



Sewer Systems Are Like Your Arteries: You Want to Keep Them Flowing

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Worcester is located in the heart of Massachusetts



Worcester Operations - Municipal Stormwater System

- 374 miles of drain
- 354 outfalls
- 29,000 catch basins



Worcester's Municipal Sanitary Sewer System

- 61 Miles of Combination Sewers
- 29 Pump Stations
- 1 CSO Treatment Facility



Worcester's Municipal Sanitary Sewer System

- Dates back to 1882
- 450 miles of Sewer
- Sanitary Sewer Interceptors ranging from 18-inch to 108-inch in diameter
- Sewer interceptor includes approximately 38 miles of pipeline

1905.

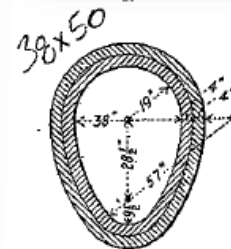
Fig. 156a.—Worcester, Mass., Sewer Dept., 38 × 50-in. brick, egg-shaped sewer, typical of construction used extensively in many old systems throughout the country. In recent years, however, this type has been replaced largely by sections shown in Figs. 156c, d, e and f. Many of these old sewers show but few signs of distortion due to earth pressures. Where this type was built on steep grades in combined systems the invert bricks have been worn to a considerable extent and in some cases worn through, causing backfilling and supporting earth outside of brickwork to be washed away and resulting in caving in of sewer. This trouble overcome by making invert masonry heavier and lining invert with hard-burned or vitrified brick, calculated to resist wear better.

Fig. 156b.—Worcester, Mass., Sewer Dept., 48 × 72-in. brick, egg-shaped sewer, interesting on account of special shape used in several instances in that city.

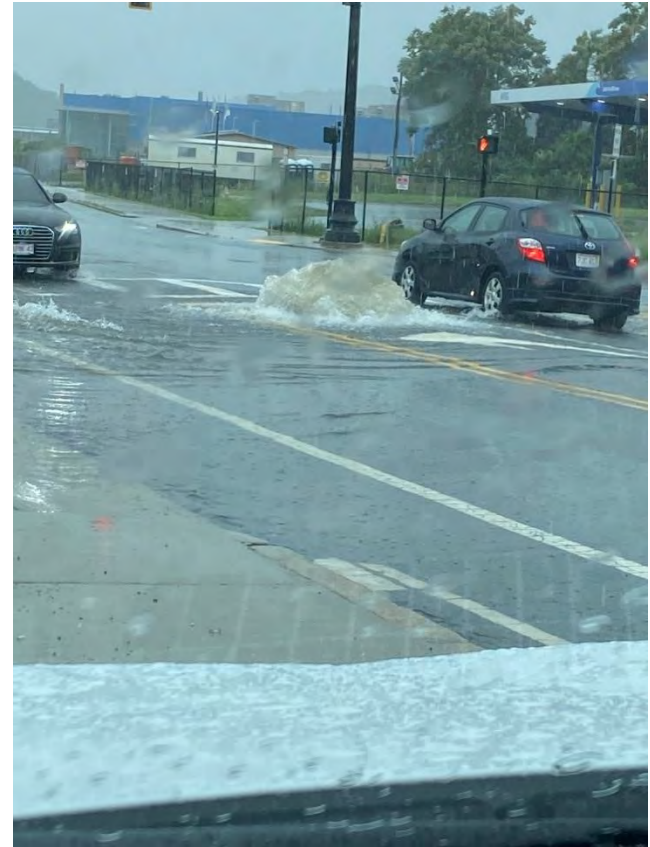
Department of Brooklyn. New York City. 1901, H. R. Asserson, Chief Eng.,



TWENTY-SIX FOOT ROCK EXCAVATION FOR SIX-FOOT CEMENT SEWER



City Concerns



How does the City make sure the arteries are flowing properly?



