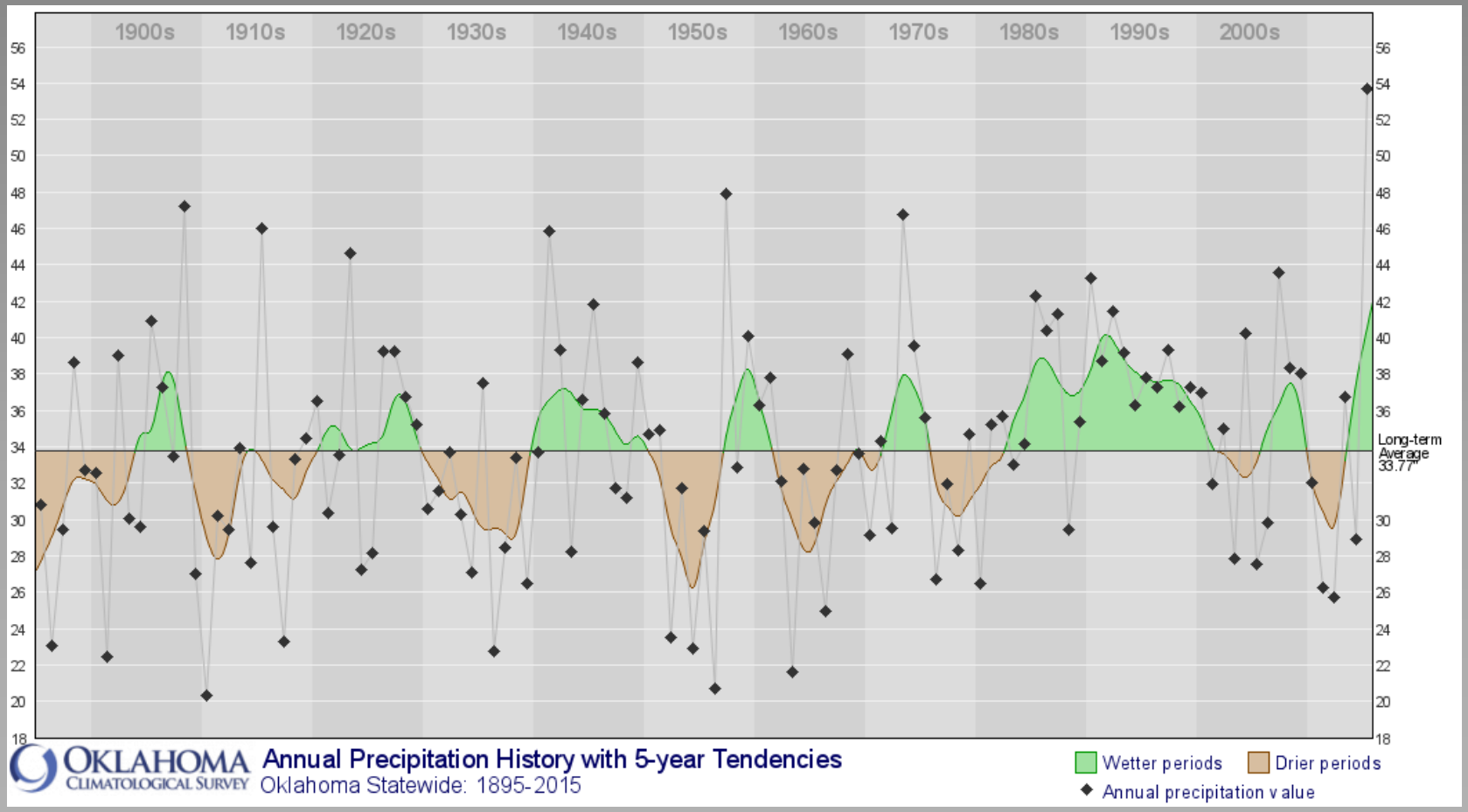
Water Quality Management 101

Norman City Council Meeting
November 14th, 2016

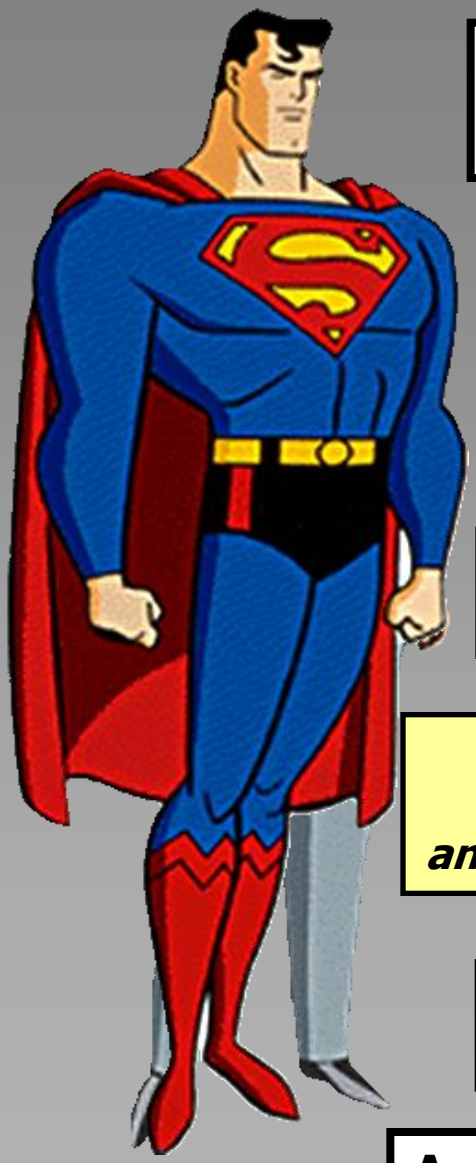
Derek Smithee, Chief
Water Quality Division
Oklahoma Water Resources Board

Water Health – Why Should We Care?



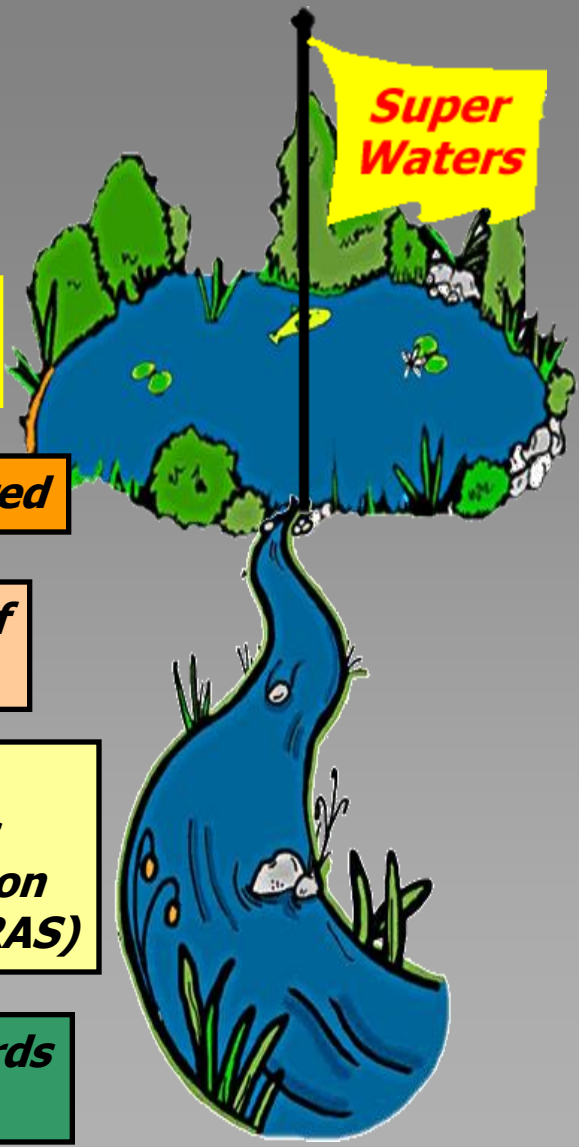
Human Health Planning & Water Quality Management

