MANAGING INFLOW AND INFILTRATION

NorCal Pipe Users Group Monthly Meeting | January 8, 2019

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Presentation Outline

- Sources of Inflow/Infiltration (I/I)
- I/I Identification/Quantification Techniques
- I/I Analysis Tools
- I/I Reduction Methods
Sources of Inflow/Infiltration
Typical Sources of I/I
Saltwater Intrusion

Conductivity, μS/cm
- 5,000 and less
- 5,000 - 20,000
- 20,000 - 30,000
- 30,000 and greater

Note: Data points are labeled with the maximum EC measurement and the number of data points (in parentheses).
Saltwater Intrusion Issue: WWTP Salinity

**Graph Description:**
- **EC, μS/cm**: Y-axis (left side)
- **Sample Date**: X-axis (bottom)
- **Lagoon Level (secondary axis)**
- **WWTP Influent Composite EC**
- **Lagoon Outlet EC (divided by 10)**

**Key Observations:**
- EC values fluctuate over time, with peaks and troughs.
- Lagoon level shows a secondary trend.
- WWTP influent composite EC is consistently monitored.
- Lagoon outlet EC values, when divided by 10, are depicted.

**Company:** West Yost Associates
Identification & Quantification Techniques
<table>
<thead>
<tr>
<th>Technique</th>
<th>Objective</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro-Basin Flow</td>
<td>Quantifies I/I levels</td>
<td>High – Limited to minimum flows</td>
</tr>
<tr>
<td>Monitoring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Level Monitoring</td>
<td>Confirms high vs. low I/I levels</td>
<td>Medium – No minimum flow limit, but not accurate for flow rates: only relative rainfall response</td>
</tr>
<tr>
<td>CCTV Inspection</td>
<td>Significant structural defects, poor maintenance,</td>
<td>Medium – Defect ratings are subjective, leaks may not be visible</td>
</tr>
<tr>
<td></td>
<td>visual I/I</td>
<td></td>
</tr>
<tr>
<td>Smoke Testing</td>
<td>Cross connections, inflow sources, structural defects</td>
<td>Low – Detects some (above flowline) but not all</td>
</tr>
<tr>
<td>Dye Testing</td>
<td>Confirms cross connections</td>
<td>High – Does not locate exact point of inflow along main/lateral – only yes/no</td>
</tr>
<tr>
<td>Visual Manhole</td>
<td>Determines structural defects, poor design, or</td>
<td>Medium – Limited to accessible manholes only; leaks may not be visible</td>
</tr>
<tr>
<td>Inspection</td>
<td>settlement issues</td>
<td></td>
</tr>
<tr>
<td>Salinity Monitoring</td>
<td>Detect elevated salinity levels in wastewater</td>
<td>High – Can be used in successive manholes to detect changes in salinity along a single pipeline; gather diurnal data (not grab samples)</td>
</tr>
</tbody>
</table>
Wastewater Flow & Rainfall Monitoring

Goal is to Capture:

- Minimum of two storms: all meters/rain gauges working
- Reach typical ground saturation
- Big storms (2-year), not huge storms (no SSO flow losses)
- Good response at flow meters
- Dry weather data
Challenge: Capturing Storms

The graph illustrates the relationship between inches of rain and storm duration. It includes lines representing storm frequency for various return periods, such as 25-year, 10-year, 5-year, 2-year, 1-year, 50-year, 100-year, and 250-year storms. The graph shows the expected rainfall for different storm durations, with blue and red lines indicating specific storm events (Feb 5–9 and Feb 26–28) for comparison.

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Challenge: Siting Rain Gauges

![Graph showing rainfall data for different locations over a period of time.](graph_image)

- Green Valley School
- San Anselmo Town Hall
- Larkspur PS
- White Hill School

The graph plots rainfall (inches/hour) for the period from 2/5/2014 to 2/9/2014, showing the variability in rainfall at different times of the day and the different locations.
Results: 2-Year Storm Response

FM-16 (L180.030, 24" Pipe)

Flow (MGD) vs Rainfall (inches/hour)

- Flow
- Baseflow
- Rain

[Graph showing flow response over time, with peaks and troughs indicating storm events and associated rainfall.]
Saltwater Intrusion Testing

- Electroconductivity vs. Temperature
- 1-week at all sites concurrently
Interpreting Conductivity Results

Electroconductivity, $\mu$S/cm

Target Recycled Water EC Levels

Average Wastewater Conductivity Readings, Ross Valley Sewer System

Target Recycled Water EC Levels

Tributary Area Average Conductivity

- 8,900 - 12,700 $\mu$S/cm
- 1,900 - 2,800 $\mu$S/cm
- 850 - 1,400 $\mu$S/cm
- 500 - 600 $\mu$S/cm
I/I Analysis Tools
Hydraulic Modeling: Flow Projections
Modeling Results: Wet Weather Response by Basin
I/I Analysis Using InfoMaster Sewer Risk Modeling Software

- Magnitude of I/I Criteria (instead of LOF)
  - Flow Monitoring Results
  - Smoke and/or Salinity Testing Results
  - Groundwater Levels
  - CCTV I/I Contributing Defects
Defect Severity: From Failure to I/I Focus
I/I Defect Severity Results

Symbology
- City Limits
- Study Area
- Pump Station
- Force Main
- Gravity Main
- Manhole
- Manhole Investigation

