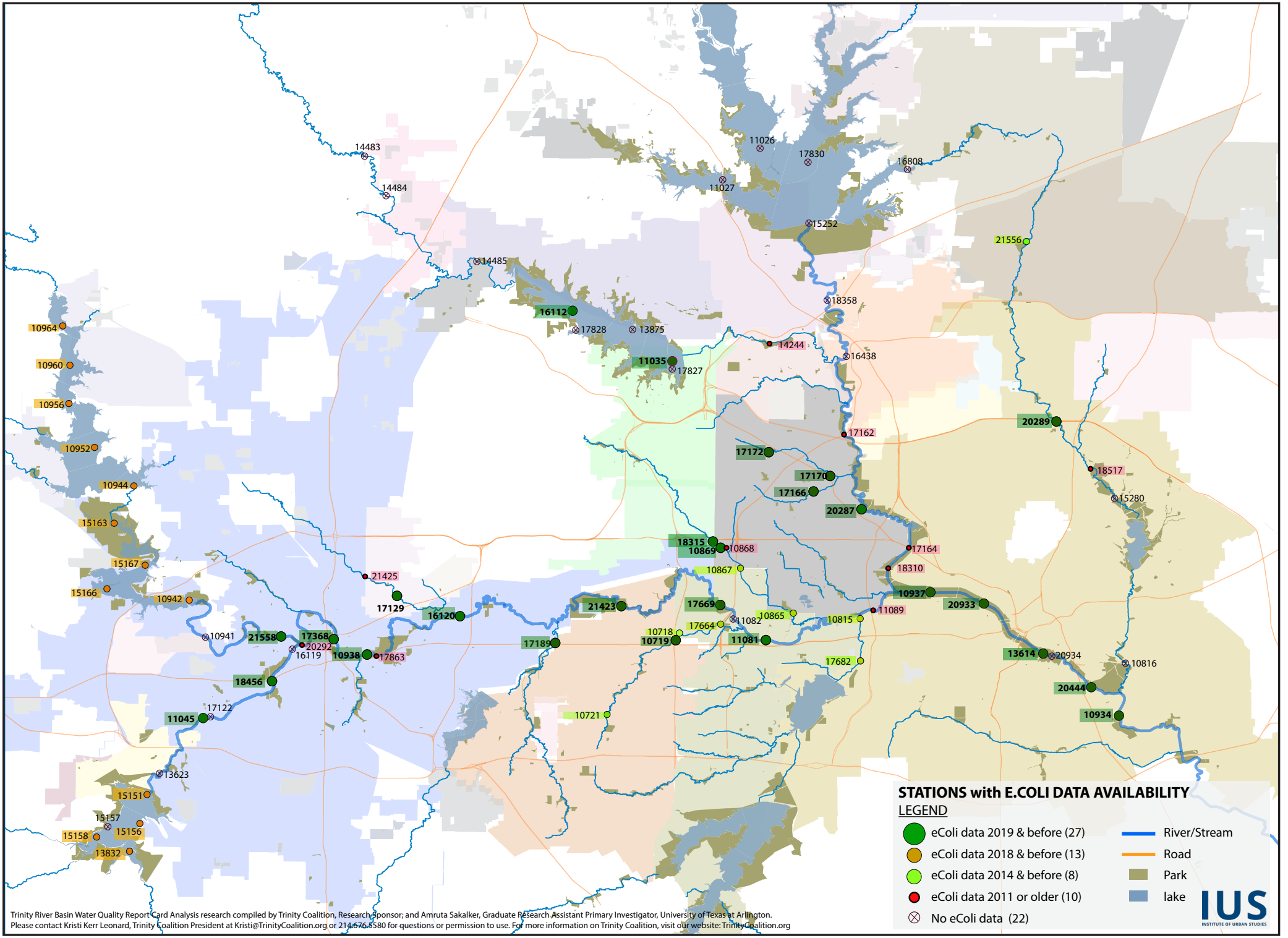


Figure 8 : Map showing the geographic location of the monitoring stations located within the study area.



Trinity River Basin Water Quality Report Card Analysis research compiled by Trinity Coalition, Research Sponsor; and Amruta Sakalker, Graduate Research Assistant Primary Investigator, University of Texas at Arlington.
Please contact Kristi Kerr Leonard, Trinity Coalition President at Kristi@TrinityCoalition.org or 214.676.5580 for questions or permission to use. For more information on Trinity Coalition, visit our website: TrinityCoalition.org

4.2 Summary of Available Data from TCEQ

The graphs in Figure 10, Figure 11 and Figure 12 show the numeric distribution of the samples available for each monitoring station. X-axis indicates the monitoring station numbers arranged as per the water-body to which they belong. Y-axis shows the number of cases available for each monitoring station, dating back to the year when data was recorded for the station. The horizontal yellow line at 28 cases indicates the minimum number of sample cases preferred by TCEQ for the seven years study period, 2013 to 2019. TCEQ provides this preference considering one sample per season, adding up to four samples each year and 28 samples for seven years. It is evident in the graphs that though 28 is the preferred number of cases, many locations do not adhere to this number and have lesser and a greater number of cases.

Figure10 is a graph for monitoring stations located within the five Trinity river segments in the study area. As observed in the map, Elm Fork has the least number of data points and data, with only one monitoring station with 26 E. coli data samples within the study period. Whereas, the Lower West Fork segment has three monitoring stations with E. coli data. One of the segment's monitoring station has 80 data samples, one sample for each month of the 7 years study period. Upper Trinity segment also good data. It has five monitoring stations with 26 data points for the study period. The total of 15 monitoring stations with E. coli data are within the Upper Trinity segments of the study area. These do not cover all critical areas of the river segments leaving geographic and temporal gaps in the data available for the main Trinity river segments.

Figure 11 is the graph for all monitoring stations located within the lakes in the Upper Trinity Basin. There are eight lakes in the study area. All lakes except Lewisville Lake have E. coli data for the study period. TCEQ tool does not have any data for Lewisville lake. Joe Lake has recently begun submitting surface water quality data to TCEQ. Hence, monitoring stations within Joe Pool lake have only six sample data collected in the past two years. Rest of the lakes have enough data, suitable for the analysis.

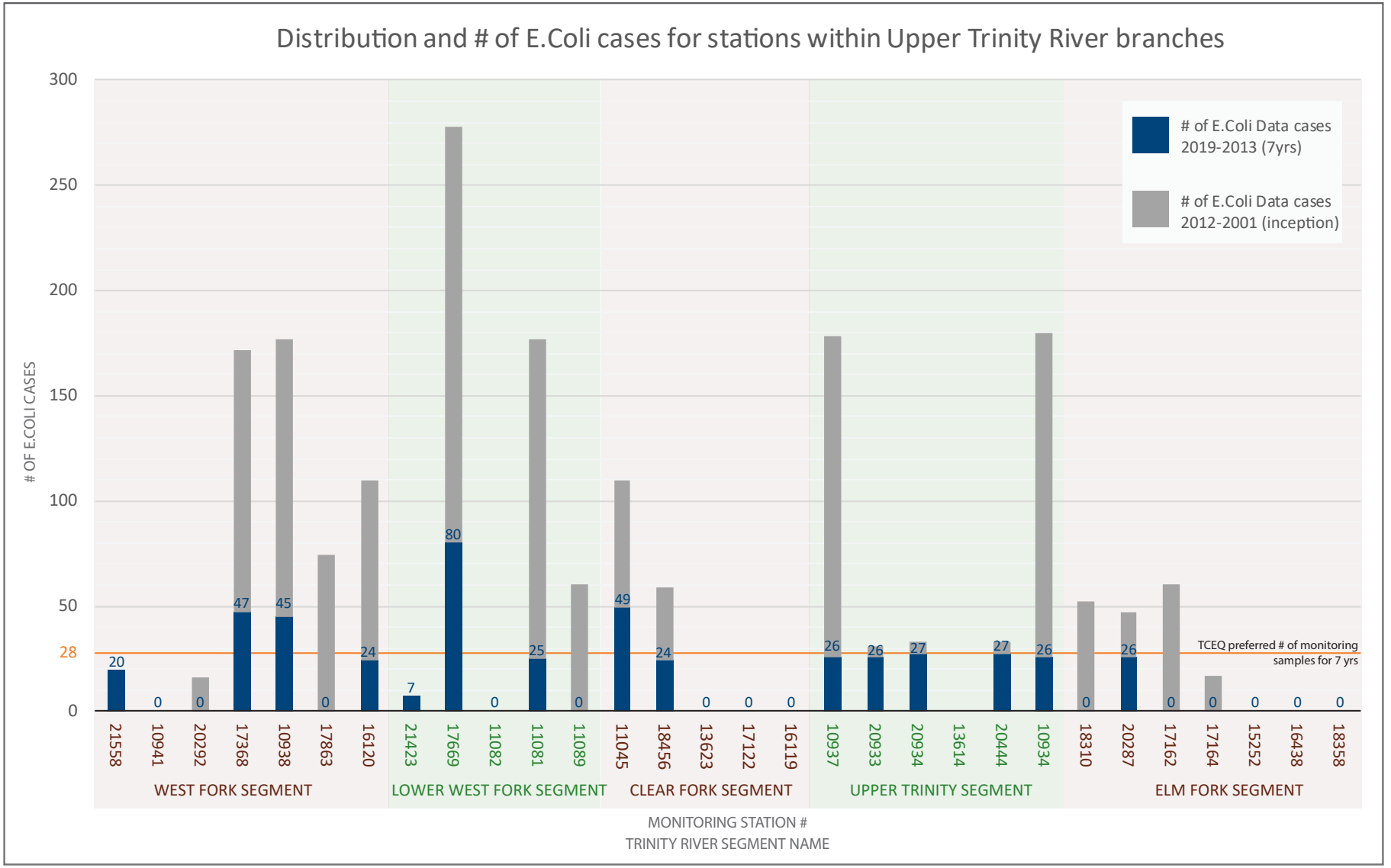


Figure 10: A graph of all TCEQ monitored stations with E. coli data within the five Trinity river segments in the study area.

