Modeling for Brady Creek Watershed Protect Plan

An Overview and Introduction

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What Are Models?

- Mathematical models are analytical abstractions of the real world and as such represent an approximation of the real system.

- In the context of watershed planning, mathematical models are computer based, simplified representations of water quality processes that govern the fate and transport of one or more pollutants.

Why Use Watershed Modeling?

Models provide a viable approach for estimating loads, providing source load estimates, and evaluating various management alternatives.

How will models be used on this project?

- Evaluate stormwater runoff control measures in certain areas of City of Brady (SWMM model)
- Evaluate depressed dissolved oxygen in Brady Creek within City of Brady (QUAL2K model)
- Evaluate Brady Lake watershed for stakeholder concerns (for example, aging flood-retardation dams and related sediment control, brush control and water quality benefits) (SWAT model)
- Evaluate probable sources and causes of increasing total dissolved solids concentrations in Brady Lake. (WRAP model)

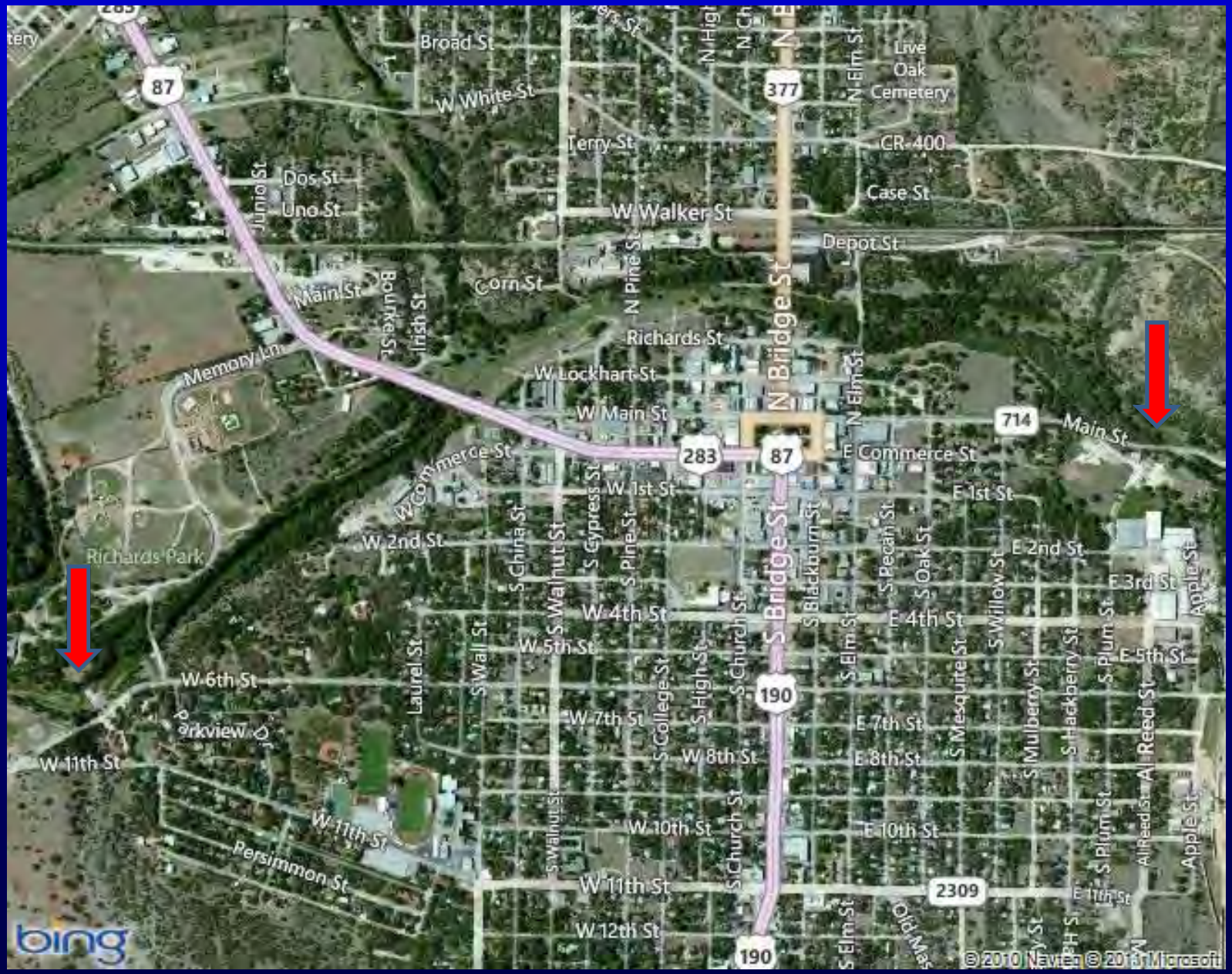
Documentation of Impairment State of Texas 2010 Integrated Report

Brady Creek (Segment 1416A) from San Saba River upstream to Brady Lake dam.

- Depressed dissolved oxygen from FM714 in City of Brady to Brady Lake dam

(focused area within City of Brady)

