**Metals (2013)**

Leon County's NPDES program requires trace element analysis monitoring for several stations throughout the County. Staff decided in 2012 to expand the trace element program to include all sampling locations to more accurately evaluate the County's watersheds. Trace elements naturally occur in very small amounts (few parts per million or less) in a given system. While a small amount of these elements are sometimes required for animal or plant life, many can be toxic at elevated levels **(Table 1)**.

**TABLE 1. Trace elements sampled for by Leon County.**

| Element | Anthropogenic Sources | Effects and Significance |
|---|---|---|
| Arsenic | Alloys, pesticides, wood preservative semiconductors | Toxic, possibly carcinogenic |
| Boron | Coal, detergents, used to make types of glass and ceramics | Essential trace element, toxic at higher levels, especially to arthropods, used to track sewer line and septic tank failures |
| Cadmium | Industrial discharge, mining waste, metal plating, plumbing, manufacture of phosphate fertilizers | Toxic to aquatic biota, carcinogenic to humans, kidney is critical target organ |
| Copper | Alloys, metal plating, electrical wiring, plumbing, automotive brake pads, mining, pesticides, roofs, gutters, flashing and other architectural elements | Essential trace element, toxic to vascular plants and algae at higher levels |
| Lead | Fuel additive, paint, bullets and shots (ammunition), fishing weights, lead acid batteries | Toxicity (anemia, kidney disease, nervous system), harmful to wildlife |
| Nickel | Alloys, electroplating, batteries, coins, industrial plumbing | Essential element in some animals, toxic at higher levels |
| Titanium | Alloys, used as a white pigment for toothpaste, soaps, makeup, paints, paper | Non-toxic, can be used to track sewer line and septic tank failures |
| Zinc | Galvanized metal surfaces, motor oil and hydraulic fluid, tire dust, industrial waste, wood preservatives, paints, plumbing, batteries, deodorants | Essential element in many metalloenzymes, aids in wound healing, toxic to plants at higher levels |

Toxic effects of heavy metals on freshwater organisms are related to water hardness (concentration of $Ca^{2+}$ and $Mg^{2+}$). A higher total hardness level prevents fish from absorbing metals such as lead, arsenic and cadmium into their bloodstream through their gills. Because of this, state water quality limits for heavy metals are partially derived from total hardness concentrations. The naturally acidic (i.e. low hardness) conditions of most Leon County streams and lakes means that a given amount of heavy metal is more toxic and that water quality limits are correspondingly lower.

Most Leon County soils have a low sorption capacity for metal ions due to high sand content, low pH and low organic material. These characteristics often result in metals being relatively mobile in the environment; meaning that metals can readily and sometimes continually disperse downstream and downwind of their sources.

The above factors are reflected by the several lakes and streams with trace element levels exceeding Class III water quality standards in 2013 (**Tables 2A and 2B**). The elements that exceeded Class III water quality standards include lead (22 stations), copper (six stations), cadmium (four stations), and zinc (two stations). Most of these exceedances are thought to be caused by relict anthropogenic sources combined with enhanced metal mobility due to the naturally acidic soil and water conditions commonly found in Leon County.

**Fisher Creek**

Fisher Creek's copper levels exceeded Class III water quality criteria during the 4$^{th}$ quarter of 2013. Prior to sampling, the area received 0.33 inches of rain that possibly allowed copper contaminated runoff to enter the creek.

**Harvey and Summer Creeks**

Harvey and Summer Creek lead levels exceeded Class III water quality criteria during the 3$^{rd}$ quarter. Due to the natural soil characteristics of these watersheds, lead from relict anthropogenic sources can migrate relatively easily through the soil, leaching into the surface waters. These surface waters are more susceptible to even low levels of lead due to lead's bioavailability at the stream's normally low pH levels.

