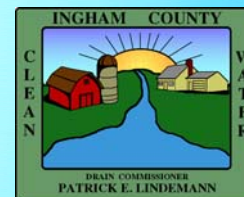


Red Cedar River - Clean Water  
Healthy Environment

INCLUDING

Land Development - Better Economy  
More Jobs

**MONTGOMERY DRAIN**

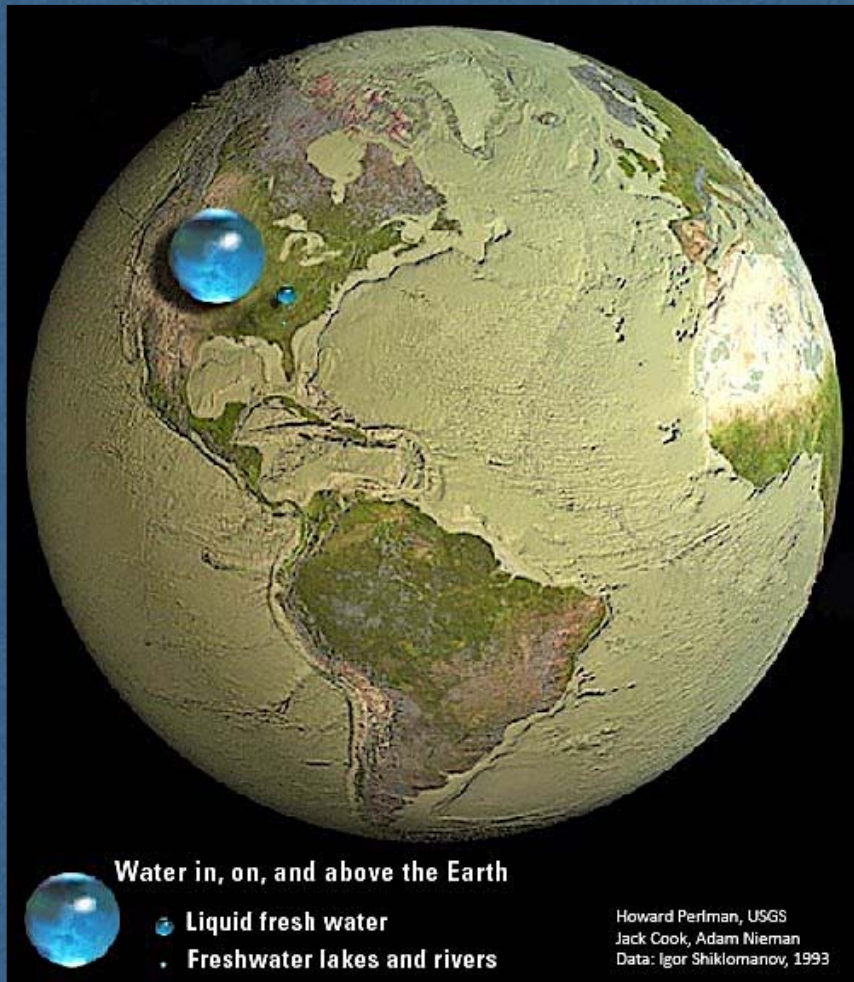




1966 MSU's Campus Canoe Livery

The problem  
Many years of  
land-use abuse

How could we  
ever have let this  
happen to our  
water resources?



It seems remarkable to me that the earth which seems to have so much water, has so little water.

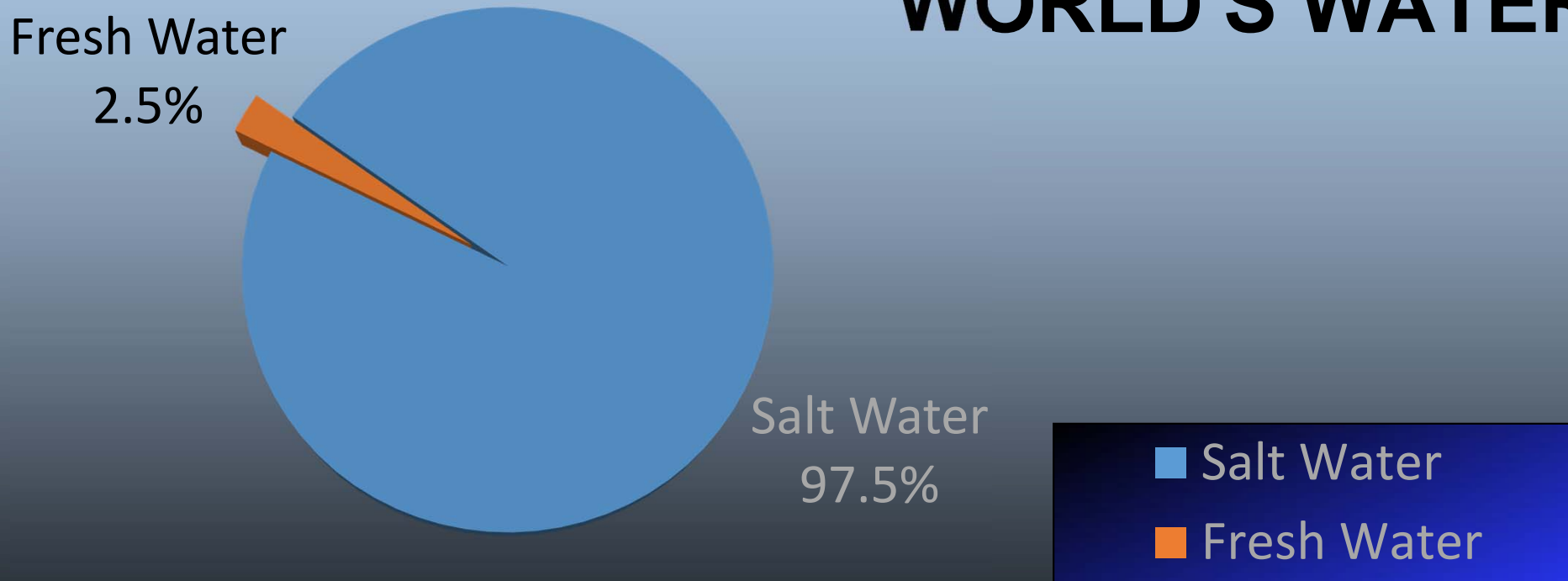
This graphic shows all the water in the world. The reality is, our water is really a thin layer on our globe's surface.

