CMOM Program

Force Main Rehabilitation/Replacement Program

November 1, 2017

Prepared by

The Miami-Dade Water and Sewer Department and the Consent Decree CMOM Program Team

Prepared for

United States Environmental Protection Agency and
Florida Department of Environmental Protection

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Force Main Rehabilitation/Replacement Program

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00. Acronyms / Glossary

00.01 Acronyms / Abbreviations

Table 00.1
Abbreviations Used in the Force Main R/R Program

Abbreviation	Description
ASTT	Australian Society for Trenchless Technology
BWCCP	Bar-wrapped Concrete Cylinder Pipe
CCTV	Closed Circuit Television
CD	Consent Decree
CFR	Code of Federal Regulations
CMOM	Capacity, Management, Operations, and Maintenance
CMP	Corrugated Metal Pipe
County	Miami-Dade County
CWA	Clean Water Act
CIP	Cast Iron Pipe
CIPP	Cured in Place Pipe
D&R	Dig and Replace
DIP	Ductile Iron Pipe
FDEP	Florida Department of Environmental Protection
FM R/R Program	Force Main Rehabilitation/Replacement Program
FMOPMARP	Force Main Operations, Preventative Maintenance, and Assessment / Rehabilitation Program
FRP	Fiberglass Reinforced Pipe
GRP	Glass Reinforced Pipe
GPD	Gallons Per Day
GIS	Geographic Information Systems
HDD	Hydraulic Directional Drilling
HDPE	High Density Polyethylene
IPBA	International Pipe Bursting Association
MDPE	Medium-density polyethylene
MGD	Million Gallons Per Day
MJ	Mechanical Joint
MT	Microtunneling
MTBM	Microtunneling Boring Machine
O&M	Operations and Maintenance
PB	Pipe Bursting
PCCP	Pre-stressed Concrete Cylinder Pipe
PE	Polyethylene Pipe

Abbreviation	Description
PIR	Project Initiation Request
PJ	Pipe Jacking
Program	Consent Decree Program
PSOPMP	Pump Station Operations and Preventative Maintenance Program
PVC	Polyvinyl Chloride
RCP	Reinforced Concrete Pipe
R/R	Rehabilitation/Replacement
RAP	Remedial Action Plan
RER-DERM	Miami-Dade County Department of Regulatory and Economic Resources – Division of Environmental Resources Management
SSO	Sanitary Sewer Overflow
TBM	Tunnel Boring Machine
MDWASD	Miami-Dade Water and Sewer Department
WCTS	Wastewater Collection and Transmission System
WWCTLD	MDWASD Wastewater Collection and Transmission Line Division
WWTP	Wastewater Treatment Plant
VCP	Vitrified Clay Pipe

00.02 Glossary

Auger: A drill bit that includes a rotating helical fighting, a screw conveyor to remove drilled out material.

Boring: (1) The dislodging or displacement of spoil by a rotating auger or drill string to produce a hole called a bore. (2) An earth-drilling process used for installing conduits or pipelines. (3) Obtaining soil samples for evaluation and testing.

Bypass: A temporary arrangement of pipes and valves whereby the flow may be passed around a hydraulic structure or appurtenance.

Capacity, Management, Operations, and Maintenance (CMOM): A program of accepted industry practices to properly manage, operate, and maintain sanitary wastewater collection, transmission, and treatment systems, investigate capacity constrained areas of these systems, and respond to sanitary sewer overflow (SSO) events.

Closed-circuit Television (CCTV): Technology by which Miami-Dade inspection crews and/or its outside contractors use a video camera to visually inspect the internal condition of pipes and sub-surface structures.

Consent Decree (CD): The Consent Decree, Case: 1:12-cv-24400-FAM, entered between Miami-Dade County, Florida (Defendant), the State of Florida, the Florida Department of Environmental Protection, and the U.S. Environmental Protection Agency (Plaintiffs).

Construction Cost Evaluation: A prediction of quantities, cost, and/or price of resources required by the scope of an asset investment option, activity, or project.

Cost-Benefit Analysis: A process by which business decisions are analyzed by summing the benefits of a given situation or business-related action and then subtracting the costs associated with taking that action.

Critical Repair: A repair resulting from an identified risk of imminent force main failure.

Cured-in-place Pipe (CIPP): A lining system in which a thin flexible tube of polymer or glass fiber fabric is impregnated with thermo set resin and expanded by means of fluid pressure into position on the inner wall of a defective pipeline before curing the resin to harden the material.

Directional Drilling: A steerable system for the installation of pipes, conduits, and cables in a shallow arc using a surface launched drilling rig.

Emergency Repair: A repair resulting from a force main failure or break.

Environmental Protection Agency (EPA): United States Environmental Protection Agency and any of its successor departments or agencies.

Florida Department of Environmental Protection: State of Florida Department of Environmental Protection and any of its successor departments or agencies.

Force Mains: Pipes that receive and convey, under pressure, wastewater from the discharge side of a pump.

High Density Polyethylene: A strong, relatively opaque form of polyethylene thermoplastic made from petroleum. It has a dense structure with few side branches off the main carbon backbone.

Host Pipe: In trenchless rehabilitation and replacement methods, an existing, old, or deteriorated pipe.

Hydraulic Capacity: The maximum design flow, expressed in millions of gallons per day, at which a plant is expected to consistently provide the required treatment or at which a conveyance structure, device or pipe is expected to properly function without creating a backup, surcharge or overflow.

Infiltration and Inflow (I/I): The total quantity of water from inflow, infiltration, and rainfall-induced infiltration and inflow without distinguishing the source.

Infiltration: As defined by 40 CFR § 35.2005(b)(20) shall mean water other than wastewater that enters the WCTS (including sewer service connections and foundation drains) from the ground through such means as defective pipe, pipe joints, connections, or manholes.

Inflow: As defined by 40 CFR § 35.2005(b)(21) shall mean water other than wastewater that enters the WCTS (including sewer service connections) from sources such as, but not limited to, roof leaders, cellar drains, yard drains, area drains, drains from springs and swampy areas, manhole covers, cross connections between storm sewers and sanitary sewers, catch basins, cooling towers, storm water, surface runoff, street wash waters, or drainage.

Inversion: The process of turning a resin-saturated tube inside out by application of air or water pressure.

International Pipe Bursting Association: The International Pipe Bursting Association (IPBA) was formed in the year 2000 as a Division of the National Association of Sewer Service Companies

(NASSCO) as an independent organization to promote, educate, train, and expand the utilization of pipe bursting.

Lift Station: A facility in the WCTS (not at the wastewater treatment plants) comprised of pumps which lift wastewater to a higher hydraulic elevation, including related electrical, mechanical, and structural systems necessary to the operation of the lift station (referenced in this document as pump station). As defined in MDWASD's 1996 O&M Manual, lift stations discharge to a downstream gravity main.

Manhole or Junction Box: Part of the gravity sewer system. A structure that provides a connection point for gravity lines, private service laterals, or force mains, as well as an access point for maintenance and repair activities.

Miami-Dade: Miami-Dade County, Florida, including all of its departments, agencies, instrumentalities such as the Water and Sewer Department and the Department of Regulatory and Economic Resources – Division of Environmental Resources Management, and any successors thereto.

Microtunneling: A trenchless construction method for installing pipelines with the following features: (1) Remote controlled - The microtunneling boring machine (MTBM) is operated from a control panel, normally located on the surface. Personnel entry is not required for routine operation. (2) Guided - The guidance system usually references a laser beam projected onto a target in the MTBM. (3) Pipe jacked - The process of constructing a pipeline by consecutively pushing pipes and MTBM through the ground using a jacking system for thrust. (4) Continuously supported – Continuous pressure is provided to the face of the excavation to balance groundwater and earth pressures.

Microtunneling Boring Machine: Mechanized excavating equipment that is remotely operated, steerable, connected to and shoved forward by the jacked pipe or mechanical rods.

Open Cut: The method by which access is gained by excavation to the required level underground for the installation, maintenance, or inspection of a pipe, conduit, or cable.

Offline Replacement: the installation of a new pipe without regard to the line and grade of the existing pipe. Normally, the existing deteriorated pipe being replaced is kept in service (at reduced operating conditions if necessary), while the new replacement pipe is being installed.

Online Replacement: The process of breaking out of an existing, old, or host pipeline and the installation of a new pipeline at the same location. With this method, the existing pipeline will serve as a “pilot bore” for the new pipe installation, which might be a different pipe material with the same or larger diameter, and will be installed with the same alignment of the existing pipe.

Pilot Bore: The action of creating the first (usually steerable) pass of any boring process which later requires back-reaming or similar enlarging. Most commonly applied to Guided Boring, Directional Drilling, and 2-pass microtunneling systems.

Pipe Bursting: A technique for breaking the existing pipe by brittle fracture, using force from within, applied mechanically, with the remains of the existing pipe being forced into the surrounding ground. At the same time, a new pipe, of the same or larger diameter, is drawn in behind the bursting tool.

Pipe Jacking: A trenchless technology method for installing a prefabricated pipe through the ground from a drive shaft to a reception shaft. The pipe is propelled by jacks located in the drive shaft.

Pneumatic Method: A pipe bursting method in which the bursting tool is a soil displacement hammer driven by compressed air and operated at a rate of 180 to 580 blows per minute.

Prohibited Bypass: The intentional diversion of waste streams from any portion of a treatment facility which is prohibited pursuant to the terms set forth at 40 CFR § 122.41(m).

Pump Station: A facility in the WCTS (not at the WWTPs) comprised of pumps which transport wastewater from one location to another location, including all related electrical, mechanical, and structural systems necessary to that pump station. As defined in MDWASD’s 1996 O&M Manual, pump stations discharge to a force main, to a booster station, or to a WWTP.

Repair: Permanent or temporary fix of a pipeline failure or a deteriorated section of pipe.

Rehabilitation: All aspects of reconstructing, renovating, or upgrading an existing pipeline to extend its design life.

Replacement: Replacing an old, existing, or deteriorated pipe with a new pipe by use of open-cut, inline replacement (pipe bursting), and/or other new installation methods (HDD, microtunneling, etc.). The new pipe may have a larger diameter and different pipe material from the existing or old pipe.

Resins: An organic polymer, solid or liquid; usually thermoplastic or thermosetting.

Routine Repair: A repair resulting from scheduled force main maintenance activities.

Service Life Cycle Cost: Sum of all recurring and non-recurring costs over the full life span or a specified period of a good, service, structure, or system. Service life cycle cost includes purchase price, installation cost, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life.

Sewer System: The Wastewater Collection and Transmission System (WCTS) and the Wastewater Treatment Plants (WWTPs).

Sliplining: Insertion of a new pipe by pulling or pushing it into the existing pipe and grouting the annular space. The pipe used may be continuous or a string of discrete pipes.

Standard Dimension Ratio: The ratio of pipe outside diameter to wall or liner thickness.

Static Method: A pipe bursting method in which a larger tensile force is applied to the cone-shaped expansion head through a pulling rod assembly or cable inserted through the existing pipe.

Trenchless Technology: Techniques for utility line installation, replacement, rehabilitation/renovation, repair, inspection, location and leak detection, with minimum excavation from the ground surface.

Tunnel Boring Machine: A machine used to excavate tunnels with a circular cross section through a variety of rock strata.

Tunneling: A construction method of excavating an opening beneath the ground without continuous disturbance of the ground surface and of large enough diameter to allow individuals access and erection of a ground support system at the location of material excavation.

Upsizing: Any replacement method that increases the cross sectional area of an existing pipeline.

Vitrified Clay Pipe: A pipe made from clay that has been subjected to vitrification, a process which fuses the clay particles to a very hard, inert, glass-like state.

Wastewater Collection and Transmission System (WCTS): The municipal wastewater collection, and transmission system, including all pipes, force mains, gravity sewer lines, pump stations, manholes, and appurtenances thereto, which are owned or operated by Miami-Dade Water and Sewer Department designed to collect and convey municipal sewage (domestic, commercial, and industrial) to Miami-Dade's WWTPs.

Wastewater Treatment Plant (WWTP): Devices or systems used in the storage, treatment, recycling, and reclamation of municipal wastewater and include all facilities owned, managed, operated, and maintained by Miami-Dade Water and Sewer Department, including but not limited to the North District WWTP, the Central District WWTP, and the South District WWTP, and all components of those plants.

