EPS Modeling for IDSE Compliance: An Abilene Case Study

Presented by:
Melissa Waltzer, E.I.T., Project Engineer

AWWA Distribution Systems Symposium, September 2008
Acknowledgments

- Scott Cole, P.E., Freese and Nichols, Inc.
- Rodney Taylor, City of Abilene
- Tommy O’Brien, City of Abilene
- Ken Martin, P.E., Jacob and Martin, Ltd.
- Kirt Harle, P.E., Jacob and Martin, Ltd.
Agenda

- Overview of Distribution System
- Model Development and Calibration
- IDSE Compliance
- Capital Improvements Plan Development
Overview of Distribution System

- Current population: 122,000
- Average Day Demand: 22.0 MGD
- Maximum Day Demand: 37.7 MGD
- Pressure Planes: 5
- Water Treatment Plants: 3
- Elevated Storage Tanks: 8
- Ground Storage Tanks: 7
- Pump Stations: 9
- Wholesale Customers: 13
Overview of Distribution System
Agenda

- Overview of Distribution System
- Model Development and Calibration
- IDSE Compliance
- Capital Improvements Plan Development
Model Development and Calibration

- Physical Model
- Demand Allocation
- Field Testing
- Operational Controls
- EPS Calibration
Physical Model: Pipes

- Utilized City’s pipe shapefile
- Met IDSE length and volume requirements
  - 84% Volume
  - 50% Length
  - Total length of 2,211,774 feet modeled
- Initial Hazen Williams Roughness Coefficients

<table>
<thead>
<tr>
<th>Material</th>
<th>AC</th>
<th>Cast Iron</th>
<th>Concrete</th>
<th>Ductile Iron</th>
<th>PVC</th>
<th>No Material Listed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>120</td>
<td>100</td>
</tr>
</tbody>
</table>
Physical Model: Pipes
Physical Model: Facilities

- Pump Stations
  - Field Verified Pump Curves
- Ground and Elevated Storage
- Valves
- Water Treatment Plants
Demand Allocation

- 2005 Annual Billing Data
- Matched 97% of nearly 37,000 billing accounts
- Thiessen Polygons

Innovative approaches. . . practical results. . . outstanding service
Field Testing

- Two weeks of testing
- 6 Pressure Recorders per week

Innovative approaches. . . practical results. . . outstanding service
Field Testing
Operational Controls

- SCADA Data
- Diurnal Curves
- Model
- Demand Patterns by Pressure Plane
EPS Calibration

Grimes Pump Station Discharge Flow

Flow (MGD)

Time

- Recorded Flow
- Model Flow
EPS Calibration

- Issues encountered with SCADA data and limited wholesale data
EPS Calibration

Overflow Elevation: 1989’

35’  89 EST  40’

35’  707 EST  40’
EPS Calibration

- Issues encountered with tank information (incorrect overflow elevations)
Agenda

- Overview of Distribution System
- Model Development and Calibration
- IDSE Compliance
- Capital Improvements Plan
Peak TTHM Month

- Occurred in 4th quarter
- Selected October
Operational Controls

- Reviewed October SCADA
- Determined typical October pumping schedule
Water Age Model Runs

- 672 hours
- Used last 72 hours for averages
Histogram of Average Water Age Results

Average Water Age (Hours)

Number of Nodes

Innovative approaches... practical results... outstanding service
## Sampling Location Selection

<table>
<thead>
<tr>
<th>ID</th>
<th>Node</th>
<th>Address</th>
<th>Pressure Plane</th>
<th>Average Water Age (last 72 hours)</th>
<th>Preliminary Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSS-1</td>
<td>5936</td>
<td>Northeast WTP</td>
<td>First</td>
<td>0.39</td>
<td>Entry Point</td>
</tr>
<tr>
<td>SSS-2</td>
<td>9834</td>
<td>Grimes WTP</td>
<td>First</td>
<td>7.46</td>
<td>Entry Point</td>
</tr>
<tr>
<td>SSS-3</td>
<td>6806</td>
<td>Hargesheimer WTP</td>
<td>Third</td>
<td>1.25</td>
<td>Entry Point</td>
</tr>
<tr>
<td>SSS-4</td>
<td>5042</td>
<td>902 Fannin Street</td>
<td>First</td>
<td>18.16</td>
<td>Average Water Age</td>
</tr>
<tr>
<td>SSS-5</td>
<td>3872</td>
<td>2501 E. Hwy 80</td>
<td>First</td>
<td>10.87</td>
<td>Average Water Age</td>
</tr>
<tr>
<td>SSS-6</td>
<td>3810</td>
<td>4741 FM 18</td>
<td>Second</td>
<td>18.33</td>
<td>Average Water Age</td>
</tr>
<tr>
<td>SSS-7</td>
<td>6530</td>
<td>6328 Hardwick Road</td>
<td>Third</td>
<td>14.41</td>
<td>Average Water Age</td>
</tr>
<tr>
<td>SSS-8</td>
<td>2742</td>
<td>8250 Old Hwy 80</td>
<td>Fifth</td>
<td>135.96</td>
<td>High TTHM</td>
</tr>
<tr>
<td>SSS-9</td>
<td>6962</td>
<td>149 E. Beltway (FM 707)</td>
<td>Third</td>
<td>127.13</td>
<td>High TTHM</td>
</tr>
<tr>
<td>SSS-10</td>
<td>6434</td>
<td>3950 Ligustrum Drive</td>
<td>First</td>
<td>46.35</td>
<td>High TTHM</td>
</tr>
<tr>
<td>SSS-11</td>
<td>6806</td>
<td>3965 Georgetown Drive</td>
<td>Second</td>
<td>176.01</td>
<td>High TTHM</td>
</tr>
<tr>
<td>SSS-12</td>
<td>7140</td>
<td>47 Pinehurst</td>
<td>Second</td>
<td>190.98</td>
<td>High TTHM</td>
</tr>
<tr>
<td>SSS-13</td>
<td>1960</td>
<td>11250 West Lake Road</td>
<td>First</td>
<td>63.22</td>
<td>High HAA5</td>
</tr>
<tr>
<td>SSS-14</td>
<td>6320</td>
<td>6502 Hwy 277 S</td>
<td>Second</td>
<td>110.40</td>
<td>High HAA5</td>
</tr>
<tr>
<td>SSS-15</td>
<td>6938</td>
<td>7102 Lantana Avenue</td>
<td>Third</td>
<td>58.27</td>
<td>High HAA5</td>
</tr>
<tr>
<td>SSS-16</td>
<td>4926</td>
<td>4600 Pine St. (US Bus. 83)</td>
<td>First</td>
<td>40.63</td>
<td>High HAA5</td>
</tr>
</tbody>
</table>
Sampling Location Selection

