City of Columbus
Jackson Pike Wastewater Treatment Plant

Cogeneration Facilities

August 1, 2018

THE CITY OF COLUMBUS
ANDREW J. GINTHER, MAYOR

DEPARTMENT OF PUBLIC UTILITIES

ARCADIS

Agenda

- Project Background and Drivers
- JPWWTP Overview
- Cogeneration Overview
- Challenges During Preliminary Design

City of Columbus

- Two Wastewater Treatment Plants
- Jackson Pike WWTP
  - 68 MGD average day design flow
- Southerly WWTP
  - 114 MGD average day design flow

Project Background and Drivers

- 2009 Solids Treatment and Utilization Master Plan (STUMP)
  - Recommended exploring beneficial reuse options for biosolids and for biogas, such as cogeneration

Project Background and Drivers

- Get Green Columbus Community Plan 2015-2020
  - In January 2005, former Mayor Michael B. Coleman launched the “Get Green Columbus” initiative
  - Created strategic plan in 2015 – Green Memo III
    - Proposed sustainability objectives for the City of Columbus, Ohio to reach by 2020.
      - Evaluates reducing energy consumption in municipal facilities.

This cogeneration project can meet objectives within the Green Memo categories of climate change, energy, built environment and community engagement.

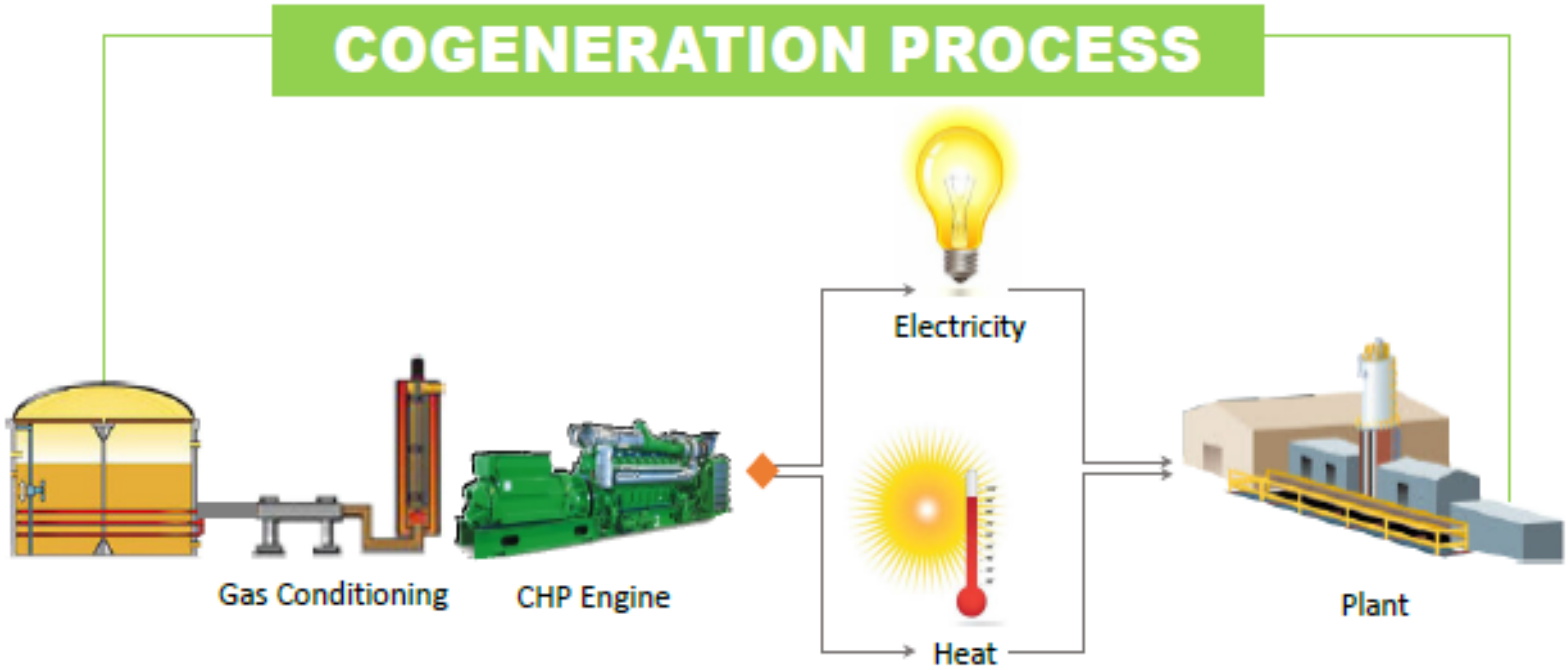