Note the size relationship between how much freshwater there is, compared to all the water there is.



70% of the world is covered in water.

## WHERE IS THE WORLD'S WATER?



# 2.5% of all the World's Water is Fresh Water



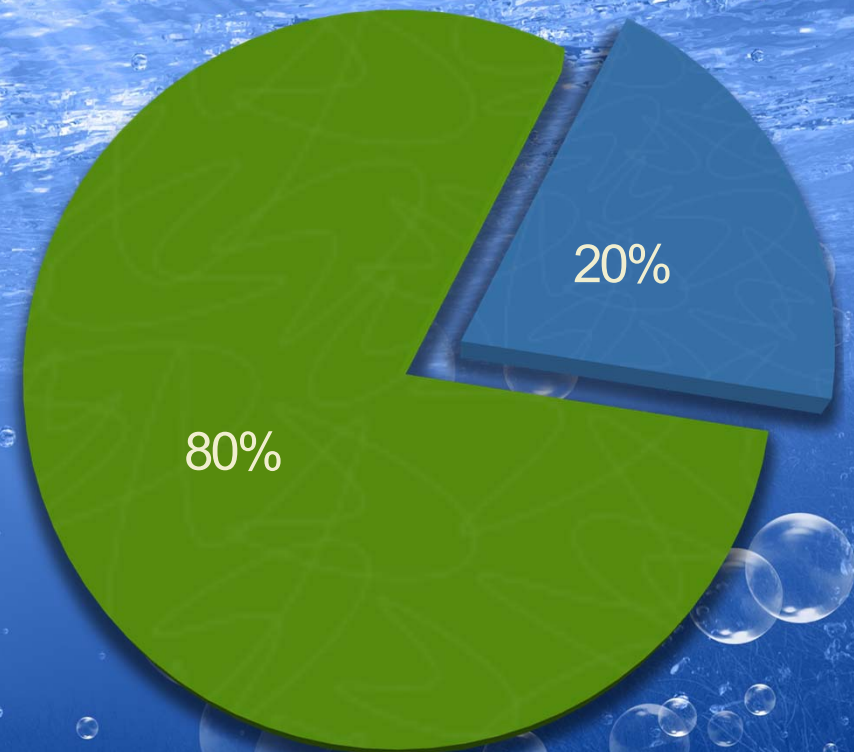
Usable Surface or  
Shallow Ground  
Water  
0.4%

Most of the world's fresh water is not easily reached and therefore not available to our use

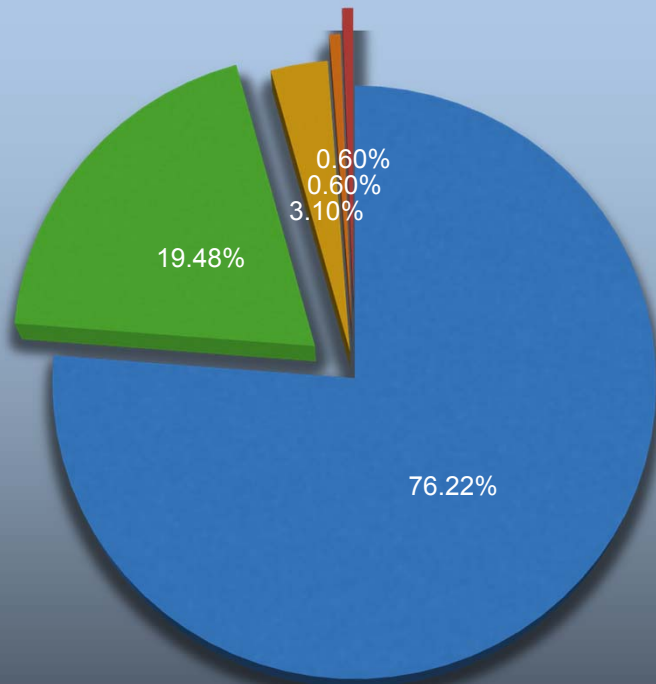
- Fresh water Tied up in Glaciers
- Deep Ground Water
- Usable Surface or Shallow Ground Water



