Targeted Bacteria Monitoring Project
Field Investigation Final Report
Assessment Unit 1017B_02, Cole Creek

Environmental Institute of Houston

June 2, 2023

Prepared by:
Jenny Oakley, Ph.D., Associate Director, Research Programs
Kaylei Chau, Research Associate
Sherah McDaniel, Research Associate

Environmental Institute of Houston, University of Houston-Clear Lake
2700 Bay Area Blvd, MC 540, Houston TX 77058

Segment Description

Segment 1017B is a freshwater stream called Cole Creek (Figure 1). This segment consists of one assessment unit (AU) of concern. The most downstream AU, 1017B_02, is 6.55 km and is defined as being from Flintlock Street to the confluence with White Oak Bayou in Harris County. There is one current and one historic surface water quality monitoring (SWQM) stations located on this AU (station IDs: 16593 and 11154). This AU has been selected for targeted monitoring due to a bacteria (*Escherichia coli*) seven-year geometric mean of 1,601.6 MPN/100 mL (H-GAC QAPP, 2022). The AU was listed for exceedances of bacteria in the water (Recreation use) and has a current impairment category of 4a (TCEQ, 2022). The potential sources of bacteria are non-point source pollution, urban runoff, and sanitary sewer overflows (TCEQ, 2022).

The contributing watershed for this segment is 30 km^2 (Data Source: HGAC, SWRC, 2023). The predominant soil group in the watershed is medium/very slow infiltration coverage and land cover is developed land (96.6%) (Data source: United States Department of Agriculture Hydrologic Soil Groups from gSSURGO 2016 and National Land Cover Database NLCD 2019). There are also 131 documented permitted on-site sewage facilities (OSSFs) and 310 parcels of documented unpermitted OSSFs within the watershed (Data source: H-GAC).

Background

Clean Rivers Program (CRP) routine monitoring data are analyzed each year as part of the Houston-Galveston Area Council (H-GAC) Basin Summary/Basin Highlights Report process. Bacteria continues to be the most prevalent pollutant in the H-GAC CRP Basins (H-GAC, 2022). The Bacteria Implementation Group (BIG), formed in 2008, oversees the Total Maximum Daily Load (TMDL) Implementation Plan (I-Plan). The BIG requested that H-GAC produce a list of the water bodies with the highest bacteria concentrations in the BIG project area and conduct targeted monitoring to identify potential bacteria sources.

Houston-Galveston Area Council, using information from previous Basin Highlights/Summary Reports, BIG annual reports, and previous targeted monitoring efforts, identified and selected waterways for targeted bacteria monitoring to refine our understanding of the spatial distribution of elevated bacterial concentrations contributing to these waterways. Phase 1 of this targeted monitoring project includes an intensive desktop review and a windshield survey (WS) of each AU catchment area, and sampling of the AU from primary road crossings. Phase 2 of this targeted monitoring project includes a field investigation (FI) of the entire AU conducted during dry conditions where all flowing point and non-point sources are evaluated.

