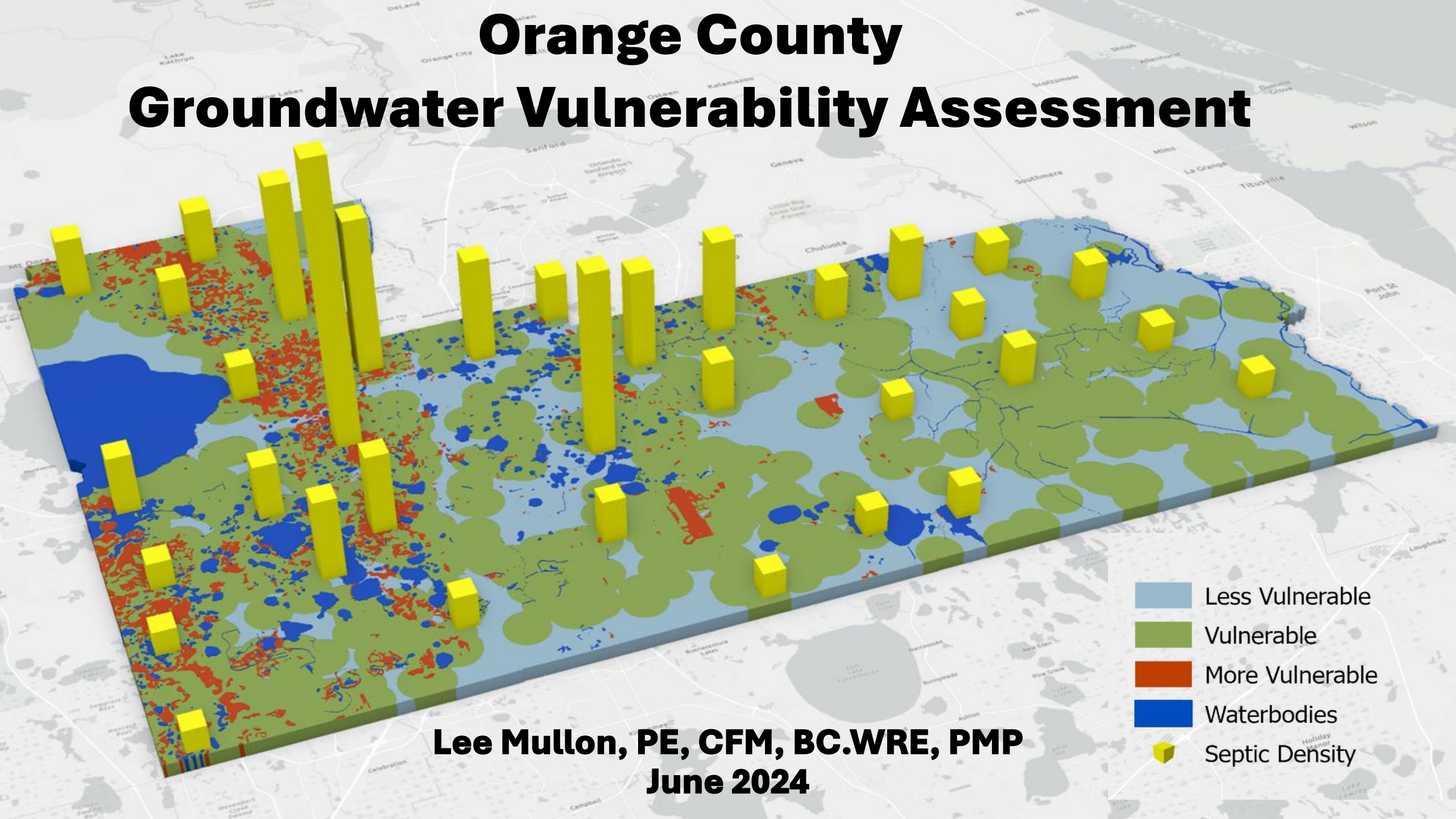
Orange County
Groundwater Vulnerability Assessment



Lee Mullon, PE, CFM, BC.WRE, PMP

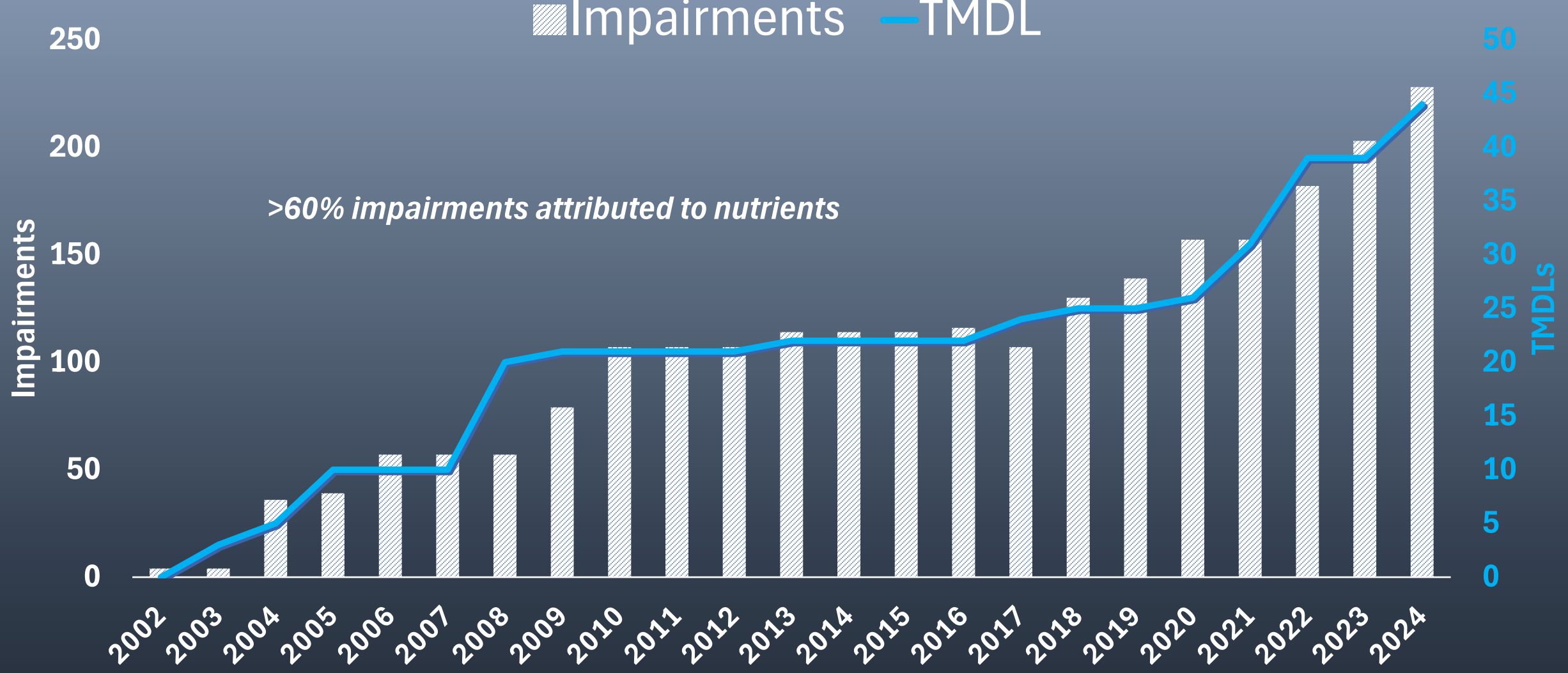
June 2024

Water Resources of Orange County

- 600+ named lakes
- 9 river/creek systems
- Wekiwa & Rock Springs (Outstanding Florida Springs)
- Wekiva River (1 of 2 Wild & Scenic Rivers in Florida)
- Econlockhatchee River (OFW)
- Headwaters of the Everglades
  - Butler Chain of Lakes (OFW)
  - Hart Branch, Shingle, Boggy, Cypress, Reedy Creeks

Water Quality Trends

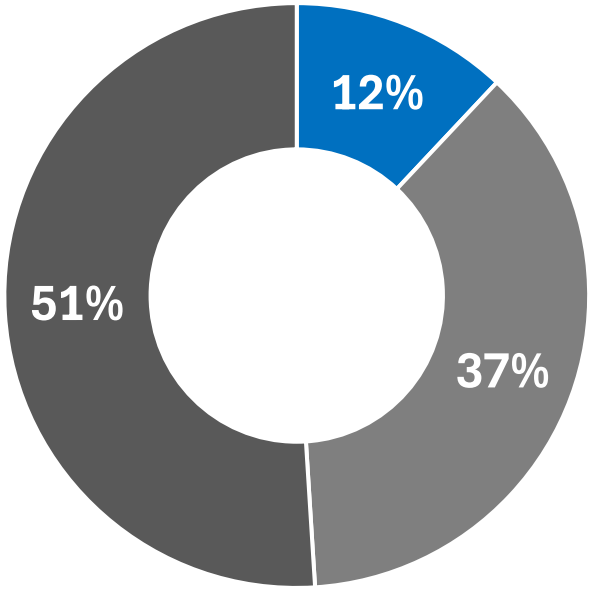
DRUMMOND CARPENTER
engineering + research



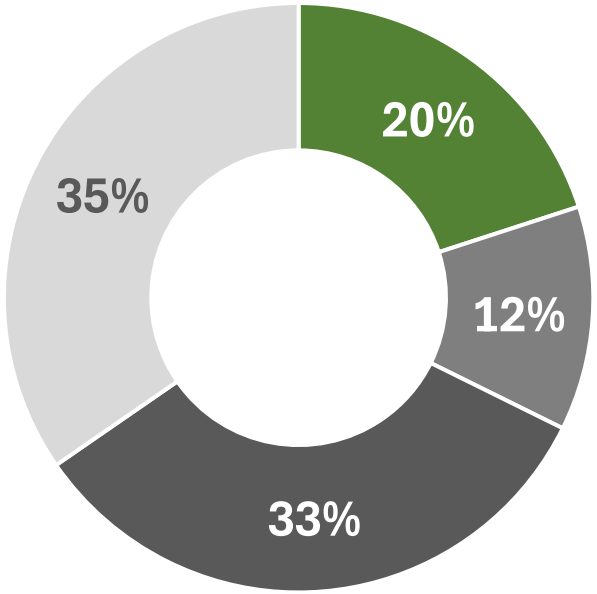
Impairments based on all verified impaired, ongoing restorations, adopted TMDLs, and Study List of unincorporated and incorporated areas
TMDLs include adopted, draft, and priority lists of unincorporated and incorporated areas