01. Introduction

The Miami-Dade Water and Sewer Department (MDWASD) prepared this Force Main Rehabilitation/Replacement Program (FM R/R Program) in compliance with Paragraph 19(g)(iv) of the Consent Decree (CD) between Miami-Dade County (County) and the plaintiffs, the United States of America, the State of Florida (State), and the Florida Department of Environmental Protection (FDEP), adjudicated by the United States District Court for the Southern District of Florida in Case No. 1:12-cv-24400-FAM. The CD requires the County to develop, submit, finalize, and implement plans for the continued improvement of its wastewater collection and transmission system (WCTS) and wastewater treatment plants (WWTPs) to eliminate, reduce, prevent, or otherwise control sanitary sewer overflows (SSOs).

The FM R/R Program has three components, namely, repair, rehabilitation, and replacement, each requiring MDWASD to submit to the EPA and FDEP for approval, “Standard Procedures” associated with each. These standard procedures are required by the CD for force mains in the County’s “WCTS that are in need of repair pursuant to the Force Main Criticality Assessment and Prioritization Report and/or Force Main Assessment Program.” This report presents the standard procedures employed by MDWASD in the decision making process associated with the selection of different force main repair, rehabilitation, or replacement technologies. Any methods or technologies not currently employed by MDWASD are verified by the New Technology/Product Committee to establish appropriate field testing and/or pilot projects. New Technology/Product Committee is comprised of the Assistant Director of Water, Assistant Director of Wastewater, Chief of Engineering Division, Manager of Specifications Section, Manager of Plans Review Section, and the Chief of Construction Contracts Management Division. The committee by-laws and product application forms are provided in Appendix A - New Product/Technology Committee By-Laws and Standard Forms.

The CD requires standard procedures for repairing force mains “…in the WCTS using Repair technologies which shall include, but not be limited to, open cut replacement of section(s) of pipe, spot repairs using cured-in-place pipe (CIPP), mechanical sleeves or repair clamps, or joint repairs using internal sleeves or external devices.” MDWASD defines a repair as a temporary or permanent fix to expeditiously correct a defect in a force main. As part of the decision making process, repairs undertaken by MDWASD require an open cut of the area around the point of the repair, but the repair method that is applied depends on the localized problem encountered in the field and the feasibility of performing a particular repair method. The two permanent repair methodologies used by MDWASD maintenance crews for force main repairs are dig and replace and repair sleeve. The temporary repair method of choice is the use of a repair clamp, which is primarily used to prevent any further spill or damage to the environment and to restore service as quickly as possible when a permanent repair cannot be performed expeditiously. Other repair technologies are not performed by MDWASD crews, but are outsourced through design/bid/build procurement procedures. These technologies/methods are based on best industry practices, specified to meet current ASTM standards and coordinated and managed by MDWASD throughout the construction duration to assure compliance. Contractor's installation and construction means and methods are not dictated by MDWASD for these technologies, however, compliance with contract general and special conditions, and technical specifications is required.

For force main rehabilitation, the CD requires standard procedures for rehabilitating each force main pursuant to the "Force Main Criticality Assessment and Prioritization Report" and/or "Force Main Assessment Program". The rehabilitation technologies suggested include, but are not limited to, spray-on linings, close fit linings, CIPP, and woven hose linings (including adhesive-backed linings, non-adhesive backed linings and glass-reinforced thermoplastic linings). With the exception of CIPP and close fit lining, the other technologies referenced in the CD are not currently used by MDWASD and would have to be evaluated by the New Technology/Product Committee. None of the rehabilitation technologies for force mains as described herein are performed by MDWASD maintenance crews, therefore all force main rehabilitation will be outsourced through typical design/bid/build procurement procedures. These technologies/methods are based on best industry practices, specified to meet current ASTM standards and coordinated and managed by MDWASD throughout the construction duration to assure compliance. Contractors' installation and construction means and methods are not dictated by MDWASD for these technologies, however, compliance with construction contract general and special conditions, and technical specifications is expected required.

The replacement technologies listed in the CD include open cut replacement, slip-lining, pipe bursting, directional drilling, and microtunneling. As with repair and rehabilitation technologies, the FM R/R Program presents the decision making process associated with the selection of the most appropriate replacement technologies by MDWASD. Tunneling and dig and replace (D&R), although not mentioned in the CD, are considered options for force main replacement. Other than the short segmental dig and replace as previously discussed as a repair option, none of the replacement technologies for force mains are performed by MDWASD maintenance crews, therefore all force main rehabilitation will be outsourced through typical design/bid/build procedures. These technologies/methods are based on best industry practices, specified to meet current ASTM standards and coordinated and managed by MDWASD throughout the construction duration to assure compliance. Contractors' installation and construction means and methods are not dictated by MDWASD for these technologies, however, compliance with construction contract general and special conditions, and technical specifications is required.

01.01 Sewer System Summary

As of February 1, 2015, MDWASD's WCTS consists of approximately 6,300 miles of pipelines (gravity lines and force mains), 1,028 MDWASD pump stations, 19 pump stations maintained under maintenance agreement with other agencies and departments. The WCTS conveys wastewater to three WWTPs. In addition, there are numerous private pump stations and private collection systems discharging wastewater into MDWASD's WCTS. The numbers cited herein are subject to change due to additions and abandonments in a dynamic and urban service area such as Miami-Dade County.

01.02 Regulatory Drivers

Compliance with the requirements of the Clean Water Act (CWA) is the primary regulatory driver for the FM R/R Program. The County entered into the CD in response to violations of the CWA, which consisted of unpermitted discharges of untreated sanitary sewage into waters of the United States from the WCTS and which are referred to as SSOs.

To support realization of the goal of reducing, preventing, or otherwise controlling SSOs and prohibited discharges to waters of the United States, the CD, Paragraph 18, requires MDWASD to continue programs initiated under previous CDs, and Paragraph 19 stipulates the development of CMOM programs across all areas of the wastewater, collection, transmission, and treatment systems, including: pump stations, force mains, gravity sewers, and wastewater treatment plants. CD Paragraph 18 "existing" CMOM programs and Paragraph 19 "new" CMOM programs are listed below. The CD Programs listed in ***bold italics*** have direct impact on elements and requirements of the FM R/R Program.

1. ***18(a) Adequate Pumping, Transmission, and Treatment Capacity (APTTC) Program;***
2. 18(b) Pump Station Remote Monitoring (PSRM) Program;
3. ***18(c) WCTS Model;***
4. ***18(d) Spare Parts Program (SPP);***
5. 18(e) Volume Sewer Customer Ordinance (VSCO) Program;
6. 19(a) Fats, Oils, and Grease (FOG) Control Program;
7. ***19(b) Sewer Overflow Response Plan (SORP);***
8. ***19(c) Information Management System (IMS) Program;***
9. ***19(d) Sewer System Asset Management Program (SSAMP);***
10. 19(e) Gravity Sewer System Operations and Maintenance Program (GSSOMP);
11. ***19(f) Pump Station Operations and Preventative Maintenance Program (PSOPMP);***
12. ***19(g) Force Main Operations, Preventative Maintenance, and Assessment / Rehabilitation Program (FMOPMARP);***
13. 19(h) WWTP Operations and Maintenance Program (WWTP OMP);
14. ***19(i) Specific Capital Improvements Projects (CIP);*** and
15. 19(j) Financial Analysis Program.

In addition to the specific requirements of Paragraph 19, the CD references specific guidance tools that support the incorporation of industry CMOM "best-practices" in municipal wastewater utility operations. Industry CMOM best-practices are those core WCTS management attributes commonly found in highly performing utilities and often include adoption of asset and life cycle cost management concepts through implementation of preventative and predictive management policies and procedures. Reductions in emergency maintenance and repair activities leading to reductions in SSOs demonstrate the effectiveness of these best-practices. The CD requires concurrent development and implementation of the above mentioned 15 separate management programs. The programs' inherent interdependencies require an interdisciplinary and integrated approach to wastewater system management, operations, and management.

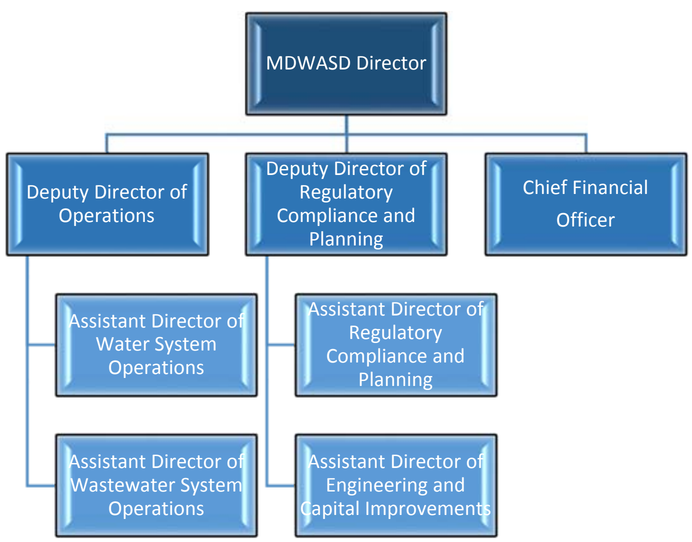
01.03 Miami-Dade County Organization

The County operates under Home-Rule Authority granted by the Florida State Constitution. The unincorporated areas of Miami-Dade County are governed by the 13-member Board of County Commissioners (Commission). The County government provides major metropolitan services countywide and city-type services for residents of the unincorporated areas. Miami-Dade County has a Mayor who oversees the day-to-day operations of the County. The County is organized into multiple Departments, each led by a Mayor-appointed Director.

01.04 Water and Sewer Department Organization

As shown on Figure 01.1, two Deputy Directors manage MDWASD under the authority of the Director: the Deputy Director of Operations and the Deputy Director of Regulatory Compliance and Planning. There are two Assistant Directors under the Deputy Director of Operations and two Assistant Directors under the Deputy Director of Regulatory Compliance and Planning.

Figure 01.1
MDWASD Organizational Chart



01.05 Document Organization

Table 01.1
Locations of CD Requirements in the Force Main R/R Program

CD Paragraph	Force Main R/R Program Section	Page #
	00 Acronyms / Glossary	00-1
	01 Introduction	01-1
Paragraph 19	02 FM R/R Program Purpose and Goals	02-1
Paragraph 19	03 Phased FM R/R Program Implementation	03-1
	04 Technology Selection Methodology	04-1
Paragraph 19(g)(iv)(A)	05 Force Main Repair	05-1
Paragraph 19(g)(iv)(B)	06 Force Main Rehabilitation	06-1
Paragraph 19(g)(iv)(C)	07 Force Main Replacement	07-1
	08 Appendices	08-1

02. Force Main R/R Program Purpose and Goals

In accordance with the CD requirement to establish a written, defined purpose and written, defined goals, Section 02.01 provides the FM R/R program purpose and Section 02.2 provides the FM R/R Program goals.

02.01 Force Main R/R Program Purpose

The purpose of the FM R/R Program is to establish and document decision based processes and procedures for the repair, rehabilitation, and/or replacement of force mains in the WCTS that are deemed in need of repair, rehabilitation, and/or replacement pursuant to the CD Section 19(g)(ii) Force Main Criticality Assessment and Prioritization Report, which will set forth the results of MDWASD's criticality assessment of the structural integrity of its force mains and the risk of force main critical failure.

02.02 Force Main R/R Program Goals

The FM R/R Program goals, set to assist MDWASD in achieving additional lifecycle cost savings through coordination of force main R/R projects with other Capital Improvement Projects, are as follows:

- Provide proactive force main repair, rehabilitation, and replacement planning that offers the best opportunity for capital cost savings;
- Document established force main repair, rehabilitation, and replacement method/technology selection processes;
- Document communication among WWCTLD, Planning, and Engineering Divisions; and
- Identify the process for evaluation of new technologies to be included in the alternatives evaluation for force main repair, rehabilitation, and replacement.

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03. Force Main R/R Program Development

Pursuant to the CD, Miami-Dade shall implement the FM R/R Program in accordance with the prioritization of the Force Main Criticality Assessment and Prioritization Report and based on the results and finding of its implementation of the Force Main Assessment Program; provided, however, that all force mains shall be repaired, rehabilitated, and/or replaced pursuant to the Force Main Assessment Program on or before sixty months after completion of the condition assessment. Within three months after completion of all work pursuant to the FM R/R Program, Miami-Dade shall submit to EPA and FDEP for review and comment a FM R/R Program Final Report summarizing the implementation of the program.

