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Integrated Northern Tampa Bay Hydrologic Model: Overview of Conceptual Basis

Consolidated Wellfield

Water Use Permit

Pre-Application Meeting

June 3, 2008

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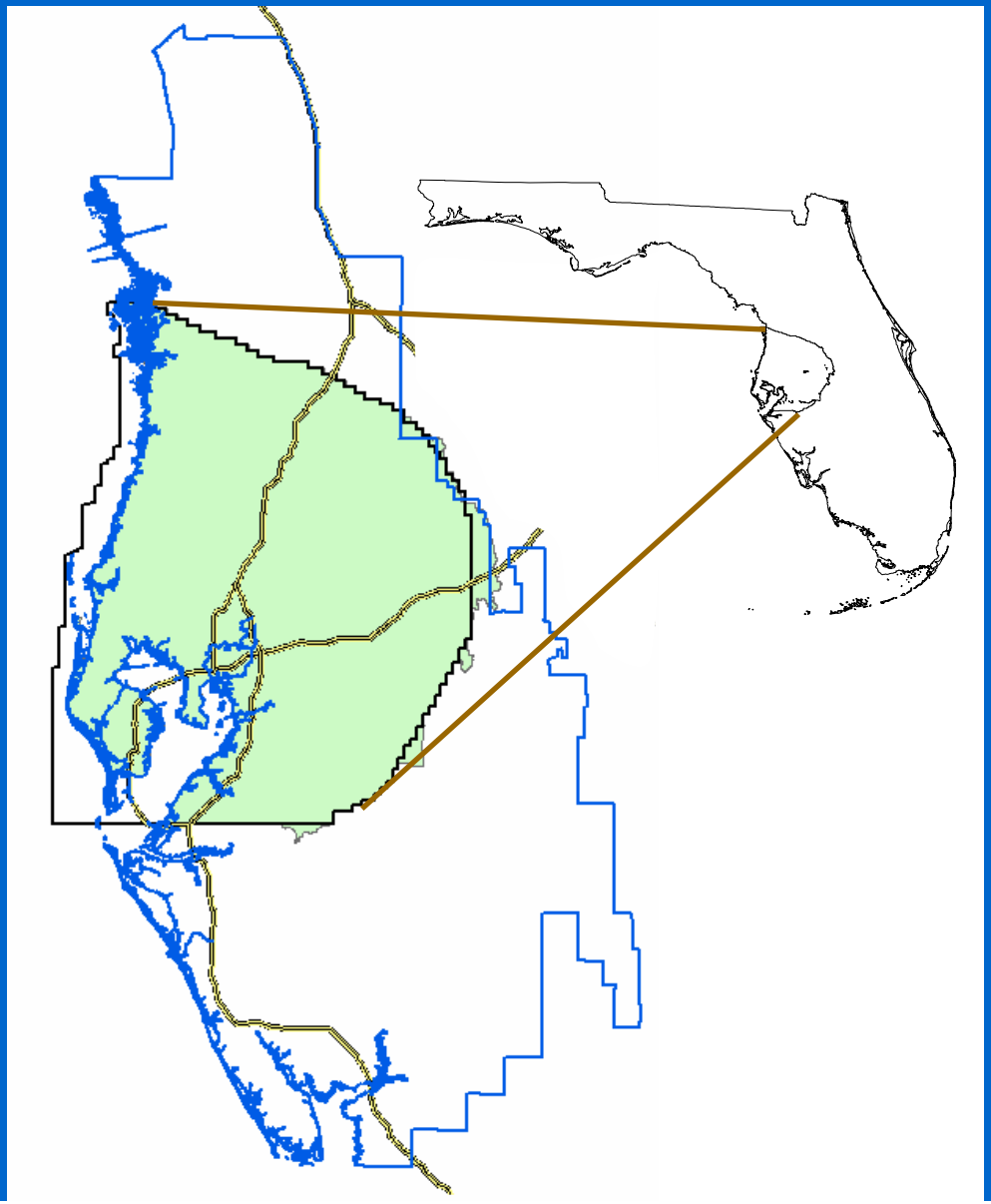
Integrated Northern Tampa Bay Model Domain Extent 4,000 sqmi or 10,000 sqkm



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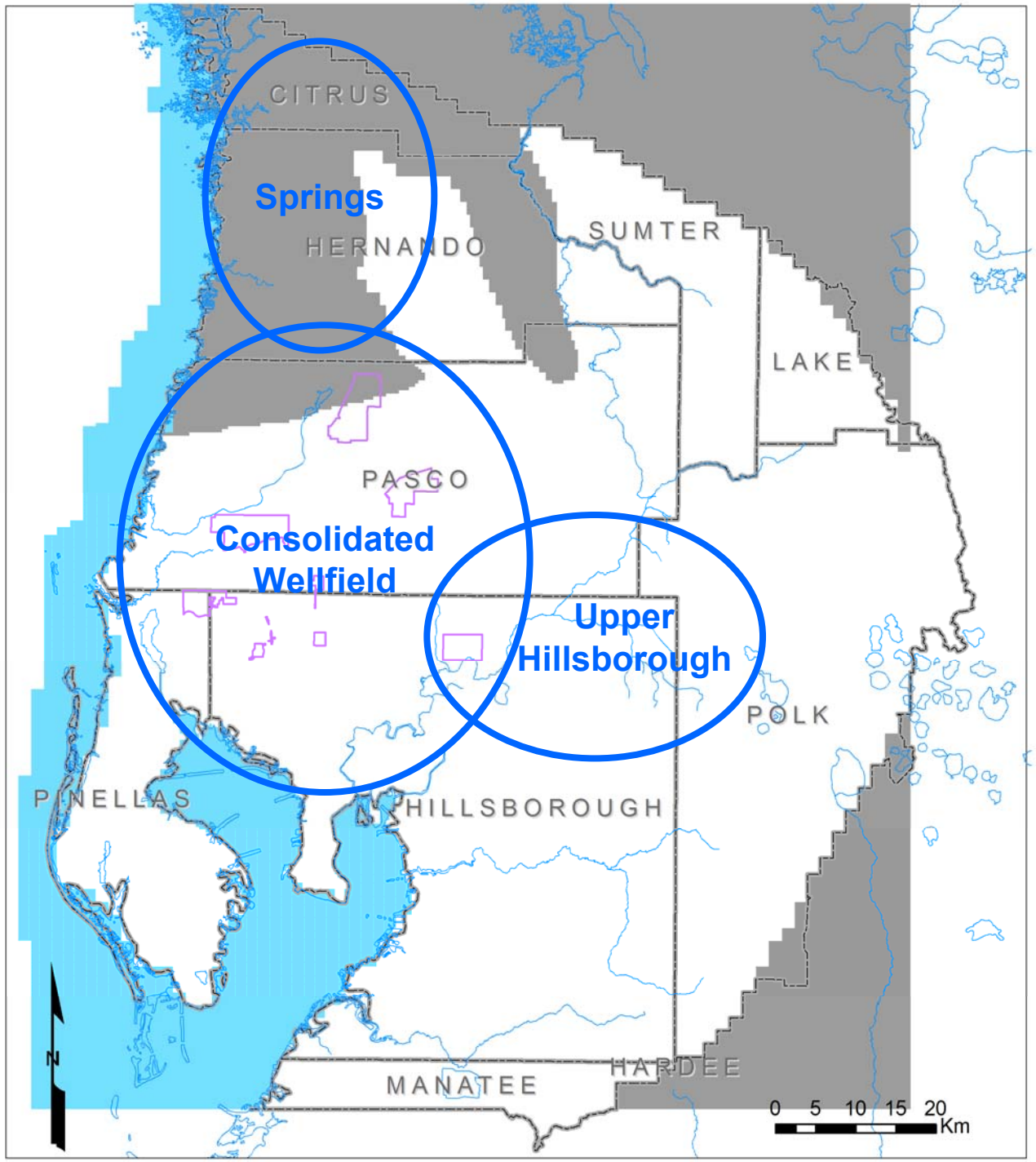
Model Domain and Near-Term Focus Regions



Integrated Northern Tampa Bay Model General Characteristics of Region

- Interdependent surface/groundwater processes
- Near-surface (0-2 m) depth to water table (>50% of area)
- Land Cover: water/wetlands (25%), grass/pasture (25%), urban (22%), forested (15%)
- Rainfall: 52 inches/year with annual range of 50 inches
- Evapotranspiration: 70% of average annual rainfall
- Streamflow: 5 to 15 inches/year
- Three-layer ground-water system
- Surficial: surface, unconsolidated, serves as reservoir
- Intermediate: confining unit transitions to aquifer
- Floridan: carbonate, semi-confined, unconfined in north

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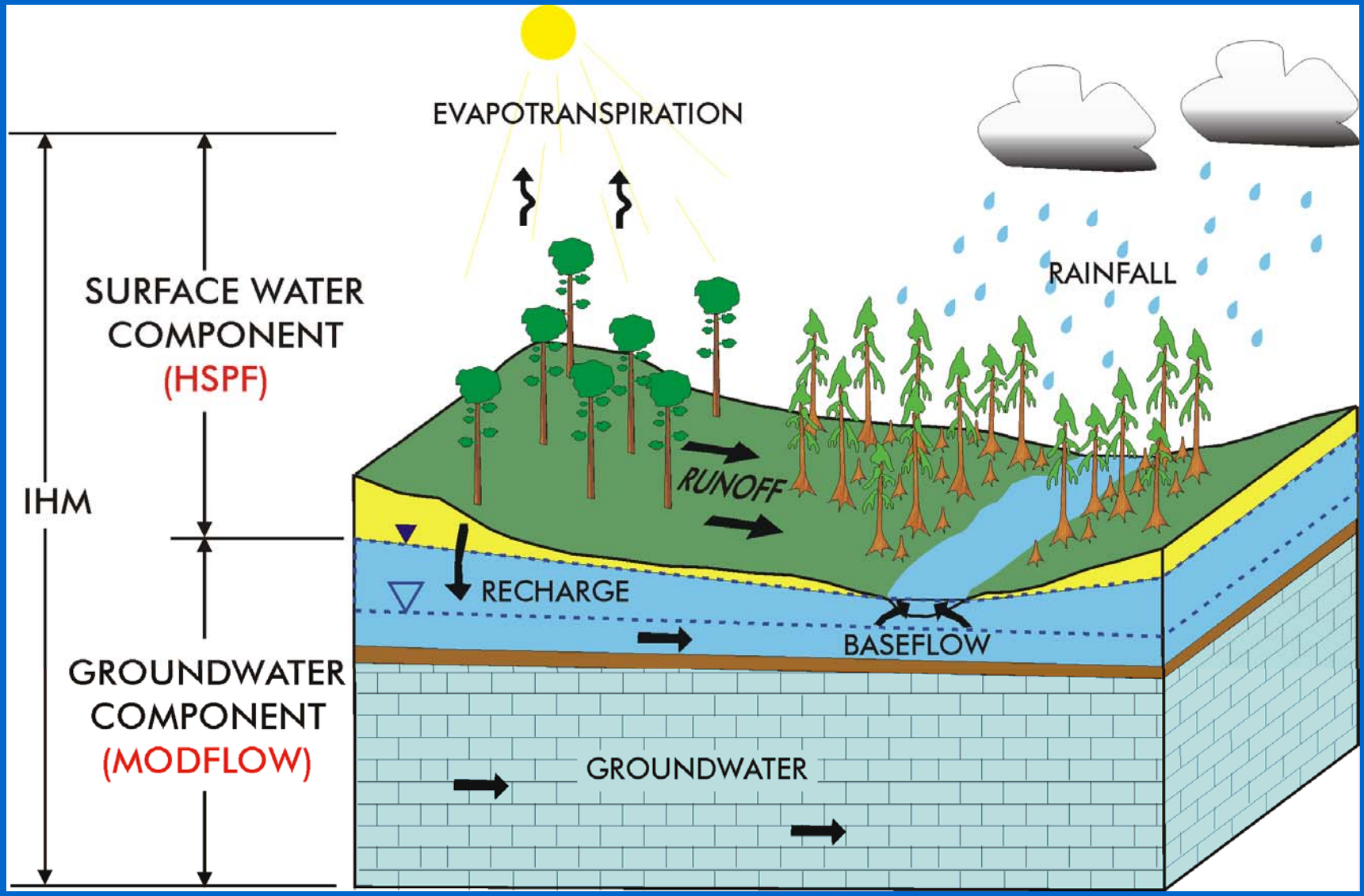
Integrated Hydrologic Model (IHM) Component Model Domains



