Development of an Aquifer Vulnerability Assessment Methodology for Source Water Protection

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Tampa Bay Water

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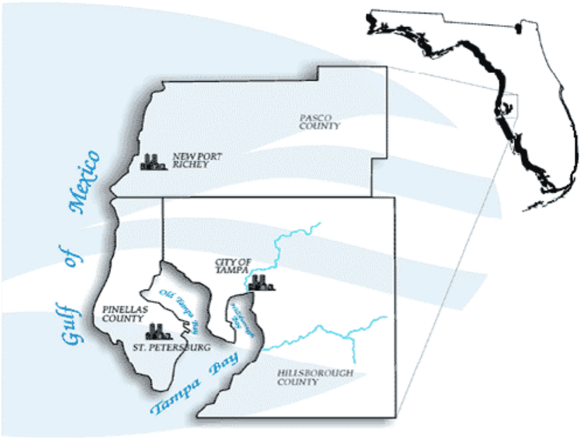
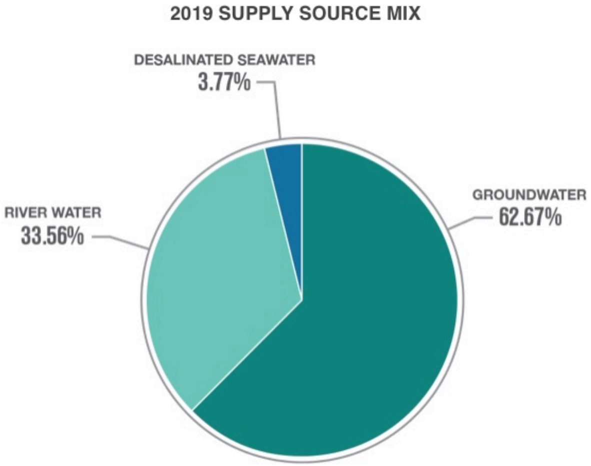
Presentation Overview

- Source Water Assessment and Protection Program
- Vulnerability of groundwater to contamination
- Hydrogeology and vertical migration of contaminants
- Aquifer Vulnerability Assessment
- Relative Vulnerability Zones
- Application for potential contamination sources screening

Source Water Assessment and Protection for Regional Drinking Water Supplies

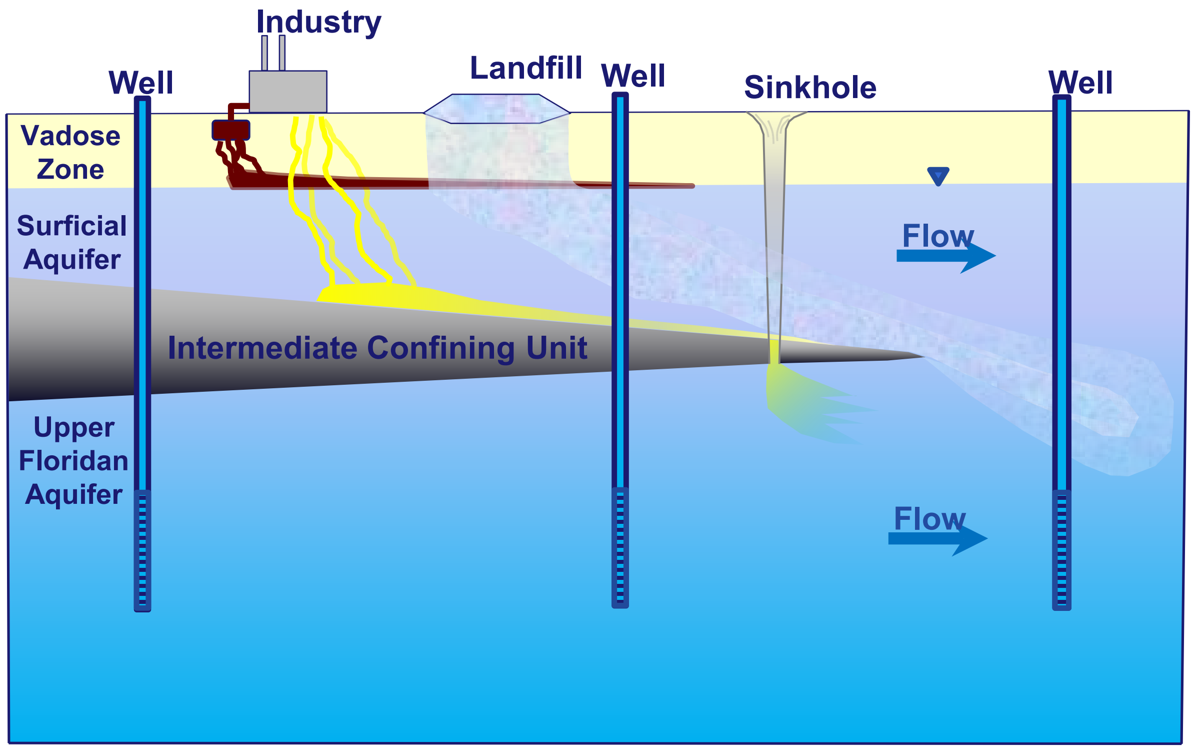




- Supply Sources for Tampa Bay Water's Regional Drinking Water System:
  - Groundwater - Wellfields and Dispersed Wells
  - Surface Water – Canal, River, Seawater Desalination
- Source Water Assessment and Protection Program (SWAPP) to Protect Current and Future Supplies:
  - Source Water Quality Monitoring
  - Land Use Change Reviews
  - Potential Contaminant Sources (PCS) Inventory
  - Treatment Barrier Evaluations
  - Regulatory Agency and Stakeholder Interaction

