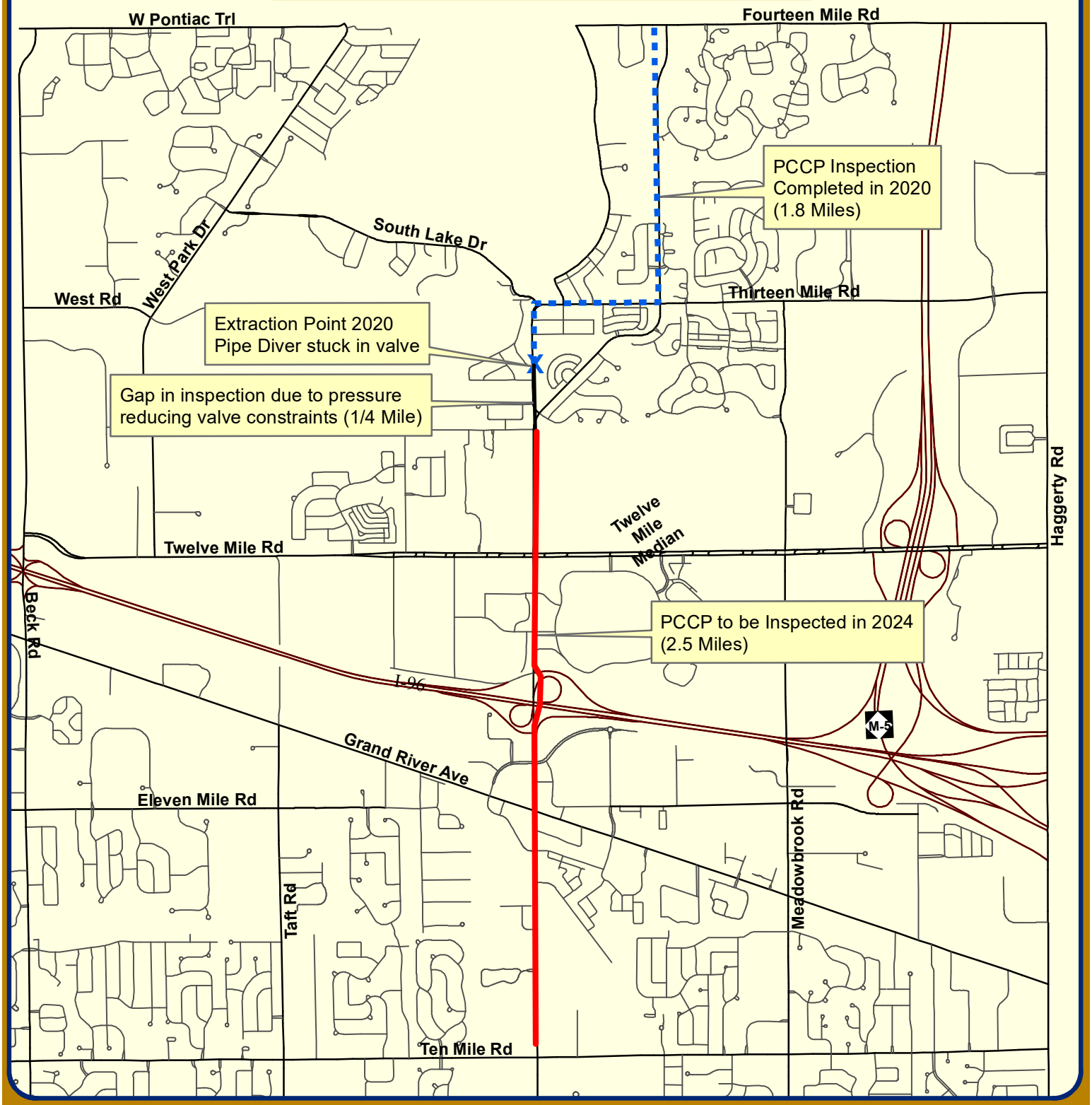
PCCP Transmission Main Inspection

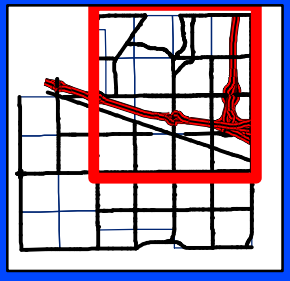
Pipe Diver



Map Author: Croy
Date: 3/15/2024
Project:
Version #: v1.0

MAP INTERPRETATION NOTICE

Map information depicted is not intended to replace or substitute for any official or primary source. This map was intended to meet National Map Accuracy Standards and use the most recent, accurate sources available to the people of the City of Novi. Boundary measurements and area calculations are approximate and should not be construed as survey measurements performed by a licensed Michigan Surveyor as defined in Michigan Public Act 132 of 1970 as amended. Please contact the City GIS Manager to confirm source and accuracy information related to this map.