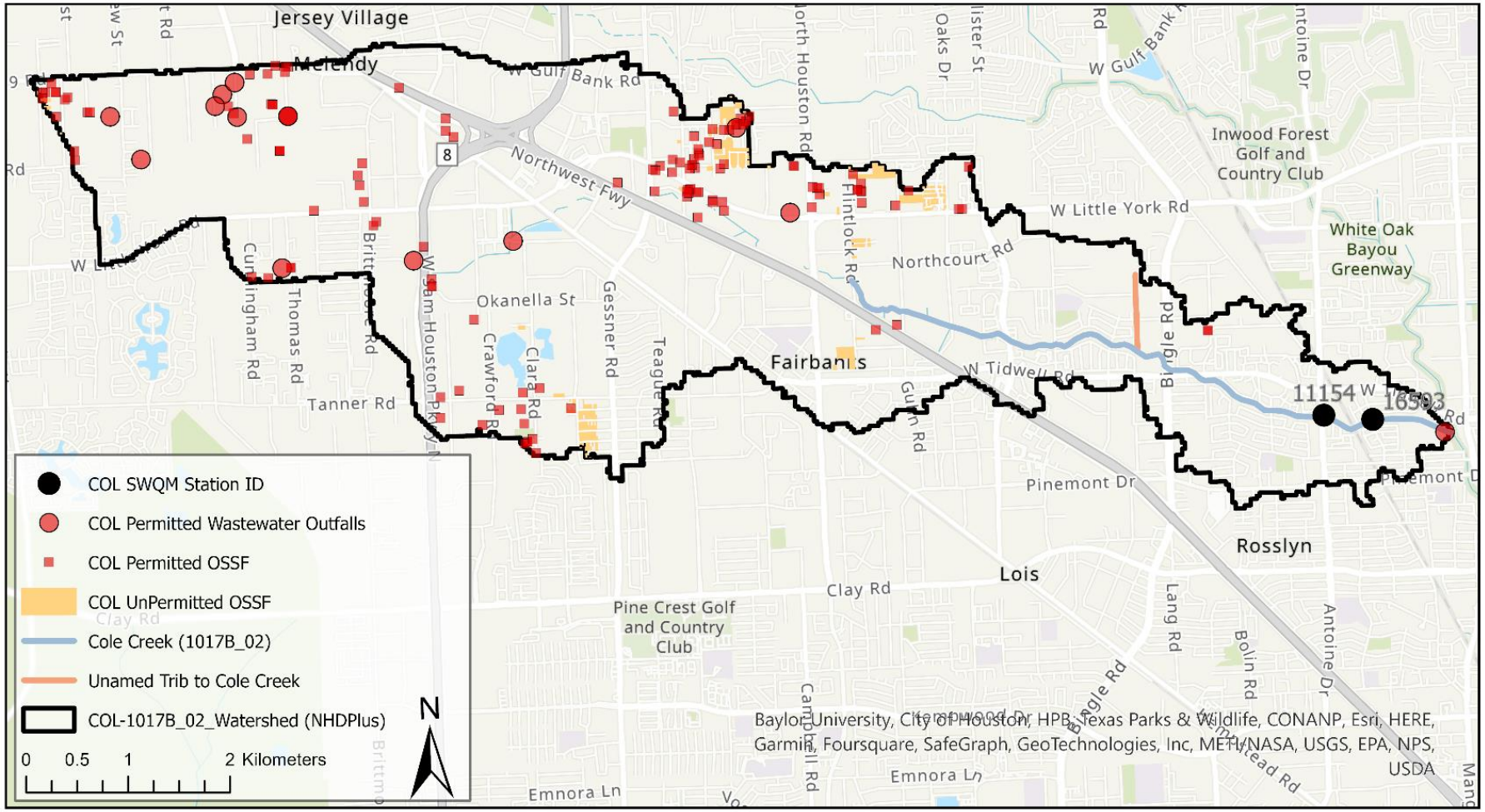

Figure 1 Watershed Map for Cole Creek, Assessment Unit 1017B_02.

Desktop Review

Methods

The intensive desktop review included an evaluation of permitted discharges, outfalls, and potential sources of point source and nonpoint source pollution that may contribute to bacteria loading in the AU. Using Google Earth imagery and GIS, the locations of wastewater treatment facilities, permitted OSSFs, and potential locations of unpermitted OSSFs were identified. Other potential sources such as landfills and industrial facilities, were also identified. Parks were noted, as these can contribute to bacterial sources through runoff of animal wastes but also provide opportunity for contact recreation. Bridge crossings and other entry points were identified in order to provide access into the stream to collect bacteriological samples.

Results

The results of the desktop review indicated that this AU lies within a highly developed urban/suburban area with many potential non-point sources from roads, parking lots, homes, and businesses, as well as many point sources (permitted outfalls, see Figure 1) that may be impacting the water quality of the creek. Publicly accessible entry points into the stream were identified at Bolivia Blvd., Antoine Dr., Tidwell Dr., Bingle Rd., Langfield Rd., and Hollister Rd.

Windshield Survey

Methods

Field events must take place during dry weather (after three or more days without significant rainfall in the watershed). This ensures that any flowing water into the AU is not stormwater. Windshield surveys of the watershed were conducted and bacteria sampling was performed at public access points throughout the AU (primarily at bridge crossings). The survey consisted of driving the catchment area to confirm identified pollution sources found during the desktop review and to find any potential sources not identified during that review. Bridge crossings chosen for sampling were spatially distributed to provide a spatial snapshot of bacteria concentrations in the AU and identify sections of the AU where elevated bacteria concentrations were found. Those areas with elevated bacteria levels identified in the WS monitoring were focused on during Phase 2, FI.

Assessment Units, sample collection and laboratory methods, and data handling practices are detailed in Appendix J of the FY 2022-2023 H-GAC Multi-Basin Clean Rivers Program Quality Assurance Project Plan (H-GAC QAPP, 2022). For all WSs, bacteria monitoring field personnel documented the latitude and longitude of sample location. All bacteria samples were analyzed by a National Environmental Laboratory Accreditation Program (NELAP)-Accredited laboratory.

Results and Recommendations

The WS was conducted on March 06, 2023. At that time, it had been 4 days since the last significant rainfall in the watershed. A total of eight samples were collected on AU 1017B_02 and one on a contributing tributary during the WS (Table 1 and Figure 2).

Table 1: Windshield survey bacteria results from sampling on 03/06/2023 on Cole Creek (AU 1017B_02). Samples were taken at bridge crossings and other publicly accessible points. US = Upstream, DS = Downstream. LB = Left Bank, RB = Right Bank.

Sample ID	Latitude	Longitude	*E. coli* Sample Results (MPN/100 mL)	Comments
COL-WS-01	29.84491	-95.46012	155	
COL-WS-02	29.84617	-95.46786	3,260	Slight smell of bat guano.
COL-WS-03	29.84673	-95.47311	933	Encampments present under bridge. Smell of feces in ambient air.
COL-WS-04	29.85037	-95.48577	171	Encampments present under bridge. Smell of feces in ambient air. Discarded used feminine hygiene products on bank.
COL-WS-05	29.85225	-95.48920	171	Encampment in woods on LB.
COL-WS-06	29.85364	-95.50004	512	Possible encampment under bridge.
COL-WS-07	29.85436	-95.50516	2,910	Flocculant in water.
COL-WS-08	29.85691	-95.51580	331	Large encampment under bridge - sampled US of bridge.
T1COL-WS-01	29.85325	-95.49181	31	Sampled from tributary of Cole Creek.