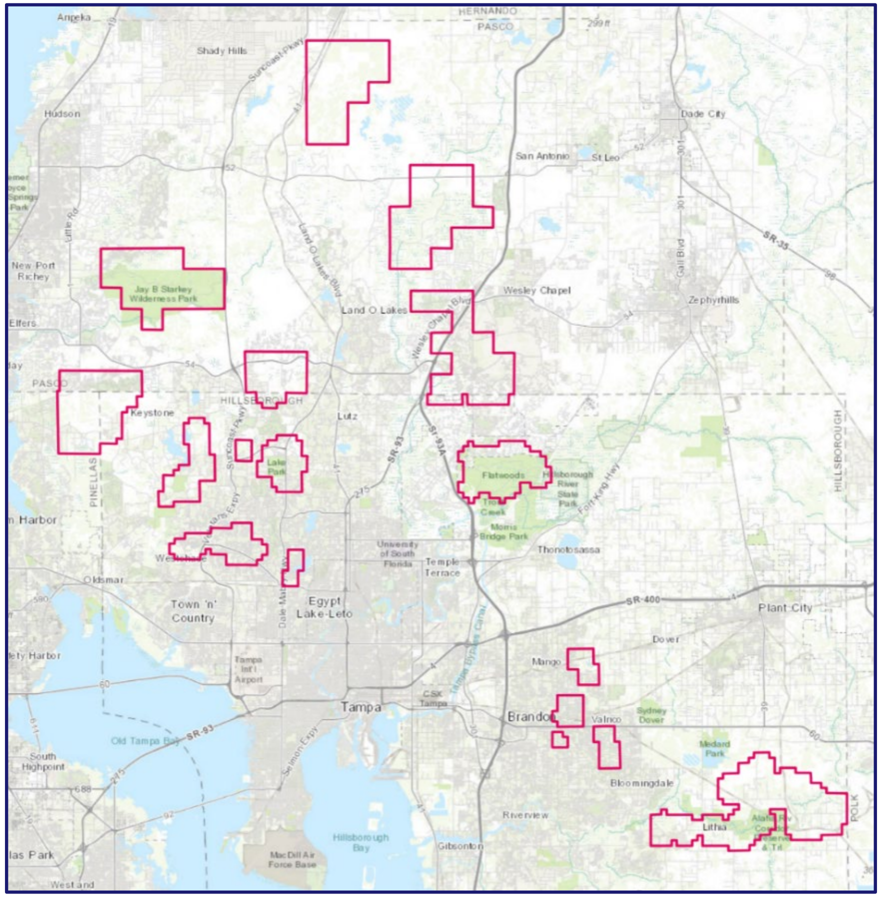
Vulnerability of Groundwater to Contamination

- Major Florida groundwater supply source is Upper Floridan Aquifer (UFA)
- Potential contaminants travel through soil/vadose zone, surficial aquifer and Intermediate Confining Unit (ICU)
- Migration affected by ICU thickness, clay content, sinkholes, karst features



SWAPP Groundwater Assessment Areas

- County Wellhead Protection Ordinances
  - Wellhead locations
  - Boundaries based on 5- and 10-year travel times for well capture zones
- SWAPP Wellfield Areas of Concern(AOC)
- SWAPP Regional Areas of Concern
  - 143 square miles
  - 164 wellheads



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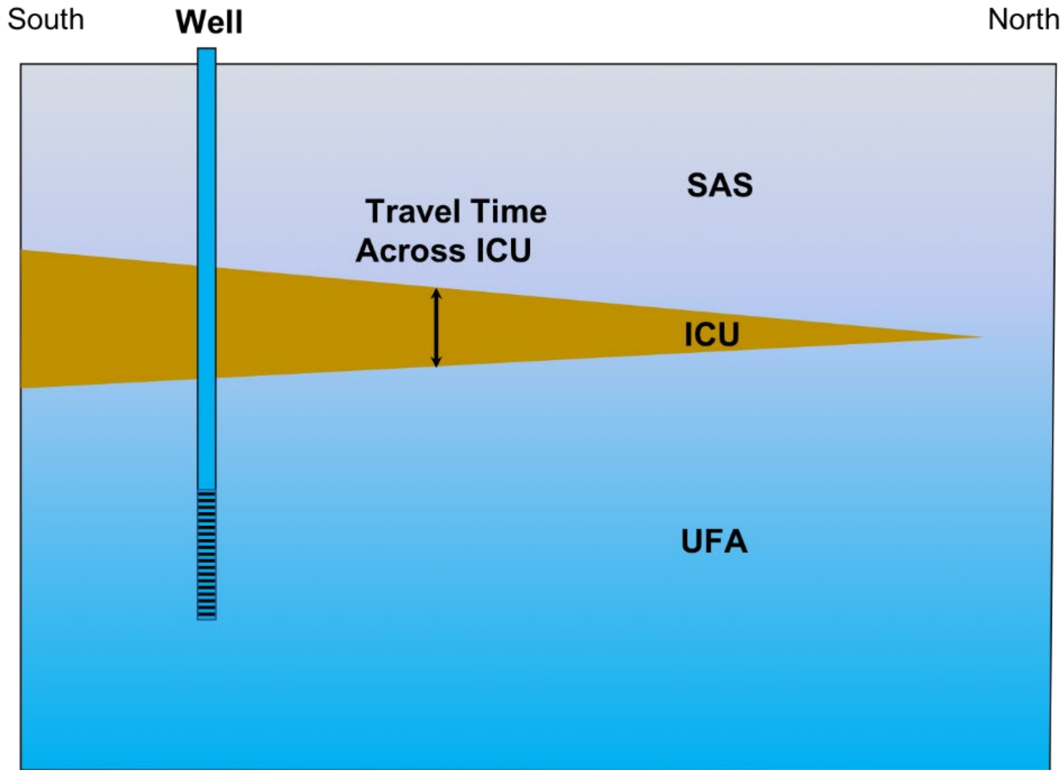
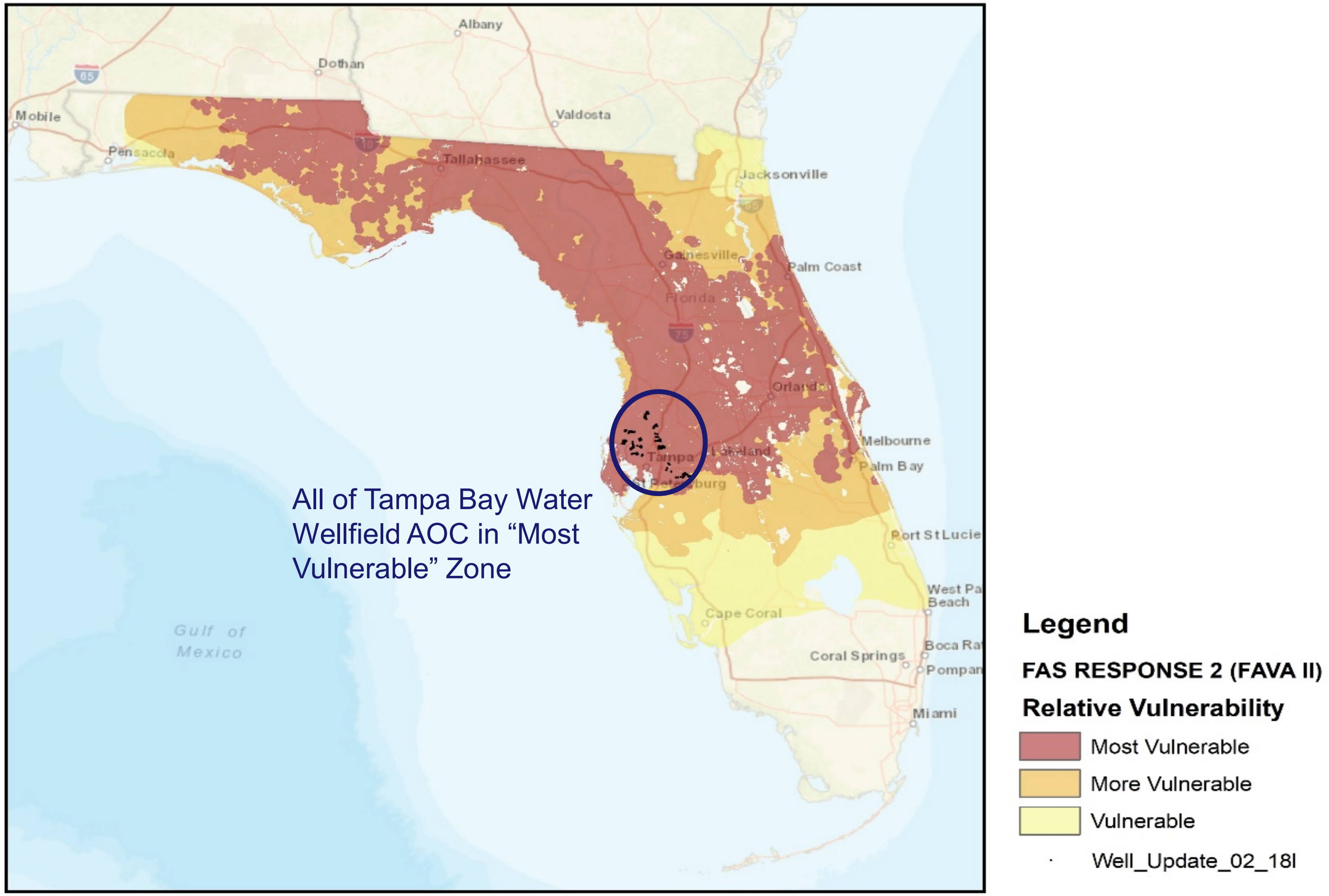
Risk of UFA Contamination - Vertical Migration

