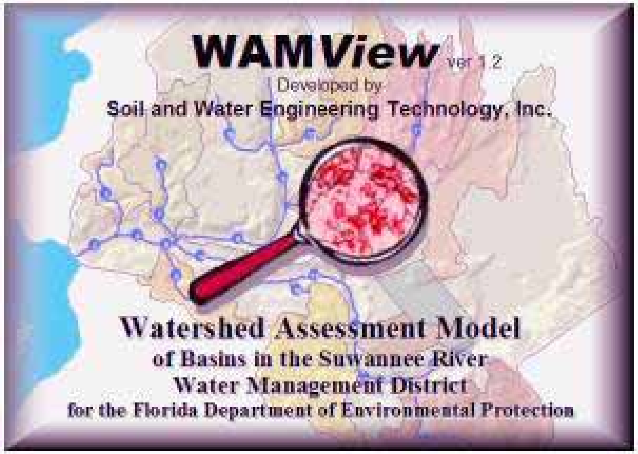
Watershed Assessment Model (WAM)

Evaluation of the Suwannee River Basin



Presented by

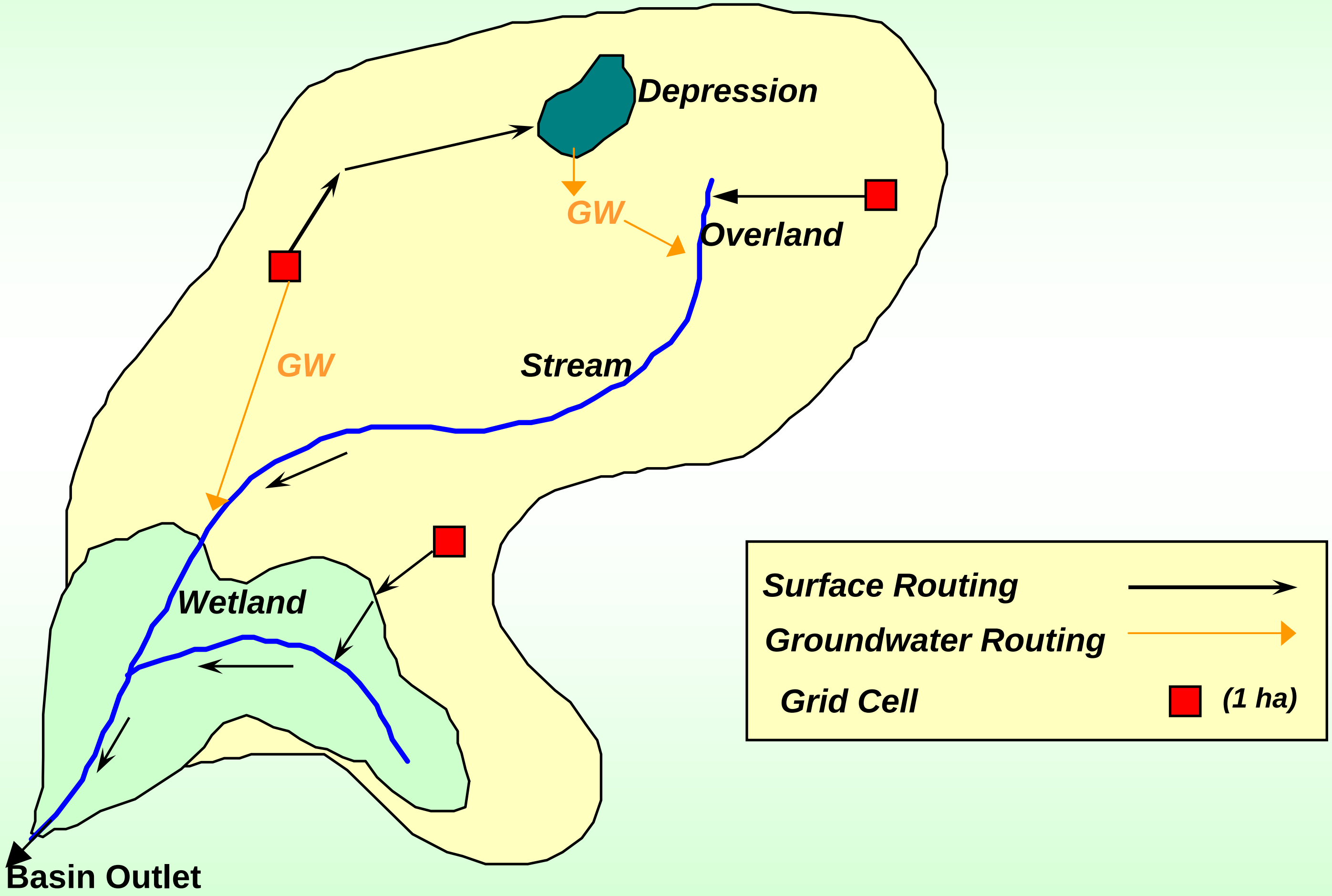
Del Bottcher

Soil and Water Engineering Technology, Inc.

WAM Development History

- 1984 - 1st GIS watershed model “Basin” developed for Kissimmee River, FL (UF / COE)
- 1988 - Basin New Zealand (BNZ) GIS watershed model (UF/SWET/NIWA)
- 1988-96 - Multiple upgrades of BNZ (UF/SWET)
- 1997 - First release of the Watershed Assessment Model - WAM for Suwannee River WMD (SWET/Mock•Roos)
- 1998 - Daily routing option of WAM released SJR-WAM
- 2000 - WAMView Release (ArcView version of WAM Model)
- 2000 - WAM-O(Okura Catchment) release in New Zealand
- 2001-04 – Multiple upgrades of WAM

How the Model Works!