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04. Technology Selection Methodology

After a force main failure occurs, the first corrective step involves an initial inspection by a field crew aimed at preventing any further spill or damage to the environment, and restoring service as quickly as possible. Once the leak is stopped, an assessment is made by the WWCTLD to determine whether multiple breaks have occurred along the same section of pipe with the same cause. If multiple breaks having the same cause have occurred on the same force main, a Project Initiation Request (PIR) is generated by the WWCTLD to begin the process of rehabilitating or replacing the force main.

Once a PIR is generated, the Planning Division reviews the funding needs and verifies there are no duplicate projects in the Capital Improvements Program. Afterwards, the Planning Division performs a flow capacity evaluation to determine the current and future capacity needs of the force main. Flow data can provide direct measurement of actual flow conditions; and then be interpolated using the hydraulic model to calculate hydraulic capacity of a pipe segment under current or projected conditions. If the force main is not considered to be undersized for current and future flow conditions, the R/R technology selection evaluation will be based on the previously identified root cause, as shown in Figure 04.1, Force Main R/R Technology Selection Flow Chart. If the force main is determined to be undersized for current or future flow conditions, the Planning Division evaluates the need for a redundant pipe before the Engineering Division performs an alternatives analysis evaluation to select the most appropriate R/R method/technology. Depending on project specific conditions, MDWASD may elect to outsource the alternatives analysis evaluation to outside consultants.

A cost-benefit analysis is performed for each of the R/R alternatives referenced in Figure 04.1. The cost-benefit analysis includes the following parameters: (1) pipe characteristics (i.e., linear feet and diameter); (2) technology equipment; and (3) site-specific requirements (i.e., pavement restoration and bypass requirements). Appendix B provides MDWASD's Spill Process Review Flowchart that initiates independently of Figure 04.1 when a force main failure occurs.

In some instances, the force main R/R process is initiated after a condition assessment or other field investigations identify a pipe in need of R/R, such as pre-stressed concrete cylinder pipe

(PCCP) with wire breaks, Asbestos Cement Pipe (ACP), non-pressure pipes, or other conditions that may warrant evaluating the need for repairing, rehabilitating, or replacing a force main.

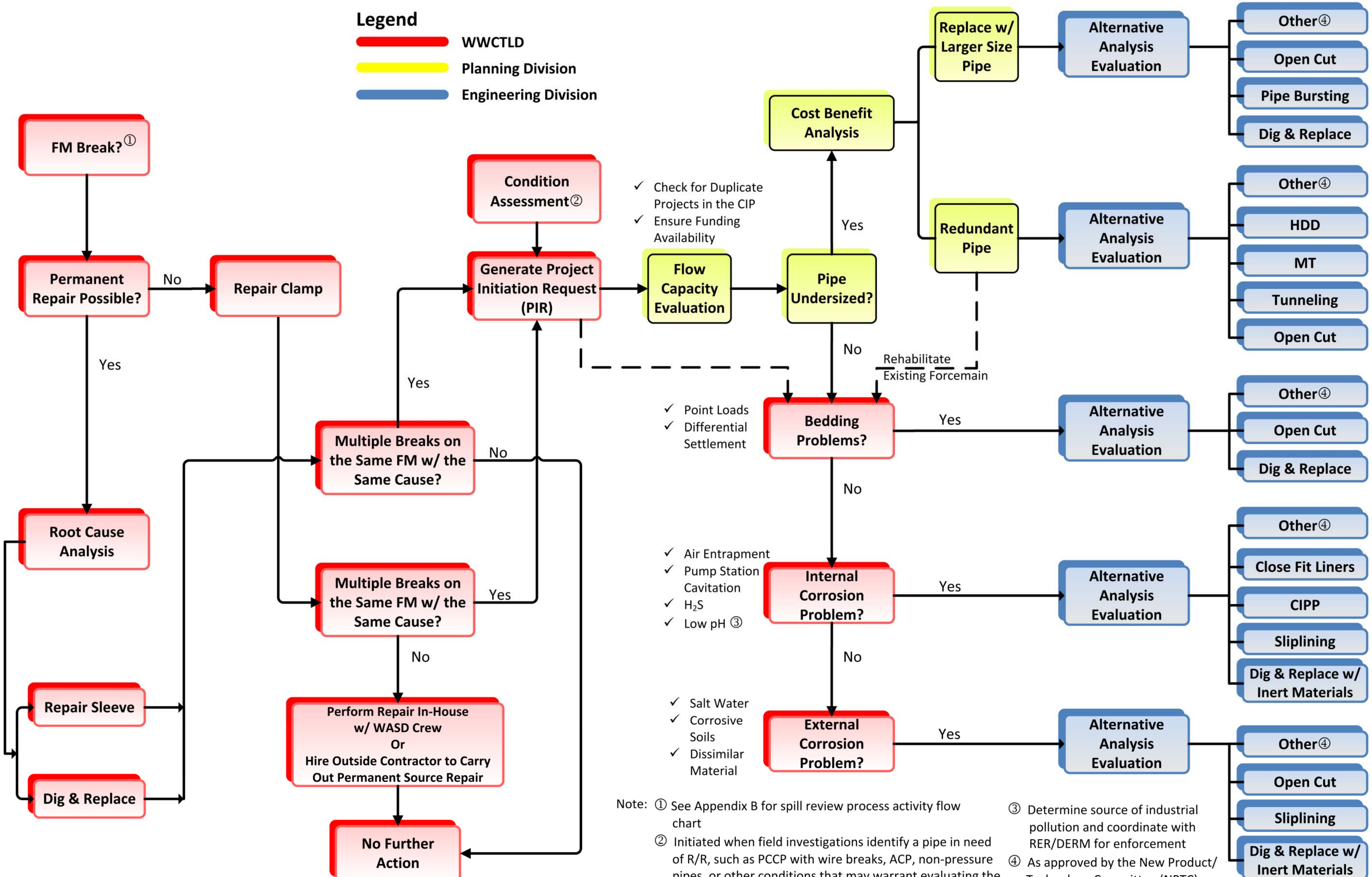
04.01 R/R Alternative Analysis

The capital cost and the service life cycle cost of the R/R method and its impact on extending the life of the asset are often the primary concerns in technology selection. The alternatives analysis evaluation, performed as part of a Preliminary Engineering Report or Basis of Design Report, includes the following parameters to be considered: Capital Cost, Hydraulic Capacity, O&M Needs, Public Impact, and Constructability. Upon evaluation, MDWASD assigns each criterion identified below a score between 0 and 5, with 0 being the least beneficial and 5 being the most beneficial. An alternative analysis evaluation decision matrix template/example is presented in Table 04.1. Those technologies not being evaluated in the template/example below are presented as not applicable (N/A).

Table 04.1
Sample Alternative Analysis Evaluation Decision Matrix

Parameter	Close Fit Lining	Sliplining	CIPP	D&R	Open Cut	PB	HDD	MT	Tunneling
Capital Cost	1	3	2	N/A	4	N/A	N/A	N/A	N/A
Hydraulic Capacity	4	2	3	N/A	2	N/A	N/A	N/A	N/A
O&M Needs	5	4	4	N/A	1	N/A	N/A	N/A	N/A
Public Impact	4	3	3	N/A	2	N/A	N/A	N/A	N/A
Constructability	1	2	2	N/A	3	N/A	N/A	N/A	N/A
Totals	**15**	**14**	**14**	**N/A**	**12**	**N/A**	**N/A**	**N/A**	**N/A**

Figure 04.1
Force Main R/R Technology Selection Flow Chart



Note: ① See Appendix B for spill review process activity flow chart
② Initiated when field investigations identify a pipe in need of R/R, such as PCCP with wire breaks, ACP, non-pressure pipes, or other conditions that may warrant evaluating the need for R/R
③ Determine source of industrial pollution and coordinate with RER/DERM for enforcement
④ As approved by the New Product/ Technology Committee (NPTC)

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The selection parameters for the Alternative Analysis Evaluation Decision Matrix are defined as follows:

- **Capital Cost:** This criterion represents the cost estimated to implement the project, including engineering, administration, permitting and construction, plus a contingency. The rating is inversely proportional to the cost. In other words, the lower the capital cost, the higher the score. Cost is the most important selection criteria used to make replacement method selection decisions. Estimates are used in feasibility studies and provide guidance on basic decision making. Comparative estimates combine an order of magnitude estimate with the specific factors of a particular project and are developed for comparing alternative solutions to a particular problem. As the needed accuracy increases, the information required for developing the costs becomes more extensive. Capital costs are both direct and indirect costs; direct costs include the planning, design, contracting costs, permanent reinstatement and professional charges. Indirect costs include diversion of existing facilities, reduction in road pavement life, the increase in road maintenance requirements, and damage to adjacent property and disruption to businesses directly involved with the works.
- **Hydraulic Capacity:** This criterion evaluates the alternatives versus the project specific capacity needs. Alternatives with less reduction in capacity (or increased capacity) would be scored higher.
- **Operation and Maintenance:** This criterion represents the frequency at which the infrastructure proposed in an alternative requires on-site O&M attention. Alternatives requiring less frequent attention receive the higher, more favorable scores.
- **Public Impact:** This factor recognizes that some alternatives will disrupt the public more than others. For example, a force main installed by trenching often will impact roadways, with detours and road closures. Tunneled/trenchless installations are typically less disruptive to the public-at-large. Those with fewer impacts receive the higher, more favorable scores.
- **Constructability:** Considerations such as depth of installation and pressure rating affect the constructability score. Alternatives which are considered to be typical and common receive the higher, more favorable scores. Alternative which require more challenging and risky construction techniques, receive the lowest scores.

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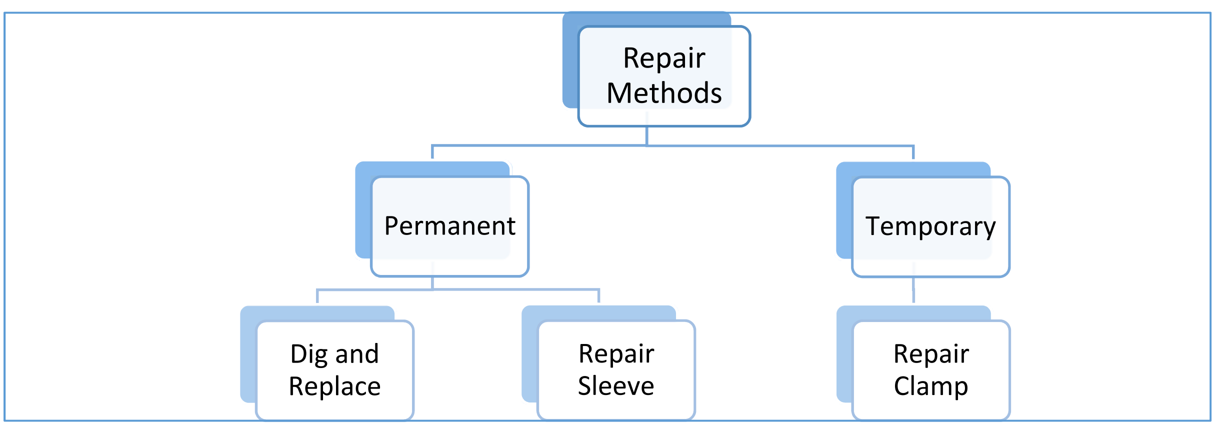
05. Force Main Repair

Force mains, when properly designed, manufactured, and installed, will provide safe, reliable, and continuous service under normal and transient conditions. Unfortunately, due to damage by action of other parties or unforeseen circumstances, it is sometimes necessary to repair or replace a pipe, or sections of pipe. Though durable, pipelines are not designed to withstand impact from a backhoe, jackhammer or an auger, or point loads imparted by non-select bedding or backfill material. This section describes repair techniques currently utilized by MDWASD.

The EPA defines repair as a technique that is used when the existing pipe is structurally sound, provides acceptable flow capacity, and can serve as the support or host of the repair method. In the case of MDWASD, a repair is a temporary or permanent fix used to expeditiously correct a defect in a force main and keep it operational. Repairs may be classified as routine, if resulting from scheduled maintenance activities; critical, if resulting from an identified risk of imminent failure; or emergency, if a failure or break has occurred.

MDWASD's primary focus during the repair of any failed, damaged, or deteriorated section of a force main, is to prevent SSOs by making sure that remedial action is taken as soon as possible, with regard to the sections of pipe that may be affected. MDWASD uses various repair methodologies to repair force main failures, as illustrated in Figure 05.1.