**Of the World's accessible or usable  
0.4% Fresh Water  
about 20% is in the  
Great Lakes Basin**



- Great Lakes
- The Rest of the World



## Project Goal

- ◆ The design concept for the Montgomery Drain can manage and clean 95.7% of all the storm events.
- ◆ Leaving only 4.3% partially cleaned.
- ◆ The design criteria for this project is to collect, store and clean the storm water before it is sent to the Red Cedar River.
- ◆ The capacity of this system can handle slightly over a 2 inch storm in 48 hours (which represents roughly 96% of all the storms).

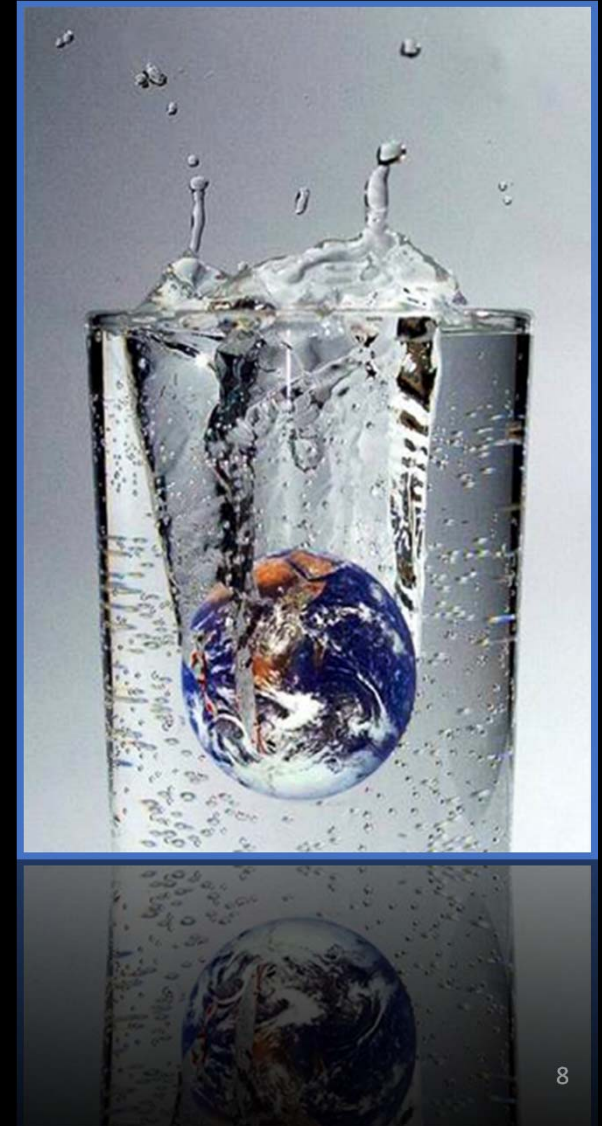
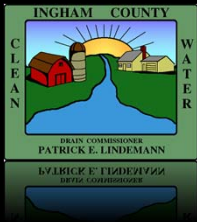
■ 0-1in ■ 1-2in ■ 2-3in ■ 3-4in ■ 4in+

# Improving Water Quality by managing the World's Fresh Water

Not for short term gain, but for the future

What folly we perform when  
we act contrary to our best  
interest

why do we do it?  
how can we stop?





