



NASTT-NE's 2018 Regional Trenchless Conference

IMPLEMENTING ACTION ITEMS DEVELOPED FROM EVALUATING 200,000 LINEAR FEET OF LARGE-DIAMETER SEWER MULTI-SENSOR INSPECTIONS IN THE CITY OF HARTFORD

JASON WATERBURY PE, THE METROPOLITAN DISTRICT
VINTA VARGHESE PE, JACOBS, WETHERSFIELD, CT
JOHN OSOSKIE PE, JACOBS, WETHERSFIELD, CT

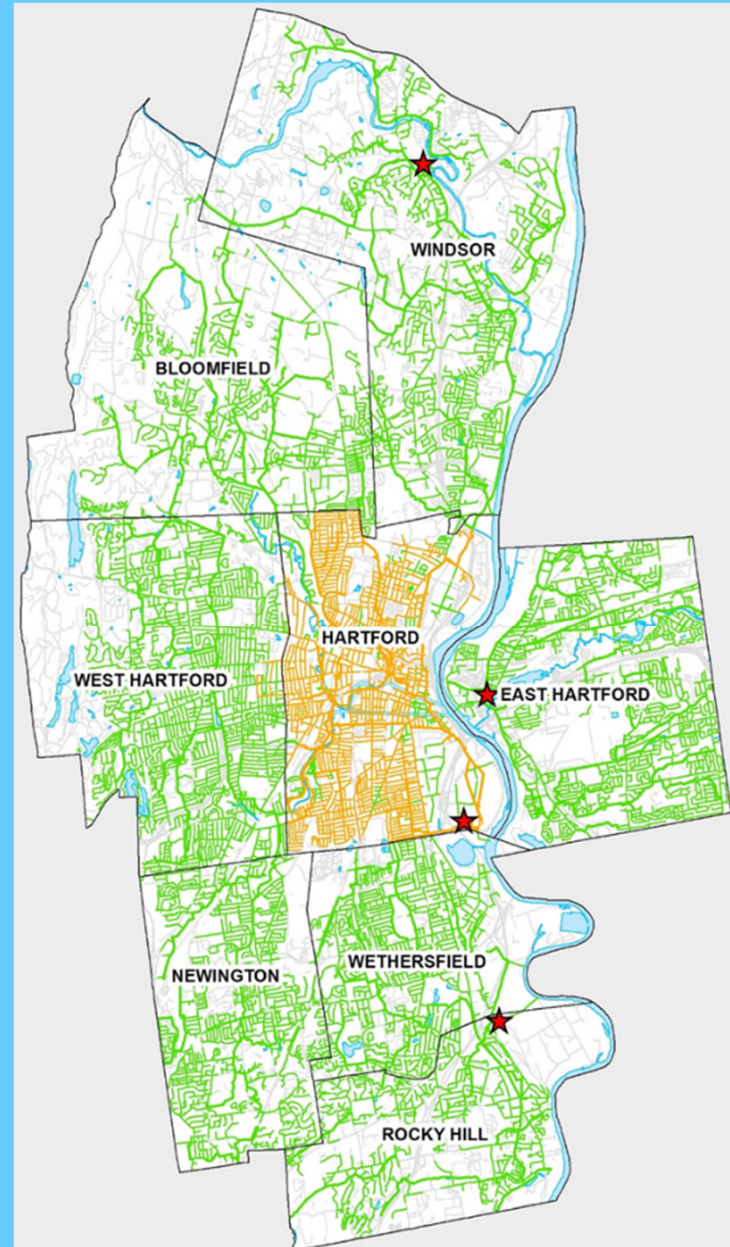
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The Metropolitan District
Hartford, Connecticut