Based upon the results of the WS and ground-truthing, a FI covering the entire length of the AU was recommended. The unnamed tributary that has a confluence with Cole Creek situated between Pine Grove Drive and Bingle Road had a bacteria level of 31 MPN and therefore was not targeted for a FI. Based on the results of the WS, we expected to identify potential non-point sources or point sources of elevated bacteria near the following portions of the AU:

1) COL-WS-02, which was collected from the downstream side of the bridge at Bolivia Blvd. This sample had an elevated bacteria result compared to the samples collected upstream and downstream of this area.

2) COL-WS-03, which was collected from the downstream side of the bridge at Antoine Dr. This sample had an elevated bacteria result compared to the sample collected ~0.8 mi upstream of this area.

3) COL-WS-07, which was collected from the upstream side of the bridge at Hollister Rd. This sample had an elevated bacterial level compared to the sample collected ~0.65 mi upstream of this area.

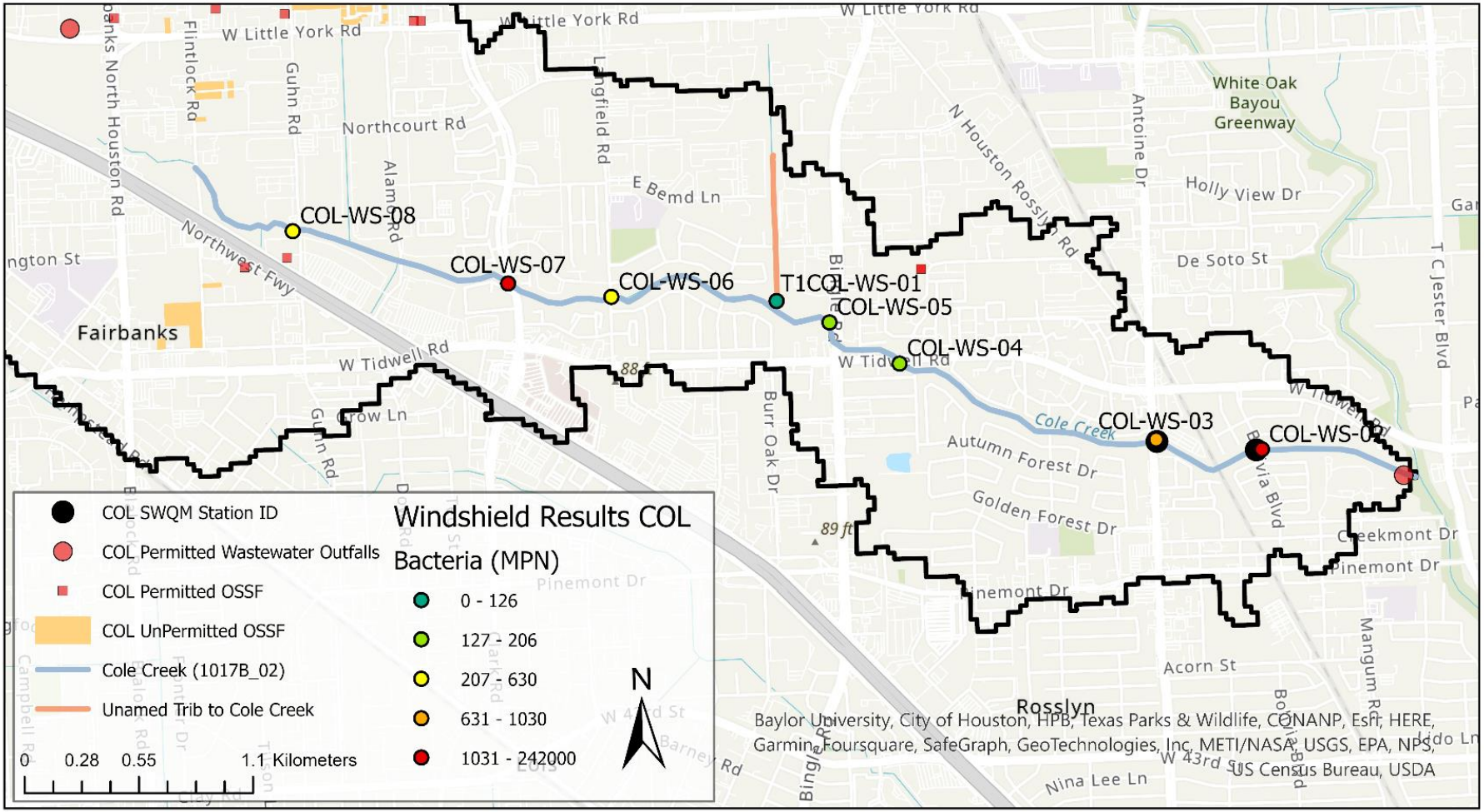

Figure 2: Windshield survey/ground truthing bacteria results from sampling on 03/06/2023 on Cole Creek (AU 1017B_02).

This AU has some changes in depth making it partially boatable and wadeable. The FI for the portion upstream of the bridge at Langfield Rd. was conducted as wadeable while the portion downstream of Langfield Rd. was conducted from kayaks. There was also a safety concern for our field crew as there were encampments encountered at most bridge crossings. Some of these encampments were observed to have multiple residents and at some encampments on-going illicit activities were observed by our WS field crew. Therefore, the FI field crew was escorted by Harris County Constable Peace Officers.

