Incident Report for 120-inch Water Transmission Main Break of August 13, 2022

December 20, 2022

Prepared by:

Todd King, P.E., Field Services Director

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List of Abbreviations

BWA	Boil Water Advisory
CEO	Chief Executive Officer
COO	Chief Operating Officer
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EOC	Emergency Operations Center
FAQ	Frequently Asked Questions
GCDC	Genesee County Drain Commissioner
GLWA	Great Lakes Water Authority
IMC	Imlay City Booster Pump Station
LHWTP	Lake Huron Water Treatment Plant
LSIP	Linear System Integrity Program
MGD	Million Gallons per Day
NEWTP	Northeast Water Treatment Plant
NSC	North Service Center Booster Pump Station
PCCP	Pre-stressed Concrete Cylinder Pipe
psi	Pounds per Square Inch
SCC	GLWA Systems Control Center
SEOC	State of Michigan Emergency Operations Center
SCCEOC	St. Clair County Emergency Operations Center

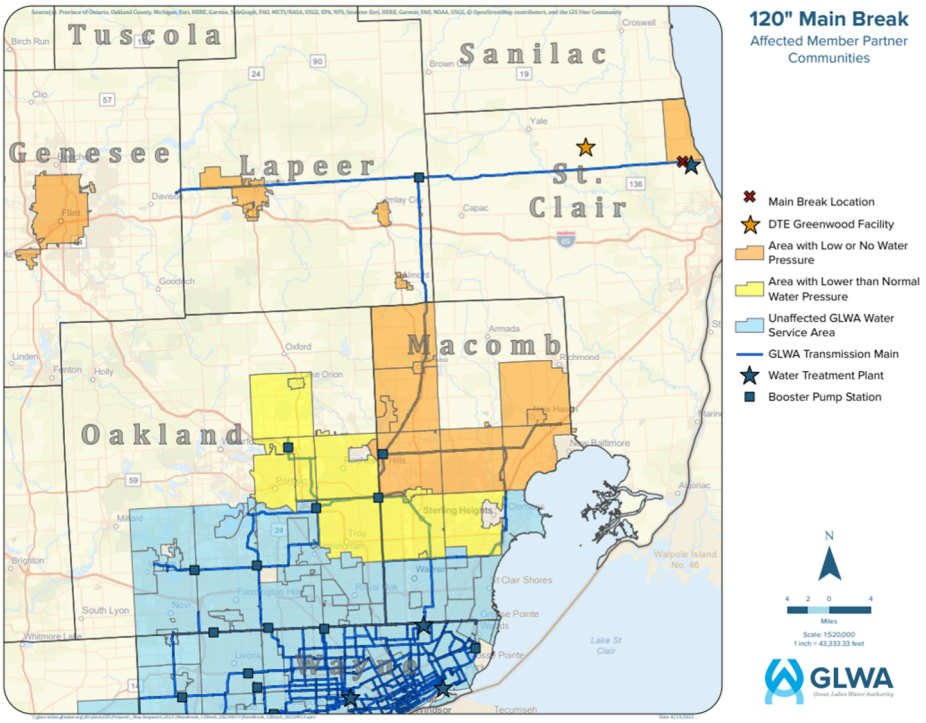
Executive Summary

On Saturday, August 13, 2022, at approximately 4:30 AM, a sudden drop in pressure occurred in the 120-inch diameter water transmission main (the main) operated by the Great Lakes Water Authority (GLWA) between the Lake Huron Water Treatment Plant (LHWTP) and the Imlay City Booster Pump Station (IMC). At the time, the LHWTP was providing over 25 percent of the potable water to the GLWA transmission system, with an estimated flow rate of approximately 162 million gallons per day (MGD). GLWA team member from the LHWTP investigated to the west of the plant and found extensive flooding of a farmer's field approximately one-half mile due west of the facility.

GLWA Field team members and contractors mobilized to the site and a large debris field and hole were discovered over the alignment of the main. A catastrophic failure of the main, whose material of construction was pre-stressed concrete cylinder pipe (PCCP), was determined to be the cause of the pressure drop and flooding. GLWA activated its Emergency Operating Center (EOC) and designated Cheryl Porter, Chief Operating Officer for Water and Field Services, as its incident commander.

Initially, GLWA issued a precautionary boil water advisory (BWA) for 23 communities with an estimated 935,000 persons affected:

- Village of Almont
- City of Auburn Hills
- Bruce Township
- Burtchville Township
- Chesterfield Township
- Clinton Township
- City of Flint
- Flint Township
- City of Imlay City
- Lenox Township
- Macomb Township
- Mayfield Township
- Village of New Haven
- Orion Township
- City of Pontiac
- City of Rochester
- City of Rochester Hills
- Industrial Park in Romeo
- Shelby Township
- City of Sterling Heights
- City of Troy
- City of Utica
- Washington Township



Based on further review of GLWA's pressure data later in the day, the precautionary BWA was lifted for City of Auburn Hills, Clinton Township, the City of Flint, Flint Township, the City of Lapeer, Orion

Township, the City of Pontiac, the City of Rochester Hills, the City of Sterling Heights, the City of Troy, and the City of Utica, since it did not appear that water pressure in these communities fell below the 20 pounds per square inch (psi) threshold for declaring a BWA. In addition, the City of Romeo BWA was reduced to only cover the industrial park served by the GLWA system.

GLWA team members and emergency contractors Ric-Man Construction and Lakeshore Global Corporation mobilized to the site to isolate the break, stabilize the system, and begin repairs. In addition, HDR, GLWA's engineering consultant for its Linear System Integrity Program (LSIP), began investigations to support forensic analysis of the cause of the break and determine if any pipe segments showed signs of distress that should be addressed prior to the repair being completed.

Recovery actions were initiated to redirect flow from the North Service Center Booster Pump Station (NSC) north through the 96-inch transmission main between NSC and IMC. Pressures were partially restored to customers along the 96-inch main throughout the day and were near normal by 5p.m. on Sunday, August 14, 2022.

Immediately after the break, the City of Flint requested increased flow from the Genesee County Drain Commissioner (GCDC) and did not experience any loss of service to its distribution customers. Efforts to repair the 120-inch main were initiated on Saturday, August 13 with pumps and equipment being mobilized to the site. The 120-inch repair/closure piece with a laying length of 16-feet was priority shipped from Texas to the site and arrived on Sunday, August 14. However, when the pipe was fully excavated, it was determined that a minimum of two 16-foot-long pipe lengths would require replacement. An order for three additional pipe lengths was placed with the Thompson Pipe Company and expedited manufacturing of the order was initiated at their South Beloit, Illinois facility.

The Cities of Lapeer and Imlay City, and the Village of Almont each began use of their independent emergency connection to provide water to their distribution systems on August 13. There was one portion of the Imlay City system that could not be served to the north of the city. In addition, the Detroit Edison (DTE) Greenwood Power Generation Facility could not be served while the 120-inch was out of service.

By Sunday, August 14 at 11:30 a.m., BWAs were lifted for all but seven communities: Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, Washington Township, DTE Greenwood, and the Romeo industrial park representing an impacted population of approximately 133,000 people.

With additional adjustments to the GLWA transmission system, and requisite water quality sampling results, the BWAs were lifted for the remaining seven communities by August 20.

The 120-inch main was dewatered for inspection by GLWA consultants HDR, Xylem/Pure Technologies, and Pipeline Inspection & Condition Analysis Corporation (PICA), to determine if there was any evidence of distressed piping through visual and electromagnetic investigations. Investigations were completed without impact to the repair schedule.

The replacement pipe was delayed at the manufacturer's facility and did not arrive onsite until August 28. Repairs continued and a total of three 16-foot lengths of pipe were replaced. Each joint was welded, and the repair was completed on September 2. Filling of the 120-inch main began and the main was flushed and disinfected. After clearance from the GLWA Water Quality staff, the main was returned to

service on September 30, and the system was restored to its normal flow pattern with flow from LHWTP to the IMC, and flow south through the 96-inch main to NSC.

The City of Flint flushed and monitored its 72-inch main from GLWA prior to restoring normal service on October 13.

This is the second catastrophic failure of this main in the nearly 50 years it has been in service. The first break, reported in 1985, has little surviving information with respect to the cause, and was approximately one-half mile to the west of the August 13, 2022 break.

This report is prepared in accordance with the rules promulgated under Michigan's Safe Drinking Water Act (1976 PA 399, MCL 325.1005), specifically Rule 2304 (R325.12304 Emergency procedure) which requires:

> (2) A public water supply shall, within 90 days after an emergency, file a written report with the department outlining in detail its discovery, the cause, the corrective actions taken by the public water supply to meet the emergency, and the procedures by which its customers or users were notified. The report shall outline in detail the area of the waterworks system affected by the emergency, its duration, and the ability of the public water supply to cope with the emergency by providing an adequate supply of safe drinking water.

1.0 Introduction

The largest diameter water transmission main in the GLWA system extends approximately 26 miles from the Lake Huron Water Treatment Plant (LHWTP) to the Imlay City Booster Pump Station (IMC). The 120-inch diameter main was installed in the early 1970s and has a normal operating pressure of up to 200 psi.

The main is constructed using prestressed concreted cylinder pipe (PCCP). PCCP is an engineered piping system that consists of a steel cylinder and concrete with reinforcing wire wrapped around the outside in order to withstand the design operating pressure. A cross section of the pipe at the joint is shown in Figure 1.

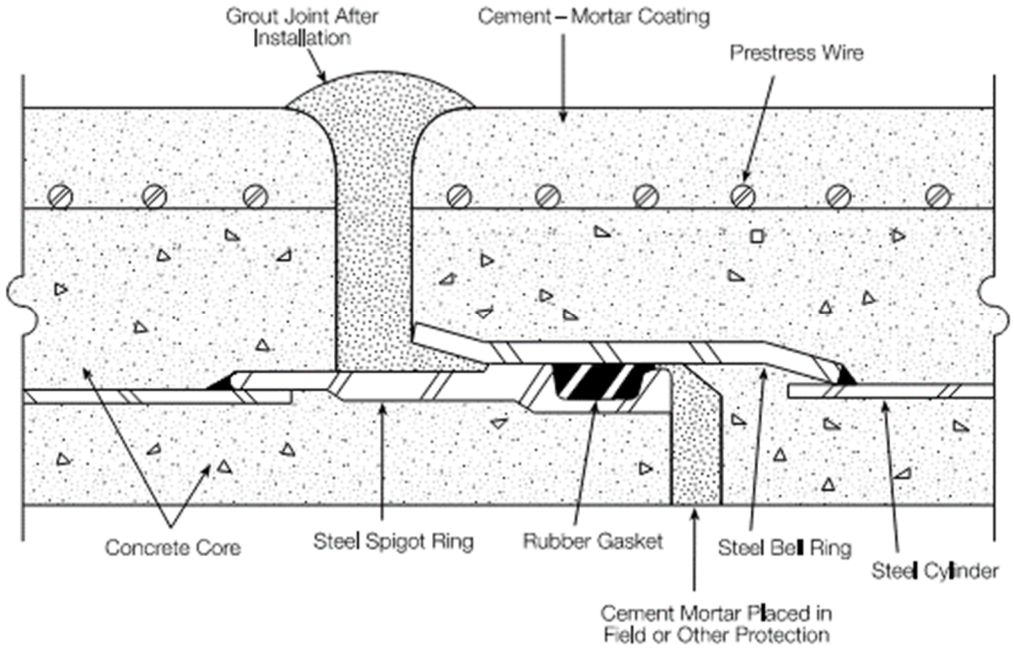


Figure 1 – Cross section of PCCP main at joint

Because the steel cylinder alone cannot withstand the operating pressure of the main, when a number of prestress wires are compromised via corrosion or other means, the pipe fails catastrophically. [1]

This main reportedly failed in 1985 but has had no other issues prior to this event. Evidence of the repair was found approximately one-half mile west of this break during the internal inspections conducted by HDR and Xylem.

The 120-inch main directs potable water from the LHWTP to the west and terminates at the IMC. From there, a 72-inch main serves customers to the west up to the City of Flint. At IMC, a 96-inch main directs water south and provides water to the Rochester Pump Station and terminates at the North Service

[1] Andrew Romer, Ellison, D., Bell, G. Clark, B. "*Failure of Prestressed Concrete Cylinder Pipe", Awwa Research Foundation, 2008.*

Center (NSC). Normally, 20 to 30 percent of the overall GLWA system drinking water flows are provided by the LHWTP.

A map of the 26-mile long, 120-inch diameter main with major roads, pump stations, and master meters is shown in Figure 2.

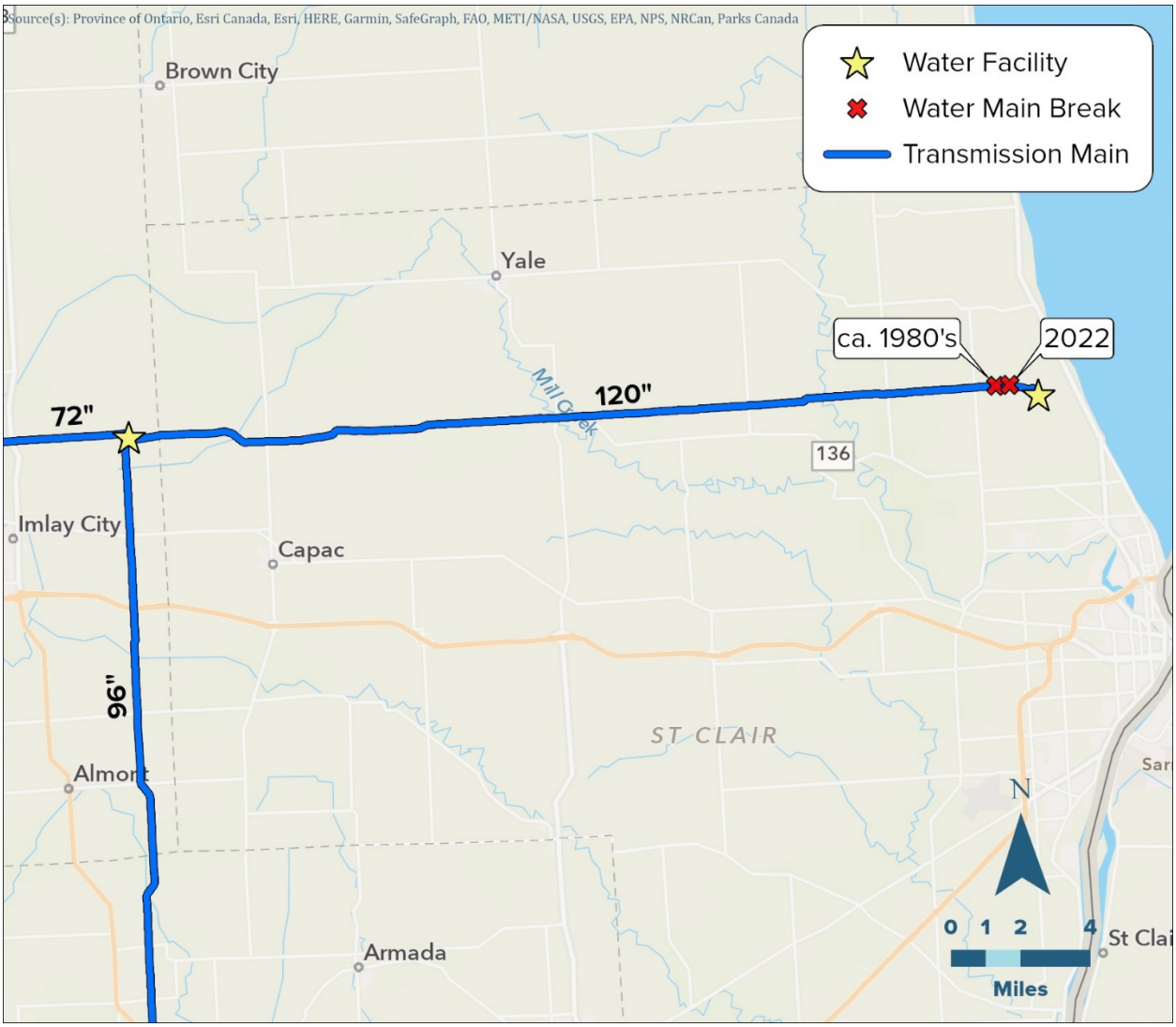


Figure 2 – Route of 120-inch Transmission Main

Although the NSC was originally designed to pump water from the City of Detroit-based water treatment facilities (primarily the Northeast WTP) to Flint in the 1970s, this mode of operation had not been used in more than 30 years.

2.0 Background

The 120-inch main is the largest diameter and highest operating pressure transmission main within the GLWA water transmission system. The main has been in continuous service since the mid-1970s with the exception of one reported break in 1985. The main is the sole conduit to transmit finished water from the LHWTP west to the IMC. Potable water can be directed to the 20-million-gallon reservoir and repumped during peak demand or bypassed around the station during low demand. From the IMC, flow can be pumped or bypassed to the 72-inch main that runs west and serves the cities of Flint, Lapeer, and Imlay City and the 96-inch main that runs south to serve the NSC and member partners along the way.

PCCP is typically made in large diameters (greater than 24-inches) and failures of PCCP are typically catastrophic and costly.[2] There are over 100 million feet of PCCP installed in the United States and GLWA has approximately 2.3 million feet of PCCP in service with diameters of up to 120 inches. The 120-inch PCCP main was manufactured by Interpace (then known as International Pipe & Ceramics) in 1968. According to the American Water Works Association (AWWA) Research Foundation Report completed in 2008, PCCP manufactured in 1970 experience a failure rate of approximately one for every 10,000 lengths of pipe made.

This is the second catastrophic failure of this main in the nearly 50 years it has been in service. The first break, reported in 1985, has little surviving information with respect to the cause, and was approximately one-half mile to the west of the August 13, 2022 break.

[2] "Failure of Prestressed Concrete Cylinder Pipe," A. E. Romer, D. Ellison, G. Bell, B. Clark; AWWA Research Foundation and US EPA, 2008, p. xvii.

3.0 Timeline

On Saturday, August 13, 2022, at approximately 4:30 a.m., a sudden drop in pressure was noted in the master water meters served by GLWA along the 120-inch Water Transmission Main (the main) as shown in Figure 3.

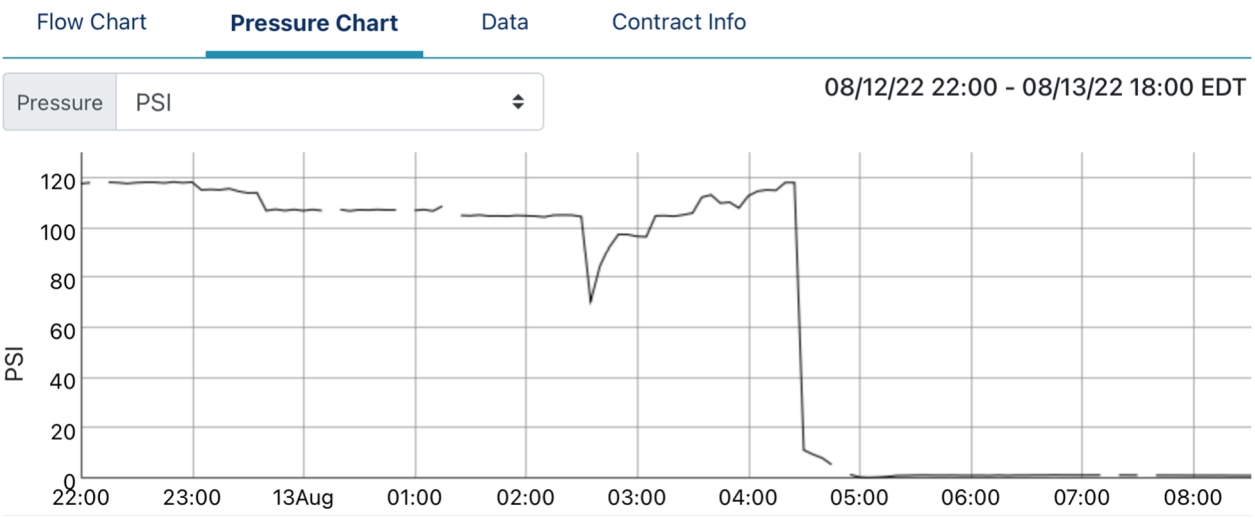


Figure 3 – Pressure at Greenwood Township Meter SN-01, August 12-14, 2022

GLWA team members, and GLWA's emergency contractors, Ric-Man Corporation and Lakeshore Global Corporation, mobilized to the site immediately that night to secure the area of the break and begin isolation and recovery procedures. The water main break resulted in temporary extensive flooding in the area but was in the middle of a farmer's field and caused no damage to nearby residences.

Figure 4 – Water main break on 120-inch Transmission Main, approximately 1/2 mile west of LHWTP

Figure 5 – Portion of the inner cylinder located approximately 100 feet from the break and aerial view of break

At the time, the LHWTP was providing over 25 percent of the potable water to the GLWA water transmission system with an estimated flow rate of approximately 162 million gallons per day (MGD). GLWA team members from the LHWTP investigated and found extensive flooding of a farmer's field approximately one-half mile due west of the facility.

GLWA Field staff and contractors mobilized to the site where a large debris field and water filled hole were discovered over the alignment of the main. A catastrophic failure of the main, whose material of construction was pre-stressed concrete cylinder pipe (PCCP), was determined to be the cause of the pressure drop and flooding. GLWA activated its Emergency Operating Center and designated Cheryl Porter, Chief Operating Officer for Water and Field Services as its incident commander.

Initially, GLWA issued a precautionary boil water advisory (BWA) for 23 communities with an estimated 935,000 persons affected:

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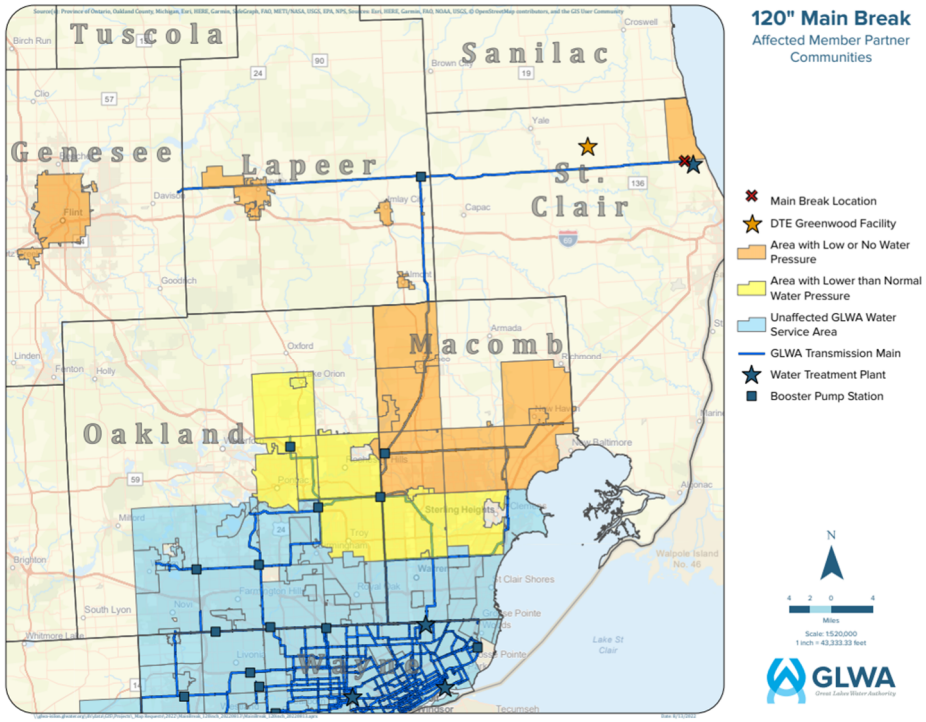

Figure 6 - Affected service area

Based on further review of GLWA's pressure data later in the day, the precautionary BWA was lifted for City of Auburn Hills, Clinton Township, the City of Flint, Flint Township, the City of Lapeer, Orion Township, the City of Pontiac, the City of Rochester Hills, the City of Sterling Heights, the City of Troy, and the City of Utica since it did not appear that water pressure in these communities fell below the 20 pounds per square inch (psi) threshold for declaring a BWA.

GLWA team members and emergency contractors, Ric-Man Construction and Lakeshore Global Corporation, mobilized to the site to isolate the break, stabilize the system, and begin repairs. In addition, HDR, GLWA's engineering consultant for its Linear System Integrity Program (LSIP) began investigations to support forensic analysis of the cause of the break and determine if any pipe segments showed signs of distress that should be addressed prior to the repair being completed.

Recovery actions were initiated to re-direct flow from the North Service Center Booster Pump Station (NSC) north through the 96-inch transmission main between NSC and IMC. By reversing flow at the NSC, something that had not been attempted in nearly 50 years, GLWA was able to pump water north through the 96-inch main to feed the Rochester Booster Pump Station, Romeo (Industrial Park), Bruce Township, Washington and Macomb Townships, and the Village of Almont. Near normal pressures were restored by the evening of Sunday, August 14.

Immediately after the break, the City of Flint requested increased flow from the Genesee County Drain Commissioner (GCDC) and did not experience any loss of service to its distribution customers. GCDC also opened an emergency connection to the City of Flint 72-inch transmission main immediately west of the

Potter-Baxter valve. GCDC estimated that they were providing 2-5 MGD in addition to supplying the City of Flint's average demand of 14 MGD.

Efforts to repair the 120-inch main were initiated on Saturday, August 13, with pumps and equipment being mobilized to the site. The 120-inch repair/closure piece with a laying length of 16-feet was priority shipped from Texas to the site and arrived on Sunday, August 14.

Figure 7 - Portion of repair pipe from Texas

Figure 8 - Pumping water at break site

However, when the pipe was fully excavated, it was determined that a minimum of two additional 16-foot-long pipe lengths would require replacement. An order for three additional pipe lengths was placed with the Thompson Pipe Company and expedited manufacturing of the order was initiated at their South Beloit, Illinois facility.

The Cities of Lapeer and Imlay City, and the Village of Almont each began use of their independent emergency connection to provide water to their distribution systems on August 13. There was one portion of the Imlay City system that struggled to meet pressures served to the north of the city. In addition, the Detroit Edison (DTE) Greenwood Power Generation Facility could not be served while the 120-inch was out of service.

By Sunday, August 14 at 11:30 a.m., BWAs were lifted for all but seven communities: Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, Washington Township, DTE Greenwood, and the Romeo industrial park representing an impacted population of approximately 133,000 people.

With additional adjustments to the GLWA transmission system, and requisite water quality sampling results, the BWAs were lifted for the remaining seven communities by Saturday, August 20.

The 120-inch main was dewatered for inspection by GLWA consultant HDR, to determine if there was any evidence of distressed piping through visual and electromagnetic investigations. Investigations were completed without impact to the repair schedule. PICA inspected 0.5 miles east of the break and 1.0 miles west of the break and the report is included as Appendix C. Pure Technologies inspected 0.62 miles to the east of the break (Appendix D) and 3.77 miles to the west of the break (Appendix E).

The pipe was cut with a wire saw in order to minimize potential damage to the joints of the remaining pipes and carefully lifted out in sections by crane, as shown below.

Figure 9 - Wire cutting and lifting section of main

GLWA has initiated a LSIP under the direction of its Planning Services Group. The program is supported by the engineering firm HDR and has contingency funds to provide GLWA engineering support to respond to transmission main emergencies. Staff from HDR and their subcontractors Xylem/Pure Technologies and Pipeline Inspection & Condition Analysis Corporation (PICA) were mobilized to the site to inspect the isolated portion of the main. Tools included electromagnetic survey to locate wire breaks, and visual/sounding inspections to determine if there was evidence of imminent failure of a pipe section. The PICA team inspected approximately 1.58 miles of pipe on August 23-24. The Xylem/Pure Technologies team inspected 4.4 miles of pipe August 22-25.

The preliminary indications from the surveys were that there was no unacceptably distressed pipe beyond the three pipe segments removed to complete the repairs.

Figure 10 - Preparing for manned inspection of pipe

The replacement pipe was delayed at the manufacturer's facility and did not arrive onsite until August 28. Repairs continued and a total of three 16-foot lengths of pipe were replaced. Each joint was welded, and the repair was completed on Friday, September 2. Filling of the 120-inch main began and the main was flushed and disinfected. After clearance from the GLWA Water Quality Team, the main was returned to service on Friday, September 30, and the system was restored to its normal flow pattern with flow from LHWTP to the IMC, and flow south through the 96-inch main to NSC. All GLWA requested restrictions on water use were lifted at this time.

The City of Flint restored normal service on October 13, 2022.

4.0 Discussion

The main break resulted in a water emergency[3] with the loss of pressure and lack of adequate water supply to the impacted service area. In accordance with Michigan Department of Environment, Great Lakes, and Energy (EGLE) Rule R325.12304[4], GLWA has prepared this report that outlines the discovery, cause, corrective actions, and procedures by which the public was notified of the emergency. It also describes the area of the waterworks system affected, its duration and the ability of GLWA and affected member partners to cope with the emergency. Through intergovernmental cooperation, an adequate supply of safe drinking water was maintained to people within the region, and water service was provided to all customers, except the DTE Energy Greenwood Township facility, at nearly normal pressures through the inspection and repair process.

4.1 Discovery

The water main break was discovered almost immediately by GLWA operators in the Systems Control Center (SCC). There were no high-pressure fluctuations recorded prior to the pipe failure.

GLWA team members were on site within two hours. Since the 120-inch was feeding the IMC reservoir during peak season, the break was isolated within five hours once the LHWTP was offline. The 108-inch butterfly valve was closed at LHWTFP to allow service to Burtchville to be restored. Corrective actions were conducted initiated on a 24-hour basis until the transmission main was inspected. Delays in the manufacture of the replacement pipe resulted in substantial delays to the repair and work was limited to daylight hours. Once the repair sections were in place, welding was conducted on a 24-hour basis until repairs were completed.

4.2 Cause

The failure of PCCP has been studied by the water service sector throughout the nation. Over 100 million feet of PCCP is installed in the United States and the GLWA system has approximately 2.3 million feet of PCCP installed or 435 miles. While PCCP has been in use since 1942, the standards have changed over time. The overall failure rate of PCCP is about eight catastrophic failures for every 100,000 lengths of pipe made. However, PCCP manufactured from 1968 to 1971 were reported to fail just over once for every 10,000 lengths of pipe.[5] Figure 11 shows the area of the pipe failed at the bottom of the pipe. For

Figure 11 – Area of Pipe Failure

[3] As defined by Rule R325.10104(m) of the Michigan Administrative Code, accessed 12/20/2017 http://dmbinternet.state.mi.us/DMB/ORRDocs/AdminCode/1684_2017-008EQ_AdminCode.pdf

[4] Ibid.

[5] "Failure of Prestressed Concrete Cylinder Pipe," A. E. Romer, D. Ellison, G. Bell, B. Clark; AWWA Research Foundation and US EPA, 2008, p. 129, Table 5.1.

reference, GLWA has approximately 125,000 lengths of pipe installed.

A review of operational data by GLWA indicates that the operating pressure of the main did not exceed its design pressure of 200 psi at any time immediately leading up to the event. GLWA tasked HDR to study the water main failure to determine the probable cause(s) under its LSIP. The study reviewed operational records, field investigations, and laboratory testing of the failed pipe. Preliminary Inspection of the failed length of pipe indicates that the failure of the pipe appeared to be the direct result of the mortar coating being adversely affected by the environment allowing for a combination of corrosion and hydrogen embrittlement induced damage of the prestressing wire.

4.3 Corrective Actions

Shortly after the water main break occurred, GLWA stood up its Emergency Operations Center and designated Cheryl Porter, Chief Operating Officer for Water and Field Services, as the incident commander. The initial response and corrective actions were focused on re-establishing water to as many customers as possible while the repairs to the 120-inch main were made. LHWTP team members closed the main 108-inch diameter butterfly valve which allowed them to build pressure and serve Burtchville. Pressure was restored by the evening of Saturday, August 13.

The morning of Sunday, August 14, Governor Whitmer declared a state of emergency for Lapeer, Macomb, Oakland, and St. Clair counties. By declaring the state of emergency, the Michigan State Police Emergency Management and Homeland Security Division was authorized to provide resources and coordinate and maximize State efforts to assist. The State Emergency Operations Center (SEOC) was activated at 4:00 p.m. on August 13 to support the St. Clair County EOC (SCCEOC), which was coordinating the overall response that was activated shortly after the break.

The remaining efforts to restore flow to the customers along the 96-inch and 72-inch mains normally fed by IMC were focused on altering valve positions at NSC to pump water north into the 96-inch main from NEWTP. Partial pressures were restored to the 96-inch by the evening of Sunday, August 14.

Although GCDC opened its emergency connection to the 72-inch main immediately west of the FL-01 master meter near the intersection of Baxter and Potter roads no significant water flow was being received by the City of Lapeer, Mayfield Township, or Imlay City.

GLWA maintains a fleet of three bulk water trucks which were dispatched on request to provide bulk water to residents. One-Gallon containers of bottled water were distributed by team members from

GLWA's Southwest Water Treatment Facility and coordinated through the SEOC and SCCEOC using established emergency distribution protocols.

GLWA, City of Flint, and GCDC staff continued to investigate the emergency connection issues and lack of water coming from the GCDC emergency connection. Finally, GLWA requested that the City of Flint close the FL-01 valve on August 25, and this allowed GLWA to increase pressure sufficiently on the 72-inch main to provide water to the City of Lapeer, Mayfield Township, and Imlay City. The City of Lapeer and Imlay City then discontinued use of their emergency connections for this event.

In order to complete the repair to the 120-inch main, two new 16-foot-long lengths of 120-inch diameter PCCP pipe were made by the Thompson Pipe Group at their facility in South Beloit, Illinois. The final pipe segment arrived on August 28 and the pipes were placed shortly thereafter. To avoid issues with potential gasket leaks, each joint was welded inside and out. Once welding commenced, welders worked on a 24-hour basis until the repair was completed on September 2, 2022.

4.3.1 Main Repair Disinfection and Sampling

The repaired main was filled, chlorinated, and flushed in two sections, the first from the LHWTP to the DTE Greenwood Facility was where the break, all manned inspections, and entry into the pipe had occurred. The second section, from Welch Road to the IMC, was never accessed except to place the dry chlorine at the access point of the pipe at Welch Road. The volume of water to fill the 120-inch main between LHWTP and IMC is approximately 81 million gallons.

Disinfection, pressure testing, flushing, and water analysis was completed as required under the Michigan Safe Drinking Water Act for new water mains and repairs (section R325.11109-10). After inspection of the replacement pipe by GLWA, the new 120-inch diameter pipe and repair sections were chlorinated by GLWA water quality staff according to AWWA CS651-14 disinfection standard using the slug method. Chlorine residuals were monitored by water quality staff during the flushing process. Once chlorine residuals returned to normal levels, bacteriological samples were collected and passed. The lab results are presented in Appendix B.

