State of the Solids Stream:

An Update on the City of Columbus Biosolids Program

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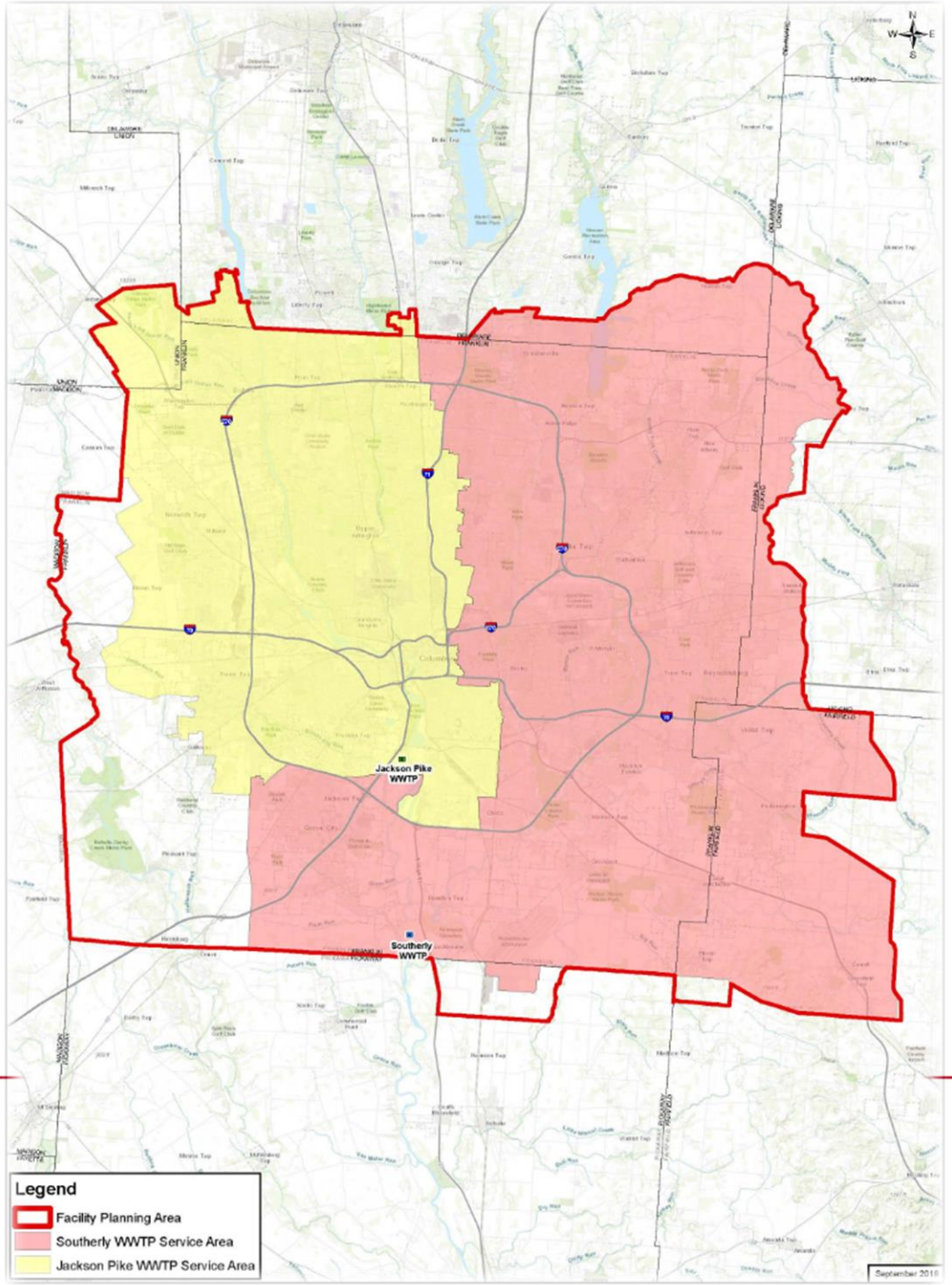
Division of Sewerage and Drainage

Facility Planning Area- 686 Square Miles

- Serve ~280,000 sewer accounts
- Southerly Permitted Daily Flow – 114 MGD
- Southerly Permitted Peak Flow – 440 MGD
- JP Permitted Daily Flow – 68 MGD
- JP Permitted Peak Flow – 150 MGD



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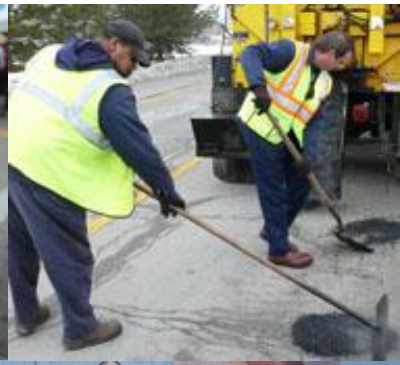
Outline

- Stabilization
  - Acid Phase Digestion
  - Methanogenic Digestion
  - BLAF & BLAI
- Disposal
  - Compost Facility
  - Deep Row Hybrid Poplar
  - Class B Liquid Land Application
  - Commercial Digestion
  - Landfill
- Risks
- Growth
- Innovation



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Southerly WWTP Solids Stream