Figure 05.1
Force Main Repair Methods



As shown in Figure 04.1 in the previous section, once the root cause of a force main failure has been identified, the first objective of the MDWASD repair crew is to prevent any further spill or damage to the environment, and the second objective is to restore service as quickly as possible. The root cause analysis will guide the decision as to what repair methodology will be used for the permanent repair. MDWASD has two permanent repair methods, namely D&R and repair sleeve. In the event that a permanent repair cannot be performed expeditiously, MDWASD uses repair clamps as a temporary repair method.

While these repair methods are typically employed by MDWASD repair crews in most situations, MDWASD staff recognizes that each situation is different and that each repair must be carried out using a technique unique to the situation. For example, wire breaks on RCP discovered during a condition assessment are repaired in house by MDWASD's field crews using post tensioning technique. For pipe repair larger than 30 inches, MDWASD outsources repairs; for diameter pipes ranging between 4 and 24 inches, force mains are repaired in house by MDWASD crews.

Table 05.1 provides advantages and disadvantages of the different repair methods, and presents the most suitable conditions for the application of each.

Table 05.1
Repair and Maintenance Procedures for Sewer Force Mains

Advantages	Disadvantages	Most Suitable Conditions for Application
	Dig and Replace	
• Commonly used and well understood • Permanent solution • Robust and easy to apply	• Extensive surface disruption and disturbance • High cost of street replacement • Generally high construction cost • Major restoration	• Open area without obstacles • Shallow pipe • Completely damaged pipe • Where complete replacement is needed
	Repair Sleeve	
• Sleeves are very simple to fabricate and install • Protects against interior corrosion	• Typically more costly than dig and replace • May be considered a temporary repair	• Where sleeve strength is required to be equivalent to the existing pipe strength
	Repair Clamp	
• Commonly used and well understood	• Temporary fix • Cost of street replacement due to excavation required	• Shallow pipe • For full circumferential repair

05.01 Force Main Break Isolation Procedures

During force main repairs, because the pipeline is under pressure, a shutdown of associated pump station(s) is required, and dewatering of the force main carried out if possible. The force main network within the MDWASD service area is a complex array of various pipe sizes, pipe material, pump stations, isolation valves, and air release valves (ARVs). In many cases, numerous pump stations are affected if a force main segment is taken out of service for repairs, as well as the normal flow route to any one of the three wastewater treatment plants (North District, Central District, and South District). The isolation of a damaged force main for repair(s), and rerouting of normal sewage flow, requires shutdown of affected pump stations and the closing and opening of key valves. This scenario dictates very careful planning of force main isolation procedures, affected pump station shutdown procedures, and sewage rerouting and tanker availability for sewage hauling, if necessary. Thorough communication and coordination among key MDWASD personnel are essential. MDWASD's follows established force main and pump station shutdown procedures in the event of a force main segment break.

05.02 Force Main Emergency Repairs

Emergency repairs, more often than not, are carried out in response to an unscheduled disruption of service. The first objective of the repair crew is to prevent any further spill or damage to the environment, and the second objective is to restore service as quickly as possible. During emergency repairs a typical approach is to replace a section of force main with a new pipe segment. Repair clamps are only used when a permanent repair is not immediately possible, in order to restore the force main operation.

MDWASD defines an emergency as an interruption of service, and/or if an SSO occurs or is imminent. Force mains identified pursuant to the Criticality and Prioritization Report as having the highest risk of failure (probability of failure times the consequence of failure), will be scheduled for proper remedial action.

05.03 Dig and Replace

The traditional sewer repair method, dig and replace, involves replacing portions of old pipes with new pipes. It is MDWASD's preferred solution unless special conditions warrant the use of a repair sleeve or the inability to quickly shut down a force main warrants the use of a temporary repair clamp. However, the dig and replace methodology may be disruptive (at the surface) not only to the environment but to the general life of residents. The construction activities associated with the dig and replace technique may involve lengthy durations and extensive excavation with a need to stockpile surplus excavated material. Utilities crossing the vicinity of the excavated trench need to be carefully protected, and traffic needs to be controlled around construction. (For specific dig and replace repair procedures, see Appendix C for DR-001 Dig & Replace (DR) for Force Mains - Standard Operating Procedures)

05.04 Repair Sleeve

Repair sleeves are used to reinforce pipes which are weakened due to structural deficiencies. An internal repair plate is fusion epoxy coated to provide a quality repair that protects against corrosion of the pipe interior. Repair sleeves are also used by MDWASD for repairs of its large diameter cast iron, ductile iron, steel, and other types of large diameter rigid pipe. The direct concentration of bolting of the sleeve enables the repair of the damaged area while maintaining the pipeline's pressure capability. (For specific repair sleeve repair procedures, see Appendix C for RC-001 Repair Clamps (RC) for Force Mains - Standard Operating Procedures)

05.05 Repair Clamps

The use of a full circumferential repair clamp over the damaged section of pipe is usually utilized as a quick repair methodology. The clamp must be wide enough to seal on adjacent pipe wall that is structurally sound. If the wall is not sound, then replacement is the only viable solution. There are a wide variety of repair clamps; some coming in multiple pieces that can be placed around a damaged section of pipe. MDWASD limits the use of repair clamps to temporary fixes to keep the system functional until a permanent repair can be implemented.

06. Force Main Rehabilitation

The CD listed rehabilitation technologies such as spray-on lining, close fit linings, CIPP and woven hose linings as part of the FM R/R Program. Currently, MDWASD does not use spray on lining or woven hose technologies as a rehabilitation method for force mains. As force main deterioration or failure occurs in the MDWASD system, the technologies used to correct these failures are of the structural liner variety, namely CIPP and Close Fit Lining which carry internal and external loads without the support of the host pipe. For fully deteriorated situations, the existing pipe acts merely as a right-of-way for the installation of the structural liner. For this reason, MDWASD installations of CIPP (Class IV) and Close Fit linings are designed to structurally replace the host pipe.

As applied by MDWASD, each of these methods are used as a mean of installing a new structural pipe within the existing host pipe, in the process sealing minor leaks and providing structural stability independent of the host pipe. Class IV, fully structural liners, can independently handle the full internal pressure without support from the host pipe and resist external hydrostatic pressure. Close Fit Liners and CIPP lining are rehabilitation methods which can be designed for full structural rehabilitation.

06.01 Close Fit Lining

The use of close fit liners is often referred to modified sliplining. It involves the use of Polyethylene pipe (PE) with an outside diameter that is similar to the inside diameter of the host pipe. Close fit liners can be classified into two broad categories including those that achieve temporary diameter reduction through: (1) a symmetrical reduction process; and (2) a fold-and form process. MDWASD uses only structural Class IV liners and employs the symmetrical reduction swage lining method for pipe renewal. Close-fit lining systems are independent systems which do not require adhesion to the host pipe to maintain their form. The diameter range for application is 4 inches to 60 inches and can reach a maximum length of 3,000 feet for smaller diameter pipe. The reinstatement of connections and valves requires special techniques and fittings. Reduced diameter liners (swaged) are suitable for the structural relining of pressure pipes. The process may not be suitable for pipes with bends or dimensional irregularities, as swaged liners are not able to accommodate significant variations in host pipe. The friction between the old and new pipe during installation will reduce the length of liner that can be pulled in without overstressing the pipe.

Special conditions or limitation of methods specified: Diameter reduction is typically 10% by the compression (i.e. symmetrical reduction) process and uses Standard PE-80/PE-100. The process maximizes the liner bore of the host pipe and removes the need for annulus grouting as required in typical sliplining processes. Due to the close tolerances between the host pipe and the liner, any obstacle can cause jamming or damage to the liner. The diameter range is typically 4 to 48 inches however, larger diameter has been recorded. The standard dimension ratio (SDR) for structural liners may range from 11 to 26. The process can negotiate up to 11-1/4 degree bends and can be installed in lengths up to 1,000 feet. The process does require long insertion trenches, and smaller excavation access at the terminating end. Manifold pipe systems will require excavation and reconnection of any connecting pipes.

06.02 Cured in Place Pipe (CIPP)

CIPP liners are non-woven polyester felt or fiber reinforced fabric which are manufactured to fit the inside diameter of the host pipe. The liner is thoroughly saturated with polyester, vinyl ester epoxy or silicate resin using vacuum, gravity or other applied pressure. The resin includes a chemical catalyst or hardener to facilitate curing. The outermost layer of the liner tube is coated with a polymer film to protect the liner during handling and installation. The impregnated liner may be chilled for transportation to maintain stability until installed. CIPP liners are initially interactive system which assume the shape and adheres to the inner wall of the host pipe. If designed as a structural liner, once cured, the liner becomes an independent pipe which can withstand both external loading and the internal system pressure without transferring the load to the host pipe.

CIPP technology can be applied to pipe diameters from 4 inches to 120 inches; and is capable of navigating bends and changes in diameter. CIPP liners can be installed in continuous segments. The length of a continuous section is dependent on the overall weight of the liner, but can span several thousand feet for smaller diameter pipes.

MDWASD's use of CIPP lining technology is only applied as a renewal technology in which the lining systems are designed for classification as fully structural by AWWA M28 Class IV standards. To achieve structural renewal, fiber reinforced tubes and/or multiple layers are used.

The preferred installation method by MDWASD is the inversion method and is typically cured by hot water or steam. The inversion method involves inverting the resin-impregnated tube through the pipe. The liner is essentially pushed inside-out using water or air pressure. The outside of inverted liners are coated to hold the resin, but during the installation the coating is inverted with the liner and serves as a coating on the inside of the liner with the wet resin now on the exterior of the liner. The setup will vary depending on whether water or air pressure is used to invert the liner. Curing is typically performed by circulating hot water through recirculation hoses interior to the liner or by introducing or circulating controlled steam.

Advantages of Inversion:

- Inversion allows for resin to interface with the interior of the existing host pipe, allowing for resin migration in pipe joints. Resin migration aids in preventing water migration and root intrusion into the annular space between the liner and host pipe;
- Water inversion (and some air inversion processes) keeps the liner expanded from the beginning of the insertion all the way through curing, pushing water and debris ahead of the liner during insertion. This reduces the chances of debris from being caught under the liner and allowing pockets of water to become heat sinks during curing; and
- Air inversion and steam curing is a relatively fast process.

Disadvantages of Inversion:

- Wet resin on the exterior of the liner during inversion can lead to resin washout;
- Pressures during inversion must be controlled to prevent stretching of the liner;
- During most air inversion processes, the liner is "deflated" during insertion and prior to curing, allowing debris to get caught under the liner or water to fill sags and create possible heat sinks during the curing process;
- Steam curing leads causes the rapid emission of VOCs (i.e., styrene) that may lead to resident complaints; and

- Water inversion may require a much more invasive setup, depending on the pressures required to invert the liner.

CIPP liners are not considered a viable rehabilitation option when the following conditions exist:

- When existing pipe has large holes or gaps;
- Where there is a collapse, unless a localized pipe repair is performed;
- When the requirement is to increase existing pipe capacity; and
- Where chemicals can erode or dissolve the CIPP liner material, e.g. wastewater treated to reduce odors may contain chemicals that could deteriorate the lining.

06.03 Close Fit Lining and CIPP Applicability

Although MDWASD prefers pipe replacement over structural rehabilitation, there are circumstances in which structural rehabilitation is used. Table 06.1 presents different applicability parameters for both technologies. Typical situations which may drive consideration of these two rehabilitation methods are:

- Highly congested utility areas where open-cut or directional drilling are not options due to limited space resulting from utility congestion, conflicts or manifold connection which would be difficult to reestablish at directional drill depths;
- Time constraints in which bypass of critical flows section need to be minimized; and
- Areas which would require closure of critical travel routes or impede access to hospitals, schools, emergency evacuation routes or emergency facilities.

All rehabilitation processes result in a loss of cross sectional area and reduction in pipe capacity. Operational factors such as existing and future capacity needs, internal pressure and external loading requirements are evaluated prior to consideration and selection of a renewal technology. Liner thickness for a fully structural CIPP liner typically ranges from 2/3 inch to 3 inches depending on pipe diameter, external loading and internal pressure requirements. For installation of close fit liners the diameter loss is dependent on the required pipe SDR rating which is required for a structural replacement. For structural rehabilitation, SDR 21 will support internal pressure of 80 psi, and SDR 17 pressures of 100 psi. External loading conditions may require lower SDR rating (thicker walled pipe).

