Pump Station 7 Improvements

Project Purpose:

The purpose of this project is to ensure that Pump Station 7 continues to operate in an efficient and effective manner following construction of Pump Station 18.

Project Proposers/Champions: Todd Gebert

Department: Engineering/Operations & Maintenance

Project Involvement:

Management of the project will be provided by the Engineering Department. Staff from the Engineering Department and the O&M Department will be assigned to areas of need as the project schedule and scope become better defined. Strand Associates was retained in January of 2018 to provide design services for the improvements.
**Project History and Status:**

In its 2009 *Collection System Study*, the Capital Area Regional Planning Commission (CARPC) projected peak hourly flow rates at Pump Station 7 of 60 million gallons per day (mgd) and 72 mgd for the years 2030 and 2060, respectively. The existing firm capacity at Pump Station 7 is only 39 mgd, thus a major capacity upgrade was required to convey these future flowrates.

Pump Station 7, located at 6300 Metropolitan Lane, had been the largest District pumping facility by volume of wastewater pumped prior to the construction of Pump Station 18. Prior to Pump Station 18 becoming operational Pump Station 7 pumped roughly 40% of the District’s wastewater to the Nine Springs Wastewater Treatment Plant, delivering flow from the entire east side of the City of Madison as well as the villages of DeForest, Waunakee, Cottage Grove and McFarland. The facility is in excess of 60 years old and was last rehabilitated in 1992. Elements of the 1992 rehabilitation included an increase in flow capacity, installation of surge control facilities, and the replacement of pumps, electrical gear, and other equipment.

Pump Station 18 was placed into operation in April of 2015 and works in tandem with Pump Station 7 by intercepting part of the flow that presently flows to Pump Station 7. The District plans to provide repairs, replacement, and upgrades to Pump Station 7 to ensure that it continues to function properly and work well in parallel with Pump Station 18.

Pump Station 18 has generally performed as expected since being placed into operation. From April of 2015 until November of 2015 it conveyed 70% of the flow that was previously pumped only by Pump Station 7. Some problems have been experienced in diverting so much flow away from Pump Station 7, however. Prior to Pump Station 18, the A pump at Pump Station 7 did not cycle very often and was able to provide a consistent and steady flow to the treatment plant. With the drop in flow to Pump Station 7 in April of 2015, the A pump began to cycle much more frequently and the flowrate to the treatment plant became more sporadic. This had the effect of making it difficult to balance the flows in the west aeration tanks.

In an effort to correct this, in November and December of 2015 the flow split between the two stations was essentially reversed, such that Pump Station 7 now pumps roughly 2/3 of the flow and Pump Station 18 the remaining 1/3 of the flow from the combined service area. This has helped to reduce the cycling of the A pump at Pump Station 7 and a more stable input of flow to the west aeration tanks.

It is also believed that total suspended solids may be depositing at a greater rate in the Pump Station 7 force mains than prior to the start-up of Pump Station 18. This is due to the lower flowrate (and velocities) being pumped from Pump Station 7. While the large pump at Pump Station 7 is operated on a routine basis to help scour the force mains, data from the District’s User Charge program indicates a decrease in solids from this service area since April of 2015.

**Options:**

a. **Description:**

Pump Station 7 must continue to operate efficiently and effectively after Pump Station 18 becomes operational. As such, anticipated improvements to Pump Station 7 must be considered in evaluating the various options for meeting capacity needs in the Eastside Collection System.

Recommendations for improvements to Pump Station 7 were identified in AECOM’s Final Design
Report for Pump Station 18 (March 2013). The following is a list of improvements to Pump Station 7 based on AECOM’s design report and evaluation by District staff:

- Replacement of existing controllers and control system
- Replacement of electrical switchgear, including outdoor transformers and utility equipment
- Replacement of Pump A
- Installation of odor control system
- Replacement and/or modifications to HVAC system
- Separation of control room space from garage area and screen room
- Installation of variable speed drive to optimize pumping operations
- Replacement of manual valves with electrically actuated valves

b. Alternatives

**Alternative 1 – Pump Station 7 Improvements**

Improvements at Pump Station 7 will be implemented after Pump Station 18 is brought online to address deficiencies related to existing equipment condition and age. Examples of these improvements include replacement of aging pump controllers and the control system. Replacement parts for these items are becoming obsolete and difficult to obtain. Other potential improvements include: replacement of electric switchgear, HVAC modifications, isolation of the dry well and wet well spaces, installation of an odor control system, installation of a variable speed pump drive and replacement of manual valves with electrically actuated valves (including installing an electrically actuated valve on each force main to allow for operation of a single force main during dry weather).

