Innovative Approach to Calculate I/I for SSES Study: City of Austin Case Study
Drivers for Crosstown SSES

• Long-term flow monitoring showed increasing flows CT basin
• City historically conducted SSES projects internally
• Wanted to have an outside perspective on SSES approach
• Public/private partnership for SSES approach
• Best practices and CMOM Guidelines
Crosstown Tunnel Basin

- 26 long-term meters in CT Basin
- 3.6 million LF of gravity main
- Diameter range: 2-inch to 96-inch
- 14,035 manholes
Project Approach

• Evaluate three years of flow data for long-term meters
• Review SSO history by long-term meter basin
• Identify areas for micro-metering based on historical response
• Expand hydraulic model to all-pipes models
• Conduct field work in top RDII response micro-meter basins
  • Smoke testing
  • Manhole inspections
  • Dye-water testing
• Develop prioritized renewal/rehabilitation CIP
**Historical Flow Analysis**

**DRAFT Figure 2-3**

Crosstown Tunnel SSES

Historical Flow Analysis - Metered Wet Weather Flows

May 23 - 26, 2015

**LEGEND**

- Q Peak = Peak Flow (mgd)
- PFF = Peak Storm Flow / Average Dry Day Flow
- Vol = Storm Volume - Average Daily Flow (MG)
- RDII = Rainfall dependent infiltration and inflow (gal/ft)
- Q inc = Meter Area Incremental Peak Wet Weather Flow (mgd)
- Vol inc = Meter Area Incremental Volume of I/I (MG)

**Event Characteristics**

- Period: May 23, Noon to May 26, Noon 2015
- Length (hours): 72
- Rainfall Total (inches): 4.01 to 5.44

**Meter ID**

- Low (less than 20 gal/ft)
- Medium (20-40 gal/ft)
- High (greater than 40 gal/ft)
- Inconclusive data

* Meter issues
**Meter issues and potential flow bypass at CT-C09
*** Peak flows at meters not coincident
**** RDII generally not directly applicable to some tunnel meters
Historical SSO Analysis

CAUSE OF SSO
- NO CAUSE
- BROKEN PIPE
- CAPACITY, SURCHARGE
- COLLAPSED PIPE
- CONTRACTOR DAMAGE
- DEBRIS
- DETERIORATED PIPE
- GREASE BLOCKAGE
- INFLATION AND INFLOW
- LIFT STATION PROBLEMS
- MISSING PIPE
- OFFSET PIPE
- ROOTS
- SAG IN LINE
- UNKNOWN BLOCKAGE
- VANDALISM
ONE MONITOR - 385,000 LF
100% OF BASIN HAS EXCESSIVE INFLOW

FOUR MONITORS - 85,000 LF
70% OF BASIN HAS EXCESSIVE INFLOW

12 MONITORS - 31,000 LF
60% OF BASIN HAS EXCESSIVE INFLOW

57 MONITORS - 8,100 LF
22% OF BASIN HAS EXCESSIVE INFLOW
Temporary Meter Basin Selection

Candidates for Micro-Metering

* Meter issues
**Meter issues and potential flow bypass at CT-C9
***Peak flows at meters not coincident
****RDII generally not directly applicable to some tunnel meters
Micro-Metering

• Select 4 meter basins for micro-metering

• Deployed 25 temporary meters at key locations in basins
Micro-Metering

DRAFT FIGURE 4
CITY OF AUSTIN
EXISTING WASTEWATER SYSTEM
FLOW METER IDENTIFICATION
BASIN CT C18

Legend

Pipeline Connectivity by FM Basin
- Proposed Temporary Flow Meter
- Permanent Flow Meter
- 8” and Smaller Wastewater Line
- 10” and Larger Wastewater Line
- Road
- Stream
- Lake/Pond
- Parcel
- Temporary Flow Meter Basin Boundary
- Permanent Flow Meter Basin Boundary

CT-C18 (Shoal)
Q Peak 15.1
PFF 4.9
RDII 44.8
Vol 20.8
Micro-Metering Results (Round 1)

- October 8 – December 30, 2016
- 4 permanent meters
  - CT-C02 (Fort Upper)
  - CT-C06 (Waller Upper)
  - CT-C17 (Shoal Upper)
- CT-C18 (Shoal Upper)
- 25 temporary meters
- Limited wet weather and system response