Meta Analysis of County Loading Studies

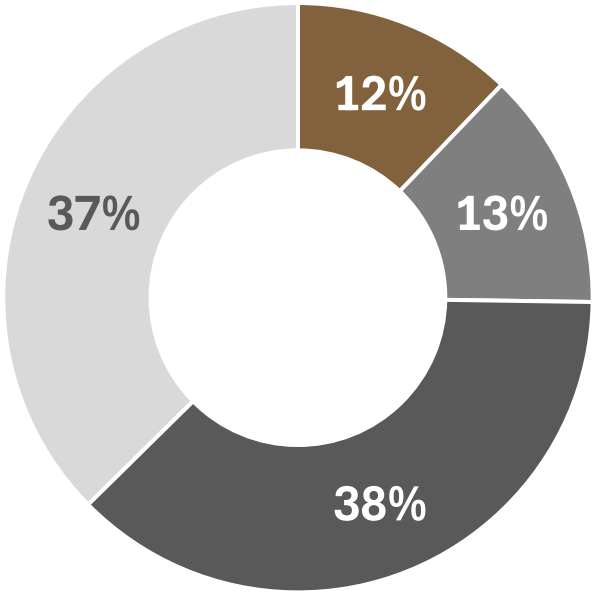
Hydrologic Input



TN Input



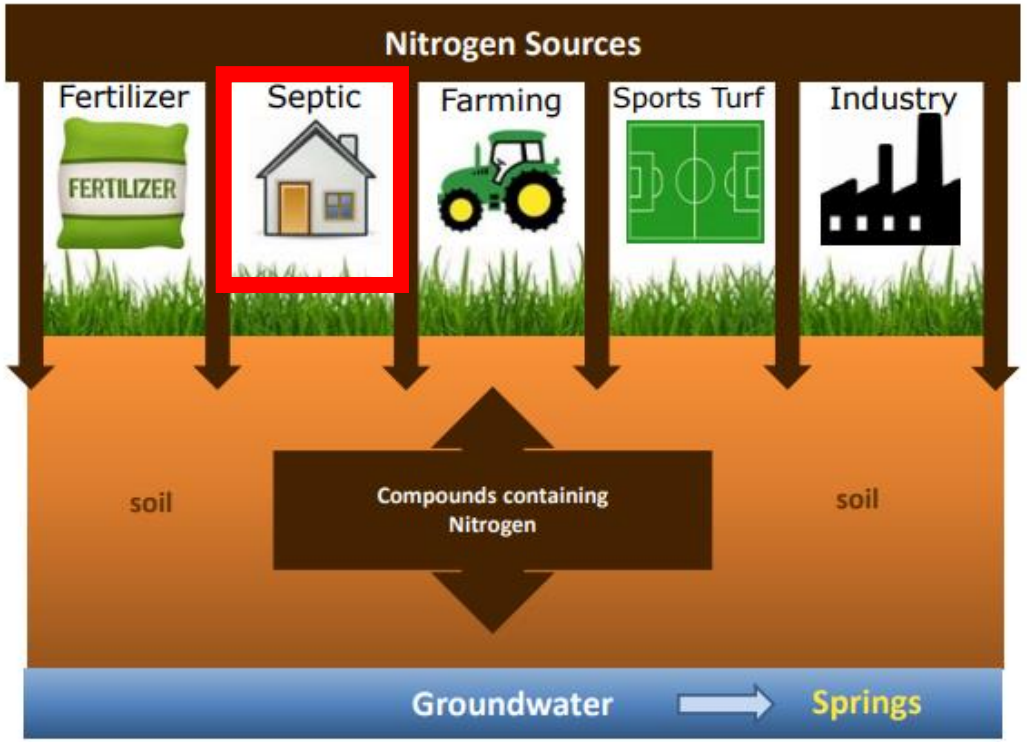
TP Input



** Based on a limited dataset. Subject to change as further monitoring is conducted on lakes.*

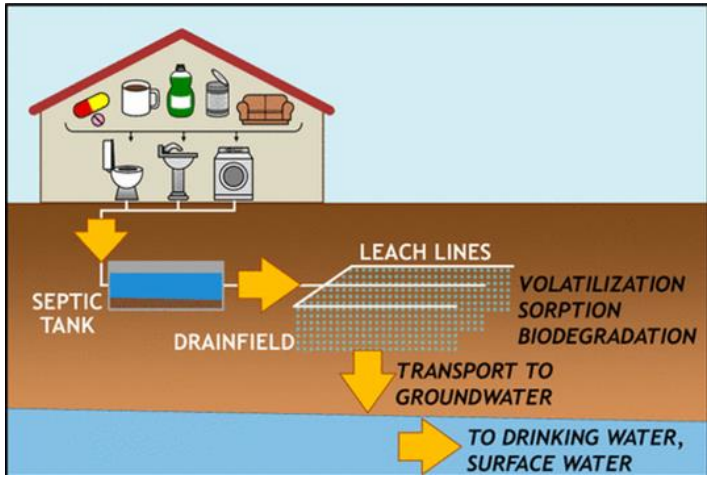
Groundwater Nutrient Source

- Orange County is conducting groundwater nutrient source tracking
  - Conventional sampling, isotopic sampling and mixing models



OC Utilities Department 2022

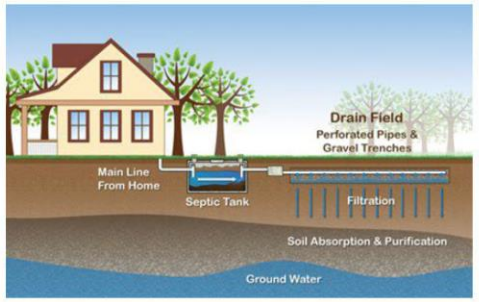
Septic loading is considered a leading nitrogen source to Wekiwa Spring and other waterbodies



Septic Systems

- Conventional septic systems are effective in the right locations and densities
  - Over 87,000 septic systems within Orange County, mostly conventional.
  - Typical nitrogen concentration entering septic systems = 60mg/L
- Transport of nutrients to waterbodies is complicated

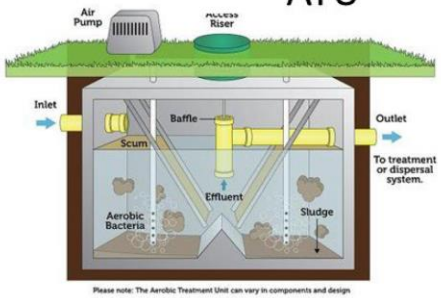
Conventional



Conventional septic systems efficiency at reducing nitrogen is ~30-40%

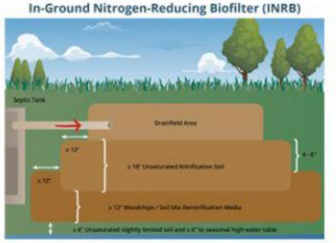
Advanced

ATU

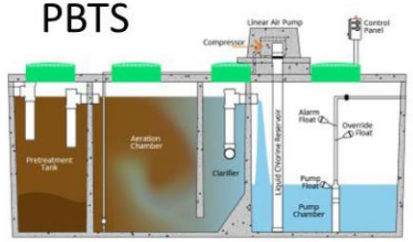


Passive

In-Ground Nitrogen-Reducing Biofilter (INRB)



PBTS



Advanced treatment systems can achieve 50-95% efficiency

Purpose of Groundwater Vulnerability Assessment[1]

- Which waterbodies are most vulnerable to excessive nutrient loading from existing conventional septic systems
- Where should the use of conventional septic systems be restricted for new development
- Where should connections to the central sewer or upgrading to enhanced septic systems be prioritized for existing conventional septic systems
- Are current setback requirements from septic systems in the code adequate to protect nearby surface waters

1 – From OC Septic Tank Workgroup Presentation 2024-02-27

Background – Groundwater Vulnerability Assessment

The GVA identified the County Priority Vulnerability Areas (PVAs)

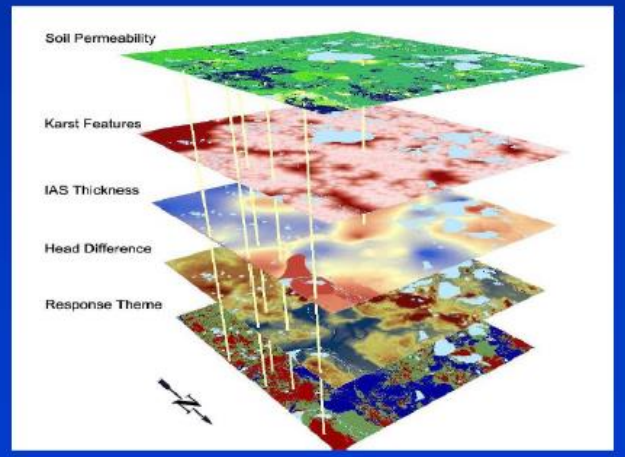
More Vulnerable Areas + **Subdivisions with Septic Systems** + **Proximity to Waterbodies** → **PVAs**

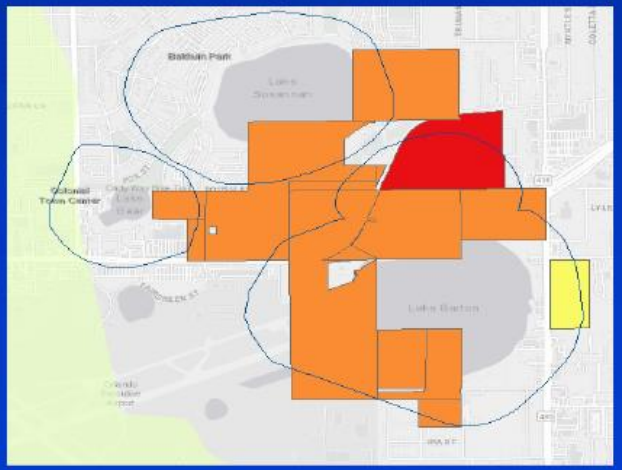
Easy Flow to Groundwater

Source of Nutrients

Target of Nutrients

Priority Vulnerability Areas





From OC Septic Tank Workgroup Presentation 2024-02-27

What's a PVA?

Priority Vulnerability Area

- Adaptation of FDEP's Priority Focus Area (PFA) methodology

Outstanding Florida Springs
Upper Floridan Aquifer

→

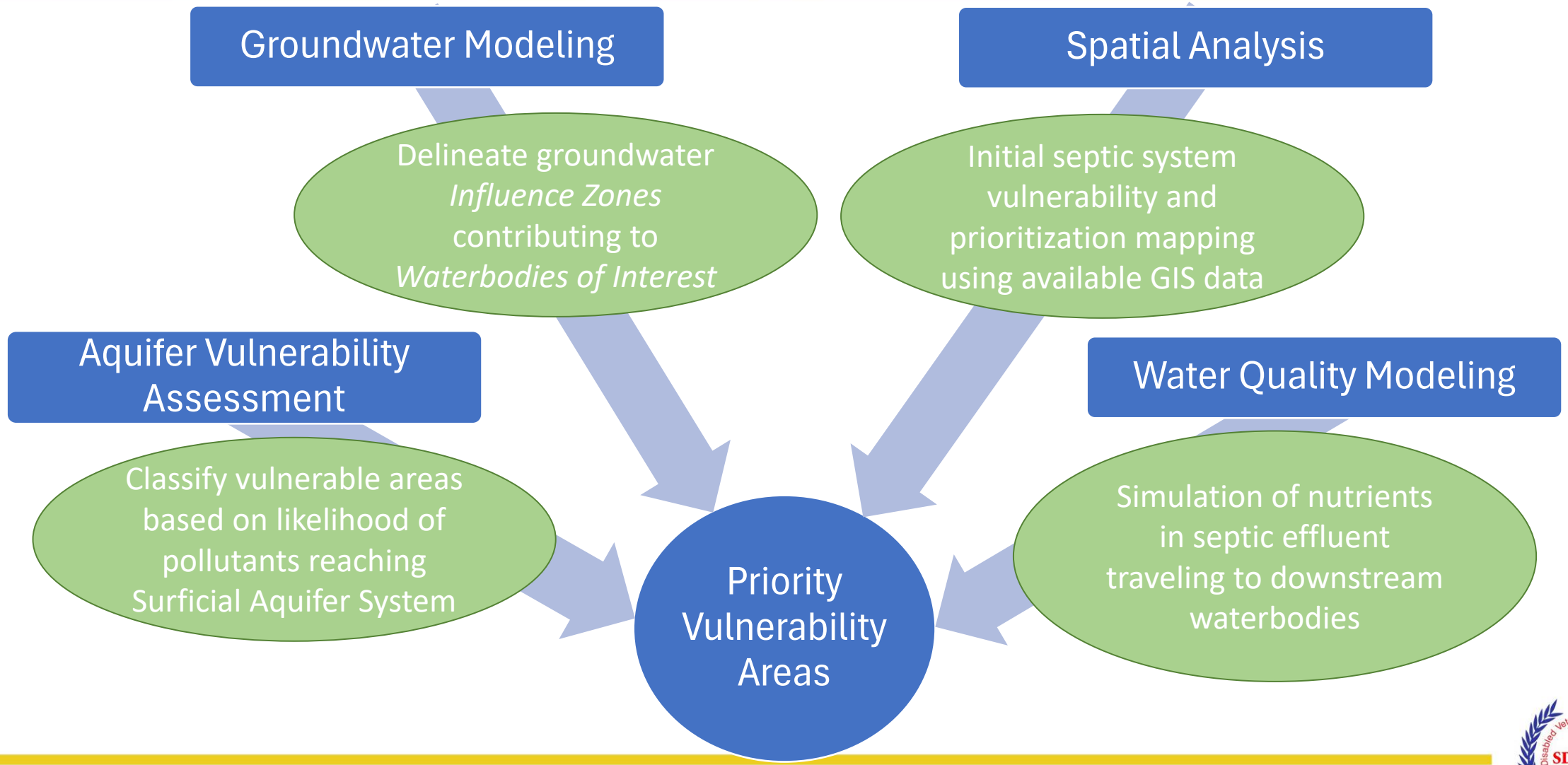
Surface Waters (Lakes, Rivers)
Surficial Aquifer

"Priority focus area" means the area or areas of a basin where the Floridan Aquifer is generally most vulnerable to pollutant inputs where there is a known connectivity between groundwater pathways and an Outstanding Florida Spring, as determined by the department in consultation with the appropriate water management districts and delineated in a basin management action plan."

