MSDGC Biosolids and Odor Control Master Planning Efforts

Matt Spidare, MSDGC // Natalie Sierra, Brown and Caldwell
Overview

1. MSDGC System
2. Goals and Objectives of Study
3. Key Focus Areas
4. Vision Statement
5. Methodology
6. Results
7. Conclusions
Metropolitan Sewer District of Greater Cincinnati

• Formed in 1968 as an agreement between Hamilton County and City of Cincinnati
• City is responsible for the management and operation of the sewer district
• Board of County Commissioners establishes sewer service charges, adopts rules and regulations, and approves operating and capital improvement program (CIP) budgets.
• Serves ~850,000 people in a service area of over 290 square miles
MSDGC System

- MSD maintains about 3,000 miles of sanitary and combined sewers
- Seven major wastewater treatment plants (WWTPs)
- High rate treatment for wet weather provided at satellite facilities
- ~160 MGD of wastewater treated daily
MSDGC Facilities

**Mill Creek WWTP** // Largest WWTP (112 MGD ADWF), location of new FBI (2010), receives sludge from Taylor Creek WWTP

**Little Miami** // Second largest (29 MGD ADWF), receives sludge for dewatering from Polk and Sycamore WWTPs

**Muddy Creek** // 12 MGD ADWF, receives sludge from Indian Creek WWTP

**Outlying plants** // Polk Run WWTP, Sycamore Creek WWTP, Indian Creek WWTP, and Taylor Creek WWTP
Project Background

- Numerous individual plant studies to address **odors and solids handling**
- **Increasing scrutiny** over odor complaints throughout the system
- Desire to **assess the best use** of the Mill Creek Incineration facility
- Desire to **develop a 30-year comprehensive plan** for solids handling in the MSD system
- **Transparent process** for decision making
Considerations for MSDGC Include:

How to best:
• Integrate/regionalize solids handling?
• Consider Resource Recovery?
  • Energy – renewable power and fuel production?
  • Biosolids land application?
  • Nutrient treatment/recovery now and/or future?
• Best use of/available useful life of existing infrastructure?
• Make operation/maintenance easier?
• Mitigate odors through solids improvements?
• Consider risks of fatal failures?

Plot the best value program for the next 30 years
Critical Success Factors

- Reduce odors
- Reduce transport of solids
- Increase reliability
- Optimize operations
- Identify opportunities for resource recovery
- Improve regulatory resiliency
Key Outcome » A Clear Path Forward

Roadmap for near and long term improvements

Sustainable, system wide vision for capital improvements

Transparent, defensible process

All inputs presented in workshops

Reliable information

Key stakeholders involved in decision-making
Vision Statement

To create a 30-year **system-wide implementable plan**, including near and long term improvements, that improve the reliability of MSDGC’s solids handling assets in consideration of a goal of no offsite odors, rate impacts, community benefits, operational optimization, and resiliency. Opportunities for synergies within county operations to enhance regional economic, social and environmental sustainability will be incorporated within the financial constraints of affordability for ratepayers.
Overview of the Process

- Data Collection and Analysis
- Mass Balances
- Development of Integrated Alternatives
- Alternatives Analysis
- Narrowing of Alternatives
- Master Plan
- Capital Plans
Establishing the Baseline

- Condition assessment review
- Plant mass balances
- Energy consumption
- Operating costs
- Staffing levels
- Evaluation of solid waste district
- Regulatory outlook
- Future flows and loads
Major Considerations

- Population growth across service area
- Making best use of the existing incinerator
- Pumping vs. hauling sludge
- Regional benefits (e.g. codigestion, importation of outside sludge)
- Level of technology development
Integrated Alternatives Involve All Aspects of Implementation

Emissions

Energy

Biosolids Market and Regulatory Analysis

Biosolids On Site Technologies

Solids-Water Energy Evaluation Tool (SWEET)
End to End Approach

**ENERGY and WASTE HEAT**

- **THICKENING**
  - EXISTING CENTRIFUGE
  - EXISTING DAF
  - EXISTING GT
  - RDT

- **STABILIZATION**
  - MESOPHILIC
  - THERMOPHILIC
  - TEMPERATURE PHASED

- **DEWATERING**
  - EXISTING CENTRIFUGE
  - EXISTING BFP

- **POST-DEWATERING**
  - EXISTING INCINERATION

**EMISSIONS INVENTORY/CONTROLS**

**END USE**

- EXISTING LANDFILL
  - CLASS A LAND APP
  - CLASS B LAND APP

**INNOVATION**

- CLASS A THP
- SOLIDSTREAM THP
- LYSTEK
- OREGE

Options for Evaluation

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Brown and Caldwell
How Do You Model Alternatives for MSDGC’s Seven WWTPs?