- Localized soil and surficial aquifer (SA) contamination is common
- UFA typically separated from SA by ICU of variable thickness
- What is likelihood that contaminated SA water will reach UFA?



Floridan Aquifer Vulnerability Assessment (FAVA)

- Purpose “to provide a science-based water-resource management tool to help minimize adverse impacts on groundwater quality”
- Follows DRASTIC
- FAVA assumes “all groundwater is vulnerable”



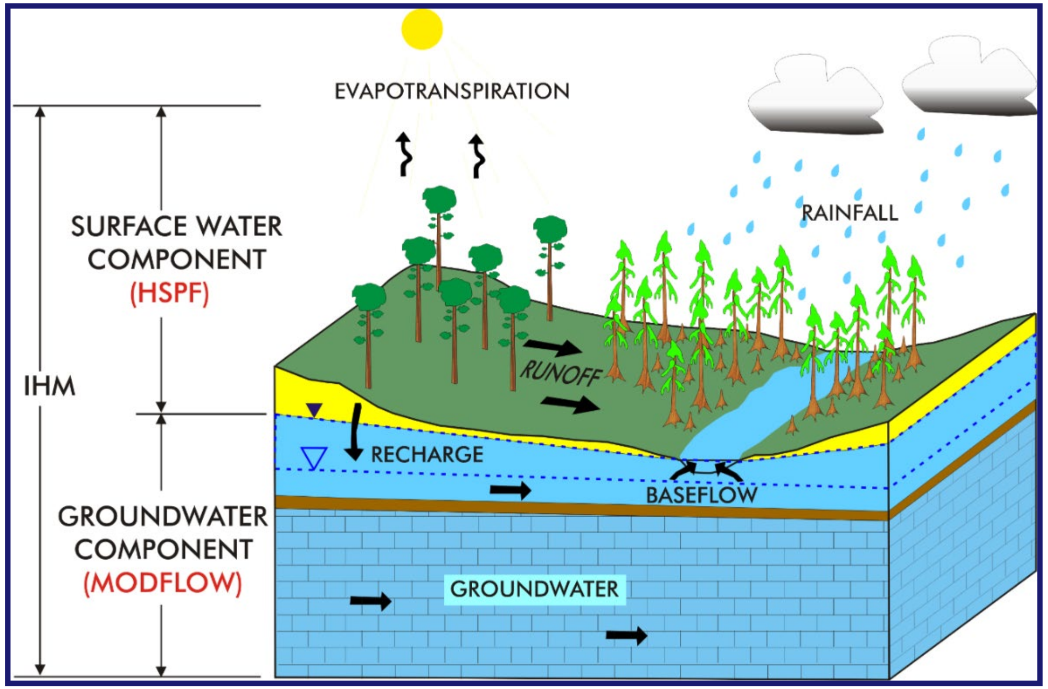
(after Arthur, J.D. et al, 2005 and Baker, A.E. & J.R. Cichon, 2009)

SWAPP Aquifer Vulnerability Assessment (AVA)

