Toilet to tap:
Has the time come?

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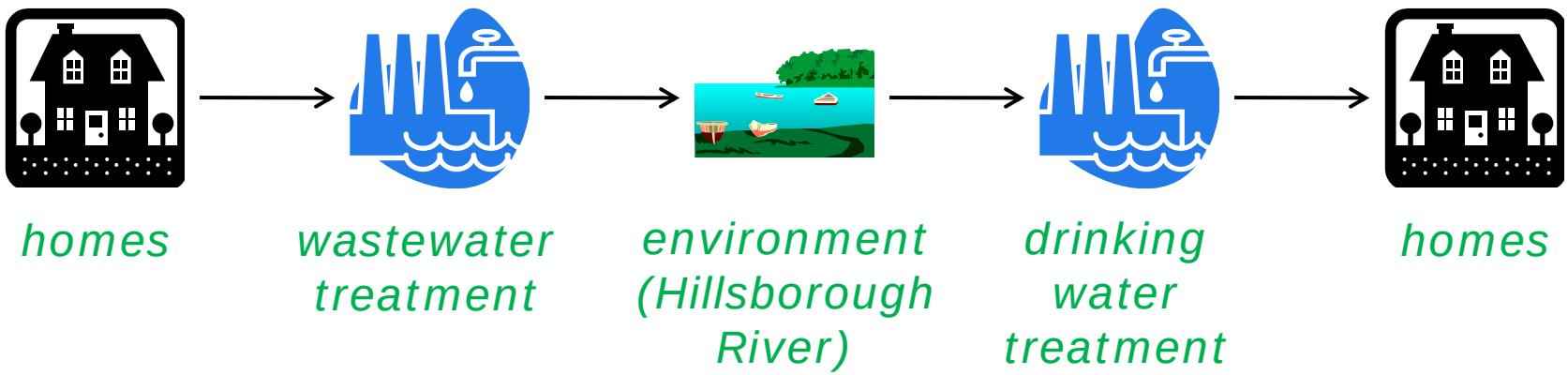
Observation

- For reuse of reclaimed water to be a viable option for providing Tampa with a sustainable supply of potable water:
  - It must be safe;

    and
  - It must be perceived as safe by the public.

Is “toilet to tap” an accurate name?

- Not really…
  - “toilet to treatment to environment to more treatment to tap”



So, is it safe?

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Maybe.

Pop Quiz

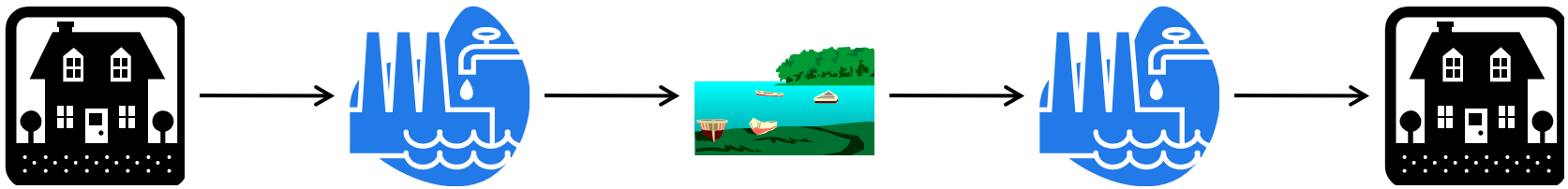
- What do these cities all have in common:
  - Houston, New Orleans, Philadelphia, Baton Rouge, Cincinnati, St Louis, Memphis, Kansas City, Louisville, Savannah, Indianapolis, Minneapolis, and Omaha?

Answer to Pop Quiz

- People in those cities all drink water that used to be in somebody else's toilet

Answer to Pop Quiz

- People in those cities all drink water that used to be in somebody else's toilet
- "Unplanned indirect potable re-use"