- Have developed unique alternatives at each plant
- “Winners” for each plant get combined into regional alternatives
- We screened out some alternatives, and combined or added new alternatives
- We retained status quo options throughout this process that include necessary capital upgrades to keep facilities in a state of good repair
MSDGC Alternatives Bracket

FIRST-ROUND EVALUATION

Eastside First-Round Alternatives

Muddy Creek First-Round Alternatives

Mill Creek First-Round Alternatives

OPTIMIZED ALTERNATIVE EVALUATION

Eastside Winner

Muddy Creek Winner

Mill Creek Winner

Mill Creek Regional Winner

Offsite Regional Winner

Moves to Round 2

FIRST-ROUND EVALUATION

Mill Creek Regional First-Round Alternatives

Off-site Regional First-Round Alternatives
Optimizing Winning Ideas

Cambi options were burdened with CHP options

rCNG presents clear economic advantages for gas use

![Bar chart showing comparison of different options including Cambi + FBI + NG Turbine, Cambi + NG Turbine, SolidStream + FBI + NG Engine, Thermo + FBI + rCNG + NG Engine, with various costs associated with each option.](chart.png)
Common features:

- Incorporation of outside cake and/or high strength waste
- Regionalization of east side operation
- West side plants (Muddy Creek and Indian Creek) can continue operating as is unless landfill tip fees rise significantly
- Benefits associated with optimizing Mill Creek incinerators
- Digestion options offer opportunities for revenues and regional benefits

19 Brown and Caldwell
Non-Cost Criteria Used to Narrow Down to Three

- Ease of Mitigating Off Site Odors // 10%
- Transportation Logistics // 5%
- Revenue Generating Potential // 15%
- Operation and Maintenance Impacts // 20%
  - Process simplicity, admin & regulatory burden, staff training, and new skill sets (recruiting)
- Future Flexibility // 15%
- Reliability // 20%
- Regional Benefits // 10%
- Resource Recovery // 5%
- Constructability later added as a differentiator
Evaluation on Net Present Value

• 30-Year Net Present Value (NPV) of the three alternatives at this level of analysis is essentially the same
• Sensitivities examined based on risk and non-cost criteria to make a decision
## RINS Sensitivity – Alt 2C

**Alt 2C: NPW of Total 30 –Yr Net Operation Costs Variability with Cambi at LM**

<table>
<thead>
<tr>
<th>RIN price - $/D3 RIN</th>
<th>$1.75</th>
<th>$2.13</th>
<th>$2.50</th>
<th>$2.88</th>
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<tr>
<td><strong>HSW Volume (gpd +/- 50%)</strong></td>
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<tr>
<td>0</td>
<td>$225,100,000</td>
<td>$217,800,000</td>
<td>$210,600,000</td>
<td>$203,300,000</td>
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<td>11,000</td>
<td>$221,100,000</td>
<td>$214,100,000</td>
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<tr>
<td><strong>22,000</strong></td>
<td><strong>$217,200,000</strong></td>
<td><strong>$210,500,000</strong></td>
<td><strong>$204,000,000</strong></td>
<td><strong>$197,300,000</strong></td>
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<td>33,000</td>
<td>$213,200,000</td>
<td>$206,900,000</td>
<td>$200,700,000</td>
<td>$194,300,000</td>
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<tr>
<td>44,000</td>
<td>$209,300,000</td>
<td>$203,200,000</td>
<td><strong>$197,300,000</strong></td>
<td>$191,300,000</td>
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<td>44,000*</td>
<td>$198,500,000</td>
<td>$194,400,000</td>
<td>$186,500,000</td>
<td>$180,500,000</td>
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*includes 50% higher tip fee compared to base assumption of $0.06/gallon
Preferred Alternative
Advantages of Preferred Alternative

- Provides diversification in solids handling through creation of a Class B product
- Reduces solids generated on the east side through digestion
- Reduces MSD’s reliance on landfills
- Provides future flexibility – possibility of incorporating other WWTPs sludge into the Little Miami facility
- Provides revenue stream possibilities through biogas sale, RINs sale, and HSW receiving
Other Features Included in the Plan

- **System wide** odor control improvements
- **Debottlenecking** upstream of Mill Creek FBIs
- **Replacement of aging equipment** with more robust technologies
Next Steps

- Project prioritization
- Five year CIP
- 30-year Master Plan
Thank you.