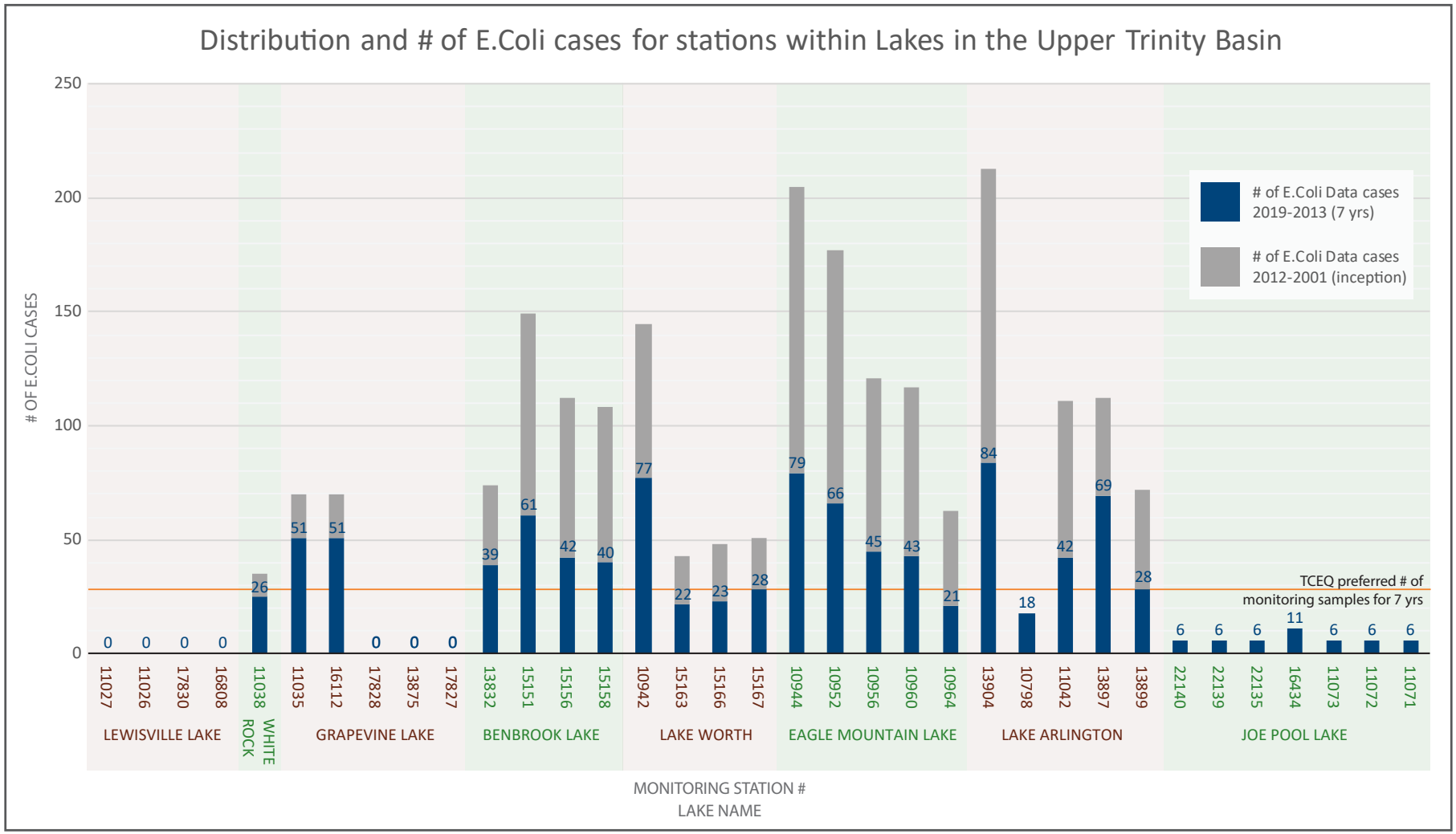


Figure 11 : Graph of all TCEQ monitoring stations E. coli data located within Upper Trinity lakes.

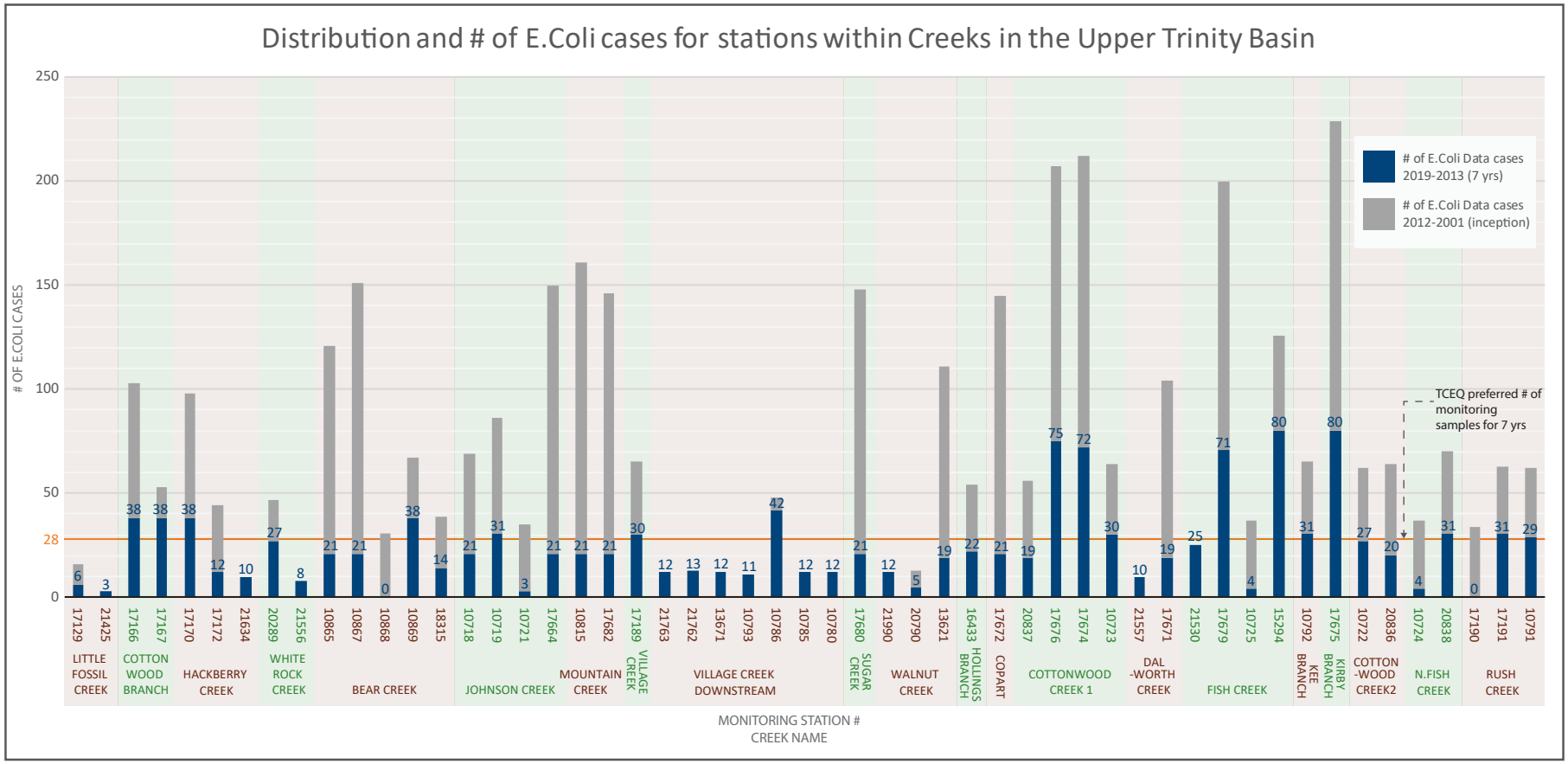


Figure 12 : Graph of all TCEQ monitoring stations E. coli data located within the creeks.

The distribution of E. coli data and monitoring stations located within creeks in the study area is recorded in figure 12. TCEQ data only covers major creeks within the study area. Most creeks documented above have at least 20 cases for at least one monitoring station.

4.3 Addressing the Data Availability Gap

A large portion of the Elm Fork, Lewisville Lake and other parts of the Trinity river did not have enough data. To address the data gaps in TCEQ's Online portal, local and regional governments within the DFW metroplex were contacted. The initial study of the data was presented to local and regional governments and stewards like the North Central Texas Council of Governments (NCTCOG), City of Dallas, City of Fort Worth, Tarrant Regional Water District and Trinity River Authority, and others. City of Dallas, city of Fort Worth and the Tarrant

Regional Water District responded back with data of monitoring stations for parts of the river that falls within their jurisdiction. Due to time constraints and scope of this phase of the project, only the data from the city of Dallas was included in the analysis.