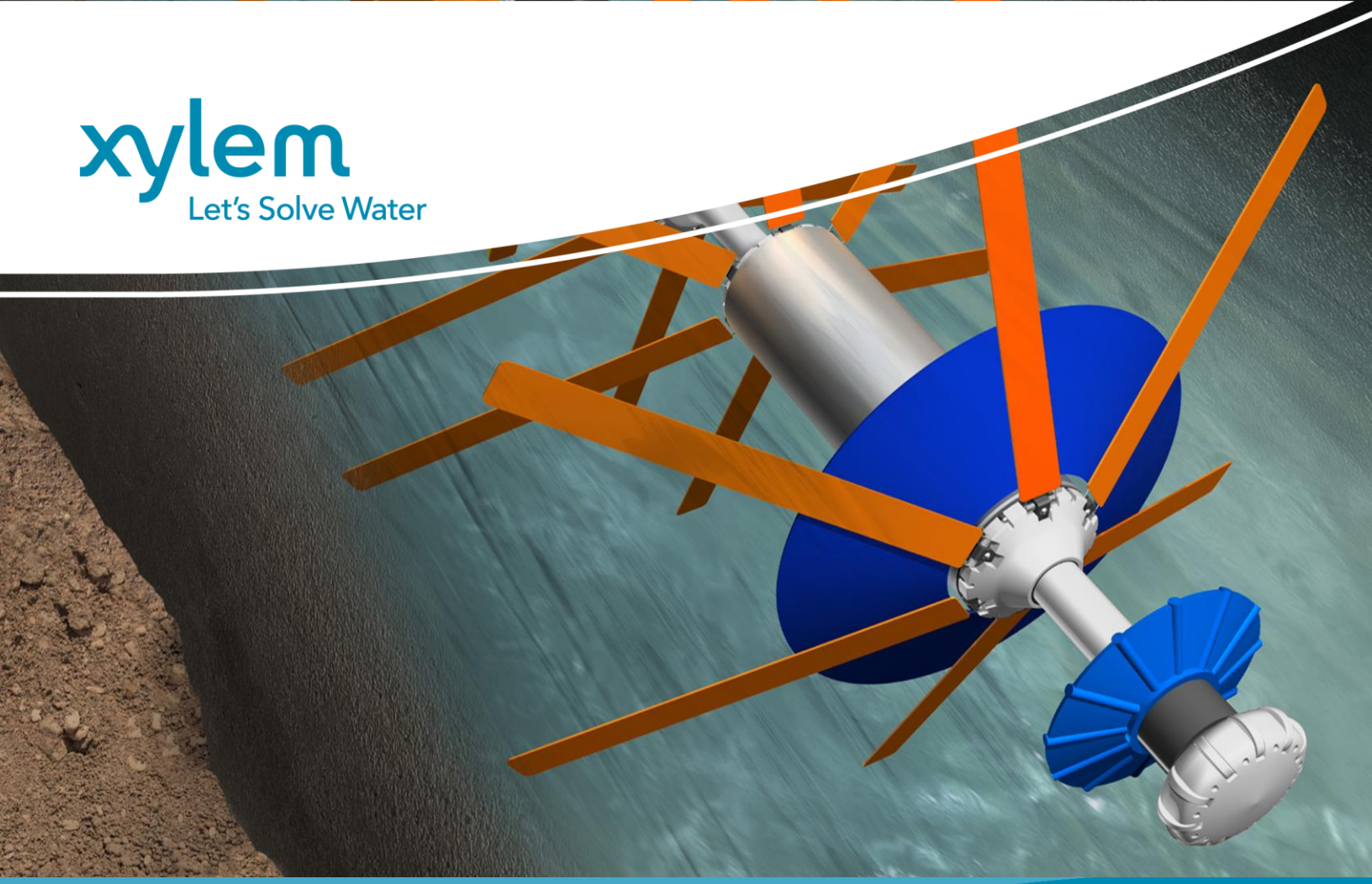


City of Novi
Engineering Division
Department of Public Services
26300 Lee BeGole Drive
Novi, MI 48375
cityofnovi.org

Feet
0 550 1,100 2,200 3,300

1 inch = 2,856 feet

xylem
Let's Solve Water



Proposal for

IN-SERVICE PCCP INLINE WALL CONDITION ASSESSMENT INSPECTION

PipeDiver®

January 8, 2024
Prepared for
Ben Croy
City of Novi Department of Public Works
26300 Lee BeGole Dr. Novi, MI 48375

pure TECHNOLOGIES
a xylem brand

Ben Croy
City Engineer
City of Novi Department of Public Works

RE: In Service PCCP Inline Wall Condition Assessment Inspection

Dear Mr. Croy;

Pure Technologies U.S. Inc., a Xylem brand, is pleased to offer our services for the inspection of the City of Novi prestressed concrete cylinder Pipe (PCCP) transmission main using our PipeDiver platform. The inspection scope involves approximately 2.5 miles of 36, 30 and 24-inch diameter PCCP potable water pipeline. We propose using the PipeDiver® free-swimming electromagnetic (EM) inspection platform to identify individual pipes with broken steel prestressing wire wraps, a key structural component of PCCP.

We also propose to provide a suite of Condition Assessment Engineering (CAE) services—design review, finite element analysis (FEA), and remaining useful life (RUL) analysis—to enable you to proactively manage the failure risk and asset life of your pipeline. This engineering analysis will incorporate all of the data collected to date including transient pressure monitoring (TPM), SmartBall acoustic inspection data and previous PipeDiver Inspection Data.

Data from thousands of miles of PCCP inspections show that, on average, only four percent of individual pipes have broken wire wraps and only one percent of pipes require rehabilitation; though, broken wire wraps can cause a quick and catastrophic failure of the asset. The purpose of this inspection is to determine the condition of each individual pipe within the transmission main with minimal disruption to pipeline operation and service.

The PipeDiver platform has been successfully used to inspect and inform the management of over 1,500 miles of pipelines around the world. As a result, we have identified key success factors for free-swimming inspections to minimize risk and disruption to pipeline operations. Highly trained and experienced technicians will work closely with your operations personnel to understand and mitigate inspection risks during project planning and execution.

Pure Technologies is a recognized industry leader in the inspection, assessment, and management of pressurized water and wastewater pipelines, having built a reputation of providing state-of-the-art and innovative solutions. We look forward to addressing any questions you may have and helping you solve your water challenges.

Evan Biedenbach
Business Development Manager - Midwest
Pure Technologies U.S. Inc., a Xylem brand
(330) 705-0796
evan.biedenbach@xylem.com

In-Service PCCP Inspection

Concrete core compression and structural strength of a PCCP, such as the Novi transmission main, comes from tension in the pipe's prestressing wire wraps. When wire wraps break and core compression is lost, the pipe can yield under its internal pressure and can fail in a quick and catastrophic manner. An EM inspection can identify where prestressing wire wraps have broken and can allow for proactive management of PCCP prior to failure.

The project scope detailed in this proposal leverages our PipeDiver® inspection platform with EM technology to inspect the transmission main for broken wire wraps.

The best way to proactively manage any pipeline is to better understand its health using proven condition assessment solutions combined with advanced analysis. A comprehensive condition assessment of PCCP water pipeline involves deploying inspection tools to accurately assess the health of the buried infrastructure along with advanced engineering analysis to provide a clearer understanding of risks that inform short- and long-term repair and replacement strategies. We propose a condition assessment initiative for Novi that includes three phases:

1. **Inline Wall Inspection** identifies and locates broken wire wraps to provide a critical baseline for pipe degradation. The PipeDiver® platform is a free-swimming condition assessment tool that is easy to deploy and operates while the pipeline remains in service.
2. **TPM Analysis** accurately measures the operating pressure in a pipeline to better understand the system hydraulics and the effect of pressure surges on the pipeline. This information was already collected and will be included in the reporting for this project.
3. **CAE** turns inspection and monitoring data into actionable recommendations for PCCP owners. Structural evaluation services, such as FEA and degradation modeling, help utilities make long-term capital planning decisions about reinspection, rehabilitation, and replacement while ensuring safe pipeline operation into the future.

Since 2010, utilities around the world have relied on the PipeDiver platform to inspect more than 1,500 miles of pipeline.

PipeDiver

The PipeDiver platform, as shown in **Figure 1**, provides accurate, detailed pipe wall condition data to inform proactive management decisions. Pure Technologies' industry-leading, patented EM technology can locate groups of as few as five broken wire wraps along the length of the pipe. Dig sheets are provided alongside the PipeDiver report to help Novi accurately locate any pipe in question.

