City of Portland Find & Fix Program –

Utilizing GIS Analysis to Target the Preventive Maintenance of Sewer Laterals

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Defining the Problem:

Focus of this study is on sewage releases into private property due to a problem on the City's portion of the lateral. How to find and fix the problems that cause them?

- SSO: Sanitary Sewer Overflow
- An uncontrolled discharge of sewage due to a blockage or capacity overflow in the lateral or main.

- CSO: Combined Sewer Overflow
- A discharge of a mixture of sanitary sewage and stormwater at a point in the combination sewer system designed to relieve surcharging flows.

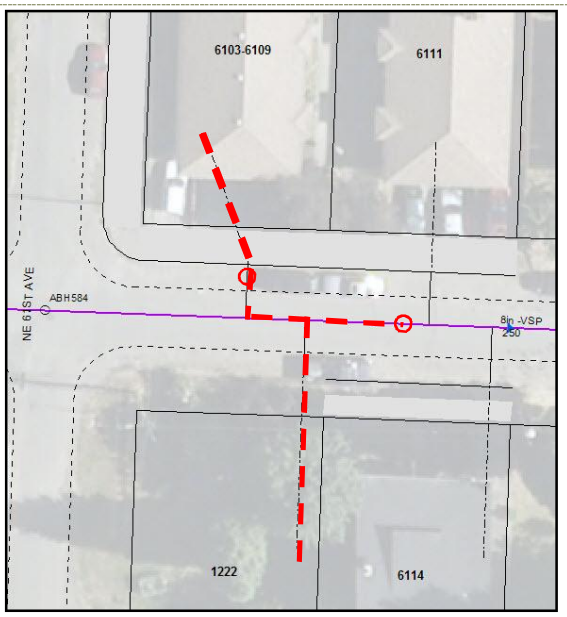
The Back-Up:

✓On the Main:

A blockage on the Main line causes sewage to back-up into properties up-stream of the problem.

✓On the Lateral:

A blockage on the lateral causes localized release into the property.



Find & Fix the problems or wait until a back-up occurs

Preventative Maintenance VS. Reactive Maintenance

Send two person crew out with lateral launch camera to inspect laterals in targeted areas to identify problems on laterals for an 8 hour day finds 1 to 10 properties with problems on laterals that may cause sewer back-up	$1500.00
Plan and Prep Repair	$100.00
48 hour locates called and utilities respond during normal business hours	$300.00
Send Repair Crew out to dig up the problem lateral replace/rehab pipe and install a cleanout	$5,000.00
Prep & Pave and Close out work order	$300.00
Total	**$7,200.00**

Property Backs-up Damaging Property: Very Unhappy Rate Payer and a Call to Plumber	$400.00
Call to Maintenance Operations Dispatch- Duty Supervisor and Sr. Supervisor Notified & Respond	$150.00
Emergency Crew or On Call Crew Dispatched to address problem	$200.00
BES Notified Total cost of Tracking of Release & Documentation to DEQ	$300.00
Emergency Locates Called Gas, Water, Locating Contractors respond	$450.00
Call Emergency Repair Crew on Overtime to Dig a Relieve problem	$1800.00
Send Repair Crew back out to replace/rehab pipe and install a cleanout	$5000.00
Pave and Close out work order	$300.00
Risk Claim initiated by property owner-City Response to Property Owners Risk Claim	$1500.00
Time Risk Management Spend Processing Property Owner's Claim	$400.00
Total	**$10,400.00**

The Triple Bottom-Line: Mitigating Negative Social, Environmental, & Economic Impacts

Project statement

Proactive Lateral Repair - Find & Fix :

"Using state-of-the-art geographic information system mapping tools to identify hot spots and a combination of trenchless and traditional repair methods, the City will embark on a find and fix repair program specifically designed to identify and repair lateral problems before they have failed completely."

City of Portland - Capacity, Management, Operations, & Maintenance (CMOM) Report Draft 2008

- Geocoded records of pending and completed work on laterals.
- Used ArcGIS to display sewer releases densities due to problems on the City maintained portion of the sewer lateral.
- Created problem area densities to determine areas of focus for maintenance and investigation work in the field.
- Constructed as a live model for daily scheduling of collection system maintenance.