Southerly Solids Stabilization

- Acid Phase Digestion
  - Constructed in 2006
  - Operational issues diagnosed through 2012, abandoned
  - Brought back online in 2017
  - Breaks complex fats, proteins, and carbs into short chain fatty acids, amino acids, and sugars
  - Improves efficiency of methane phase digestion
  - Allows complete digestion of waste activated sludge
- Methane Phase Digestion
  - Built in 1967
  - Rehabilitated in 2006
  - Limited loadout functionality
  - Gas reuse limited due to siloxanes

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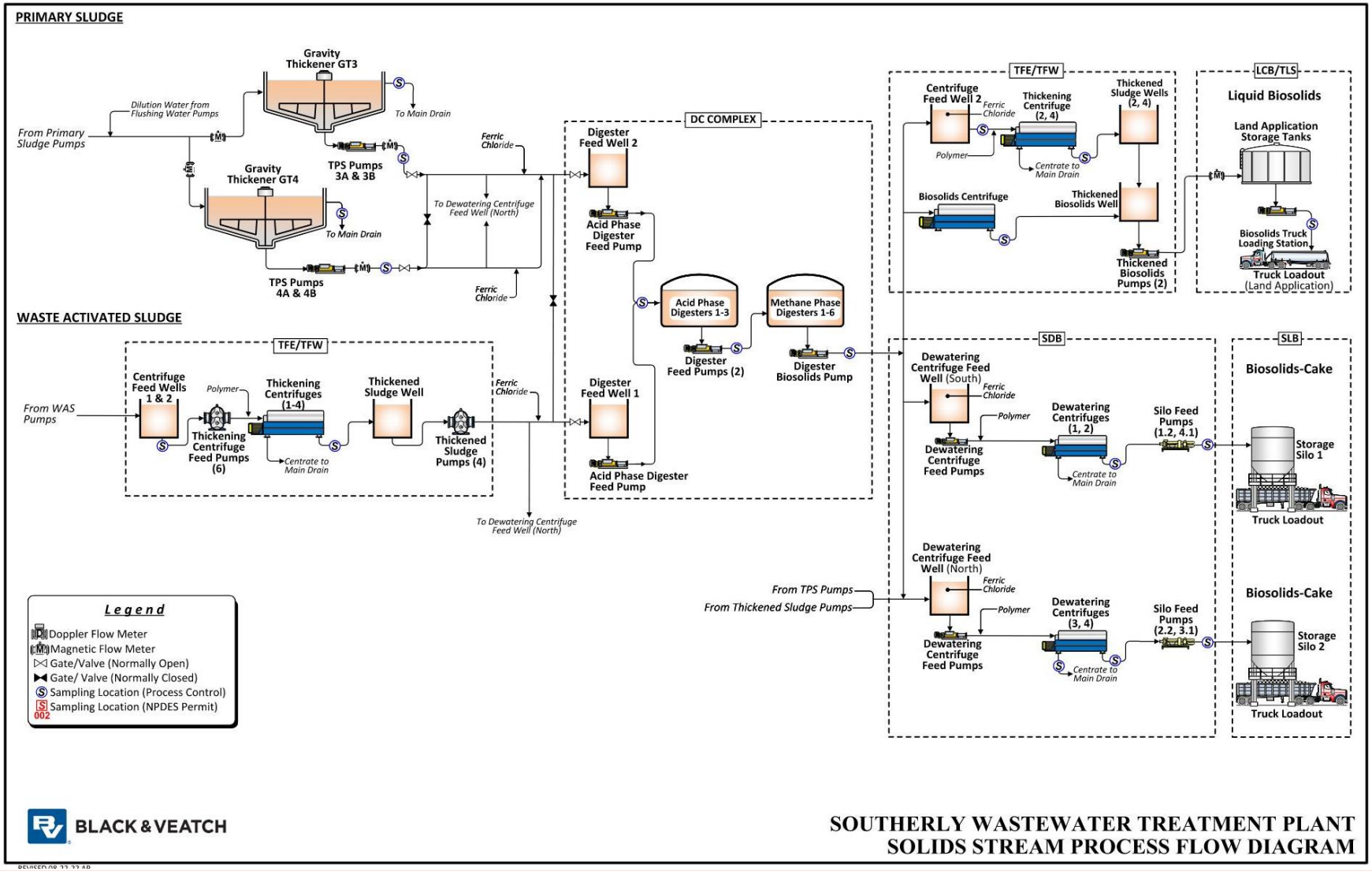
Southerly Solids Flow Diagram



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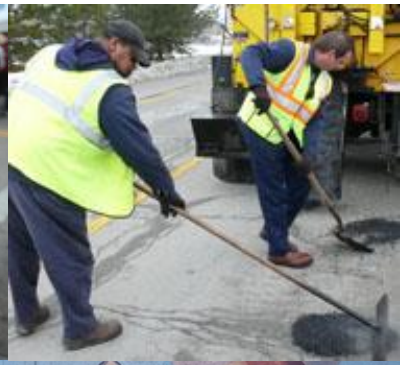
Southerly Biosolids Land Application Facility

- Constructed in 2016 to coincide with Incinerator shutdown
- 8 Million Gallons of Biosolids Storage
- Goal of 10% solids, closer to 6% in practice
- Provides wide spot for storage between application seasons