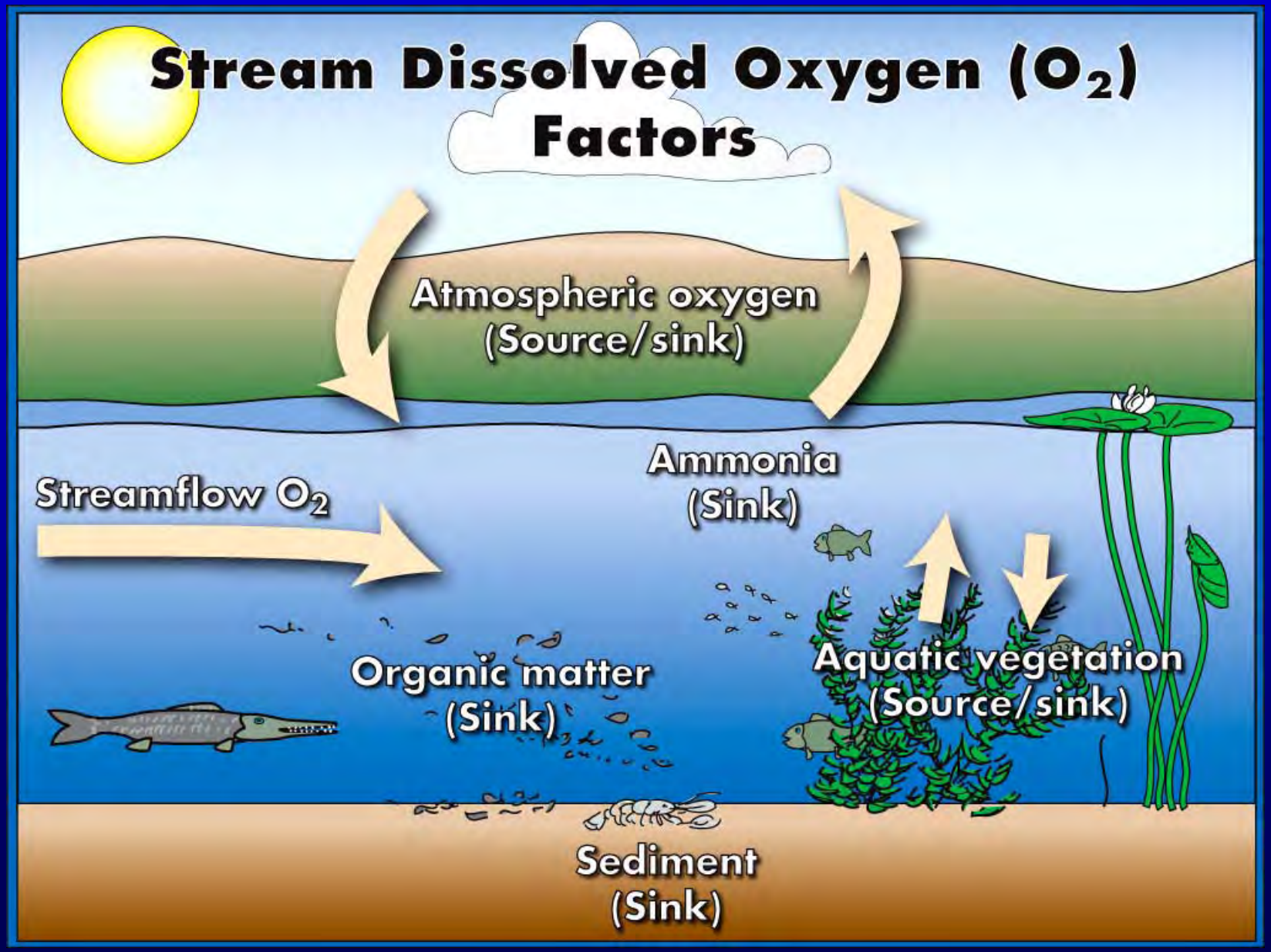
Brady Creek: Area of Focus



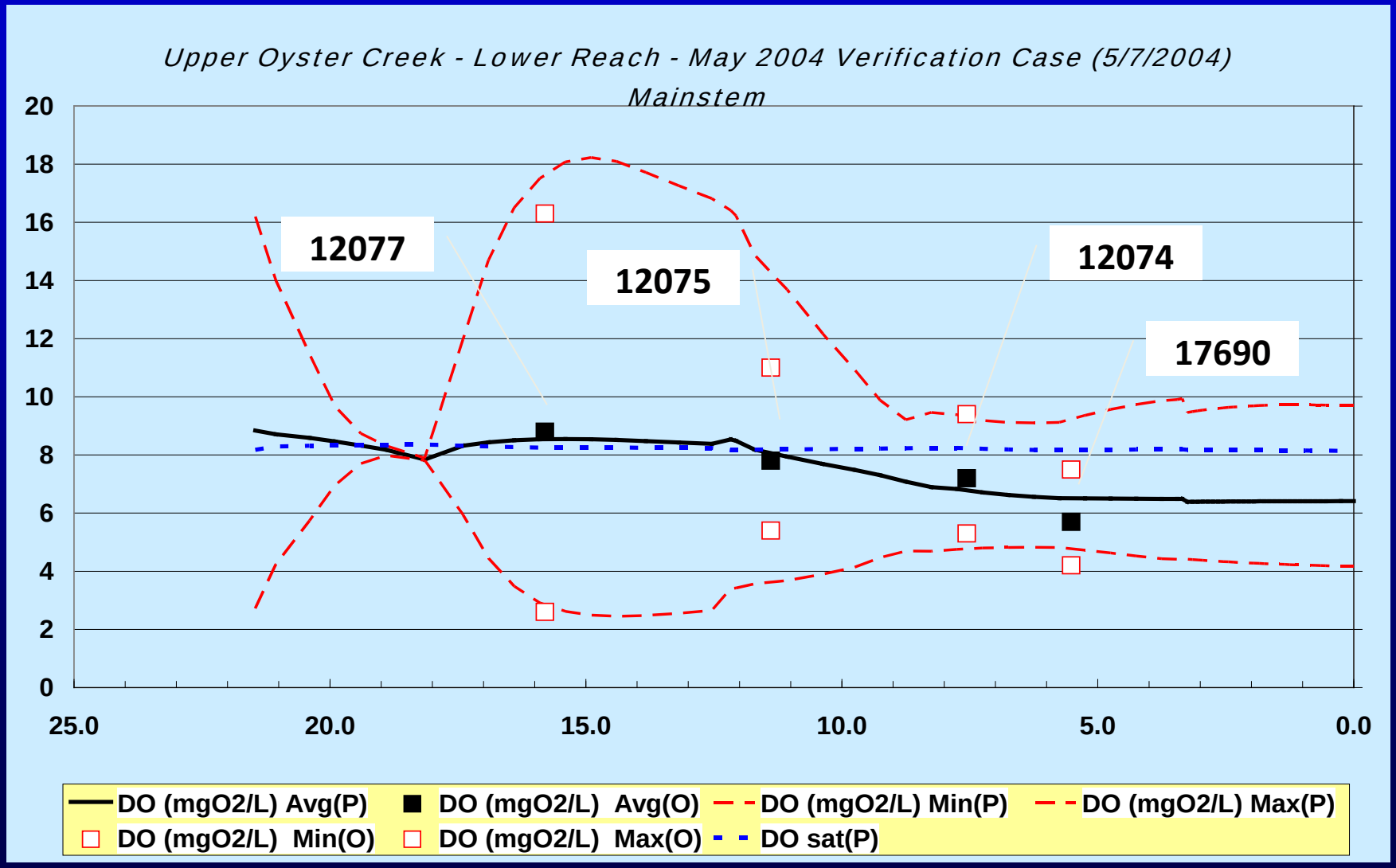
Tool to Address Need – QUAL2K

- QUAL2K is a stream water quality model. It is one-dimensional* and operates under steady-state flow.
- All water quality variables are simulated on a diurnal (24-hour) time scale, including dissolved oxygen.

