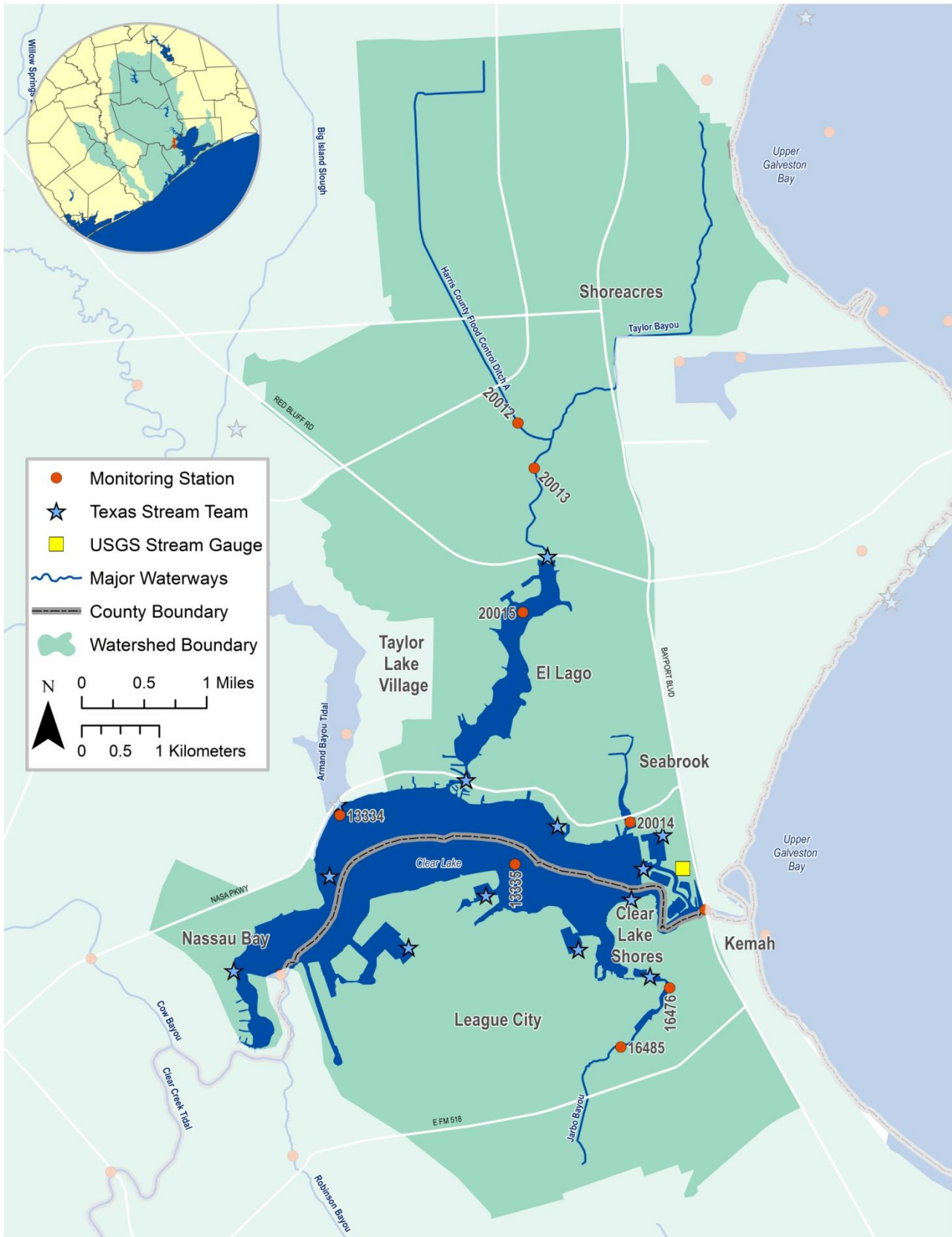
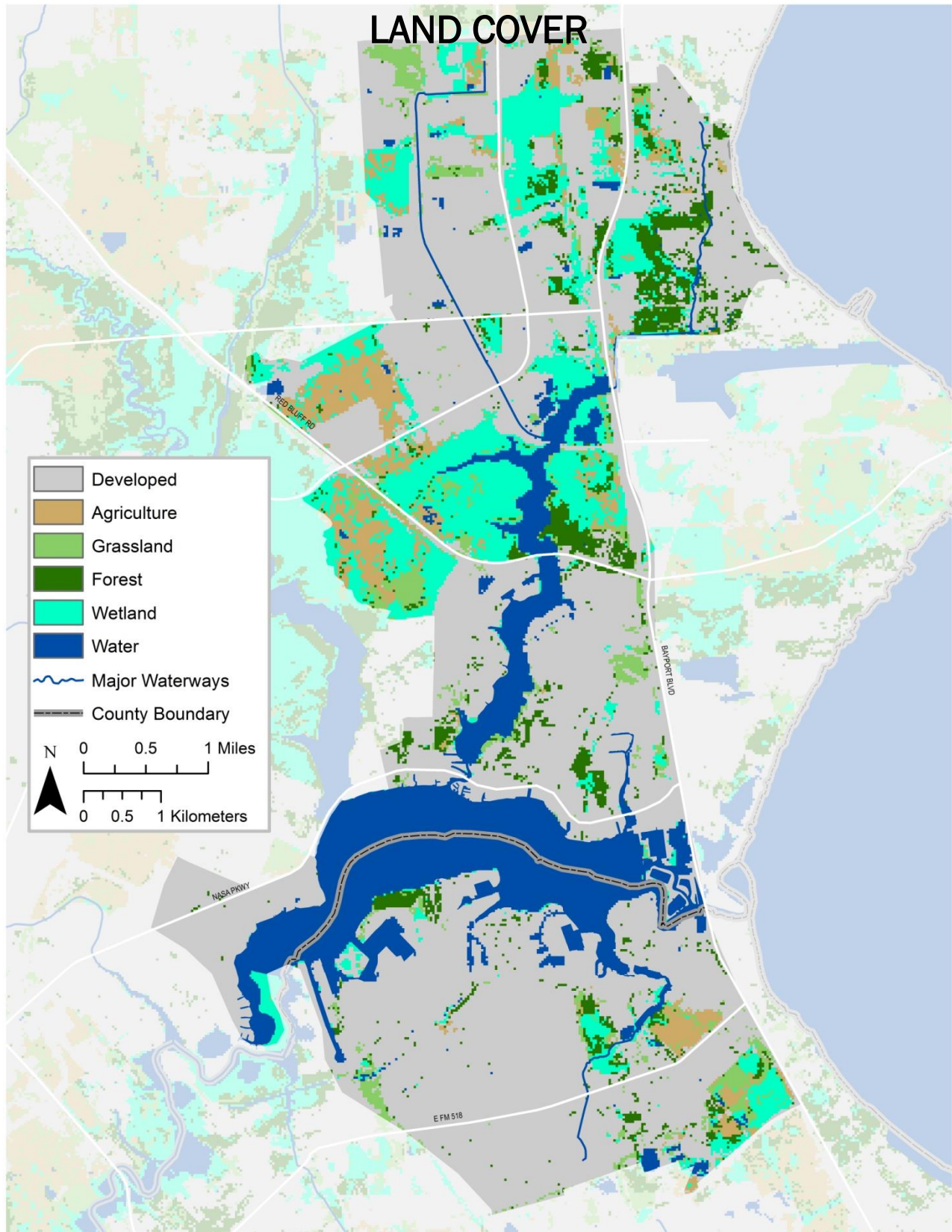


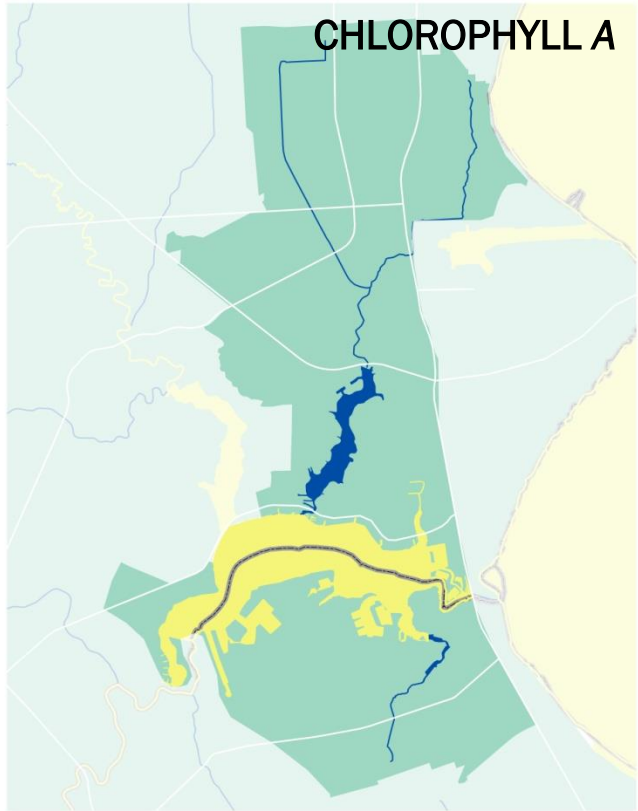
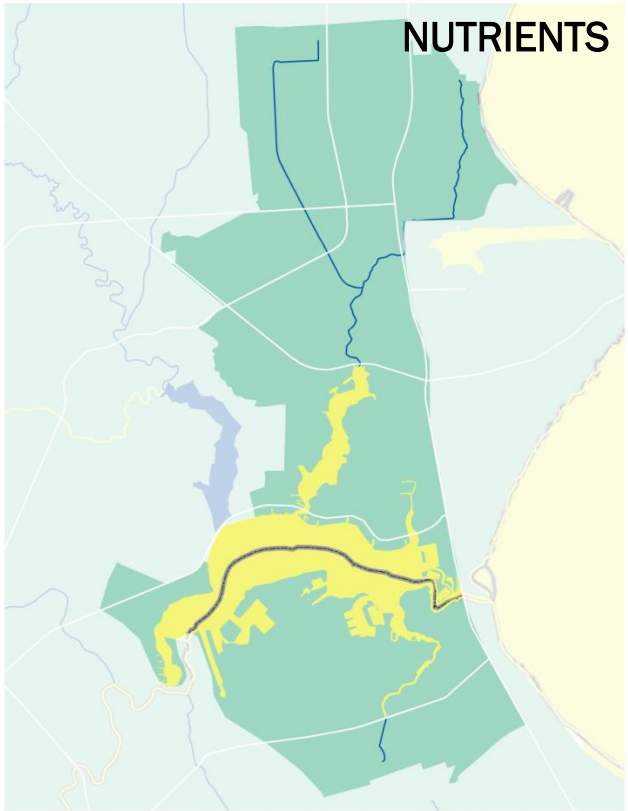
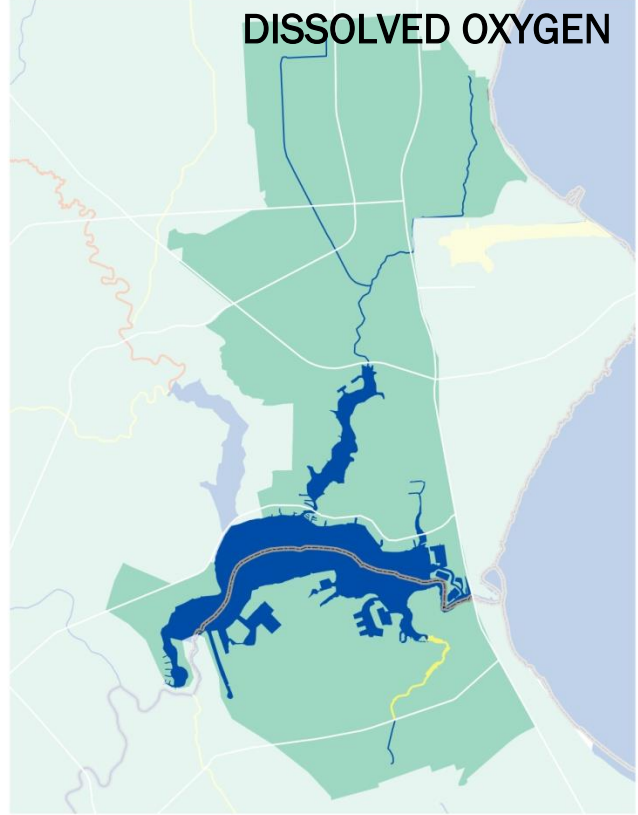
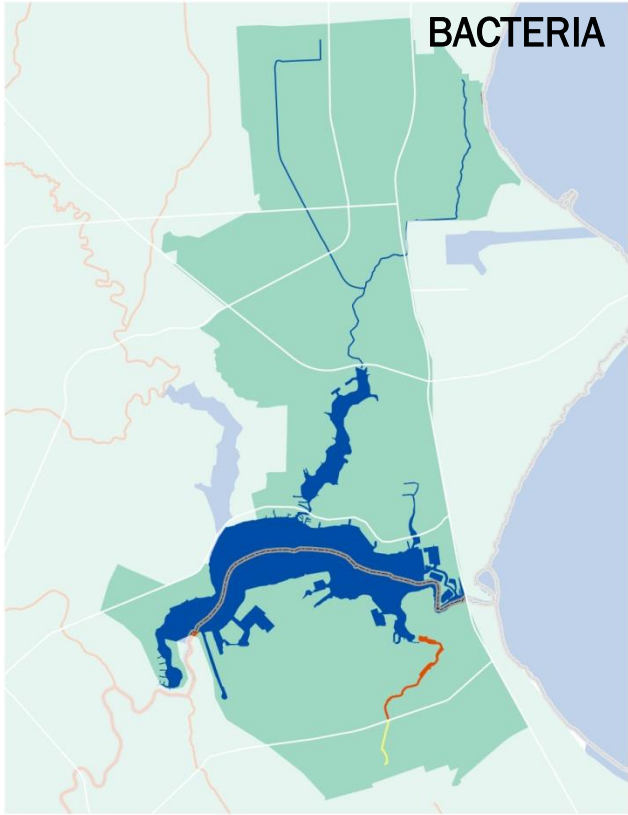
CLEAR LAKE - SEGMENT 2425



CLEAR LAKE - SEGMENT 2425

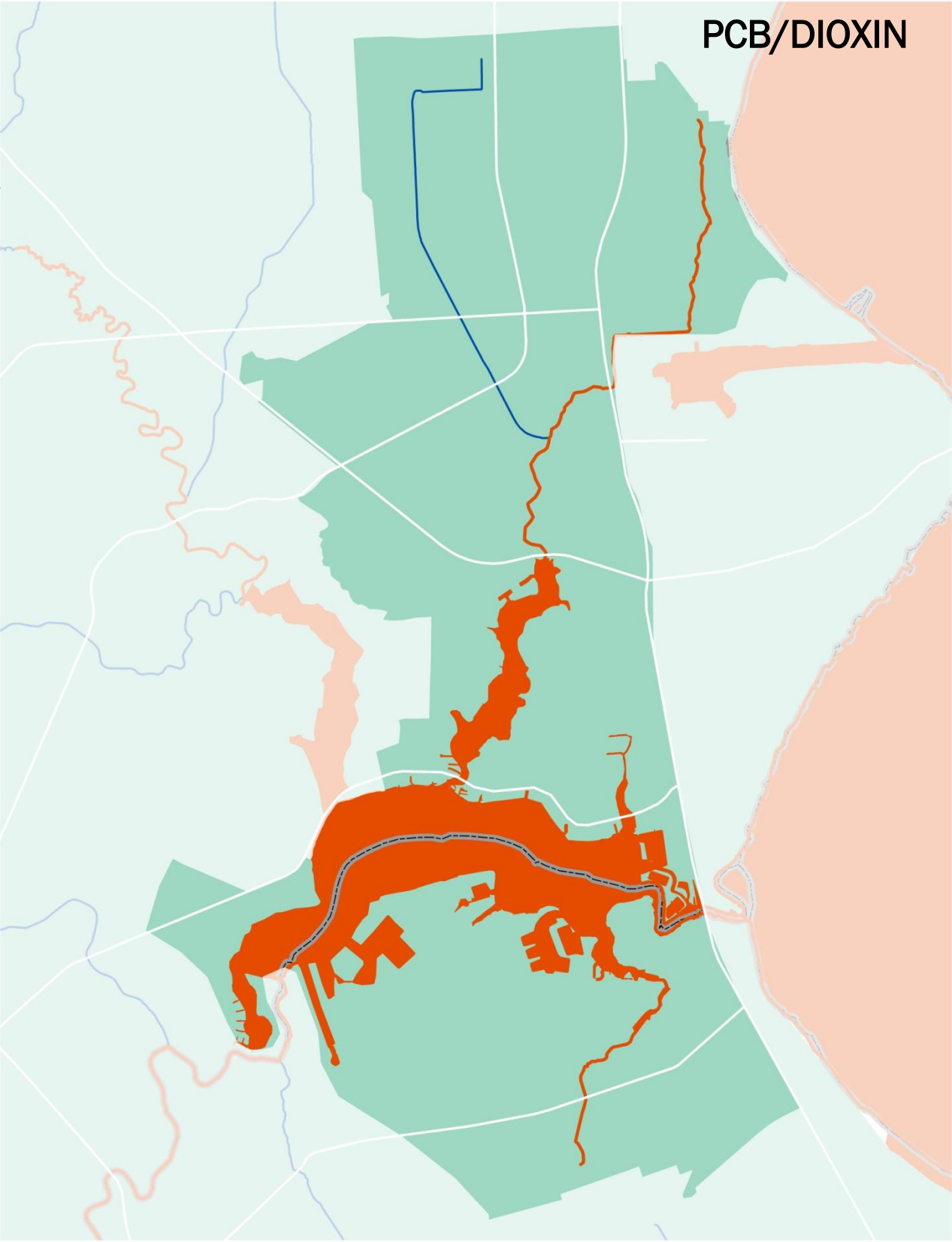
LAND COVER





 Impairment  Concern  No Impairments or Concerns

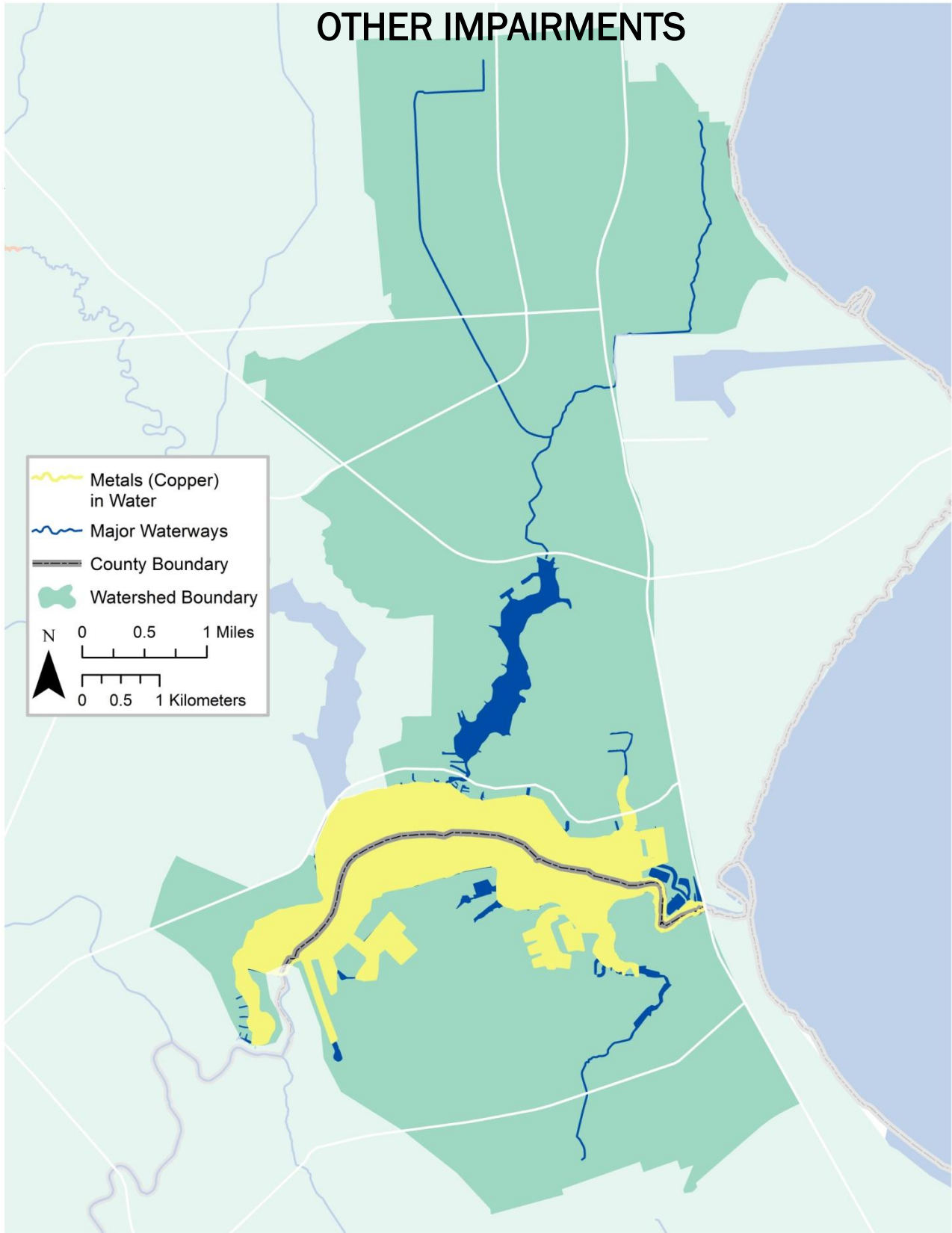
PCB/DIOXIN



~~~~~ Impairment    ~~~~~ Concern    ~~~~~ No Impairments or Concerns

# CLEAR LAKE - SEGMENT 2425

## OTHER IMPAIRMENTS



|                        |             |              |                   |
|------------------------|-------------|--------------|-------------------|
| <b>Segment Number:</b> | <b>2425</b> | <b>Name:</b> | <b>Clear Lake</b> |
|------------------------|-------------|--------------|-------------------|

|              |                |                            |            |                         |                                                     |
|--------------|----------------|----------------------------|------------|-------------------------|-----------------------------------------------------|
| <b>Area:</b> | 3 square miles | <b>Miles of Shoreline:</b> | 31.6 miles | <b>Designated Uses:</b> | Primary Contact Recreation 1; High Aquatic Life Use |
|--------------|----------------|----------------------------|------------|-------------------------|-----------------------------------------------------|

|                                              |   |                                    |    |                            |   |
|----------------------------------------------|---|------------------------------------|----|----------------------------|---|
| <b>Number of Active Monitoring Stations:</b> | 9 | <b>Texas Stream Team Monitors:</b> | 12 | <b>Permitted Outfalls:</b> | 1 |
|----------------------------------------------|---|------------------------------------|----|----------------------------|---|

|                     |                                                                                                                                                                                                                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Description:</b> | Segment 2425: A 5.2 square kilometer (2.0 square mile) brackish, tidally influenced water body on the western shore of Upper Galveston Bay that receives inflows from Clear Creek, Jarbo Bayou, Armand Bayou, and Taylor Lake, and also serves as the boundary between Galveston and Harris Counties. |