Routine
Maintenance –
Flushing



Interceptor
Evaluation
Program



Annual Television
Inspection
Program



Sewer System
Evaluation
Surveys

Sewer Interceptor Inspection Program – Phased Approach

Phase 1 - 2008

- ≈ 68,000 If
- ≈ 350 MH

Phase 2 - 2011

- ≈ 30,000 If
- ≈ 150 MH

Phase 3 - 2016

- ≈ 19,300 If
- ≈ 45 MH

Phase 4 - 2017

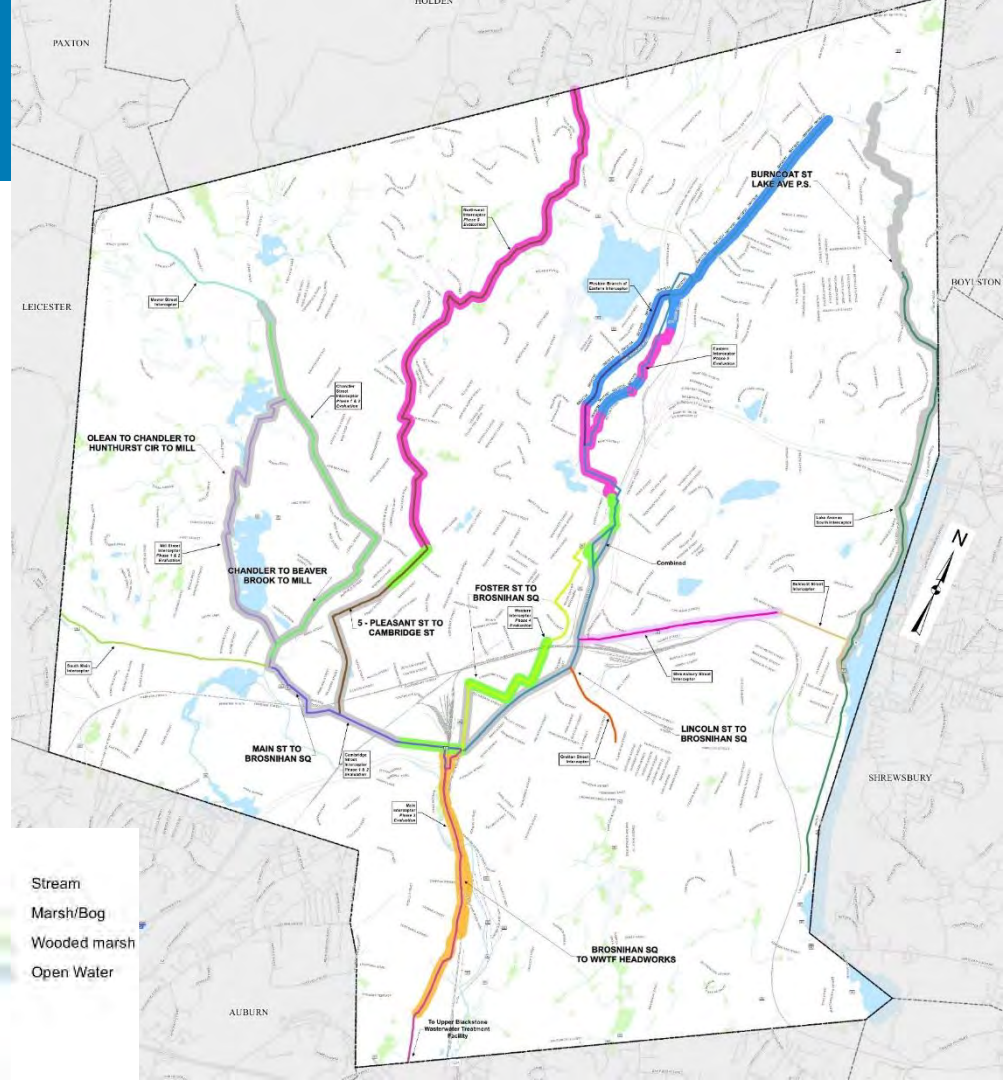
- ≈ 12,200 If
- ≈ 60 MH

Phase 5 - 2021

- ≈ 28,000 If
- ≈ 150 MH

Legend

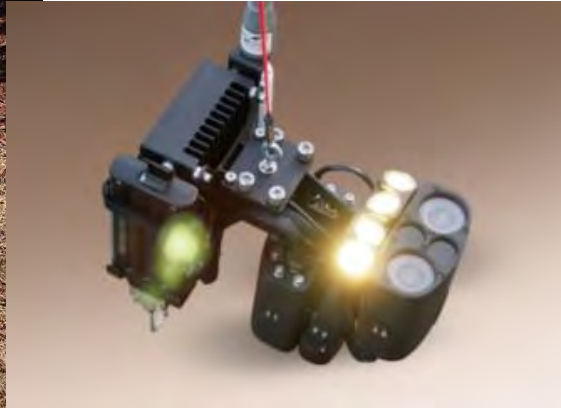
	Sewer Lift Station		Belmont Street Interceptor		Mill Street Interceptor
