QUERY: WHAT ARE THE MECHANICS INNOVATIONS PROPOSED BY THE CITY OF DELTONA TO CONTAIN CONTAMINENTS IN A POROUS LIMESTONE KARST SYSTEM.

ANSWER: THEY DON'T EXIST. PROVE ME WRONG

We can support innovation, but not at the cost of permanently compromising the Aquifer that supplies every home in this city. Once the aquifer is contaminated, there is no fixing it.
~ Christine Peacock

This is not about slogans like '**toilet-to-tap**.' The real issue is that true potable reuse does not require injecting anything into the aquifer. My concern is the irreversible risk of injecting modified wastewater into a porous karst aquifer. Once contaminants enter the Floridan Aquifer, they cannot be removed. This is our only drinking water source, and we should not use it as a disposal vessel.

Chapter 62-610 is a general regulatory framework that allows utilities to propose groundwater recharge projects, but it does not provide a proven design, a validated treatment train, or any demonstrated method for containing contaminants in a porous, fractured karst aquifer like the Upper Floridan.

1. What the City Is Actually Promoting

- This comes from Florida's **Potable Reuse Rule (62-610)**
- It is **not** the same as "toilet-to-tap" used in other states
- True potable reuse uses **advanced treatment** and **surface reservoirs**
- **Florida's version allows injecting treated wastewater into the Floridan Aquifer(!!!)**

2. The Real Issue: Aquifer Injection

- The Floridan Aquifer is a **karst system** — fractured, porous, unpredictable
- Karst does **not** naturally filter contaminants
- Injected water can travel miles through underground conduits
- Once something enters the aquifer, **there is no way to remove it**

3. How Florida's Approach Differs From Other States

- Other states do **not** inject into karst aquifers
- They use:Microfiltration, reverse osmosis. advanced oxidation, real-time monitoring
    - surface reservoirs for blending
- **Florida is trying to use the aquifer as a storage tank, which it is not**

4. Irreversible Risks

- **No natural filtration** in karst geology
- Unpredictable flow paths — contamination can bypass monitoring wells
- **Emerging contaminants persist**, including:
    - PFAS
    - pharmaceuticals
    - endocrine disruptors
    - microplastics
- Even advanced treatment cannot fully remove these
- **Groundwater contamination can last centuries**

5. Why This Matters for Deltona

- The Floridan Aquifer is **our only drinking water source**
- Damage to it is **permanent and cannot be reversed**
- This is not a reversible experiment
- Residents deserve full clarity about what “reuse” means in Florida
- We should not adopt a process that risks **irreparable harm** to the water supply

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6. Water Treatment Chemicals and Karst Aquifer Integrity

Florida’s potable reuse framework focuses on meeting water quality targets at the plant and at monitoring points, but it does **not** fully address how treatment chemicals and residuals interact with a **porous limestone karst aquifer** over decades.

a. Chemical additives used in advanced treatment

Treated wastewater destined for recharge typically involves multiple chemical additives, including:

- **Coagulants and flocculants:** aluminum or iron salts, polymers used to remove particles.
- **Anti-scalants and corrosion inhibitors:** phosphonates, polyphosphates, or other agents to prevent mineral scaling and protect infrastructure.
- **pH adjustment and alkalinity control:** acids or bases to optimize treatment and disinfection.
- **Disinfectants and oxidants:** chlorine, chloramines, ozone, hydrogen peroxide, UV-AOP byproducts.
- **Residual organic carbon sources:** sometimes added to support biological processes.

Even when these chemicals are largely consumed in treatment, **residual concentrations** and **reaction byproducts** remain in the water that is ultimately injected.

b. Geochemical effects on limestone and confining units

The Floridan Aquifer is primarily composed of **carbonate rocks** (limestone and dolomite) that are highly sensitive to changes in pH, alkalinity, and ionic composition. Treatment chemicals can:

- **Increase dissolution of limestone:**
  - Acidic conditions, complexing agents, and certain phosphates can enhance calcite and dolomite dissolution.
  - Over time, this can **enlarge fractures and conduits**, increasing karstification and reducing the integrity of any confining layers.
- **Alter mineral equilibria:**
  - Changes in carbonate chemistry can shift the balance between dissolution and precipitation.
  - This can clog some pores while **opening others**, making flow paths more unpredictable.