Innovative approaches... practical results... outstanding service
## Sampling Results

- **August 2007**

<table>
<thead>
<tr>
<th>Site Number</th>
<th>THMs</th>
<th>HAAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>109.0</td>
<td>51.7</td>
</tr>
<tr>
<td>2</td>
<td>51.9</td>
<td>14.6</td>
</tr>
<tr>
<td>3</td>
<td>48.2</td>
<td>13.8</td>
</tr>
<tr>
<td>4</td>
<td>119.0</td>
<td>50.9</td>
</tr>
<tr>
<td>5</td>
<td>111.0</td>
<td>50.7</td>
</tr>
<tr>
<td>6</td>
<td>93.6</td>
<td>48.6</td>
</tr>
<tr>
<td>7</td>
<td>47.6</td>
<td>18.2</td>
</tr>
<tr>
<td>8</td>
<td>69.9</td>
<td>50.7</td>
</tr>
<tr>
<td>9</td>
<td>47.4</td>
<td>17.7</td>
</tr>
<tr>
<td>10</td>
<td>63.3</td>
<td>48.4</td>
</tr>
<tr>
<td>11</td>
<td>68.7</td>
<td>34.4</td>
</tr>
<tr>
<td>12</td>
<td>46.8</td>
<td>14.0</td>
</tr>
<tr>
<td>13</td>
<td>73.1</td>
<td>36.8</td>
</tr>
<tr>
<td>14</td>
<td>60.9</td>
<td>20.2</td>
</tr>
<tr>
<td>15</td>
<td>57.0</td>
<td>21.1</td>
</tr>
<tr>
<td>16</td>
<td>106.0</td>
<td>50.2</td>
</tr>
</tbody>
</table>
Agenda

- Overview of Distribution System
- Model Development and Calibration
- IDSE Compliance
- Capital Improvements Plan
Projected Water Demands

- Demands distributed based on population projections by billing district
- Peaking factors: Max. Day to Avg. Day: 2
  Peak Hour to Max. Day: 2
- Planning periods: 2010, 2015 and 2030

<table>
<thead>
<tr>
<th>Year</th>
<th>Abilene Per Capita Water Use (MGD)</th>
<th>Avg. Day (MGD)</th>
<th>Max. Day (MGD)</th>
<th>Peak Hour (MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>164</td>
<td>23.65</td>
<td>48.37</td>
<td>96.15</td>
</tr>
<tr>
<td>2015</td>
<td>162</td>
<td>24.05</td>
<td>49.24</td>
<td>96.97</td>
</tr>
<tr>
<td>2030</td>
<td>158</td>
<td>24.88</td>
<td>51.07</td>
<td>99.35</td>
</tr>
</tbody>
</table>
Model Runs

- **Average Day Demand**
- **Maximum Day Demand**
- **Peak Hour Demand**
- **Vulnerability Assessment**
- **Water Age**
- **Source Tracing (Mixing Zones)**
Development of Improvements
Vulnerability Assessment

Legend
- Flow (MGD)
- Pump Station
- Water Treatment Plant
- Storage Tank
- Valve

Figure 1
City of Abilene
Flow Balance Diagram
System Reliability
Buildout Average Day
Total System Demand = 24.9 MGD

Innovative approaches... practical results... outstanding service
Innovative approaches. . . practical results. . . outstanding service
Innovative approaches... practical results... outstanding service

Mixing Zones
Lessons Learned

- Verify/survey tank elevations
- Recognize deficiencies in wholesale customer data
- Small tanks are difficult to calibrate
- Check water ages at all tanks to ensure repeating patterns
- Demand allocation to all non-facility nodes is important in water age modeling
- Maximize existing infrastructure in CIP Planning
- Model can be used for a variety of applications
Questions?!?