



Florida Department of Environmental Protection

Investigations of Sucralose and Select Pharmaceuticals and Pesticides as Tracers for Contaminants of Concern in Florida's Ambient Freshwaters

Division of Environmental Assessment and Restoration
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The Question

In 2011 we were asked by our Division Director, 'How prevalent are emerging contaminants in Florida's ambient freshwaters?'.





Contaminants of Concern AKA Emerging Contaminants

- Chemicals and microorganisms which are not included in routine monitoring that pose a real or perceived threat to the environment
- Lack published human health or aquatic life criteria and their synergistic effects are largely unknown.
- Effects may include behavior modification, reduced fecundity, sterility and increased mutagenicity and toxicity



Contaminants of Concern

- **Organic Waste Water Compounds**
 - pharmaceuticals and personal care products (PPCPs), synthetic hormones, disinfectant by-products
- **Current Use Pesticides (over 20,000!)**
- **Brominated Flame Retardants**
 - found in furniture, mattresses, carpet padding, insulation, & automobile seats
- **Akylphenolic Substances**
 - additives for fuels, and lubricants
- **Perfluorinated Compounds (PFCs)**
 - surfactants including fire fighting foam, used in the production of teflon and other fluorinated polymers
- **Chlorinated Paraffins**
 - lubricants, plasticizers, flame retardants, plastic products including PVC pipe



How to address the Q???

- Can't sample for all of these compounds!
- Need indicators to predict where they may be found.
- FDEP's probability-based status monitoring network a good place to add indicators to estimate occurrence statewide





Indicators of Emerging Contaminants

- **Sucralose** (provided by DEP lab since 2010)
 - Wastewater
- **Pharmaceuticals at trace levels** (provided by DEP lab since 2014)
 - Wastewater (acetaminophen is mostly removed by wastewater treatment)
- **Pesticides at trace levels** (provided by DEP lab since 2013)
 - Land use applications





Sucralose

- Not metabolized by body and is not removed by waste treatment
- Typical values found in receiving waters impacted by sewage treatment effluent - 0.004 - 10 $\mu\text{g}/\text{L}$





Select Pharmaceuticals

- **Acetaminophen** – Anti-pain
 - Removed by standard wastewater treatment
- **Carbamazepine** – Anti-seizure
 - May be removed by standard wastewater treatment
- **Primidone** – Anticonvulsant
 - May be removed by standard wastewater treatment





Select Pesticides

Occurrence in absence of Sucralose and Pharmas may indicate land use application practices

- **Imidicloprid** – Most widely use insecticide in the world
 - Widespread use in agriculture, termiticide, pet protection
- **Diuron** - Herbicide
 - Used for weed control
- **Linuron** - Herbicide
 - Used for weed control



FDEP's Status Monitoring Network

GOALS:

- Characterize statewide water resource conditions
- Infer percentage of each resource that meets standards or designated use (surface & ground water) with known confidence



Status Sample Survey Design

- Random Stratified
 - Strata include
 - Water Resource: canals, rivers, streams, large and small lakes, and confined and unconfined aquifers
 - Geography: 6 regions based on the Florida Water Management District boundaries