City of Dallas provided E. coli data for monitoring stations located within Elm Fork and the Lewisville Lake from 2013 to summer of 2020. City of Dallas monitor's four stations within Elm Fork and four monitoring stations within Lewisville Lake. Each monitoring station has about 80 cases of E. coli data collected for the time period. This data is included in the analysis presented in chapter 5 of the report.

4.4 Analysis and Grading Methodology

This report follows a similar methodology to the EPA Mystic River report card (OA US EPA, 2018), as shown in Table 2. The Mystic River report card uses single sample criterion of 235 E.coli per 100 mL, as the swimming parameter standard and 1260 E. coli per 100 mL for as the boating standard, as specified by the state of Massachusetts. Similarly, for this report, the single sample criterion of 399 per 100 mL is used as the swimming standard, as prescribed by the State of Texas. Unlike the State of Massachusetts, the State of Texas does not have two different standards for boating and swimming. Hence the maps, tables and charts created for swimming standards are also true for boating standards, in the study area. Unlike the Mystic River Report Card, this report is not weighted for wet and dry weather.

Each sampling location and water-body is analyzed for the compliance rates and letter grades. All TCEQ sample locations are analyzed for the 2013 to 2019 time period. Whereas, all city of Dallas locations are analyzed for 2013 to 2020 time period. Multiple years data is used to reduce uncertainty of the grading. The compliance rate of a monitoring station is calculated as the percentage of days that the E. coli count is within the single sample criterion standard of 399 per 100 mL. The value is then assigned to individual grades in 5% increments. The appendix of this report shows tables that were created using 1030 E. coli per 100 mL as the boating standard for the water-bodies in the study area. These tables demonstrate the similarity and differences between the Mystic River report card and the Upper Trinity river report card.

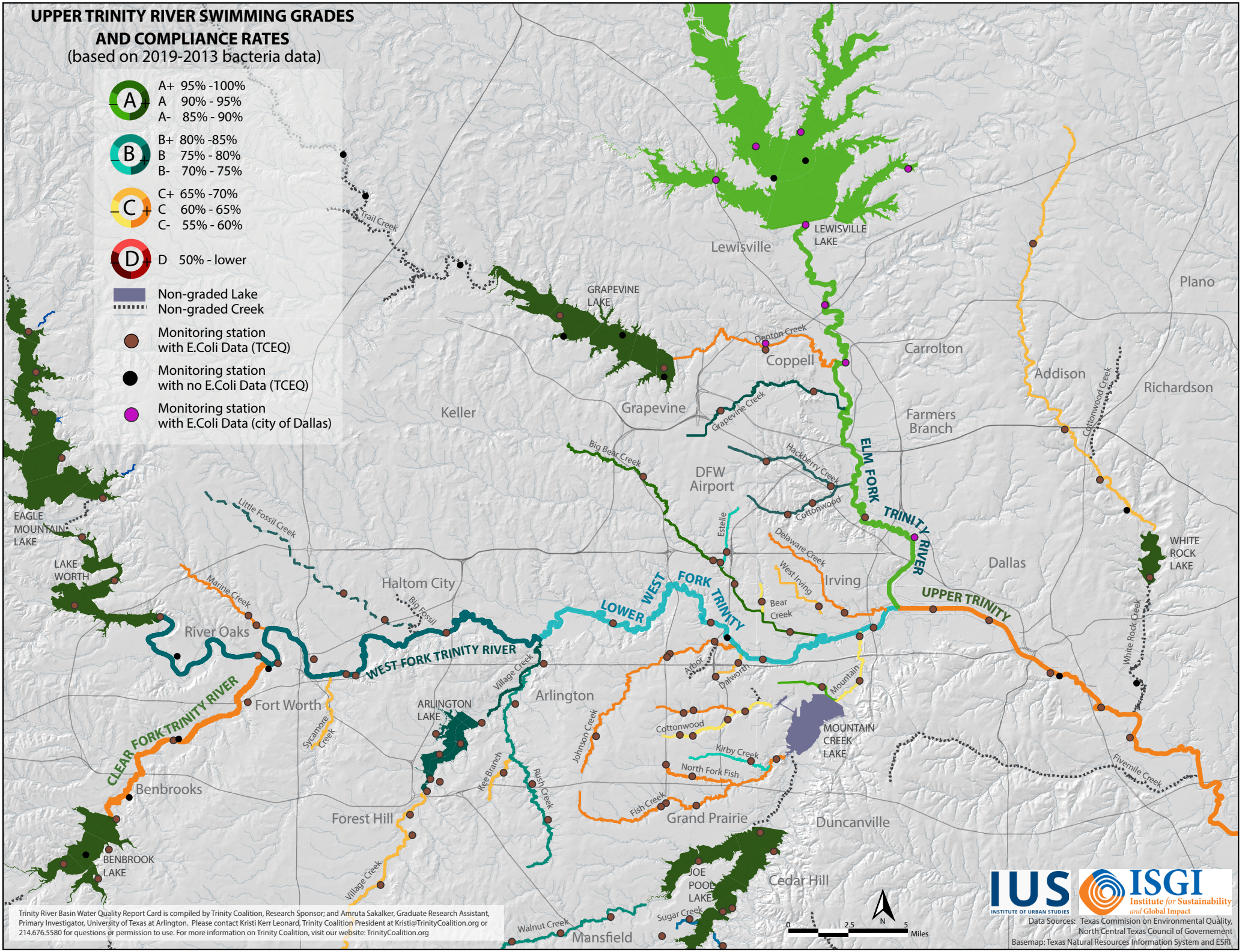
GRADE	COMPLIANCE RANGE
A+	95% - 100%
A	90% -95%
A-	85% - 90%
B+	80% - 85%
B	75% - 80%

GRADE	COMPLIANCE RANGE
B-	70% - 75%
C+	65% - 70%
C	60% - 65%
C-	55% - 60%
D	50% - Lower

Table 2 : Assigned grades and Compliance rate distribution


WERNER
WERNER

5. ANALYSIS AND RESULTS



Trinity River Basin Water Quality Report Card is compiled by Trinity Coalition, Research Sponsor; and Amruta Sakalker, Graduate Research Assistant, Primary Investigator, University of Texas at Arlington. Please contact Kristi Kerr Leonard, Trinity Coalition President at Kristi@TrinityCoalition.org or 214.676.5580 for questions or permission to use. For more information on Trinity Coalition, visit our website: TrinityCoalition.org

Data Sources: Texas Commision on Environmental Quality, North Central Texas Council of Governement
Basemap: Texas Natural Resources Information System and ESRI

Upper Trinity River - Water Quality Grades and Compliance Rates : River Segments Only

						---------Near Term Compliance Rate---------	
MUNICIPALITY	STATION #	RIVER STATION DESCRITION	# OF E.COLI SAMPLES 2019-2013*	SWIM GRADE	SWIM PERCENT	SEGMENT SWIM GRADE	SEGMENT SWIM GRADE
Fort Worth	21558	WEST FORK | UPSTREAM JACKSBORO	20	C+	70	75.5	B
Fort Worth	10941	WEST FORK | SH 183	0	-----	----		
Fort Worth	20292	WEST FORK | HERITAGE PARK	0	----	----		
Fort Worth	17368	WEST FORK | 4TH ST	47	B+	81		
Fort Worth	10938	WEST FORK | BEACH ST	45	B	80		
Fort Worth	17863	WEST FORK | GATEWAY	0	----	----		
Fort Worth	16120	WEST FORK | HANDLEY	24	B-	71		
Grand Prairie	17669	LOWER W. FORK | ROY ORR	80	B	77.5	72.75	B-
Grand Prairie	11082	LOWER W. FORK | G. PRAIRIE	0	----	----		
Grand Prairie	11081	LOWER W. FORK | BELT LINE	25	C+	68		
Dallas	11089	LOWER W. FORK | LOOP 12	0	----	----		
Fort Worth	11045	CLEAR FORK | BRYANT ST	49	B-	70.8	68.74	C+
Fort Worth	18456	CLEAR FORK |ROSEDALE	24	C+	66.67		
Fort Worth	**13623**	CLEAR FORK | BENBROOK DAM1	0	----	----		
Fort Worth	**17122**	CLEAR FORK | BENBROOK DAM2	0	----	----		
Fort Worth	**16119**	CLEAR FORK | PURCEY	0	----	----		
Dallas	10937	UPPER TRINITY | N WESTMORELAND	26	B+	84.6	66.12	C+
Dallas	20933	UPPER TRINITY | SYLVAN AVENUE	26	C	61.5		
Dallas	20934	UPPER TRINITY | SANTA FE AVE.	27	C	61.5		
Dallas	**13614**	UPPER TRINITY | CEDAR CREST BLVD	0	----	----		
Dallas	20444	UPPER TRINITY | S. CENTRAL EXP	27	C	61.5		
Dallas	10934	UPPER TRINITY | LOOP SH 12	26	C	61.5		
Dallas	20287	ELM FORK | WILDWOOD DR	26	B	77	85.85	A-
Dallas	E1	ELM FORK | LEWISVILLE LK	80	A+	98.75		
Dallas	E2	ELM FORK | ELM FORK INTAKE	86	B+	82.56		
Lewisville	**E3**	ELM FORK | BACHMAN PLANT INTAKE	85	A-	88.37		
Carrolton	**E4**	ELM FORK | HEBRON PKW	84	B+	82.55		
				Overall Trinity River Grade		**73.79**	**B-**

