Lake Thunderbird Project

Informational Meeting

May 24, 2012

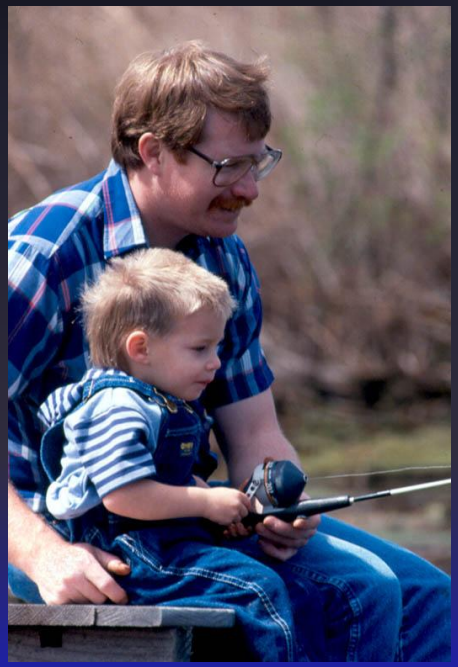
Agenda

1. Opening remarks
2. Project background
3. Project status
4. Overview of the watershed model
5. Overview of the lake model
6. Question-answer session

Project website:
http://www.deq.state.ok.us/WQDnew/tmdl/thunderbird/index.html

The Clean Water Act

First Adopted 1972



Clean Water Goals:

July 1, 1983

Wherever attainable, Fishable Swimmable water quality

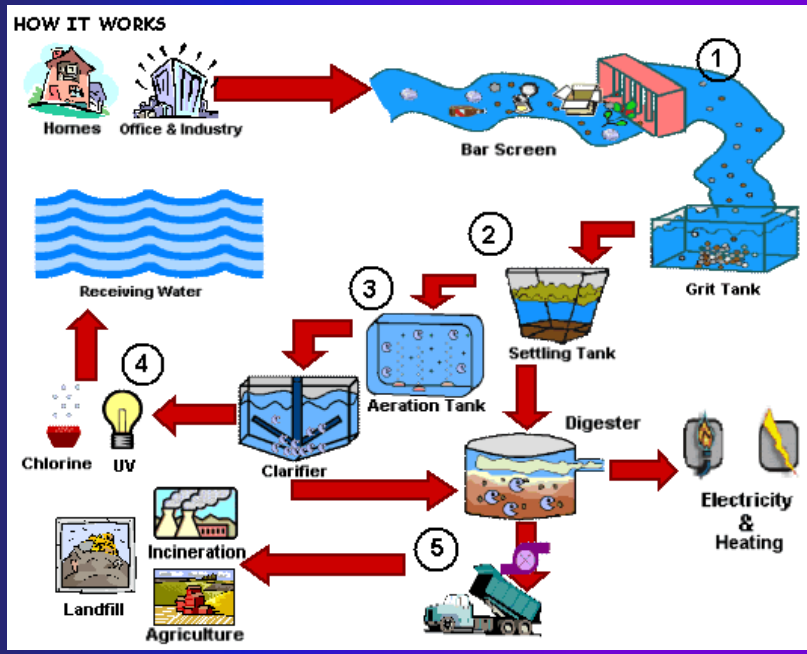
1985

Eliminate discharge of pollutants

How Do We Get There ???

Two Step Approach

Technology-Based Limits For All Point Sources



Additional Water Quality Based Controls To Meet Water Quality Standards

Identifying Problem Areas

Compare Monitoring Results

To

Water Quality Standards

Set Priorities

Compile Problem Areas And Priorities In the 303d List

Lake Thunderbird Impairments

Aquatic Life

- **High Turbidity**
  - Target
    - < 10% exceeds 25 NTU
- **Low Dissolved Oxygen**
  - Targets
    - 5 mg/L at surface
    - < 50% Lake volume below 2 mg/L

Drinking Water

- **High Chlorophyll a**
  - Target
    - Average < 10ug/L

The TMDL

Amount Of Pollution A Waterbody Can Receive Without Violating Water Quality Standards