Project Background and Drivers

- Incinerator Air Regulations
  - New Maximum Achievable Control Technology (MACT) standards required incinerators to meet specific emission standards by March 2016
  - Columbus ceased incineration at both WWTPs based on anticipated cost
  - Large amount of biogas available for beneficial reuse at Jackson Pike WWTP.

Project Background and Drivers

- Feasibility Study for Cogeneration (2016)
  - Arcadis recommended installing a CHP system that would:
    - Produce 2.5-3 MW of electricity at each plant, roughly half the total electricity used at each facility
    - Be large enough to handle the swings in biogas production at the plant to minimize the need for flaring
    - Provide capacity for increased production of biogas in the future

What is Combined Heat and Power "(CHP)" or "Cogeneration"?



Jackson Pike Digestion Process

- JPWWTP operates six single phase anaerobic digesters
- Each digester has dual membrane gas storage covers
- Biogas produced is used to fuel the process boilers and the heating boilers, and any unused biogas is flared.

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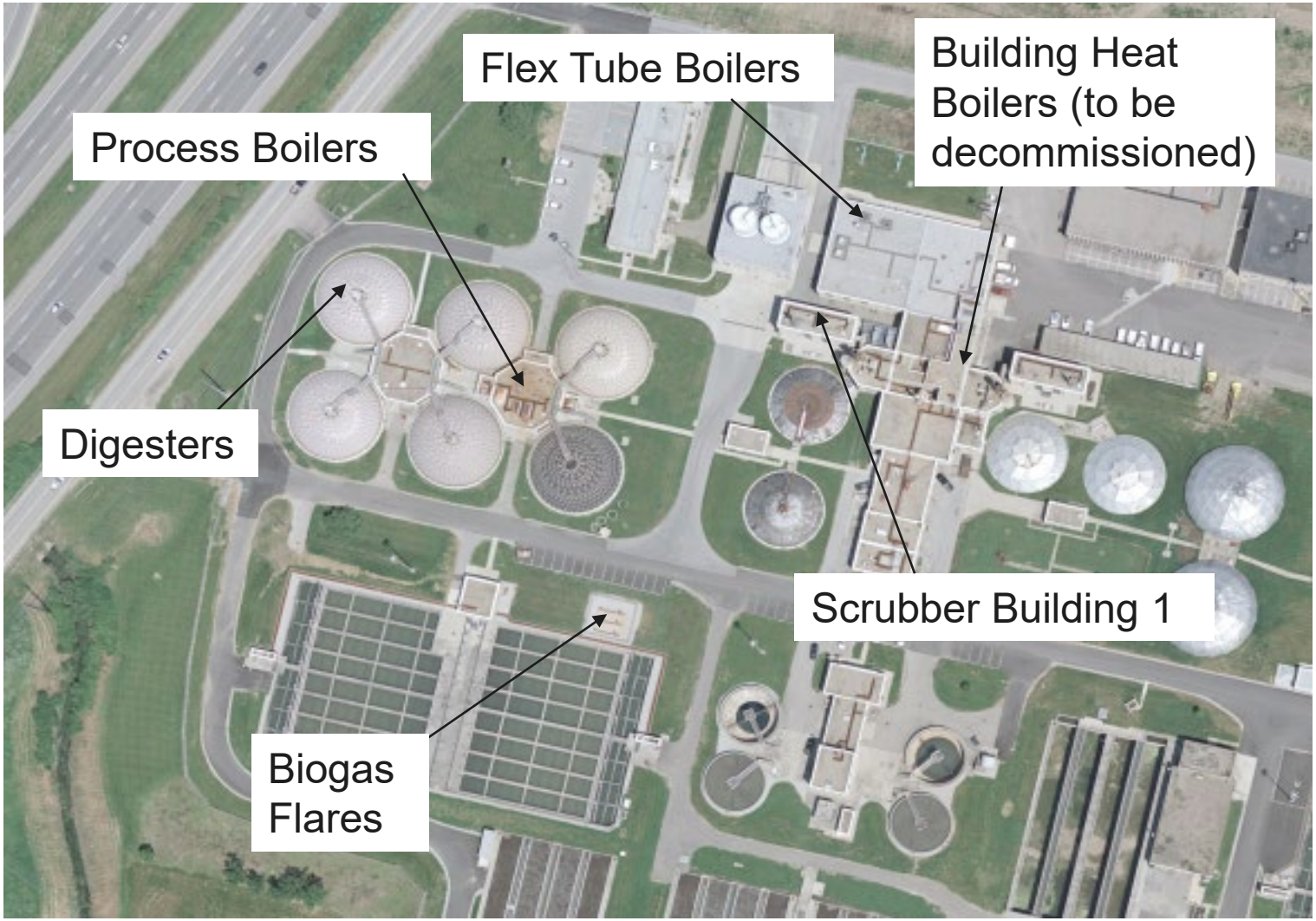
JPWWTP Project Area Overview