Consider the following:

1. Groundwater Travel Time
2. Hydrogeology (e.g., recharge, transport)
3. Nutrient Load (Measured or Modeled)
4. Other factors that can lead to degradation of the waterbody (e.g., sources of pollution)
5. Be established using identifiable boundaries for ease of implementation (e.g., subdivisions)

PVA Development Approach



Aquifer Vulnerability Assessment

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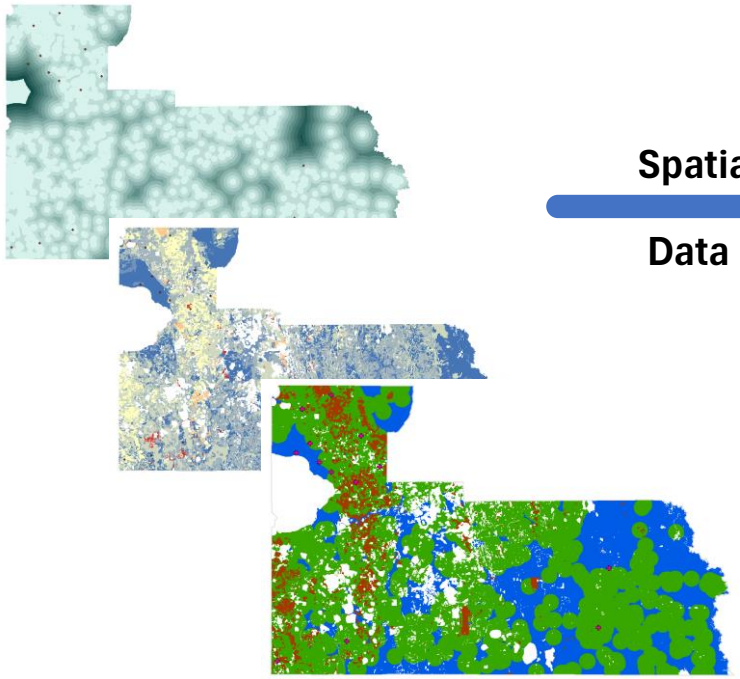
engineering + research

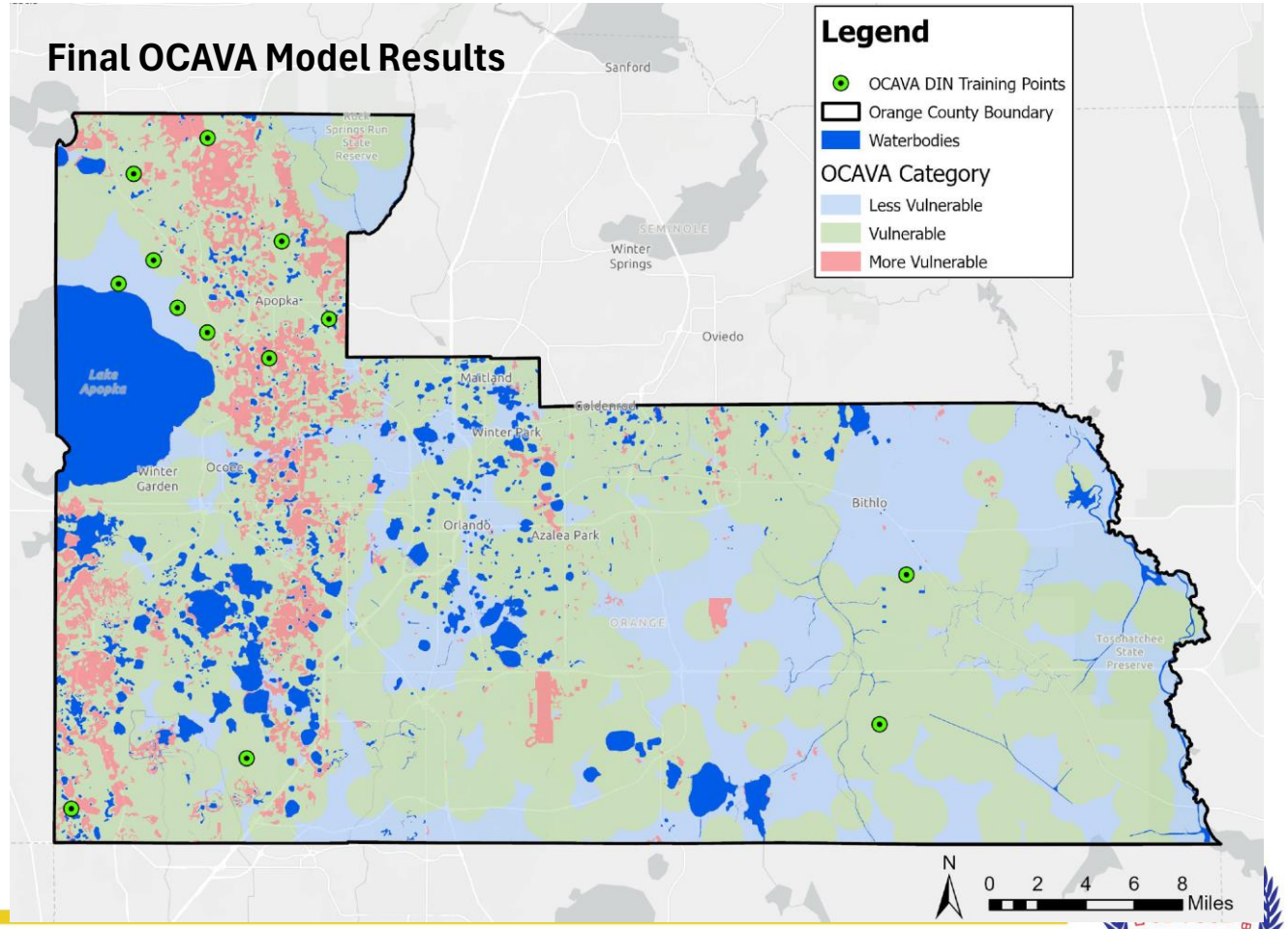
Where in Orange County is the surficial aquifer more vulnerable to pollution?

ArcSDM Tool based on FGS Weights of Evidence approach



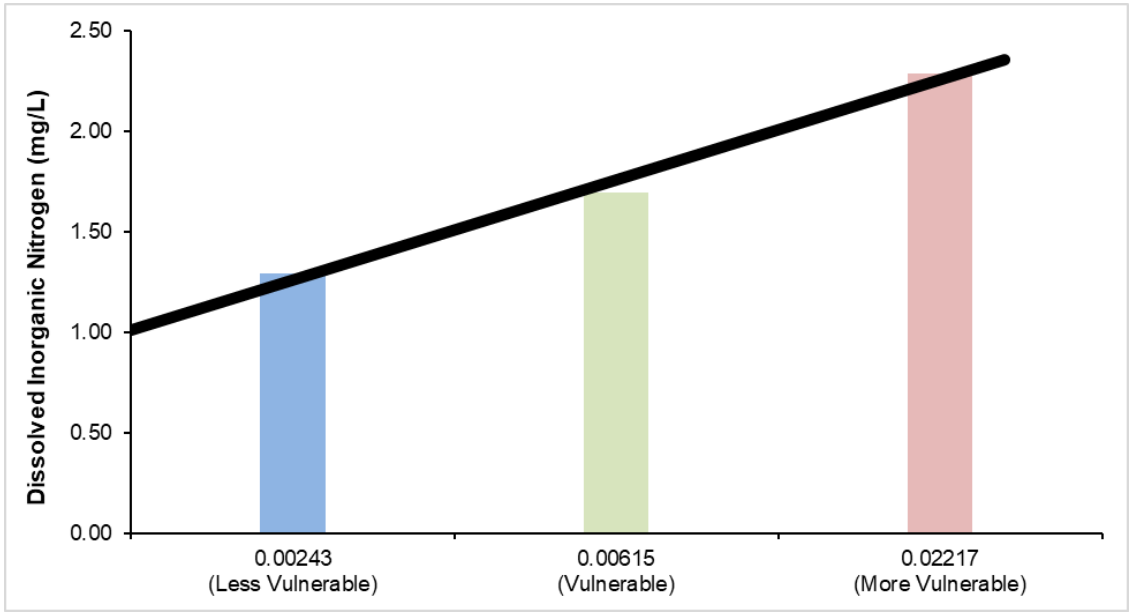
Spatial Tool

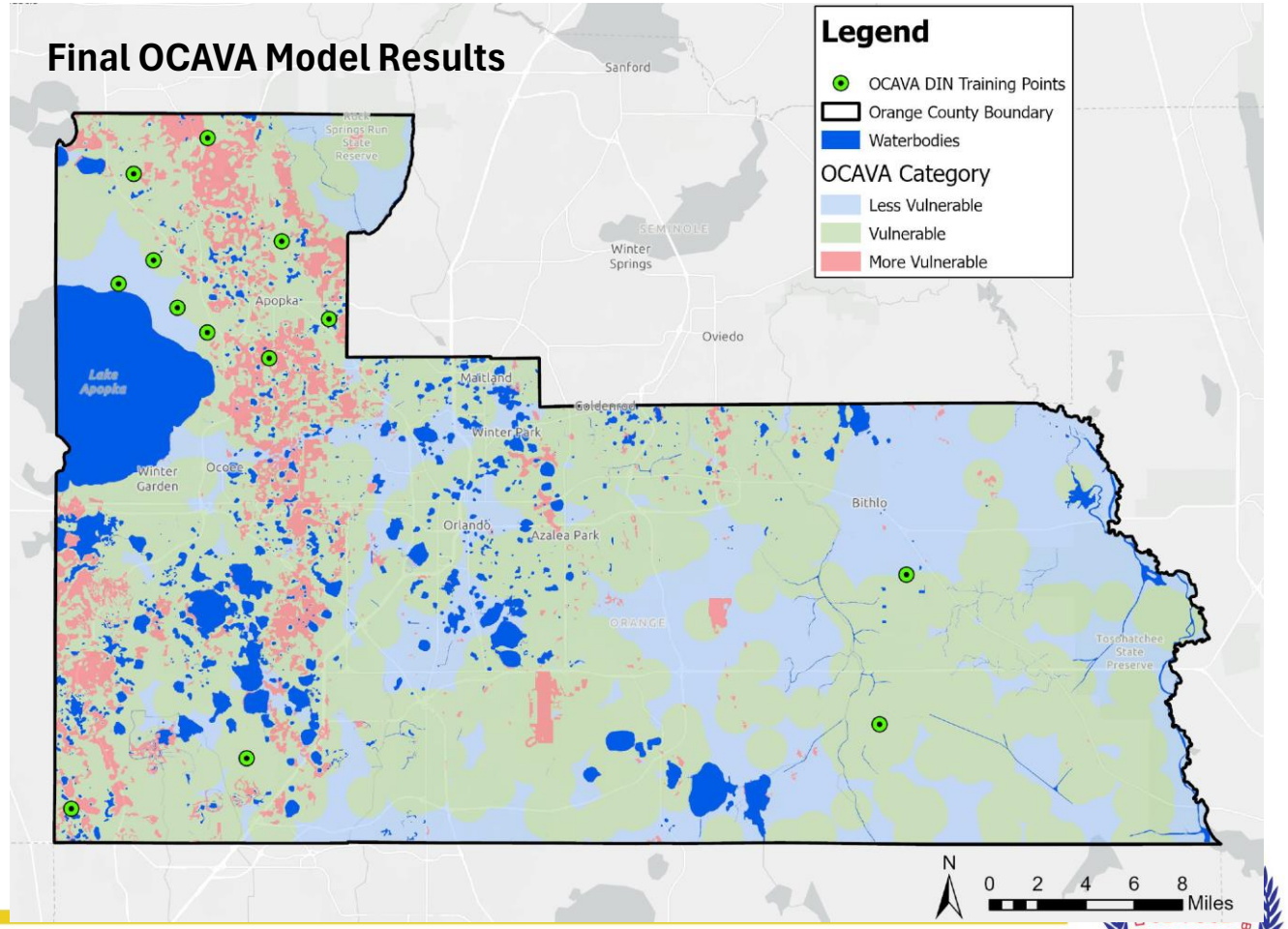
Data Driven



Aquifer Vulnerability Assessment

Higher GW N Concentration = Increased Vulnerability





Waterbodies of Interest (WOIs)

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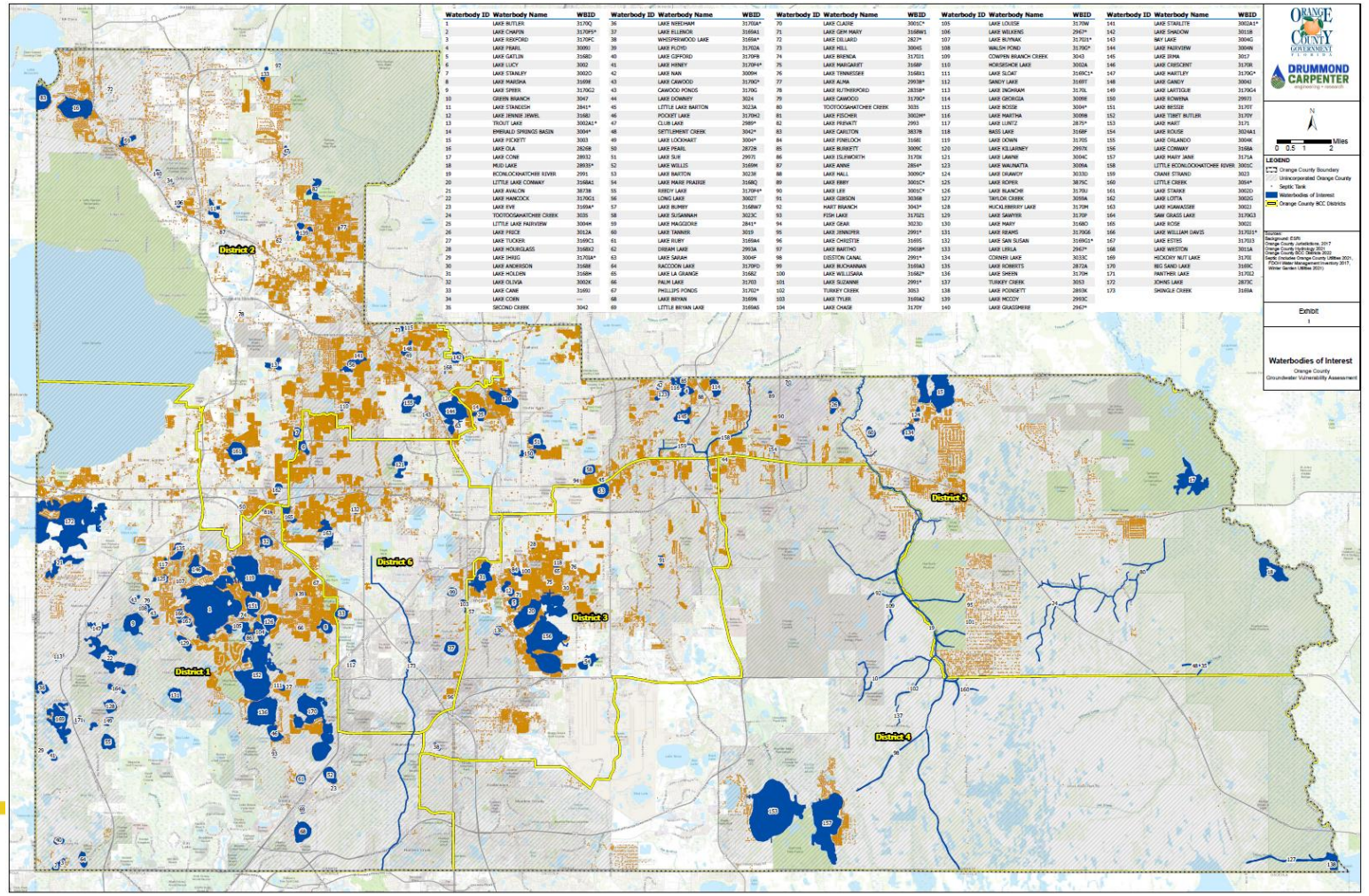
engineering + research

Which waterbodies should we consider adding greater protection from septic?