Point Sources

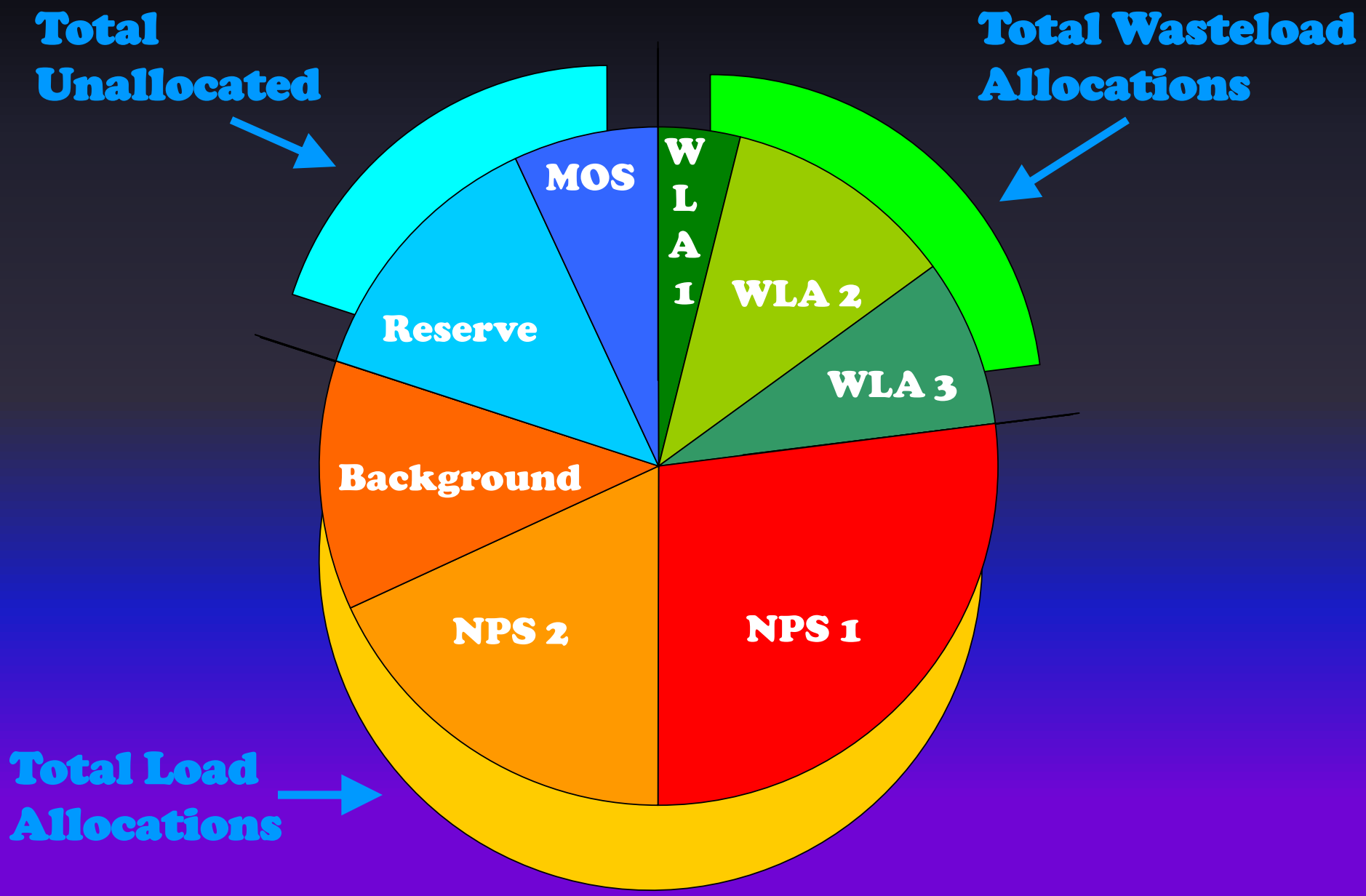
- **Wasteload Allocations**

Nonpoint Sources

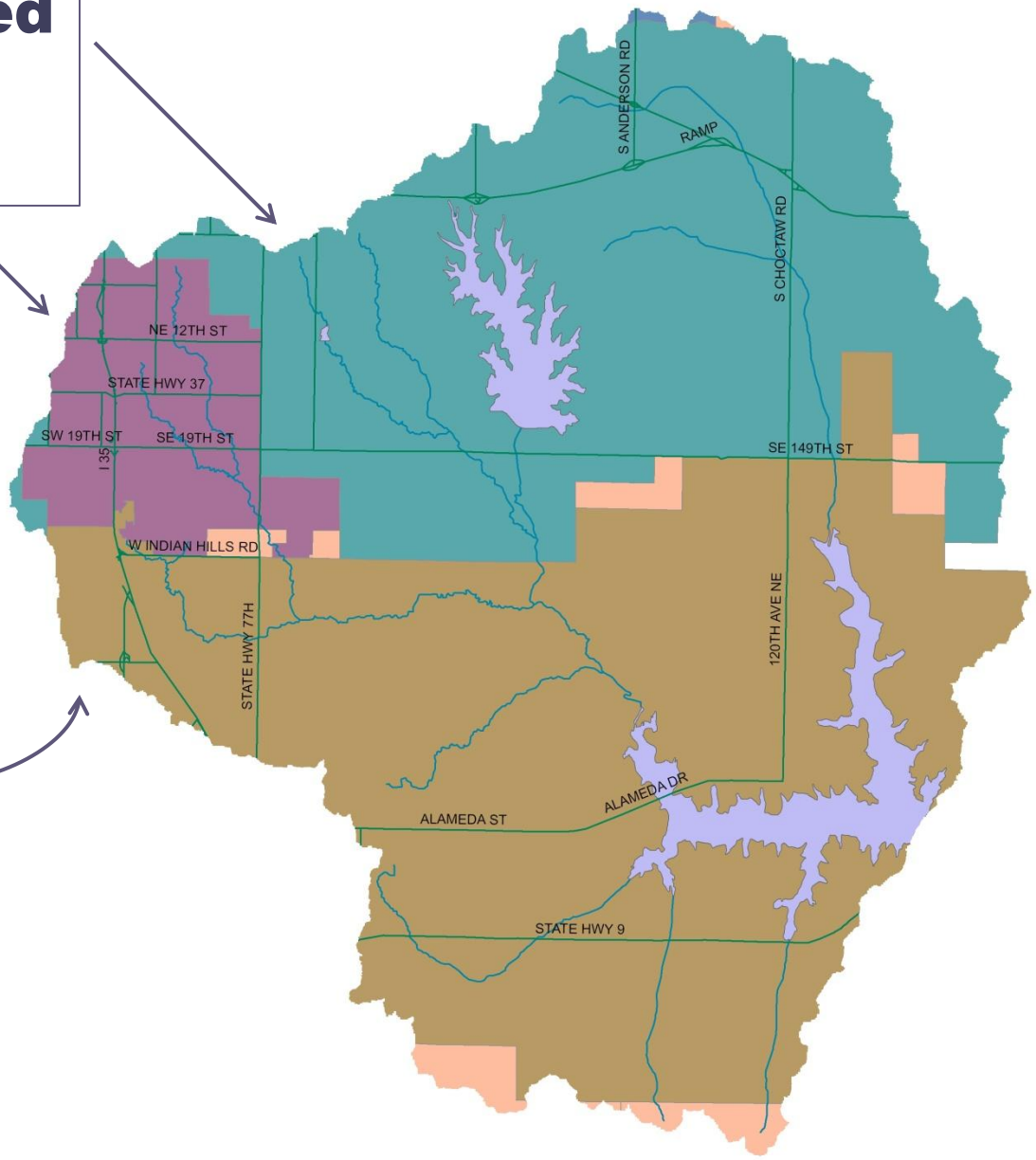
Natural Background

- **Load Allocations**

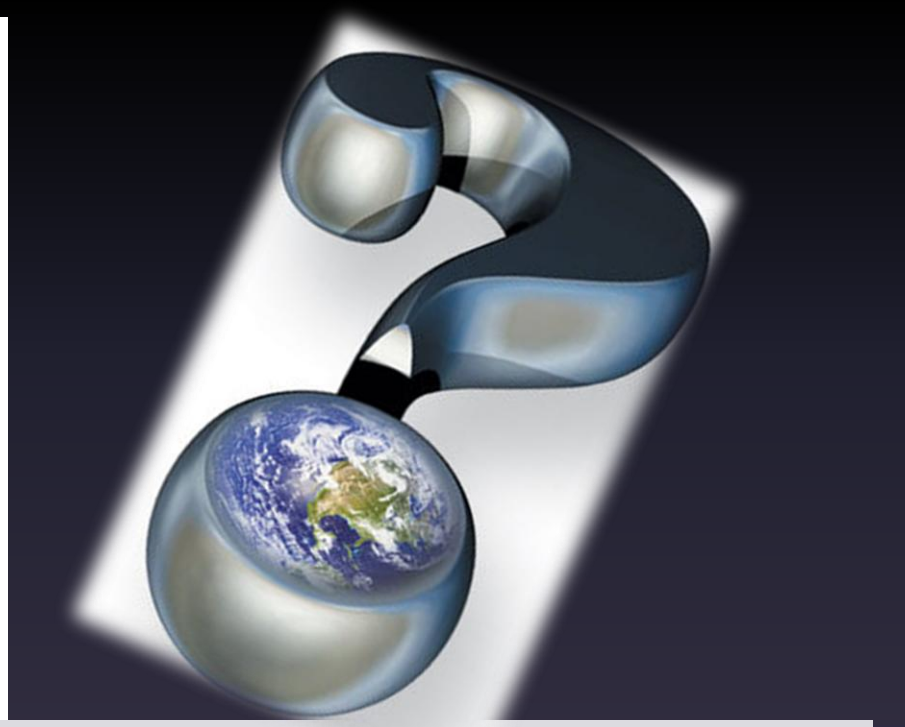
The TMDL Pie

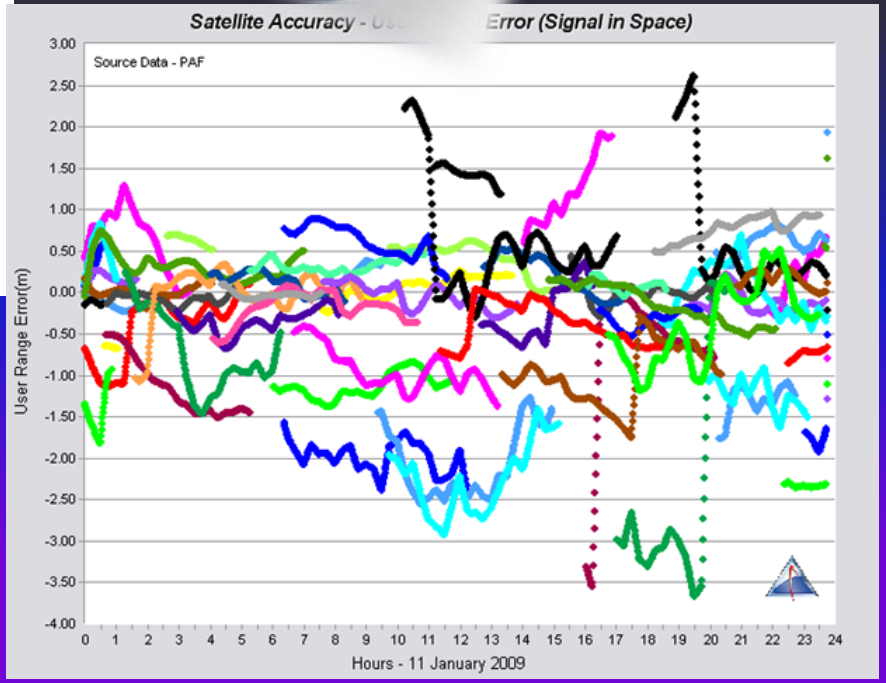

Total Unallocated
Total Wasteload Allocations
MOS
WLA 1
WLA 2
WLA 3
Reserve
Background
NPS 2
NPS 1
Total Load Allocations

Regulated Point Sources



WHERE do we GO From HERE?





Next Steps

New Contract For Additional Work

- **Refine Models**
- **Simulate Limited Number Of Management Scenarios**
- **Submit Draft TMDL Report to EPA November 2012**

Next Steps

- EPA Review and Comments
- Public Notice and Comment Period
- Submit Final TMDL Report to EPA

Project Status

Water Quality Models

- To establish TMDL, we need to know
  - How much pollutants are entering the waterbody now
  - How much pollutants a waterbody can take
  - How much reductions we need
- Ideally, we would also like to know how we can get the reductions in a most cost effective way

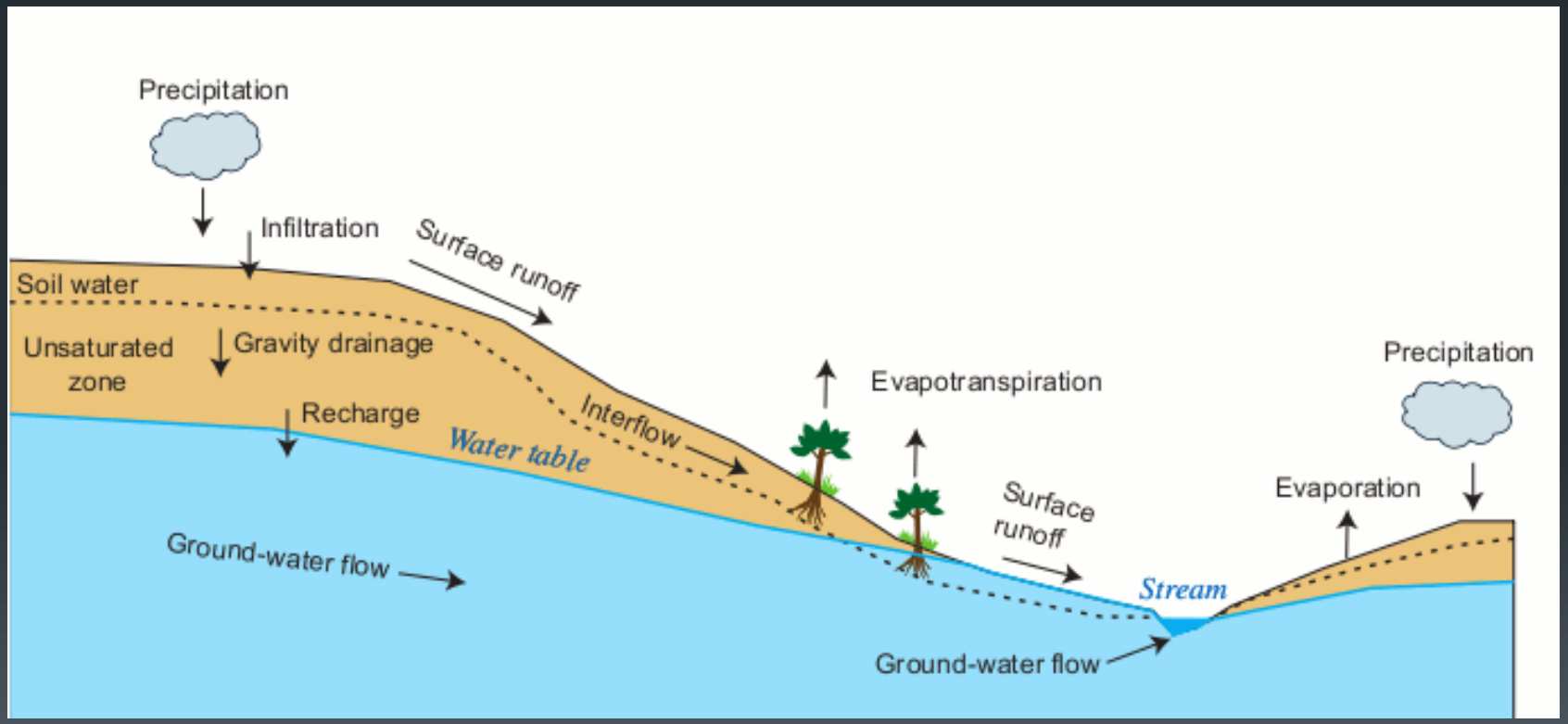
Water Quality Models

- Why computer models?
  - It's not practical to measure pollutant loadings all the time on a watershed scale and for a long period of time
  - Models estimate pollutant loadings in-between measurements
  - Models give you a continuous picture of loading
  - What-if projections can be done only by models: to find the most effective ways to reduce pollutants

