Watershed Assessment Model (WAM) Applications in Florida



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Why Model?

Educate stakeholders on watershed behavior for better decision making!

- Quantify change from native conditions
- Quantify relative contributions by land use
- Evaluate alternative abatement scenarios
  - Environmental benefit
  - Economic Impact
- Evaluate impact of new developments
  - Environmental response vs. cost
- Help set reasonable TMDLs
- Evaluate compliance of implemented programs

A Few of the Available Watershed Models

- ANSWERS
- HSPF
- MIKE-SHE
- SWAT
- SWMM
- WASH
- Neural Networks
- EMC models
- RSM
- WAM

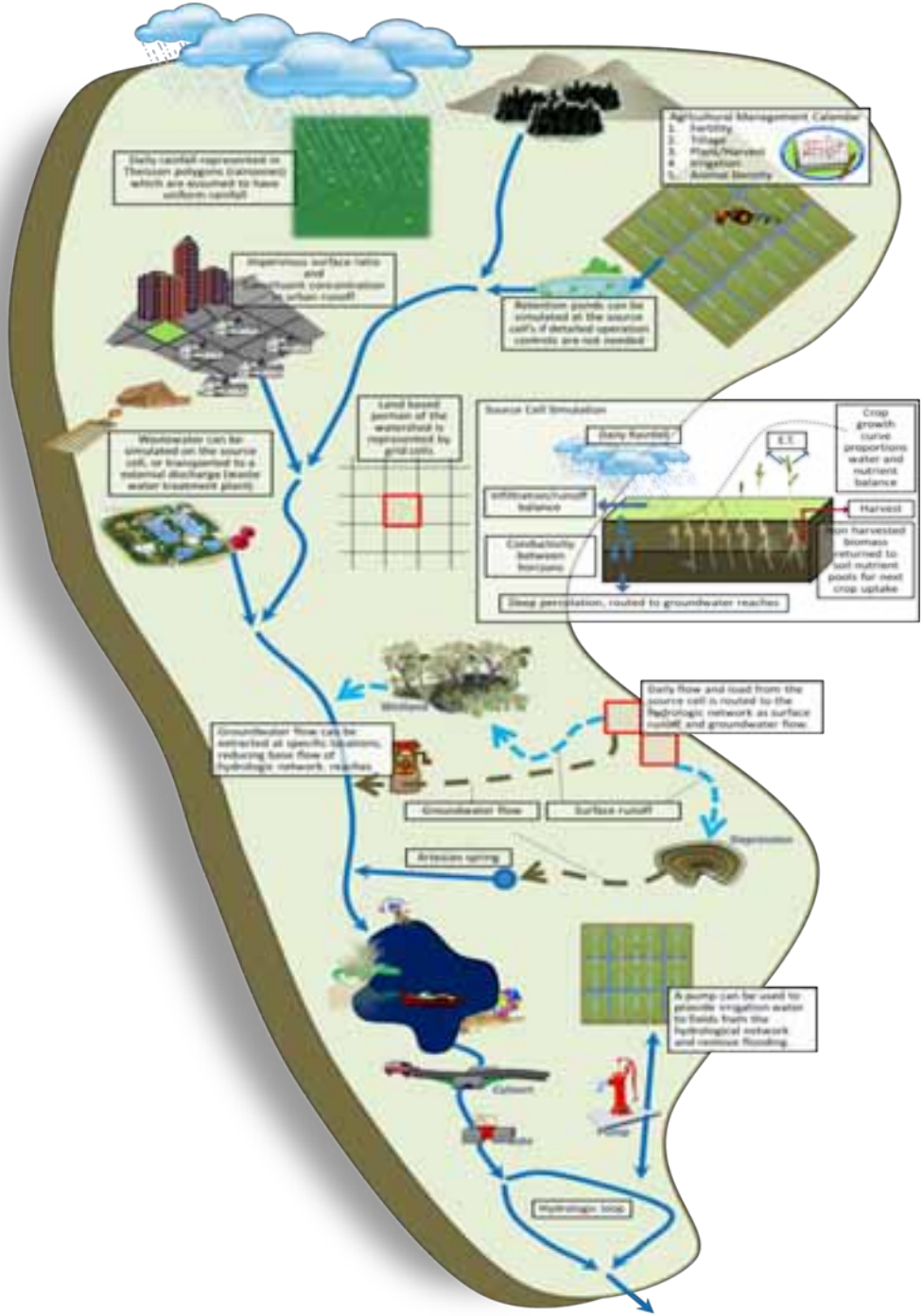
Each model has its strengths and weaknesses so selection should be based on the modeling objectives and the model's available to meet those objectives.

Watershed Assessment Model (WAM)

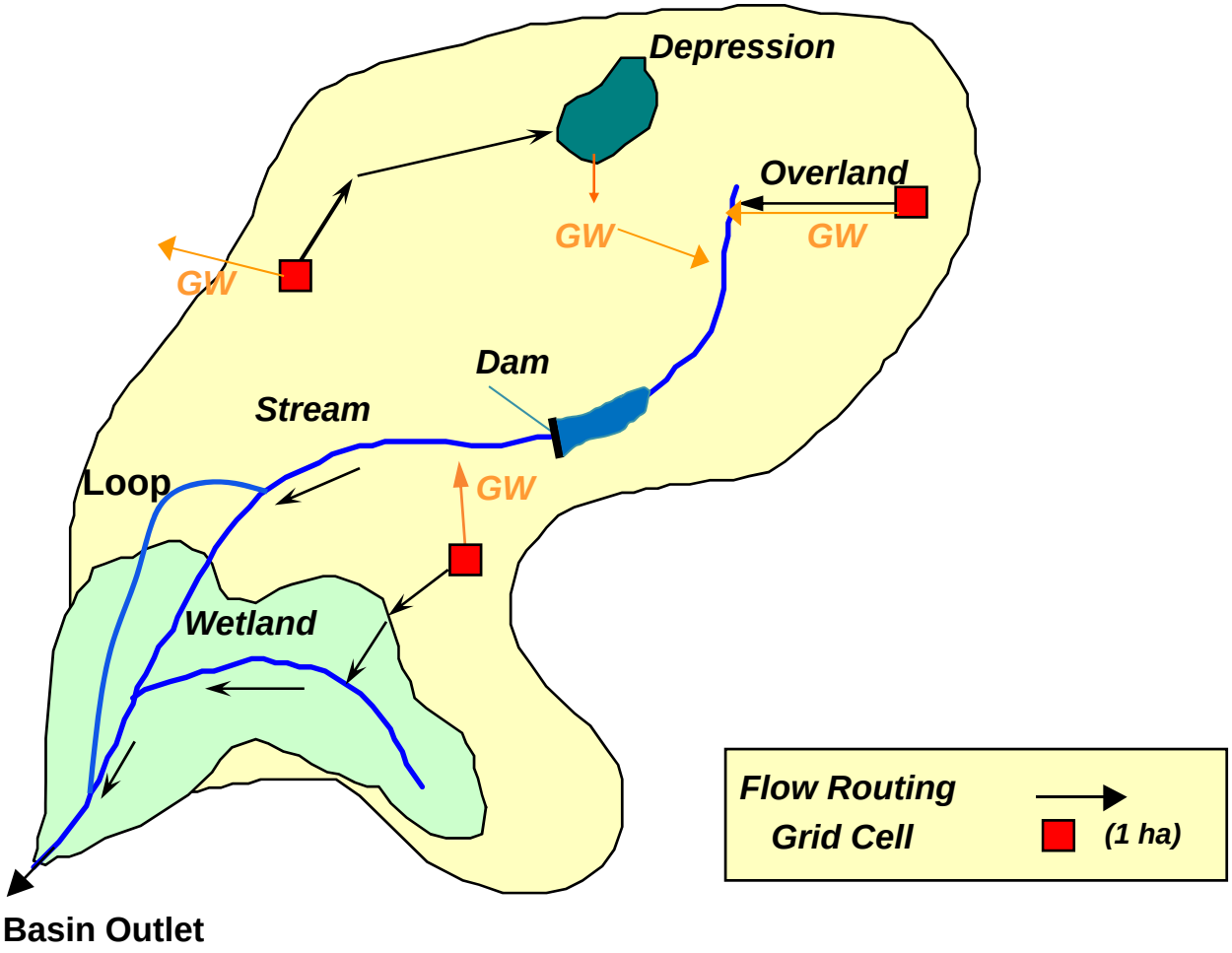
- Developed specifically for Florida conditions
- Simulates surface and groundwater flow and TSS and nutrient loadings. DO and Chl-a when combined with WASP
- GIS Based to maximize use of spatial datasets
- Detailed field scale land source simulation
- Handles complex flow networks
- User friendly interface

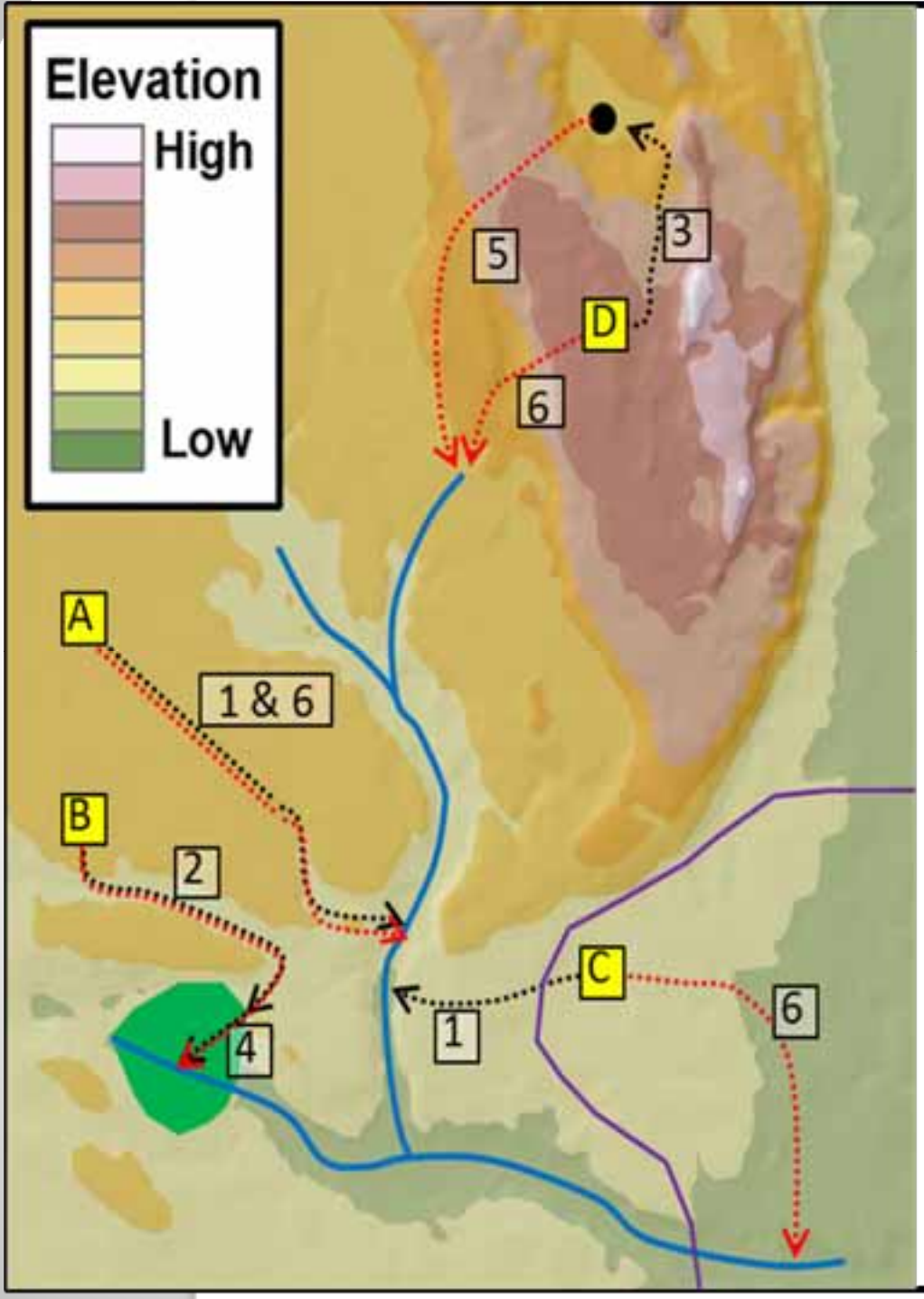
Conceptual Layout of WAM

Processes Handled



How WAM Works!