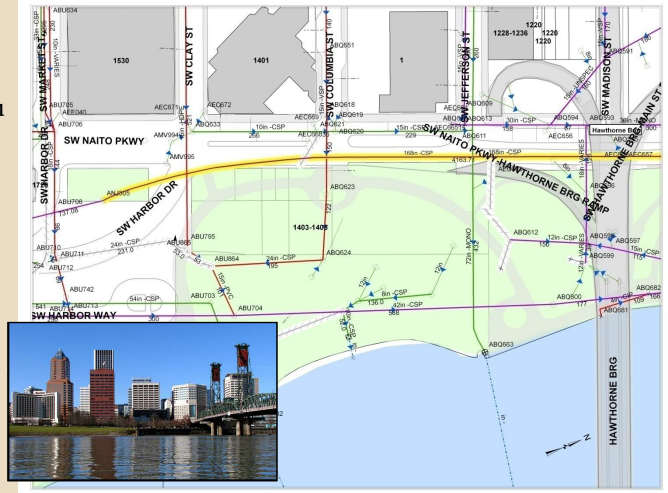
Study Area & Data Sources

- Focus area is inside the City of Portland boundary.
- All density maps are based on City of Portland Boundary extent with a 50ft X 50ft raster cell size

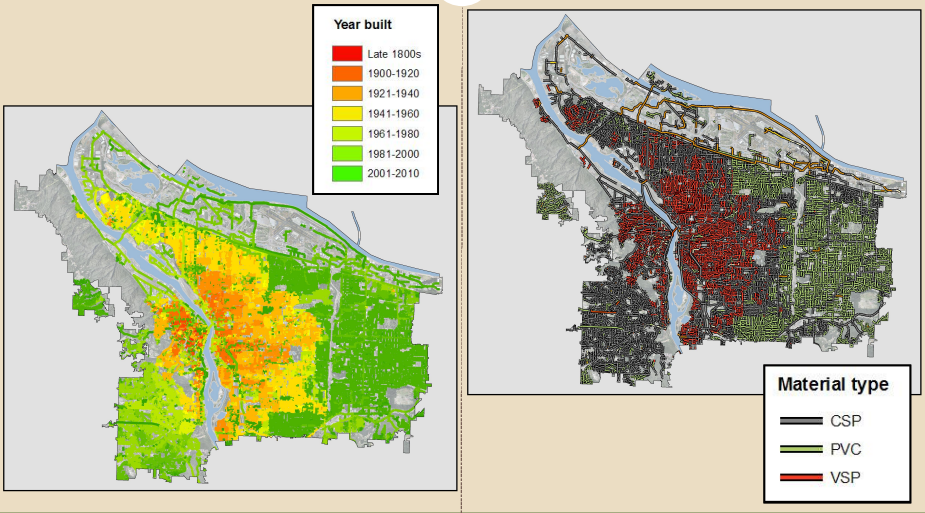
- City of Portland Collection System
  - Sewer Lines
    - Combination
    - Sanitary
  - Taxlots
- Hansen Database
  - Data Collected on Repairs to Laterals
  - Problem & Priority Codes
  - Asset Information
- SSR Database
  - Tracking of Releases for DEQ
  - Cause & Impact
  - Asset Information

City of Portland Sewer Collection System Background

- Owned by the City of Portland
- Managed by Bureau of Environmental Services
- Maintained by the Portland Bureau of Transportation, Maintenance Operations
- 2323 miles of piped system
- 96,000 acres of service area



Pipe Age & Pipe Material



SSR Database & Hansen Database

- City of Portland Tracking of All Sewer Releases
- 2118 - Tracked Sewer Releases
- 1068 - Were City Responsibility
- 407 - City Lateral Component (Refined to 272)
- 1996 – Current
- Location & Date Notified
- Volume & Destination
- Cause & Component
- Impact