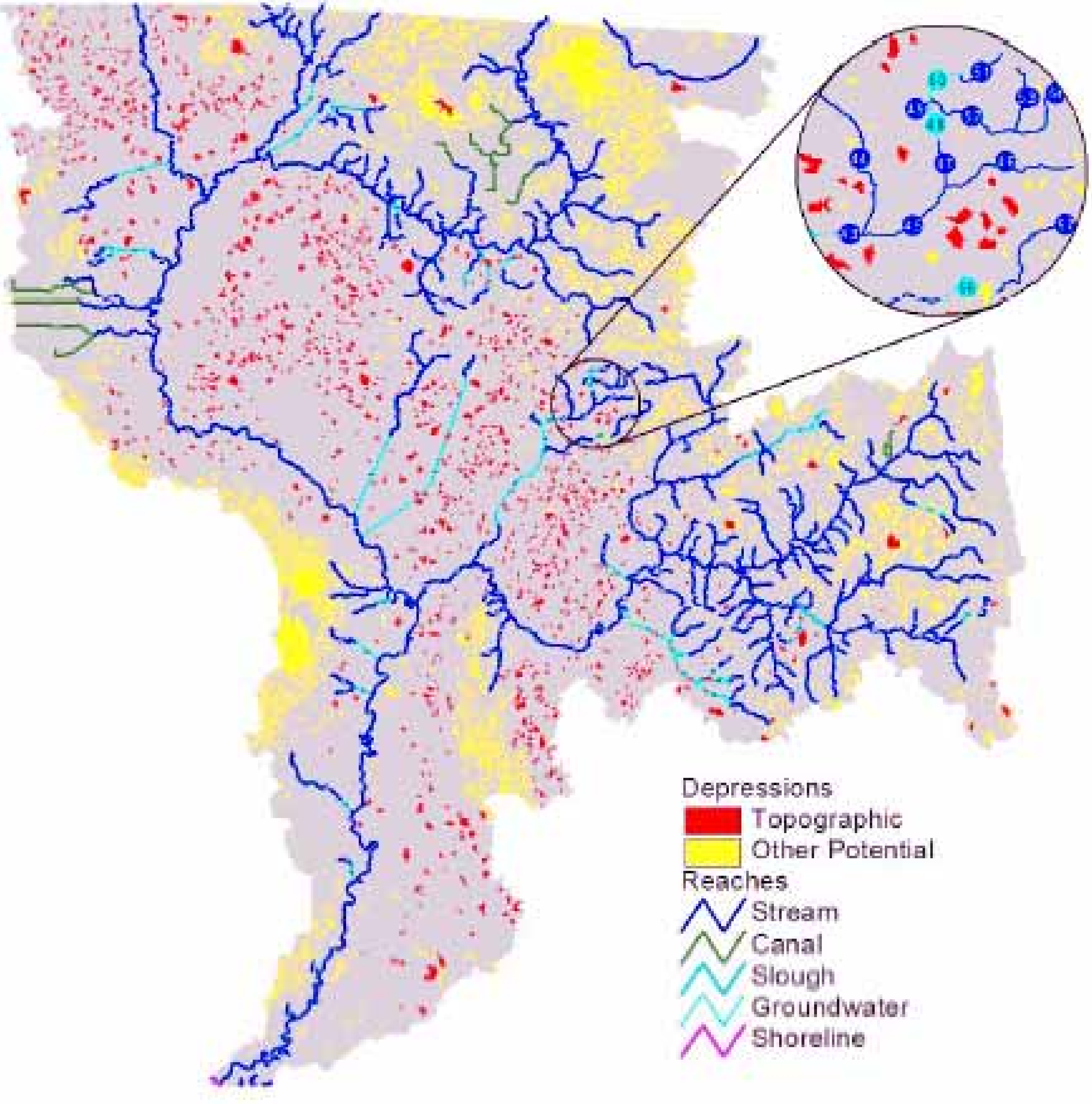
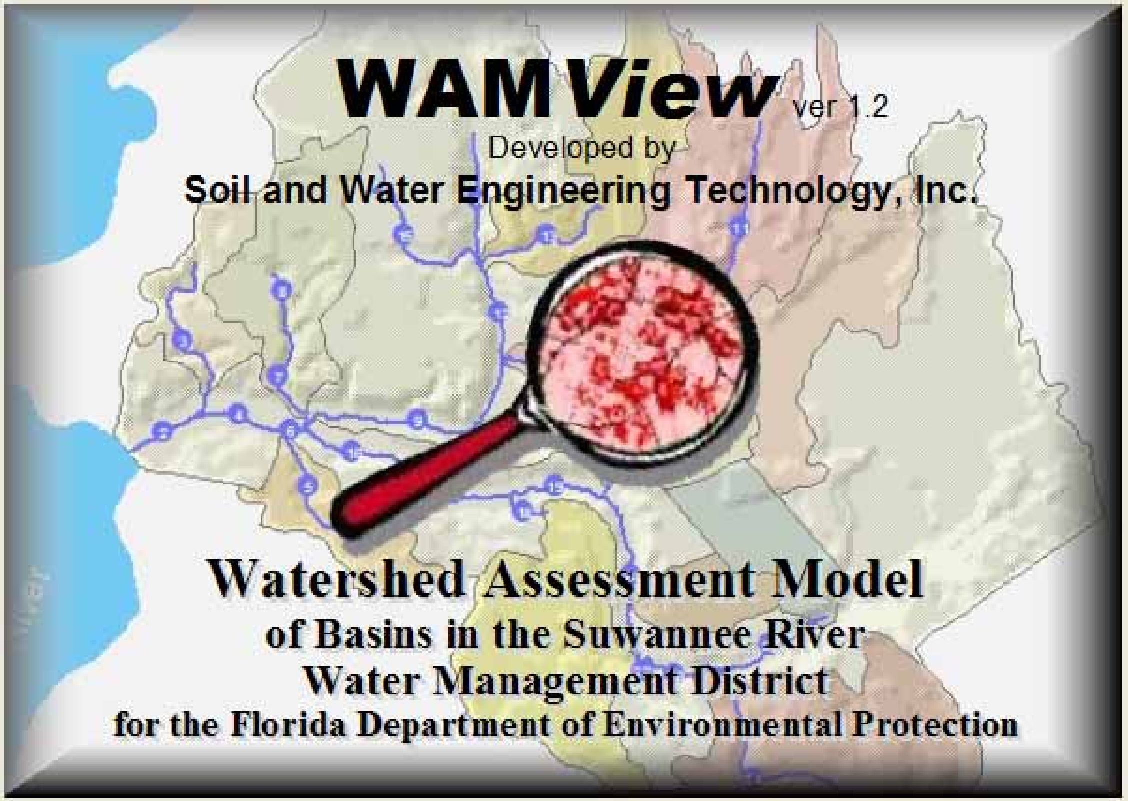
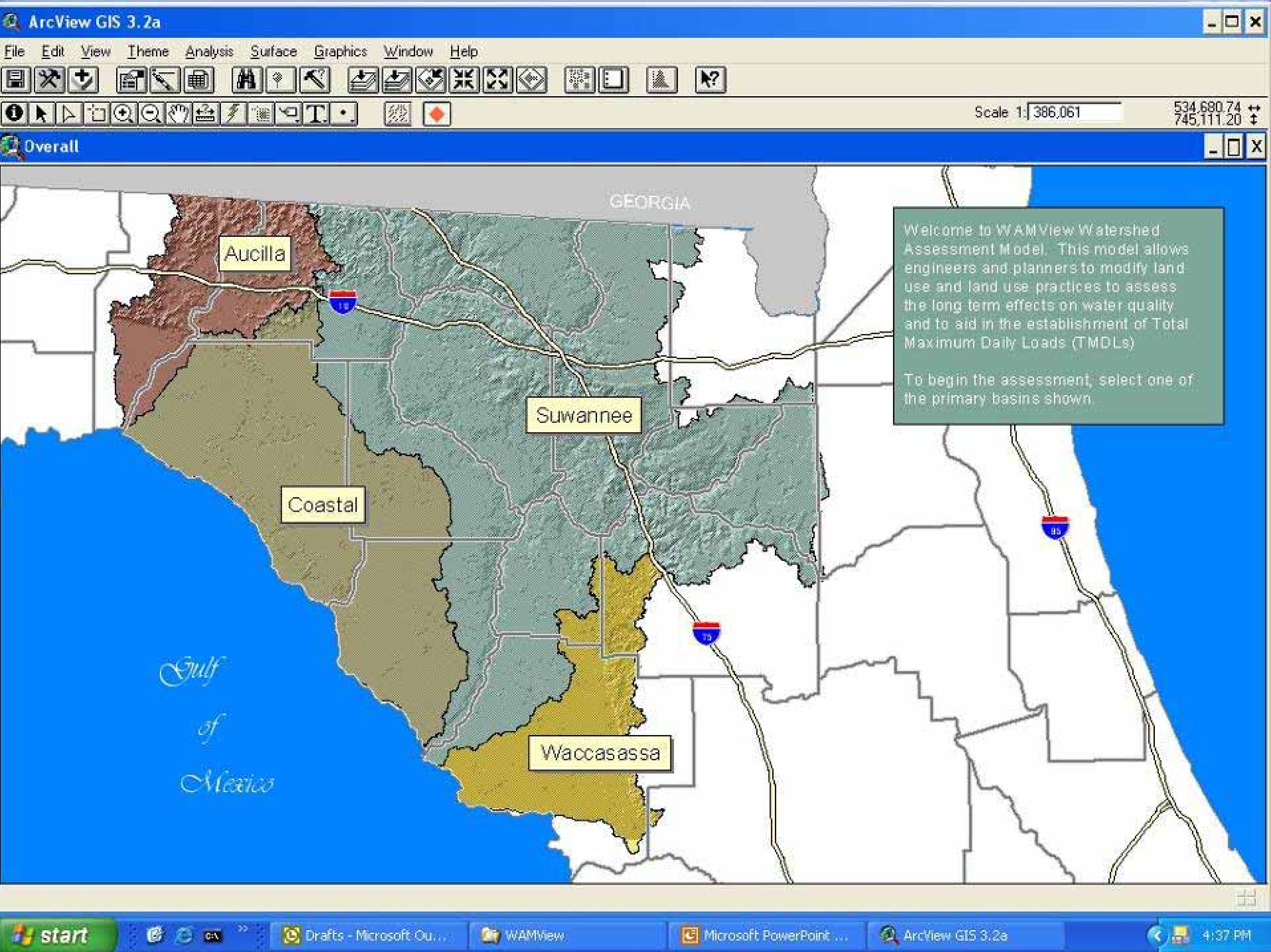