|                     | Segment 2425A (Estuary w/ high ALU): Taylor Lake (unclassified water body) – From the confluence with Clear Lake upstream to the terminus of Taylor Bayou south of Bay Forest Golf Club in La Porte in Harris County                                                                                  |
|                     | Segment 2425B (Tidal Stream w/ high ALU): Jarbo Bayou (unclassified water body) – From Clear Lake confluence with Clear Lake to 1.1 km (0.67 mi) upstream of FM 518 in Galveston County                                                                                                               |
|                     | Segment 2425D (Tidal Stream w/ high ALU): Taylor Bayou (unclassified water body) – From the Taylor Lake confluence to a point 4.6 km (2.8 mi) upstream of State Hwy 146                                                                                                                               |
|                     | Segment 2425E (Tidal Stream w/ high ALU): Harris County Flood Control Ditch A (unclassified water body) – From the Taylor Bayou confluence to a point 0.28 km (0.17 mi) downstream of Fairmont Parkway                                                                                                |

| Percent of Stream Impaired or of Concern |  |  |  |  |  |  |
|------------------------------------------|--|--|--|--|--|--|
|------------------------------------------|--|--|--|--|--|--|

| Segment ID | PCBs/Dioxin | Bacteria | Dissolved Oxygen | Nutrients | Chlorophyll a | Other |
|------------|-------------|----------|------------------|-----------|---------------|-------|
| 2425       | 100         | -        | -                | 100       | 100           | 100   |
| 2425A      | 100         | -        | -                | 100       | -             | -     |
| 2425B      | 100         | 100      | 77.7             | 77.7      | -             | -     |
| 2425D      | 100         | -        | -                | -         | -             | -     |
| 2425E      | -           | -        | -                | -         | -             | -     |

