Case Study in Sustainability
Madison MSD Pump Station #18

Bryan K Lewis, P.E
October 12, 2016
Mission: Protect public health and the environment

Vision: Enrich life through clean water and resource recovery

TRIPLE BOTTOM LINE
Sustainability for any organization relies on more than just money as the bottom line. Factors for success must include not only financial, but also human and environmental outcomes, often referred to as the Triple Bottom Line. At the District, people, planet, and prosperity are all taken into consideration when we measure our success and weigh our options in planning for the future.
Before PS 18 System – PS7 Limitations

• Limited Upstream Interceptor Capacity

• Limited Force Main Pressure Rating

• Limited Room for PS 7 Expansion
  – Limited Site Space
  – No Space Allocated for Future Pumps
Pump Station 7
Limitations
Collection System Schematic
Showing Average Daily Volumes in mgd
(Actual Volume 2010/Projected Volume 2030)
Madison Metropolitan Sewerage District

(Note: Projected 2030 Volumes taken from CARPC’s MMSD Collection System Evaluation (2008). 2030 Volumes derived from Traffic Analysis Zone (TAZ) data.)
Madison Metropolitan Sewerage District Pumping Station, Interceptor & Force Main Project

PS-18 (April 2015)
2030 Firm Capacity = 45 MGD
2060 Firm Capacity = 66 MGD

NEI Relief Sewer (SEI to FEI)

54" NEI Capacity = 52 MGD

42" FEI Capacity = 16 MGD

48"FM from PS-18 to Springs WWTP

Abandoned 48" NEI Section to SEI

60" SEI Capacity = 38 MGD
12060 Peak Flow

60" NEI to SEI

36" SEI Capacity = 11 MGD

Existing 60" Southeast Interceptor (SEI)

East Broadway

City of Monona

City of Madison

USH 51

USH 12/18

Exsiting Far East Interceptor (FEI)

Existing 48" Northeast Interceptor (NEI)

Municipal Boundary
PS 18 Force main
The PS 18 project came with the construction of a new force main to transport water from the pumping station to the treatment plant. In simple cases, installing new pipes involves digging a trench and laying the pipe underground. But this wasn’t a simple case. There were some significant obstacles between PS 18 and the treatment plant, including wetlands, the Yahara River, and the Beltline. Recognizing this, the District carefully planned the force main project to minimize its impacts on the environment and the community.

The force main itself, a pipe four feet across, was constructed in South Beloit, using local labor and reducing transportation costs and energy. Rather than digging through the Beltline and water bodies in the pipe’s path, the District used a process called “trenchless technology” to install the pipe underground. Through this process, the District avoided unnecessarily disturbing the environment and traffic. Wetland areas that were disturbed in the process were re-seeded with native plants.

During this project, the District sought and received a great deal of community interaction. Parts of Broadway Avenue had to be shut down during the construction, so the District strove to minimize effects on local businesses, commuters, and residents. The District held public meetings, put out press releases, and sent emails and mass mailings with updates about the project. The District also branched out its communications on this project through social media, with an eye toward increasing public education and engagement.

Benefits to the Community
NEW ROAD ON BROADWAY
Drivers on the westbound side of Broadway Avenue in Monona can thank the force main project for a smoother ride. The District had to tear up about 6000 feet of this road during the project since the force main runs beneath it, so after the pipe was in place, the District covered it with new, better road.

BIKE STATION
If you’re a biker, chances are you’ve biked near the Nine Springs plant on the Capital City bike path. As a perk of the force main construction project, the District is collaborating with Madison Water Utility to add a bike repair station and water fountain on the bike path near the plant. The station, provided free by Dane County, will be a great way to educate passing bikers and pedestrians about the plant.
Design Goals and Objectives for New PS 18

• Flow Splitting and Balancing with PS 7
  – Provide Adequate Firm Pumping Capacity for East Side
  – Defer PS 7 Improvements

• Redundancy & Reliability
  – PS 7 is at a Critical Location (40% of Total Flow to plant)
  – Mitigate Overflows and Back-ups
  – Accept Flows from Downstream, if PS 7 Fails

• Wastewater Screening
  – Ragging Issues at PS 7
  – 70 to 80% of Current PS 7 Flow will pass through PS 18
Sustainability Goals and Objectives for PS 18

• **Standby Power**
  – Engine generator, instead of twin primary electrical feed, to prevent sewer backups in the event of power failure.

• **Noise Control**
  • relative to engine exhaust and proximity to public.

• **Odor Control**
  – Adjacent Medical Clinic; limited space.

• **Energy Management**
  – Ventilation heat recovery.
  – Reduced winter make-up air with gas detection per NFPA 820.

