Planning & Assessment for Upgrades to ADOT Storm Water Pump Stations

ITE/IMSA Spring Conference
March 2, 2016
ADOT Storm Water Pump Stations
Phoenix Maintenance District

- Large system
  - 275 miles of divided freeway
  - 72 storm Water pump stations
  - 258 pumps

- Diverse system
  - Five different configurations
  - Two types of pumps
  - Varying energy sources
  - Capacity varies from 2,400 to 128,000 gpm

- Integral part of freeway drainage system
  - Roadway flooding severely affects the mobility and safety of the traveling public
Many pump stations are reaching the end of their useful life

- Constructed incrementally over a period of time starting from 1964
- Has resulted in a system that lacks:
  - Uniformity, standardization, and a long-term maintenance and/or replacement plan
- Increasing annual operation and maintenance (O&M) costs until rehabilitation or replacement occurs
- Maintenance concerns and issues that have compounded over time:
  - Has exceeded the PMD’s maintenance staff ability to adequately maintain and repair the facilities
ADOT’s P3 Program
Stormwater Pump Rehabilitation

- Goals of renewal
  - Identify assets reaching the end of their useful life
  - Identify stations with high trash/mud/silt accumulation
  - Rehabilitate, overhaul or replace, pumps, engines and motors throughout the PMD
  - Develop capital improvements and annual O&M costs
  - Provide reliable operation and maintenance of pump stations for 20 years after renewal

- P3 evaluation initiated in 2015
  - System-wide renewal, operation, and maintenance
  - Determine most appropriate delivery method

- Condition assessment needed for P3 evaluation
Development of Program Framework

Assessment Phase

Collect Data
Set Goals and Metrics
Assess Purpose and Need of Asset
ADOT Input
Condition Assessment
Build Data Sets
Prioritize Asset Groups
Develop CIP and PM Schedule
In-depth Investigation
Rehabilitation

Reassess

Rehabilitation Phase
Program Approach

- Standard Condition Assessment Ratings System (CARS)
- Field checklist
- Field observation and condition assessment
  - Limited performance assessment
- Evaluation and prioritization of assets
  - Field debrief and analysis

Assessment Team

- 3 to 4 specialists accompanied by ADOT staff
  - Senior civil engineer(s)
  - Electrical engineer
  - Staff engineer
  - Structural engineer (as required)
Standard Condition Assessment Ratings System (CARS)

- An excellent tool that:
  - Standardizes the ratings assigned to each assessment criteria
  - Guides the assessment team during the inspection
  - Ensures consistency from site to site to facilitate appropriate prioritization of the pump station inventory

<table>
<thead>
<tr>
<th>Rating</th>
<th>Designation</th>
<th>Description</th>
<th>Maintenance Benchmark</th>
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<tr>
<td>1</td>
<td>New</td>
<td>New or excellent condition</td>
<td>Normal preventive maintenance</td>
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<td>2</td>
<td>Good</td>
<td>Minor defects only</td>
<td>Normal preventive and minor corrective maintenance</td>
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<td>3</td>
<td>Fair</td>
<td>Moderate deterioration</td>
<td>Normal preventive and major corrective maintenance</td>
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<td>4</td>
<td>Poor</td>
<td>Significant deterioration</td>
<td>Rehabilitation, if possible</td>
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<td>5</td>
<td>Critical</td>
<td>Extremely damaged; virtually unserviceable</td>
<td>Replace</td>
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# Field Checklist

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<tr>
<th>No</th>
<th>Asset</th>
<th>Equipment/Serial No</th>
<th>Size (gpm, IN, KW etc)</th>
<th>Inspected Items</th>
<th>Source</th>
<th>Condition</th>
<th>Photo No</th>
<th>Comments</th>
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<td>Grounding</td>
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</tbody>
</table>
Observations: VT Pumps

- Good to fair condition
- Moderate to severe leakage at pump seals
- Coating defects on some column and discharge steel pipes
- Some pump bowls exhibiting corrosion
- The impellers appeared to be in good condition (no pitting)
  - Impellers covered with mud and lubricant
Observations: Engines/Generators