	Phase 1 & 2 Evaluation		Cambridge Street Interceptor		Mower Street Interceptor
	Phase 3 Evaluation		Chandler Street Interceptor		Northwest Interceptor
	Phase 4 Evaluation		Eastern Interceptor		Shrewsbury Street Interceptor
	Phase 5 Evaluation		Grafton Street Interceptor		South Main Interceptor
	Shrewsbury Street Evaluation		Lake Avenue South Interceptor		Western Branch of Eastern Interceptor
	Inspected by City		Main Interceptor		Western Interceptor



Detailed Investigation & Evaluation

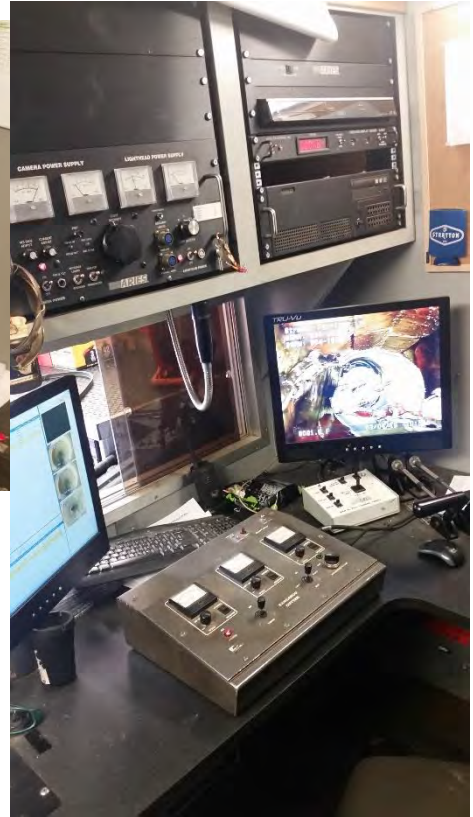
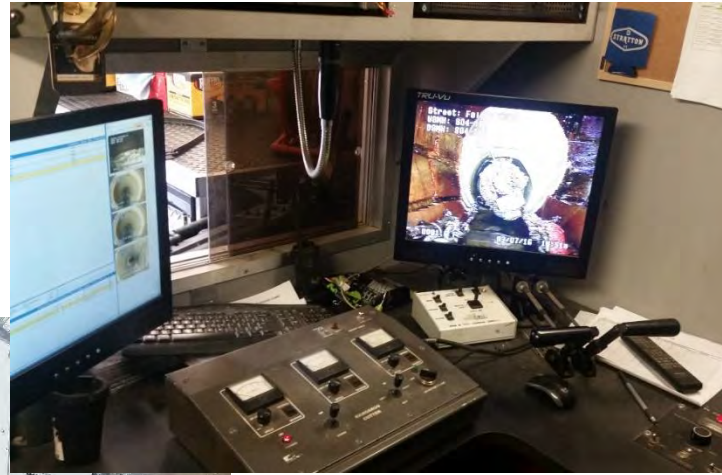