## Segment 2425

| Standards                                  | Bays & Estuaries | Tidal Streams | Screening Levels                  | Bays & Estuaries | Tidal Streams |
|--------------------------------------------|------------------|---------------|-----------------------------------|------------------|---------------|
| Temperature (°C/°F):                       | 35 / 95          | 35 / 95       | Ammonia-N (mg/L):                 | 0.10             | 0.46          |
| Dissolved Oxygen (24-Hr Average) (mg/L):   | 4.0              | 4.0           | Nitrate-N (mg/L):                 | 0.17             | 1.10          |
| Dissolved Oxygen (Absolute Minima) (mg/L): | 3.0              | 3.0           | Orthophosphate Phosphorus (mg/L): | 0.19             | 0.46          |
| pH (standard units):                       | 6.5-9.0          | 6.5-9.0       | Total Phosphorus-P (mg/L):        | 0.21             | 0.66          |
| Enterococci (MPN/100mL) (grab):            | 104              | 104           | Chlorophyll a (µg/L):             | 11.6             | 21            |
| Enterococci (MPN/100mL) (geometric mean):  | 35               | 35            |                                   |                  |               |

## FY 2016 Active Monitoring Stations

| Site ID | Site Description                                                                                | Frequency    | Monitoring Entity | Parameter Groups                                     |
|---------|-------------------------------------------------------------------------------------------------|--------------|-------------------|------------------------------------------------------|
| 13332   | Clear Lake at SH 146                                                                            | Bi-Monthly   | HCPHES            | Field, Conventional, Bacteria, Chlorophyll a (Qrtly) |
| 13334   | Clear Lake at NASA Rd 1 bridge                                                                  | Quarterly    | TCEQ              | Field, Conventional, Bacteria, Chlorophyll a         |
| 13335   | Clear Lake at CM 17                                                                             | Quarterly    | TCEQ              | Field, Conventional, Bacteria, Chlorophyll a         |
| 13335   | Clear Lake at CM 17                                                                             | Twice / Year | TCEQ              | Metals in Water                                      |