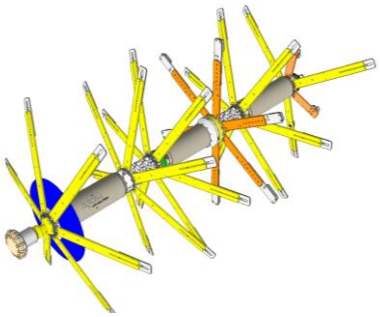


Figure 1: PipeDiver Inspection Platform for concrete pressure pipeline inspection

The PipeDiver platform is flexible, offering a number of insertion and extraction options to meet various operational requirements. While the tool can be inserted into a live pipeline under pressure, it is more commonly inserted

through a depressurized appurtenance. Extraction options also vary and include nets or grates to stop the tool. The tool can be extracted through a depressurized appurtenance or retrieved at a reservoir, chamber, or tank.

As the platform travels through the pipeline, field crews track the tool from aboveground at regular intervals. The PipeDiver platform's flexible design allows it to navigate valves and bends in the pipeline. The tool can also travel long distances in a single deployment.

An overview of the PipeDiver platform inspection process is shown in **Figure 2**.

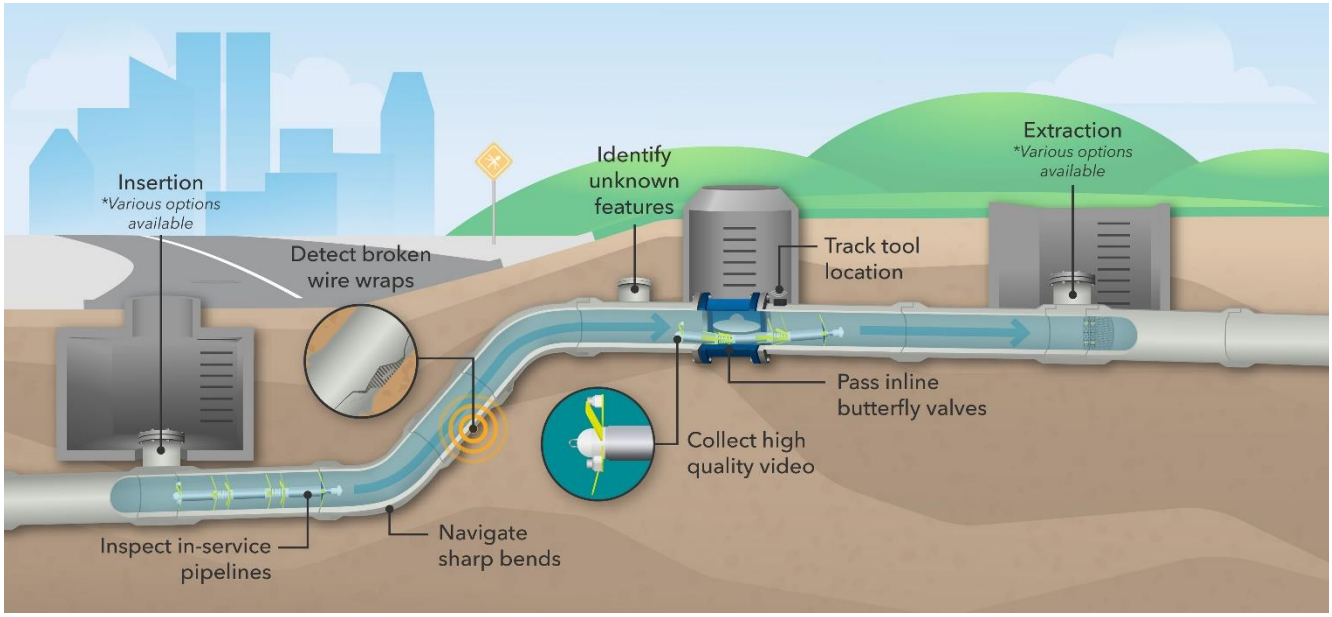


Figure 2: PipeDiver Inspection Overview

Condition Assessment Engineering

While many inspection techniques provide real data specific to pipe wall deterioration, leaks, and/or operational conditions, this information alone does not fully describe the significance of data and alone cannot conclude the current condition of a pipeline. The primary intent of the structural analysis is to evaluate the associated risk of each pipe section that has reduced structural capacity as identified during the inspection, as shown in **Figure 3**. The prestressing wire is a principal structural component of PCCP and each individual class of PCCP installed in the subject pipelines was designed specifically for the maximum hydraulic operating pressure and soil covers expected along the route. Thus, any amount of wire break damage poses some level of risk to PCCP and should be carefully evaluated. A design review can determine the appropriateness of the pipeline's design relative to the actual current loads that act on the pipeline. Finite Element Modeling can then be selectively used to further evaluate individual defects, providing increased confidence in pipeline management and repair decisions.

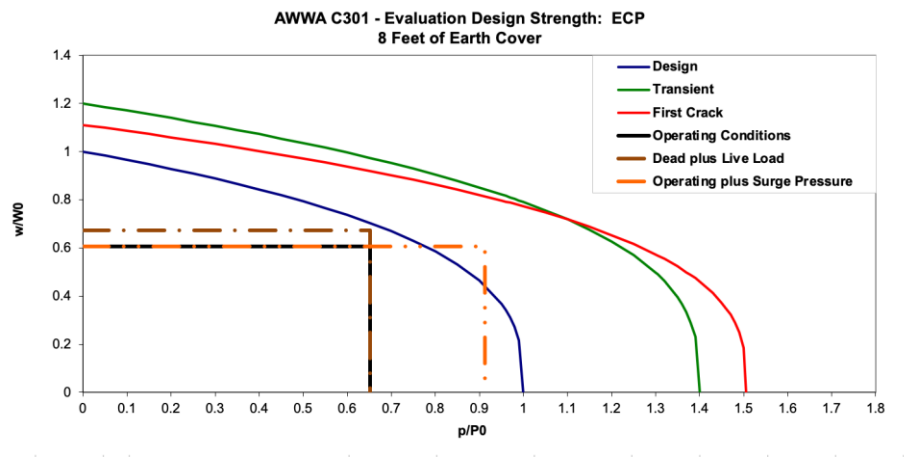


Figure 3: Structural Capacity

Design Review

A pipe design analysis determines if the pipe specifications are adequate for the anticipated loads in the pipeline. The analysis includes examining pipe design, operating and transient pressures, and internal and external loads.

Pure Technologies will consult the PCCP design standard in place at the time of installation to reverse engineer the pipe design and determine if it meets that standard. Pure Technologies will also consult the current American Water Works Association (AWWA) PCCP design standard, AWWA C304 PCCP, Steel Cylinder Type (AWWA C304-14) to reverse engineer the pipe design and determine if it meets the current PCCP standard.