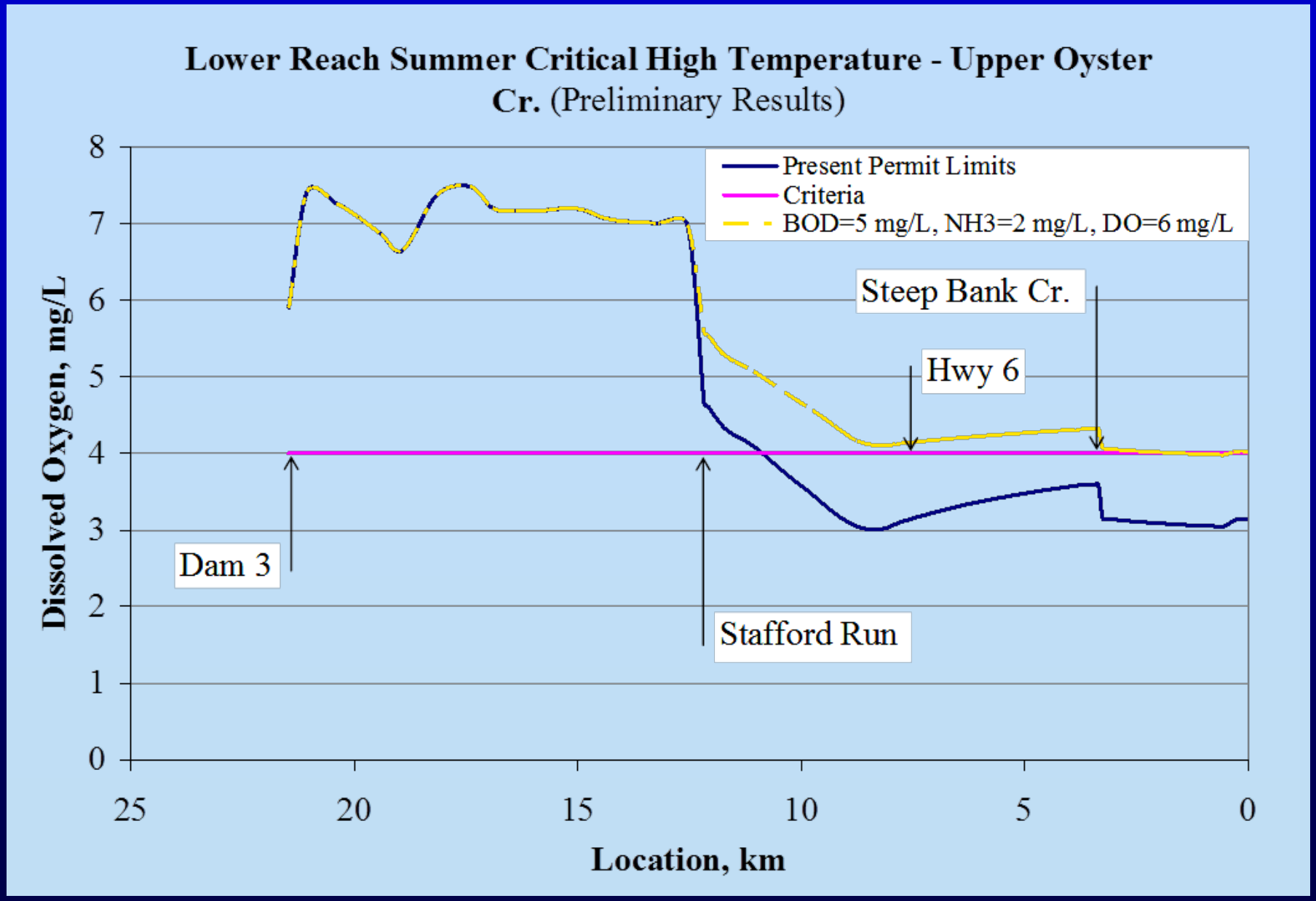
  * One-dimensional means the model divides the Pecos River into computation elements along the river's length (each element about 0.5 mile long).


Stream Dissolved Oxygen (O_2) Factors
Atmospheric oxygen (Source/sink)
Streamflow O_2
Ammonia (Sink)
Organic matter (Sink)
Aquatic vegetation (Source/sink)
Sediment (Sink)

Portion of Oyster Creek – Dissolved Oxygen (DO) Results for Calibration Period



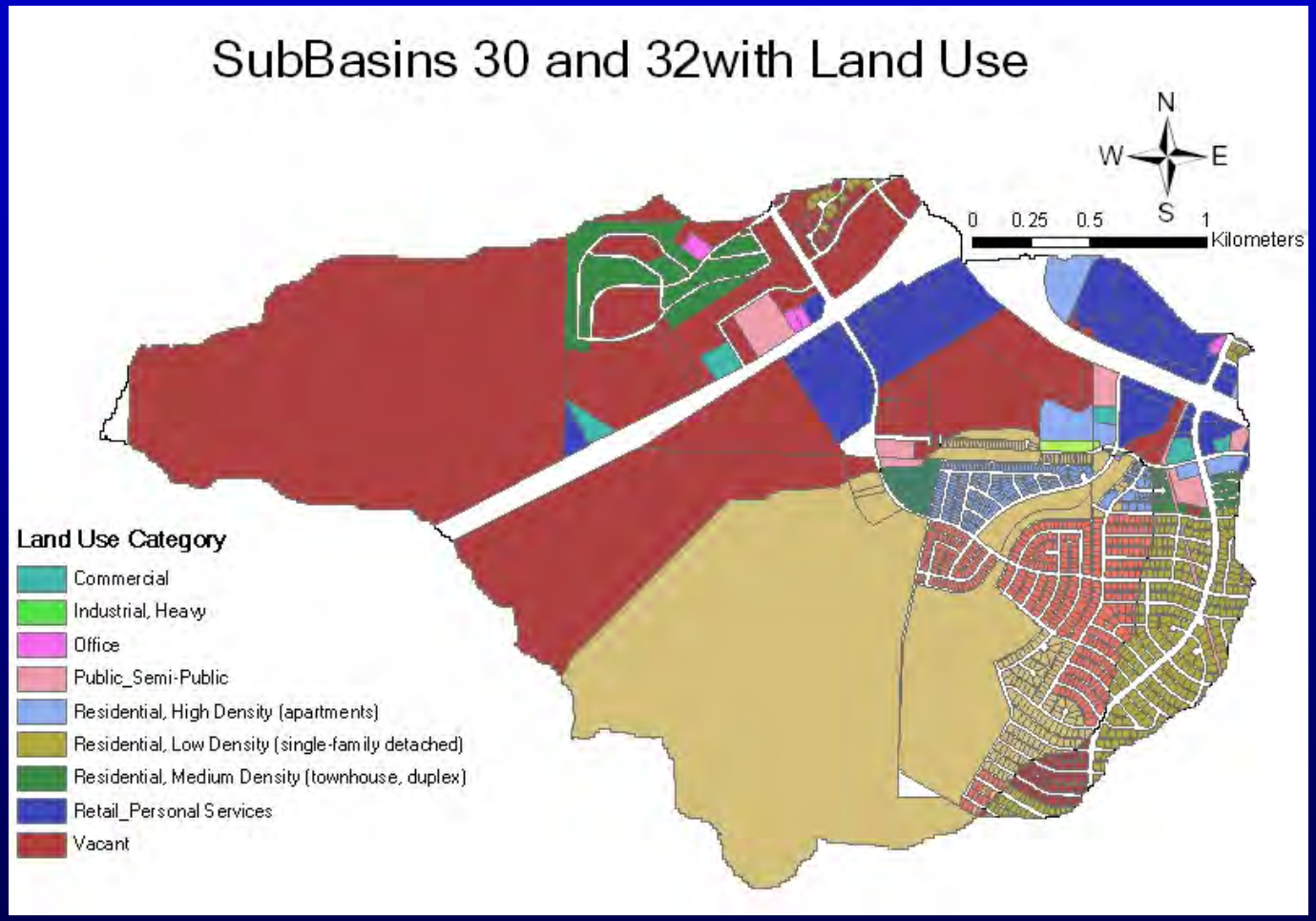
Example Application of QUAL2K for Dissolved Oxygen