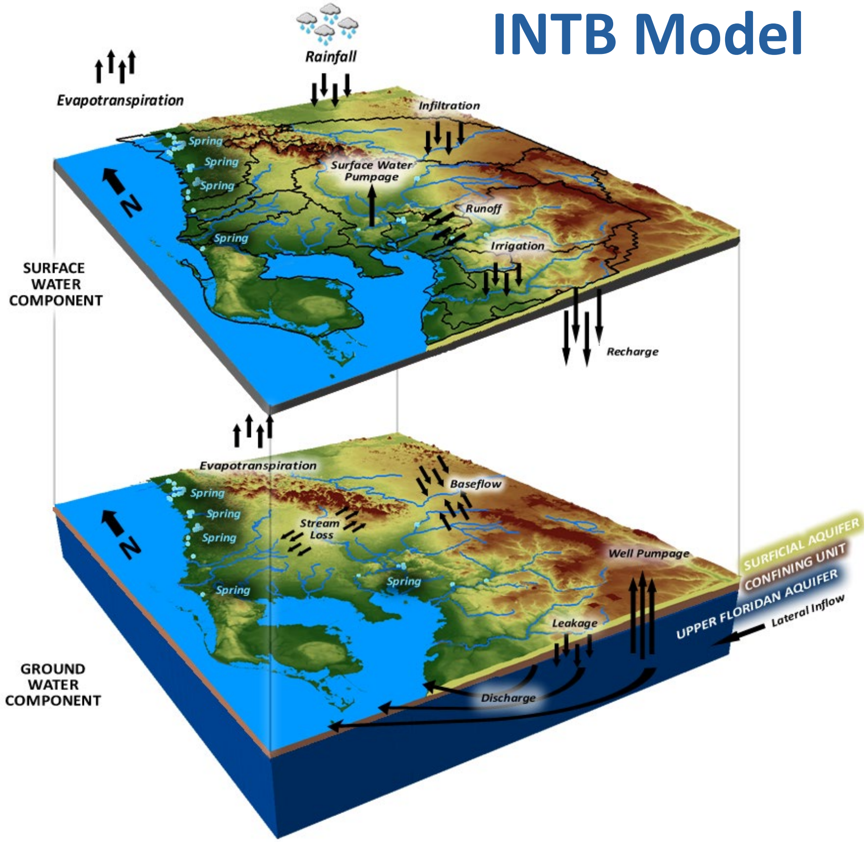
- Develop Method Localized to Tampa Bay Region
- Utilize Integrated Northern Tampa Bay Model (INTB) and Local-Scale Geologic and Hydrologic Data
  - Travel Time From Surficial Aquifer Through ICU to UFA
  - Recharge Flux to UFA
  - Other Potential Factors Influencing Flux Through ICU
- Develop Aquifer Vulnerability Zones for Groundwater AOC
- Incorporate into SWAPP PCS Screening and Ranking

Integrated Northern Tampa Bay Model (INTB)

Integrated Hydrologic Model (IHM)



INTB Model



INTB is a calibrated application of the IHM

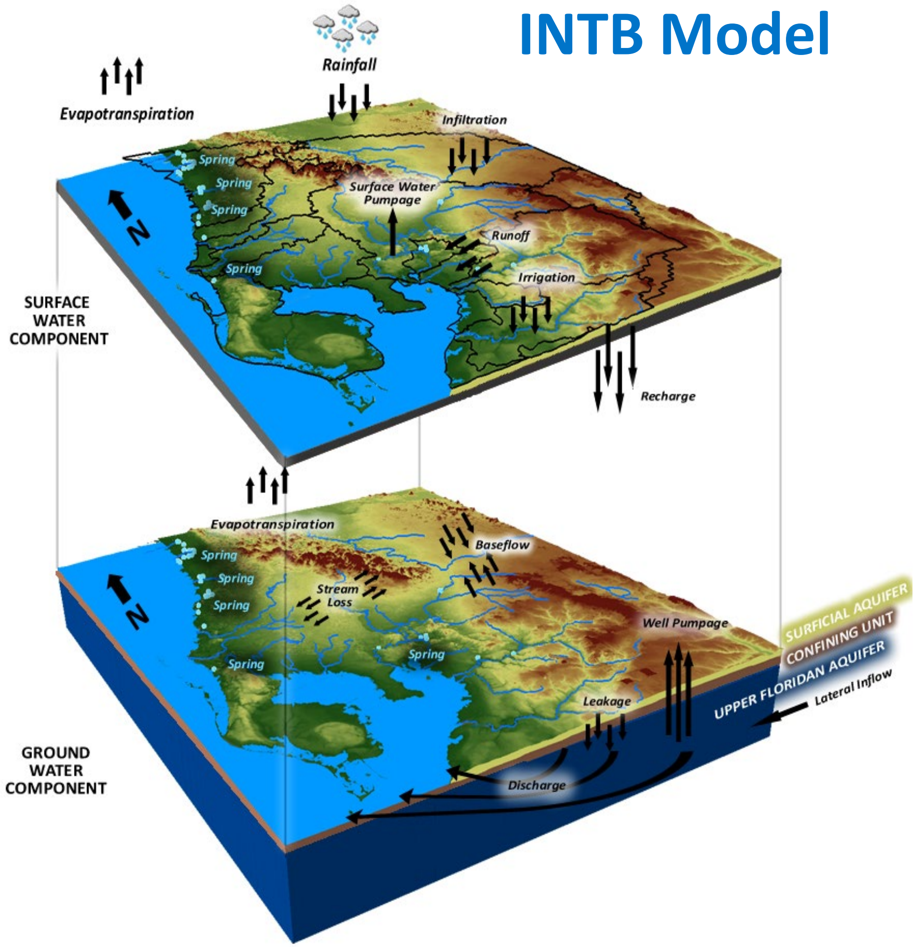
Calculation of Travel Time Through ICU

- INTB Model Parameters Used
  - ICU thickness, ft (*dl*)
  - Leakance, day^{-1} (K_z/dl)

- INTB Model Output Used
  - Simulated head Surficial Aquifer, ft (h)
  - Simulated head Upper Floridan, ft (h)
  - Calculate simulated head difference, ft
    - (*dh*, Surficial - Floridan)

- Assumed Parameter Used in Travel Time Calculations
  - Effective Porosity = 0.2