Figure 5: Model Reaches and Estimated Depressions for the Suwannee Basin

RUNNING the INTERFACE





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Overall
GEORGIA
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Welcome to WAMView Watershed Assessment Model. This model allows engineers and planners to modify land use and land use practices to assess the long term effects on water quality and to aid in the establishment of Total Maximum Daily Loads (TMDLs)
To begin the assessment, select one of the primary basins shown.
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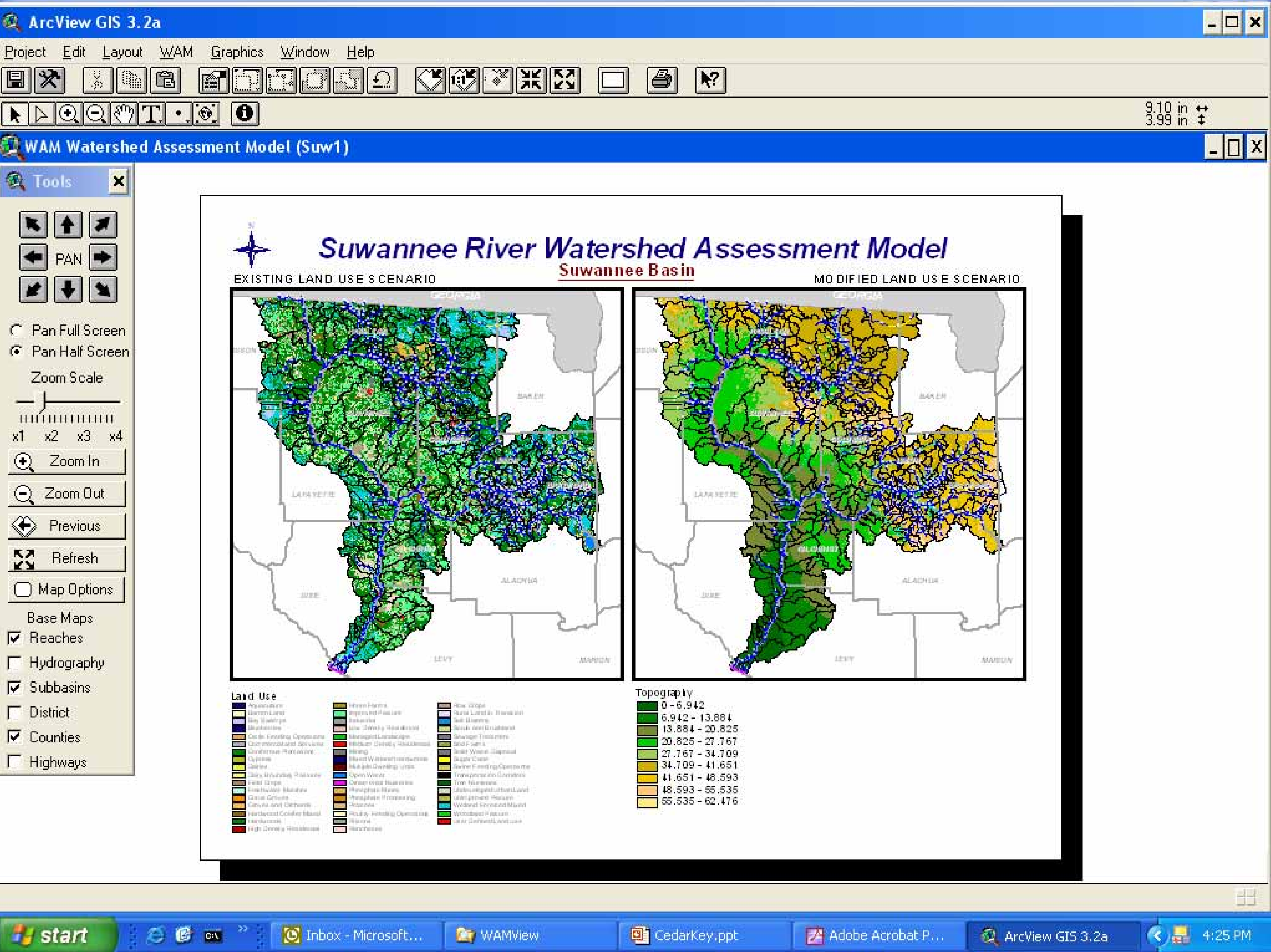
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Suwannee River Watershed Assessment Model
Suwannee Basin
EXISTING LAND USE SCENARIO
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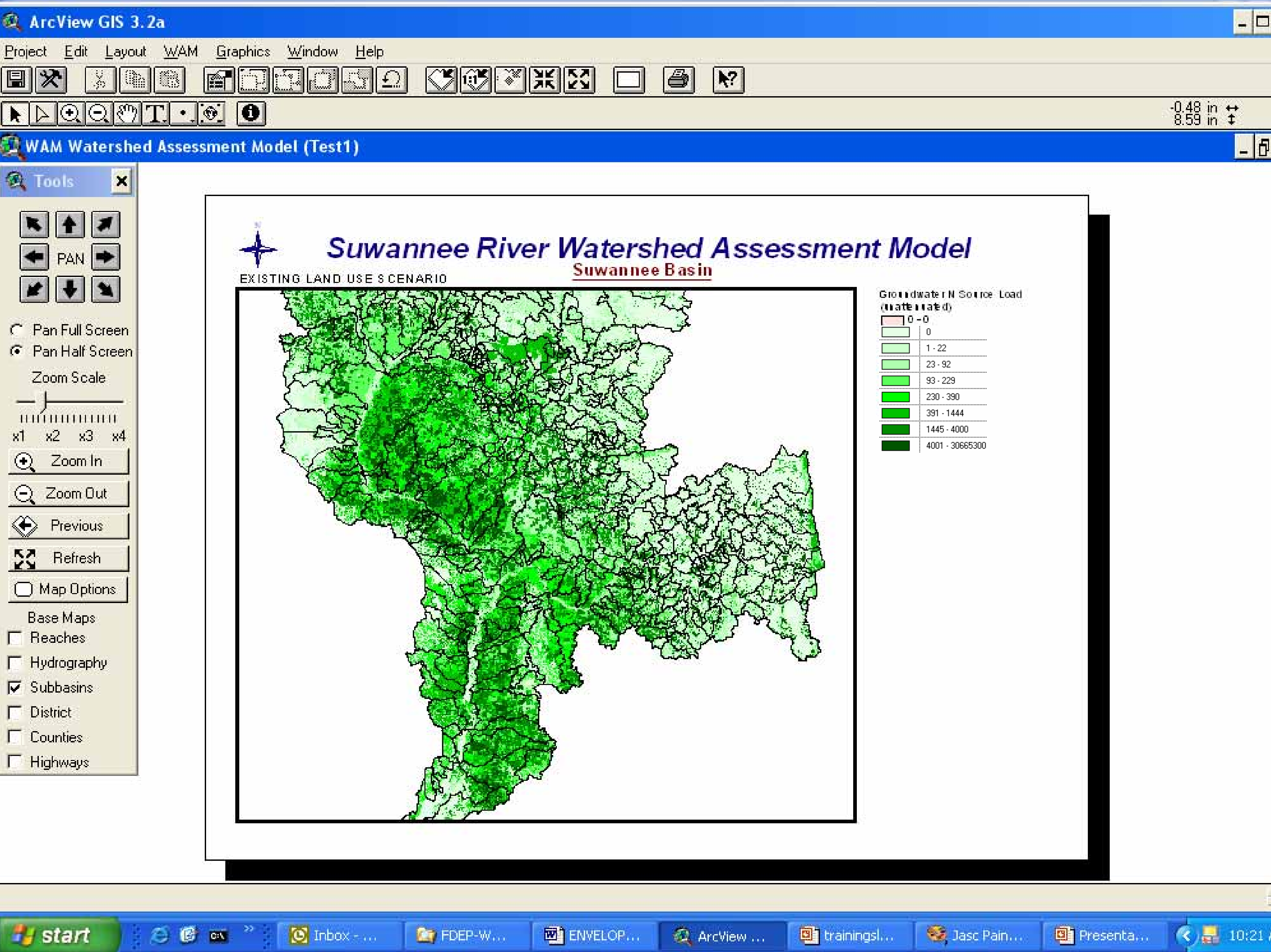
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Suwannee River Watershed Assessment Model
Suwannee Basin
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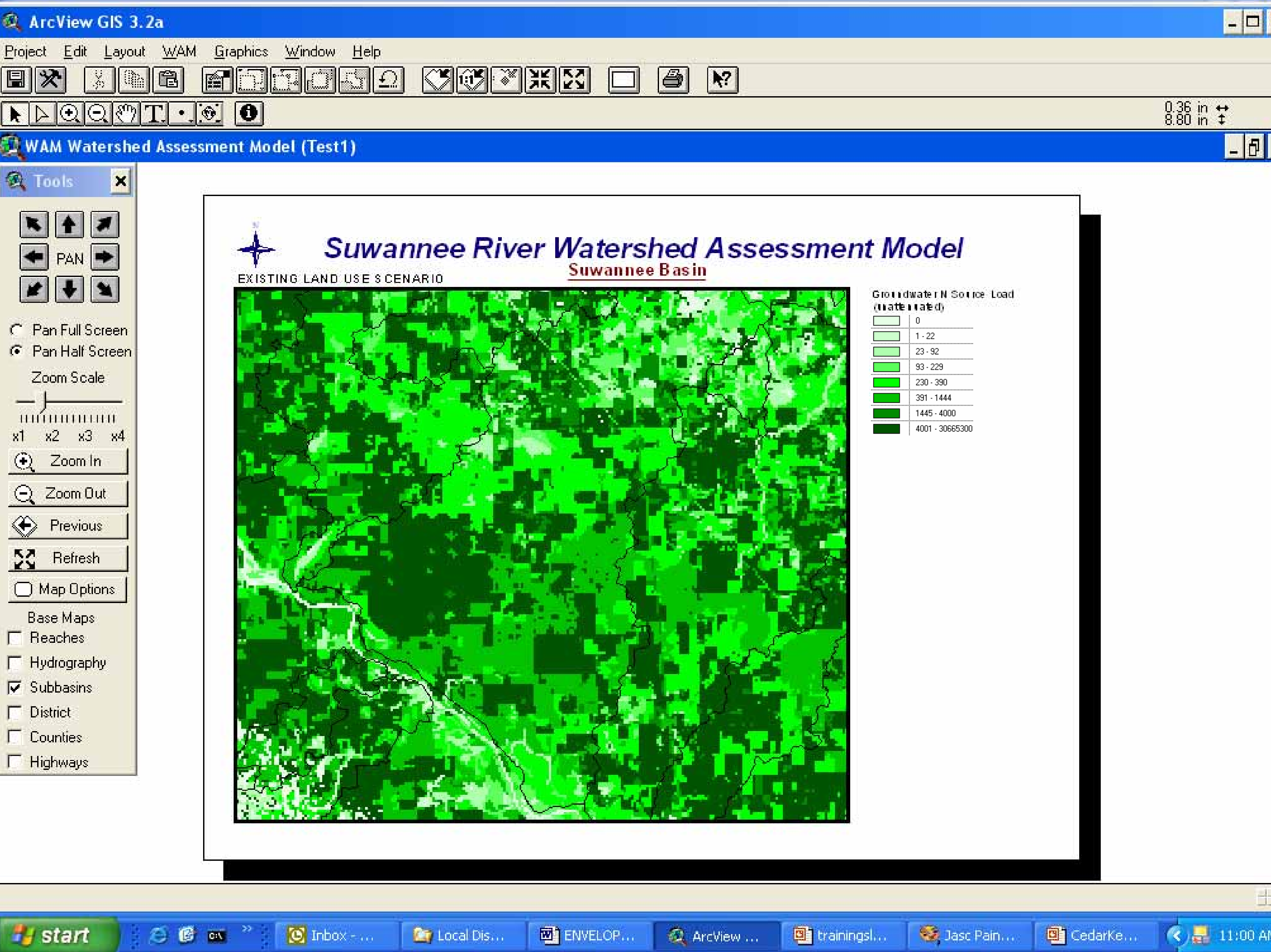
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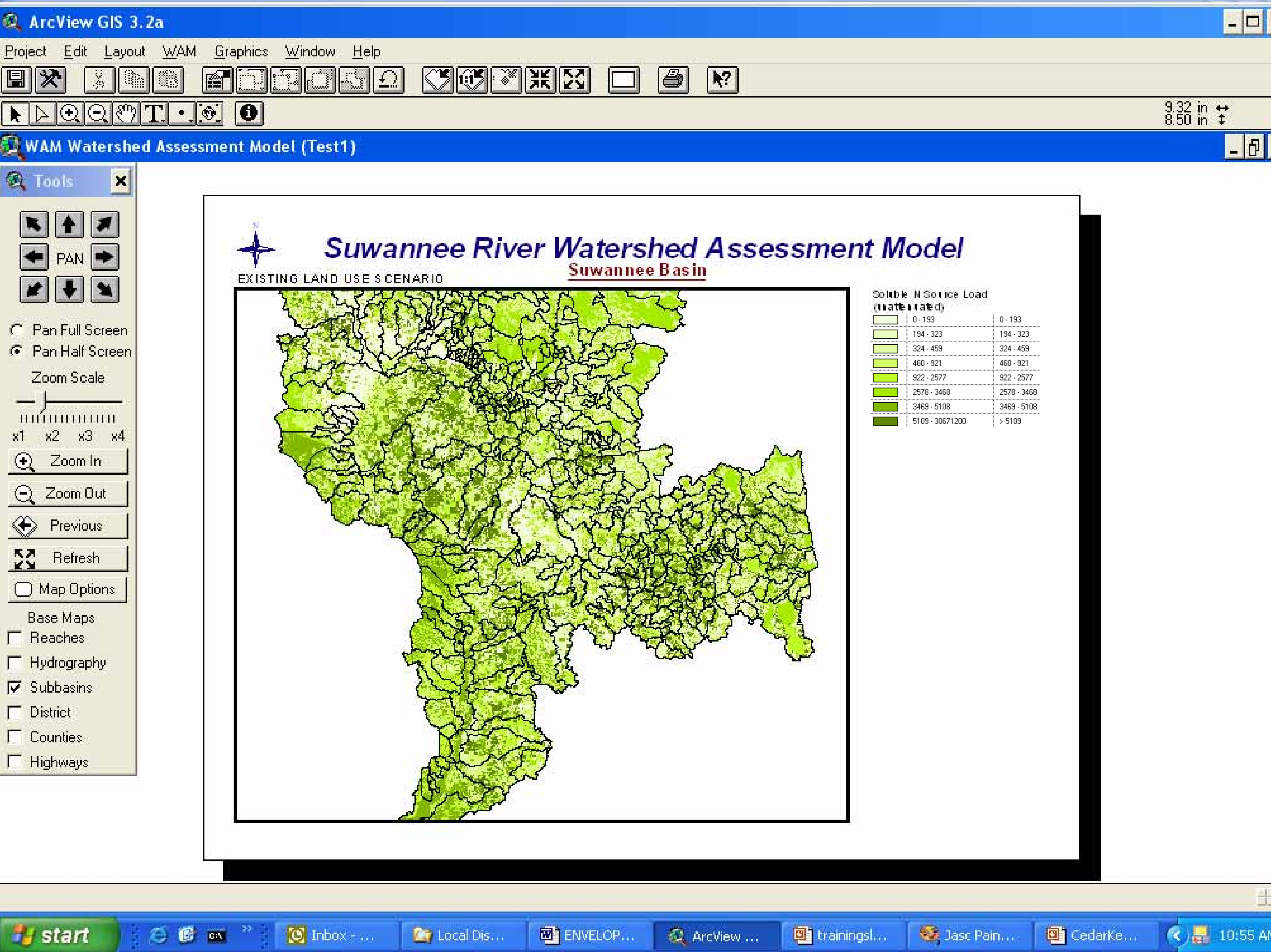