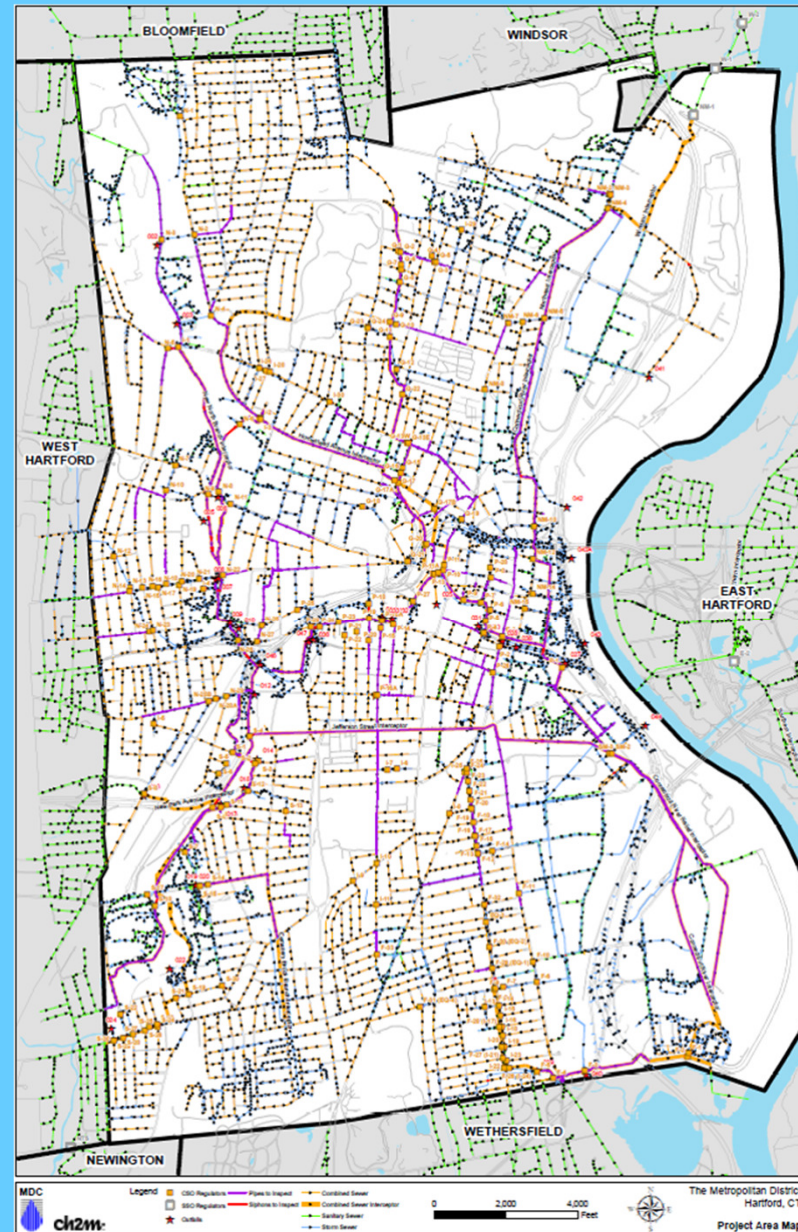
Background

- The Metropolitan District (MDC) owns and operates
 - 4 water pollution control facilities (WPCF)
 - ~ 1,200 miles of sewer pipes
 - 187 miles combined sewer
 - 77 pump stations
- large-diameter sewers
 - > 24-inch-diameter
 - 10% of the sewer system
 - 34% are older than 75 years
 - 55% brick pipes
- Consent order
 - Signed in 2006
 - Capacity Management Operations and Maintenance (CMOM) —
televise sewers by 2017 (ROW)



Multi-sensor Inspections

- 2015/2016: Inspected large-diameter sewers in the City of Hartford using multi-sensor inspections (MSI)
 - Laser
 - SONAR
 - closed-circuit television (CCTV)
- Goals
 - Evaluate condition
 - Sediment/Debris Buildup
 - Pipeline Defects
 - Prioritize Assessment of Problem pipes
 - Recommend near-term and long-term follow-up actions
 - Maintenance
 - Capital Improvements
 - Reduce Number of combined sewer overflows (CSOs)
 - Comply with Consent Order (CMOM)



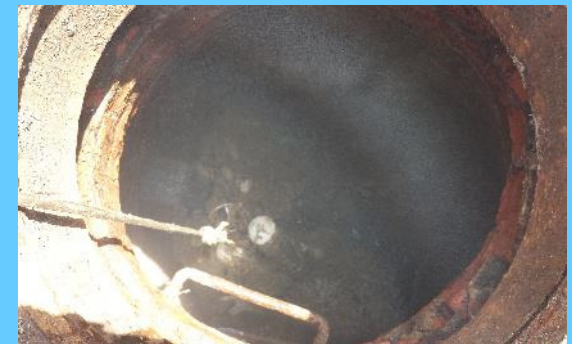
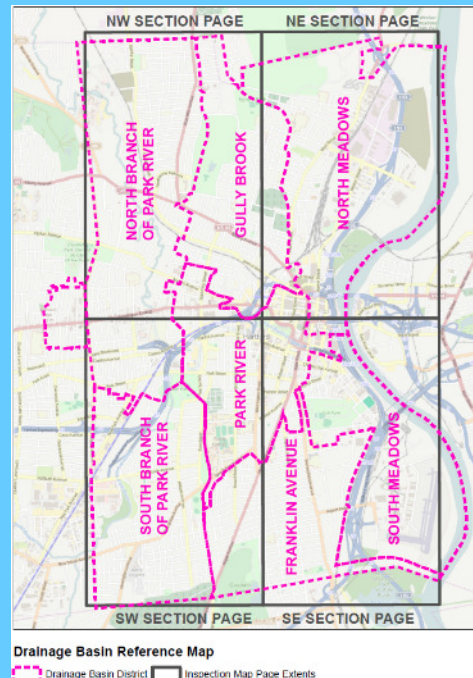
Cleaning Plan Development

- Conduct inspections
 - 760 manhole inspection
 - 200,000 linear feet (LF) of MSI
 - 27 Siphons
- Analyze field data
 - CCTV – Pipeline Assessment Certification Program (PACP) data
 - SONAR results
- Develop cleaning plan
 - Operation and maintenance (O&M) status



Field Work — MSI

- Divided project area into seven drainage basis
- Prioritized basins based on severity and constraints
- Notified MDC Command center daily through email
- Obtained police detail for streets
- Obtained State road permit
- Mailed notifications to property owners
- Identified street that may need customized traffic plan
- Inspected: May 2015 – May 2016



Data Analysis for Cleaning

- CCTV inspection data
 - Relates condition of large-diameter pipes using PACP defect codes
 - Includes structural, maintenance and construction PACP defect codes
 - Videos and photos provided for each pipe segment
 - Microsoft Access database contains defect codes for each pipe segment
- SONAR data
 - Displays volume of debris



HYDRO

Sonar Inspection Report

Inspection Details

| | |
|---------------------|-------------------|
| Upstream Manhole: | GIS2000163 |
| Downstream Manhole: | GIS2000164 |
| Segment Reference: | GIS1000188 |
| Direction: | downstream |
| Distance: | 274.5 |
| Scan Date: | November 03, 2015 |

As-Built info

| | |
|--------------------|-----|
| Internal Diameter: | 30" |
| Material: | RCP |