<table>
<thead>
<tr>
<th>Meter ID</th>
<th>Gross Average Dry Weather Flow (MGD)</th>
<th>Gross Maximum Wet Weather Flow (MGD)</th>
<th>Wet Weather to Dry Weather Peaking Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT-C02</td>
<td>0.384</td>
<td>1.082</td>
<td>2.82</td>
</tr>
<tr>
<td>C02-01</td>
<td>0.238</td>
<td>0.683</td>
<td>2.87</td>
</tr>
<tr>
<td>CT-C06</td>
<td>1.782</td>
<td>5.321</td>
<td>2.99</td>
</tr>
<tr>
<td>C06-01</td>
<td>0.243</td>
<td>0.496</td>
<td>2.04</td>
</tr>
<tr>
<td>C06-02</td>
<td>1.152</td>
<td>2.850</td>
<td>2.47</td>
</tr>
<tr>
<td>C06-03</td>
<td>0.091</td>
<td>0.177</td>
<td>1.95</td>
</tr>
<tr>
<td>C06-04</td>
<td>0.100</td>
<td>0.171</td>
<td>1.71</td>
</tr>
<tr>
<td>C06-05</td>
<td>0.836</td>
<td>1.817</td>
<td>2.17</td>
</tr>
<tr>
<td>C06-06</td>
<td>0.076</td>
<td>0.203</td>
<td>2.67</td>
</tr>
<tr>
<td>C06-07</td>
<td>0.106</td>
<td>0.226</td>
<td>2.13</td>
</tr>
<tr>
<td>C06-08</td>
<td>0.357</td>
<td>0.735</td>
<td>2.06</td>
</tr>
<tr>
<td>CT-C17</td>
<td>6.589</td>
<td>17.526</td>
<td>2.66</td>
</tr>
<tr>
<td>C17-01</td>
<td>3.837</td>
<td>8.313</td>
<td>2.17</td>
</tr>
<tr>
<td>C17-02</td>
<td>3.357</td>
<td>7.829</td>
<td>2.33</td>
</tr>
<tr>
<td>C17-03</td>
<td>0.144</td>
<td>0.324</td>
<td>2.25</td>
</tr>
<tr>
<td>C17-04</td>
<td>0.320</td>
<td>0.916</td>
<td>2.86</td>
</tr>
<tr>
<td>C17-05</td>
<td>0.270</td>
<td>0.725</td>
<td>2.69</td>
</tr>
<tr>
<td>C17-06</td>
<td>0.189</td>
<td>0.521</td>
<td>2.76</td>
</tr>
<tr>
<td>CT-C18</td>
<td>2.963</td>
<td>6.658</td>
<td>2.25</td>
</tr>
<tr>
<td>C18-01</td>
<td>0.184</td>
<td>0.477</td>
<td>2.59</td>
</tr>
<tr>
<td>C18-02</td>
<td>0.287</td>
<td>0.624</td>
<td>2.17</td>
</tr>
<tr>
<td>C18-03</td>
<td>3.268</td>
<td>6.008</td>
<td>1.84</td>
</tr>
<tr>
<td>C18-04</td>
<td>1.410</td>
<td>2.876</td>
<td>2.04</td>
</tr>
<tr>
<td>C18-05</td>
<td>0.296</td>
<td>0.728</td>
<td>2.46</td>
</tr>
<tr>
<td>C18-06</td>
<td>0.198</td>
<td>0.299</td>
<td>1.51</td>
</tr>
<tr>
<td>C18-07</td>
<td>0.142</td>
<td>0.278</td>
<td>1.96</td>
</tr>
<tr>
<td>C18-08</td>
<td>0.137</td>
<td>0.266</td>
<td>1.94</td>
</tr>
<tr>
<td>C18-09</td>
<td>0.225</td>
<td>0.354</td>
<td>1.57</td>
</tr>
<tr>
<td>C18-10</td>
<td>0.549</td>
<td>0.901</td>
<td>1.64</td>
</tr>
</tbody>
</table>
Micro-Metering Results (Draft Round 2)

- May 1 – June 30, 2017
- 21 depth only meters
- Temporary flow meters
- 4 permanent meters
- Preliminary data analysis using EPA SSOAP

*Flow data provided is preliminary and not processed
*Flow summary calculations performed in EPA SSOAP