Internal Manhole Inspections



Detailed Investigation & Evaluation

Television Inspection



Detailed Investigation & Evaluation

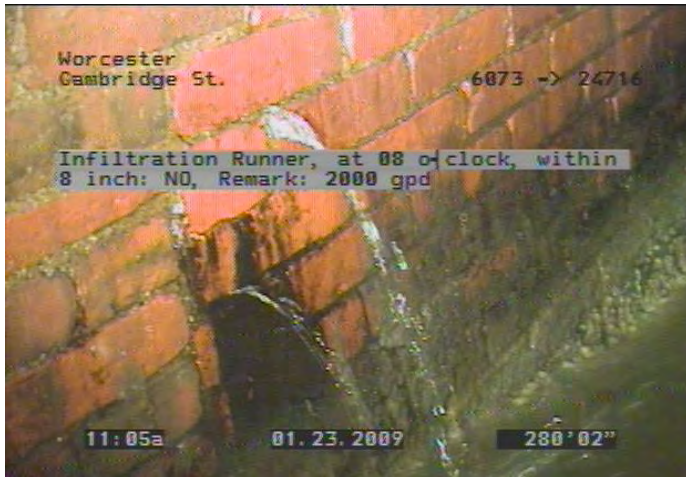
- Sonar
- Laser
- H2S Monitoring



Multi-Sensor Inspection (MSI)
CCTV/Lidar/Sonar

Observations

Infiltration



Observations



Roots



Missing Mortar

Observations

Debris



30%



50%



30% to 40%

Observations

Utility Crossings

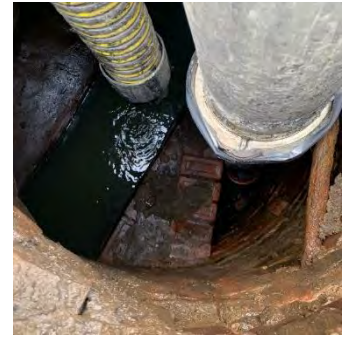


Important Items with Respect to Cleaning

- Sampling before cleaning to characterize the soil for disposal
- Location for debris storage
- Selecting good contractor



What Methods can be Used for Cleaning



- Vactor truck
- Flushing



What Methods can be Used for Cleaning



- Drag Plate
- Hazenator

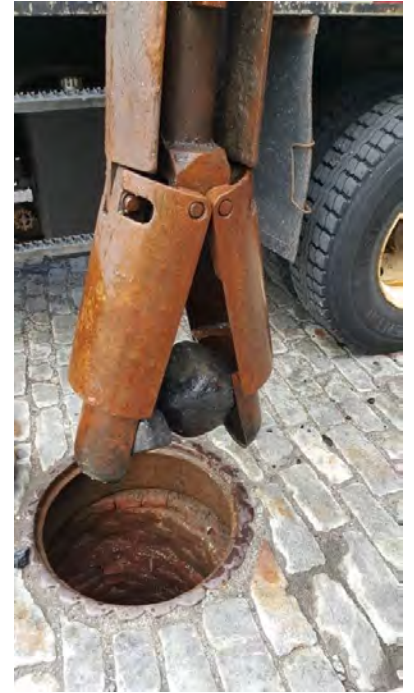
City of Worcester Cleaning Program Between 2008 and 2022

- More than **30 miles** of interceptor has been inspected
- More than 67,000 linear feet or **12 miles** of sewers has been identified with debris
- Approximately **1,200 cubic yards** or **2,040 tons** of debris were estimated
- Most debris within pipes ranging from 24-inch diameter to 60- by 80-inch egg-shaped



Western Interceptor

- 3,242 lf
- 32-inch by 34-inch to 48-inch
- 279 cubic yards = 475 tons

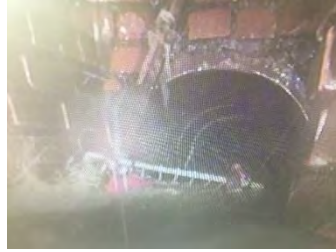


Eastern Interceptor



- 1,850 lf
- 26-inch by 34-inch to 48-inch diameter
- 120 cubic yards = 204 tons

Pre-cleaning 20-inch on West Boylston Street for 2017 Rehabilitation



Green Street Siphon

- Triple barrel – 8-inch, 10-inch and 30-inch
- 80 lf each = 240 lf total
- 8 cubic yards = 14 tons



Green Street Sewer (upstream and downstream of siphon)



- 365 lf of 30-inch
- 1,255 lf of 32-inch by 42-inch
- 33 cubic yards = 56 tons

Western Interceptor Siphon



- Triple barrel – 30-inch
- Approximately 200 lf each = 600 lf total
- 13 cubic yards = 22 tons