4.3.2 Restoration of Main to Service and Lifting of BWAs

The BWAs were lifted when three sets of samples collected on consecutive days met the requirements set forth in the 1976 Michigan Safe Drinking Water Act PA 399 and its amendments. Lab results are included under Appendix B. Emergency connections were closed and use discontinued once system pressures were stabilized. Each member partner made these decisions in coordination with GLWA and EGLE.

The main was restored to service on September 30, 2022, and all requested limits for reduced water usage were lifted. The City of Flint purged and sampled their 72-inch main and returned to normal GLWA service on October 13, 2022, ending the event.

4.4 Public Notice Procedures

The procedures to notify the public were conducted by the GLWA Public Affairs Officer via traditional media outreach, as well as social media posting and posting on GLWA's website, including an emergency banner update, in conjunction with SEOC, the SSCEOC and communications through our Member Outreach channels. GLWA initiated a regular, on-going cadence of communication throughout the main break, sometimes issuing two to three updates in one day, when necessary. Initially extensive coverage by local news stations occurred until normal operations were restored. GLWA and stakeholders worked together to develop unified messaging to the public, with GLWA taking the lead on communications and media response. News releases are provided in Appendix A.

4.5 Affected Areas

The affected areas for the BWA were described in the Executive Summary and Section 3.0, Timeline.

4.6 Duration of Event

The duration of the event was from August 13, 2022, at 4:30 AM through October 13, 2022, when the City of Flint returned to GLWA service. The approximate timeline of events was presented in Section 3.0.

4.7 Ability to Provide Adequate Supply of Safe Drinking Water

The ability of GLWA and Member Partners to provide an adequate supply of safe drinking water was accomplished using emergency interconnects, back up groundwater wells, emergency operations at the LHWTP, use of three GLWA bulk water carriers, and bottled water distribution through the SEOC and SSCEOC.

5.0 Conclusions

The following conclusions can be made about the main break based on the above discussion and attached appendices:

1) The pipe failure did not appear to be caused by an increase in system pressures;
2) The main break occurred during normal operating pressures; and
3) Preliminary Inspection of the failed length of pipe indicates that the failure of the pipe appeared to be the direct result of the mortar coating being adversely affected by the environment allowing for a combination of corrosion and hydrogen embrittlement induced damage of the prestressing wire.

6.0 Recommendations

The following are recommendations for changes in the design, operation, and/or response to the emergency for consideration by GLWA, Member Partners, and ELGE to consider based on the events of this main break:

1) GLWA is re-evaluating the proposed decommissioning of the Northeast WTP. This facility was key in providing water north through the 96-inch transmission main from NSC;
2) GLWA is considering unmanned interior in-service assessment of the 120-inch main using the Pure Technologies “Pipe Diver” electromagnetic frequency technology;
3) GLWA is considering lowering the operating pressure of the 120-inch transmission main to prolong the life of the asset;
4) GLWA, GCDC, and City of Flint are reviewing the data collected during this event to determine improvements to the emergency operations procedures.

GLWA
Great Lakes Water Authority

Appendices

Appendix A

GLWA News Releases

GLWA Statement on 120-Inch Water Main Break in Port Huron

FOR IMMEDIATE RELEASE

August 13, 2022

Media Contacts:

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/ michelle.zdrodowski@glwater.org

GLWA WORKING TO ISOLATE BREAK ON 120-INCH WATER TRANSMISSION MAIN IN PORT HURON; BOIL WATER ADVISORY BEING ISSUED FOR 23 COMMUNITIES

- *Transmission main is the largest in the regional water distribution system;*
- *An estimated 935,000 people in 23 communities, as well as one business in Greenwood and one business in Imlay Township, are potentially impacted;*
- *Out of an abundance of caution, a precautionary Boil Water Advisory is being issued for the 23 impacted communities.*

DETROIT – In the early morning hours of Saturday, August 13, 2022, the Great Lakes Water Authority (GLWA) discovered a leak on a 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area (*see attached map*). The 120-inch transmission main is the largest in the regional water distribution system.

Crews have identified the location of the leak, which is approximately one mile west of GLWA's Lake Huron Water Treatment Facility and are working to isolate the area around it so that repair work can begin. Once the leak is isolated, crews will begin to open emergency connections to other mains in the system to restore some flow to the impacted communities.

Due to changing water pressure levels, and out of an abundance of caution, GLWA is issuing a precautionary Boil Water Advisory for the following communities impacted by the break: the Village of Almont,

of Rochester, City of Rochester Hills, City of Romeo, Shelby Township, City of Sterling Heights, City of Troy, City of Utica, and Washington Township.

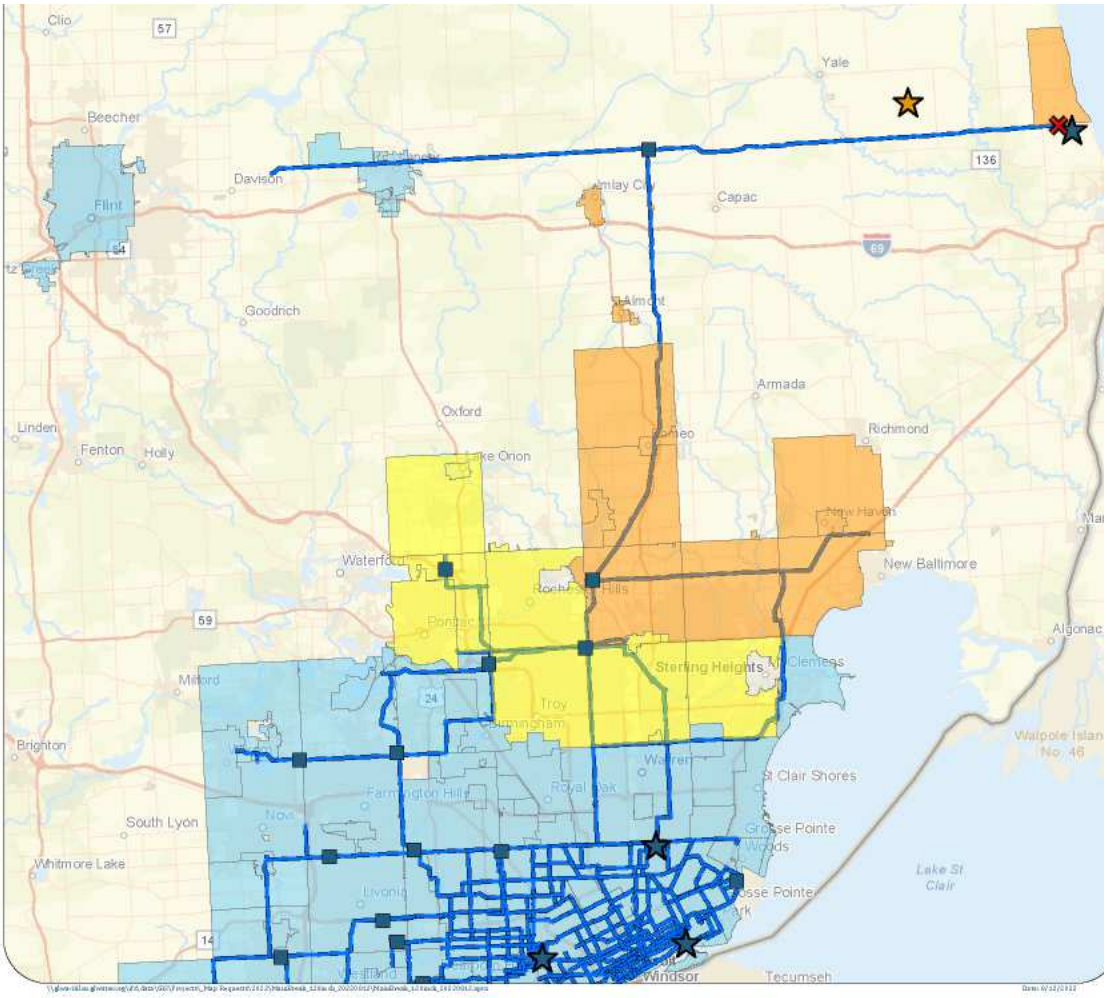
Under this precautionary Boil Water Advisory, residents should not drink the water without boiling it first. Residents must bring all water to a boil for at least one minute and then let it cool before using. Boiled, bottled or disinfected water should be used for drinking, making ice, washing dishes, brushing teeth, and preparing food until further notice.

Whenever a water system loses pressure for any significant length of time, precautionary measures are recommended since a loss of pressure can lead to bacterial contamination in the water system. Bacteria are generally not harmful and are common throughout our environment. Boiling water before using it will kill bacteria and other organisms that may be in the water.

GLWA is currently investigating the cause of the break. The Boil Water Advisory will remain in effect until results from sampling verify the water is safe to drink. GLWA Water Quality will advise the affected communities when the Boil Water Advisory has been lifted.

For more information, please contact Great Lakes Water Authority Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

The Authority will continue to provide updates as they become available.



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delivering the nation's best water and wastewater services to southeast Michigan.

Freedom of Information Act

GDRSS Portal

Update 1: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE **3:00 p.m.**

August 13, 2022

Media Contacts:

Molly Young / C: 248-917-2876 / molly.young@fleishman.com

Michelle Zdrodowski / C: 313-618-0552
/ michelle.zdrodowski@glwater.org

UPDATE 1: 120-INCH WATER TRANSMISSION MAIN BREAK AND BOIL WATER ADVISORY

- *Clinton Township, Flint, Flint Township, Rochester Hills, Pontiac, Auburn Hills, Orion Township, Utica, Troy, Sterling Heights and Lapeer removed from the precautionary Boil Water Advisory*
- *Village of Romeo added to the precautionary Boil Water Advisory*
- *Precautionary Boil Water Advisory now covers only 13 communities*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued earlier today.

Effective immediately, the precautionary Boil Water Advisory has been lifted for City of Auburn Hills, Clinton Township, the City of Flint, Flint Township, the City of Lapeer, Orion Township, the City of Pontiac, the City of Rochester Hills, the City of Sterling Heights, the City of Troy and the City of Utica. Based on further review of GLWA's water pressure data, it does not appear that water pressure in these communities fell below the 20psi threshold for declaring a Boil Water Advisory.

In addition, the Village of Romeo has been added to the precautionary Boil Water Advisory.

GLWA issued the precautionary Boil Water Advisory earlier today after it discovered a break on a 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area. The 120-inch transmission main is the largest in the regional water distribution system.

connections to other mains in the system to restore some flow to the impacted communities.

Communities that remain under a Boil Water Advisory include: the Village of Almont, Bruce Township, Burtchville Township, Chesterfield Township, City of Imlay City, Lenox Township, Macomb Township, Mayfield Township, Village of New Haven, City of Rochester, City of Romeo, Shelby Township, Washington Township, as well as one business in Greenwood and one business in Imlay Township.

Under this precautionary Boil Water Advisory, residents should not drink the water without boiling it first. Residents must bring all water to a boil for at least one minute and then let it cool before using. Boiled, bottled or disinfected water should be used for drinking, making ice, washing dishes, brushing teeth, and preparing food until further notice.

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GLWA is currently investigating the cause of the break. The Boil Water Advisory will remain in effect until results from sampling verify the water is safe to drink. GLWA Water Quality will advise the affected communities when the Boil Water Advisory has been lifted.

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The Authority will continue to provide updates as they become available.

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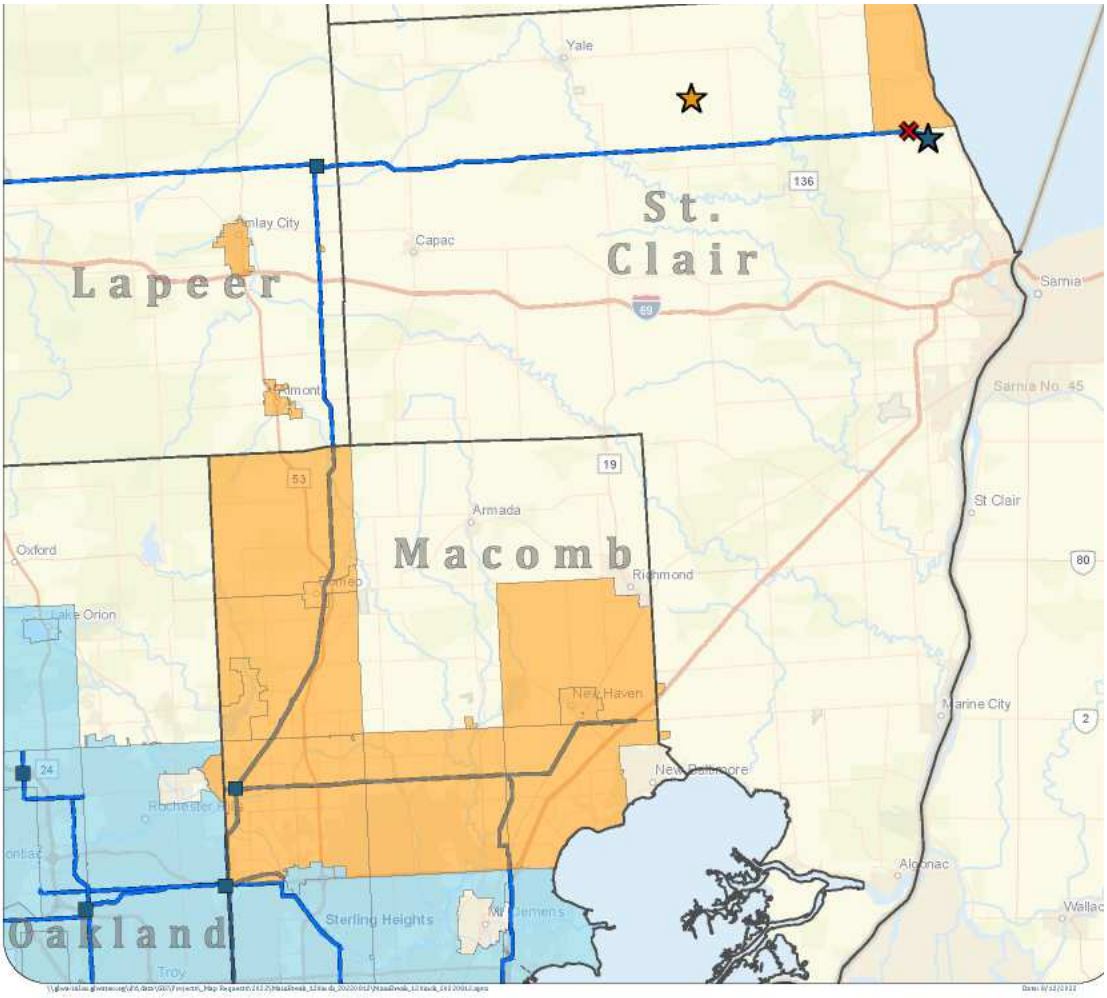

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Update 2: Correction 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE **8:00 p.m.**

August 13, 2022

Media Contacts:

Molly Young / C: 248-917-2876 / molly.young@fleishman.com

Michelle Zdrodowski / C: 313-618-0552
/ michelle.zdrodowski@glwater.org

UPDATE 2: CORRECTION

120-INCH WATER TRANSMISSION MAIN BREAK AND BOIL WATER ADVISORY

- ***The Boil Water Advisory does NOT include the entire Village of Romeo, just the industrial park***

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued earlier today.

The entirety of the Village of Romeo was mistakenly included on the Boil Water Advisory, when in fact, it just includes the Industrial Park location. Romeo residents are on well water and not connected to the GLWA system.

The precautionary Boil Water Advisory had been previously lifted for Auburn Hills, Clinton Township, the City of Flint, Flint Township, the City of Lapeer, Orion Township, the City of Pontiac, the City of Rochester Hills, the City of Sterling Heights, the City of Troy and the City of Utica. Based on further review of GLWA's water pressure data, it does not appear that water pressure in these communities fell below the 20psi threshold for declaring a Boil Water Advisory.

GLWA issued the precautionary Boil Water Advisory earlier today after it discovered a break on a 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area. The 120-inch transmission main is the largest in the regional water distribution system.

connections to other mains in the system to restore some flow to the impacted communities.

Communities that remain under a Boil Water Advisory include: the Village of Almont, Bruce Township, Burtchville Township, Chesterfield Township, Imlay City, Lenox Township, Macomb Township, Mayfield Township, Village of New Haven, City of Rochester, Shelby Township, Washington Township, as well as one business in Greenwood and one business in Imlay Township.

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GLWA is currently investigating the cause of the break. The Boil Water Advisory will remain in effect until results from sampling verify the water is safe to drink. GLWA Water Quality will advise the affected communities when the Boil Water Advisory has been lifted.

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represent member partner communities outside of the tri-county area.

Update 3: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE **11:30 a.m.**

August 14, 2022

UPDATE 3

120-INCH WATER TRANSMISSION MAIN BREAK AND

BOIL WATER ADVISORY

- *At least some water pressure restored to all communities*
- *Boil Water Advisory Lifted Chesterfield Township, Lenox Township, Mayfield Township, Macomb Township and the City of New Haven*
- *Water main break isolated and being prepared for repairs to begin*
- *Seven communities, including 133,000 people, remain under a Boil Water Advisory*
- *Estimated timeframe is two weeks, including repairs and water quality testing*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued yesterday, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

As of Sunday morning, water flow/pressure has been restored those communities impacted by the water main break. While it will not be at normal levels, there will be enough flow to use for sanitary purposes. GLWA was able to accomplish this by making changes in the direction that water is pumped in the transmission system.

Additionally, the precautionary Boil Water Advisory had been previously lifted for Chesterfield Township, Lenox Township, Mayfield Township, Macomb Township, and the Village of New Haven. Based on further review of GLWA's water pressure data, it does not appear that water pressure in these communities fell below the 20psi threshold for declaring a Boil Water Advisory.

Coffey, GLWA Chief Executive Officer. “I am grateful for the GLWA team who has been working tirelessly to restore water pressure to all communities and working as quickly as possible to restore service.”

Crews have isolated the break and started the process of removing water from the site using four eight-inch pumps, which will prepare the area for the repairs to begin. Replacement pipe has been ordered and is currently on a truck from Texas to Michigan.

Barring any unforeseen circumstances, GLWA expects the timeline for returning the pipeline to service to be two weeks – one week for the repairs and an additional week for water quality testing.

Communities that remain under a Boil Water Advisory include: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, Washington Township, as well as one business in Greenwood, and an industrial park in Romeo.

Under this precautionary Boil Water Advisory, residents should not drink the water without boiling it first. Residents must bring all water to a boil for at least one minute and then let it cool before using. Boiled, bottled or disinfected water should be used for drinking, making ice, washing dishes, brushing teeth, and preparing food until further notice.

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GLWA is currently investigating the cause of the break. The Boil Water Advisory will remain in effect until results from sampling verify the water is safe to drink. GLWA Water Quality will advise the affected communities when the Boil Water Advisory has been lifted.

For more information, please contact Great Lakes Water Authority Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

GLWA will continue to provide updates as they become available.

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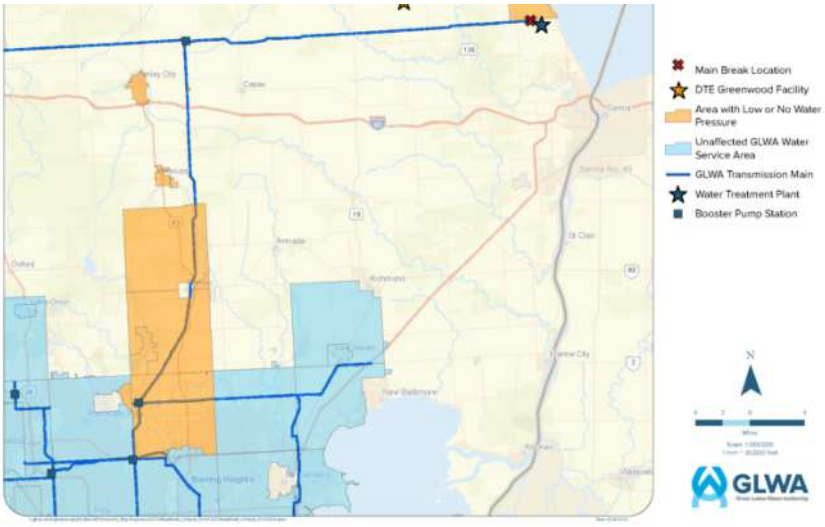

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Update 4: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE 11:30 a.m.

August 15, 2022

- *Some water pressure restored to all impacted communities*
- *Seven communities covering 133,000 people, remain under a Boil Water Advisory*
- *New section of 120-inch pipe arrived and is on-site*
- *Engineering Inspection being conducted today to determine repair plan*
- *Estimated timeframe is two weeks, including repairs and water quality testing*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

As of Monday, August 15, 2022, the following seven communities remain under a Boil Water Advisory: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township. In addition, there is also one business in Greenwood, and an industrial park in Romeo that remain under the Boil Water Advisory. GLWA is asking homeowners in these impacted communities to refrain from watering their lawns while the Boil Water Advisory is in effect.

To assist communities impacted by the Boil Water Advisory, GLWA has put together a Frequently Asked Questions resource, which is available on its website at www.glwater.org.

With the main break isolated on Sunday, August 14, and removal of the water at the site now complete, the next step is an engineering inspection of the pipe, which will occur today. Replacement pipe arrived on-site yesterday.

Barring any unforeseen circumstances, GLWA expects the timeline for returning the pipeline to service to be two weeks from the initial break on August 13 – one week for the repairs and an additional week for

water is safe to drink. GLWA's Water Quality Team will advise the affected communities when the Boil Water Advisory has been lifted.

For more information, please contact GLWA Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

GLWA will continue to provide updates as they become available.

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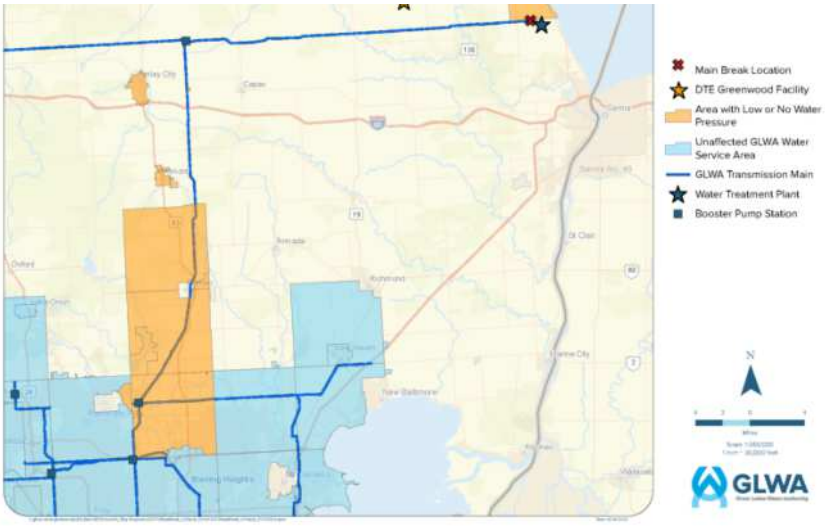

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Update 5: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE **2:30 p.m.**

August 16, 2022

- *Initial engineering inspection finds additional damage to 120-inch pipe*
- *Order placed for the manufacturing of 48 addition feet of replacement pipe; GLWA currently has all available 120-inch pipe in the country on-site*
- *Repair timeline extended one week to accommodate manufacturing and delivery of additional pipe*
- *Repair work continues in anticipation of delivery of additional pipe being manufactured*
- *Seven communities covering 133,000 people, remain under a Boil Water Advisory*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Sunday, August 14, 16-feet of replacement 120-inch pipe was delivered to the site from Texas. On Monday, August 15, GLWA completed the initial inspection of the 120-inch water main that broke this past Saturday. The inspection found more damage to the pipe than initially thought, which will require the acquisition of additional lengths of the water main.

While the inspection was occurring, GLWA proactively ordered an additional 48-feet of replacement pipe as a precaution. This pipe is in the process of being manufactured, because GLWA had previously obtained all the 120-inch pipe available in the United States after the water main broke on Saturday.

The new pipe is expected to be delivered on-site on Tuesday, August 23, which will add an additional week to the repair timeline. In the meantime, GLWA and its contractors are moving forward with repairs that can be implemented, including removing the broken pipe and preparing the existing replacement pipe for installation.

presence of bacteria. GLWA will also be conducting additional inspections within the 120-inch main.

The Boil Water Advisory will remain in effect until results from sampling verify the water is safe to drink. GLWA's Water Quality Team will advise the affected communities when the Boil Water Advisory has been lifted.

As of Tuesday, August 16, 2022, the following seven communities remain under a Boil Water Advisory: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township. In addition, there is also one business in Greenwood, and an industrial park in Romeo that remain under the Boil Water Advisory.

"I know that adding an additional week to the repair timeline and the Boil Water Advisory is going to create further burden on the residents and businesses of the seven impacted communities," said Suzanne R. Coffey, GLWA Chief Executive Officer. "But I want them all to know that we are doing everything within our capabilities to expedite this repair and return them to full service. We are also in conversations with the impacted communities, as well as the Michigan Department of Environment, Great Lakes, and Energy (EGLE) about any options for modifying the current Boil Water Advisory given that pressures have largely stabilized at reasonable level. However, we have nothing definitive to report at this time."

Coffey added, "I want to thank everyone for their patience and understanding as we work through this very difficult situation. I also want to thank our member partner communities, our partners in the Emergency Management community and all our water utility workers both in GLWA and the municipalities who are on the ground operating their systems during this emergency."

GLWA is asking homeowners in all seven impacted communities, as well as Macomb Township and Chesterfield Township to refrain from watering their lawns until the repair has been completed. The seven communities are: the Village of Almont, Bruce Township, Burtchville Township, City of Imlay City, City of Rochester, Shelby Township, and Washington Township.

To assist communities impacted by the Boil Water Advisory, GLWA has put together a Frequently Asked Questions resource, which is available on its website at www.glwater.org.

For more information, please contact GLWA Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

GLWA is currently investigating the cause of the break. GLWA will continue to provide updates as they become available.

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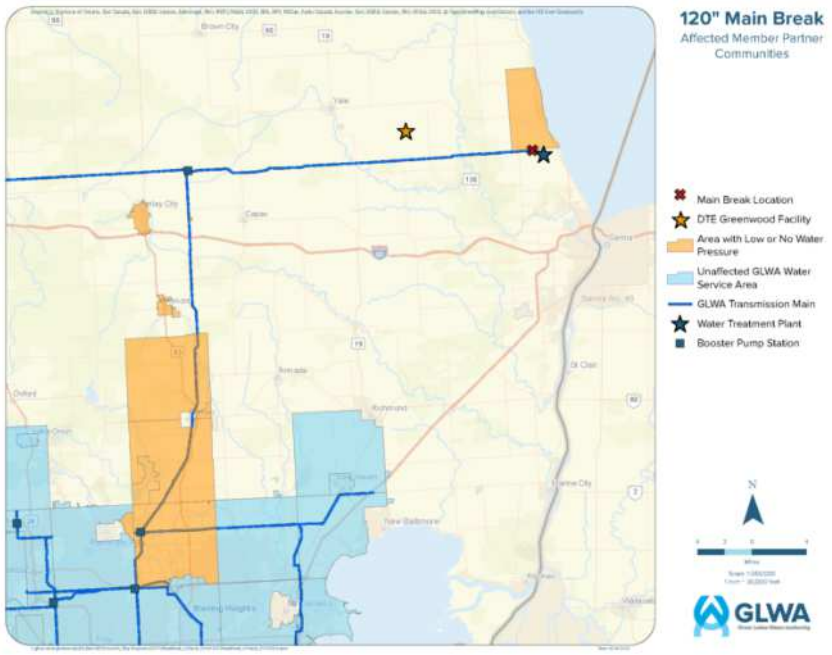

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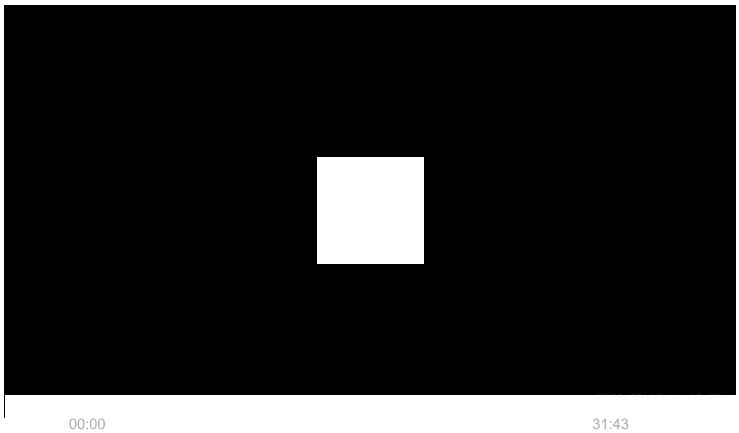
READ MORE

August 16 Water Main Break Update News Conference

On Tuesday, August 16, GLWA CEO Sue Coffey and COO-Water & Field Services Cheryl Porter held a virtual press briefing on the status of the 120-Inch main break and boil water advisory. Please click play on video below to watch. Press the full screen button to increase size of video for viewing.



READ MORE

Update 6: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE
12:00 p.m.

August 17, 2022

- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe on Tuesday, August 23*
- *Repair timeline remains at three weeks (September 3)*
- *Seven communities covering 133,000 people, remain under a Boil Water Advisory*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

Repair work continues at the site of the break with crews continuing efforts to stabilize the existing pipe. This will ensure that damage does not occur when the new pipe segments are installed. The additional 48-feet of pipe is being manufactured in Mississippi and is expected to be delivered to the repair site on Tuesday, August 23.

GLWA is also using this time to conduct further inspection of the 120-inch transmission main while it is not filled with pressurized water.

As of Wednesday, August 17, 2022, the following seven communities remain under a Boil Water Advisory: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township. In addition, there is also one business in Greenwood, and an industrial park in Romeo that remain under the Boil Water Advisory.

GLWA continues to ask homeowners in the seven communities remaining under a Boil Water Advisory, as well as Macomb Township and Chesterfield Township to refrain from watering their lawns until the repair has been completed.

To assist communities impacted by the Boil Water Advisory, GLWA has put together a Frequently Asked Questions resource, which is available on its website at www.glwater.org.

1(800) 426-4791.

GLWA is currently investigating the cause of the break. GLWA will continue to provide updates as they become available.

GLWA CEO Suzanne Coffey and Chief Operating Officer, Water and Field Services Cheryl Porter held a news conference on Tuesday, August 16 to provide an update on repair status. A link to the video can be found HERE.

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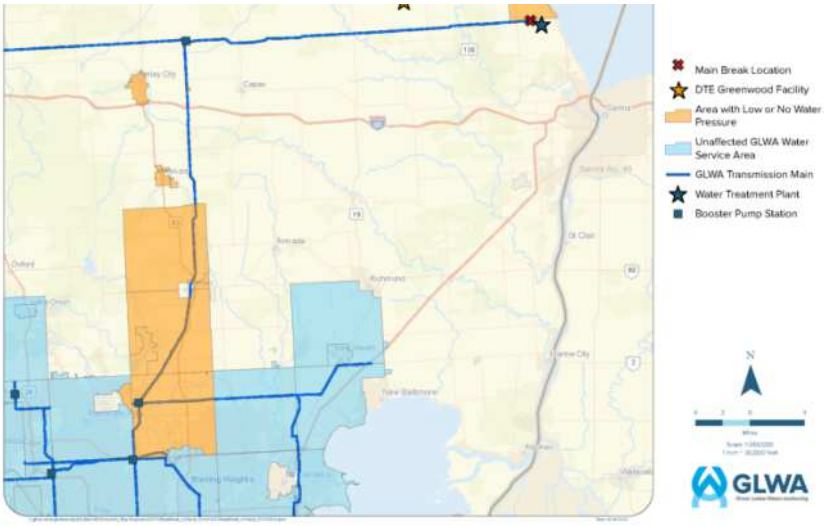

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Update 7: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE **11:00 a.m.**

August 18, 2022

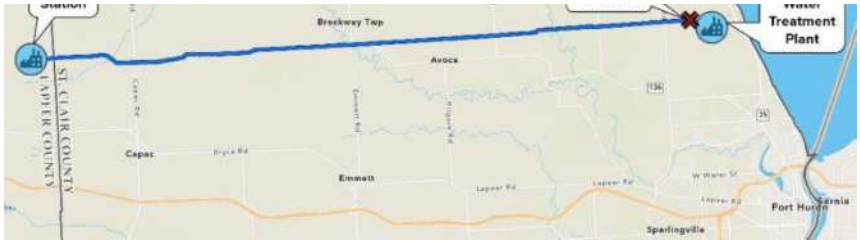
- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe on Tuesday, August 23; concrete pads being poured under existing pipe for stabilization*
- *GLWA requested all 23 communities that were initially under a Boil Water Advisory limit outdoor water use during repairs*
- *GLWA deploys water trucks and distributes 6,000 one gallon containers from Imlay City Fairgrounds*
- *GLWA crews inspecting portions of the 26-miles of 120-inch water main; residents may see GLWA team members and contractors out along the main's route*
- *Repair timeline remains at three weeks (September 3)*
- *Seven communities covering 133,000 people, remain under a precautionary Boil Water Advisory*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the precautionary Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

Repair work continues at the site of the break with crews continuing efforts to stabilize the existing pipe. Yesterday, concrete pads were poured under the existing pipe to prepare for removal of the damaged section of pipe, which is expected sometime this weekend.

In addition, GLWA continues further inspection of portions of the 120-inch transmission main while it is not filled with pressurized water. This inspection is occurring along the entire 26.1 miles of the main. Residents who live along the 120-inch main route may see GLWA team members and consultants out conducting their inspections, which may sometimes include them seeking access to homeowners' property. These GLWA team members and consultants will have their photos IDs displayed.

A map of the route is below:



As of Thursday, August 18, 2022, the following seven communities remain under a precautionary Boil Water Advisory: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township. In addition, there is also one business in Greenwood, and an industrial park in Romeo that remain under the Boil Water Advisory.

GLWA has expanded its request for the limiting outdoor water usage until the repair is completed to include all 23 communities that were originally under the precautionary Boil Water Advisory when it was issue on August 13. This will help in reducing the load on the regional water system and may help as GLWA reviews options with the Michigan Department of Environment, Great Lakes and Energy (EGLE) to restore system operations as quickly as possible. The 23 communities are the Village of Almont, Auburn Hills, Bruce Township, Burtchville Township, Chesterfield Township, Clinton Township, the City of Flint, Flint Township, City of Imlay City, the City of Lapeer, Lenox Township, Macomb Township, Mayfield Township, Village of New Haven, Orion Township, the City of Pontiac, City of Rochester, the City of Rochester Hills, Shelby Township, the City of Sterling Heights, the City of Troy, the City of Utica, and Washington Township.