| 13335   | Clear Lake at CM 17                                                                             | Once / Year  | TCEQ              | Benthics, Metals in Sediment                         |
| 16476   | Jarbo Bayou at FM 2094                                                                          | Quarterly    | EIH               | Field, Conventional, Bacteria                        |
| 16485   | Jarbo Bayou at Lawrence Rd                                                                      | Quarterly    | EIH               | Field, Conventional, Bacteria                        |
| 20012   | Harris County Flood Control Ditch A Tributary to Taylor Bayou, 385 M upstream of confluence     | Bi-Monthly   | HCPHES            | Field, Conventional, Bacteria                        |
| 20013   | Taylor Bayou at mid Channel 400 M downstream of Port Road Bridge                                | Bi-Monthly   | HCPHES            | Field, Conventional, Bacteria                        |
| 20014   | Clear Lake Unnamed Inlet 115 M southwest of the intersection of NASA Road 1 and Oceanview Drive | Bi-Monthly   | HCPHES            | Field, Conventional, Bacteria                        |
| 20015   | Taylor Lake mid lake at blue windows 230 M south of Lakeway Drive dead end                      | Bi-Monthly   | HCPHES            | Field, Conventional, Bacteria                        |

## Water Quality Issues Summary

| Issue                                        | 2014 Assessment<br><i>I – Impaired</i><br><i>C – Of Concern</i> | Possible Causes / Influences / Concerns Voiced by Stakeholders                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Possible Solutions / Actions To Be Taken                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Elevated Levels of Indicator Bacteria</b> | 2425B I                                                         | <ul style="list-style-type: none"> <li>▪ Rapid urbanization and increased impervious cover</li> <li>▪ Constructed stormwater controls failing</li> <li>▪ Animal waste from agricultural production, hobby farms, and riding stables</li> <li>▪ Improper or no pet waste disposal</li> <li>▪ Developments with malfunctioning OSSFs</li> <li>▪ Waste haulers illegal discharges/improper disposal</li> <li>▪ Direct and dry weather discharges</li> <li>▪ Poorly operated or undersized WWTFs</li> <li>▪ WWTF non-compliance, overflows, and collection system