A Correlation



Human

Annual Physical	Monitoring BUMP/305(b)
Healthy	Meets Water Quality Standards
Sick	Water Quality Impaired
See a Specialist	Add to 303(d) List of Impaired Waters
Get Well (Antibiotics and/or Surgery)	Complete TMDL's & Intensive Studies (Watershed Restoration Action Strategies -- WRAS)
A Healthy Routine	Water Quality Standards Implementation
Annual Physical	Monitoring



Waters of the State

Human Health Planning & Water Quality Management

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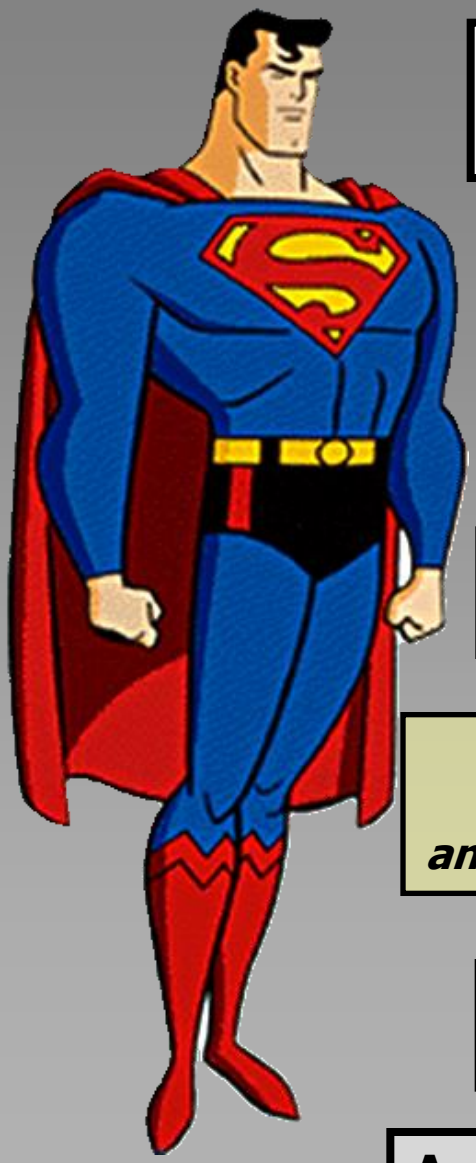

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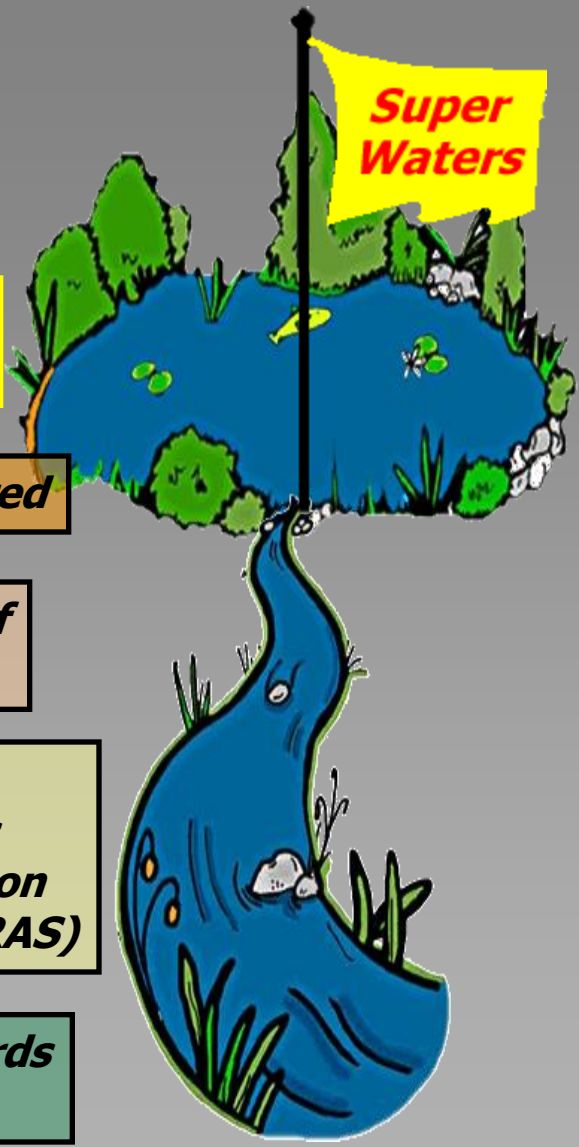


Waters of the State

Annual Physical - Monitoring
Beneficial Use Monitoring Program (BUMP)

- The 305(b) Report is a report to Congress on "The state of the state's waters".
- Published every two years by the ODEQ and available on the ODEQ website at www.deq.state.ok.us.
- Provides programmatic information on whether the beneficial uses assigned to surface waters are being supported, threatened or impaired.
- Identifies the trophic status of Oklahoma's significant publicly owned lakes.
- Also reviews the quality and status of waters receiving additional protection consistent with the Anti-degradation policy.
- If a water is NOT meeting its beneficial uses; it is listed on the state's 303(d) list.

Annual Physical - Monitoring
Beneficial Use Monitoring Program (BUMP)

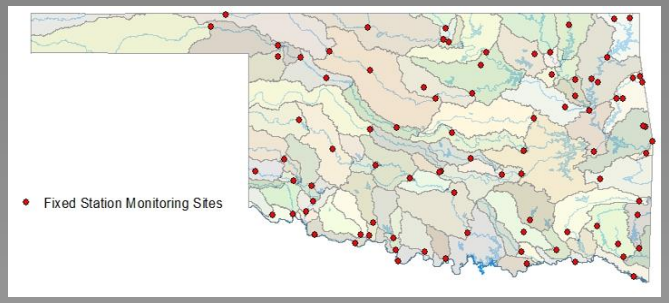
Overview -- (BUMP)

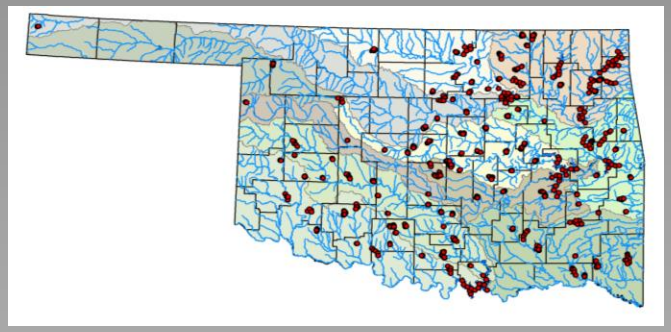
- Created in 1998.
- Statewide water quality monitoring program directed by the OWRB.
- Provides objective evaluation of Oklahoma waters concerning their ability to support individual beneficial uses prescribed by Oklahoma's Water Quality Standards:
  - determine the effectiveness of point and non-point source controls in maintaining beneficial uses;
  - identify waters supporting (or not supporting) beneficial uses, locate threatened waters and determine water quality trends.