Upper Trinity River - Water Quality Grades and Compliance Rates : Lakes Only

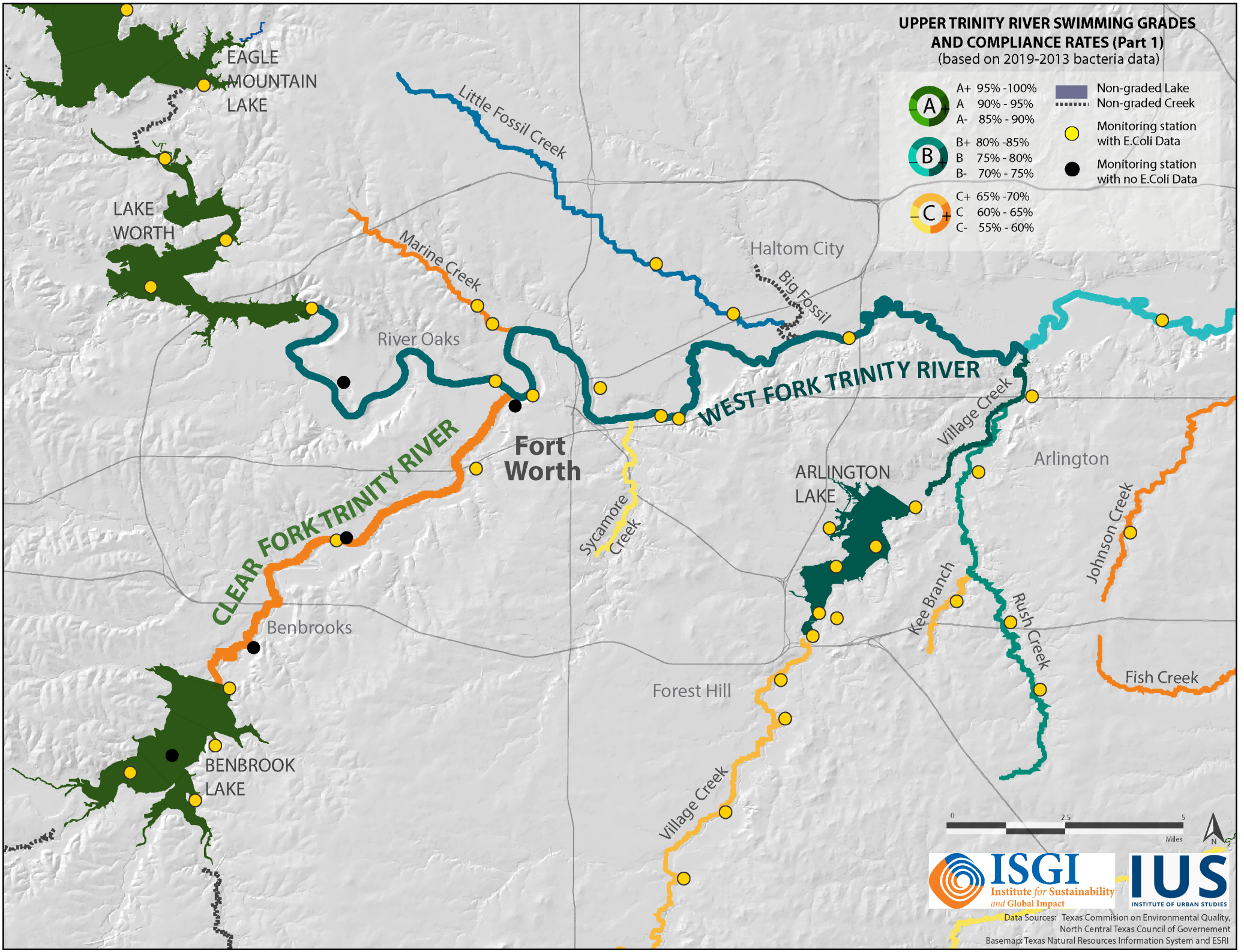
LOCATION COUNTY	STATION #	RIVER STATION DESCRITION	# OF E.COLI SAMPLES 2019-2013*	DATE RANGE	STN. SWIM GRADE	STN. SWIM PERCENT	LAKE SWIM PERCENT	LAKE SWIM GRADE
						--------Near Term Compliance Rate-------		
Denton	L4	LEWISVILLE LK | F.M. 423	82	2013-2020	B	78	88.49	A-
Denton	L5	LEWISVILLE LK | Old Lake Dallas	65	2013-2021	B	79.27		
Denton	L6	LEWISVILLE LK | Elm Creek	33	2017-2020	A+	100		
Denton	L7	LEWISVILLE LK |Hickory Creek Arm	30	2017-2020	A+	96.67		
Dallas	11038	WHITE ROCK LK | MID LAKE	26	2019-2008	A+	96.1	96.1	A+
Denton/ Tarrant	11035	GRAPEVINE LK |MID LAKE	51	2019-2010	A+	100	100	A+
Denton/ Tarrant	16112	GRAPEVINE LK |NORTHWEST	51	2019-2010	A+	100		
Denton/ Tarrant	17828	GRAPEVINE LK | MARINA	0	--------				
Denton/ Tarrant	13875	GRAPEVINE LK | SITE BC	0	--------				
Denton/ Tarrant	17827	GRAPEVINE LK | DWU INTAKE	0	--------				
Tarrant	13832	BENBROOK | SITE CR	39	2018-2008	A+	100	100	A+
Tarrant	15151	BENBROOK |NEAR DAM	61	2018-2002	A+	100		
Tarrant	15156	BENBROOK | EAST SIDE	42	2018-2002	A+	100		
Tarrant	15158	BENBROOK | MAIN CHANNEL	40	2018-2002	A+	100		
Tarrant	10942	LAKE WORTH |NR DAM	77	2018-2007, 2002, 2001	A+	100	98.81	A+
Tarrant	15163	LAKE WORTH |TRINITY RIVER	22	2018-2015, 2013-2007	A+	95.24		
Tarrant	15166	LAKE WORTH | SILVER CREEK MOUTH	23	2018-2007, 2002, 2001	A+	100		
Tarrant	15167	LAKE WORTH | NEAR SH 199 BRIDGE	28	2018-2007	A+	100		
Tarrant/Wise	10944	EAGLE MOUNTAIN |NR DAM	79	2018-2002	A+	100	100	A+
Tarrant/Wise	10952	EAGLE MT |NEAR TX ELECTR	66	2018-2002	A+	100		
Tarrant/Wise	10956	EAGLE MOUNTAIN	45	2018-2002	A+	100		
Tarrant/Wise	10960	EAGLE MT | INDIAN CREEK CV	43	2018-2002	A+	100		
Tarrant/Wise	10964	EAGLE MT | NEWPORT BEACH	21	2013-2002	A+	100		
Tarrant	13904	LAKE ARLINGTON | SITE AC	84	2019-2002	A+	96.4	82.75	B+
Tarrant	10798	TRIBUTARY OF LAKE ARLINGTON	18	2019-2016	D+	50		
Tarrant	11042	LAKE ARLINGTON | MID LAKE	42	2019-2002	A+	97.6		
Tarrant	13897	LAKE ARLINGTON |SITE FC	26	2019-2002	B+	80.76		
Tarrant	13899	LAKE ARLINGTON | SITE EC	28	2019-2002	A-	89		
Dallas/Tarrant/Ellis	22140	JOE POOL LK |ANDERSON ROAD	6	2019	A+	100	100	A+
Dallas/Tarrant/Ellis	22139	JOE POOL LK | MARINA	6	2019	A+	100		
Dallas/Tarrant/Ellis	22135	JOE POOL LK |SOUTH HOLLAND	6	2019	A+	100		
Dallas/Tarrant/Ellis	16434	JOE POOL | US 287	11	2019-2018	A+	100		
Dallas/Tarrant/Ellis	11073	JOE POOL LK | MID LAKE	6	2019	A+	100		
Dallas/Tarrant/Ellis	11072	JOE POOL LK | WALNUT CREEK	6	2019	A+	100		
Dallas/Tarrant/Ellis	11071	JOE POOL LK| MOUNTAIN CK	6	2019	A+	100		
				Overall Lakes Grade		**95.60**		**A+**