2015 Design Document found at

<http://www.dep.state.fl.us/water/monitoring/pubs.htm>

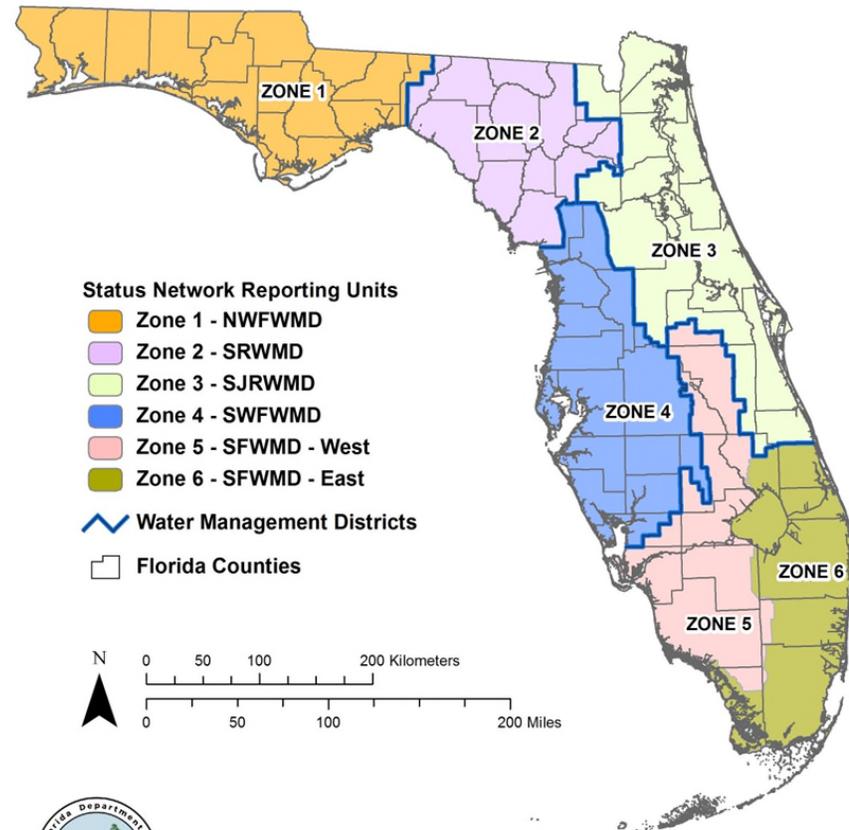


Probabilistic Design

Random Stratified

- 7 water resources
- 6 geographic areas
 - 15 random samples per surface water resource per zone per year
 - 20 randomly selected wells per ground water resource per zone per year

Watershed Monitoring Reporting Units



Created August 24, 2015 by Florida Department of Environmental Protection staff in the Division of Environmental Assessment and Restoration, Watershed Monitoring Section. This map is a representation of ground conditions and is not intended for further analysis. For more information contact (850)-245-8433.



Sampling Process

- Reconnoiter first site. If site falls into one of the 'exclusion categories', exclude site, record reason for exclusion and move on to next site in the site list.
- Continue procedure until desired number of sites are sampled or the random selections of the resource are exhausted.



Random Sample Surveys

Sucralose added to all status monitoring for 2012

- Results show presence in all water resources is ubiquitous, with the exception of confined aquifers.
 - Values ranged from 0.018 - 27 $\mu\text{g/L}$



Pharmaceutical and Pesticide Sample Surveys

- Select pharmaceuticals/pesticides and sucralose added to Status resources for 2015 sample survey.
- Did not add them to confined aquifers due to low occurrence of sucralose in 2012 survey.



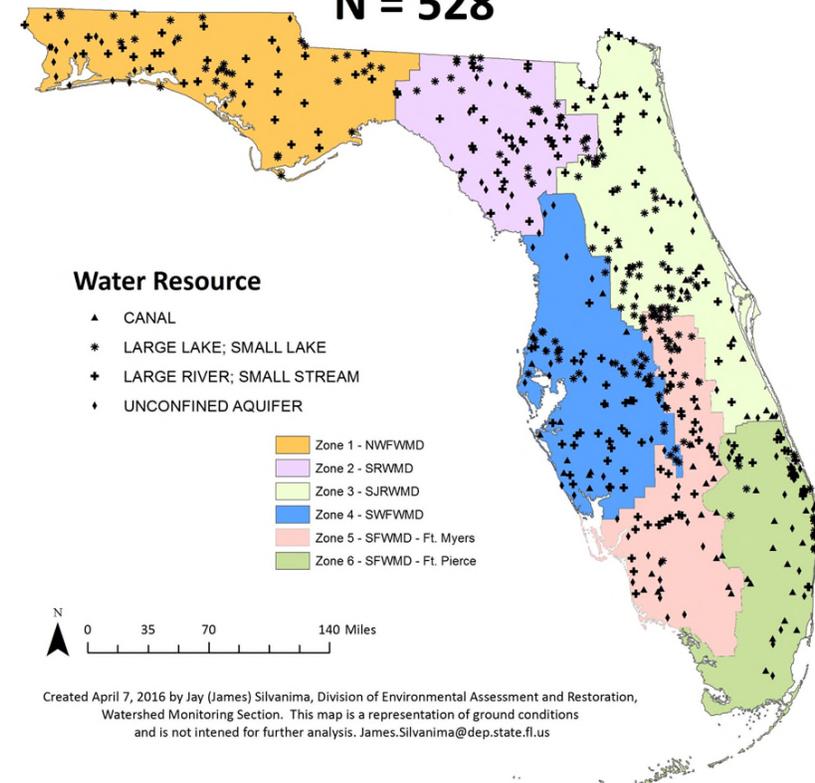
2015 Sample Surveys

■ Sucralose, pharmaceuticals and pesticides collected at 528 sites

- 60 canal sites
- 90 river sites
- 90 stream sites
- 90 large lake sites
- 78 small lake sites
- 120 unconfined wells