Table 06.1
Close Fit Lining and CIPP Applicability Parameters

Trenchless Technology	Range of Diameter (inches)	Typical Pull Length (feet)	Depth of Installation	Installed Pipe Materials	Typical Applications	Advantages	Disadvantages	Other
CIPP (Structural Class IV) Inversion method	8 to 72	200 to 1,000. The larger the diameter, the shorter the pull length	Limited by the ability to excavate to the pipe and keep pipe and excavation area dewatered/dry during installation.	Multiple non-woven synthetic/glass reinforcement tube with vinyl ester resin.	• Areas of limited space or multiple existing utility and conflicts • Areas of limited accessibility. • For use in pipe which exhibit wall thinning due to internal corrosion	• Provides structural renewal. • Spans over small holes, gaps or open joints. • Can be installed in line with bends up to 45 degrees • Reduction of impact to traffic & pedestrian flow • Reduction in restoration cost.	• Reduction in capacity • Interior requires extensive cleaning • All obstructions, including reducers, line valves and protruding connections to be remove • CCTV inspection may reveal additional issue to be address prior to lining.	Diameters and length are subject to installer's equipment abilities. The weight of the CIPP tubing will dictate the length of the pull. The larger the diameter; the shorter the pull length due to weight restrictions. Fully structural lining system required additional wall thickness and adds additional weight to the pull, which shortens pull lengths.
Close Fit Liners	4 to 48. Larger pipes fall under sliplining	Up to 3,000 feet between excavations for small diameter pipe. The weight of the pipe and friction factor between host and renewal pipe determine actual lengths.	Limited by the ability to excavate to the pipe and keep pipe and excavation area dewatered/dry during installation.	PE 80/100 SDR 26-11(SDR 21-11) Pressure dependent upon SDR rating. SDR 21 (80 psi) and SDR 17 (100 psi) are typical for internal force main pressure however, for structural liners; external loading may dictate required pipe thickness.	• Areas of limited space or multiple existing utility and conflicts • Areas of limited accessibility • For use in pipe which exhibit wall thinning due to internal corrosion	• Cost effective • Can span moderate sized holes and gaps • No shrinkage • Shorter down time since no curing is required • Not as sensitive to moisture in the pipe • Flexible, leak tight, and highly resistant to chemical attack.	• Reduction in capacity • Interior must be clean with no protrusions • Pipe must be of consistent diameter • Minimal ability to navigate bends • Require greater entrance area excavation and layout area for butt welding of pipe • All obstructions, including reducers, line valves and protruding connections must be excavated or removed and reinstalled.	Not as sensitive to moisture in the pipe. Reduction in diameter is typically greater than in CIPP process for large diameter pipe.

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06.04 Close Fit Lining and CIPP Constructability

From an economic and environmental standpoint, close fit lining is usually the preferred method. It is typically less expensive and does not require curing which shorten “off line” time. It produces no offences odor or requires large quantities of water/steam needed for curing, thereby eliminating environmental discharge and disposal concerns. Close fit linings are independent of the host pipe and therefore less sensitive to internal moisture during the installation process. Being independent pipes they can span larger holes and gaps in the host pipe. CIPP systems are an interactive system and the success of the installation is dependent upon adherence to the host pipe. They typically require a more extensive cleaning and are moisture sensitive.

The ultimate choice between CIPP system and close fit linings will depend upon individual characteristics of the host pipe and site limitations. Construction consideration includes the following:

Site Limitation: CIPP installations require smaller excavation entrances. The setup will require area for the refrigerated storage truck for the liner, insertion scaffolding/tower, and equipment for heating and recovery for the curing process.

Close Fit linings require a longer excavation area for insertion of the PE pipe. The diameter, SDR rating (bend radius) and depth of the pipe will dictate the required length of the excavation. The setup area must also be sufficient for the layout of the entire length of the section to be replaced in order to butt welded the PE replacement pipe.

Host Pipe Configuration: Force main are not typically level installation and frequently have deflections along the route. In addition, bends are frequently installed along the route to navigate conflicts.

MDWASD’s preference of the CIPP inversion methods allows installations that are more conducive to these deflections and can normally accommodate 22-1/2 degrees bends and up to 45 degree bends in some cases.

This method requires smaller diameter pipe to be pulled in place. While this method can navigate minor deflection, and in some cases, bends up to 11-1/4 degree, the increase in friction due to these navigations can drastically reduce the pull length.

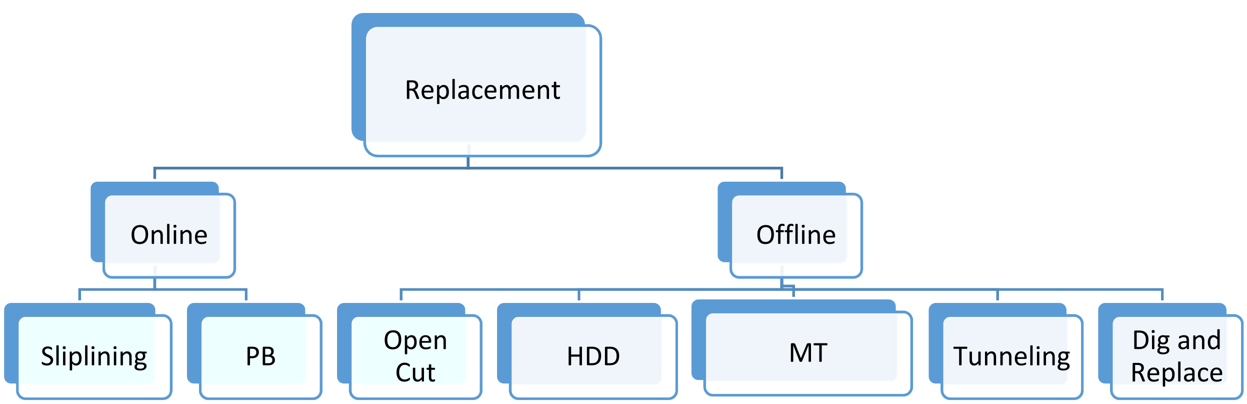
Hydraulic Considerations: Loss of pipe cross-sectional area is common to both CIPP and Close-Fit Lining systems. A hydraulic analysis of both the piping and all pumps connected to the system is required. Initial hydraulic questions to determine if the lining is a feasible option are as follows:

- Is the system currently operating below the system's designed capacity? The smaller the pipe, the greater percentage of loss in capacity. The length of pipe to be rehabilitated should also be considered. Over short section of rehabilitated pipe, the increase in friction loss may not be significant in comparison to the total friction loss of the system.
- Where are the pumps operating on the pump curve? If the pumps are currently operating to the right of the pumps maximum efficiency point, it's likely that the existing pumps will be able to handle the additional head. Upgrades to existing pumps are a consideration, but typical have a chain effect if other lift station manifold into the same pipe section.
- How comparable is the hydraulic loss between CIPP and Close Fit lining? The comparison is based on required liner thickness for an internal pressure rating of 80 PSI (PE SDR 21). Loss in capacity is greater for CIPP liners than in Close-fit Pipe for small diameter pipe. At diameters between 16 inches and 24 inches, the loss in cross sectional area is about equal. At larger diameters, close-fit pipes have a greater loss in capacity. Other factors such as external live load requirement may increase thickness requirement or the use of fiber reinforce tubing which may reduce the liner thickness requirement of CIPP. The middle ground diameter may increase or decrease depending on the specifics of the chosen liner system design and should be used as only a relative guide line.

07. Force Main Replacement

Force main replacement involves the installation of a new fully structural pipe to take over the functions of the deteriorated force main. MDWASD has several technologies available for online and offline replacement as presented on Figure 07.1. Historically, the most common method of replacement has been offline replacement of an underground main by open cut construction. MDWASD has implemented new trenchless methods of construction that minimize the amount of excavation. These trenchless methods fall into both online and offline methods. Online is where the host pipe is used to accommodate the new force main which is installed to the same line and grade as the deteriorated pipe being replaced. With online replacement, by-pass of the existing pipe is needed during the replacement construction. Offline replacement consists of installing a new force main using a different line and possibly grade as the existing pipe. Normally, a by-pass of the existing pipe is not necessary with offline replacement.

Figure 07.1
Online and Offline Pipe Replacement Technologies



Most trenchless construction methods have a higher dollar cost per foot than that of their open cut counterparts. However, the benefits that trenchless construction provides should be weighed against all of the costs before deciding against using a trenchless technique. It is easy to determine the cost of the tangible work items that trenchless construction avoids, such as pavement removal and replacement, dewatering, surface restoration, right-of-way, and utility easement acquisition. The benefits of trenchless construction go well beyond these items and include reducing public inconvenience and lost business revenue caused by a closed roadway; minimizing utility conflicts; reducing dust, erosion, vibration, tree removal, and other environmental impacts; eliminating danger to workers and the public posed by an open trench; and reducing the potential damage to adjacent structures caused by large scale dewatering operations. Unfortunately, it is difficult to assign a dollar value to these potential situations.

The economic and social feasibility of a trenchless technology installation process should be determined and considered especially in Miami-Dade County, where high built up areas are common. The economic and social costs associated with any construction process also require careful assessment in addition to the standard monetary values. These social costs include environmental loss associated with air pollution, noise, vibration, loss of amenity and the disruption to commercial and private traffic, and an increased level of traffic delays. Economic feasibility consideration should be determined by using historical data that is available. Other possible considerations are mobilization and de-mobilization, site cleanup, traffic diversion during operation and site restoration.

07.01 **Sliplining**

The sliplining method involves the insertion of a new pipe into an existing pipe; it is also the simplest trenchless replacement technique. A new pipe with an outside dimension smaller than the inside dimension of the host pipe is either pulled or pushed through the host pipe. The ideal host pipes for sliplining are straight segments with no deformities, specifically pipes with no or modest bends, and no severe protrusions into the pipe. Advantages and disadvantages of the method are as follows:

Advantages

- Provides a new pipeline, independent and fully structural regardless of the host pipe or the condition of the host pipe;
- Increased Hazen-Williams coefficient helps maintain capacity lost to reduced internal diameter; and
- Utilizes the existing utility alignment, thus limiting the crowding of an existing utility corridor.

Disadvantages

- Requires that the new pipe be smaller than the original host pipe in terms of flow area;
- Constructability may not always be favorable;
- Not well suited for small diameter pipes; and
- By-pass of the existing pipe is needed during the replacement.

The size of the host pipe can range from small non-man entry to larger man entry pipes. Segmental liners may be pushed into the host pipe by hydraulic power or winched in place. Table 07.1 presents the applicability and constructability for segmental sliplining.

Table 07.1
Sliplining Applicability and Constructability

Evaluation Criteria	Sliplining - Segmented
Flow Capacity and Diameter Range	While a reduction in pipe diameter does occur as a consequence of sliplining, it is largely compensated by an increase in the Hazen-Williams Coefficient. As a result, flow capacity is maintained at or near the original flow condition. Diameter reduction of approximately 10% depending on pipe material selected.
Structural Integrity	Excellent. Structural strength of the sliplining pipe is independent of the host pipe.
Corrosion Resistance	High
Expected Useful Life	50 to 100 years
Construction Factors	Requires bypass pumping. Requires excavation of installation pits depending on material/length of push or pull. Bends or other conditions can impact the ability to push or pull the pipe and should be taken into consideration when selecting the sliplining method.
Social Costs	Residents could be impacted by noise and limited access due to staging of equipment. Impact to residences due to excavation of installation pits (access, safety, removal of landscaping).

07.02 **Pipe Bursting**

Pipe bursting (PB) is a trenchless method which is used to replace defective or under capacity pipelines by utilizing the original pipe alignment. The process uses a bursting head to crack the defective installed pipe and displace the cracked pipe outwards into the surrounding soil. A new replacement pipe of the same or larger diameter is simultaneously pulled in behind the bursting head. The most common pipe bursting methods are described below.

- *Pneumatic Pipe Bursting:* This is the most frequently used type of pipe bursting to date. It is used on the majority of pipe bursting projects worldwide. In the pneumatic pipe bursting, the bursting head is a cone-shaped soil displacement hammer. It is driven by compressed air, and operated at a rate of 180 to 580 blows per minute.
- *Static Pull System*: This technique utilizes force for breaking of the existing pipe by pulling the bursting head forward. The head is pulled by either a pulling rod assembly or a winch cable, which is inserted through the existing pipe and attached to the front of the bursting head.

In force main applications, pipe bursting is mainly considered for AC pipes, long runs with few connections, or for pipes with accessibility issues (such as force mains located in rear easements). Table 07.2 provides a general approach for selecting the correct pipe bursting method when considering the pneumatic or static methods. Other less common PB methods will be considered based on a case-by-case basis as each project is unique and those less common methods have limited capabilities.