**Lake Bradford Chain of Lakes**

Elevated lead levels in Lakes Bradford, Hiawatha and Cascade are thought to be due to both relict and potentially current sources. Relict anthropogenic sources of lead in the area include a former shooting range and the former Dale Mabry airfield, while possible current sources include the Tallahassee Regional Airport (aviation fuel). The acidic nature of these lakes causes increased lead due to the enhanced solubility of lead under low pH conditions. Because acidic systems like the Bradford Chain of Lakes are more sensitive to metals contamination, exceedance levels tend to be lower and oftentimes more frequent than a similar metal level in a more alkaline system.

**Lake Jackson and Lexington Tributary**

Copper levels exceeded Class III water quality criteria during the 4$^{th}$ quarter at both stations J05 (southeast Lake Jackson) and the Lexington Tributary station (station 26) that flows into this portion of Lake Jackson. The source(s) of copper are unknown at this time. The Lexington Tributary station also exceeded water quality criteria for lead during the 3$^{rd}$ quarter.

**Lake Iamonia**

The Bull Headley boat ramp station on Lake Iamonia exceeded Class III water quality criteria for lead during the 1st quarter sampling event. While relict anthropogenic sources could have contributed to the elevated lead levels, this site is often used for skeet shooting. The use of lead shot in shotgun shells normally used for this type of shooting may be contributing to elevated lead levels.

**Munson Slough and Lake Munson**

Both Munson Slough and Lake Munson exceeded Class III water quality criteria for lead several times in 2013. Relict anthropogenic sources such as leaded gasoline are most likely to be the cause of these exceedances.

**Lake Talquin**

The Lake Talquin stations LT1 (located at the Ben Stoutamire boat landing) and T0D (located approximately 0.6 miles northwest of station LT1) had high levels of lead, copper, zinc and cadmium during the 2nd quarter. Staff believes that these high levels may be associated with dock construction that occurred during the sampling period in the small cove where station LT1 is located. Station T0E2 (located approximately 0.6 miles northwest of Luther Hall Landing) also showed elevated levels of cadmium; however, the source of the cadmium is unknown.

**Ochlockonee River**

Station T02 (Ochlockonee River at State Route 20) also showed high levels of cadmium, copper, and lead during the 2nd quarter of 2013. Though not as high as the 2nd quarter, moderate levels of copper and lead were detected at station T02 during the 1st quarter of 2013. Lead levels were elevated at Station 100 (Ochlockonee River at Fairbanks Ferry Road) during the 2nd and 3rd quarter of 2013. It is assumed that the elevated results are associated with anthropogenic activities.

**Panther and Polk Creeks**

Panther and Polk Creek lead levels exceeded Class III water quality criteria during the 1st quarter. A recent controlled burn adjacent to Panther Creek and 0.5 inches of rain prior to sampling both Polk and Panther Creeks probably contributed to lead flushing out of the nearby soils into the creeks. Relict anthropogenic sources such as leaded gasoline are most likely the source of lead.

**Unnamed Creek at Chaires Road**

The unnamed creek that drains Lower Lake Lafayette into the St. Marks River had lead levels that exceeded Class III water quality criteria during the 2nd quarter. Relict anthropogenic sources and acidic soils/waters are thought to be the cause of this exceedance.