At the request of several of the communities currently under the precautionary Boil Water Advisory, on Wednesday, GLWA deployed three water trucks to the Imlay City Fairgrounds where 6,000 one gallon containers of water were given out to residents in under two hours.

To assist communities impacted by the precautionary Boil Water Advisory, GLWA has put together a Frequently Asked Questions resource, which is available on its website at www.glwater.org.

For more information, please contact GLWA Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by microbes are available from the EPA Safe Drinking Water Hotline at 1(800) 426-4791.

GLWA is currently investigating the cause of the break. GLWA will continue to provide updates as they become available.

GLWA CEO Suzanne Coffey and Chief Operating Officer, Water and Field Services Cheryl Porter held a news conference on Tuesday, August 16 to provide an update on repair status. A link to the video can be found HERE.


GLWA


GLWA
Your Source for Water

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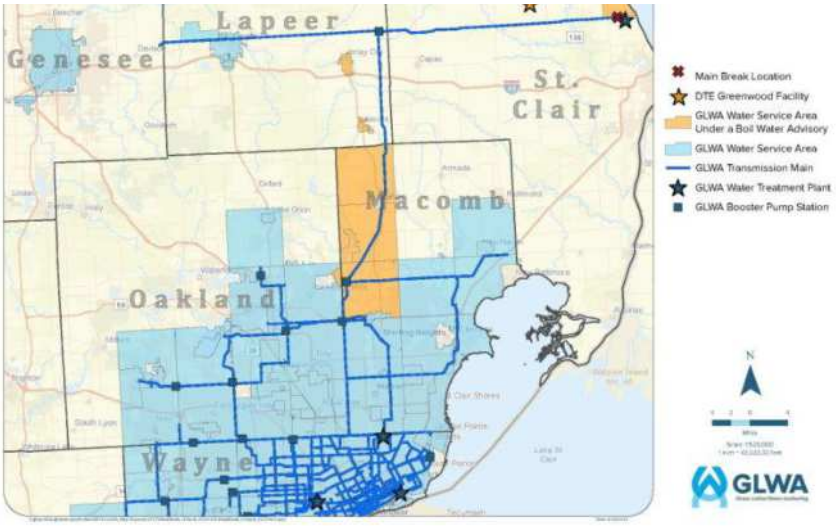

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Update 8: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE
10:00 a.m.

August 19, 2022

- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe on Tuesday, August 23; damaged section of pipe being cut today for removal by crane on Saturday*
- *GLWA deploying water trucks to Eastern Michigan State Fairgrounds in Imlay City today from 10a.m.-noon*
- *Repair timeline remains at three weeks (September 3)*
- *Seven communities covering 133,000 people, remain under a precautionary Boil Water Advisory*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the precautionary Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

Repair work continues at the site of the break. Crews have stabilized the existing pipe and will begin cutting the damaged section to prepare it for removal by crane on Saturday.

As of Friday, August 19, 2022, the following seven communities remain under a precautionary Boil Water Advisory: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township. In addition, there is also one business in Greenwood, and an industrial park in Romeo that remain under the Boil Water Advisory.

GLWA will be deploying its three water trucks to the Eastern Michigan State Fairgrounds in Imlay City today from 10 a.m. through noon, where they will be giving out one-gallon containers of water.

To assist communities impacted by the precautionary Boil Water Advisory, GLWA has put together a Frequently Asked Questions resource, which is available on its website at www.glwater.org.

For more information, please contact GLWA Water Quality at waterquality@glwater.org or by calling (313) 926-8102 or (313) 926-8128. General guidelines on ways to lessen the risk of infection by

continue to provide updates as they become available.

GLWA CEO Suzanne Coffey and Chief Operating Officer, Water and Field Services Cheryl Porter held a news conference on Tuesday, August 16 to provide an update on repair status. A link to the video can be found HERE.

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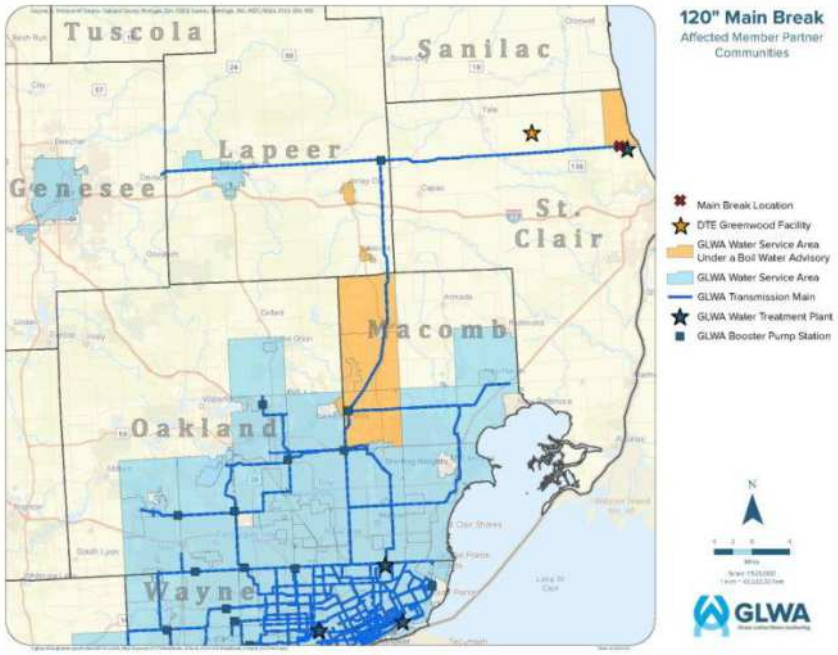

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Update 9: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE
10:00 a.m.

August 20, 2022

- *Precautionary Boil Water Advisory lifted for all seven communities; if significant pressure drops occur in the regional system a precautionary Boil Water Advisory may need to be re-issued*
- *Only the business in Greenwood remains under a precautionary Boil Water Advisory*
- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe on Tuesday, August 23; damaged section of pipe being removed by crane this weekend*
- *Repair timeline remains at three weeks (September 3)*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the precautionary Boil Water Advisory it issued on August 13, as well as the break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

Because of stabilized system pressures and the completion of water quality testing within the regional transmission and local distribution system in accordance with regulations set forth by the Michigan Department of Environment, Great Lakes and Energy (EGLE), GLWA is lifting the precautionary Boil Water Advisory, effective immediately, for all seven impacted communities: the Village of Almont, Bruce Township, Burtchville Township, Imlay City, City of Rochester, Shelby Township, and Washington Township and the industrial park in Romeo. Just the one business in Greenwood remains under a precautionary Boil Water Advisory.

Those who have been under the precautionary Boil Water Advisory should take the following steps before using their water now that it has been lifted:

1. Flush
   - Unscrew and remove the faucet aerator (screen)
   - Turn on each cold water faucet/tap slowly
   - Run cold water for five minutes

through a 24-hour cycle. Make three batches of ice and discard them. The water line should be clear, and ice should be safe to consume with the fourth batch

2. Clear Hot Water Tanks/Heaters
   - Run hot water only at all faucets and flush until water runs cool or typically a minimum of:
     - 15 minutes for a typical household 40-gallon hot water tank
     - 30 minutes for a hot water tank greater than 40 gallons
3. Replace Filters
   - Water filters, such as ones used in refrigerators, faucets, pitchers and under the sink, are not designed to remove the specific bacteria potentially present during a Boil Water Advisory. If you ran water through your filter during the Boil Water Advisory, the filter should be replaced.
   - Remove and discard water filters
   - Replace with a new filter following flushing

For a full list of actions for residents and businesses to take after a Boil Water Advisory is lifted, please click HERE.

In the event that the regional water system experiences any significant pressure drops during the repair or the transmission main's return to service, it is possible that another Boil Water Advisory could need to be issued.

GLWA is still asking all 23 initially impacted communities to limit their outdoor water usage through the completion of the repair. Repair work continues at the site of the break. With the existing pipe stabilized by the pouring of concrete pads, crews will be removing the damaged section by crane this weekend. The repair timeline remains at three weeks.

GLWA is currently investigating the cause of the break. GLWA will continue to provide updates as they become available.

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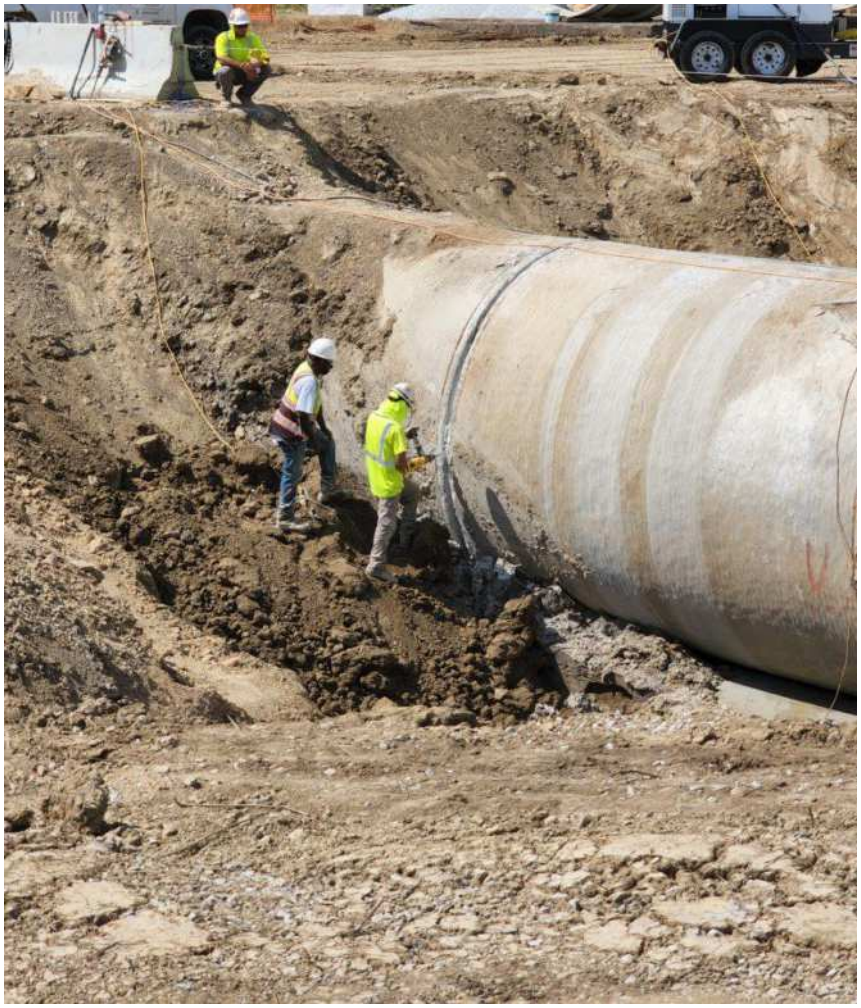

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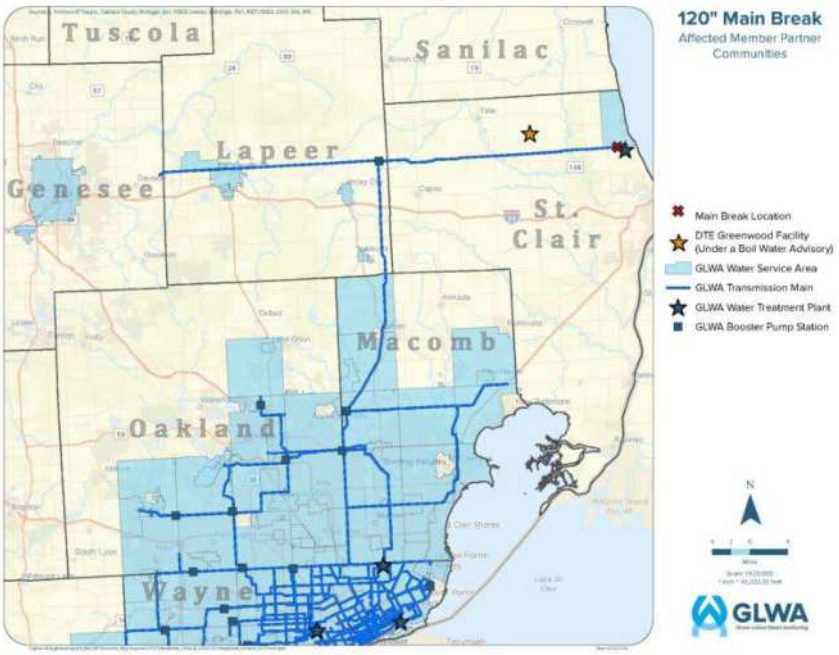

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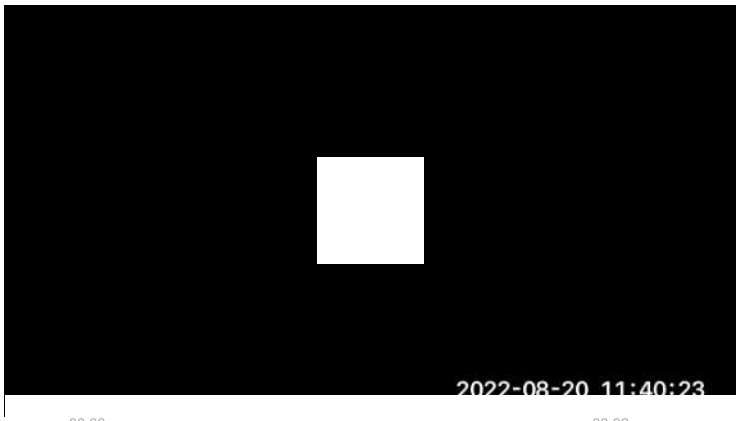
READ MORE

120-Inch Main Break News Conference with Boil Water Advisory Lifted

On Saturday, August 20, GLWA CEO Sue Coffey held a virtual press briefing on 120-Inch Main Break News Conference with Boil Water Advisory Lifted . Please click play on video below to watch. Press the full screen button to increase size of video for viewing.



Update 10: 120-inch Water Transmission Main Break and Boil Water Advisory

FOR IMMEDIATE RELEASE
10:00 a.m.

August 22, 2022

- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe on Tuesday, August 23; damaged section of pipe removed by crane on Sunday, August 21*
- *Precautionary Boil Water Advisory lifted for all seven communities; if significant pressure drops occur in the regional system a precautionary Boil Water Advisory may need to be re-issued*
- *Repair timeline remains at three weeks (September 3)*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

Repair work continues at the site of the break. On Sunday, August 21, crews successfully removed the damaged section of pipe by crane in anticipation of the delivery of an additional 48-feet of 120-inch pipe, which is expected on Tuesday, August 23.

On Saturday August 20, due to the stabilization of system pressures and the completion of water quality testing within the regional transmission and local distribution system in accordance with regulations set forth by the Michigan Department of Environment, Great Lakes and Energy (EGLE), GLWA lifted the precautionary Boil Water Advisory for the remaining seven communities and the industrial park in Romeo. Just the one business in Greenwood remains under a precautionary Boil Water Advisory.

In the event that the regional water system experiences any significant pressure drops during the repair or the transmission main's return to service, it is possible that another Boil Water Advisory could need to be issued. GLWA is still asking all 23 initially impacted communities to limit their outdoor water usage through the completion of the repair.

To assist resident and businesses coming out of the precautionary Boil Water Advisory, GLWA has created checklists for the actions for residents and businesses should take after a Boil Water Advisory is lifted. These checklists can be found HERE.

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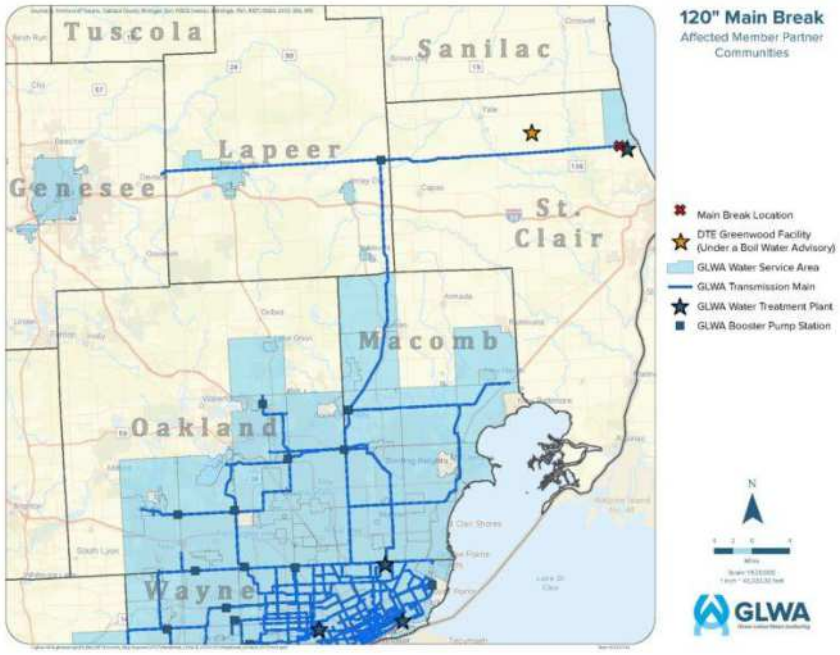

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Update 11: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE 1:30 p.m.

August 23, 2022

- *Work continues at break site to prepare for delivery of 48-feet of additional 120-inch pipe*
- *Pipe delivery delayed; Delivery expected in several segments between Thursday, August 25 and Saturday, August 27*
- *Repair timeline being reviewed and will be updated once the new pipe arrives*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Tuesday, August 23, GLWA was notified by its contractor that the delivery of the 48-feet of 120-inch pipe GLWA ordered last week has been delayed at the manufacturer. The pipe will now be delivered to the repair site in several segments between Thursday, August 25 and Saturday, August 27.

GLWA will share more information as it becomes available and plans to share photos and video with the media upon the pipe's delivery.

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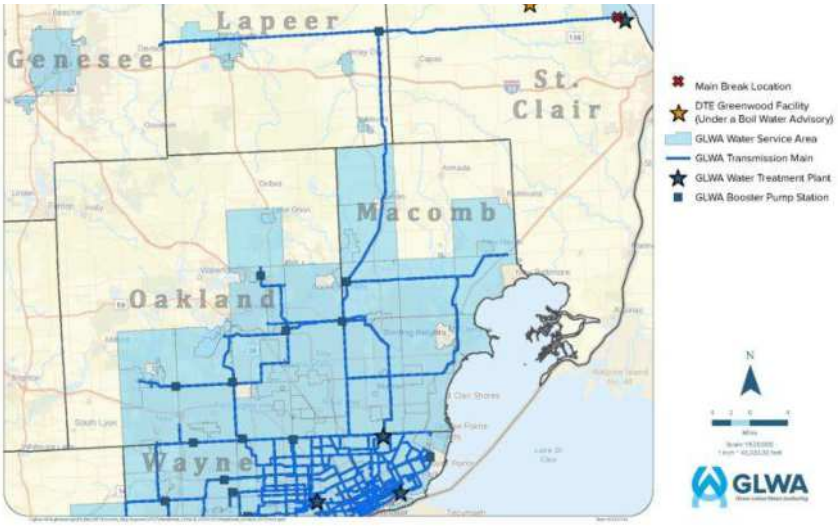

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Update 12: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE **12:30 p.m.**

August 25, 2022

- *First segment of the additional 48 feet of 120-inch replacement pipe arrived on-site today*
- *Remaining pipe expected to be delivered over the weekend*
- *Pipe inspection work continues*
- *Repair timeline being reviewed and will be updated once all the new pipe arrives*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Thursday, August 25, GLWA received delivery on the first 16-foot segment of the second order of additional 120-inch replacement pipe at the site of the main break. GLWA expects to receive the remaining 32-feet of the second order of replacement pipe over the weekend. The first order of 16-feet of pipe was received on August 14.

Crews continue using the opportunity of having an open, unpressurized pipe to conduct inspections of the several miles of the existing pipe on either side of the break.

GLWA will share more information as it becomes available and plans to share photos and video with the media upon delivery of the remainder of the additional pipe.

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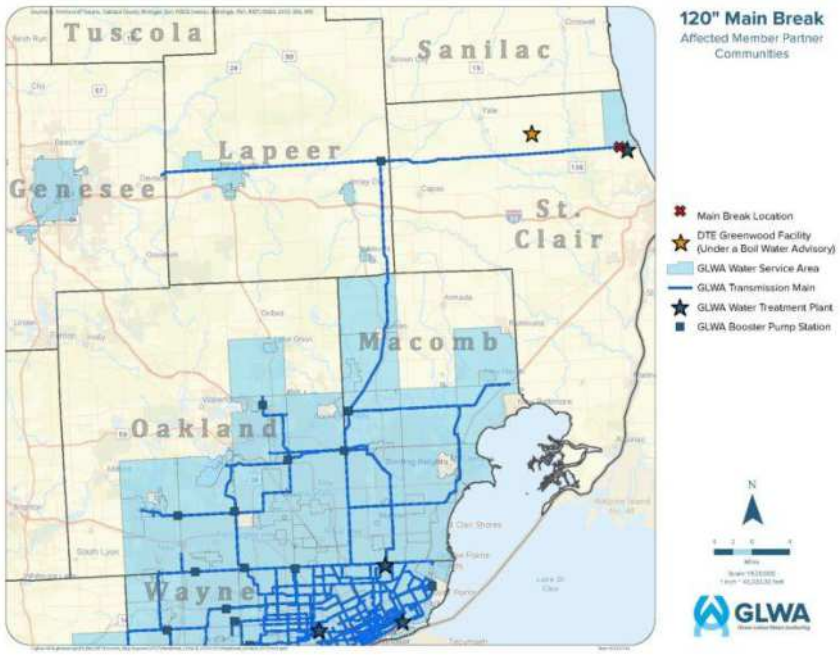

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Update 13: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE
10:30 a.m.

August 26, 2022

- *16-foot segment of the additional 48-feet of 120-inch replacement pipe delivered on August 25 sent back to manufacturer because it did not meet specifications*
- *Expecting the updated piece of pipe to be returned by Sunday with the remainder of the additional order of pipe*
- *Crews ready to begin repairs when pipe is delivered*
- *Repair timeline being reviewed and will be updated once all the new pipe arrives*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Thursday, August 25, GLWA received delivery on the first 16-foot segment of the second order of additional 120-inch replacement pipe at the site of the main break. After inspection of the pipe, GLWA determined that it did not meet the specifications submitted to the manufacturer. As a result, it was sent back to the manufacturer for updating and is expected to be returned with the delivery of the remaining 32-feet of the second order of replacement pipe on Sunday.

Crews are ready to begin repairs upon delivery of all 120-inch pipe to the repair site.

GLWA will share more information as it becomes available and plans to share photos and video with the media upon delivery of the remainder of the additional pipe.

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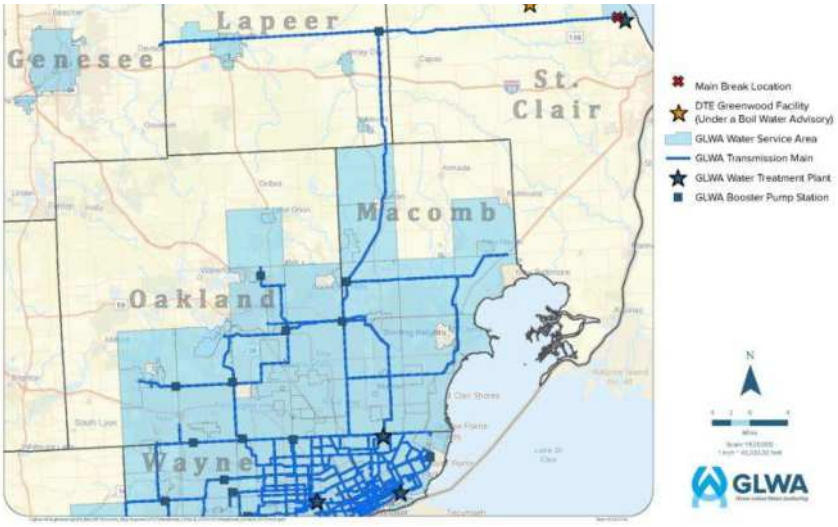

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Update 14: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE
10:30 a.m.

August 29, 2022

- *16-foot segment of the additional 48-feet of 120-inch replacement pipe, which was sent back to the manufacturer last week, delivered on-site on Sunday August 28*
- *One additional piece of pipe is in transit and expected to be delivered today; remaining piece being shipped today with an expected arrival in the next 1-2 days*
- *System remains stable*
- *Repair timeline will be extended beyond September 3; an updated timeline will be provided upon arrival of all remaining pipe*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Sunday, August 28, GLWA received delivery on the 16-foot segment that was sent back to the manufacturer because it did not meet GLWA's specifications. The remaining 32-feet of pipe will be delivered in two shipments. One shipment is due to arrive on-site today, and the final piece will be put in-transit by this afternoon with an anticipated arrival within the next two days.

Crews are ready to begin repairs upon delivery of all 120-inch pipe to the repair site.

"Given the delays in receiving all required segments of pipe, I can confirm that GLWA will not be able to meet the original completion date of September 3, 2022," said Suzanne R. Coffey, Chief Executive Officer, GLWA. "As soon as all the pipe is received on-site our crews will reassess the timeline and provide an update on the completion of repairs, including the steps we need to place the transmission main

GLWA will share more information as it becomes available and plans to share photos with the media upon delivery of the remainder of the additional pipe.

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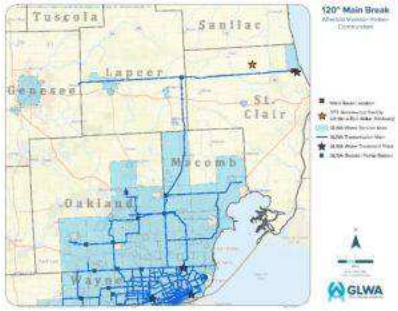

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Act

Update 15: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE 12:30 p.m.

August 30, 2022

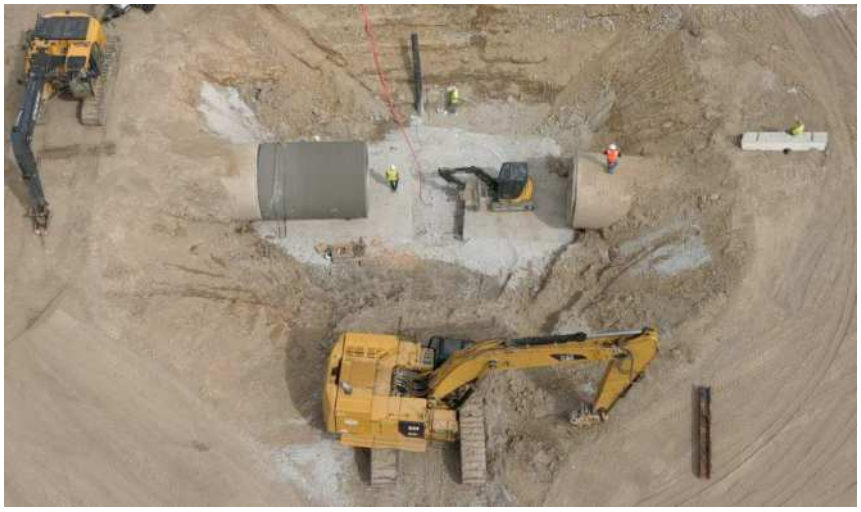
- *Work continued at the site with a 16-foot segment of 120-inch replacement pipe connected to the existing pipe on Monday*
- *An additional 16-foot segment of pipe will be delivered today, and work will continue throughout the night, if necessary, to place it and complete the connection with the existing pipe*
- *An updated timeline for returning the 120-inch transmission main to service will be provided once all the pipe is connected and the main is fully closed*

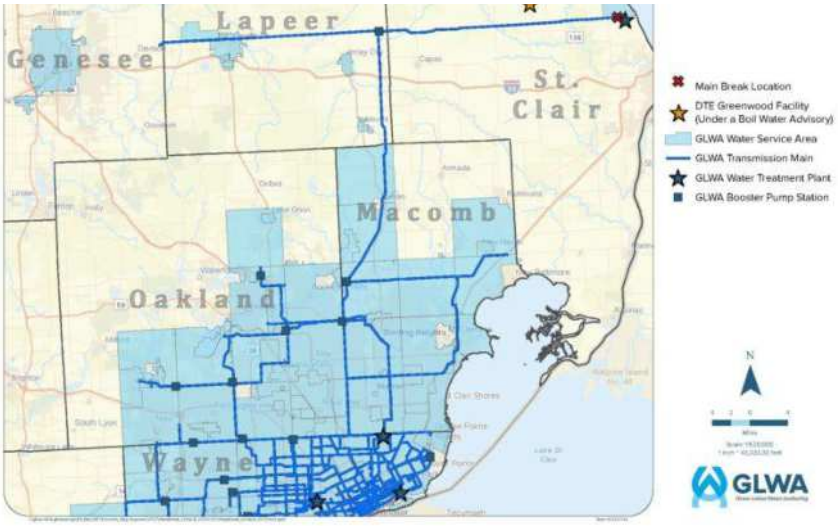
DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Monday, August 29, crews placed and connected one 16-foot segment of replacement pipe at the site of the broken 120-inch transmission main just west of GLWA's Lake Huron Water Treatment Facility. Upon delivery of an additional 16-foot segment pipe today, crews will immediately begin working to put it in place and connect it with the other existing pipe. Depending on the pipe's time of arrival, crews are prepared to work throughout the night to complete all connections necessary to fully close the transmission main.

Once the final connections are made, GLWA will be able to share an updated timeline for returning the 120-inch transmission main back to service.

GLWA will share more information as it becomes available and plans to share photos with the media upon delivery of the remainder of the additional pipe.





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Update 16: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE 11:30 a.m.

August 31, 2022

- *Second 16-foot segment of replacement pipe delivered to repair site and connected on Tuesday*
- *Work continues at the site today with crews sizing, cutting, and placing the final segment of pipe*
- *It may take several days to complete all the connections between pipes to fully close the transmission main*
- *An updated timeline for returning the 120-inch transmission main to service will be provided once the main is fully closed*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Tuesday, August 30, crews placed and connected a second 16-foot segment of replacement pipe at the site of the broken 120-inch transmission main just west of GLWA's Lake Huron Water Treatment Facility. Today, crews are working to size, cut and place the last segment of pipe. It may take several days to complete all the connections between pipes that are required to fully close the transmission main.

Once the transmission main is fully closed, GLWA will be able to share an updated timeline for returning the 120-inch transmission main back to service.

GLWA will share more information as it becomes available, as well as photos of progress being made at the repair site.

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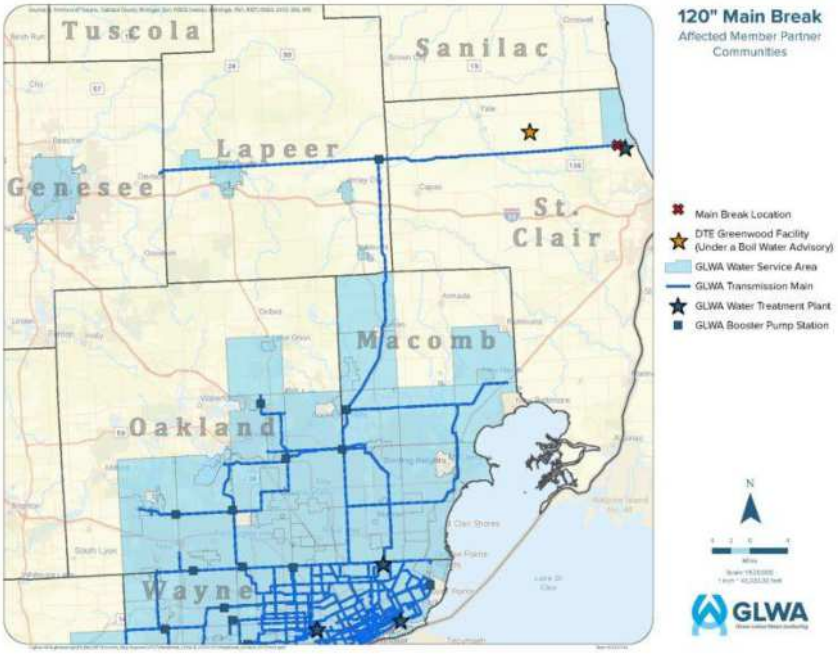

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WE ARE ONE WATER

The Great Lakes Water Authority is your source for water! We are dedicated to efficiently delivering the nation's best water and wastewater services to southeast Michigan.

ADDITIONAL LINKS

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Freedom of Information Act

MEMBER LOGINS

Member Outreach Portal

WAMR Portal

GDRSS Portal

Update 17: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE 11:00 a.m.

September 1, 2022

- *All new segments of replacement pipe are now in the ground at the repair site*
- *Work continues at the site today with crews completing all the connections necessary to fully close the transmission main and a concrete foundation being poured underneath the new pipe*
- *An updated timeline for returning the 120-inch transmission main to service will be provided once the main is fully closed*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

On Wednesday, August 31 crews completed the placement of all new segments of pipe at the site of the broken 120-inch transmission main just west of GLWA's Lake Huron Water Treatment Facility. Today, crews are working to complete all the connections between pipes that are required to fully close the transmission main, as well as pour a concrete foundation underneath the new segments of pipe to provide it with long-term stabilization.

GLWA will share an updated timeline for returning the 120-inch transmission main back to service once the transmission main is fully closed.

GLWA will share more information as it becomes available, as well as photos of progress being made at the repair site.

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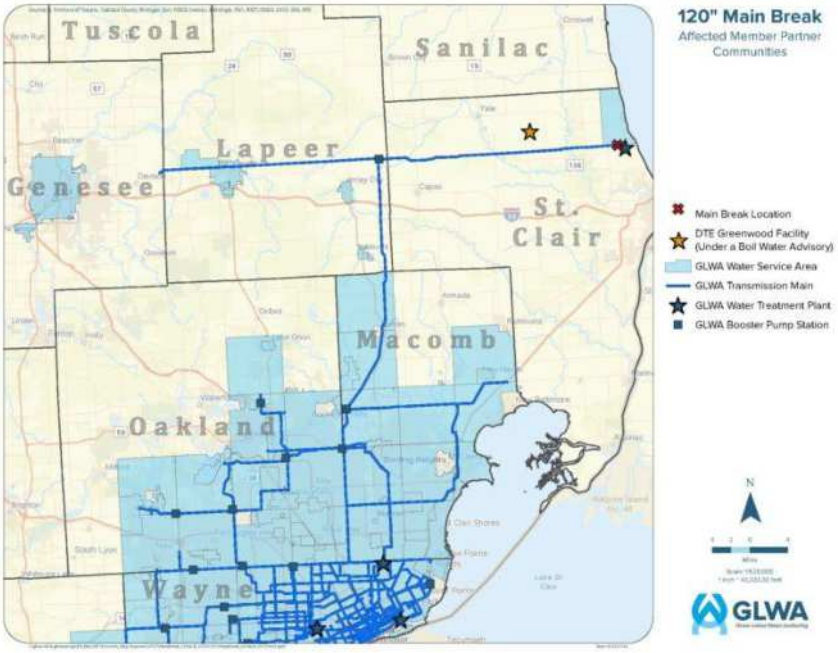

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About the Great Lakes Water Authority (GLWA)

The Great Lakes Water Authority (GLWA) is the provider-of-choice for drinking water services to nearly 40 percent, and efficient and effective wastewater services to nearly 30 percent, of Michigan's population. With the Great Lakes as source water, GLWA is uniquely positioned to provide those it serves with water of unquestionable quality. GLWA also has the capacity to extend its services beyond its 88 member partner communities. As part of its commitment to water affordability, the Authority offers a Water Residential Assistance Program to assist low-income households in participating member communities throughout the system. GLWA's board includes one representative each from Oakland, Macomb, and Wayne counties, two representatives from the city of Detroit, and one appointed by the Michigan governor to represent member partner communities outside of the tri-county area.

