Leveraging GIS Data to Prevent Water Pollution

Presented By:

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Overview

- **Sewers and Water Pollution**

- **Preventing Water Pollution**

- **GIS Techniques**

Sewerage Systems

- **Collect, convey and treat wastewater**

- **Sanitary, storm or combined**

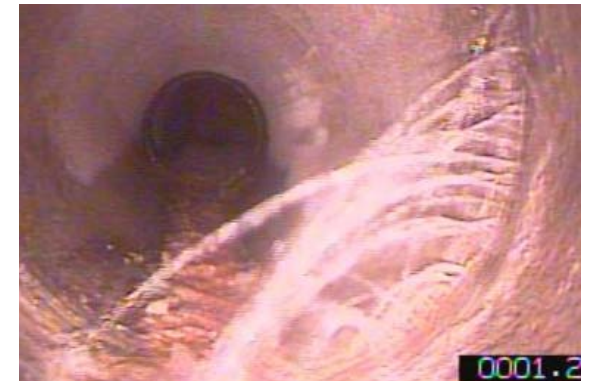- **Maintain health, safety of people & environment**
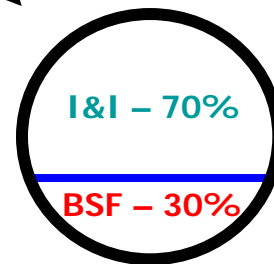
What Makes Up Sewer Flows

Inflow & Infiltration (I&I)
- Direct Stormwater Connections
- Leaking Joints & Defects

Base Sanitary Flow (BSF)
- Fixtures
- Industrial Processes

I&I – 70%

BSF – 30%

Inflow & Infiltration

- **Rainfall or Snowmelt**

- **Inflow from Surface Runoff**

- **Infiltration from Groundwater**

- **Private & Public Sources**

Roof Drain Connection

Uncapped Cleanout

Storm Cross-Connection

Root Intrusion into Lateral

Connected Foundation Drain

Broken House Lateral

Faulty Lateral Connection

Faulty Manhole Cover or Frame

SANITARY SEWER MAIN

Cracked or Broken Pipe

STORM SEWER

Deteriorated Manhole

Source: King County Natural Resources & Parks

INFLOW SOURCES (black text)

INFILTRATION SOURCES (white text)

I&I Flow Event

White Rock 2001/2002 Flow Monitoring

Site 1

Feb 21-24, 2002

Legend: - - - - DWF   —— Feb 21-24, 2002   —— RDII   Rainfall

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O:\0400-0499\452-019\IIAnalysis\[Site1II.xls]Setup

Sanitary Sewer Overflows

- **Causes**

  - **Blockage/Collapse**

  - **I&I Events**

  - **Mechanical/Electrical Failure**

  - **Inadequate Design**

- **Over 1,000,000,000 Litres Spilled Last Year**
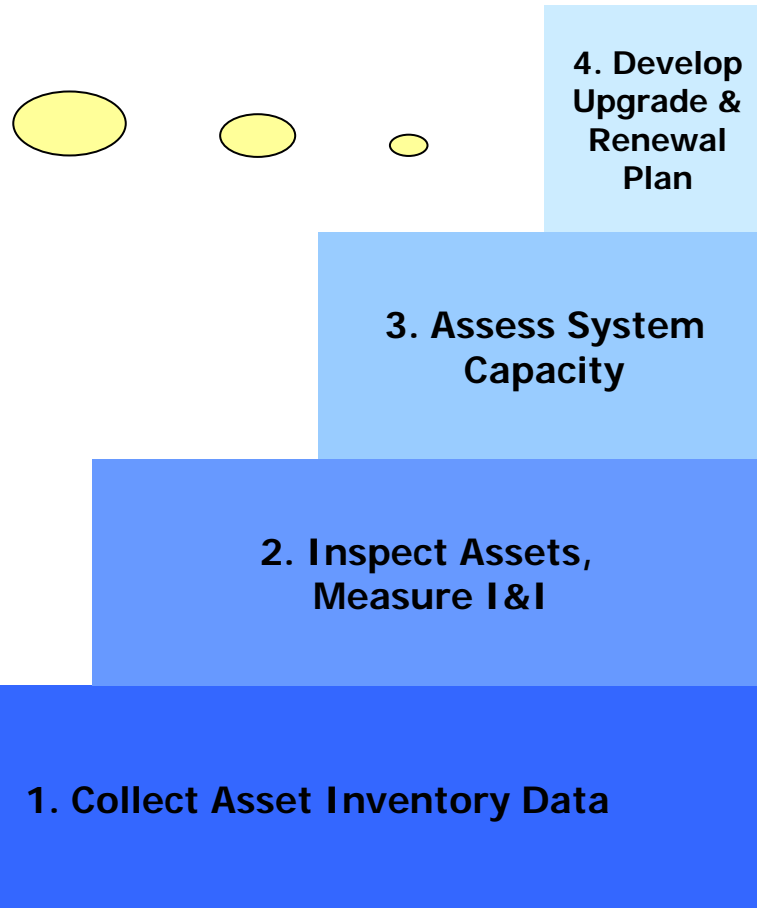