Finite Element Analysis (FEA) Based Pipe Performance Evaluation

Standard structural analysis of PCCP involves performing analyses based on AWWA C301 and C304, but these standards are intended for design of new pipe and do not provide a detailed prediction on the condition of pipes with broken prestressing wire wraps. To provide a better analysis tool, Pure Technologies will develop a three-dimensional nonlinear finite element model that is used to predict the condition of a pipeline given known loading conditions and wire break damage from an EM inspection. The model is used to develop performance curves that are used to determine the predicted condition of a pipe section with wire break damage using limit states defined in AWWA C304, as shown in **Figure 4**.

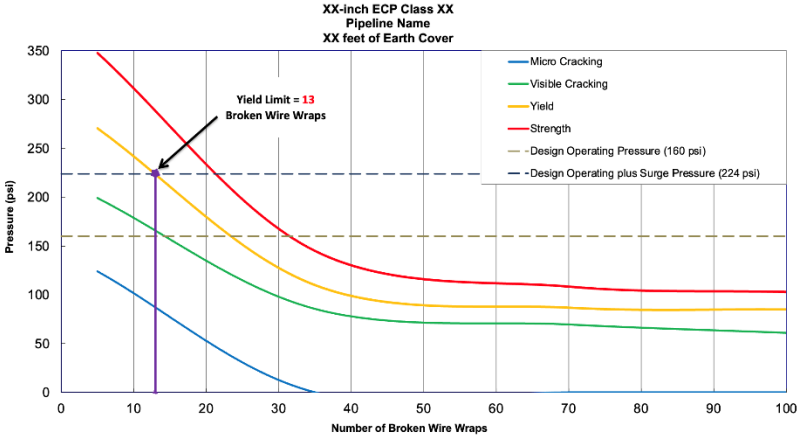


Figure 4: Example of an FEA based Pipe Performance Curve for PCCP

It is possible that damaged pipe is found with different designs (pressure class or bury depth). If multiple pipe designs exist or the pipe has earth cover depths differing from design, then additional structural performance curves may be needed.

Remaining Useful Life Analysis

The project will use our advanced RUL analysis model, the results from the EM inspections, and information from similar pipes from our data library of inspected and monitored PCCP. Note that our PCCP database includes over 3,000 miles of EM inspection data, over 680 miles of monitoring results, and over 700 FEA. The following is an overview of the methodology:

1. Review and compile all applicable available data, including but not limited to, inspection data, geographic information systems (GIS) pipeline data, repair history, structural analysis and design data.
2. Assign each pipe to a condition-state (called a 'case') based on the number of broken wire wraps identified in the EM inspection.
3. Create thousands of deterioration scenarios using the RUL model. Degradation rates are computed based on known conditions: the assumed original condition (zero breaks) and the condition identified from EM inspections.
4. Compare all deterioration scenarios to the current condition rating for each inspected pipe. Only deterioration scenarios that result in deterioration such as that observed during the inspection and monitoring are recorded and stored.
5. Simulate the deterioration of all the pipes for the pipeline until the likelihood of failure exceeds the yield limit state.

Note that RUL results are predictive and therefore do not define the absolute condition of a pipe at exact times. Uncertainty does exist when forecasting future degradation rates; therefore, a distribution of possibilities via simulated models is used.

Project Milestones and Deliverables

Additional details regarding insertion, extraction and tracking of the inspection tools are provided in Appendix A, Inspection Considerations.

Planning and Mobilization

The planning process is an integral part of the project. Gathering more detailed pipeline information during the planning process facilitates a more successful inspection. The team begins by identifying site or pipe features that could pose a challenge during the inspection. Steps are then put into place to mitigate any potential risk. Based on information gathered and the preliminary site visit, the team drafts a detailed Project Planning Document (PPD) that outlines the inspection plan, including insertion and extraction procedures and tracking sensor locations. The PPD will be submitted to Novi prior to starting the work. Changes in scope that arise from the planning process that impact pricing outlined in this proposal will be discussed with Novi and mutually agreed upon before proceeding.

Civil work may be required for successful insertion and/or extraction of the PipeDiver tool and will be identified during the detailed planning process. Civil work may include, but is not necessarily limited to, pipeline fitting modifications, excavation, tapping, shoring, and/or any other activity necessary to access valves and appurtenances identified as critical to the inspection. It is expected that Novi will complete this work.

Pure Technologies will utilize the pressurized insertion stack to live launch the PipeDiver inspection tool. This will require coordination with Novi and the preferred contractor that will be performing the pipeline modification to accommodate the equipment. See example in Figure 5 below.

Figure 5: PipeDiver Pressurized Insertion Stack

Activities undertaken as part of the planning and mobilization process include, but are not necessarily limited to:

- Project document review
- Preliminary site visit and review
- Evaluation of the need for alternative methods for insertion and extraction, such as utilizing pressurized insertion and extraction tubes or retrieval from a reservoir using a remotely operated vehicle
- Pre-inspection coordination/meetings
- Planning document development, including tracking plan and tracking sensor installation details
- Equipment and staffing logistics
- Tool preparation
- Pre-inspection activities required in advance of the scheduled inspection date

Planning and Mobilization Deliverables

1. PPD that outlines the inspection plan, including insertion and extraction procedures and tracking sensor locations.

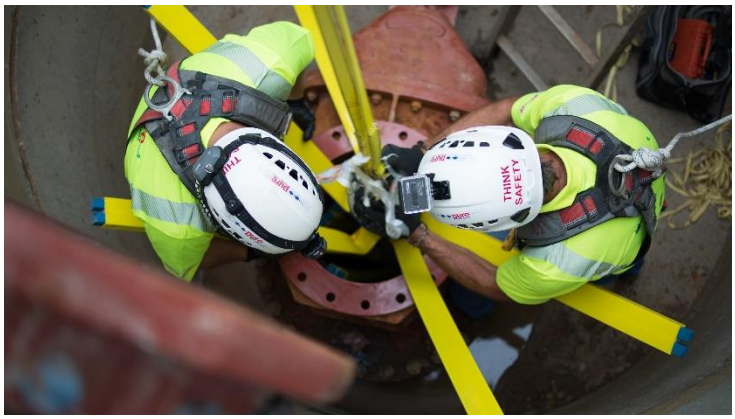


Figure 6: PipeDiver Insertion

Inspection and Analysis

PipeDiver tracking sensor installation will occur approximately one week prior to inspection and may take one to two days for complete installation, depending on sensor locations and accessibility. It is expected that Novi will assist in any installations that require soft digs or pavement coring to access the pipeline and will provide appropriate traffic control during tracking installations, if required, as outlined in the PPD.