- **Mobilize metals and other constituents:**
    - Changes in redox conditions and pH can mobilize naturally occurring metals or previously sorbed contaminants.

In a **layered system** where an upper potable zone overlies a deeper brine zone, increased dissolution and new conduits can **compromise the separation** between them, raising the risk that brine or contaminants migrate into the potable zone.

c. Interaction with deeper brine and density effects

If the lower zone contains **higher-salinity brine**, the density contrast between injected water and native fluids becomes critical:

- Injecting less dense, chemically modified water into or above a brine zone can:
    - Create **unstable density gradients**.
    - Promote **vertical mixing** along fractures and conduits.
- If treatment chemicals enhance dissolution along these pathways, they may **accelerate the formation of vertical conduits** that connect the brine zone to the upper aquifer.

Any breach between the upper Floridan Aquifer and a deeper brine zone would be **effectively irreversible** at the city scale.

d. Long-term persistence and lack of remediation options

Many **emerging contaminants** (PFAS, pharmaceuticals, endocrine disruptors, microplastics) are designed to resist breakdown. Even with advanced treatment, **trace levels remain** and are carried into the aquifer:

- Karst systems provide **minimal natural attenuation** for these compounds.
- Once distributed through a regional karst aquifer, there is **no practical way to extract or treat** the contaminated groundwater at scale.
- The same is true for **geochemical changes**—once fractures are enlarged or confining units compromised, there is no way to “rebuild” the rock.

Direct question to the City:

What specific geochemical studies, pilot tests, and long-term modeling has the City of Deltona conducted to demonstrate that the full suite of treatment chemicals, residuals, and byproducts will *not*:

- Increase dissolution of limestone or confining units,
- Create or enlarge vertical conduits between the upper potable aquifer and deeper brine zones, or
- Compromise the long-term integrity of the Floridan Aquifer as a drinking water source?

Until those mechanics and protections are clearly demonstrated—not just asserted—the honest answer to your query stands:

<u>ISSUES MISSING FROM THE CITY OF DELTONA INDEPTH PRESENTATION</u>

(information to **ASK** of the engineers and geologists)

Missing: Site-specific geology and confinement

- Identify which **Floridan Aquifer zone** Deltona intends to inject into (Upper vs Lower).
- Describe the **confining units** (if any) between the injection zone and the potable zone—thickness, continuity, known breaches, sinkholes, paleokarst.
- Ask for **site-specific karst mapping**: dye tracing, borehole imaging, fracture mapping, and any evidence of vertical conduits that could connect upper and lower zones.

Missing: Hydraulic "containment" mechanics

- Require a clear explanation of **how they claim to contain a plume in porous karst**:
  - Hydraulic mounding? Recovery wells? Pressure control? Directional flow control?
- Ask for **numerical groundwater modeling** outputs:
  - Assumptions about porosity, fracture networks, anisotropy, and dispersivity in karst.
  - Sensitivity analyses showing what happens under drought, heavy pumping,
  - or well failure.
- Demand **failure scenarios**:
  - Loss of power, pump failure, well casing failure, unexpected conduit, or confining unit breach.
  - Time to detection and time to impact on potable wells.

Missing: Monitoring network limitations

- Require a map of **all monitoring wells**, screened intervals, and distances from injection.
- Ask how they address **karst bypass**—flow through conduits that never intersect a monitoring well.
- Ask for **detection limits and response time**:
  - How quickly can they detect a problem?
  - What is the **emergency response protocol** once contamination is detected?

Missing: Full treatment train and chemical inventory

- List **every treatment step** proposed under Rule 62-610 Part V (groundwater recharge and potable reuse).
- Require a **complete chemical inventory**:
  - Coagulants, anti-scalants, corrosion inhibitors, pH adjusters, disinfectants, residual oxidants, and any added carbon sources.
- Ask for **maximum and typical concentrations** of each chemical in the water at the point of injection.

Missing: Geochemical interaction with limestone and brine

- Require **geochemical modeling** (e.g., PHREEQC or equivalent) showing:
  - Effects of treatment chemicals on **calcite/dolomite dissolution** and precipitation.
  - Potential to **increase karstification** (enlarging fractures, conduits, or breaching confining layers).
  - Interaction with **deeper brine**—density differences, mixing, and potential upward migration.
- Ask for **lab or pilot data** specific to:
  - Florida limestone/karst samples.
  - The exact chemical recipe they plan to inject.