Source: US EPA

Steps to Overflow Prevention

This is where decisions get made.

It is critical to complete the previous steps to make the right decision!

$$Q = (1/n)\, A\, R_h^{2/3}\, S^{1/2}$$

4. Develop Upgrade & Renewal Plan

3. Assess System Capacity

2. Inspect Assets, Measure I&I

1. Collect Asset Inventory Data

What Do We Know About It?

- **Must Have:**

  - **Unique ID**

  - **Dimensions**

  - **Location**

  - **Material**

  - **Elevation**

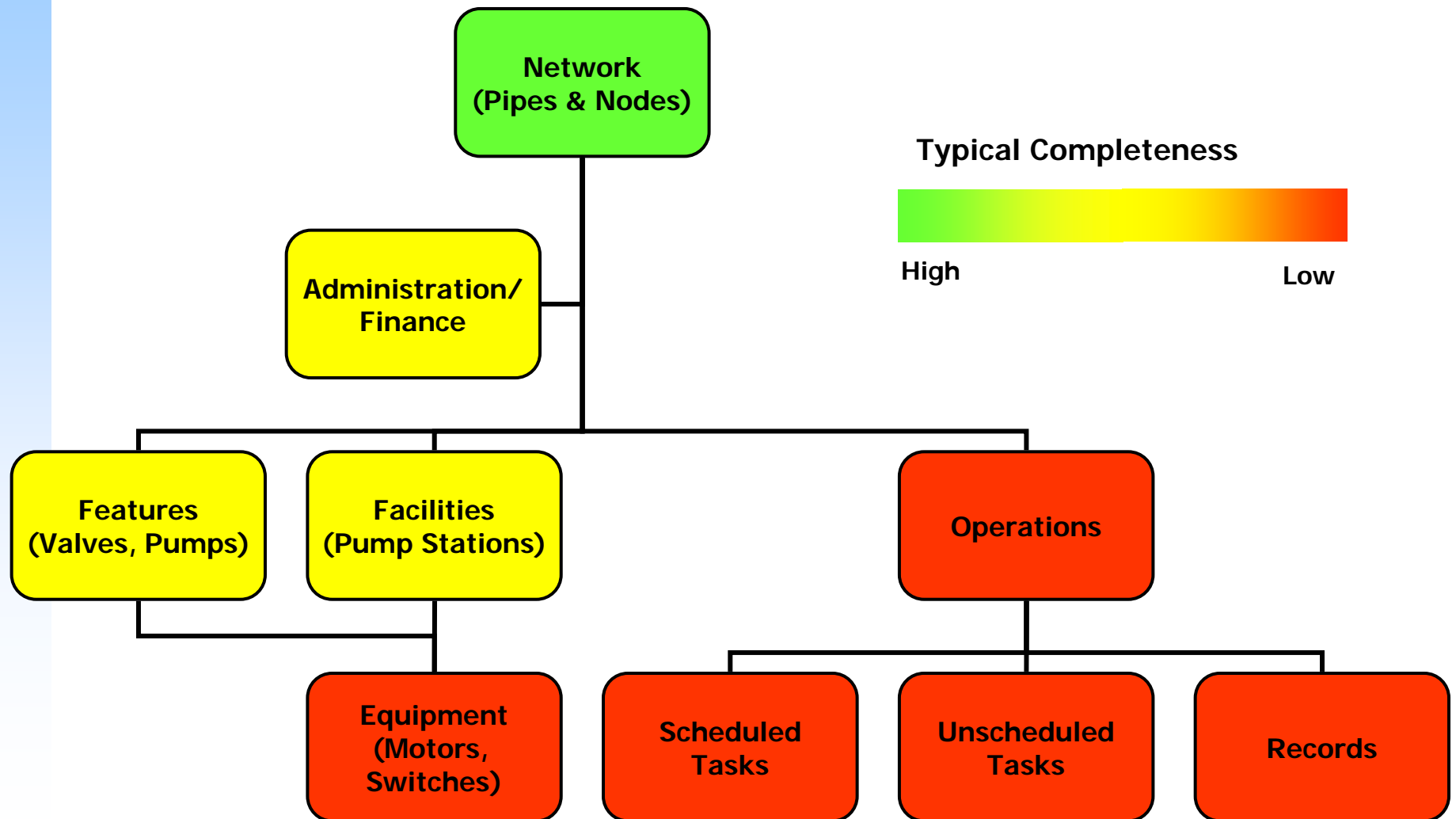 - **Metadata**

- **Nice to Have:**

  - **Age**

  - **Condition**

  - **Make/Model**

  - **Supplier/Contractor**

  - **Record Drawings**

  - **Operations Records**

Data Management

- **Industry Standard Templates**

- **Computerized Maintenance Management Systems**

- **DIY**

- **Open Data Structures**

- **Proprietary Systems**

- **Interoperability**

- **Consistency & Documentation**

Relational Model for Sewers

Network
(Pipes & Nodes)

Administration/
Finance

Features
(Valves, Pumps)

Facilities
(Pump Stations)

Operations

Equipment
(Motors,
Switches)