INTB Model



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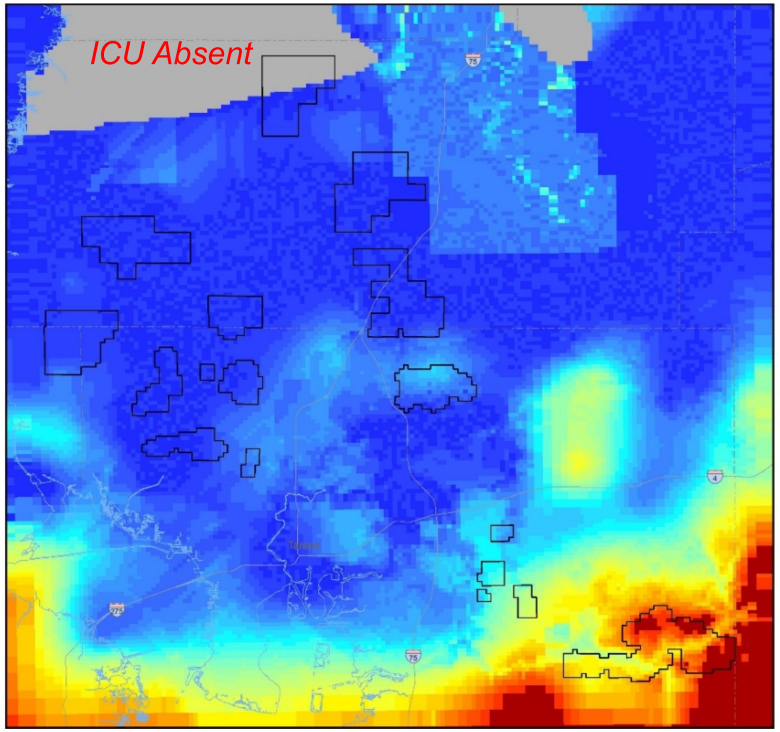
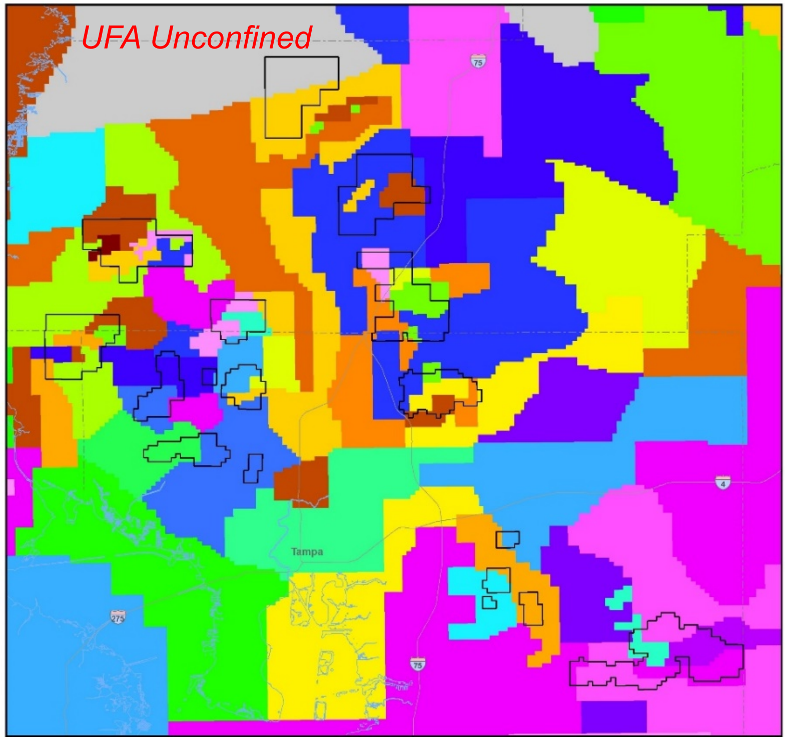
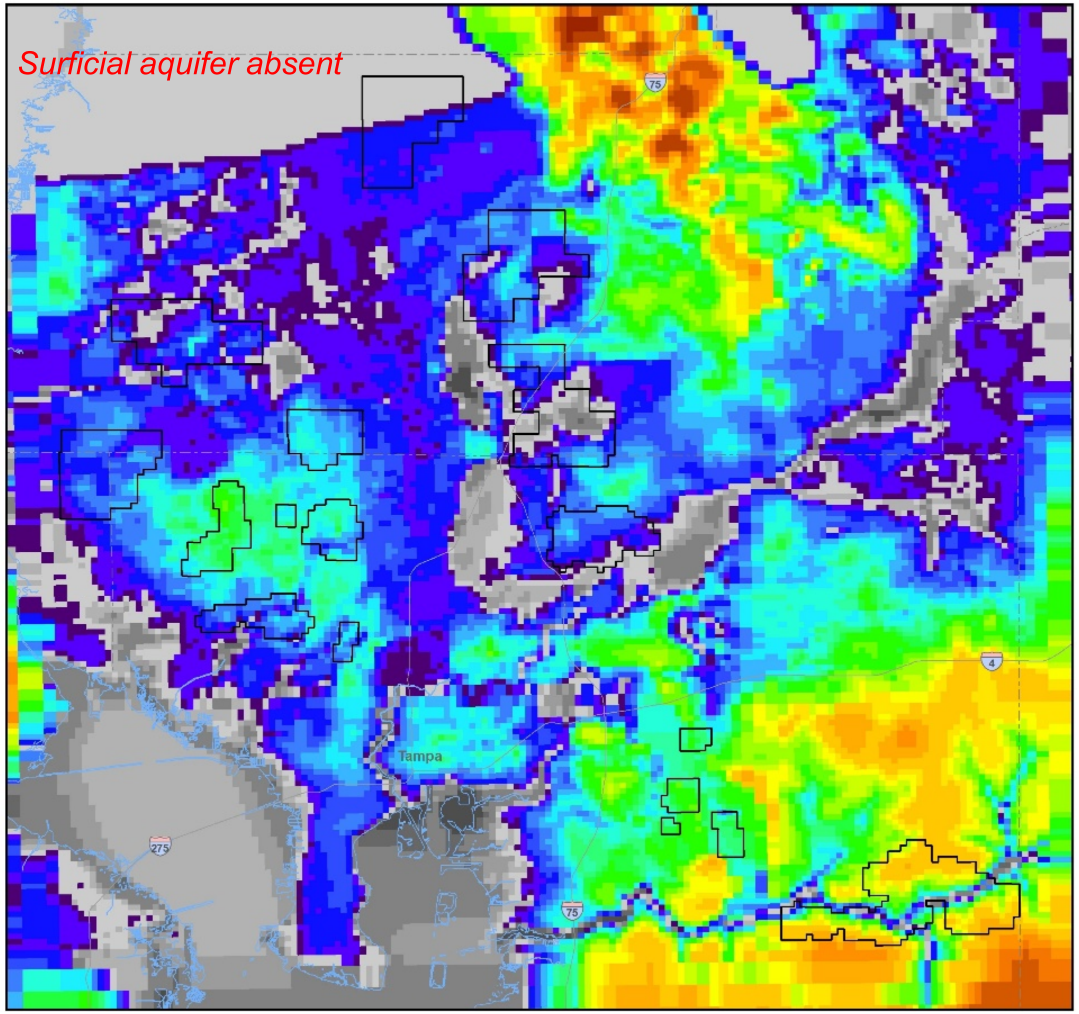
INTB Model ICU Thickness and Leakance





