

# **GLWA's biosolids research program: failures and successes**

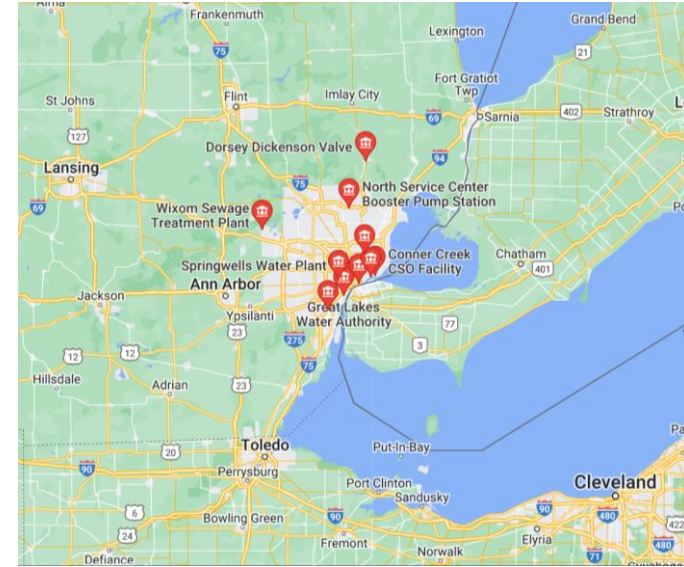
John W. Norton, Jr., PhD., PE., M.ASCE  
Director of Energy, Research, and Innovation

Great Lakes Water Authority

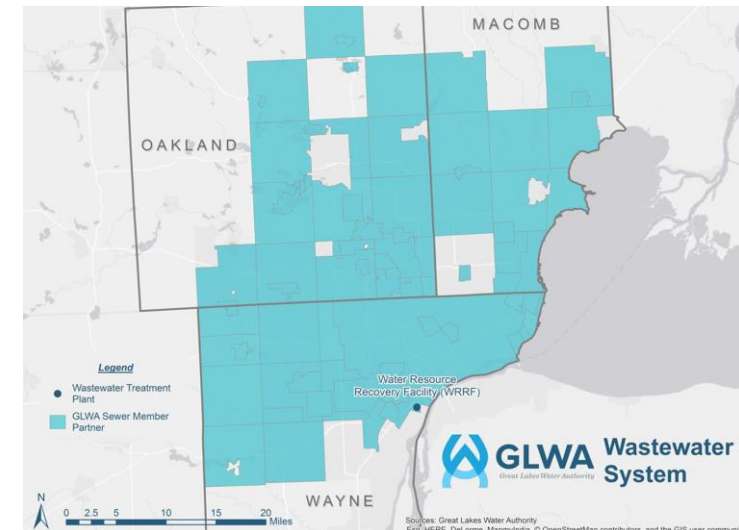
March 26, 2024

# GLWA overview - biosolids

- Single site wastewater treatment plant
- 1.7 BGD peak primary treatment capacity
- 930 MGD peak secondary treatment capacity
- 2.9 million population (nearly 30% of Michigan)
- \$471 million/year revenue
  
- 181 miles of trunk sewers and interceptors
  
- >24,000 miles of connected sewers (enough to cross the ENTIRE United States!)
  
- Roughly 320 dry tons/day solids generated
  - 240 TPD → biosolids dryer, then land applied
  - 80 TPD → incinerator, then landfill (ash)
  - “de minimis” → stabilized, then landfill