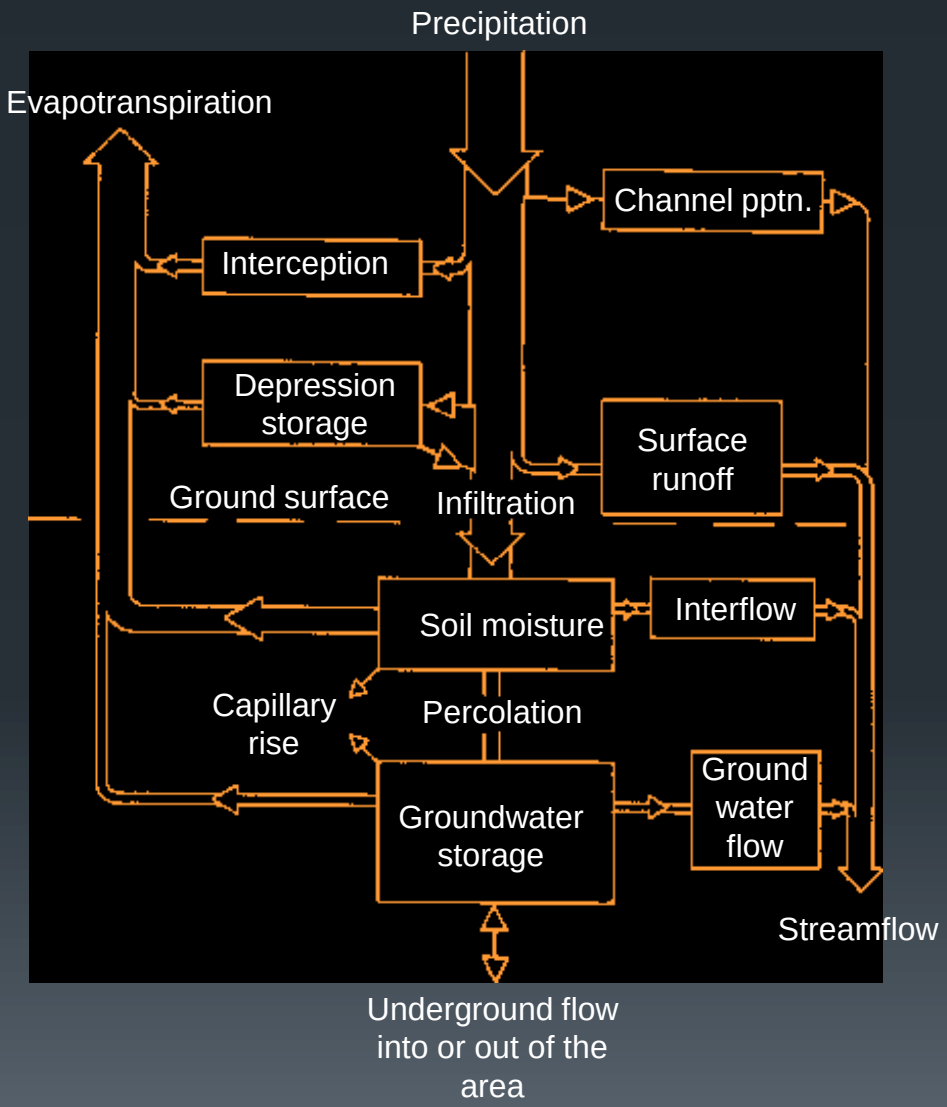
Water Quality Models

- Watershed models
  - How much and where pollutants are generated from the watershed
  - What we can do and how effective those practices would be
  - Feed the lake model
- Lake models
  - What happens to the pollutants in the lake
  - How much pollutants the lake can take and still meet WQS
  - How long does it take to get there

Watershed Model



Watershed Model



Watershed Model

IBAR = (INFILT/(LZS/LZSN)**INFEXP)*INFFAC

IMAX = INFILD*IBAR

IMIN = IBAR - (IMAX - IBAR)

d(UZS)/dt = (d(UZRAT)/dt)*UZSN = PDRO*FRAC

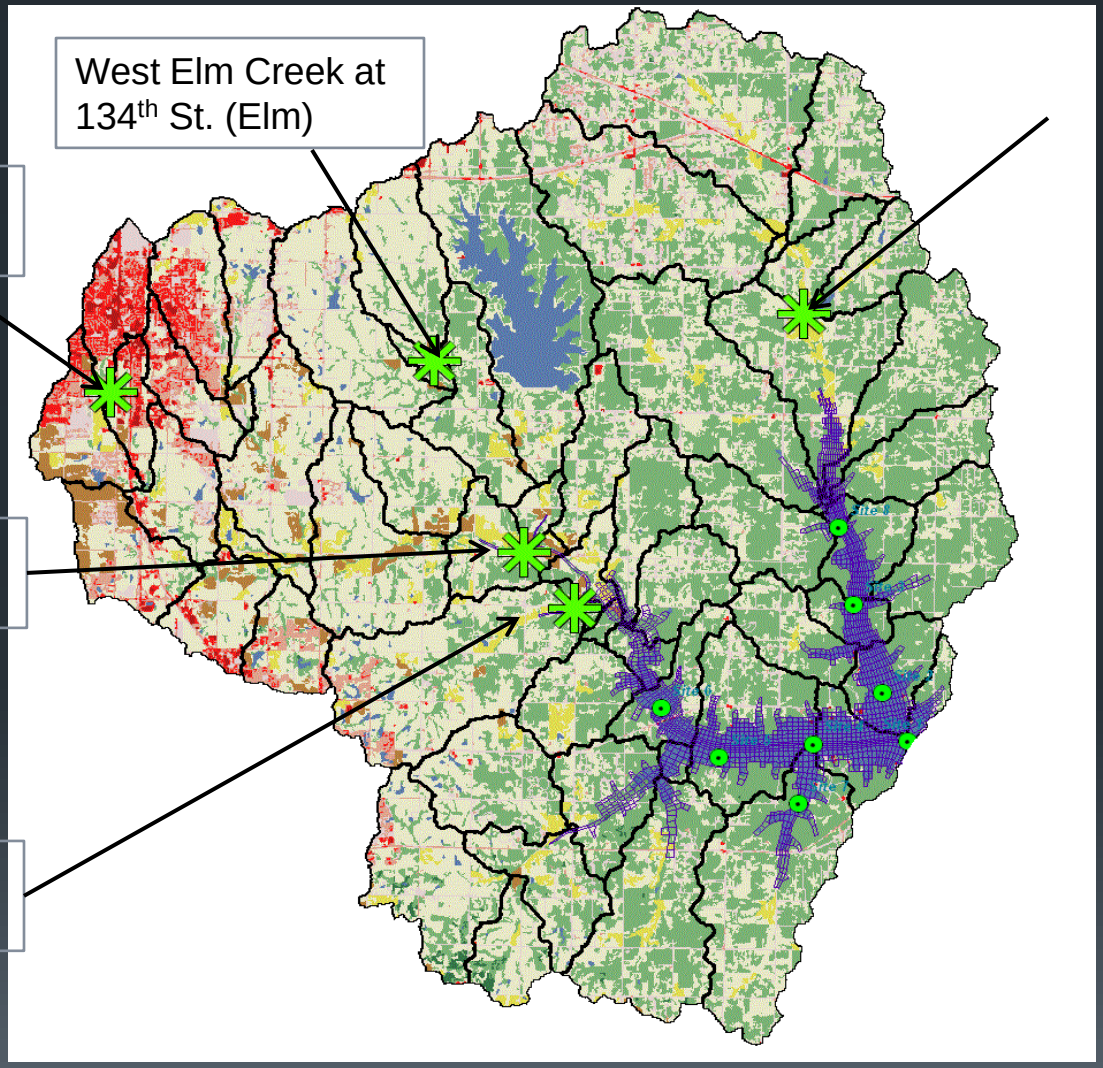
d(UZRAT)/FRAC = (PDRO/UZSN)*dt

$$\text{INTGRL} = \int_{\text{UZRATt1}}^{\text{UZRATt2}} \frac{d(\text{UZRAT})}{\text{FRAC}} = (\text{PDRO}/\text{UZSN})(t2-t1)$$