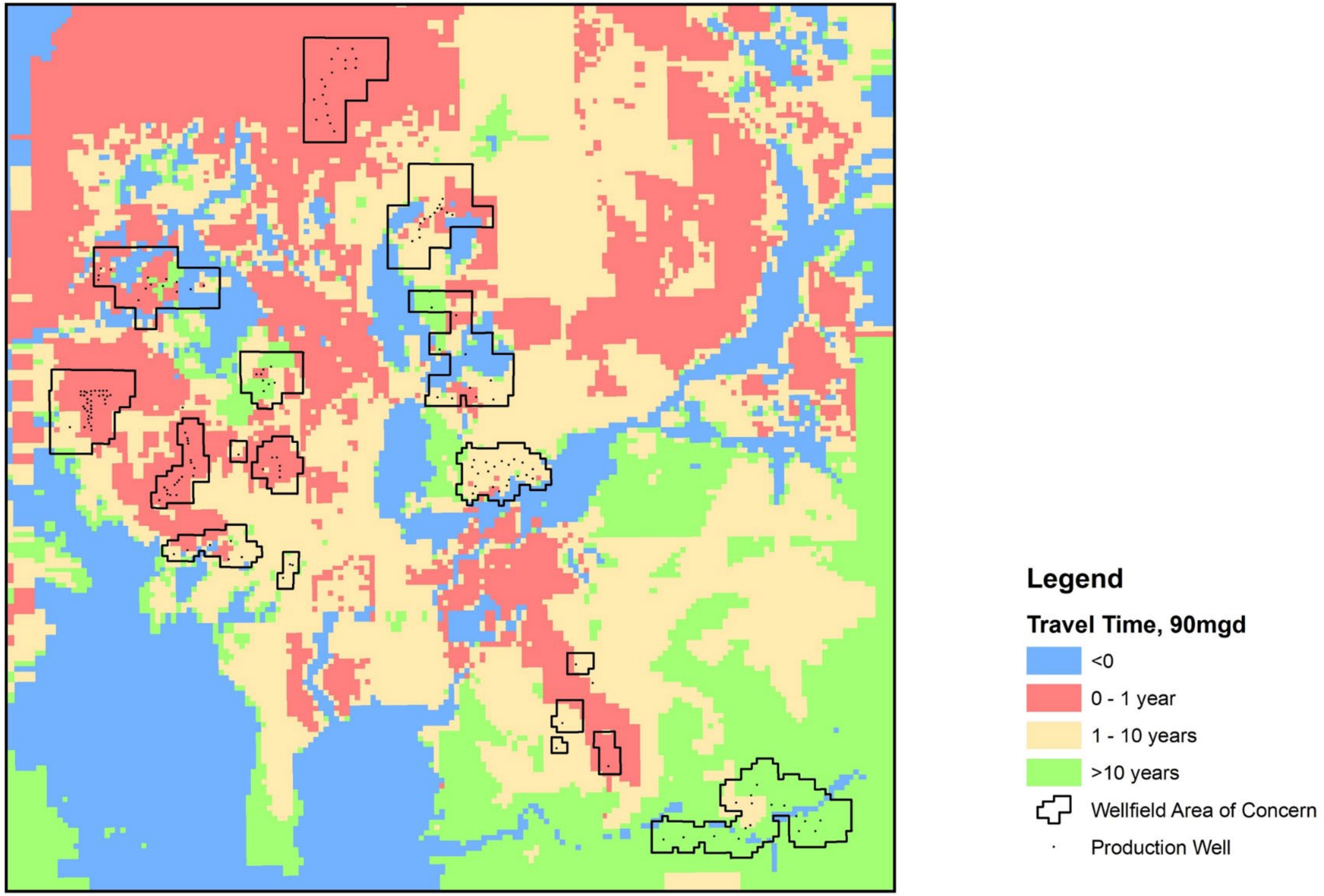
Surficial / UFA Water Level Head Difference in INTB



Water Levels Represent Current Conditions with Wellfield Operation

Calculation of Travel Time Through ICU

- Darcy's Law, Q = -KA(*dh*/*dl*)
- Average Linear Velocity for Porous Medium
  - v = -Leakance (head difference/porosity)
- Travel Time,
  - t = ICU thickness / v



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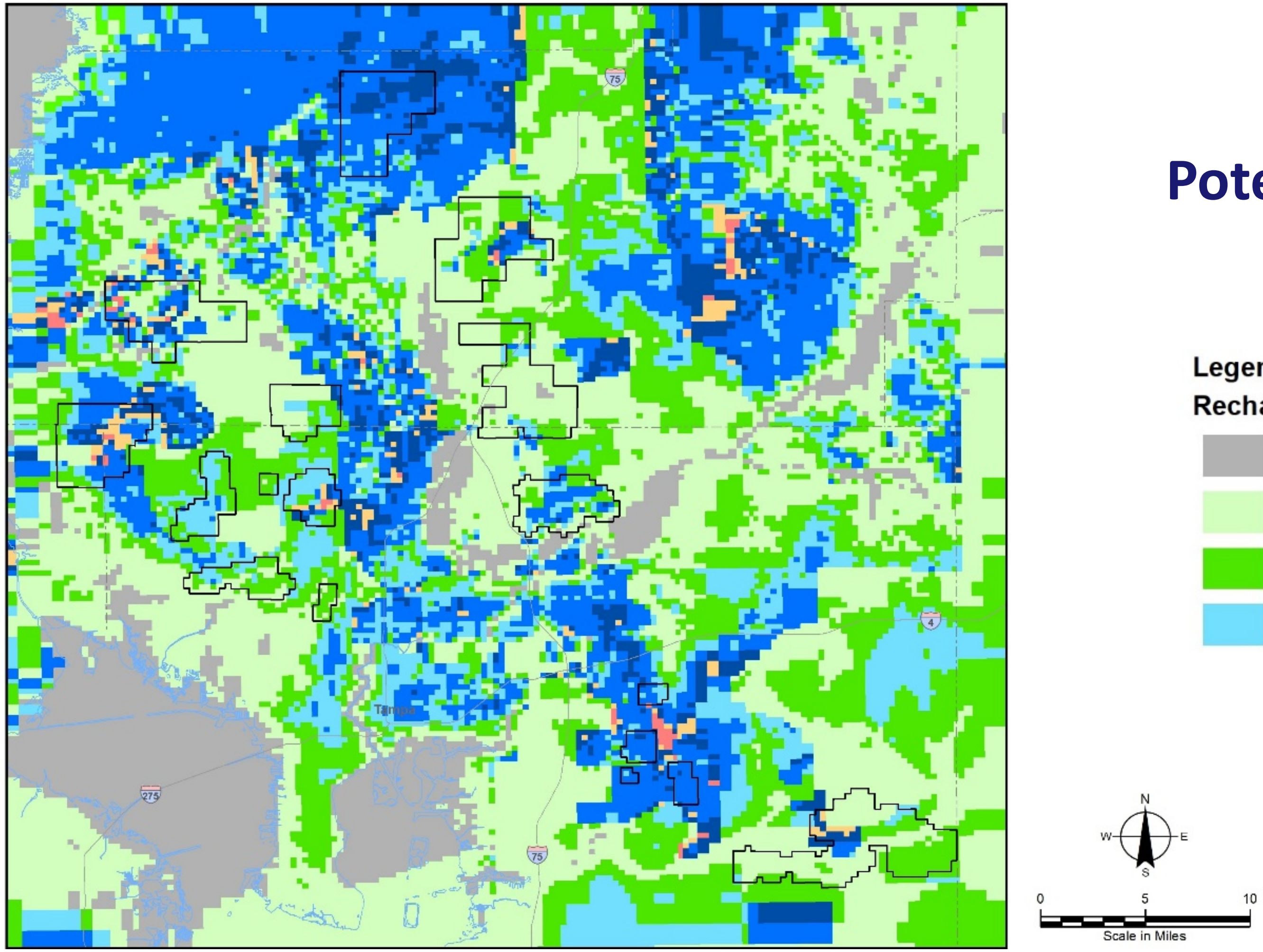
Recharge Flux to UFA from INTB Model