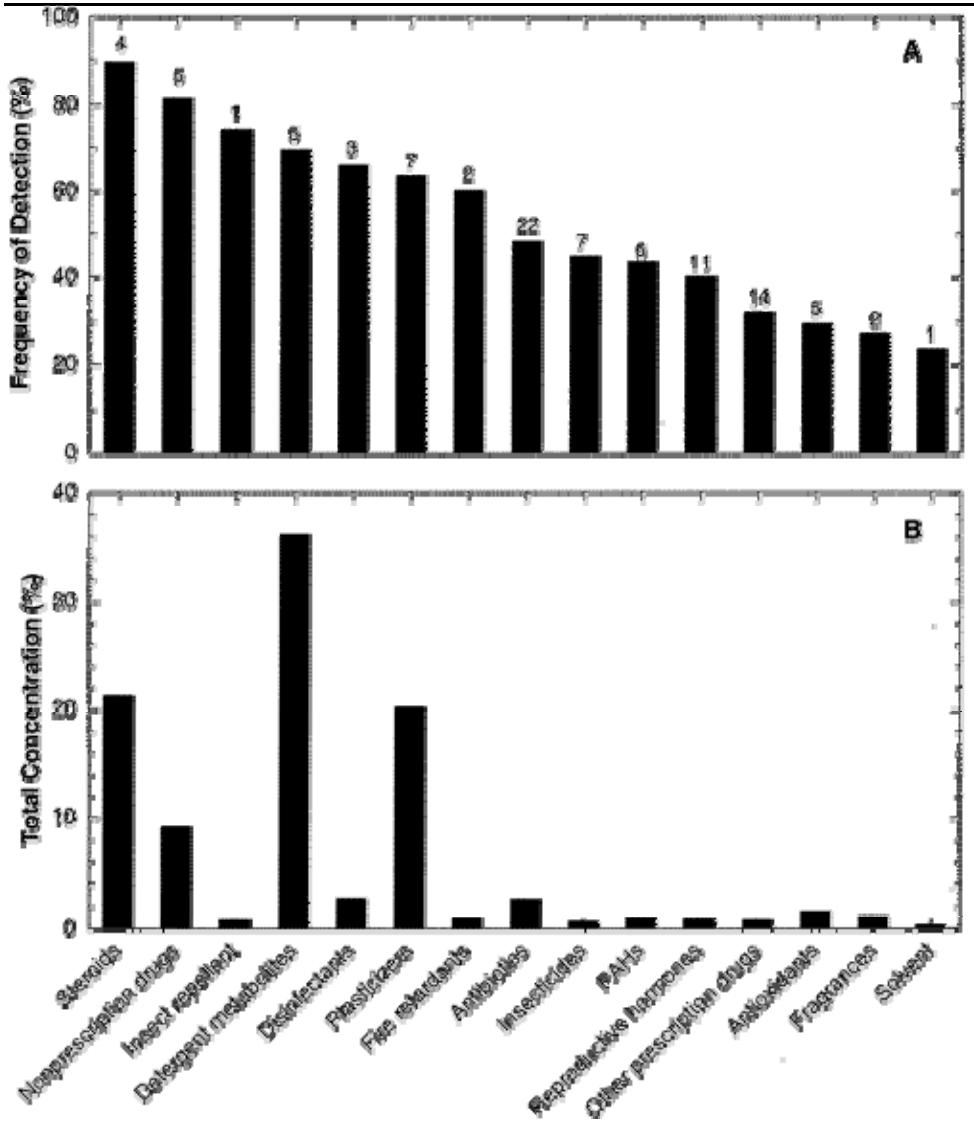


homes (upstream) → *wastewater treatment* → *environment (rivers)* → *drinking water treatment* → *homes (down-stream)*

Risks

- Pathogens – biological agents
  - *E coli* bacteria
  - Protozoan cysts (*Cryptosporidium parvum*)
- Microconstituents – chemical agents present at low concentrations
  - carcinogens (cancer-causing agents)
  - endocrine-disrupting chemicals (EDCs)
  - pharmaceutically active chemicals

Microconstituents in Rivers that Receive Reclaimed Water



Source:

Kolpin DW, Furlong ET, Meyer MT, et al., **2002**. Pharmaceuticals, hormones, and other organic wastewater contaminants in US streams, 1999-2000: A national reconnaissance. *Environmental Science & Technology*, 36(6), 1202-1211.

Is this dangerous to public health?

- We're not sure.
- The good news:
  - Typically the concentrations are very low (ng/L = parts per *trillion*)
  - Drinking-water treatment plants provide another barrier before we drink the water
  - No apparent public-health crises in cities that are drinking "unplanned" reclaimed water
- The bad news:
  - The toxicology of how these chemicals interact in our bodies is mostly unknown

What options do we have?

- Put additional treatment steps in the wastewater plant
- Improve our understanding of how these chemicals behave in the environment
- Test how well the chemicals are removed in the drinking-water plant (and improve if necessary)
- Give up on reuse of reclaimed water for potable supply
  - Other options for Tampa? Better conservation? More desalination?