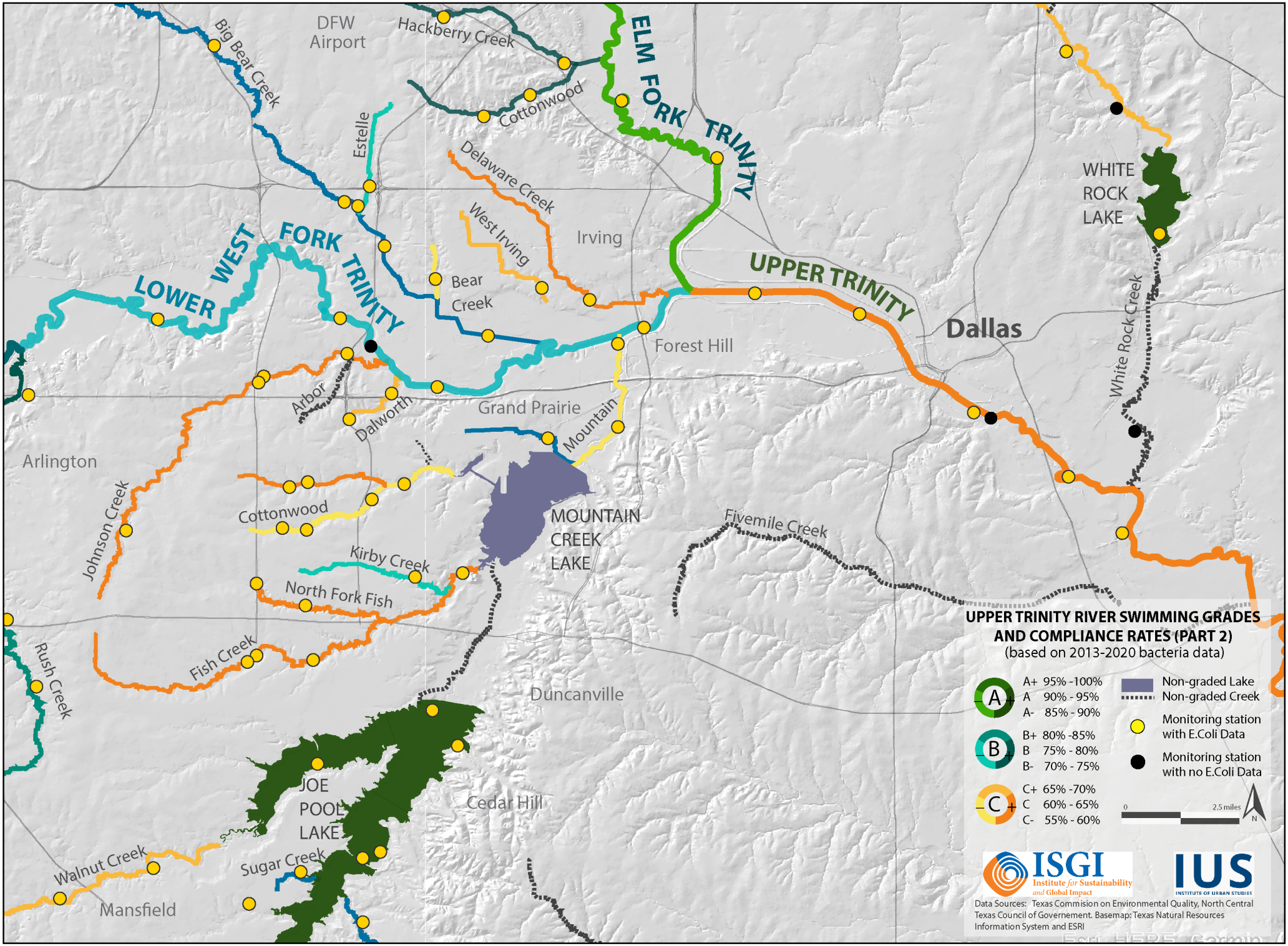
Upper Trinity River - Water Quality Grades and Compliance Rates : Creeks Only

						---------Near Term Compliance Rate---------	
Municipality	**STATION #**	**RIVER STATION DESCRITION**	**# of E.Coli samples 2019-2013***	**STN. SWIM GRADE**	**STN. SWIM PERCENT**	**CREEK SWIM PERCENT**	**CREEK SWIM GRADE**
Fort Worth	17129	LITTLE FOSSIL CK|THOMAS RD	6	B+	83	83	B+
Haltom City	21425	LITTLE FOSSIL CK |MESQUITE RD	3	----	----		
Irving	17166	COTTONWOOD BRANCH | STORY RD	38	B-	71	81.6	B+
Irving	17167	COTTONWOOD BRANCH | MACARTHUR	38	A	92		
Irving	17170	HACKBERRY CREEK | COLWELL BLVD	38	B+	84	79.6	B
Irving	17172	HACKBERRY CREEK AT CABELL RD	12	B-	75		
Dallas	20289	WHITE ROCK CK |IH635	27	C	62	55.8	C-
Dallas	21556	WHITE ROCK CK |WEST SPRING PKWY	8	D+	50		
Grand Prairie	10865	BEAR CK|W HUNTER FERRELL	21	A	90	90.8	A
Grand Prairie	10867	BEAR CK | ROCK ISLAND RD	21	A	90		
Irving	10869	BEAR CK |COUNTY LINE RD	38	A-	89		
Irving	18315	BEAR CK |COUNTY LINE ROAD	14	A	93		
Grand Prairie	10718	JOHNSON CK | UPSTRM OF AVE J	21	B+	81	65.9	C+
Arlington	10719	JOHNSON CK | SH 360	31	D+	55		
Grand Prairie	17664	JOHNSON CK | N CARRIER PKWY	21	C	62		
Grand Prairie	10815	MOUNTAIN CK |SINGLETON BLVD	21	F	19	57.1	C-
Grand Prairie	17682	MOUNTAIN CK | W JEFFERSON	21	A+	95		
Arlington	17189	VILLAGE CK | UPSTREAM OF IH 30	30	B+	80	80	B
Tarrant County	21763	VILLAGE CK | A	12	B-	75	64.08	C
Tarrant County	21762	VILLAGE CK |FREEMAN DR	13	B	77		
Tarrant County	13671	VILLAGE CK |EVERMAN RD	12	C-	58		
Tarrant County	10793	VILLAGE CK |CRAVENS ROAD	11	D	45		
Tarrant County	10786	VILLAGE CK |RENDON ROAD	42	C-	60		
Tarrant County	10785	VILLAGE CK |OAK GROVE	12	B-	75		
Tarrant County	10780	VILLAGE CK | IH 20	12	C-	58		
Grand Prairie	17680	SUGAR CK|SEETON ROAD	21	A+	100	100	A+
Tarrant County	21990	WALNUT CK | FOOT BRIDGE	12	B-	75		

Upper Trinity River - Water Quality Grades and Compliance Rates : Creeks Only continued...

Municipality	STATION #	RIVER STATION DESCRITION	# of E.Coli samples 2019-2013*	STN. SWIM GRADE	STN. SWIM PERCENT	CREEK SWIM PERCENT	CREEK SWIM GRADE
Tarrant County	20790	WALNUT CK | RETTA RD	5	B		76.98	B
Tarrant County	13621	WALNUT CK | MATLOCK RD	19	B	79		
Grand Prairie	16433	HOLLINGS CK | TANGLE RIDG	22	A	91	91	A
Grand Prairie	17672	MOUNTAIN CK	21	A-	86	86	A-
Grand Prairie	20837	COTTONWOOD CK |SOUTHWEST PKWY	19	B	79	67.68	C+
Grand Prairie	17676	COTTONWOOD CK | ROBINSON	75	C	61		
Grand Prairie	17674	COTTONWOOD CK |SW 3RD ST	72	C	64		
Arlington	10723	COTTONWOOD CK | TRIBUTARY	30	C+	67		
Grand Prairie	21557	DALWORTH CK |TURNPIKE/SH 161	10	C+	70	61.5	C
Grand Prairie	17671	DALWORTH CK | PALACE PKWY	19	D+	53		
Arlington	21530	FISH CK |UPSTREAM OF SH 360	25	B-	72	72.6	B-
Grand Prairie	17679	FISH CK | FM 1382	71	B-	75		
Arlington	10725	FISH CK | SH 360	4	D+			
Grand Prairie	15294	FISH CK | SOUTHWEST PKY	80	B-	71		
Arlington	10792	KEE BRANCH AT WEST PLEASANT RD	31	C	65	65	C
Grand Prairie	17675	KIRBY CREEK AT CORN VALLEY RD	80	B-	70	70	C+
Arlington	10722	COTTONWOOD CK AT TIMBERLAKE DR	27	F	26	60.5	C
Grand Prairie	20836	COTTONWOOD CK | SW PKWY	20	A	95		
Grand Prairie	20838	N. FISH CK | SOUTHWEST PKWY	31	C+	68	68	C+
Arlington	17191	RUSH CK | SH 180	31	B+	84	79.84	B
Arlington	10791	RUSH CK | W. SUBLETT RD	29	B	76		
Coppell	22089	DENTON CK	14	A	93	93	A
				Overall Creeks Grade	**73**	**B-**	**B+**


UPPER TRINITY RIVER SWIMMING GRADES AND COMPLIANCE RATES (Part 1)
(based on 2019-2013 bacteria data)
A+ 95% -100%
A 90% - 95%
A- 85% - 90%
B+ 80% -85%
B 75% - 80%
B- 70% - 75%
C+ 65% -70%
C 60% - 65%
C- 55% - 60%
Non-graded Lake
Non-graded Creek
Monitoring station with E.Coli Data
Monitoring station with no E.Coli Data
EAGLE MOUNTAIN LAKE
LAKE WORTH
Little Fossil Creek
Marine Creek
Haltom City
Big Fossil
River Oaks
WEST FORK TRINITY RIVER
Village Creek
Arlington
Fort Worth
CLEAR FORK TRINITY RIVER
Sycamore Creek
ARLINGTON LAKE
Johnson Creek
Kee Branch
Rush Creek
Benbrooks
Forest Hill
Fish Creek
BENBROOK LAKE
Village Creek
0
2.5
5
Miles
N
ISGI Institute for Sustainability and Global Impact
IUS INSTITUTE OF URBAN STUDIES
Data Sources: Texas Commision on Environmental Quality, North Central Texas Council of Governement
Basemap: Texas Natural Resources Information System and ESRI