READ MORE

Update 18: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE 11:00 a.m.

September 6, 2022

UPDATE 18
120-INCH WATER TRANSMISSION MAIN BREAK
• Transmission main is fully closed
• Lake Huron Water Treatment Plant begins producing water to fill the 120-inch transmission main; 81 million gallons necessary to fill the 26 miles of main
• GLWA is working with EGLE to implement a flushing and disinfection plan for the transmission main
• GLWA expects the filling, flushing, and disinfecting process to take some time
• Due to the size and length of the transmission main, GLWA estimates a return to normal operations within 15 days (September 21)

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

With the 120-inch transmission main now fully closed, GLWA's Lake Huron Water Treatment Facility has begun producing the 81 million gallons of water it will take to fill the 26 miles of main. Once the transmission main is filled, GLWA will work with the Michigan Department of Environment, Great Lakes, and Energy (EGLE) to implement a flushing and disinfection plan. Due to the size and length of the transmission main, GLWA expects this flushing and disinfection to take some time and is estimating a return to normal operations within 15 days (September 21).

GLWA will share more information as it becomes available, as well as photos of progress being made at the repair site.

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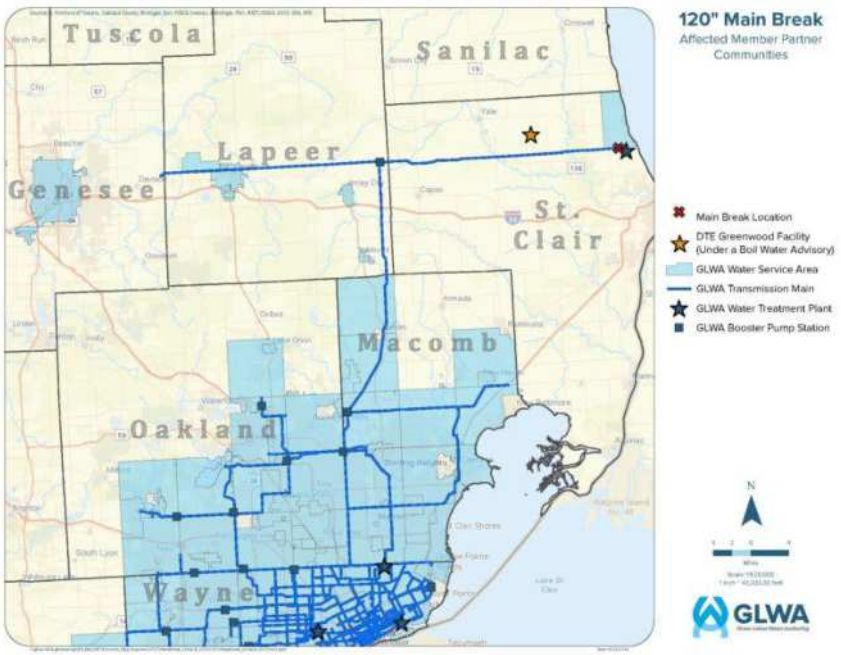

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About the Great Lakes Water Authority (GLWA)

positioned to provide those it serves with water of unquestionable quality. GLWA also has the capacity to extend its services beyond its 88 member partner communities. As part of its commitment to water affordability, the Authority offers a Water Residential Assistance Program to assist low-income households in participating member communities throughout the system. GLWA's board includes one representative each from Oakland, Macomb, and Wayne counties, two representatives from the city of Detroit, and one appointed by the Michigan governor to represent member partner communities outside of the tri-county area.

Update 19: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE
10:00 a.m.

September 19, 2022

- *Flushing and disinfection process of the 120-inch water transmission main is ongoing*
- *Due to the size and length of the pipe, the amount of water and the technical nature of the work, the process is taking longer than anticipated*
- *GLWA now estimates a return to normal operations will take 6-16 days longer than originally thought (October 5)*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

While the flushing and disinfection of the 120-inch transmission main has been ongoing, due to the size and length of the pipe, as well as the technical nature of the process, GLWA is now expecting that it will take an additional six to 16 days to return the main to normal operations (October 5).

"We want to thank everyone for their patience as we navigate this situation together," said Suzanne R. Coffey, P.E., Chief Executive Officer, GLWA. "We know that extending the timeframe to return the transmission system back normal operations will further inconvenience all of the communities and their residents, but it is necessary for us to ensure that we complete this repair in a way that safeguards the public health and the system."

GLWA will share more information as it becomes available, as well as photos of progress being made at the repair site.

###

About the Great Lakes Water Authority (GLWA)

The Great Lakes Water Authority (GLWA) is the provider-of-choice for drinking water services to nearly 40 percent, and efficient and effective wastewater services to nearly 30 percent, of Michigan's population. With the Great Lakes as source water, GLWA is uniquely positioned to provide those it serves with water of unquestionable quality. GLWA also has the capacity to extend its services beyond its 88 member partner communities. As part of its commitment to water affordability, the Authority offers a Water Residential Assistance Program to assist low-income households in participating member communities throughout the system. GLWA's board includes one representative each from Oakland, Macomb, and Wayne counties, two representatives from the city of Detroit, and one appointed by the Michigan governor to represent member partner communities outside of the tri-county area.

Update 20: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE
10:00 a.m.

September 30, 2022

- *Flushing and disinfection process of the 120-inch water transmission main is completed*
- *Three rounds of water quality testing completed; results confirm that the water meets or surpasses regulatory standards*
- *GLWA has now begun the process of returning the regional system to normal operations; this is expected to occur by October 5*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

As repairs were being made, GLWA communicated that there were three phases to the repair process: 1) water main inspection and repair, 2) water main disinfection, flushing, and water quality testing; and 3) restoration of the water transmission main to normal operations.

With phases one and two completed, and water quality testing results confirming that the water meets or surpasses regulatory standards, GLWA has now begun the process of returning the 120-inch water transmission main to service, as well as the rest of the regional system to normal operations. While GLWA does not expect there to be any major impacts to the regional system during the restoration, some of the 23 originally impacted communities may see limited fluctuations in their water pressure throughout the next day or so.

GLWA expects this return to normal operations to occur by October 5.

More information will be shared as it becomes available.

###

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Update 21: 120-inch Water Transmission Main Break

FOR IMMEDIATE RELEASE **11:00 a.m.**

October 03, 2022

- *120-inch water transmission main returned to service; regional system restored to normal operations*
- *All requests for limited outdoor water usage lifted*
- *Final incident report due to EGLE in 30 days*

DETROIT – The Great Lakes Water Authority (GLWA) is providing an update on the August 13 break to the 120-inch water transmission main that distributes finished drinking water from its Lake Huron Water Treatment Facility to communities in the northern part of GLWA's drinking water service area.

This past weekend GLWA returned its 120-inch water transmission main back to service and the regional system back to normal operations. This was several days ahead of the previously stated timeline of October 5. With normal operations restored, GLWA is lifting the request that the 23 originally impacted communities limit outdoor water usage.

"On behalf of everyone at GLWA, I want to express my gratitude to our member partner communities and their residents for their collaboration and support as we worked through the complexities of the break on what is the largest pipe in our regional system," said Suzanne R. Coffey, GLWA Chief Executive Officer. "Although we encountered a number of obstacles along the way, I am so proud of how everyone involved dug-in and used their knowledge, skills and ingenuity to ensure that we made the repair as quickly as possible and kept our focus on protecting the public health."

A final incident report is due to the Michigan Department of Environment, Great Lakes and Energy (EGLE) within 30 days. GLWA will post the completed report on its website, once it is submitted to EGLE.

###

About the Great Lakes Water Authority (GLWA)

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the Authority offers a Water Residential Assistance Program to assist low-income households in participating member communities throughout the system. GLWA's board includes one representative each from Oakland, Macomb, and Wayne counties, two representatives from the city of Detroit, and one appointed by the Michigan governor to represent member partner communities outside of the tri-county area.

Appendix B

GLWA Water Quality Results

GLWA
Great Lakes Water Authority

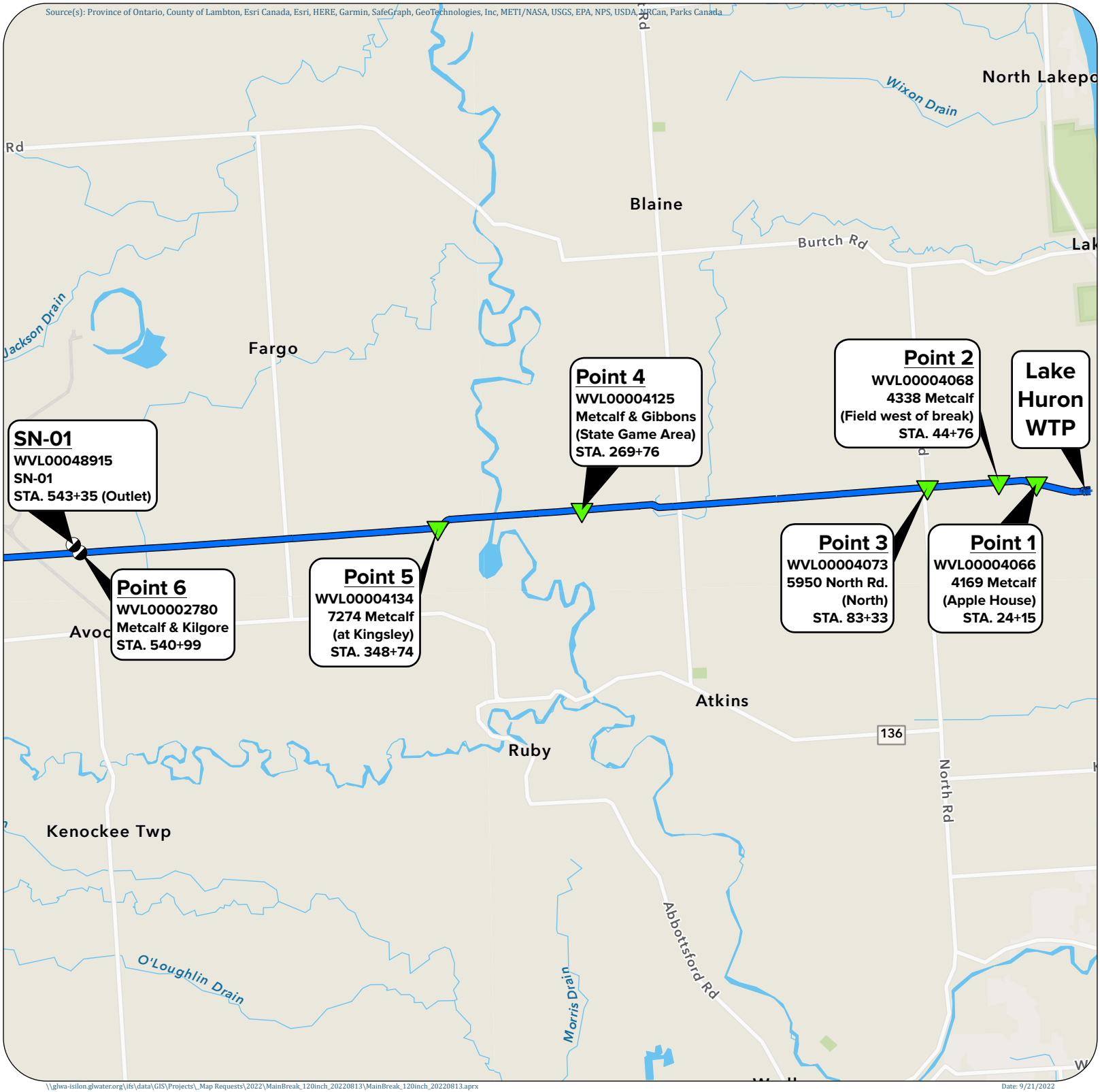
Todd King

From: Mary Lynn Semegen
Sent: Thursday, September 29, 2022 12:43 PM
To: Todd King; Terry Daniel; Biren Saparia; Donovan Walton; Clemon Beverly; Yvette Hayes-Johnson; Thomas Hall; Christopher Steary; Jeffrey Dorsey; Craig Steele; Eddie Hudson; Justin Woods; Peter Bommarito; David Bradwell; Joe Carl; Joe Burchi; Bryon Wood; Patrick Williford
Subject: Final bacteriological results for 120" WMB
Attachments: 120 WMB 9-26-22, 9-27-22, 9-28-22 results.xlsx

Good afternoon,

All samples collected on Sept. 26th, 27th and 28th for the 120" main break have passed water quality criteria. The main can be released for service. Results are attached.

Mary Lynn Semegen, BS, MS
Water Quality Manager
Great Lakes Water Authority • 10100 E. Jefferson • Detroit, MI 48214
P: 313.926.8102
C: 313.999.3641
E: *mary.semegen@glwater.org*
General Information: 844.455.GLWA (4592)



Sampling Points

Between SN-01 and Lake Huron WTP

Water Valves

- Butterfly
- Manual Air

Transmission Main

N

1 ½ 0 1

Miles

Scale: 1:84,000
1 inch = 7,000 feet

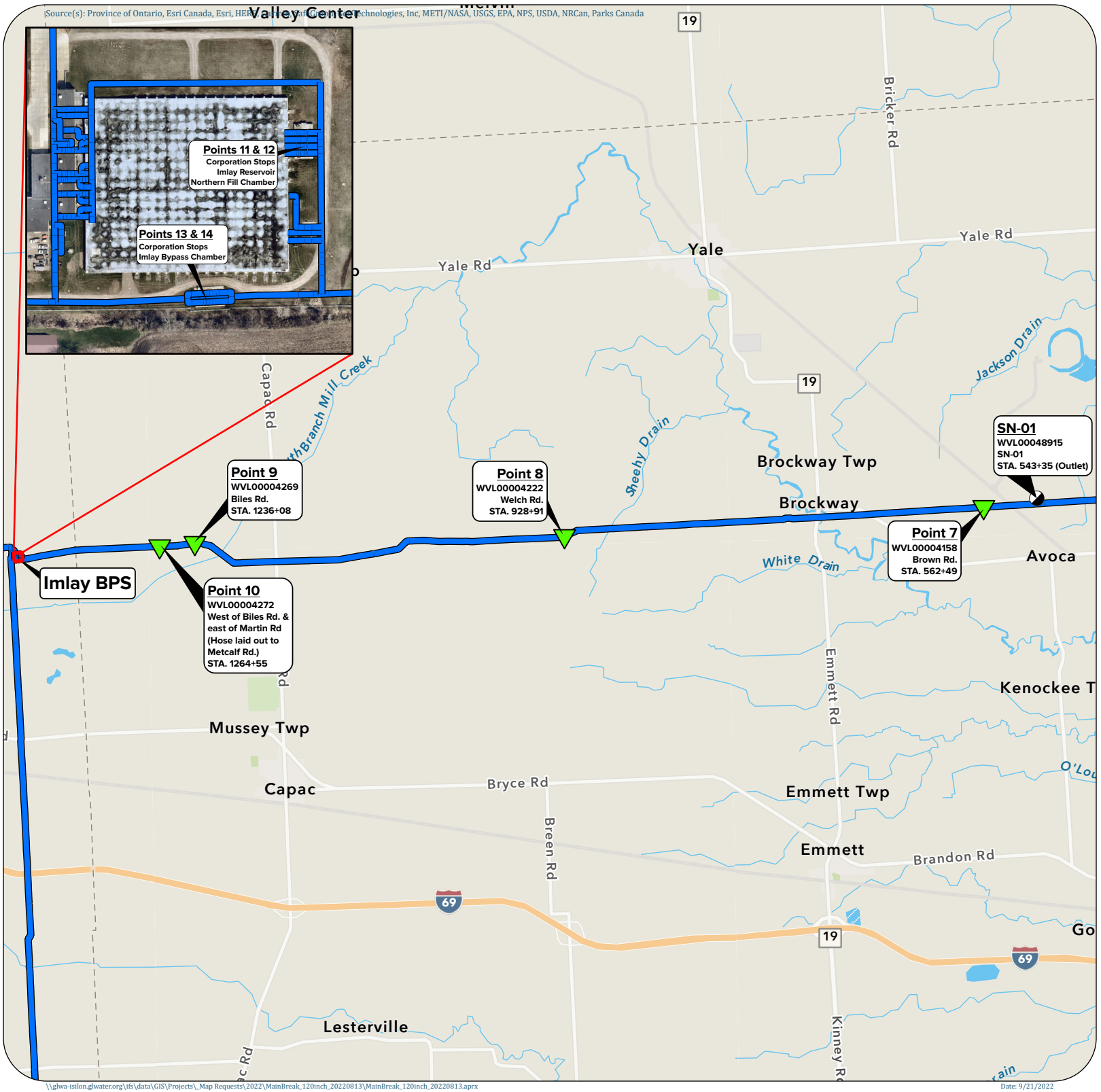
GLWA
Great Lakes Water Authority

\\glwa-isilon.glwater.org\ifs\data\GIS\Projects_Map Requests\2022\MainBreak_120inch_20220813\MainBreak_120inch_20220813.aprx

Date: 9/21/2022

Sampling Points

Between SN-01 and Imlay BPS



Water Valves

- Butterfly
- Manual Air

Transmission Main

N

2 1 0 2

Miles

Scale: 1:126,720
1 inch = 2 miles

GLWA
Great Lakes Water Authority

\\glwa-isilon.glwater.org\ifs\data\GIS\Projects_Map Requests\2022\MainBreak_120inch_20220813\MainBreak_120inch_20220813.aprx

Date: 9/21/2022

120" Water Main Break - Disinfection Sample Results September 2022

Date	Sample location	Address or Location	Type of Discharge	Chlorine residual	Total Coliform	E. coli	Duplicate Total Coliform	Duplicate E. coli	P. Alk mg/L	T. Alk mg/L	Hardness mg/L	Color	Odor	Fluoride mg/L	Turbidity N.T.U.	HPC-Simplate #/1mL
9/26/2022	1	4169 Metcalf	120" to Hose	F: 1.8 T: 2.0	ND	ND	ND	ND	0	64	86	0	0	0.71	0.25	4
9/27/2022	1	4169 Metcalf	120" to Hose	F: 1.7 T: 2.0	ND	ND	ND	ND	0	74	92	0	0	0.71	0.22	
9/28/2022	1	4169 Metcalf	120" to Hose	F: 1.8 T: 2.0	ND	ND										
9/26/2022	2	4338 Metcalf	120" to Hose	F: 1.8 T: 2.0	ND	ND	ND	ND	0	80	86	0	0	0.72	0.51	<2
9/27/2022	2	4338 Metcalf	120" to Hose	F: 1.7 T: 1.9	ND	ND	ND	ND	0	73	90	0	0	0.77	0.31	
9/28/2022	2	4338 Metcalf	120" to Hose	F: 1.7 T: 1.8	ND	ND										
9/26/2022	3	5950 North	120" to Hose	F: 1.8 T: 2.0	ND	ND	ND	ND	0	76	90	0	0	0.74	0.3	4
9/27/2022	3	5950 North	120" to Hose	F: 1.8 T: 1.9	ND	ND	ND	ND	0	74	94	0	0	0.73	0.34	
9/28/2022	3	5950 North	120" to Hose	F: 1.8 T: 2.0	ND	ND										
9/26/2022	4	Metcalf & Gibbons	120" to Hose	F: 1.6 T: 1.8	ND	ND	ND	ND	0	84	88	0	0	0.75	0.2	<2
9/27/2022	4	Metcalf & Gibbons	120" to Hose	F: 1.6 T: 1.8	ND	ND	ND	ND	0	77	95	0	0	0.78	0.42	
9/28/2022	4	Metcalf & Gibbons	120" to Hose	F: 1.5 T: 1.7	ND	ND										
9/26/2022	5	Metcalf & Kingsley	120" to Hose	F: 1.7 T: 1.9	ND	ND	ND	ND	0	80	94	0	0	0.75	0.38	<2
9/27/2022	5	Metcalf & Kingsley	120" to Hose	F: 1.6 T: 1.9	ND	ND	ND	ND	0	75	94	0	0	0.72	0.28	
9/28/2022	5	Metcalf & Kingsley	120" to Hose	F: 1.6 T: 1.8	ND	ND										
9/26/2022	6	Metcalf & Kilgore	120" to Hose	F: 1.8 T: 2.1	ND	ND	ND	ND	0	80	96	0	0	0.77	0.57	2
9/27/2022	6	Metcalf & Kilgore	120" to Hose	F: 1.7 T: 1.9	ND	ND	ND	ND	0	74	93	0	0	0.73	0.33	
9/28/2022	6	Metcalf & Kilgore	120" to Hose	F: 1.6 T: 1.8	ND	ND										

120" Water Main Break - Disinfection Sample Results September 2022

Date	Sample location	Address or Location	Type of Discharge	Chlorine residual	Total Coliform	E. coli	Duplicate Total Coliform	Duplicate E. coli	P. Alk mg/L	T. Alk mg/L	Hardness mg/L	Color	Odor	Fluoride mg/L	Turbidity N.T.U.	HPC-Simplate #/1mL
9/26/2022	7	SN-01	120" to Hose	F: 1.9 T: 2.1	ND	ND	ND	ND	0	80	86	0	0	0.77	0.59	<2
9/27/2022	7	SN-02	120" to Hose	F: 1.7 T: 1.9	ND	ND	ND	ND	0	76	95	0	0	0.77	0.45	
9/28/2022	7	SN-03	120" to Hose	F: 1.7 T: 1.8	ND	ND										
9/26/2022	8	15615 Biles	120" to Hose	F: 1.6 T: 1.7	ND	ND	ND	ND	0	80	108	0	0	0.81	0.63	2
9/27/2022	8	15615 Biles	120" to Hose	F: 2.1 T: 2.3	ND	ND	ND	ND	0	79	97	0	0	0.71	0.46	
9/28/2022	8	15615 Biles	120" to Hose	F: 1.5 T: 1.6	ND	ND										
9/26/2022	9	15890 Bowers	120" to Hose	F: 1.9 T: 2.1	ND	ND	ND	ND	0	90	106	0	0	0.81	0.21	<2
9/27/2022	9	15890 Bowers	120" to Hose	F: 1.2 T: 1.3	ND	ND	ND	ND	0	77	95	0	0	0.73	0.21	
9/28/2022	9	15890 Bowers	120" to Hose	F: 1.6 T: 1.8	ND	ND										
9/26/2022	10	Metcalf & Brown	120" to Hose	F: 2.0 T: 2.2	ND	ND	ND	ND	0	74	98	0	0	0.74	0.52	<2
9/27/2022	10	Metcalf & Brown	120" to Hose	F: 1.8 T: 1.9	ND	ND	ND	ND	0	74	93	0	0	0.71	0.21	
9/28/2022	10	Metcalf & Brown	120" to Hose	F: 1.7 T: 1.8	ND	ND										
9/26/2022	11	Metcalf & Welch	120" to Hose	F: 1.3 T: 1.5	ND	ND	ND	ND	0	80	104	0	0	0.74	0.42	<2
9/27/2022	11	Metcalf & Welch	120" to Hose	F: 1.3 T: 1.5	ND	ND	ND	ND	0	75	93	0	0	0.75	0.25	
9/28/2022	11	Metcalf & Welch	120" to Hose	F: 1.4 T: 1.5	ND	ND										
9/26/2022	12	Imlay Station South	120" to Hose	F: 2.1 T: 2.2	ND	ND	ND	ND	0	84	86	0	0	0.83	0.21	2
9/27/2022	12	Imlay Station South	120" to Hose	F: 1.9 T: 2.0	ND	ND	ND	ND	0	78	98	0	0	0.72	0.37	
9/28/2022	12	Imlay Station South	120" to Hose	F: 1.9 T: 2.0	ND	ND										

120" Water Main Break - Disinfection Sample Results September 2022																
Date	**Sample location**	**Address or Location**	**Type of Discharge**	**Chlorine residual**	**Total Coliform**	**E. coli**	**Duplicate Total Coliform**	**Duplicate E. coli**	**P. Alk mg/L**	**T. Alk mg/L**	**Hardness mg/L**	**Color**	**Odor**	**Fluoride mg/L**	**Turbidity N.T.U.**	**HPC-Simplate #/1mL**
9/26/2022	13	Imlay Station North	120" to Hose	F: 1.8 T: 2.0	ND	ND	ND	ND	0	80	84	0	0	0.82	0.22	<2
9/27/2022	13	Imlay Station North	120" to Hose	F: 1.7 T: 1.9	ND	ND	ND	ND	0	76	95	0	0	0.78	0.25	
9/28/2022	13	Imlay Station North	120" to Hose	F: 1.9 T: 2.0	ND	ND										
mg/L		milligrams per liter														
ND		Not detected														
N.T. U.		Nephelometric turbidity Unit														
HPC need to be <500/mL																

GREAT LAKES WATER AUTHORITY												
Imlay station sample results 120" WMB Repair												
Date	**Address or Location**	**Type of Discharge**	**Chlorine residual**	**Total Coliform**	**E. coli**	**P. Alk mg/L**	**T. Alk mg/L**	**Hardness mg/L**	**Color**	**Odor**	**Fluoride mg/L**	**Turbidity N.T.U.**
10/3/2022	Imlay Reservoir 430 Wheeling Imlay, MI	sample line #3	F: 0.95 T: 1.02	ND	ND	0	80	94	0	0	0.8	1.23
10/4/2022	Imlay Reservoir 430 Wheeling Imlay, MI	sample line #3	F: 0.92 T: 1.03	ND	ND	0	76	100	0	0	0.75	0.34

GREAT LAKES WATER AUTHORITY												
DTE Greenwood results												
Date	**Address or Location**	**Type of Discharge**	**Chlorine residual**	**Total Coliform**	**E. coli**	**P. Alk mg/L**	**T. Alk mg/L**	**Hardness mg/L**	**Color**	**Odor**	**Fluoride mg/L**	**Turbidity N.T.U.**
10/3/2022	DTE Greenwood 7000 Kilgore	1st floor Nurses Station restroom	F: 1.40 T: 1.55	ND	ND	0	74	96	0	0	0.77	0.39
10/4/2022	DTE Greenwood 7000 Kilgore	1st floor Nurses Station restroom	F: 1.35 T: 1.46	ND	ND	0	84	90	0	0	0.75	0.53
10/3/2022	DTE Greenwood 7000 Kilgore	1st floor maintenance lunch rm sink	F: 1.42 T: 1.58	ND	ND	0	78	94	0	0	0.76	0.40
10/4/2022	DTE Greenwood 7000 Kilgore	1st floor maintenance lunch rm sink	F: 1.38 T: 1.51	ND	ND	0	84	98	0	0	0.75	0.37
10/3/2022	DTE Greenwood 7000 Kilgore	2nd floor restroom	F: 1.43 T: 1.54	ND	ND	0	78	96	0	0	0.75	0.43
10/4/2022	DTE Greenwood 7000 Kilgore	2nd floor restroom	F: 1.34 T: 1.48	ND	ND							

AquaTest
LABORATORIES, INC.
COMPLETE WATER TESTING SERVICES
CERTIFIED WELL & SEPTIC INSPECTORS

TO: City of Rochester
RE: Various
WSSN: 05723

DATE: August 18, 2022
SAMPLE NO: 7045
COLLECTED BY: Cory Bendick

ANALYTICAL REPORT

	PARAMETER	Result	Date/Time Sampled		Sample Location	Date/Time Analyzed		Analyst	EPA's MCL / AL	Reporting Limit	Testing Method
650 Letica											
1.	Total Coliform Bacteria	Not Detected	8/17/22	9:40a	Kitchen	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
1.	E-Coli Bacteria	Not Detected	8/17/22	9:40a	Kitchen	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
1200 Parkdale											
2.	Total Coliform Bacteria	Not Detected	8/17/22	10:00a	Bath	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
2.	E-Coli Bacteria	Not Detected	8/17/22	10:00a	Bath	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
52999 Dequindre											
3.	Total Coliform Bacteria	Not Detected	8/17/22	10:15a	Kitchen	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
3.	E-Coli Bacteria	Not Detected	8/17/22	10:15a	Kitchen	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
1998 Runyon											
4.	Total Coliform Bacteria	Not Detected	8/17/22	10:30a	Sink	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B
4.	E-Coli Bacteria	Not Detected	8/17/22	10:30a	Sink	8/17/22	1:44p	VC	0	1 cfu/100ml	9223B

AquaTest
LABORATORIES, INC.
COMPLETE WATER TESTING SERVICES
CERTIFIED WELL & SEPTIC INSPECTORS

UNDERSTANDING YOUR REPORT

Terms	Explanation
Parameter	The contaminate we tested for in your sample.
Result	The actual findings of your test.
Not Detected	The contaminate was not found above the reporting limit.
Positive	In an absence/presence test the contaminate was found.
cfu	Colony forming unit is an estimate of viable bacterial or fungal numbers.
ppm	Parts per million denotes one part per 1,000,000 parts; This is equivalent to one drop of water diluted into 50 liters
ppb	Parts per billion denotes one part per 1,000,000,000 parts; This is equivalent to one drop of water diluted into 250 chemical drums.
pCi/L	Picocuries per Liter is a measure of the radioactivity in water.
Date/Time Sampled	The date and time the water was collected.
Sample Location	This tells you where the sample was collected.
Date/Time Analyzed	The date and time the water was tested.
Holding Time	The time between sample collection and testing; for compliance must not exceed 30 hours for Total Coliform, 48 hours for Nitrates/Nitrites.
Analyst	The initials of the location or of who tested your water.
EPA	Environmental Protection Agency is a government agency whose purpose is to protect human health and the environment.
MCL	Maximum Contaminate Level is highest amount of a contaminate allowed for safe drinking water set by the EPA.
AL	Action Level - EPA level If exceeded triggers treatment or other requirements.
NSDWS	National Secondary Drinking Water Standard is an unenforceable recommended limit of a contaminate set by the EPA.
Reporting Limit	The reporting limit is a quality control measure. A parameter would need to be above this level to register a reliable result.
Testing Method	The testing method is the procedure we used to test your sample.

More information on drinking water and the Environmental Protection Agency can be found at: http://water.epa.gov/drink/

AquaTest
LABORATORIES, INC.
COMPLETE WATER TESTING SERVICES
CERTIFIED WELL & SEPTIC INSPECTORS

TO: City of Rochester
RE: Various
WSSN: 05723

DATE: August 19, 2022
SAMPLE NO: 7046
COLLECTED BY: Cory Bendick

ANALYTICAL REPORT

PARAMETER	Result	Date/Time Sampled		Sample Location	Date/Time Analyzed		Analyst	EPA's MCL / AL	Reporting Limit	Testing Method
650 Letica										
1. Total Coliform Bacteria	Not Detected	8/18/22	9:45a	Kitchen	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
1. E-Coli Bacteria	Not Detected	8/18/22	9:45a	Kitchen	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
1200 Parkdale										
2. Total Coliform Bacteria	Not Detected	8/18/22	10:05a	Bath	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
2. E-Coli Bacteria	Not Detected	8/18/22	10:05a	Bath	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
52999 Dequindre										
3. Total Coliform Bacteria	Not Detected	8/18/22	10:20a	Kitchen	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
3. E-Coli Bacteria	Not Detected	8/18/22	10:20a	Kitchen	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
1998 Runyon										
4. Total Coliform Bacteria	Not Detected	8/18/22	10:35a	Sink	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B
4. E-Coli Bacteria	Not Detected	8/18/22	10:35a	Sink	8/18/22	2:06p	VC	0	1 cfu/100ml	9223B

AquaTest
LABORATORIES, INC.
COMPLETE WATER TESTING SERVICES
CERTIFIED WELL & SEPTIC INSPECTORS

UNDERSTANDING YOUR REPORT

Terms	Explanation
Parameter	The contaminate we tested for in your sample.
Result	The actual findings of your test.
Not Detected	The contaminate was not found above the reporting limit.
Positive	In an absence/presence test the contaminate was found.
cfu	Colony forming unit is an estimate of viable bacterial or fungal numbers.
ppm	Parts per million denotes one part per 1,000,000 parts; This is equivalent to one drop of water diluted into 50 liters
ppb	Parts per billion denotes one part per 1,000,000,000 parts; This is equivalent to one drop of water diluted into 250 chemical drums.
pCi/L	Picocuries per Liter is a measure of the radioactivity in water.
Date/Time Sampled	The date and time the water was collected.
Sample Location	This tells you where the sample was collected.
Date/Time Analyzed	The date and time the water was tested.
Holding Time	The time between sample collection and testing; for compliance must not exceed 30 hours for Total Coliform, 48 hours for Nitrates/Nitrites.
Analyst	The initials of the location or of who tested your water.
EPA	Environmental Protection Agency is a government agency whose purpose is to protect human health and the environment.
MCL	Maximum Contaminate Level is highest amount of a contaminate allowed for safe drinking water set by the EPA.
AL	Action Level - EPA level If exceeded triggers treatment or other requirements.
NSDWS	National Secondary Drinking Water Standard is an unenforceable recommended limit of a contaminate set by the EPA.
Reporting Limit	The reporting limit is a quality control measure. A parameter would need to be above this level to register a reliable result.
Testing Method	The testing method is the procedure we used to test your sample.

More information on drinking water and the Environmental Protection Agency can be found at: http://water.epa.gov/drink/

Village of Lexington

Water Microbiology Request

2

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville Twp.

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-14-22 Time Collected: 8:45 AM

System / Owner Name: Burtchville Twp.

Collection Site (Street Address): 6011 Lakeshore Rd.

City: Lakeport State: MI Zip Code: 48059

(Please Circle One)

County: St Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.) Bathroom

CHAIN OF CUSTODY:

Sample Relinquished By: Brandon Doan

Date: 8-14-22 Time: 9:15 AM

Sample Received By: Mccoy

LABORATORY INFORMATION: (Lab Use Only) T-107

Date In: 8-14-22 Time In: 9:30 Operator: MB

Date Out: 8-15-22 Time Out: 9:35A Operator: B.A.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

Village of Lexington
Water Microbiology Request

3

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville DPW

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St. Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-14-22 Time Collected: 8:30 A.M.