**Alternative 2 – Do nothing**

As part of this alternative improvements will not be undertaken at Pump Station 7. Pumps, electrical and control equipment will continue to be refurbished or replaced as their component parts fail. This option may eventually lead to sanitary sewer overflows in the collection system due to its inability to meet capacity requirements and due to increased failures of critical electrical and control equipment. Since this option does not provide the District’s required level of service it was not advanced for further economic analysis.

c. Key Risks and Issues

**Alternative 1**

A more detailed evaluation of asset condition and potential alternatives is required to determine all of the key risks and issues associated with this alternative. Despite the addition of Pump Station 18, Pump Station 7 must continue to be an operational pumping station; however, the critical nature of the pumping station is significantly reduced.

The following areas are of the greatest concern at Pump Station 7:
The controllers and message displays on the pumping units and station control center installed during the rehabilitation in 1992 are over twenty years old and are becoming obsolete. Individual pumps each have their own controllers and the telemetry system’s controller provides backup to the station control center. The District does have some of the obsolete controllers in stock.

The HVAC system no longer functions as originally designed. This is an issue that should be considered along with structural changes that would separate the control room from the rest of the station. Migration of hydrogen sulfide gasses into the dry well and control room areas adds to deterioration of existing equipment, especially electrical gear and control systems.

The diversion of flow from Pump Station 7 has increased the cycling of the pumps and may be causing solids deposition in the force mains due to the reduced pumping velocities. Installing a variable frequency drive on one of the smaller pumps will allow more efficient coverage of flows and reduce pump cycling. Installation of electrically actuated valves on the force mains will allow one force main to operate during normal dry weather and increase the flow velocity such that solids are less likely to settle.

It should also be noted that Pump Station 7 is adjacent to the Monona Riverfront redevelopment project. The area proposed for redevelopment is bounded by Bridge Road, West Broadway and the Yahara River. The types and location of specific land uses within the redeveloped area could influence the need, timing and scope of some of the improvements at Pump Station 7 (i.e. odor control).

**Alternative 2**

This alternative poses a very high degree of risk. Much of the mechanical and electrical equipment at the station has reached the end of their useful lives. Failure to modify the HVAC system and separate the dry well and wet well spaces will allow corrosion to further deteriorate the equipment. Continuing to operate this station without major repairs and/or replacement will result in escalating maintenance costs going forward and catastrophic failure of key equipment at some point. The ultimate consequences of this option will be a high risk of sewer backups into businesses and homes in the City of Monona and an increased chance for overflows from the collection system into the Yahara River.
d. Economic Analysis

Please see the attached 40-year life cycle cost estimate. A summary of present worth costs is provided in the following table:

<table>
<thead>
<tr>
<th></th>
<th>Capital Cost</th>
<th>Replacement Cost</th>
<th>O&amp;M Cost</th>
<th>Salvage Value</th>
<th>Total Present Worth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1</td>
<td>$3,860,000</td>
<td>$600,000</td>
<td>$79,000</td>
<td>$81,000</td>
<td>$4,501,000</td>
</tr>
<tr>
<td>Alternative 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not evaluated</td>
</tr>
</tbody>
</table>

Recommended Option

Staff recommends Alternative 1 as the preferred option. Pump Station 7 will remain a vital component of the District’s collection system, even with the recent addition of Pump Station 18. The replacement of aging equipment and the addition of measures to better control the corrosive atmosphere at Pump Station 7 are essential to ensure that the station continues to operate in a reliable and efficient manner.

Alternative 2 presents significant risk as it will eventually lead to equipment failures and possible basement backups in adjacent homes and/or sanitary sewer overflows to the Yahara River. Staff does not consider this to be a viable alternative.