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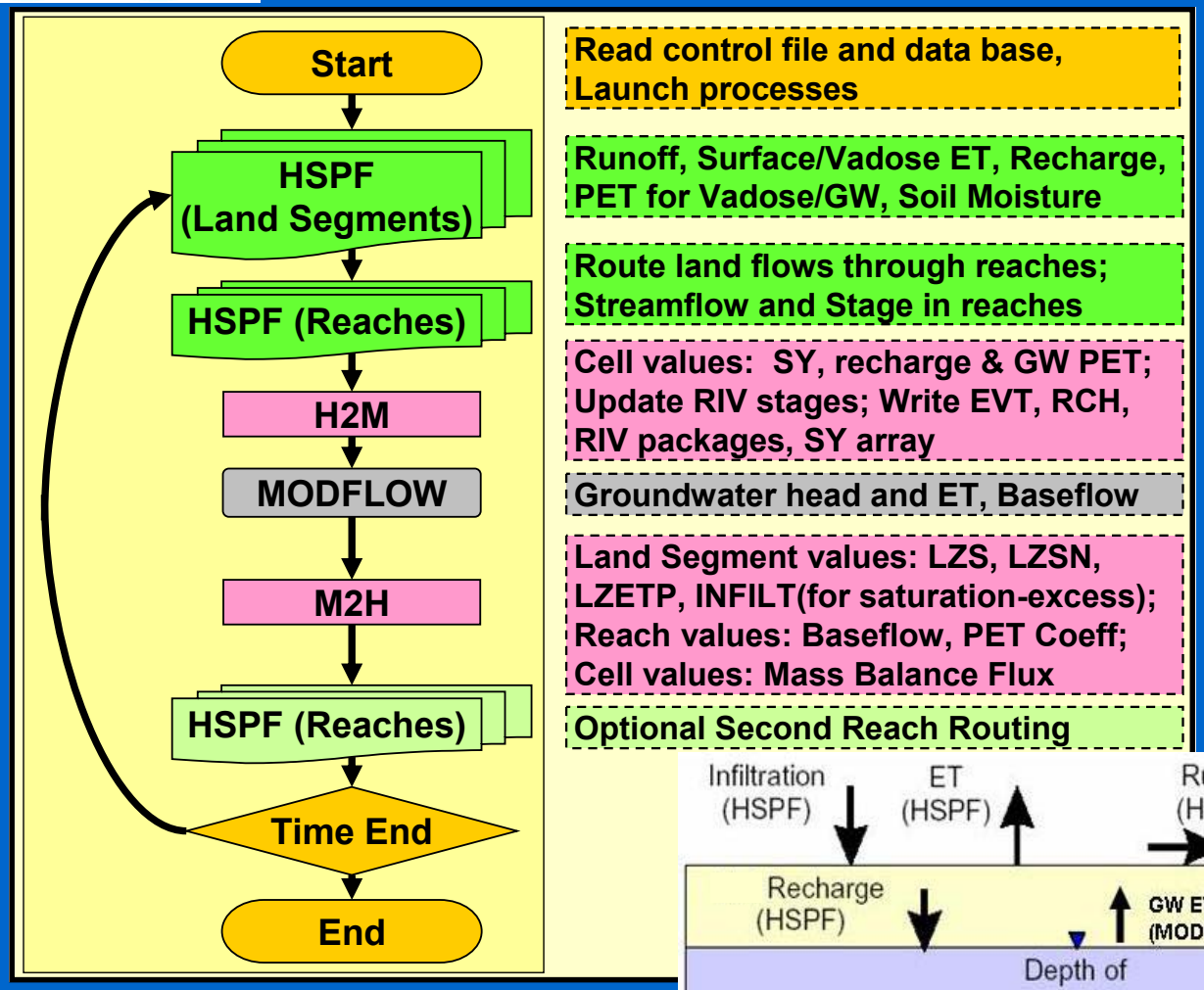
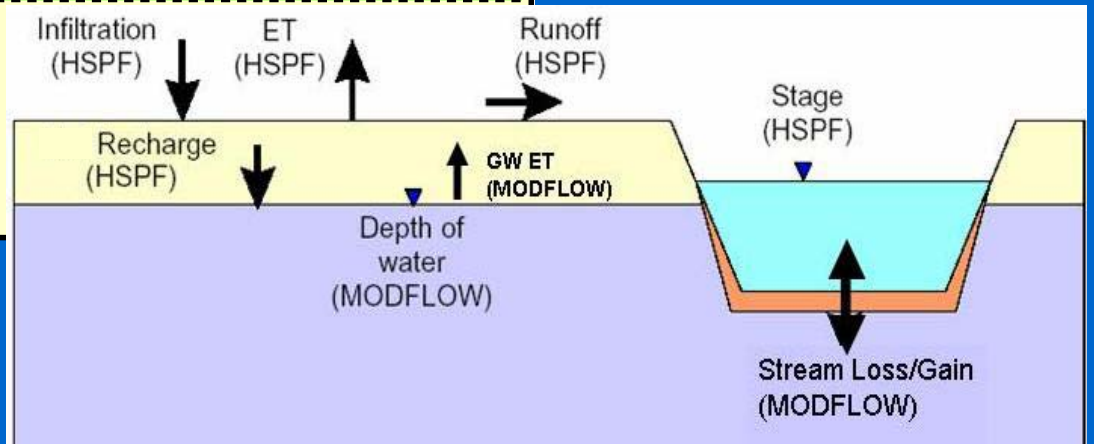
IHM Simulation Sequence





Integrated Northern Tampa Bay Model Conceptual Basis

- **Surface Water**
  - Rainfall and Evapotranspiration (ET) Stressors
  - Land use, Water, and Wetlands
  - Soils and Depth to Water Table
  - Streamflow Variability
  - Other Surface Stressors (Irrigation and Diversions)
  - Discretization
- **Ground Water**
  - Hydrogeology
  - Flow Hydraulics and Fluxes
  - Ground-water Pumping
  - Discretization and Boundary Conditions