System / Owner Name: Burtchville Twp

Collection Site (Street Address): 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

(Please Circle One)

County: St. Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.) Bathroom

CHAIN OF CUSTODY:

Sample Relinquished By: Brandon Doan

Date: 8-14-22 Time: 9:15 A.M.

Sample Received By: Micky

LABORATORY INFORMATION: (Lab Use Only) T- .84

Date In: 8-14-22 Time In: 8:30A Operator: MS

Date Out: 8-15-22 Time Out: 9:35A Operator: B.H.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

Village of Lexington
Water Microbiology Request

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville DPW

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St. Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-14-22 Time Collected: 8:30 AM

System / Owner Name: Burtchville Twp

Collection Site (Street Address): 4000 Burtch Road

City: Lakeport State: MI Zip Code: 48059
(Please Circle One)

County: St. Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.) Kitchen

CHAIN OF CUSTODY:

Sample Relinquished By: Brandon Doan

Date: 8-14-22 Time: 9:15 AM.

Sample Received By: Micicky

LABORATORY INFORMATION: (Lab Use Only) T - .89

Date In: 8-14-22 Time In: 9:30A Operator: MB

Date Out: 8-15-22 Time Out: 9:35A Operator: B.A.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

Village of Lexington
Water Microbiology Request

5

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville DPW

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St. Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-15-22 Time Collected: 8:00 AM

System / Owner Name: Burtchville Twp

Collection Site (Street Address): 4000 Burtch Road

City: Lakeport State: MI Zip Code: 48059

(Please Circle One)

County: St. Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.) Kitchen

CHAIN OF CUSTODY:

Sample Relinquished By: BRANDON DOAN

Date: 8-15-22 Time: 9:15 AM

Sample Received By: B.A

LABORATORY INFORMATION: (Lab Use Only) T- .93

Date In: 8-15-22 Time In: 9:25A Operator: B.A.

Date Out: 8-16-22 Time Out: 9:30A Operator: B.A.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

Village of Lexington

Water Microbiology Request

4

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville DPW

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St. Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-15-22 Time Collected: 8:10 AM

System / Owner Name: Burtchville Twp

Collection Site (Street Address): 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059
(Please Circle One)

County: St. Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.) Bathrooms

CHAIN OF CUSTODY:

Sample Relinquished By: Brandon Doan

Date: 8-15-22 Time: 9:15 AM

Sample Received By: B.A

LABORATORY INFORMATION: (Lab Use Only) T-1.01

Date In: 8-15-22 Time In: 9:25A Operator: B.A

Date Out: 8-16-22 Time Out: 9:30A Operator: B.A.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

Village of Lexington

3

Water Microbiology Request

REPORT RESULTS AND BILLING TO: (Please Print)

Name: Burtchville Twp

Phone: 810-385-8555

Street Address: 4000 Burtch Rd

City: Lakeport State: MI Zip Code: 48059

County: St Clair WSSN #: 1008

SAMPLE COLLECTION INFORMATION: (Please Print)

Sample Collector Name: Brandon Doan

Date Collected: 8-15-22 Time Collected: 8 30 AM

System / Owner Name: Burtchville Twp

Collection Site (Street Address): 6011 Lakeshore Rd

City: Lakeport State: MI Zip Code: 48059

(Please Circle One)

County: St Clair Does Sample Contain Chlorine? (Yes) or No

Sampling Point (kitchen, bath, etc.)

CHAIN OF CUSTODY:

Sample Relinquished By: Brandon Doan

Date: 8-15-22 Time: 9:15 AM

Sample Received By: B.A.

LABORATORY INFORMATION: (Lab Use Only) T-1,10

Date In: 8-15-22 Time In: 9:25A Operator: B.A.

Date Out: 8-16-22 Time Out: 9:30A Operator: B.A.

TOTAL COLIFORM RESULTS:

Present: _____ Absent: X E. Coli: _____

Nitrate: _____ Nitrite: _____

(Please Note Nitrate & Nitrite Results are for non-regulatory purposes only)

City of Mount Clemens Water Purification Plant
36570 Jefferson, Harrison Township, MI 48045

MEQ Certified Lab # 4510

Bacteriological Samples

Month of Aug, 20 22

Address #1	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
106 Malcom	Sink	.69/.98	8/17/22	9:34	[signature]	Routine (Repeat, Special)	8-17-22	1045
Analysis Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by: BB	24 hour		8-17-22	1050	Rebecca Brennan	8-18-22	1050	Rebecca Brennan

Note any remarks or deficiency in the condition of the sample. | Emergency contact for positive samples. | Sample Result A WATER CONSIDERED SAFE

Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)

Address #2	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
Romeo STP	Tap	.76/1.01	8/17/22	9:47	[signature]	Routine (Repeat, Special)	8-17-22	1045
Analyses Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by: BB	24 hour		8-17-22	1050	Rebecca Brennan	8-18-22	1050	Rebecca Brennan

Note any remarks or deficiency in the condition of the sample. | Emergency contact for positive samples. | Sample Result A WATER CONSIDERED SAFE

Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)

Company Name: Village of Romeo DPW **WSSN#** 5780

Billing Address Or Attach Business Card (only if company has never been here) 586-752-2684

City of Mount Clemens Water Purification Plant
36570 Jefferson, Harrison Township, MI 48045

MEQ Certified Lab # 4510

Bacteriological Samples

Month of Aug, 20 22

Address #1	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
106 McLean	Sink	.46 / .82	8/18/22	10:00	[signature]	Routine ~~Repeat~~ Special	8-18-22	1110
Analysis Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by: BB	24 hour		8-18-22	1115	Rebecca Brennan	8-19-22	1115	[signature]
Note any remarks or deficiency in the condition of the sample.		Emergency contact for positive samples				Sample Result A WATER CONSIDERED SAFE		
Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)								

Address #2	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
Romeo STP	Tap	.72 / .87	8/18/22	10:15	[signature]	Routine ~~Repeat~~ Special	8-18-22	1110
Analyses Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by: BB	24 hour		8-18-22	1115	Rebecca Brennan	8-19-22	1115	[signature]
Note any remarks or deficiency in the condition of the sample.		Emergency contact for positive samples				Sample Result A WATER CONSIDERED SAFE		
Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)								

Company Name: Village of Romeo DPW **WSSN#** 5780

Billing Address Or Attach Business Card (only if company has never been here) 586-752-2684

★ Email These To: romeoDPW@att.net ★
For Fri 8/19/22 only

City of Mount Clemens Water Purification Plant
36570 Jefferson, Harrison Township, MI 48045

MEQ Certified Lab # 4510

Bacteriological Samples

Month of Aug, 20 22

* Chlorine Residual Only no Bacti Sample

Address #1	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
106 McLean	Sink	.60 / .81	8/19/22	9:25		Routine Repeat Special		
Analysis Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by:	24 hour							
Note any remarks or deficiency in the condition of the sample.			Emergency contact for positive samples.			Sample Result		
Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)								

Address #2	Location	Chlorine Free / Total	Date Collected	Time Collected	Samplers Signature	Sample Type	Date Received	Time Received
Romeo STP	Tap	.70 / .93	8/19/22	9:45		Routine Repeat Special		
Analyses Requested: Coliforms	Test Type Colilert Method 9233B		Date Planted	Time Planted	Signature	Date Read	Time Read	Signature
Received for Lab by:	24 hour							
Note any remarks or deficiency in the condition of the sample.			Emergency contact for positive samples.			Sample Result		
Date, Time, and Name of Person Contacted for positive sample results. (Notification must be made within 24 hours)								

Company Name: Village of Romeo DDW WSSN# 5780

Billing Address Or Attach Business Card
(only if company has never been here) 586-752-2684

Imlay City Results BWA

Imlay City, Michigan			
Date	Address	Cl2 mg/L	TC/EC
8-17-2022	1939 Shagbark	F: 1.36	ND/ND
8-18-2022	"	F: 1.39	ND/ND
8-17-2022	395 Third St.	F: 1.71	ND/ND
8-18-2022	"	F: 1.26	ND/ND

ND Non- Detect

Great Lakes Water Authority
Water Quality

RESULTS (BY TOWN) (08/16/2022 To 08/18/2022)

Town Name: Bruce Twp.

Date	Pt.	Br.	Sample #	T.Coliform	E.Coli	Cl2	Need Recheck	Reckeck Date
Town Name: Bruce Twp.								
08/17/2022	1		11	-	-	0.63		
08/18/2022	1		41	-	-	0.71		

Total No. of Samples Collected: 2

Great Lakes Water Authority
Water Quality

RESULTS (BY TOWN) (08/17/2022 To 08/18/2022)

Town Name: Shelby Twp.

Date	Pt.	Br.	Sample #	T.Coliform	E.Coli	Cl2	Need Recheck	Reckeck Date
Town Name: Shelby Twp.								
08/17/2022	1		82	-	-	0.48		
08/17/2022	5		83	-	-	0.73		
08/17/2022	7		84	-	-	0.34		
08/17/2022	9		86	-	-	0.74		
08/17/2022	10		87	-	-	0.11		
08/17/2022	11		88	-	-	0.72		
08/17/2022	12		89	-	-	0.25		
08/17/2022	15		85	-	-	0.62		
08/17/2022	20		90	-	-	0.80		
08/17/2022	39		91	-	-	0.74		
08/17/2022	41		92	-	-	0.73		
08/17/2022	42		93	-	-	0.62		
08/17/2022	43		94	-	-	0.58		
08/17/2022	44		95	-	-	0.10		
08/18/2022	1		88	-	-	0.70		
08/18/2022	5		89	-	-	0.78		
08/18/2022	7		90	-	-	0.64		
08/18/2022	9		92	-	-	0.78		
08/18/2022	10		93	-	-	0.82		
08/18/2022	11		94	-	-	0.77		
08/18/2022	12		95	-	-	0.34		
08/18/2022	15		91	-	-	0.59		
08/18/2022	20		96	-	-	0.82		
08/18/2022	39		97	-	-	0.90		
08/18/2022	41		98	-	-	0.61		
08/18/2022	42		99	-	-	0.59		
08/18/2022	43		100	-	-	0.54		
08/18/2022	44		101	-	-	0.70		

Total No. of Samples Collected: 28

Great Lakes Water Authority
Water Quality

RESULTS (BY TOWN) (08/17/2022 To 08/18/2022)

Great Lakes Water Authority
Water Quality

RESULTS (BY TOWN) (08/17/2022 To 08/18/2022)

Town Name: Washington Twp.

Date	Pt.	Br.	Sample #	T.Coliform	E.Coli	Cl2	Need Recheck	Reckeck Date
Town Name: Washington Twp.								
08/17/2022	3		1	-	-	0.62		
08/17/2022	5		2	-	-	0.29		
08/17/2022	6		3	-	-	0.22		
08/17/2022	7		4	-	-	0.44		
08/17/2022	9		5	-	-	0.53		
08/17/2022	11		6	-	-	0.54		
08/17/2022	12		7	-	-	0.26		
08/17/2022	13		8	-	-	0.65		
08/17/2022	15		9	-	-	0.11		
08/17/2022	17		10	-	-	0.64		
08/18/2022	3		35	-	-	0.63		
08/18/2022	5		33	-	-	0.52		
08/18/2022	6		32	-	-	0.57		
08/18/2022	7		31	-	-	0.50		
08/18/2022	9		37	-	-	0.62		
08/18/2022	11		38	-	-	0.62		
08/18/2022	12		40	-	-	0.58		
08/18/2022	13		36	-	-	0.69		
08/18/2022	15		39	-	-	0.59		
08/18/2022	17		34	-	-	0.60		

Total No. of Samples Collected: 20

Appendix C

PICA Investigation Report

GLWA
Great Lakes Water Authority

Great Lakes Water Authority (GLWA)
120-Inch PCCP Water Transmission Main

Metcalf Rd (State Rd to North Rd)
Condition Assessment Report, NFT Analysis

PICA – Pipeline Inspection & Condition Analysis Corporation
(A Subsidiary of Russell NDT Holdings Ltd.)

Near Field-Testing Inspection – 120" Potable Water NFT Tool

120-Inch PCCP Water Transmission Main

Fort Gratiot Township, Michigan

Report:	GLWA 2022 - 120in PCCP Water Transmission Main REPORT
Submission:	December 7th, 2022
Revision:	1.1; 1.0 (October 25, 2022)
Inspection Date(s):	August 23rd – 24th, 2022
Operators:	C. Russell, S. Popovic, J. Regala
Analysts:	J. Regala
Reviewers:	A. Shatat

Table of Contents

Great Lakes Water Authority (GLWA)

120-Inch PCCP Water Transmission Main - Metcalf Rd (State Rd to North Rd)
Condition Assessment Report, Standard Analysis

Executive Summary

On August 13th, 2022, at 4:30 AM, the Great Lakes Water Authority (GLWA) experienced a significant failure on its 120-inch Water Transmission Main originating from the Lake Huron Water Treatment Plant (LHWTP). The 120-inch transmission main, the largest in the regional water distribution system, was constructed in 1968 using embedded PCCP pipe, and failed approximately 1 mile west of the treatment plant.

PICA was contracted by HDR, GLWA's supporting engineering firm for the break, to access the water main at the failure location and inspect approximately 1.5 miles of pipe (there was a closed isolation valve between the treatment plant and failure location, limiting the inspectable length in the East leg to approximately 0.5 mile). PICA mobilized its Near-Field Testing (NFT) inspection equipment within a day after being contacted by HDR, and PICA's crew travelled to Detroit two and half days later, arriving roughly at the same time as the equipment.

On August 23rd, PICA collected the inspection equipment from the LHWTP in the morning and assembled the NFT tool inside the eastern leg of the transmission main by mid-afternoon. Several short calibration scans were also performed on the eastern leg of the main to fine tune the settings on the NFT tool. Both legs (east and west) were successfully inspected the following day on August 24th. Preliminary analysis result tables were submitted to HDR for review within 24-hours of completing the inspection. *Note that the results presented in this report supersede the previously submitted findings.*

The comprehensive analysis of the NFT data from both East and West legs identified a combined total of seven (7) wire break (WB) regions. The majority, five (5) WB regions in total, were estimated to contain up to 5 WBs, while the remaining two (2) regions were estimated to contain up to 10WB and 15WB each. No regions measuring above 15 WBs were found. Detailed wire break results and locations can be found in the supplementary spreadsheet, ***GLWA 2022 - 120in PCCP Water Transmission Main RESULTS.***

Table 1. Overview of the NFT findings from the inspected section.

Table 1: Feature Indication Summary	
Total Inspected Length:	**8,321.13ft** *(1.58 miles)*
Number of Analyzed Pipes:	**525**
Number of Pipes with Wire Break (WB) Regions:	**7**
Total Number of WB Regions Identified:	**7**
• *Number of WB Regions with up to 5WB:*	*5*
• *Number of WB Regions with 6 to 10WB:*	*1*
• *Number of WB Regions with 11 to 15WB:*	*1*
• *Number of WB Regions with >15WB:*	*0*
Total Number of Anomalies Identified:	**22**
• *Number of Suspected Manufacturing anomalies:*	*3*
• *Number of Anomalous Joints:*	*19*
Pipeline Feature Summary	
Number of Pipeline Features:	**13**
• *Number of Manholes (includes newly installed manhole at failure site):*	*9*
• *Number of 12" Blow-offs:*	*4*

Figure 1 illustrates the distribution of wire break regions along the inspected sections, while Figure 2 provides an overview of the inspected section. PICA accessed both the East and West legs at the failure site, where three (3) ~16ft pipe segments were removed for the repair.

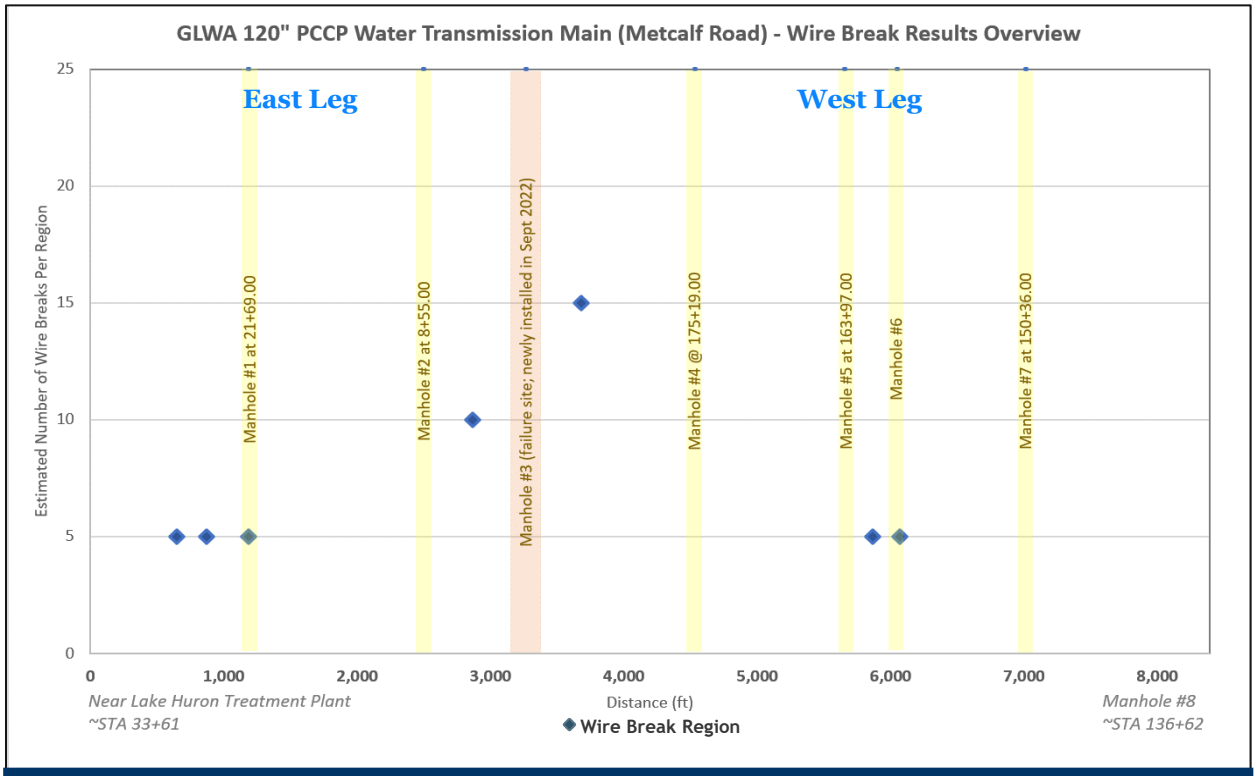


Figure 1. Distribution of wire break regions along GLWA's 120-Inch PCCP Water Transmission Main between the 120"/108" Reducer near the Lake Huron Water Treatment Plant and Manhole #8 east of North Road.

Figure 2 shows an overview of the inspected section.

Figure 2. Overview of the inspected section of GLWA's 120-Inch PCCP Water Transmission Main south of Metcalf Road. PICA inspected the section between the 120"/108" Reducer near the Lake Huron Water Treatment Plant and MH #8 east of North Road.

Inspection Overview

Access Location

PICA accessed the water transmission main through the excavation that exposed the ruptured pipe approximately 1 mile from the treatment plant. Figure 3 below shows the ruptured pipe prior to the excavation.

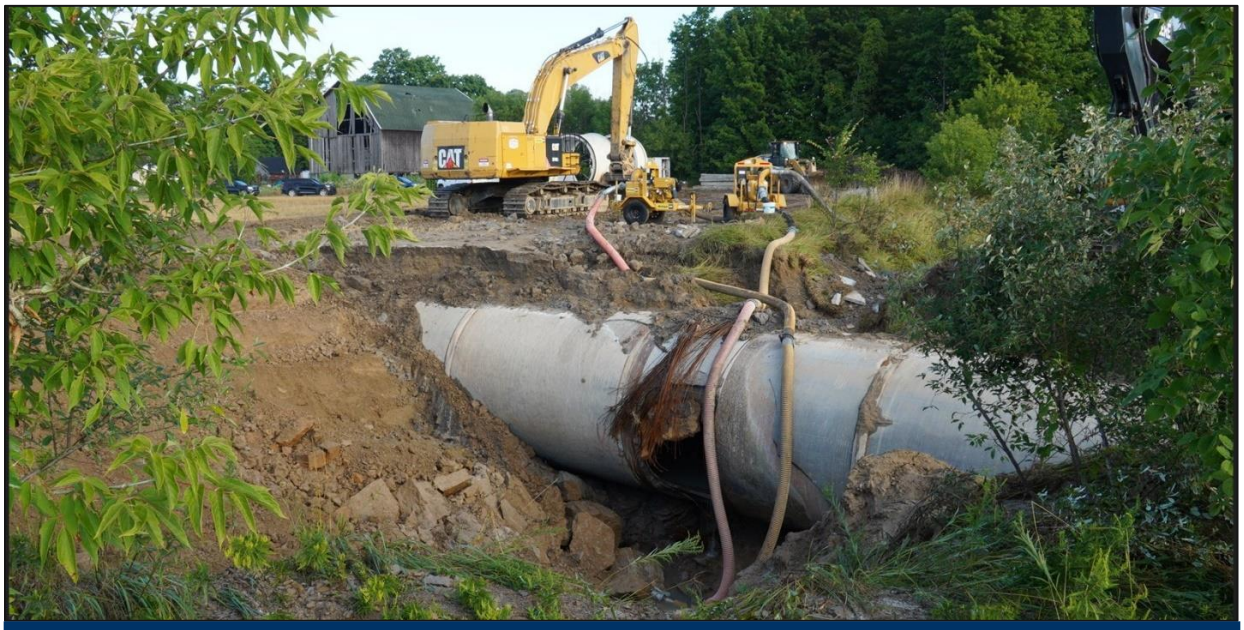


Figure 3. GLWA experienced a significant water main failure on its 120-inch Transmission Main originating from the Lake Huron Water Treatment Facility on August 13th , 2022, at 4:30 AM *(image obtained from GLWA's social media post).*

Figures 4a and 4b shows the ruptured section after it was removed from the excavation.

Figure 4a. Side profile image of the ruptured pipe. Note that the rupture occurred near the invert and on the south side of the pipe.

Figure 4b. PICA closely inspecting the inside of the ruptured pipe.

Three (3) of the original 16ft-long standard PCCP pipes, which included the ruptured pipe and both adjacent pipes, were removed during the repair process (PICA Pipe ID 205-207; HDR Pipe ID 2-45, 3-0 and 3-1). Referring to the *1973 "As-Built" Plan and Profile* drawings, the removed pipes are located between 0+64 and 1+11 (ruptured pipe was between 0+80 and 0+95). PICA used this opening to inspect the main in both east and west directions. Since PICA's inspection scope was to only inspect up to Manhole #8 at 136+73 (near North Rd), the crew utilized this single location during the NFT inspection of both legs. Figure 5 shows the excavation in its entirety following the removal of the three pipes.

Figure 5. Panoramic image of the excavation, (looking south) prior to the concrete base pour and repairs.

NFT Tool Disinfection, Confined Space/Safety and Tool Assembly

Prior to insertion, the NFT tool components were laid out on a tarp outside of the excavation and underwent a thorough disinfection using a diluted bleach solution. In addition, PICA's personnel sanitized their footwear prior to first entry into the main by first stepping into a diluted bleach solution bath situated next to the pipe opening.

As mentioned earlier, tool insertion during the NFT inspection of both East and West legs was performed using the full-bore pipe opening in the excavation. Confined space entry monitoring and safety was managed by Amerisafe, with one of their personnel assigned to accompany PICA's in-pipe crew during the inspection. Pipeline atmospheric conditions were assessed regularly, and all entrants wore personal air monitoring devices when inside the main. To facilitate the loading of the tool components into the pipe, a crane was used to lower each component into the excavation and then guided into the pipe.

Tool assembly was completed within 2 hours once all components were lowered into the excavation. Figure 6 shows the nearly fully assembled NFT tool.

Figure 6. PICA crew completing the assembly of the NFT tool during the inspection of the East leg.

Inspection Operations

Once tool assembly was completed, PICA performed several short calibration scans to ensure the tool was functioning properly and to optimize the inspection frequency setting for the pipe. The inspection tool was conveyed through both legs using an electric drive wheel that could be set to a specific speed. Once dialed-in, the electric drive wheel maintained the desired speed for the full inspection run, making data acquisition smooth and independent of the walking speed of the accompanying PICA crew. Each leg was inspected twice: an outbound run set at two lower frequencies that averaged 30-40ft/min, and an inbound/return run set at high dual frequency values that averaged 60-80ft/min. Both outbound and inbound data sets provided similar data sets with the sampling rate being the fundamental difference. The outbound data was used as the primary set during the analysis as the data quality was slightly better (less travel-related artifacts), while the inbound data was utilized to confirm repeatability when necessary.

An overview of all runs is provided in Table 2 below.

Table 2: PICA's NFT-EM Inspection Overview

Run #	Leg	Scan Date	Scan Direction	Scan Start Time	Scan End Time	Inspection Speed	Comments
1	East	Aug 23, 2022	Various	5:15PM	7:00PM	30-40ft/min	Tool calibration scans.
2	East	Aug 24, 2022	Failure site to 120"/108" Reducer	9:40PM	11:22AM	30-40ft/min	Outbound run from the access opening to the 120"/108" Reducer near the water treatment plant.
3	East	Aug 24, 2022	120"/108" Reducer to Failure site	11:30AM	12:15PM	60-80ft/min	Return/inbound run from the 120"/108" Reducer to the access opening.
4	West	Aug 24, 2022	Failure site to Manhole #8	1:55PM	4:33PM	30-40ft/min	Outbound run from the access opening to Manhole #8.
5	West	Aug 24, 2022	Manhole #8 to Failure site	5:00PM	6:05PM	60-80ft/min	Return/inbound run from Manhole #8 to the access opening.

The acquired data is displayed live on a laptop, which means that data quality review can be performed in real-time while the data is streaming in. If the data in a certain area is noisy, the run can be stopped, and the section of pipe rescanned. The in-pipe PICA crew also noted the pipes that exhibited broken wire signatures as the NFT tool scanned past them.

After completing the calibration scans on August 23rd in the East leg, the battery powering the electric drive wheel, as well as the two batteries for the NFT components, were extracted from the main and charged overnight. The NFT tool itself was secured and left in the East leg for the evening.

Figure 7. PICA operator monitoring the EM data as it's collected during the August 2022 NFT inspection of GLWA's 120-inch PCCP Transmission Main.

Daily Summary

Table 3 below provides a detailed account of PICA's on-site activities.

Table 3: Inspection Job Notes

Date	Activities
August 23, 2022	**8:00 AM:** PICA arrived at the plant. NFT equipment was delivered prior to the crew's arrival. **8:30 AM:** PICA headed to failure site to evaluate the access and met with HDR crew. **9:30 AM:** PICA heads back to the plant to unpack the equipment, begin partial assembly and perform post-shipping diagnostics. **12:00 PM:** PICA arrives at the work site. **1:00 PM:** NFT equipment is staged on a tarp and disinfected with bleach solution. **1:15 PM:** PICA on standby while a contractor pours concrete in the excavation. **2:15 PM:** Begin lowering NFT equipment down into the East leg using crane. **3:15 PM:** PICA begins assembling the NFT tool within the main. **5:15 PM:** Begin calibration scans in the East leg. **7:00 PM:** Calibration scans completed. PICA leaves site with NFT tool secured in the pipe overnight. Batteries were extracted for charging.
August 24, 2022	*East Leg* **7:45 AM:** PICA arrived on site. Safety meeting with HDR, Amerisafe and Pure. **8:50 AM**: Batteries hooked up. PICA standing by until MH1 is opened, and tripod set up. NFT odometer calibrated in Pipe 2-43. **9:40 AM:** Begin NFT scan of East leg. **11:22 AM:** PICA reached the 120" x 108" reducer (pipe # 0-3). **11:30 AM:** Begin return run. **12:15 PM:** Return run complete. PICA exits the East leg for a brief lunch break (~30minutes). *West Leg* **12:35 PM:** Tool inserted in the West leg and prepare for NFT scan. **1:05 PM:** PICA crew ready to go. Standing by for Amerisafe personnel. **1:55 PM:** PICA begins West leg scan. **4:33 PM:** NFT scan reaches target distance at MH8. **5:00 PM:** Begin return scan. **6:05 PM:** Return scan complete. **7:00 PM:** Pack up equipment and depart from site.
August 25, 2022	**8:00 AM:** Two of PICA's technicians returned to the plant to pack up the NFT equipment for shipment. The remaining PICA team stayed back at the hotel to perform preliminary analysis of the East and West leg EM data. **12:00 PM:** Both shipping containers are packed and ready for pick up. Shipping documents provided to GLWA representative. **12:10 PM:** PICA submitted preliminary results to HDR, then demobilized from site.

Analysis Results

Preliminary On-Site Data Review

The electromagnetic (EM) data was reviewed immediately after completing the inspection scans on August 24th. PICA then submitted preliminary inspection results before leaving site at around noon the following day (August 25). PICA identified a number of wire break regions and also flagged a minor discrepancy between the field numbering based on the lay sheets vs actual pipe sticks in the main. *Note that the results presented in this report supersede the previously submitted preliminary findings.*

Location Reporting, Pipe Lengths & Features

The total distance logged during the NFT-EM inspection of the 120-inch PCCP Water Transmission Main along Metcalf Road was 8,321.13ft (1.58 miles). This span combines both East and West inspection legs and covers the full distance between the 120" x 108" Reducer at ~33+75 at the east end (near the Lake Huron Water Treatment Plant) and Manhole #8 at 136+73 to the west (near North Rd). The excavated failure site, which included the removal of three (3) 16ft-long standard pipes, was used by PICA to access both the East and West legs. This is located between 0+64 and 1+11 (ruptured pipe was between 0+80 and 0+95).

A combined total of 525 individual pipe segments were inspected, with the common standard length being 16ft. To facilitate the distance and location reporting for the inspected pipes, both the As-Built stationing and a cumulative distance chainage from the NFT tool's onboard odometer were provided in the supplementary spreadsheet, ***GLWA 2022 - 120in PCCP Water Transmission Main RESULTS.***

The zero-reference datum (ZRD) point for the NFT data was set within the short 13.57ft pipe adjacent to the 120"/108" Reducer at the east end of the main (near the water treatment plant). This short pipe, referred to as *PICA Pipe #2 (HDR Field #0-4)* in PICA's pipe tally, was only partially inspected (3.4ft of 13.57ft scanned) as the NFT tool's positioning within the segment was physically limited by the reducer.

For the failure site, PICA elected to continue the pipe numbering and distance chainage assignment to provide continuity between the two inspected sections. The extracted 16ft pipes, which span between 3,238.51ft and 3,285.97ft in the NFT data, were assigned pipe numbers 205, 206 and 207, with Pipe 206 being the ruptured pipe. It is worth noting that this sequence of three consecutive 16ft pipes does not match the newly installed replacements. Since the repair work was done after PICA's inspection, the details for the newly installed pipes could not be accounted for in this report.

The end-reference datum (ERD) point after combining both the East and West leg data sets was in the standard 16ft pipe immediately after and west of Manhole #8 at 136+72. The ERD location represents the end of PICA's NFT inspection. Between the ZRD and ERD locations, PICA collected EM data to successfully assess this 8,321.13ft (1.58 miles) section of GLWA's 120-inch PCCP Water Transmission Main for any broken prestressing wires.

A total of 13 pipeline features were identified in the EM data, with four (4) being blow-offs and the remaining nine (9) as manholes. Apart from Manhole #3, which was installed following PICA's inspection, all features were visually confirmed during PICA's walk-through.

A detailed correlation of these features was also performed using the *1973 "As-Built" Plan and Profile* drawings. Note that all but two of the features were listed in the drawings. Manhole #3 was newly installed because of the recent failure, while Manhole #6 was installed at some point following the original construction (installation records for this manhole were not provided). Table 4 below provides a summary of all identified pipeline features.

Table 4. Pipeline Feature Summary

Section	PICA's Pipe No.	Feature Type	Low Station*	Cumulative NFT Start Joint Location (ft) *Measured from the 120"x108" Reducer	Cumulative NFT End Joint Location (ft) *Measured from the 120"x108" Reducer	Length (ft)*
East Leg	**3**	24" Outlet	33+50.00	3.14	19.17	16.03
East Leg	**30**	12" Blow-Off	29+18.00	435.06	451.11	16.05
East Leg	**76**	Manhole #1 (16" x 18")	21+69.00	1,172.56	1,188.61	16.05
East Leg	**158**	Manhole #2 (16" x 18")	8+55.00	2,486.34	2,502.36	16.02
East Leg	**163**	12" Blow-off	7+75.00	2,566.02	2,582.06	16.04
Failure Site	**206**	Manhole #3** *(Installed immediately after PICA's inspection)*	0+87.43	Not inspected	Not inspected	Unknown
West Leg	**285**	Manhole #4 (16" x 18")	175+19.00	4,520.03	4,536.07	16.04
West Leg	**298**	12" Blow-Off	173+11.00	4,728.37	4,744.40	16.03
West Leg	**355**	Manhole #5 (16" x 18")	163+97.00	5,642.63	5,658.66	16.03
West Leg	**373**	16" Blow off	161+09.00	5,930.53	5,946.36	15.83
West Leg	**380**	Manhole #6 (16" x 18")**	160+02.83	6,041.17	6,049.19	8.02
West Leg	**441**	Manhole #7 (16" x 18")	150+36.00	7,003.42	7,019.45	16.03
West Leg	**528**	Manhole #8	136+72.50	8,358.98	8,375.01	16.03

**Obtained from the As-Builts (marked up 1973 Plan and Profiles).*
***Not part of the original construction.*

A detailed correlation of each inspected segment in the EM data was also performed using the supplied As-Built drawings and field records by both PICA and HDR. In general, the correlation between all sources matched well, with most pipes found at the same location across all sources. There are the following exceptions:

- PICA observed several inconsistencies with the measured pipe lengths in HDR's field records compared to the EM data and PICA's field records (e.g., HDR Field #s 6-54, 7-6, 7-7, etc…) wherein the measured values significantly varied from the standard 16ft length. These discrepancies were ignored as they were assumed to be due to inaccuracies caused by the measuring wheel.
- **Pipes 205, 206 and 207:** These three (3) originally listed 16ft standard pipes make up the entire section that was replaced due to the failure (Pipe 206 was the ruptured pipe). No EM data is available for these pipes as they were removed during the repair work.
- **Pipes 380, 381:** These two 8ft pipes were part of the modification that resulted in the installation of Manhole #6 (~160+03). The As-Built records noted a 16ft standard pipe at this location.
- **Pipes 525, 526 and 527:** These three short pipes (lengths of ~2.05ft, 1.35ft and 5.52ft) were identified in the EM data and confirmed in the field, while the As-Built drawings listed a single 8.92ft closure piece at this location (136+89 to 136+98).
- **Pipe 528**: The 8.50ft short pipe listed between 136+81 and 136+89 was not found in the EM data, nor was it observed in the field. Instead, a 16ft pipe with a manhole (#8) was found in its place.