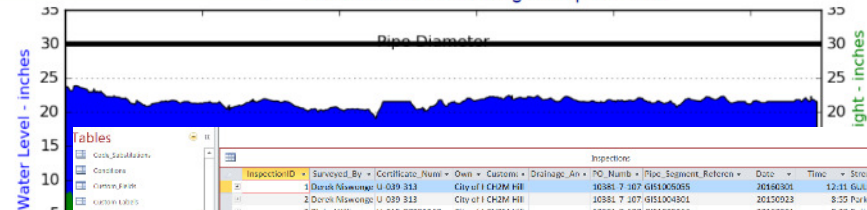
November 03, 2015

GIS2000164

Key Metrics

| | |
|--|-----------------|
| Average Water Level(in.): | 22 |
| sediment Volume(Cubic yards): | 11.4 |
| As-is Capacity / As-built Capacity (%): | 77.3 |
| Average Cross-Sectional Restriction(sq in.): | 160.8 |
| Max Cross-Sectional Restriction: | 38.0% at 251.1' |
| Average Height of Sediment: | 11.1" |
| Max Depth of Sediment: | 14.9" at 221.5' |

Sediment and Water Height Graph: 0 - 276'



| InspectorID | Surveyed By | Certificate Number | Own | Custom | Drainage Area | PO Number | Pipe Segment Reference | Date | Time | City | Location Data | Upstream | Downstream |
|-------------|------------------|--------------------|-------------------|--------|---------------|-----------|------------------------|----------|-------|----------------|-----------------------------|-------------|------------|
| 1 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000565 | 20160301 | 12:11 | Gully Brook | Gully Brook | GIS20004254 | |
| 2 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000561 | 20160301 | 9:55 | Park St. North | North Branch of Gully Brook | GIS20003622 | |
| 3 | Blake Williams | U-015-0700107 | City of CH2M Hill | | | 10381 | 7-307-GIS1000536 | 20160301 | 8:52 | Emmett | Emmett Brook | GIS20004122 | |
| 4 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000565 | 20160301 | 12:14 | NEEDLE HART | North Meadows | GIS20004928 | |
| 5 | Jeremy Spauldick | U-715-0100061 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20160301 | 2:55 | MAIN ST | North Meadows | GIS20004106 | |
| 6 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000480 | 20160315 | 15:43 | NORTH | North Meadows | GIS20004010 | |
| 7 | Blake Williams | U-015-0700107 | City of CH2M Hill | | | 10381 | 7-307-GIS1000270 | 20160310 | 15:57 | Ardan | North Meadows | GIS20002211 | |
| 8 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000579 | 20160303 | 12:38 | FRANKLIN | North Meadows | GIS20001508 | |
| 9 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000486 | 20160307 | 10:01 | Mark | North Meadows | GIS20001974 | |
| 10 | Jeremy Spauldick | U-715-0100061 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20160316 | 2:53 | High St. | North Meadows | GIS20004086 | |
| 11 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000480 | 20160301 | 13:03 | Mark | North Meadows | GIS20002930 | |
| 12 | Jeremy Spauldick | U-715-0100061 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20160320 | 1:43 | MAIN ST | North Meadows | GIS20002267 | |
| 13 | Blake Williams | U-015-0700107 | City of CH2M Hill | | | 10381 | 7-307-GIS1000788 | 20160301 | 18:08 | Sanford | North Meadows | GIS20003957 | |
| 14 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000480 | 20160301 | 15:48 | NEEDLE HART | North Meadows | GIS20001974 | |
| 15 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000480 | 20160305 | 11:27 | Mark | North Meadows | GIS20002728 | |
| 16 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20160308 | 9:48 | NEEDLE HART | North Meadows | GIS20002630 | |
| 17 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000501 | 20160326 | 14:03 | SOUTH | North Meadows | GIS20001807 | |
| 18 | Blake Williams | U-015-0700107 | City of CH2M Hill | | | 10381 | 7-307-GIS1000941 | 20160314 | 8:20 | Lawrence | North Meadows | GIS20008053 | |
| 19 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000941 | 20160301 | 16:31 | MARK | North Meadows | GIS20002930 | |
| 20 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000941 | 20160308 | 9:38 | POPE | North Meadows | GIS20006792 | |
| 21 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000568 | 20161103 | 8:58 | BRADLEY | North Meadows | GIS20000653 | |
| 22 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000902 | 20161104 | 9:46 | KIMBLE | North Meadows | GIS20003925 | |
| 23 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20161108 | 9:38 | POPE | North Meadows | GIS20003725 | |
| 24 | Jeremy Spauldick | U-715-0100061 | City of CH2M Hill | | | 10381 | 7-307-GIS1000476 | 20160310 | 1:53 | Seague | North Meadows | GIS20001974 | |
| 25 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000941 | 20160308 | 16:08 | SOUTH | North Meadows | GIS20001974 | |
| 26 | Blake Williams | U-015-0700107 | City of CH2M Hill | | | 10381 | 7-307-GIS1000480 | 20160320 | 9:55 | Fanning | North Meadows | GIS20004447 | |
| 27 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000983 | 20160315 | 14:03 | POPE | North Meadows | GIS20007052 | |
| 28 | Derek Niswonger | U-039-313 | City of CH2M Hill | | | 10381 | 7-307-GIS1000562 | 20160324 | 11:08 | FRANKLIN | North Meadows | GIS20002288 | |

Priority Scoring for O&M

| LOF Category | Score = 1 | Score = 3 | Score = 5 | Score = 7 | Score = 10 |
|--------------------------|----------------------------|--|--|--|---|
| O&M Condition | Functionality Not Affected | Functionality Maintained, Negligible Capacity Loss (Sags, Roots, Grease, Debris are <30%) | Functionality Affected, Capacity Loss (Sags, Roots, Grease, Debris are 30 to 50%) | Functionality Significantly Affected, Significant Capacity Loss, Moderate Surcharging (Sags, Roots, Grease, Debris are 50 to 75%) | Functionality Lost, Active Blockage or Major Surcharging (Sags, Roots, Grease Debris are >75%) |