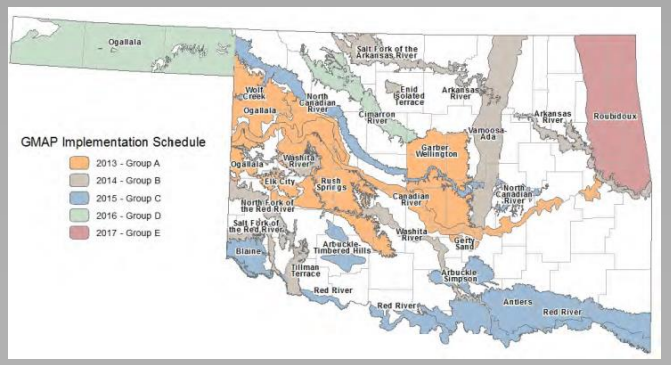
Annual Physical - Monitoring
Beneficial Use Monitoring Program (BUMP)

The 6 Monitoring Components of BUMP:

- **Fixed Station Stream Monitoring**
- **Rotating Station Stream Monitoring**
- **Biological Monitoring**
- **Fixed Station Lakes Monitoring**
- **Fixed Station Load Monitoring (Stream Gauging)**
- **Fixed Station Groundwater Monitoring (Funding added in 2013)**







Annual Physical - Monitoring
Groundwater Monitoring Program (GMAP)

- Assessments of baseline conditions (2013)
  - Targets Major bedrock/alluvial aquifers
  - Major ions, nutrients, trace elements (700 wells)
  - Seasonal and continuous groundwater level measurements (1,100 wells)
  - Informs about drought/recovery and seasonality
- Trend monitoring informed by baseline results (2018)
  - Smaller network reflects (more targeted approach)
- Assess/assign beneficial uses based on results
  - Water supply/agriculture/industrial
- Develop criteria or augment existing criteria for groundwater quality standards

Human Health Planning & Water Quality Management

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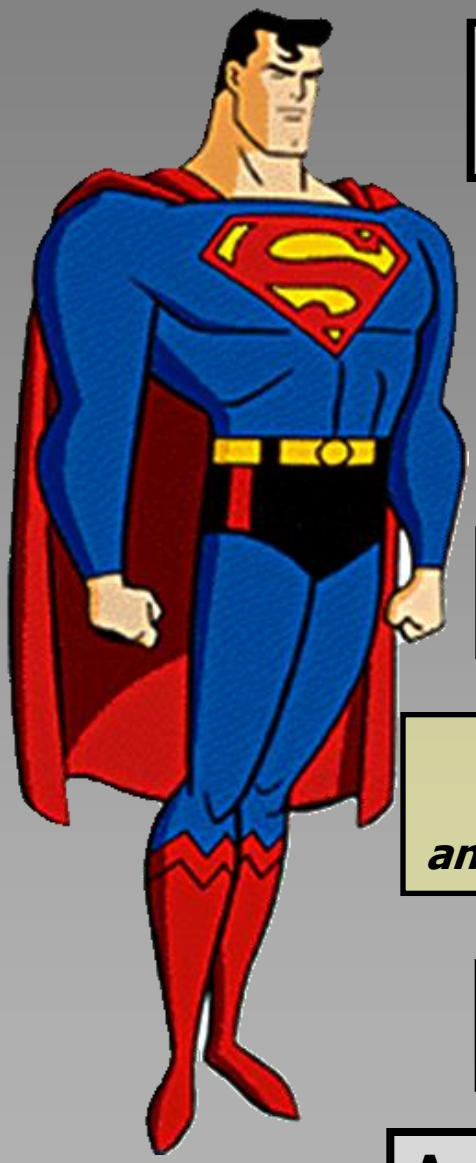

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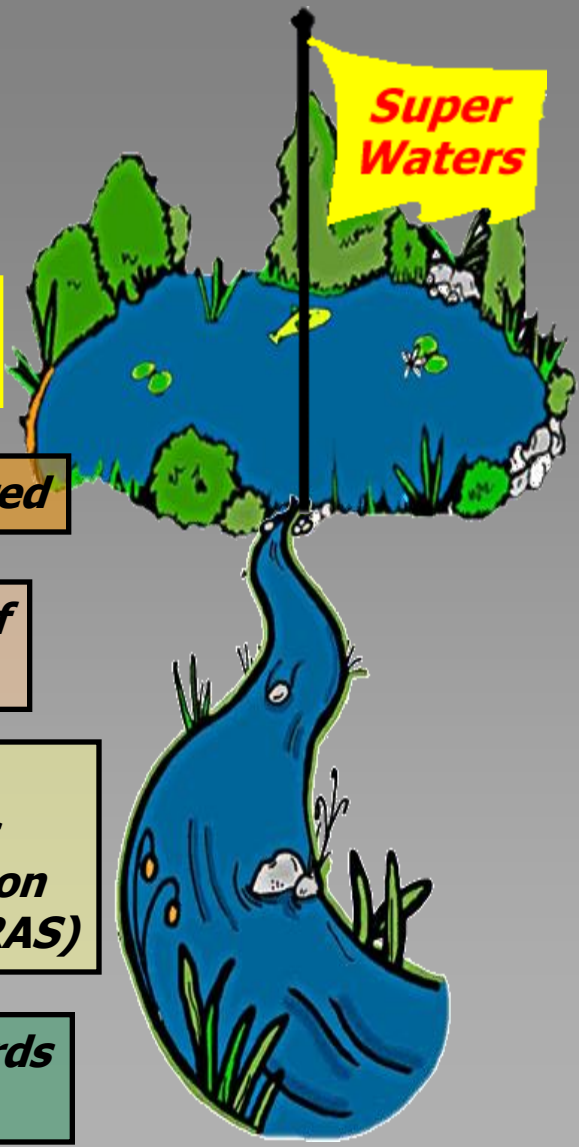

Waters of the State

Healthy - Meets Standards
Oklahoma Water Quality Standards

- Clean Water Act requires revision at least once every three years. Done annually in Oklahoma by the OWRB and found at OAC 785:45.
- Are both state and federal law.
- OWQS are composed of three parts: Beneficial Uses, Criteria, and an Anti-degradation Policy
- Beneficial Uses are assigned to all waters and include uses like Fish and Wildlife Propagation, Primary Body Contact Recreation, Public and Private Water Supply, Agriculture, Aesthetics, etc.

Healthy - Meets Standards
Oklahoma Water Quality Standards

- Criteria (both narrative and numerical) are promulgated to protect each beneficial use.
- The Antidegradation Policy is designed to protect those waters where we want water quality better than that necessary to support beneficial uses. Includes Sensitive Water Supply protection, High Quality Waters, Appendix B areas and Outstanding Resource Waters. More stringent pollution controls are put in place in these waters.
- WQS MUST balance environmental protection, sound science and rational public policy and be promulgated in a transparent public process.
  - Remember - WQS are the water quality management targets for all water quality management activities.

Human Health Planning & Water Quality Management

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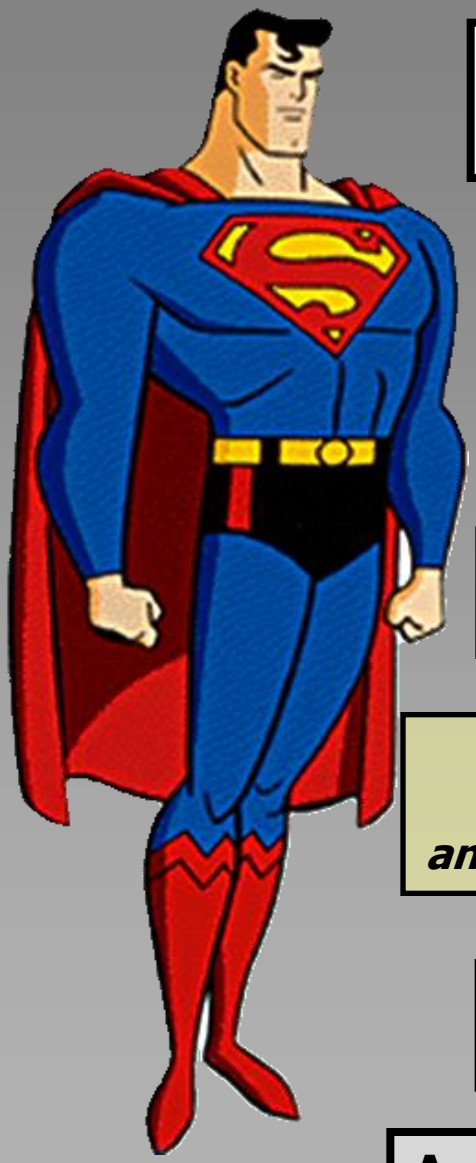