by-passes</li> </ul> | <ul style="list-style-type: none"> <li>▪ Improve compliance and enforcement of existing stormwater quality permits</li> <li>▪ Improve construction oversight to minimize TSS discharges to waterways</li> <li>▪ Add water quality features to stormwater systems</li> <li>▪ Implement stream fencing or alternative water supplies to keep livestock out of or away from waterways</li> <li>▪ Create and implement Water Quality Management Plans for individual agricultural properties</li> <li>▪ Install and/or conserve vegetative buffer areas along all waterways</li> <li>▪ More public education on pet waste disposal</li> <li>▪ More public education regarding OSSF operation and maintenance</li> <li>▪ Ensure proper citing of new or replacement OSSFs</li> <li>▪ Increase monitoring requirements for self-reporting</li> <li>▪ Regionalize chronically non-compliant WWTFs</li> <li>▪ Require all systems to develop and implement a utility asset management program and protect against power outages at lift stations</li> <li>▪ Impose new or stricter bacteria limits than currently designated by TCEQ</li> </ul> |
| <b>Dissolved Oxygen Concentrations</b>       | 2425B C                                                         | <ul style="list-style-type: none"> <li>▪ Excessive nutrients from domestic lawn fertilizers</li> <li>▪ Excessive nutrients and organic matter from agricultural production, and related activities</li> <li>▪ Excessive nutrients and organic matter from WWTF effluent, SSOs, malfunctioning OSSFs, illegal disposal of grease trap waste, and biodegradable solid waste (e.ge., grass clippings and pet waste)</li> <li>▪ High temperature discharges from</li> </ul>                                                                                                            | <ul style="list-style-type: none"> <li>▪ Improve compliance and enforcement of existing stormwater quality permits</li> <li>▪ More public education regarding fertilizer use</li> <li>▪ Install and/or maintain riparian buffer areas between agricultural fields and waterways</li> <li>▪ Create and implement Water Quality Management Plans for individual agricultural properties</li> <li>▪ More public education on pet waste disposal</li> <li>▪ More public education regarding OSSF operation and maintenance</li> <li>▪ Ensure proper citing of new or replacement OSSFs</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |



|                                                   |                                         |  |                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------|-----------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                   |                                         |  | <ul style="list-style-type: none"> <li>industrial WWTFs</li> <li>Vegetative canopy removed</li> </ul>                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>More public education regarding disposal of household fats, oils, and grease</li> <li>Improve operation and maintenance of existing WWTF and collection systems</li> <li>Regionalize chronically non-compliant WWTFs</li> <li>Conserve or restore trees and habitat along waterways to maintain/create shade to cool water</li> <li>Work with drainage districts and agencies to change practices of clear cutting and channelizing waterways to protect from solar heating</li> </ul> |
| <b>Elevated Nutrients</b>                         | 2425 C<br>2425A C<br>2425B C            |  | <ul style="list-style-type: none"> <li>Fertilizer runoff from urbanized properties, such as landscaped areas, residential lawns, and sport fields</li> <li>Agricultural runoff from row crops, fallow fields, and animal operations</li> <li>WWTF effluent, sanitary sewer overflows, and malfunctioning OSSFs</li> </ul>                                             | <ul style="list-style-type: none"> <li>Implement YardWise and Watersmart landscape practices</li> <li>Create and implement Water Quality Management Plans for individual agricultural properties</li> <li>Install and/or maintain riparian buffer areas between agricultural fields and waterways</li> <li>Monitor phosphorus levels at WWTFs to determine if controls are needed</li> </ul>                                                                                                                                  |
| <b>PCBs/Dioxin in Edible Fish Tissue</b>          | 2425 I<br>2425A I<br>2425B I<br>2425D I |  | <ul style="list-style-type: none"> <li>Unknown industrial or urban sources</li> </ul>                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Encourage additional testing to locate all unknown sources/deposits</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Elevated Chlorophyll a Concentrations</b>      | 2425 C                                  |  | <ul style="list-style-type: none"> <li>Excess