Total Defect Score per Mile of Pipe
- < 150
- 150 to 300
- 301 to 450
- 451 to 600
- > 600

Salinity Monitor Average Conductivity (μS/cm)
- <= 1,500
- 1,501 - 15,000
- > 15,000

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I/I Analysis Using InfoMaster Sewer Risk Modeling Software

- Benefits of I/I Reduction Criteria (instead of COF)
  - Ability to Accurately Quantify I/I Reduction
  - Increased Compliance with Regulations
  - Reduced Maintenance
## Analysis Performed on a Sub-Basin Level

<table>
<thead>
<tr>
<th>WY Subbasin</th>
<th>Flow Monitoring Data Quality</th>
<th>Metered MH</th>
<th>Max R-Value</th>
<th>CCTV I/I Score per Mile Inspected</th>
<th>Work Order Count per Parcel</th>
<th>Salinity Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-6A</td>
<td>Acceptable</td>
<td>223-39X</td>
<td>47%</td>
<td>987</td>
<td>0.4</td>
<td>None</td>
</tr>
<tr>
<td>S-3</td>
<td>Good</td>
<td>537-14X</td>
<td>44%</td>
<td>585</td>
<td>0.3</td>
<td>None</td>
</tr>
<tr>
<td>S-9A</td>
<td>Acceptable</td>
<td>453-07X</td>
<td>22%</td>
<td>245</td>
<td>0.2</td>
<td>None</td>
</tr>
<tr>
<td>LP-4A</td>
<td>Poor</td>
<td>329-08X</td>
<td>28%</td>
<td>538</td>
<td>0.7</td>
<td>None</td>
</tr>
<tr>
<td>S-4A</td>
<td>Acceptable</td>
<td>558-11X</td>
<td>32%</td>
<td>432</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>LP-4C</td>
<td>Good</td>
<td>350-07X</td>
<td>34%</td>
<td>391</td>
<td>0.4</td>
<td>None</td>
</tr>
<tr>
<td>LP-3B</td>
<td>Acceptable</td>
<td>392-07X</td>
<td>25%</td>
<td>430</td>
<td>0.3</td>
<td>Area of Interest</td>
</tr>
<tr>
<td>LP-4D</td>
<td>Acceptable</td>
<td>350-01X</td>
<td>33%</td>
<td>318</td>
<td>0.5</td>
<td>None</td>
</tr>
<tr>
<td>LP-3A</td>
<td>Acceptable</td>
<td>392-43X</td>
<td>34%</td>
<td>267</td>
<td>0.3</td>
<td>Area of Interest</td>
</tr>
<tr>
<td>S-9B</td>
<td>Acceptable</td>
<td>432-22X</td>
<td>40%</td>
<td>392</td>
<td>0.1</td>
<td>None</td>
</tr>
<tr>
<td>LP-4B</td>
<td>Acceptable</td>
<td>329-32X</td>
<td>20%</td>
<td>348</td>
<td>0.6</td>
<td>None</td>
</tr>
<tr>
<td>LP-5A</td>
<td>Good</td>
<td>413-35X</td>
<td>22%</td>
<td>222</td>
<td>0.3</td>
<td>Area of Interest</td>
</tr>
<tr>
<td>LP-2A</td>
<td>Acceptable</td>
<td>539-15X</td>
<td>19%</td>
<td>91</td>
<td>0.3</td>
<td>Area of Interest</td>
</tr>
</tbody>
</table>
Other Benefits: Defect & Lateral Locations
Other Benefits: R/R Method Selection

- Pipe Bursting
- Sewer Replacement
- InfoMaster identifies sag and sewer lateral locations
Other Benefits: R/R Method Selection

- Sewer Relocation
  - Backyard easement to street ROW
- InfoMaster/GIS identify potential utility conflicts
I/I Reduction Methods
Rehab/Replacement Methods

- CIPP Lining
- Pipe Bursting
- Open Cut
- Horizontal Directional Drilling
Inflow Source Disconnection
Private Sewer Lateral Toolbox

- Ownership
- Grants
- Outreach
- Maintenance
- Insurance
- Mandates

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Private Sewer Lateral Toolbox
Mandates: Legal Ordinance Tools

☑️ Mandate Good PSL Condition
1. Good working order
2. No cracks/breaks or root intrusion
3. Holds water (passes a pressure test)
4. Does not discharge stormwater or grease

☑️ Define Agency Rights
1. Right to inspect triggers
2. Right test triggers
3. Right to repair triggers
4. Right to recover costs
   ▪ Enforcement provisions & protocols
Mandates: Legal Ordinance Tools

- Triggers requiring inspection
  - Sale of property
  - Blockage/SSO
  - Agency discretion

- Testing parameters and pass/fail limits
  - Pressure Test (pass/fail)
  - CCTV Inspection (identifies problem – or pass/fail)

- Enforcement provisions
  - Violation notification process
  - Timeframes and penalties
  - Consider agency administrative requirements
Private Sewer Lateral Toolbox

Ownership
Grants
Outreach
Maintenance
Insurance
Mandates

WEST YOST ASSOCIATES
Questions?

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City of San Mateo I/I Reduction Plan

- **City of San Mateo:**
  R-factors range from 1.5 to 88 percent

- **Goal:** Develop an I/I Reduction Pilot Program to reduce wet-weather SSO’s and comply with EPA consent decree requirements