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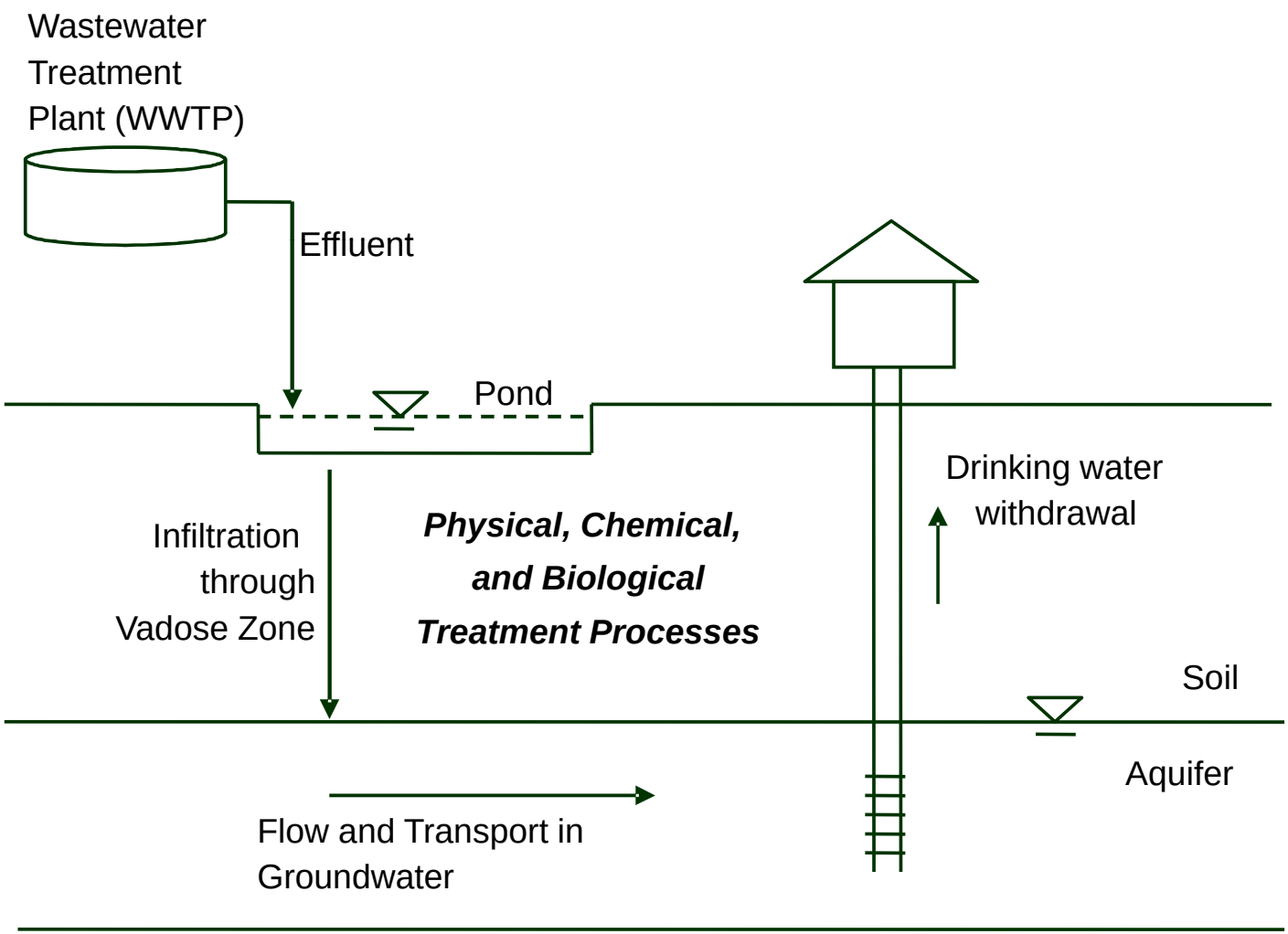
Example: Soil-Aquifer Treatment



Infiltration pond for soil-aquifer treatment (SAT) in Mesa, Arizona.

Why Soil-Aquifer Treatment?

- Inexpensive – as opposed to membrane treatment, other options at the treatment plants
- Effective at improving the quality of tertiary wastewater for water reclamation
- Provides water storage through aquifer recharge
- May maintain the health of a stressed aquifer
- Effective means of producing potable water? Not sure yet!
- Might not be a great choice for Tampa – water table is too shallow

Objectives

- Lab experiments to measure how concentrations of microconstituents are attenuated during SAT
  - Biodegradation of microconstituents under varying conditions
  - Transfer of microconstituents from the water to the soil (adsorption – like the Brita® water filter in your refrigerator)
  - How do these depend upon conditions in the soil?
- Write equations and write a computer program that can predict the extent to which contaminants are removed

Take-Home Messages (1)

- Reclaimed water is potentially an important resource for sustainable supply of water.
- “Toilet to tap” actually includes intermediate steps which are important.

Take-Home Messages (2)

- Implementing water reclamation projects requires two things:
  - It must be safe;
  - The public must perceive it to be safe.
- These two factors are of equal importance – both are necessary.

Take-Home Messages (3)

- Microconstituents are chemicals present in reclaimed water at low concentrations.
- The presence of these chemicals represents a health risk that might or might not be significant.
- Technologies already exist which are effective at removing microconstituents, but they are expensive.

Take-Home Messages (4)

- “Toilet to tap” (i.e., indirect potable reuse) can be made safe.
  - It is not a question of “if” we can do it…
  - It is a question of if we can do it inexpensively enough to make it worthwhile.
  - My research focuses on processes in the natural environment that might enable us to achieve our goals at a reasonable cost.

Thank you for your attention

Thank you for your interest in the future of Tampa's water supply