2015 Status Sites Sampled for Select Pharmas/Pesticides

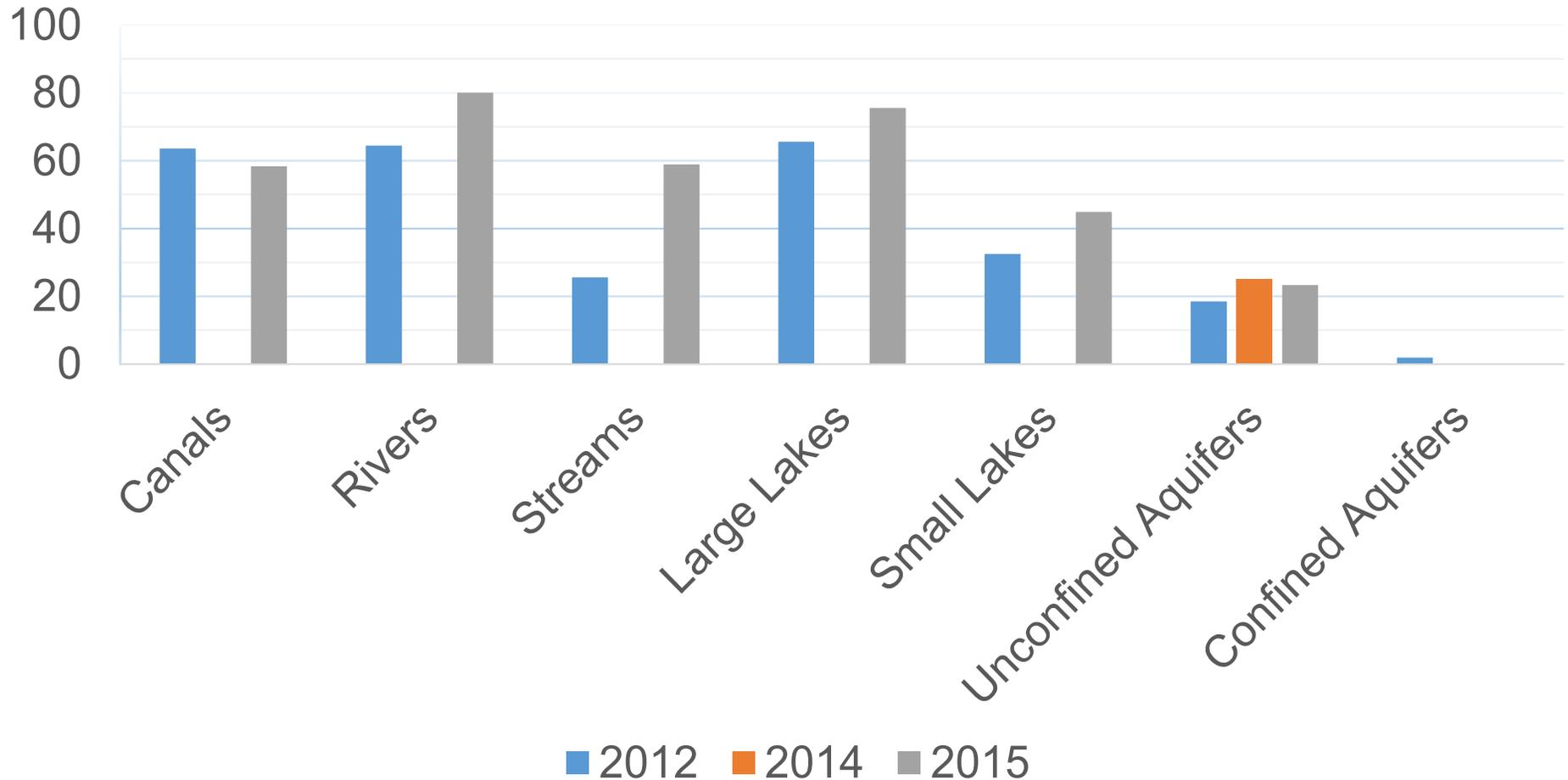
N = 528





2015 Sample Surveys

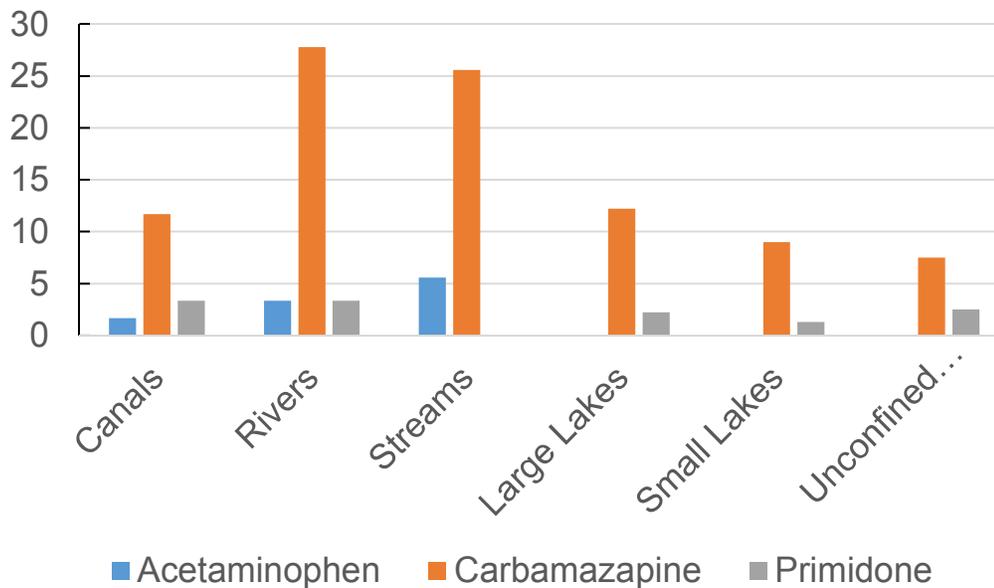
Water Resource % with Detectable Sucralose





2015 Sample Surveys

Water Resource % with Detectable Pharmaceuticals



■ Acetaminophen

- 9 detections (0.002 $\mu\text{g/L}$ to 0.011 $\mu\text{g/L}$) only one quantified.