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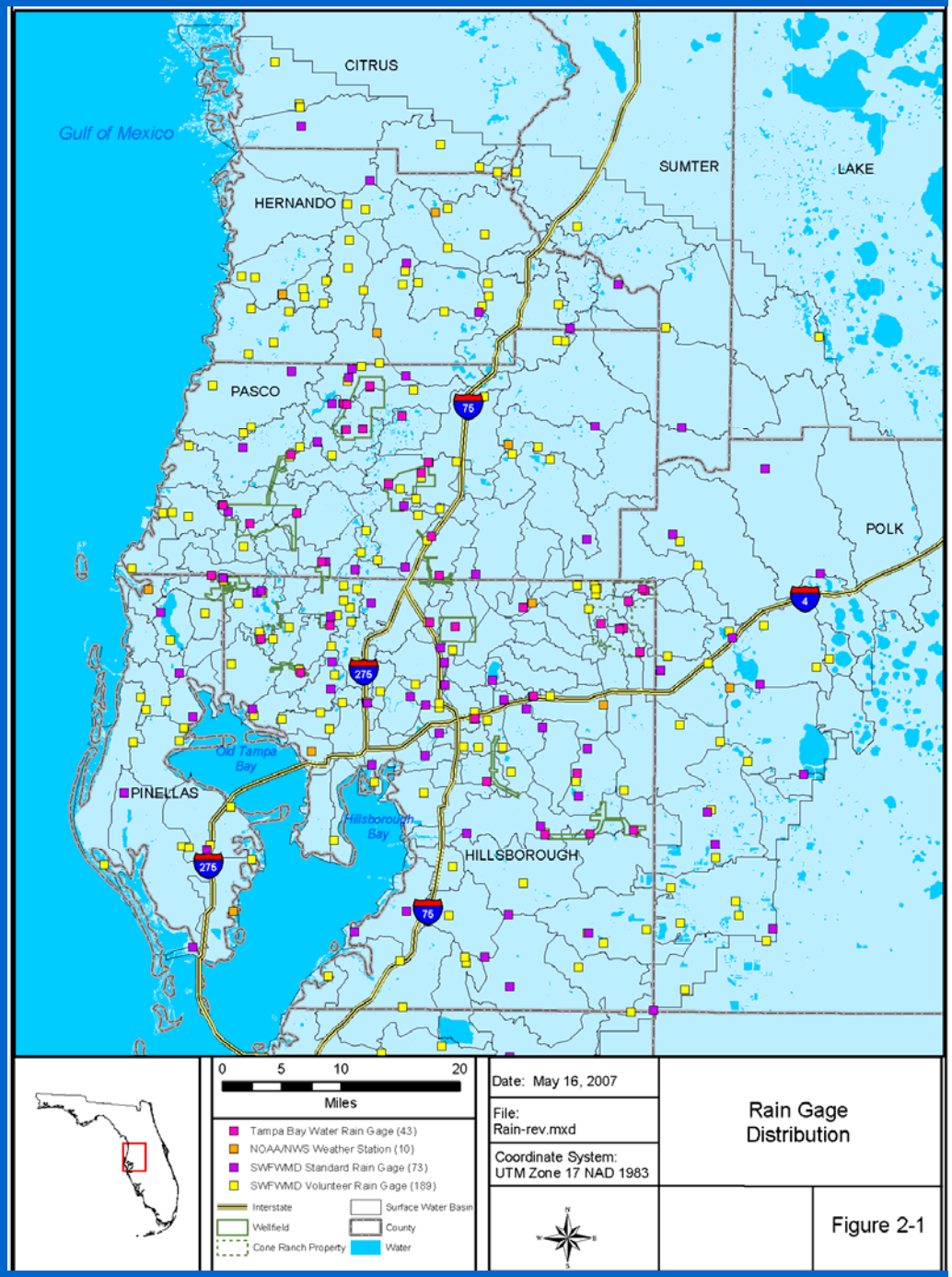
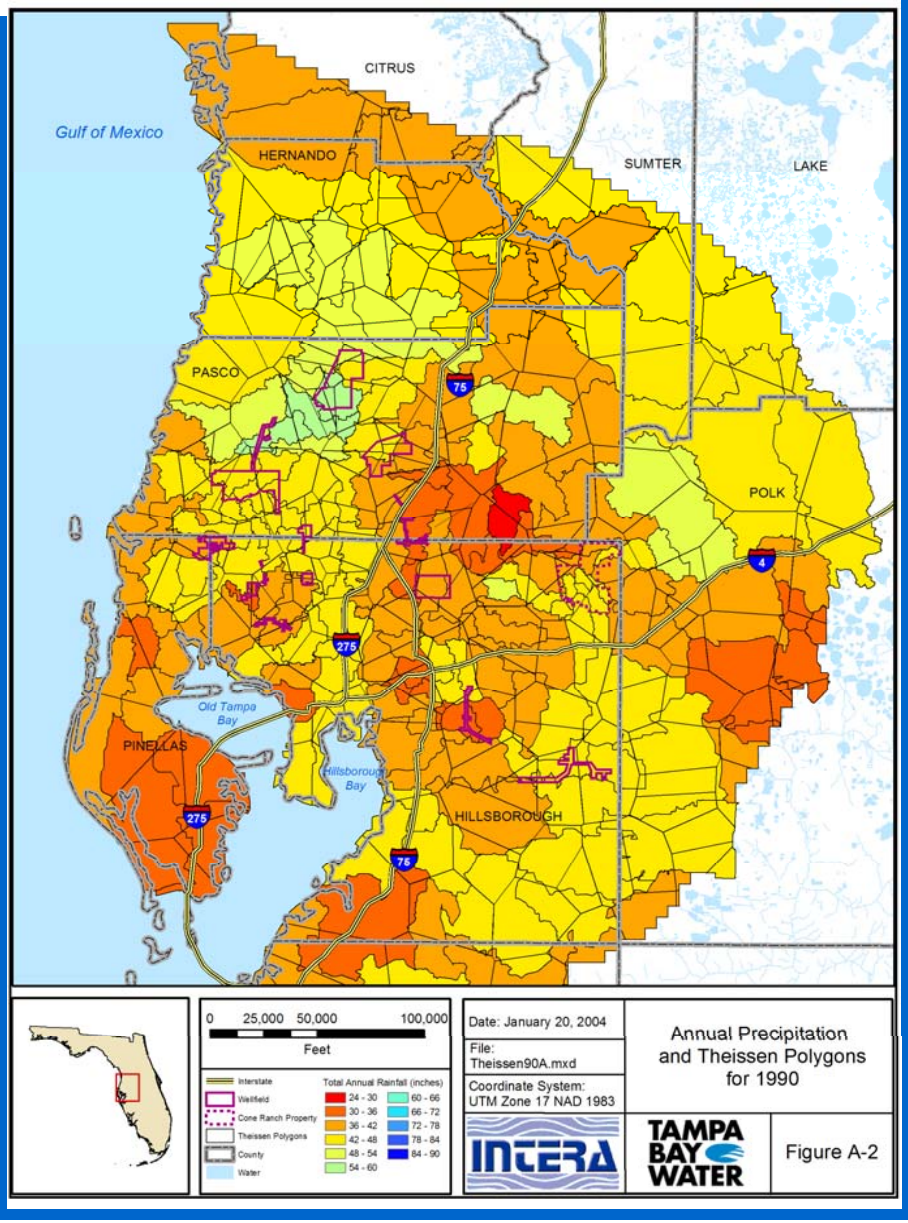
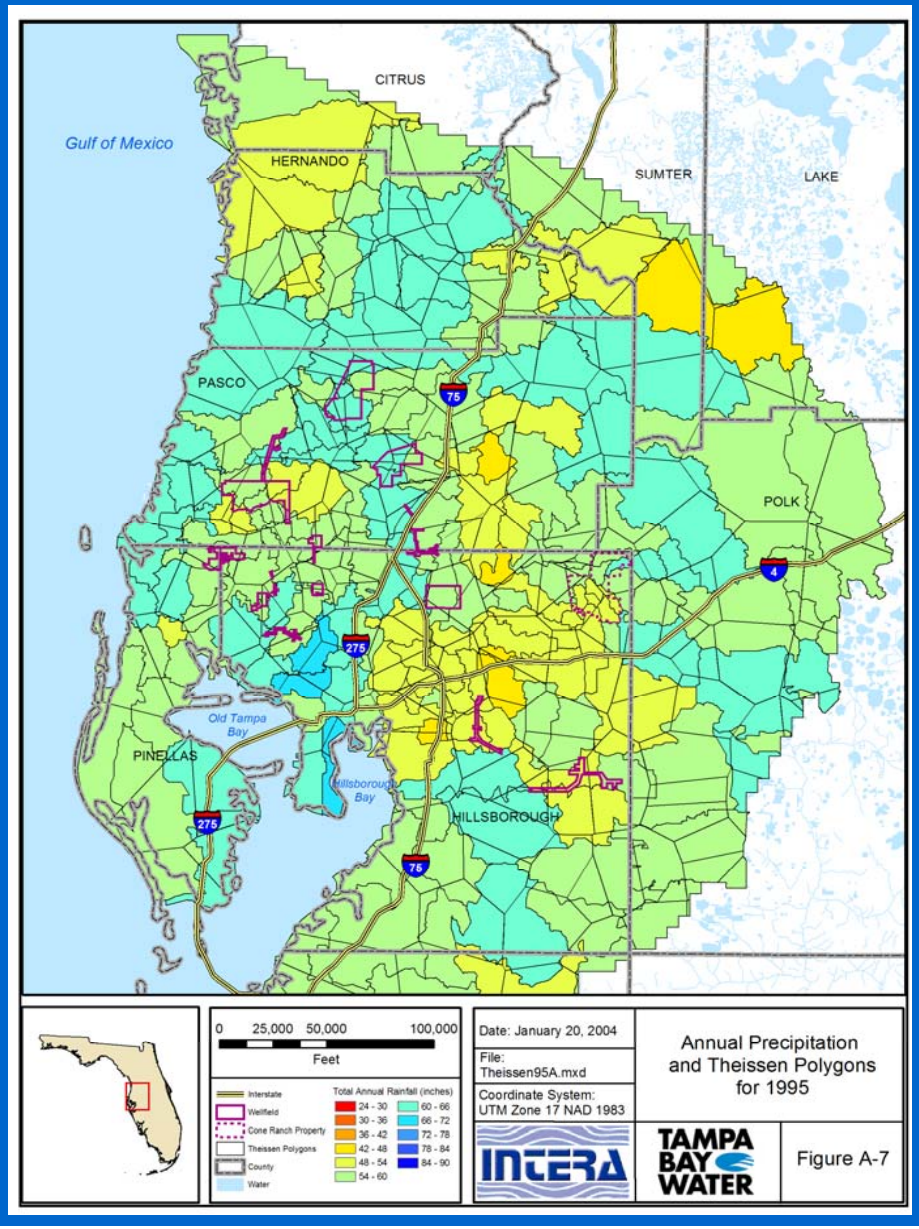
Rainfall

- Annual avg. 52 in.
- Annual range 30 to 80 in.
- Convective summer storms contribute majority of rainfall
- Frontal winter storms
- Station density captures volume (300 stations)
- Temporal distribution by 15-minute frequency