The inspection is anticipated to take one day to complete. Several tracking teams will be assigned to monitor the tool's movement through the pipeline. If required, Novi will provide traffic control during the inspection at each tracking sensor location. Coordination with operations staff will be required throughout the duration of the inspection, particularly for activities such as valve operation, pump management, etc. These activities will be outlined in the PPD.

The PipeDiver platform is equipped with fixed closed-circuit television (CCTV) cameras on the rear petals of the device and will capture and record video of the illuminated pipe wall. Video quality is dependent on several factors related to the operating conditions of the inspected pipeline. Although real time viewing is not available, a copy of the video file with points of interest flagged will be submitted as part of the final report.

After completing the inspection, data will be downloaded from the PipeDiver and shared with the EM data analysis team. EM analysts identify, quantify, and locate areas of prestressing wire wrap damage. Quantifying EM results depends on a number of variables including accuracy of pipeline specifications, calibration data, repairs (cylinder or wire splicing), presence of nearby EM fields, shorting straps, and the number and complexity of wire break regions.

Once the draft Inspection Report is developed, the team will conduct a follow-up site visit to assist in identifying and locating specific pipes of concern and counting broken wire wraps.

External Wall Inspection. Following the EM inspection, excavations of individual pipe sections are often required to repair the pipeline or to determine the root cause of pipeline deterioration. Pure Technologies can support this investigation, conducting an external EM and visual inspection of the pipe section to verify the condition of the pipe sections to be repaired or replaced. Results will be compared to the initial report and updates made where required.

Inspection and Analysis Deliverables

1. Draft Inspection Report including:
    - Project background and inspection details
    - Details of EM results including the location and quantity of broken wire wraps identified through the inspection
    - Video file with points of interest flagged
    - Up to three dig sheets to aid in locating and excavating reported pipes with broken wire wraps
2. Final Inspection Report incorporating comments from Novi
3. Geodatabase including a pipe-by-pipe representation of the pipeline, including basic pipe attributes (stationing, material, diameter, etc.) as well as PipeDiver platform inspections results mirroring the results of the inspection.

Condition Assessment Engineering

Pipeline specifications for each pipe class within the pipeline (45 unique pipe classes) will be evaluated for satisfaction with both the AWWA C301 PCCP design standards that were in effect at the time of the pipeline manufacture and installation as well as the current AWWA C304 PCCP design standards.

FEA models will be developed to determine the structural consequence of broken prestressed wire wraps by utilizing pipe design specifications, design parameters, and the current condition of the prestressed wire wraps, as determined during the EM inspection. During the analysis, the model of a pipe design will be subjected to internal pressure, pipe and fluid weights, and external loads while varying the number of broken wire wraps. Each FEA model will predict the performance of a class of PCCP utilizing the tensile strengths of the prestressed wire, the steel cylinder, and the concrete core, as well as a plasticity algorithm which simulates concrete crushing in compression regions. A performance curve will be developed for each identified pipe class with distressed pipes (four pipe classes total), displaying the effects of broken wire wraps, to determine the number of broken wraps required for the design to experience theoretical limits.

Using the results from the inspections and information from our data library of inspected and monitored PCCP, together with our advanced RUL analysis model, probability of failure will be evaluated and recommendations for management of the pipeline will be identified.

Note that RUL results are predictive and therefore do not predict absolute condition of pipe at exact times. Uncertainty does exist when forecasting future degradation rates, therefore a distribution of possibilities via simulated models is used.

Condition Assessment Engineering Deliverables

1. Geodatabase of the pipeline, segmented by individual pipes, populated with inspection data, and structural evaluation results in a format consistent with the results of the framework to be determined in the data management work request.
2. RUL report that summarizes the methodology and results, including:
    - Deterioration Projection (probability of failure for each pipe segment)
    - Number of pipes forecasted to require repair up to year 2045
    - Recommendations for asset management
3. Technical Report describing all of the analyses conducted, the results of the analyses, a summary of all principal conclusions, and management recommendations.
4. Workshop to review analysis results.

Client Responsibilities

It is expected that the activities listed below will be completed by Novi. Requirements will be determined in more detail during the inspection planning process.

- Provide information about the pipeline at least four weeks prior to the inspection date including, but not limited to, plan and profile drawings, lay sheets, shop drawings, manufacturing details, and details of access structures and appurtenances – if available.
- Obtain any required legal right-of-entry on the property.
- Provide support personnel during the inspection for locating the access structures, traffic control, valve operation, pump operation, and other support as necessary.
- Provide Pure Technologies with the typical flow velocities and pressures for pipeline operation, and the expected minimum and maximum values for each. If this data is unavailable, Pure Technologies would like the opportunity to verify flow velocities recommended prior to performing the inspection.
- Provide and maintain safe and reasonable access to all work sites throughout the inspection and obtain permits as required.
- Prepare and/or modify existing pipeline fittings and structures as indicated by Pure Technologies to accommodate insertion and extraction of the equipment as outlined in the Planning Document.
- Render confined space areas safe for the services, including lockout/tagout of pumps, valves and motors; dewatering chambers and vaults to permit movement of persons and equipment; and vector and rodent control as necessary.
- Excavate, dewater, shore up, and/or provide scaffolding of job area and other civil activity as necessary in compliance with Occupational Safety and Health Administration (OSHA) and local standards and regulations.

- Operate the pipeline in a manner that will achieve the minimum required flow velocity indicated in the Planning Document throughout the inspection.

Project Schedule

A typical schedule for this project is shown below.

Inline Wall Inspection	
Task	**Timing**
Site visit	Within 30 days following Notice to Proceed
Project Planning Document	2 weeks after site visit
Field Inspection	1-3 weeks following Project Planning document approval
Draft PipeDiver Inspection Report	6-8 weeks following inspection
Draft Condition Assessment Report (CAE) & Geodatabase	2-4 weeks after receipt of comments on Draft Inspection Report
Final CAE & Geodatabase	2 weeks after receipt of comments on Draft CAE Report

Proposed Fee and Payment Schedule

The estimated cost for this project is based on the information provided at the time of this proposal and detailed in the table below.