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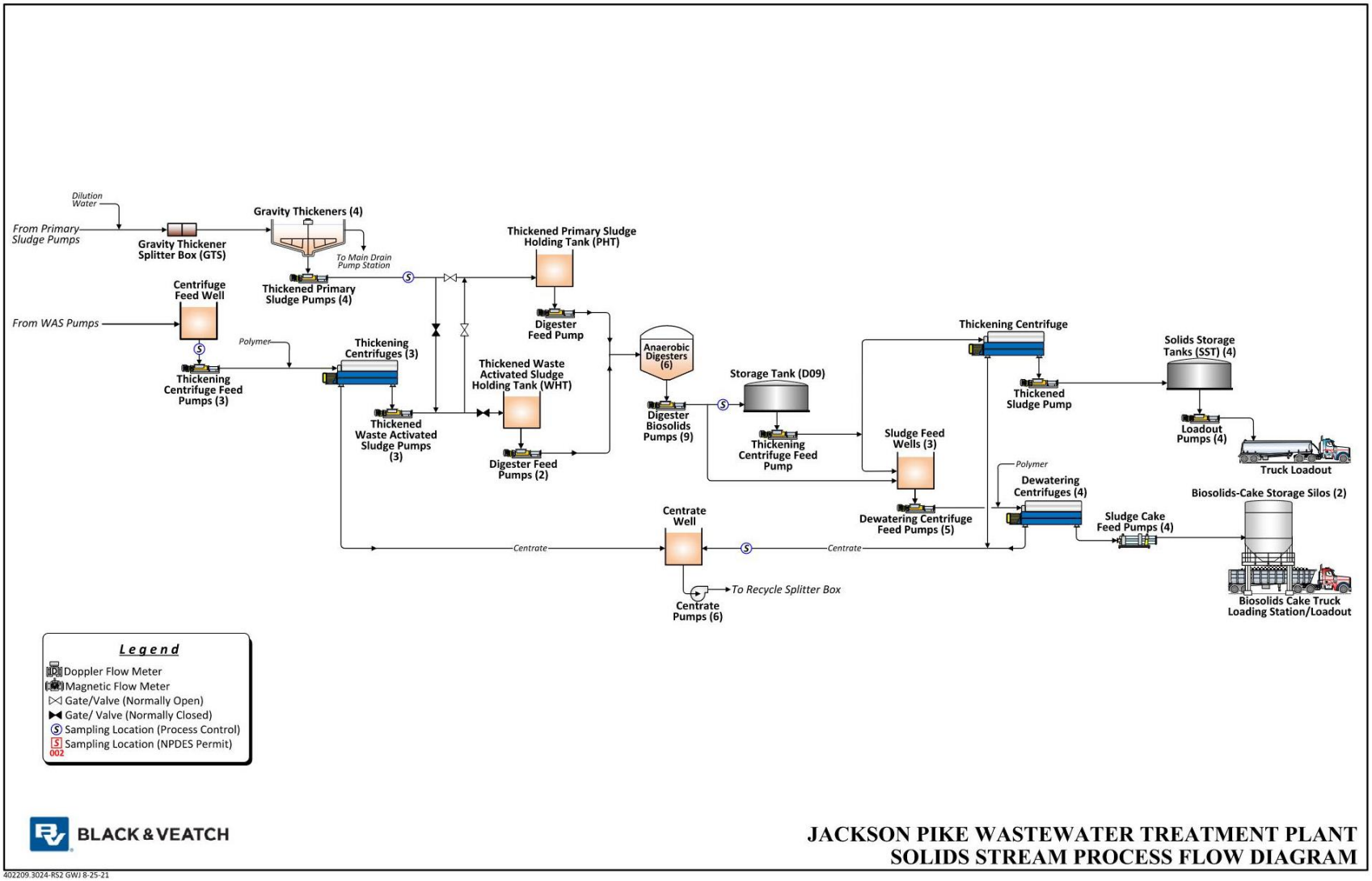
Jackson Pike WWTP Solids Stream

Jackson Pike Solids Stabilization

- Digesters built in 1934
- Last complete renovation in 1987
- Covers and control system rehabilitated in 2008