nutrients from residential lawns</li> <li>Fertilizer runoff from surrounding watershed promotes algal growth in waterways</li> <li>Nutrient loading from WWTF effluent, sanitary sewer overflows, and malfunctioning OSSFs promotes algal growth</li> </ul>                                                             | <ul style="list-style-type: none"> <li>Improve compliance and enforcement of existing stormwater quality permits</li> <li>Improve stormwater controls in new developments</li> <li>Educate residents about excessive fertilizer use</li> <li>Reduce or manage fertilizer runoff from agricultural areas</li> <li>More public education regarding nutrients and consequences</li> </ul>                                                                                                                                        |
| <b>Elevated Heavy Metals in Sediment (Copper)</b> | 2425 C                                  |  | <ul style="list-style-type: none"> <li>Discharges from domestic, agricultural, or industrial sources</li> <li>Build up in pipelines, pressure tanks, water heaters, and water softeners from industrial point sources</li> <li>Dissolution from natural deposits</li> <li>Particle deposition and re-suspension processes from dredging or tidal movements</li> </ul> | <ul style="list-style-type: none"> <li>Increase monitoring and enforcement efforts to identify and control industrial point sources</li> <li>Encourage additional testing to locate all unknown sources/deposits</li> </ul>                                                                                                                                                                                                                                                                                                   |

## Segment Discussion:

**Watershed Characteristics:** Clear Lake is home to one of the most concentrated fleets of recreational boats in Texas and the United States. Numerous marinas are located around the lake providing easy access to Upper Galveston Bay. On the south shore of Clear Lake, the watershed encompasses the Cities of League City, Clear Lake Shores and Kemah. High and low intensity residential and mixed commercial developments are the prominent land use for the majority of the south shore. The exception is an area of homes and businesses on small acreages in the southeast portion of the watershed.