• **Green Roof**
  – Reduced stormwater runoff.
  – Reduced heat build up.
  – Reduced greenhouse gas emission.
Madison MSD - PS 18
Hydraulic Coverage for 2 Small & 3 Large Pumps,
Current Conditions

48-inch Force Main Velocity, fps

Pumping Rate, gpm

Pumping Rate, MGD
## Centrifugal Pumps – Current Conditions

<table>
<thead>
<tr>
<th>Pump Characteristic</th>
<th>Pumps 18A and 18B</th>
<th>Pump 18C</th>
<th>Pumps 18D and 18E</th>
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<tbody>
<tr>
<td>Pump Designation</td>
<td>“Small”</td>
<td>“Large”</td>
<td>“Large”</td>
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<tr>
<td>Number of Units</td>
<td>2</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Constant or Variable Speed</td>
<td>Variable</td>
<td>Constant</td>
<td>Variable</td>
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<tr>
<td>Suction Size (in.)</td>
<td>14</td>
<td>30</td>
<td>30</td>
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<tr>
<td>Discharge Size (in.)</td>
<td>14</td>
<td>24</td>
<td>24</td>
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<tr>
<td>Max Speed (rpm)</td>
<td>890</td>
<td>585</td>
<td>585</td>
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<tr>
<td>Performance Requirements at Rated Maximum Speed</td>
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<tr>
<td>Capacity (gpm)</td>
<td>7,000</td>
<td>15,630</td>
<td>15,630</td>
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<tr>
<td>Head (ft.)</td>
<td>49</td>
<td>80</td>
<td>80</td>
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<tr>
<td>Design Operating Point</td>
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<tr>
<td>Electric Motor Characteristics</td>
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<tr>
<td>Horsepower</td>
<td>125</td>
<td>450</td>
<td>450</td>
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<tr>
<td>Nominal Speed (rpm)</td>
<td>900</td>
<td>600</td>
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Madison MSD
Pump Station #18
Construction
PUMP STATION 18
SECTION VIEW
DIAGRAM

ELEVATION VIEW OF BAR
SCREENS
AND CHANNEL ROOM
Channel Room

PS-7 FLUME INLET GATE (SLD-18-8-1)
(TYPICALLY NORMALLY OPEN)

PS-7 FLUME BYPASS GATE (SLD-18-8-2)
(TYPICALLY NORMALLY CLOSED)

PS-7 FLUME CHANNEL

CHANNEL ROOM
<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Huber</th>
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<tbody>
<tr>
<td>Bar Screen Model</td>
<td>Huber RakeMax® Multi-Rake Bar Screen</td>
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<tr>
<td>Screenings Compactor Model</td>
<td>Huber Hydropress Ram Press HP 2 Size: 250 mm diameter / 500 mm feed length</td>
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</tbody>
</table>
“Small” Wastewater Pump Unit “B”

PUMP P18B
Fairbanks Nijhuis
Model 14” B5721
Horizontal Angle Flow
Serial No. 2367790-1
7000 GPM @ 49' TDH

US Electric Motors
125 HP/480V/3PH/60Hz
Inverter Duty Motor
Large Wastewater Pump Unit “E”

PUMP P18 E
Fairbanks Nijhuis
Model 24” C5722
Serial No. 2368059-1
15630 GPM @ 80' TDH

US Electric Motors
450 HP/480V/3PH/60Hz
Inverter Duty Motor
Wastewater Pump Room

FUTURE 38" SUCTION FROM WEST WET WELL

FUTURE LARGE RAW WASTEWATER PUMP 18 F DESIGNED TO BE LOCATED BETWEEN PUMP 18 B AND PUMP 18 E

38-IN GATE VALVE
PV-18-20-3
'Large Wastewater Pump Unit "C"
Pump Removal Access Hatch
Discharge Check Valve and Isolation Gate Valve
Discharge Check Valves and Isolation Gate Valve
PS 18  HMI Screen
Resource Transfer Facility Overview

Facility Control - Automatic

Pumping Unit C
Pump C, Lead
Pumping Unit B

Outdoor Air Temp. 72.0
Indoor Air Temp. 68.0

Active Wetwell
Level 16.87 Feet
Elevation 16.94 Feet
High Wall Level 16.75 FT
Lead Pump Start 17.80 FT
Control Point 17.83 FT
Lead Pump Start 16.50 FT
Pumps Off 12.78 FT
Wetwell Low Level 6.75 FT

AC Power System
Service 1: MGE, EIM 1304 Normal
Service 2: 1500KW Generator In-Standby

Telemetry Communications Normal

Pump Room Occupied, 100% Outdoor Supply Air

Flow to PS7 MGD 7.25 T

PS 18 HMI Screen
Madison MSD - PS 18
Hydraulic Coverage for 2 Small & 3 Large Pumps, Current Conditions