DFW Airport
Hackberry Creek
Big Bear Creek
Cottonwood
ELM FORK TRINITY
Estelle
Delaware Creek
West Irving
Irving
WHITE ROCK LAKE
WEST FORK TRINITY
LOWER
Bear Creek
UPPER TRINITY
Dallas
Forest Hill
White Rock Creek
Arbor
Dalworth
Grand Prairie
Mountain
Arlington
Johnson Creek
Cottonwood
MOUNTAIN CREEK LAKE
Fivemile Creek
Kirby Creek
North Fork Fish
Rush Creek
Fish Creek
Duncanville
JOE POOL LAKE
Cedar Hill
Walnut Creek
Sugar Creek
Mansfield
UPPER TRINITY RIVER SWIMMING GRADES AND COMPLIANCE RATES (PART 2)
(based on 2013-2020 bacteria data)
A+ 95% -100%
A 90% - 95%
A- 85% - 90%
B+ 80% -85%
B 75% - 80%
B- 70% - 75%
C+ 65% -70%
C 60% - 65%
C- 55% - 60%
Non-graded Lake
Non-graded Creek
Monitoring station with E.Coli Data
Monitoring station with no E.Coli Data
0
2.5 miles
N
ISGI Institute for Sustainability and Global Impact
IUS INSTITUTE OF URBAN STUDIES
Data Sources: Texas Commision on Environmental Quality, North Central Texas Council of Governement. Basemap: Texas Natural Resources Information System and ESRI

5.2 A Comparison between the Upper Trinity River Report Card with the TCEQ's 2020 Texas Integrated Report

Under Sections 305(b) and 303(d) of the federal Clean Water Act, Texas Commission on Environmental Quality (TCEQ) recently completed the 2020 Texas Integrated Report for Surface Water Quality (Texas Commission for Environmental Quality, 2019). The report evaluates the status of water bodies within the Trinity River Basin for water quality criteria, including fitness of the water body for recreational use, use by aquatic life and other attributes. The evaluation is done at the segment level of each water body. Example of the type of information compiled for each water-body within the Trinity Basin is provided in Table 3 below. A map comparing the two results is represented on the next page. The map show which segments are fully supported for recreational use as per TCEQ standards and their compliance grades.

2020 Texas Integrated Report - Assessment Results for Basin 8 - Trinity River Basin

SEGID: 0841 Lower West Fork Trinity River

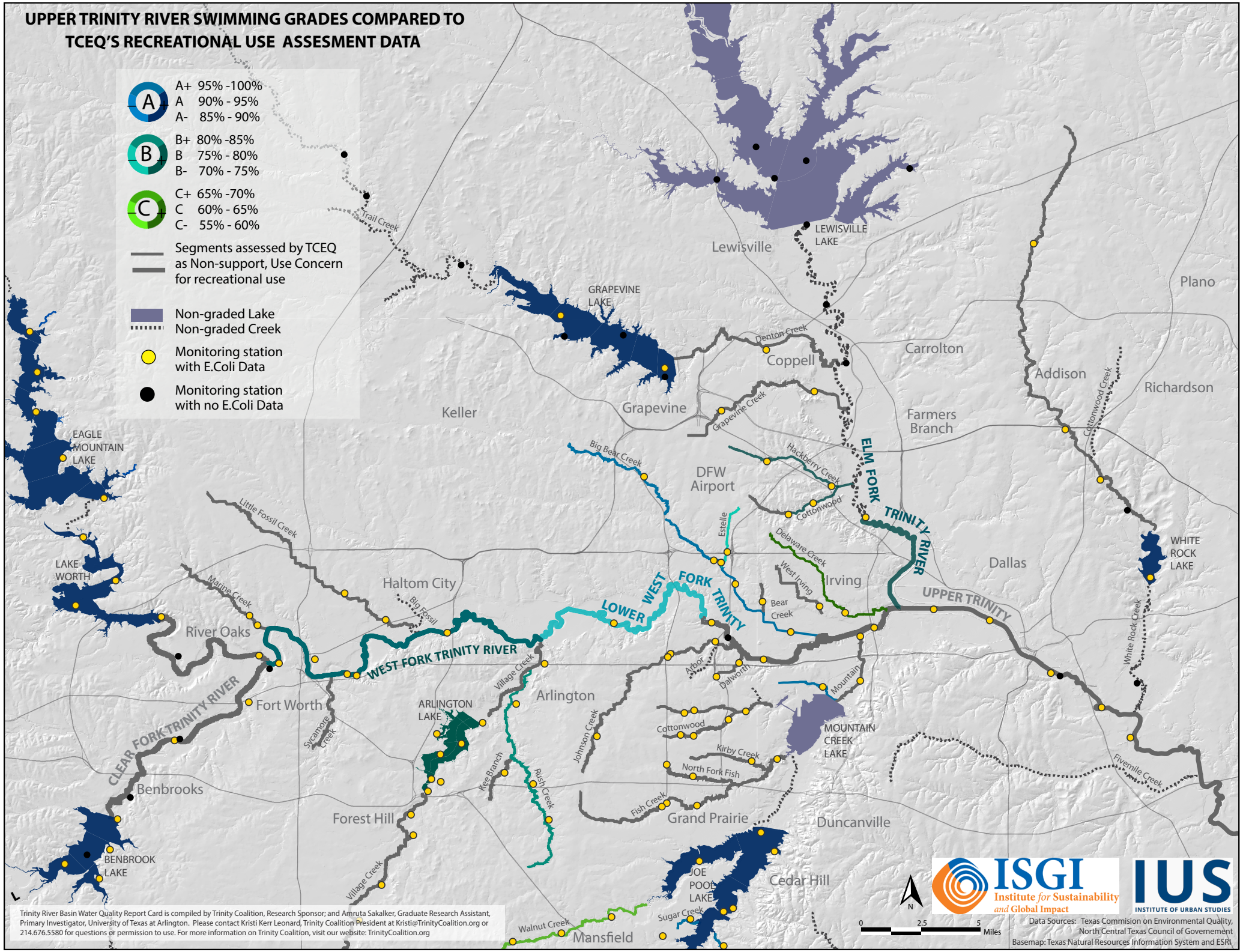
AUID: 0841_02 From the confluence with Johnson Creek upstream to the confluence of Village Creek.

Aquatic Life Use

Method	Parameter	Period of Record	Criteria	Data Assessed #	Data Assessed Value	Exceedances #	Exceedances Value	Data Qual	LOS	CF	Int LOS	TCEQ Cause	Cat
Acute Toxic Substances in water	Cadmium (dissolved)	12/01/11 - 11/30/18	15.19	6		0		LD	NC	☐	NC		
Acute Toxic Substances in water	Chromium (Tri)(dissolved)	12/01/11 - 11/30/18	922.07	6		0		LD	NC	☐	NC		
Acute Toxic Substances in water	Copper (dissolved)	12/01/11 - 11/30/18	24.71	6		0		LD	NC	☐	NC		
Acute Toxic Substances in water	Lead (dissolved)	12/01/11 - 11/30/18	121.70	6		0		LD	NC	☐	NC		
Acute Toxic Substances in water	Zinc (dissolved)	12/01/11 - 11/30/18	192.82	4		0		LD	NC	☐	NC		
Chronic Toxic Substances in water	Cadmium (dissolved)	12/01/11 - 11/30/18	0.34	6	0.15	0		LD	NC	☐	NC		
Chronic Toxic Substances in water	Chromium (Tri)(dissolved)	12/01/11 - 11/30/18	108.91	6	2.50	0		LD	NC	☐	NC		
Chronic Toxic Substances in water	Copper (dissolved)	12/01/11 - 11/30/18	14.15	6	2.11	0		LD	NC	☐	NC		
Chronic Toxic Substances in water	Lead (dissolved)	12/01/11 - 11/30/18	4.18	6	0.84	0		LD	NC	☐	NC		
Chronic Toxic Substances in water	Zinc (dissolved)	12/01/11 - 11/30/18	175.93	4	10.95	0		LD	NC	☐	NC		
Dissolved Oxygen grab minimum	Dissolved Oxygen Grab	12/01/11 - 11/30/18	3	83		0		AD	FS	☐	FS		
Dissolved Oxygen grab screening level	Dissolved Oxygen Grab	12/01/11 - 11/30/18	4	83		0		AD	NC	☐	NC		

Recreation Use

Method	Parameter	Period of Record	Criteria	Data Assessed #	Data Assessed Value	Exceedances #	Exceedances Value	Data Qual	LOS	CF	Int LOS	TCEQ Cause	Cat
Bacteria Geomean	E. coli	12/01/11 - 11/30/18	126	83	105.05	0		AD	FS	☐	FS		