Table 07.2
Pipe Bursting Applicability

Existing Pipe Materials	Pneumatic	Static
Metallic pipes including aluminum, copper, ductile iron, wrought iron, steel, or stainless steel.	No	Yes
Plastic pipe, including HDPE or MDPE,PVC,CIPP, or fiberglass	Yes	Yes
Pre-stressed or bar-wrapped concrete cylinder pipe (PCCP or BWCCP), corrugated metal pipe (CMP), or corrugated plastic pipe	No	No
Asbestos cement (AC)[1], reinforced concrete pipe (RCP), CI, VCP	Yes	Yes

[1] MDWASD is in the process of getting approval from EPA to implement pipe bursting technology on AC pipes.

The International Pipe Bursting Association (IPBA) classifies pipe bursting work into three classifications A, B, and C as shown in Table 07.3. These classifications are meant to be used as a general guideline in the design and preconstruction phase of an online replacement by pipe bursting. The success of the pipe bursting project is dependent on the qualifications of the project team, geotechnical conditions, existing pipe material and condition, burst length, depth of pipe, and degree by which the pipe diameter will be increased. Some advantages and disadvantages are listed below.

Advantages

- Substantial project cost can be saved when pipe bursting is used for the replacement of old pipelines; and
- Pipe size can be increased along the same route.

Disadvantages

- Causes unwanted compaction of soil within the range of pipe run. Expansive soil causes difficulty to nearby structure including other utilities during bursting operation; and
- The dynamic method of pipe bursting causes high vibration and noise level.

Table 07.3
IPBA Pipe Bursting Classification

Degree of Difficulty		Depth of Pipe (feet)	Existing Pipe Internal Diameter (inches)	New Pipe Diameter Comparative to Existing Pipe	Burst Length (feet)
A	Minimum	< 12	2-12	Size on Size	Up to 350
B	Moderate	>12 to <18	12-18	Single Upsize	350 to 500
C	Comprehensive	>18+	20-36	Double / Triple Upsize	500 to 1,000

07.03 Open Cut Replacement

Open cut replacement is defined as excavation from the surface to replace a buried force main. In accordance with the EPA report dated July 2010, "State of Technology for Rehabilitation of Wastewater Collection Systems", open cut replacement may be the cheapest direct-cost option when sewers are relatively shallow and road pavement replacement costs are low. However, open cut replacement becomes less desirable where sewer lines are deeper, are situated around environmentally sensitive areas, are in areas where high impact traffic disruption would occur, and in circumstances where high structural capacity road pavements must be cut and replaced.

Open cut replacement of force mains can be rather disruptive. It affects traffic patterns, the normal lifestyle of people living in/or working in the area, and disruptions tend to last much longer than planned. Additionally, due to Miami-Dade's high water table, dewatering is difficult for deeper excavations. Table 07.4 provides advantages and limitations of open-cut replacement, and presents the most suitable conditions for its application.

Table 07.4
Open Cut Replacement Advantages and Limitations

Advantages	Limitations	Most Suitable Conditions for Application
• New pipe is installed • Unlimited upsizing • Commonly used and well understood • Permanent repair	• Extensive surface disruption • Time-consuming • Often expensive • Access to private property may be required • Dewatering requirements for deep excavation	• Open area without obstacles • Shallow pipe • Large upsize needed • Completely damaged pipe

In urban areas, this method of sewer pipe replacement along busy roadways is increasingly subject to political and environmental forces, and is often interconnected with the following:

- Safety risks associated with neighboring structures;
- Noise, detouring of traffic and pollution emission from the construction site;
- Damage to street landscapes;
- Danger of damaging other pipes in the proximity of the work location;
- Increased cost associated with the pipe depth in areas with many utility conflicts and the number of laterals;
- MDWASD's resources that have to be devoted to the work in progress to minimize impacts; and
- Citing and disposal of the waste, sometime hazardous waste, associated with the activity.

07.04 Horizontal Directional Drilling (HDD)

HDD is a versatile trenchless technology that is used for the installation of everything from service connections to residences and buildings, to pipes and cables under roadways and rivers. HDD is best suited for installing pressure pipes and conduits where precise grades are not required.

The HDD process is completed in three parts, as follows: 1) drilling of a pilot hole along the proposed centerline; 2) enlarging of the hole with a reamer; and 3) installing the new pipe behind the reamer during the last pass of the reaming process. Nevertheless, ensuring the correct borehole diameter may take more than one pass or reaming before the borehole is large enough in diameter to install the new pipe. The number of required reaming passes may also be affected by soil and other physical conditions. Below are some advantages and disadvantages.

Advantages

- Steering capability;
- Set up time is relatively shorter than other trenchless technologies;
- Since no shafts are required, the related excavation project costs are reduced; and
- The single drive length that can be achieved by HDD is longer than any other non-man entry trenchless method.

Disadvantages

- Since the HDD operation installs pipes through pullback process, the pipes chosen for the project should have sufficient axial tensile strength; and
- Construction cost.

The HDD industry is divided into three major sectors: large-diameter HDD (maxi-HDD), medium-diameter HDD (midi-HDD), and small-diameter HDD (mini-HDD, also called guided boring). Although there is no significant difference in the operation mechanisms among these systems, the different application ranges often require corresponding modification to the system configuration and capacities, mode of spoil removal, and directional control methods to achieve optimal cost-efficiency. Table 07.6 compares typical maxi-, midi-, and mini-HDD systems.

Table 07.5
Summary of Main Features of Typical HDD Methods

Type	Diameter (inches)	Depth (feet)	Drive Length (feet)	Typical Application
Maxi-HDD	24-48	< 200	< 6,000	Rivers and Highways Crossings
Midi-HDD	12 to 24	< 75	< 900	Rivers and Roadway Crossings
Mini-HDD	2 to 2	< 15	< 600	Telecommunication, Power Cables, Gas lines

Before any pipe design or installation process begins, HDD Constructability criteria need to be identified and studied, as described in Table 07.7. These criteria are the namely type of pipe material, required work space, productivity, and accuracy and soil conditions. With this information the best crossing route can be determined, drilling tools and procedures selected, and the pipe designed. The extent of the geotechnical investigation often depends on the pipe diameter, bore length and the nature of the crossing.

Table 07.6
HDD Constructability

HDD Criteria	Parameter
Pipe material	In general, the pipe to be installed is limited to one that can be joined together continuously, while maintaining sufficient strength to resist the high tensile stresses imposed during the pullback operation.
Required working space	The directional drilling process is a surface-launched method; therefore, it usually does not require access pits or exit pits. If utility installation is being undertaken, pits may be required to make connections with the existing utility. The rig working area should be reasonably level, firm, and suitable for movement of the rig. For maxi- and midi-HDD, an area of 400-ft by 200-ft is considered adequate. The equipment used in mini-HDD is portable, self-contained, and designed to work in congested areas.
Soil condition	Clay is considered ideal for HDD methods. Cohesionless fine sand and silt generally behave in a fluid manner and stay suspended in the drill fluid for a sufficient amount of time; therefore, they are also suitable for HDD.
Productivity	HDD systems have the highest pilot hole boring rate among all trenchless methods for new installation. For mini-HDD rigs, a three-person crew is sufficient. In suitable ground conditions, a 600-ft conduit can be installed in 1 day by a work crew.
Accuracy	The accuracy of installation for maxi- and midi-HDD depends on the tracking system being used and the relative skill of the operator. However, the reported accuracy is within 1% of the length.

07.05 Microtunneling (MT) / Pipe jacking (PJ)

Microtunnelling (MT) and Pipe Jacking (PJ) are trenchless technologies often utilized to install pipes under protected sites and busy urban areas. MT and PJ are means of installing pipes, ducts, and culverts below ground in a wide range of soil conditions. It is a very popular option for installing brittle pipelines such as concrete and installed in areas where open excavation would prove too costly, socially unacceptable (traffic diversions and route blockages), economically damaging to local business, and or environmentally unacceptable (surface damage causing distress to flora and fauna). MT and PJ also require less labor than conventional open trenching methods and therefore can be a very cost effective solution. It achieves tolerances of +/- 25 mm in line and grade. Five components systems are incorporated into a Microtunneling system:

- Microtunneling boring machine (MTBM);
- Jacking and propulsion system;
- Spoil removing system;
- Laser guidance and remote control system; and
- Pipe lubrication system.

Advantages

- The method is capable of installing pipes to extremely accurate line and grade tolerances;
- It has the capability of performing in difficult ground conditions without expensive dewatering systems and/or compressed air;
- Lines can be installed at a greater depth without a drastic effect on the cost;
- Safety is enhanced because workers are not required to enter trenches or tunnels; and
- The finished product (carrier) pipe can be jacked directly without the need of a separate casing pipe.

Disadvantages

- The capital cost in equipment is high; and
- Some MTBM systems have difficulty in soils with boulders with size more than 20 or 30 percent of the machine diameter.

Table 07.7
MT Applicability and Constructability

MT Criteria	Parameter
Diameter range	10 inches to 136 inches. The most common range is from 24 inches to 48 inches.
Depth of installation	Since the microtunneling operation is performed in the driving and reception shaft, there is no theoretical limitation for the maximum depth of installation for microtunneling.
Drive length	The most common range for drive lengths is from 500 feet to 1,000 feet for slurry microtunneling systems and from 200 feet to 400 feet for auger microtunneling systems.
Pipe Material	The most common types of pipe used with microtunneling are steel, reinforced concrete, vitrified clay, and glass-fiber reinforced plastic. A small amount of ductile iron pipe and PVC pipe have been installed with microtunneling.
Required working space	The space requirement is determined by the drive shaft size, which can range from 16 feet by 33 feet to 50 feet by 100 feet, depending on pipe diameter and length and equipment dimensions. Adequate working space typically would range from 20 feet to 40 feet wide and from 75 feet to 150 feet long.
Soil condition	The most favorable ground condition for slurry microtunneling is wet sand, and the most favorable ground condition for auger microtunneling is the stable sandy clay. However, a wide selection of MTBM cutter heads are available that provide the capability to handle a range of soil conditions, including boulders and solid rock. Typically, boulders of 20 to 30 percent of the machine diameter can be removed by microtunneling by crushing the boulders into particle sizes of ¾ inch to 1 inch and smaller.
Productivity	Crews of four to eight can obtain a production rate of 30-feet to 60-feet per shift in microtunneling operations.
Accuracy	The method is capable of installing pipes to a high precision. The laser system for controlling the alignment permits systems to be installed to an accuracy of 1 inch.

07.06 Tunneling

Utility Tunneling is accomplished with the use of a Tunnel Boring Machine (TBM). The primary difference between the TBM construction and other jacking methods are:

- The process typically requires worker-entry of the bore tunnel;
- Tunnel boring is a two stage process that includes the construction of a shield /liner system behind the tunneling process and then the carrier pipe is installed after the tunnel phase is completed. The annular space between the carrier pipe and the liner is grouted

on completion. Other jacking processes are one-stage process in which the carrier pipe is installed during the boring process; and

- The TBM bores through the earth and advances without the requirement of a stationary jacking station at the entrance to the bore tunnel. The TBM generates its thrust by applying pressure to the shields/liner (concrete or metal casing) that is constructed behind the TBM as it progresses. This method eliminates the build-up of friction forces as the pipe is advanced using other methods which limit maximum installation lengths. TBM advance independently, with thrust station advancing with the boring.

TBMs typically consist of a rotating cutting wheel, called a cutter head, followed by a main bearing, a thrust system and trailing support mechanisms. The type of TBM used depends on the particular geology of the project, the amount of ground water present and other factors.

Utility tunneling using TBM's are expensive to construct and therefor selected only when the diameter requirement or the length of pipe to be installed cannot be accomplished by other methods. Typically they are used in deep tunneling operations which involve water or highway crossing. The TBM are diameter specific and can range from 42 inches and up to 50 feet. For diameter less than 60 inches, other trenchless technologies are more cost effective.

Utility tunneling requires extensive engineering design and a complete geological study. The method typically requires extensive construction of set-up and retrieval areas. In most situations the construction of launching area requires major excavation, control of ground water infiltration, and ground stabilization in order to support the weight and thrust forces of the equipment. In some cases a caisson system is needed at the cutting head for slurry shield TBMs. Workers entering this space for inspection, maintenance and repair need to be medically cleared as "fit to dive" and trained in the operation of the locks.