■ Carbamazapine

- 82 detections of carbamazepine (0.00044 $\mu\text{g/L}$ to 0.068 $\mu\text{g/L}$) 21 quantified. Notice the MDL is ~ an order of magnitude lower than Acetaminophen/Primidone

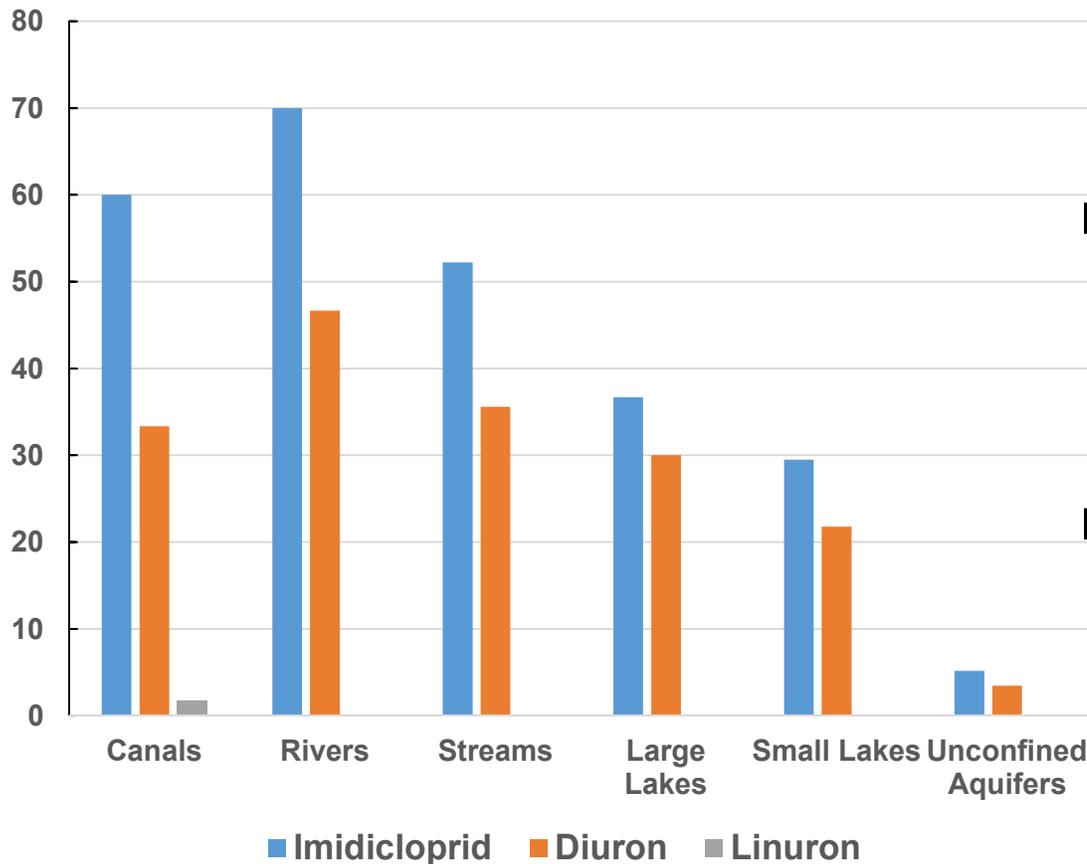
■ Primidone

- 11 detections (0.0058 $\mu\text{g/L}$ to 0.088 $\mu\text{g/L}$) two quantified.



