The Big Data Behind the Flush







Jessica Gooch – Asset Manager City of Portland Maine, Water Resources Division



City of Portland - Demographics

- Largest City in Maine
 - Over 66,000 residents and
 - 16,500 Residential and Commercial sewer users
- Land area 21 sq miles including 48 sq miles of water
- First settled in 1632 and incorporated on July 4, 1786
- Ranked top craft beer city in the WORLD!!!





Water Resources Overview

- Water Resources Division Created in 2014
- Protect human health and the environment
- EPA Administrative Order required separate funding streams
- 40 Full-time staff Water Resources Manager, Compliance, Engineers, Asset Management and GIS, Stormwater team, Field Operations
- Water Resources Programs
 - Sewer Stormwater System Evaluation CCTV, Dye and Smoke Testing, Inspections
 - Asset Management GIS, COF/LOF Risk Analysis
 - Industrial Pretreatment, Fats Oils and Grease
 - Stormwater Utility Fee
 - Stormwater Education
 - Infiltration and Inflow
 - Pump stations and SCADA
 - Construction projects, Street Sweeping, Training



Compliance Directives

- EPA Administrative Order
 - Inventory of collection system, assign unique identifiers to every asset
 - O&M practices
 - Causes of leaks, spills, releases of sewerage
 - SSO (Sanitary sewer overflows) listing and reporting
 - CCTV 6% of the system each year
 - Integrate CCTV data into CMMS
 - Flow monitoring
- Capacity, Management, Operation and Maintenance (CMOM)
 - Asset Management
 - Operations and Maintenance
 - Wastewater Programs and Ordinance Assessment
 - Capital Planning and Prioritization Wishes and needs vs. Risk Based approach
 - Staffing and Organizational Analysis
- Municipal Separate Stormwater Sewer System (MS4)
 - Clean Water Act
 - 30 communities in Maine
 - Addresses stormwater discharges



What We Need to Manage:

93 miles of Sanitary Sewer Pipe

120 miles of Stormwater Pipe

143 miles of Combined Pipe



9 Wastewater Pump Stations

15,000 Storm and Sewer Manholes and Catch Basins

12 CSO Outfalls

East End WWTF Shared-Responsibility



History of the Sewer System

- Portland's Sewer system = Very old!
 - Combined sewer system
 - Diameters range from 8" to 96"
 - Earliest known sewer main 18"
 Brick sewer built circa 1864 on Munjoy Hill
- Combined vs Separated
 - 236 miles of pipe
 - 143 combined
 - 93 separated
 - 9 pump stations
 - 30 Combined Sewer Overflows



Brick Sewer Circa 1864



East End Age of Pipe





Outline of the Data Gathering System

- Historical Records
- GIS Data
- CMMS Cityworks
- CCTV IT Pipes
- Web Mapping/Mobile Data Collection



Historical Data Collection

• The Vault – Location of all of the City plans dating back to the mid 1800's







Historical Data Collection

- **Catalog System**
- Field books
- **Sewer Cards**
- Plan References









Historical Data Collection

- Infiltration and Inflow maps
- Site Plans



Old vs. New

SEWER CONNECTIONS VOL. 9

Sewer Connections Field Book



198 Walton St Sewer Lateral page



198 Walton St Sewer Storm GIS



Modern Data Gathering and Review

- GIS Conversion of paper maps using plans, I&I study, catch basin and lateral cards – GIS digitization of sewers began in the 1990's
- CCTV of mains and manholes gathers GIS and condition data
- Field Data Collection iPads, GPS, Survey
- Aerial Imagery used to check locations of manholes and catch basins
- CMMS Service Requests, Inspections, Work Orders
- GIS Updates CAD, ESRI tools, historical & abandoned features



CCTV Software

- Old...
 - CCTV Data used to be stored on VHS tapes with no way to integrate the data into our systems and GIS
 - No data quality check was performed
 - No easy way to update GIS or share data