Project Pricing					
Item	**Description**	**Unit**	**Unit Price**	**Quantity**	**Total Price**
1	Project Planning and Mobilization	LS	$78,750.00	1	$78,750.00
2	PipeDiver Inspection and Analysis (minimum 2 miles)	Mile	$87,000.00	2.5	$217,500.00
3	PipeDiver Inspection Technology Report	EA	$18,000.00	1	$18,000.00
4	CAE Analysis and Reporting (includes structural and RUL analysis for three diameters/pipe specifications)	EA	$45,000.00	1	$45,000.00
5	Pressurized Launch equipment for PipeDiver Inspection	EA	$10,500.00	1	$10,500.00
				Estimated Total Project Cost	**$369,750.00**

Notes and Assumptions

- All travel, shipping and related expenses are included in the mobilization and field data collection/inspection.
- If additional work is required due to circumstances outside of Pure Technologies' control or based on additional requests from Novi, a mutually agreed upon change order will be required.
- A rescheduling charge 50% of the mobilization fee may apply should the work be cancelled by Novi within two weeks prior to the agreed mobilization date and the crew/equipment resources are already in transit to the work site.

- If Novi requests a change to the mobilization date within two weeks of the previously agreed date, additional charges may occur.
- A stand-by charge of $15,750 per day applies if the project is delayed by Novi after mobilization.
- Pricing does not include traffic control, civil works, permitting, confined space support, or valve exercising. These tasks are the responsibility of Novi, unless otherwise agreed.
- Civil work required for insertion and extraction of the inspection tool and tracking sensor installation as well as any required maintenance of traffic shall be provided by Novi.
- Please note that Project Pricing included herein is valid for 120 days from the date of this proposal.

Invoicing Schedule		
Service	**Fee**	**Invoicing Period**
Project Planning and Mobilization	$ 78,750.00	Upon submittal of the PPD
PipeDiver Inspection and Pressurized Insertion	$228,000.00	Upon completion of the onsite inspection work
Draft Inspection Report	$18,000.00	Upon delivery of the Draft Inspection Report
Draft Condition Assessment Report	$30,000.00	Upon delivery of the Draft CAE Report
Final Condition Assessment Report and Geodatabase	$15,000.00	Upon receipt of comments on the Draft Reports

Standard Terms and Conditions

CONDITIONS OF ENGAGEMENT FOR THE PROVISION OF SERVICES (North America)

The Proposal is issued upon and is subject to these Conditions of Engagement. If the Proposal is accepted by the Client, these Conditions of Engagement and the Proposal will be deemed to form part of the Contract between the Client and Pure.

1. DEFINITIONS

In these Conditions of Engagement the following definitions apply:

"Client" means any person or persons, firm or company engaging Pure to provide the Services.

"Contract" means the agreement awarded to Pure as a result of the Proposal.

"Pure" means Pure Technologies Ltd., Pure Technologies U.S. Inc., PureHM Inc., PureHM U.S. Inc. or any of their affiliates, as the case may be, which submitted the Proposal and is a party to the Contract.

"Proposal" means Pure's offer to carry out the Services and includes all related correspondence plus agreed written variations or amendments thereto.

"Services" mean those services of whatever nature to be supplied by Pure under the Contract.

"Site" means the facility, land, installation or premises to which Pure is granted access for the purposes of the Contract and may include any combination of the foregoing.

2. PURE'S OBLIGATIONS

2.1 Pure will perform the Services in accordance with the procedures described in the Proposal, using reasonable skill, care and diligence and consistent with industry standards.

2.2 Pure will ensure that the equipment used in performing the Services is in a good and functional state.

3. CLIENT'S OBLIGATIONS

3.1 The Client will provide to Pure full, good faith co-operation to assist Pure in providing the Services. Unless otherwise specified in the Proposal and without limiting the generality of the foregoing, the Client will at its own expense:

(i) ensure, if required, access to private land will be given to Pure and that any official permits or permissions required for Pure to have access to the Site or carry out the Services are obtained and are in force for the duration of the Services;

(ii) inform Pure in writing of any special circumstances or danger which the execution of the Services may entail or which are inherent in the Site, including the existence and identity of any known hazardous substance or material;

(iii) perform such additional duties and responsibilities and provide such information and resources as are described in the Proposal.

3.2 The description of the Services and related compensation amount set out in the Proposal will be based upon information that the Client shall have provided to Pure, and assumptions that Pure shall have identified in the Proposal. The Client acknowledges that if any such information provided by Client is materially incomplete or inaccurate, or if the assumptions identified by Pure are not correct, then the parties will modify the Proposal to reflect the actual information, assumptions, and Services required, and the compensation to Pure will be adjusted accordingly using the change order process set out in the Contract, or if there is no such process, on an equitable basis.

3.3 Client will pay Pure within 30 days of Client's receipt of an invoice therefrom. Client acknowledges that Pure is entitled to payment for any and all Services performed hereunder up and until the date of the full completion of such Services.

3.4 Upon Client's termination of the provision of Services or any goods by Pure hereunder, Pure will be entitled to payment for any and all goods and Services provided up to and until the date Pure receives notice of termination from Client. Such payments will be at the rates as provided to Client in the Proposal.

3.5 The pricing provided in the proposal shall remain firm for 12 months from the date hereof. Thereafter, in recognition of the current inflationary environment and potential of labor and component cost increases to Pure, a price adjustment may be requested by Pure to account for such cost increase.

4. PROPRIETARY AND CONFIDENTIAL INFORMATION

4.1 All reports generated in the performance of the Services and delivered by Pure to the Client will become the property of the Client.

4.2 Pure's equipment which is made available to the Client in connection with the Contract and the raw data generated in the performance of the Services will remain the sole and exclusive property of Pure. The Client will not acquire any proprietary rights in Pure's equipment, systems, software, technology, inventions (whether or not patentable), patents, patent applications, documentation, specifications, designs, data, databases, methods, processes or know-how ("Pure's Proprietary Technology"). Any modifications or improvements to the Pure's Proprietary Technology made during the performance of the Services will be the sole and exclusive property of Pure.

4.3 Both parties agree to keep confidential all documentation and information provided by the other during the performance of the Contract. The obligations set out in this clause 4.3 will remain in full force and effect after any termination or expiry, as the case may be, of the Contract.

4.4 Notwithstanding anything herein to the contrary, Contractor will have a limited, non-exclusive, royalty-free license to utilize data collected and received in the performance of services hereunder for purposes of (a) providing services, (b) analyzing and improving the services, and (iii) internal research and development for the benefit of Contractor and Client's clients.

5. LIABILITY AND WARRANTIES

5.1 Pure will indemnify and hold the Client harmless against any expense, demand, liability, loss, claim, lawsuit or proceeding whatsoever in respect of personal injury to or the death of any person, or any loss, destruction or damage to any tangible property and arising directly or indirectly from the negligence of Pure, its employees, servants or agents except

to the extent caused by the negligence of the Client or any person for whom the Client is responsible. The Client will similarly indemnify Pure.