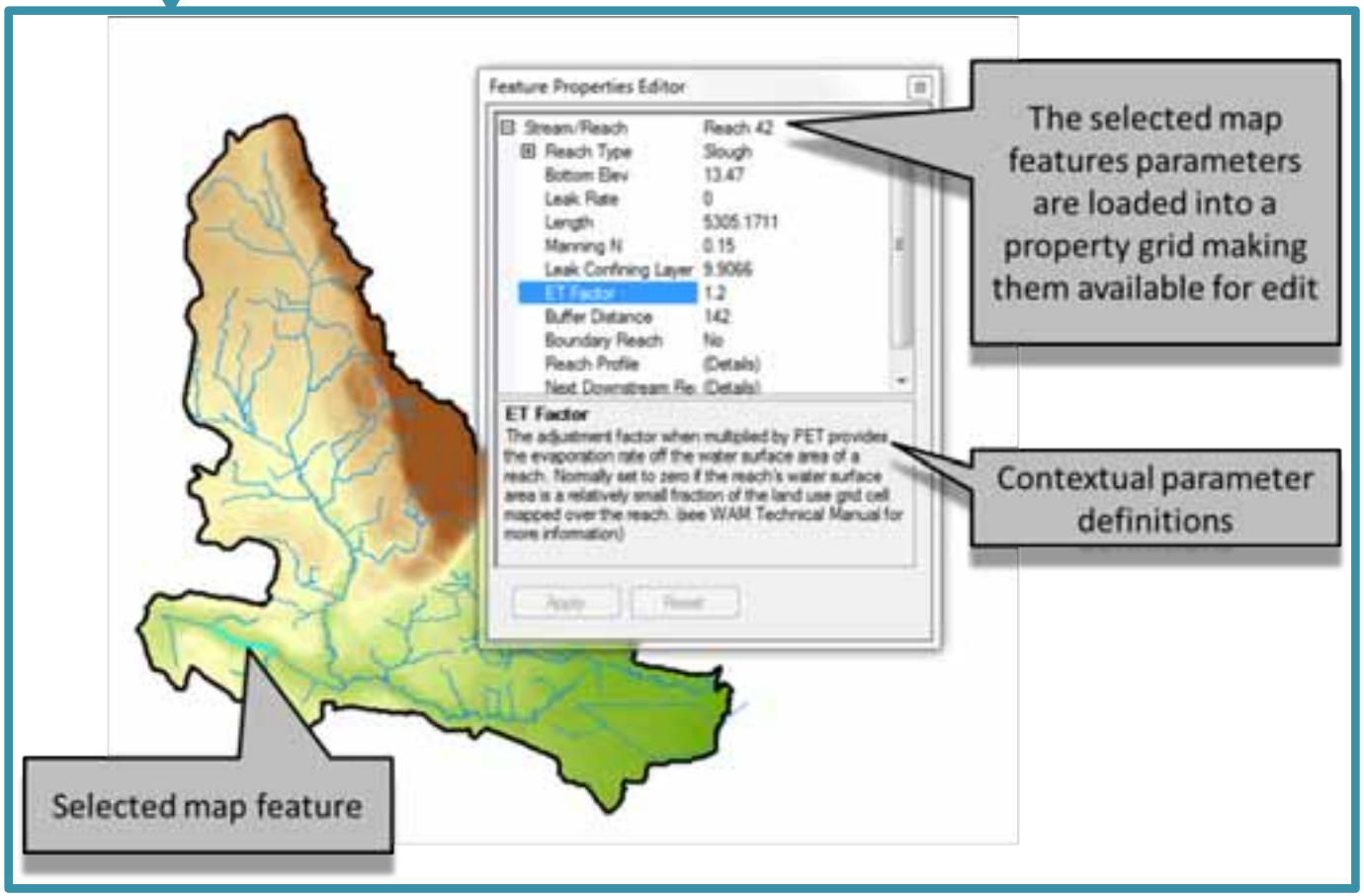
Key

1. Source to nearest Stream
2. Source to Nearest Wetland
3. Source to Nearest Depression
4. Wetland to nearest stream
5. Depression to nearest stream
6. Source to groundwater stream

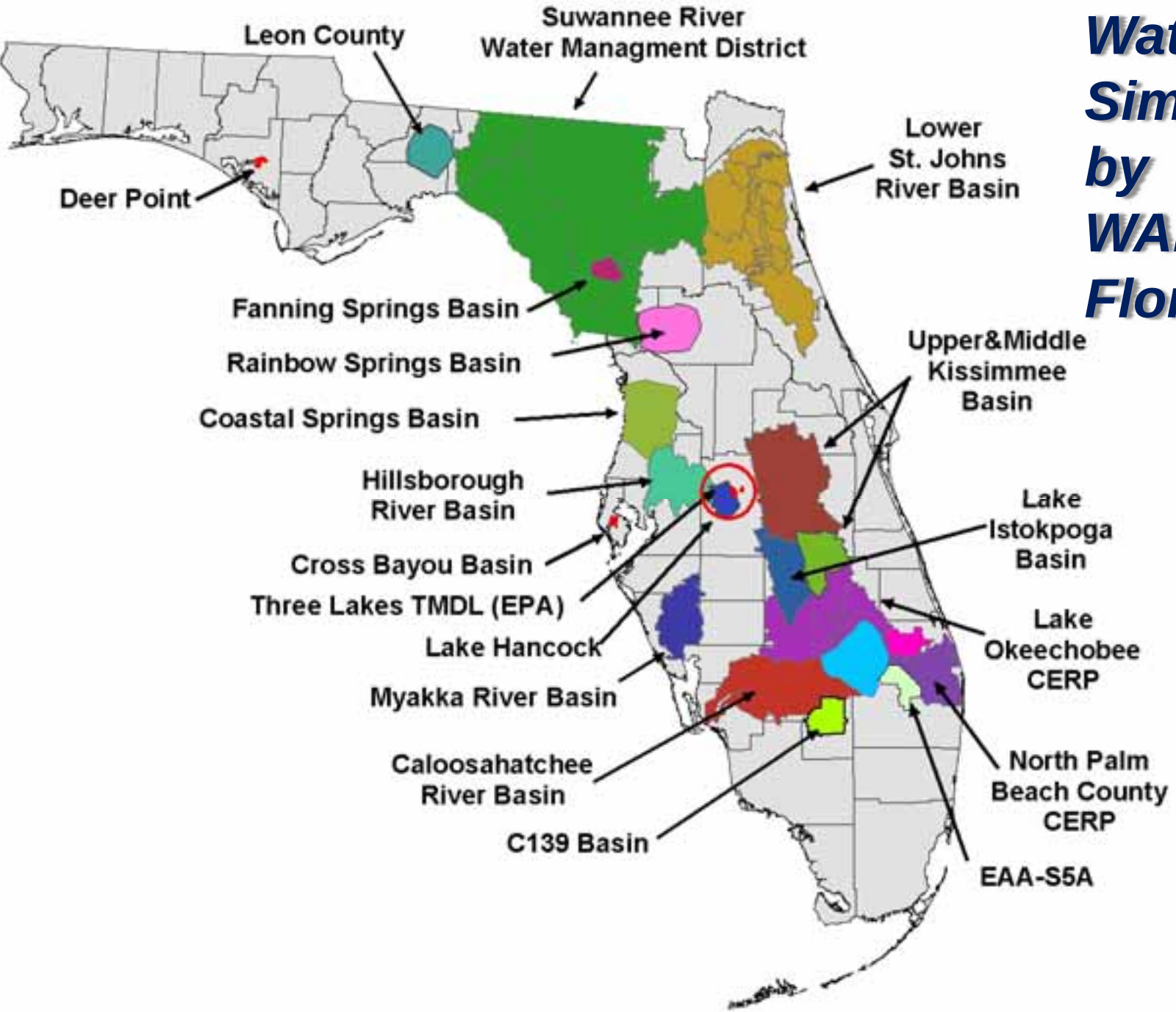
Legend

- Source Cell
- Springshed Boundary
- Surface Runoff
- Groundwater Flow
- Wetland
- Reach
- Depression

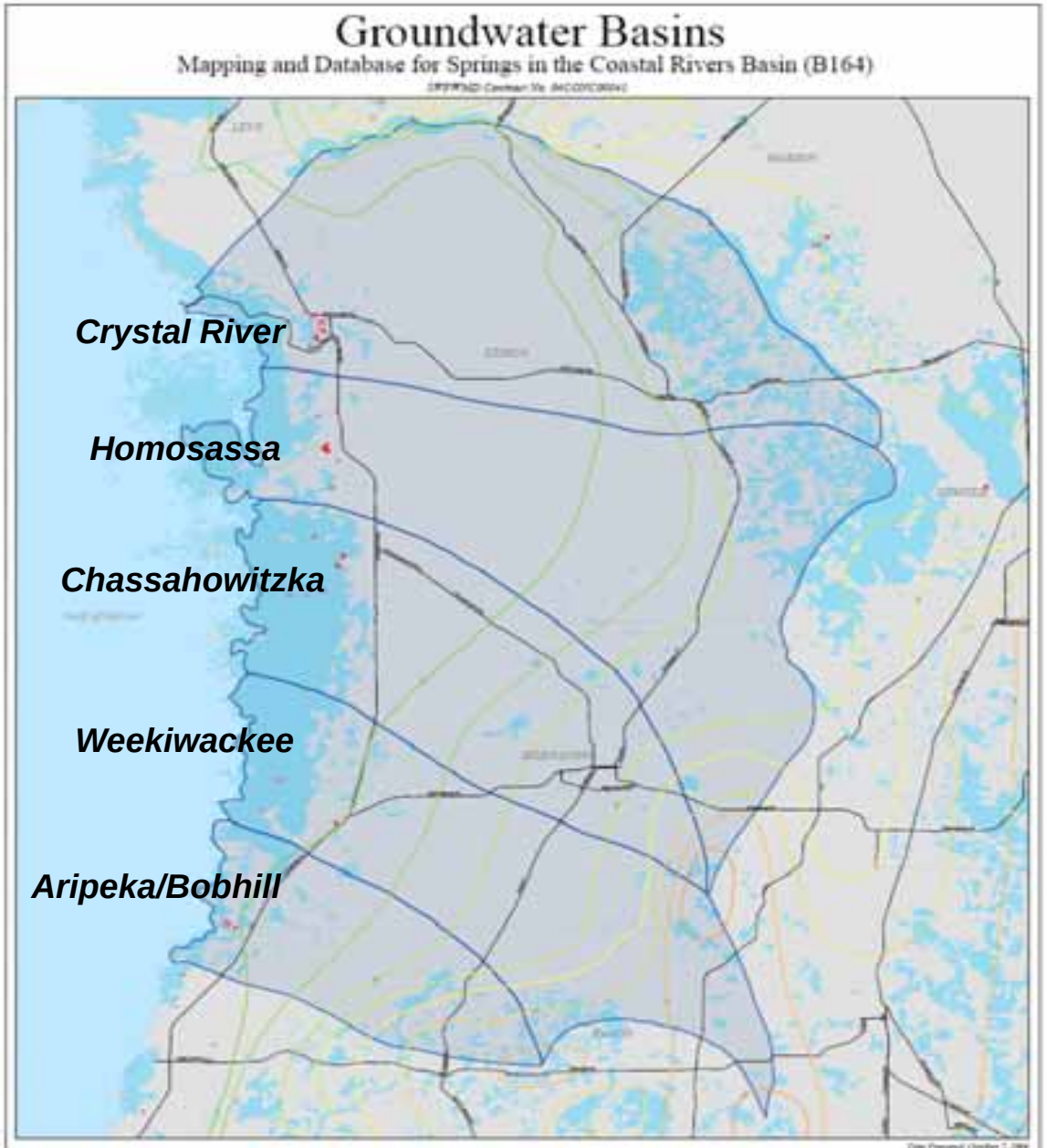
WAM ToolBar in ArcMap 10



Watersheds Simulated by WAM in Florida



WAM MODELING OF COASTAL RIVERS/SPRINGS BASIN



Developing Predevelopment Conditions

- Digital Elevation Maps
- Soils Map
- Historic Photos
- Historic Land Cover
  Maps & Research Lit.
- Descriptive
  Literature

Coastal Springs Watershed Assessment Model

Existing Land Use

Predevelopment Land Use

Land Use

- Aquaculture
- Barren Land
- Bay Swamps
- Cattle Feeding Operations
- Citrus Groves
- Commercial and Services
- Coniferous Plantations
- Cypress
- Dunes
- Freshwater Marshes
- Hardwood Conifer Mixed
- High Density Residential
- Improved Pasture
- Industrial
- Low Density Residential
- Medium Density Residential
- Mining
- Mixed Wetland Hardwoods
- Open Water
- Ornamental Nurseries
- Prisons
- Row Crops
- Rural Land in Transition
- Salt Barrens
- Scrub and Brushland
- Sewage Treatment
- Sod Farms
- Sugar Cane
- Transportation Corridors
- Tree Nurseries
- Undeveloped Urban Land
- Unimproved Pasture
- Wetland Forested Mixed