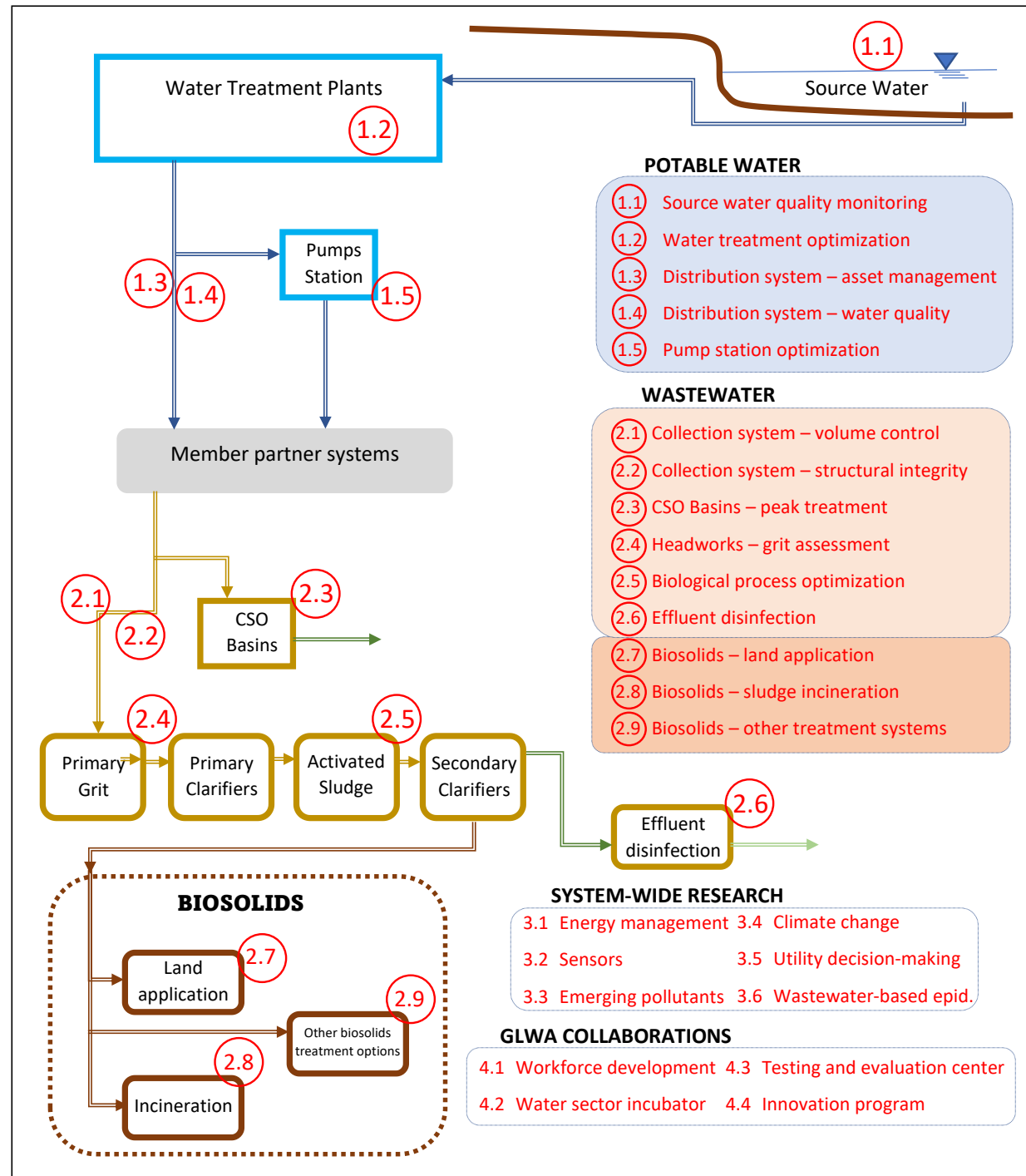
Tri-state region



Service area

# Research overview

- \$3.5 million/year budget
- 12 FTE, 5 PhDs
  - (hiring one more!)
- Source water
- Water Treatment
- Distribution – Water Quality
- Distribution – Pipeline Integrity
- Collection system optimization
- Wastewater treatment
- Biosolids



# 1. GLWA biosolids treatment program – WHY EVALUATING ALTERNATIVES?

- a) Incinerators: 8-10 years remaining operational life
- b) Potential \$450-550 million upgrade investment due to operational needs and resulting air pollution control requirements
- c) GLWA released “Biosolids feasibility” RFP in December 2023

# 2. Research efforts: **Waste to energy**

- a) Hydrothermal liquefaction (and Dept. of Energy-funded project win!)