5.2 Pure will not be liable for any loss of production, loss of use of property, loss of revenue or profit, equipment downtime, business interruption, loss of goodwill, loss of anticipated savings, cost of procurement of substitute goods or services, or for any consequential, indirect, incidental, or special loss or damage suffered by the Client or any third party, or for any punitive damages, even if advised of the possibility thereof and notwithstanding the failure of essential purpose of any remedy.

5.3 Pure's cumulative liability hereunder, whether in contract, tort, or otherwise, will in no event exceed the greater of (i) the aggregate consideration paid by the City to Pure for the portion of the Services that gave rise to the liability, or (ii) $2 million; provided, however, that this clause shall not limit Pure's indemnification obligations hereunder. The report(s) and any other recommendations or advice made by Pure relating to the pipeline or the Services will be made in accordance with the procedures described in the Proposal, using reasonable skill, care and diligence consistent with industry standards, but do not and will not constitute a warranty of the pipeline's quality, capacity, safety or fitness for purpose. Pure will not be liable to the Client for any liability or damages that arise from the Client's reliance upon or application or use of such final report or recommendations or advice made by Pure in relation to the pipeline or Services, and the Client will indemnify Pure against any liability to third parties resulting therefrom.

5.4 Pure's warranties for the Services will be set out in the Contract. Pure disclaims all implied or statutory warranties or conditions, including of merchantability, merchantable quality, durability, or fitness for particular purpose to the extent allowed by applicable law. This means Pure's warranty obligations will be limited to what is expressly set out in the Contract.

6. INSURANCE

Pure will provide the Client with a certificate of insurance evidencing the following coverages:

6.1	Commercial General Liability	$2,000,000
6.2	Automobile Liability	$1,000,000
6.3	Workers Compensation	Statutory
6.4	Professional Liability	$500,000

7. SPECIAL CONDITIONS/ACKNOWLEDGEMENT OF EVENTS.

Pure and Client (the "Parties") acknowledge and agree that the global COVID-19 pandemic ("COVID-19") is ongoing, dynamic, unpredictable, and as such may impact the ability of Pure to meet its obligations under this Agreement. The Parties agree that, for so long as there is an impact of COVID-19 on Pure's performance, all performance efforts by Pure will be on a reasonable efforts basis only and Pure shall not be responsible for failure to meet its obligations, to the extent that it is precluded from doing so as a result of COVID-19. The Parties shall work, in good faith, to make any reasonable adjustments that may be required as a result of COVID-19.

Appendix A - Inspection Considerations

Insertion and Extraction

The PipeDiver tool is typically inserted through a minimum 12-inch (300 mm) access port; however, a 16-inch (350 mm) access is recommended if installing a new tap. For insertion, a brief shutdown and depressurization of the pipeline will be required to allow a flanged access to be removed and the PipeDiver tool inserted. Once the tool is placed in the pipe, the flange is replaced, and the pipeline is returned to operation. From the time the access point is depressurized, the process typically takes two hours. Depending on the pipeline configuration, equipment may be installed to hold the PipeDiver tool in place during the refill and re-pressurization process. Once optimal flow conditions are met, the tool will be released to perform the inspection.

There are various methods by which the PipeDiver tool can be extracted from the pipeline. Typically, a net is installed into the pipeline during a brief shutdown and depressurization that will stop the PipeDiver tool at the end of an inspection. Once in the net a second depressurization is required to remove the tool and net from the pipeline through a minimum 12-inch access.

Alternative methods for insertion and extraction, such as utilizing pressurized insertion and extraction tubes or retrieval from a reservoir using a remotely operated vehicle (ROV), are possible and can be evaluated by the PipeDiver technical team for feasibility.

Tracking PipeDiver

Prior to the inspection, tracking sensors will be installed along the pipeline to track the position of the PipeDiver tool. The tracking sensors function best when they are installed as close as possible to the water column in the pipeline and are attached to metal surfaces of pipeline appurtenances, such as air release valves, flanges, valves, or any other contact point on the pipeline. At these locations, Pure Technologies staff will adhere the tracking sensors to the pipeline using a fast-drying epoxy. Computers that are synchronized with the PipeDiver will be attached to the tracking sensors to calculate the location and velocity of the PipeDiver as it approaches and passes the tracking location. Tracking teams will set up at tracking sensors before deploying the PipeDiver and will leap-frog to subsequent tracking locations as the PipeDiver traverses the pipeline on its way to the extraction point. A tracking plan and details for installing tracking sensors will be included in the PPD submitted to Novi prior to the inspection.

Flow Requirements

Each PipeDiver configuration requires specific fluid velocity for optimum data quality, traversing slopes and allowing the tracking teams to relocate to the next tracking location. Fluid velocity guidelines are found on the PipeDiver technical data sheet. The PipeDiver usually travels at approximately 90% of average fluid velocity. Novi staff will control the flow rate to confirm the requisite velocity during tool deployment as requested in the PPD. Pure Technologies will also evaluate pumping rates and cycle times to determine if supplemental water will be required to complete the inspection. Flow changes during the inspection may be needed to assist the tools in navigating obstacles in the pipeline or for contingency measures.

Pipeline Pressure

Maximum allowable pressure varies by PipeDiver configuration and is found on the PipeDiver technical data sheet. For pipelines with river crossings, the resultant hydrostatic head should be taken into consideration. Novi staff will operate the system to maintain pipeline pressures as necessary to accommodate the needs of its customers. A review of the pipeline will be performed as part of the planning process to identify potential areas where the maximum pressure might be exceeded. Approximate pressure measurements may be requested prior to and/or during the inspection to ensure the pipeline is operating within expected conditions.

Project Risks

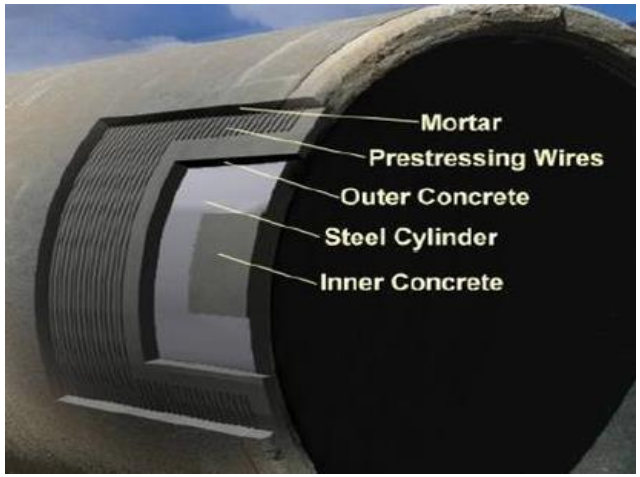
Despite meticulous planning and preparation, live pipeline inspection involves inherent risk that cannot be avoided. There is always a possibility that the inspection platform could encounter problems during the inspection run that could lead to loss of data, requiring a re-inspection or, at worst, the tool getting stuck in the pipeline due to unforeseen or unknown obstructions. The team will work closely with Novi to identify and mitigate any potential risks.