Field Investigation

Methods

The FI was a thorough survey where a team of two either walked or paddled the entire assessment unit and sampled any water observed flowing into the stream. Water could be flowing in from a pipe, culvert, natural tributary, or earthen ditch. Flowing water was categorized into two source types: permitted outfalls or unpermitted outfalls. Permitted outfalls included wastewater facilities and municipal separate storm sewer systems (MS4). Any pipe greater than 12 inches (in.) in diameter was assumed to be permitted by our field crews. When flowing water was observed from a permitted outfall, two samples were collected.

One sample was collected immediately downstream of the outfall where the flowing outfall was mixing with the ambient water. The second sample was taken upstream of the flowing outfall outside of the realm of influence from the outfall to provide the ambient bacteria levels of the assessment unit in that area. The second type of source was an unpermitted outfall, which was any other flowing source of water that was not assumed to be permitted including flowing small (<12 in. diameter) “homemade” pipes and tributaries.

When a flowing unpermitted outfall was observed, the bacteria sample was taken directly from the source. If the source was a flowing pipe, the sample was collected directly from the pipe, before it entered the AU. If it was an open-top earthen ditch or natural tributary, the sample was collected from far enough into the inflow source that there was no mixing with the receiving water. In some cases, when no flowing permitted or unpermitted outfalls were observed in an extended section of the AU, a single ambient reference sample was taken mid-stream. Left and right bank references are oriented with the observer facing downstream.

Assessment Units, collection and laboratory methods, and data handling practices are detailed in Appendix J of the FY 2022-2023 H-GAC Multi-Basin Clean Rivers Program Quality Assurance Project Plan (H-GAC QAPP, 2022). For all field investigations the field team recorded location of the flowing outfall (latitude and longitude), the diameter, material, and water depth of the flowing outfall, and documented site conditions by taking photos and other relevant notes. All bacteria samples were collected following procedures listed in Appendix J of the FY 2022-2023 H-GAC Multi-Basin Clean Rivers Program Quality Assurance Project Plan (H-GAC QAPP, 2022)

and analyzed by a National Environmental Laboratory Accreditation Program (NELAP)-Accredited laboratory.

Results

The FI was conducted on May 24, 2023 (eight days since last significant rainfall) and a total of 61 bacteria samples were collected. The values of the bacteria samples collected from downstream of permitted outfalls, directly from unpermitted outfalls, or as ambient samples are summarized in Table 2 and Figure 3. Based on the data collected, four locations with elevated *E. coli* bacteria levels measured during the FI are recommended for high priority and five locations for low priority investigation by the proper authorities. High priority sites had the highest potential bacteria loading observed and are recommended to be the areas for local authorities to focus efforts on should there be insufficient resources to address all referral sites. As time and resources allow the low priority and investigate further referrals also are recommended for further investigation. These locations are summarized in Table 2 and Figure 4. Four locations were flagged where ambient or upstream samples had elevated bacteria levels with no obvious explanations. Further investigation of these areas by the proper authorities is recommended. Each of these referrals are summarized by site, herein. The referral summaries are listed in order of priority (High, Low, then Investigate Further). Within each priority group, sites are listed from downstream to upstream.

Table 2: Field investigation bacteria results from sampling on 5/24/2023 on Cole Creek (Assessment Unit 1017B_02). Referrals (gray rows): N = No, Y-H = Yes – High Priority, Y-L = Yes-Low Priority, IF = Investigate Further, US = Upstream, DS = Downstream. LB = Left Bank, RB = Right Bank.

Sample ID	Lat	Long	DS or Direct *E. coli* Sample Results (MPN/100 mL)	US *E. coli* Sample Results (MPN/100 mL)	Difference* DS - US (MPN/100 mL)	Referral	Comments
COL-FI1-21-D	29.84494	-95.46087	< 100	24,900	-24,800	N	Wastewater outfall on RB just US of confluence with White Oak Bayou. Took US sample ~30m US of outfall to avoid large mixing zone. This is the most DS sample.
COL-FI1-20-D	29.84618	-95.46779	27,200	< 100	27,100	Y-H	Pipe is located on RB, flowing well, and the bottom of the pipe is coated in algae.
COL-FI1-19-D	29.84581	-95.46939	5,860	27,600	-21,740	N	Pipe is trickling and located on LB. There is a large amount of vegetation growing in front of pipe.
COL-FI1-18-D	29.84575	-95.47127	< 100	48,800	-48,700	N	Pipe is dripping and located on RB.
COL-FI1-17-D	29.84618	-95.47206	> 242,000	98,000	144,000	Y-H	RB. Water is trickling, somewhat white, cloudy, and smells of effluent. Pipe is smashed at opening and vegetation is thick around it.
COL-FI1-16-D	29.84673	-95.47327	242,000	242,000	0	N	LB. Pipe directly across from another pipe under bridge. Encampment under bridge. Same US sample.
COL-FI1-15-D	29.84668	-95.47326	173,000	242,000	-69,000	N	RB. Pipe directly across from another pipe under bridge. Encampment under bridge.
COL-FI1-NS-2	29.84658	-95.47467	NA	NA	NA	N	Pipe on RB. Did not sample due to not being able to locate where water flows in as pipe is broken in several places. Could hear flow. Pipe just DS of COL-FI1-14-D.
COL-FI1-14-D	29.84663	-95.47520	155,000	> 242,000	-87,000	N	LB. Flowing steadily.
COL-FI1-13-D	29.84723	-95.47820	< 100	> 242,000	-241,900	IF	LB. water in pipe is cloudy and smells like effluent. Decent flow.
COL-FI1-NS-1	29.84904	-95.48244	NA	NA	NA	N	Not sampled. Pipe on LB (between samples COL-FI1-12-D and COL-FI1-13-D) dripping once every 30 seconds.
COL-FI1-12-D	29.84995	-95.48375	< 100	3,170	-3,070	IF	LB. Crystal clear water coming out of pipe. Sheen on water in front of pipe. Live apple snails present.
COL-FI1-11-D	29.85010	-95.48491	1,460	1,350	110	N	RB. Decently flowing. Crystal clear water.