Jackson Pike Solids Flow Diagram



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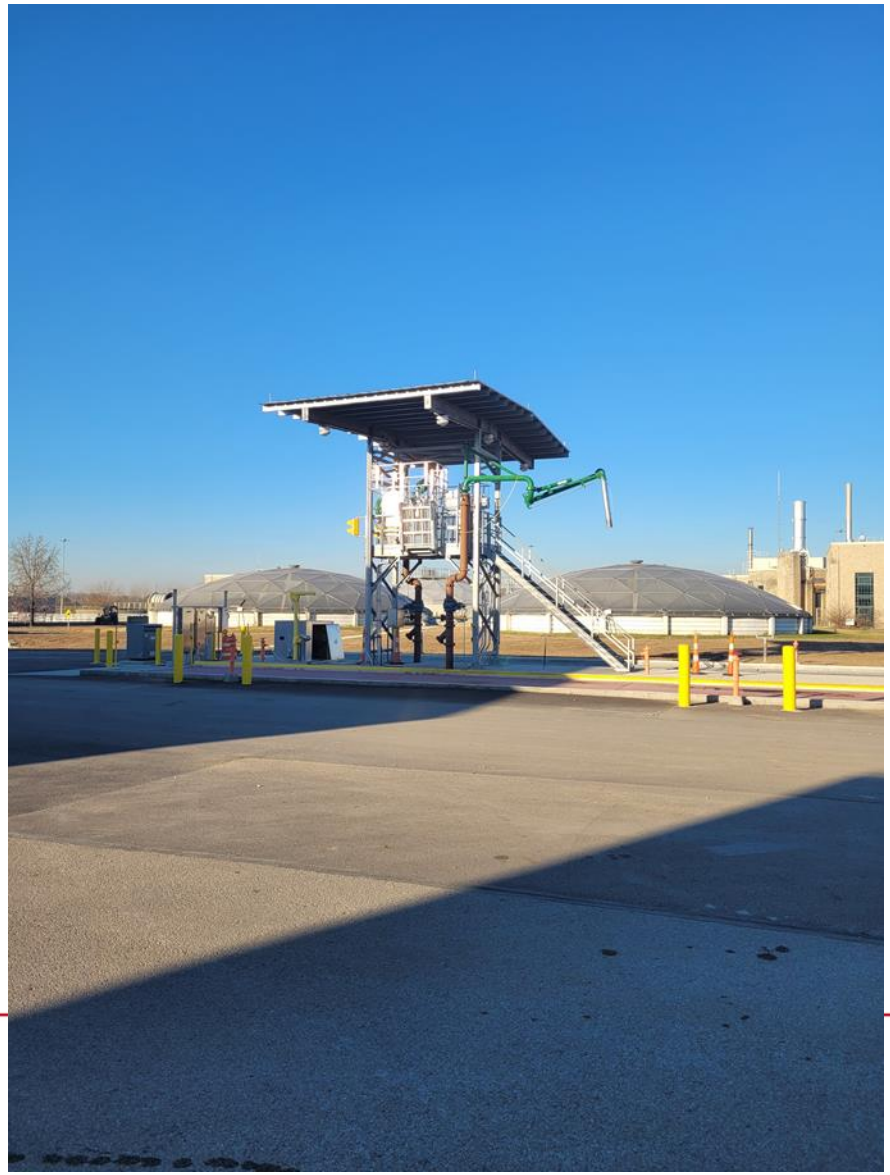
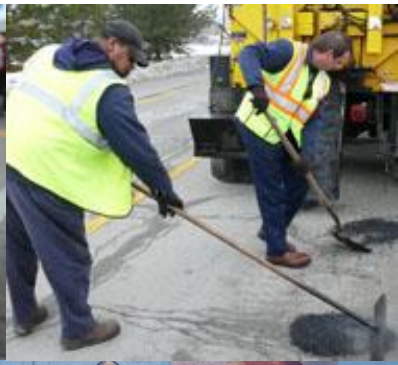
Jackson Pike Biosolids Land Application Improvements

- Facility has been commissioned
- 5.1 Million Gallons of Class B storage
- Solids goal of 10%, closer to 8% in practice