CCTV Software

- New!!!
 - Implemented new CCTV software in 2015
 - PACP/MACP/LACP database industry standard data collection
 - QAQC of data
 - Seamless integration with GIS
 - both to receive data into GIS and push data out
 - Uploads CCTV data directly into the City's CMMS
 - Data is easily shared via web maps



CCTV Software

Mainlin	e M	anhole															
Assets	Grade Report	New Asset	Test	LOF Report	Date	TBC Update	s 👍										
Pipe Segment.	🛆 City	Street	U	pstream MH	Downstream M	IH Pipe Mate	rial	Shape	Height	Width Asset Owner	Asset	Water	Linin	Pipe Use	Year Laid	Sewer	Location Code
SSGM-00003	Portland ME	W Kidder St	SS	SMH-4402	SSMH-4403	Vitrified Cla	ay Pipe	Circular	22	22				Combined			Light Highway
SSGM-00005	Portland ME	Johansen St	SS	SMH-1424	SSMH-1425	Concrete 9	egments (Un	Circular	48	48 City				Combined	1953		
SSGM-00006	Portland ME	Johansen St	SS	SMH-6400	SSMH-1426	Concrete 9	egments (Un	Circular	48	48 City				Combined	1953		
SSGM-00011	Portland ME	W Kidder St	SS	SMH-4234	SSMH-4233	Vitrified Cla	ay Pipe	Circular	15	15				Sanitary			Light Highway
SSGM-00013	Portland ME	Fernald St	SS	SMH-4230	SSMH-1398	Vitrified Cla	ay Pipe	Circular	15	15				Sanitary			Light Highway
SSGM-00014	Portland ME	Fernald St	SS	SMH-1398	SSMH-1397	Vitrified Cla	y Pipe	Circular	15	15				Sanitary			Light Highway
SSGM-00015	Portland ME	Lynda Rd	SS	6MH-4228	SSMH-4229	Vitrified Cla	ay Pipe	Circular	8	8				Sanitary			Light Highway
SSGM-00017	Portland ME	Sylvia St	SS	SMH-1400	SSMH-1399	Vitrified Cla	ay Pipe	Circular	8	8				Sanitary			Light Highway
SSGM-00020	Portland ME	Fernald St	SS	SMH-6436	SSMH-4402	Polyethyle	ne	Circular	18	18				Sanitary			Light Highway
SSGM-00024	Portland ME	Morse ST	SS	SMH-0091	SSMH-0090	Vitrified Cla	ay Pipe	Circular	30	30				Combined			Light Highway
SSGM-00025	Portland ME	Morse St	SS	SMH-0090	SSMH-0089	Vitrified Cla	ay Pipe	Circular	30	30				Combined			Light Highway
SSGM-00027	Portland ME	Sherwood St	SS	SMH-1409	SSMH-0119	Vitrified Cla	ay Pipe	Circular	8	8				Sanitary			Light Highway
SSGM-00032	Portland ME	Johansen St	SS	SMH-0146	SSMH-0086	Brick		Circular	42	42 City				Sanitary	1934		
SSGM-00034	Portland ME	Morse St	SS	SMH-0089	SSMH-0082	Vitrified Cla	y Pipe	Circular	30	30				Combined			Light Highway
SSGM-00041	Portland Me	Morse St	SS	SMH-6498	SSMH-0076	PolyVinyl 0	hloride	Circular	8	8				Sanitary			Light Highway
SSGM-00042	Portland ME	Morse St	SS	SMH-0076	SSMH-4232	PolyVinyl C	hloride	Circular	8	8				Combined			Light Highway
SSGM-00043	Portland ME	Washington A	Ave SS	SMH-4395	SSMH-4232	Vitrified Cla	ay Pipe	Circular	8	8				Sanitary			Light Highway
SSGM-00045	Portland ME	Washington A	Ave SS	5MH-4232	SSMH-0094	Vitrified Cla	ay Pipe	Circular	12	12				Sanitary			Light Highway
SSGM-00046	Portland ME	Washington A	Ave SS	5MH-0073	SSMH-0072	Vitrified Cla	ay Pipe	Circular	12	12				Sanitary			Light Highway
SSGM-00047	Portland ME	Washington A	Ave 55	MH-1522	SSMH-1524	Vitrified Cla	ay Pipe	Circular	12	12				Sanitary			Light Highway