Land Use

- Aquaculture
- Barren Land
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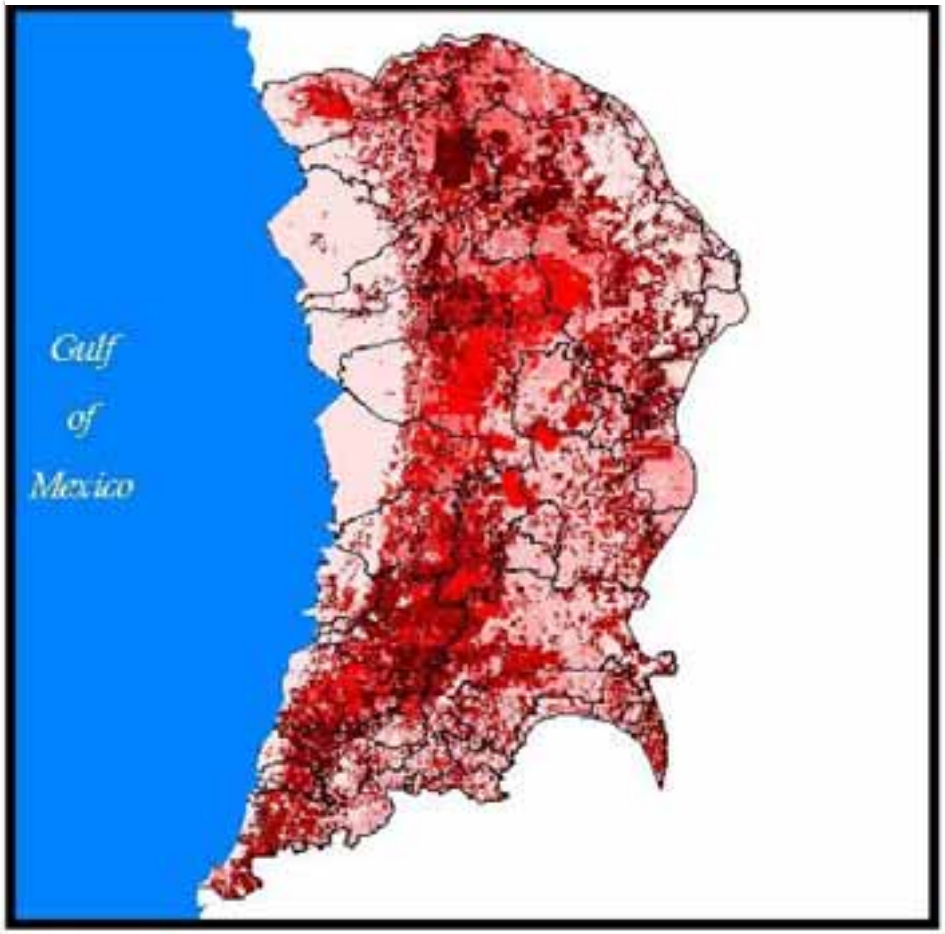
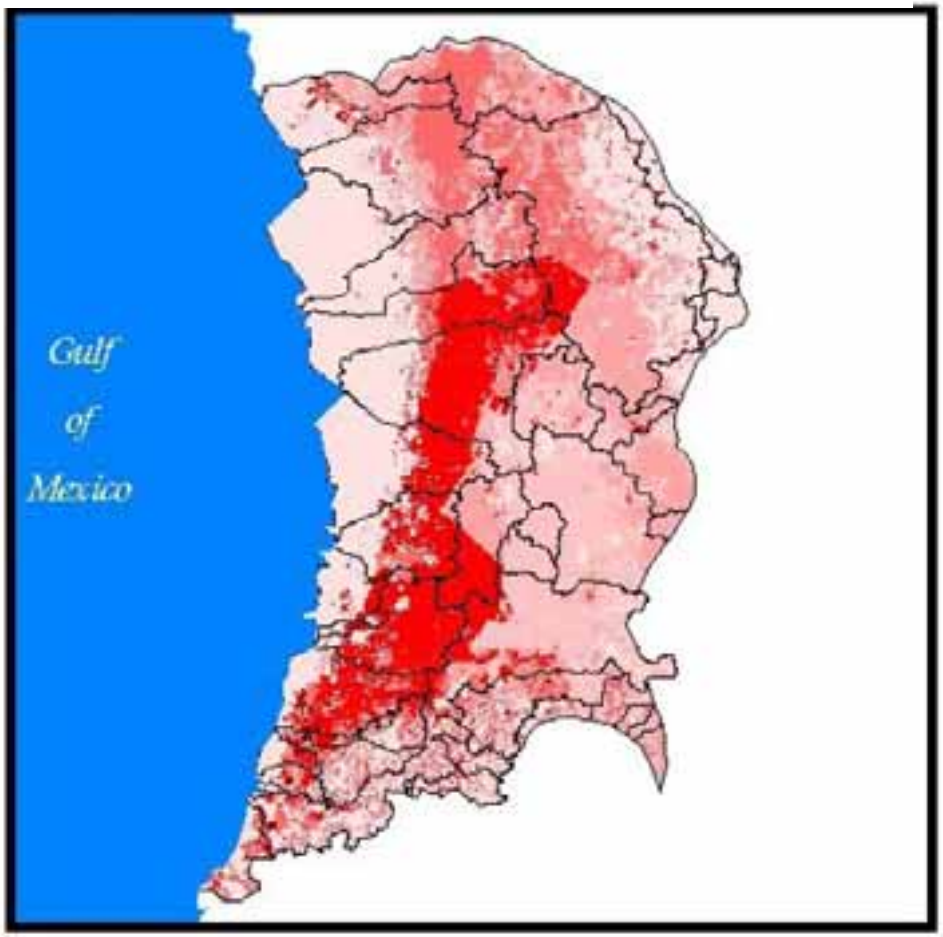
GW Recharge - N
Existing vs Pre-Dev.

Coastal Springs Watershed Assessment Model

Existing Land Use



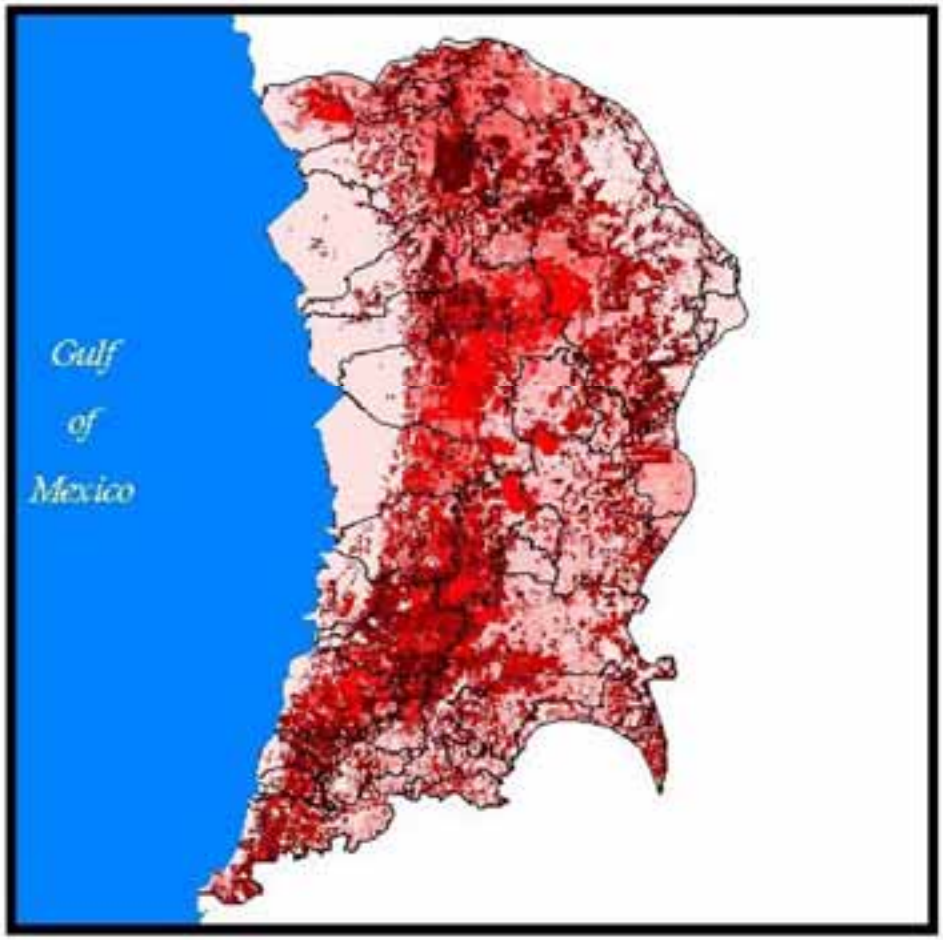
Predevelopment Land Use



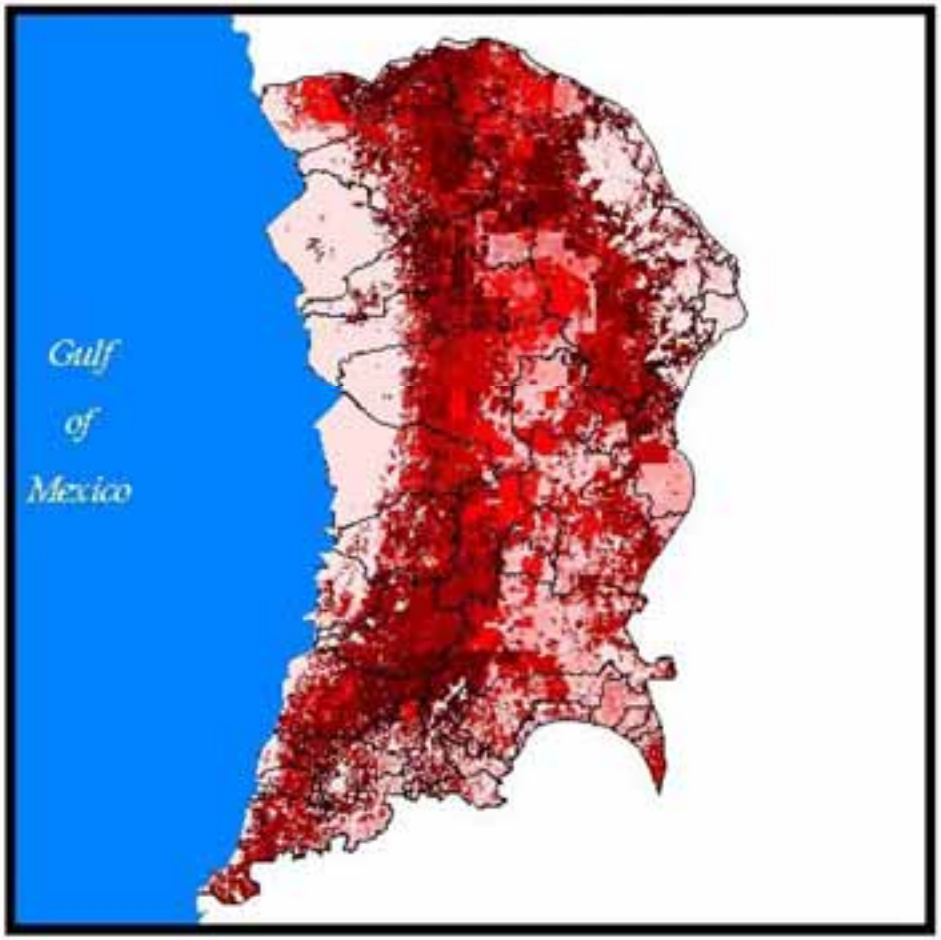
GW Recharge - N
Existing vs Build-Out

Coastal Springs Watershed Assessment Model

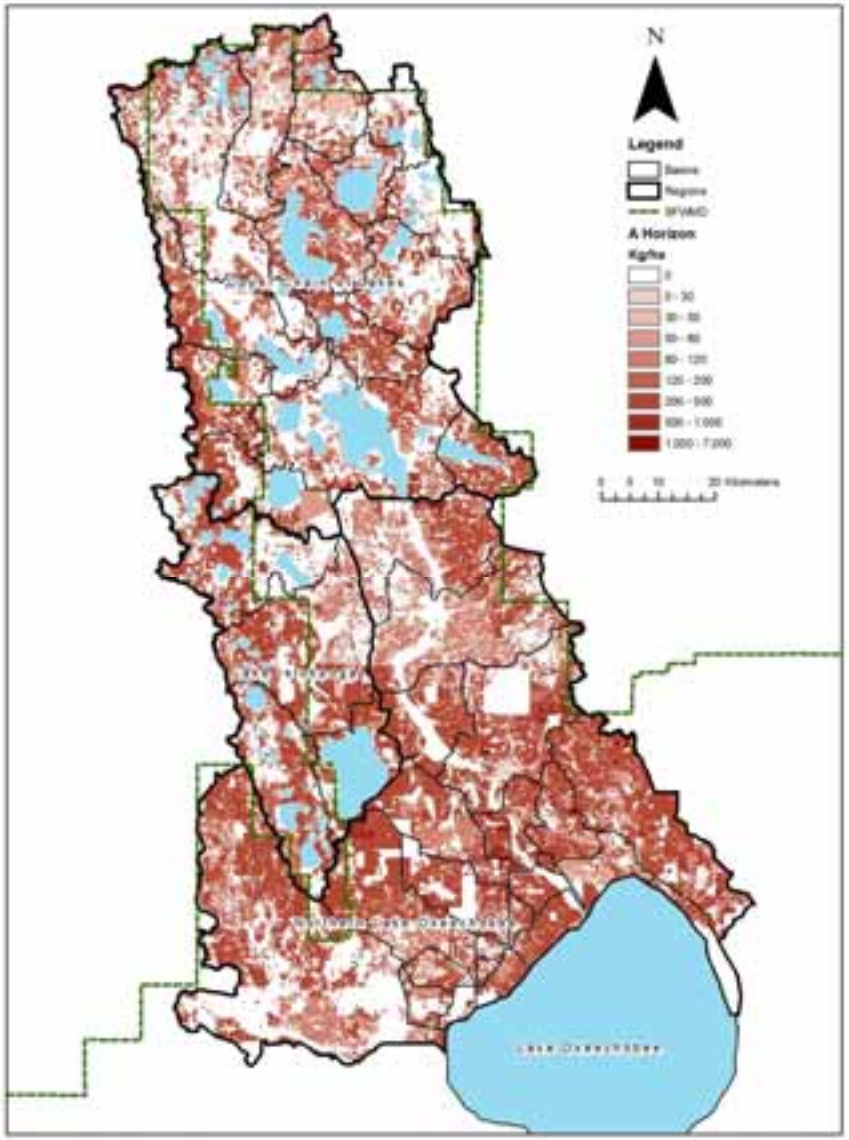
Existing Land Use



Build Out Land Use



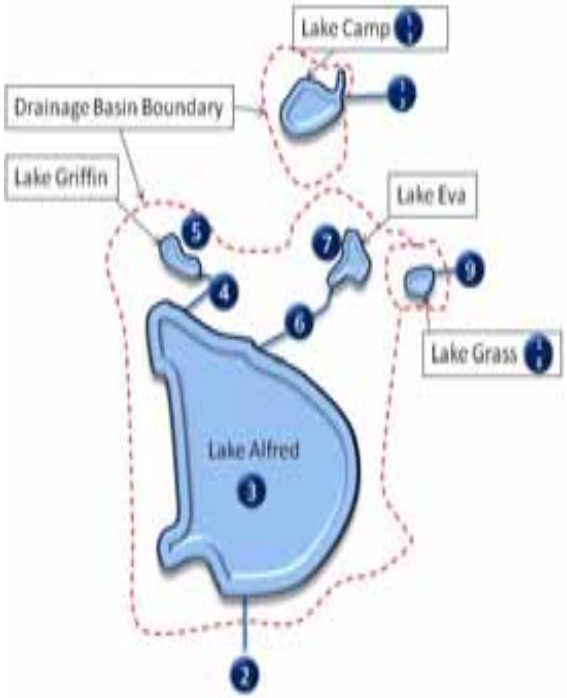
Distribution of Anthropogenic (Legacy) P in Okeechobee Watershed