- **173 identified in Orange County**
  - Associated with a BMAP,
  - assigned a TMDL,
  - on the Verified List
  - associated with an OFW Outstanding Florida Waters,
  - within a closed basin or karst area,
  - adjacent to areas with a high density of septic systems, or
  - are considered important waterbodies of Orange County.

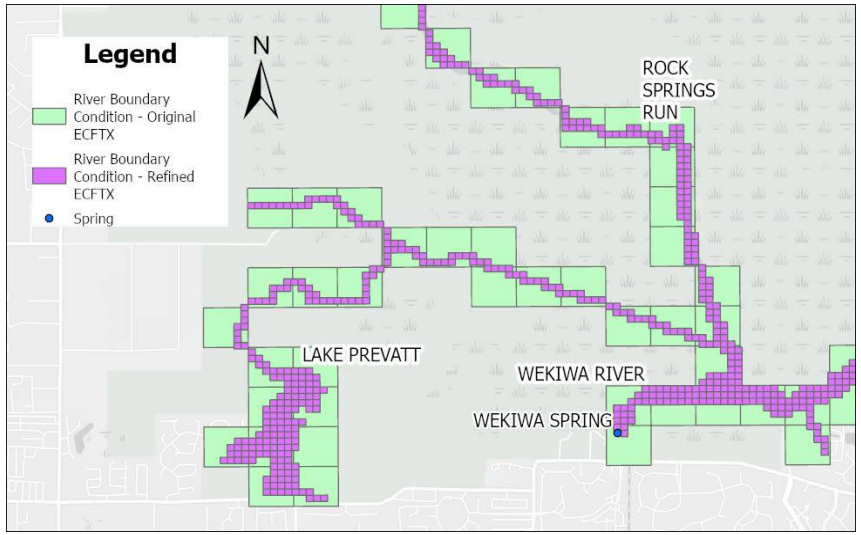


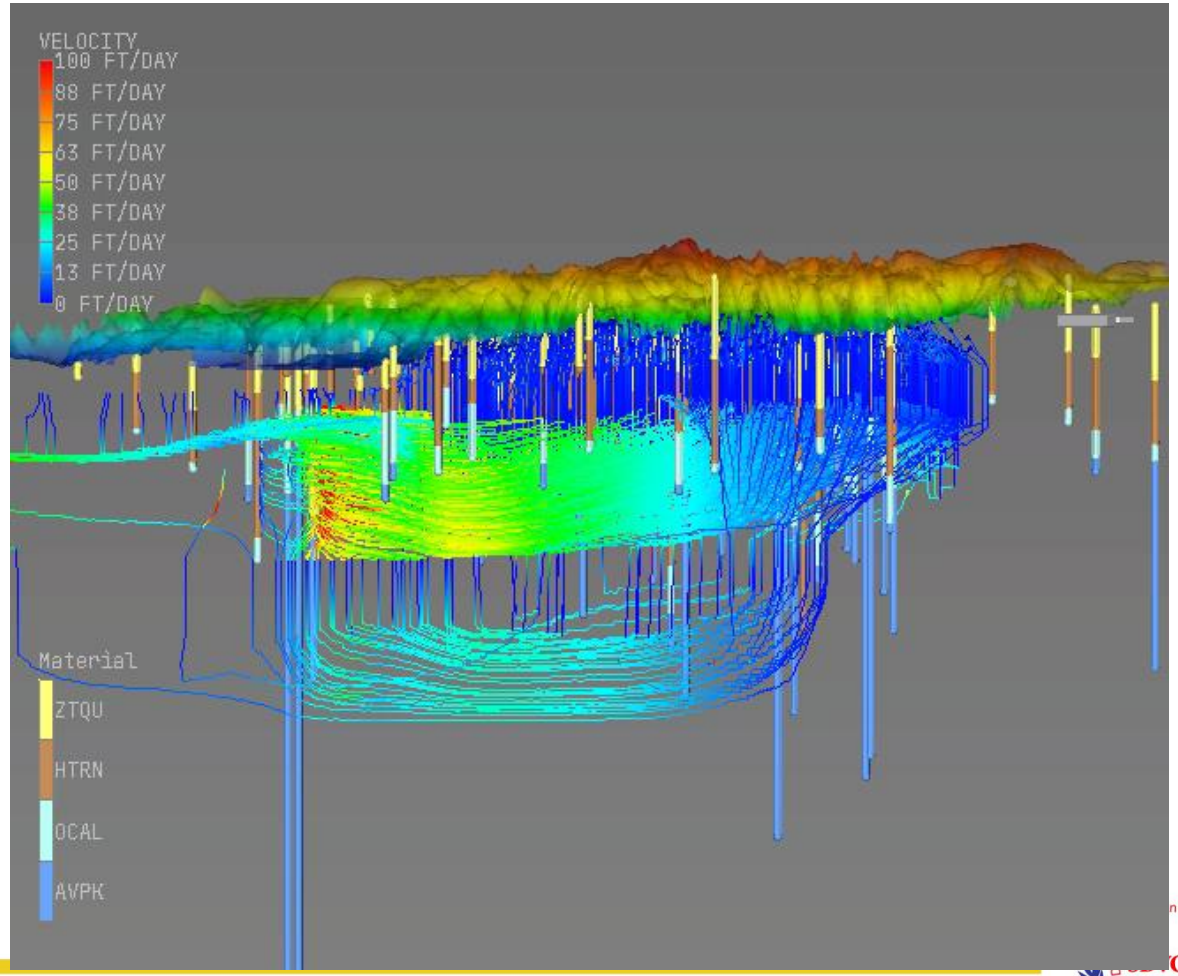
Waterbodies of Interest

What areas around the waterbodies contribute pollutants from septic?

Identify Groundwater Influence Zones

- **Modified regional ECFTX model**
- **Simulated influence zones for the Waterbodies of Interest**





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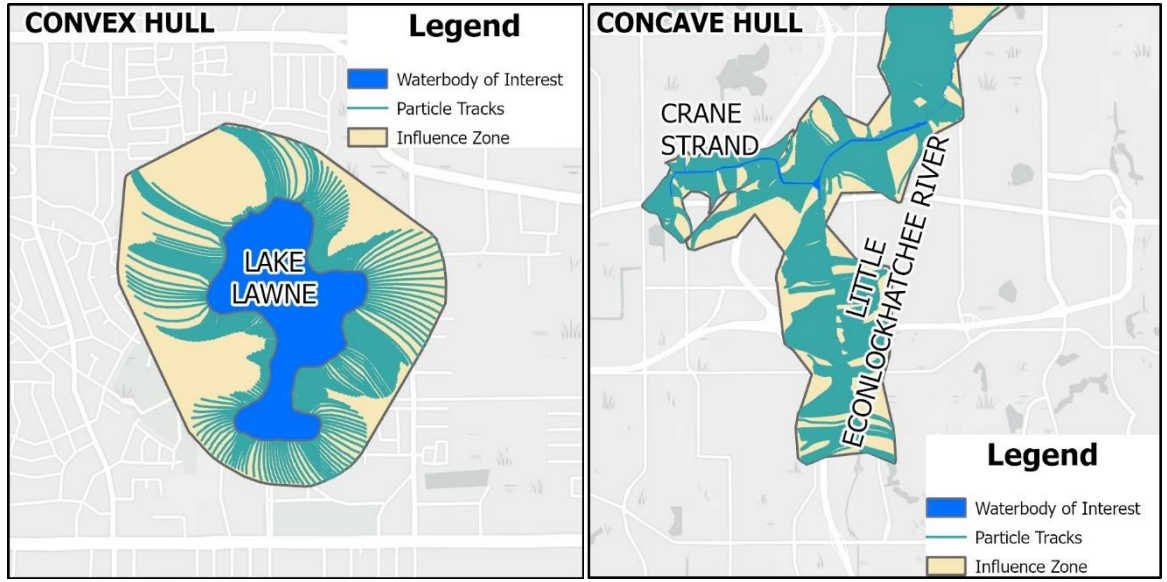