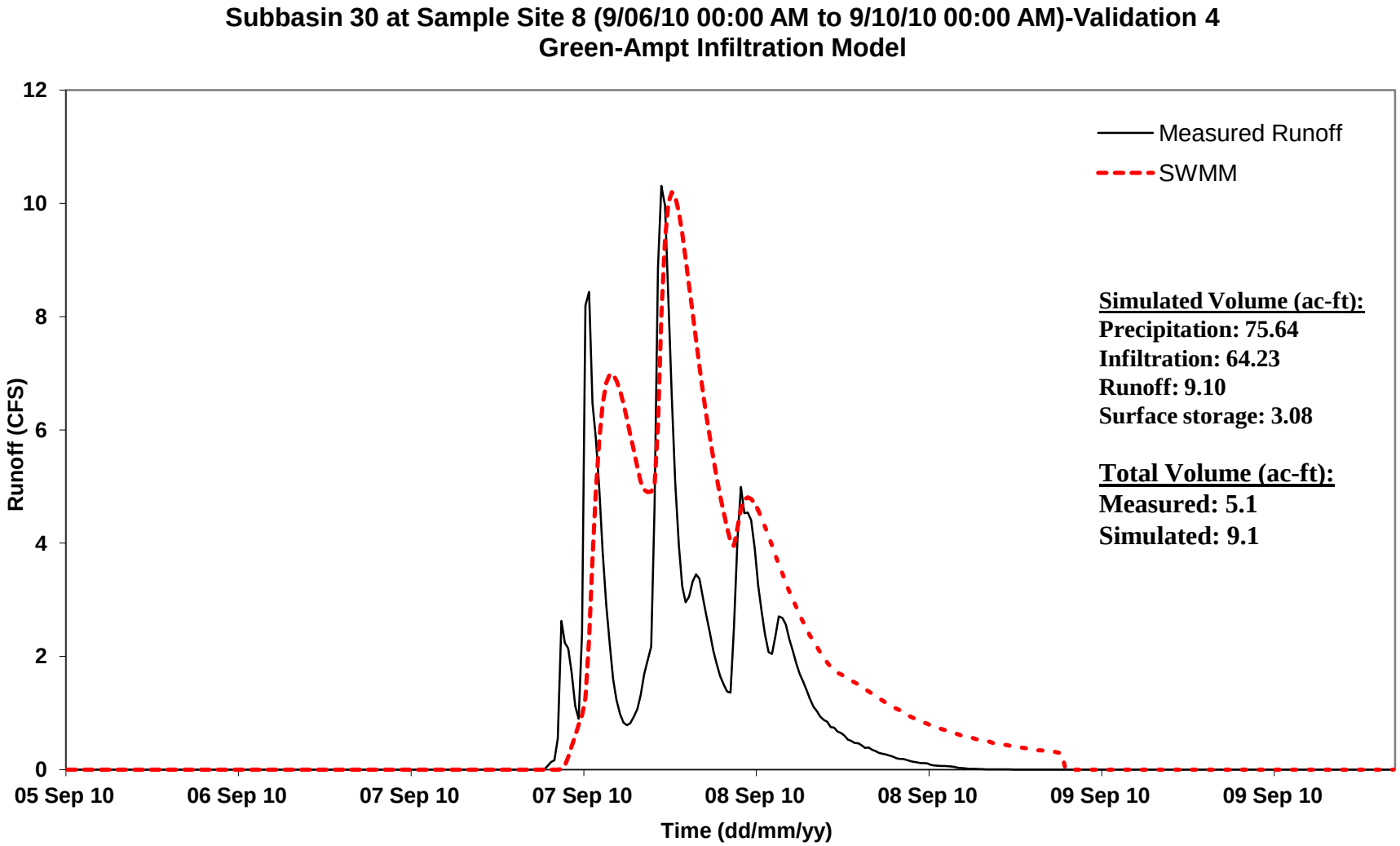
Selected Urban Runoff Model: SWMM

- SWMM – Storm Water Management Model
- First developed in 1971 by U.S. Environmental Protection Agency
- Several significant upgrades, most recent in 2009.
- Simulate urban and non-urban landscape
- Dynamic rainfall-runoff simulation model
- Capabilities:
  - Hydrologic processes
  - Water quality processes