Watershed Model

- Hydrologic Simulation Program-FORTRAN (HSPF) watershed model
  - Developed and supported by US EPA and USGS
  - One of the most widely used watershed models
  - Simulates water flow, sediment losses, and nutrient movement, etc.
- Models need to be adjusted to reflect local conditions
  - Soil properties and land uses, for example
  - Measured data used to make sure correct adjustment (calibration)

HSPF model calibration



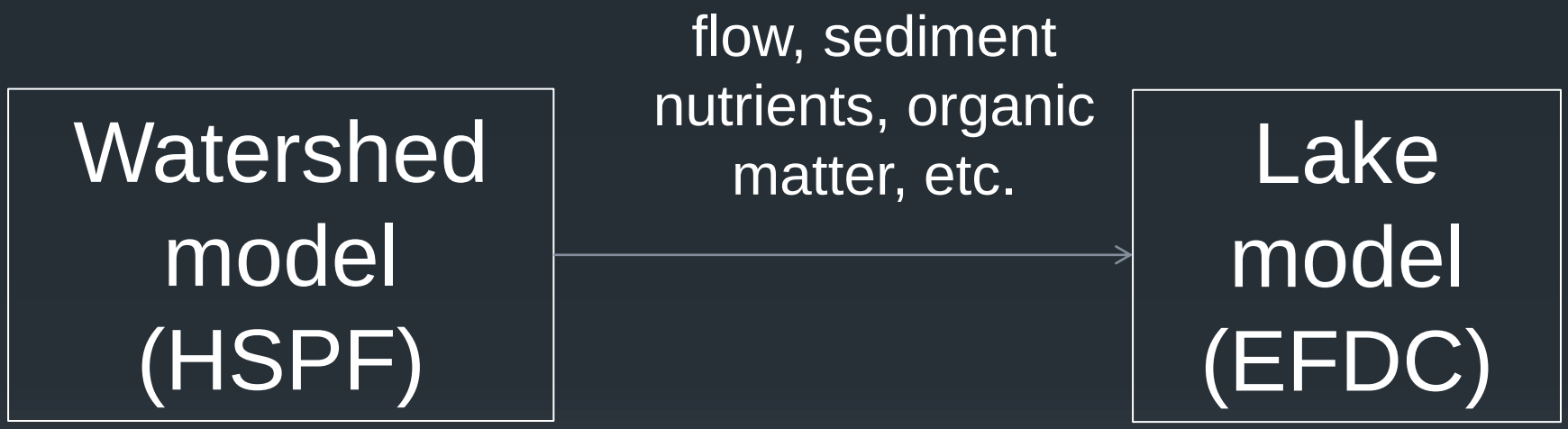
Monitoring Sites

Watershed Model - HSPF

Current Pollutant Loading per Acre

Site	Main landuses	Phosphorus (lbs/ac/yr)	Nitrogen (lbs/ac/yr)
Little R. at 17th Ave.	Urban residential, roads, and commercial	2.52	9.41
W. Elm Crk.	Rangeland	0.43	2.26
Little R. at 60th Ave.	Mixture of rangeland, urban residential, roads, and forest	1.49	5.37
Rock Creek	Rangeland and forest	0.36	1.90
Hog Creek	Forest and rangeland	0.58	2.59

Watershed to Lake Model



Lake Thunderbird EFDC Model

Lake Thunderbird Project Informational meeting

May 24, 2012
Norman, Oklahoma

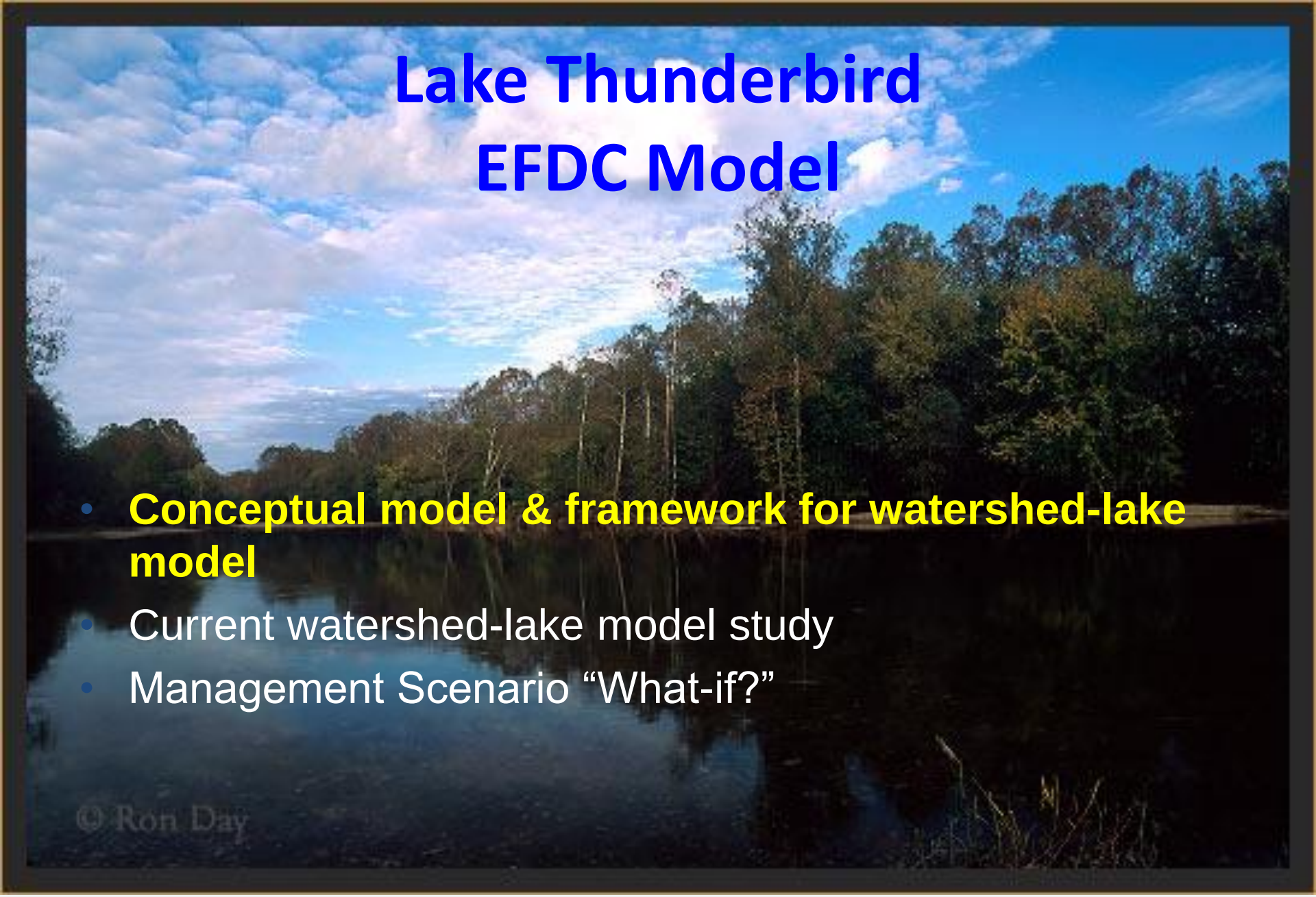
Andrew Stoddard
Dynamic Solutions, LLC
Knoxville, TN

Dynamic Solutions LLC

Water Quality Issues

- Nutrient enrichment (Total-P)
- Turbidity and water clarity
- Eutrophication/algae biomass
- Low oxygen in hypolimnion during summer stratification
- Blue green algae blooms
- Sensitive Water Supply (SWS) designation

Lake Thunderbird EFDC Model



- **Conceptual model & framework for watershed-lake model**
- Current watershed-lake model study
- Management Scenario “What-if?”

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Conceptual Model of Lake

- Model describes cause-effect interactions of watershed flow and pollutants on water quality conditions in Lake Thunderbird
- Summer-winter water temperature differences cause stratification in summer
- Summer stratification controls oxygen depletion in bottom and loading of nutrients from the sediment bed to the lake
- Water quality targets for the lake are turbidity, chlorophyll and dissolved oxygen