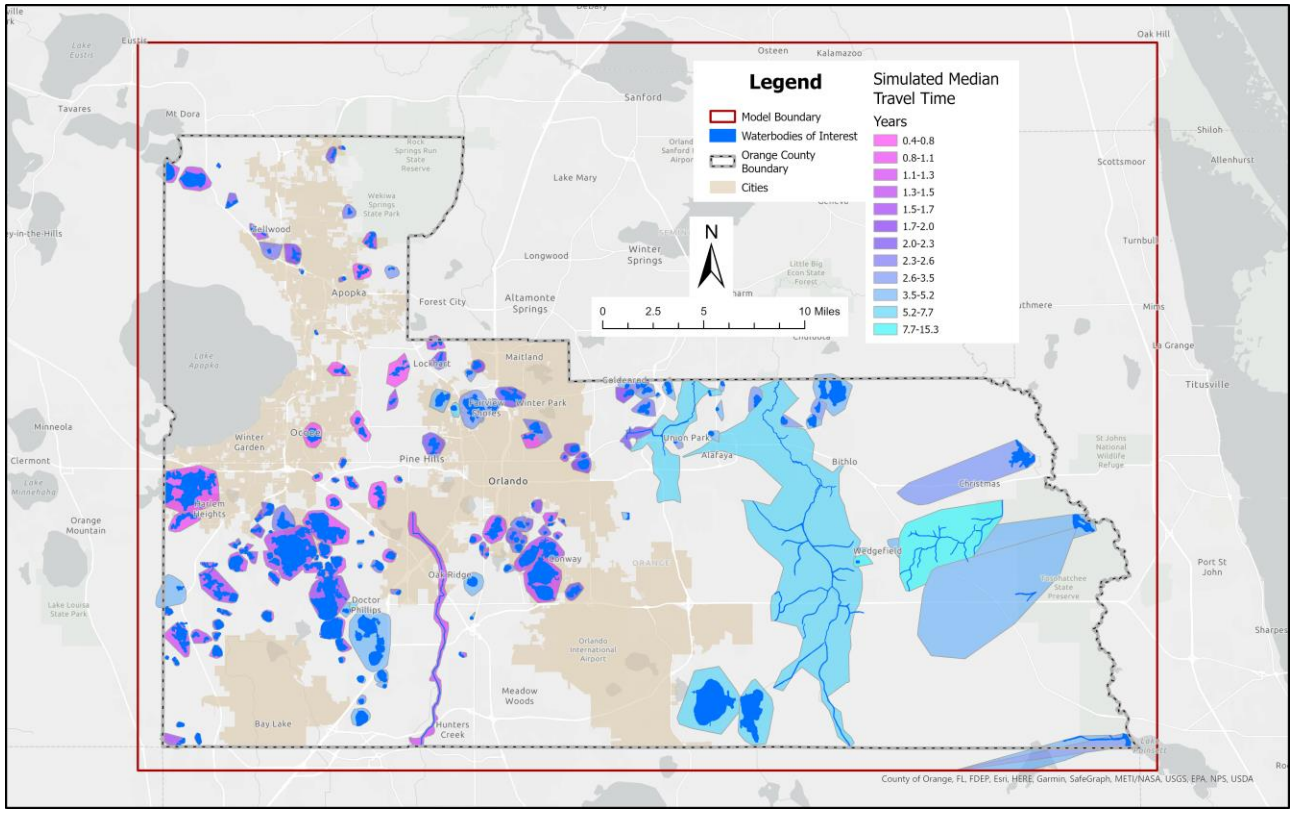

Spatial Analysis

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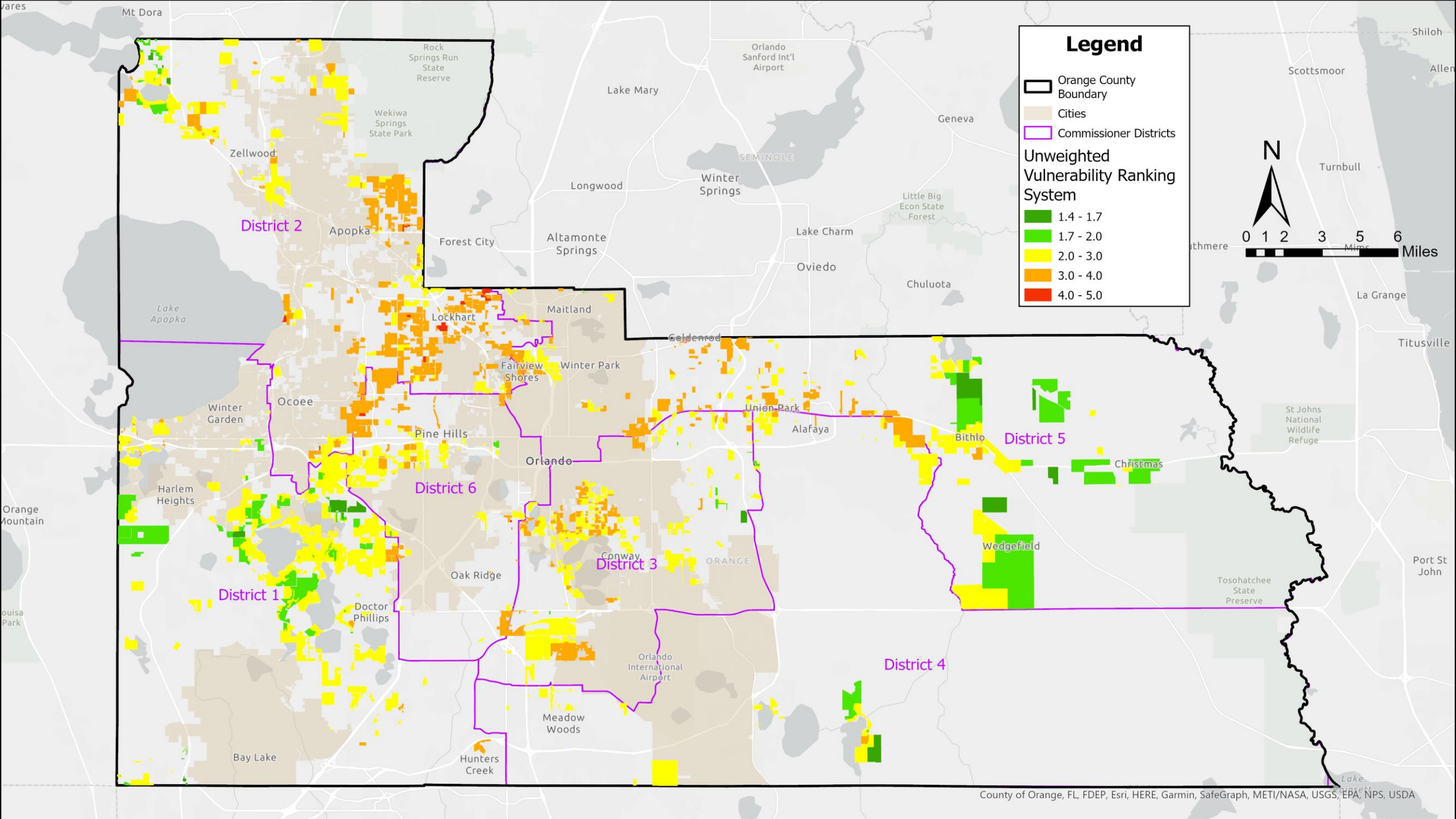
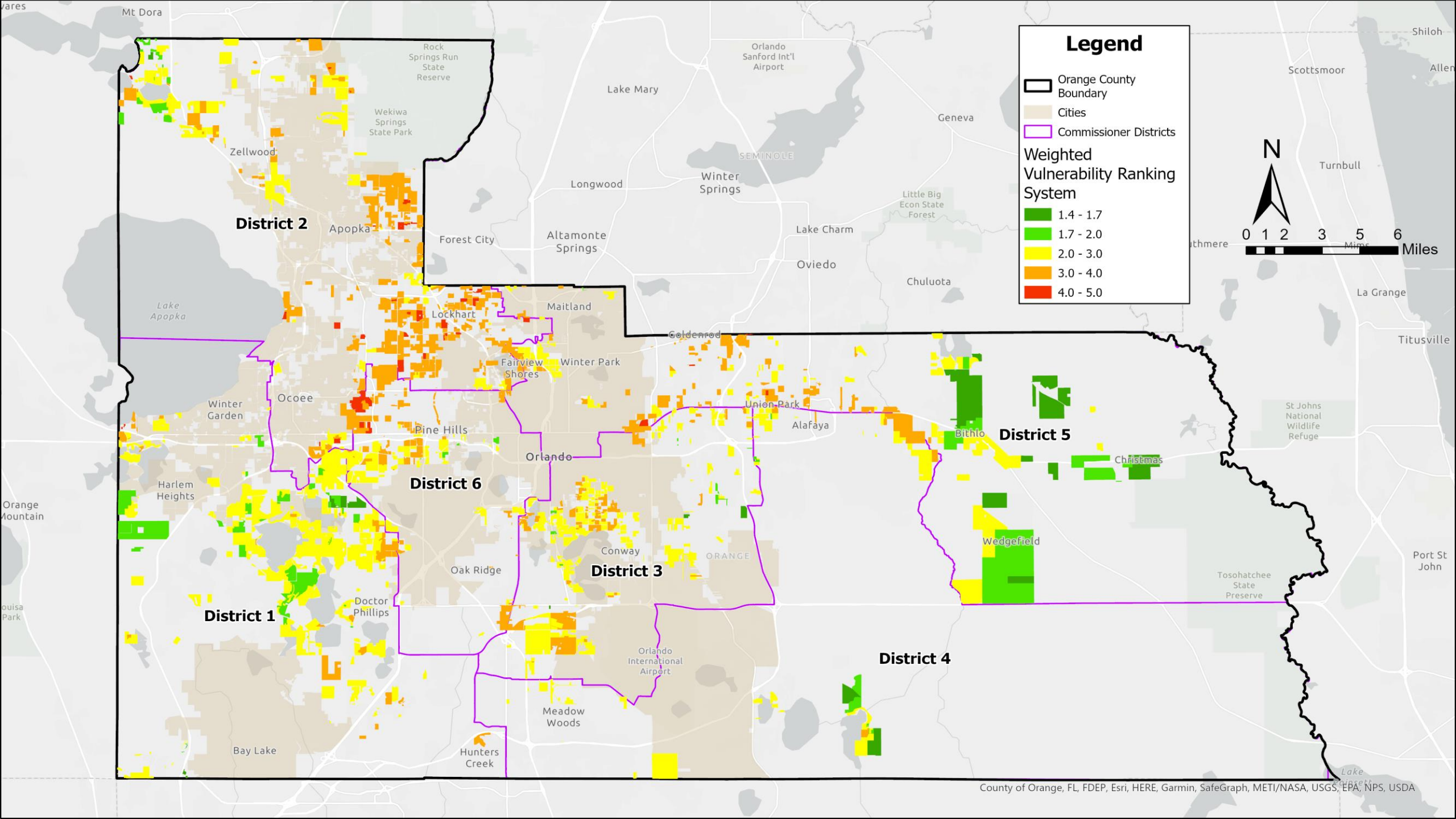
Which subdivisions on septic (>50%) are more likely to contribute to water quality impairment?

Ranking System Parameters

VARIABLE NAME	UNWEIGHTED VULNERABILITY RANKING SYSTEM	WEIGHTED VULNERABILITY RANKING SYSTEM
SEPTIC DENSITY (#/ACRE)	1	2
OCAVA VULNERABILITY CATEGORY	1	2
PERCENT SUBDIVISION IN IMPAIRED WATERSHED OR SPRINGSHED	1	2
HOUSING DENSITY CHANGE (2020-2050)	1	0.5
POPULATION DENSITY CHANGE	1	1
MEAN YEAR BUILT	1	1
MEAN DISTANCE TO WATERBODY (METERS)	1	2
MEAN SURFACE ELEVATION (FT)	1	1


Legend
Orange County Boundary
Cities
Commissioner Districts
Unweighted Vulnerability Ranking System
1.4 - 1.7
1.7 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
N
0 1 2 3 5 6
Miles
District 1
District 2
District 3
District 4
District 5
District 6
Mt Dora
Rock Springs Run State Reserve
Wekiwa Springs State Park
Zellwood
Apopka
Lake Apopka
Orlando Sanford Int'l Airport
Lake Mary
Geneva
Longwood
Winter Springs
SEMINOLE
Little Big Econ State Forest
Forest City
Altamonte Springs
Lake Charm
Oviedo
Chuluota
Shiloh
Scottsmoor
Turnbull
La Grange
Titusville
Lockhart
Maitland
Goldenrod
Fairview Shores
Winter Park
Winter Garden
Ocoee
Pine Hills
Orlando
Union Park
Alafaya
Bithlo
Christmas
St Johns National Wildlife Refuge
Harlem Heights
Orange Mountain
Conway
ORANGE
Oak Ridge
Wedgefield
Port St John
Tosohatchee State Preserve
Doctor Phillips
Orlando International Airport
Meadow Woods
Bay Lake
Hunters Creek
County of Orange, FL, FDEP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA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1.4 - 1.7
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Miles
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La Grange
Titusville
Port St John
Lake Poinsett
County of Orange, FL, FDEP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA

Water Quality Modeling

What happens when leachate leaves the drainfield?

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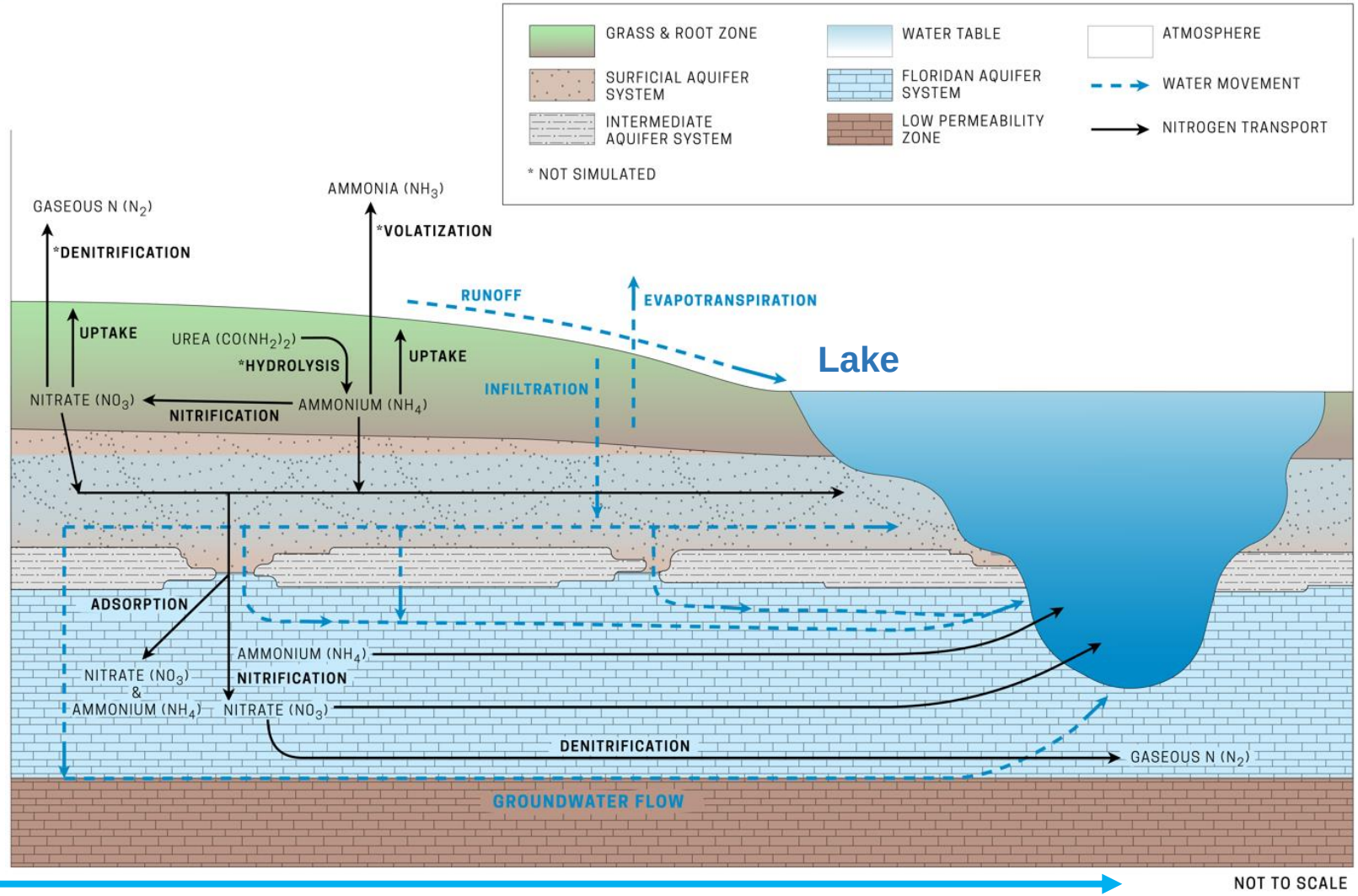
Leaching Model
STUMOD+FL

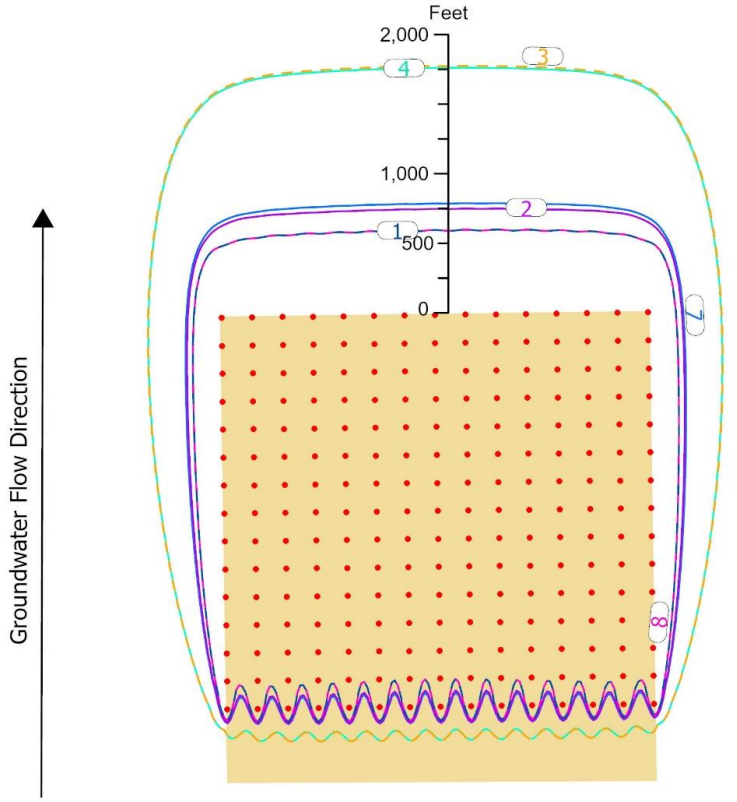
Reactive Transport Model
MODFLOW + MT3D



SDVOSB Service Disabled Veteran Owned Small Business cVE

Water Quality Modeling

MODELING SCENARIO	DEPTH TO GW	SOIL HYDRAULIC CONDUCTIVITY	SEPTIC SYSTEM TYPE
1	10 ft	10 ft/day	Conventional
2	2 ft	1.5 ft/day	Advanced
3	2 ft	10 ft/day	Conventional
4	2 ft	1.5 ft/day	Conventional
5	10 ft	1.5 ft/day	Advanced
6	10 ft	10 ft/day	Advanced
7	2 ft	10 ft/day	Advanced
8	10 ft	1.5 ft/day	Conventional



1 mg/L Nitrate-N Plume Extents at the End of 40-year Simulation

Note: Extent of 1 mg/L nitrate-N plume at the end of the 40-year model simulation shown for Scenarios 1-4, 7, and 8. Plume extents not shown for Scenarios 5 and 6 as nitrate-N plume concentrations did not exceed 1 mg/L.