Missing: Emerging contaminants performance limits

- You already list PFAS, pharmaceuticals, endocrine disruptors, microplastics—**now ask**:
  - Which of these are **explicitly monitored** under the permit?
  - What are the **removal efficiencies** for each treatment step?
  - What **residual concentrations** are expected at the point of injection?
- Ask them to identify **which contaminants are not regulated at all** under 62-610 but are known to persist.

Missing: Comparison to best-practice potable reuse

- Explicitly contrast Deltona's approach with **non-karst, above-ground storage models**:
  - Advanced treatment → surface reservoir → blending → conventional treatment → distribution.
- Ask: **Why is Deltona choosing the highest-risk option (karst injection) instead of proven surface storage?**
- Require them to state whether **any other jurisdiction injects into a similar karst system for potable reuse**—and if so, where, and with what track record.

Missing: End-of-life and irreversibility

- Ask: **If the project is shut down in 10–20 years, what is the condition of the aquifer?**
- Require a statement on:
  - Expected **permanence of geochemical changes** (dissolution, new conduits).
  - **Timeframe of contaminant persistence** in groundwater (decades to centuries).
- Ask them to identify **any technology that could realistically "clean" a contaminated regional karst aquifer**—and if none, to say so plainly.

Why is this even being proposed? Who came up with this insane idea?
WHO??? and WHY???

Here is the truth — the part no one says out loud.

⭐ **1. This idea did NOT originate in Deltona.**

It did not come from Deltona staff, Deltona engineers, Deltona residents, or the Deltona water utility, This concept comes from **state-level policy pressure**, not local need.

⭐ **2. The push comes from Tallahassee — specifically DEP and the Legislature.**

Over the last decade, Florida's Legislature and the Florida Department of Environmental Protection (DEP) have been pushing a statewide agenda:

"Increase reuse. Reduce surface discharges. Move toward potable reuse."

This agenda is driven by:

- Statewide water supply planning
- Pressure to reduce wastewater discharges to rivers, springs, and estuaries
- Political messaging around "water sustainability"
- A desire to avoid building expensive new reservoirs
- Lobbying from engineering firms that want to build reuse projects

DEP's 2020–2023 rulemaking created **Chapter 62-610 Part V**, which *allows* potable reuse via groundwater recharge.

But — and this is the key — **DEP never solved the karst problem**. They simply created a *legal pathway* and left the engineering burden to local governments.

⭐ **3. Engineering firms are the ones promoting injection to cities.**

This is the part residents never see.

Large engineering firms (the ones who design water plants, wells, and pipelines) have been:

- Pitching "potable reuse via injection" to cities
- Selling it as "innovative" and "cost-effective"
- Downplaying the geological risks
- Using DEP's rule as justification
- Hoping to be the first to build a flagship project

Why?

Because the first city to do this becomes a multi-million-dollar contract.

This is not about Deltona's water needs. This is about **market opportunity**.

⭐ **4. Why Deltona? Because Deltona is vulnerable.**

Deltona is:

- A fast-growing city
- With limited surface water
- With political pressure to "do something" about wastewater
- With no in-house hydrogeologists
- With a karst aquifer that is poorly mapped
- With a history of relying on outside consultants

This makes Deltona a **prime target** for a "pilot" project.

You are not being offered a proven solution. You are being offered a **test case**.

⭐ **5. Why injection? Because it is the cheapest option — on paper.**

Surface reservoirs, advanced treatment, and engineered storage are:

- Expensive
- Regulated
- Visible to the public
- Harder to sell politically

Injection wells are:

- Out of sight
- Cheaper to build
- Easier to permit
- Easier to market as "sustainable"
- Convenient for consultants

But they are **completely inappropriate** for a porous, fractured, unpredictable karst aquifer.

⭐ **6. Why is this "insane idea" being proposed?**

Here is the honest, unvarnished answer:

Because the State wants to increase reuse numbers.

Because consultants want the contracts.

Because injection is the cheapest option to sell.

Because no one else has been willing to be the guinea pig.