- Tracking all work on the collection system
- 4151 - Completed "R/RLAT:" Lateral Work Orders with costs
- 1994 – Current
- Location & Asset
- Activity & Problems
- Priority Level
- Comments

The Main:

✓ 8"- 6' Diameter pipe

✓ Typical Material:

- VSP (Vitrified Sewer Pipe a.k.a. *Clay*)
- CSP (Concrete Sewer Pipe)
- PVC (Polyvinyl Chloride)

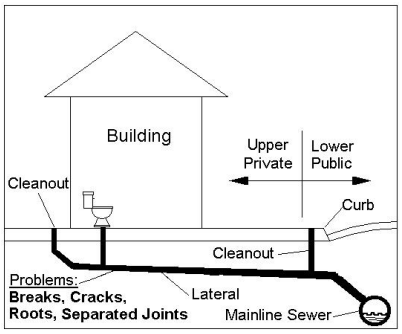
✓ 5' to 20' deep

- 250-300 linear feet
- Serves approximately 15-20 houses per street
- Maintained by City

The Lateral:

- Average size 6" Diameter pipe
- Typical Material:
  - VSP (Vitrified Sewer Pipe a.k.a. *Clay*)
  - CSP (Concrete Sewer Pipe)
  - PVC (Polyvinyl Chloride)
- 3' to 12' deep at the curb (*curb line is the delineation line of the City's maintenance responsibility*)
- 4' to 30' is an average range length in length of a lateral

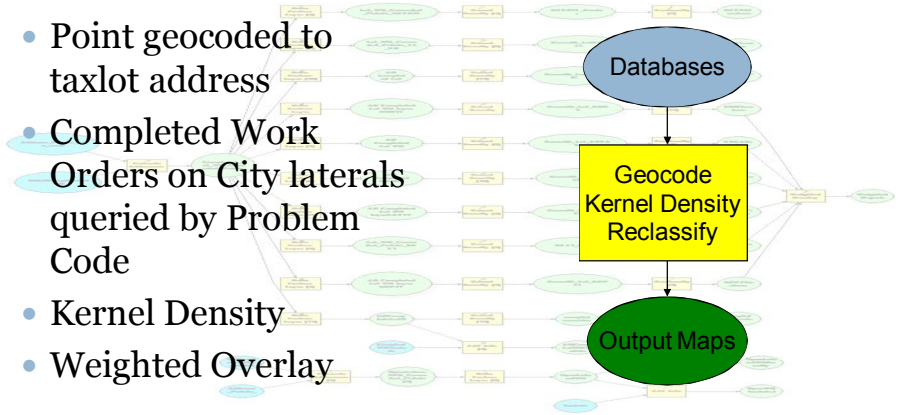
- 30 feet curb to curb
- 20 laterals per street
- 293 linear feet of lateral per street
- 233 linear feet of unknown lateral condition



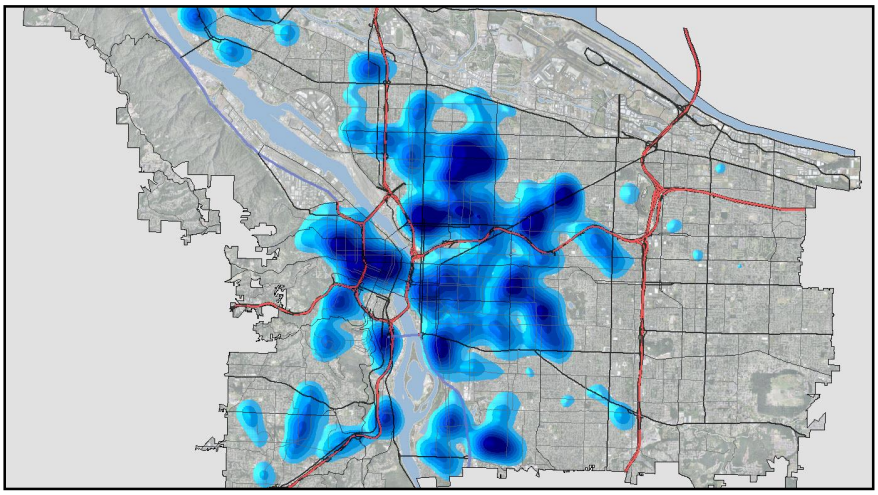
Methodology

Using Model Builder allows these outputs to connect to live database queries in Access.