In Florida, various strata of fractured rock (limestone) and soft grounds (sands and gravel) are typically encountered. These types of soft ground will required the construction of a shield to reinforce the tunnel, prevent cave-in and provide a structure for the forward thrust of the TBM. The tunneling process is typically slow since the tunnel support system must be built/installed behind the tunneling machine. A complete geological study of the entire tunnel route is required to determine the appropriate TBM for the types of soils and rock that will be encountered during tunneling.

07.07 Dig and Replace

Dig and Replace of a force main is the most common method used by MDWASD for pipe replacement. This is especially true for burst type failures, which usually require the excavation and replacement of one or two sections of pipe. Depending on the type of pipe material, special adapters may be necessary to rejoin the new pipe sections to the existing pipe. Other materials (such as CI, DI, or PVC) are spliced by using either repair clamps or mechanical couplings so that service can be restored quickly, with a permanent replacement to follow soon thereafter, following a force main failure.

08. Appendices

Appendix A: *New Technology/Product Committee By-Laws and Standard Forms*

Appendix B: *MDWASD Spill Process Flow Chart*

Appendix C: *DR-001 Dig & Replace (DR) for Force Mains - Standard Operating Procedures*

RC-001 Repair Clamps (RC) for Force Mains - Standard Operating Procedures

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APPENDIX A New Technology/Product Committee By-Laws and Standard Forms

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New Technology/Product Committee
3575 Le Jeune Road
Miami, Florida 33146

New Technology/Product Committee
Bylaws
November 2015

WASD New Technology/Product Committee (NTC) provides centralized review and determination if a product, operational software or hardware is applicable to the needs of WASD. NTC is a cross functional WASD workgroup created to evaluate new materials/products and vendors for use in WASD water and wastewater systems.

NTC goals are to:

- Provide WASD operators with best possible equipment and materials to perform their work
- Establish process and procedures for evaluating new products to ensure consistency, efficiency, and transparency
- Promote competition among qualified manufactures, vendors, and suppliers
- Communicate approved products for consideration by design teams

1. Committee Membership

NTC is comprised of the following WASD employees representing engineering, planning, and operations:

- Chief of Engineering and Design Division
- Manager of Specifications Section
- Chief of Construction Management
- Manager of Plans Review Section
- Assistant Director of Water
- Assistant Director of Wastewater

2. Term of Membership

Committee members will serve a period of 2 years. Members may serve multiple terms with concurrence of NTC Chair and Deputy Director.

3. Chair

The Chief of Engineering and Design Division will serve as the initial Chair for a period of one (1) year. After that, the Chair will be elected to a two (2) year term by NTC members. Interim elections may be held should the Chair not be able to serve the entire term.

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4. NTC Secretary

NTC may appoint a committee secretary to provide support. This includes serving as primary contact for vendors, preparing agenda and meeting minutes, maintaining NTC SharePoint site, and other duties as necessary.

5. Authority

NTC has sole authority on behalf of WASD to review and recommend products or new technology for use in WASD water and wastewater projects, processes or facilities.

6. Product Approval

WASD Deputy Director has sole authority to approve products or new technology for use in WASD water and wastewater projects, processes or facilities.

7. Product Substitution (Or-Equal)

NTC recommendation and Deputy Director approval of products proposed as substitutions (or equal) during construction is required.

WASD construction specifications may allow contractors to propose “or equal” products. WASD has three basic needs in reviewing and approving substitutions:

- The proposed product must work for its intended purpose and design service life
- The proposed product must support current or proposed WASD processes and facilities, and
- WASD must be able to maintain it

The design professional is responsible for reviewing the product for suitability of purpose and other design considerations. NTC recommendation and Deputy Director approval is required for acceptability for use in WASD facilities.

Contractors and vendors are encouraged to secure NTC recommendation and Deputy Director approval prior to submitting a product as a substitution. Untimely substitution request are not recognized as a basis for delay.

8. Meetings

NTC will meet as needed to approve meeting minutes, address open action items, and review new product applications. The meetings may be attended by members in person or teleconference.

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9. Quorum

Four committee members are required to hold a meeting and conduct NTC business.

10. Voting

Four committee member votes are required to recommend a new product. Only NTC members are eligible to vote.

11. Technical Advisors and Subject Matter Experts

NTC may appoint technical advisors and subject matter experts as necessary to assist in evaluating new products. Recommendations will be in writing and presented to the NTC.

12. Recommendations

NTC will review products and new technology for:

- Applicability to project, process or facility
- Compatible with or supports current or proposed process or facility
- Compatible with current or proposed operations or maintenance protocols and resources
- Meets or exceed current or proposed specifications and/or performance requirements/expectations

NTC review may result in one of the following recommendations:

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Miami, Florida 33146

Recommendations	Description
Recommended	Product or technology is recommended for use in WASD projects, processes or facilities
Recommended with Stipulations	Product or technology is recommended for use in WASD projects, processes or facilities with stipulations that must be considered. For example, a product may be suitable for water but not wastewater applications
Deferred	Product or technology recommendation is deferred pending product demonstration that may include field tests or demonstrations. Conditions and time requirements of the product demonstration, if any, will be noted
Not Applicable	Product or technology not applicable to WASD projects, processes or facilities, either current or in the foreseeable future
Not Recommended	Product or technology does not meet WASD criteria, specifications, or expectations for use in WASD projects, processes or facilities, either current or in the foreseeable future

13. Product Review Process

The review process is:

Vendors will be directed to the WASD website for application form and submittal instructions.

NTC secretary will record receipt of the application and route through NTC. NTC will indicate an interest in the product and concurrence for further review.

If sufficient interest exists, the secretary will coordinate product presentations or demonstrations.

NTC may defer making a recommendation pending further evaluation of the product including assigning technical advisors, securing subject matter experts, and/or conducting field demonstrations.

Technical advisors will present their findings and recommendations to NTC in writing.

Committee members will review the results of the evaluation and indicate their recommendation to the secretary, including comments.

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The secretary will tally the recommendations and record comments. The results will be posted to SharePoint and reviewed at the next NTC meeting.

Products unanimously recommended for acceptance will be marked “conditionally recommended” prior to formal voting by NTC and forwarded to Deputy Director for approval. Once approved by the Deputy Director, the vendor will be notified and the product may be incorporated in WASD projects.

Products not unanimously recommended for acceptance or with significant comments will be deferred to the next NTC meeting for further discussion

A simple majority (4 of 6 members) is required to recommend a new product. Concerns, objections, etc., if any, will be recorded as well.

NTC recommendations will be submitted to Deputy Director for final approval. The NTC secretary will record the final decision, notify the vendor of the decision, and close the application.

14. Vendor Communication

Vendors will use the following for correspondence and submittal of application:

WASD New Technology/Product Committee
3071 SW 38th Avenue
Miami, Florida, 33233-0316
ATTN: Chief, Engineering and Design Division

Vendors may also communicate using the NTC email address at NTC@miamidade.gov.

NTC will communicate findings to the vendor in writing.

15. Removal of Approved Product

WASD reserves the right to remove a product from the approved list should changes in the product affect the intended purpose. The vendor may reapply.

16. NTC Information System

NTC established a WASD SharePoint home page to facilitate communication, document management, and support workflows. The SharePoint site:

- Provides a homepage for coordination and communication

New Technology/Product Committee
3575 Le Jeune Road
Miami, Florida 33146

- Posts processes, procedures and forms
- Retains product information in electronic format
- Maintains decisions, meeting agendas, and meeting minutes
- Maintains product list with NTC comments
- Maintains NTC schedule and appointments
- Includes workflows for routing of applications and documents

NTC SharePoint is accessible for use by WASD personnel at http://ewasd/ntc

17. Use of Product List

The product list is provided as a technical resource for engineering and architectural professionals for use in design and construction of WASD projects. Design professionals are responsible for selection, reference, and appropriate application of these resources. The list of acceptable products may be augmented with supplemental specifications and modified details produced by the design professional and approved by WASD. WASD accepts no liability for use of these resources. This information is not intended as a substitute for the professional judgment of the design professional.

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WWW.MIAMIDADE.GOV/WATER

New Technology/Product Committee
3575 Le Jeune Road
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NTC Bylaws:

Chief of Engineering, Chair	Date
Manager of Specifications	Date
Chief of Construction Management	Date
Manager of Plans Review Section	Date
Assistant Director of Water	Date
Assistant Director of Wastewater	Date

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Miami Dade Water and Sewer Department (WASD) will review products relative to the operation and maintenance of water treatment and distribution, wastewater collection, wastewater treatment, pump stations, and SCADA systems.

Product review requests and supporting product information should be submitted in writing to:

WASD New Technology/Product Committee
3071 SW 38 Avenue
Miami, Florida, 33233-0316
ATTN: Chief, Engineering and Design Division
NTC@miamidade.gov

Firms, manufacturers or manufacturer's representatives desiring to have products reviewed and considered for use within WASD systems will submit this form and one (1) product catalog and seven (7) copies of product specification information sheet. Vendor may submit an electronic copy in Adobe format instead of hardcopies to the email address above. Specific items to be addressed are listed below.

Product Name: ____

Product Use: ____

Product Manufacturer: ____

Applicable product discipline(s):

____ Wastewater

____ Water

____ Pump Stations & Pumps

____ SCADA

____ Other: ____

Vendor Representative Contact Information:

Name ____

Phone Number: ____

Address: ____

City, State, Zip Code: ____

Email: ____

Website: ____

New Technology/Product Committee
3071 SW 38 Avenue
Miami, Florida 33233-0316

Is your firm a Registered Miami Dade County Vendor? Yes ____, No _____
If no, please see vendor registration requirements at www.miamidade.gov

Requests should include statements of interest, experience, and qualifications, and not contain more than seven (7) pages, excluding product information. Printing on both sides of a sheet counts as two pages, but is acceptable, and if tabs or dividers have text (other than the label), they count as a page.

Section I: Firm Experience Record

A. Name of Manufacturer

B. Manufacturer website address

C. Number of years in business and descriptions of areas of general and specific expertise

D. List of similar completed projects using your product, maximum of five (5), providing for each:
   - Location and description of product use.
   - References and contact information. (Name, Municipality/Company, title, phone number, date of installation, specific use, etc.)
   - Project team involved with specific responsivities

Section II: Product Information

A. Name of Product and specific function

B. What issue is it designed to handle

C. Length of time product has been in use and under what conditions

D. Material safety data sheet (MSDS), if applicable

E. Applicable product standards (NSF, AWWA, ASTM, AASHTO, etc.) as appropriate

F. Product warranty

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Miami, Florida 33233-0316

Section III: Field Testing, Product Training and Maintenance Approach

A. Narrative statement on standard maintenance program requirements and unique features, which you believe makes your product the most desirable.

B. Work plan that addresses the ability to furnish equipment and services for multiple projects simultaneously.

C. Description of the introduction and training program for your product, if needed.

WASD will review the information and determine if there is interest in further evaluation. You will be contacted with the decision and requests for additional information, if required.

WASD may request product demonstrations or product field testing. The vendor is responsible for all costs associated with the supply and delivery of the proposed product.

WASD reserves the right to not accept for use any product that, in the opinion of WASD, does not meet the intent or expectations of the applicable discipline or process.

Upon completion of the evaluation, you will receive a letter of acceptance or rejection. The letter will outline the reason for that decision.

Questions may be directed to NTC@maimidade.gov.

WASD appreciates your participation in this product review process.