Legend

- Septic Tanks
- Scenario 1
- Scenario 2
- Scenario 3
- Scenario 4
- Scenario 7
- Scenario 8
- Subdivision

ORANGE COUNTY GOVERNMENT FLORIDA

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Water Quality Modeling

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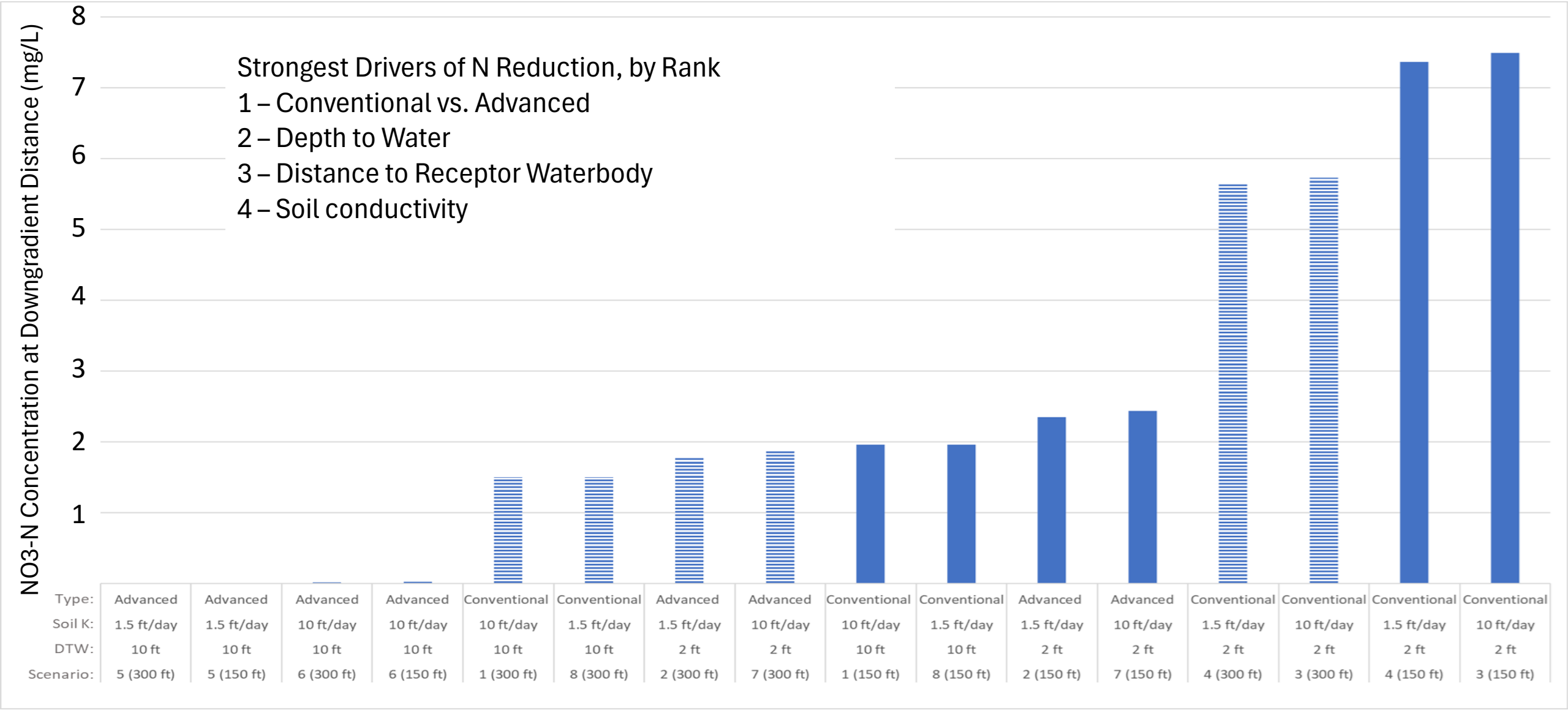
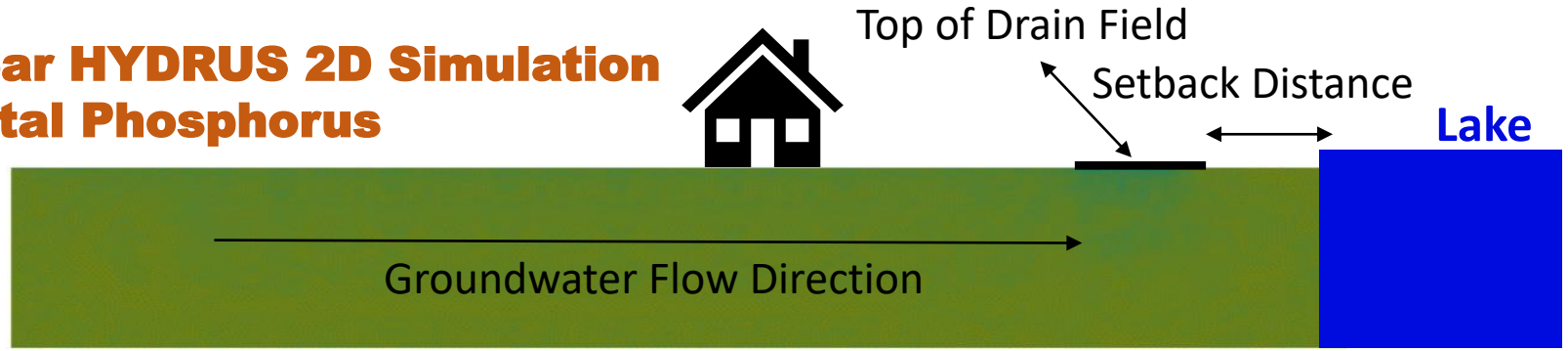


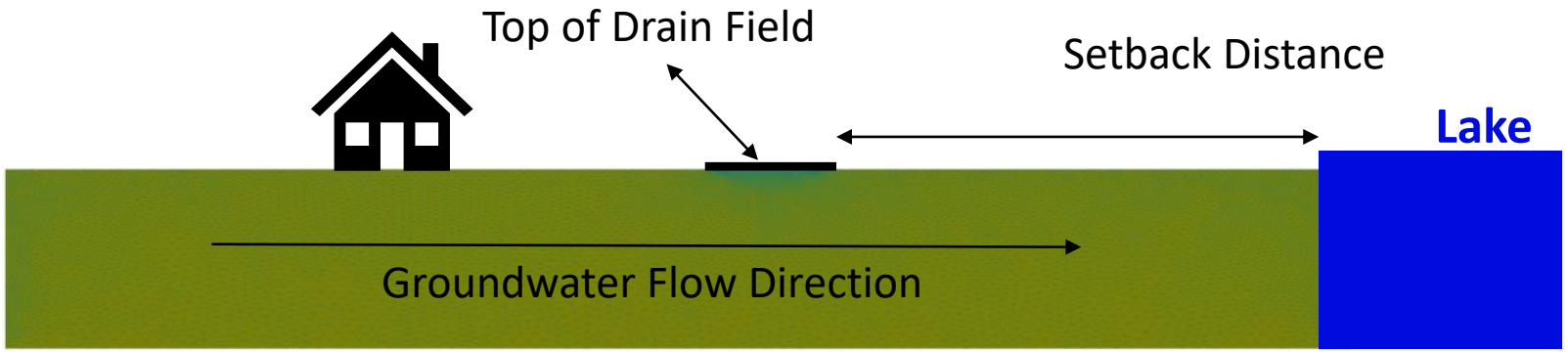
Water Quality Modeling

40-Year HYDRUS 2D Simulation Of Total Phosphorus



50 ft Setback

Sandy Soil



300 ft Setback

Loamy Soil

Priority Vulnerability Areas

How Should we Prioritize Septic Subdivisions?

$$Cumulative\ PVA\ Vulnerability\ Score = \sum_{i}^{n} (V_w * A_{sd})$$

$$Normalized\ PVA\ Vulnerability\ Score = \frac{\sum_{i}^{n} (V_w * A_{sdPVA})}{A_{PVA^*}}$$

Where:

V_w = Weighted vulnerability ranking score for the subdivision

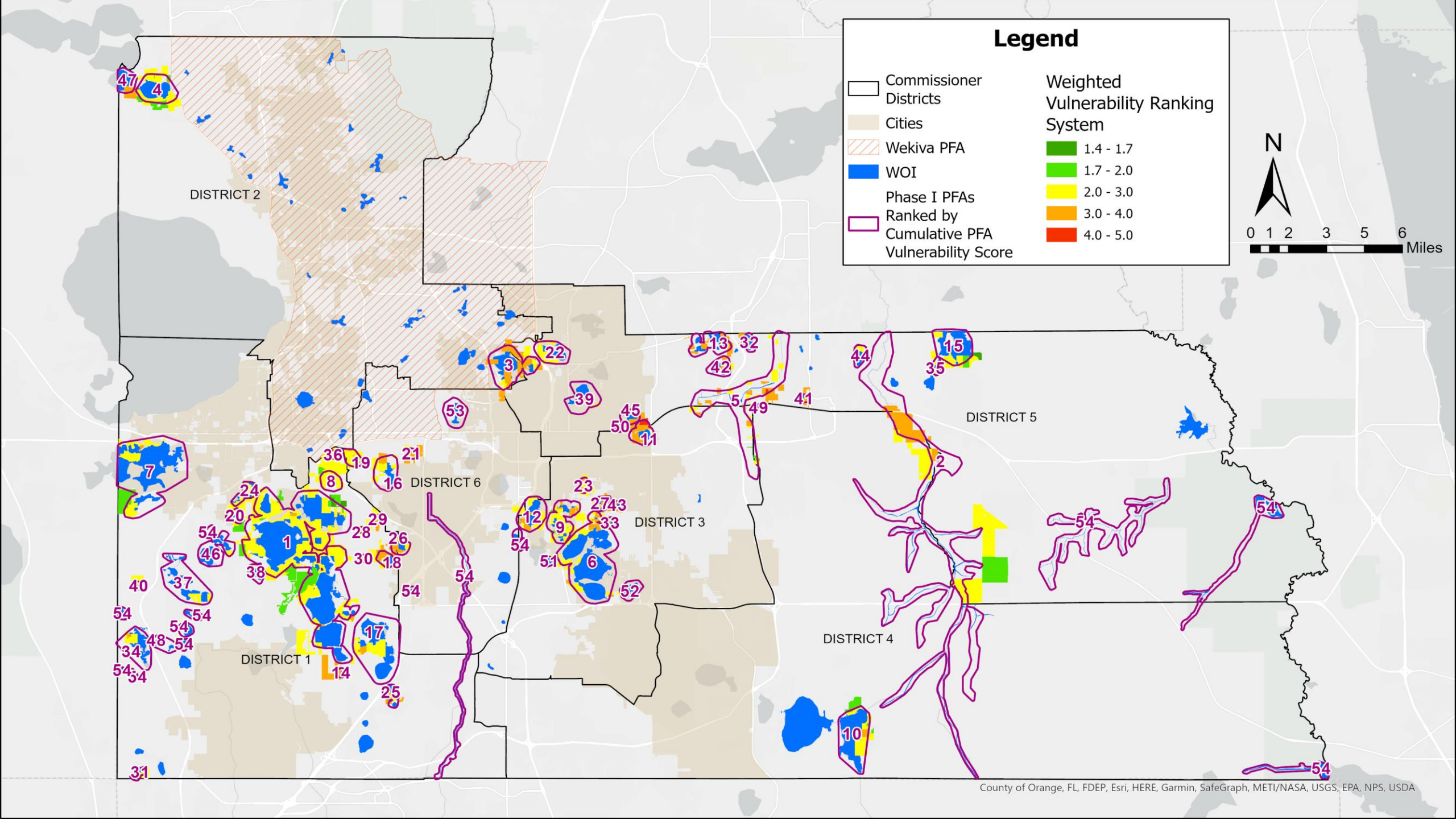
A_{sd} = Total area of the subdivision area (acres)