A detailed breakdown of segment lengths and feature locations can be found in the supplementary spreadsheet, ***GLWA 2022 - 120in PCCP Water Transmission Main RESULTS.***

Wire Break Results

Analysis of the NFT data from both East and West legs identified a combined total of 7 wire break (WB) regions. The majority, five (5) WB regions in total, were estimated to contain up to 5 WBs, while the remaining two regions were estimated to contain up to 10WB and 15WB each. No regions measuring above 15 WBs were found. The summary below provides a more detailed breakdown of the results within each leg.

East Leg

- A total of four (4) WB regions across four (4) pipes were identified in this section. More specifically, three (3) regions measured up to 5 WBs and one (1) region up to 10 WBs.
- **Pipe 76 (HDR Pipe# 1-0)**: The 5WB region identified in this pipe is also collocated with a 16" x 18" manhole (#1). While the WB and manhole related signals are distinctly visible in the EM data, there is a slight overlap between the two signatures. As a result, the WB region reported in this pipe is with reduced confidence.

West Leg

- A total of three (3) WB regions across three (3) pipes were identified in this section. Two (2) regions measured up to 5 WBs and one (1) region up to 15 WBs.
- The observed WB signals for both 5WB regions are located less than 2.5ft from a bell and spigot joint connection. As a result, the resulting EM response for the WB region partly overlaps with the joint signature. While additional measures were taken to isolate the WB signal from the joint signature, the analysis results for these two regions are with reduced confidence.
- **Pipe 232 (HDR Pipe# 3-26)**: The largest WB indication, measuring up to 15WB was observed in this pipe. A data capture of the WB signal is provided below.

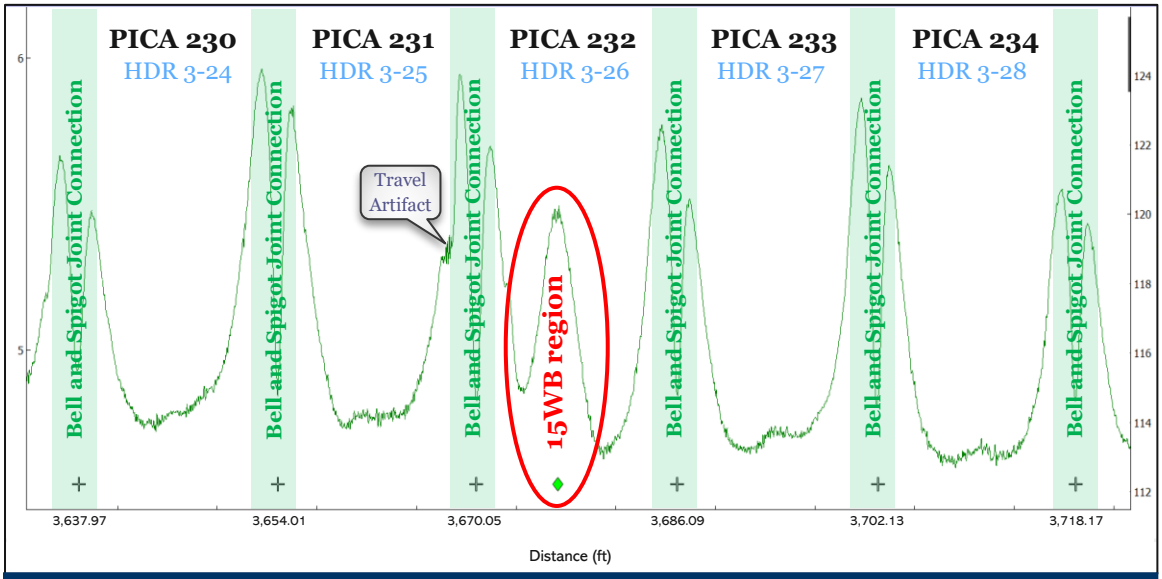


Figure 8: Electromagnetic (EM) data (phase) capture highlighting the 15WB region detected in Pipe 232 (HDR Pipe 3-26). EM data for neighboring Pipes 230, 231, 233 and 234, which did not contain any wire breaks, were included as baseline references.

A distribution graph with respect to the location of the wire break regions along the inspected section is provided in Figure 1 as part of the executive summary on page 4. Detailed wire break results and locations can be found in the supplementary spreadsheet, ***GLWA 2022 - 120in PCCP Water Transmission Main RESULTS.***

Anomalies

The analysis of the EM data also identified a total of 22 anomalies. There are two types of anomalies that were observed.

Manufacturing Anomalies

A total of three (3) suspected manufacturing anomalies were identified, two (2) of which were in the East leg and one (1) in the West leg. In general, these anomalies all share the same characteristics: they appear as small magnitude signal responses and exhibit the same signal phase and amplitude traits in the EM data. They are suspected to be related to the manufacturing of the pipe, and possibly related to the prestressed wires, since they are the dominant EM field contributors to the NFT signal. Below is an example of one of the suspected manufacturing anomalies. A wire break indication in Pipe 57 (HDR Pipe 0-59), estimated as having 5WB, is shown for comparison.

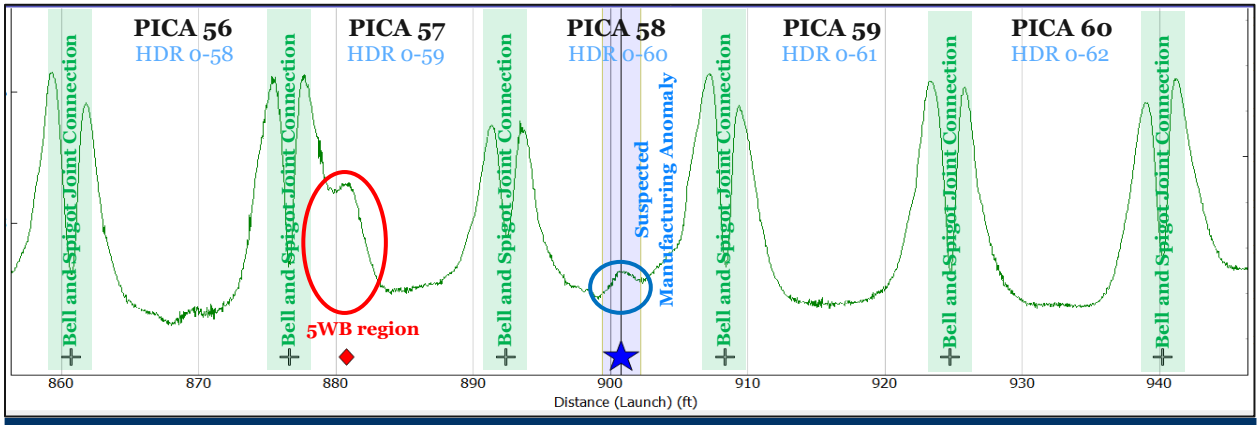


Figure 9. EM (phase) data showing one of the suspected manufacturing anomalies identified in Pipe 58 (HDR Pipe 0-60). For comparison, a typical signal response due to a wire break can be seen in Pipe 57 (HDR Pipe 0-59).

Anomalous Joint Signals

A total of 19 anomalous joints were identified, eight (8) of which are in the East leg and eleven (11) in the West leg. All anomalous joints appear similarly in that they all exhibit a significantly stunted response compared to the majority of the bell and spigot joint signals. Limited interpretation can be provided as to the cause of this type of anomaly, but PICA does not suspect them to be related to wire breaks. It is possible that the affected pipes were installed differently compared to the rest of the main. Below is an example of an anomalous joint surrounded by "normal" joints.

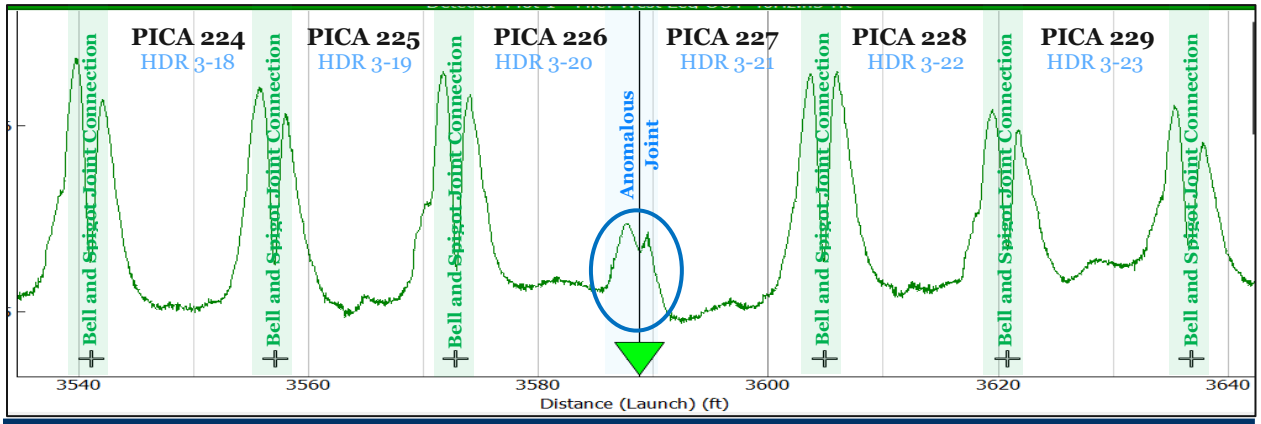


Figure 10. EM (phase) data showing one (1) of the 19 anomalous joints (highlighted in blue) between pipes 226 and 227 (HDR Pipes 3-20 and 3-21). These unique joints appear stunted in the EM data compared to the common bell and spigot joint

Disclaimer – PICA Corporation

Scope of Services

The agreement of PICA Corp to perform services extends only to those services provided for in writing. Under no circumstances shall such services extend beyond the performance of the requested services. It is expressly understood that all descriptions, comments and expressions of opinion reflect the opinions or observations of PICA Corp based on information and assumptions supplied by the owner/operator and are not intended nor can they be construed as representations or warranties. PICA Corp is not assuming any responsibilities of the owner/operator and the owner/operator retains complete responsibility for the engineering, manufacture, repair and use decisions as a result of the data or other information provided by PICA Corp. Nothing contained in this Agreement shall create a contractual relationship with or cause of action in favor of a third party against either the Line Owner or PICA Corp. In no event shall PICA Corp's liability in respect of the services referred to herein exceed the amount paid for such services.

Standard of Care

In performing the services provided, PICA Corp uses the degree, care, and skill ordinarily exercised under similar circumstances by others performing such services in the same or similar locality. No other warranty, expressed or implied, is made or intended by PICA Corp.

Appendix D

Xylem/Pure Technologies Inspection Report – East

xylem
Let's Solve Water

PipeWalker® Electromagnetic Inspection Report

120-inch PCCP Main – East of Failure Location

Great Lakes Water Authority and
Ric-Man Construction Florida, Inc.

Version 1.0 – October 2022

pure TECHNOLOGIES
a xylem brand

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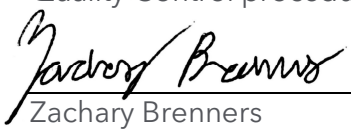
Quality Assurance and Quality Control Statements

This report has been prepared and reviewed in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:



December 6, 2022

Zachary Brenners — Date
Project Manager

Editorial Review Statement

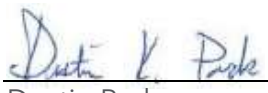
This report has been prepared and reviewed for editorial content in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:

October 27, 2022

Linda Konopka — Date
Editorial Reviewer

Technical Review Statement

This report has been prepared and reviewed for technical correctness in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:

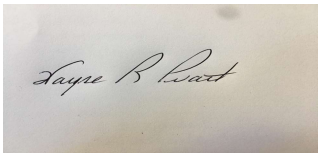


October 27, 2022

Dustin Park — Date
Technical Reviewer

Contractual Review Statement

This report has been reviewed for contractual completeness in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:



October 28, 2022

Wayne Pratt — Date
Contractual Reviewer

Confidentiality Clause

This report contains confidential commercial information regarding proprietary equipment, methods, and data analysis, which is the property of Pure Technologies, a Xylem brand. It is for the sole use of the Great Lakes Water Authority, Ric-Man Construction Florida, Inc., and their engineering consultants and is not to be distributed to third parties without the express written consent of Pure Technologies, a Xylem brand.

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Appendices

Executive Summary

On August 22, 2022, Pure Technologies, a Xylem brand (Pure Technologies), conducted a non-destructive evaluation of the prestressed concrete cylinder pipe (PCCP) in the 120-inch PCCP Main east of the failure location on the main. The evaluation was performed using Pure Technologies' proprietary PipeWalker® platform, a non-destructive electromagnetic inspection technology. The purpose of the inspection was to locate and identify pipes that have broken prestressing wire wraps after a failure occurred on the 120-in PCCP Main. The electromagnetic inspection scope is highlighted in Table ES.1.

Table ES.1: Scope of the Electromagnetic Inspection

Pipeline	Section	Start Station	End Station
120-inch PCCP Main	East of Failure	1+11	33+79

The inspection covered a cumulative distance of 0.62 miles and spanned a total of 204 pipes. Analysis of the data obtained during the inspection determined that a total of four (4) pipes in the section east of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 15 broken wire wraps:

A summary of the results is presented in Figure ES.1, Table 2.2 and Table 2.3 and a complete discussion is provided in Section 2.4.

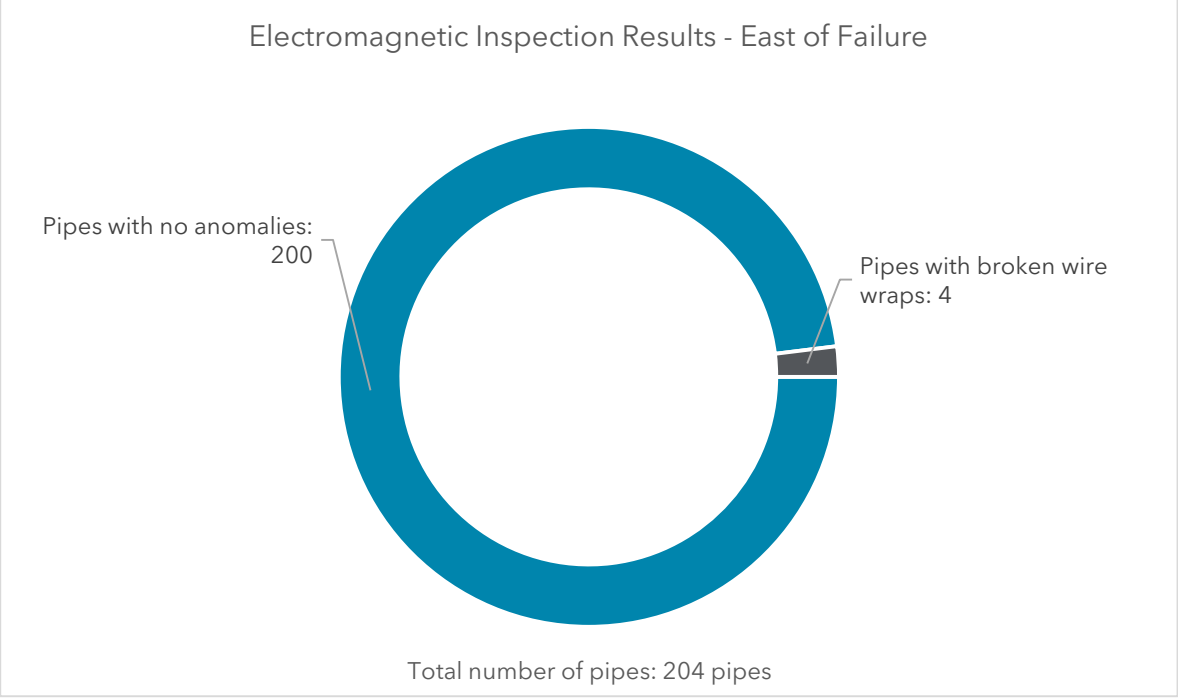

Figure ES.1: Electromagnetic Inspection Results

1. Project Background

On August 22, 2022, Pure Technologies, a Xylem brand (Pure Technologies), conducted a non-destructive evaluation of the prestressed concrete cylinder pipe (PCCP) in the 120-inch PCCP Main. The evaluation was performed using Pure Technologies' proprietary PipeWalker® platform, a non-destructive electromagnetic inspection technology. The purpose of the inspection was to locate and identify pipes that have broken prestressing wire wraps after a failure occurred on the 120-in PCCP Main.

The inspected portion of the PCCP Main is composed of 120-inch single wrap embedded cylinder pipe (ECP) without shorting straps. The pipes were manufactured by Interpace Corporation in 1968. The 120-inch PCCP Main is owned and operated by the Great Lakes Water Authority.

A map of the inspected section of the 120-inch PCCP Main is shown below (Figure 1.1). This map shows the approximate geographical location of the pipeline.

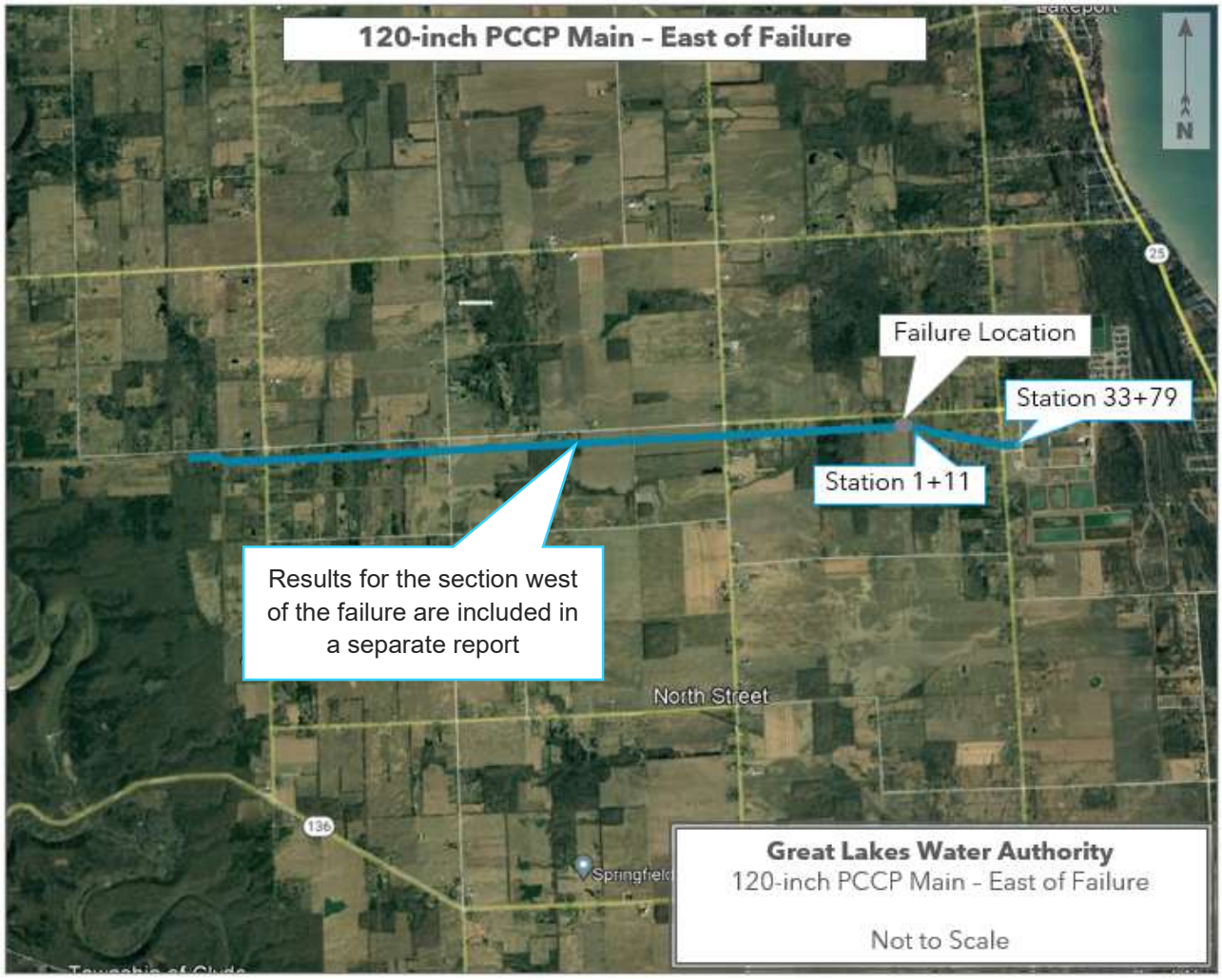

Figure 1.1: Inspection Limits

Figure 1.2 shows the primary access point for the inspection.

Figure 1.2: Access for the Inspection was the Failure Location

2. Inspection Results

2.1. Introduction

Electromagnetic data was collected on August 22, 2022, for the 120-inch PCCP Main. The inspected section spanned an overall distance of 0.62 miles.[1] Pure Technologies' inspection schedule is presented in Table 2.1.

Table 2.1: Inspection Summary

Date	Pipeline	Section	Start Station	End Station	Distance
August 22, 2022	120-inch PCCP Main	East of Failure	1+11	33+79	0.62 miles

Distance *includes partially inspected pipe.*

A summary of the total number of pipes that had electromagnetic signatures consistent with broken prestressing wire wraps, as well as replacement pipes is presented in Table 2.2.

Table 2.2: Summary of Inspected Pipes

Section	Diameter (inches)	Number of Inspected Pipes	Pipes with Broken Wire Wraps	Replacement Pipes
East of Failure	120	204	4	0

Number of Inspected Pipes *includes partially inspected pipes.*

A summary of the number of pipes with five (5) broken wire wraps, 10 to 15 broken wire wraps, and more than 15 broken wire wraps detected during the inspection is presented in Table 2.3.

Table 2.3: Summary of Pipes with Broken Wire Wraps

Section	Diameter (inches)	Length (feet)	Pipes with 5 Broken Wire Wraps	Pipes with 10 to 15 Broken Wire Wraps	Pipes with more than 15 Broken Wire Wraps
East of Failure	120	3,256	2	2	0

Length *includes partially inspected pipes.*

2.2. Comparison and Correlation to Pipeline Drawings

The Great Lakes Water Authority and Ric-Man Construction Florida, Inc. provided Pure Technologies with the plan and profile drawings, pipe laying schedules, and as-built drawings for the inspected portions of the 120-inch PCCP Main. The stationing used in this report was obtained from the pipe laying schedules or as-built drawings.

[1] All reported mileage is based on pipe laying lengths, and accounts for station equations, correlation differences and not inspected sections.

An important part of the data analysis process is correlating the electromagnetic data to the physical pipe in which it was collected. Features that can be identified in the electromagnetic data, such as inline valves, bends, or outlets, are used as correlation points. A few differences were noted between the provided pipe laying schedules or as-built drawings and the collected data for the 120-inch PCCP Main. These differences included either a pipe observed in the data that was not listed in the pipe laying schedules or as-built drawings or vice versa.

2.3. Calibration

Effective analysis of electromagnetic data requires knowledge of how the electromagnetic signal behaves when no broken wire wraps are present (i.e., the baseline condition) and being able to compare that baseline condition to the data signal received when there are broken wire wraps on the pipe.

As the data signal is sensitive to the properties of a particular pipe (i.e., wire diameter and spacing, cylinder thickness, etc.), pipes with the same diameter, but with different design specifications, exhibit different signal properties, or "baselines". Additionally, these pipes will display data signals that respond differently when broken wire wraps are present.

To understand how the data signal responds in varying conditions, Pure Technologies performs calibration scans on pipes similar to the inspected pipe. The calibration process involves scanning a pipe or set of pipes with properties (i.e., diameter, wire class, wire gauge, etc.) that are as close as possible to the properties of the in-situ pipe. These representative pipes are initially scanned to establish the baseline signal. Pure Technologies uses this information to assess signal variation due to the pipe properties alone.

Once the baseline signal has been established, additional scans are performed on the pipe while varying the number and layout of broken wire wraps to determine:

- The resolution of the system when the number of broken wire wraps changes, and
- The optimal system settings that should be used for that particular pipe.

A calibration curve is created from this information and incorporated into Pure Technologies' analysis software. At this point, an experienced data analyst can measure a distress signal and compare it to the calibration curve to quantify the number of broken wire wraps represented by that signal. The distressed regions of each inspected pipe are then identified, measured, and compared against the calibration curves to quantify the number of broken wire wraps in each distressed region.

As the calibration process was not performed on any of the pipes from the 120-inch PCCP Main, the calibration curve was calculated using mathematical modeling based on the pipe design properties (i.e., wire spacing and diameter, the absence of shorting straps, etc.) and Pure Technologies' in-depth knowledge of calibration scans from other projects.

Variations in pipe properties do not affect the ability of the electromagnetic inspection equipment to locate broken wire wraps, but the variations will affect the accuracy of the quantification of distress. If calibration tests are done on any pipes from the 120-inch PCCP Main at a future date, the resulting calibration curve can be applied to the data signal from this inspection to refine the calculated number of broken wire wraps for the distressed pipes.

2.4. Electromagnetic Inspection Results

Of the 204 pipes inspected in the 120-inch PCCP Main, four (4) pipes in the section east of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 15 broken wire wraps.

The distressed pipes are presented in Table 2.4 and are sorted in descending order by the total number of broken wire wraps, where applicable.

- The Pure Reference Number is the unique pipe number assigned by Pure Technologies for reference only and does not correlate with existing pipeline information.
- The Internal Pipe Marking is the number assigned to each pipe during the visual and sounding inspection.
- The stationing shown in the table is the low station for the pipe.
- The Break Position of the region with broken wire wraps is measured from the low station of the distressed pipe to the center of the distress region and was rounded to the nearest 0.5 feet.
- The Number of Broken Wire Wraps by Region have each been rounded to the nearest five (5) broken wire wraps. Regions with fewer than five (5) broken wire wraps are reported as having five (5) broken wire wraps, which implies that regions shown as containing five (5) broken wire wraps may be overestimated.

Table 2.4: Pipes with Broken Wire Wraps in the 120-inch PCCP Main – East of Failure

Pure Reference Number	Internal Pipe Marking	Low Station	Pipe Length (feet)	Pipe Class	Break Position (feet)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Note
13024	2-21	4+79	16	225	1.5;7.0	5;10	15	
13129	1-0	21+61	16	225	5.0;11.5	5;5	10	1
13148	0-59	24+66	16	225	11.5	5	5	
13162	0-45	26+91	16	225	10.0	5	5	

Break Position *of the break region is measured from the low station (feet).*

Notes:

1. Distress is identified on a feature pipe; therefore, it is reported with less certainty.

3. Conclusions

Pure Technologies' evaluation of the 120-inch PCCP Main concluded that:

- Of the 204 pipes inspected, a total of four (4) pipes in the section east of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 15 broken wire wraps.

APPENDIX A

Glossary & Abbreviations

AV: Air Valve
BO: Blowoff
BWP: Bar Wrapped Pipe
ECP: Embedded Cylinder Pipe
EL: Elbow
EM: Electromagnetic
LCP: Lined Cylinder Pipe
OL: Outlet
MH: Manhole
NSS: Non-Shorting Strap
PCP: Prestressed Concrete Pipe
PCCP: Prestressed Concrete Cylinder Pipe
RCP: Reinforced Concrete Pipe
RCCP: Reinforced Concrete Cylinder Pipe
SP: Short Pipe Length
SS: Shorting Strap
STD: Standard Pipe Length
TO: Turn Out
VS: Vent Structure
PW: Pumping Well

Amplitude: A component of the data signal produced during pipeline inspection; amplitude is an indication of signal strength.

Anomalous Pipe: A pipe that produces a data signal that cannot be interpreted as distressed or distress-free due to some irregularity. This irregularity may be due to unexplained signal influence during the inspection process or due to the properties of the pipe itself.

Calibration: A controlled inspection of a pipe similar to the in situ pipe that is performed to determine the expected signal response. The data signal recorded while inspecting the in situ pipes is then compared to this signal to estimate number of broken wire wraps. Calibration typically requires the destructive testing of a removed pipe.

Distressed Pipe: A pipe that exhibits electromagnetic anomalies consistent with broken wire wraps. The amount of distress can be estimated by comparing the distress signal with the signal obtained during the calibration process.

Distressed Region: A section of pipe that exhibits electromagnetic anomalies consistent with broken wire wraps. There may be one or more regions of distress in any distressed pipe.

Downstream: In the direction of water flow.

Feature: Fixtures in the pipeline that affect the inspection (e.g., Manholes, Air Valves, Tees, Elbows).

Feature Pipe: Pipes with features that may be used to locate distressed pipes. The feature pipes cannot be analyzed for distress at or near the feature due to the signal distortion caused by the presence of the feature.

Joint: An area of the pipeline where two pipe ends are fixed together. Typically, pipe ends are joined spigot to bell; however, special pipes are available that join two bells ends or two spigot ends.

Phase: A component of the data signal produced during pipeline inspection; phase is a representation of the signal's travel time.

Rank: Listing of pipes with respect to the total number of broken wire wraps in the pipe (descending order).

Pipe: Single section of pipe, from bell end to spigot end.

Upstream: Against the direction of water flow.

APPENDIX B

Electromagnetic Inspection Technology

B1 Electromagnetic Inspection Technology

Assessing the condition of a prestressed concrete cylinder pipe (PCCP) transmission main is a challenging task that is best performed using a combination of non-destructive testing technology, internal visual inspection and sounding (in embedded cylinder pipe (ECP)), engineering science, and experiential judgment. The primary goal of an inspection is to provide an understanding of the condition of the structural component that provides the pipe's strength, the prestressing wire. An electromagnetic inspection provides a non-destructive method of evaluating the baseline condition of the prestressing wire. Electromagnetic inspections ascertain a magnetic signature for each pipe to identify anomalies that are produced by zones of broken wire wraps. Various characteristics associated with an electromagnetic anomaly are evaluated to provide an estimate of the number of broken wire wraps. This inspection method is able to quantify the amount of wire wrap damage and is the best method of determining the baseline condition of a pipeline.

B1.1 Background and Theory of Electromagnetic Inspection

For years, it has been possible to exploit the concept of eddy currents to measure structural properties in metals. The application of a time-varying magnetic field to metal structures can create internal electric currents as free electrons which are driven by the field along discontinuities in the metal itself. Many applications of this phenomenon have been developed to detect damaged sections in steel and iron pipelines.

For PCCP, a different mechanism exists that can be used to determine the structural condition of the pipe. Eddy currents that are generated in a wire wrap can flow along the length of the wire wrap, generating a solenoidal field (see Figure B.1). If the current is interrupted by a break in the prestressing wire, the field will be affected.

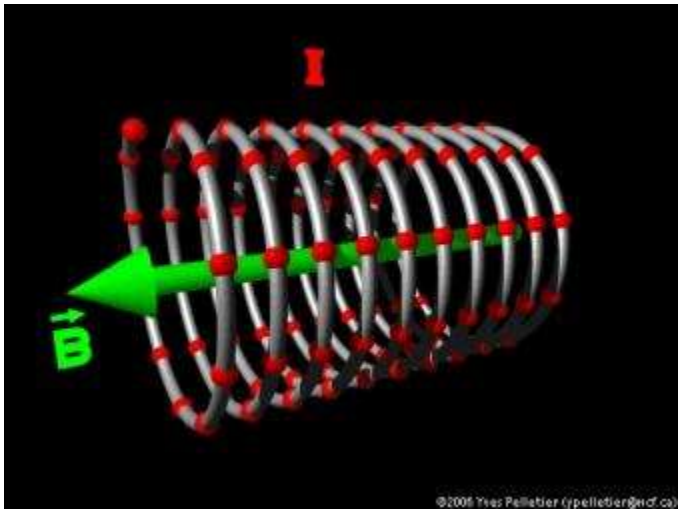

Figure B.1: Electric currents induced by time-varying magnetic field

The electromagnetic system used by Pure Technologies generates eddy currents in the wire wrap and detects where the field is altered by the presence of breaks in the prestressing wire.

To create an electric current in the prestressing wire, the Pure Technologies electromagnetic system generates a magnetic field inside a PCCP. A signal generator outputs a low frequency alternating electric current (typically less than 100 Hz) into a coil of wire (known as an exciter coil) positioned near the inner surface of the pipe. The magnetic field generated by this coil extends through the concrete core, steel cylinder, and finally into the prestressing wire wraps. As the coil travels along the length of the pipe, the field moves as well, creating a localized magnetic field that then generates eddy currents in the wire. As long as there are no breaks in the prestressing wire, the current will flow uniformly along the wire; however, where a broken wire wrap exists, a discontinuity in the current forms. As the magnetic field passes over the section of the broken wire, currents are generated that form opposing magnetic field lines.

Detectors are placed on the opposite side of the pipe from the exciter coil to record the variations in the magnetic field that are created when broken wire wraps interrupt the current flow. Analyzing and interpreting the response of the magnetic field allows for estimates of the number of broken wire wraps and the approximate location of the broken wire wraps along the length of the pipe.

B1.2 Analysis Considerations

- Electromagnetic inspections detect electromagnetic anomalies, or differences, in the expected induced field of a PCCP. Anomalies that are consistent with broken wire wraps are important; however, the induced field of interest is small and other sources of interference can mask or distort the size and shape of the electromagnetic signal. The accuracy of the broken wire wrap detection and quantification depends on a number of factors including, but not limited to:
- Accuracy and completeness of the information supplied by the client
- Type and configuration of pipe being inspected
- Availability of relevant calibration information
- Type, complexity, location, and number of distressed regions in a given pipe
- Inspection conditions observed in the pipe during the data collection period

Accuracy and completeness of the information supplied by the client. The inspection system is sensitive to all magnetic properties of a pipe, including cylinder thickness and composition, wire spacing and diameter, and the number of wire wraps. Pure Technologies uses the information provided by the client to perform the analysis. Drawings that indicate the exact location of pipe features and varying pressure classes are used to correlate the inspection data. Drawings that indicate how each class of pipe is constructed (cylinder thickness, wire diameter and spacing, shorting strap or non-shorting strap, etc.) are used to identify and quantify regions of distress. Discrepancies in the drawings and the data may affect the accuracy of the analysis.

Unknown or sealed appurtenances along the pipeline. Although most appurtenances exhibit a signal that is different and distinguishable from broken wire wraps, in some cases, the signals are similar and an appurtenance could be misinterpreted as broken wire wraps if it is not listed on the drawings and not visible during the inspection.

Existence of ferromagnetic (steel) materials near the pipeline. When extra steel is in close proximity to the pipeline, it can cause a signal distortion that may mask broken wire wraps or could also cause anomalies that may be misinterpreted as broken wire wraps.