Notes:

< = less than; > = more than; % = percent; LOF = likelihood of failure

O&M Recommendation Assignments

| O&M Recommendation | Definition |
|---------------------------|--|
| Maintain Existing O&M | Assigned to pipes that were fully functional at the time of the inspection and that can be maintained at a default O&M frequency. A default reinspection frequency is recommended on a 10- to 12-year cycle to monitor the pipes condition over time. |
| Clean | Assigned to pipes that require cleaning due to sags, grease, or debris. After near-term cleaning, CCTV reinspection frequency is provided to monitor debris buildup and determine an optimized O&M cleaning frequency. Pipes with debris having a minor impact to the pipe's functionality were assigned a cleaning at the default frequency (10 to 12 years). |
| Root Removal | Assigned to pipes with observed root intrusions that require root removal. After root removal, CCTV reinspection frequency is provided to monitor root buildup and determine an optimized O&M cleaning frequency. |
| Further Inspection Needed | Assigned to pipes that do not have sufficient data to provide an O&M recommendation. Complete CCTV and/or SONAR data should be acquired so that a long-term O&M recommendation may be assigned. |

O&M Reinspection Guide

| O&M Observation | Extent* | Reinspection** Guide for Interceptors (years) |
|----------------------------|--------------------|---|
| Debris/Grease/Sag | 30% | 7–9 |
| | 30–50% | 3–6*** |
| | 50–75% | 2–4 |
| | >75% | 0–2 |
| Root Removal | >30% | 1–3 |
| Functionality Not Affected | No to Minor Debris | 10–12 |

* Percentages in this column refer to maximum percentages observed or measured (SONAR) at a given point in an asset.

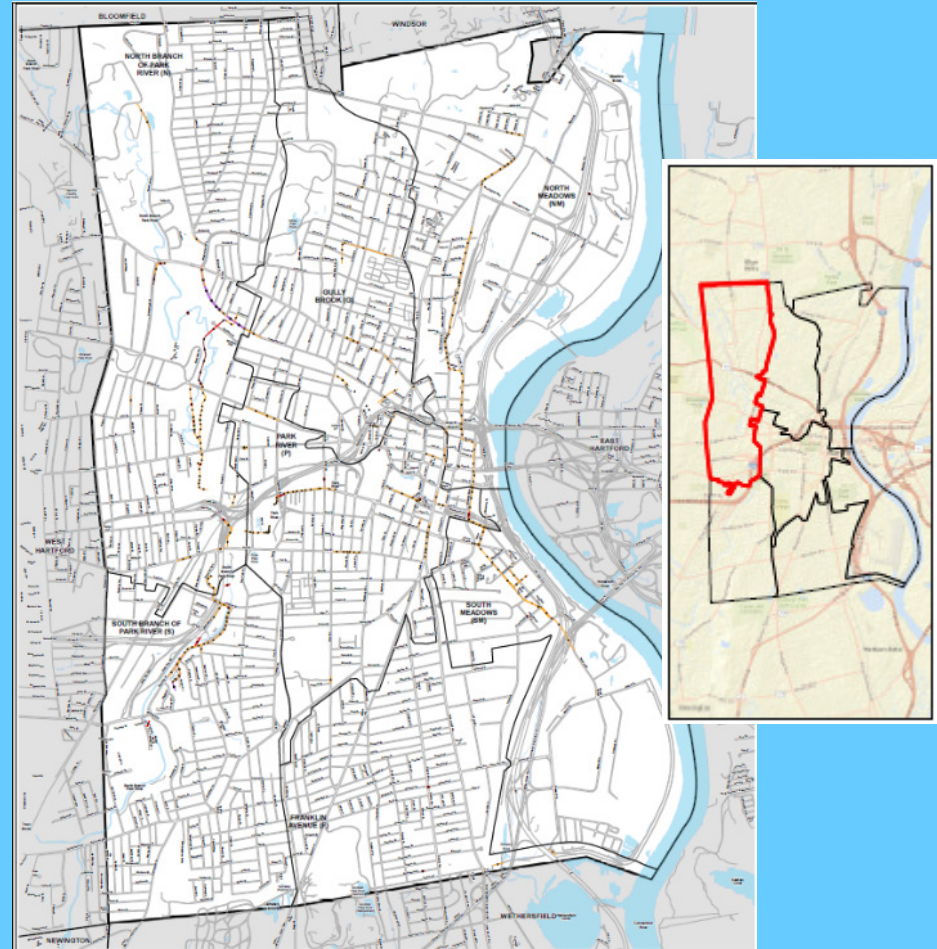
** Reinspection is recommended to track, evaluate and determine an optimized inspection and cleaning frequency.

*** For pipes that could not be CCTV inspected or SONAR inspected due to debris as reported by the inspection contractor, a “Clean” recommendation was provided with a 3- to 6-year reinspection frequency. The District may choose a more aggressive frequency.