# 3. Research efforts: **Emerging contaminants**

- a) US EPA-funded project: *Assessing Biosolid Treatment Processes on Pollutant Environmental Fate and Plant Uptake following Land Application*

# 4. Creation of the Midwest Biosolids Association

- a) Dr. Cox covered this! 😊

# Research into three “new to us” technologies

- Anaerobic digestion (“AD”)
  - Use of bacteria to convert carbon-based feedstock into methane
- Hydrothermal liquefaction (“HTL”)
  - Physical/chemical process using high temperatures and extremely high pressures to convert carbon-based feedstock into “biocrude”, ash, and liquid waste stream
- Pyrolysis (“PITA”)
  - Physical/chemical process using moderate temperatures and pressures to convert carbon-based feedstock into tar, clogged equipment, and crushed hopes and dreams.





# Biosolids disposal options?

A new dog poop disposal system that fills dog poo bags with helium to float them away forever!



**Float-A-Poo**  
Dog Waste Disposal System

By Todd Lamm

"My portable helium gun sends dog waste up, up and away!"

**FILL IT!**  
Collect your dog's waste, insert the Float-A-Poo helium gun, and fill with a pre-measured amount of helium.

**FLOAT IT!**  
Once your bag is filled, use it with a tie and remove. Avoid power lines, windmills, towers and airports.

**FORGET IT!**  
Get back to your life! Float-A-Poo bags typically carry your dog's waste 2-3 quarters away!

**1600 Ties**  
Two stylish colors ensure a tight seal and a long flight!



# Hydrothermal liquefaction – NEW WIN!

## \$1,500,000 Department of Energy-funded project

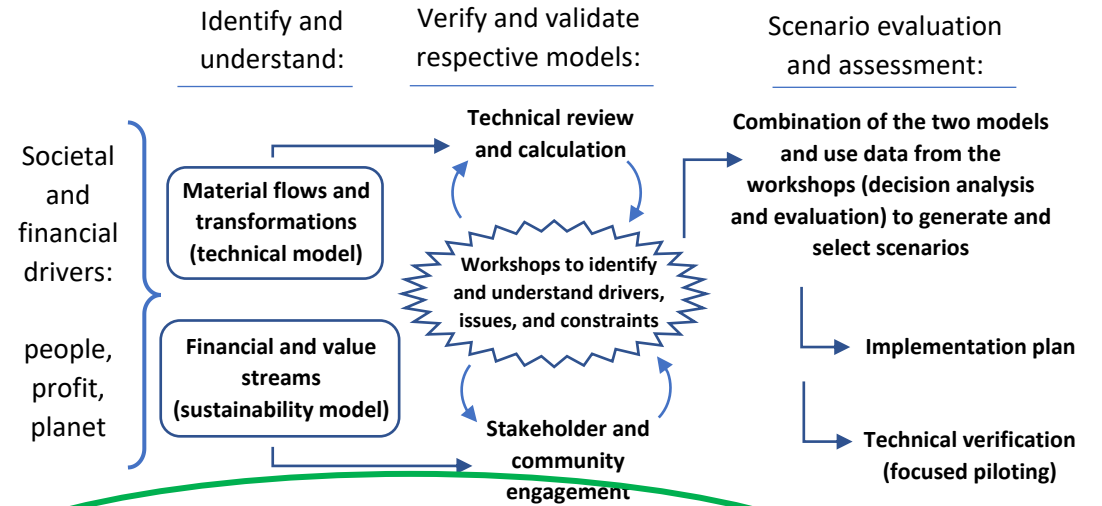
- **Federal Funding Requested: \$1,500,000/Cost Share: \$375,000**
- **Project Duration: 3 years**

**GLWA (Prime):** Dr. Xavier Fonoll Almansa (PI), Dr. John Norton

**PNNL:** Dr. Michael Thorson, Dr. Lesley Snowden Swan, Dr. Uriah Kilgore

**Genifuel:** James Oyler

**Wayne State University:** Dr. Carol J. Miller



A community based HTL waste conversion project which:

- Enables wastewater utilities to properly evaluate HTL in biosolids treatment and conversion to biofuel
- Provides a real world HTL demonstration for GLWA and other utilities
- Develops business case evaluation of HTL in biosolids/waste conversion
- Examines social and environmental impacts of wet waste conversion
- Studies social, environmental, equitable, economic and sustainability impacts of the HTL for disposal of wet wastes.
- Evaluate expanded organic wet waste feeds in the greater Detroit area
  - Food waste, yard waste, wastepaper, etc.
  - Evaluate the potential for jobs creation