55GM-00048	Portland ME	Inverness St	55	MH-1402	SSMH-0070	Vitrified Lia	ay Pipe	Lircular	8	8				Sanitary			Light Highway
55GM-00062	Portland ME	Isliey St	55	0MH-3362	SSMH-1412	Reinforced	Loncrete Pipe	Circular	30	30				Sanitary			Light Highway
SSGM-00063	Portland ME	Isliey St	55	MH-1412	SSMH-1441	Reinforced	Loncrete Pipe	Circular	30	30				Sanitary			Light Highway
55GM-00064	Portland ME	Isliey St	55	MH-1441	SSMH-1440	Reinforced	Loncrete Pipe	Circular	30	30				Sanitary			Light Highway
55GM-00077	Portland ME	Front Ct	55	0MH-4473	55MH-4474	Polyvinyi u Reinferees	nioride Constato Piso	Circular	10	21 City				Sanitary	1022		Light Highway
55GM-00034	Portland ME	Front St	33	DMH-1428	55MH-4430	Reinforced	Concrete Pipe	Circular	21	21 LIQ				Combined	1933		Calls Diskursu
55GM-00035	Portiand ME	Front St	00 Di 00	2MH-4430	55MH-0100	Neinforced	Dincrete Pipe	Circular	24	24				Canitary			Light Highway
SSGM-00101	Portland ME	Wordsworth a	01 00	2MIT-1000	CCMU 0112	Painfaraa	iy Fipe I Conorata Dina	Circular	10	10				Sanitary			Light Highway
SSGM-00114	Portland ME	Victor nu Lloud Aug	00		CCMU 01E0	Vitrified Cl-	Dinciele Fipe	Circular	10	0				Sanitary			Light Highway
SSGM-00118	Portland ME	Lloyd Ave	00	SMIT-1040	CCMU 0112	Vitrified Cla	iy Fipe w Dine	Circular	12	12				Sanitary			Light Highway
SSGM-00127	Portland ME	Washington /	Aug CC	SMH-1524	SSMH-0066	Vitrified Cla	ay Pipe	Circular	12	12				Sanitaru			Light Highway
SSGM-00120	Portland ME	Fore St	-176 JC	SMH-3871	SSMH-1959	Beinforcer	l Concrete Pine	Circular	24	24				Combined			Light Highway
SSGM-00131	Portland ME	North St	50	SMH-0362	SSMH-4734	Vitrified Cla	Pine	Circular	12	12 Citu				Sanitaru			Light Highway
SSGM-00132	Portland ME	Quebec St	90	SMH-4734	SSMH-4733	Ashestos (ement	Circular	12	12 City				Sanitaru			
SSGM-00135	Portland ME	Lloud Ave	50	SMH-0159	SSMH-1549	Vitrified Cla	au Pine	Circular	8	8				Sanitaru			Light Highway
SSGM-00138	Portland ME	Wellwood Bd	1 59	SMH-0134	SSMH-0135	PoluVipul (bloride	Circular	8	8 Citu				Sanitaru	2006		Light High Hoy
SSGM-00164	Portland ME	Bay St		SMH-1517	SSMH-1516	PoluVinul (bloride	Circular	18	18				Sanitary	2000		Light Highway
SSGM-00165	Portland ME	Bay St	S	SMH-1514	SSMH-4467	PolyVinyl C	hloride	Circular	8	8				Sanitary			Light Highway
SSGM-00166	Portland ME	Bay St	SS	SMH-4467	SSMH-0139	PolyVinul (hloride	Circular	8	8				Sanitary			Light Highway
SSGM-00167	Portland ME	Ray St	SS	5MH-0139	SSMH-4454	PolyVinul 0	hloride	Circular	8	8				Sanitary			Light Highway
SSGM-00169	Portland ME	Maine Ave	SS	SMH-4454	SSMH-4462	Reinforced	Concrete Pine	Circular	30	30				Sanitary			Light Highway
SSGM-00170	Portland ME	Maine Ave	SS	SMH-4462	SSMH-4455	Reinforced	Concrete Pipe	Circular	30	30				Sanitary			Light Highway
SSGM-00171	Portland ME	Maine Ave	SS	6MH-4455	SSMH-4456	Reinforced	Concrete Pipe	Circular	30	30				Sanitary			Light Highway
SSGM-00172	Portland MF	Maine Ave	çe	SMH-4456	SSMH-4458	Reinforcer	Concrete Pine	Circular	30	30				Sanitaru	- 22		Light Highway
The second se																	