48-inch Force Main Velocity, fps

2 Large Pumps Operating

1 Large Pump Operating

2 Small Pumps Operating

1 Small Pump Operating

Pumping Rate, gpm

Pumping Rate, MGD
<table>
<thead>
<tr>
<th>Date</th>
<th>PS18 To NSPWWTP (MGD)</th>
<th>PS18 Bypass To PS07 (MGD)</th>
<th>Total Flow (MGD)</th>
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<tbody>
<tr>
<td>January</td>
<td>4.44</td>
<td>6.81</td>
<td>11.25</td>
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<tr>
<td>February</td>
<td>4.81</td>
<td>6.32</td>
<td>11.14</td>
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<tr>
<td>March</td>
<td>5.22</td>
<td>6.53</td>
<td>11.74</td>
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<tr>
<td>April</td>
<td>4.77</td>
<td>7.18</td>
<td>11.95</td>
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<tr>
<td>May</td>
<td>5.17</td>
<td>6.29</td>
<td>11.46</td>
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<tr>
<td>June</td>
<td>5.17</td>
<td>6.34</td>
<td>11.51</td>
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<tr>
<td>July</td>
<td>5.04</td>
<td>6.40</td>
<td>11.44</td>
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<tr>
<td>August</td>
<td>5.04</td>
<td>6.66</td>
<td>11.70</td>
</tr>
<tr>
<td>Min</td>
<td>0.00</td>
<td>4.95</td>
<td>9.23</td>
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<tr>
<td>Ave</td>
<td>4.95</td>
<td>6.55</td>
<td>11.50</td>
</tr>
<tr>
<td>Max</td>
<td>7.02</td>
<td>12.10</td>
<td>14.72</td>
</tr>
</tbody>
</table>
### FireRay 50/100 RU
- **Reflective Optical Beam Smoke Detector**

### FireRay 2000 EEExd
- **Explosion Proof Optical Beam Smoke Detector**

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**General Initiating Devices**
- Manual Pull Station: X
- Smoke Detector: X
- Heat Detector: X
- Supervisory Duct Smoke Detector: X

**Optical Beam Smoke Detection Units**
- Optical Beam Smoke Detector System Smoke Detector: X
- Optical Beam Smoke Detector System Trouble Condition: X
Diesel Engine Generator
Standby Generator
PS 18 HVAC

18-RTU-1 Electrical and Pump Room HVAC

HVAC Penthouse

18-EF-1 Exhaust Fan Screening and Channel Rooms

Roof Stairwell

Load Bank for Generator

36" Exhaust Stack 18-OCU-1 Odor Control Unit

18-EF-1 Exhaust Fan Screening and Channel Rooms

18-MAU-1 Screening and Channel Rooms
HVAC Rooftop Unit
Calgon Carbon Phoenix™ Odor Control System
10,240 CFM
Exhaust
36” dia. Stack
Odor Control System
4 Green Roofing System with Natural Lighting

- A green roofing system reduces PS 18 temperatures.
- The plants transpire water, absorb heat, reduce greenhouse gasses and improve air quality.
- Staff can remove the tray system to maintain the roof.
- Skylights and translucent wall panels help illuminate PS 18.

Madison Metropolitan Sewerage District
Preparing for Growth

Pumping Station 18 (PS18)

As communities expand and populations grow, adequate sewer infrastructure is needed to reliably transport wastewater from throughout the District’s service area to the treatment plant. To equip the system for future growth and higher flows, the District constructed a new pumping station (PS 18) in Monona that will serve up to 12 communities. Pumping Station 7 (PS 7) currently serves the area, but is reaching capacity as the area continues to develop.

PS 18 will increase the District’s overall water pumping capacity, preparing our sewer system to serve more residents and businesses. With another pumping station, the system will also better handle a large amount of water in times of heavy precipitation, reducing the risk of overflows and sewer backups.

As another protection against sewer backups, PS 18 has an onsite backup generator, which will act as another protection against sewer backups. The generator, which could produce enough electricity for 1000 homes, will keep the station pumping in the event of a regional power outage.

In times of normal flow, PS 18 will work in tandem with PS 7. Currently, PS 7 itself conveys 16 million gallons of wastewater to the treatment plant each day, or almost 40% of the plant’s total flow. With the help of PS 18, flows to PS 7 will be reduced and the overall system will have plenty of capacity for future growth.

GREEN FEATURES

PS18 has green features to make it friendlier to its neighbors and the environment. These innovative aspects will be considered during rehabilitation of existing pump stations throughout the District. In a first for District buildings, the station has a green roof, which will help to control stormwater and energy costs. The station also has an odor control system to reduce odors for the surrounding community.
Acknowledgments

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