Department of Public Works
Water and Sewer Division

Pre-Stressed Concrete Pipe Assessment and Inspection Program 2019

Pre-Stressed Concrete Cylinder Pipe from GLWA Break 14 Mile Main Break

PCCP Overview



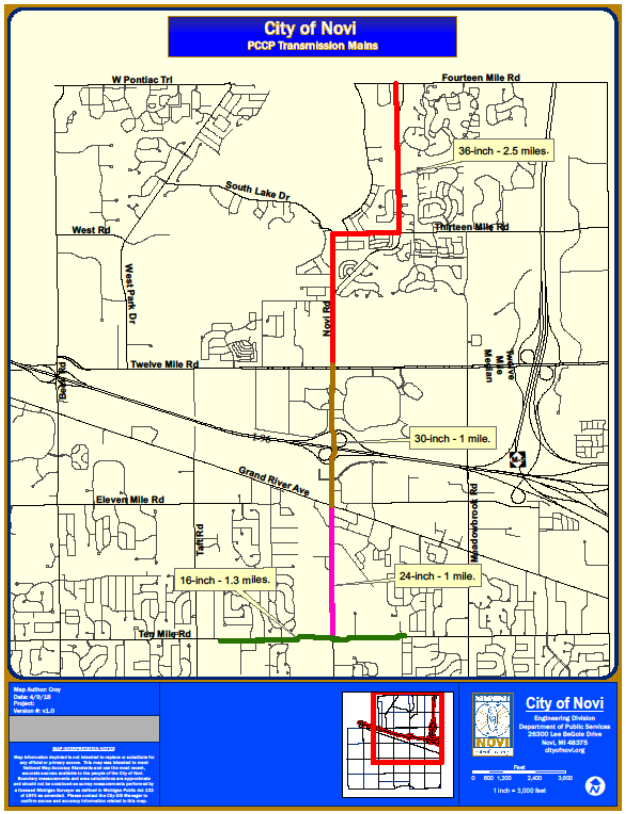
- PCCP is commonly found in water mains
- PCCP can range in size from 16” to 20’ diameter
- A prestressed wire is wrapped helically around the pipe providing resistance to internal pressure and external loads
- Designed to handle high pressures

Types of PCCP Failures

Corrosion

Hydrogen Embrittlment

City has 2.5 Miles of 36”, 1 Mile of 30”, 1 Mile of 24” and 1.3 Mile of 16” PCCP water main. This is the primary water service for the majority of Novi.

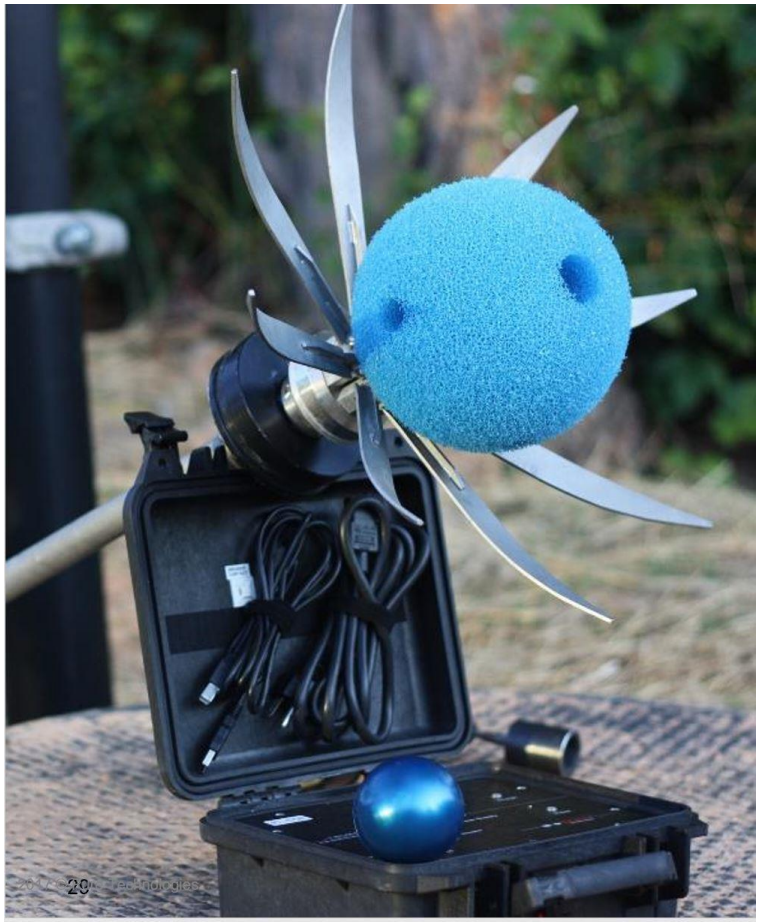


Our goal is to reduce your capital expenditures by focusing repair/rehab/replacement on bad pipe

PCCP Inspection Toolbox

- Transient pressure monitoring
- Leak and air pocket detection (Smart Ball)
- Structural pipe wall inspections - counting wire breaks (Pipe Diver)
  - Electromagnetics
  - Visual and Sounding
  - Forensic investigation and design review
  - Structural assessment
  - Remaining useful life
- Acoustic fiber optic (AFO) monitoring for wire breaks – (Option)

In-line Acoustic Leak & Gas Pocket Detection



- Free Swimming/ Non-Tethered Hydrophone
- Technology
- Locates leaks and gas pockets in transmission or force mains
- Launch and retrieve in live flow through
- 4” openings

Structural Pipe Inspection

External

Diameter: Any

Pipe segments excavated to springline

Manned system

Free-Swimming

Diameter: 16”+

Pipeline In Service

Free swimming

*SONAR

*CCTV recording

PCCP Pipe Inspection Proposal

- SmartBall – Identification and location of any leaks and/or air pockets in the pipeline as well as ARV installation recommendations.
- PipeDiver - Identification and location of the estimated number of broken prestressing wire wraps within each PCCP pipe section inspected.
- Xylem will also provide transient pressure monitoring and structural modeling (FEA curves) to determine the significance of any defects detected.
- Pure Technologies typically provides a presentation summarizing draft results to stakeholders to facilitate review of the draft report.

Summary

- Budgeted in 2019-2020 FY
- Scheduled to start fall 2019
- Preventitive and proactive maintenance with the goal to prevent a catastrophic failure
- Failures result in $$$ and loss of service
- Projects can be planned and more cost effective with control of service maintained
- Same program GLWA just completed first phase of inspection