Rainfall Distribution by Annual Thiessen Spatial Variability at Annual Scale





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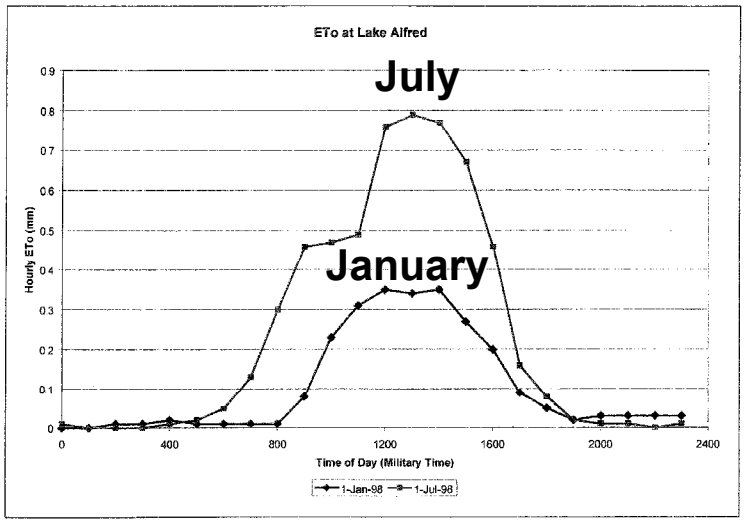
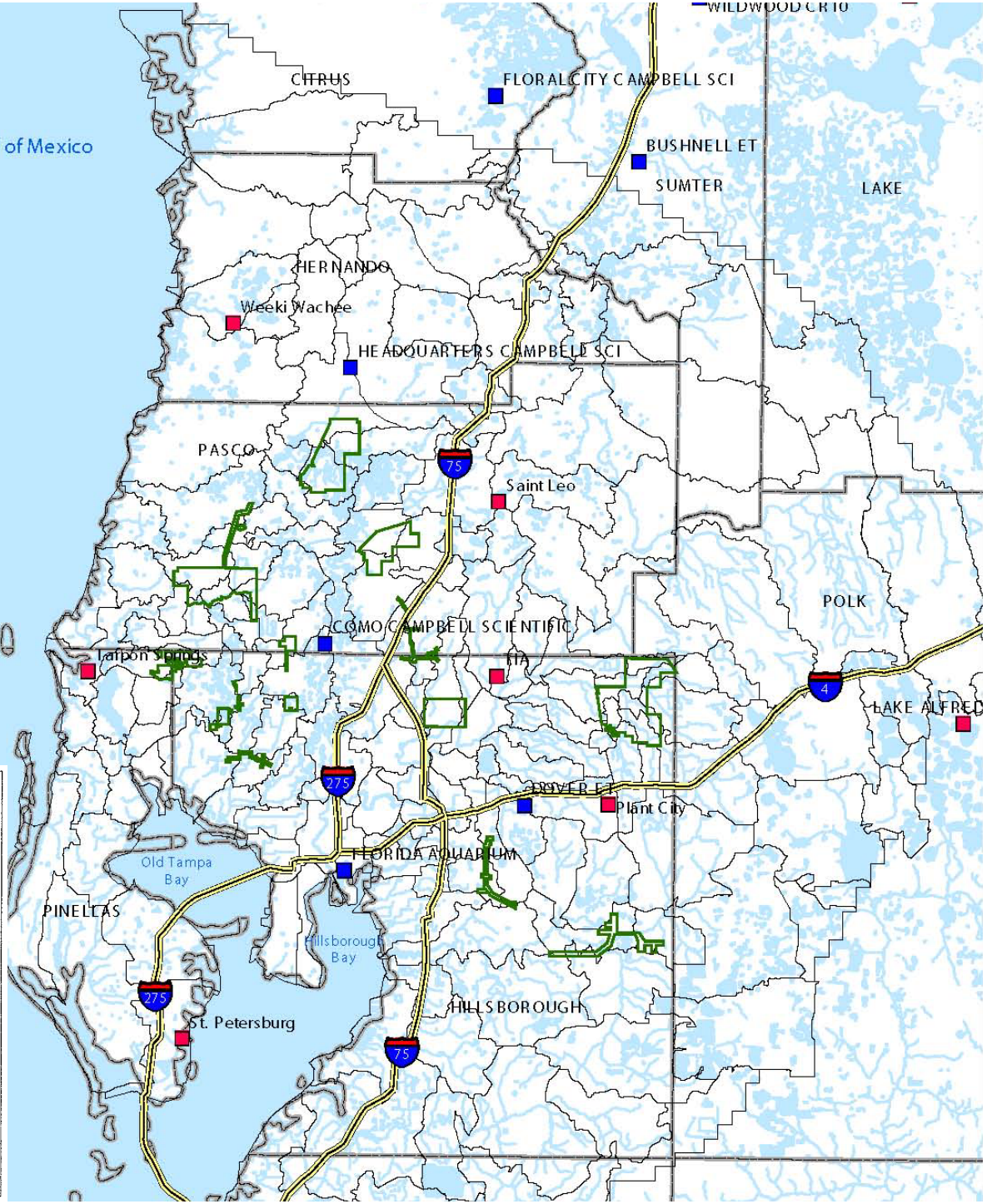
Reference ET

- **Small annual variability**
- **Large seasonal variability**
- **Hargreaves reference ET**





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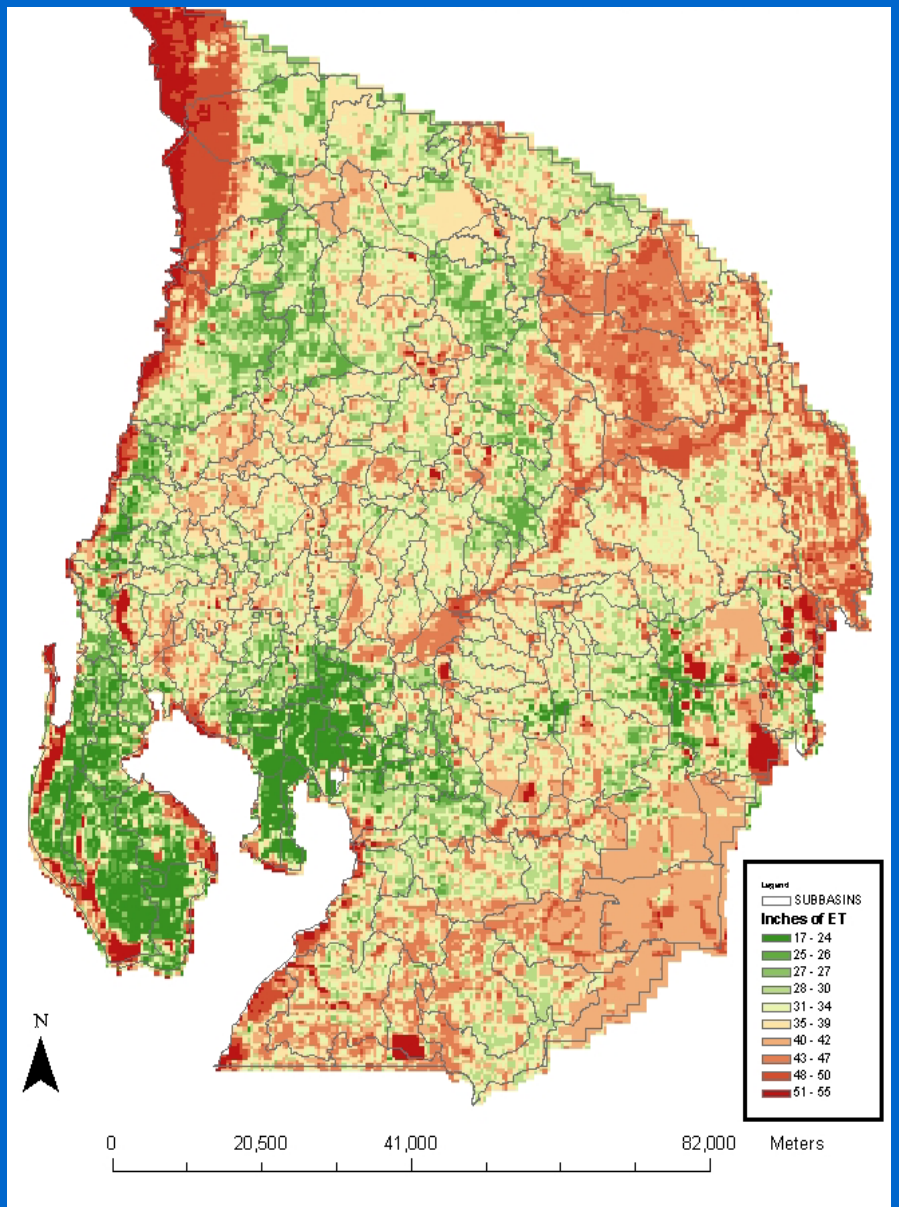
Actual Evapotranspiration

- **Model domain**
  - Average annual 37 inches
  - 70% of avg. annual rainfall
  - ⅓ of ET at water/wetlands
- **Land use/cover and depth to water table**
- **Varies from 15 to 55 in/yr**
- **Lake/wetland density**
- **Influences recharge and runoff**
- **Need distinct simulation units**



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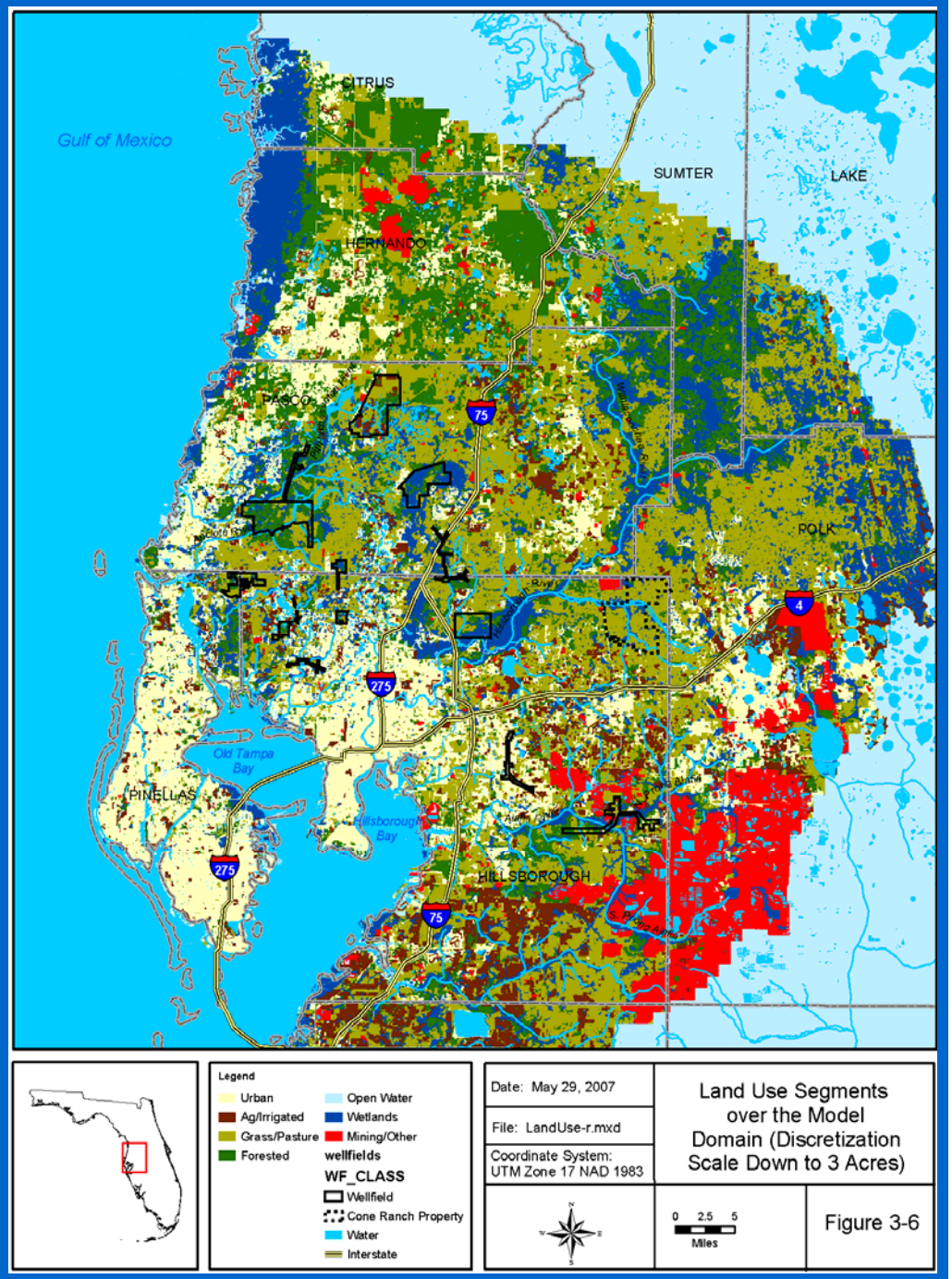
Diverse Land Use

- **Water/wetlands 25%**
  Grass/pasture 25%
  Urban 22%
  Forested 15%
  Other 13%
- **Imperviousness**
- **Hydrologic Response Units (HRU) – similarity groups**
- **Discrete vs Average Parameterization**