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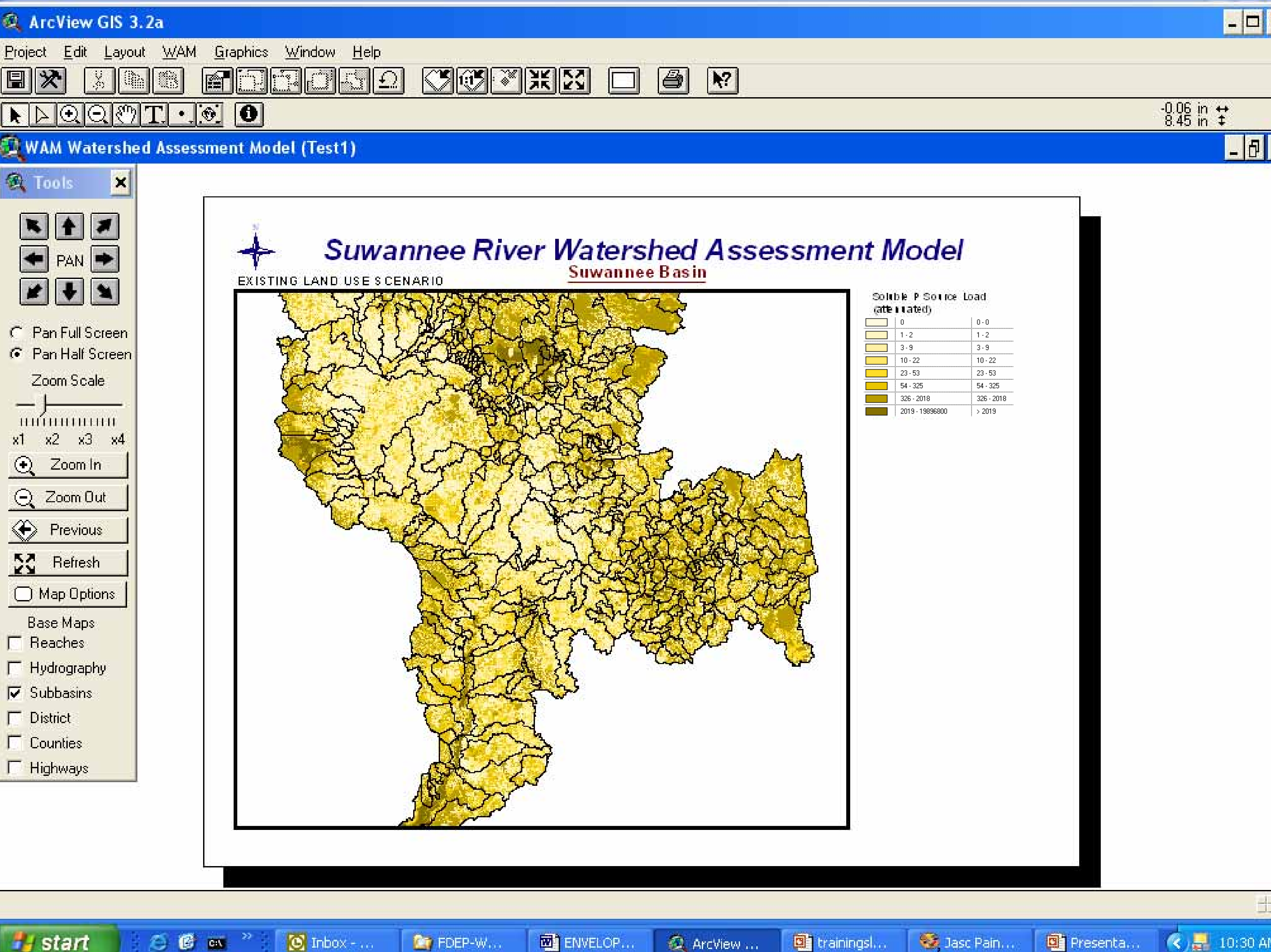
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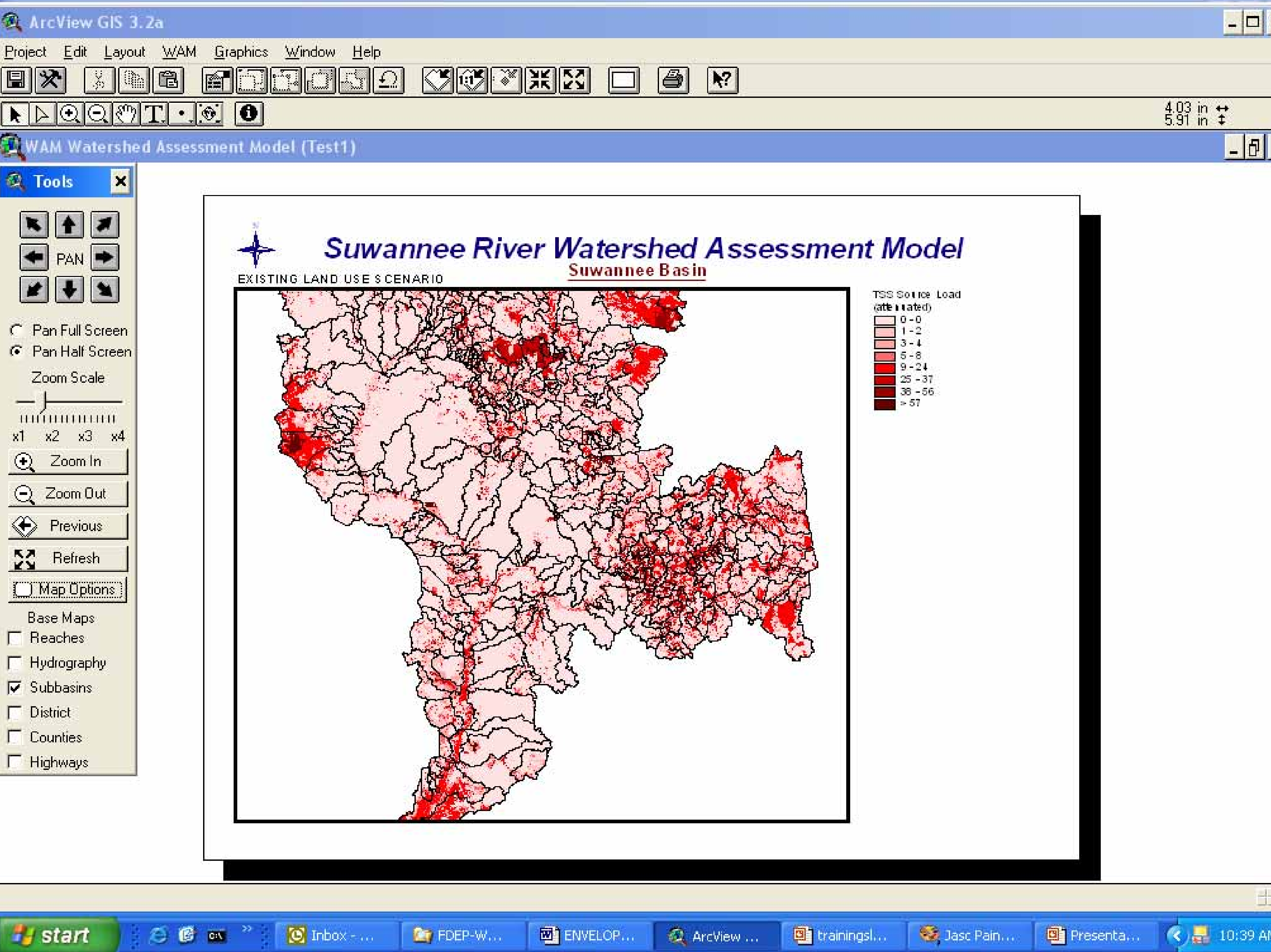