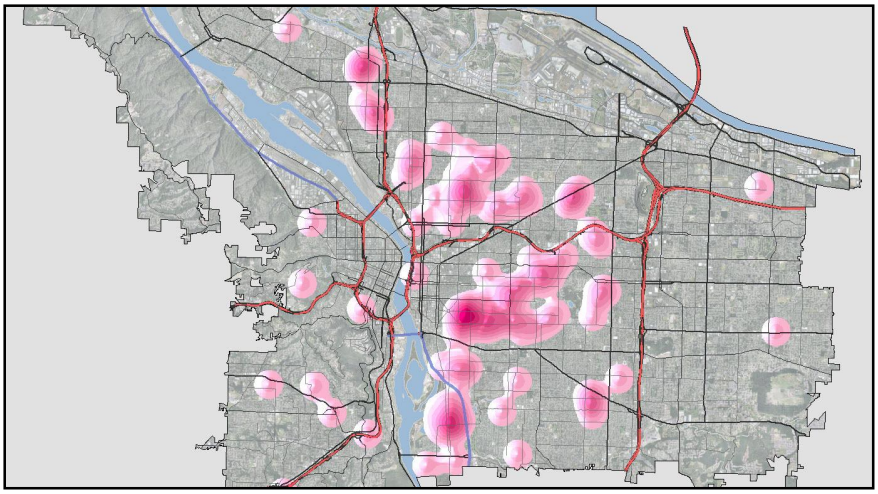
- Point geocoded to taxlot address
- Completed Work Orders on City laterals queried by Problem Code
- Kernel Density
- Weighted Overlay



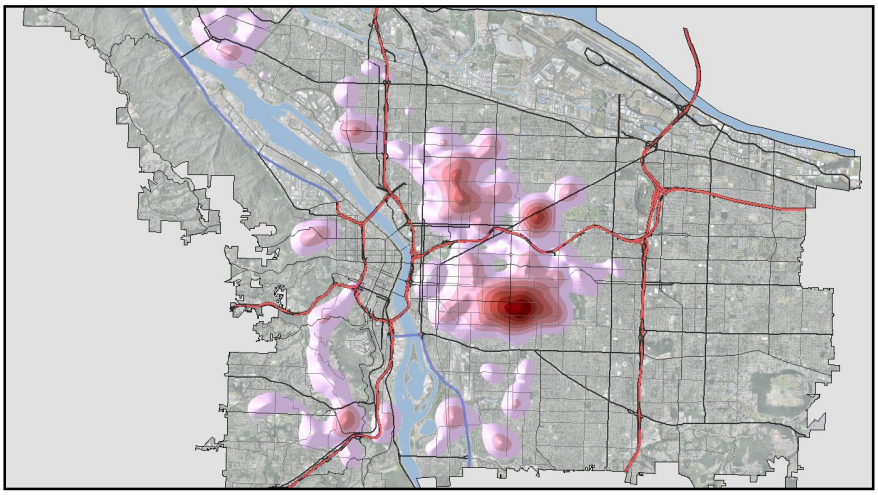
Kernel Density of SSRD & Hansen Lateral Back-up Problems