Sample ID	Lat	Long	DS or Direct *E. coli* Sample Results (MPN/100 mL)	US *E. coli* Sample Results (MPN/100 mL)	Difference* DS - US (MPN/100 mL)	Referral	Comments
COL-FI1-10-D	29.85018	-95.48518	200	1,200	-1,000	N	LB. Descent flow into creek.
COL-FI1-09-D	29.85109	-95.48705	1,340	1,220	120	N	LB. Trickling. The bridge DS has a large encampment.
COL-FI1-08-D	29.85125	-95.48873	750	1,480	-730	N	This pipe is the most DS pipe of the group of 3 pipes and is located on the RB. Same US sample and coordinates as COL-FI1-06-D.
COL-FI1-07-D	29.85125	-95.48873	4,350	1,480	2,870	Y-L	COL-FI1-07-D is on the LB (second most US). Pipe is submerged- took sample from within. Same US sample and coordinates as COL-FI1-06-D.
COL-FI1-06-D	29.85125	-95.48873	< 100	1,480	-1,380	N	COL-FI1-06-D is the most US pipe of a grouping of 3 pipes. Two are located on the LB and one is on RB. This pipe is on the LB. Coordinates taken DS out from under the bridge.
COL-FI1-05-D	29.85273	-95.49168	410	520	-110	N	Pipe on LB is submerged but could audibly hear it flowing. Sounds like a heavy flow. Took sample from within pipe. Floating animal feces observed.
COL-FI1-04-D	29.85289	-95.49187	750	630	120	IF	Tributary empties into creek on LB. Was not flowing during WS but is currently flowing (trickling).
COL-FI1-03-D	29.85346	-95.49439	410	200	210	N	RB. Pipe on opposite bank but is dry.
COL-FI1-02-D	29.85357	-95.49923	1,100	310	790	Y-L	RB. Trickling.
COL-FI1-01-D	29.85365	-95.49991	1,210	860	350	N	RB. Barely a trickle. Sampling from US to DS in kayak.
COL-FI1-22-D	29.85367	-95.50023	15,500	520	14,980	Y-H	LB. Trickling. Start of walking portion from DS to US. Could kayak.
COL-FI1-23-D	29.85356	-95.50025	630	1,200	-570	N	RB. Heavy flow. Water is clear.
COL-FI1-24-D	29.85363	-95.50098	1,460	1,210	250	N	LB. Steady drip.
COL-FI1-25-D	29.85368	-95.50156	1,080	1,320	-240	N	RB. Trickling.
COL-FI1-26-D	29.85355	-95.50272	740	1,970	-1,230	N	LB. Trickling.
COL-FI1-27-D	29.85351	-95.50322	2,310	2,060	250	N	RB. Dripping.
COL-FI1-28-D	29.85395	-95.50445	2,130	970	1,160	Y-L	Submerged pipe on the RB. Sample taken within pipe.
COL-FI1-29-D	29.85437	-95.50517	8,390	2,460	5930	Y-H	RB. Steady trickle.

Sample ID	Lat	Long	DS or Direct *E. coli* Sample Results (MPN/100 mL)	US *E. coli* Sample Results (MPN/100 mL)	Difference* DS - US (MPN/100 mL)	Referral	Comments
COL-FI1-30-D	29.85453	-95.50523	2,460	1,310	1,150	Y-L	Submerged pipe on the LB. Sample taken within pipe.
COL-FI1-31-D	29.85460	-95.50725	410	310	100	N	Rusted out pipe on the RB. Steady trickle close to the bank.
COL-FI1-32-D	29.85465	-95.50780	< 100	100	0	N	Rusted out metal pipe on the LB.
COL-FI1-33-D	29.85542	-95.51025	200	300	-100	N	Pipe on RB hidden behind vegetation is trickling steadily.
COL-FI1-34-D	29.85550	-95.51059	1,560	520	1,040	Y-L	Submerged pipe on RB. Sample taken within pipe. This is the most US sample.