# How Clean is Clean?

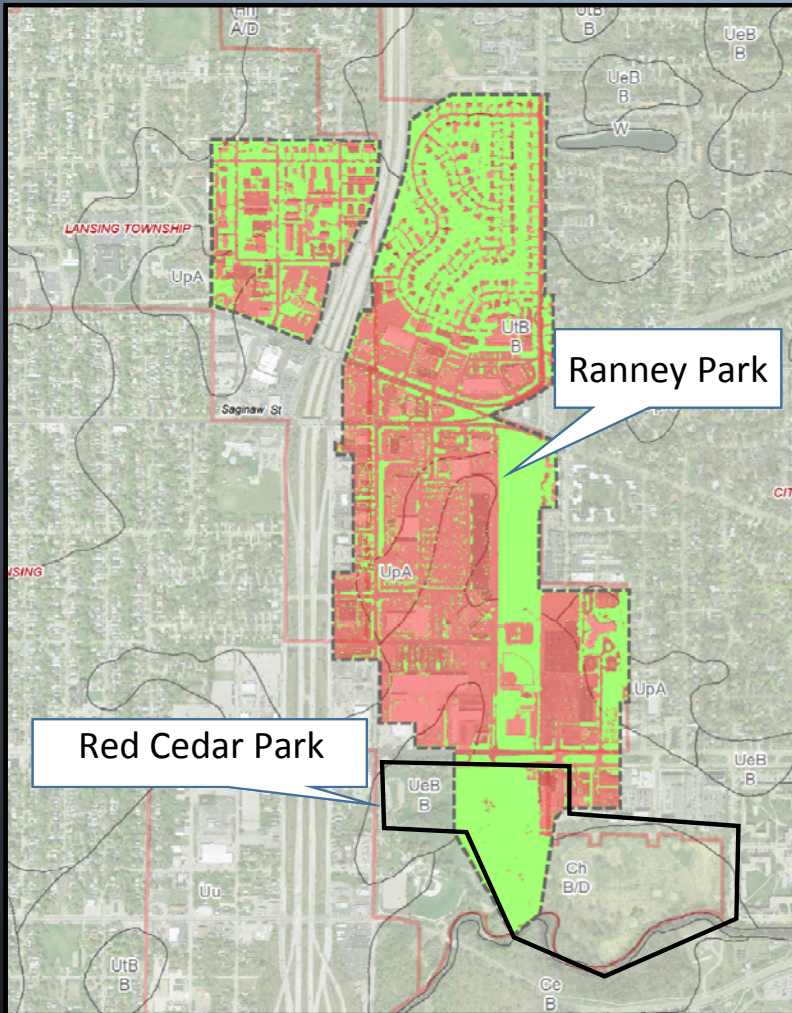
## The Clean Water Act of 1972 Sets the Standard

- **“Fishable and swimmable” wherever attainable by 1983**
- Elimination of the discharge of pollutants (zero discharge) by 1985
- Prohibition of the discharge of “toxic pollutants in toxic amounts.”
- “Restore and maintain the chemical, physical, and biological integrity of the Nation’s water”

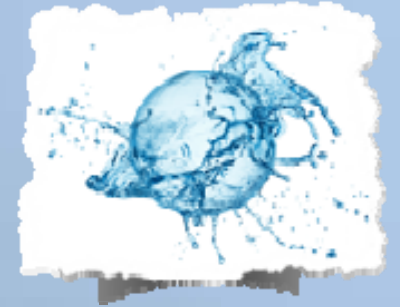


## Intensive Land Use

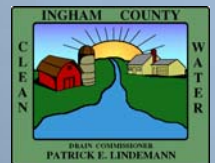
Montgomery Drain's watershed is about 80% impervious. The stormwater from any storm event makes it to the Red Cedar River in a matter of hours or less, untreated and heavily polluted from impervious surfaces of its watershed.



A watershed is a geographical area which holds a system of many complex and interrelated sets of an ecosystem (layers) that are interdependent on a common flow of energy, material transport (waste removal), and nutrient input and output as a result of water collection, storage and movement.



Patrick E. Lindemann (1996)



# Grants for this Project.

SAW Grant

2016 Grant Award anticipated  
\$1,537,000 total amount  
\$1,319,417 state portion

MDNR GRANT

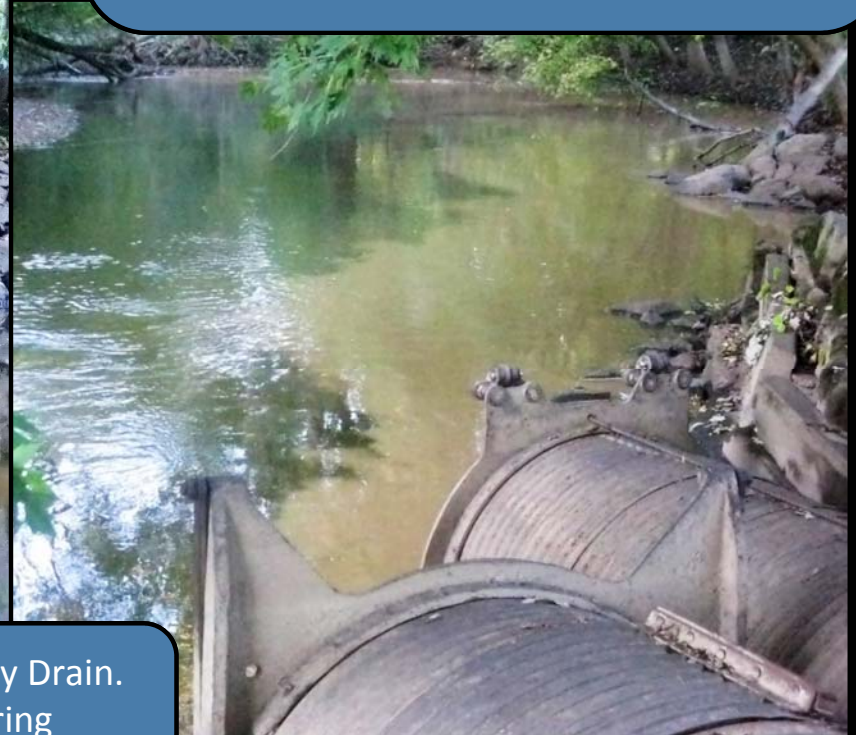
2017 Grant applied for  
\$500,000 total