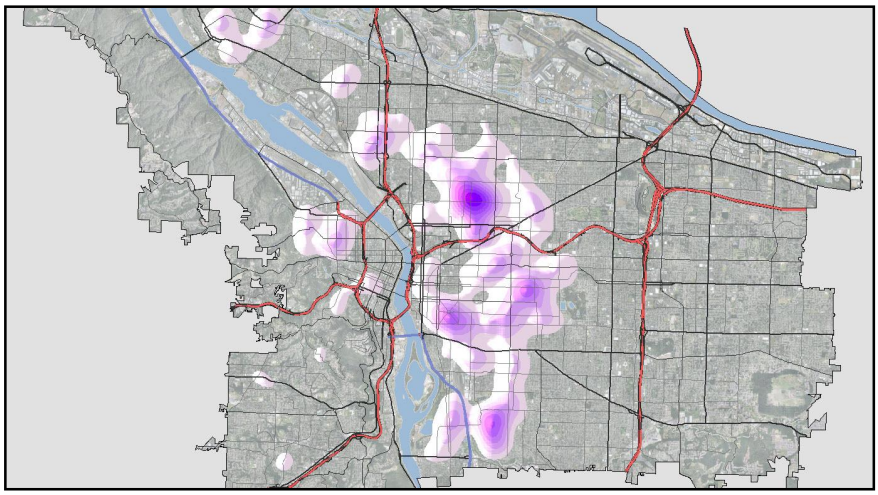
Kernel Density of 'Destroyed' Lateral Work Orders



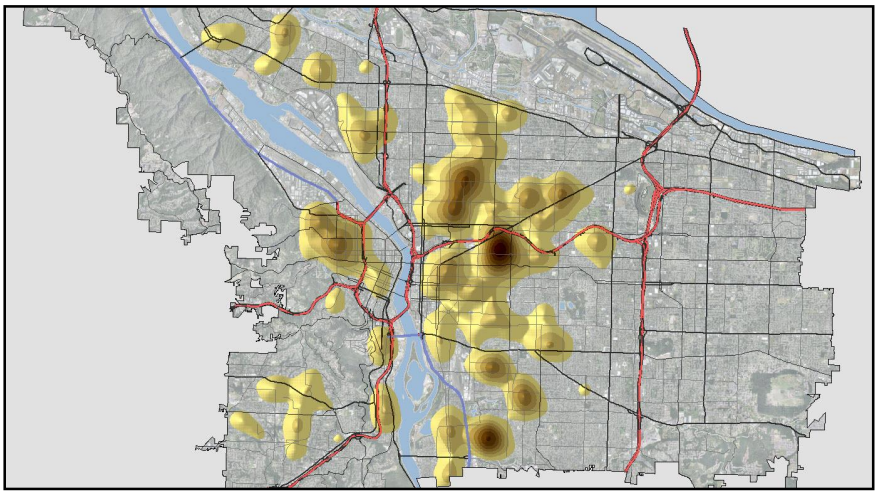
Kernel Density of 'Cavity' Lateral Work Orders



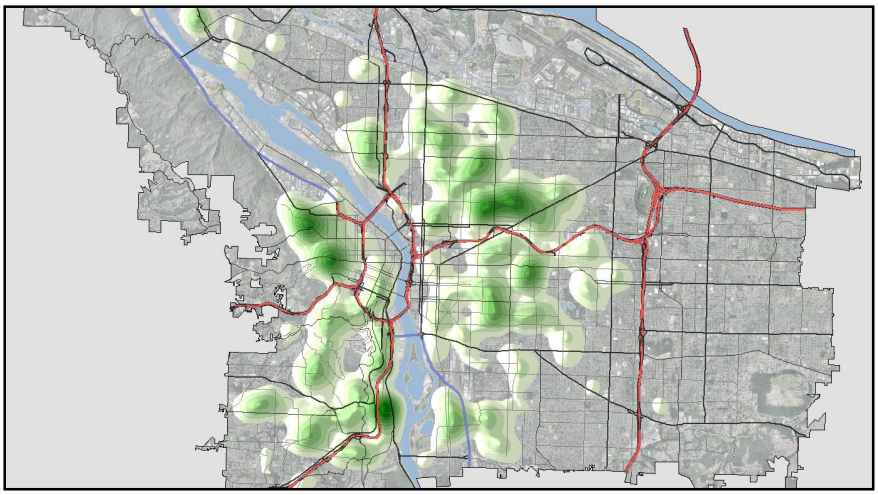
Kernel Density of 'Dropped Joint' Lateral Work Orders



Kernel Density of 'Root' Lateral Work Orders



Kernel Density of 'Break' Lateral Work Orders



Pairwise Table - Analytic Hierarchy Process (AHP)

- 16 Experts in the field with an average of 20 years of experience with sewers
- Created a pairwise table to calculate weighted scores for problem codes for laterals.
- Experts asked to rank top 5 problems that cause sewer lateral back-ups.