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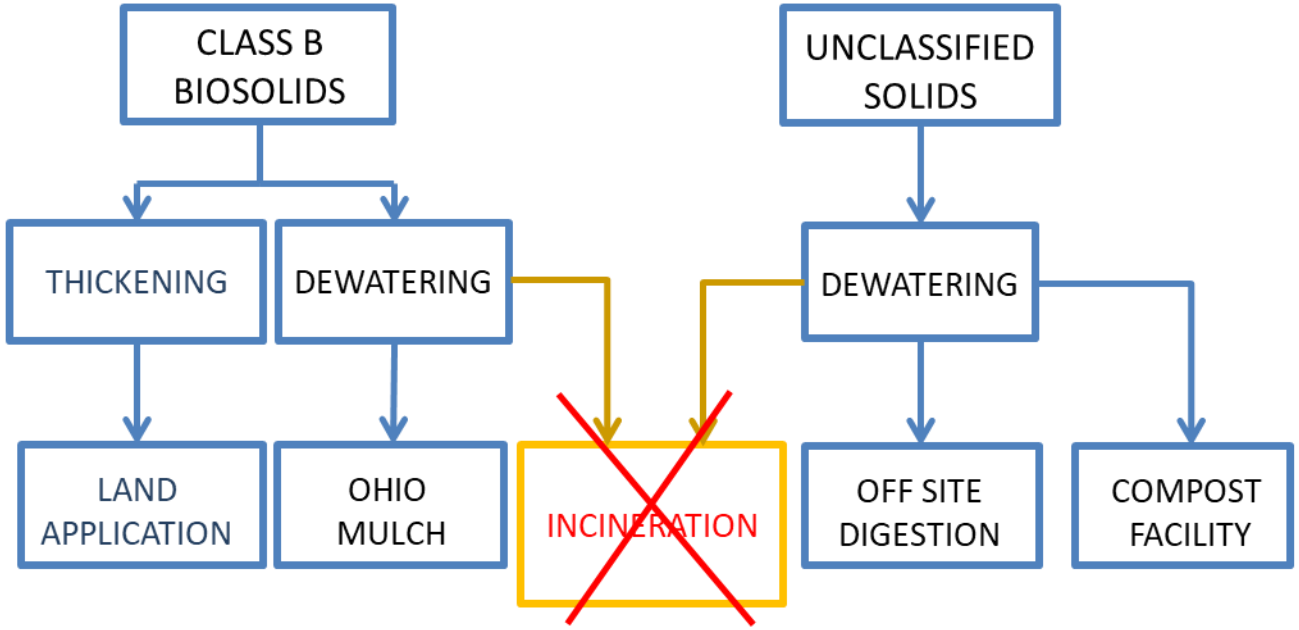
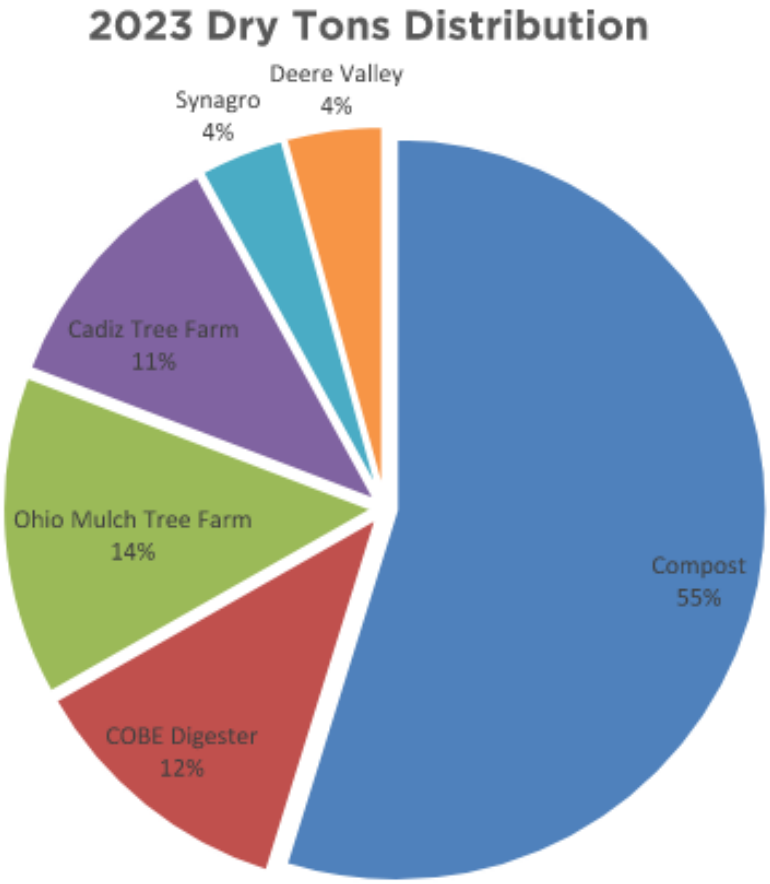
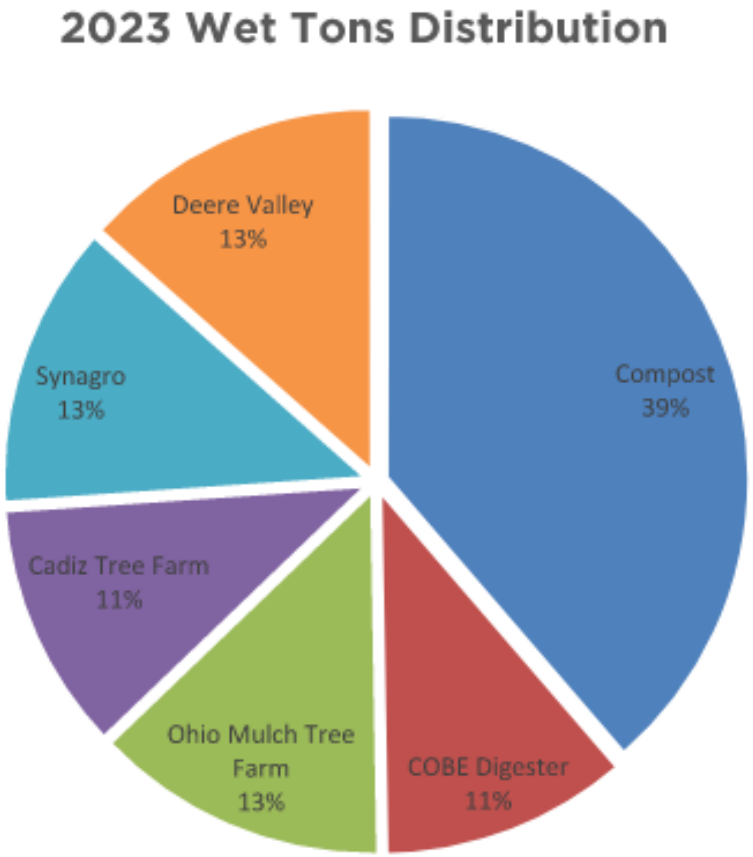
Residuals Management