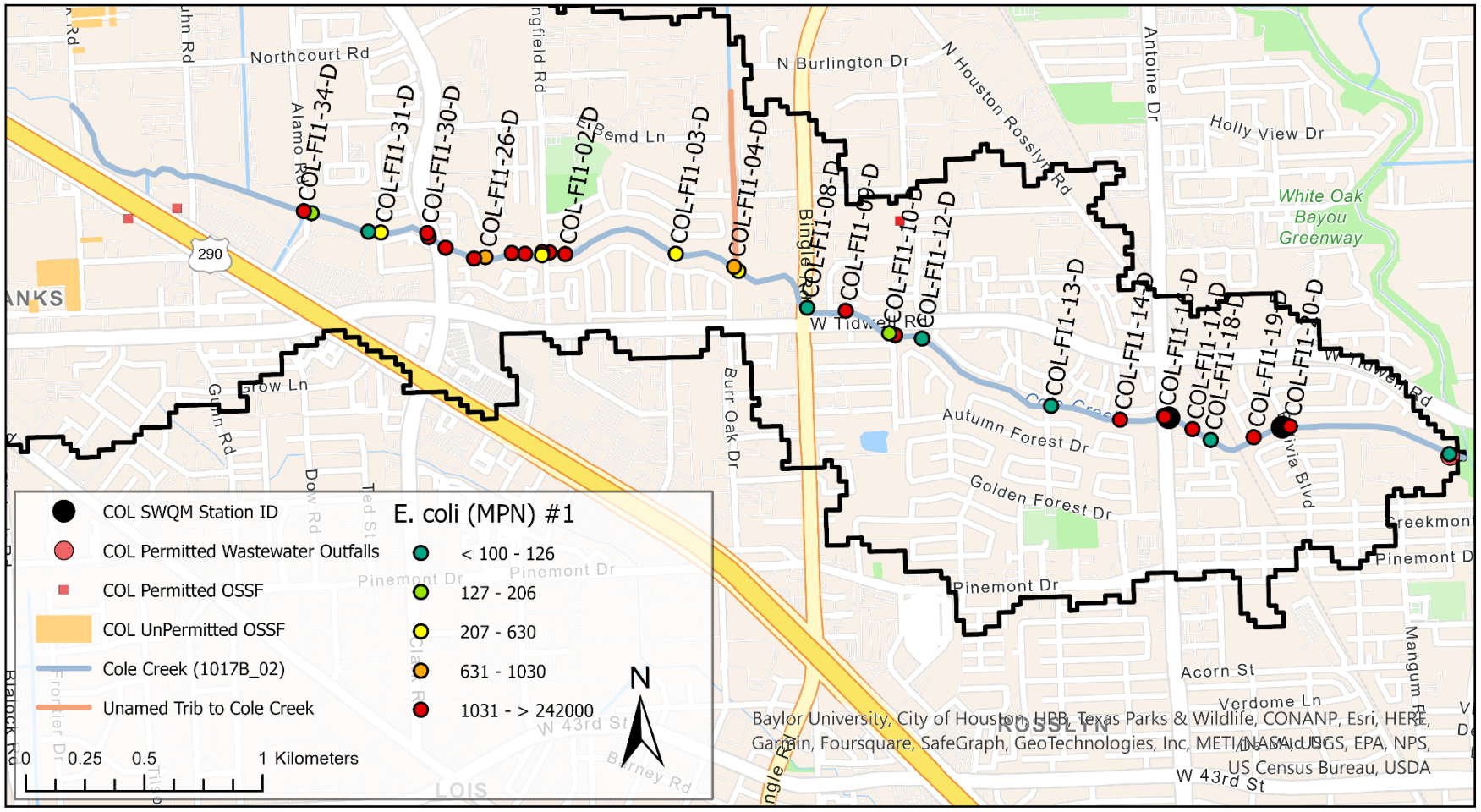

Figure 3: Field investigation bacteria sampling Results from on 5/24/2023 on Cole Creek (Assessment Unit 1017B_02).