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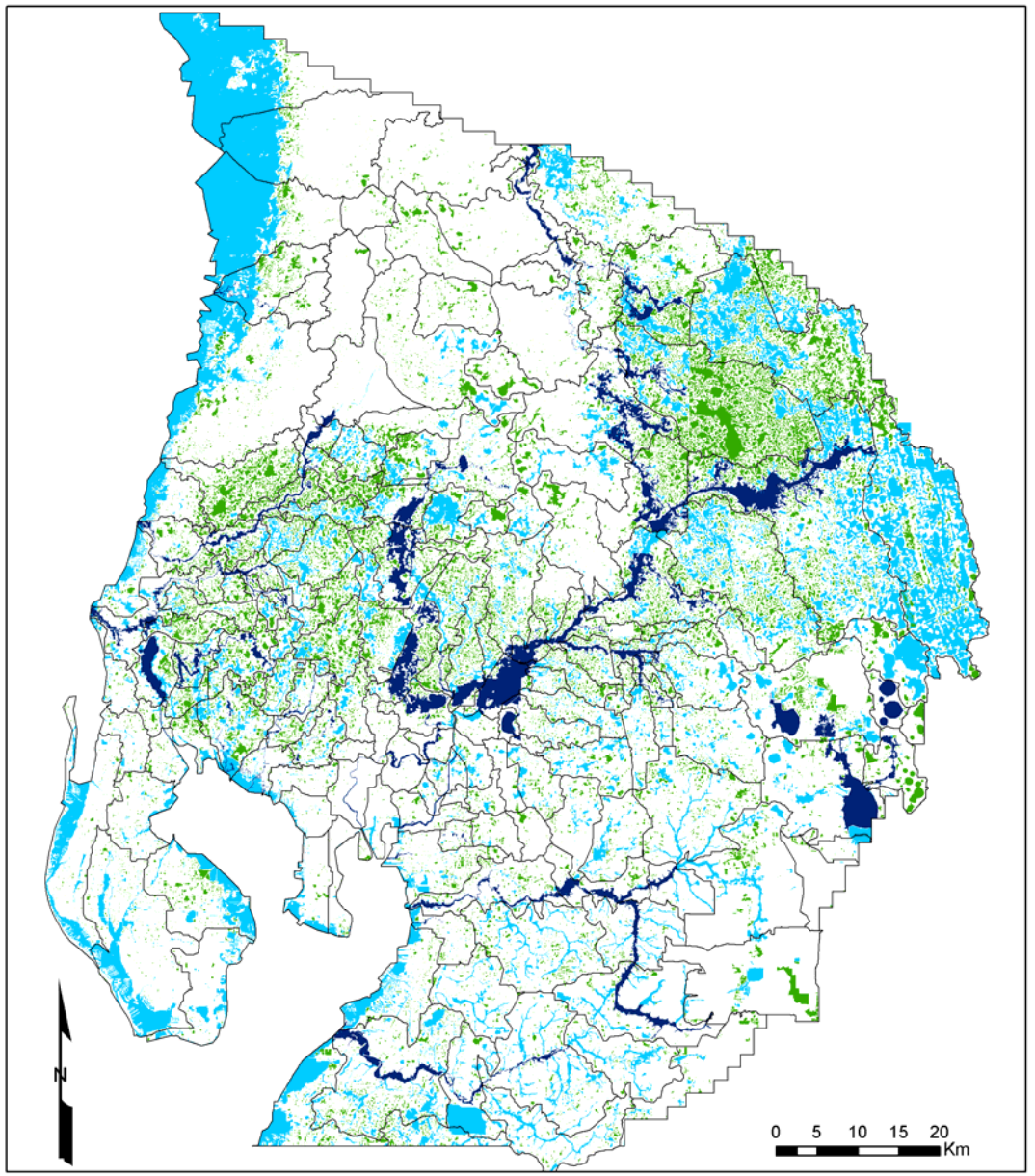
Water and Wetlands

- 25% of model domain
- Storage volume to attenuate and store runoff & baseflow
- Connectedness for discharge timing
- Direct rain and ET
- ET decreases with decreasing water depth
- Interaction (gain/loss) with groundwater



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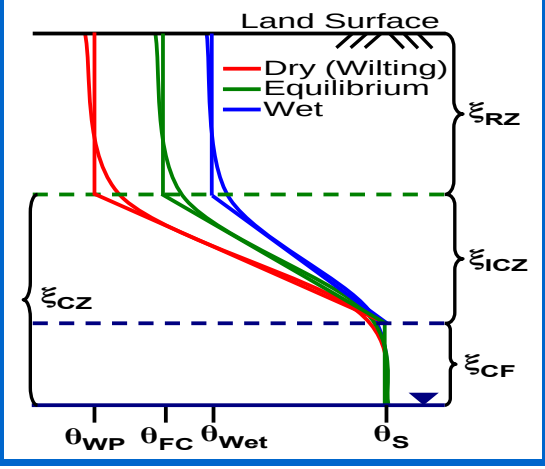
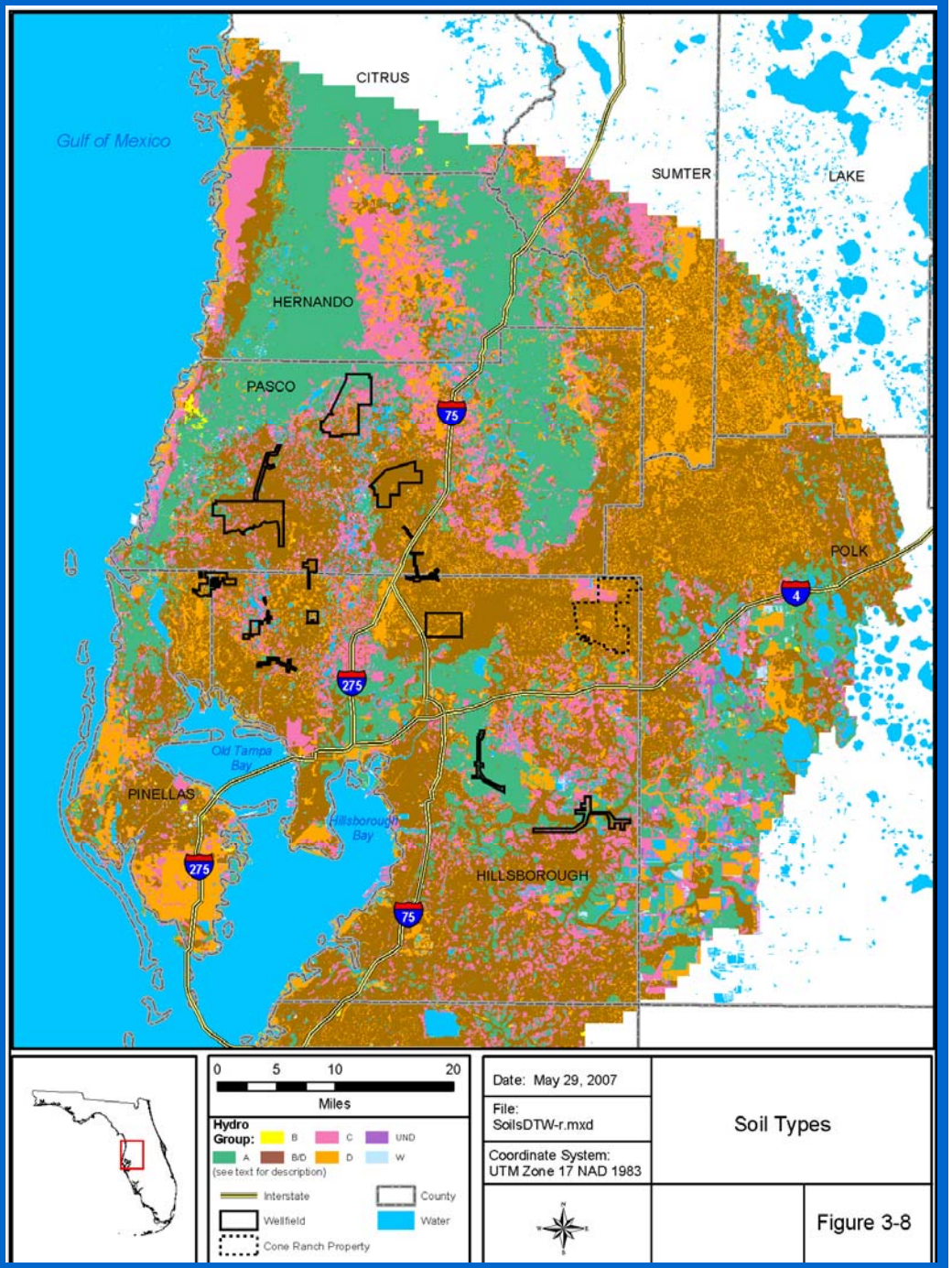
Soil Properties

- Sand, silt, clay, organic matter
- Vadose zone storage
- Specific yield storage for surficial aquifer
- Antecedent moisture
- Capillary rise above water table (2-3 feet)