- Good to critical condition
- Exhaust system
  - Heavy Corrosion
  - No insulation
- Moderate to severe paint/corrosion issue
- No spare parts for older units: Waukesha
- Leaks
- Improper battery trays
Observations: Submersible/Sump Pumps

- Limited access for visual inspection due to submergence and trash
- Moderate to severe corrosion on discharge piping
- A significant number of the sump pumps were out of order
Observations: Wet Well and Trash Level

- Overall good condition
  - Discharge box undermining at one station
- Trash racks remove larger debris
- Many wet wells identified with heavy sediments
- Trash/small gravel damages pumps
- Severely corroded hatch and broken intrusion alarms
- Insufficient lighting
Observations: Safety System

- Fair to satisfactory condition
- Guard rails in few wet wells: heavy corrosion
- Light fixtures locations
  - At the edge of the guard rails with no safety hooks
- Ladders with missing or broken cage
- Non-functional gas detection systems
- Non-functional fire suppression systems
Observations: Fuel System

- Some tanks w/o proper painting or signage
- Propane piping:
  - Rusted and trip hazard
- Damaged and rusted diesel fuel piping
Observations: Site Condition

- Overall good condition
- Lifting systems/gantries
  - Derailed
  - Striking against pump building
- Metal roof decking: corrosion
- Concrete roof: leaking
- Site wall at one station: leaning towards I-10
- Site drainage grating:
  - Can’t block small gravels
Observations: Electrical and I&C

- Wiring and Relays in poor condition
- Only one-way communication
- Antenna and level sensor cables unprotected
- No GFCI receptacles
- Missing proper overcurrent protection
- Floats and Cables showing wear
Evaluation and Prioritization

- Following site inspections, the condition assessment team participated in a debrief meeting.
- Each inspected category was assigned with a “Weighting Factor”
  - On a rank of 1 through 5
  - “5” denoted to “most significant” element
  - “1” denoted to “least significant” element
- A rating score for each inspection category = Rating (CARS) X Weighting factor
- The priority rankings calculated for each pump station site will be based on the cumulative scores across all criteria.
## Preliminary Evaluation and Prioritization

**Category Weights**

<table>
<thead>
<tr>
<th>Station Component</th>
<th>Sub Category</th>
<th>Weighting Factor</th>
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</thead>
<tbody>
<tr>
<td>Pumps</td>
<td>N/A</td>
<td>5</td>
</tr>
<tr>
<td>Engines/motors/generators</td>
<td>N/A</td>
<td>5</td>
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<tr>
<td>Communication/telemetry</td>
<td>N/A</td>
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<tr>
<td>Pump control</td>
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<tr>
<td>Pump station operational/maintenance history</td>
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<tr>
<td>Primary discharge piping</td>
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</tr>
<tr>
<td>Wet well physical condition - 1</td>
<td>General/Structural</td>
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<tr>
<td>UPS</td>
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<tr>
<td>I&amp;C</td>
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<tr>
<td>Wet well physical condition - 2</td>
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<tr>
<td>Sump</td>
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<tr>
<td>Site safety and security</td>
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<tr>
<td>Ventilation</td>
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<tr>
<td>Lighting</td>
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<tr>
<td>Site Condition</td>
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</table>
Conclusions

- PMD’s maintenance staff
  - Working incessantly to keep stations functional and avoid flooding
  - Preventive/corrective maintenance activities: exceeded beyond staff capacity
- Renewal is needed across to restore capacity and reliability
  - Many near-term items identified
  - Non-functional pumps, sump pumps, and engines
  - Safety deficiencies
Next Steps

- Conduct physical wet well entry and pump impeller inspection
  - 14-21 stations
  - Based on age and history of problematic operation
- Calculate priority rankings and prioritize pump station assets
- Tie into P3 program
  - Refine capital and O&M cost estimates
  - Prioritize stations for in-depth investigation