| PipeID | Basin | USMH | USMH Depth | DSMH | DSMH Depth | Inspection Direction | Total Length | Length Surveyed | Televised Date | Installed Date | Location Code | Diameter | Diameter | Material | Structural Grade | O&M Grade |
|--------------|--------------------------------|-------------------|------------|----------------|--------------------------|------------------------------|----------------|-----------------|----------------|--------------------|-----------------------|------------|-----------------|--------------------------|------------------|-----------|
| GIS1000181-A | SOUTH BRANCH OF PARK RIVER (S) | GIS2000153-B | 15.8 | GIS2000153-A | 15.8 | Downstream | 20.7 | 20.7 | 8-Oct-15 | | Parking Lot | 30 | 30 | Brick | 0 | 1 |
| GIS1000182 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000158 | NIA | GIS2000157 | NIA | NIA | 120.167 | NIA | NIA | NIA | NIA | 30 | NIA | Reinforced Concrete Pipe | NIA | NIA |
| GIS1000183 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000159 | NIA | GIS2000158 | NIA | NIA | ##### | NIA | NIA | NIA | NIA | 30 | NIA | Reinforced Concrete Pipe | NIA | NIA |
| GIS1000185 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000157 | NIA | GIS2000162 | NIA | NIA | ##### | NIA | NIA | NIA | NIA | 30 | NIA | Brick | NIA | NIA |
| GIS1000186 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000161 | NIA | GIS2000160 | NIA | NIA | ##### | NIA | NIA | NIA | NIA | 30 | NIA | Brick | NIA | NIA |
| GIS1000187 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000162 | NIA | GIS2000161 | NIA | NIA | ##### | NIA | NIA | NIA | NIA | 30 | NIA | Brick | NIA | NIA |
| GIS1000188 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000163 | 17.2 | GIS2000164 | 16.8 | Upstream | | | | | | | | | | |
| GIS1000189 | SOUTH BRANCH OF PARK RIVER (S) | GIS2000160 | NIA | GIS2000163 | NIA | NIA | | | | | | | | | | |
| PipeID | Overall Grade | Structural Rating | O&M Rating | Overall Rating | Average Water Level(in#) | Sediment Volume(Cubic Yards) | As-is Capacity | PipeID | O&M Score | OM Recommendations | Date of Last Cleaning | GIS Length | Siphon Location | | | |
| GIS1000181-A | 9 | 3100 | 3200 | 3300 | 20 | 0.3 | | GIS1000181-A | 5 | Clean | 6/20/2014 | 0.000 | | | | |
| GIS1000181-B | 16 | 0000 | 5131 | 5131 | 19 | 0.2 | | GIS1000181-B | 7 | Root Removal | 6/20/2014 | 0.000 | | | | |
| GIS1000182 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000182 | NIA | Clean | 6/27/2014 | 120.167 | | | | |
| GIS1000183 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000183 | NIA | Clean | 6/27/2014 | 200.283 | | | | |
| GIS1000185 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000185 | NIA | Clean | 6/27/2014 | 228.710 | | | | |
| GIS1000186 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000186 | NIA | Clean | 4/17/2015 | 182.999 | | | | |
| GIS1000187 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000187 | NIA | Clean | 12/8/2014 | 206.732 | | | | |
| GIS1000188 | 30 | 3421 | 321A | 3621 | 22 | 11.4 | | GIS1000188 | 7 | Clean | | 307.670 | | | | |
| GIS1000189 | NIA | NIA | NIA | NIA | NIA | NIA | NIA | GIS1000189 | NIA | Clean | 12/8/2014 | 106.719 | | | | |
| GIS1000205 | | | | | 37 | 7.7 | | GIS1000205 | 10 | Clean | 11/1/2016 | 197.004 | 001 10 | | | |

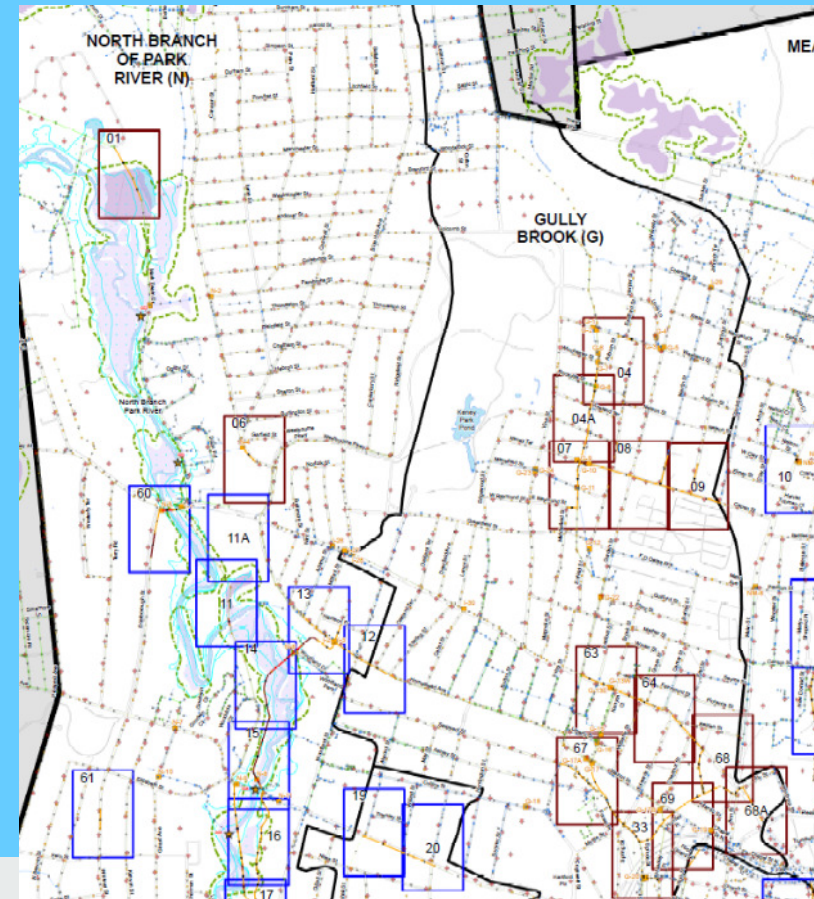
Philosophy on Cleaning Priorities within Each Basin

- Priority within drainage district:
 - Siphons and pipes upstream of siphons
 - Segments near CSO impacting outfall activation
 - District's needs and schedule requirement
 - District's flow monitoring program
 - Permits required
 - Accessibility
- Sub-priority — focus on cleaning upstream to downstream factoring in siphon and outfall locations. (w/in basin and basin to basin)