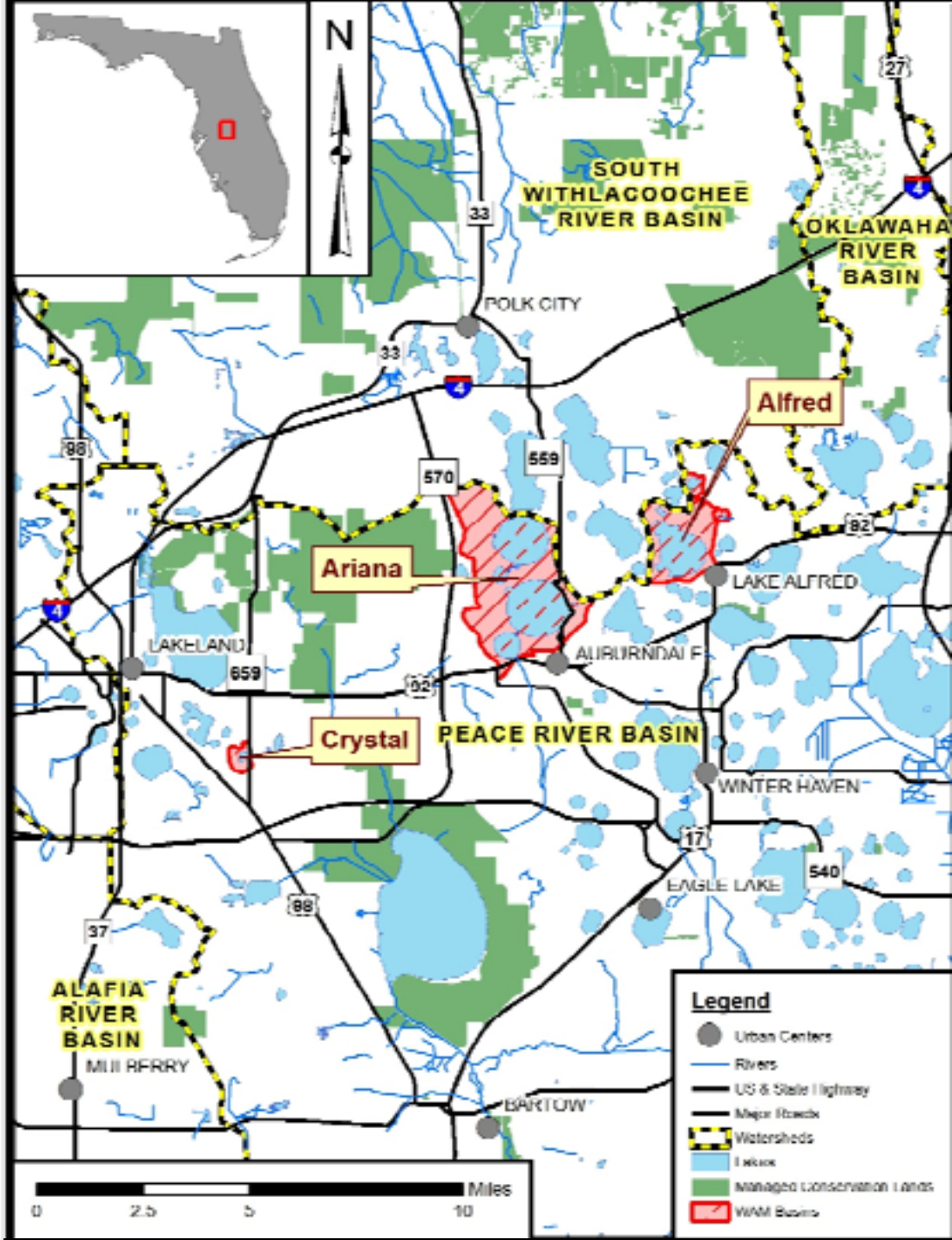


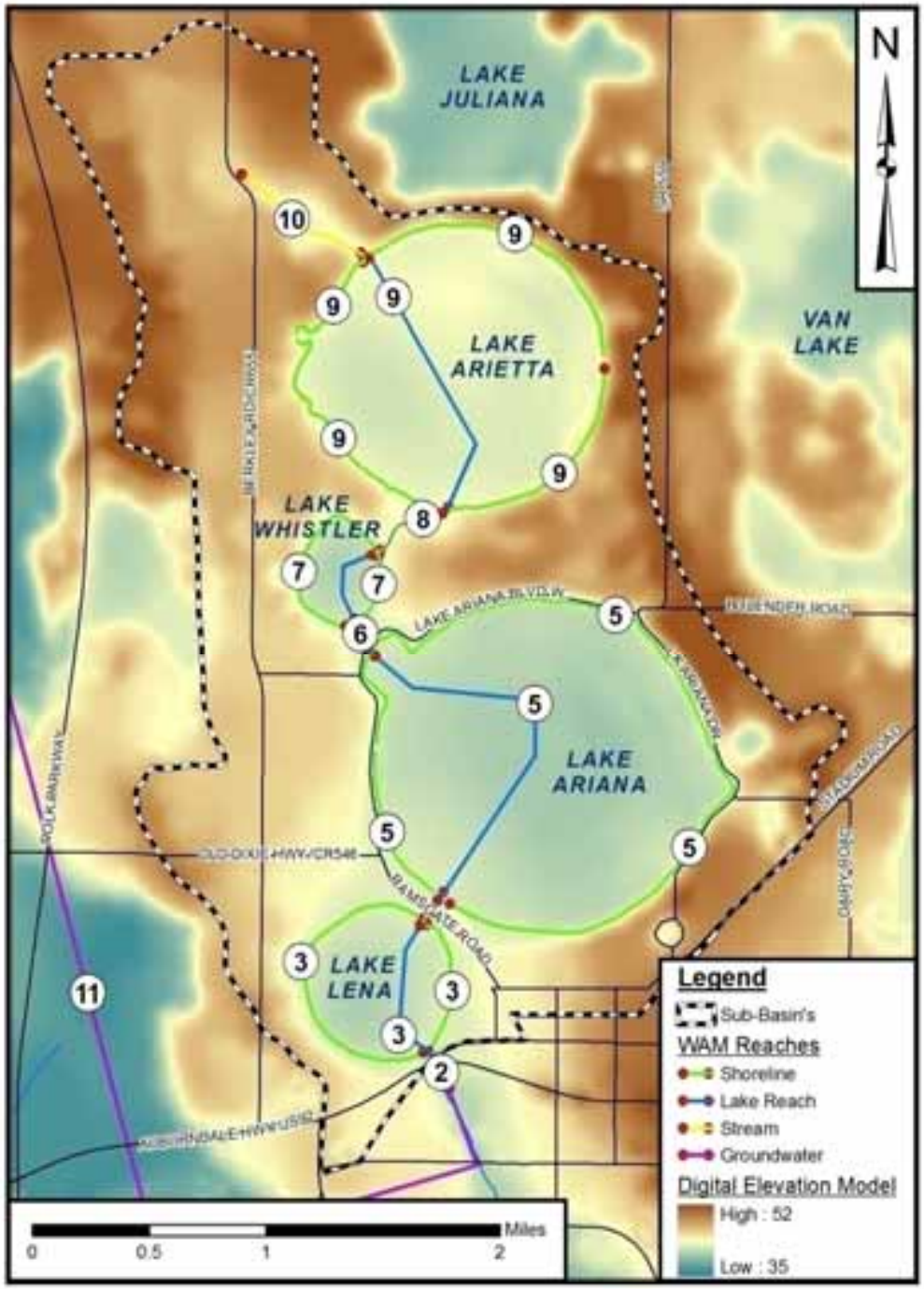
P Impacts in Okeechobee Watershed

- Legacy P in Watershed = 190,000 mt
- At current P discharge levels it would take about 380 years to wash out the existing Legacy P
- Knowledge base for transport and abatement strategies is good

Upper Peace River – Three Lakes TMDL Model Using WAM & WASP

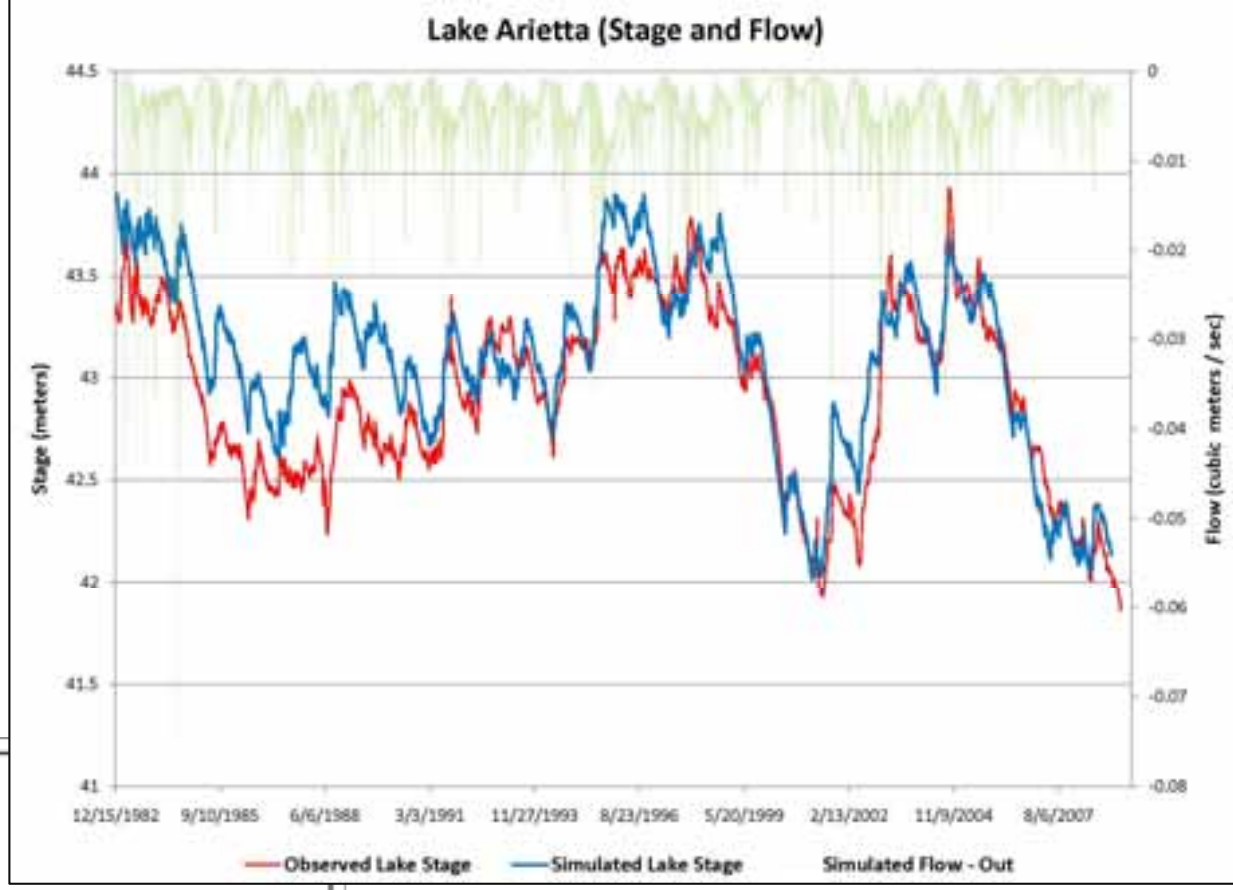


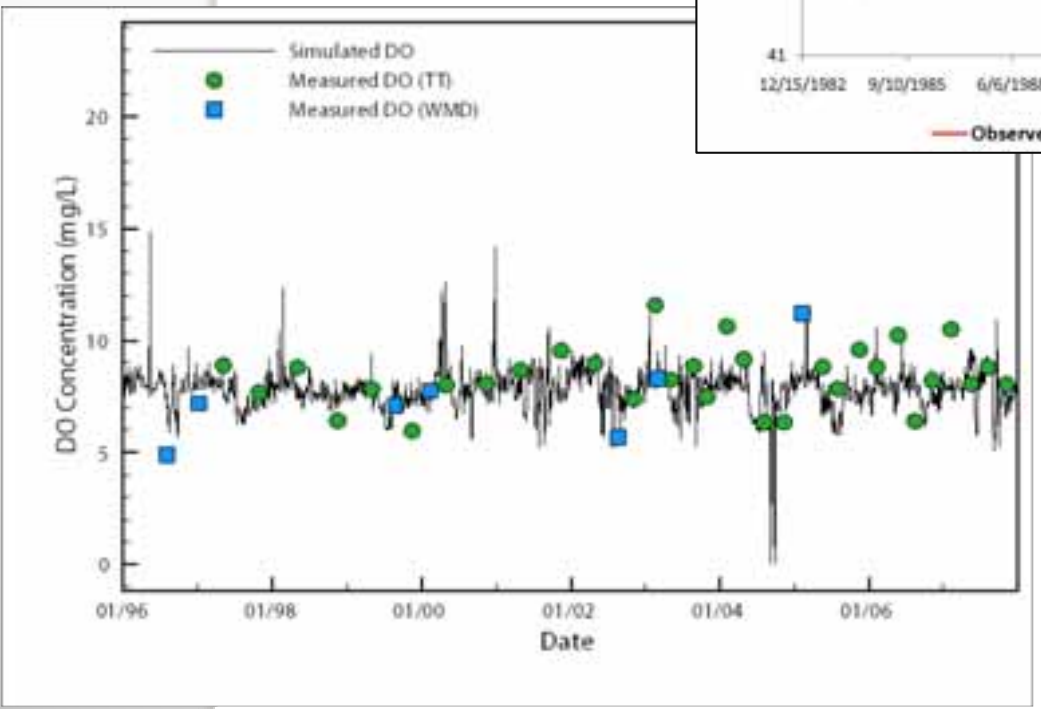



N
LAKE JULIANA
VAN LAKE
LAKE ARIETTA
LAKE WHISTLER
LAKE ARIANA
LAKE LENA
LAKE ARIANA BLVD W
PUGENDER ROAD
OLD DIXIE HWY/CR546
RAMSGATE ROAD
POLK PARKWAY
Legend
Sub-Basin's
WAM Reaches
Shoreline
Lake Reach
Stream
Groundwater
Digital Elevation Model
High : 52
Low : 35
Miles
0
0.5
1
2