Project Schedule:

A preliminary schedule for Pump Station 7 improvements is outlined below:

<table>
<thead>
<tr>
<th></th>
<th>Pump Station 7 Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>Completion</td>
</tr>
<tr>
<td>Planning</td>
<td>6/2013</td>
</tr>
<tr>
<td>Design</td>
<td>1/2018</td>
</tr>
<tr>
<td>Bid Date</td>
<td>11/2018</td>
</tr>
<tr>
<td>Construction</td>
<td>8/2019</td>
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Financial Summary (2019 dollars):

<table>
<thead>
<tr>
<th>Total Project Cost</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>District Staff</td>
<td>$336,000</td>
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<tr>
<td>Consultant</td>
<td>$503,000</td>
</tr>
<tr>
<td>Contractor</td>
<td>$3,352,000</td>
</tr>
<tr>
<td>Total</td>
<td>$4,191,000</td>
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</table>
### Fiscal Year Allocation (2019 dollars):

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td>District Staff</td>
<td>$16,000</td>
<td>$114,000</td>
<td>$105,000</td>
<td>$101,000</td>
</tr>
<tr>
<td>Consultant</td>
<td>$0</td>
<td>$265,000</td>
<td>$137,000</td>
<td>$101,000</td>
</tr>
<tr>
<td>Construction</td>
<td>$0</td>
<td>$0</td>
<td>$1,676,000</td>
<td>$1,676,000</td>
</tr>
<tr>
<td>Total</td>
<td>$16,000</td>
<td>$379,000</td>
<td>$1,918,000</td>
<td>$1,878,000</td>
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</table>

### Fiscal Year Allocation (actual dollars):

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>District Staff</td>
<td>$16,000</td>
<td>$114,000</td>
<td>$105,000</td>
<td>$104,000</td>
</tr>
<tr>
<td>Consultant</td>
<td>$0</td>
<td>$265,000</td>
<td>$137,000</td>
<td>$104,000</td>
</tr>
<tr>
<td>Construction</td>
<td>$0</td>
<td>$0</td>
<td>$1,676,000</td>
<td>$1,726,000</td>
</tr>
<tr>
<td>Total</td>
<td>$16,000</td>
<td>$379,000</td>
<td>$1,918,000</td>
<td>$1,934,000</td>
</tr>
</tbody>
</table>
# 40-Year Present Worth Cost Analysis
## For Pump Station 7 Improvements

**Present-Worth Analysis Year**: 2019  
**Analysis Period (yrs)**: 40  
**End of Analysis Year**: 2059

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Year</th>
<th>Capital Cost</th>
<th>Replacement Costs</th>
<th>O&amp;M Costs</th>
<th>Salvage Value</th>
<th>Total 2019 Present Worth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost in Year Constructed</strong></td>
<td></td>
<td><strong>2019 Present Worth</strong></td>
<td><strong>Replacement Year</strong></td>
<td><strong>2019 Present Worth</strong></td>
<td><strong>2019 Present Worth</strong></td>
<td><strong>2019 Present Worth</strong></td>
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<tr>
<td>Controllers &amp; Control System</td>
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<td>425,000</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Replace Electric Switchgear</td>
<td>2019</td>
<td>660,000</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>HVAC Replacement</td>
<td>2019</td>
<td>375,000</td>
<td>2039</td>
<td>200,000</td>
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<tr>
<td>Isolate Electrical Equipment</td>
<td>2019</td>
<td>470,000</td>
<td>-</td>
<td>0</td>
<td>282,000</td>
<td>68,000</td>
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<tr>
<td>Odor Control System</td>
<td>2019</td>
<td>755,000</td>
<td>2039</td>
<td>400,000</td>
<td>120,000</td>
<td>0</td>
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<tr>
<td>Pump VFD</td>
<td>2019</td>
<td>280,000</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Electrically actuated valves</td>
<td>2019</td>
<td>660,000</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Sustainability Initiatives</td>
<td>2019</td>
<td>235,000</td>
<td>-</td>
<td>0</td>
<td>47,000</td>
<td>11,000</td>
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<tr>
<td>New Pump A</td>
<td>2019</td>
<td>175,000</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td>3,860,000</td>
<td>600,000</td>
<td>120,000</td>
<td>79,000</td>
<td>4,501,000</td>
</tr>
</tbody>
</table>

**Alternative 2 - Do Nothing**

Not evaluated as a viable alternative

**Assumptions and Notes:**

1. Base interest rate = 3.63%
2. Construction cost escalation rate = 3.00%
3. HVAC/Odor Control Service Life (yrs) = 20
4. Pump/Drive & Controls Service Life (yrs) = 40
5. Building Service Life (yrs) = 100
6. Electric Equipment Life (yrs) = 40
7. Screening Equipment Life (yrs) = 40
8. Sustainability Initiatives Life (yrs) = 50
9. See attached annual O&M costs.
## Capital Costs for Pump Station 7 Improvements