[Bar chart showing ROIs and peaking factors for different flow meter basins]
## SSES Recommendations

### Basin Recommendations:
- Area 1: C18-03
- Area 2: C17-02
- Area 3: C18-04
- Area 4: C06-02

<table>
<thead>
<tr>
<th>Analysis</th>
<th>SSES Candidates</th>
</tr>
</thead>
</table>
| Fall 2016 (FNI)                   | CT-C06  
CT-C18  
C18-03  
C18-04 |
| Preliminary Spring 2017 (FNI)     | C06-02  
C06-05  
C17-02  
C18-03 |
| Spring 2017 (Crespo)              | C17-01  
C17-02  
C18-03  
C18-04 |
SSES Recommendations (C06-02)

C06-02

- 40,543 LF
- 175 manholes
- 6 to 24-inch diameters
SSES Recommendations (C17-02)

C17-02

- 42,619 LF
- 188 manholes
- 6 to 48-inch diameters
SSES Recommendations (C 18-02&04)

C18-03
- 55,780 LF
- 211 manholes
- 6 to 48-inch diameters

C18-04
- 41,831 LF
- 150 manholes
- 6 to 36-inch diameters
Sanitary Sewer Evaluation Survey

Prioritized Flow Monitoring to Focused Areas

Smoke Testing

Manhole Inspections
Smoke Testing
Manhole Inspections

- MACP Level 2 Inspections
- Document condition of manhole
- Develop rehabilitation recommendations
CCTV Inspection Review
SSES Field Work Plan

- Smoke test up to 220,000 linear feet of sewer lines
- Dye water test up to 20,000 linear feet of sewer lines
- Inspect up to 720 manholes
- Develop system improvement alternatives
- Study area report
- Preliminary Engineering Design Report
Hydraulic Modeling

- Expanded skeleton models to all pipes models
- Review all available as-builts to verify inverts and slopes
- Utilize to size recommendations
## Hydraulic Model Update (C02)

<table>
<thead>
<tr>
<th>Model</th>
<th>Pipes</th>
<th>Nodes</th>
<th>Subcatchments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletonized</td>
<td>35</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>All Pipes</td>
<td>390</td>
<td>391</td>
<td>104</td>
</tr>
</tbody>
</table>
Hydraulic Model Update (C17/18)

<table>
<thead>
<tr>
<th>Model</th>
<th>Pipes</th>
<th>Nodes</th>
<th>Subcatchments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletonized</td>
<td>637</td>
<td>628</td>
<td>167</td>
</tr>
<tr>
<td>All Pipes</td>
<td>4,658</td>
<td>4,633</td>
<td>663</td>
</tr>
</tbody>
</table>
Dry Weather Calibration: CT06

CT-C06-03: Weekend

Observed
Modeled

CT-C06-03: Weekday
Team has performed Dry Weather Calibration on all 4 basins

Currently finalizing Dry Weather Calibration based on AWU feedback

Wet Weather Calibration is in Progress

<table>
<thead>
<tr>
<th>Area</th>
<th>Model Development</th>
<th>Dry Weather Calibration</th>
<th>AWU Review</th>
<th>Wet Weather Calibration</th>
<th>AWU Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT 18</td>
<td>✔</td>
<td>✔</td>
<td>✗</td>
<td>✔</td>
<td>✗</td>
</tr>
<tr>
<td>CT 17</td>
<td>✔</td>
<td>✔</td>
<td>✗</td>
<td>✔</td>
<td>✗</td>
</tr>
<tr>
<td>CT 06</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✗</td>
</tr>
<tr>
<td>CT 02</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✗</td>
</tr>
</tbody>
</table>
• Field work is in progress
• Integrate inspection technology with system applications
• Take lessons learned from public/private partnership to apply to future studies
• Incorporate into best practices of CMOM program
Acknowledgements

Austin Water
• Kevin Koeller
• Soo Koon Soon
• Robert Cameron
• Joe Smith
• Stacey Burgtorf
• Rachel Chisolm
• Adrian Sandoval

Freese and Nichols
• Thomas Haster
• Stephen Johnson

White Rock
• Rod Thomhill

CP&Y
• Gopal Guthikonda
• Ryan Owen
Questions?

Grishma Shah
grishma.shah@austintexas.gov

Jessica Brown
jlb@freese.com

Mazen Kawasmi
mazen.kawasmi@freese.com