Previously repaired pipes. There are a variety of methods used to repair distressed PCCP. Some of these methods allow electromagnetic inspections to be conducted on the repaired pipe while others do not. Internal carbon fiber repairs do not appear to distort the electromagnetic signal and to date, successful repeat inspections have been performed on these repaired pipes and updated quantities of broken wire wraps have been provided for them. Conversely, external tendon repairs, internal or external steel bands, steel slip lining, and internal joint seals can all affect the electromagnetic signal. Consequently, analysis cannot be provided for these types of repaired pipes.

Changes in wire diameter and wire pitch. Broken wire wraps are estimated by measuring the physical length of an anomaly and entering it into a mathematical model known as a calibration curve. Calibration curves are based on either field testing of a similar pipe or mathematical modeling based on an extensive database of calibration test data and finite element analysis. In the case of mathematical modeling, the wire diameter and pitch information are critical factors in the calculations. If this information is not correct, the quantity of broken wire wraps will likely be incorrectly estimated.

Changing distance of the wire wrap and steel cylinder. If, during manufacturing of the pipe, there is variation in the distance of the prestressing wire and the steel cylinder, the resultant signal during an electromagnetic inspection may vary, possibly mimicking broken wire wraps. Typically, it is unknown if there are any pipes affected by this issue as only excavation and forensic analysis can reveal manufacturing defects.

Discontinuities or variations such as abnormal welding in liner construction. These discontinuities can mask actual damage or mimic damage where none exists. This situation could cause over or under estimation of the number of broken wire wraps.

Proximity to power lines. In some cases, power lines can cause distortion in the signal due to the stray magnetic fields. This can limit the effectiveness of the analysis if the distortion is too severe. This interference is rare but is noted for completeness of this document.

Motion. Turbulence, excessive debris/build up, and passing through bends or valves all produce distortion which can affect the detection and estimation of broken wire wraps or may mask actual damage in those areas. The inspection tool is designed to move as smoothly as possible to ensure optimum data quality; however, contact with the pipe wall is inevitable in some situations. Areas where noise are present and may reduce the confidence in defect detection are noted in the Pipe List.

B1.3 Type and Configuration of Pipe Being Inspected

The sensitivity to broken wire wraps is affected by the type of pipe being inspected. The following information on detection limits is based on previous calibration testing performed by Pure Technologies.

Embedded Cylinder Pipe without shorting straps (ECP-NSS)

The electromagnetic inspection system is sensitive to as few as one (1) single broken wire in the middle of the pipe while the detection limit at either the bell or spigot end will typically vary from 5 to 15 broken wire wraps. The differences in detection limits at the end of the pipe is related to differences in the fabrication and installation of the bell and spigot rings of different manufacturers and installation contractors, or differences in how the prestressing wires are anchored at the end of the pipe; some prestressing wires are in electrical contact with the steel cylinder while others are only embedded in the concrete.

ECP-NSS present a challenge to quantifying the number of broken wire wraps detected using electromagnetics. The presence of shorting straps provides some dampening of the response of the electromagnetic signal allowing for a difference in a smaller number of broken wires to be detected. Because the signal change created by a non-shorted broken wire is very large, there is little difference in the signal between a single broken wire and five continuous broken wires. This greatly improved detection (it is easy to detect a single broken wire) but makes quantification more challenging. Generally, two (2) scenarios for damage exists; continuous broken wire wraps as is usually the case with corrosion induced damaged and scattered broken wire wraps as is common when hydrogen embrittlement is the cause. Due to the way the electromagnetic signal responds to broken wires in a non-shorting strap pipe, it is difficult to resolve the difference between continuous and scattered break regions. Also, the minimum separation required to distinguish between two (2) regions with broken wire wraps can vary from 20 to 50 continuous unbroken wires wraps. This limitation may cause an overestimation in the number of broken wire wraps.

Additionally, a wide variation of calibration curves for ECP-NSS exist for pipes with similar specifications which can potentially have a larger impact on the accuracy of the analysis results. Due to these inherent issues with this pipe type, it is recommended to perform verification tests prior to making rehabilitation decisions on ECP-NSS.

Feature Pipes. The electromagnetic technology can detect distressed regions in some feature pipes; however, due to the impact of the feature on the electromagnetic signal, results are presented with less certainty for regions of the pipe near fittings, manholes, blowoff valves, or other features.

Short Pipes. The identification of broken wire wraps on pipes with a shorter length is challenging. As the effect of the changes in the data signal near the end of a pipe (bell or spigot) span is constant regardless of the pipe length (see Effects of Joints), its overall impact on the electromagnetic signal is greater as the length of a pipe decreases. For short pipes, the electromagnetic signal along the barrel of the pipe remains analyzable when it is unaffected by the joint effect; however, when most of the electromagnetic signal of a pipe is end effects, it becomes increasingly challenging to identify regions with broken wire wraps. In addition, short pipes typically make up a small portion of the pipe inventory inspected and there the number baselines (background signals) available for comparison is limited.

B1.4 Details of Estimates of Broken Wire Wraps

Break Position. The signal of a region with broken wire wraps varies along the length of a given pipe. Broken wire wraps in the middle of a pipe are easier to detect and measure than broken wire wraps near the joint. The increased presence of metal at the joint causes a distinct signal response which may affect the detection and accuracy of low to moderate quantities of broken wire wraps within approximately 18 inches or 0.5 meters of the joint. Additionally, broken wire wraps are more difficult to detect and quantify at the bell end of the pipe than at the spigot end of the pipe, since a portion of the bell section will overlap the spigot end. The minimum number of broken wire wraps required for the signal to be detectable and quantifiable depends on the pipe type (embedded cylinder pipe (ECP), lined cylinder pipe (LCP), or non-cylinder pipe (NCP)), joint configuration, proximity of the center of the break region to the joint, and whether it is the bell or spigot end. As a result, the estimated number of broken wire wraps near the center of a pipe will be provided with greater confidence than broken wire wraps near the joints, especially near the bell end.

Effects of Joints. End effects refer to changes in the data signal near the end of a pipe (bell or spigot, if applicable) that are due to a variety of installation methods of the pipe joint itself. End effects do not refer to distress at the joint. Beveled spigots, pulled joints, mitered joints, butt straps, closure pieces, steel fittings, etc., will all affect the data signal at the end of a pipe in some way. Research in this specific area has provided methods for analysts to determine if the signal is due to an end effect, or true end distress. The differences are subtle, and examination of client records can provide the additional information necessary to conclude whether a particular data signal represents end effects or end distress. In the case where both end effects and end distress exist, identification and quantification of broken wire wraps is more challenging.

Non-contiguous Broken Wire Wraps. This occurs when broken wire wraps are scattered amongst non-broken wire wraps. Non-contiguous broken wire wraps are often the result of hydrogen embrittlement as opposed to corrosion, which results in a continuous region of broken wire wraps as the corrosion typically starts at a point and grows with time.

During the inspection, a broad magnetic field is projected onto the prestressing wire (several inches or centimeters wide); therefore, it is difficult to analyze individual prestressing wire wraps. When broken wire wraps are separated by non-broken wire wraps, the non-broken wire wraps can be masked by the distress signals and may appear broken depending on the distance from the broken and non-broken prestressing wire wraps. The minimum separation required to distinguish between two (2) regions with broken wire wraps depends on the pipe properties and the total number of broken wire wraps. Non-contiguous broken wire wraps may lead to a distress signal that is larger than the actual associated prestressing wire damage.

The estimated number of broken wire wraps assumes the distress region comprise of consecutive broken wire wraps. This assumption is the only assumption that can be made without additional information, which could be obtained from field verification. It is possible that some or all the break regions on a distressed pipe will contain intermittent or scattered broken wire wraps instead of consecutive broken wire wraps. In this case, the estimated number of broken wire wraps may be overestimated.

Background Signal Variations. The electromagnetic data signal is sensitive not only to physical differences in pipeline properties (wire diameter and spacing, cylinder thickness, etc.), but it is also sensitive to any magnetic differences in the steel components of the pipe. Pipe manufacturers may use different material suppliers for the various components of the pipes within a pipeline. Even though two (2) pipes are manufactured the same physically, if the steel for the cylinder and the prestressing wire come from different suppliers, they will likely have slightly different magnetic properties, which will result in variations in the background signals.

Much like the fingerprint, every pipe in a pipeline, no matter how alike they are supposed to be, will exhibit a slightly different background signal. Since distress is quantified by measuring the distressed pipe signal relative to a background signal, any variations in background signals can affect the accuracy of the distress measurement and ultimately the estimates of the number of broken wire wraps.

Number of Break Regions. Results are predicted with greater accuracy for pipes containing single distressed regions than for pipes containing multiple distress regions. As the number of distress regions per pipe increases, or as these regions become closer together, the complexity of the interpretation increases. Distress regions can interact with each other from an electromagnetic standpoint to create signals of varying complexity. Distress regions can also span across a wider region in which case the distress region will be provided as positional range and the estimated number of broken wire wraps may be provided depending on its complexity.

Other Factors. There are often overlaps amongst the key issues listed above and there may or may not be other factors related to these issues that decrease the level of confidence in the results presented in the report. Wide variations in manufacturing processes may not impact the structural performance of the pipe but can significantly affect the electromagnetic properties. The list of factors includes ones that are known, unknown, controllable, and uncontrollable. Some can be confirmed during excavation or inspection, and some can be eliminated by studying construction records, although errors in these records are common. In all cases, every effort is made to consider the various factors during analysis; however, it should be noted that the results provide an estimate of the broken wire wraps in a pipe section based on all the information available and assuming that the signal changes are caused by discontinuity in the prestressing wire.

APPENDIX C

Pipe List

MH	Manhole.
OL	Outlet.
BO	Blowoff.
STD	Standard Length Pipe.
SP	Short Pipe.
	Not inspected by Pure Technologies.
	Pipes listed in laying schedules but not observed in data or pipes removed for replacement.

Station numbers in black font indicate numbers obtained directly from client's documents.
Station numbers in grey font indicate numbers calculated by Pure Technologies.

Pipe Class in Contract WS-219 were obtained from pipe laying schedules.

Pipes reported with an asterisk (*) following the number of broken wire wraps: the Break Region Location for these pipes show a range rather than a single distance from the low station joint. This indicates the presence of overlapping distressed regions where each broken wire wrap region is not distinct. These pipes would either have:
1. Broken wire wraps caused by corrosion across the entire length (widespread corrosion), or
2. Sporadic (i.e., a small number of) and non-contiguous broken wire wraps caused by hydrogen embrittlement.

The number of broken wire wraps reported on these pipes can be expected to span across the indicated break position range and, at the same time, does not necessarily mean that all of the wire wraps in that region are broken (i.e., broken wire wraps may exist intermittently with intact wire wraps).

Great Lakes Water Authority
120-inch PCCP Main- East of Failure

Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
Towards Failure Location										
13001	WS-219	2-44	1+11	16	1+27	225				Partially inspected. Not inspected from 0.0-3.0ft.
13002	WS-219	2-43	1+27	16	1+43	225				
13003	WS-219	2-42	1+43	16	1+59	225				
13004	WS-219	2-41	1+59	16	1+75	225				
13005	WS-219	2-40	1+75	16	1+91	225				
13006	WS-219	2-39	1+91	16	2+07	225				
13007	WS-219	2-38	2+07	16	2+23	225				
13008	WS-219	2-37	2+23	16	2+39	225				
13009	WS-219	2-36	2+39	16	2+54	225				
13010	WS-219	2-35	2+54	16	2+70	225				
13011	WS-219	2-34	2+70	16	2+86	225				
13012	WS-219	2-33	2+86	16	3+02	225				
13013	WS-219	2-32	3+02	16	3+18	225				
13014	WS-219	2-31	3+18	16	3+35	225				
13015	WS-219	2-30	3+35	16	3+51	225				
13016	WS-219	2-29	3+51	16	3+67	225				
13017	WS-219	2-28	3+67	16	3+83	225				
13018	WS-219	2-27	3+83	16	3+99	225				
13019	WS-219	2-26	3+99	16	4+15	225				
13020	WS-219	2-25	4+15	16	4+31	225				
13021	WS-219	2-24	4+31	16	4+47	225				
13022	WS-219	2-23	4+47	16	4+63	225				
13023	WS-219	2-22	4+63	16	4+79	225				
13024	WS-219	2-21	4+79	16	4+95	225	1.5;7.0	5;10	15	
13025	WS-219	2-20	4+95	16	5+11	225				
13026	WS-219	2-19	5+11	16	5+27	225				
13027	WS-219	2-18	5+27	16	5+43	225				
13028	WS-219	2-17	5+43	16	5+59	225				
13029	WS-219	2-16	5+59	16	5+75	225				
13030	WS-219	2-15	5+75	16	5+91	225				
13031	WS-219	2-14	5+91	16	6+07	225				
13032	WS-219	2-13	6+07	16	6+23	225				
13033	WS-219	2-12	6+23	16	6+39	225				
13034	WS-219	2-11	6+39	16	6+55	225				
13035	WS-219	2-10	6+55	16	6+71	225				
13036	WS-219	2-9	6+71	16	6+87	225				
13037	WS-219	2-8	6+87	16	7+03	225				
13038	WS-219	2-7	7+03	16	7+19	225				
13039	WS-219	2-6	7+19	16	7+36	225				
13040	WS-219	2-5	7+36	16	7+52	225				
13041	WS-219	2-4	7+52	16	7+68	225				
13042	WS-219	2-3	7+68	16	7+84	225				12" BO at Station 7+75.
13043	WS-219	2-2	7+84	16	7+99	225				
13044	WS-219	2-1	7+99	16	8+15	225				
13045	WS-219	2-1A	8+15	16	8+31	225				
13046	WS-219	2-1-B	8+31	16	8+47	225				
13047	WS-219	2-0	8+47	16	8+63	225				MH at Station 8+55. **MH 2.**
13048	WS-219	1-81	8+63	16	8+79	225				
13049	WS-219	1-80	8+79	16	8+95	225				
13050	WS-219	1-79	8+95	16	9+11	225				
13051	WS-219	1-78	9+11	16	9+27	225				
13052	WS-219	1-77	9+27	16	9+43	225				
13053	WS-219	1-76	9+43	16	9+59	225				
13054	WS-219	1-75	9+59	16	9+75	225				
13055	WS-219	1-74	9+75	16	9+91	225				
13056	WS-219	1-73	9+91	16	10+07	225				
13057	WS-219	1-72	10+07	16	10+23	225				
13058	WS-219	1-71	10+23	16	10+39	225				
13059	WS-219	1-70	10+39	16	10+55	225				
13060	WS-219	1-69	10+55	16	10+71	225				
13061	WS-219	1-68	10+71	16	10+87	225				
13062	WS-219	1-67	10+87	16	11+03	225				
13063	WS-219	1-66	11+03	16	11+19	225				
13064	WS-219	1-65	11+19	16	11+36	225				
13065	WS-219	1-64	11+36	16	11+52	225				
13066	WS-219	1-63	11+52	16	11+68	225				
13067	WS-219	1-62	11+68	16	11+84	225				
13068	WS-219	1-61	11+84	16	12+00	225				
13069	WS-219	1-60	12+00	16	12+16	225				
13070	WS-219	1-59	12+16	16	12+32	225				
13071	WS-219	1-58	12+32	16	12+48	225				
13072	WS-219	1-57	12+48	16	12+64	225				
13073	WS-219	1-56	12+64	16	12+80	225				
13074	WS-219	1-55	12+80	16	12+96	225				
13075	WS-219	1-54	12+96	16	13+12	225				
13076	WS-219	1-53	13+12	16	13+28	225				
13077	WS-219	1-52	13+28	16	13+44	225				
13078	WS-219	1-51	13+44	16	13+60	225				
13079	WS-219	1-50	13+60	16	13+76	225				
13080	WS-219	1-49	13+76	16	13+92	225				
13081	WS-219	1-48	13+92	16	14+08	225				
13082	WS-219	1-47	14+08	16	14+24	225				
13083	WS-219	1-46	14+24	16	14+40	225				
13084	WS-219	1-45	14+40	16	14+56	225				
13085	WS-219	1-44	14+56	16	14+72	225				
13086	WS-219	1-43	14+72	16	14+88	225				
13087	WS-219	1-42	14+88	16	15+04	225				
13088	WS-219	1-41	15+04	16	15+20	225				
13089	WS-219	1-40	15+20	16	15+36	225				
13090	WS-219	1-39	15+36	16	15+52	225				
13091	WS-219	1-38	15+52	16	15+68	225				
13092	WS-219	1-37	15+68	16	15+84	225				
13093	WS-219	1-36	15+84	16	16+00	225				
13094	WS-219	1-35	16+00	16	16+16	225				
13095	WS-219	1-34	16+16	16	16+32	225				
13096	WS-219	1-33	16+32	16	16+48	225				
13097	WS-219	1-32	16+48	16	16+64	225				
13098	WS-219	1-31	16+64	16	16+80	225				

Great Lakes Water Authority
120-inch PCCP Main- East of Failure

Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
13099	WS-219	1-30	16+80	16	16+97	225				
13100	WS-219	1-29	16+97	16	17+13	225				
13101	WS-219	1-28	17+13	16	17+29	225				
13102	WS-219	1-27	17+29	16	17+45	225				
13103	WS-219	1-26	17+45	16	17+61	225				
13104	WS-219	1-25	17+61	16	17+77	225				
13105	WS-219	1-24	17+77	16	17+93	225				
13106	WS-219	1-23	17+93	16	18+09	225				
13107	WS-219	1-22	18+09	16	18+25	225				
13108	WS-219	1-21	18+25	16	18+41	225				
13109	WS-219	1-20	18+41	16	18+57	225				
13110	WS-219	1-19	18+57	16	18+73	225				
13111	WS-219	1-18	18+73	16	18+89	225				
13112	WS-219	1-17	18+89	16	19+05	225				
13113	WS-219	1-16	19+05	16	19+21	225				
13114	WS-219	1-15	19+21	16	19+37	225				
13115	WS-219	1-14	19+37	16	19+53	225				
13116	WS-219	1-13	19+53	16	19+69	225				
13117	WS-219	1-12	19+69	16	19+85	225				
13118	WS-219	1-11	19+85	16	20+01	225				
13119	WS-219	1-10	20+01	15	20+17	225				
13120	WS-219	1-9	20+17	16	20+33	225				
13121	WS-219	1-8	20+33	16	20+49	225				
13122	WS-219	1-7	20+49	16	20+65	225				
13123	WS-219	1-6	20+65	16	20+81	225				
13124	WS-219	1-5	20+81	16	20+97	225				
13125	WS-219	1-4	20+97	16	21+13	225				
13126	WS-219	1-3	21+13	16	21+29	225				
13127	WS-219	1-2	21+29	16	21+45	225				
13128	WS-219	1-1	21+45	16	21+61	225				
13129	WS-219	1-0	21+61	16	21+77	225	5.0;11.5	5;5	10	MH at Station 21+69. **MH 1.**
13130	WS-219	0-77	21+77	16	21+93	225				
13131	WS-219	0-76	21+93	16	22+09	225				
13132	WS-219	0-75	22+09	16	22+25	225				
13133	WS-219	0-74	22+25	16	22+41	225				
13134	WS-219	0-73	22+41	16	22+57	225				
13135	WS-219	0-72	22+57	16	22+73	225				
13136	WS-219	0-71	22+73	16	22+89	225				
13137	WS-219	0-70	22+89	16	23+06	225				
13138	WS-219	0-69	23+06	16	23+22	225				
13139	WS-219	0-68	23+22	16	23+38	225				
13140	WS-219	0-67	23+38	16	23+54	225				
13141	WS-219	0-66	23+54	16	23+70	225				
13142	WS-219	0-65	23+70	16	23+86	225				
13143	WS-219	0-64	23+86	16	24+02	225				
13144	WS-219	0-63	24+02	16	24+18	225				
13145	WS-219	0-62	24+18	16	24+34	225				
13146	WS-219	0-61	24+34	16	24+50	225				
13147	WS-219	0-60	24+50	16	24+66	225				
13148	WS-219	0-59	24+66	16	24+82	225	11.5	5	5	
13149	WS-219	0-58	24+82	16	24+98	225				
13150	WS-219	0-57	24+98	16	25+14	225				
13151	WS-219	0-56	25+14	16	25+30	225				
13152	WS-219	0-55	25+30	16	25+46	225				
13153	WS-219	0-54	25+46	16	25+62	225				
13154	WS-219	0-53	25+62	16	25+78	225				
13155	WS-219	0-52	25+78	16	25+94	225				
13156	WS-219	0-51	25+94	16	26+10	225				
13157	WS-219	0-50	26+10	16	26+27	225				
13158	WS-219	0-49	26+27	16	26+43	225				
13159	WS-219	0-48	26+43	16	26+59	225				
13160	WS-219	0-47	26+59	16	26+75	225				
13161	WS-219	0-46	26+75	16	26+91	225				
13162	WS-219	0-45	26+91	16	27+07	225	10.0	5	5	
13163	WS-219	0-44	27+07	16	27+23	225				
13164	WS-219	0-43	27+23	16	27+39	225				
13165	WS-219	0-42	27+39	16	27+66	225				Equation: 27+54.91BK = 27+66.41AH.
13166	WS-219	0-41	27+66	16	27+82	225				
13167	WS-219	0-40	27+82	16	27+98	225				
13168	WS-219	0-39	27+98	16	28+14	225				
13169	WS-219	0-38	28+14	16	28+30	225				
13170	WS-219	0-37	28+30	16	28+46	225				
13171	WS-219	0-36	28+46	16	28+62	225				
13172	WS-219	0-35	28+62	16	28+78	225				
13173	WS-219	0-34	28+78	16	28+94	225				
13174	WS-219	0-33	28+94	16	29+10	225				
13175	WS-219	0-32	29+10	16	29+26	225				12" BO at Station 29+18.
13176	WS-219	0-31	29+26	16	29+42	225				
13177	WS-219	0-30	29+42	16	29+58	225				
13178	WS-219	0-29	29+58	16	29+74	225				
13179	WS-219	0-28	29+74	16	29+90	225				
13180	WS-219	0-27	29+90	16	30+05	225				
13181	WS-219	0-26	30+05	16	30+21	225				
13182	WS-219	0-25	30+21	16	30+37	225				
13183	WS-219	0-24	30+37	16	30+53	225				
13184	WS-219	0-23	30+53	16	30+69	225				
13185	WS-219	0-22	30+69	16	30+85	225				
13186	WS-219	0-21	30+85	16	31+01	225				
13187	WS-219	0-20	31+01	16	31+17	225				
13188	WS-219	0-19	31+17	16	31+34	225				
13189	WS-219	0-18	31+34	16	31+50	225				
13190	WS-219	0-17	31+50	16	31+66	225				
13191	WS-219	0-16	31+66	16	31+82	225				
13192	WS-219	0-15	31+82	16	31+98	225				
13193	WS-219	0-14	31+98	16	32+14	225				
13194	WS-219	0-13	32+14	16	32+30	225				
13195	WS-219	0-12	32+30	16	32+46	225				
13196	WS-219	0-11	32+46	16	32+62	225				

Great Lakes Water Authority
120-inch PCCP Main- East of Failure

Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
13197	WS-219	0-10	32+62	16	32+78	225				
13198	WS-219	0-9	32+78	16	32+94	225				
13199	WS-219	0-8	32+94	16	33+10	225				
13200	WS-219	0-7	33+10	16	33+26	225				
13201	WS-219	0-6	33+26	16	33+42	225				
13202	WS-219	0-5	33+42	16	33+58	225				24" OL at Station 33+50.
13203	WS-219	0-4	33+58	14	33+72	225				
13204	WS-219	0-3	33+72	7	33+79	225				120" x 108" Reducer.
Towards 108" Butterfly Valve at Station 33+94										

Appendix E

Xylem/Pure Technologies Inspection Report - West

xylem
Let's Solve Water

PipeWalker® Electromagnetic Inspection Report

120-inch PCCP Main – West of Failure Location

Great Lakes Water Authority and
HDR Engineering Inc.

December 2022

pure TECHNOLOGIES
a xylem brand

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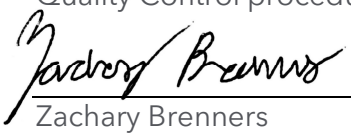
Quality Assurance and Quality Control Statements

This report has been prepared and reviewed in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:



December 6, 2022

Zachary Brenners — Date
Project Manager

Editorial Review Statement

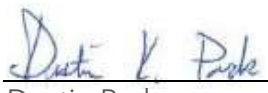
This report has been prepared and reviewed for editorial content in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:

October 27, 2022

Linda Konopka — Date
Editorial Reviewer

Technical Review Statement

This report has been prepared and reviewed for technical correctness in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:

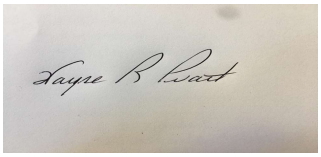


October 27, 2022

Dustin Park — Date
Technical Reviewer

Contractual Review Statement

This report has been reviewed for contractual completeness in accordance with the Quality Assurance and Quality Control procedures of Pure Technologies, a Xylem brand:



October 28, 2022

Wayne Pratt — Date
Contractual Reviewer

Confidentiality Clause

This report contains confidential commercial information regarding proprietary equipment, methods, and data analysis, which is the property of Pure Technologies, a Xylem brand. It is for the sole use of the Great Lakes Water Authority, HDR Engineering Inc. and their engineering consultants and is not to be distributed to third parties without the express written consent of Pure Technologies, a Xylem brand.

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Appendices

Executive Summary

From August 23 to August 25, 2022, Pure Technologies, a Xylem brand (Pure Technologies), conducted a non-destructive evaluation of the prestressed concrete cylinder pipe (PCCP) in the 120-inch PCCP Main west of the failure location on the main. The evaluation was performed using Pure Technologies' proprietary PipeWalker® platform, a non-destructive electromagnetic inspection technology. The purpose of the inspection was to locate and identify pipes that have broken prestressing wire wraps after a failure occurred on the 120-in PCCP Main. The electromagnetic inspection scope is highlighted in Table ES.1.

Table ES.1: Scope of the Electromagnetic Inspection

Pipeline	Section	Start Station[1]	End Station
120-inch PCCP Main	West of Failure	183+50	206+66
		N/A	14+84
		23+47	65+31
		68+19	186+99
		0+00	0+64

'N/A' is reported as the start station due to a correlation difference between the electromagnetic data and pipe laying schedules.

The inspection covered a cumulative distance of 3.77 miles and spanned a total of 1,248 pipes. Analysis of the data obtained during the inspection determined that a total of 27 pipes in the section west of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 25 broken wire wraps.

A summary of the results is presented in Figure ES.1, Table 2.2 and Table 2.3 and a complete discussion is provided in Section 2.4.

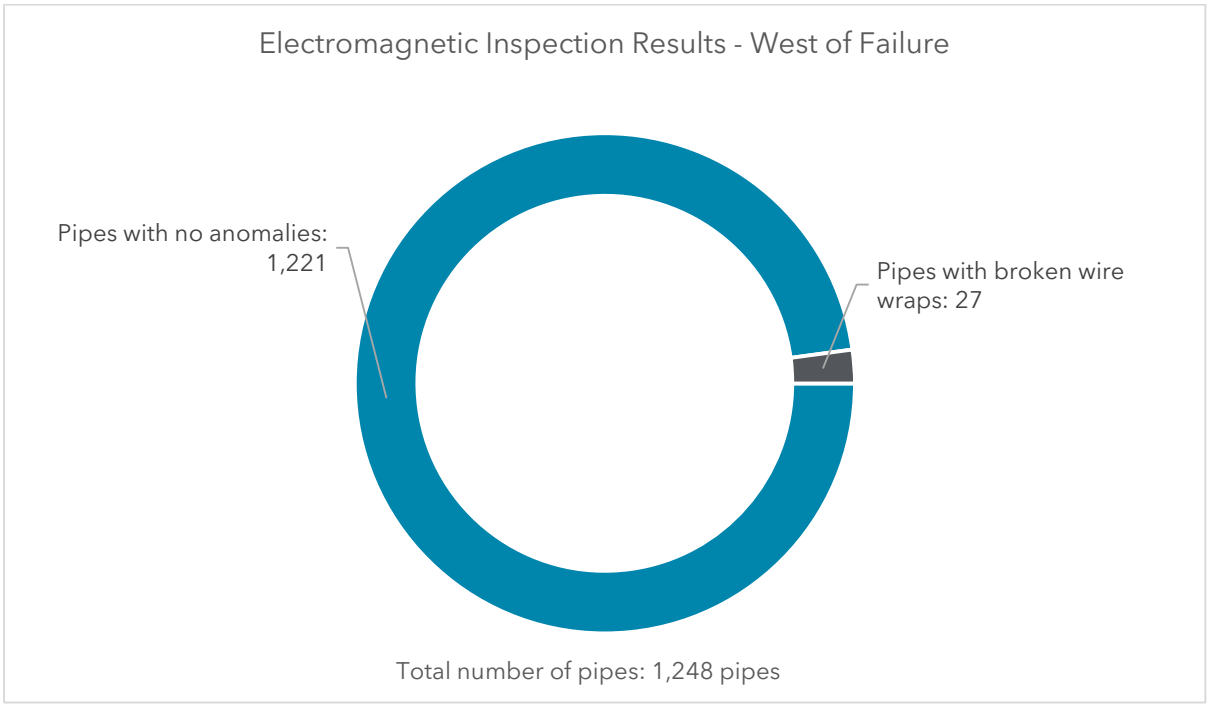

Figure ES.1: Electromagnetic Inspection Results

1. Project Background

On August 23 to 25, 2022, Pure Technologies, a Xylem brand (Pure Technologies), conducted a non-destructive evaluation of the prestressed concrete cylinder pipe (PCCP) in the 120-inch PCCP Main. The evaluation was performed using Pure Technologies' proprietary PipeWalker® platform, a non-destructive electromagnetic inspection technology. The purpose of the inspection was to locate and identify pipes that have broken prestressing wire wraps after a failure occurred on the 120-in PCCP Main.

The inspected portion of the PCCP Main is composed of 120-inch single wrap embedded cylinder pipe (ECP) without shorting straps. The pipes were manufactured by Interpace Corporation in 1968. The 120-inch PCCP Main is owned and operated by the Great Lakes Water Authority.

A map of the inspected section of the 120-inch PCCP Main is shown below (Figure 1.1). This map shows the approximate geographical location of the pipeline.

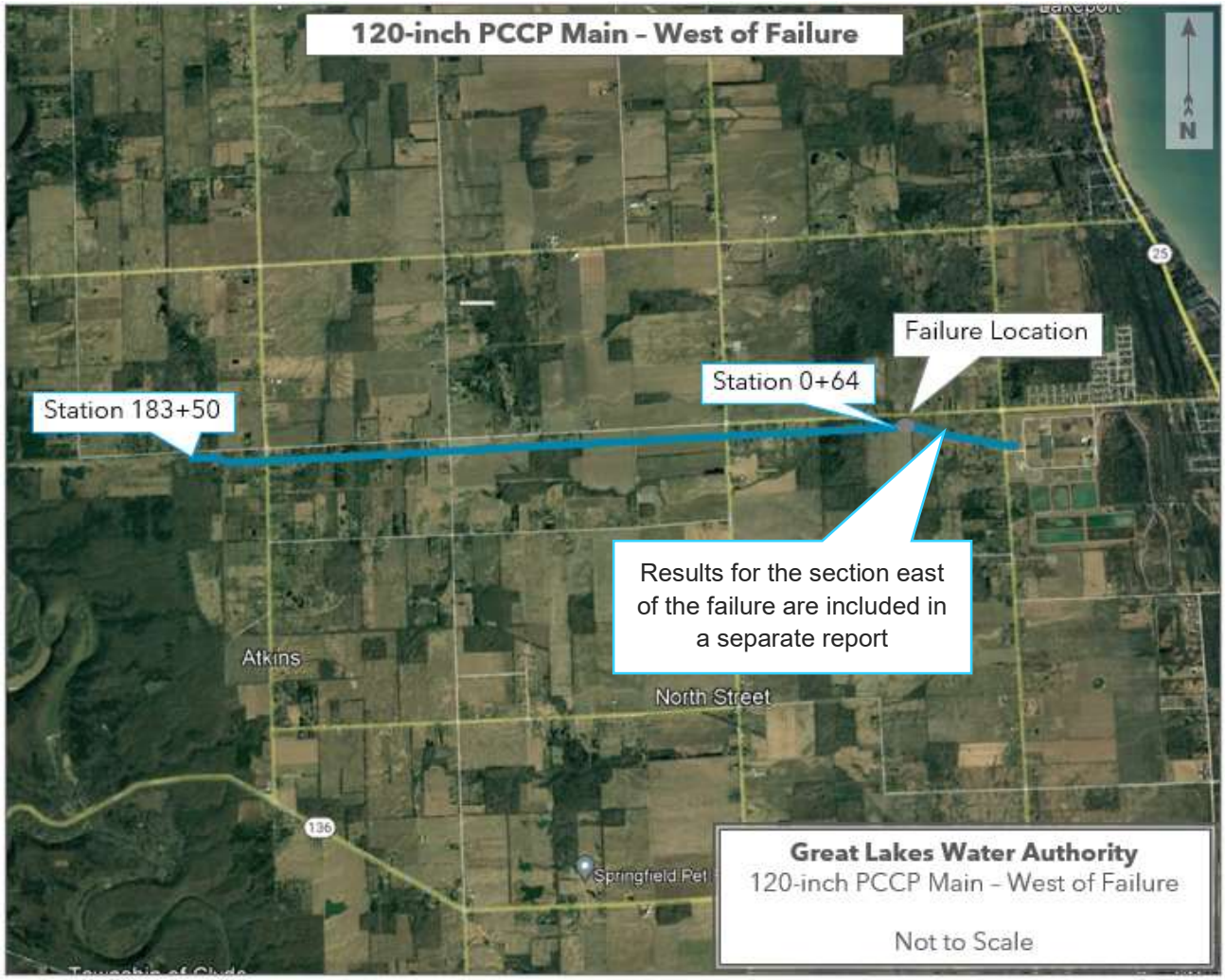

Figure 1.1: Inspection Limits

Figure 1.2 shows the primary access point for the inspection. Access Manholes were used to access locations that were not accessible due to bellies of water.

Figure 1.2: Primary Access for the Inspection was the Failure Location

2. Inspection Results

2.1. Introduction

Electromagnetic data was collected from August 23 to 25, 2022, for the 120-inch PCCP Main west of the failure location. The inspected section spanned an overall distance of 3.77 miles.[1] The sections west of the failure from Station 14+84 to Station 23+47 and from Station 65+31 to Station 68+19 were not inspected due to high water levels. Pure Technologies' inspection schedule is presented in Table 2.1.