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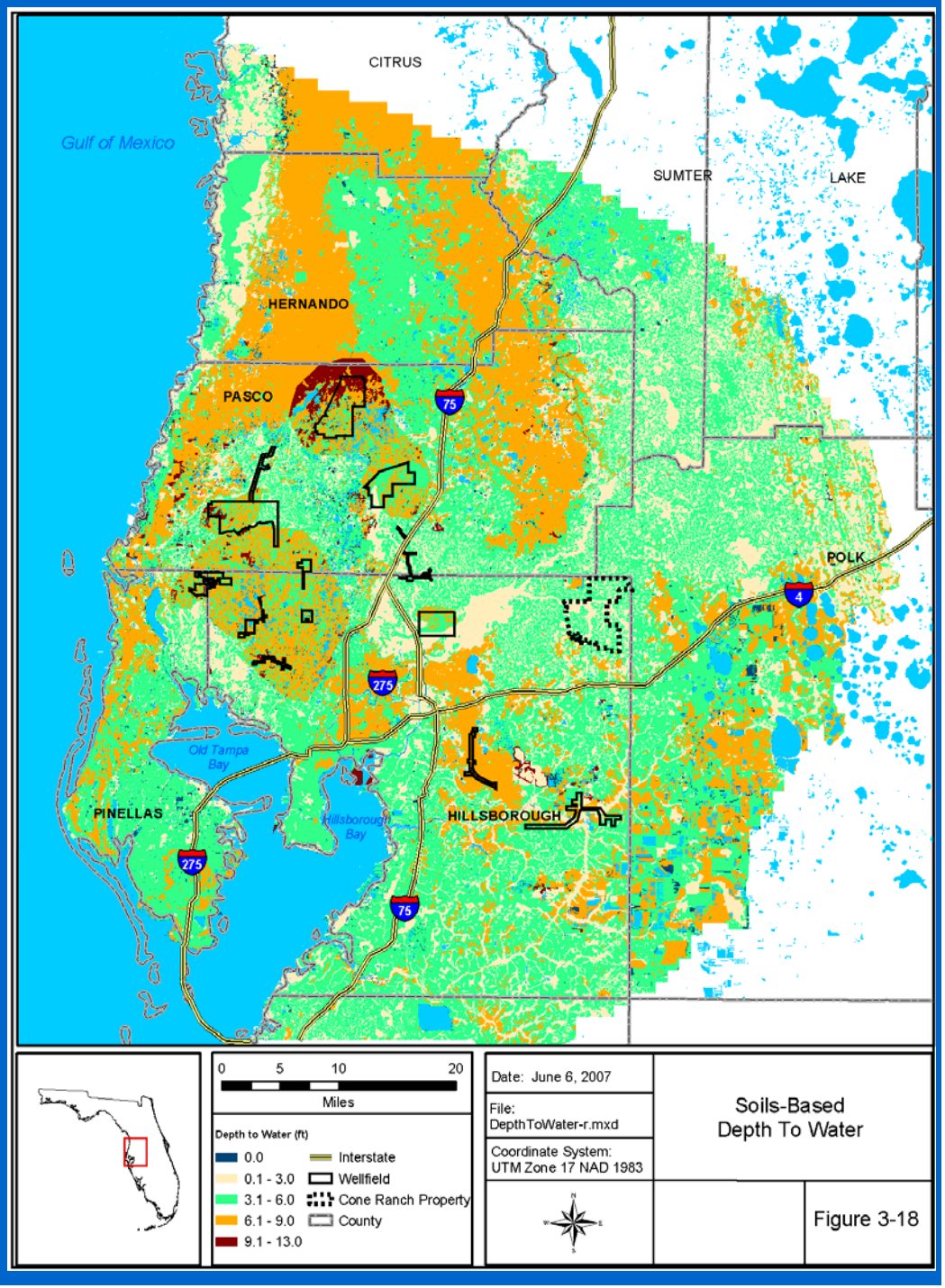
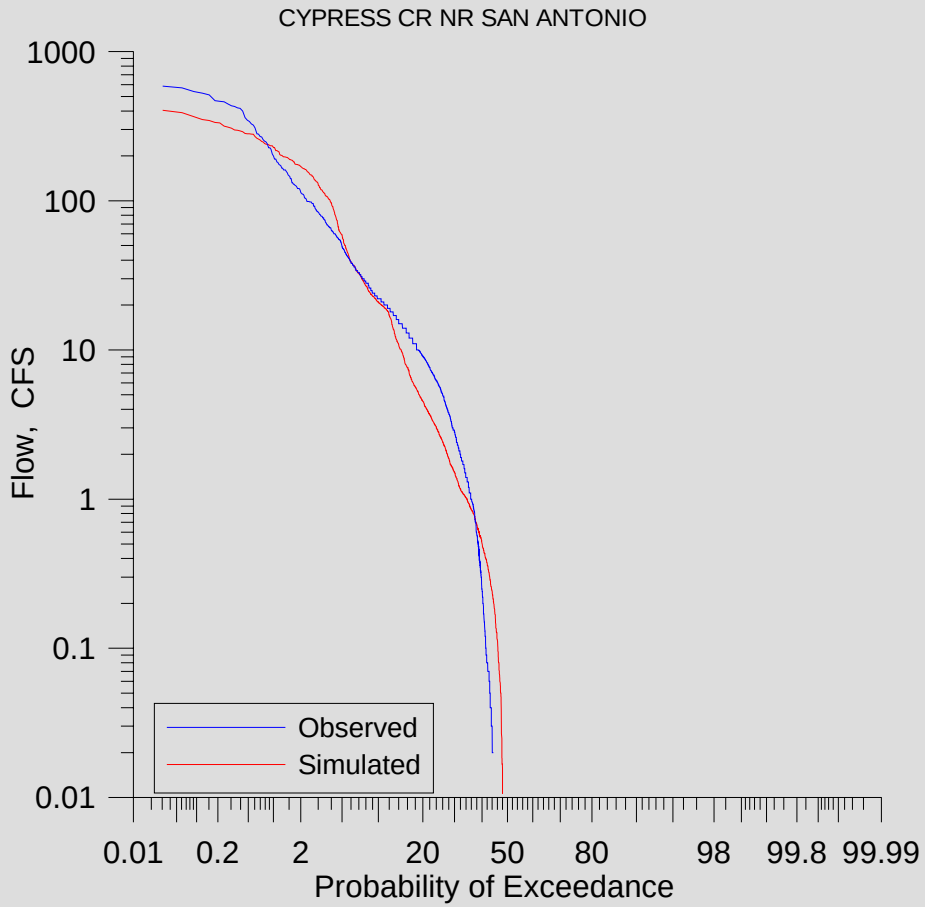
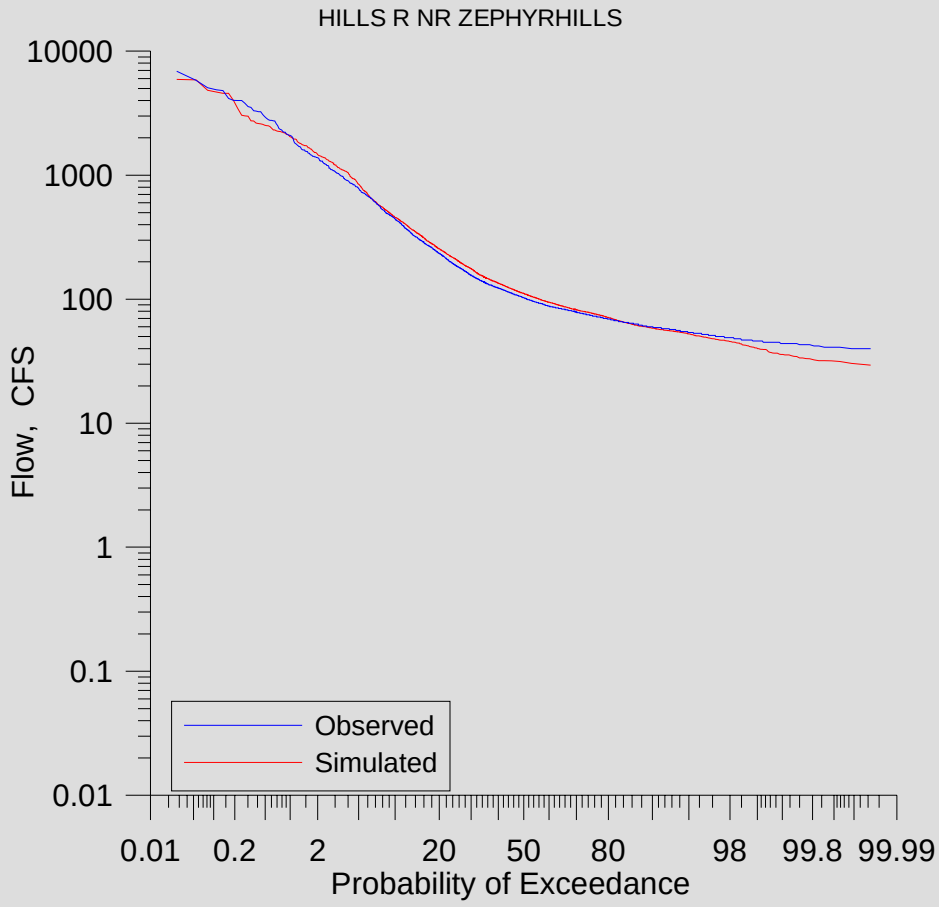
Soil-Based Depth to Water Table

- Depth Above Land
  0-2 m frequent
  2-3 m occasional
  >3 m seldom
- Near-surface (0-2 m) covers >50% of area
- Basin delineation
- Hydrologic Response Unit
- Target ET



Streamflow Variability
Frequency of High, Low, and No Flow





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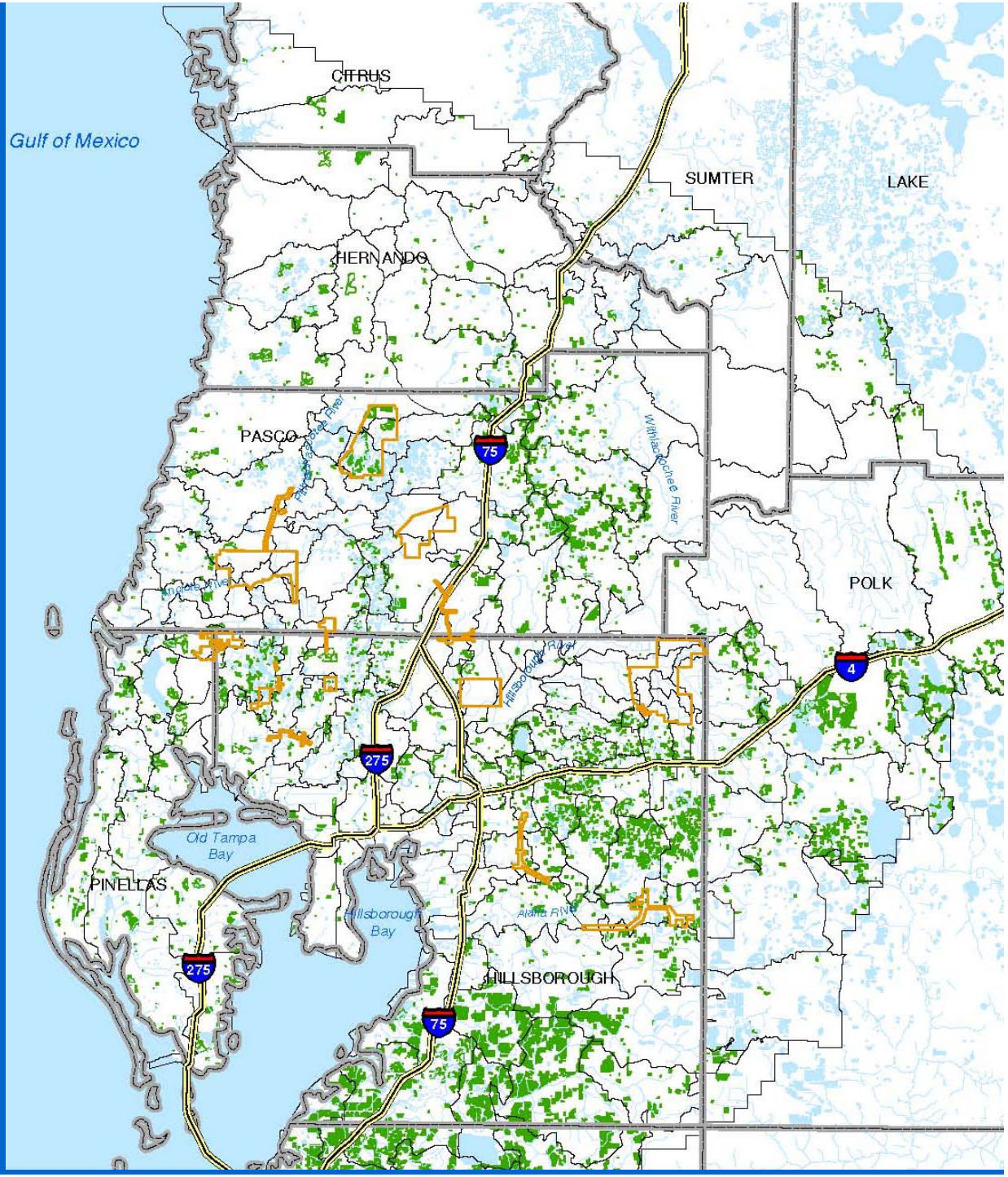
Irrigated Lands