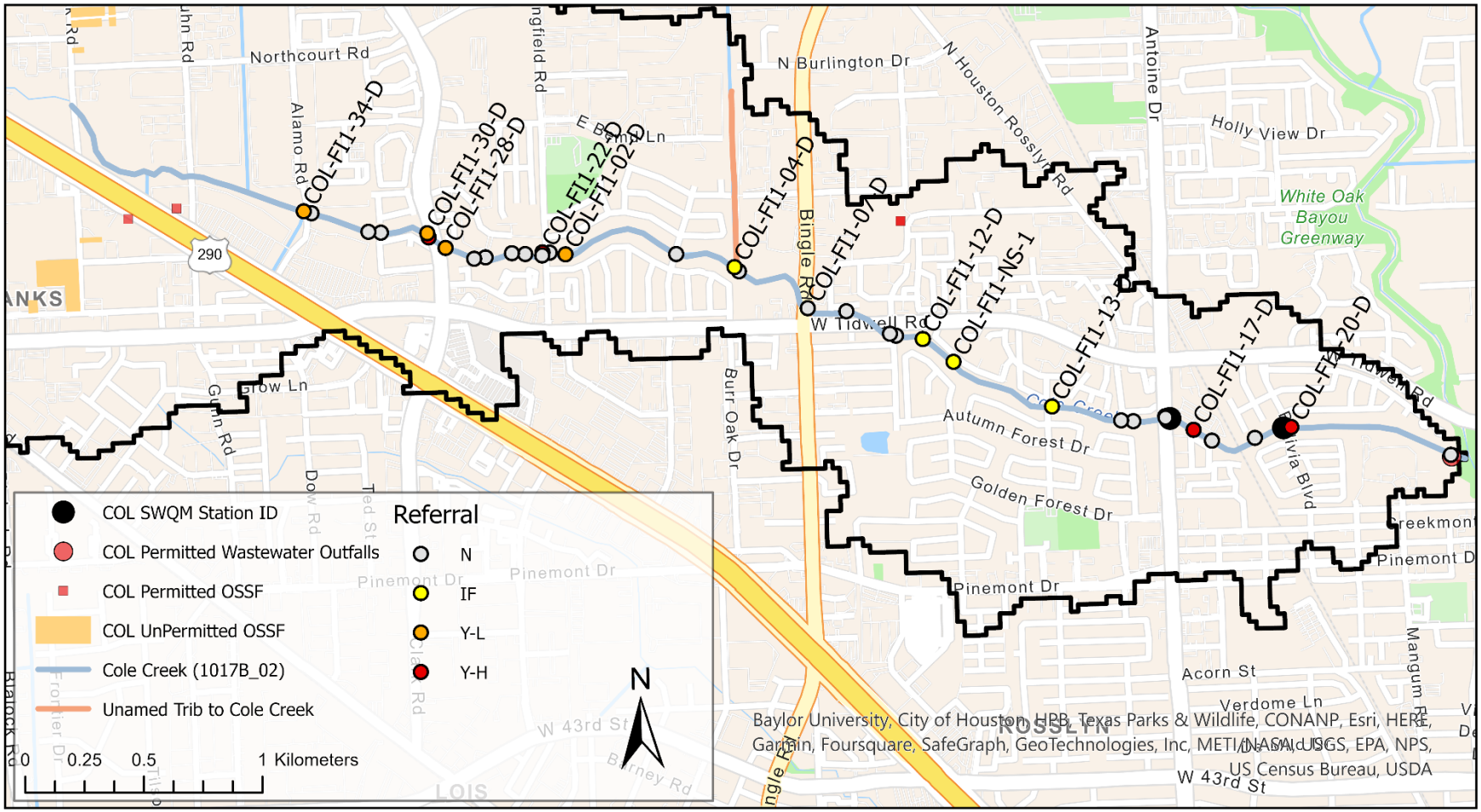

Figure 4: Field investigation sites identified for referral to the proper authorities on Cole Creek (Assessment Unit 1017B_02).

Referral site: COL-FI1-20-D – High Priority

This is a 36 in. diameter metal pipe located on the right bank of Cole Creek. Water within the pipe was 0.5 in. deep and flowing into the segment. The bottom of the pipe is coated in algae. There are single-family homes located in the area on the right bank. A sample taken 0.5 m downstream of the pipe had a bacteria value of 27,200 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of < 100 MPN/100 mL. This pipe is a high priority referral site for the proper local authority.

Referral site: COL-FI1-17-D – High Priority

This is a 26 in. diameter metal pipe located on the right bank of Cole Creek. Water within the pipe was 0.25 in. deep, somewhat white, cloudy, and trickling into the segment. There was a smell of effluent in the ambient air. The pipe is smashed at the opening and vegetation is growing thick around it. There are apartments located in the area on the right bank. A sample taken 0.3 m downstream of the pipe had a bacteria value of > 242,000 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 98,000 MPN/100 mL. This pipe is a high priority referral site for the proper local authority.

Referral site: COL-FI1-22-D – High Priority

This is a 36 in. diameter metal pipe located on the left bank of Cole Creek. Water within the pipe was 0.5 in. deep and trickling into the segment. There are apartments and single-family homes located in the area on the left bank. A sample taken 1 m downstream of the pipe had a bacteria value of 15,500 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 520 MPN/100 mL. This pipe is a high priority referral site for the proper local authority.

Referral site: COL-FI1-29-D – High Priority

This is a 24 in. diameter metal pipe located on the right bank of Cole Creek. Water within the pipe was 0.06 in. deep and trickling steadily into the segment. There are apartments located in the area on the right bank. A sample taken 0.7 m downstream of the pipe had a bacteria value of 8,390 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 2,460 MPN/100 mL. This pipe is a high priority referral site for the proper local authority.

Referral site: COL-FI1-07-D– Low Priority

This is a 66 in. diameter concrete pipe located on the left bank of Cole Creek. This pipe is the second most US pipe at this location. The pipe was submerged and water within the pipe was 8.5 in. deep. There are commercial buildings located in the area on the left bank. A sample taken at the mouth of the submerged pipe had a bacteria value of 4,350 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 1,480 MPN/100 mL. This pipe is a low priority referral site for the proper local authority.

Referral site: COL-FI1-02-D– Low Priority

This is a 28 in. diameter metal pipe located on the right bank of Cole Creek. Water within the pipe was 0.06 in. deep and trickling into the segment. There are commercial buildings, single-family homes, and apartments located in the area on the right bank. A sample taken 1 m downstream of the pipe had a bacteria value of 1,100 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 310 MPN/100 mL. This pipe is a low priority referral site for the proper local authority.

Referral site: COL-FI1-28-D– Low Priority

This is a 66 in. diameter metal pipe located on the right bank of Cole Creek. The pipe was submerged and water within the pipe was 15 in. deep. There are apartment buildings located in the area on the right bank. A sample taken at the mouth of the submerged pipe had a bacteria value of 2,130 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 970 MPN/100 mL. This pipe is a low priority referral site for the proper local authority.