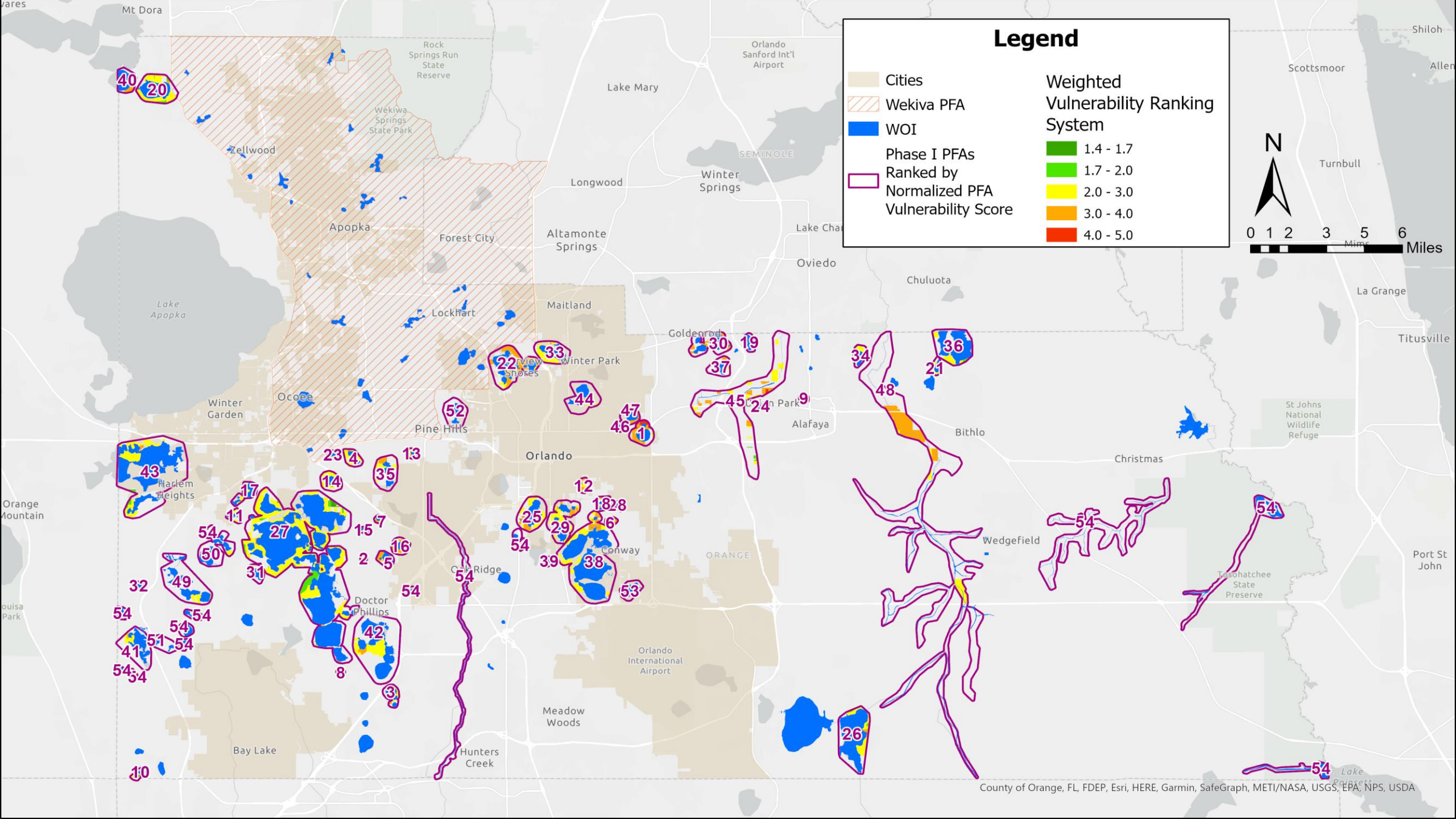
A_{sdPVA} = Area of subdivision within the PVA (acres)

A_{PVA^*} = PFA area excluding Waterbodies of Interest (acres)

i = Individual septic subdivision within the PVA

	Weighted Ranking System Score			Total
	≥ 4	3 – 4	≤ 3	
Total Number of Subdivisions included in Ranking Analysis	68	802	1040	1910
Total Number of Subdivisions within PVAs	6	215	450	671


Legend
Commissioner Districts
Cities
Wekiva PFA
WOI
Phase I PFAs Ranked by Cumulative PFA Vulnerability Score
Weighted Vulnerability Ranking System
1.4 - 1.7
1.7 - 2.0
2.0 - 3.0
3.0 - 4.0
4.0 - 5.0
N
0 1 2 3 5 6
Miles
DISTRICT 1
DISTRICT 2
DISTRICT 3
DISTRICT 4
DISTRICT 5
DISTRICT 6
County of Orange, FL, FDEP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA


Legend
Cities
Wekiva PFA
WOI
Phase I PFAs Ranked by Normalized PFA Vulnerability Score
Weighted Vulnerability Ranking System
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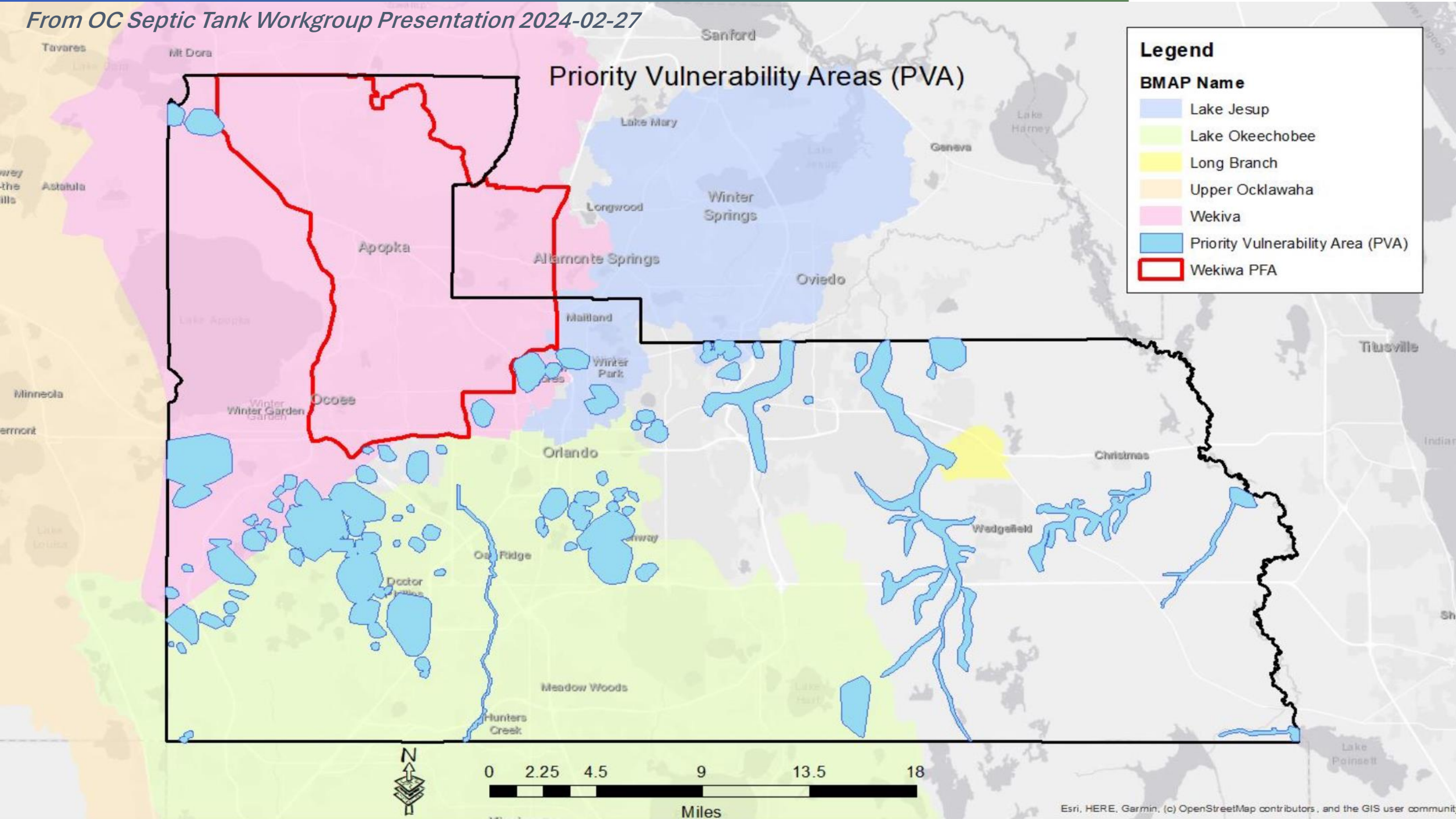
Zellwood
Longwood
Winter Springs
SEMINOLE
Apopka
Forest City
Altamonte Springs
Oviedo
Chuluota
Lake Apopka
Lockhart
Maitland
Goldenrod
Winter Park
Winter Garden
Ocoee
Pine Hills
Orlando
Alafaya
Bithlo
Christmas
Harlem Heights
Orange Mountain
Conway
ORANGE
Oak Ridge
Wedgefield
Doctor Phillips
Orlando International Airport
Meadow Woods
Bay Lake
Hunters Creek
Tosohatchee State Preserve
St Johns National Wildlife Refuge
Titusville
Port St John
La Grange
Turnbull
Scottsmoor
Shiloh
County of Orange, FL, FDEP, Esri, HERE, Garmin, SafeGraph, METI/NASA, USGS, EPA, NPS, USDA

Existing Septic Regulations

- Wekiwa and Rock Springs Priority Focus Area
  - New Septic Systems
    - Lots less than 1 acre will must use enhanced nitrogen-reducing systems (minimum 65% N removal)
  - Existing Septic Systems
    - No repairs of existing conventional septic systems on lots less than 1 acre (not yet enforced)
- BMAPs, Pollution Reduction Plans (PRPs), and Reasonable Assurance Plans (RAPs)
  - New Septic Systems
    - Lots less than 1 acre must use enhanced nitrogen-reducing systems (65% N removal)
  - Existing Septic Systems
    - No current upgrade requirements

From OC Septic Tank Workgroup Presentation 2024-02-27



County Policies Under Consideration
Existing Septic Systems

- No changes are proposed for existing septic systems
- Proposed new initiatives for vulnerable areas (State PFA + County PVAs)
  - Septic-to-Sewer
    - Continue existing program of septic to sewer within Wekiwa PFA
    - Expand the program to include County PVAs
    - Proposed funding = 25% OCU, 15% Resident, 60% State funding required
  - Septic Tank Upgrades for Homeowners
    - FDEP grant program
    - Wekiwa PFA upgrades
    - County PVA upgrades (if qualified for FDEP grants)

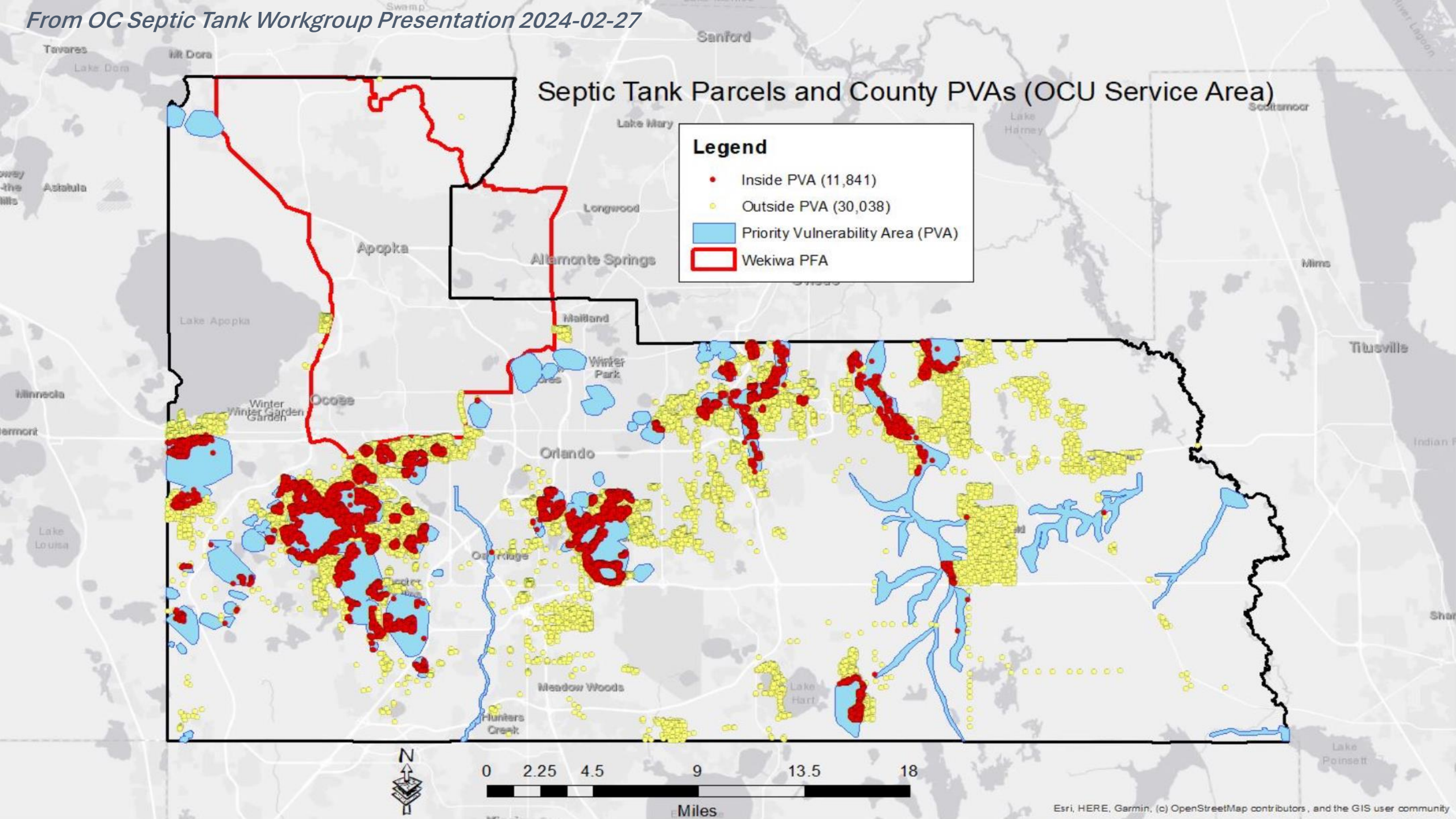
*Based on OC Septic Tank Workgroup Presentation 2024-02-27