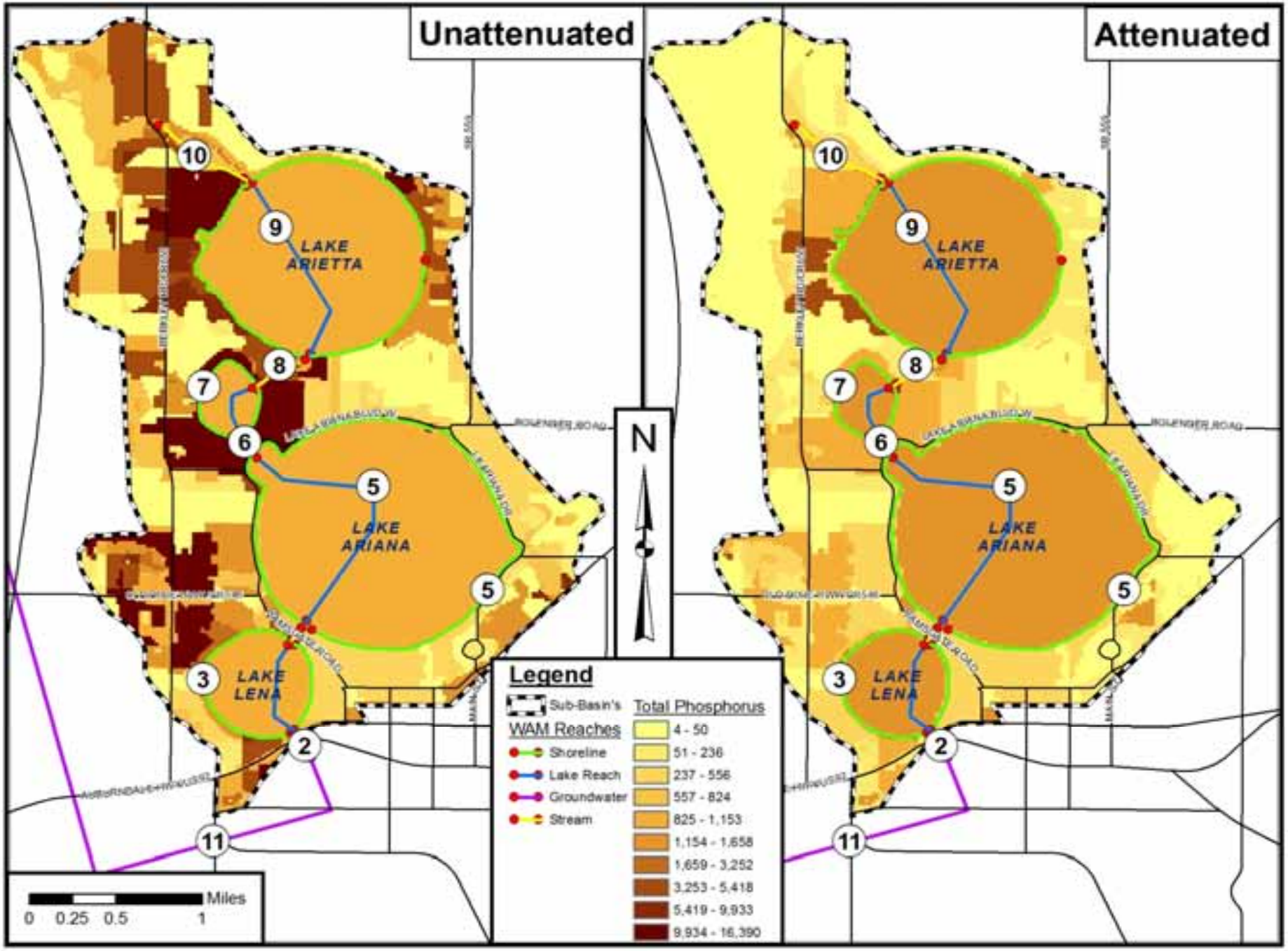

N
LAKE JULIANA
LAKE ARIETTA
LAKE WHISTLER
LAKE ARIANA
LAKE LENA
Legend
Sub-Basin's
WAM Reaches
Shoreline
Lake Reach
Stream
Groundwater
Miles
0.5
1
2

Lake Arietta





WAM Calibration


Unattenuated
Attenuated
LAKE ARIETTA
LAKE ARIANA
LAKE LENA
10
9
8
7
6
5
5
3
2
11
N
Legend
Sub-Basin's
WAM Reaches
Shoreline
Lake Reach
Groundwater
Stream
Total Phosphorus
4 - 50
51 - 236
237 - 556
557 - 824
825 - 1,153
1,154 - 1,658
1,659 - 3,252
3,253 - 5,418
5,419 - 9,933
9,934 - 16,390
Miles
0 0.25 0.5 1

TMDL and Abatement Issues

- TMDL preliminarily set at 30 TSI
- N and P reductions needed to meet TMDL were estimated
- Source loads reductions of N and P could not meet target
- Lake sediment removal was identified as a necessary abatement practice in order to meet TMDL target

Development and Application of a GIS–Based Springshed Nonpoint Source (NPS) Pollutant Loading Model for Rainbow Springs

for Marion County

by

SWET, HDR, & JGH

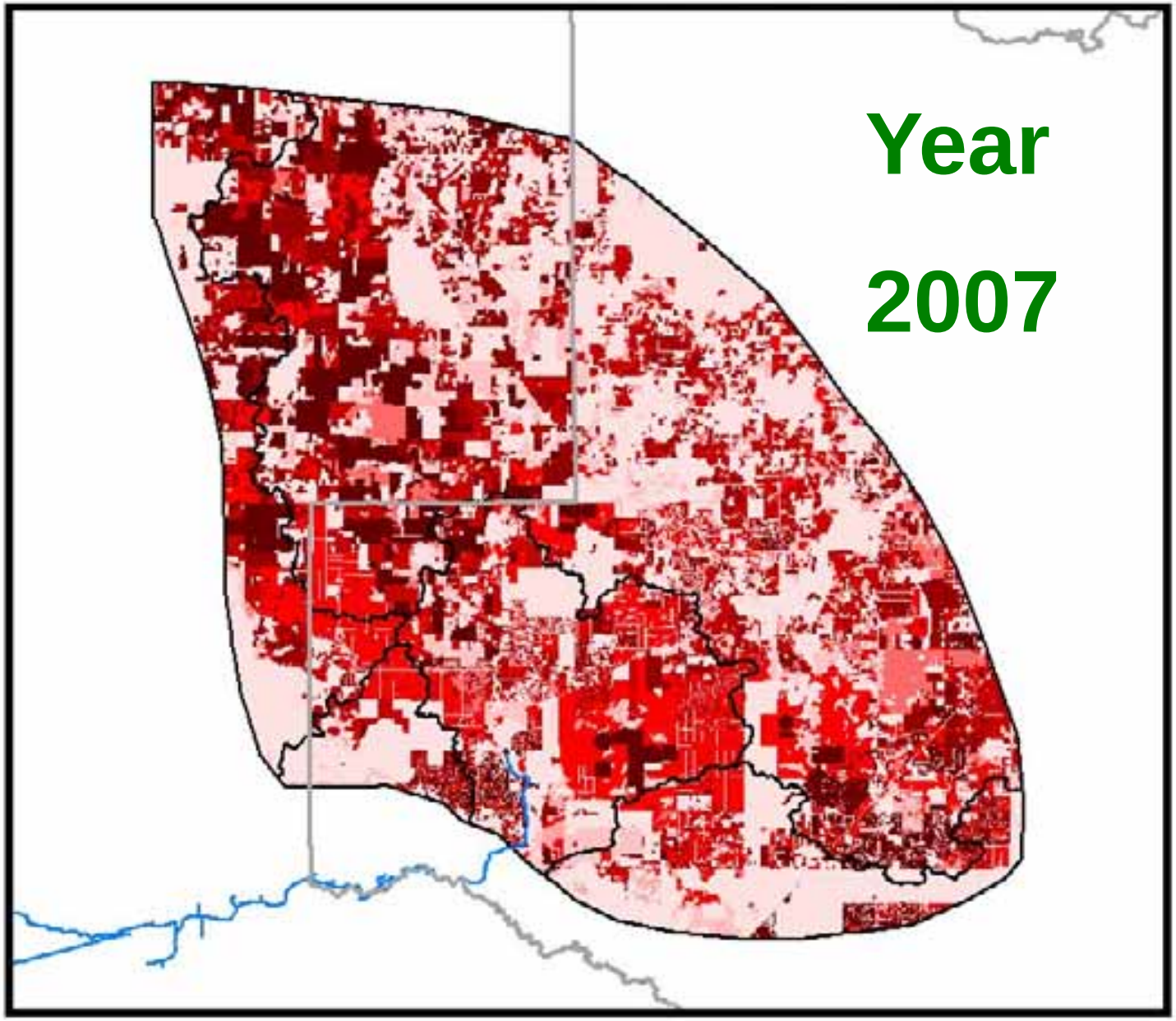

Alachua
Dixie
Levy
Marion
Rainbow Springs
study area
Rainbow Springs
Rainbow
River
Withlacoochee River
Gulf of
Mexico
Citrus
Sumter
0 2 4 8 Miles

Special Considerations

- Land use affluency
- Land management activities
- Retention systems mapping
- Well fields
- Septic tanks and service areas
- Urban impervious surfaces and landscape management
- Depressions
- Ag irrigation withdrawals

Rainbow Springs Study Area

Rainbow Springs Basin



Groundwater N Source Load (unattenuated)

- 0 - 3850
- 3851 - 5861
- 5862 - 7176
- 7177 - 8193
- 8194 - 9502
- 9503 - 30096
- 30097 - 98621
- > 98622