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Units</th>
<th>2019 Unit Cost</th>
<th>2019 Total Cost</th>
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</thead>
<tbody>
<tr>
<td>Controllers &amp; Control System</td>
<td>1</td>
<td>L.S.</td>
<td>$225,000</td>
<td>$225,000</td>
</tr>
<tr>
<td>Replace Electric Switchgear</td>
<td>1</td>
<td>L.S.</td>
<td>$350,000</td>
<td>$350,000</td>
</tr>
<tr>
<td>HVAC Replacement</td>
<td>1</td>
<td>L.S.</td>
<td>$200,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Isolate Electrical Equipment</td>
<td>1</td>
<td>L.S.</td>
<td>$250,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>Odor Control System</td>
<td>1</td>
<td>L.S.</td>
<td>$400,000</td>
<td>$400,000</td>
</tr>
<tr>
<td>Pump VFD</td>
<td>1</td>
<td>L.S.</td>
<td>$150,000</td>
<td>$150,000</td>
</tr>
<tr>
<td>Electrically actuated valves</td>
<td>1</td>
<td>L.S.</td>
<td>$350,000</td>
<td>$350,000</td>
</tr>
<tr>
<td>Sustainability Initiatives</td>
<td>1</td>
<td>L.S.</td>
<td>$125,000</td>
<td>$125,000</td>
</tr>
<tr>
<td>New Pump A</td>
<td>1</td>
<td>EACH</td>
<td>$175,000</td>
<td>$175,000</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td></td>
<td><strong>$2,225,000</strong></td>
<td></td>
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<tr>
<td>I&amp;C/Mech/Elec</td>
<td>20%</td>
<td></td>
<td><strong>$445,000</strong></td>
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<tr>
<td>Project Subtotal</td>
<td></td>
<td></td>
<td><strong>$2,670,000</strong></td>
<td></td>
</tr>
<tr>
<td>Contingencies</td>
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<td></td>
<td><strong>$683,520</strong></td>
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<tr>
<td>Construction Total</td>
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<tr>
<td>Engineering</td>
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<td><strong>2019 Project Cost</strong></td>
<td></td>
<td></td>
<td><strong>$4,190,000</strong></td>
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</table>

5/14/2019
ANNUAL OPERATION AND MAINTENANCE COSTS FOR PUMP STATION 7 IMPROVEMENTS

<table>
<thead>
<tr>
<th>Interest rate = 3.625%</th>
<th>Labor inflation rate/construction cost escalation = 3.625%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034</td>
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<tr>
<td>PW Factor</td>
<td>1.0000 0.9650 0.9313 0.8987 0.8672 0.8369 0.8076 0.7794 0.7521 0.7258 0.7004 0.6759 0.6523 0.6294 0.6074 0.5862</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Description</th>
<th>Footnotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 7 - Control Upgrades - Annual Costs</td>
<td>(1) $0</td>
</tr>
<tr>
<td>PS 7 - Control Upgrades - 2019 PW Costs</td>
<td>$0</td>
</tr>
<tr>
<td>PS 7 - Electric Switchgear - Annual Costs</td>
<td>(1) $0</td>
</tr>
<tr>
<td>PS 7 - Electric Switchgear - 2019 PW Costs</td>
<td>$0</td>
</tr>
<tr>
<td>PS 7 - HVAC - Replacement Costs</td>
<td>(1) $200,000</td>
</tr>
<tr>
<td>PS 7 - HVAC - 2019 PW Costs</td>
<td>$200,000</td>
</tr>
<tr>
<td>PS 7 - Odor Control - Annual Costs</td>
<td>(2) $20,000 $23,898 $28,555 $34,119</td>
</tr>
<tr>
<td>PS 7 - Odor Control - 2019 PW Costs</td>
<td>$20,000 $20,000 $20,000</td>
</tr>
<tr>
<td>PS 7 - Odor Control - Replacement Costs</td>
<td>$400,000</td>
</tr>
<tr>
<td>PS 7 - Odor Control - 2019 PW Costs</td>
<td>$400,000</td>
</tr>
<tr>
<td>PS 7 - Pump VFD - Annual Costs</td>
<td>(1) $0</td>
</tr>
<tr>
<td>PS 7 - Pump VFD - 2019 PW Costs</td>
<td>$0</td>
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<tr>
<td>PS 7 - Firm Capacity Improvements - Annual Costs</td>
<td>(1) $0</td>
</tr>
<tr>
<td>PS 7 - Firm Capacity Improvements - 2019 PW Costs</td>
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<tr>
<td>PS 7 - Replace Valves - Annual Costs</td>
<td>(1) $0</td>
</tr>
<tr>
<td>PS 7 - Replace Valves - 2019 PW Costs</td>
<td>$0</td>
</tr>
</tbody>
</table>