Scheduled
Tasks

Unscheduled
Tasks

Records

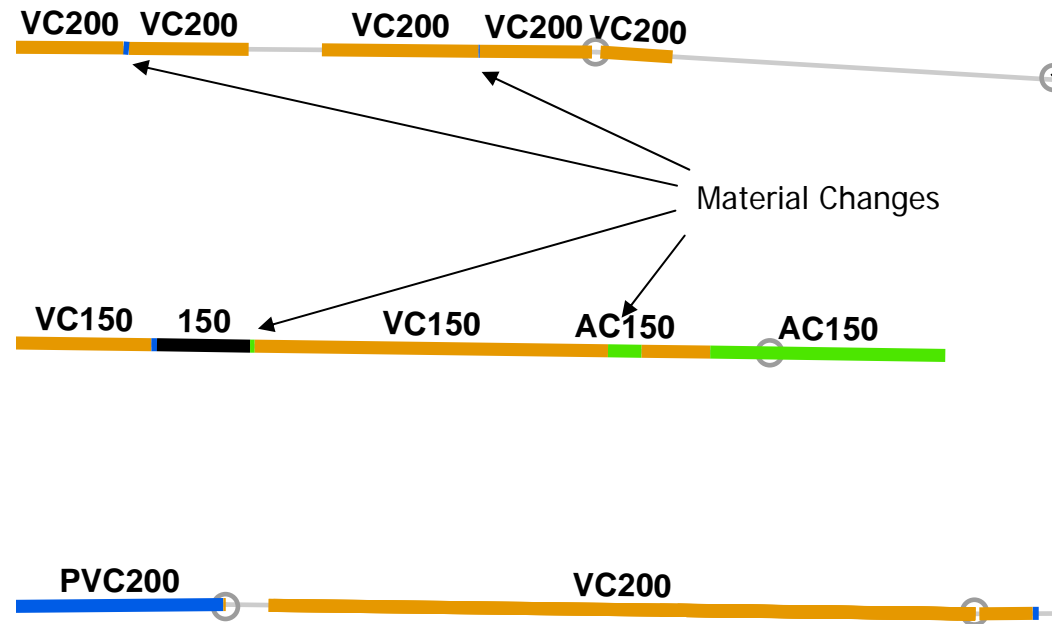**Typical Completeness**

High   Low

Inspections & Maintenance Data

- **Smoke/Dye Testing (Cross-Connections)**