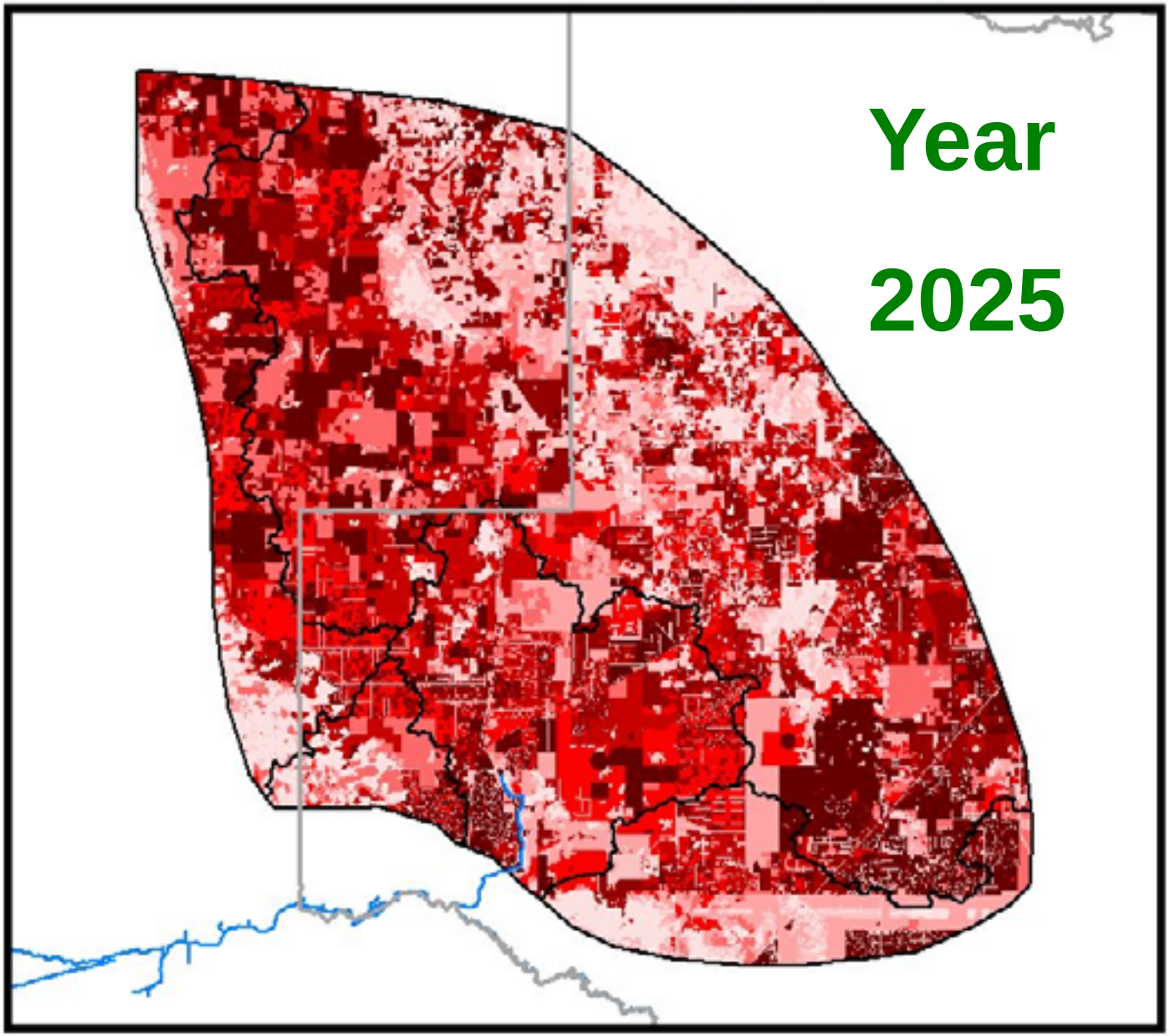
Units = grams/ha/year

Conversion
1 gram/ha/yr =.00089 lbs/ac/yr

2 0 2 4 Kilometers

Rainbow Springs Study Area

Rainbow Springs Basin



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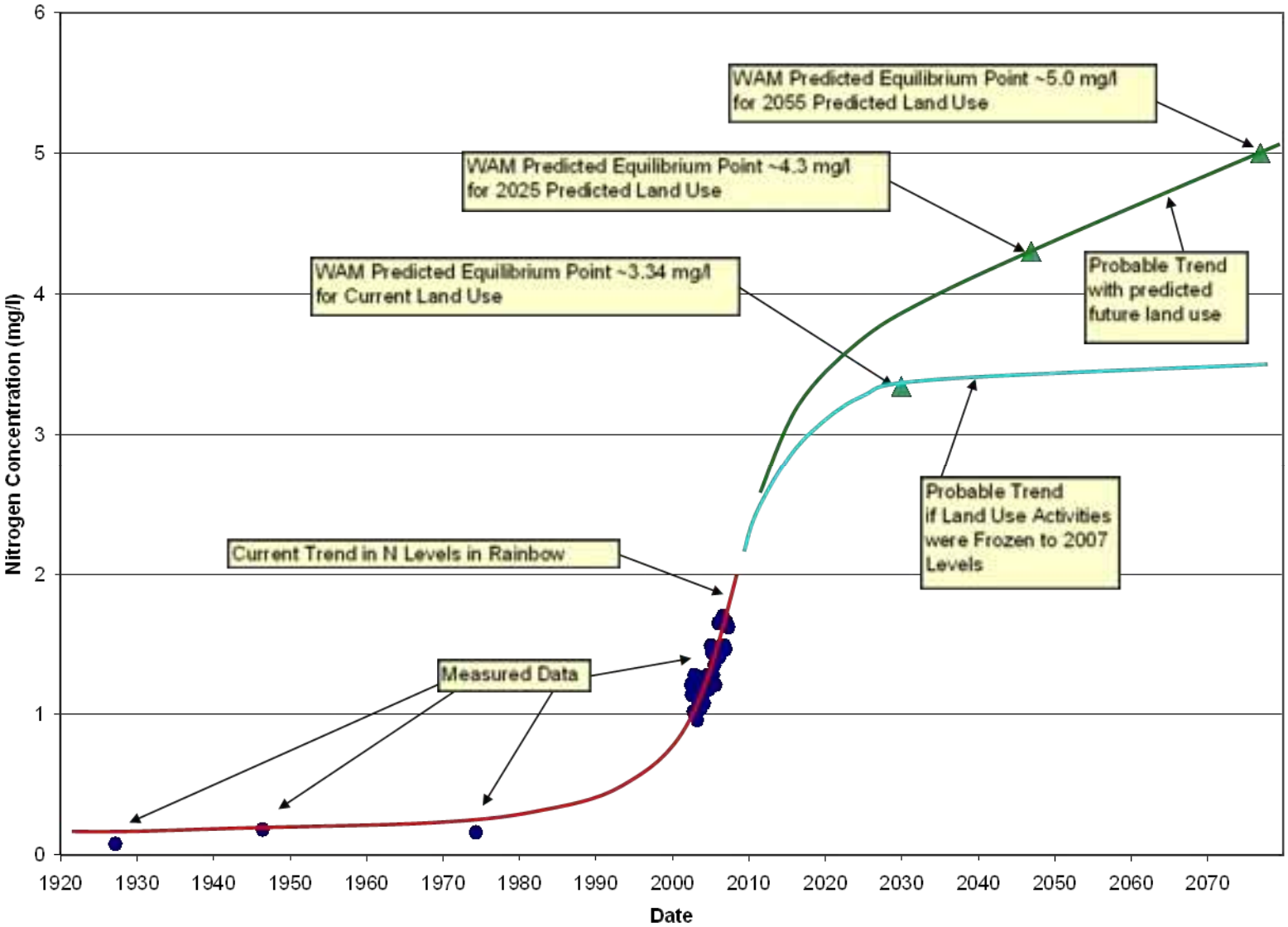
Simulated Future Impacts at Rainbow Spring