Perform In-house (District Staff)

- Pipe selection criteria
 - Developed maps and tables
 - Access based
 - Equipment based
 - Basin/ Continuous runs



Legend

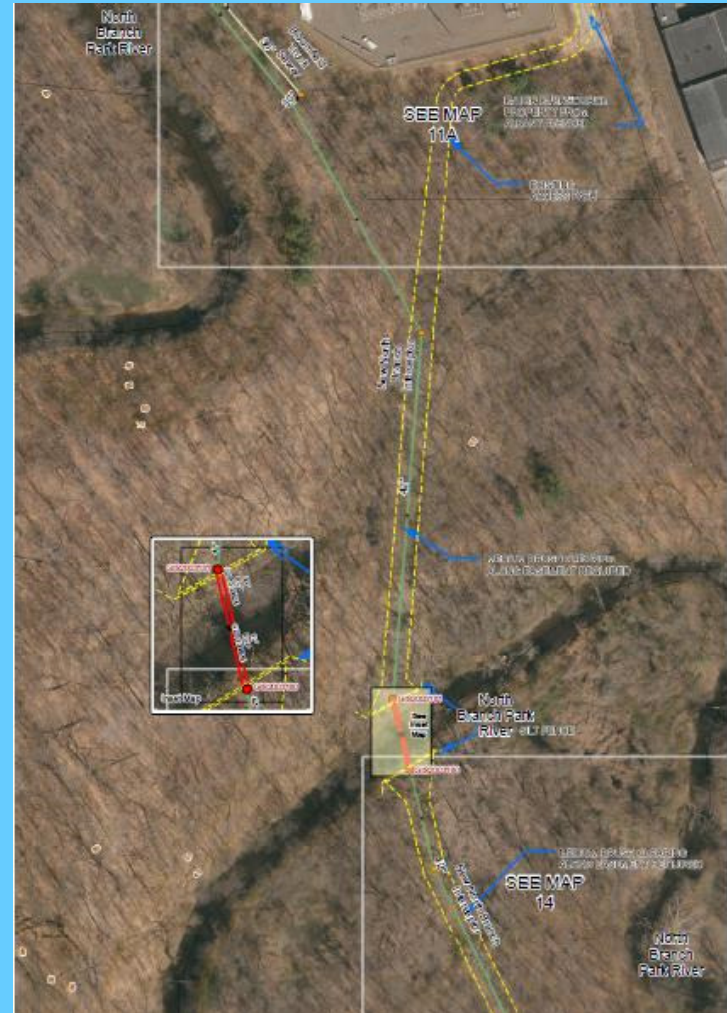
| | | | |
|---------------|----------------------------|---------------------------|--|
| Hydrant | Clean Siphon | Sanitary Sewer | Inland Wetland 100 Foot Buffer |
| CSO Regulator | Clean Non-Siphon | Storm Sewer | Inland Wetland Soils |
| SSO Regulator | Root Removal | MDC Selected Areas | Poorly Drained and Very Poorly Drained Soils |
| CSO Outfall | Combined Sewer | Contractor Cleaning Areas | Alluvial and Floodplain Soils |
| Force Main | Combined Sewer Interceptor | 100 Year Floodplain | |

Budget and Schedule

- Cleaning Contract
 - 55,000 LF of Pipe — \$2.06M
 - 23 Siphons — \$1.63M
 - Total Cost — \$3.69M
- Additional pipe cleaning self performed by MDC

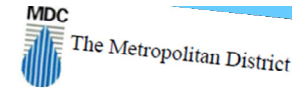
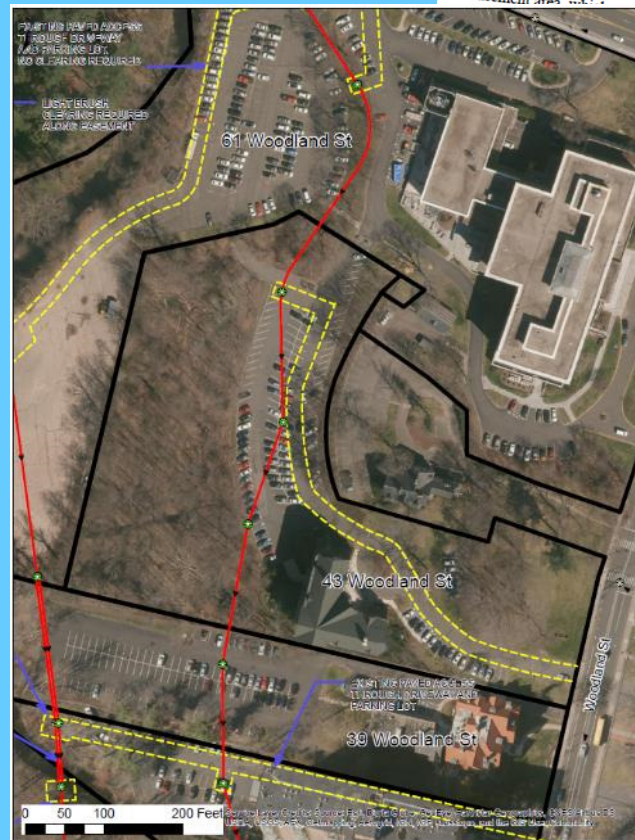
Example of Site Location Access and Constraints

- Overview and Key Location Map
- Site visits conducted to each critical site with wetland impacts
- Project Area Panels with Aerial
- Site Access – Property owner notification/access negotiation
- Permitted access plans