- **Where: FLUCCS**
- **Volume: 4500 irrigation wells**
- **Flux application:**
  - **Above canopy**
  - **Land surface**
- **Not included:**
  - **Residential**
  - **Reclaimed**



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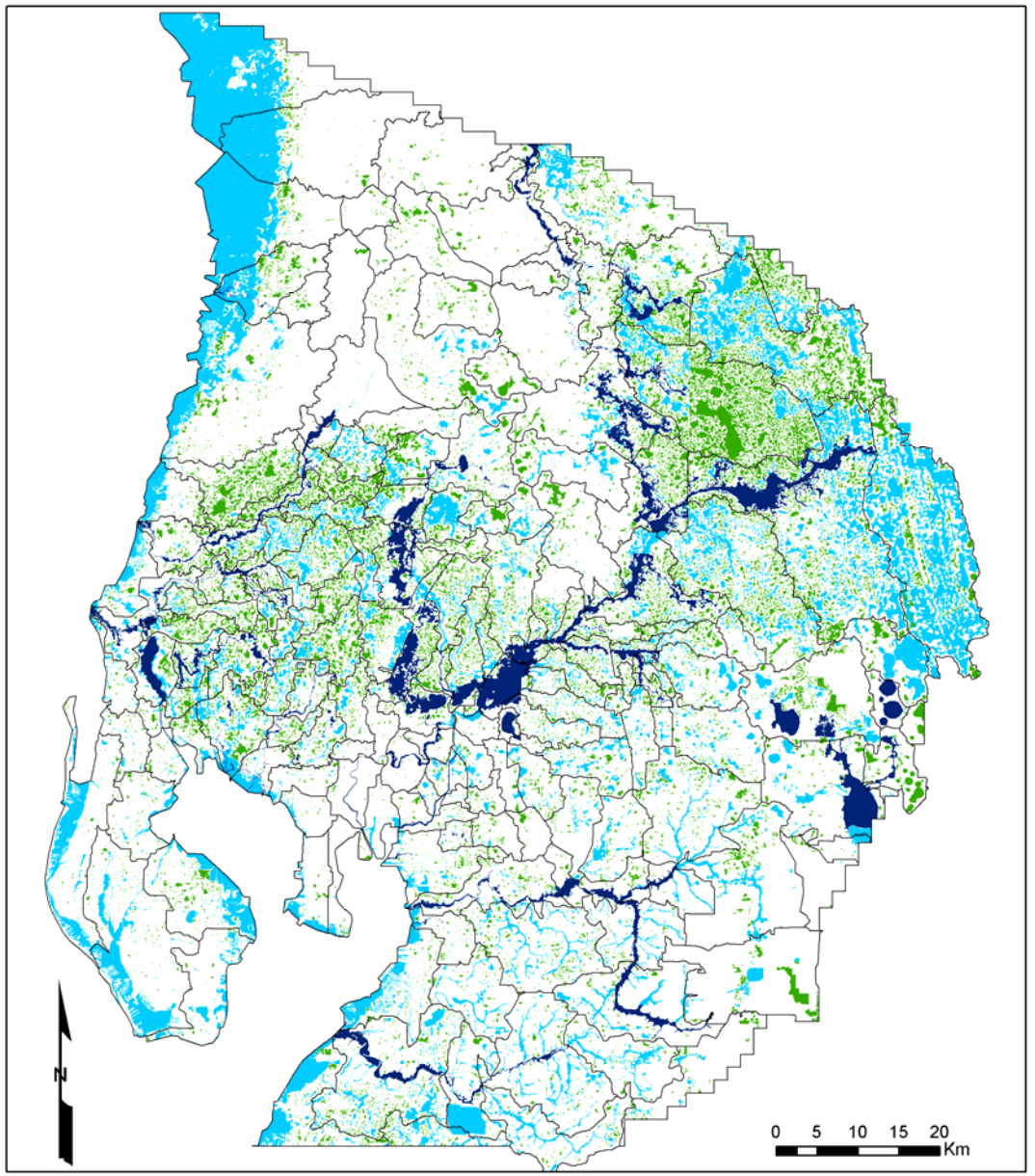
HSPF Discretization

- **Land**
  - 172 Basins
  - Up to 5 land segments per basin
  - 815 land segments
- **Water/Wetlands**
  - 409 Reaches

Cond-conn	172
Connected	163
Routing	74



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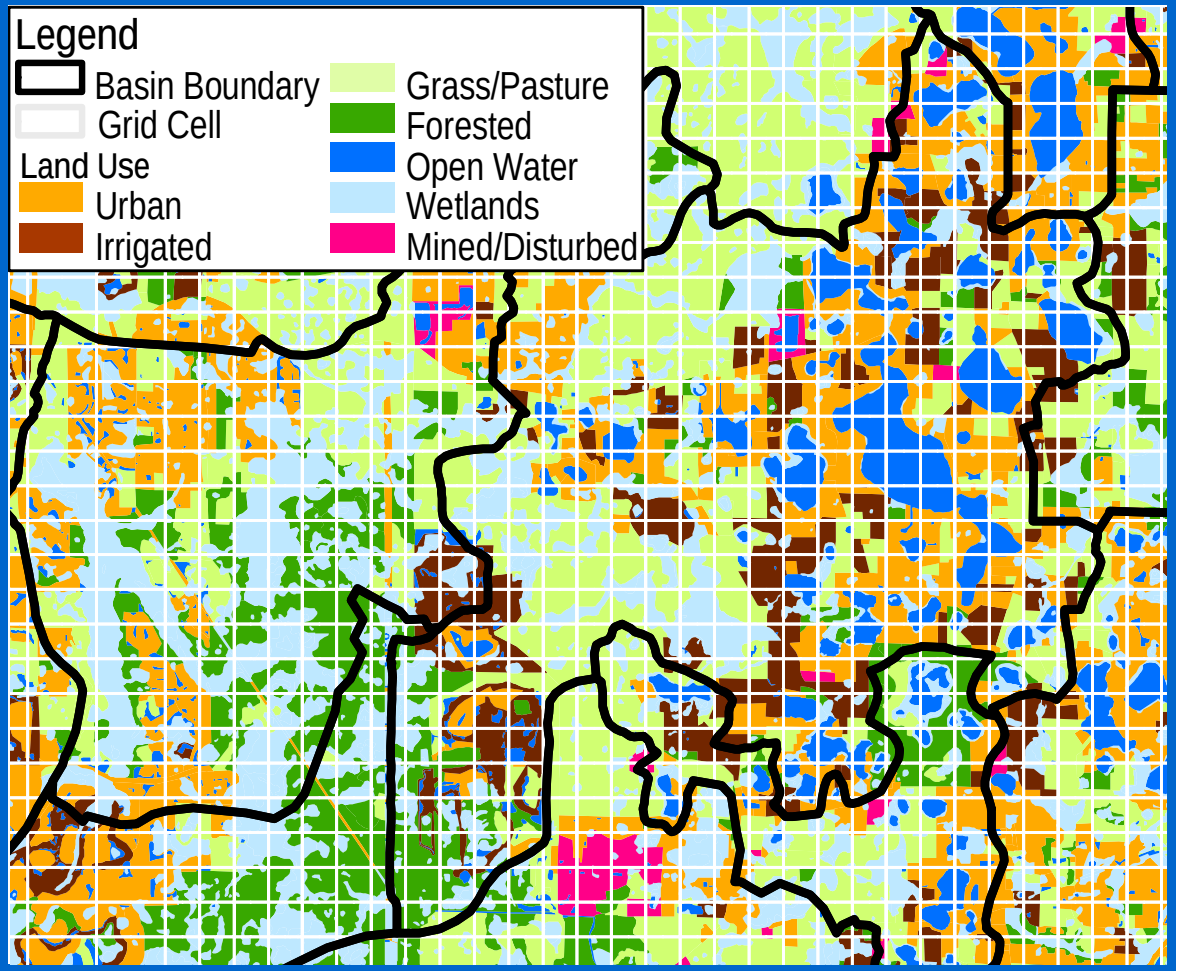
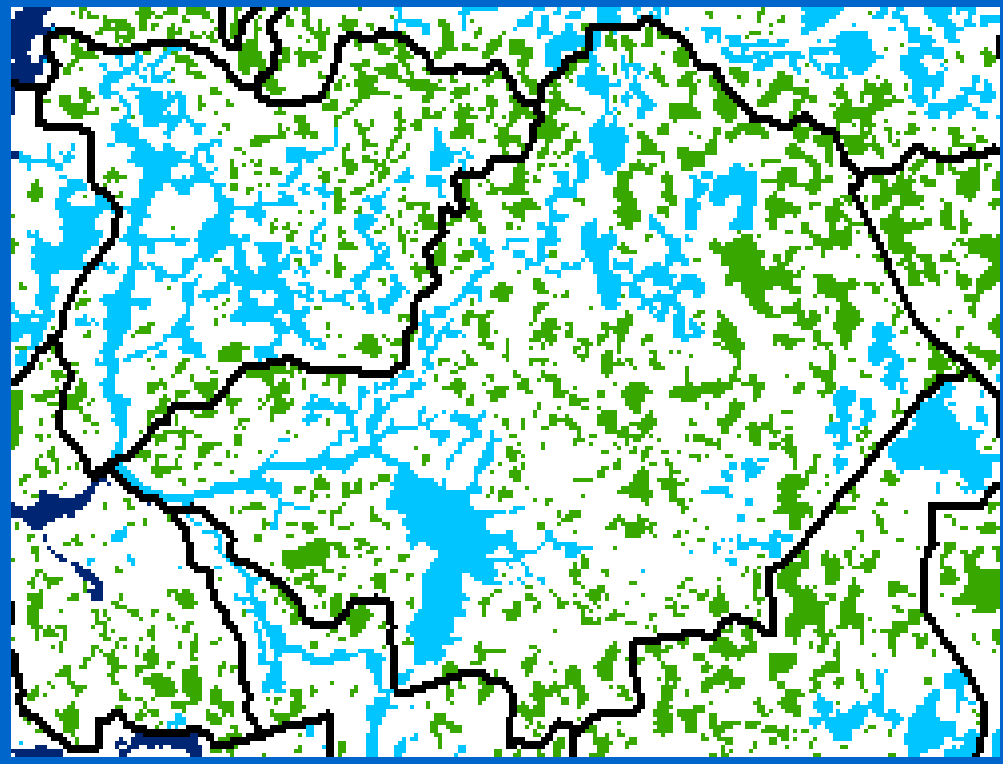
IHM Land Discretization
Basins, Land Segments, and Grid Cells

- Integration among all land fragments of land segment in basin
- Disaggregated from land segment to land fragment: Recharge, Specific Yield, Remaining PET
- Aggregated from land fragments to land segment: Soil Storage and ET Co.