## A PROBLEM WAS FOUND MID-90'S



In 1995, and for many years after, the Drain Commissioners of Ingham and Livingston County's, looked closely at 236 County Drains tributary to the Red Cedar River in both counties. Detailed analyses showed that this drain was by far the most polluted.



These Pictures show Pollution coming from the Montgomery Drain. Draining into the Red Cedar River on a sunny day in late spring



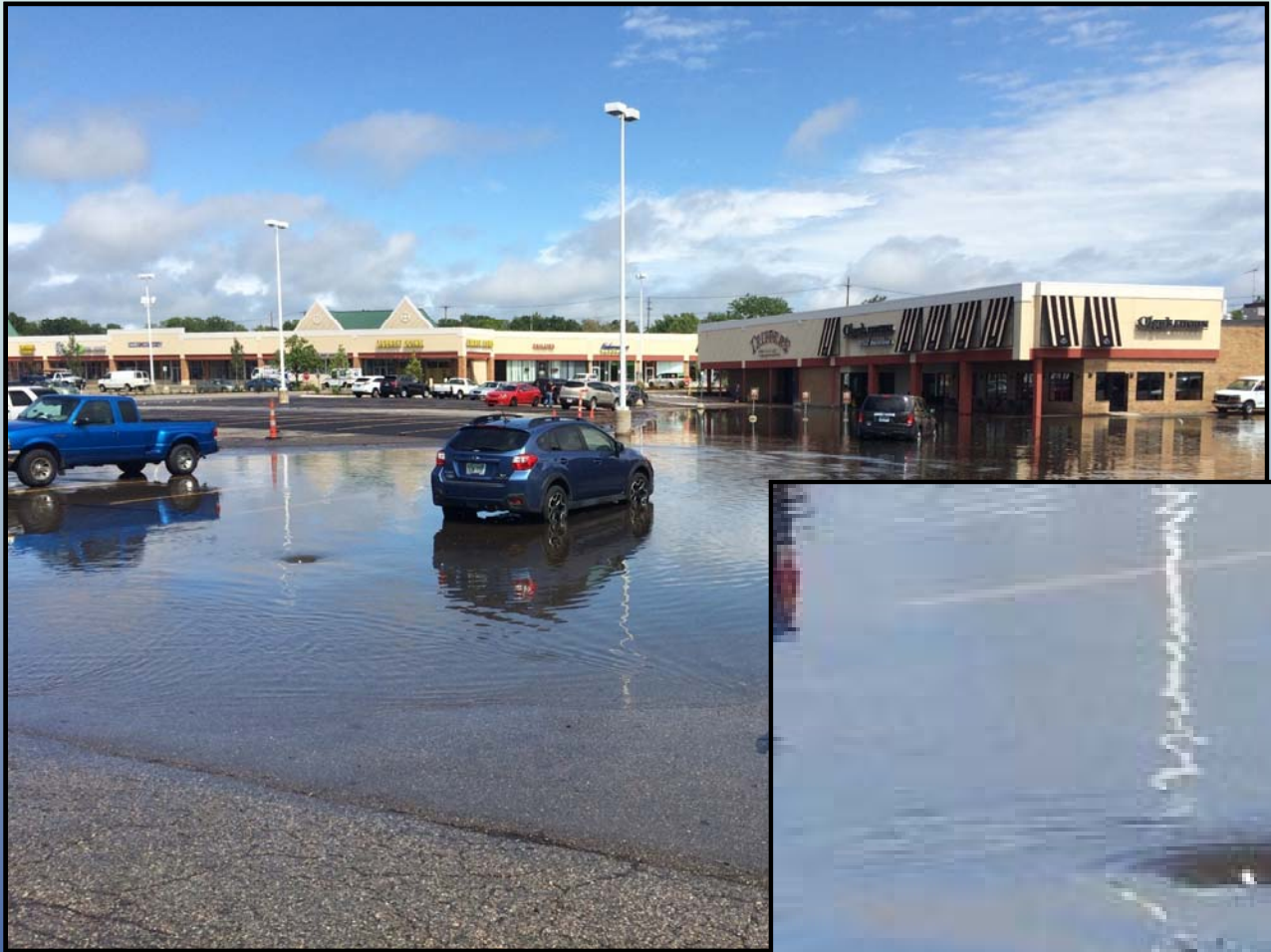
Recent data collection on the condition of the stormwater runoff showed that this watershed is more polluted than we thought.