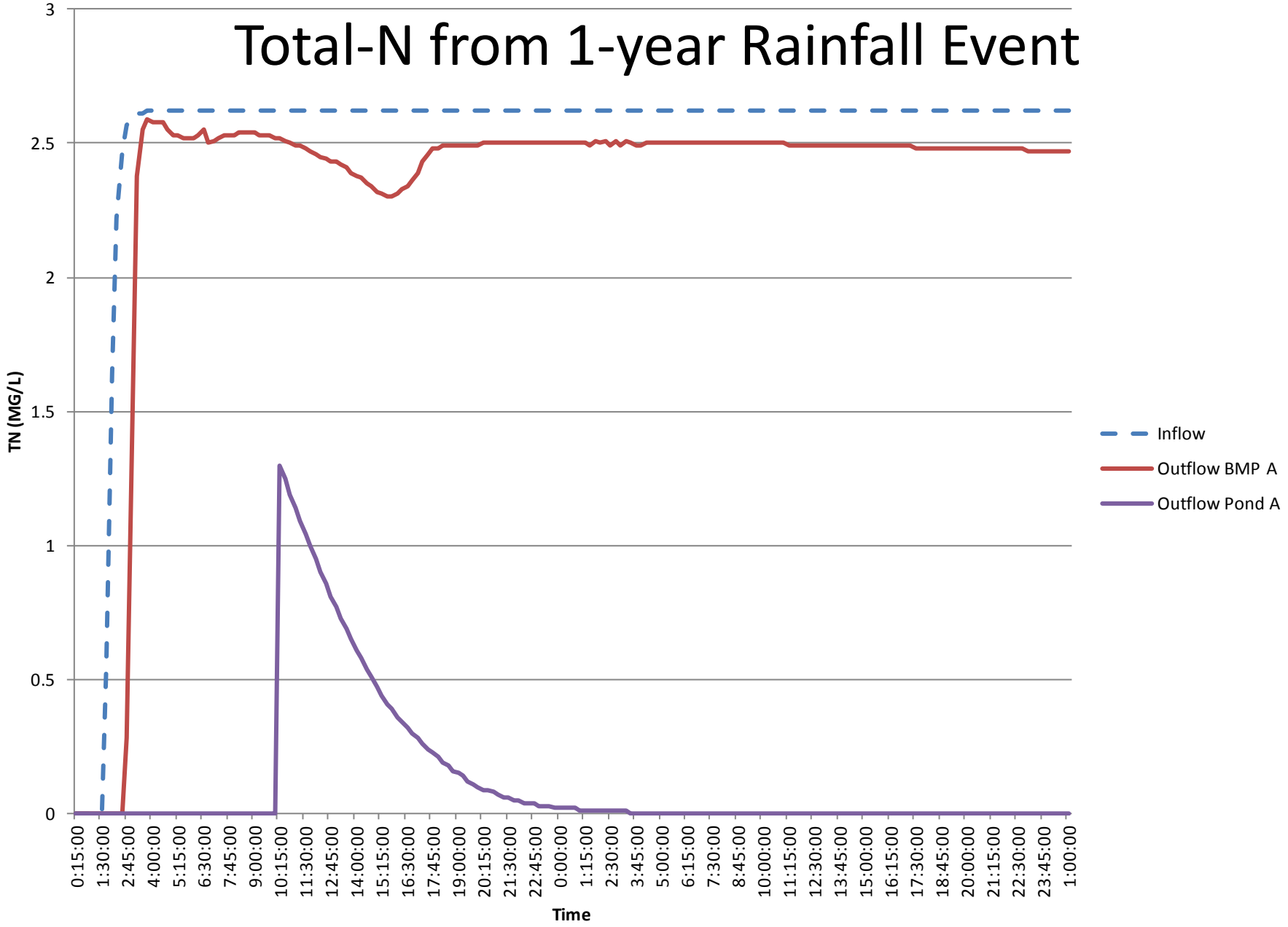
Example SWMM Model Application in San Angelo, TX