Name: Don Volsborn Position: District Engineer

Total number of years working directly with 15 *(You may include any sewer work in the private sector as well)*

How important is problem A *relative* to problem B regarding a sewer lateral?

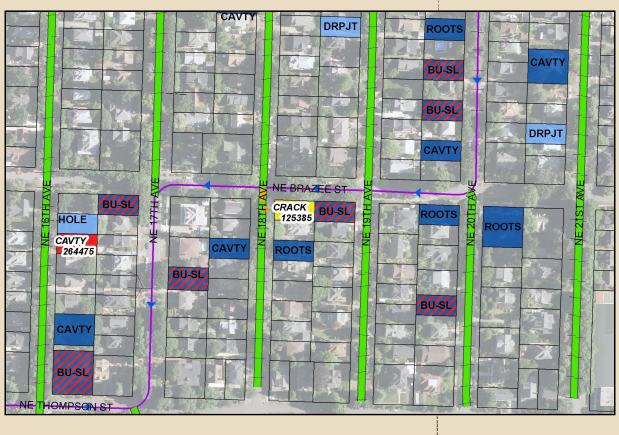
Overwhelmingly more important	9
Very Strongly more important	7
Strongly more important	5
Moderately more important	3
Equally important	1
Moderately less important	1/3
Strongly less important	1/5
Very Strongly less important	1/7
Overwhelmingly less important	1/9

MORE ↕ EQUAL ↕ LESS

PROBLEM	
DEST	1
CAVITY	2
I/I	
ROOTS	4
DRPJT	3
BREAK	5
HOLE	
DEBRIS	
RATHL	
CRACK	
GRS	
MAINT	
MORTR	

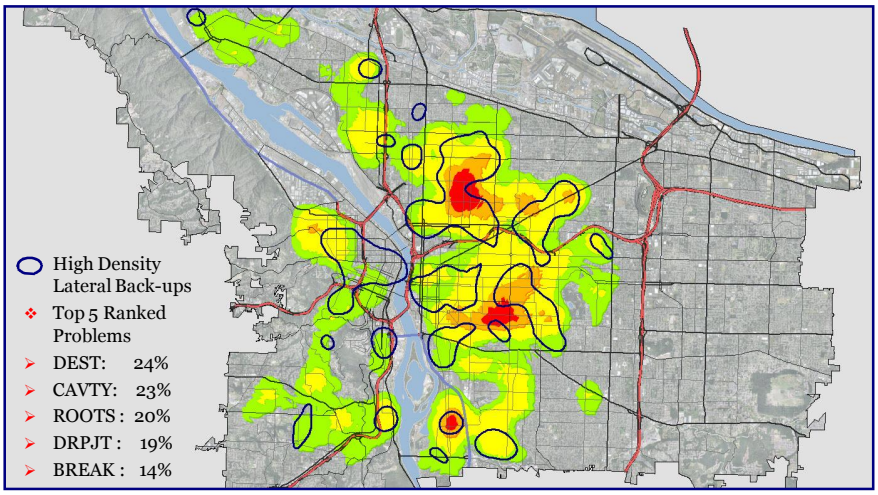
PROBLEM	DEST	CAVITY	I/I	ROOTS	DRPJT	BREAK	HOLE	DEBRIS	BU-SL	RATHL	CRACK	GRS	MAINT	MORTR		Weighted
DEST	1	1/3	7	5	7	7	7	9	9	7	9	7	7	7	4.0788	0.15844
CAVITY	3	1	9	9	9	9	9	9	1	9	9	9	9	9	6.9845	0.27134
I/I	0.1429	0.1111	1	1/3	1/3	1/3	1/3	1/3	1/9	1	1/3	1/2	1	1	0.3398	0.01320
ROOTS	0.2	0.1111	3.0000	1	1	3	1	1	1/9	1	1/3	1/2	1/3	1/3	0.5321	0.02067
DRPJT	0.1429	0.1111	3.0000	1.0000	1	1	1	1/3	1/9	1/3	1/3	1	1/3	1/3	0.4379	0.01701
BREAK	0.1429	0.1111	3.0000	0.3333	1.0000	1	1/3	1	1/9	1	3	1	1	3	0.6882	0.02675
HOLE	0.1429	0.1111	3.0000	1.0000	1.0000	3.0000	1	1/3	1/9	1	7	7	3	7	1.1392	0.04425
DEBRIS	0.1111	0.1111	3.0000	1.0000	3.0000	1.0000	3.0000	1	1/9	1/3	1	1	1	1	0.7132	0.02770
BU-SL	9	1.0000	9.0000	9.0000	9.0000	9.0000	9.0000	9.0000	1	9	9	9	9	9	7.6004	0.29523
RATHL	0.1429	0.1111	1.0000	1.0000	3.0000	1.0000	1.0000	3.0000	0.1111	1	7	1/3	1	1/3	0.7132	0.02770
CRACK	0.1111	0.1111	3.0000	3.0000	3.0000	0.3333	0.1429	1.0000	0.1111	0.1429	1	1	1/3	1/3	0.4465	0.01734
GRS	0.1429	0.1111	3.0000	3.0000	1.0000	1.0000	0.1429	1.0000	0.1111	3.0000	1.0000	1	1	1	0.6812	0.02646
MAINT	0.1429	0.1111	1.0000	3.0000	3.0000	1.0000	0.3333	1.0000	0.1111	1.0000	3.0000	1.0000	1	1	0.7271	0.02824
MORTR	0.1429	0.1111	1.0000	3.0000	3.0000	0.3333	0.1429	1.0000	0.1111	3.0000	3.0000	1.0000	1.0000	1	0.6812	0.02646
Total															25.743	1