SOLIDS MANAGEMENT PROGRAM
100 % Beneficial Reuse

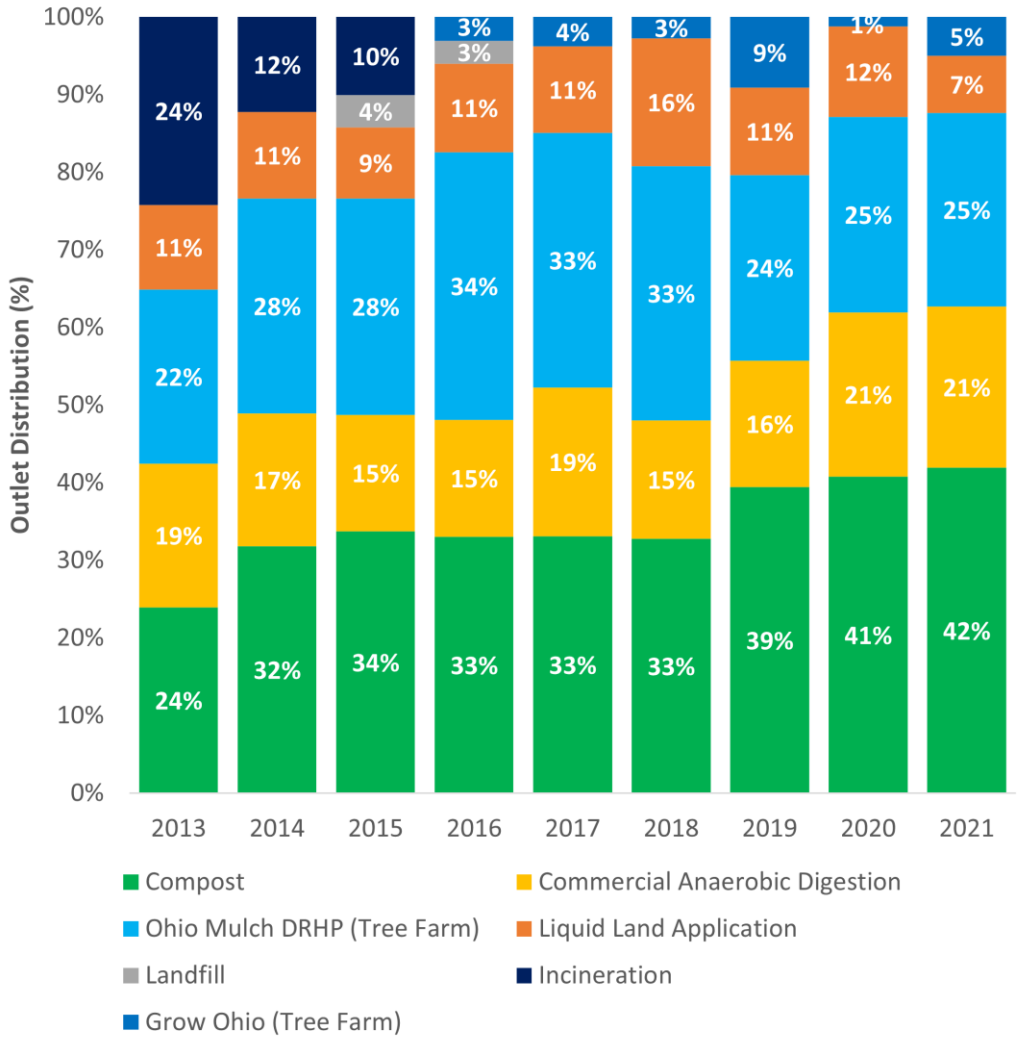


2023 Disposal Utilization





Annual Distribution Over Time



- 100% beneficial reuse for 7 the last 7 years
- Continuous process efficiency improvements by Compost staff year over year
- Liquid land application did not picked up year over year as expected, but is starting to increase.

City Compost Facility

Compost Facility Process Flow Diagram

Biosolids Hauling ~140 wt/day to Compost Facility

Carbon source of woodchips / ground yard waste added to biosolids (4:1)

Biosolids and carbon source are mixed well

Mix is composted using Negative Static Aeration: Aerate Compost for 25 days

Screen Compost thru 1/2 inch mesh

Product under ½" moves through screen (25% of volume); each pile is tested under Part 503 rules

Screen "overs" or larger woodchips are cycled back into use

Finished Com-Til Compost Product

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Com-Til Compost

Traditional market:

- Topsoil manufacturers
- Landscapers

New markets:

- Soil health conscious farmers
- Engineering Projects

Deep Row Hybrid Poplar Mine Land Reclamation

- City has contracted with Ohio Mulch since 2012
- City provides Class B dewatered biosolids to New Lexington Tree Farm

Typical Trench Composition

1 Year of Growth

Tracked Dump Truck

9 Years of Growth

Class B Liquid Land Application

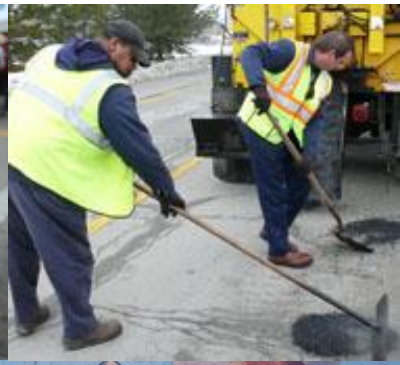
- City has avoided surface application of cake to limit odor issues and permit non-compliance
- Class B biosolids at 5-8% solids content are injected at agronomic rates determined via soil testing

Commercial Offsite Digestion

- City began sending 25,000 wet ton/year to Quasar Digester in 2010
- Ownership has changed hands, but the digester has been a consistent component of the City's disposal strategy