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APPENDIX B MDWASD Spill Process Flow Chart

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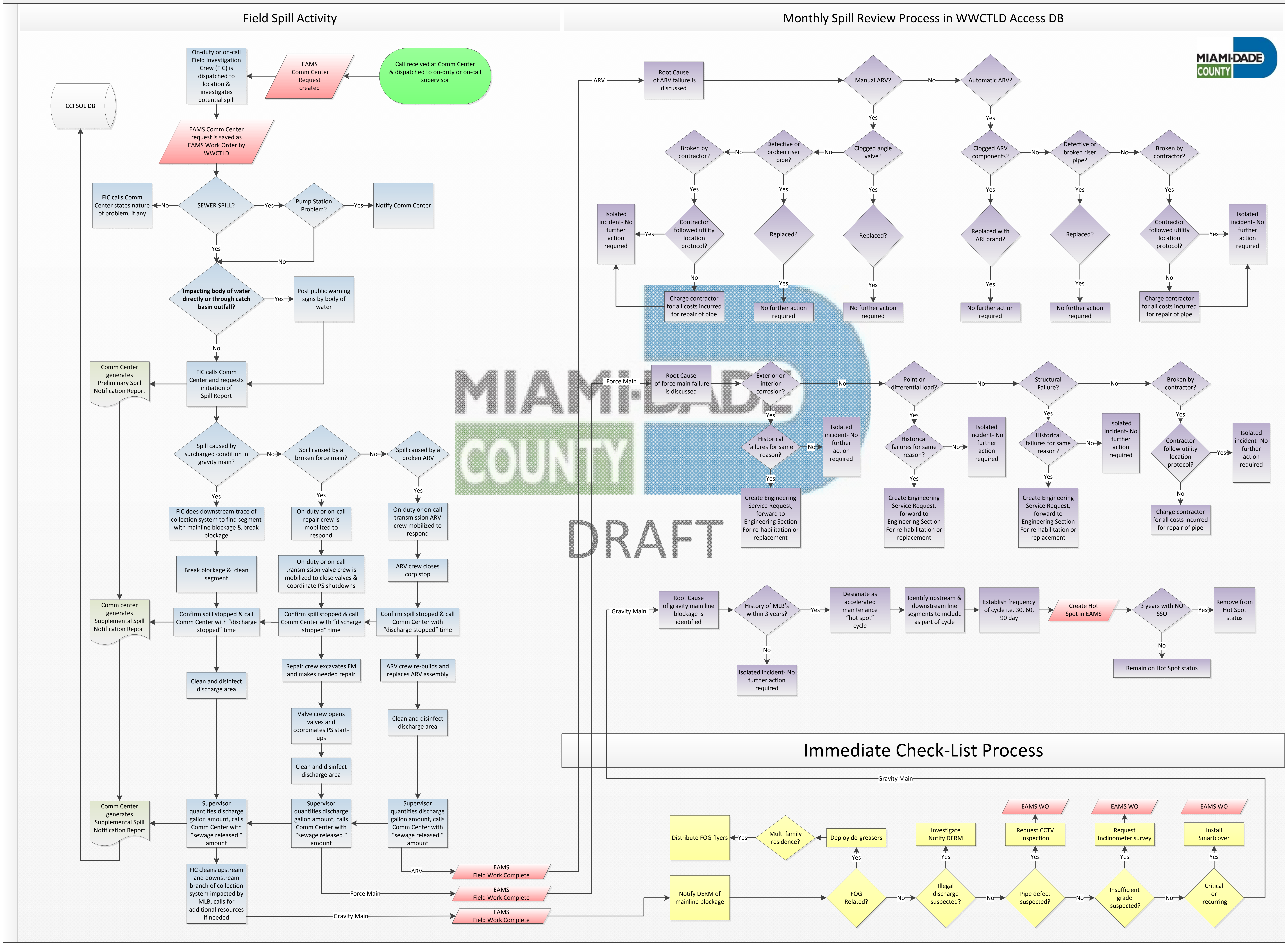
WWCTLD Spill Process Review 12.17.2013



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APPENDIX C

RC-001 Repair Clamps (RC) for Force Mains - Standard Operating Procedures

DR-001 Dig & Replace (DR) for Force Mains - Standard Operating Procedures

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General Information

The purpose of this SOP is to assist WWCTLD staff in digging and replacing damaged segments of force mains.

Responsibilities

M&R Collection Repair Crew, Cleaning Investigation Crew, Responding WWCTLD Field Investigation Crew, vactor crew, supervisor, transmission crew, and or stand by, on-call crew.

Procedure

1. Upon arrival at work site, set up work area MOT per MDWASD's Safety Procedures.
2. The field investigation crew (FIC) is the first personnel to arrive on site. Once the FIC verifies a wastewater release (spill) they must immediately contact the communication center, via radio or phone; to initiate a SPILL REPORT.
    a. The FIC shall follow the SOP SSO-002 Sanitary Sewer Overflow (SSO) Response for Force Mains for in case of spills prior to repairing force mains.
3. Isolate & verify broken force main to be repaired.
    a. Verify utility locate prior to excavation.
    b. Transmission valve crew identifies the shutdown needed to control the flow, including valve closures and pump stations that need to be turned off.
    c. If pump stations need to be turned off, the transmission crew supervisor contacts Pump Station Maintenance Division and requests respective stations to be turned off.
4. Identify and locate (hand dig) all other utilities in area of excavation.
5. Excavate using proper techniques.
    a. Slope/bench trench when possible.
    b. Use trench box and/or shoring if benching or sloping not possible.
    c. Use Confined Space procedures, if appropriate.
    d. Excavate to a depth below pipe/fittings as needed to work safely.
6. Establish a dewatering sump:
    a. Excavate adjacent to the damaged force main pipe, as far from the repair as possible.
    b. Ensure bottom of excavated area slopes toward sump.

c. Fill sump with #57 stone. Place pump in sump to keep water level as low as possible.

d. Pipe fitter Supervisor will determine the need for, and timing of, flow control.

7. Identify the section of damaged force main pipe to be replaced.
8. Remove soil around force main pipe beyond limits of damage as far as necessary to provide a clear "repair zone" for the force main pipe.
   a. Measure and mark circumference of force main pipe.
9. Place pipe strap or chain in the middle of the damaged force main pipe as a balance point and for its removal after cutting.
10. Any crack or hole that is elongated and runs along the force main pipe length should notched with a saw at the ends of the defect to prevent further spreading of the crack during cutting of the force main pipe or If the repair involves a longitudinal split (not to exceed 12” in length) drill a ½” hole at each end of the split to mitigate further splitting.
11. Using force main pipe saw, cut damaged area of force main pipe out at the mark.
    a. In some cases, multiple cuts might be needed to remove the damaged section.
    b. Make a straight saw cut on the force main pipe all the way around.
12. Remove damaged force main pipe from excavation: Lift out damaged section of force main pipe using Backhoe.
13. Inspect exposed ends of the remaining force main pipe to ensure the damaged section is completely removed.
14. At each of the two cuts, the force main pipe must be clean and smooth for coupling to seal correctly.
15. Measure the distance of the gap in the force main from top edge to top edge and bottom edge to bottom edge.
16. Cut new replacement force main pipe to fit into the measured distance.
17. Slide coupling onto both ends of existing force main, make sure cut edge of each section is exposed.
18. Using force main pipe strap located at midpoint of replacement force main pipe, lower replacement force main pipe with backhoe to set in place between cut edges of existing force main.
    a. Make sure support is provided in middle of force main pipe with compacted #57 stone under the force main pipe.
    b. Leave enough room at both ends of force main unsupported by stone to work safely.

20. Slide one coupling forward over cut edge of existing force main pipe far enough to center it over the cut.
21. On the existing force main side, tighten the coupling straps to secure it into place
22. Proceed to other end of replacement force main pipe:
    a. Ensure that the force main pipe is resting fully on the bedding material.
    b. Verify the force main pipe invert is true to grade at both ends.
    c. Adjust by adding #57 stone under force main pipe or lowering the force main pipe bedding by hand, as needed.
23. Slide other coupling onto the repair section so it is centered over the cut and tighten on the force main side of the repair to secure the coupling.
24. Complete the installation by securing the couplings on the repair side at both ends of repair.
25. Restore flow to force main, verify pipe joints and gate valves are watertight.
    a. All valves shall be provided with o-ring seals.
    b. The design and machining of valves shall be such as to permit replacing the o-ring seals while in service without undue leakage.
26. Fill trench to just above force main pipe crown with compacted #57 stone:
27. Backfill remainder of excavation with compacted fill material leaving room for any required surface treatments. Place erosion control as required with seed/mulch.
28. For roadway excavation, backfill according to the requirements of the Authority Having Jurisdiction.
29. Clean and dress the work areas as required, and check site for tools or spare parts.
30. Issue a work order request if additional landscaping, driveway repair, paving, or other restoration work is needed.
31. Leave door tag for property owner, if appropriate.

Close-out/Documentation/Follow-up

Fill in all related Work Order fields and/or reports and submit to Unit Supervisor for review.

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General Information

This SOP is intended to assist WWCTLD staff in responding to the use of a full circumferential repair clamp over the damaged section of a Force Main pipe which is usually utilized as a quick repair methodology. MDWASD limits the use of repair clamps to temporary fixes to keep the system functional until a permanent repair can be implemented.

Responsibilities

M&R Collection Repair Crew, Two or Three Man Pipe Crew w/truck.

Procedure

1. Upon mobilizing to the work site set up work area MOT following MDWASD standard Safety Procedures. The field investigation crew (FIC) is the first personnel to arrive on site. Once the FIC verifies a wastewater release (spill) they must immediately contact the communication center, via radio or phone; to initiate a SPILL REPORT.

   a. The FIC shall follow the SOP SSO-002 Sanitary Sewer Overflow (SSO) Response for Force Mains for in case of spills prior to repairing force mains.

2. Isolate & verify broken force main to be repaired.
   a. Verify utility locate prior to excavation.
   b. Transmission valve crew identifies the shutdown needed to control the flow, including valve closures and pump stations that need to be turned off.
   c. If pump stations need to be turned off, the transmission crew supervisor contacts Pump Station Maintenance Division and requests respective stations to be turned off.
3. Identify and locate (hand dig) all other utilities in area of excavation.
4. Excavate using proper techniques.
   a. Slope/bench trench when possible.
   b. Use trench box and/or shoring if benching or sloping not possible.
   c. Use Confined Space procedures, if appropriate.
   d. Excavate to a depth below pipe/fittings as needed to work safely.

5. Establish a dewatering sump:
   a. Excavate adjacent to the damaged force main pipe, as far from the repair as possible.
   b. Ensure bottom of excavated area slopes toward sump.
   c. Fill sump with #57 stone. Place pump in sump to keep water level as low as possible.
   d. Pipe fitter Supervisor will determine the need for, and timing of, flow control.

6. Isolate pipe segment. Excavate area (minimum 12" beneath pipe) and shore trench as necessary. Measure pipe diameter to assure proper clamp is on hand.

7. Check the clamp parts to insure that no damage has occurred during transit and that no parts are missing. Thoroughly clean pipe surface that will be covered by the clamp. A suitable gasket lubricant should be used on rough surfaced pipe (Iron and AC) to assure proper seal.

8. Place reference marks on the pipe each side of the crack or hole in the pipe, slightly wider than the clamp. It is highly recommended to place a thin plate of stainless steel over an open hole, puncture, gouge or any visible opening in the pipe wall. Plate should not exceed 50% of the clamp longitudinal length.

   Note: Any crack or hole that is elongated and runs along the force main pipe length should notched with a saw at the ends of the defect to prevent further spreading of the crack during cutting of the force main pipe or If the repair involves a longitudinal split (not to exceed 12" in length), drill a ½" hole at each end of the split to mitigate further splitting.

9. Back off nuts to end of bolts, but **DO NOT REMOVE THEM.** Separate clamp halves and place one half on top of the pipe.

10. Slide the other half into place and snap the bolt heads into the open lugs. Tighten finger tight. Note: If necessary (because of water pressure), Step 4 and Step 5 can be performed beside the pipe break. Slide the clamp over the break after the bolt heads have been snapped in place.

11. Make sure gasket tails are properly overlapped, and are not folded. Clamp may be rotated to facilitate seating of the tails. Center one of the sections over the point of repair.

12. Use a wrench with at least a 12" handle. Starting in the center and working toward each end, tighten all nuts evenly in 20 ft-lb. increments. Alternate from one side to the other to equalize the gap between halves, keeping torques as evenly balanced as possible. Torque to 75-85 ft-lbs. For best results, wait 10 minutes and then retighten bolts to proper torque.

13. Complete the installation by securing the couplings on the repair side at both ends of repair.

14. Restore flow to force main, verify pipe joints and gate valves are watertight.

    a. All valves shall be provided with o-ring seals.
    b. The design and machining of valves shall be such as to permit replacing the o-ring seals while in service without undue leakage.

15. Fill trench to just above force main pipe crown with compacted #57 stone.

16. Backfill remainder of excavation with compacted fill material leaving room for any required surface treatments. Place erosion control as required with seed/mulch.

17. For roadway excavation, backfill according to the requirements of the Authority Having Jurisdiction.

18. Clean and dress the work areas as required, and check site for tools or spare parts.

19. Issue a work order request if additional landscaping, driveway repair, paving, or other restoration work is needed.

Close-out/Documentation/Follow-up

Complete all required fields in the work order. Complete all reports, documenting type of cleaning conducted and any blockages encountered. Submit to the Unit Supervisor for review and approval.

MIAMI-DADE
COUNTY