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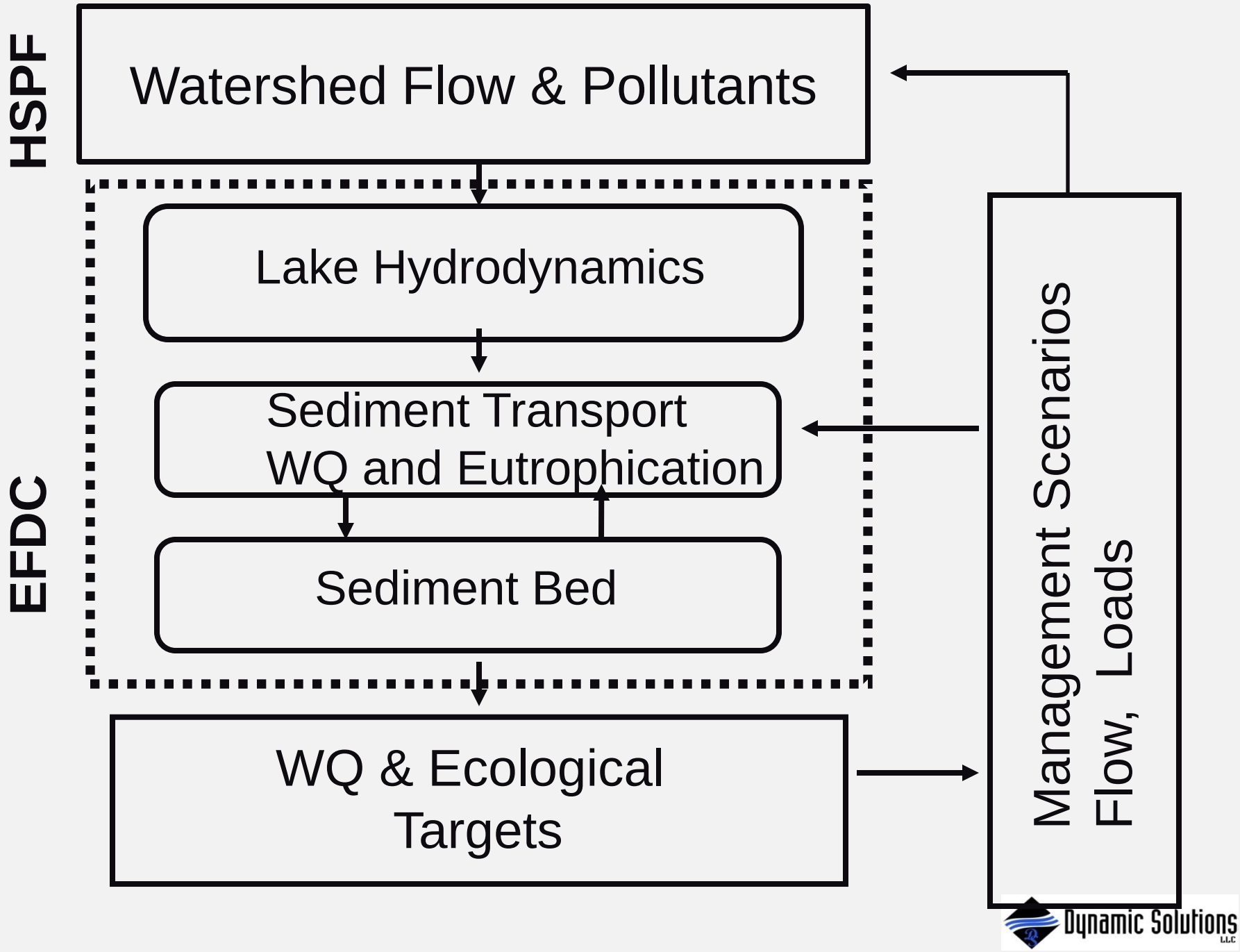
HSPF
Watershed Flow & Pollutants
EFDC
Lake Hydrodynamics
Sediment Transport
WQ and Eutrophication
Sediment Bed
WQ & Ecological
Targets
Management Scenarios
Flow, Loads
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Model Data Needs & Data Sources

- Bathymetry: OWRB survey in 2001
- Watershed flow & Water Quality: ODEQ HSPF watershed model
- Meteorology: Winds, sunshine, air temperature, precipitation, evaporation from MESONET
- Lake level & releases at dam: USACE Tulsa District
- Water supply withdrawals: COMCD (Norman, Midwest City and Del City)
- Lake WQ: OWRB monitoring for initial conditions and model calibration
- Sediment bed: OWRB surveys in 2008 for initial conditions for nutrients and solids

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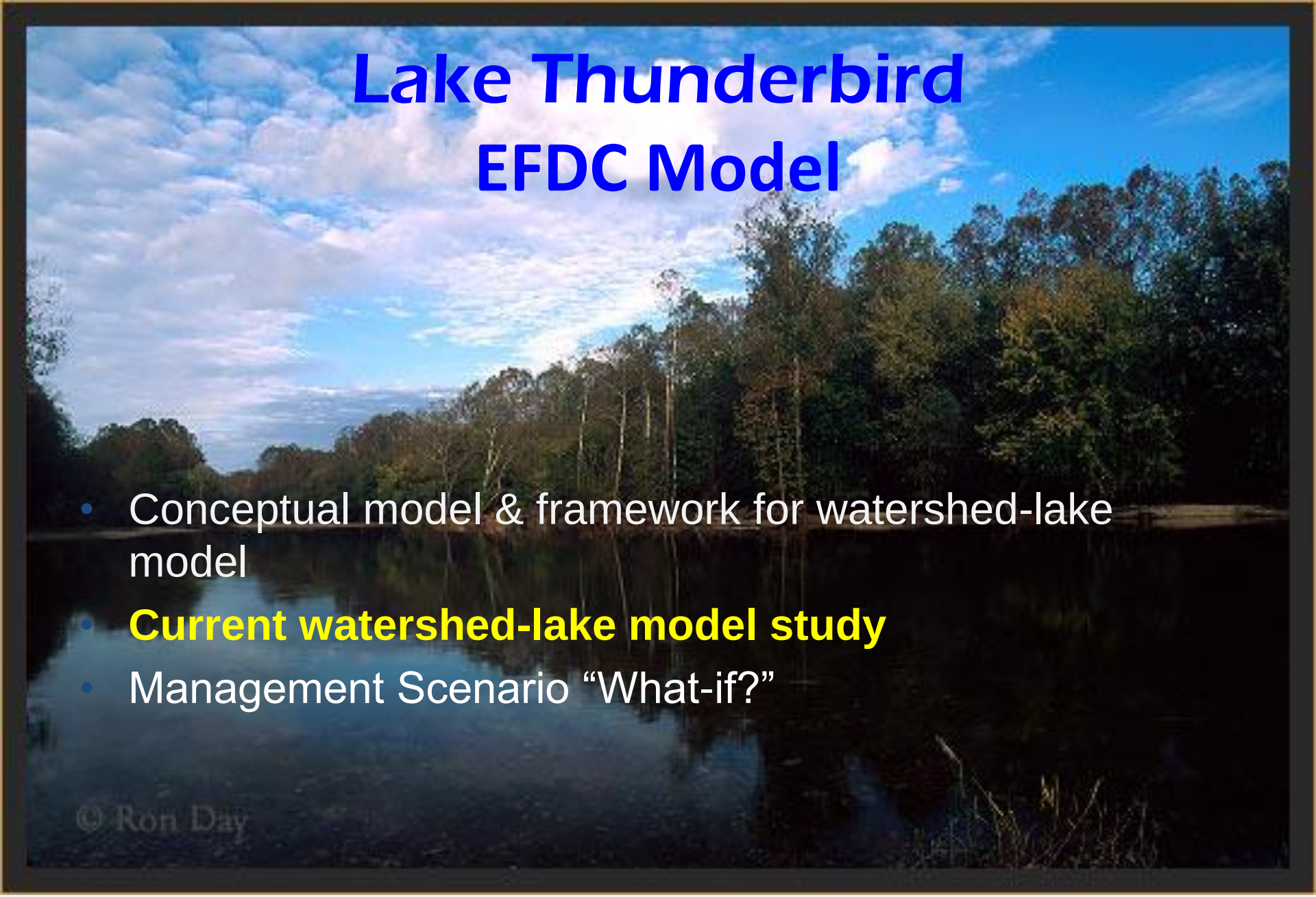
Lake Thunderbird EFDC Model



- Conceptual model & framework for watershed-lake model
- **Current watershed-lake model study**
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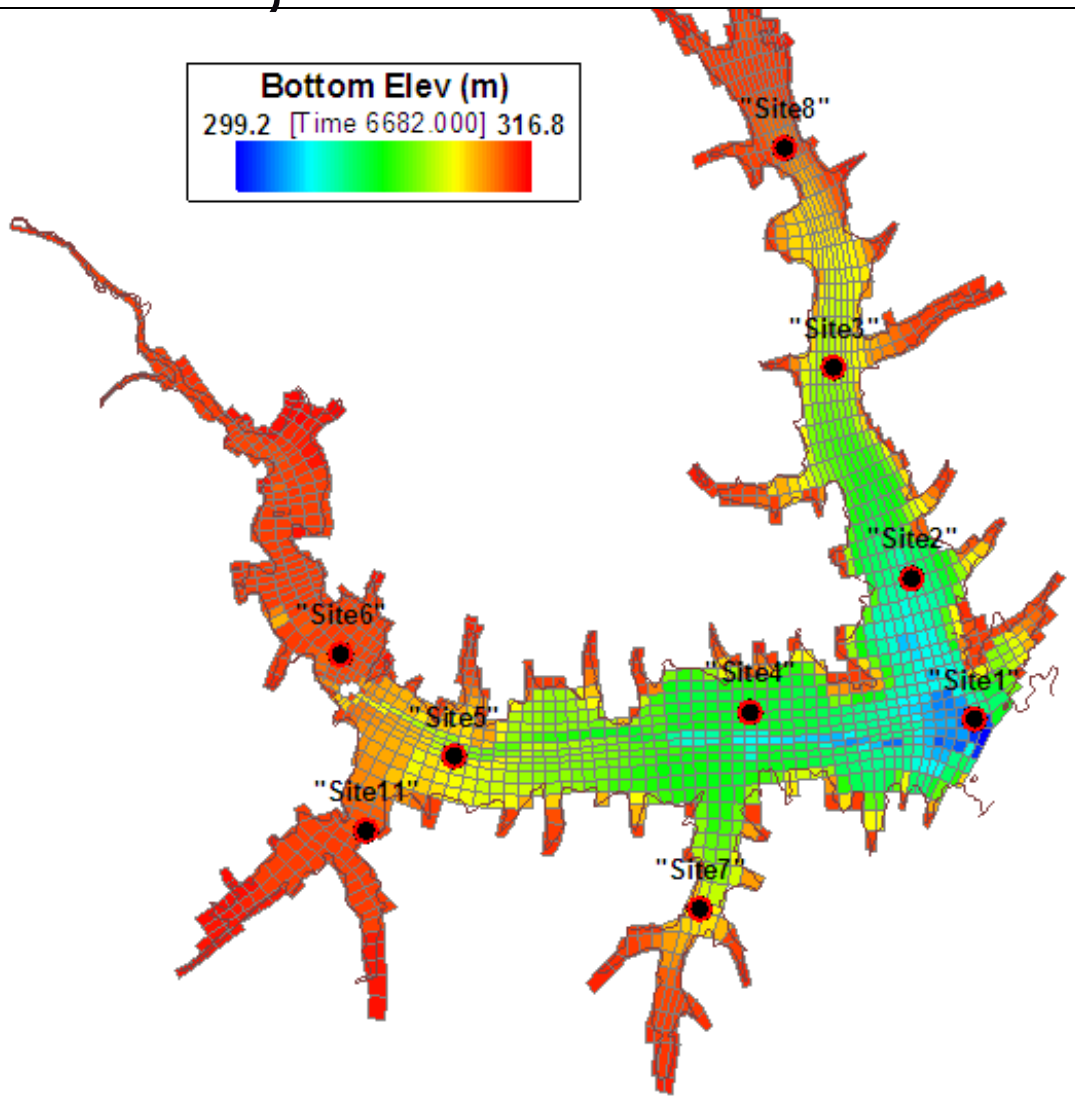
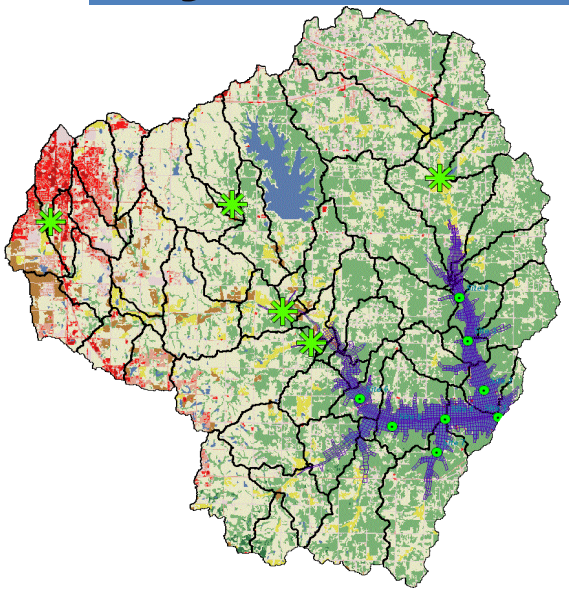
Model Domain & OWRB Sites
1,660 Grid Cells x 6 Layers