Water Quantity Simulation: Small Subbasin at Site 8



Total-N from 1-year Rainfall Event

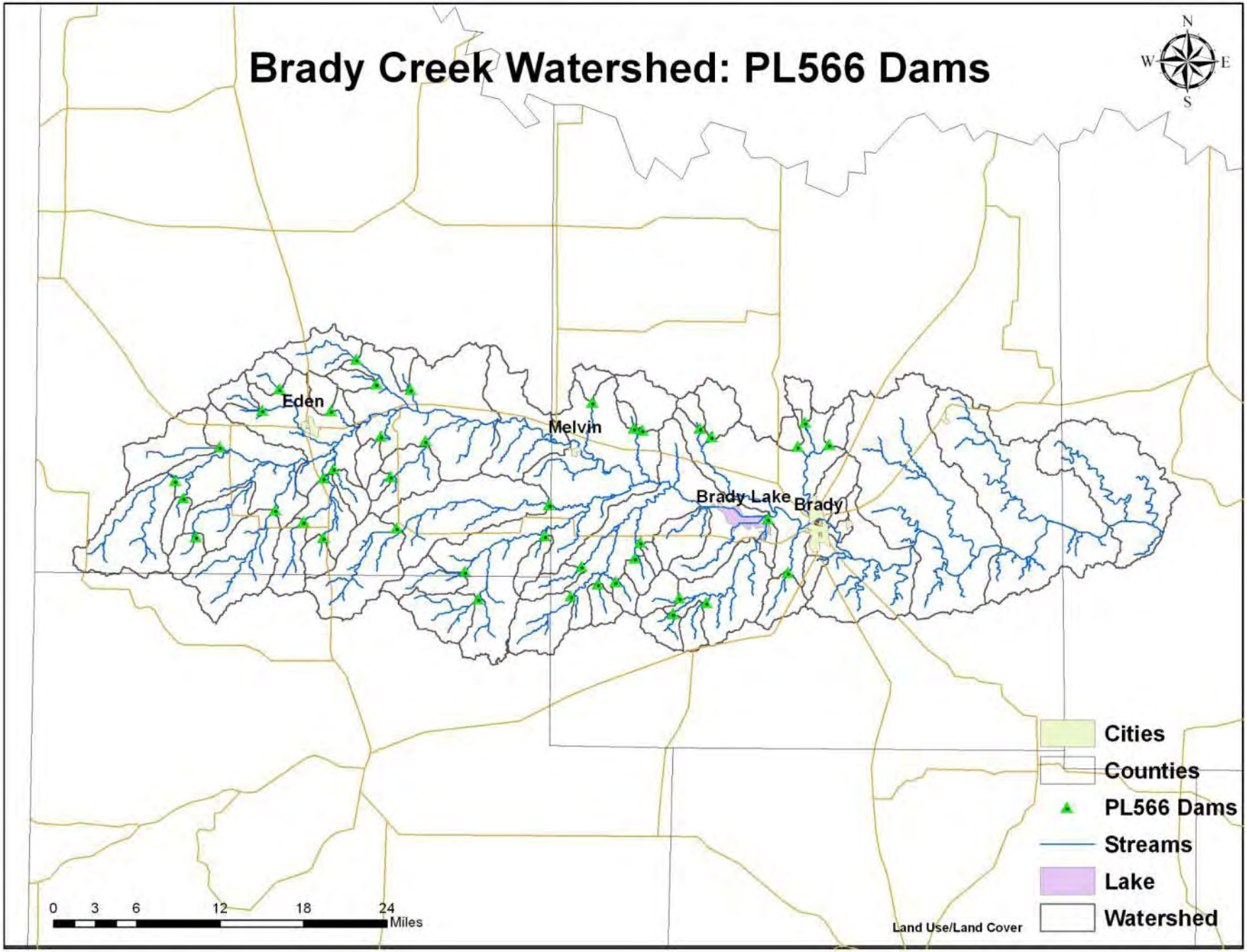


Possible areas of consideration for urban-type stormwater control practices

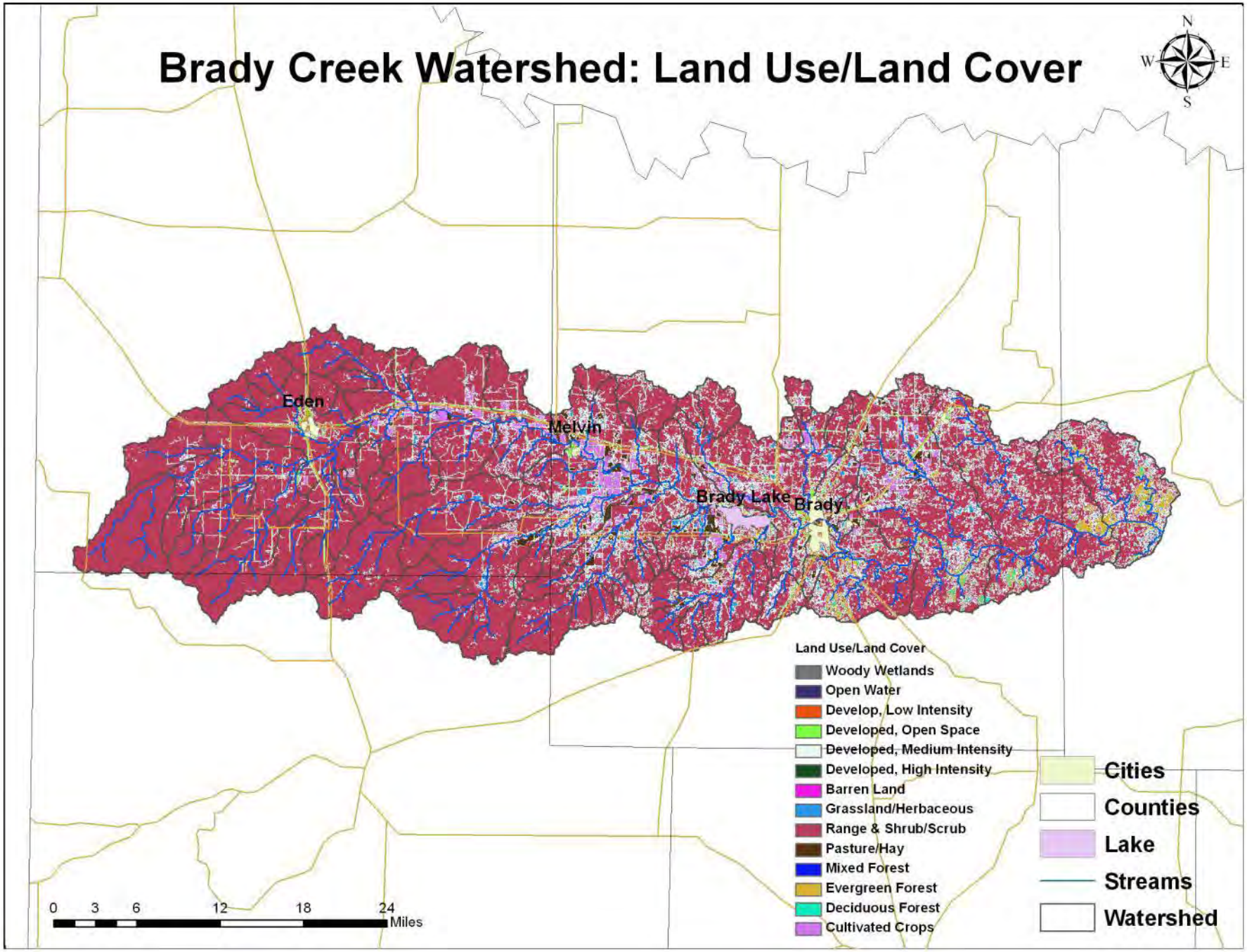
SWAT (Soil & Watershed Assessment Tool): A Common Model Used in Watershed Modeling in Texas

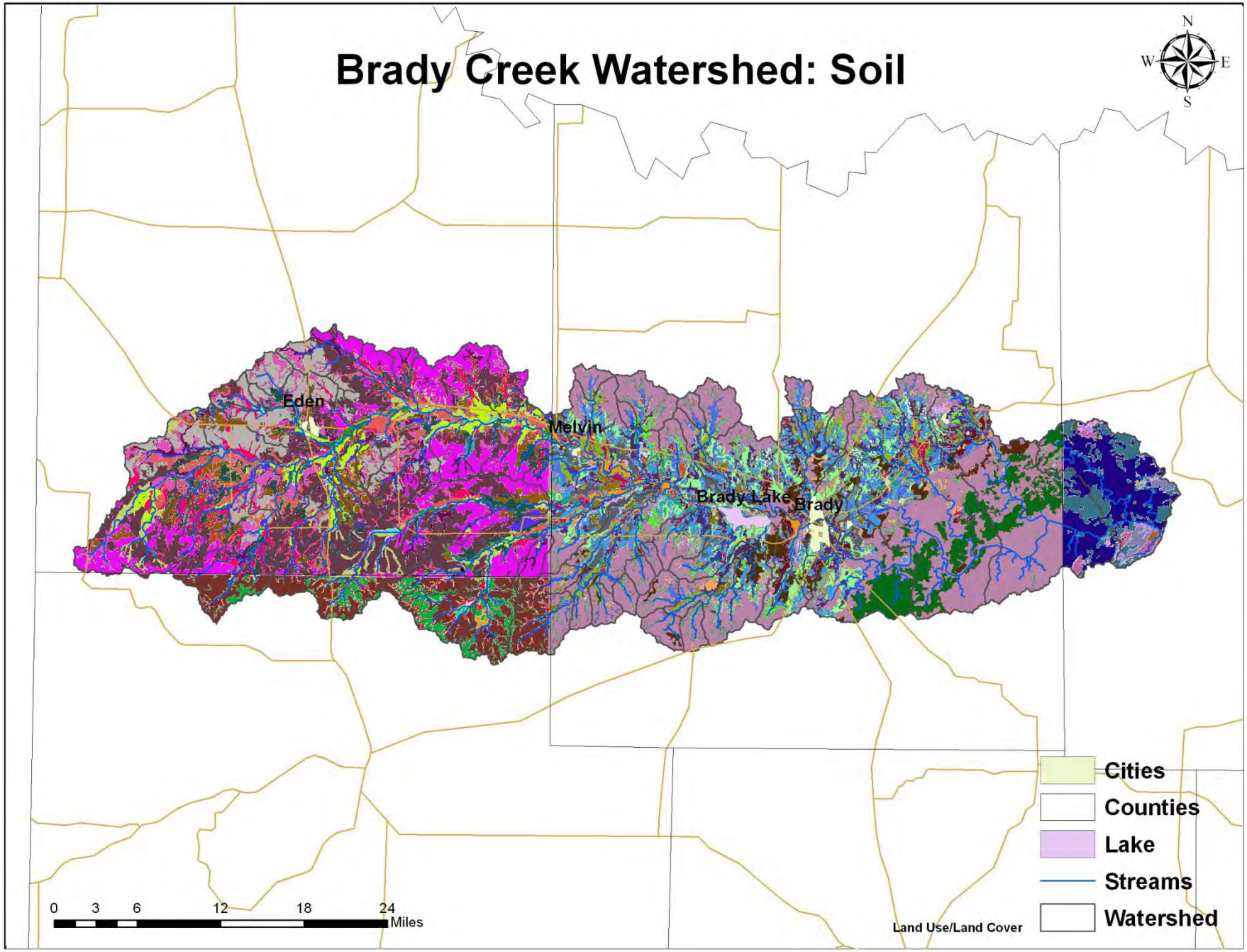
Supported by EPA BASINS (Better Assessment Science Integrating Point & Nonpoint Sources)