**TABLE 2A. Trace elements exceeding Class III water quality criteria in Leon County lakes.**

| Description | Station Number | Metal of Concern | Results µg/L | Criterion µg/L | Calendar Qtr. Exceeded* |
|---|---|---|---|---|---|
| **Bradford Chain of Lakes** | | | | | |
| Lake Bradford | B0B | Lead | 1.0, 0.71 | 0.54 | 1,4 |
| Lake Hiawatha | B0H | Lead | 0.83, 0.85 | 0.54 | 2,4 |
| Lake Cascade | B0C | Lead | 1.9, 1.2, 1.4, 1.3 | 0.54 | 1, 2, 3, 4 |
| **Lake Iamonia** | | | | | |
| Lake Iamonia at Bull Headley Ramp | LI1B | Lead | 1.0 | 0.54 | 1 |
| **Lake Jackson** | | | | | |
| Lake Jackson | J05 | Copper | 3.8 | 2.85 | 4 |
| **Lake Munson** | | | | | |
| Lake Munson Station 1 | LMU8 | Lead | 2.0 | 1.28 | 1 |
| Lake Munson Station 2 | LMU7 | Lead | 3.8 | 1.18 | 1 |
| **Lake Talquin** | | | | | |
| Lake Talquin at Ben Stoutamire Boat Landing | LT1 | Lead | 22.2 | 0.54 | 2 |
| Lake Talquin at Ben Stoutamire Boat Landing | LT1 | Cadmium | 2.8 | 0.097 | 2 |
| Lake Talquin at Ben Stoutamire Boat Landing | LT1 | Copper | 36 | 2.85 | 2 |
| Lake Talquin at Ben Stoutamire Boat Landing | LT1 | Zinc | 35,900 | 37.02 | 2 |
| Lake Talquin West | T0D | Lead | 4.2 | 0.54 | 2 |
| Lake Talquin West | T0D | Cadmium | 6.0 | 0.097 | 2 |
| Lake Talquin West | T0D | Zinc | 62.4 | 37.02 | 2 |
| Lake Talquin near Luther Hall Landing | T0E2 | Cadmium | 0.34 | 0.10 | 2 |

*1-1st quarter, 2-2nd quarter, 3-3rd quarter, 4-4th quarter

**TABLE 2B. Trace elements exceeding Class III water quality criteria in Leon County streams and rivers.**

| Description | Station Number | Metal of Concern | Results µg/L | Criterion µg/L | Calendar Qtr. Exceeded* |
|---|---|---|---|---|---|
| **Munson Slough** | | | | | |
| Munson Slough above Lake Munson | MS1 | Lead | 2.1 | 1.41 | 1 |
| Munson Slough below Lake Munson Dam | MS2 | Lead | 2.1, 3.1 | 1.29, 0.94 | 1,3 |
| Munson Slough at Oakridge Road | MS4 | Lead | 1.2, 1.3 | 1.17, 1.0 | 1,3 |
| **Ochlockonee River** | | | | | |
| Ochlockonee River at Fairbanks Ferry | 100 | Lead | 1.1, 1.7 | 0.54, 0.58 | 2,3 |
| Ochlockonee River at 20 | T02 | Lead | 0.79, 14.4 | 0.54 | 1,2 |
| Ochlockonee River at 20 | T02 | Cadmium | 2.0 | 0.1 | 2 |
| Ochlockonee River at 20 | T02 | Copper | 10.2, 28.5 | 2.85 | 1,2 |
| Ochlockonee River at 20 | T02 | Lead | 14.4 | 0.54 | 2 |
| **Fisher Creek** | | | | | |
| Fisher Creek at Springhill Road | 50 | Copper | 17 | 2.85 | 4 |
| **Harvey Creek** | | | | | |
| Harvey Creek at 20 | 39 | Lead | 1.0 | 0.54 | 3 |
| **Lexington Tributary** | | | | | |
| Lexington Tributary | 26 | Copper | 3.8 | 3.04 | 4 |
| Lexington Tributary | 26 | Lead | 1.3 | 0.75 | 3 |
| **Panther Creek** | | | | | |
| Panther Creek | 12 | Lead | 1.0 | 0.54 | 1 |
| **Polk Creek** | | | | | |
| Polk Creek | 38 | Lead | 1.1 | 0.54 | 1 |
| **Summer Creek** | | | | | |
| Summer Creek at Bannerman Road | 22 | Lead | 0.73 | 0.54 | 3 |
| **Unnamed Creek at Chaires Road** | | | | | |
| Unnamed Creek at Chaires Road | 57 | Lead | 1.1 | 0.54 | 2 |

*1-1st quarter, 2-2nd quarter, 3-3rd quarter, 4-4th quarter