Potential Quantity of Water Flowing Through ICU to UFA

Legend

Recharge Flux to the UFA (in/yr)

- <0
- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 25
- 26 - 35
- 36 - 50
- 51 - 151
- Wellfield Area of Concern (AOC)

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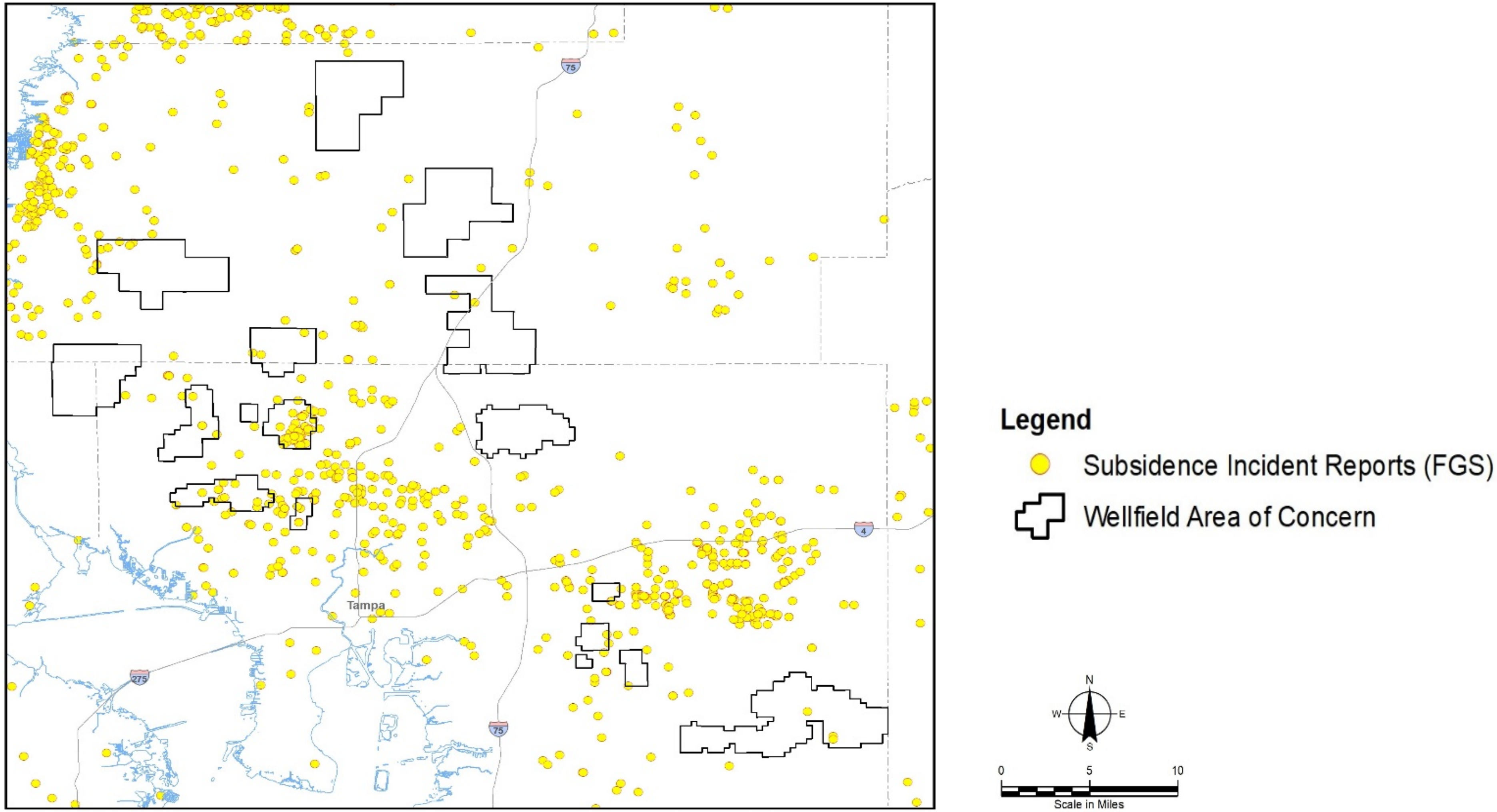
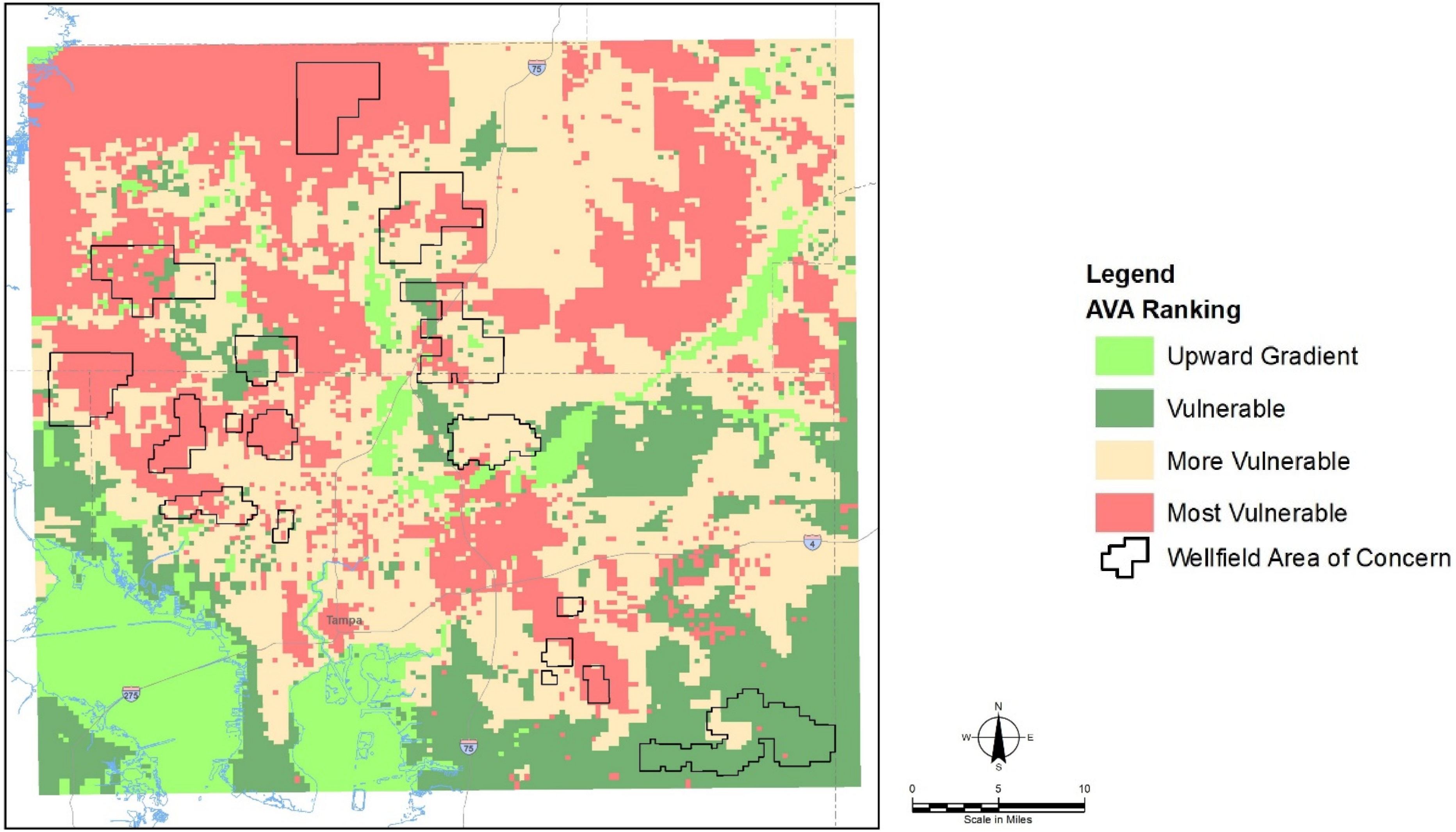
Sinkhole/Subsidence Risks and Karst Features