**POLLUTION CAPTURED CATCH BASIN IN PARKING LOTS**

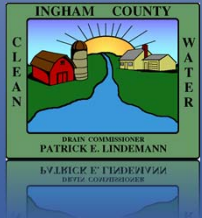
# Samples of stormwater runoff on its way to the Red Cedar River from different places in the Montgomery's Watershed



Details of these runoff samples are available, location and contamination data

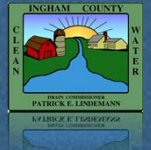


This project will reduce minor storm flooding like this one. The amount of reduced flooding will vary with each storm but there will be a noticeable difference.

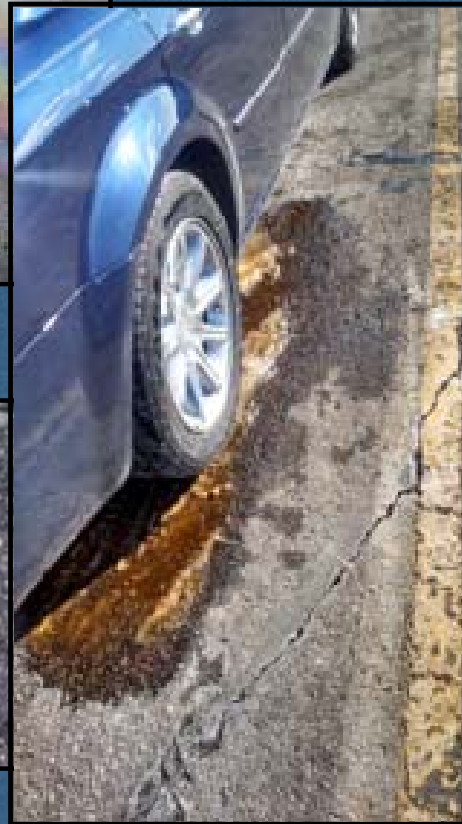




In this presentation we will include some data that we've collected. There are much more data. If you wish to see more let us know. The contaminants of concern are consistently identified in sample events. Loads on the following slides were observed for 0.5" rain events.



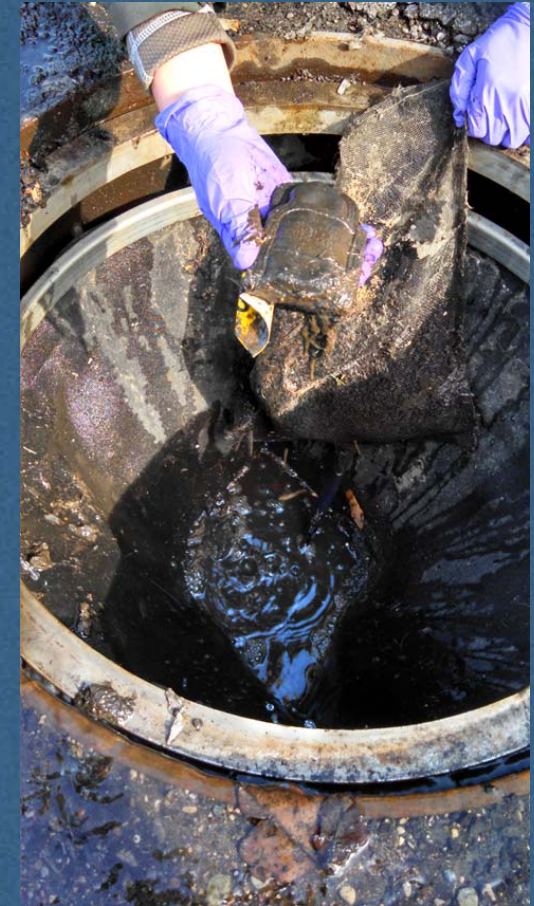
Runoff contaminated with pollutants from the drainage district flushes directly into the Red Cedar River.



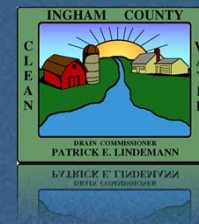
# Identified Contaminants of Concern

Metals  
Hydrocarbons  
Nitrogen  
Phosphorous  
Particulates  
Low Dissolved Oxygen Concentrations  
Chloride  
Cyanide  
Total Dissolved Solids

NOTE: Each contaminant listed exceeded Michigan Department of Environmental Quality and United States Environmental Protection Agency standards or recommendations for the protection of water quality.



Montgomery Drainage District, 2015.



# Metals

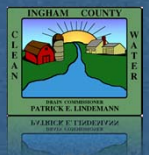
**Metals of concern:** Copper, lead, sodium, and zinc

**Sources:** Auto fluids (oils, grease) and deterioration (brake pads, tires, rust), galvanized metals, paints, wood preservatives, roofing materials, asphalt wear, road salt

**Environmental and human health effects:** The metals observed are non-biodegradable pollutants, some of which cause cellular damage, can build up in the body, and cannot be metabolized or removed. Many heavy metals commonly found in urban areas are highly toxic and lethal to organisms.