- Include processes of:
  - Rainfall/runoff
  - Erosion & sediment transport
  - Pollutant loading
  - Stream transport
  - Management practices


Brady Creek Watershed: PL566 Dams
N
W
E
S
Eden
Melvin
Brady Lake
Brady
Cities
Counties
PL566 Dams
Streams
Lake
Watershed
0 3 6 12 18 24
Miles
Land Use/Land Cover

Brady Creek Watershed: Land Use/Land Cover




Brady Creek Watershed: Soil
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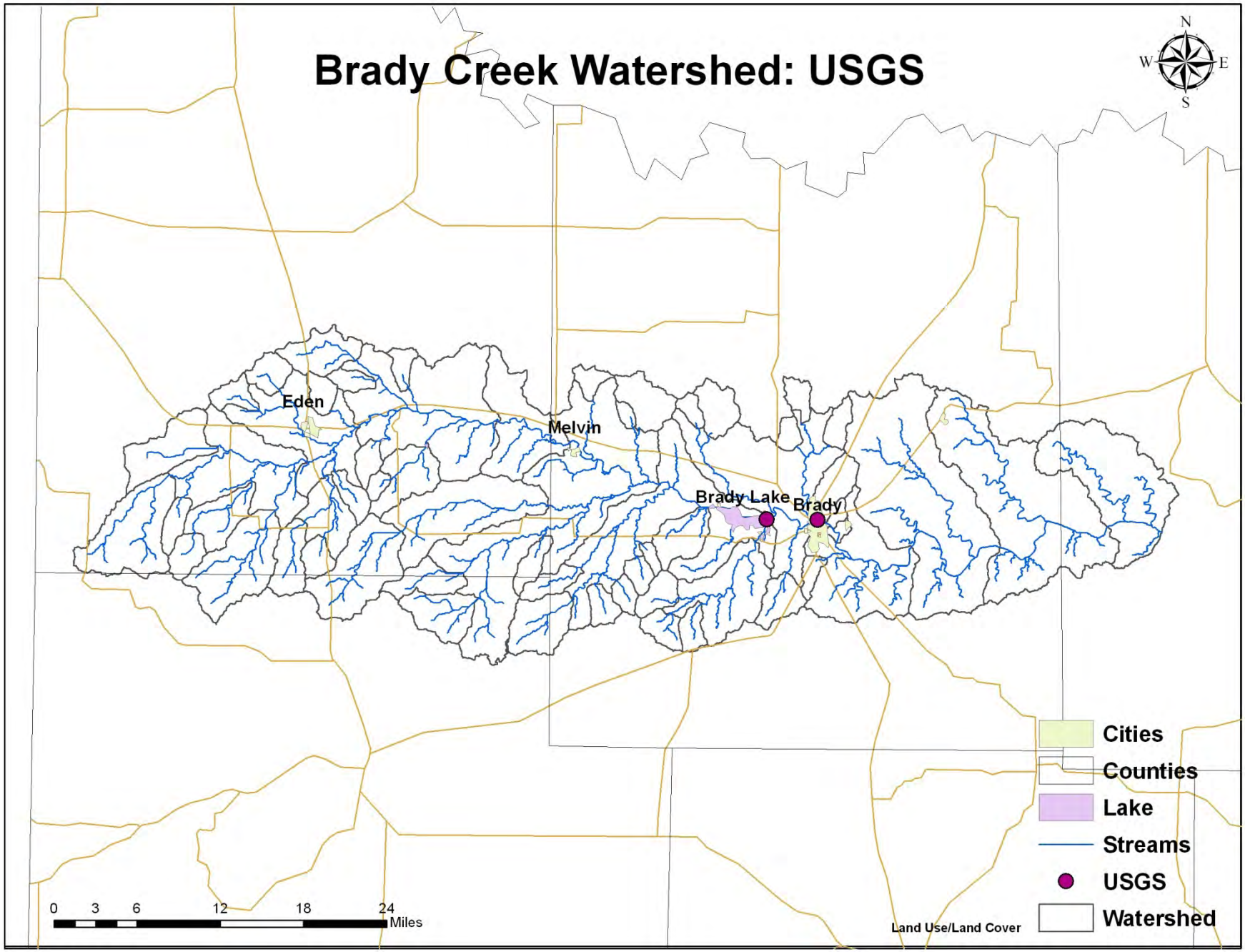
Brady Creek Watershed: USGS
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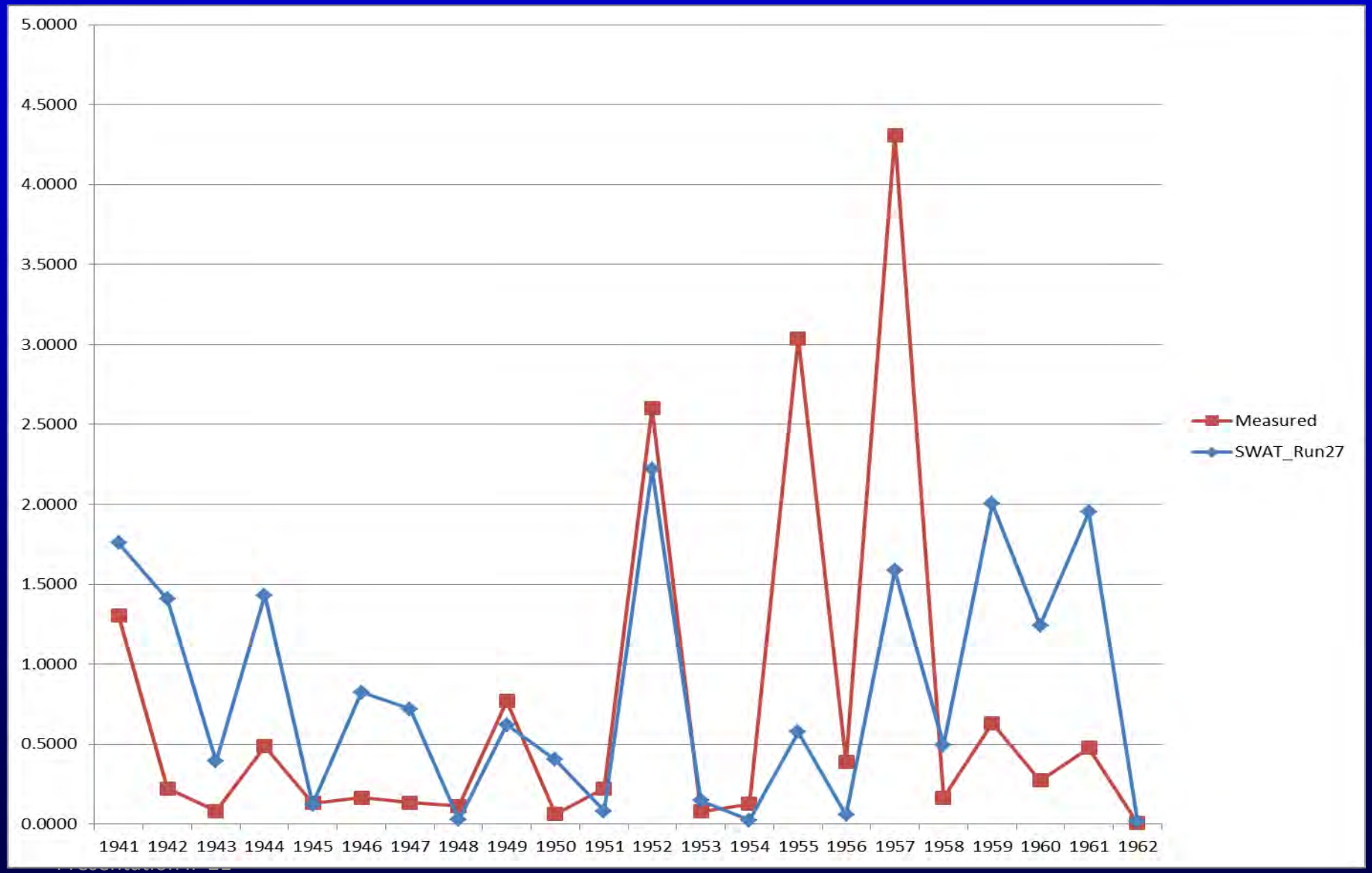