Landfill

- Landfilling biosolids is considered an operational failure as there is no benefit derived from the biosolids
- Comingling biosolids in a municipal landfill causes issues with slope stability, equipment operations, and odors that is undesirable for the landfill operator
- SWACO is moving towards organics redirection that may limit this disposal outlet in the future



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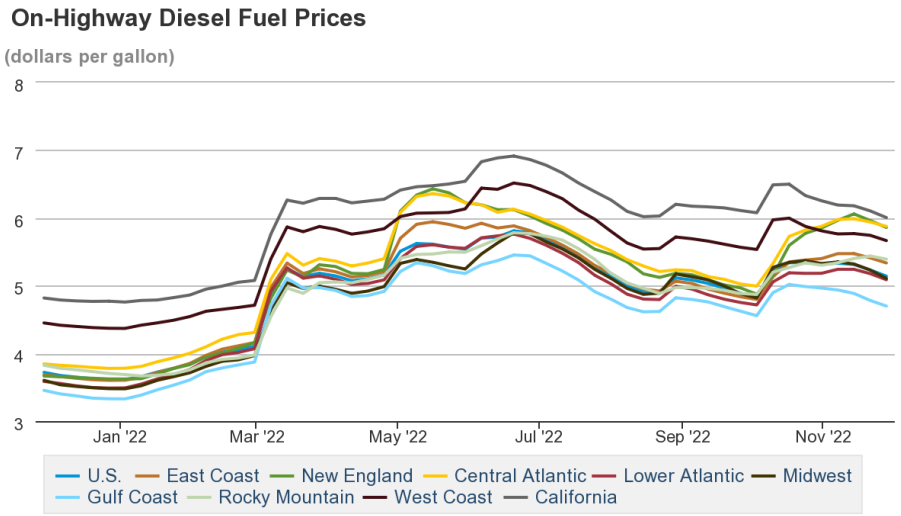
Program Risks

Program Risks and Risk Mitigation - Regulatory

- PFAS regulations – support AOMWA lobbying efforts and academic research into uptake pathways
- Zinc limits – Implement local limits and complete composite sampling to gain more representative results
- Phosphorous regulations – Evaluate and plan orthophosphate recovery systems…Bonus positive of reducing struvite formation

Program Risks and Risk Mitigation - Economic

- Diesel prices – Include fuel surcharge language in hauling contracts to account for uncertainty
- Contracted hauler default – Develop flexible, shorter term contracts with multiple haulers to diversify contractor pool
- Contracted digester outage – Develop emergency beneficial reuse outlets through the contract like tree farms and regional private digesters



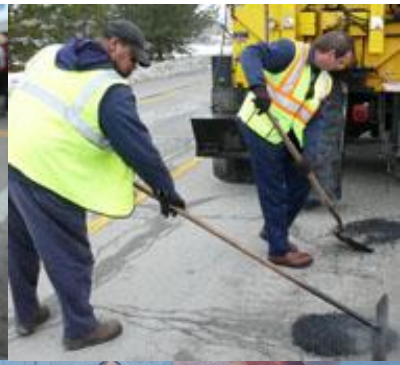
eia Data source: U.S. Energy Information Administration

Program Risks and Risk Mitigation - Social

- Public perception – Leverage community connections and access to Farm Science Review to promote Com-Til. Partner with similar municipalities to support research and outreach on beneficial reuse
- Available application land bank – Fill Biosolids Specialist position for networking and highlight Com-Til/Class B Biosolids as a beneficial source of nutrients and carbon to the farming community

Service Area Growth and Diversification

- Franklin County population is consistently growing
  - Only Midwestern City to add more than 100,000 residents between 2010 and 2020 census
- City is planning a fourth water plant to support growth
  - Fourth train for Southerly WWTP planned in the next decade
- On-shoring of manufacturing is bringing new and diverse industries back to our region
  - Semiconductors
  - Electric Vehicles and Hydrogen Fuel Cells
  - Pharmaceuticals
  - Data Centers
- New waste streams must be evaluated for impacts to residuals
  - Industrial pretreatment program and local limits



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Current and Future Improvements

Compost Facility Expansion

- Facility was not a primary outlet when constructed in the early 80s
- Buildings have been repurposed and abandoned over the years
- Existing leachate lagoon is undersized
- Facility processing capacity is limited by air permit limits on NOx emissions
- Current construction contracts are planned to expand capacity by 50%, improve blower piping reliability, and improve staff amenities

Combined Heat and Power Cogeneration at JPWWTP

- Reusing abandoned incinerator facilities
- New 3 MW biogas powered generator
- Digester gas scrubbing vessels and media
- Exhaust heat recovery to replace antiquated boilers
- Upgraded flares
- Ability to utilize more gas through acceptance of high strength waste to digestion