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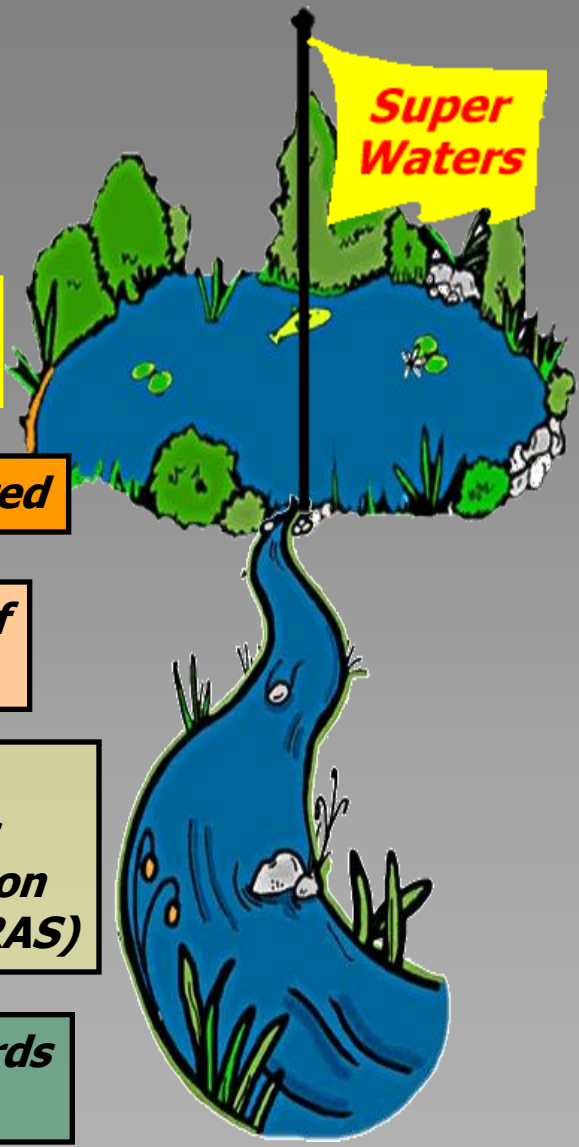

Waters of the State

Sick - Water Quality Impaired
Impairment Decision-Making

- Water quality data are subjected to Use Support Assessment Protocols (USAP) to determine in a consistent and systematic way if one or more beneficial uses in the WQS are impaired.
- Promulgated by the OWRB and found in OAC 785:46. Built around the concept of water concentration information exceeding a criterion.
- Must be followed by all agencies.
- Although first promulgated in 2000, Oklahoma's USAP's are nationally recognized and U.S. EPA is modeling a national program after us.
- Strong emphasis on frequency and magnitude of criteria exceedances and water chemistry.
- Evolving USAP's to include physical and biological evaluations as well as duration of chemical criteria exceedances.
- USAP's have stringent data quality and adequacy requirements to assure accurate and defensible use support decisions.

Specialist - 303(d) List
Add to 303(d) List of Impaired Waters

- Waters not supporting their beneficial uses (i.e. impaired) are placed on the 303(d) list and require a Total Maximum Daily Load (TMDL) be completed.
- Published every two years by the Office of the Secretary of the Environment and are found at….
- Oklahoma's 303(d) listings are made using USAP's and cooperatively with the public and all Oklahoma state agencies.
- Current 303(d) listing guidance is being updated and should affect Oklahoma in future listing cycles.

Human Health Planning & Water Quality Management

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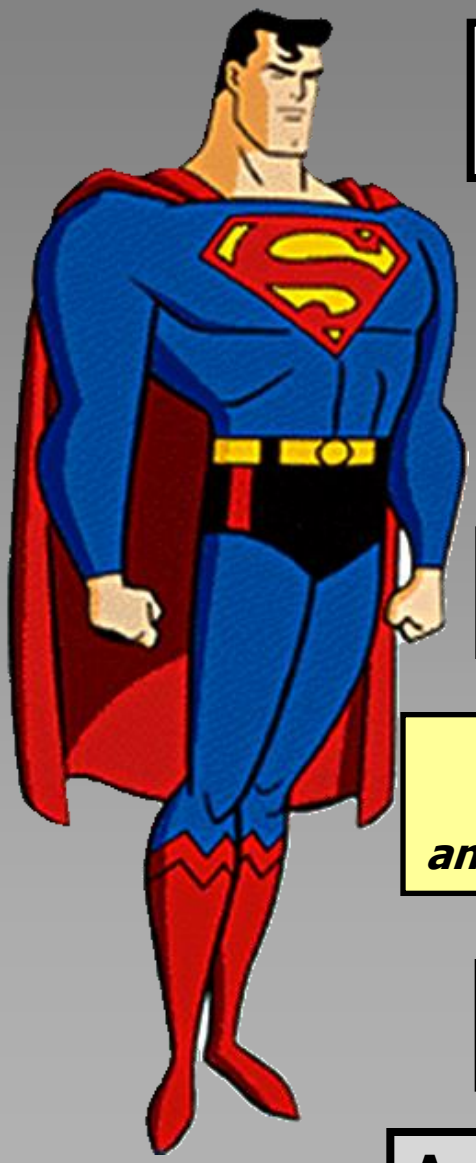

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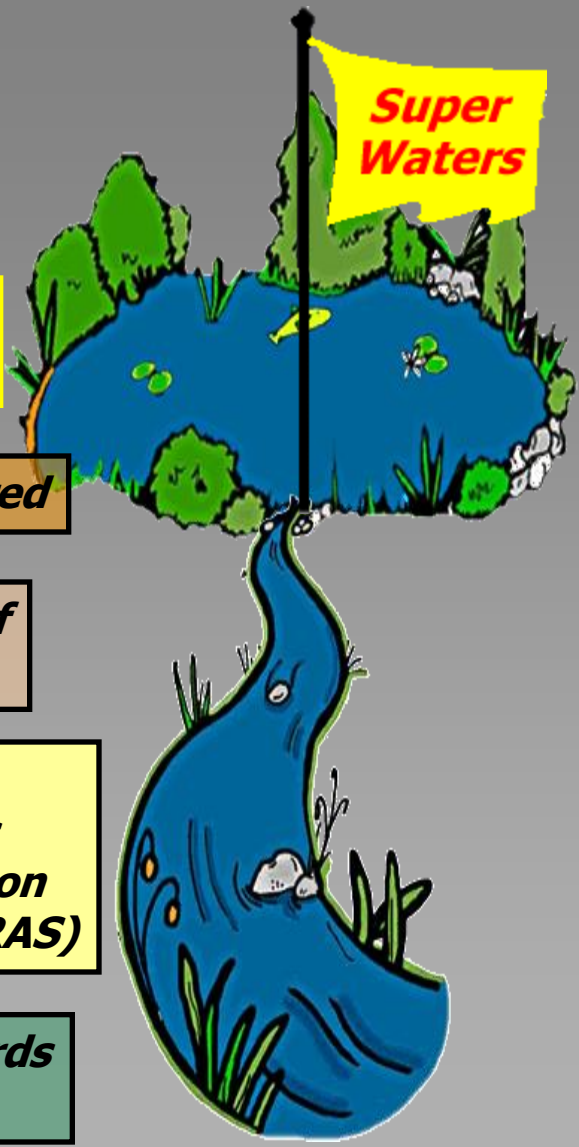

Human — Annual Physical

Monitoring — Waters of the State

Get Well - Restore Waters
Complete TMDL's and Intensive Studies

- TMDL's determine the maximum assimilative capacity of a water and then allocate contributions from multiple sources (point sources, non-point sources, background and margin of safety) to meet that maximum.
- TMDL's are built around WQS and criteria and are designed to meet beneficial uses.
- A TMDL is only the first step. To be effective, it must be implemented in permit limits, education, NPS controls.
- TMDL's are only one tool available to restore impaired uses. Others include BMP's to control NPS pollution, technology based limits for municipal and industrial dischargers, Watershed Restoration Action Strategies, etc.