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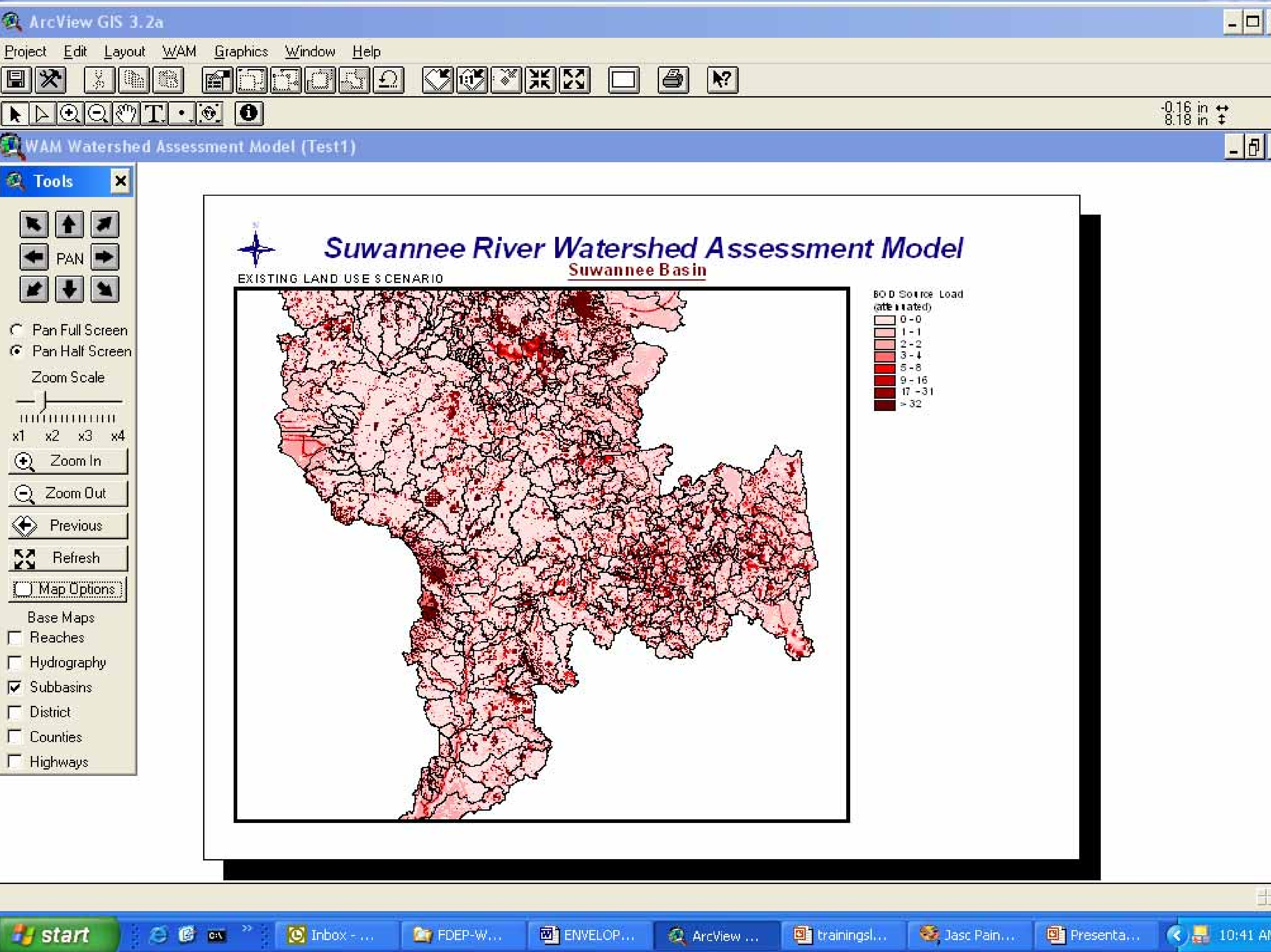
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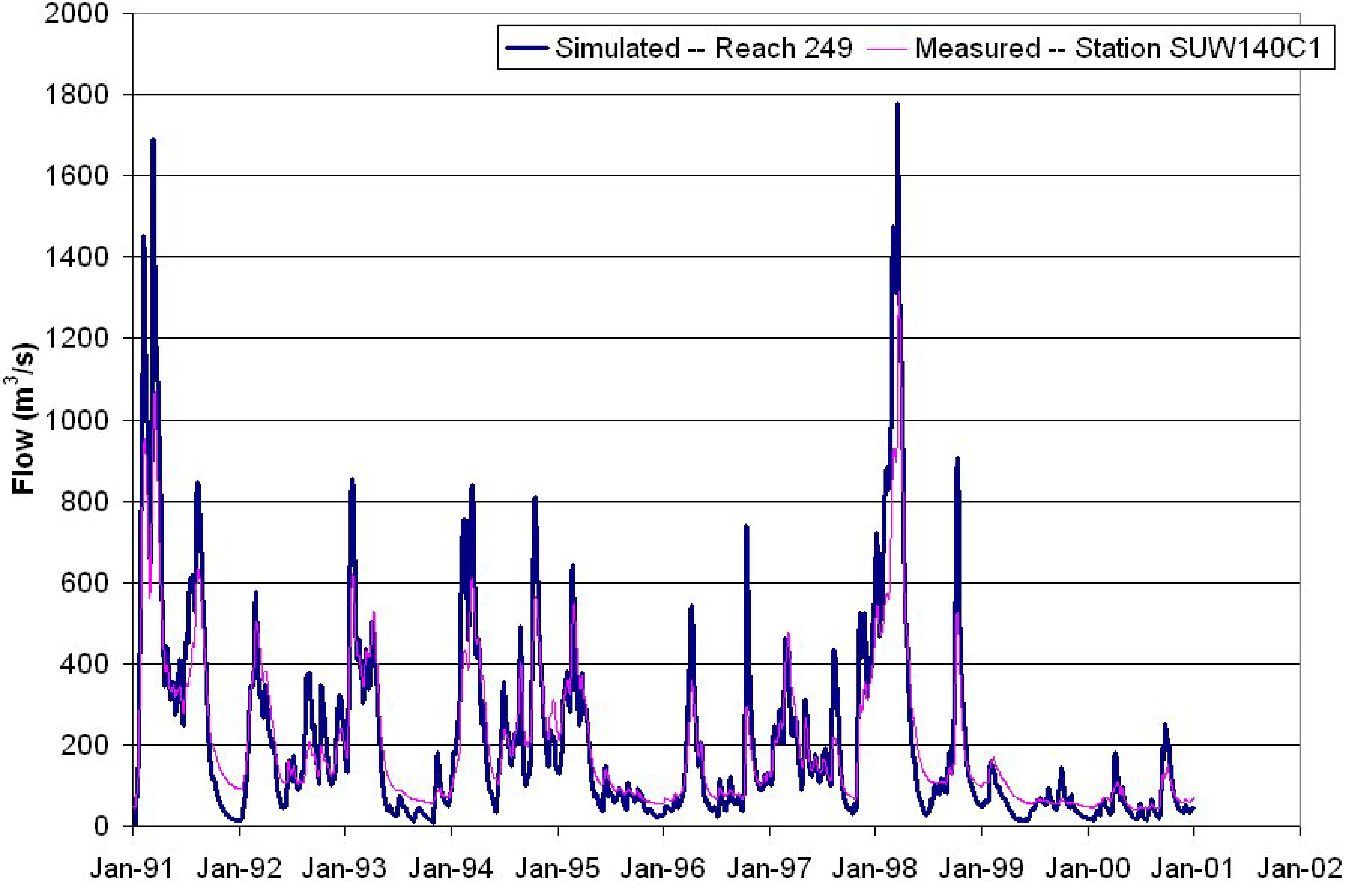
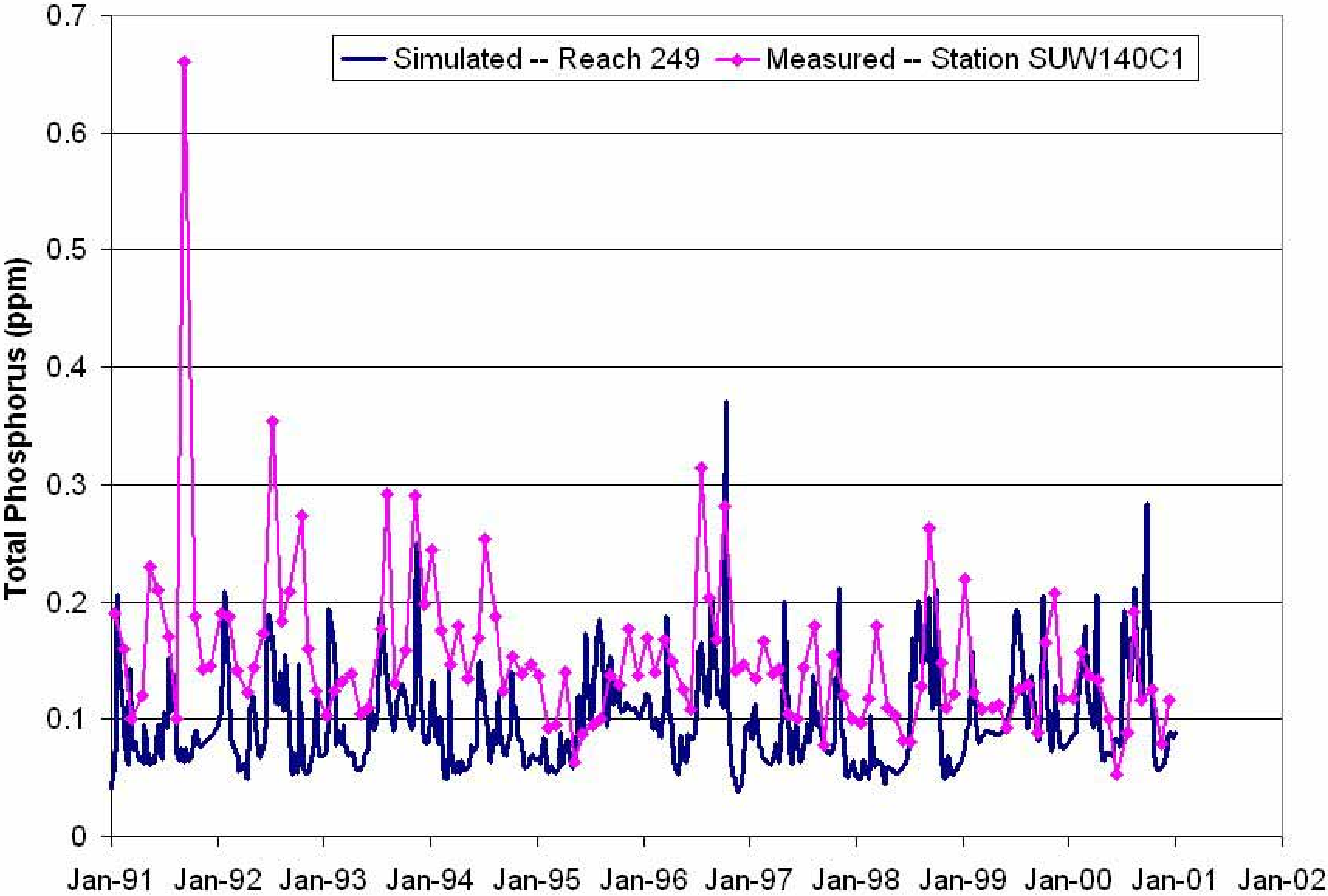
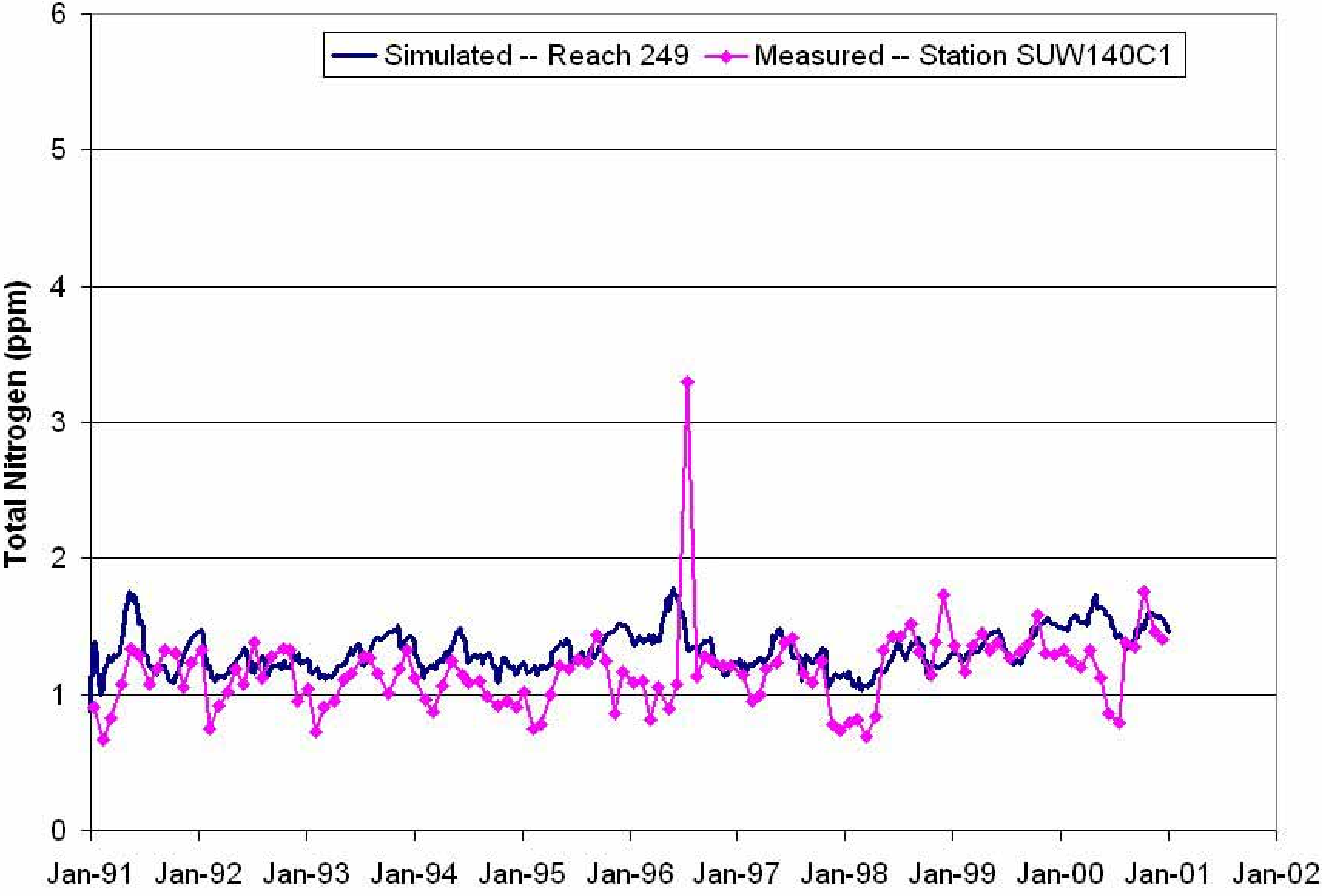
Suwannee River @ US 27