Referral site: COL-FI1-30-D– Low Priority

This is a 78 in. diameter metal pipe located on the left bank of Cole Creek. The pipe was submerged and water within the pipe was 12 in. deep. There are apartment buildings located in the area on the left bank. The sample was taken at the mouth of the submerged pipe and had a bacteria value of 2,460 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 1,310 MPN/100 mL. This pipe is a low priority referral site for the proper local authority.

Referral site: COL-FI1-34-D– Low Priority

This is an 82 in. diameter metal pipe located on the right bank of Cole Creek. The pipe was submerged and water within the pipe was 22 in. deep. There are commercial buildings located in the area on the right bank. The sample was taken at the mouth of the submerged pipe and had a bacteria value of 1,560 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 520 MPN/100 mL. This pipe is a low priority referral site for the proper local authority.

Referral site: COL-FI1-13-D – Investigate Further

This is a 36 in. diameter metal pipe located on the left bank of Cole Creek. When sampled on May 24, 2023, the water in the pipe was 0.5 in. deep and was flowing into the segment. Although the water in the pipe was cloudy and smelled like effluent, a sample taken 0.3 m downstream of the pipe had a bacteria value of < 100 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of > 242,000 MPN/100 mL. These results seemed suspicious and the pipe was revisited on June 14, 2023 to take additional samples but the pipe was not discharging into the segment at that time. On the revisit, a sample was taken from a pool below the pipe and from a riffle upstream of the pipe. Both of those samples resulted in bacteria values of < 100 MPN/100 mL. On May 24, 2023, a pipe about 460 m upstream of this pipe on the left bank was observed dripping about once every 30 seconds and was not sampled. The unsampled pipe (COL-FI1-NS-1) could have potentially been the source of the elevated bacteria for this site if it had been flowing heavier prior to the field team observing it only dripping during the time of the FI. Further investigation is recommended by the proper local authority to determine the source of elevated bacteria in this section of the segment. There are apartments and single-family homes located upstream of the site.

Referral site: COL-FI1-12-D – Investigate Further

This is a 38 in. diameter metal pipe located on the left bank of Cole Creek. A sample taken 1 m downstream of the pipe had a bacteria value of < 100 MPN/100 mL. The ambient sample collected upstream of the pipe had a bacteria value of 3,170 MPN/100 mL. The next sample taken about 100 m upstream (COL-FI1-11-D) of this location had a value of 1,460 MPN/100 mL. It was not apparent during the FI where the elevated bacteria were sourced from. Further investigation is recommended by the proper local authority to determine the source of elevated bacteria between the two locations. There are apartments and single-family homes located upstream of the site.

Referral site: COL-FI1-04-D– Investigate Further

This is an earthen tributary of Cole Creek on the left bank. An ambient sample taken within the tributary had a bacteria value of 750 MPN/100 mL and a sample taken upstream of the tributary had a bacteria value of 630 MPN/100 mL. During the WS, the tributary was not flowing but it was trickling during the FI. Further investigation is recommended by the proper local authority to determine the source of elevated bacteria within the tributary. There are single-family homes and commercial buildings located in the area of the tributary.

List of Acronyms and Abbreviations

AU	Assessment Unit
BIG	Bacteria Implementation Group
COL	Cole Creek 1017B_02
CRP	Clean Rivers Program
DS	Downstream
E. Coli	Escherichia coli
FI	Field Investigation
FY	Fiscal Year
GIS	Geographic Information Systems
H-GAC	Houston-Galveston Area Council
IF	Investigate Further
in.	inch
I-Plan	Implementation Plan
km	kilometer
LB	Left Bank
m	meter
mL	milliliter
MPN	Most probable number
N	No
NELAP	National Environmental Laboratory Accreditation Program
NLCD	National Land Cover Database
OSSF	On-Site Sewage Facilities
QAPP	Quality Assurance Project Plan
RB	Right Bank
SWQM	Surface Water Quality Monitoring
SWRC	Stroud Water Research Center
T or trib.	Tributary
TCEQ	Texas Commission on Environmental Quality
TMDL	Total Maximum Daily Load
US	Upstream
WS	Windshield Survey
Y-H	Yes – High Priority
Y-L	Yes-Low Priority

Literature Cited

Houston-Galveston Area Council (H-GAC). 2022. How's the Water? Basin Highlights Report. On-line resource, accessed March 21, 2023. Available from: https://www.h-gac.com/getmedia/42de64a6-36cf-4a3f-afd2-ba119322f853/How_s-the-Water_2022-FINAL-05-12-2022_1

Houston-Galveston Area Council Multi-Basin Quality Assurance Project Plan (H-GAC QAPP). 2022. Appendix J to the Houston-Galveston Area Council (H-GAC) Multi-Basin Clean Rivers Program FY 2022/2023. Targeted Monitoring in Selected Assessment Units (AUs). Houston, TX. Pp 74.

Stroud Water Research Center (SWRC). 2023. Model My Watershed [Software]. On-line resource, accessed March 20, 2023. Available from: https://wikiwatershed.org/

Texas Commission on Environmental Quality (TCEQ). 2012. Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods. Austin, TX. RG-415. Pp 202.

Texas Commission on Environmental Quality (TCEQ). 2022. 2022 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d). On-line resource, accessed March 21, 2023. Available from: https://www.tceq.texas.gov/waterquality/assessment/22twqi/22txir