- **Closed-Circuit TV (Pipelines)**

- **Visual Inspections (Manholes, Facilities)**

- **Work Orders & Service Calls**
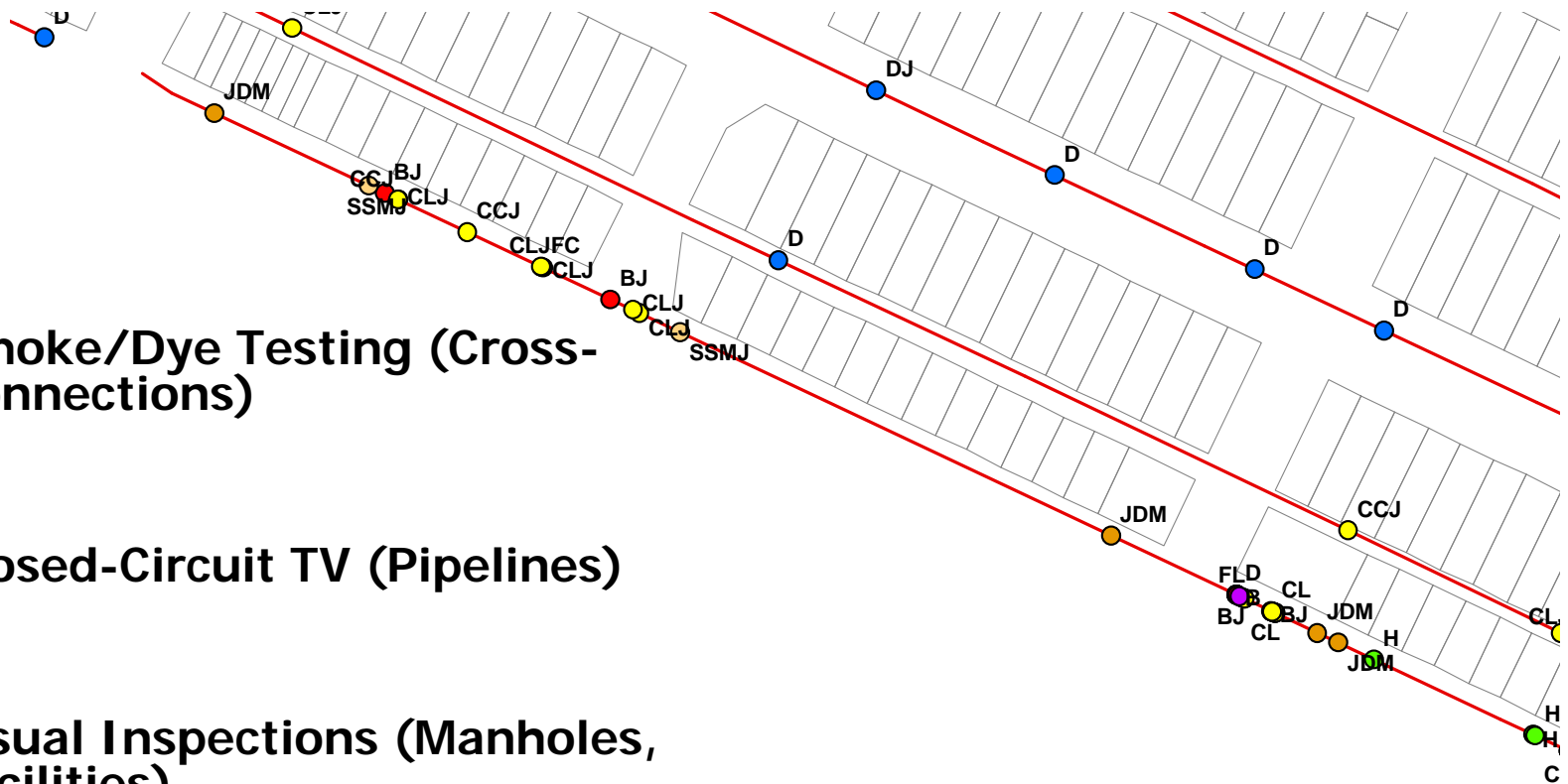
Linear Referencing for CCTV