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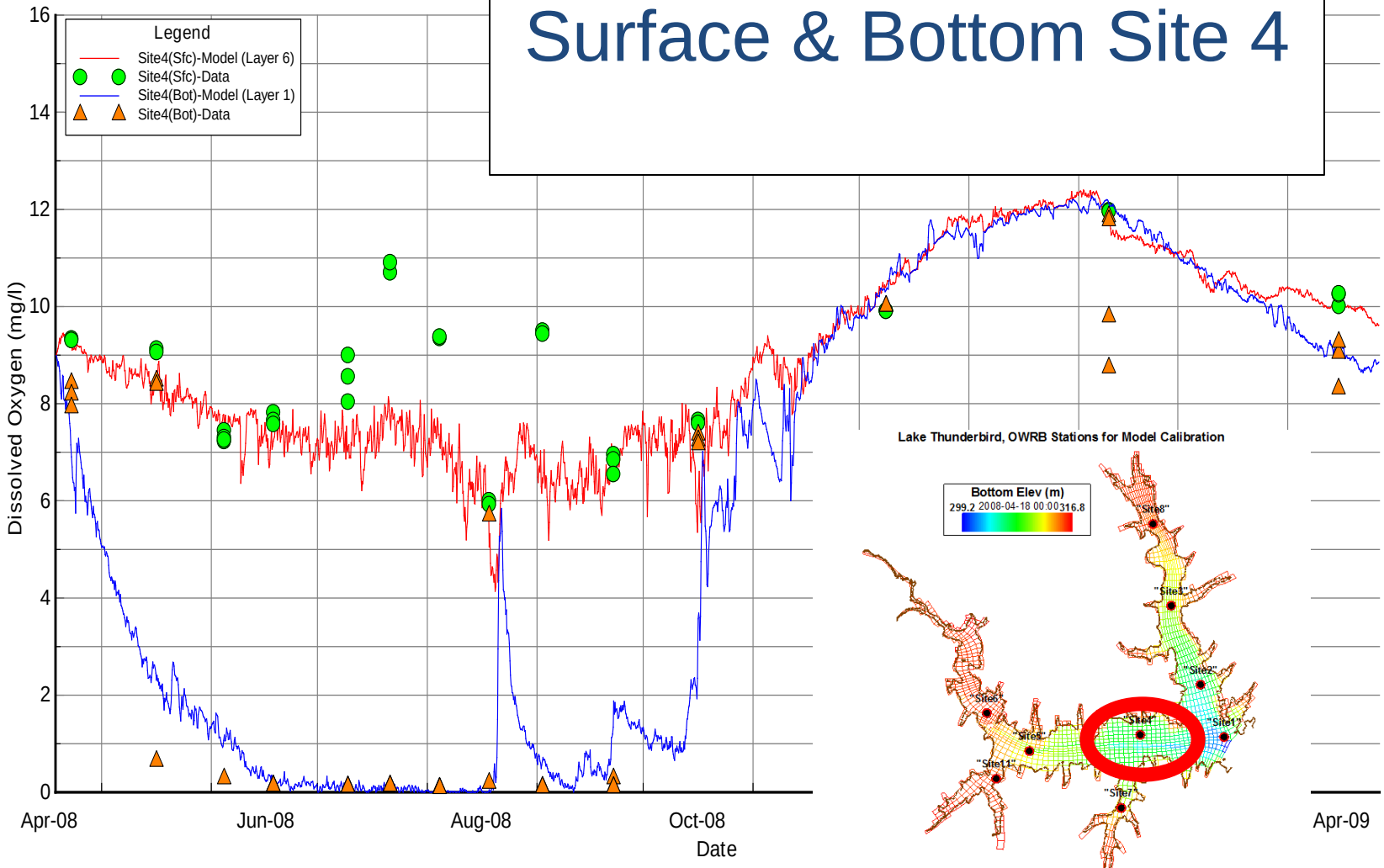
Dissolved Oxygen (Aquatic Life) Surface & Bottom Site 4