Questions?
Bullpen
1 Incinerator with Hauling Peak Loads

Sludge volume being stored

Incinerator Operating

Sludge volume of 1 tank

Solids (dry tons)
1 Incinerator with Hauling Peak Loads

- Operation time at various capacity
  - at 100% 71.60%
  - between 90 and 100% 5.70%
  - between 70 and 90% 10.70%
  - zero feed 12.00%
- One incinerator with hauling 10 or 11 trucks once a month
- Storage remains below 1 tank volume
Summary of MSDGC Annual O&M

Total O&M Costs

Hauling Breakdown

- Polymer
- Natural Gas
- Electricity
- Cake Hauling
- Liquid Hauling
- Other Chemicals
- Labor
- Vactor Services
## Options for First-Round Consideration

<table>
<thead>
<tr>
<th></th>
<th>Polk Run</th>
<th>Sycamore Creek</th>
<th>Little Miami</th>
<th>Indian Creek</th>
<th>Muddy Creek</th>
<th>Taylor Creek</th>
<th>Mill Creek</th>
<th>Regional Facility</th>
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<tr>
<td><strong>Pumping / Sewer</strong></td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td><strong>Mechanical Thickening</strong></td>
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<td></td>
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<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td><strong>Anaerobic Digestion</strong></td>
<td></td>
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<td></td>
<td></td>
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<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td><strong>Centrifuge Dewatering</strong></td>
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<td><strong>Incineration</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>■</td>
<td></td>
<td>■</td>
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<tr>
<td><strong>Innovative Technologies</strong></td>
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<td></td>
<td></td>
<td></td>
<td>■</td>
<td>■</td>
<td>■</td>
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<tr>
<td><strong>Biogas Utilization</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>■</td>
<td>■</td>
<td>■</td>
</tr>
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</table>
Regional Facility

- Fluidized Bed Incineration – Import dewatered cake from all east and west plants
- Cambi Digestion – Import dewatered cake from all east and west plants
- Considerations:
  - Take in other regional solids (from other districts)?
  - Include allowance for codigestion?
  - Odor considerations for receiving station
Cake Receiving

• Many “open” receiving hoppers exist - these often allow significant odor release into the community. Picture on left is an older receiving facility at the Cotton Valley plant, UK.
• The replacement receiving station is the fully enclosed structure on the right, currently under construction.
Positive Odor Control – Full Truck Enclosure (Oxford Plant)
Market Overview

- 4 main generators/managers
- Most comingle grease and septage though willing to separate
- Market Size: 46,000 gpd (5 d/w)

Recommendations

- Balance tipping fees with potential savings on haul distance, better clarify disposal locations
- Anticipated less than full participation
  - Modular facility design
  - Plan for load leveling
Market Overview: Food and Food Processing Wastes

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
<th>Quantity</th>
<th>Frequency</th>
<th>Preprocessing Required</th>
<th>Est. Biogas Production</th>
<th>Est. Biosolids Production</th>
<th>Est. Return Stream Imp.</th>
<th>Program Role</th>
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<tbody>
<tr>
<td>John Morell</td>
<td>DAF Float</td>
<td>High</td>
<td>High</td>
<td>No</td>
<td>High</td>
<td>Mod</td>
<td>High/Mod</td>
<td>Anchor</td>
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<tr>
<td>G&amp;J Pepsi Co.</td>
<td>High Str. Liquid</td>
<td>Med</td>
<td>Mod.</td>
<td>No</td>
<td>High</td>
<td>V. Low</td>
<td>Low</td>
<td>Anchor</td>
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<tr>
<td>JTM Foods</td>
<td>Food Waste</td>
<td>Low</td>
<td>Mod.</td>
<td>Yes</td>
<td>High</td>
<td>Mod.</td>
<td>Mod</td>
<td>Potential</td>
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</tbody>
</table>

**Producers**
- JTM Foods- Solid food waste
- G&J Pepsi Co.- soft drink waste
- John Morrell/Smithfield- sludge cake
- Total
Mill Creek as Regional

30-year Net Present Worth

Cake Hauling + 2 FBI
$114
$161
$192

FM + 2 FBI
$156
$175
$265
$266

THP + 1 FBI
$10
$67
$360

Thermo + 1 FBI
$57
$64
$346

Mill Creek Capital
Outlying Plants Capital
Mill Creek Operating Cost
Outlying Plants Operating Cost
NPV
PB NPV
Implementation of HSW

- Waste must be liquid and pumpable
- Suitability of waste will need to be evaluated
- 22,000 gpd represents large FOG haulers and one industrial waste provider
- Additional wastes may be identified by HCSWD
- LM mesophilic digesters can receive a max of 75,000 gpd
D3 and D5 Split Strategy

- Operate standby digester as secondary digester dedicated to HSW.
- Under avg day cond. all muni biogas to D3 and HSW to D5
- Annual 4 week downtime where all biogas to D5
D3 and D5 Split Strategy

• At Little Miami
  • Meso: 3 primary, 1 secondary/HSW
  • Cambi: 2 primary, 1 secondary/HSW
    • Separate Cambi units to maintain Class A