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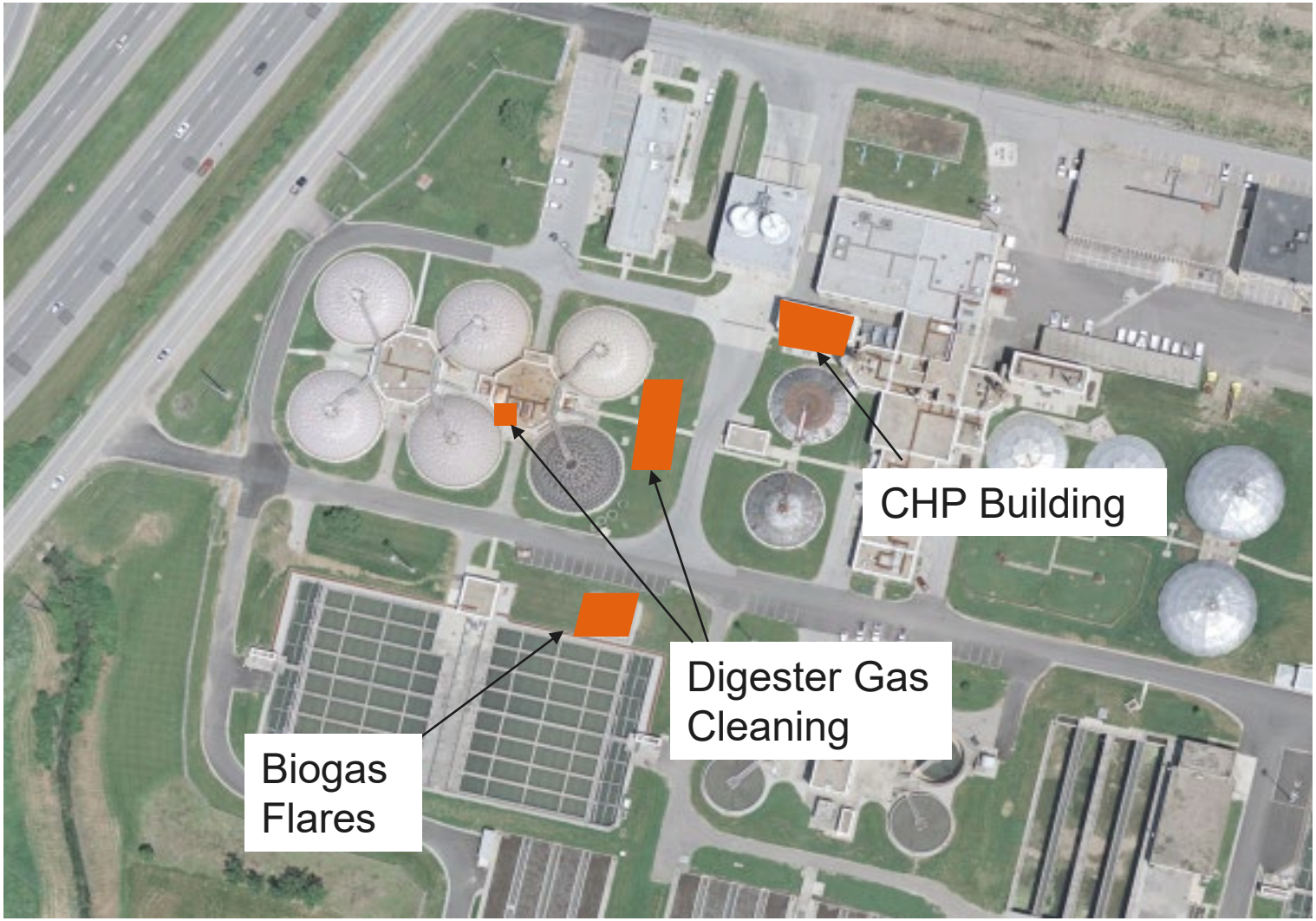
JPWWTP Proposed Facilities