2015 Sample Surveys

Water Resource % with Pesticide Detection



■ Imidicloprid

- 210 detections (0.0021 $\mu\text{g/L}$ to 0.52 $\mu\text{g/L}$), 103 quantified.

■ Diuron

- There were 142 detections (0.002 $\mu\text{g/L}$ to 0.35 $\mu\text{g/L}$), 58 were quantified.

■ Linuron was found at one canal site

- 0.2 $\mu\text{g/L}$ and it was quantified



Summary

While no existing health or aquatic benchmarks were exceeded

- Very low levels of human waste indicators are found in all status resources in Florida.
- Very low levels of the commonly used pesticides imidicloprid and diuron are found in all status surface waters and in status unconfined wells.



Next Steps

- We are pursuing means to integrate these indicators into some of our monitoring plans (strategic and basin management action plan monitoring).
- Investigating additional sampling means (passive sampling devices) to collect a more extensive list of contaminants, including hormones.



Acknowledgements

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- Andy Woeber & Stephanie Sunderman – WMS FDEP
 - Geographic Information Systems and Quality Assurance



Questions?

Watershed Monitoring's Web Page:

<http://www.dep.state.fl.us/water/monitoring/index.htm>

The screenshot shows the Florida Department of Environmental Protection's Watershed Monitoring web page. The page is titled "Watershed Monitoring" and features a navigation menu with links for "DEP Home", "About DEP", "Programs", "Contact", "Site Map", and "Search". The main content area is divided into two columns: "Watershed Monitoring" and "Highlights". The "Watershed Monitoring" section includes a heading "Watershed Monitoring" and a photograph of a river. The text describes the program's goals and provides information about the Integrated Water Resource Monitoring Network (IWRM). The "Highlights" section lists various resources such as "Interactive Water Quality Report Cards", "Status Network", "Trend Network", "Water Quality Data", "Watershed Monitoring Sampling Manual", "Sediment Guidelines", "Reports, Documents, and Links", and "Contacts". The "Information" section lists links for "Data", "DEP Districts", "Contacts", "Forms & Applications", "Permits", "Public Notices", and "Publications".

Florida Department of Environmental Protection

DEP Home About DEP Programs Contact Site Map Search

Watershed Monitoring

Watershed Monitoring

One of FDEP's top priorities is "getting the water right". The process begins with collecting reliable data. FDEP's Watershed Monitoring Program (WMP) fills this role by taking water samples from rivers, streams, lakes, canals, and wells around the state. Laboratory scientists measure the levels of certain "indicator" substances in each sample. Dissolved oxygen, nutrients, and bacteria are examples of these water quality indicators. Other sections in FDEP use the measurements to determine which waters are impaired and what should be done to restore them. The success of these plans is dependent upon accurate and representative data.

In 1996, FDEP updated its water monitoring strategy to increase efficiency and save money. The new program, called the Integrated Water Resource Monitoring Network (IWRM), monitors Florida's water at three spatial scales or "tiers". Tier I relates to the state as a whole. Tier II includes basin-scale monitoring to identify and confirm impaired waters. Tier III consists of site-specific monitoring to determine regulatory compliance. Results from IWRM are used in the state's [Integrated 303\(d\) / 305\(b\) Report](#) to the U.S. Environmental Protection Agency.

Several FDEP and regional monitoring groups work together to achieve the goals of IWRM. The role of the WMP is to manage two programs in Tier I: the [Status](#), and [Trend](#) monitoring networks. These programs have distinct but complementary goals. Briefly, the Status Network provides a snapshot of Florida's current water quality; the Trend Network measures changes over time. Open the links above for more details. The WMP developed a new design for these networks in 2009, and made some minor revisions in 2012. See the latest [Design Document](#) for more information.

Along with participation in IWRM, the WMP staff leads the [Florida Water Resources Monitoring Council](#). The Council aims to enhance communication among monitoring groups to reduce duplication of efforts and to coordinate fresh and marine monitoring programs.

Please browse the links at right for more information on Watershed Monitoring's programs, reports, and data. For further assistance, call us at **(850) 245-8433**.

Highlights

- [Interactive Water Quality Report Cards](#)
- [Status Network](#)
- [Status Network Brochure](#)
- [Trend Network](#)
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