Because Deltona was told it's "innovative" instead of "experimental."

No one expected residents to understand the geology well enough to call it out.

⭐ **7. A question we should collectively ask the Mayor, as I am— directly**

"Name one Florida community that injects treated wastewater into the Upper Floridan Aquifer for containment or potable reuse. If none exist, why is Deltona being asked to be the first?"

HINT: There are NONE.

"Why Deltona Is Being Positioned as a Test Case — and Why We Must Decline."

WHY DELTONA IS BEING POSITIONED AS A TEST CASE — AND WHY WE MUST DECLINE

Prepared by: Christine Peacock

1. Deltona Did Not Create This Idea — It Came From Tallahassee

Deltona is not the author of this proposal. The push for "potable reuse" comes from **state-level policy pressure**, not local need. Over the last decade, the Florida Legislature and the Florida Department of Environmental Protection (DEP) have promoted a broad agenda to:

- Increase reuse
- Reduce surface discharges
- Move toward potable reuse

To support this, DEP created a **regulatory pathway** in Chapter 62-610, F.A.C. But this rule is **not a program**, **not a design**, and **not a proven model**. It simply allows utilities to *apply* for groundwater recharge projects — including injection — without solving the underlying geological risks.

2. Engineering Firms Are Driving the Proposal, Not Proven Science

Large engineering firms have been marketing "potable reuse via injection" to cities across Florida because:

- It is cheaper to build than surface reservoirs
- It is easier to permit
- It is out of public view
- **It represents a multi-million-dollar contract**

These firms are seeking a **first-in-Florida flagship project**. Deltona is being approached not because the method is safe — but because the city is seen as **politically and structurally vulnerable** to adopting it.

3. No Florida Community Uses Injection Into the Upper Floridan Aquifer for Potable Reuse

This is the critical fact:

No Florida city injects treated municipal wastewater into the Upper Floridan Aquifer for containment or potable reuse.

Florida has:

- **Deep well injection** — for disposal into deep saline formations
- **Aquifer Storage & Recovery (ASR)** — injecting treated drinking water, not reclaimed wastewater
- **Reuse irrigation** — surface application, not aquifer recharge

But **no one** injects reclaimed wastewater into the **drinking-water portion** of the Floridan Aquifer. There is **no precedent**, **no long-term data**, and **no demonstrated containment** in a karst system.

Deltona would be the **first** — and that is precisely the problem.

4. Deltona's Geology Makes It the Worst Possible Test Site

The Upper Floridan Aquifer beneath Deltona is:

- **Porous**, **Fractured**, **Conduit-dominated**, **Unpredictable**, **Poorly mapped**

Karst does **not** behave like a storage tank. It cannot contain a plume. It cannot filter contaminants. It cannot be remediated once damaged.

Any breach, migration, or geochemical reaction is **permanent**.

5. The Proposal Is Not Innovation — It Is Experimentation

Innovation requires:

- Proven models
- Demonstrated safety
- Long-term data
- Peer-reviewed results
- Successful precedents

This proposal has **none** of these. It is not innovation — it is **experimental aquifer manipulation** in the only drinking-water source Deltona has.

6. The Risk Is Irreversible and City-Wide

If the aquifer is compromised:

- There is **no cleanup technology**
- There is **no containment strategy**
- There is **no replacement aquifer**
- There is **no recovery timeline**

Groundwater contamination in karst lasts **centuries**. This is not a reversible experiment.

7. The Question the City Must Answer

Before moving forward, the City must answer one simple, unavoidable question:

"Name one Florida community that injects treated municipal wastewater into the Upper Floridan Aquifer for containment or potable reuse — and show its long-term safety record."

There is no answer. Because no such project exists.

8. Why Deltona Must Decline

Deltona is being positioned as the **first test case** for a method:

- Never proven in Florida
- Never demonstrated in karst
- Never shown to be safe
- Never used in a drinking-water aquifer
- Never validated by long-term monitoring

The City has a responsibility to protect the aquifer that supplies every home. Until real, site-specific, peer-reviewed evidence exists — not promises, not models, not marketing — Deltona must decline to be the experimental site.