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

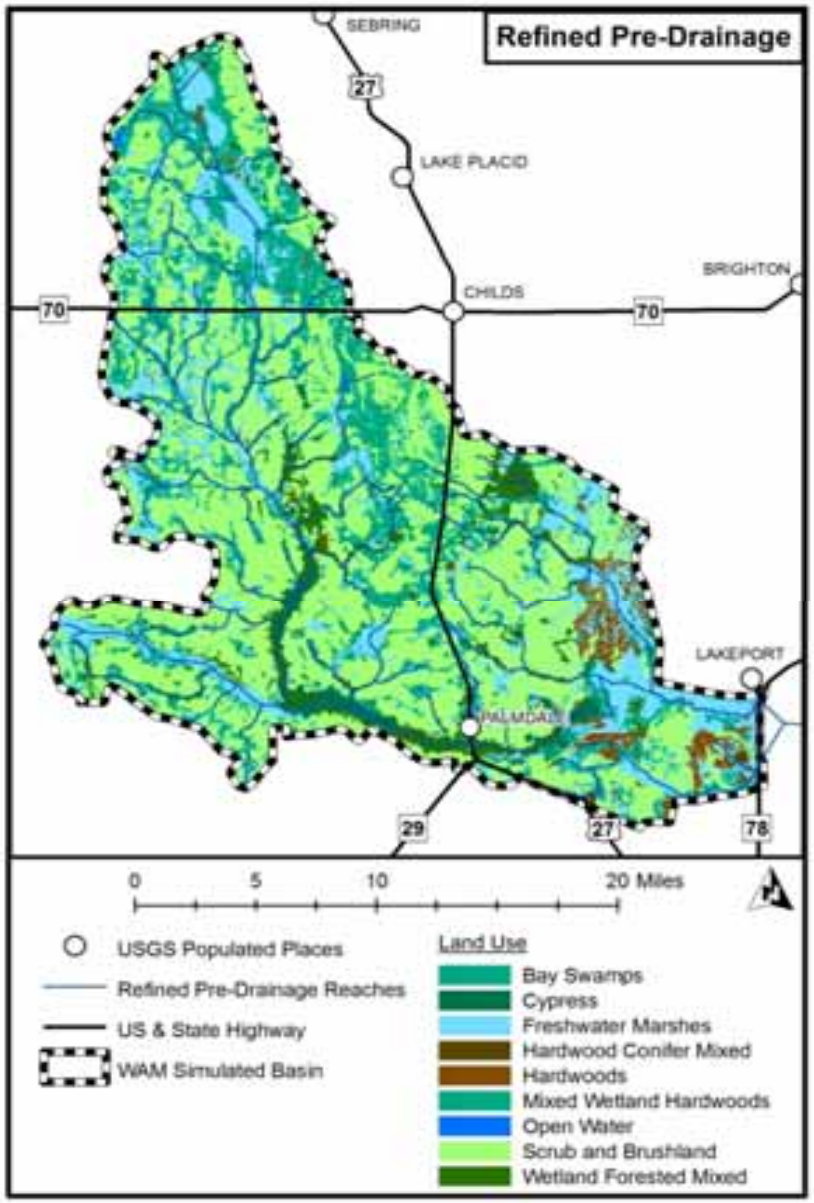
PreDrainage vs Post Drainage Assessment

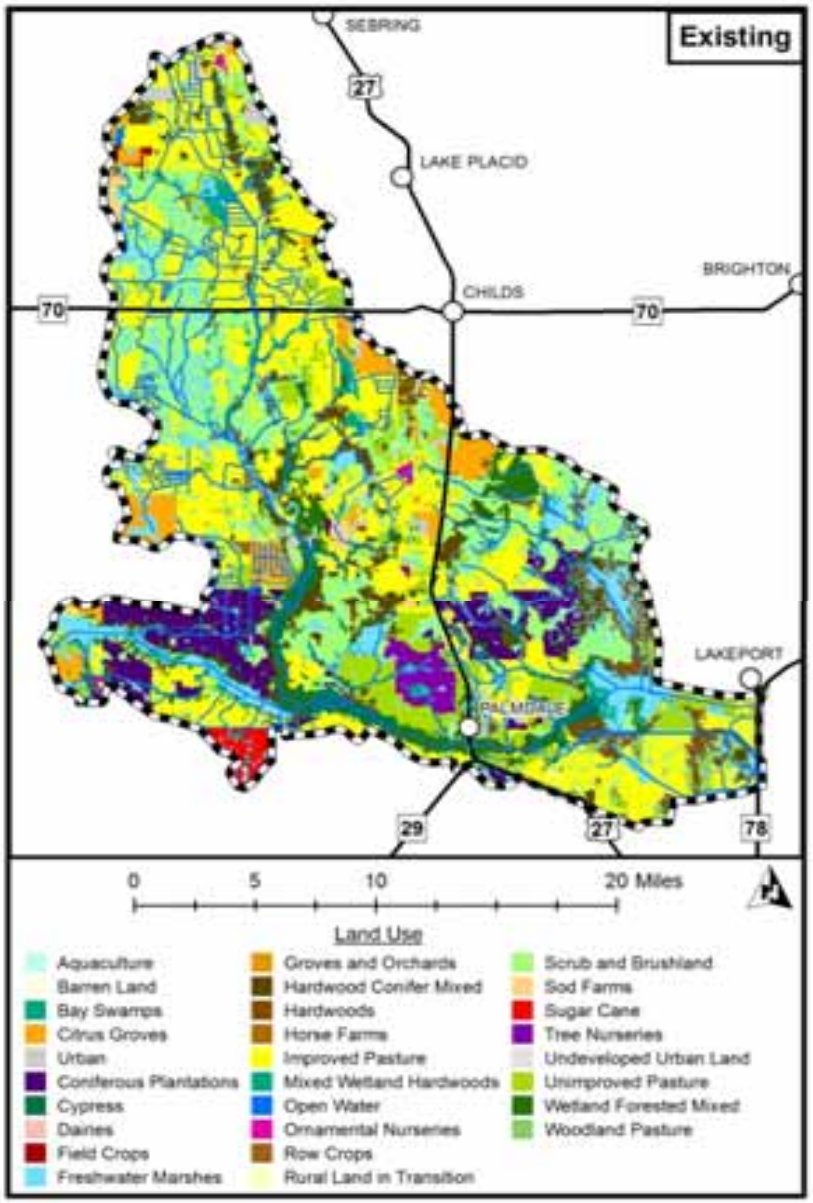
Modeled by

SWET and HDR

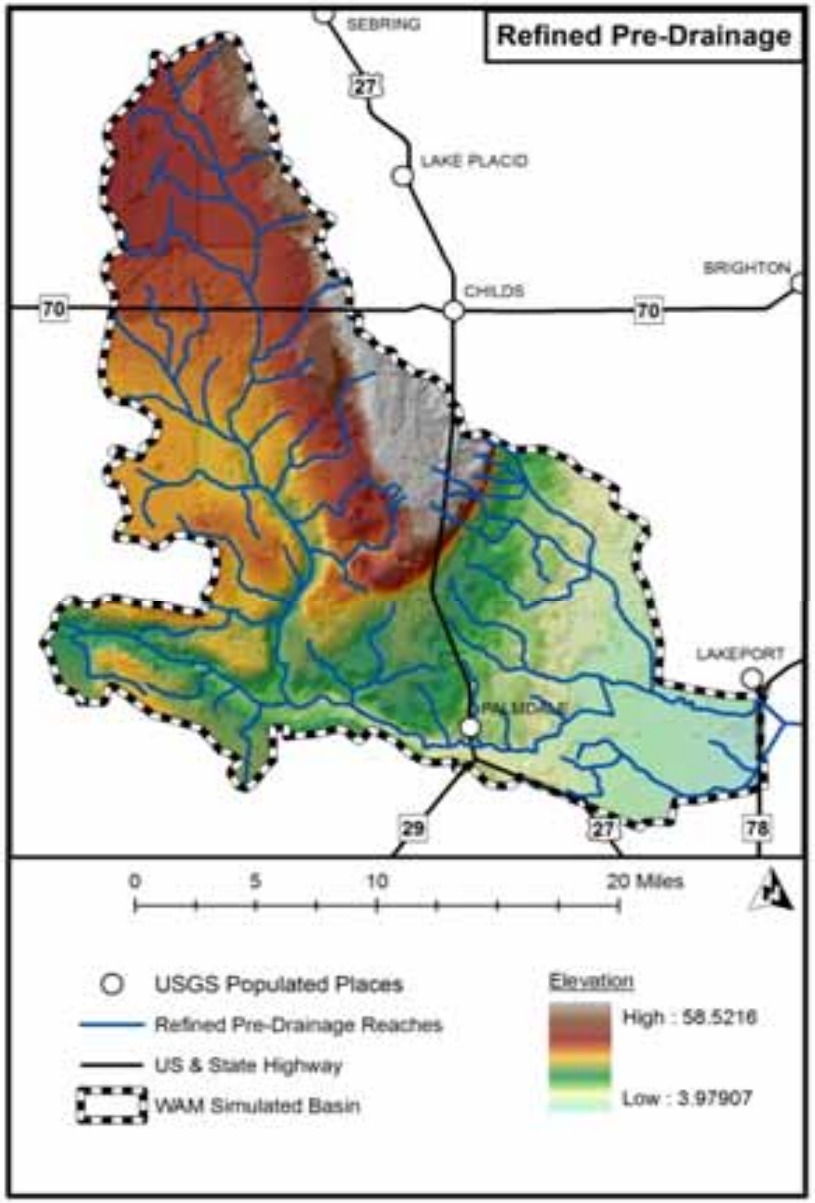
Fisheating Creek Feasibility Study

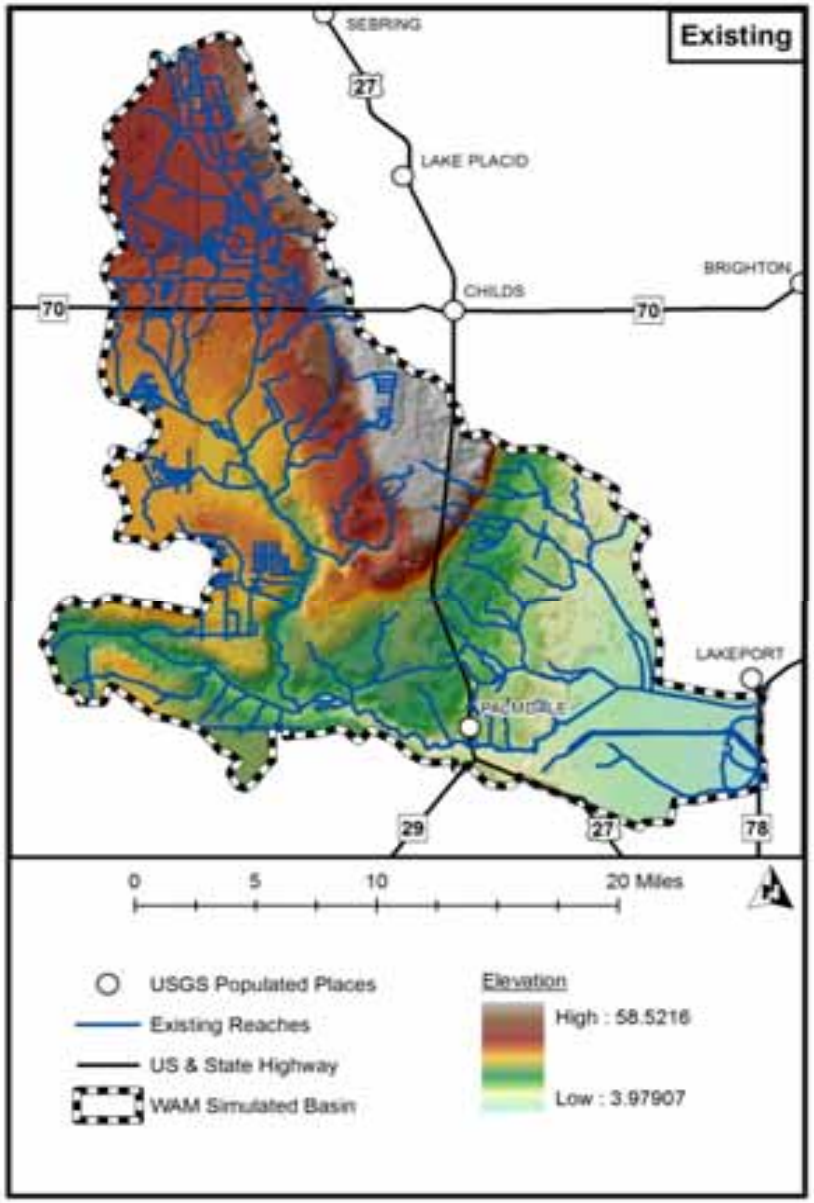
Pre-drainage vs. Existing Land Use



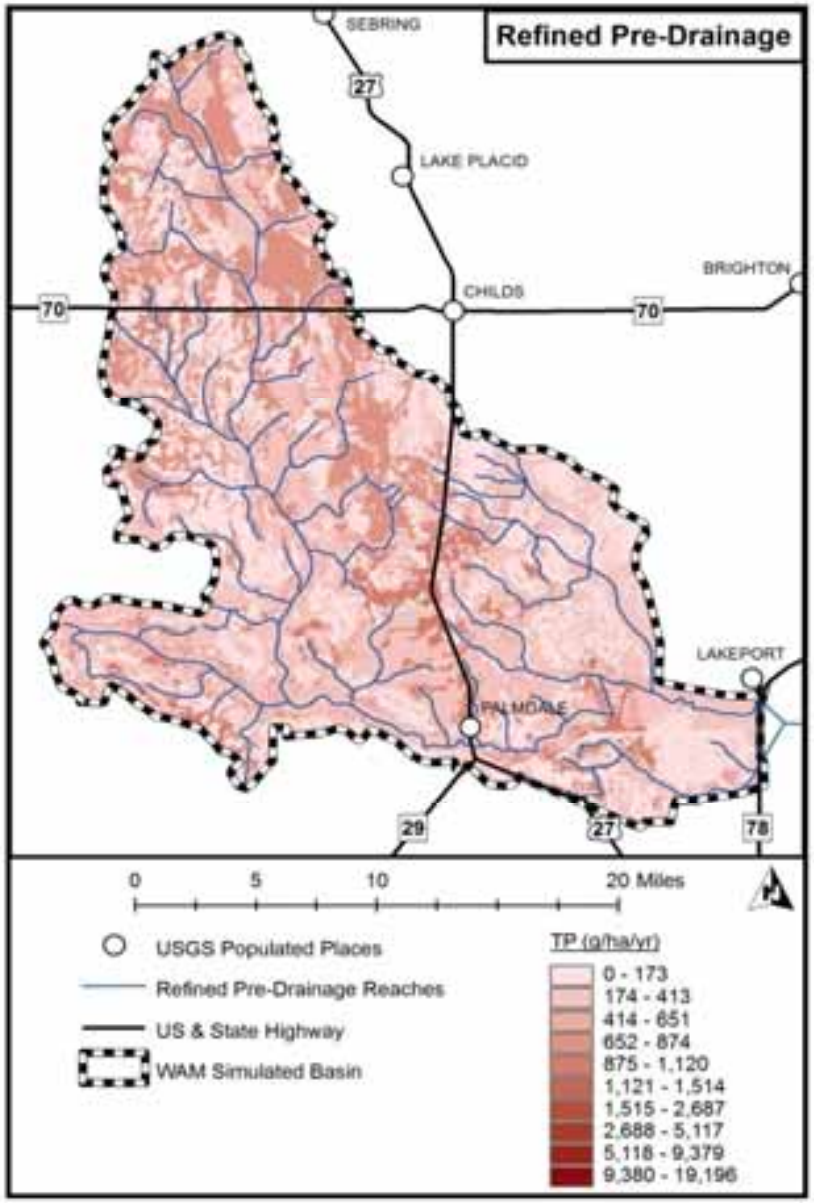


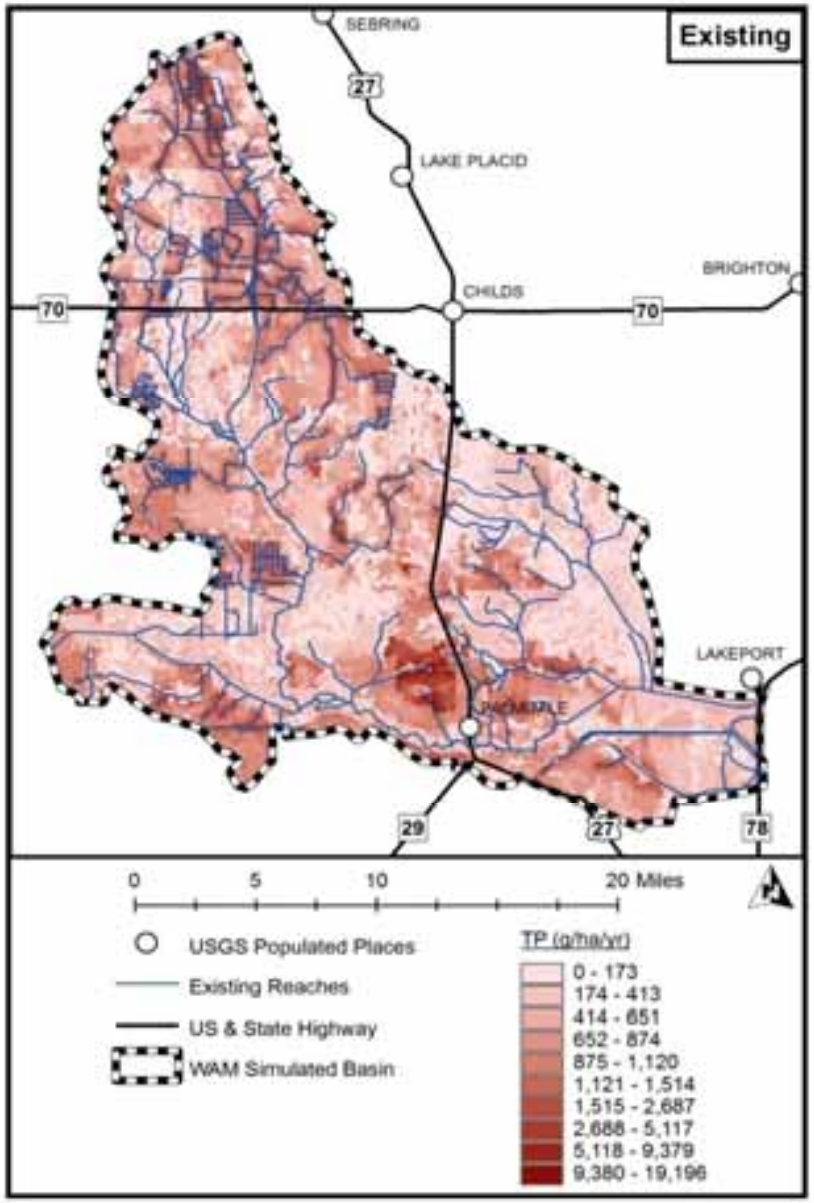
Pre-drainage vs. Existing Hydrography



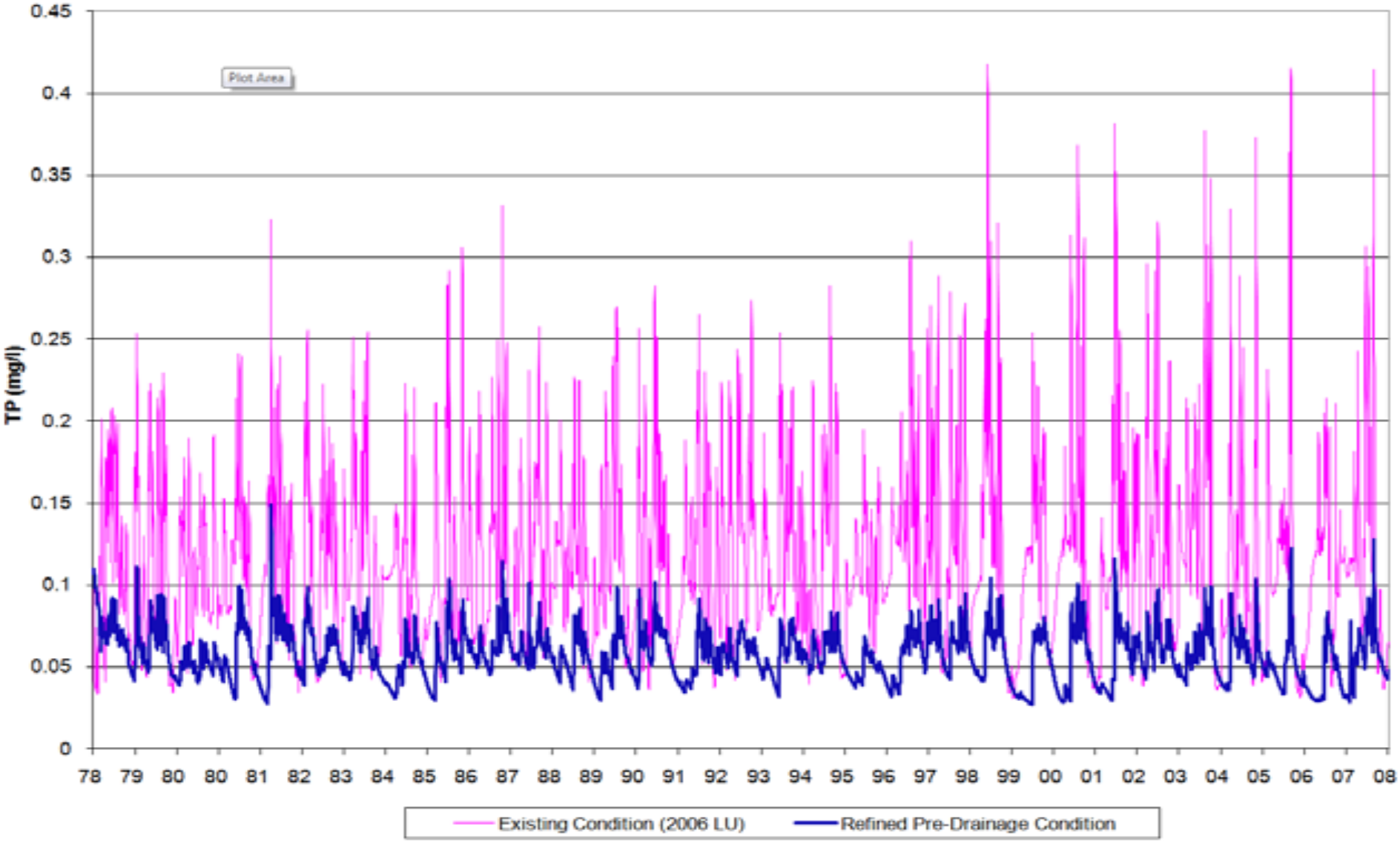


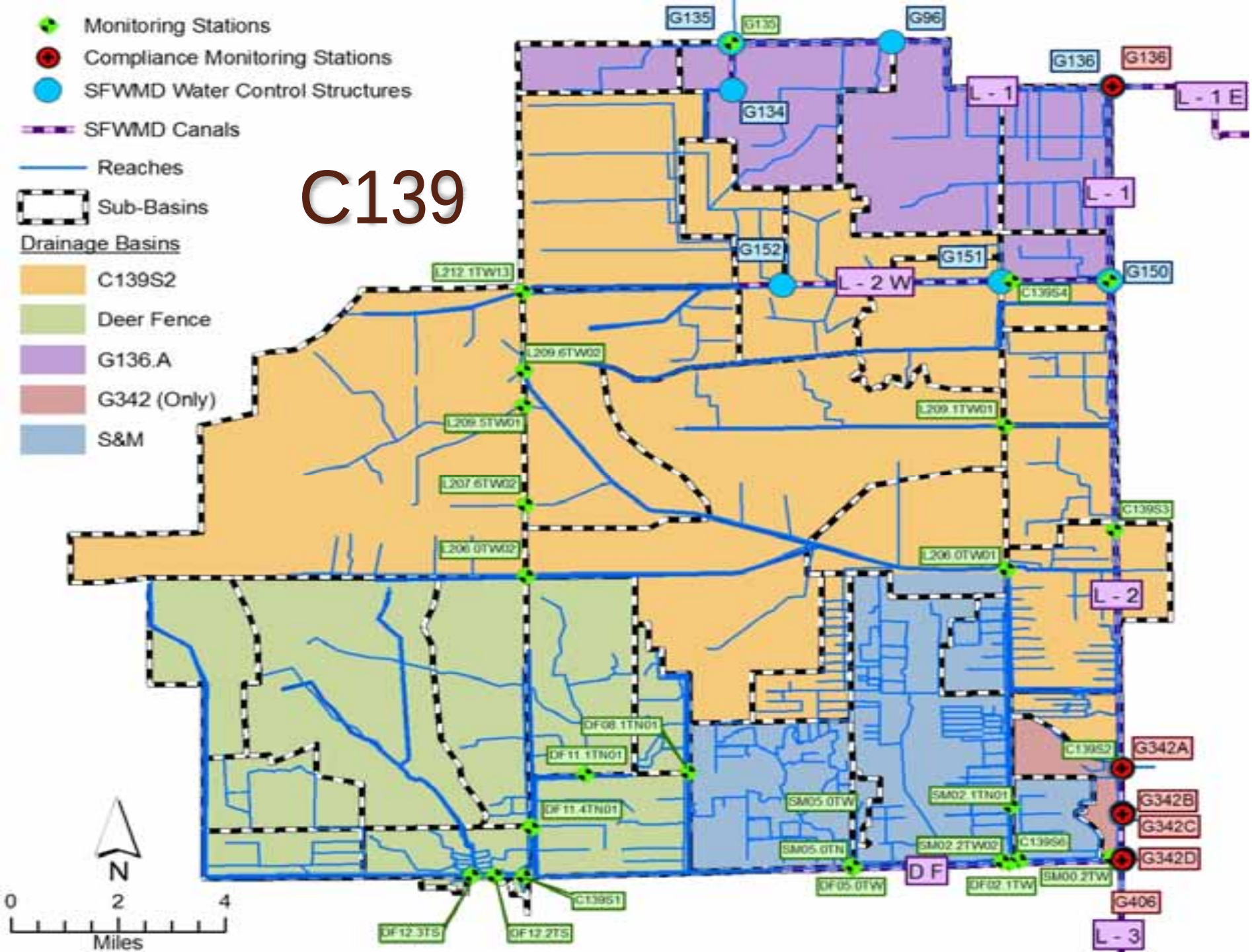
Pre-drainage vs. Existing TP Runoff



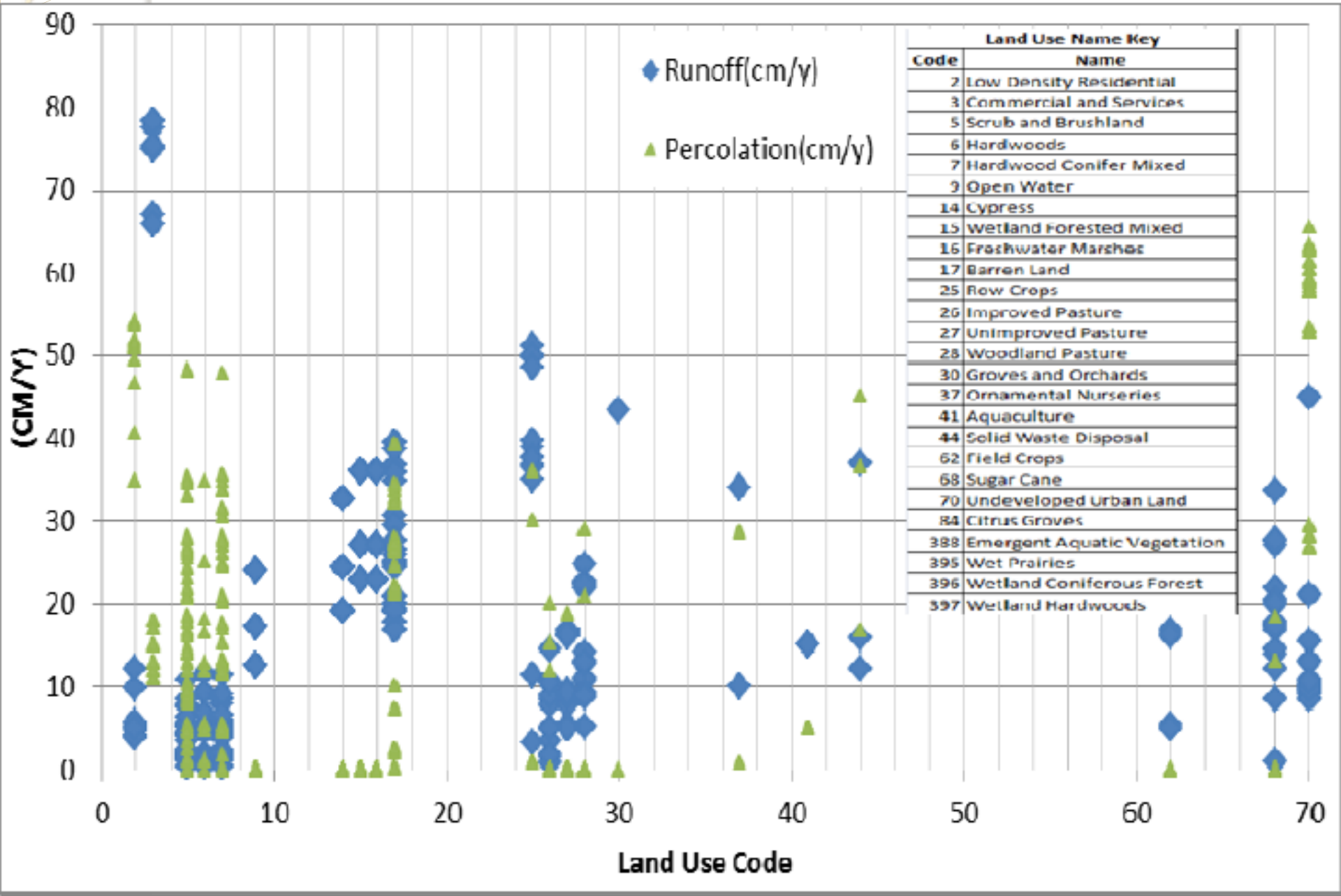


Fisheating Creek WAM Results

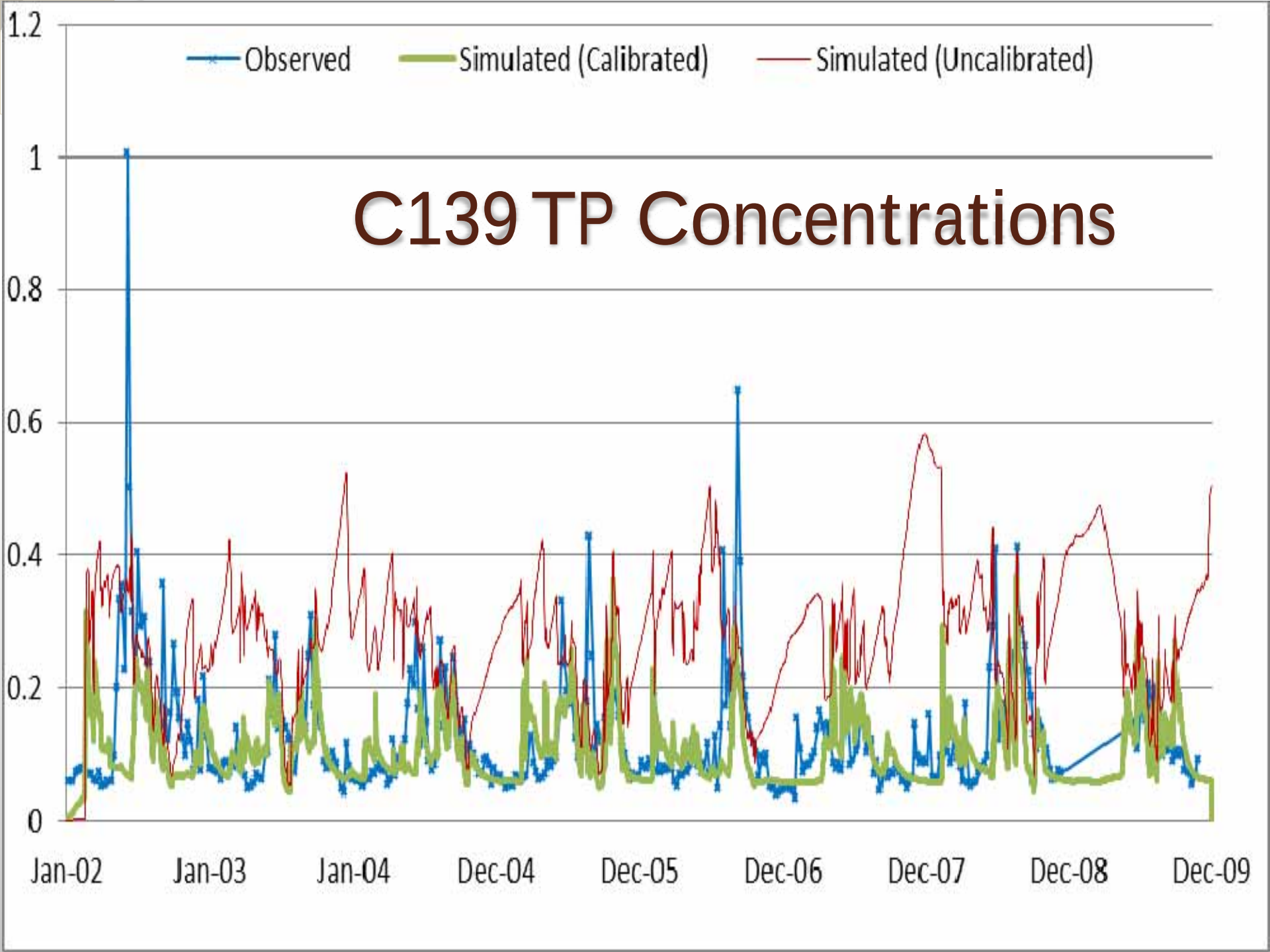



C139
Monitoring Stations
Compliance Monitoring Stations
SFWMD Water Control Structures
SFWMD Canals
Reaches
Sub-Basins
Drainage Basins
C139S2
Deer Fence
G136.A
G342 (Only)
S&M
G135
G130
G96
G136
G136
L - 1
L - 1 E
G134
L - 1
G152
G151
G150
L - 2 W
L212.1TW13
C139S4
L209.6TW02
L209.1TW01
L209.5TW01
L207.6TW02
C139S3
L206.0TW02
L206.0TW01
L - 2
DF08.1TN01
DF11.1TN01
C139S2
G342A
DF11.4TN01
SM05.0TW
SM02.1TN01
G342B
G342C
SM05.0TN
SM02.2TW02
C139S6
G342D
D F
DF05.0TW
DF02.1TW
SM00.2TW
G406
C139S1