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Cogeneration Risk Workshop – 9/26/2017

- Cogeneration projects have inherent risk
- Workshop held to identify risks
  - Included stakeholders from treatment plant, City of Columbus engineering department, and design team
- Identified 40 different threats and opportunities for the project

Cogeneration Risk Workshop – 9/26/2017

- Identified risks include:
  - Low bid process could result in less preferred equipment
  - System could be undersized or oversized
    - Oversized system would lack payback
    - Undersized system would continue to send potential fuel to the flare
  - Daily gas swings challenging to accommodate
  - Equipment downtime could hurt payback
    - Lack of redundancy
    - Lack of parts and available, trained staff

Challenges During Preliminary Design

- Determining Digester Gas Production
  - Historic digester gas metering at Jackson Pike not reliable
  - Accurate quantity of biogas necessary to properly size engine.
  - New meters installed on the biogas flare and the digester production lines.

Challenges During Preliminary Design

- Determining Digester Gas Production
  - WGB pilot in May 2018 – all biogas through the flare.
    - Flare meter compared against sum of production meters
    - Meters within 15% of each other.
  - Plant staff also measured pressure drop across the flare to verify accuracy of the new meter. Calculated flows were within 10% of metered flows.

Challenges During Preliminary Design

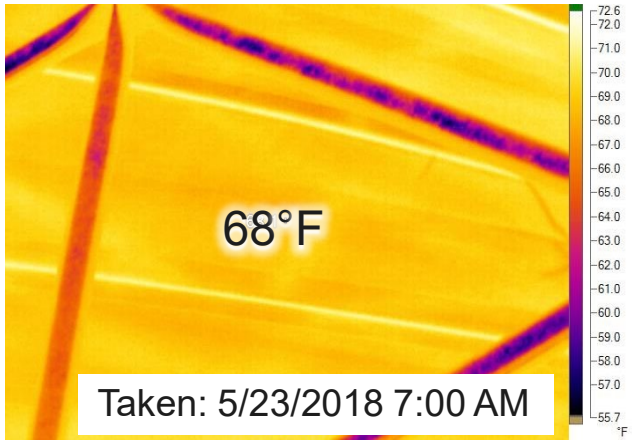
- Determining Building Heat Demands
  - Digester gas boilers at the end of their useful life
  - Boiler replacement an additional scope item on the contract
    - Will cogen provide enough heat to decommission boilers?
  - The flex tube boilers are exclusively fired off natural gas with reliable metering.
    - Typically used to supplement building heat boilers to accommodate peak heating demands.

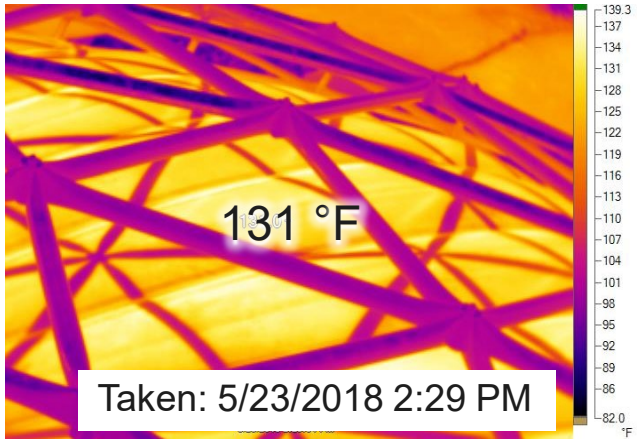
Challenges During Preliminary Design

- Determining Building Heat Demands – Heating Boiler Pilot
  - January 2018 flex tube boilers were used exclusively for heat.
    - Generate enough heat to serve the entire building heating loads.
  - For the month of January 2018 temperature lows ranged from -4°F to 52°F
    - Comparable to peak winter season conditions.