Digestion Expansion at SWWTP
Phase 1

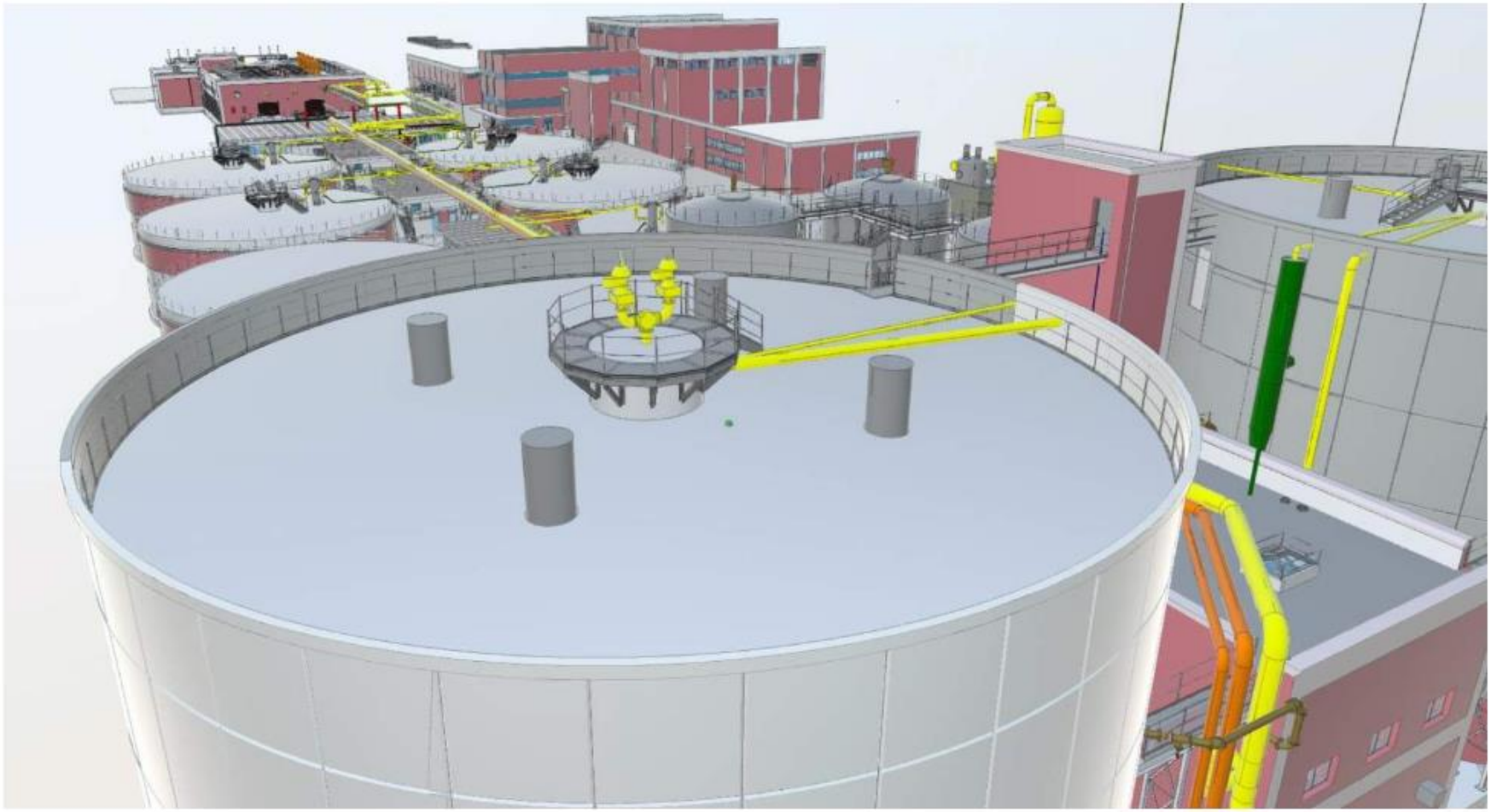
- Facility currently operating near minimum solids retention time of 15 days
- New Digester 7 is under construction.
- All existing digesters will undergo grit removal
- Digesters 1-5 will undergo cover rehabilitation needed.
- Digester 6 will have a concrete cover

Digestion Expansion at SWWTP Phase 2

- Project under detailed design
- Pilot Studies
  - Microaeration
  - Class B Equivalency
- Rehabilitate APDs
- Add VFDs to digester mixing pumps

SWWTP Bioenergy Project

- New Big Digesters 1 and 2
  - 3 MG each
  - Draft tube mixing
  - Waffle bottom cones
- Cogeneration facility
  - 4 – 2 MW generators
  - Gas conditioning system
    - Iron Sponge
    - TSA
- New Waste Gas Flares
- Vapor Combustion Unit for fugitive methane control
- High Strength Waste/FOG receiving



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Long Term Capital Planning

- Last major round of upgrades was completed at the plants between 2005-2012
- Centrifuges, conveyors, feed wells, and holding silos are all showing their age at both plants
  - Manufacturer support is ending for much of the equipment
- Equipment upgrades and facility improvements are planned for virtually all solids handling facilities over the current 10 year planning horizon

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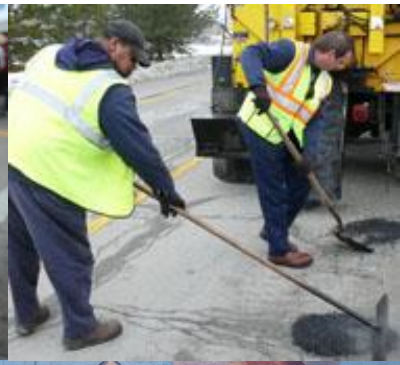

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Questions/Discussion/Jokes at our Expense?