• At Mill Creek
  • Cambi and Thermo: 3 primary, 1 secondary/HSW
  • No need to meet Class A (FBI)
Mill Creek Layout: FBIs
Alternative 4A – Layout for Costing
Alternative 2C Layout for Costing
Alternative 3 – Layout for Costing
Consideration – Pumping vs. Hauling Sludge

• Can we eliminate solids handling at the smaller plants by installing sludge force mains?
• What is technically feasible?
• What is feasible from a regulatory perspective?
How to Make Best Use of the Existing Incinerator

- What operating conditions facilitate autogenous burn?
- How many incinerators should MSD operate?
- What improvements are needed to facilitate operation of the FBIs?
Impact of Population Projections
Seek out highest value for digester gas with “other processes”
Incorporating Flexibility for Codigestion
## Little Difference on Non-Cost Analysis

<table>
<thead>
<tr>
<th>Non-Monetary Criteria Evaluation</th>
<th>Alt 2C LM Cambi</th>
<th>Alt 3 LM Meso</th>
<th>Alt 4A Regional FBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of Mitigating Off Site Odors (10%)</td>
<td>6.0</td>
<td>5.0</td>
<td>4.0</td>
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<tr>
<td>Transportation Logistics (5%)</td>
<td>4.0</td>
<td>3.0</td>
<td>6.0</td>
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<tr>
<td>Revenue Generating Potential (15%)</td>
<td>6.0</td>
<td>4.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Operational and Maintenance Impacts (20%)</td>
<td>3.5</td>
<td>5.0</td>
<td>7.0</td>
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<tr>
<td>Future Flexibility (15%)</td>
<td>6.5</td>
<td>4.5</td>
<td>3.5</td>
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<tr>
<td>Reliability (20%)</td>
<td>3.5</td>
<td>5.0</td>
<td>6.0</td>
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<tr>
<td>Regional Benefits (10%)</td>
<td>7.0</td>
<td>7.0</td>
<td>4.0</td>
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<td>Resource Recovery (5%)</td>
<td>6.0</td>
<td>6.0</td>
<td>1.0</td>
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<td>Constructability (10%)</td>
<td>7.0</td>
<td>7.0</td>
<td>8.0</td>
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<tr>
<td>Total Score (from 110%)</td>
<td>5.8</td>
<td>5.7</td>
<td>5.5</td>
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## Net Present Value Overview

### Financial Evaluation

<table>
<thead>
<tr>
<th></th>
<th>Alt 2C LM Cambi</th>
<th>Alt 3 LM Meso</th>
<th>Alt 4A Regional FBI</th>
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<tr>
<td><strong>Capital Expenditures</strong></td>
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<tr>
<td>Capital Outlay (Eastside)</td>
<td>$109,080,000</td>
<td>$ 71,710,000</td>
<td>$ 39,380,000</td>
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<tr>
<td>Capital Outlay (Westside)</td>
<td>$  6,110,000</td>
<td>$  6,110,000</td>
<td>$  6,110,000</td>
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<tr>
<td>Capital Outlay (Mill)</td>
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<td>$140,460,000</td>
<td>$149,250,000</td>
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<tr>
<td>Total Capital Outlay</td>
<td>$255,650,000</td>
<td>$218,280,000</td>
<td>$194,740,000</td>
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<td>PW of 30-yr Capital Outlay (with R&amp;R)</td>
<td>$456,700,000</td>
<td>$411,000,000</td>
<td>$382,300,000</td>
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<td><strong>Annual O&amp;M Cost and Revenues</strong></td>
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<tr>
<td>Annual O&amp;M Costs (Eastside)</td>
<td>$ 4,380,000</td>
<td>$ 3,640,000</td>
<td>$ 2,590,000</td>
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<td>Annual O&amp;M Costs (Westside)</td>
<td>$  700,000</td>
<td>$  820,000</td>
<td>$  700,000</td>
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<td>Annual O&amp;M Costs (Mill)</td>
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<td>Annual HSW Tipping Fee</td>
<td>$(480,000)</td>
<td>$(480,000)</td>
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<td>Annual Cake Tipping Fee</td>
<td>$(510,000)</td>
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<td>$(510,000)</td>
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<td>Annual rCNG Sale</td>
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<td>Annual RINs sale</td>
<td>$(2,070,000)</td>
<td>$(1,260,000)</td>
<td>$ -</td>
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<td>Total Net Annual O&amp;M Cost (with Revenue)</td>
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<td>PW of 30-yr Total Net Annual O&amp;M Cost*</td>
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<td>$248,900,000</td>
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<td><strong>Total 30-yr Net Present Value Cost</strong></td>
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<td>$632,980,000</td>
<td>$631,220,000</td>
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