SURG

CCTV Software

Pipe Observations

Severity of issue

Dist ∆1		Description	Value 1	Value 2	%	VCR Time	Code	Clock 1	Clock 2	Joint	Remarks	Grade	Cont.	
0	1	Manhole			0		AMH	0	0		SSMH-4525	0		
0	2	Water Level			5		MWL	0	0			0		
2	3	Tap Break-in Active	4		0		TBA	10	0			0		
3.1	4	Tap Factory Capped	6	-	0		TFC	10	0			0		
13.7	5	Roots Tap Joint			10		RTJ	9	0	~		2	2	
24.1	6	Deposits Settled Gravel			15		DSGV	5	7			3	S01	
37.9	7	Deposits Settled Gravel			15		DSGV	5	7			3	F01	
58.4	8	Water Level	1		25		MWL	0	0	E		0)	
67.6	9	Tap Break-in Active	6	·	0		TBA	10	0			0		
82.2	10	Deposits Settled Gravel			5		DSGV	6	7			2		
105.2	11	Tap Break-in Active	6		0		TBA	10	0			C		
109	12	Water Level	1		10		MWL	0	0			0		
110.4	13	Infiltration Weeper			0		IW.	1	5			2		
128.8	14	Tap Factory Capped	6		0		TFC	10	0			0)	1
227.5	15	Manhole		*	0	-	AMH	0	0	Π	SSMH-1598	. C		

SURGA CONTROL

CCTV Software

Unique Facility ID's



Images of observations

CCTV Software

Asset Info

Inspection Info

*				
All	Asset	Inspection	Media	Plot
Pipe Segme	nt Reference	SSGM-00183		
City		Portland ME		
Street		Auburn St		
Upstream M	Н	SSMH-4525		
Downstream	n MH	SSMH-1598		
Pipe Materia		Vitrified Clay P	ipe	~
Shape		Circular		~
Height		15		
Width		15		
Asset Owne	at and a second s			~
Asset Mana	ger			~
Water_Type	e			~
Lining Meth	od			~
Pipe Use		Sanitary		~
Year Laid				
Sewer Cate	gory			~
Location Co	ide	Light Highway		~
Location De	etails			
Drainage Ar	ea			
Year Renew	ved			
Total Lengtl	h			
Up Rim to In	nvert			
Up Grade to	o Invert			
Up Rim to G	irade			
Down Rim t	o Invert			
Down Grade	e to Invert			
Down Rim t	o Grade			
Pipe Joint L	ength			
Project		M-14-364		

12-St			6					
All	Asse	t Inspection	Media	Plot				
Surveyed By		Admin						
Certificate Nu	imber	123						
)ate		20110101						
^p roject Name		M-14-364						
Emergency Y	7N			~				
ourpose		Maintenance Relate	ed					
nspection Ca	ategory			~				
^p re-Cleaning		Not Known		~				
Direction		Downstream						
Veather		Dry 🗸						
Vork Order		M-14-364						
ength surve	yed	227.5						
) ate Cleanec	1							
Tow Control		Not Controlled						
Customer		Portland Public Wo	rks					
Additional Info	D							
^p ressure Valu	le							
Reverse Setu	ιp	No	~					
Sheet Numbe	er	1						
Start X Coord								
Start Y Coord								
Start Z Coord								
s Imperial		Yes		~				
AMS Inspecti	on Type			~				