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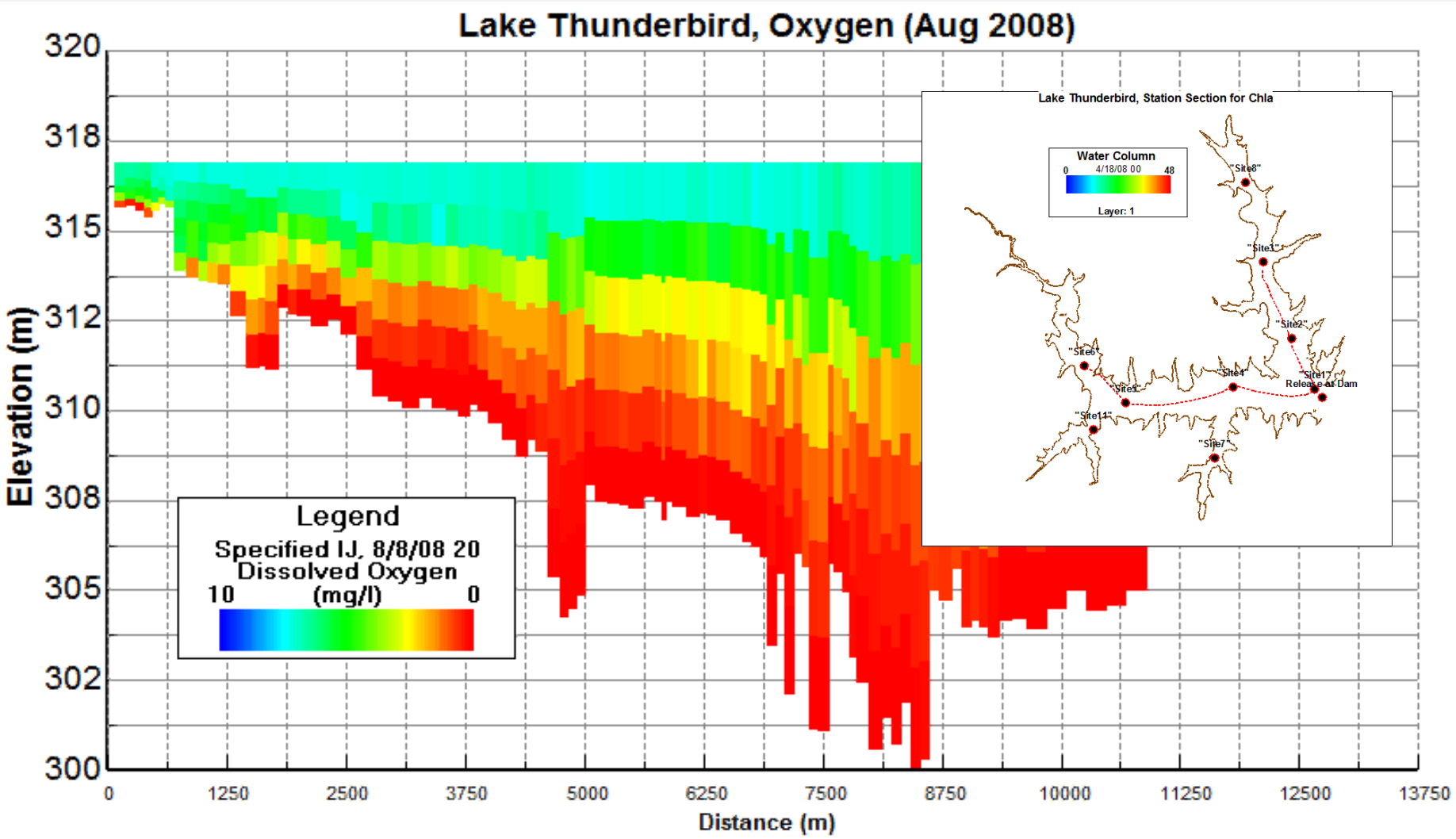
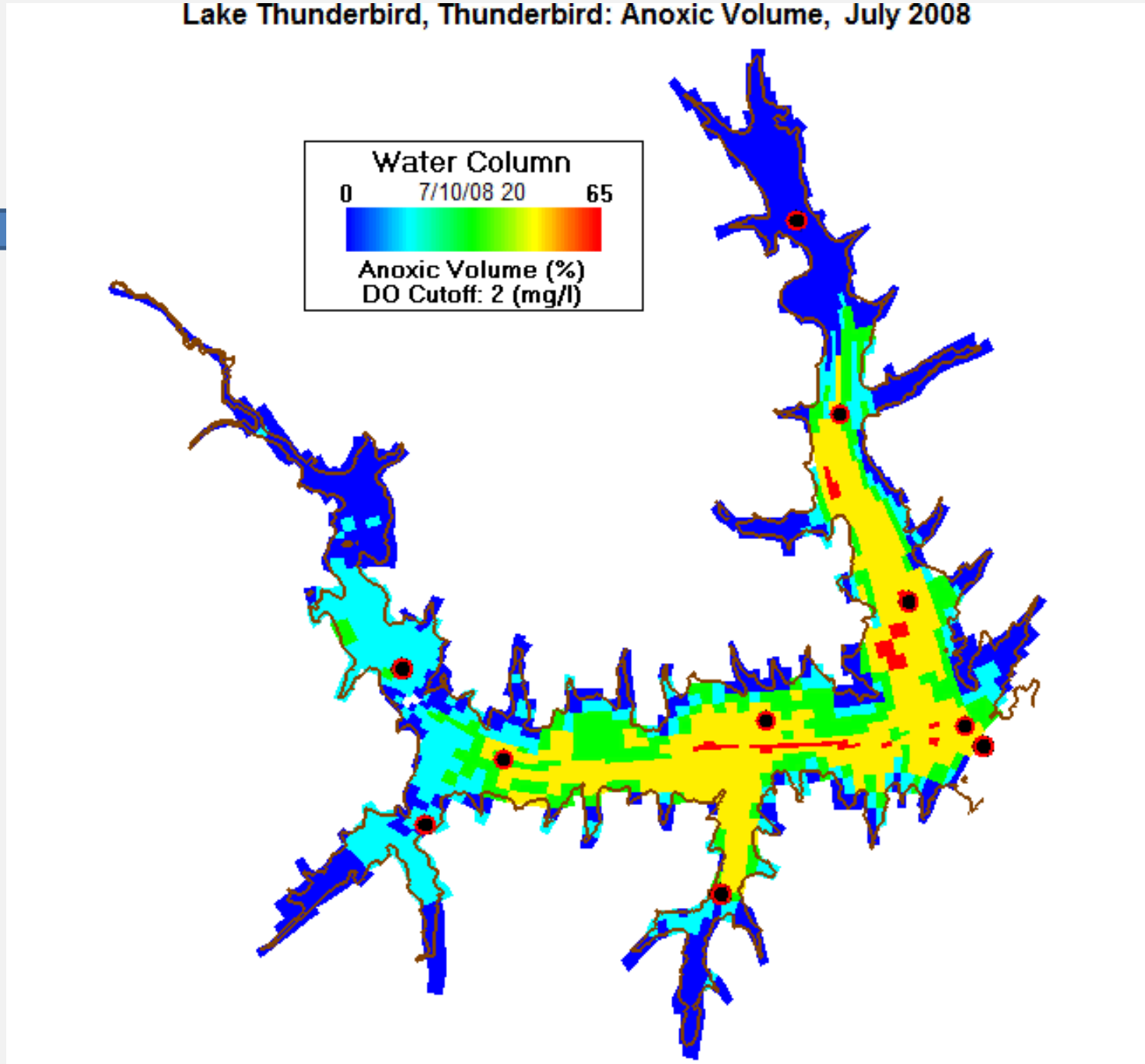
Oxygen Aug-2008





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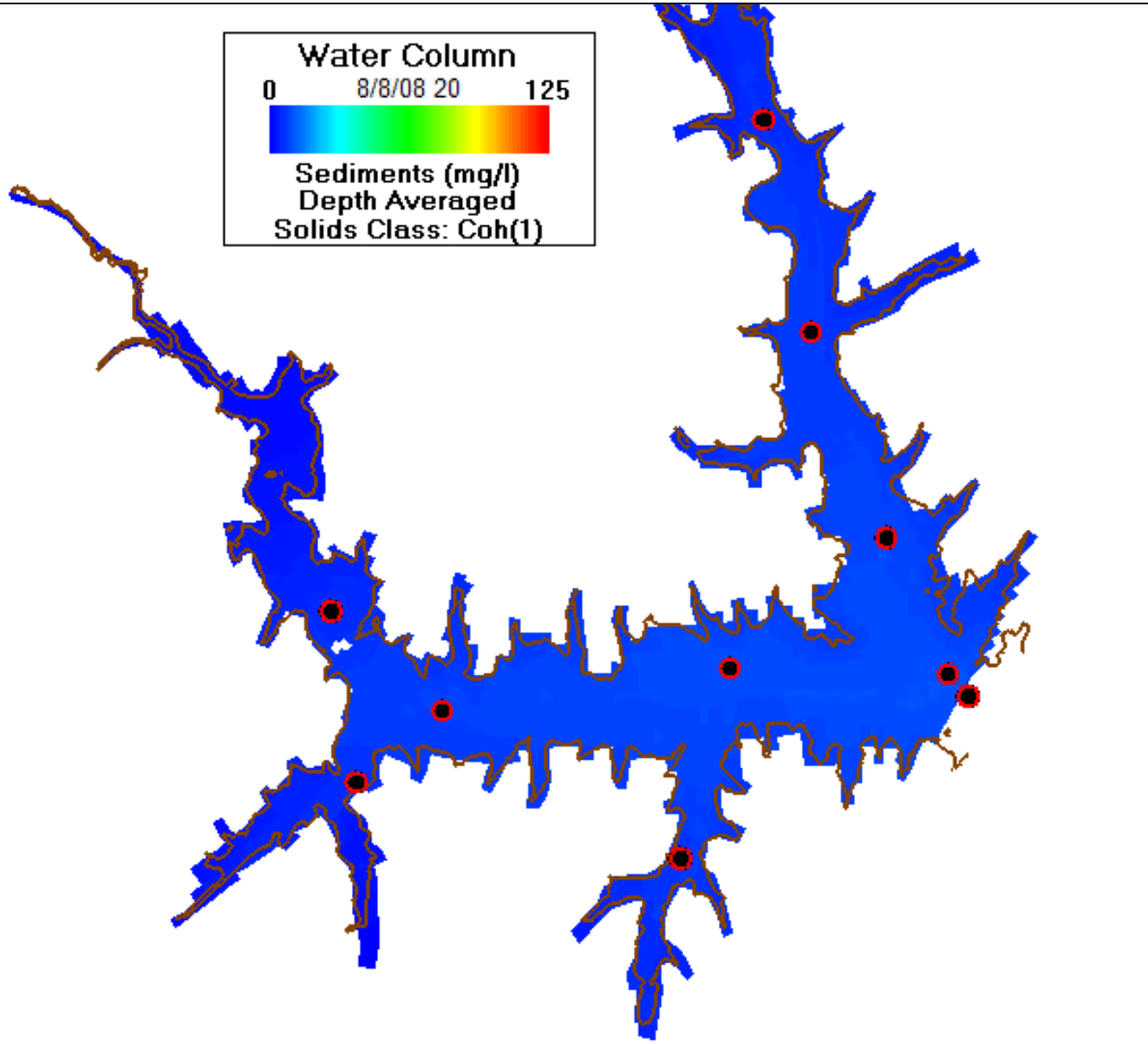
Suspended Solids Aug-2008