- **Award notification: August 2022**
- **Contract signed: April 1, 2023**
- **Subcontracts....**
  - U of Michigan – Signed Winter 2024
  - Wayne State – Winter 2024
  - **U of Texas – still under negotiation!!!**
- **REASON: Bizarre terms and conditions!!**

# Pollutants in biosolids research - \$1.5 million US EPA win!

(in collaboration with Michigan State University, Colorado State University, University of Georgia)

Assessing Biosolid Treatment Processes on Pollutant Environmental Fate and Plant Uptake following Land Application  
EPA Grant R840252, Project Period: September 1, 2021, to August 31, 2024, Project amount: \$1,499,999

## Project Investigators

**Hui Li, Courtney Carignan and Wei Zhang**

*Michigan State University*

**James Ippolito**

*Colorado State University*

**Qingguo Huang**

*University of Georgia*

**John Norton, Jr.**

*Great Lakes Water Authority, Detroit*

- GLWA add-on project - \$388,000
- What's the impact of upstream treatment processes on subsequent fate and transport of pollutants?
- Utilities not willing to participate to extreme press coverage
- Solution → Double-blind study
  - Ship the samples to B&C Tennessee lab, they repackage and send to labs for subsequent analysis

## **Awesome set of utility collaborators:**

California Association of Sanitation Agencies; Clay County Water Authority, GA; Chicago Metropolitan Water Reclamation District; Denmark VSC; Denver Metro Wastewater Reclamation District; Englewood South Platte Renew, CO; Hillsborough County Water Resources Department; King County Wastewater Treatment Division, WA; Lake County Utilities, OH; Louisville MSD, KY; Massachusetts Water Resources Authority; New York City Department of Environmental Protection; South Australian Water Corporation; Vancouver Metro Liquid Waste Services, BC, Canada



# Research challenges – it's worse than you think



The “distance” of understanding between these sectors is often so extreme as to be unpassable. Reasons? Ego, boundaries of experience, “relevance paradox”, simple limit on ability to learn multiple disciplines, trust, ....

Players cannot make good decisions outside of their knowledge space because they are unaware of the drivers and constraints existing in those spaces.

# Los Angeles bus stop “shades” – “La Sombrita”

“Within hours of the news conference, La Sombrita was being held up as a symbol of everything wrong with cities by observers across the political spectrum. On the left, it indicated an uncaring government doing less than the bare minimum for its citizens. On the right, it was evidence of a blue city mired in regulation — dopey Los Angeles unable to execute. “How to Fail at Infrastructure,” trumpeted a post from the conservative Cato Institute.”

- *Los Angeles Times*, May 25, 2023

“To build each bus shelter, the company must get sign-offs from eight discrete city agencies, an alphabet soup of bureaus and departments. That’s for every. single. shelter.”

- *Cato Institute*, May 22, 2023



# Conclusions – such as they are

- **Bureaucracy is miserably stifling to research and progress**
  - Utilities: limited capability or expertise to collaborate on proposals and subsequent contract negotiations
  - IP/Patents – agencies want exclusive IP and don't understand or appreciate the “ask”
  - National labs have 10,000's of patents with zero income
  - Nondisclosure agreements (NDAs) – we were required to get an NDA to share data with... the US EPA!!
- **Trade-offs are rarely considered when prolongating policy**
  - Treatment of de minimis PFAS would require thermal treatment of biosolids
  - incineration: ~ \$600/ ton biosolids ... ~ 2 metric ton CO<sub>2</sub>e/ton biosolids (this is only from the gas!)
  - Increase: Operations \$52.50 million/year, debt service \$50 million/year, IFF current destruction rate is ok
- **There is limited scientific consensus on anything.**
  - Huge piles of folks with “science is real” yard signs conveniently ignore any science that doesn't fit their beliefs. The “other side” is just as bad.
- **Collaboration is CRITICAL.... Should be required for all funding, tenure, etc., WHY? To understand the boundary space!**

*Many thanks to my collaborators:*

Xavi Fonoll, PhD.; Majid Khan, PhD.; Stephen Kuplicki, PE.; Navid Mehram, PE.; Sajit George; Sanjay Patel; Kati Bell, PhD, PE.; Lloyd Winchell, PE.; John Ross, PE.; Martha Wells, PhD.; Lesley Snowden-Swan; Michael Thorson, PhD.; Andrew Schmidt; Justin Billing; Daniel Anderson; James Oyler; Jeff Moeller, P.E.; Glen Daigger, PhD, PE.; Danny Ko; Hui Li, PhD.; Jim Ippolito, PhD.; Qingguo Huang, PhD.; Shubhashini Oza, PhD.; Yifei Wang, PhD.; Felicia Morrissette; Andrew Marcus, PhD., Dienye Tolofari, PhD.