County Policies Under Consideration
Existing Septic Systems

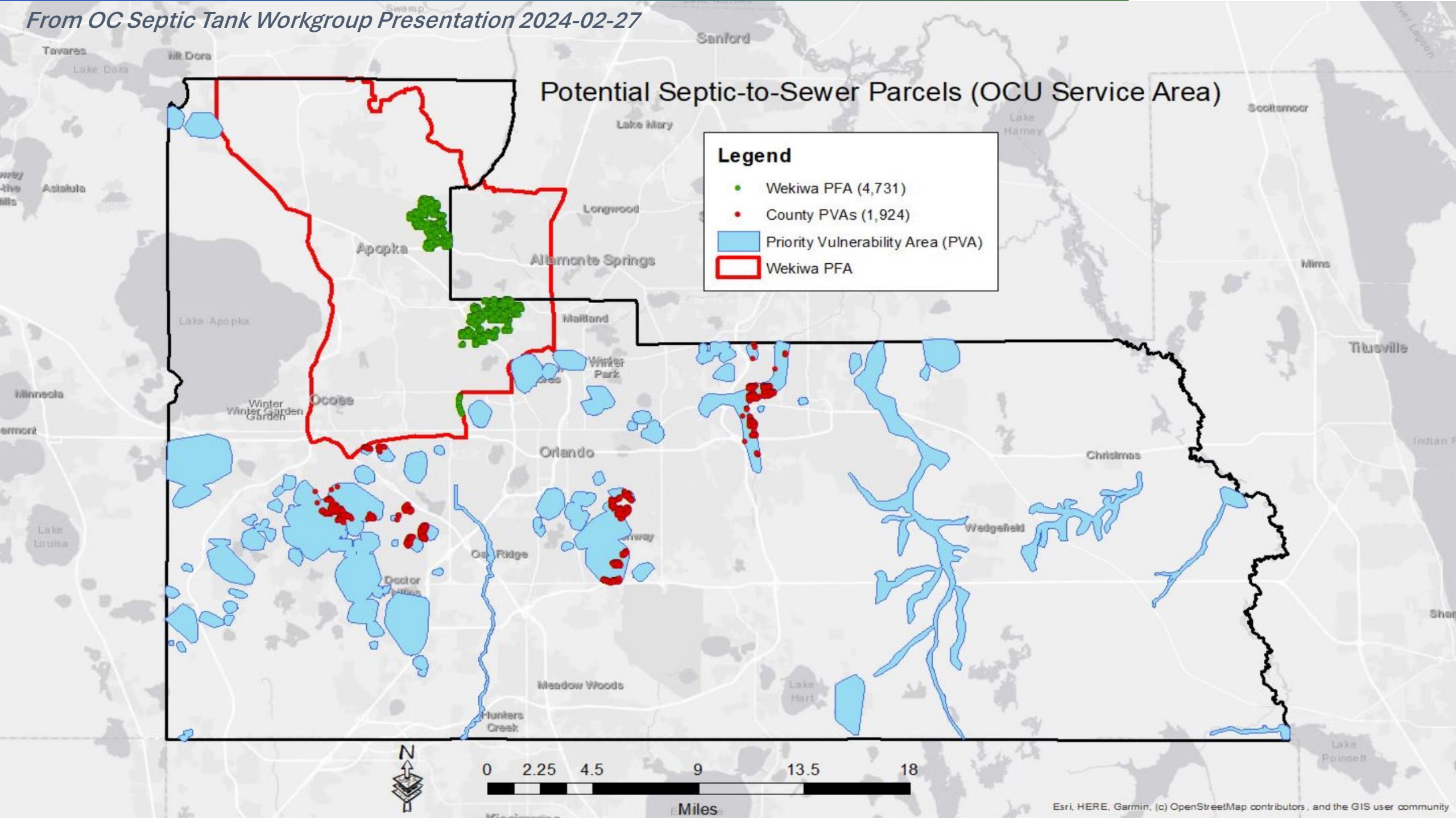
- Where sewer is not available on lots less than 1 acre in County PVAs
  - Require enhanced septic systems with minimum 65% nitrogen reduction
    - A requirement already within BMAPs/RAPs/PRPs
  - Require variances for septic systems proposed within 150 feet from any waterbody
    - Approved variances would require enhanced septic systems with 80% nitrogen reduction

*Based on OC Septic Tank Workgroup Presentation 2024-02-27

From OC Septic Tank Workgroup Presentation 2024-02-27



From OC Septic Tank Workgroup Presentation 2024-02-27



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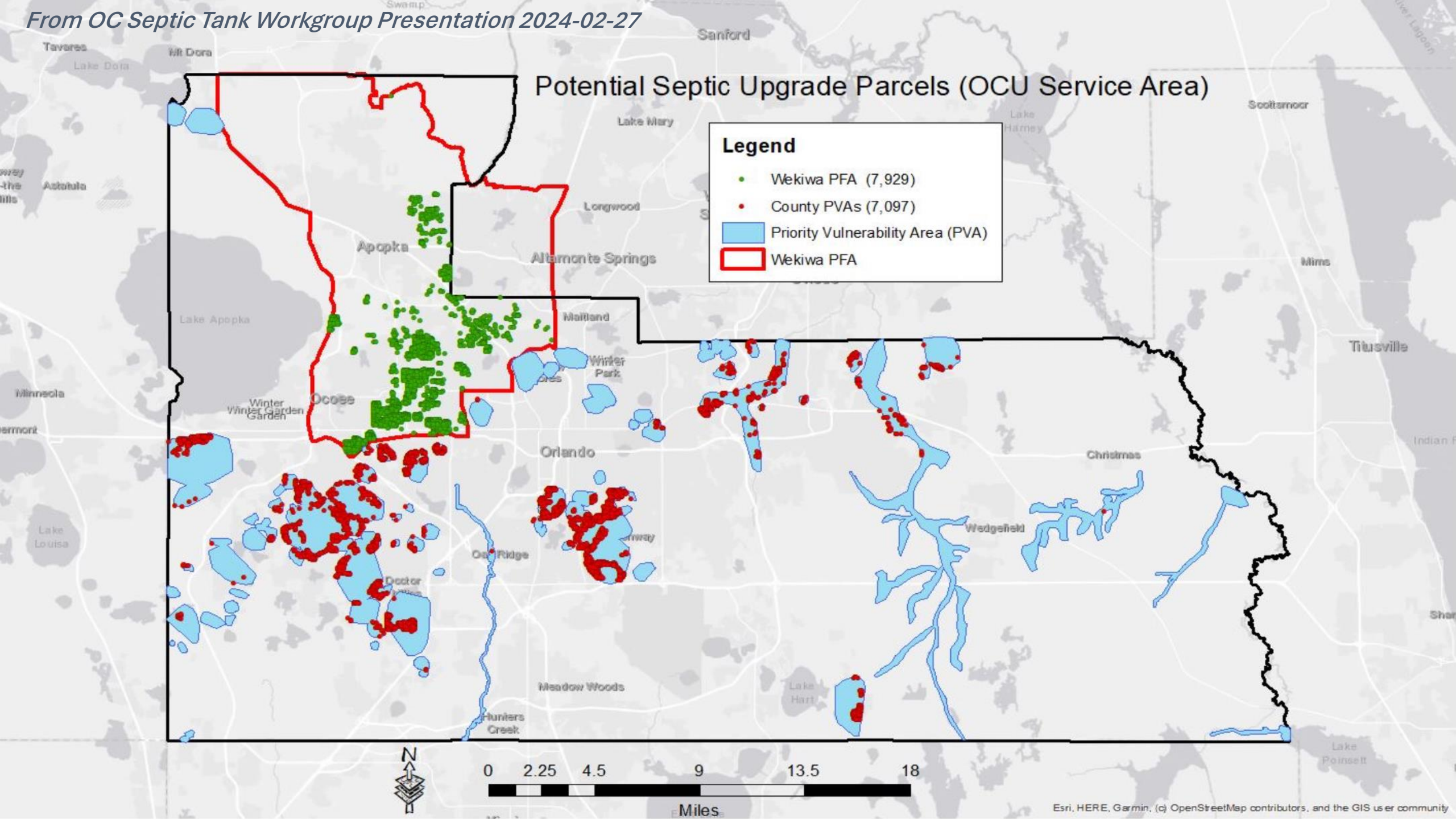
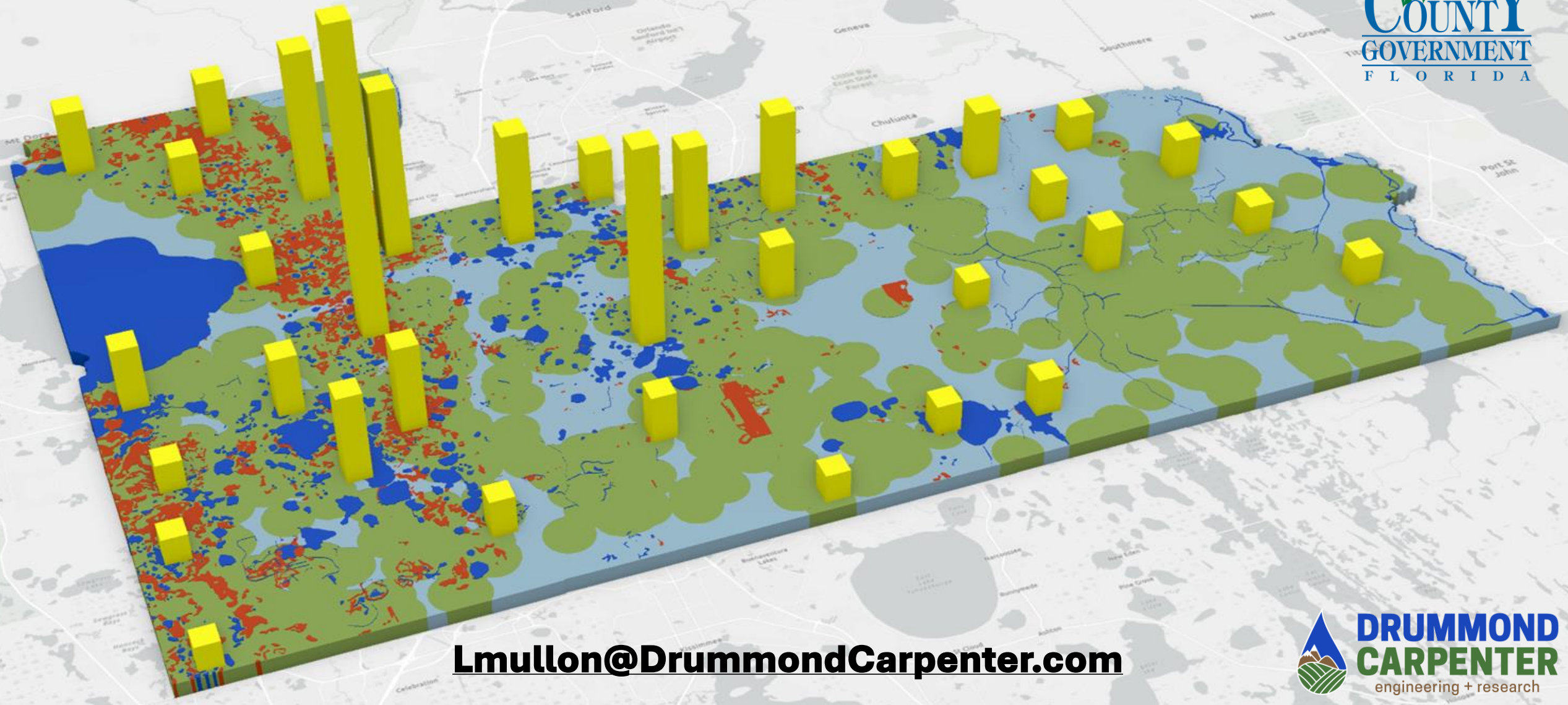


THANK YOU!



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