Easement and Permitting Coordination

- Property Owner Contact via Form Letter (easement and public outreach)
- General Access Language
- Site Restoration to be included as allowance
- Local Municipal Traffic Control Permit
 - Contractor to obtain a single Obstruction Permit with the City of Hartford.
- Connecticut Department of Transportation Traffic Control Permit
- Inland Wetlands Permit



January 18, 2017

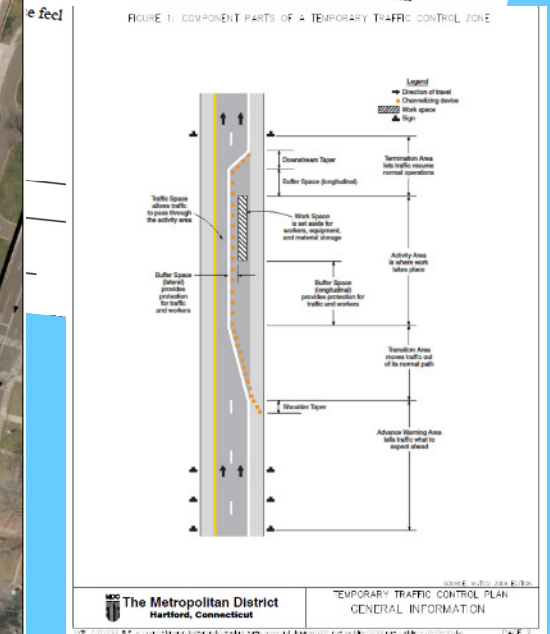
GREATER HTFD TRANSIT DISTRICT
1 UNION PL.
HARTFORD, CT 06103-1490

Subject: Temporary Access Request

Dear Property Owner:

The Metropolitan District (MDC) is requesting permission to enter your property known as 5 UNION PL (the "Property") to access the sewer manhole shown on the attached map (the "Manhole"). The Manhole needs to be accessed to conduct necessary cleaning of the sanitary sewer lines within your area (the "Work"). The existing MDC easement for the sewer line is approximately 20 feet wide and is centered along the pipe alignment crossing the Property. If MDC were to access the Manhole by sole use of the easement, shrub clearing or other structure removal might be necessary. To avoid these measures, MDC is hereby requesting your permission to access the Manhole utilizing the Property's existing drives and grass areas located outside of the easement area.

is more particularly described on the attached map. If any damage to the paving or lawns occurs as a result of this alternative access, such damage will be restored at MDC's cost to substantially the same condition operation with this matter and requests that you sign below to the above-described contractor to enter the Property pursuant to the Work, and that you return this letter with such signed process of hiring a contractor and anticipates the Work 17.



Wetlands Permit Application

Planning and Zoning



85 Woodland Street: The western access to the siphon can be reached from the Classical magnet School parking lot. The wetlands will not be traversed, however the upland buffer area will be.



CITY OF HARTFORD Planning & Zoning Commission and Inland Wetlands Commission Meeting 260 Constitution Plaza – Hartford, CT

MINUTES
March 28, 2017

The Planning & Zoning Commission held a Public Hearing at 6:00 p.m. on Tuesday, March 28, 2017 at the Plaza Level Conference Room of 260 Constitution Plaza, Hartford, CT 06103.

Attendance

Present: Chair Sara Bronin, Commissioners David Blatt, Sandra Bobowski, Mehryn Colón, Anthony Koos; Alternates Tom Gold and Kristen Marcroft

Absent: Commissioners Aaron Gill, and John Thomas;

Staff Present: Caitlin Palmer, Lisa Silvestri and Vanessa Walton

CALL TO ORDER

Chair Sara Bronin called the meeting to order at 6:03 pm and announced that Commissioners Gold and Marcroft would be sitting for Commissioners Gill and Thomas in their absence.



Inland Wetlands Application Determination – 1577 Albany Avenue – 1 Elizabeth Street, 61 Woodland Street, 28 Woodside Circle, 230 Scarborough Street. Principal Planner Sandy Fry, who is also the Inlands Wetlands Agent for the City of Hartford gave an overview of the report. The applicant is proposing to clean a number of segments of large capacity sewer lines which run under the North Branch of the Park River. Jason Waterbury of MDC and John Wisowski of CH2M Health was present to address and answer questions from the Commission. Commissioner Koos **MOVED** that the application be **APPROVED**, **Seconded** by Commissioner Gold. The application was **APPROVED** by a vote of 7-0

Plans and Specifications

- Performance Specification – “How clean is clean.”
Most work to be “step cleaning” approach, not by the “passes.”
 - Heavy cleaning
 - Remove all debris, roots, intruding services, deposits and other blockages
 - 95% open area at any single location along the alignment of the sewer
- Post cleaning CCTV and/ or SONAR
 - Flows up to 20% of pipe diameter CCTV
 - Flows in excess of 20% SONAR
- Heavy Cleaning
 - Sewer pipes on a LF basis only for the length required to be cleaned
 - Siphon Cleaning – Siphons will be measured on a lump sum basis
 - Bypass pumping to be included in the cost
- Use of MDC Hydrants shown on plans
- Public notification
- Safety
- Cleaning schedule

MDC
THE METROPOLITAN DISTRICT
HARTFORD COUNTY, CONNECTICUT

INVITATION TO BID
LARGE DIAMETER SEWER AND SIPHON CLEANING
SOLICITATION NUMBER: 2017B-06

ISSUE DATE: March 17, 2017
BIDS DUE: April 20, 2017 at 2:00 p.m. Local Time
Sealed proposals will be received by the Office of District Clerk at 555 Main Street, Hartford, Connecticut until the date and time specified above and will be publicly opened and read.

NOTICE: FAILURE TO RETURN THIS BID PROPOSAL INTACT MAY BE CAUSE FOR REJECTION.