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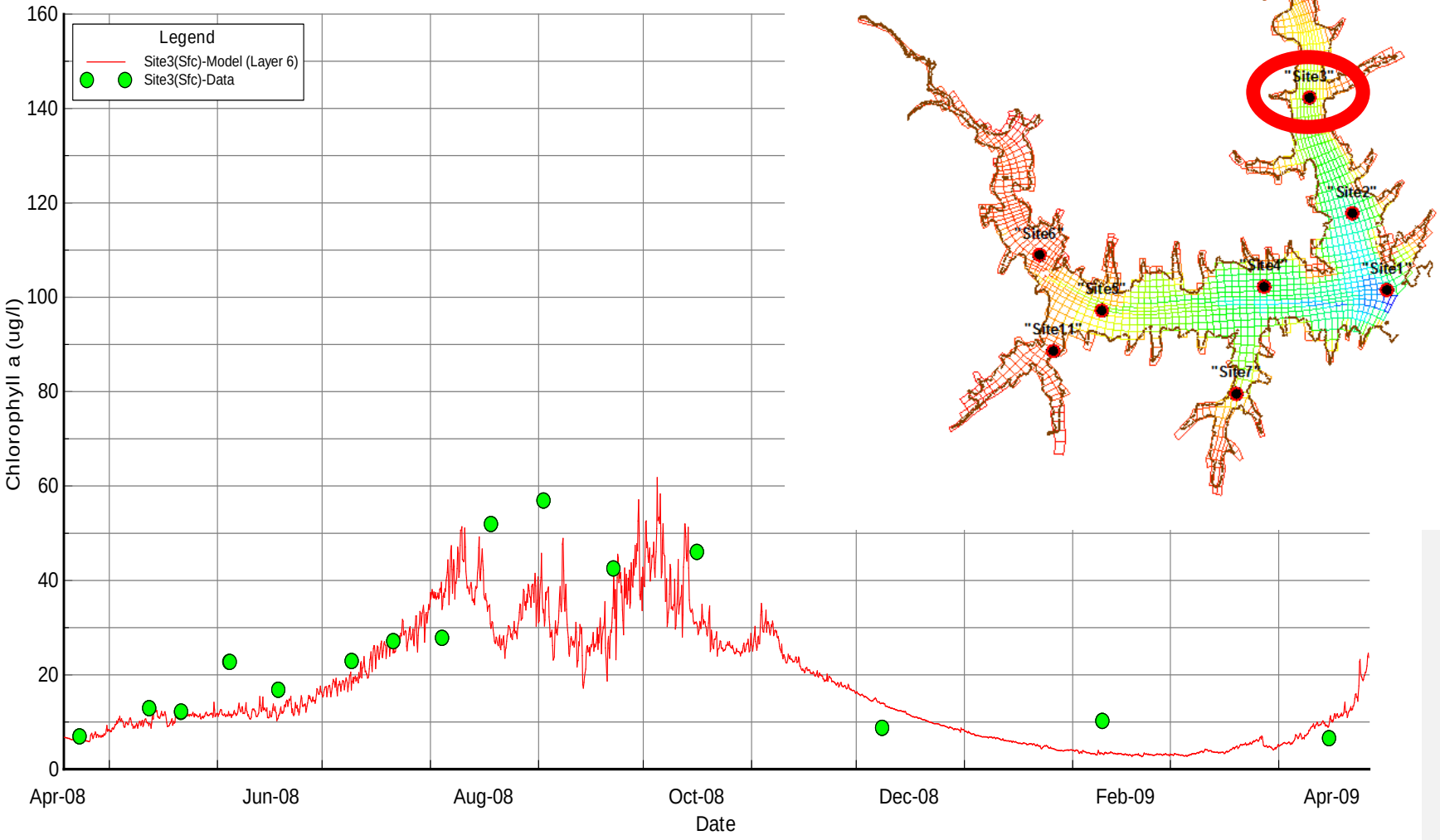
Algae Chlorophyll-a Surface Site 3



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How Well Did the Lake Model Match Observed Data

- Model generated seasonal stratification with good match to observed data for vertical profiles of water temperature and dissolved oxygen
- Model matched seasonal trends of water temperature, dissolved oxygen, water clarity, algae (Chl-a) and nutrients
- Model oxygen results used to determine anoxic volume of the lake as percentage
- Sediment bed model essential to obtain good agreement between model results and observed data

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How Lake Model Can be Used

- Model can be used to test “what-if?” solids, nutrients and organic matter loading from the watershed are reduced
- How would load reductions from the watershed change lake water quality?
- Would projected water quality conditions be in compliance with water quality targets for Lake Thunderbird for turbidity, chlorophyll and oxygen?
- How long might it take for the lake to attain compliance with water quality targets?

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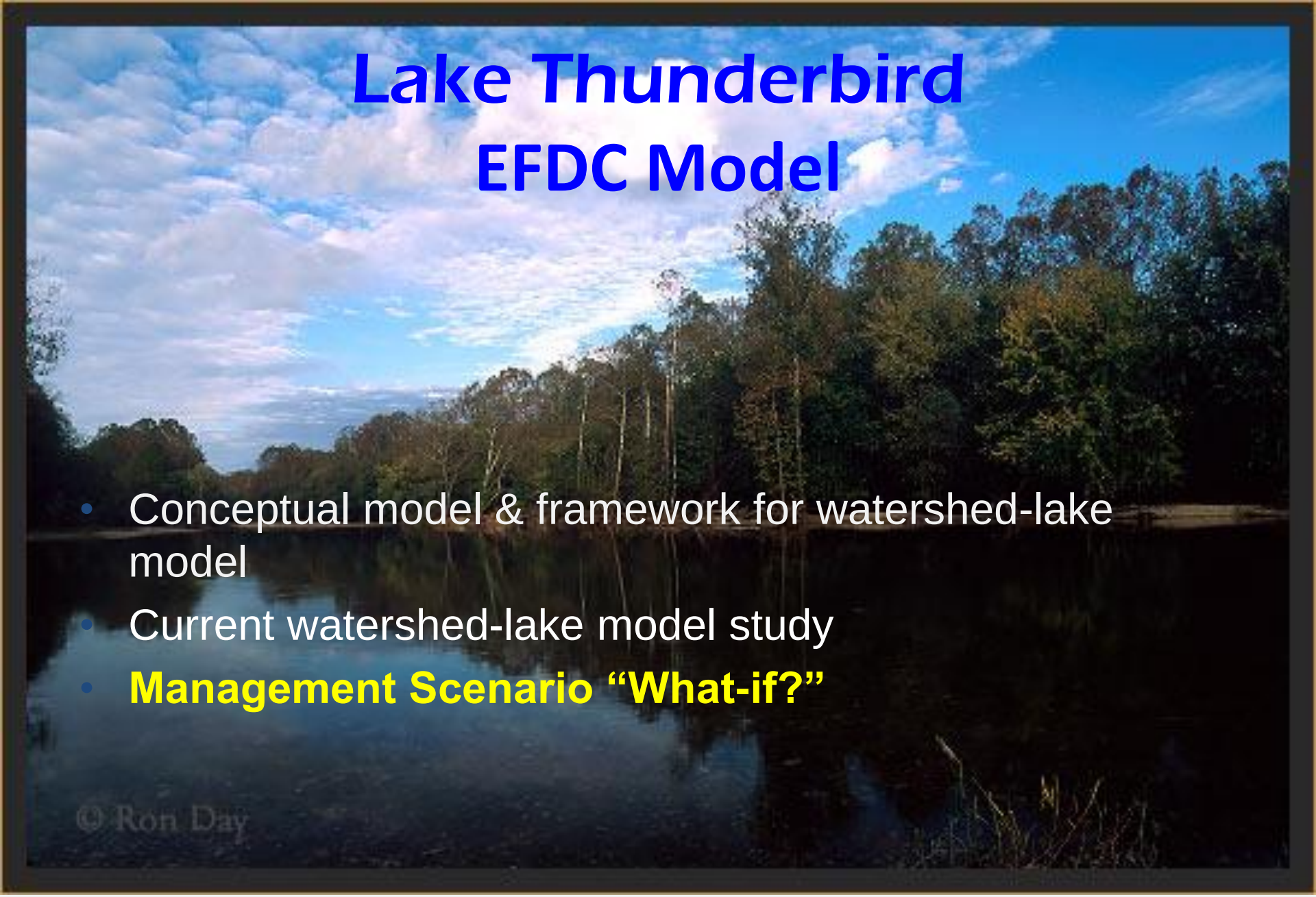
Lake Thunderbird
EFDC Model



- Conceptual model & framework for watershed-lake model
- Current watershed-lake model study
- **Management Scenario "What-if?"**

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What-if? Load Reduction Scenario

- “What-if?” 75% of pollutants are removed from watershed
- Sediment bed changes slowly in response to changes in watershed loading
- Changes in sediment bed control changes in water quality of lake
- Track how water quality changes over time

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Summary: Turbidity

- Turbidity standard requires that 90% of data must be less than 25 NTU. Standard can be achieved with 75% removal of pollutants from the watershed.
- Water clarity will improve.

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Summary: Chlorophyll

- Chlorophyll standard for Sensitive Water Supply requires that long term average be less than 10 ug/L.
- Chlorophyll may increase at first because of removal of turbidity and improved water clarity.
- Standard can be achieved with 75% removal scenario over time as BMPs are implemented.

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Summary: Dissolved Oxygen

- Anoxic volume criteria for Aquatic Life of 2 mg/L or better can be achieved over time with 75% removal of watershed pollutant loads.

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Conclusion

- The Lake Thunderbird HSPF watershed and EFDC lake model framework provides Oklahoma DEQ with a technically defensible tool
- Calibrated models have been applied to test “What-if?” impacts of watershed management scenarios on lake water quality and compliance with WQ targets
- HSPF-EFDC model framework can help support water quality management planning efforts for Lake Thunderbird

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Thanks to Ron Day for
use of photographs
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Question-Answer: FAQ's

Q: Why are we using a contractor for the lake model?

A: So that we can complete the project faster.

Q: Why has it taken so long?

A: We want to do a good job and the models are complex.

Q: What's next?

A: Refine the models then send the draft TMDL for EPA review.

Question-Answer: FAQ's

Q: What about discharging wastewater to augment the lake water supply?

A: COMCD is doing a study. Their "preferred alternative" is for Moore and Norman to discharge to the lake. That is not included in this study.

Q: How much new development would be allowed?

A: We will not be able to answer this.

Q: What happens to stormwater controls?

A: There will be requirement for such controls. Details will be studied.

Question-Answer: FAQ's

Q: Will there be another meeting?

A: That has not been decided. The public will have a chance to comment on the draft TMDL after EPA's review.

QUESTIONS ?


Thanks For Coming
Please Drive Safely