Montgomery Watershed, 2015.



# Hydrocarbons

## Hydrocarbons of concern:

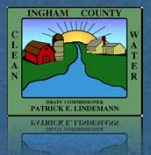
benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, carbazole, chrysene, di-n-octyl phthalate, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene

**Sources:** Combustion, gasoline spills and vapor, motor oil, asphalt sealcoats

**Environmental and human health effects:** Identified hydrocarbons of concern are cancer-causing and have toxic effects on the immune, reproductive, nervous, and circulatory systems.



Montgomery Watershed, 2015.



# Nitrogen and Phosphorous

**Sources:** Fertilizers, detergents, leaking sanitary sewers, animal waste, fossil fuel combustion

**Environmental and human health effects:** Excessive nitrogen is harmful to ecosystems as it may lead to oxygen depletion in the water, which inhibits the growth of aquatic life and can be lethal.



Algae Ingham County Stormwater Outlet, 2015.

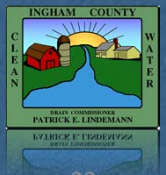
# Particulates

**Sources:** Non-dissolved solids from construction activities, automotive deterioration, eroded pavement and landscape, dust buildup on surfaces, high runoff flow rates

**Environmental and human health effects:** In urban areas, heavy metals and hydrocarbons often bind to particulates. Particulate-bound chemicals transported in runoff are introduced to water systems, increasing contaminant availability to aquatic life. Particulates can cause direct harm to aquatic species and deteriorate habitats, as well as degrade the aesthetic quality of water bodies.



Montgomery Watershed, 2015



# Oxygen Demand

## Oxygen demand concerns:

Microorganisms and chemical reactions can use up large amounts of oxygen from the water as it is required for many processes by which organic and chemical substances are broken down.

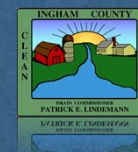
**Sources:** Nutrients, animal wastes, detergents, fats, oils, grease, engine coolants, antifreeze, leaves and grass clippings

## Environmental and human health effects:

Runoff during precipitation events introduces impurities to the water which serve as food for microorganisms. Excessive amounts of these substances may increase microorganism populations too rapidly which reduces oxygen availability for other aquatic life.



Snowmelt Samples from the Montgomery Watershed, 2015.





# Low Dissolved Oxygen Concentrations

## **Dissolved oxygen concerns:**

Concentrations observed below levels that support aquatic life.

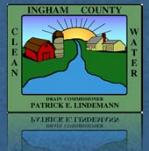
**Sources:** Dissolved oxygen is decreased by oxygen-demanding microorganisms and chemical reactions. Physical conditions, such as high temperatures, also lower oxygen concentrations.

## **Environmental and human health effects:**

Sufficient levels of oxygen are needed to support aquatic life. Low dissolved oxygen availability can inhibit the growth of aquatic life and prove lethal.



Snowmelt Samples from the Montgomery Watershed, 2015.



# Chloride

**Sources:** Road salts and deicers, water conditioning salt, synthetic fertilizer (primarily KCl)

**Environmental and human health effects:** Chloride in surface waters causes aquatic stress and can be toxic to many aquatic species inhibiting survival, growth, and reproduction. It can lead to illness in other wildlife species and inhibit plant growth. Chloride and other salts can increase the availability of other toxic substances in the water and lower dissolved oxygen levels.



Montgomery Watershed, 2015

# Cyanide

**Sources:** Road salt (anti-caking agent), vehicle exhaust, chemical processing

**Environmental and human health effects:** Cyanide inhibits reproduction, is a neuro toxin, affects the respiratory and osmoregulation systems, and is lethal at low concentrations (in the parts per billion range for some aquatic organisms).



Montgomery Watershed, 2015

# Total Dissolved Solids

**Sources:** Road salts, construction activities, poor landscape maintenance, auto leaks and deterioration, galvanized metals, paints, wood preservatives, roofing materials, excessive fertilizers and pesticides, atmospheric pollution and dust buildup

**Environmental and human health effects:** The concentration of total dissolved solids can provide a general indication of pollution in water. Dissolved solids can impact aquatic life directly by reducing spawning rates and causing juvenile mortality, and indirectly by increasing salinity, which increases the toxicity of other contaminants in the water column.



Sampling Red Cedar River, 2015

## Pollutant Loads-Metals

2.5 lbs of metals – Metal pollution of the tire wear of 6,069 drivers of whom drive the total Montgomery Watershed road mileage each day for a week.