Get Well - Restore Waters
Complete TMDL's and Intensive Studies

- It is possible that a water listed as impaired and on the 303(d) list was assigned an incorrect beneficial use in the WQS or the criterion is wrong. Modifications to the WQS are also a possible outcome of a listing and Use Attainability Analysis (UAA) or Site-Specific Criteria modification may be in order.
- Lastly, it is possible the impairment is from some pollution source not conducive to a TMDL (temperature via solar radiation). Other strategies (i.e.: WRAS's) can then be initiated.
- Remember - the goal should be to restore impaired uses (not merely complete a TMDL) and make our waters fishable and swimmable.

Human Health Planning & Water Quality Management

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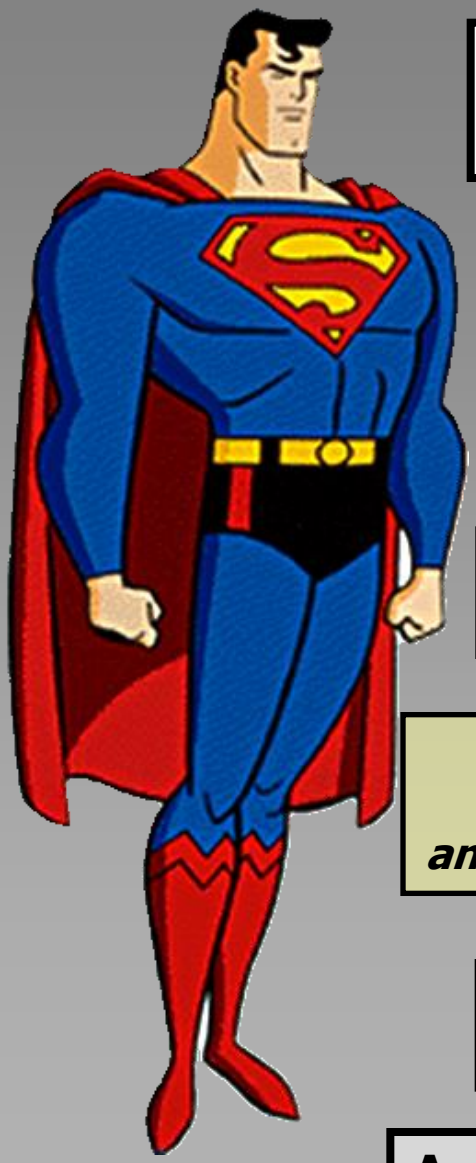

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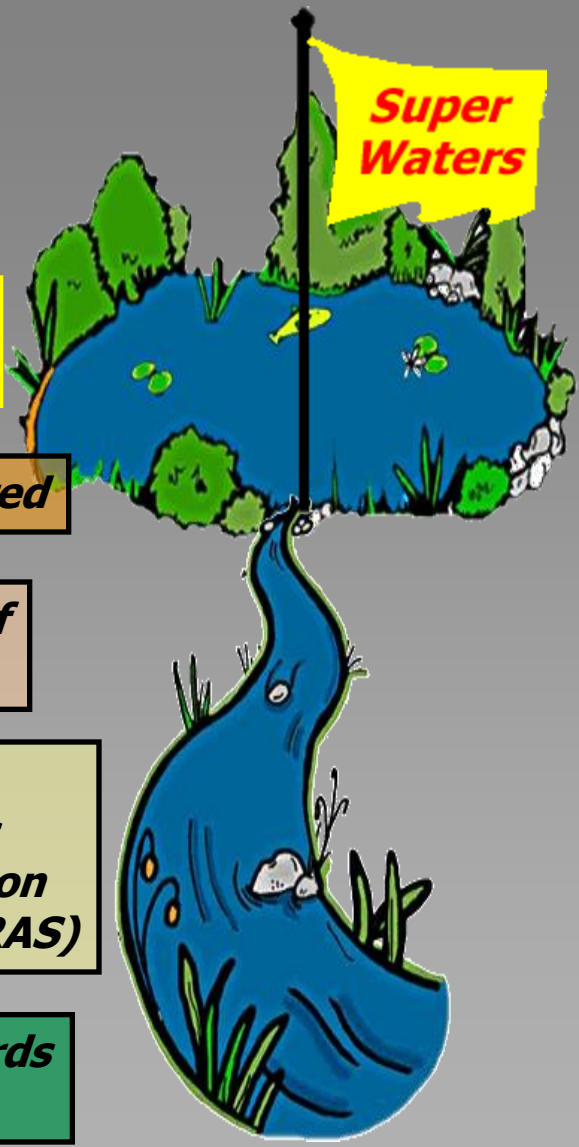


Waters of the State

Healthy Routine - WQS Implementation

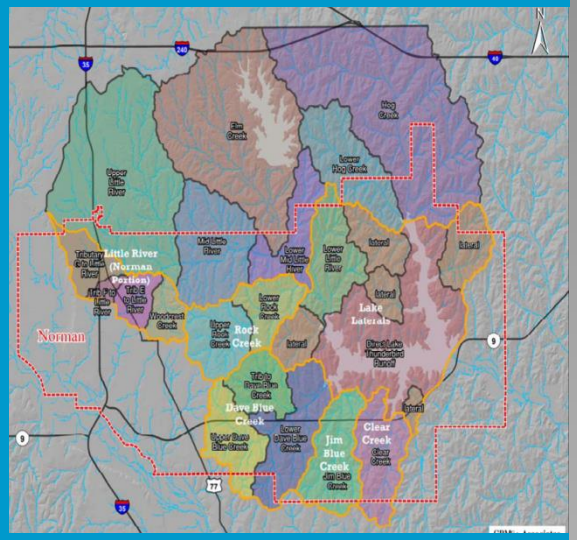
Routine Water Quality Standards Implementation

- All state agencies must use the WQS within the scope of their jurisdiction, and it is important the WQS be correctly and consistently translated from the WQS into their respective programs (i.e. NPDES permits, Superfund clean-ups, mining, agriculture, storm water control, BMP's, education, etc.)
- These things are the "blocking and tackling" each agency must do to keep our waters "healthy" and the WQS maintained.
- Each state agency is required to promulgate rules (called WQS Implementation Rules) outlining how they will translate the WQS into their programs.
- Each agency’s WQS Implementation rules can be found in Oklahoma Administrative Code.

So What Does "Healthy" Monitoring Mean for Norman?

City of Norman
Building an Inclusive Community
Home of the University of Oklahoma

TMDL Monitoring Plan
City of Norman, OK



October 27, 2015

GBMC & Associates
Strategic Environmental Services

OLSSON ASSOCIATES

Canadian River at Purcell

Sample Record	Times Visited	Station ID
February 1999 - Current	169	520610010010-001AT

Stream Data

County	McClain	View Site Data
Location	East of the Town of Purcell on State Highway 77	
Latitude/Longitude	35.01433266, -97.35035449	
Planning Watershed	Central (8-digit HUC - 11090202)	

Parameters

	Parameter (Descriptions)	n	Mean	Median	Min./Max	p25/p75	Comments
In-Situ	Water Temperature (°C)	135	17.3	18.6	-2.3/34.1	10.7/24.7	
	Turbidity (NTU)	134	135	35	4/>1000	14/138	
	pH (units)	135	8.34	8.25	7.36/9.85	8.06/8.56	
	Dissolved Oxygen (mg/L)	135	10.45	10.19	4.21/26.87	8.17/12.33	
	Hardness (mg/L)	137	421	428	74/990	296/538	
Minerals	Total Dissolved Solids (mg/L)	73	797	774	285/1804	619/989	
	Specific Conductivity (uS/cm)	136	1236	1245	303/2215	893/1597	
	Chloride (mg/L)	138	137	127	20/419	85/185	
	Sulfate (mg/L)	138	275	271	41/972	181/341	
Nutrients	Total Phosphorus (mg/L)	146	0.542	0.422	0.011/2.765	0.27/0.631	
	Total Nitrogen (mg/L)	139	2.95	2.62	0.56/11.87	1.87/3.49	
	Nitrate/Nitrite (mg/L)	140	1.19	0.87	<0.05/9.69	0.25/1.41	
	Chlorophyll A (mg/m³)	78	55.1	33.7	0.5/211	10.5/93.6	TSI=69.9
Bacteria	Enterococcus (cfu/100ml)(*-Geo. Mn.)	30	2480	322	<10/31700	83/1296	Mean>OWQS
	E. Coli (cfu/100ml)(*-Geo. Mn.)	30	1028	36	<10/19863	12/563	