Relative Vulnerability Zones Based on AVA Methodology



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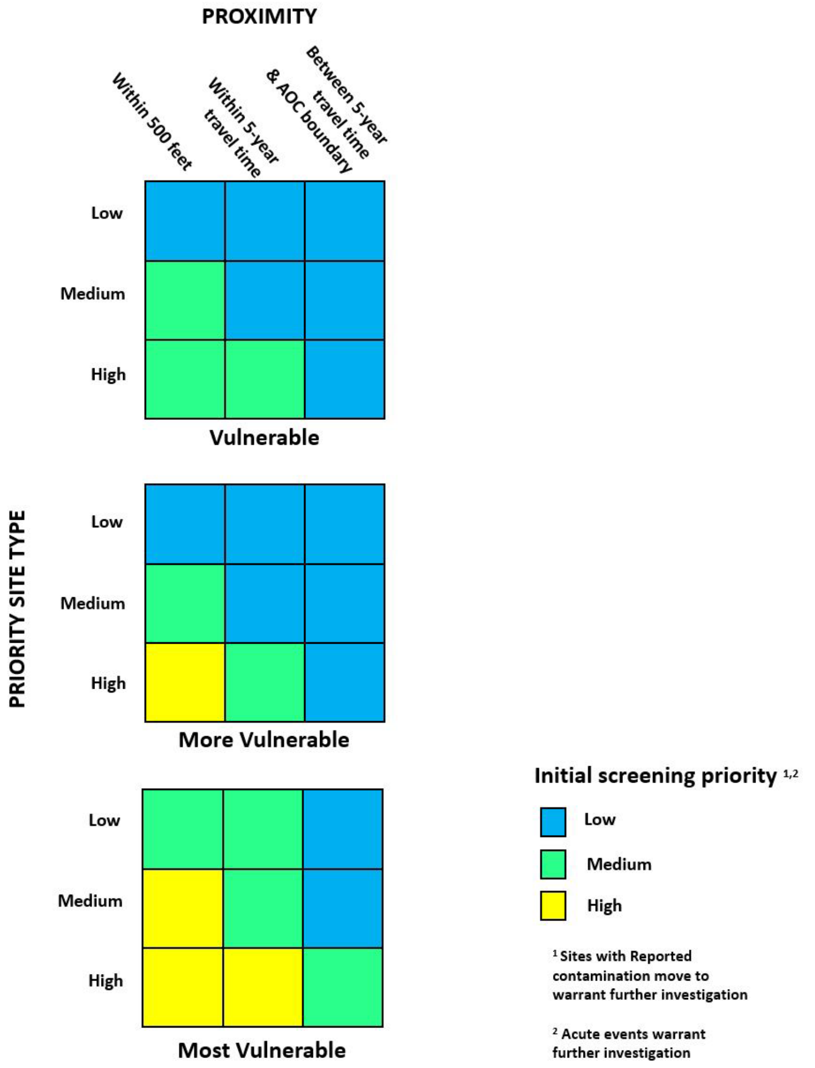
Use of AVA Zones for PCS Screening

SWAPP PCS Screening Process Steps

1. Location in Area of Concern (AOC)
2. Proximity to Wellheads
3. AVA Vulnerability Zones (Vulnerable, More, Most)
4. Land Use Categories
    - High Priority Land Use Categories (e.g., fuel tanks, liquid hazardous materials)
    - Medium Priority Land Use Categories (e.g., biosolids facilities, auto salvage, pesticide storage)
    - Low Priority Land Use Categories (e.g., shooting ranges, electrical substations, animal stables)
5. Acute Event within AOC
6. Documentation of Previous Contamination
7. Site and Land Use Screening Matrix



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Thank You

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