Suwannee River @ US 27



Suwannee River @ US 27



Fanning Springs Flow

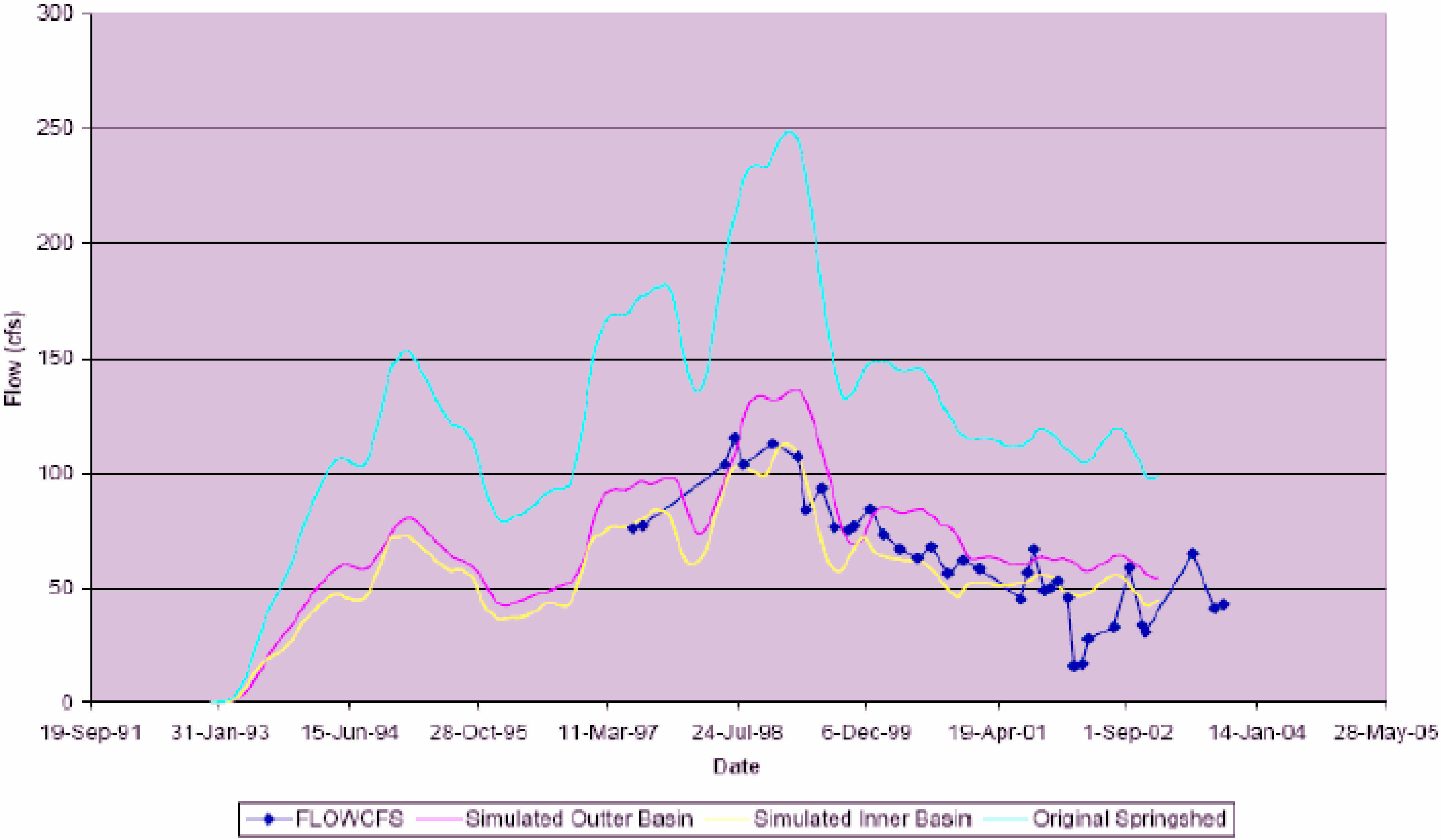


Figure 9. Simulated Flow for Fanning Springs for the Original and Two Split Spingsheds

Fanning Springs Nitrogen

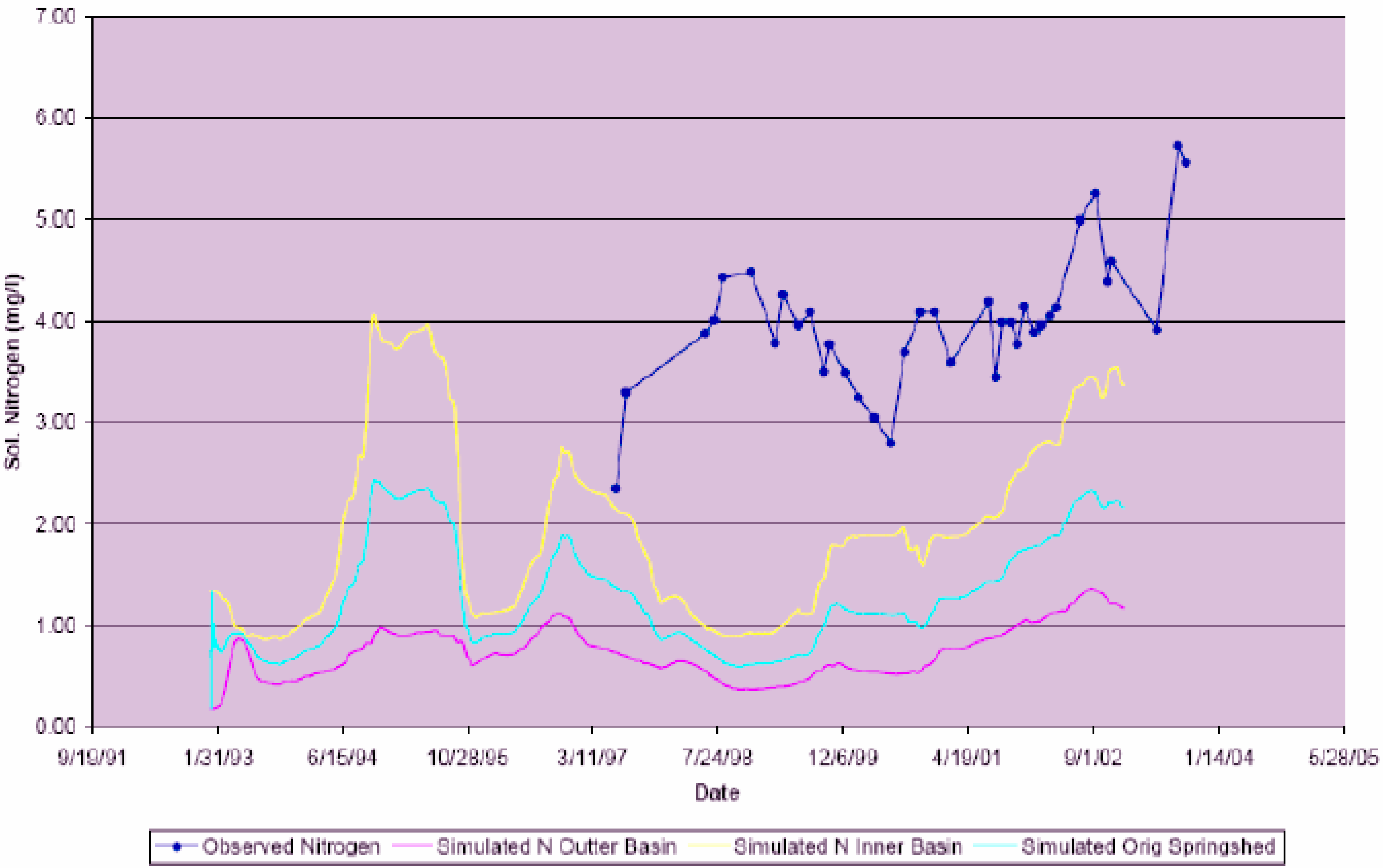
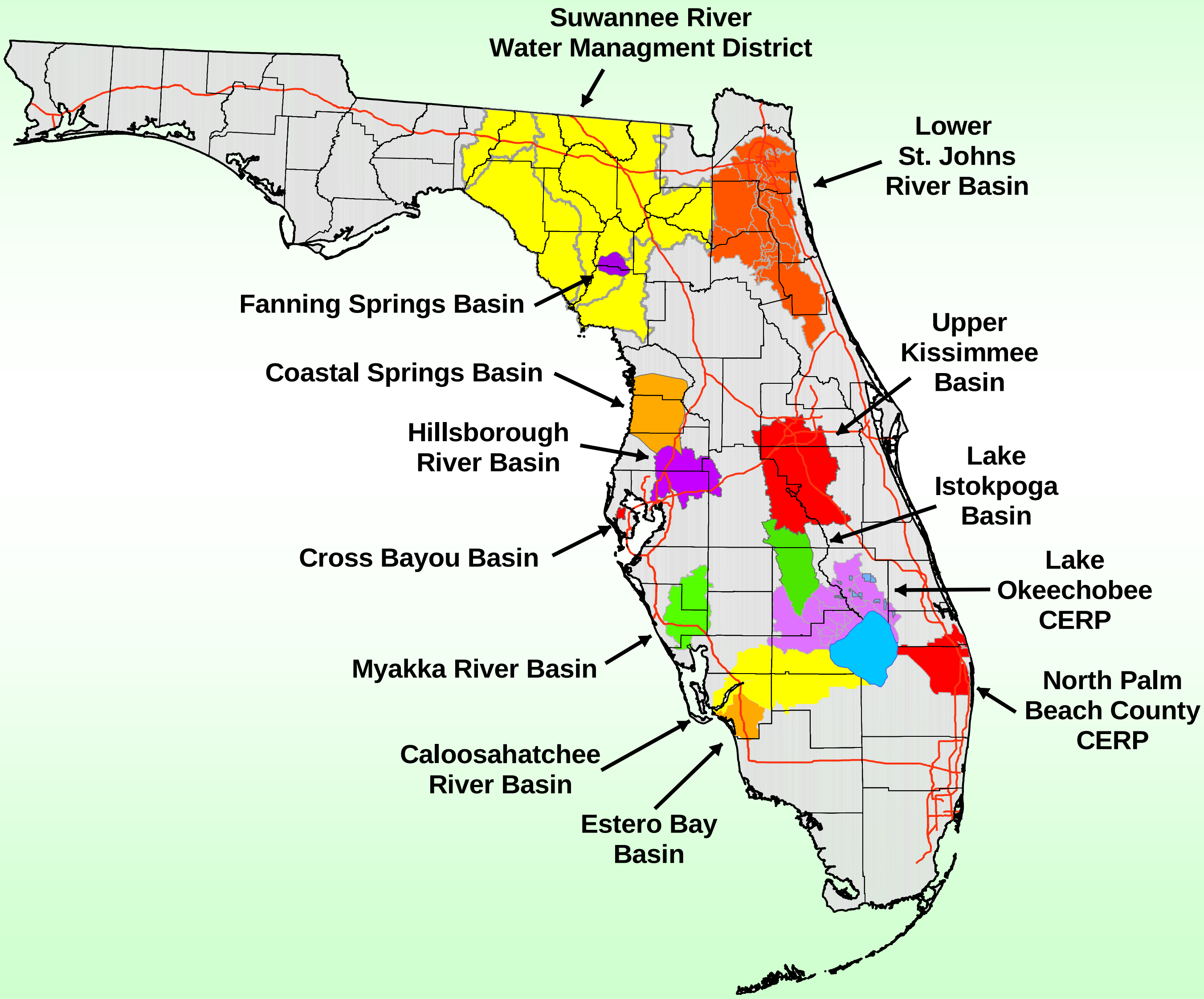
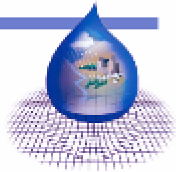