Beneficial Uses

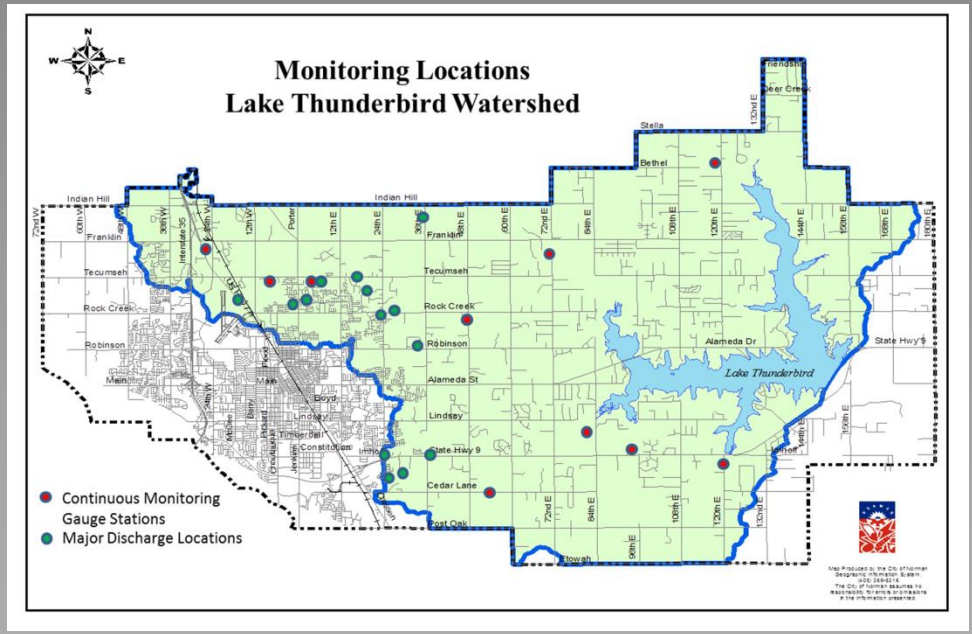
Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	Sulfates	Nitrates	Chlorides	Total Dissolved Solids	Bacteria	Bio. Fish	Bio. BMI	Sediment
Fish & Wildlife Propagation	S	S	S	S						U	S	S
Aesthetics												NEI
Agriculture					S		S	S				
Primary Body Contact Recreation									NS			
Public & Private Water Supply				S		S			S			
Fish Consumption				S								

S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

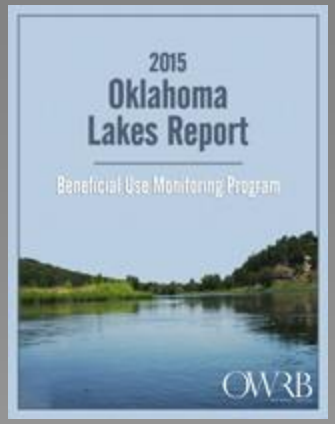
Notes U = Assessment yielded undetermined supporting status

Norman TMDL Monitoring

- **Water Quality Monitoring**
  - **Water Quality Monitoring at TMDL Monitoring Stations**
  - **Flow Monitoring at TMDL Monitoring Stations**
  - **Water Quality Monitoring at Major Discharge Points**



Lake Thunderbird BUMP Monitoring



Thunderbird

Sample Period	Times Visited	Sampling Sites
October 2014 – July 2015	4	7

General

Location	Cleveland County — Click map for site data
Impoundment	1965
Area	6,070 acres
Capacity	119,600 acre-feet
Purposes	Flood Control, Water Supply, Recreation, Fish & Wildlife

Parameters

	Parameter (Descriptions)	Result	Notes/Comments
In Situ	Average Turbidity	14 NTU	4% of values > OWQS of 25 NTU
	Average Secchi Disk Depth	59 cm	
	Water Clarity Rating	Average	
	Chlorophyll-a	21 mg/m3	
	Trophic State Index	61	Previous value = 56
	Trophic Class	Hypereutrophic	
Profile	Salinity	0.13 – 0.26 ppt	
	Specific Conductivity	281.5 – 530 µS/cm	
	pH	7.14 – 8.68 pH units	Neutral to slightly alkaline
	Oxidation-Reduction Potential	90.2 to 454 mV	
	Dissolved Oxygen	Up to 67% of water column < 2 mg/L in July	Occurred at sites 1, the dam
Nutrients	Surface Total Nitrogen	0.80 mg/L to 1.27 mg/L	
	Surface Total Phosphorus	0.018 mg/L to 0.064 mg/L	
	Nitrogen to Phosphorus Ratio	23:1	Phosphorus limited

Beneficial Uses

Click to learn more about Beneficial Uses	Turbidity	pH	Dissolved Oxygen	Metals	TSI	True Color	Sulfates	Chlorides	Total Dissolved Solids	Enterro. & E. coli	Chlor-a
Fish & Wildlife Propagation	NS	S	NS	S							
Aesthetics					NEI*	S					
Agriculture							S	S	S		
Primary Body Contact Recreation										S	
Public & Private Water Supply											NS

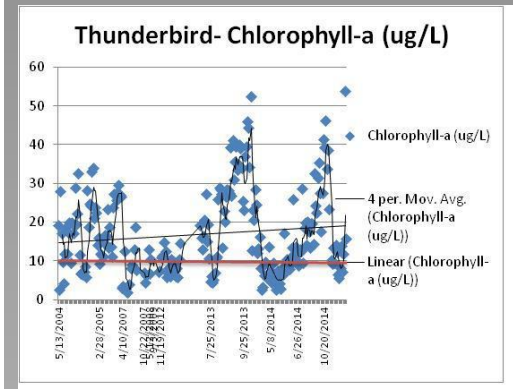
S = Fully Supporting
NS = Not Supporting
NEI = Not Enough Information

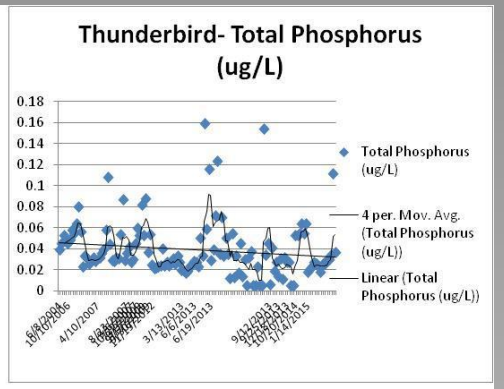
Notes: * The lake is listed in the Oklahoma Water Quality Standards (WQS) as a Nutrient Limited watershed (NLW). This listing means that the lake is considered threatened from nutrients until a more intensive study can confirm the Aesthetics beneficial use non-support status.