Bid Proposal Submitted By:

Company Name _____

Street Address _____

City _____ State _____ Zip _____

Federal Tax ID _____ CT State Business License Number _____

Company Contact Person _____ Email Address _____ Phone Number _____

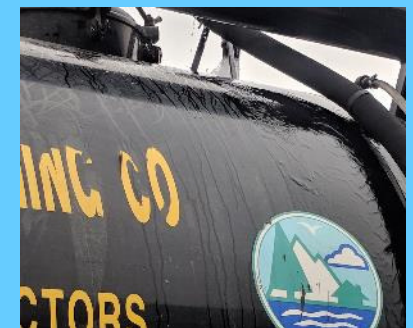
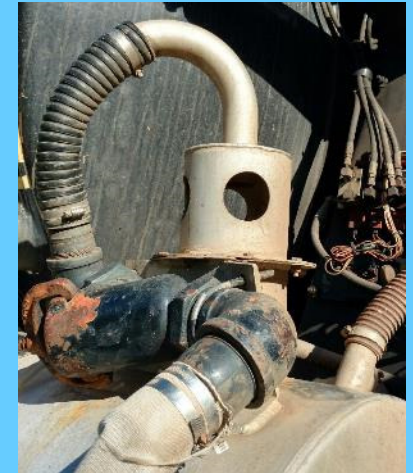
Registered with the MDC on eBid? Yes ☐ No ☐

Pre-Qualified with State of CT DAS? Yes ☐ No ☐ N/A ☐

*Registration with the MDC on eBid is mandatory.

Water for Jetting

- Connect to MDC hydrants
 - Air gap and backflow preventer for the hydrant
 - Hose connection to the hydrants
 - Winter months — Hydrant draining before end of day
- When away from a hydrant/ street and closer to a waterbody
 - Use stream water (withdrawal permit)
 - Less than 50,000 GPD
 - Department of Energy and Environmental Protection General Permit



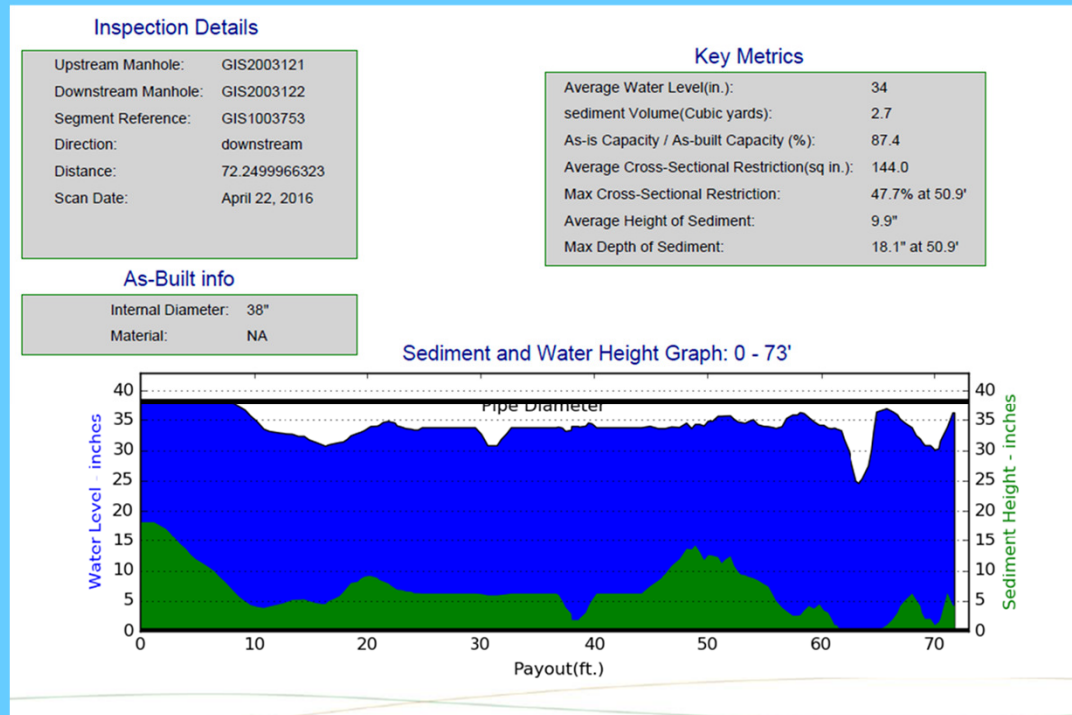
Pre- and Post-Cleaning



Pipe prior to cleaning with roots



Pipe after cleaning and root removal



Sediment level in pipe – SONAR inspection

Lessons Learned

- Key to have a full-time inspector onsite during inspection and cleaning
- Obtaining additional equipment and crew hourly rates for use in investigation work
- Early verification of CCTV and database deliverable quality
- Wetland pre-application meetings and access agreements





NASTT-NE's 2018 Regional Trenchless Conference

Contacts/Questions?

Jason Waterbury, P.E.

Manager/Team Leader

Technical Services

The Metropolitan District

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Hartford, CT 06142-0800

Email: jwaterbury@themdc.com

John Ososkie, P.E.

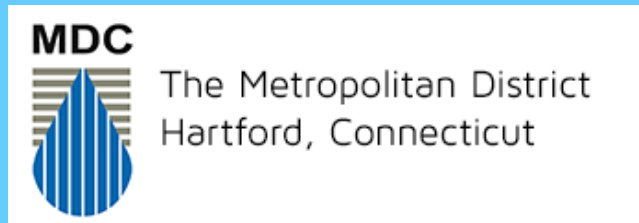
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100 Great Meadow Road, Ste 707

Wethersfield, CT 06109

Email: john.ososkie@jacobs.com



JACOBS®