Location of observations



Update GIS with CCTV info

- ITpipes has GIS tools to import asset information from ITpipes to GIS
- CCTV Operator enters the asset information in the field
- Asset Management team runs the tools and double checks the data
- Data is updated through the GIS tools within ArcGIS

urrent IT pipes Databa	ase					
ttabase Type: SQL Ser ttabase Name: ITPipes	ver MasterDB				% s	ettin
Find Updates	Include:	🗸 mains 🗌 ma	nholes 🔲 laterals			
Asset ID	Asset Type	Field Name	Current GIS Value	GIS Update Value	Status	^
WIDTH						-8
SSGM-02030	Main	WIDTH	8"	15"	Pending	
томн	2008000		···			
3 SSGM-01074	Main	томн	SSMH-6649	SSMH-2121	Pending	
SSGM-06505	Main	ТОМН	SSMH-6386	SSMH-4034	Pending	
SSGM-02037	Main	томн	SSMH-5128	SSFT-0020	Pending	
SSGM-02030	Main	томн	SSMH-2585	SSMH-5124	Pending	
MATERIAL						
3 SSGM-02030	Main	MATERIAL	Vitrified Clay Pipe	Polyvinyl Chloride	Pending	
SWGM-00514	Main	MATERIAL	Ductile Iron PipeDuctile Ir	Ductile Iron Pipe	IT value "Duc	til
SSGM_02218	Main	LOCDESC	Verrill St	Verrill St	Pending	
SSGM-03478	Main	LOCDESC	Wilkie St	Wilkie St	Pending	
SSGM-02037	Main	LOCDESC	Wall St	Wall St	Pending	
SWGM-01259	Main	LOCDESC	Ballpark Dr	Ball Park Drive	Pendina	
SWGM-09614	Main	LOCDESC	Anderson St	Anderson St	Pending	
HEIGHT						
7 SSGM_02030	Main	HEIGHT	8"	15"	Pending	
			Ĭ.		rending	
	Usia	FROMMA	CCMU 1965	CCNH 2449	Deadias	
33GM-042/9	Main	FROMME	0001-1000	SSMH 6386	Pending	
SSGM-07124	Main	FROMMH	SSFT-0451	SSMH-3840	Pending	
SSGM-02038	Main	FROMMH	SSMH-2593	SSMH2593	Pending	
3 SSGM-02187	Main	FROMMH	SSMH-2676	SSMH-2672	Pending	
SSGM-02030	Main	FROMMH	SSMH-5124	SSMH-5123	Pending	
DIAMETER						
	Main	DIAMETER	8"	15"	Dending	
_ 33GM-02030	Main	DIAMETER	0	15	Pending	Y
					2	۲.



6% of the System

- EPA AO requires the City to CCTV 6% of the system
- Larger, planned projects use ArcGIS Online web maps to outline project areas



CCTV Inspection Data into CMMS

- EPA AO Requires CCTV Inspection data to be integrated with our CMMS
- IT Pipes and Cityworks use a sync tool to sync data between the two
- Data must be coded properly for this to work
- Sync logs are created to identify issues and success
- Inspection information, videos and images are added to Cityworks for each inspection that is complete

TPipes Host:	
server: localhost : 8102	Available
sync Settings:	
requency: Daily	
itart: 11:00 PM	End: 11:00 PM
itatus:	
Ready	

Insp	ection	s					
ł	Add Ins	pection:					
	ld	Туре	Description	Entity Id	Entity Type	Date	Inspected By
	424	TVI	TV Inspection	SSGM-01745		5/3/2017	Frank_R.
	<u>449</u>	TVI	TV Inspection	SSGM-0 <mark>173</mark> 9		5/3/2017	Frank_R.
	450	TVI	TV Inspection	SSGM-01744		5/3/2017	Frank_R.
	<u>489</u>	TVI	TV Inspection	SSGM-01742		5/3/2017	Frank_R.
	490	TVI	TV Inspection	SSGM-01743		5/3/2017	Frank_R.
4							E.