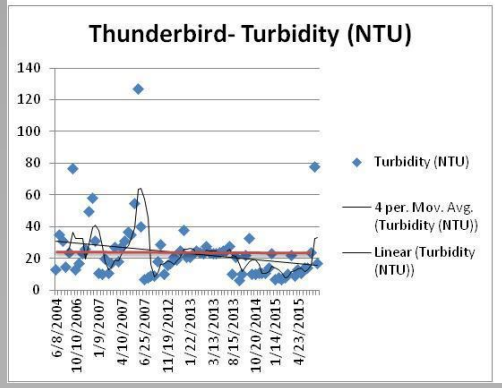
NTU = nephelometric turbidity units
µS/cm = microsiemens per centimeter
E. coli = Escherichia coli
OWQS = Oklahoma Water Quality Standards
mV = millivolts
Chlor-a = Chlorophyll-a
mg/L = milligrams per liter
µS/cm = microsiemens/cm
ppt = parts per thousand
En = Enterococci

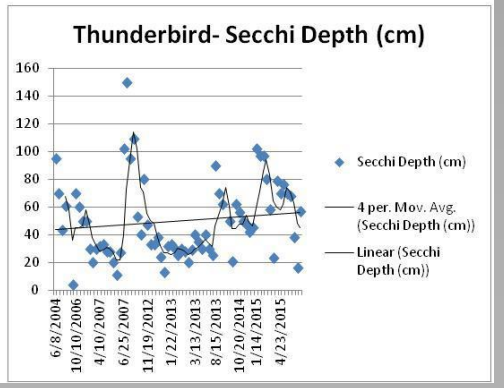
Sampling and Assessment by the **Oklahoma Water Resources Board** – 3800 Classen Blvd, Oklahoma City, OK, 73118 – 405.530.8800 – http://www.owrb.ok.gov

Bathy map available: http://www.owrb.ok.gov/maps/PMG/owrbdata_Bathy.html





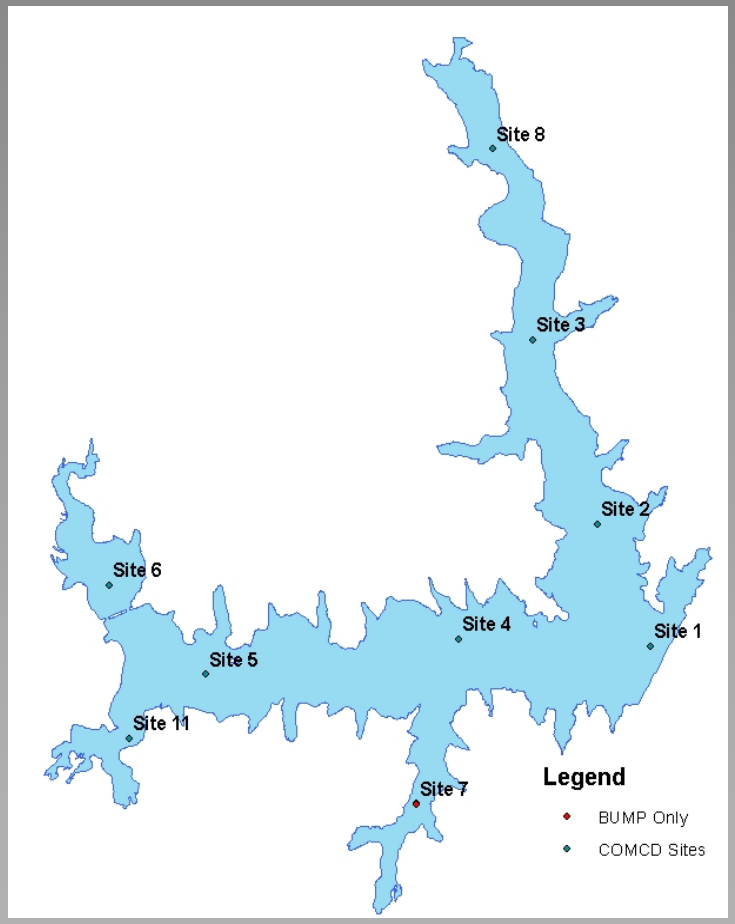




Lake Thunderbird Monitoring For COMCD

- Field sampling and monitoring occur twice a month July through September and once per month in April, May, June and October.

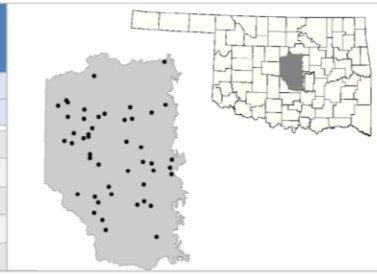
- Sites 1-6, 8, 11, and 12 are monitored for:
  - Dissolved Oxygen
  - Temperature
  - Specific Conductance
  - pH
  - Oxidation-reduction Potential
  - Secchi disk depth
  - Chlorophyll-*a*
  - Turbidity
  - Total Organic Carbon
  - Total phosphorus, ortho-phosphorus, ammonia, nitrate, nitrite, and total kjeldahl nitrogen are at site 1. Additional samples for nutrients are collected at the surface of the riverine sites (6, 8, and 11). In addition, pre- and post-stratification sediment samples will be analyzed for soil phosphorus storage capacity.



GMAP Monitoring Results

Garber Wellington Aquifer

Baseline Sample Period	Sampling Sites	Water Level Sites
October-November 2013	47	61



General		
Location	Central Oklahoma	
Area (km^2)	7,493	
Storage (acre-feet)	58,000,000	
Primary Uses	Municipal & Domestic Supply; Industrial	
Category	Bedrock-Sandstone	

Parameters – General Field

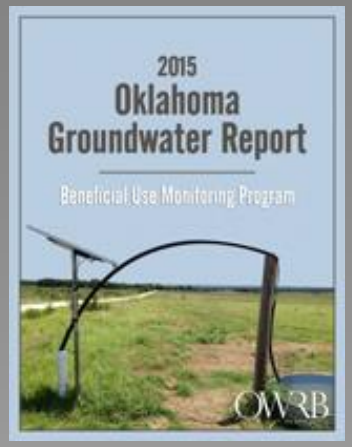
Parameter	Mean	SEM	Minimum	25%	Median	75%	Maximum	Comments
Well Depth (ft)	192	7.6	43	155	200	220	380	N=65
Depth to Water (ft)	77.30	5.53	20.19	50.51	69.94	89.78	228.10	Below ground surface
Temperature (°C)	17.39	0.229	13.61	16.33	17.25	18.89	20.07	
Specific Conductance (µS/cm)	728	73.04	233	472	617	821	2550	
Dissolved Oxygen (mg/L)	4.89	0.337	0.3	3.25	4.91	6.92	8.58	
pH (units)	6.95	0.075	5.82	6.81	6.97	7.16	8.85	
Alkalinity (mg/L)	268	14.8	44.0	214	284	326	450	
Hardness (mg/L)	278	30.1	31.0	137	261	326	1273	N=46
Calculated Bicarbonate (mg/L)	322	18.2	54.3	263	350	400	554	
Total Dissolved Solids (mg/L)	419	53.0	123	244	328	447	2150	SMCL: 500; 9 over

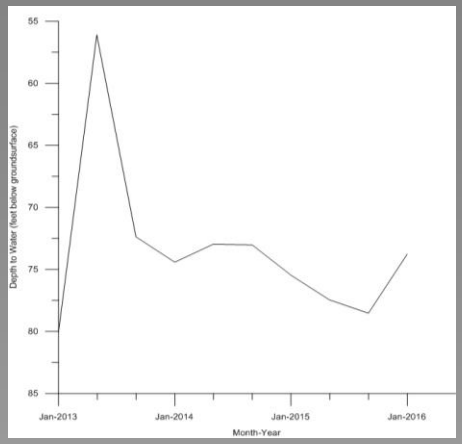
Parameters – Nutrient Constituents

Parameter	Mean	SEM	Minimum	25%	Median	75%	Maximum	Comments
Nitrate & Nitrite (mg/L)	1.84	0.399	<0.05	0.415	0.89	2.17	14.8	MCL: 10; 1 over
Total Dissolved Phosphorus (mg/L)	0.019	0.0049	<0.005	<0.005	<0.005	0.0205	0.156	