- **Material**

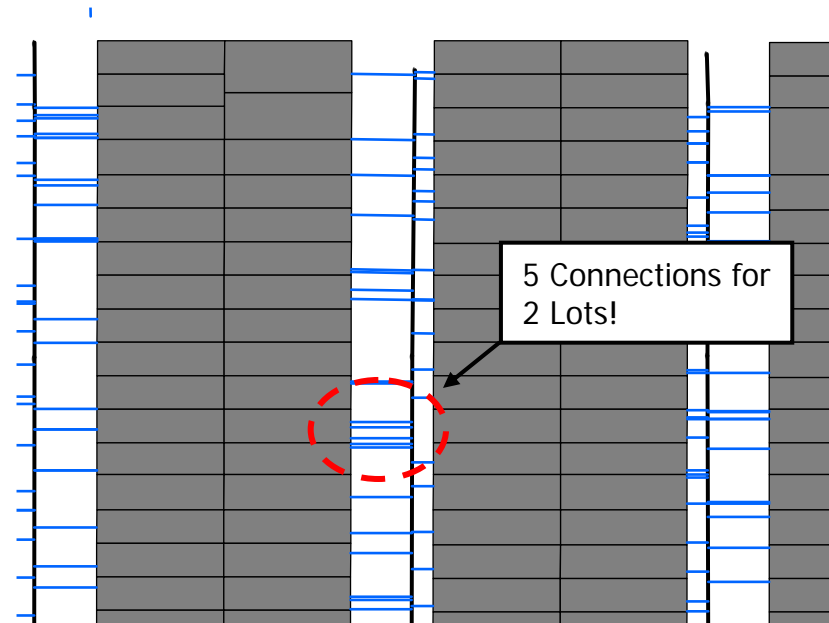- **Diameter**

- **Defects**

- **Network Features**

VC200   VC200   VC200   VC200 VC200

Material Changes

VC150   150   VC150   AC150   AC150

PVC200   VC200

Locating the Problems

OBSERVATION ID: 5 FOOTAGE: 85.4FT
CODE - DEFECT:PIPE BROKEN BEGIN
CLOCK POSITION:

Blockages

- Roots
- Debris
- Structural Defects

I&I

- Visible Infiltration
- Abandoned or Storm Connections

5 Connections for 2 Lots!

Sewer Rehabilitation

SanRepairs

Shape	Line
Subtype	Excavated Point Repair
RepairID	**EPR-39**
Length	3.0
Defects	CLJ, BJ

SanStructuralDefects

Shape	Point (M)
Subtype	Break
DetailID	13495
Distance	34.5
DefectCode	BJ
RepairID	**EPR-39**

Legend:
- - - - Proposed Lining
- ▬▬ Proposed Excavated Point Repair
- ○ Sanitary Manhole
- — Sanitary Main

Structural Defects
- ! Break/Collapse
- ✕ Crack
- ◇ Deformation
- ✕ Fracture
- ○ Hole
- ▪ Joint
- + Spalling/Wear

- **Maintain relational link between repairs and defects**

- **Spatial accuracy is important**

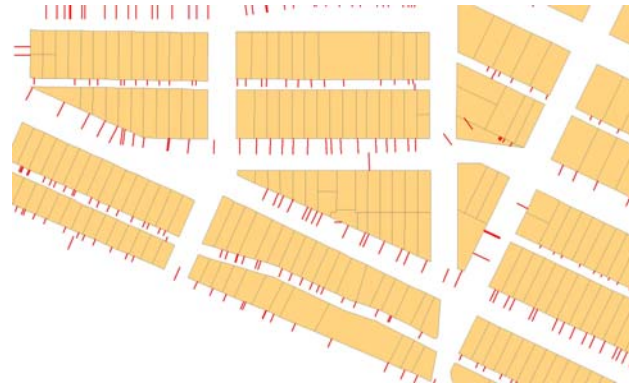GIS Routine Plots CCTV Observations Along Pipe at Measured Distance
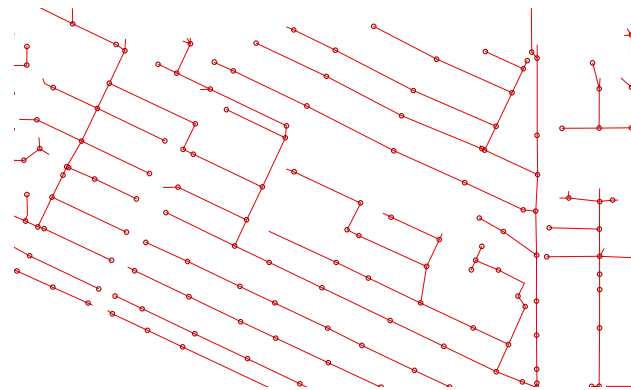
Hydraulic Modelling

"Service Layer"
- Generate Demands
- Legal & Land Use
- Service Connections
- Population & Area