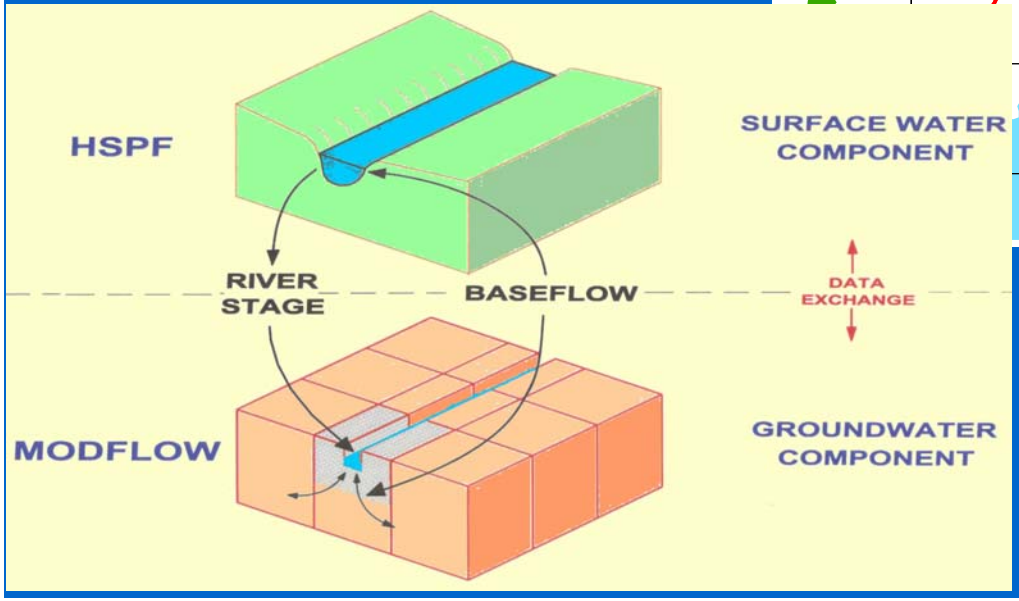
IHM Water/Wetland Discretization Reach Classes and Aggregation

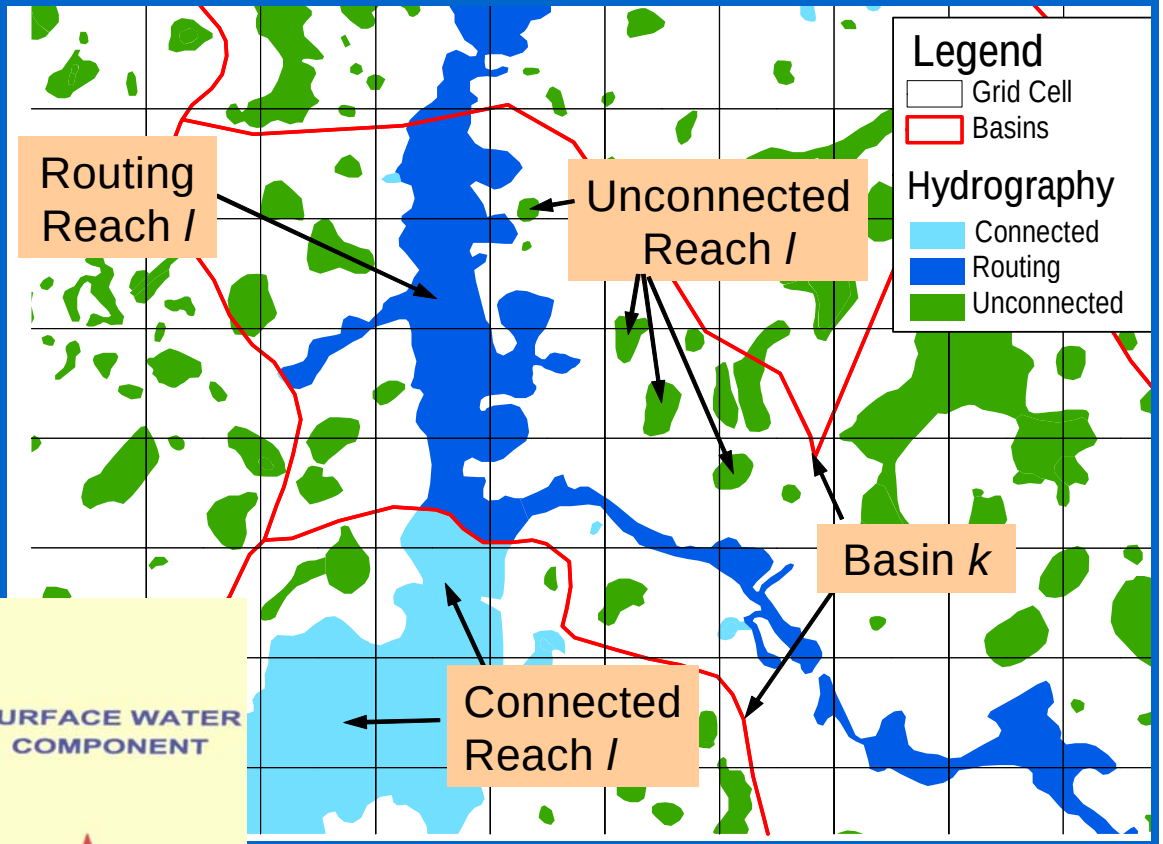
- **IHM reach classes**
  - Conditionally-connect. (isolated water-bodies)
  - Connected
  - Routing
- **Aggregate 100s of water bodies into one reach**
- **Reach contained within basin (except Routing)**
- **Reservoir routing from reach to reach**



IHM Water/Wetland Discretization Reaches and MODFLOW River Cells

- **Aggregate water bodies to river cells within cell by reach**
- **IHM disaggregates reach depth to stage at river cells in time and space**





- **Dispersed GW flux interaction aggregated to reach by IHM**

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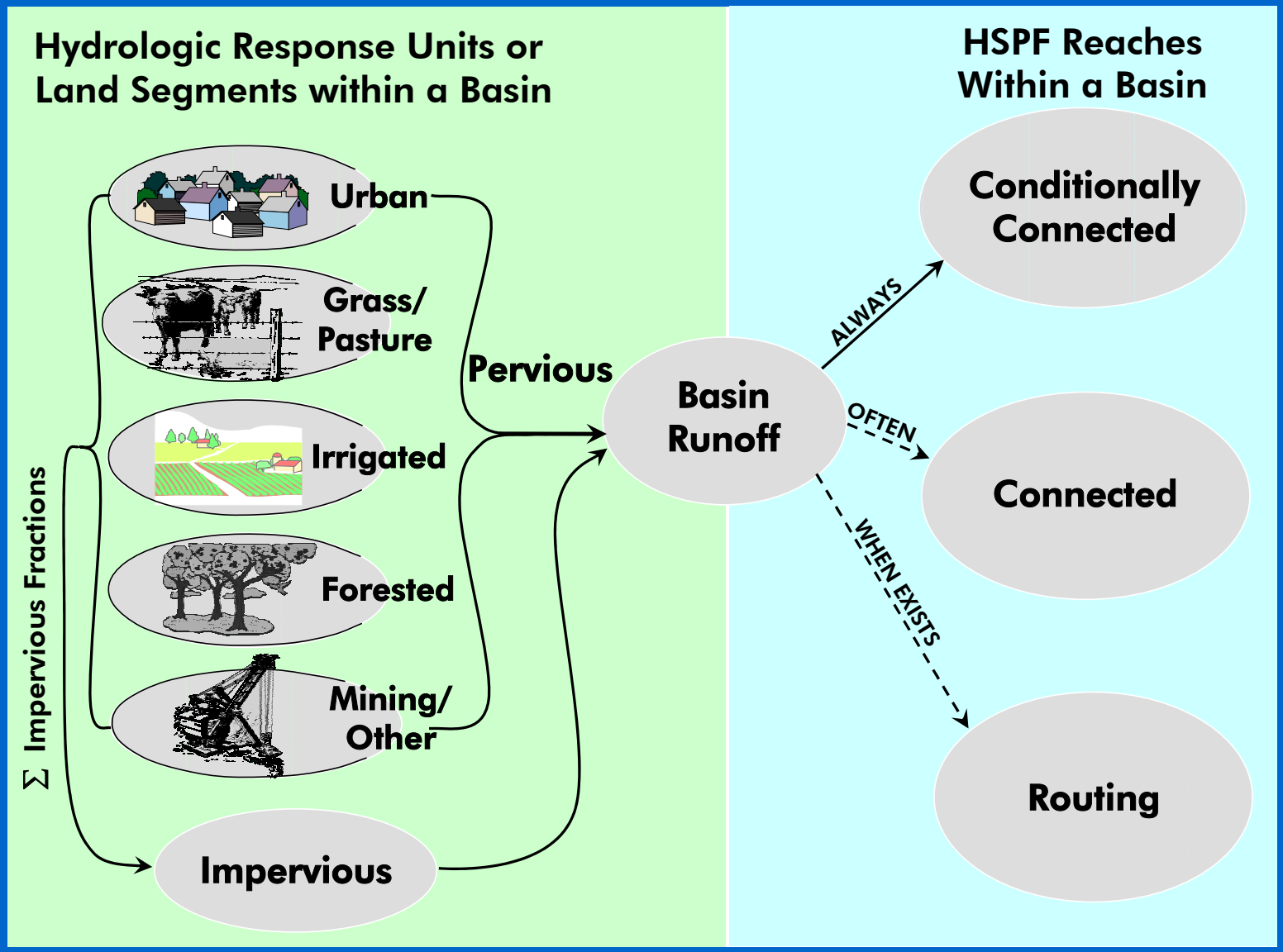
Aggregation and Routing Surface Runoff and Interflow



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Surface-Water Model Component

Questions