DEFINITIONS AND CONCEPTS ADDENDUM

1. What Is a Karst System?

Karst forms when **limestone or other soluble rocks dissolve**, creating a highly porous, unpredictable underground landscape. Key characteristics (all supported by the search results):

- **Cavities, conduits, and underground channels** form as limestone dissolves.
- These conduits can be **large enough to walk through** and can move water rapidly.
- Karstification creates **sinkholes, shafts, fractures, and caverns** that interconnect.
- Water flow is **fast, turbulent, and bypasses natural filtration**.
- Flow paths are **non-linear and unpredictable**, often extending miles.

In short: A karst aquifer is not a sponge. It is a **plumbing system** of cracks and caves.

2. Is Containment Possible in a Karst Aquifer?

A "containment mechanism" would require the ability to **control, isolate, or predict** where injected water goes.

Karst makes this impossible because:

- Water moves through **fractures and conduits** that cannot be mapped fully.
- Flow velocities can be extremely high, meaning contaminants can travel far before detection.
- Monitoring wells only sample **one point**, while water may bypass them entirely.
- Recharge and extraction in karst systems show **complex, unpredictable water-quality dynamics**.

Conclusion: There is **no known engineering method** that can reliably contain or track injected water in a karst aquifer. The geology itself prevents containment.

3. Effect of Chemically Treated Water on Limestone in the Upper Floridan Aquifer

Chemically treated wastewater typically contains:

- Disinfection byproducts
- Chloramines or chlorine
- Acids/alkalinity adjustments
- Residual organics
- Nutrients
- Pharmaceuticals
- PFAS and other persistent compounds

Limestone reacts to chemical exposure:

- Chemical changes can **open new fractures and enlarge existing ones**.
- Dissolution accelerates when water chemistry is altered.
- Over time, this can **increase porosity**, **weaken structural integrity**, and **connect previously isolated conduits**.

Meaning: Injecting chemically altered water into limestone **accelerates karstification**, increasing the risk of:

- Sinkholes
- Aquifer breaches
- Cross-contamination between aquifer zones
- Permanent structural changes

4. Treatment Steps Required to Avoid Contaminating a Karst Aquifer

To safely inject water into a karst aquifer, the water must be **cleaner than drinking water** because the aquifer cannot filter anything.

Required treatment steps include:

A. Advanced Pretreatment

- Screening
- Coagulation/flocculation
- Sedimentation
- Filtration

B. High-Level Contaminant Removal

- **Reverse Osmosis (RO)** — removes PFAS, pharmaceuticals, microplastics
- **Activated Carbon (GAC)** — removes organics, some PFAS
- **Ion Exchange** — removes PFAS and dissolved ions
- **Advanced Oxidation Processes (AOP)** — breaks down complex organics

C. Final Disinfection

- UV
- Ozone
- Chlorination

D. Continuous Real-Time Monitoring

- Turbidity
- Organics
- PFAS
- Conductivity
- Microbial indicators

Cost Reality

RO-based advanced treatment is:

- **$50–$200+ million** to build
- **$5–$15 million per year** to operate
- Requires **high energy**, **specialized staff**, and **brine disposal**
- Far beyond the budget of most municipalities with failing infrastructure

Without these steps, injected water will contaminate the aquifer.

5. The Imminent Environmental Disaster

Injecting inadequately treated wastewater into a karst aquifer creates a cascade of irreversible risks:

A. Permanent Aquifer Contamination

- PFAS, pharmaceuticals, microplastics, and industrial chemicals persist for **centuries**.
- Once in the aquifer, they **cannot be removed**.

B. Rapid Spread Through Karst

- Contaminants travel quickly through conduits and fractures.
- They bypass monitoring wells, meaning contamination is detected **after the damage is done**.

C. Structural Damage to the Aquifer

- Chemically treated water accelerates limestone dissolution.
- This increases sinkhole risk and destabilizes the subsurface.

D. Loss of the Region's Only Drinking Water Source

- The Upper Floridan Aquifer is the **sole potable water supply** for millions.
- A contamination event is **irreversible** on human timescales.

E. Regulatory and Financial Collapse

- Utilities become liable for cleanup they cannot perform.
- Ratepayers face massive increases.
- Property values decline.
- Long-term public health impacts emerge.

This is not a theoretical risk — it is a geologically guaranteed outcome if injection proceeds without RO-level treatment.