Source: Faris Tires. Accessed 2016. [http://www.faristires.com/tire\\_inventory\\_pictures](http://www.faristires.com/tire_inventory_pictures)

# Pollutant Loads-Nutrients

Over 17 lbs of nutrients – Nitrogen and phosphorous within 2 bags (total of 66 lbs) of 13-13-13 lawn care fertilizer (N-P-K)



Source: Smith Farm Supply. Accessed 2016. <http://www.smithfarmsupply.com/13-13-13-products>



**Algae Observed at an Ingham County Stormwater Outlet, 2015.**

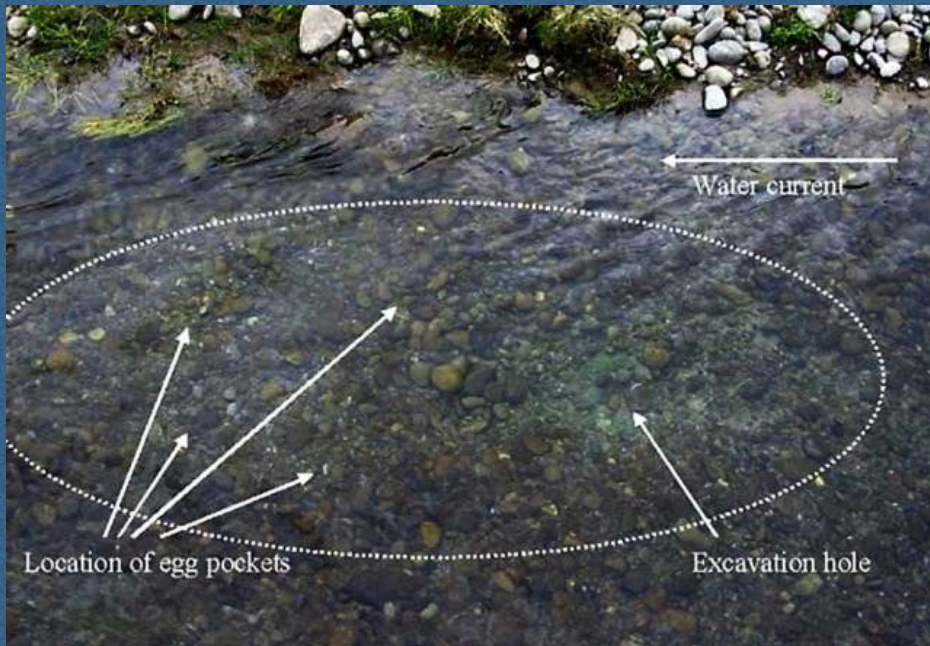
# Pollutant Loads-Sediment

Over 900 lbs of sediment - Water volume of a baseball infield 22 ft deep would be required to dilute the sediment load observed in runoff to levels of non-concern



# Pollutant Loads-BOD

Over 150 lbs of BOD– The oxygen consumption of 26,747 steelhead trout beds (1000 eggs per bed) through a complete incubation period (4 weeks)



Source: Big Hole Lodge. Accessed 2016. <http://montanafishingblog.com/2011/04/page/2/>



Source: Biology Around Kris. Accessed 2016. <http://www.krisweb.com/stream/sediment.htm>



# Pollutant Loads-Total Dissolved Solids

Almost 2500 lbs of total dissolved solids – 125 bags (20 lbs each) of sidewalk/road salt



Source: Population Education. Accessed 2016. <https://www.populationeducation.org/content/environment-under-salt>



Source: Cloud Snow Removal. Accessed 2016. <http://www.iceandsnowremovalservice.com/salt-sales.aspx>



**This is the Goal**

# References

## **WATER QUALITY CRITERIA:**

### **Part 4:** Michigan Department of Environmental Quality Part 4 Rules

Digital Source: [http://www.michigan.gov/deq/0,4561,7-135-3313\\_3686\\_3728-350340--,00.html](http://www.michigan.gov/deq/0,4561,7-135-3313_3686_3728-350340--,00.html)

### **Part 201:** Michigan Department of Environmental Quality Part 201 Rules

Digital Source: [http://www.michigan.gov/deq/0,1607,7-135-3311\\_4109\\_9846\\_30022-251790--,00.html](http://www.michigan.gov/deq/0,1607,7-135-3311_4109_9846_30022-251790--,00.html)

### **USEPA:** United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria

National Recommended Water Quality Criteria - Aquatic Life Criteria Table

Digital Source: <http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm#D>

National Recommended Water Quality Criteria - Human Health Criteria Table

Digital Source: [http://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health\\_criteria-table](http://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health_criteria-table)

### **NURP:** National Urban Runoff Program study conducted by the USEPA

Digital Source: [http://www3.epa.gov/npdes/pubs/usw\\_b.pdf](http://www3.epa.gov/npdes/pubs/usw_b.pdf)

### **ECO-25:** Ecoregion VII Rivers and Streams study conducted by the USEPA

Digital Source: <http://www.epa.gov/sites/production/files/documents/rivers7.pdf>

### **RCRB:** Red Cedar River Baseflow water quality criteria developed from measured parameters of the Red Cedar River under baseflow conditions—sampling and data analyses were performed by Spicer Group