... and many others.

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**SLIDES IN RESERVE**



# GLWA – System overview

## Water System

- Provides over 40% of Michigan’s drinking water
- Vast water supply system consisting of:
  - 5 water treatment plants
  - 19 booster pumping stations
  - 32 water storage reservoirs
  - Over 800 miles of > 4ft diameter pipe
- \$340 million/year revenue

## Sewer System

- Provides sewer services to nearly 30% of Michigan population
- Single site wastewater treatment plant
  - 5 pump stations
  - 8 CSO facilities, including 5 retention treatment basins and 3 flow-through type facilities
  - 181 miles of trunk sewers and interceptors
- \$471 million/year revenue





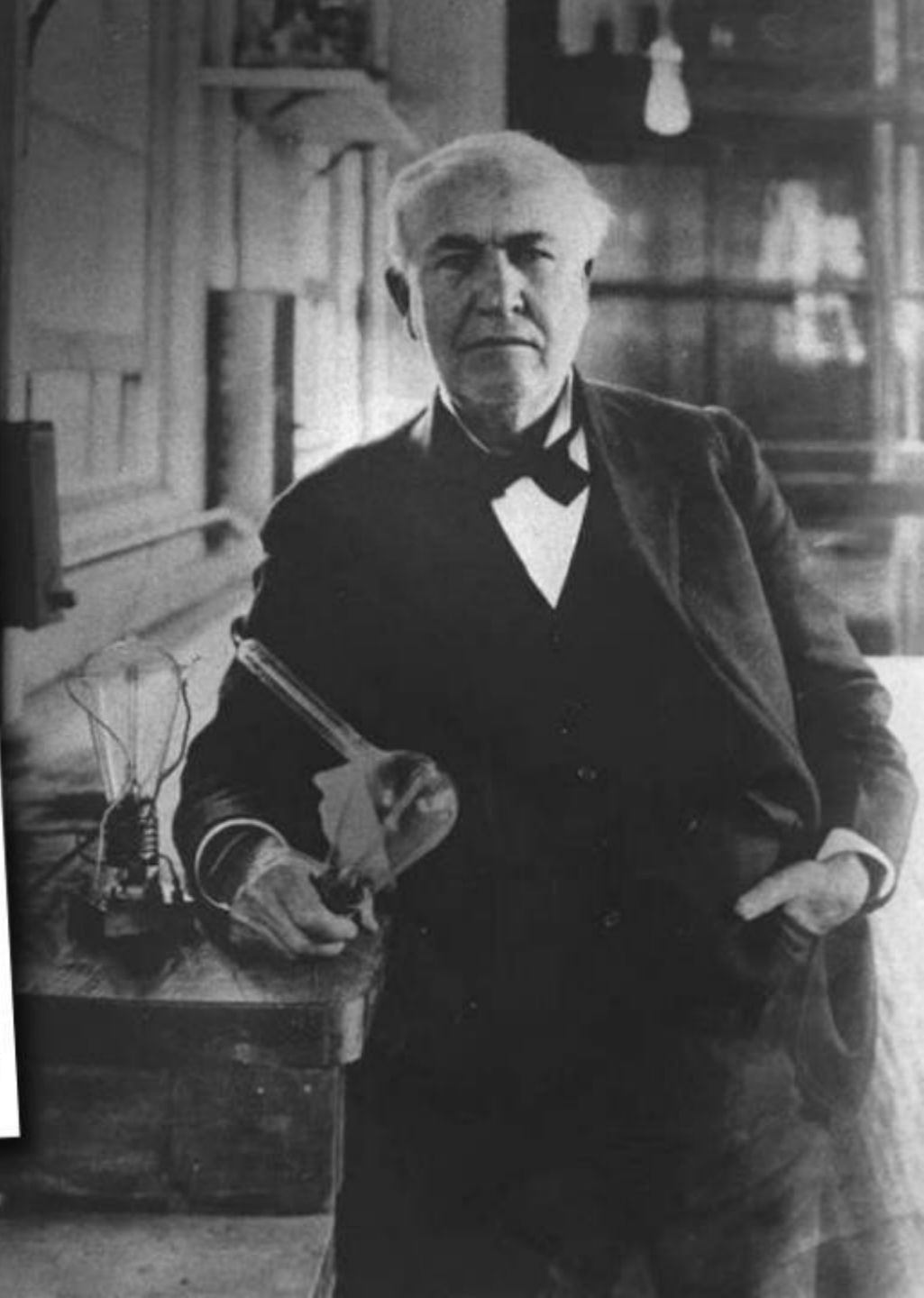