"Network Layer"
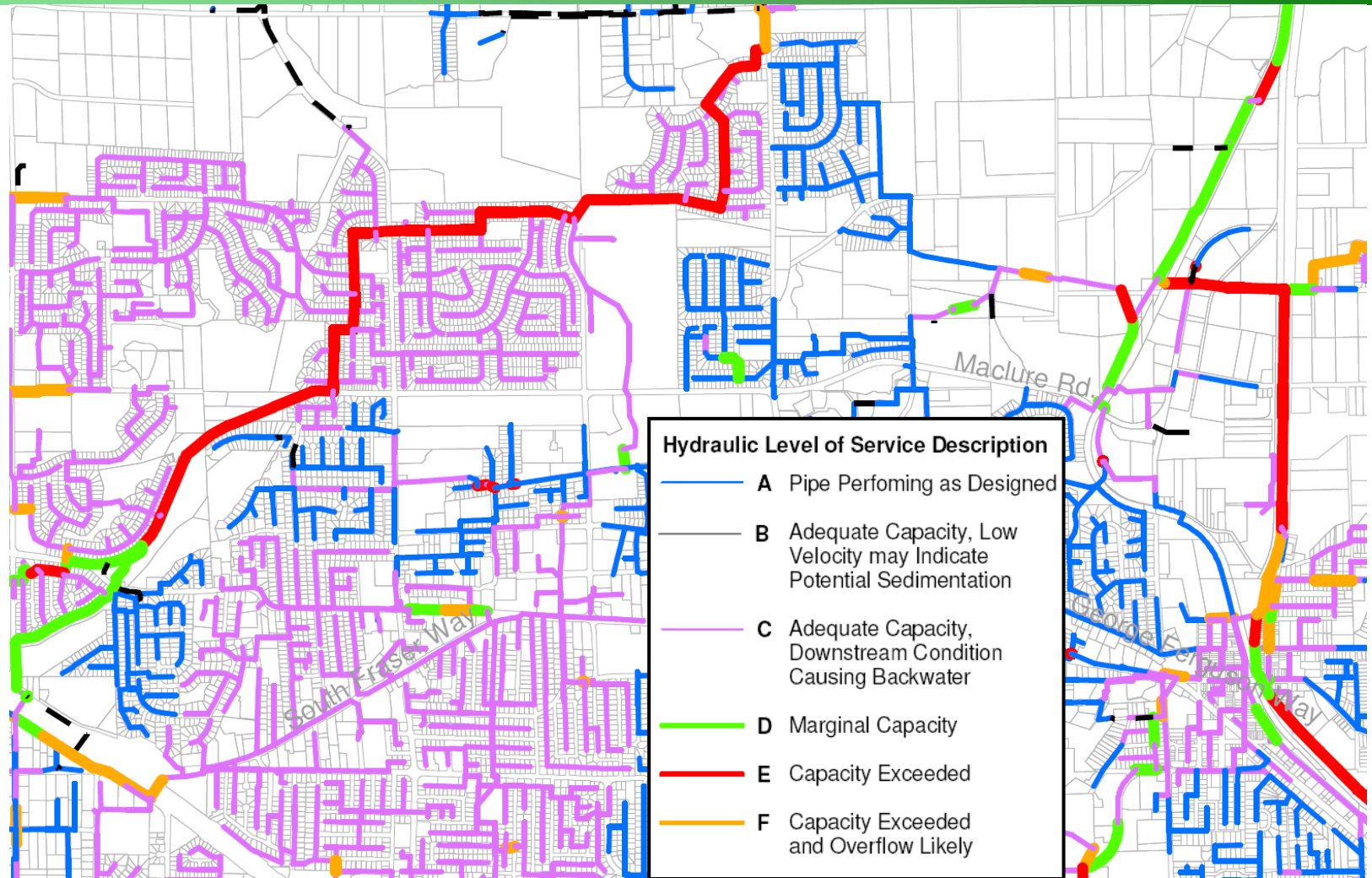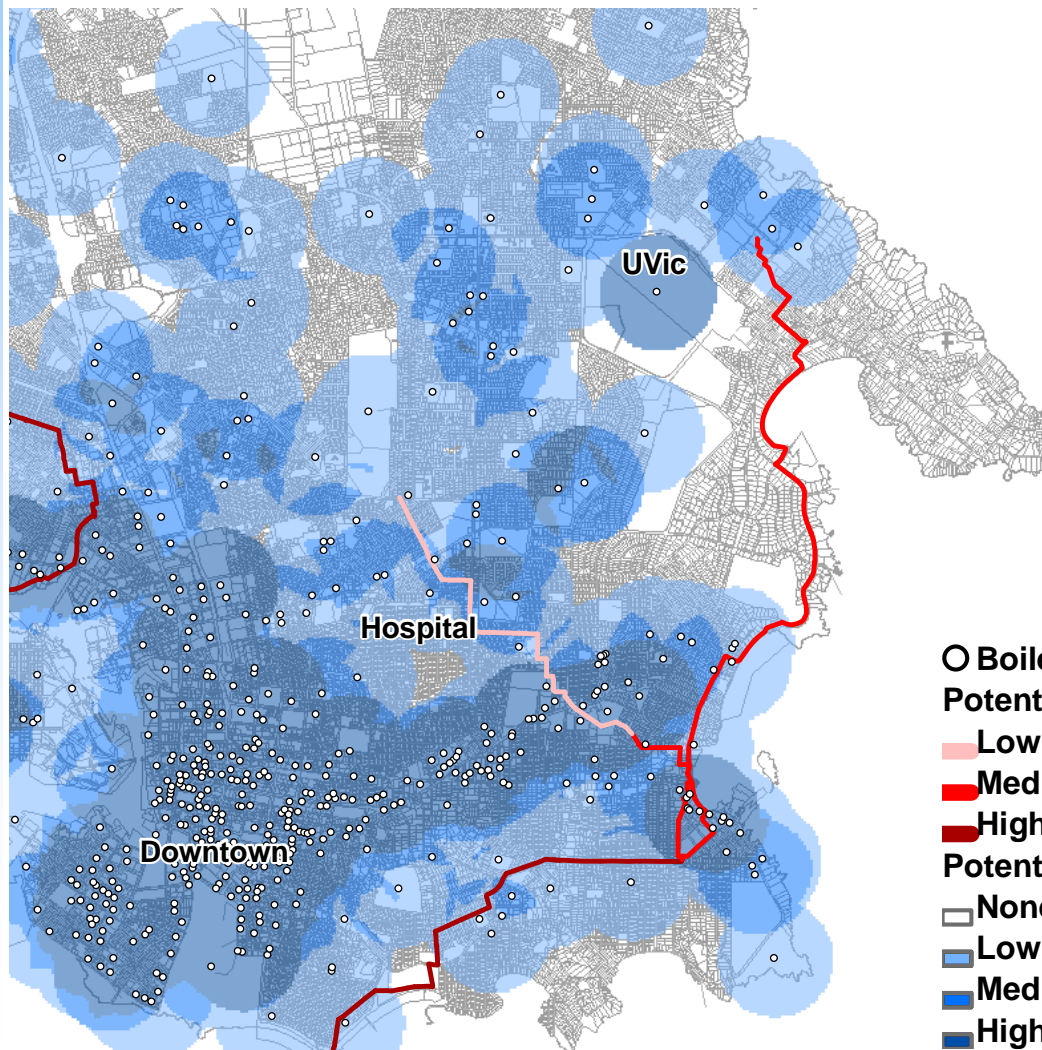- Assess Capacity
- Pipes
- Manholes/Nodes
- Facilities

System Analysis

Hydraulic Level of Service Description

A — Pipe Perfoming as Designed

B — Adequate Capacity, Low Velocity may Indicate Potential Sedimentation

C — Adequate Capacity, Downstream Condition Causing Backwater

D — Marginal Capacity

E — Capacity Exceeded

F — Capacity Exceeded and Overflow Likely

Capital Planning

- **Size Upgrades**
- **Estimate Costs**
- **Determine Priorities**

Resource Recovery

- Sewer Flow ~15-20°C

- Extract Heat Using Heat Pump

- Distribute to Buildings

Legend:
- ○ Boiler
- **Potential Heat Supply**
  - Low
  - Medium
  - High
- **Potential Heat Demand Density**
  - None
  - Low
  - Medium
  - High

Map labels: UVic, Hospital, Downtown

Leveraging GIS for Wastewater

1. Complete & Accurate Asset Inventory

2. Publish Inspections & Maintenance Data Through GIS

3. Models & Geoprocessing to Enhance Decision Making

Questions?

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