Parameters – Mineral Constituents

Parameter	Mean	SEM	Minimum	25%	Median	75%	Maximum	Comments
Bromide (µg/L)	425	42.9	139	272	335	486	1820	
dissolved Calcium (mg/L)	60.8	8.84	<5	26.4	55.6	73.7	409	
Chloride (mg/L)	47.0	11.8	<10	11.4	18.8	46.8	448	SMCL: 250; 2 over
Fluoride (mg/L)	0.194	0.028	<0.2	<0.2	<0.2	0.23	0.99	MCL: 4; 0 over
dissolved Magnesium (mg/L)	28.6	2.62	<5	13.3	27.9	34.8	79.1	
dissolved Potassium (mg/L)	1.52	0.106	<0.5	1.0	1.2	2.05	3.6	
dissolved Silica (mg/L)	18.6	0.632	10.1	16	17.8	21.4	30.3	
dissolved Sodium (mg/L)	63.5	10.0	7.2	15.1	31.8	85.7	318	
Sulfate (mg/L)	59.3	24.7	<10	7.85	17.4	26.5	1090	SMCL: 250; 2 over





Parameters – Metal & Trace Element Constituents

Parameter	Mean	SEM	Minimum	25%	Median	75%	Maximum	Comments
dissolved Arsenic (µg/L)	All Values <10, except 1 (11.8)							MCL: 10; 1 over
dissolved Barium (µg/L)	302	32.6	<10	119	242	457	923	MCL: 2000; 0 over
dissolved Boron (µg/L)	253	65.7	<50	55.6	88.0	158	2450	HA: 6000; 0 over
dissolved Chromium (µg/L)	All Values <5, except 3 (16.3,16.5,24.4)							MCL: 100; 0 over
dissolved Copper (µg/L)	11.0	2.19	<5	<5	<5	12.0	75.6	MCL: 1300; 0 over
dissolved Iron (µg/L)	All Values <50, except 5 (69.4,81.1,93,109,136)							SMCL: 300; 0 over
Dissolved Lead (µg/L)	All Values <10, except 1 (12.7)							MCL: 15; 0 over
dissolved Manganese (µg/L)	All Values <50, except 1 (405)							SMCL: 50; 1 over. HA: 300; 1 over
dissolved Selenium (µg/L)	All Values <20, except 2 (28.4,30.8)							MCL: 50; 0 over
dissolved Uranium (µg/L)	5.20	1.45	<1	<1	1.5	4.3	57.0	MCL: 30; 1 over
dissolved Vanadium (µg/L)	50.7	7.38	<10	13.6	52.6	65.9	296	
dissolved Zinc (µg/L)	27.7	5.48	<10	<10	<10	34.3	184	SMCL: 5000; 0 over. HA: 2000; 0 over

Parameters – Parameters Below Detectable Limits

Aluminum	Beryllium	Mercury	Silver
Ammonia	Cadmium	Molybdenum	Thallium
Antimony	Cobalt	Nickel	

SEM = Standard Error of the Mean
MCL = EPA's Maximum Contaminant Level – enforced for public drinking water systems
SMCL = EPA's Secondary MCL – guidelines not enforced
HA = EPA's Health Advisory

Note: Groundwater samples collected for GMAP were filtered in the field, resulting in dissolved concentrations of constituents. The total concentration for any given constituent might be higher for an unfiltered sample from the same source.

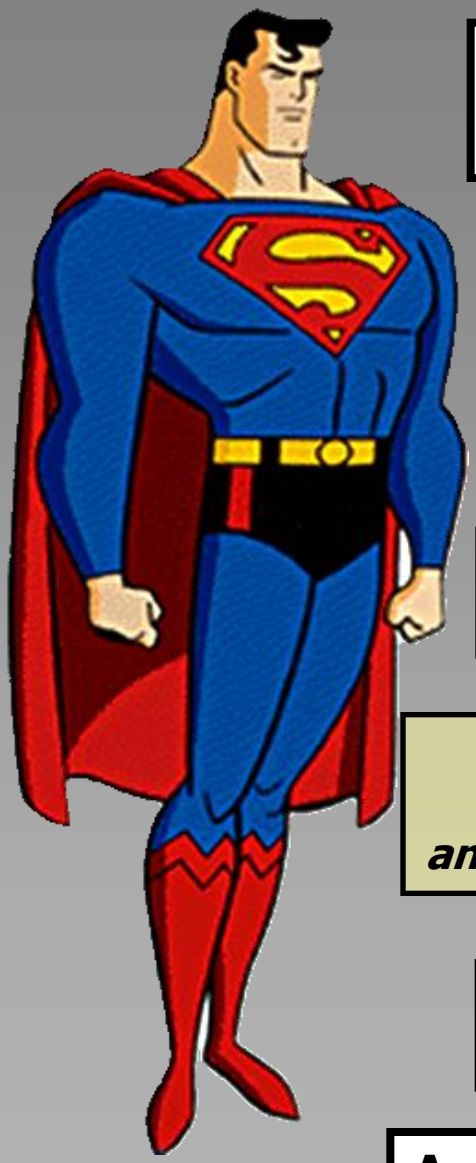
Healthy Routine – OWW Public Awareness

Make Protecting Our Water Resources Part of a Healthy Routine

- The Oklahoma Water Resources Board participates in events throughout the year to promote awareness of protecting and restoring our valuable water resources.
  - Public Presentations
  - Governor's Water Conference
  - Technical Conferences
  - Public Outreach Events

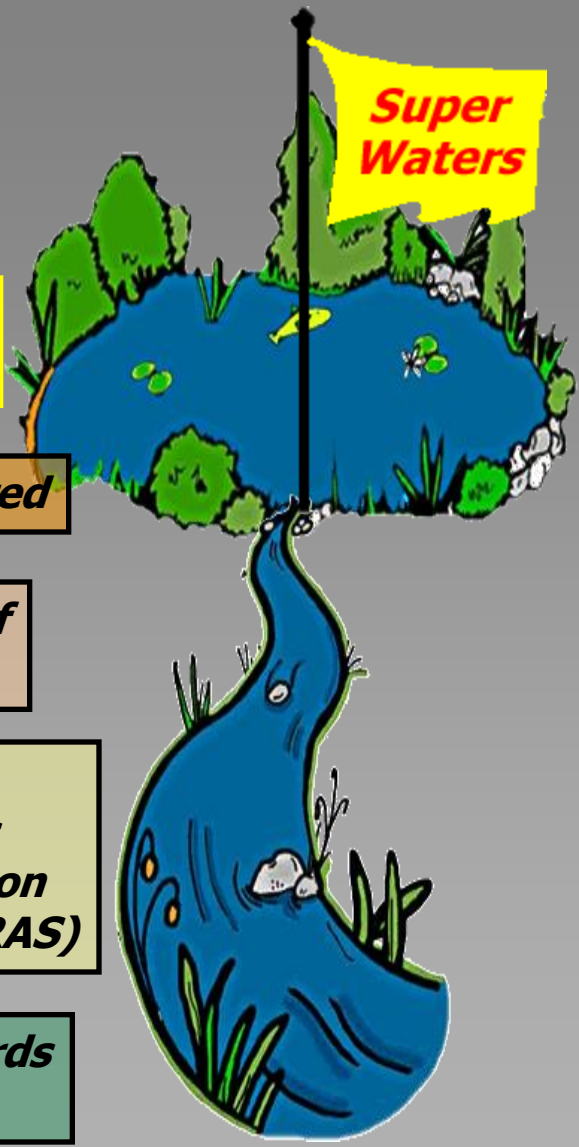
Human Health Planning & Water Quality Management

A Correlation



Human

Annual Physical	Monitoring BUMP/305(b)
Healthy	Meets Water Quality Standards
Sick	Water Quality Impaired
See a Specialist	Add to 303(d) List of Impaired Waters
Get Well (Antibiotics and/or Surgery)	Complete TMDL's & Intensive Studies (Watershed Restoration Action Strategies -- WRAS)
A Healthy Routine	Water Quality Standards Implementation
Annual Physical	Monitoring



Waters of the State

Water Quality Management 101

- Questions?
- I can be reached at (405) 530-8800 or DRSmithee@owrb.state.ok.us
- You may also want to explore the OWRB's web site at:
  - www.owrb.state.ok.us