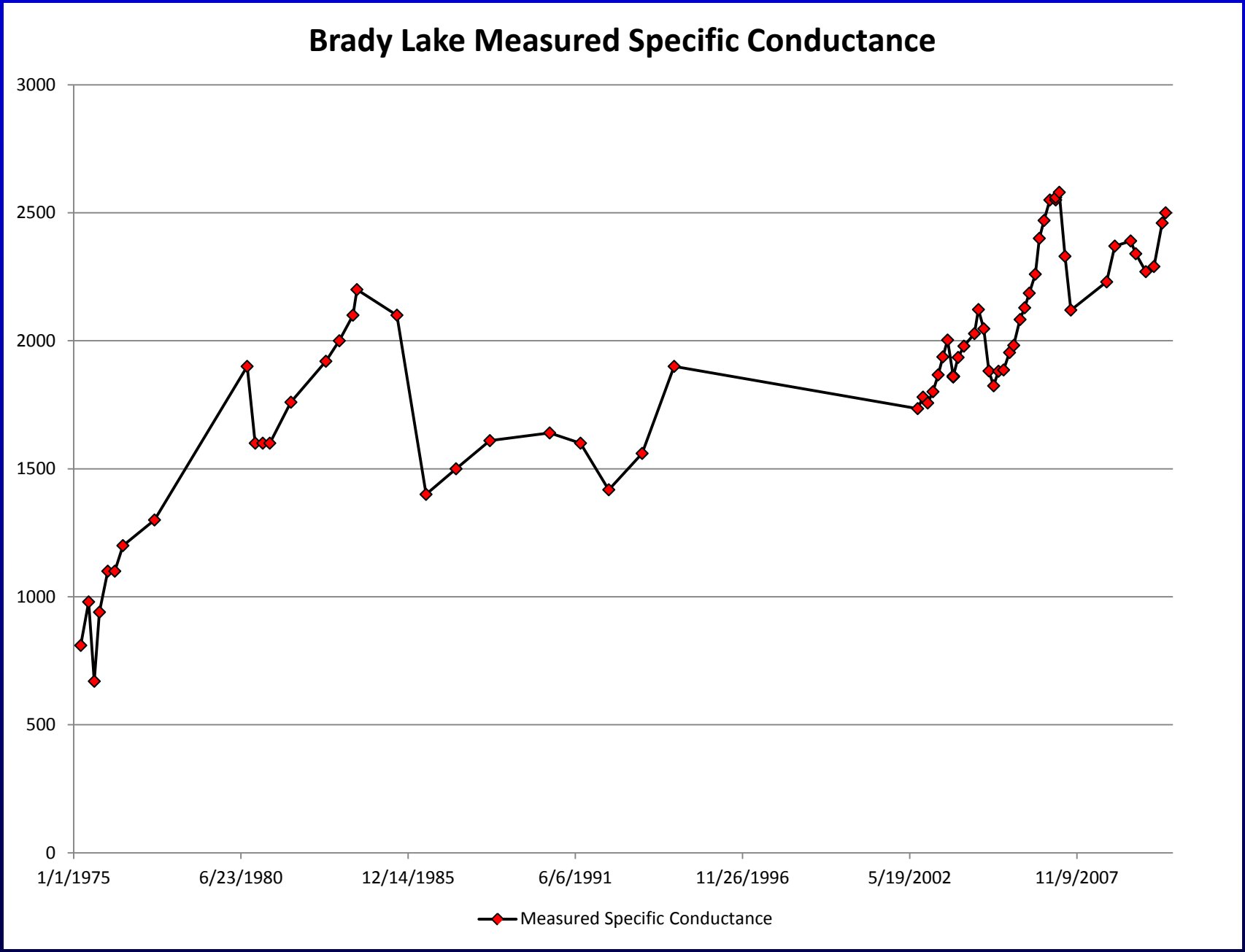
SWAT Preliminary Calibration of Total Streamflow for Pre-Lake Period



WRAP (Water Rights Analysis Package) Adapted for Total Dissolved Solids Analysis of Brady Lake

- WRAP to represent Brady Lake
- SWAT to predict inflows
- Use measured data to estimate TDS of inflows
- Include TWDB evaporation data
- WRAP to predict TDS


Brady Lake Measured Specific Conductance
3000
2500
2000
1500
1000
500
0
1/1/1975
6/23/1980
12/14/1985
6/6/1991
11/26/1996
5/19/2002
11/9/2007
Measured Specific Conductance

Thank You

Questions?