Summer Street Interceptor

- 5,560 lf
- 24-inch to 40-inch by 54-inch diameter
- 500 cubic yards = 853 tons



Summer Street Interceptor Chambers

before



after



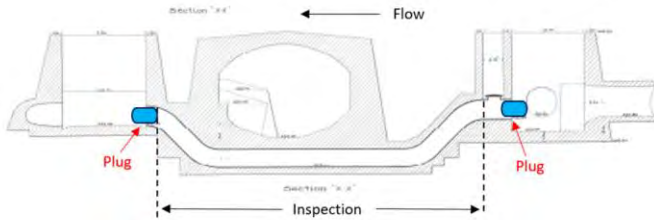
Millbury Street Siphon

- 18-inch
- 781 lf of VC, 260 lf of PVC and 610 lf of RC
- 28 cubic yards = 48 tons



Eastern Interceptor Siphon

- Triple barrel – 30-inch
- Approximately 52 lf each = 156 lf total
- 3 cubic yards = 5 tons
- Prior to cleaning
 - Barrel 1 – 70% capacity
 - Barrel 2 – 15% capacity
 - Barrel 3 – 30% capacity



Rope from Barrel 1



Rope from Barrel 3

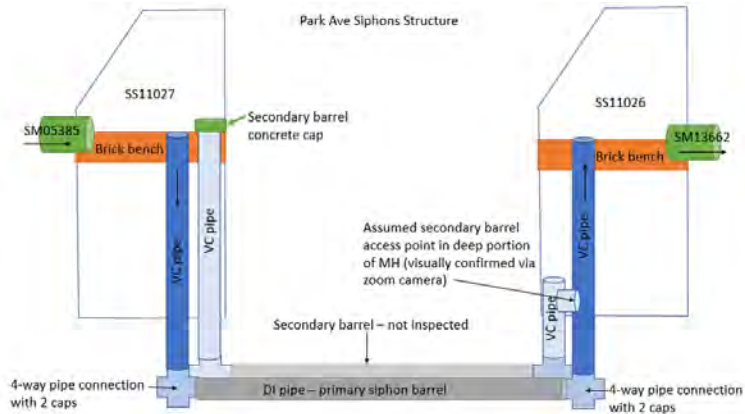
Eastern Interceptor Siphon Barrel 2

Mass of rags, wipes and 100 feet of 3/8-inch rope



Park Ave Siphon

- 66 lf
- 15-inch
- 2 cubic yards = 3.5 tons



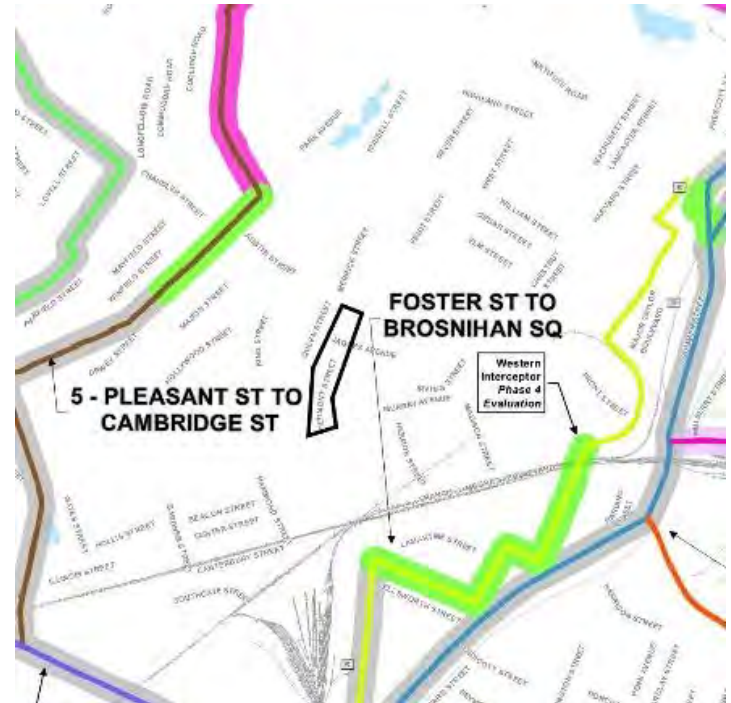
Before



After

Piedmont Street Sewer

- 995 lf
- 30-inch by 45-inch
- 40 cubic yards = 68 tons



What type of debris was found?