The Cities of Nassau Bay, Pasadena, Taylor Lake Village, El Lago and Seabrook border the lake on the north shore. These cities are heavily urbanized with high and low intensity developments. Upstream of Red Bluff Road, the Taylor Lake (2425A) sub-watershed is mostly undeveloped with large tracts of wetlands, grasslands and forested land. Large industrial facilities are located along the major highway corridors of Bay Area Boulevard and Port Road in the upper reaches of the sub-watershed. The majority of the watershed developments are serviced by municipal wastewater collection and treatment systems.

**Water Quality Issues:** The 2014 Texas IR lists the downstream assessment unit of Jarbo Bayou (2425B\_01) as impaired for contact recreation due to elevated levels of the indicator species enterococci bacteria. According to the TCEQ assessment, the geomean for this assessment unit is 99 MPN/100 ml, which is more than two and half times the geomean standard of 35 MPN/100 ml. The upstream assessment unit of Jarbo Bayou (2425\_02) is listed in the 2014 IR for a concern for near nonattainment due to elevated levels of enterococci.

Segments 2425 Clear Lake, 2425A Taylor Lake, 2425B (Jarbo Bayou), and 2425D Taylor Bayou are listed in the 2014 IR for fish consumption impairments due to elevated levels of dioxin and PCBs found in edible fish tissue. The Texas Department of State Health Services has issued a Limited Fish Consumption Advisory for these segments.

Segments 2425, 2425A, and 2425B also have numerous concerns based upon water quality screening criteria levels. Approximately 85% of the total phosphorus samples in Clear Lake have been above the screening criteria level of 0.21 mg/L. In addition to the nutrient concerns, Clear Lake has a chlorophyll a water quality screening criteria concern with over 66% of samples exceeding the 11.6 micrograms/L screening criteria level. Clear lake also has a concern for near nonattainment for metals (copper) in water. Segment 2425A has nutrient concerns for water quality screening criteria levels for ammonia nitrogen, nitrate nitrogen, and total phosphorus. Approximately 35 percent of ammonia nitrogen samples, 40% of nitrate nitrogen samples, and 88 percent of total phosphorus samples were above the screening criteria levels for this segment. Segment 2425B is listed as having concerns for depressed dissolved oxygen and total phosphorus.

**Special Studies/Projects:** This segment is included in one TMDL project, the Galveston Bay System Survey for Dioxin and PCBs, which is currently under way. For more information, please refer to the Public Involvement and Outreach section of the 2016 Basin Summary Report.

**Trends:** Regression analysis of water quality data revealed a total of ten statistically significant parameter trends for four out of the five AUs located in the Clear Lake segment. The main Clear Lake AU had six significant parameter trends including increasing chloride, pH, salinity, and sulfate while total Kjeldahl nitrogen (TKN), and total suspended solids (TSS) are decreasing over time. Segment 2425B, Jarbo bayou, revealed two significant increasing trends in salinity and specific conductance (SPCond) while a decreasing trend in enterococci was detected for 2425D and 2425E.

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The 2014 Texas Integrated Report lists Jarbo Bayou as impaired for elevated levels of indicator bacteria. Regression analysis identified a relatively stable trend in [enterococci](#) concentrations for Jarbo Bayou, however, the majority of concentrations have remained significantly greater than the 35 MPN/100 standard during the period of record. Jarbo Bayou is also listed as having a concern for low dissolved oxygen (DO) levels in water. Analysis of [DO](#) data show most samples in compliance with state water quality standards with less than five samples falling below the 3.0 mg/L minimum standard since 2000.

A nutrient concern exists for the main Clear Lake AU, as well as for Taylor Lake and Jarbo Bayou. Regression analysis of total phosphorous (TP) ([2425A](#), [2425B](#)) and nitrate ([2425A](#)) for these AUs revealed relatively stable nutrient trends over time. Finally, Clear Lake is also listed as having a concern for elevated chlorophyll *a* concentrations. Analysis of [chlorophyll a](#) data for Clear Lake revealed that concentrations have remained stable with the majority of samples collected exceeding the 11.6 µg/L screening criteria since 2000.

## Recommendations

Continue collecting water quality data to support actions associated with any future watershed protection plan development and possible modeling.

Coordinate education efforts with other local TMDL and watershed protection plan efforts.

Pursue a new local partner to Clean Rivers Program to collect additional data that would help better isolate problem areas.

Support additional sampling to investigate sources of elevated dioxin and PCB levels.

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