Figure 10. Simulated versus Observed Nitrogen Concentration in the Fanning Springs.

WAM Applications in Florida



Watershed Assessment Model (WAM)



WAM is a tool that has been shown to be useful in the assessment of watershed-related properties. WAM was developed to allow engineers and planners to assess the water quality of both surface water and groundwater based on land use, soils, climate, and other factors. The model simulates the primary physical processes important for watershed hydrologic and pollutant transport. The WAM GIS-based coverages including:

- Land use,
- Soils,
- Topography,
- Hydrography,
- Basin and sub-basin boundaries,
- Point sources and service area coverages,
- Climate data, and
- Land use and soils description files.

The coverages are used to develop data that can be used in the simulation of a variety of physical and chemical processes. The advantage of this model over others is its ability to:

- Use a grid-based system to assess the spatial impact of existing and modified land uses on water quality and quantity for tributaries within the Lake Okeechobee watershed;
- Develop phosphorus (P) load allocations for total maximum daily loads (TMDLs) that will be acceptable to Florida Department of Environmental Protection (FDEP);
- Identify P and flow "hot spots";
- Rank P loadings by source, subbasin, and sub-watersheds

The model can be used to assess P load strategies including the use of stormwater treatment areas (STAs) and reservoir assisted stormwater treatment areas (RASTAs). WAM also has the ability to aid in the assessment of the impact of growth changes in the watershed.

WAM was developed based on a grid cell representation of the watershed. The grid cell representation allows for the identification of surface and groundwater flow and phosphorus concentrations for each cell. The model then "routes" the surface water and groundwater flows from the cells to assess the flow and phosphorus levels throughout the watershed and at the discharge to Lake Okeechobee. Figure 1 shows the conceptual routing schemes and flow distances that are calculated for each cell. Thus, the model simulates the following elements:

- Surface water and ground water flow allowing for the assessment of flow and pollutant loading for a tributary reach at both the daily and hourly time increment as necessary.
- Water quality including particulate and soluble phosphorus, particulate and soluble nitrogen (NO3, NH4, and organic N), total suspended solids, and biological oxygen demand. WAM was recently linked to WASP (SWET, 2003), which enables the simulation of dissolved oxygen and chlorophyll-a.
- Time-series outputs at the source cells, subbasins, and individual tributary reaches including: source load maps (surface water and groundwater), attenuated subbasin and basin loads, ranking of land uses by load source, daily time series of flows and pollutants, and comparative displays of different BMP/Management Scenarios.

The model simulates the hydrology of the watershed using other imbedded models including "Groundwater Loading Effects of Agricultural Management Systems" (GLEAMS; Knisel, 1993), "Everglades Agricultural Area Model" (EAAMod; Botcher et al., 1998; SWET, 1999), and two submodels written specifically for WAM to handle wetland and urban landscapes. Dynamic routing of flows is accomplished through the use of an algorithm that uses a Manning's flow equation based technique (Jacobson et al., 1998). Attenuation is based on the flow rate, characteristics of the flow path, and the distance of travel. The model provides many features that improve its ability to simulate the physical features in the generation of flows and loadings including:

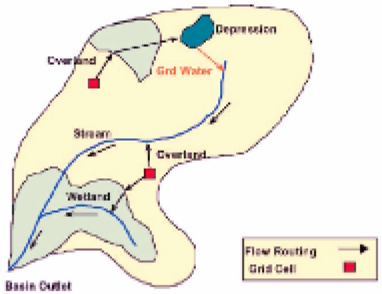


Figure 1. Flow Path Routing for Attenuation Distance Determination

- Flow structures simulation
- Generation of typical farms
- BMPs
- Rain zones built into unique cells definitions, which also allows use with NEXRAD Data
- Full erosion/deposition and in-stream routing –is used with pond/reservoirs
- Closed basins and depressions are simulated
- Separate simulation of vegetative areas in residential/urban
- Simulation of point sources with service areas
- Urban retention ponds
- Impervious sediment buildup/washoff
- Shoreline reaches for more precise delivery to rivers/lakes/estuaries
- Wildlife diversity within wetlands
- Spatial map of areas having wetland assimilation protection
- Indexing submodels for BOD, bacteria, and toxins

A schematic of WAM major components is shown in Figure 2. As seen, the overall operation of the model is managed by the ArcView-based interface. The interface allows the user to view available data, modify land use conditions, execute the model, and view results.

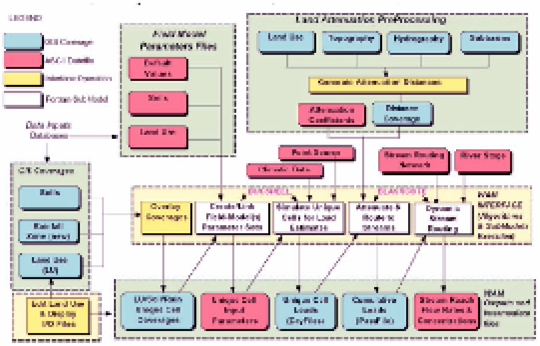


Figure 2. Schematic of WAM Layout

References

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Jacobson, Barry M., Adelbert B. Bottcher, Nigel B. Pickering, and Jeffrey G. Hiscock. 1998. Unique routing algorithm for watershed assessment model. ASAE Paper No. 98-2237. Am. Soc. of Agr. Eng., St. Joseph, MI 49085.

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Visit the
Watershed & Water Quality Modeling Technical Support Center Website
http://www.epa.gov/athens/wwqtsc/index.html

EPA United States Environmental Protection Agency

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Dynamic Modeling Process