Before and After Cleaning



In the Last 10 Years

- More than **4 miles** of interceptor have been heavy cleaned
- More than 1,175 cubic yards or **1,900 tons** of debris were removed from sewers, siphons and interceptors across the City

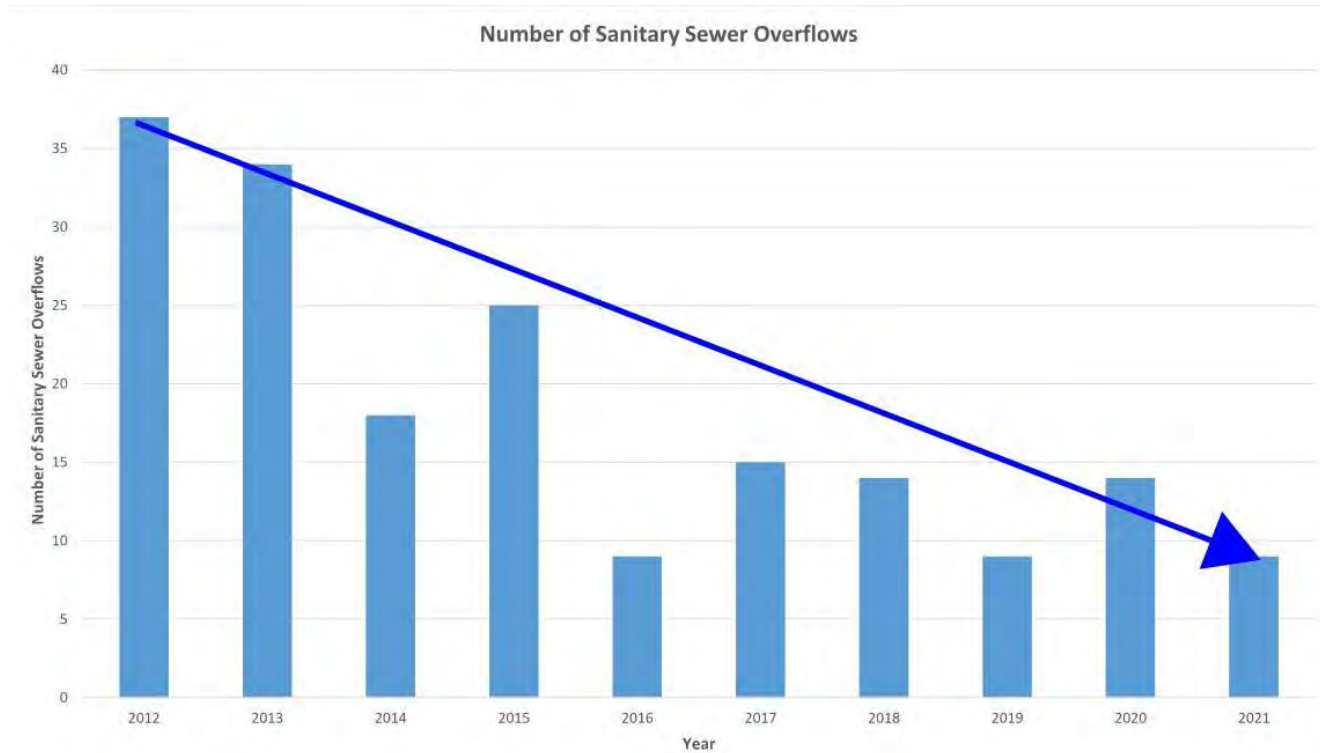


In the Last 10 Years

- **1,900 tons** is equivalent to 180 school buses



Capacity Improved



Lessons Learned

- Improvement - reduction of SSOs
- Sewer grit may be hazardous, best to sample first
- Disposal can be expensive, but worth it
- Three options for Capacity Issues:
 - Reduce Flow / I&I
 - Building Larger System
 - Clean System – arguably most cost effective
- I&I reduction combined with cleaning = Success

thank you



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