UPPER TRINITY RIVER SWIMMING GRADES COMPARED TO TCEQ'S RECREATIONAL USE ASSESMENT DATA
A+ 95% -100%
A 90% - 95%
A- 85% - 90%
B+ 80% -85%
B 75% - 80%
B- 70% - 75%
C+ 65% -70%
C 60% - 65%
C- 55% - 60%
Segments assessed by TCEQ as Non-support, Use Concern for recreational use
Non-graded Lake
Non-graded Creek
Monitoring station with E.Coli Data
Monitoring station with no E.Coli Data
Trail Creek
LEWISVILLE LAKE
Lewisville
GRAPEVINE LAKE
Denton Creek
Coppell
Carrolton
Plano
Addison
Richardson
Keller
Grapevine
Grapevine Creek
Farmers Branch
Cottonwood Creek
EAGLE MOUNTAIN LAKE
Big Bear Creek
Hackberry Creek
DFW Airport
Cottonwood
ELM FORK TRINITY RIVER
Estelle
Delaware Creek
West Irving
Irving
Dallas
WHITE ROCK LAKE
LAKE WORTH
Little Fossil Creek
Haltom City
Marine Creek
Big Fossil
LOWER WEST FORK TRINITY
Bear Creek
UPPER TRINITY
White Rock Creek
River Oaks
WEST FORK TRINITY RIVER
Village Creek
Arlington
Arbor
Dalworth
Mountain
CLEAR FORK TRINITY RIVER
Fort Worth
ARLINGTON LAKE
Sycamore Creek
Johnson Creek
Cottonwood
MOUNTAIN CREEK LAKE
Kirby Creek
North Fork Fish
Fivemile Creek
Benbrooks
Kee Branch
Rush Creek
Fish Creek
Forest Hill
Grand Prairie
Duncanville
BENBROOK LAKE
JOE POOL LAKE
Cedar Hill
Sugar Creek
Walnut Creek
Mansfield
N
0 2.5 5 Miles
ISGI Institute for Sustainability and Global Impact
IUS INSTITUTE OF URBAN STUDIES
Data Sources: Texas Commision on Environmental Quality, North Central Texas Council of Governement
Basemap: Texas Natural Resources Information System and ESRI
Trinity River Basin Water Quality Report Card is compiled by Trinity Coalition, Research Sponsor; and Amruta Sakalker, Graduate Research Assistant, Primary Investigator, University of Texas at Arlington. Please contact Kristi Kerr Leonard, Trinity Coalition President at Kristi@TrinityCoalition.org or 214.676.5580 for questions or permission to use. For more information on Trinity Coalition, visit our website: TrinityCoalition.org

5.3 Geometric Mean and Median

Upper Trinity River - Water Quality Geometric mean & median: River Segments Only

MUNICIPALITY	STATION #	RIVER STATION DESCRITION	# of E.coli samples 2013-2019/20	Geometric Mean	Median
Fort Worth	21558	WEST FORK | UPSTREAM JACKSBORO	20	219	165
Fort Worth	17368	WEST FORK | 4TH ST	47	**70**	56
Fort Worth	10938	WEST FORK | BEACH ST	45	**91**	99
Fort Worth	16120	WEST FORK | HANDLEY	24	238.3	195
Arlington	21423	LOWER W. FORK | RIVER LEGACY PARK	7	**108**	60
Grand Prairie	17669	LOWER W. FORK | ROY ORR	80	145	91
Grand Prairie	11081	LOWER W. FORK | BELT LINE	25	241.23	88
Fort Worth	11045	CLEAR FORK | BRYANT ST	49	205.88	145
Fort Worth	18456	CLEAR FORK |ROSEDALE	24	341.73	185
Dallas	10937	UPPER TRINITY | N WESTMORELAND	26	194.65	145
Dallas	20933	UPPER TRINITY | SYLVAN AVENUE	26	195.84	120
Dallas	20934	UPPER TRINITY | SANTA FE AVE.	27	341.05	200
Dallas	20444	UPPER TRINITY | S. CENTRAL EXP	27	235.44	180
Dallas	10934	UPPER TRINITY | LOOP SH 12	26	246.9	225
Dallas	20287	ELM FORK | WILDWOOD DR	26	**105.74**	65.5
Dallas	E1	ELM FORK | LEWISVILLE LK	80	**8.823**	8.55
Dallas	E2	ELM FORK | ELM FORK INTAKE	86	**80.4**	49.55
Dallas	E3	ELM FORK | BACHMAN PLANT INTAKE	85	**40.2**	25.9
Dallas	E4	ELM FORK | HEBRON PKW	84	**84.18**	56.45

Upper Trinity River - Water Quality Geometric mean & median: Lakes Only

LOCATION COUNTY	STATION #	RIVER STATION DESCRITION	# OF E.COLI SAMPLES 2019-2013*	Geometric Mean	Median
Denton	11027	LEWISVILLE LK | HICKORY CK ARM	82	86.83	93.35
Denton	11026	LEWISVILLE LK | ELM FORK	65	11.14	9.5
Denton	17830	LEWISVILLE LK | LITTLE ELM CK	33	8.9	9.8
Denton	16808	LAKE LEWISVILLE | FM 423	30	7.97	6.75
Dallas	11038	WHITE ROCK LK | MID LAKE	26	31.74	44.5
Denton/ Tarrant	11035	GRAPEVINE LK |MID LAKE	51	2.22	2
Denton/ Tarrant	16112	GRAPEVINE LK |NORTHWEST	51	3.34	2
Denton/ Tarrant	17828	GRAPEVINE LK | MARINA	0		
Denton/ Tarrant	13875	GRAPEVINE LK | SITE BC	0		
Denton/ Tarrant	17827	GRAPEVINE LK | DWU INTAKE	0		
Tarrant	13832	BENBROOK | SITE CR	39	3.87	3
Tarrant	15151	BENBROOK |NEAR DAM	61	6.78	8
Tarrant	15156	BENBROOK | EAST SIDE	42	3.05	2.5
Tarrant	15158	BENBROOK | MAIN CHANNEL	40	6.91	5.5
Tarrant	10942	LAKE WORTH |NR DAM	77	2.52	2
Tarrant	15163	LAKE WORTH |TRINITY RIVER	22	13.25	13
Tarrant	15166	LAKE WORTH | SILVER CREEK MOUTH	23	2.56	2
Tarrant	15167	LAKE WORTH | NEAR SH 199 BRIDGE	28	2.84	2
Tarrant/Wise	10944	EAGLE MOUNTAIN |NR DAM	79	3.5	2
Tarrant/Wise	10952	EAGLE MT |NEAR TX ELECTR	66	2.99	2
Tarrant/Wise	10956	EAGLE MOUNTAIN	45	3.94	3
Tarrant/Wise	10960	EAGLE MT | INDIAN CREEK CV	43	4.41	2
Tarrant/Wise	10964	EAGLE MT | NEWPORT BEACH	21	9.46	11
Tarrant	13904	LAKE ARLINGTON | SITE AC	84	7.29	6.5
Tarrant	10798	TRIBUTARY OF LAKE ARLINGTON	18	458.45	380
Tarrant	11042	LAKE ARLINGTON | MID LAKE	42	7.35	3
Tarrant	13897	LAKE ARLINGTON |SITE FC	26	87.6	63.5
Tarrant	13899	LAKE ARLINGTON | SITE EC	28	18.5	16.5
Dallas/Tarrant/Ellis	22140	JOE POOL LK |ANDERSON ROAD	6	2.82	2
Dallas/Tarrant/Ellis	22139	JOE POOL LK | MARINA	6	3.17	3
Dallas/Tarrant/Ellis	22135	JOE POOL LK |SOUTH HOLLAND	6	16.91	23
Dallas/Tarrant/Ellis	16434	JOE POOL | US 287	11	18.56	22
Dallas/Tarrant/Ellis	11073	JOE POOL LK | MID LAKE	6	3.72	3
Dallas/Tarrant/Ellis	11072	JOE POOL LK | WALNUT CREEK	6	2.83	3
Dallas/Tarrant/Ellis	11071	JOE POOL LK| MOUNTAIN CK	6	2.52	2

Upper Trinity River - Water Quality Geometric mean & median: Creeks Only

Municipality	STATION #	RIVER STATION DESCRITION	# of E.Coli samples 2019-2013*	Geomean	Median
Fort Worth	17129	LITTLE FOSSIL CK|THOMAS RD	6	290	210
Haltom City	21425	LITTLE FOSSIL CK |MESQUITE RD	3	**80**	110
Irving	17166	COTTONWOOD BRANCH | STORY RD	38	175.9	125
Irving	17167	COTTONWOOD BRANCH | MACARTHUR	38	**27.76**	21.5
Irving	17170	HACKBERRY CREEK | COLWELL BLVD	38	**43.26**	30
Irving	17172	HACKBERRY CREEK AT CABELL RD	12	**48.89**	40
Dallas	20289	WHITE ROCK CK |IH635	27	341.61	270
Dallas	21556	WHITE ROCK CK |WEST SPRING PKWY	8	210	400
Grand Prairie	10865	BEAR CK|W HUNTER FERRELL	21	**99.63**	95
Grand Prairie	10867	BEAR CK | ROCK ISLAND RD	21	**61.3**	68
Irving	10868	BEAR CK |VALLEY VIEW LN	0	-----	-----
Irving	10869	BEAR CK |COUNTY LINE RD	38	**78.72**	78.5
Irving	18315	BEAR CK |COUNTY LINE ROAD	14	**48.49**	45.5
Grand Prairie	10718	JOHNSON CK | UPSTRM OF AVE J	21	**99.69**	120
Arlington	10719	JOHNSON CK | SH 360	31	312.8	350
Grand Prairie	17664	JOHNSON CK | N CARRIER PKWY	21	171.3	180
Grand Prairie	10815	MOUNTAIN CK |SINGLETON BLVD	21	1325	1600
Grand Prairie	17682	MOUNTAIN CK | W JEFFERSON	21	**20.33**	19
Arlington	17189	VILLAGE CK | UPSTREAM OF IH 30	30	152.2	125
Tarrant County	21763	VILLAGE CK | A	12	171.88	145
Tarrant County	21762	VILLAGE CK |FREEMAN DR	13	**110.28**	30
Tarrant County	13671	VILLAGE CK |EVERMAN RD	12	328.11	165
Tarrant County	10793	VILLAGE CK |CRAVENS ROAD	11	523.72	770
Tarrant County	10786	VILLAGE CK |RENDON ROAD	42	296.11	115
Tarrant County	10785	VILLAGE CK |OAK GROVE	12	274.54	145
Tarrant County	10780	VILLAGE CK | IH 20	12	486.82	295
Grand Prairie	17680	SUGAR CK|SEETON ROAD	21	**9.47**	10
Tarrant County	21990	WALNUT CK | FOOT BRIDGE	12	276.22	200
Tarrant County	20790	WALNUT CK | RETTA RD	5	243.44	130
Tarrant County	13621	WALNUT CK | MATLOCK RD	19	**116.73**	130
Grand Prairie	16433	HOLLINGS CK | TANGLE RIDG	22	**26.31**	35.5
Grand Prairie	17672	MOUNTAIN CK	21	**80.67**	84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6. CONCLUSION & NEXT STEPS