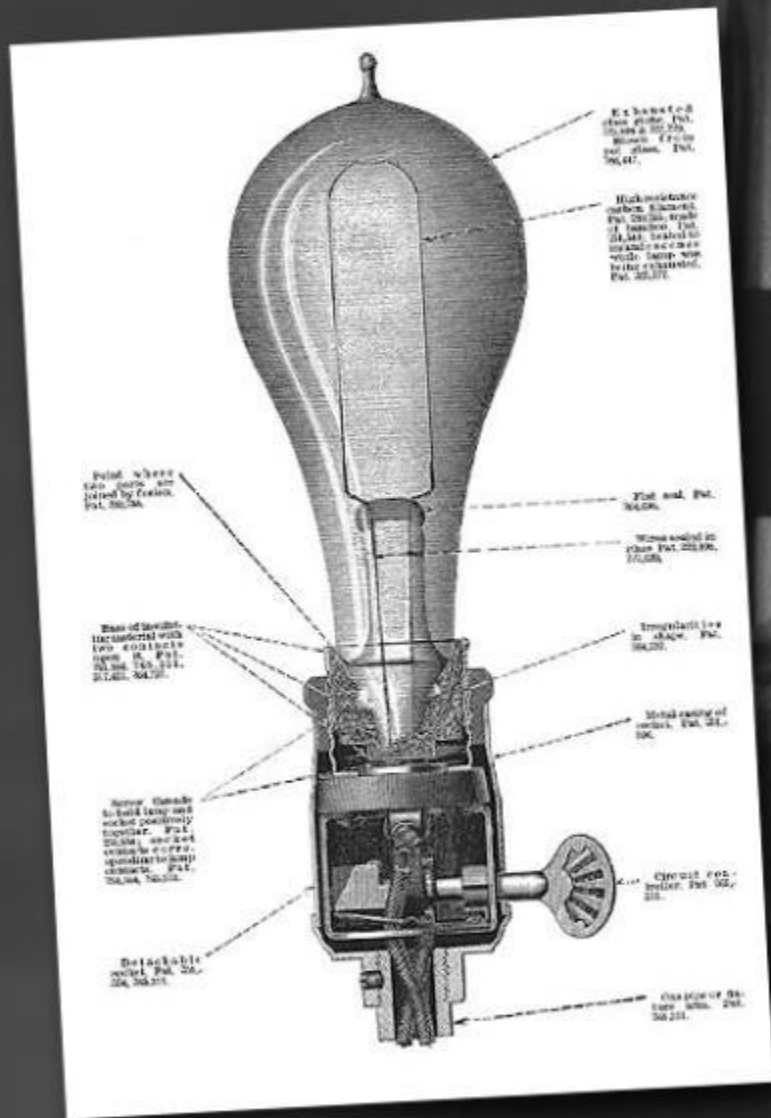
# GLWA current biosolids treatment

$\frac{3}{4}$  goes to Biosolids Drying Facility



$\frac{1}{4}$  goes to incineration





# John's advice slide

- ~~Higher~~ Hire folks brighter than you!
- TEAMS: Buy and mail them a book relevant to the project
- Let your ego go... and do what's useful/needed for your organization
  - “If all you have is a hammer, everything is a nail.”
- Be nice to everyone, always.
- “Annoying ray of sunshine”
- Organizational change is huge and challenging and critical
- “To get to ‘yes’, learn to know.”
- There *ARE* good reasons for:
  - Silos
  - Resisting change
  - Bureaucracy
- Learn what these reasons are to understand how to confront them