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To: City of Alachua

From: Khiem Tran, Ph.D.
Professor of Geotechnical Engineering

Statement Supporting the Need for Additional Subsurface Imaging for Tara April Project and Associated Development

I am writing to provide professional geotechnical and geophysical input regarding the proposed Tara April floodplain compensation project and the associated Tara Phoenicia roadway and Tara Forest West development. Based on the available information and my expertise in subsurface characterization in karst environments, I strongly support the need for *additional subsurface investigation and imaging prior to final design and construction*.

1. Site-Specific Geological and Hydrogeological Concerns

The proposed development is located directly over and adjacent to a mapped subsurface cave system, within a region known for active karst processes, proximity to the Cody Scarp, and inclusion within the cross-county fracture zone. These factors collectively create conditions highly favorable for *cover-collapse sinkholes, subsidence, and rapid groundwater transport*.

Of particular concern is the verified rapid hydraulic connectivity in this area, with *groundwater travel times on the order of days* (approximately 12 days) rather than centuries, as observed in less vulnerable regions of the Floridan Aquifer system. This level of connectivity substantially elevates the risk that construction-related disturbance, surface loading, or changes in drainage could directly impact regional groundwater quality.

While portions of the cave system have been physically mapped by human divers, it is well established that diver-accessible mapping captures only a fraction of total subsurface void space. Smaller conduits, collapse-prone cavities, sediment-filled voids, and fracture-controlled extensions commonly remain undetected without volumetric subsurface imaging.

2. Risks of Proceeding Without Additional Subsurface Exploration

Designing and constructing Tara Phoenicia directly over an incompletely characterized cave system introduces several significant risks:

a) **Structural and Public Safety Risks**

Undetected voids or weakened rock zones may lead to progressive subsidence or sudden cover-collapse sinkholes, particularly under roadway embankments and concentrated loads.

b) **Long-Term Infrastructure Performance**

Differential settlement can result in chronic maintenance issues, roadway deformation, and premature failure, imposing long-term costs on the City and developers.

c) **Water Resource Impacts**

Earthwork associated with Tara Forest West, combined with roadway construction, may alter recharge pathways, increase turbidity, mobilize sediments, or introduce contaminants directly into the aquifer through karst conduits.

d) **Regulatory and Liability Exposure**

Development without reasonable characterization of known karst hazards increases exposure to future remediation, emergency response, and environmental liability.

3. Recommended Seismic Subsurface Investigation Methods

Given the geological complexity and known karst conditions at this site, I recommend the use of **three-dimensional (3D) active and passive seismic subsurface imaging methods** as the primary means of subsurface characterization:

- **3D Active Seismic Full-Waveform Tomography**

Active seismic testing uses controlled surface sources and dense receiver arrays to generate high-resolution, three-dimensional images of subsurface stiffness and rock quality. Full-waveform tomography is capable of detecting:

- Subsurface voids and cavities
- Highly fractured or weakened limestone zones
- Variations in material properties relevant to roadway and embankment performance

This method has been successfully applied in Florida karst environments to image voids at depths relevant to transportation and infrastructure projects.

- **3D Passive Seismic (Ambient Noise) Tomography**

Passive seismic methods utilize naturally occurring ground vibrations to characterize subsurface conditions over broader areas and at greater depths. These methods are particularly effective for:

- Imaging deeper karst features and conduits
- Identifying zones of anomalously low stiffness associated with voids or weakened rock
- Establishing baseline conditions suitable for long-term monitoring and early warning of ground instability

The use of 3D active or passive seismic imaging provides a volumetric and continuous understanding of subsurface conditions that cannot be achieved through limited point-based testing alone.

4. Professional Recommendation

Given the known presence of subsurface caves, the high susceptibility to sinkhole formation, and the exceptional vulnerability of regional groundwater resources, it is my professional opinion that 3D active or passive seismic subsurface imaging is warranted and necessary before proceeding with final site design and construction.

These studies will reduce uncertainty, inform safer design decisions, and support responsible development that protects public safety, infrastructure performance, and regional water resources. Supporting examples of these methods and their application are provided in the attached *3D subsurface imaging* documentation.

Respectfully,

A handwritten signature in blue ink, appearing to read 'Uke', with a long horizontal flourish extending to the right.

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