Challenges During Preliminary Design

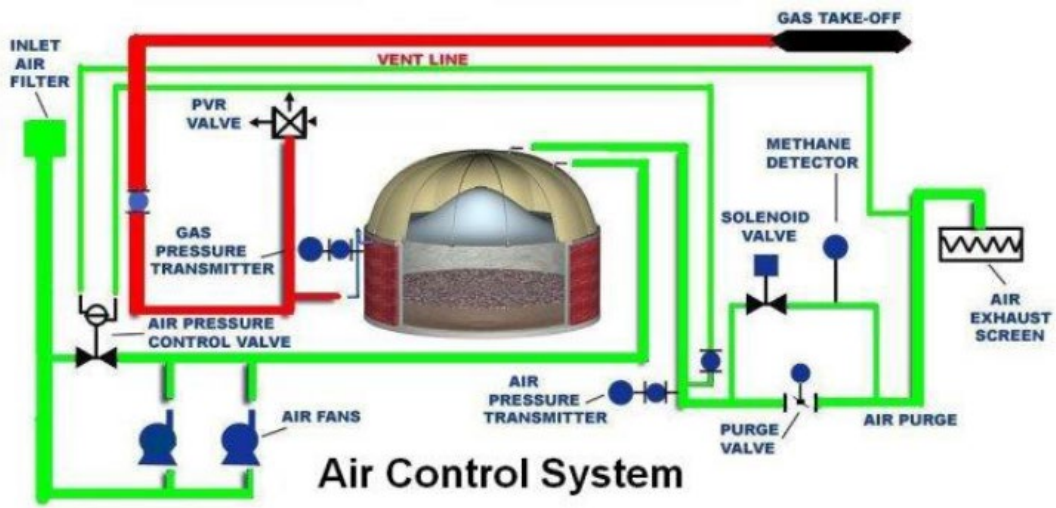
- Digester Gas Production Fluctuations
  - Digester gas flow rates at Jackson Pike vary significantly in response to temperature changes.
  - These variations are important considerations in sizing the engine-generator
    - minimizing flaring vs. risk of oversizing the engine
  - During hot, sunny days the digester gas will heat up and expand under the covers, forcing additional gas out.





Challenges During Preliminary Design

- Digester Gas Storage
  - Plant has historically had issues with the digester gas storage controls.
    - Malfunctioning pressure relief valves
    - Control of pressure within the storage membrane
  - Design will work with plant staff to help address these problems



Typical Dystor membrane cover configuration

Major Design Decisions

- Natural Gas Blending
  - Evaluated blending of natural gas into engine fuel feed
    - Would allow for running at max engine capacity during periods of low production
    - Would accommodate swings in digester gas production
    - Can create a large operating expenditure
  - Design incorporates natural gas blending
    - minimize the amount blended on average day

Major Design Decisions

- Engine Procurement
  - Engine will be procured under separate contract
    - Ensure the City receives the desired equipment
    - Ensure the City receives the desired maintenance contract
    - Allow for engines to be manufactured while the rest of the design proceeds

Major Design Decisions

- 10 Year Service Contract
  - Will ensure that unit is properly maintained and achieves operating time goals
    - Would allow for plant staff to focus on learning operation of unit
    - Plant staff can make informed decisions on what maintenance items to assume down the road
  - Will be incorporated in the engine procurement
    - Not all service contracts are the same
    - Allow for greater control in selecting what is covered

Major Design Decisions

- 1 vs 2 Engines
  - Evaluated one large engine versus two smaller engines
    - One large engine less expensive
    - 2 smaller engines would allow for keeping half the system running during maintenance
  - Decided to design 2 smaller engines for operational flexibility

Questions?

We can consider replacing this slide with name and contact info for presenters.