Pairwise Table - Analytic Hierarchy Process (AHP)



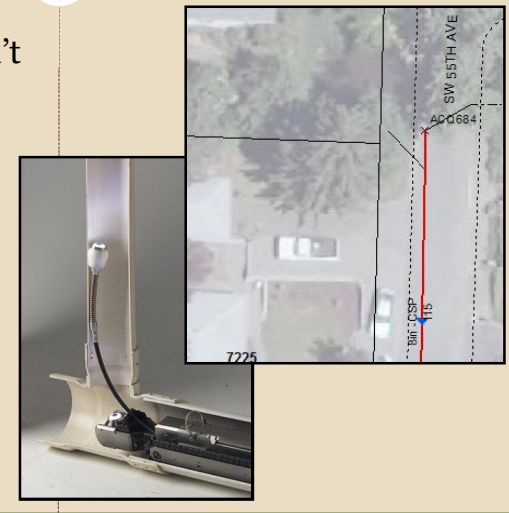
- BU-SL: 0.2404
- CAVTY: 0.1502
- DEST: 0.1396
- ROOTS: 0.0784
- GRS: 0.0610
- DEBRIS: 0.0554
- BREAK: 0.0549
- RATHL: 0.0465
- MORTR: 0.0451
- HOLE: 0.0448
- DRPJT: 0.0338
- CRACK: 0.0193
- I/I: 0.0172
- MAINT: 0.0138

Weighted Overlay and High-Density Back-up Areas



Lateral Launch Inspection

- Finds the problems that Main Line Cameras Can't See
  - Dropped Joints
  - Broken Connections
  - Deterioration
  - Blockages
- Needs 'wye' connection to work well
- Preferable to launch in 10" to 15" main



Lateral Launch Inspection

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Limitations & Pitfalls

- Incomplete or inaccurate data
- Potential Geocoding errors
- Completed work orders that do not have costs associated with them were excluded

City of Portland vactor truck falls in sinkhole @ SE 16th & Oak on Dec 29, 2006

Questions?


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TO
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"The City That Works" – *City of Portland Motto*
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