DF12.3TS
DF12.2TS
L - 3
N
0
2
4
Miles

C139 Basin Field Model Results



Land Use Name Key	
Code	Name
2	Low Density Residential
3	Commercial and Services
5	Scrub and Brushland
6	Hardwoods
7	Hardwood Conifer Mixed
9	Open Water
14	Cypress
15	Wetland Forested Mixed
16	Freshwater Marshes
17	Barren Land
25	Row Crops
26	Improved Pasture
27	Unimproved Pasture
28	Woodland Pasture
30	Groves and Orchards
37	Ornamental Nurseries
41	Aquaculture
44	Solid Waste Disposal
62	Field Crops
68	Sugar Cane
70	Undeveloped Urban Land
84	Citrus Groves
388	Emergent Aquatic Vegetation
395	Wet Prairies
396	Wetland Coniferous Forest
397	Wetland Hardwoods


C139 TP Concentrations
Observed
Simulated (Calibrated)
Simulated (Uncalibrated)
1.2
1
0.8
0.6
0.4
0.2
0
Jan-02
Jan-03
Jan-04
Dec-04
Dec-05
Dec-06
Dec-07
Dec-08
Dec-09

Summary and Conclusions

- Florida is highly impacted by humans
- Modeling of anthropogenic impacts can
  - Identify and quantify sources
  - Quantify changes – what did it used to be like? or
    "How can we know where we are going, if we don't know where we came from?"
  - Evaluate alternative abatement scenarios
- Educate stakeholders for better decision making

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