6. Conclusion and Next Steps

The system of grading each water-body within the study area has provided a much clearer picture about the safer water-bodies

for swimming and boating. A wider variation is observed in the compliance and resulting grades for all the different water-bodies throughout the Upper Trinity River Basin within the study area. The creeks tend to have lower compliance than the mainstem and lake stations. The data availability on the TCEQ website was quite patchy. The main Trinity river segments have 30 monitoring stations, but only 15 stations had E.coli data for the study period of 2013 to 2019. Important creek segments like the Elm Fork of the river, which are popular amongst kayakers, had only one monitoring station. Only Lake Lewisville out of the eight lakes in the study area did not have any data for E. coli. Lastly, TCEQ only monitored some of the creeks in the study area. To address the missing data for Elm Fork segment of the Trinity River and the Lewisville Lake, data was acquired from the city of Dallas.

A total of 98 monitoring stations located in water-bodies across the study area were analyzed for this report card. 18 monitoring stations are located within the Trinity river segments, 31 monitoring stations are located within the nine lakes in the study area, and 49 stations were in the creeks of the DFW metroplex.

The data analyzed proves that the lakes in the DFW metroplex are the safest for swimming and boating. Six out of the eight lakes meet the swimming and boating standards nearly all the time, with 95 percent days within the compliance standards for E. coli. Others, like the Lewisville meets the swimming standards for 85 percent of the days and Lake Arlington meets the standards for 80 percent of the days. Trinity River has an overall grade of B-, which indicates that most parts of the river meet the swimming standards for most of the times. Parts of the main Trinity River are safe to swim and boat, while other parts need attention. The Elm Fork has 85 percent of the days within the compliance range and is the safest for swimming and boating. Parts of Lower West Fork and the West Fork segments are also performing well and are within the compliance range for 75 percent of the days. Whereas, the rest of the river which includes the main upper Trinity segment which goes downstream from downtown Dallas meets the swimming standards only some of the times.

However, most creeks within the DFW metroplex require attention and show large disparity in compliance standards across the study area. Few of the sampled creeks north of the West Fork and west of the Elm fork, like the Big Bear Creek, Hackberry Creek, Grapevine Creek, and Cottonwood Creek meet the swimming standards for most days. But most creeks south of the West Fork are not performing

well and are not meeting swimming standards for most days.

Compared to other similar urban rivers, like the Mystic River, Trinity River basin is performing well. It has the potential to be safe for swimming and boating for most days, with local and regional cooperation and commitment to improve data monitoring of the river on regular basis. The results of the analysis also prove that more data samples for each station provide more dependable results. Also, monthly or weekly data can help estimate the weather pattern for the safety of water-bodies. The last section provides suggestions for future steps to improve the awareness of the water quality of the water-bodies within the Upper Trinity River Basin.

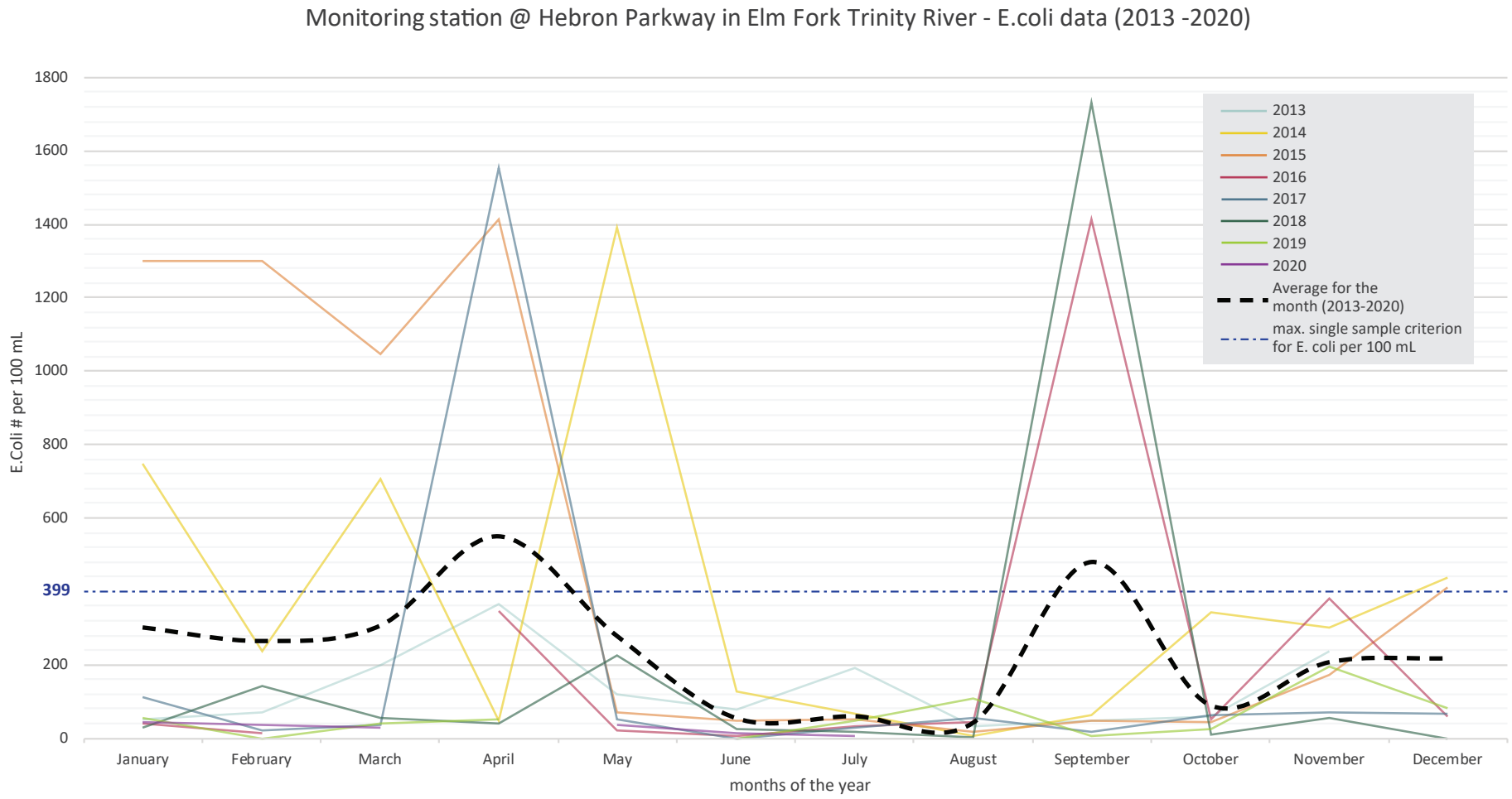

Figure 13 : A graph of monitoring station example with E. coli data distribution as per month of collection

6.1 Next Steps: Identifying Wet and Dry months - Precipitation Data

A water-body is considered most unsafe for swimming after rains. This makes it essential to understand the weather pattern of the E. coli data in the DFW metroplex. The next important step for this project would be to compare and match the E. coli sampling dates with precipitation data. This will help to understand if high E. coli number days coincide with high precipitation or high rainfall days. The figure 13 shows an example of one sample station data within the Elm Fork. The data samples have been collected each month of the study period, 2013 to 2020. The E. coli samples are arranged as per the months of the year. The graph does not show precipitation data. But it is evident from the dotted black line indicating the "average of the month" that high E. coli days tend to coincide with months with high rainfall, in April and September. The graph only indicates this pattern for one station. It will be helpful to understand if this pattern in similar for other locations within the study area. Matching the data with precipitation data will help to confirm if the reason for high E. coli levels is rainfall or other non-point source pollution. Wet and dry months can be identified, similar to the Mystic River Report Card, as the next step for the project.

6.2 Identifying other data sources for E. coli data

As it has been observed through this report, the TCEQ dataset is patchy for the 90 data stations across the metroplex. Also, monthly and weekly data will result in more reliability to the grades and compliance rates for the station. It was observed through engagements with local and regional entities that more robust dataset is available with individual municipalities and water districts. The next step for the project would be to reach out to all local and regional entities and acquire their E. coli samples.

6.3 Creating a prediction tool/model/app for real-time monitoring and informing users

Once a reliable dataset that provides E. coli sample on monthly and weekly basis. An advisory tool or model that can predict the safety of the water-body for swimming and boating activities will be very helpful.

7. References

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