Inspection information added to Cityworks

Sync Client – connects IT Pipes and Cityworks

CCTV Inspection Data into CMMS

PORTLAND

Sync Log - DPS146_2017-05-23_11.12.48.txt	5/23/2017 11:12 AM	Text Document	27 KB
Sync Log - DPS146_2017-05-23_10.46.05.txt	5/23/2017 10:46 AM	Text Document	345 KB
Sync Log - DPS146_2017-05-10_11.04.48.txt	5/10/2017 11:04 AM	Text Document	15 KB
Sync Log - DPS146_2017-05-10_10.52.39.txt	5/10/2017 10:52 AM	Text Document	18 KB
Sync Log - DPS146_2017-05-09_15.15.29.txt	5/9/2017 3:15 PM	Text Document	27 KB
Sync Log - DPS146_2017-05-09_11.20.01.txt	5/9/2017 11:20 AM	Text Document	328 KB
Sync Log - DPS146_2017-02-24_08.43.35.txt	2/24/2017 8:43 AM	Text Document	643 KB
Sync Log - DPS146_2017-01-13_08.04.31.txt	1/13/2017 8:04 AM	Text Document	2 KB
Sync Log - DPS146_2016-12-28_08.59.18.txt	12/28/2016 8:59 AM	Text Document	9 KB
Sync Log - DPS146_2016-12-27_11.09.43.txt	12/27/2016 11:09	Text Document	76 KB
Sync Log - DPS146_2016-12-14_11.11.21.txt	12/14/2016 11:11	Text Document	5 KB
Sync Log - DPS146_2016-12-14_10.49.43.txt	12/14/2016 10:49	Text Document	8 KB
Sync Log - DPS146_2016-12-14_10.40.40.txt	12/14/2016 10:40	Text Document	4 KB



Sync Logs – verify sync

Videos and images available in Cityworks



Web Maps

- ArcGIS Online web maps and apps
- Share information easily
- Staff, contractors, public
- Sewer maps
- Street sweeping
- COF/LOF Risk
- Catch basin inspections
- ID GIS updates
- CCTV



Portland Maps The City of Portland, Maine Online Map Viewer



CCTV Inspections CCTV Inspections Group owned by JAGPortland on November 2, 2015



Ask a question or make a comment





Custom PDF maps



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Water Resources City of Portland Water Resources Group

owned by JAGPortland on November 4, 2014

Story Maps

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CCTV Processor Web Map



USMH: SSMH-4709 DSMH: SSMH-4710

CCTV Processor

Observations and Images are available for review by members of the AGOL group



What do we do with all the data???

- Consequence of Failure/Likelihood of Failure
 - COF Proximity to services, hospitals, waterbodies etc.
 - LOF Age, material, use
- Risk Analysis calculation of COF*LOF
- Life Cycle Analysis
 - Determine life cycle timeline and costs of assets
- Project Planning
 - Reactive to Proactive
 - Decision making to be based on risk based analysis rather than a wish list
 - Short and long-term budget using lifecycle-analysis
 - Lining vs. repair or replace



COF/LOF to Calculate Risk





CMMS – Managing the work and data

- Asset ManagementWork order management
- Mobile data collection
- Data repository
- Compliance reporting
- Dashboards to share progress and information
- Track material, costs and equipment





4

Asset Management



What is next?



Infiltration and Inflow study









Thank you!!!

Jessica Gooch – Water Resources Asset Manager City of Portland, ME jag@portlandmaine.gov