**Notes:**

(1). Equipment O&M costs are incidental to existing PS 7 O&M costs.

(2). Assume carbon system with replacement every five years.
# Annual Operation and Maintenance Costs for Pump Station 7 Improvements

<table>
<thead>
<tr>
<th>Interest rate</th>
<th>Labor inflation/construction cost escalation</th>
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</thead>
<tbody>
<tr>
<td>3.625%</td>
<td>3.625%</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>2035</th>
<th>2036</th>
<th>2037</th>
<th>2038</th>
<th>2039</th>
<th>2040</th>
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<th>2046</th>
<th>2047</th>
<th>2048</th>
<th>2049</th>
<th>2050</th>
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</thead>
<tbody>
<tr>
<td>PW Factor</td>
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<td>0.3561</td>
<td>0.3436</td>
<td>0.3316</td>
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</tbody>
</table>

## Description and Footnotes

<table>
<thead>
<tr>
<th>Description</th>
<th>Footnotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS 7 - Control Upgrades - Annual Costs</td>
<td>(1)</td>
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<tr>
<td>PS 7 - Electric Switchgear - Annual Costs</td>
<td>(1)</td>
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<tr>
<td>PS 7 - Electric Switchgear - 2019 PW Costs</td>
<td></td>
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<tr>
<td>PS 7 - HVAC - Replacement Costs</td>
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</tr>
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<td>PS 7 - HVAC - 2019 PW Costs</td>
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<td>PS 7 - Odor Control - Annual Costs</td>
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<td>PS 7 - Odor Control - 2019 PW Costs</td>
<td>$200,000</td>
</tr>
<tr>
<td>PS 7 - Pump VFD - Annual Costs</td>
<td></td>
</tr>
<tr>
<td>PS 7 - Pump VFD - 2019 PW Costs</td>
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<tr>
<td>PS 7 - Firm Capacity Improvements - Annual Costs</td>
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<td>PS 7 - Firm Capacity Improvements - 2019 PW Costs</td>
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<tr>
<td>PS 7 - Replace Valves - Annual Costs</td>
<td></td>
</tr>
<tr>
<td>PS 7 - Replace Valves - 2019 PW Costs</td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. Equipment O&M costs are incidental to existing PS 7 O&M costs.
2. Assume carbon system with replacement every five years.

5/14/2019
## ANNUAL OPERATION AND MAINTENANCE COSTS FOR PUMP STATION 7 IMPROVEMENTS

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<thead>
<tr>
<th>Description</th>
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<tr>
<td>PS 7 - Odor Control - Annual Costs</td>
<td>(2)</td>
<td>$69,549</td>
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<td>PS 7 - Odor Control - 2019 PW Costs</td>
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<tr>
<td>PS 7 - Odor Control - Replacement Costs</td>
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<td>PS 7 - Odor Control - 2019 PW Costs</td>
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</tr>
<tr>
<td>PS 7 - Pump VFD - Annual Costs</td>
<td>(1)</td>
<td>$0</td>
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<tr>
<td>PS 7 - Pump VFD - 2019 PW Costs</td>
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<td>$0</td>
</tr>
<tr>
<td>PS 7 - Firm Capacity Improvements - Annual Costs</td>
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<td>PS 7 - Firm Capacity Improvements - 2019 PW Costs</td>
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<td>$0</td>
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<tr>
<td>PS 7 - Replace Valves - Annual Costs</td>
<td>(1)</td>
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</tr>
<tr>
<td>PS 7 - Replace Valves - 2019 PW Costs</td>
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</tbody>
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### Notes:

1. Equipment O&M costs are incidental to existing PS 7 O&M costs.
2. Assume carbon system with replacement every five years.