Table 2.1: Inspection Summary

Date	Pipeline	Section	Start Station	End Station	Distance
August 23 to 25, 2022	120-inch PCCP Main	West of Failure	183+50	206+66	0.44 miles
			N/A	14+84	0.28 miles
			23+47	65+31	0.79 miles
			68+19	186+99	2.25 miles
			0+00	0+64	0.01 miles

'N/A' is reported as the start station due to a correlation difference between the electromagnetic data and pipe laying schedules.

***Distance** includes partially inspected pipe.*

A summary of the total number of pipes that had electromagnetic signatures consistent with broken prestressing wire wraps, as well as replacement pipes is presented in Table 2.2.

Table 2.2: Summary of Inspected Pipes

Section	Diameter (inches)	Number of Inspected Pipes	Pipes with Broken Wire Wraps	Replacement Pipes
West of Failure	120	1,248	27	2

***Number of Inspected Pipes** includes partially inspected pipes.*

A summary of the number of pipes with five (5) broken wire wraps, 10 to 15 broken wire wraps, and more than 15 broken wire wraps detected during the inspection is presented in Table 2.3.

Table 2.3: Summary of Pipes with Broken Wire Wraps

Section	Diameter (inches)	Length (feet)	Pipes with 5 Broken Wire Wraps	Pipes with 10 to 15 Broken Wire Wraps	Pipes with more than 15 Broken Wire Wraps
West of Failure	120	19,928	21	3	3

***Length** includes partially inspected pipes.*

[1] All reported mileage is based on pipe laying lengths, and accounts for station equations, correlation differences and not inspected sections.

2.2. Comparison and Correlation to Pipeline Drawings

The Great Lakes Water Authority and HDR Engineering Inc. provided Pure Technologies with the plan and profile drawings, pipe laying schedules, and as-built drawings for the inspected portions of the 120-inch PCCP Main. The stationing used in this report was obtained from the pipe laying schedules or as-built drawings.

An important part of the data analysis process is correlating the electromagnetic data to the physical pipe in which it was collected. Features that can be identified in the electromagnetic data, such as inline valves, bends, or outlets, are used as correlation points. A few differences were noted between the provided pipe laying schedules or as-built drawings and the collected data for the 120-inch PCCP Main. These differences included either a pipe observed in the data that was not listed in the pipe laying schedules or as-built drawings or vice versa.

2.3. Calibration

Effective analysis of electromagnetic data requires knowledge of how the electromagnetic signal behaves when no broken wire wraps are present (i.e., the baseline condition) and being able to compare that baseline condition to the data signal received when there are broken wire wraps on the pipe.

As the data signal is sensitive to the properties of a particular pipe (i.e., wire diameter and spacing, cylinder thickness, etc.), pipes with the same diameter, but with different design specifications, exhibit different signal properties, or "baselines". Additionally, these pipes will display data signals that respond differently when broken wire wraps are present.

To understand how the data signal responds in varying conditions, Pure Technologies performs calibration scans on pipes similar to the inspected pipe. The calibration process involves scanning a pipe or set of pipes with properties (i.e., diameter, wire class, wire gauge, etc.) that are as close as possible to the properties of the in-situ pipe. These representative pipes are initially scanned to establish the baseline signal. Pure Technologies uses this information to assess signal variation due to the pipe properties alone.

Once the baseline signal has been established, additional scans are performed on the pipe while varying the number and layout of broken wire wraps to determine:

- The resolution of the system when the number of broken wire wraps changes, and
- The optimal system settings that should be used for that particular pipe.

A calibration curve is created from this information and incorporated into Pure Technologies' analysis software. At this point, an experienced data analyst can measure a distress signal and compare it to the calibration curve to quantify the number of broken wire wraps represented by that signal. The distressed regions of each inspected pipe are then identified, measured, and

compared against the calibration curves to quantify the number of broken wire wraps in each distressed region.

As the calibration process was not performed on any of the pipes from the 120-inch PCCP Main, the calibration curve was calculated using mathematical modeling based on the pipe design properties (i.e., wire spacing and diameter, the absence of shorting straps, etc.) and Pure Technologies' in-depth knowledge of calibration scans from other projects.

Variations in pipe properties do not affect the ability of the electromagnetic inspection equipment to locate broken wire wraps, but the variations will affect the accuracy of the quantification of distress. If calibration tests are done on any pipes from the 120-inch PCCP Main at a future date, the resulting calibration curve can be applied to the data signal from this inspection to refine the calculated number of broken wire wraps for the distressed pipes.

2.4. Electromagnetic Inspection Results

Of the 1,248 pipes inspected in the 120-inch PCCP Main, a total of 27 pipes in the section west of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 25 broken wire wraps.

The distressed pipes are presented in Table 2.4 and Table 2.5 and are sorted in descending order by the total number of broken wire wraps, where applicable.

- The Pure Reference Number is the unique pipe number assigned by Pure Technologies for reference only and does not correlate with existing pipeline information.
- The Internal Pipe Marking is the number assigned to each pipe during the visual and sounding inspection.
- The stationing shown in the table is the low station for the pipe.
- The Break Position of the region with broken wire wraps is measured from the low station of the distressed pipe to the center of the distress region and was rounded to the nearest 0.5 feet.
- The Number of Broken Wire Wraps by Region have each been rounded to the nearest five (5) broken wire wraps. Regions with fewer than five (5) broken wire wraps are reported as having five (5) broken wire wraps, which implies that regions shown as containing five (5) broken wire wraps may be overestimated.

Out of the 27 distressed pipes in the section west of the failure, one (1) pipe is reported with a positional range as its break region rather than a single distance from the low station joint, as presented in Table 2.4. This indicates the presence of overlapping distressed regions where each broken wire wrap region is not distinct. Generally, two (2) scenarios for damage exists; continuous broken wire wraps, as is usually the case with corrosion-induced damage and scattered broken wire wraps as is common when hydrogen embrittlement is the cause. The number of broken wire

wraps reported on this pipe can be expected to span across the indicated break position range and, at the same time, does not necessarily mean that all of the wire wraps in that region are broken (i.e., broken wire wraps may exist intermittently with intact wire wraps). Due to the complexity of the analysis of these distress regions, there is more uncertainty in the number of broken wire wraps. The reported number of broken wire wraps represents the best estimate based on the available calibration curve.

Table 2.4: Pipe with Broken Wire Wraps Across a Positional Range in the 120-inch PCCP Main – West of Failure

Pure Reference Number	Internal Pipe Marking	Low Station	Pipe Length (feet)	Pipe Class	Break Positional Range (feet)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps
10007	20-24	184+30	16	200-11'	6.0-10.0	25	25

Break Positional Range *is measured from the low station (feet). It may indicate the presence of intermittent broken wire wraps across a positional span.*

Table 2.5: Pipes with Broken Wire Wraps in the 120-inch PCCP Main – West of Failure

Pure Reference Number	Internal Pipe Marking	Low Station	Pipe Length (feet)	Pipe Class	Break Position (feet)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Note
10105	19-15	199+94	16	200-11'	9.0	20	20	
12724	3-26	183+62	16	225-11'	9.5	20	20	
11204	14-38	56+02	16	200-11'	7.5;10.5	5;5	10	
12007	13-12	69+15	16	200-11'	7.0;9.5	5;5	10	1
12316	9-5	118+68	16	200-11'	7.0	10	10	
10053	19-67	191+67	16	200-11'	11.5	5	5	
10056	19-64	192+15	16	200-11'	1.5	5	5	
10112	19-8	201+06	16	200-11'	9.0	5	5	
10124	18-24	202+98	16	200-11'	1.5	5	5	
10129	18-19	203+78	16	200-11'	1.5	5	5	
10195	17-75	7+62	16	200-11'	12.5	5	5	
10233	17-37	13+71	16	200-11'	1.5	5	5	
11050	16-33	31+32	16	200-11'	5.5	5	5	
11069	16-14	34+37	16	200-11'	1.5	5	5	
11074	16-9	35+17	16	200-11'	3.5	5	5	
11205	14-37	56+18	16	200-11'	3.5	5	5	
11220	14-22	58+58	16	200-11'	2.0	5	5	
11255	13-45	64+18	16	200-11'	9.0	5	5	

Table 2.5: Pipes with Broken Wire Wraps in the 120-inch PCCP Main – West of Failure								
Pure Reference Number	Internal Pipe Marking	Low Station	Pipe Length (feet)	Pipe Class	Break Position (feet)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Note
12094	11-65	83+09	16	200-11'	8.5	5	5	
12267	9-54	110+83	16	200-11'	8.5	5	5	
12284	9-37	113+55	16	200-11'	8.5	5	5	
12540	6-36	154+29	16	225-11'	3.5	5	5	
12574	6-2	159+75	16	225-11'	1.5	5	5	
12588	5-13	161+81	16	225-11'	1.5	5	5	
12716	3-34	182+34	16	225-11'	1.5	5	5	
12727	3-23	184+10	16	225-11'	8.0	5	5	

Break Position *of the break region is measured from the low station (feet).*

Notes:

1. Distress is identified on a feature pipe; therefore, it is reported with less certainty.

Break Position *of the break region is measured from the low station (feet).*

2.4.1. Replacement Pipes

One (1) pipe has been removed and installed with two (2) replacement pipes in the 120-inch PCCP Main - west of failure section. The details of the replacement pipes are listed in Table 2.6. The replacement pipes were not analyzed.

Table 2.6: Replacement Pipes in the 120-inch PCCP Main				
Pure Reference Number	Internal Pipe Marking	Low Station	Pipe Length (feet)	Comment
12575	6-1	N/A	8	Replacement pipe
12576	6-0	N/A	8	Replacement pipe with manhole

3. Conclusions

Pure Technologies' evaluation of the 120-inch PCCP Main concluded that:

- Of the 1,248 pipes inspected, a total of 27 pipes in the section west of the failure displayed electromagnetic anomalies consistent with prestressing wire damage ranging from five (5) to 25 broken wire wraps.

APPENDIX A

Glossary & Abbreviations

AV: Air Valve
BO: Blowoff
BWP: Bar Wrapped Pipe
ECP: Embedded Cylinder Pipe
EL: Elbow
EM: Electromagnetic
LCP: Lined Cylinder Pipe
OL: Outlet
MH: Manhole
NSS: Non-Shorting Strap
PCP: Prestressed Concrete Pipe
PCCP: Prestressed Concrete Cylinder Pipe
RCP: Reinforced Concrete Pipe
RCCP: Reinforced Concrete Cylinder Pipe
SP: Short Pipe Length
SS: Shorting Strap
STD: Standard Pipe Length
TO: Turn Out
VS: Vent Structure
PW: Pumping Well

Amplitude: A component of the data signal produced during pipeline inspection; amplitude is an indication of signal strength.

Anomalous Pipe: A pipe that produces a data signal that cannot be interpreted as distressed or distress-free due to some irregularity. This irregularity may be due to unexplained signal influence during the inspection process or due to the properties of the pipe itself.

Calibration: A controlled inspection of a pipe similar to the in situ pipe that is performed to determine the expected signal response. The data signal recorded while inspecting the in situ pipes is then compared to this signal to estimate number of broken wire wraps. Calibration typically requires the destructive testing of a removed pipe.

Distressed Pipe: A pipe that exhibits electromagnetic anomalies consistent with broken wire wraps. The amount of distress can be estimated by comparing the distress signal with the signal obtained during the calibration process.

Distressed Region: A section of pipe that exhibits electromagnetic anomalies consistent with broken wire wraps. There may be one or more regions of distress in any distressed pipe.

Downstream: In the direction of water flow.

Feature: Fixtures in the pipeline that affect the inspection (e.g., Manholes, Air Valves, Tees, Elbows).

Feature Pipe: Pipes with features that may be used to locate distressed pipes. The feature pipes cannot be analyzed for distress at or near the feature due to the signal distortion caused by the presence of the feature.

Joint: An area of the pipeline where two pipe ends are fixed together. Typically, pipe ends are joined spigot to bell; however, special pipes are available that join two bells ends or two spigot ends.

Phase: A component of the data signal produced during pipeline inspection; phase is a representation of the signal's travel time.

Rank: Listing of pipes with respect to the total number of broken wire wraps in the pipe (descending order).

Pipe: Single section of pipe, from bell end to spigot end.

Upstream: Against the direction of water flow.

APPENDIX B

Electromagnetic Inspection Technology

B1 Electromagnetic Inspection Technology

Assessing the condition of a prestressed concrete cylinder pipe (PCCP) transmission main is a challenging task that is best performed using a combination of non-destructive testing technology, internal visual inspection and sounding (in embedded cylinder pipe (ECP)), engineering science, and experiential judgment. The primary goal of an inspection is to provide an understanding of the condition of the structural component that provides the pipe's strength, the prestressing wire. An electromagnetic inspection provides a non-destructive method of evaluating the baseline condition of the prestressing wire. Electromagnetic inspections ascertain a magnetic signature for each pipe to identify anomalies that are produced by zones of broken wire wraps. Various characteristics associated with an electromagnetic anomaly are evaluated to provide an estimate of the number of broken wire wraps. This inspection method is able to quantify the amount of wire wrap damage and is the best method of determining the baseline condition of a pipeline.

B1.1 Background and Theory of Electromagnetic Inspection

For years, it has been possible to exploit the concept of eddy currents to measure structural properties in metals. The application of a time-varying magnetic field to metal structures can create internal electric currents as free electrons which are driven by the field along discontinuities in the metal itself. Many applications of this phenomenon have been developed to detect damaged sections in steel and iron pipelines.

For PCCP, a different mechanism exists that can be used to determine the structural condition of the pipe. Eddy currents that are generated in a wire wrap can flow along the length of the wire wrap, generating a solenoidal field (see Figure B.1). If the current is interrupted by a break in the prestressing wire, the field will be affected.

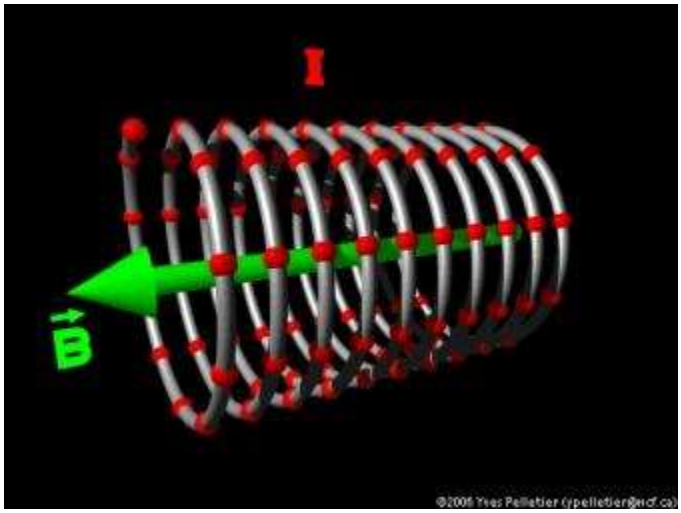

Figure B.1: Electric currents induced by time-varying magnetic field

The electromagnetic system used by Pure Technologies generates eddy currents in the wire wrap and detects where the field is altered by the presence of breaks in the prestressing wire.

To create an electric current in the prestressing wire, the Pure Technologies electromagnetic system generates a magnetic field inside a PCCP. A signal generator outputs a low frequency alternating electric current (typically less than 100 Hz) into a coil of wire (known as an exciter coil) positioned near the inner surface of the pipe. The magnetic field generated by this coil extends through the concrete core, steel cylinder, and finally into the prestressing wire wraps. As the coil travels along the length of the pipe, the field moves as well, creating a localized magnetic field that then generates eddy currents in the wire. As long as there are no breaks in the prestressing wire, the current will flow uniformly along the wire; however, where a broken wire wrap exists, a discontinuity in the current forms. As the magnetic field passes over the section of the broken wire, currents are generated that form opposing magnetic field lines.

Detectors are placed on the opposite side of the pipe from the exciter coil to record the variations in the magnetic field that are created when broken wire wraps interrupt the current flow. Analyzing and interpreting the response of the magnetic field allows for estimates of the number of broken wire wraps and the approximate location of the broken wire wraps along the length of the pipe.

B1.2 Analysis Considerations

Electromagnetic inspections detect electromagnetic anomalies, or differences, in the expected induced field of a PCCP. Anomalies that are consistent with broken wire wraps are important; however, the induced field of interest is small and other sources of interference can mask or distort the size and shape of the electromagnetic signal. The accuracy of the broken wire wrap detection and quantification depends on a number of factors including, but not limited to:

- Accuracy and completeness of the information supplied by the client
- Type and configuration of pipe being inspected
- Availability of relevant calibration information
- Type, complexity, location, and number of distressed regions in a given pipe
- Inspection conditions observed in the pipe during the data collection period

Accuracy and completeness of the information supplied by the client. The inspection system is sensitive to all magnetic properties of a pipe, including cylinder thickness and composition, wire spacing and diameter, and the number of wire wraps. Pure Technologies uses the information provided by the client to perform the analysis. Drawings that indicate the exact location of pipe features and varying pressure classes are used to correlate the inspection data. Drawings that indicate how each class of pipe is constructed (cylinder thickness, wire diameter and spacing, shorting strap or non-shorting strap, etc.) are used to identify and quantify regions of distress. Discrepancies in the drawings and the data may affect the accuracy of the analysis.

Unknown or sealed appurtenances along the pipeline. Although most appurtenances exhibit a signal that is different and distinguishable from broken wire wraps, in some cases, the signals are similar, and an appurtenance could be misinterpreted as broken wire wraps if it is not listed on the drawings and not visible during the inspection.

Existence of ferromagnetic (steel) materials near the pipeline. When extra steel is in close proximity to the pipeline, it can cause a signal distortion that may mask broken wire wraps or could also cause anomalies that may be misinterpreted as broken wire wraps.

Previously repaired pipes. There are a variety of methods used to repair distressed PCCP. Some of these methods allow electromagnetic inspections to be conducted on the repaired pipe while others do not. Internal carbon fiber repairs do not appear to distort the electromagnetic signal and to date, successful repeat inspections have been performed on these repaired pipes and updated quantities of broken wire wraps have been provided for them. Conversely, external tendon repairs, internal or external steel bands, steel slip lining, and internal joint seals can all affect the electromagnetic signal. Consequently, analysis cannot be provided for these types of repaired pipes.

Changes in wire diameter and wire pitch. Broken wire wraps are estimated by measuring the physical length of an anomaly and entering it into a mathematical model known as a calibration curve. Calibration curves are based on either field testing of a similar pipe or mathematical modeling based on an extensive database of calibration test data and finite element analysis. In the case of mathematical modeling, the wire diameter and pitch information are critical factors in the calculations. If this information is not correct, the quantity of broken wire wraps will likely be incorrectly estimated.

Changing distance of the wire wrap and steel cylinder. If, during manufacturing of the pipe, there is variation in the distance of the prestressing wire and the steel cylinder, the resultant signal during an electromagnetic inspection may vary, possibly mimicking broken wire wraps. Typically, it is unknown if there are any pipes affected by this issue as only excavation and forensic analysis can reveal manufacturing defects.

Discontinuities or variations such as abnormal welding in liner construction. These discontinuities can mask actual damage or mimic damage where none exists. This situation could cause over or under estimation of the number of broken wire wraps.

Proximity to power lines. In some cases, power lines can cause distortion in the signal due to the stray magnetic fields. This can limit the effectiveness of the analysis if the distortion is too severe. This interference is rare but is noted for completeness of this document.

Motion. Turbulence, excessive debris/build up, and passing through bends or valves all produce distortion which can affect the detection and estimation of broken wire wraps or may mask actual damage in those areas. The inspection tool is designed to move as smoothly as possible to ensure optimum data quality; however, contact with the pipe wall is inevitable in some situations. Areas where noise are present and may reduce the confidence in defect detection are noted in the Pipe List.

B1.3 Type and Configuration of Pipe Being Inspected

The sensitivity to broken wire wraps is affected by the type of pipe being inspected. The following information on detection limits is based on previous calibration testing performed by Pure Technologies.

Embedded Cylinder Pipe without shorting straps (ECP-NSS)

The electromagnetic inspection system is sensitive to as few as one (1) single broken wire in the middle of the pipe while the detection limit at either the bell or spigot end will typically vary from 5 to 15 broken wire wraps. The differences in detection limits at the end of the pipe is related to differences in the fabrication and installation of the bell and spigot rings of different manufacturers and installation contractors, or differences in how the prestressing wires are anchored at the end of the pipe; some prestressing wires are in electrical contact with the steel cylinder while others are only embedded in the concrete.

ECP-NSS present a challenge to quantifying the number of broken wire wraps detected using electromagnetics. The presence of shorting straps provides some dampening of the response of the electromagnetic signal allowing for a difference in a smaller number of broken wires to be detected. Because the signal change created by a non-shorted broken wire is very large, there is little difference in the signal between a single broken wire and five continuous broken wires. This greatly improved detection (it is easy to detect a single broken wire) but makes quantification more challenging. Generally, two (2) scenarios for damage exists; continuous broken wire wraps as is usually the case with corrosion induced damaged and scattered broken wire wraps as is common when hydrogen embrittlement is the cause. Due to the way the electromagnetic signal responds to broken wires in a non-shorting strap pipe, it is difficult to resolve the difference between continuous and scattered break regions. Also, the minimum separation required to distinguish between two (2) regions with broken wire wraps can vary from 20 to 50 continuous unbroken wires wraps. This limitation may cause an overestimation in the number of broken wire wraps.

Additionally, a wide variation of calibration curves for ECP-NSS exist for pipes with similar specifications which can potentially have a larger impact on the accuracy of the analysis results. Due to these inherent issues with this pipe type, it is recommended to perform verification tests prior to making rehabilitation decisions on ECP-NSS.

Feature Pipes. The electromagnetic technology can detect distressed regions in some feature pipes; however, due to the impact of the feature on the electromagnetic signal, results are presented with less certainty for regions of the pipe near fittings, manholes, blowoff valves, or other features.

Short Pipes. The identification of broken wire wraps on pipes with a shorter length is challenging. As the effect of the changes in the data signal near the end of a pipe (bell or spigot) span is constant regardless of the pipe length (see Effects of Joints), its overall impact on the electromagnetic signal is greater as the length of a pipe decreases. For short pipes, the electromagnetic signal along the barrel of the pipe remains analyzable when it is unaffected by the joint effect; however, when most of the electromagnetic signal of a pipe is end effects, it becomes increasingly challenging to identify regions with broken wire wraps. In addition, short pipes typically make up a small portion of the pipe inventory inspected and there the number baselines (background signals) available for comparison is limited.

B1.4 Details of Estimates of Broken Wire Wraps

Break Position. The signal of a region with broken wire wraps varies along the length of a given pipe. Broken wire wraps in the middle of a pipe are easier to detect and measure than broken wire wraps near the joint. The increased presence of metal at the joint causes a distinct signal response which may affect the detection and accuracy of low to moderate quantities of broken wire wraps within approximately 18 inches or 0.5 meters of the joint. Additionally, broken wire wraps are more difficult to detect and quantify at the bell end of the pipe than at the spigot end of the pipe, since a portion of the bell section will overlap the spigot end. The minimum number of broken wire wraps required for the signal to be detectable and quantifiable depends on the pipe type (embedded cylinder pipe (ECP), lined cylinder pipe (LCP), or non-cylinder pipe (NCP)), joint configuration, proximity of the center of the break region to the joint, and whether it is the bell or spigot end. As a result, the estimated number of broken wire wraps near the center of a pipe will be provided with greater confidence than broken wire wraps near the joints, especially near the bell end.

Effects of Joints. End effects refer to changes in the data signal near the end of a pipe (bell or spigot, if applicable) that are due to a variety of installation methods of the pipe joint itself. End effects do not refer to distress at the joint. Beveled spigots, pulled joints, mitered joints, butt straps, closure pieces, steel fittings, etc., will all affect the data signal at the end of a pipe in some way. Research in this specific area has provided methods for analysts to determine if the signal is due to an end effect, or true end distress. The differences are subtle, and examination of client records can provide the additional information necessary to conclude whether a particular data signal represents end effects or end distress. In the case where both end effects and end distress exist, identification and quantification of broken wire wraps is more challenging.

Non-contiguous Broken Wire Wraps. This occurs when broken wire wraps are scattered amongst non-broken wire wraps. Non-contiguous broken wire wraps are often the result of hydrogen embrittlement as opposed to corrosion, which results in a continuous region of broken wire wraps as the corrosion typically starts at a point and grows with time.

During the inspection, a broad magnetic field is projected onto the prestressing wire (several inches or centimeters wide); therefore, it is difficult to analyze individual prestressing wire wraps. When broken wire wraps are separated by non-broken wire wraps, the non-broken wire wraps can be masked by the distress signals and may appear broken depending on the distance from the broken and non-broken prestressing wire wraps. The minimum separation required to distinguish between two (2) regions with broken wire wraps depends on the pipe properties and the total number of broken wire wraps. Non-contiguous broken wire wraps may lead to a distress signal that is larger than the actual associated prestressing wire damage.

The estimated number of broken wire wraps assumes the distress region comprise of consecutive broken wire wraps. This assumption is the only assumption that can be made without additional information, which could be obtained from field verification. It is possible that some or all the break regions on a distressed pipe will contain intermittent or scattered broken wire wraps instead of consecutive broken wire wraps. In this case, the estimated number of broken wire wraps may be overestimated.

Background Signal Variations. The electromagnetic data signal is sensitive not only to physical differences in pipeline properties (wire diameter and spacing, cylinder thickness, etc.), but it is also sensitive to any magnetic differences in the steel components of the pipe. Pipe manufacturers may use different material suppliers for the various components of the pipes within a pipeline. Even though two (2) pipes are manufactured the same physically, if the steel for the cylinder and the prestressing wire come from different suppliers, they will likely have slightly different magnetic properties, which will result in variations in the background signals.

Much like the fingerprint, every pipe in a pipeline, no matter how alike they are supposed to be, will exhibit a slightly different background signal. Since distress is quantified by measuring the distressed pipe signal relative to a background signal, any variations in background signals can affect the accuracy of the distress measurement and ultimately the estimates of the number of broken wire wraps.

Number of Break Regions. Results are predicted with greater accuracy for pipes containing single distressed regions than for pipes containing multiple distress regions. As the number of distress regions per pipe increases, or as these regions become closer together, the complexity of the interpretation increases. Distress regions can interact with each other from an electromagnetic standpoint to create signals of varying complexity. Distress regions can also span across a wider region in which case the distress region will be provided as positional range and the estimated number of broken wire wraps may be provided depending on its complexity.

Other Factors. There are often overlaps amongst the key issues listed above and there may or may not be other factors related to these issues that decrease the level of confidence in the results presented in the report. Wide variations in manufacturing processes may not impact the structural performance of the pipe but can significantly affect the electromagnetic properties. The list of factors includes ones that are known, unknown, controllable, and uncontrollable. Some can be confirmed during excavation or inspection, and some can be eliminated by studying construction records, although errors in these records are common. In all cases, every effort is made to consider the various factors during analysis; however, it should be noted that the results provide an estimate of the broken wire wraps in a pipe section based on all the information available and assuming that the signal changes are caused by discontinuity in the prestressing wire.

APPENDIX C

Pipe List

MH	Manhole.
OL	Outlet.
BO	Blowoff.
STD	Standard Length Pipe.
SP	Short Pipe.
	Not inspected by Pure Technologies.
	Pipes listed in laying schedules but not observed in data or pipes removed for replacement.

Station numbers in black font indicate numbers obtained directly from client's documents.
Station numbers in grey font indicate numbers calculated by Pure Technologies.

Pipe Class in Contract WS-219 were obtained from pipe laying schedules.

Pipes reported with an asterisk (*) following the number of broken wire wraps: the Break Region Location for these pipes show a range rather than a single distance from the low station joint. This indicates the presence of overlapping distressed regions where each broken wire wrap region is not distinct. These pipes would either have:
1. Broken wire wraps caused by corrosion across the entire length (widespread corrosion), or
2. Sporadic (i.e., a small number of) and non-contiguous broken wire wraps caused by hydrogen embrittlement.

The number of broken wire wraps reported on these pipes can be expected to span across the indicated break position range and, at the same time, does not necessarily mean that all of the wire wraps in that region are broken (i.e., broken wire wraps may exist intermittently with intact wire wraps).

Great Lakes Water Authority
120-inch PCCP Main- West of Failure

Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
10001	WS-218	20-30	183+50	16	183+66	200-11'				
10002	N/A	20-29	N/A	8	N/A	N/A				Not listed in pipe laying schedules. Data indicates ~8ft SP.
10003	WS-218	20-28	183+66	16	183+82	200-11'				
10004	WS-218	20-27	183+82	16	183+98	200-11'				
10005	WS-218	20-26	183+98	16	184+14	200-11'				
10006	WS-218	20-25	184+14	16	184+30	200-11'				
10007	WS-218	20-24	184+30	16	184+46	200-11'	6.0-10.0	25*	25*	
10008	WS-218	20-23	184+46	16	184+62	200-11'				
10009	WS-218	20-22	184+62	16	184+78	200-11'				
10010	WS-218	20-21	184+78	16	184+94	200-11'				
10011	WS-218	20-20	184+94	16	185+10	200-11'				
10012	WS-218	20-19	185+10	16	185+26	200-11'				
10013	WS-218	20-18	185+26	16	185+42	200-11'				
10014	WS-218	20-17	185+42	16	185+58	200-11'				
10015	WS-218	20-16	185+58	16	185+74	200-11'				
10016	WS-218	20-15	185+74	16	185+90	200-11'				
10017	WS-218	20-14	185+90	16	186+06	200-11'				
10018	WS-218	20-13	186+06	16	186+22	200-11'				
10019	WS-218	20-12	186+22	16	186+38	200-11'				
10020	WS-218	20-11	186+38	16	186+54	200-11'				
10021	WS-218	20-10	186+54	16	186+70	200-11'				
10022	WS-218	20-9	186+70	16	186+86	200-11'				
10023	WS-218	20-8	186+86	16	187+02	200-11'				
10024	WS-218	20-7	187+02	16	187+18	200-11'				
10025	WS-218	20-6	187+18	16	187+34	200-11'				
10026	WS-218	20-5	187+34	16	187+50	200-11'				
10027	WS-218	20-4	187+50	16	187+66	200-11'				
10028	WS-218	20-3	187+66	16	187+82	200-11'				
10029	WS-218	20-2	187+82	16	187+98	200-11'				
10030	WS-218	20-1	187+98	16	188+14	200-11'				2-12" OL. 2-2" OL.
10031	WS-218	20-0	188+14	16	188+30	200-11'				16" x 18" MH with 1-1/2" OL. **MH 20.**
10032	WS-218	19-88	188+30	16	188+46	200-11'				
10033	WS-218	19-87	188+46	16	188+62	200-11'				
10034	WS-218	19-86	188+62	16	188+79	200-11'				
10035	WS-218	19-85	188+79	16	188+95	200-11'				
10036	WS-218	19-84	188+95	16	189+11	200-11'				
10037	WS-218	19-83	189+11	16	189+27	200-11'				
10038	WS-218	19-82	189+27	16	189+43	200-11'				
10039	WS-218	19-81	189+43	16	189+59	200-11'				
10040	WS-218	19-80	189+59	16	189+75	200-11'				
10041	WS-218	19-79	189+75	16	189+91	200-11'				
10042	WS-218	19-78	189+91	16	190+07	200-11'				
10043	WS-218	19-77	190+07	16	190+23	200-11'				
10044	WS-218	19-76	190+23	16	190+39	200-11'				
10045	WS-218	19-75	190+39	16	190+55	200-11'				
10046	WS-218	19-74	190+55	16	190+71	200-11'				
10047	WS-218	19-73	190+71	16	190+87	200-11'				
10048	WS-218	19-72	190+87	16	191+03	200-11'				
10049	WS-218	19-71	191+03	16	191+19	200-11'				
10050	WS-218	19-70	191+19	16	191+35	200-11'				
10051	WS-218	19-69	191+35	16	191+51	200-11'				
10052	WS-218	19-68	191+51	16	191+67	200-11'				
10053	WS-218	19-67	191+67	16	191+83	200-11'	11.5	5	5	
10054	WS-218	19-66	191+83	16	191+99	200-11'				
10055	WS-218	19-65	191+99	16	192+15	200-11'				
10056	WS-218	19-64	192+15	16	192+31	200-11'	1.5	5	5	
10057	WS-218	19-63	192+31	16	192+47	200-11'				
10058	WS-218	19-62	192+47	16	192+63	200-11'				
10059	WS-218	19-61	192+63	16	192+79	200-11'				
10060	WS-218	19-60	192+79	16	192+95	200-11'				
10061	WS-218	19-59	192+95	16	193+11	200-11'				
10062	WS-218	19-58	193+11	16	193+27	200-11'				
10063	WS-218	19-57	193+27	16	193+43	200-11'				
10064	WS-218	19-56	193+43	16	193+59	200-11'				
10065	WS-218	19-55	193+59	16	193+75	200-11'				
10066	WS-218	19-54	193+75	16	193+91	200-11'				
10067	WS-218	19-53	193+91	16	194+08	200-11'				
10068	WS-218	19-52	194+08	16	194+24	200-11'				
10069	WS-218	19-51	194+24	16	194+40	200-11'				
10070	WS-218	19-50	194+40	16	194+56	200-11'				
10071	WS-218	19-49	194+56	16	194+72	200-11'				
10072	WS-218	19-48	194+72	16	194+88	200-11'				
10073	WS-218	19-47	194+88	16	195+03	200-11'				
10074	WS-218	19-46	195+03	16	195+19	200-11'				
10075	WS-218	19-45	195+19	16	195+35	200-11'				
10076	WS-218	19-44	195+35	16	195+51	200-11'				
10077	WS-218	19-43	195+51	16	195+67	200-11'				
10078	WS-218	19-42	195+67	16	195+83	200-11'				
10079	WS-218	19-41	195+83	16	195+98	200-11'				
10080	WS-218	19-40	195+98	16	196+14	200-11'				
10081	WS-218	19-39	196+14	16	196+30	200-11'				
10082	WS-218	19-38	196+30	16	196+46	200-11'				
10083	WS-218	19-37	196+46	16	196+62	200-11'				
10084	WS-218	19-36	196+62	16	196+78	200-11'				
10085	WS-218	19-35	196+78	16	196+93	200-11'				
10086	WS-218	19-34	196+93	16	197+09	200-11'				
10087	WS-218	19-33	197+09	16	197+25	200-11'				
10088	WS-218	19-32	197+25	16	197+41	200-11'				
10089	WS-218	19-31	197+41	16	197+57	200-11'				
10090	WS-218	19-30	197+57	16	197+72	200-11'				
10091	WS-218	19-29	197+72	16	197+88	200-11'				
10092	WS-218	19-28	197+88	16	198+04	200-11'				
10093	WS-218	19-27	198+04	16	198+20	200-11'				
10094	WS-218	19-26	198+20	16	198+36	200-11'				
10095	WS-218	19-25	198+36	16	198+52	200-11'				
10096	WS-218	19-24	198+52	16	198+67	200-11'				
10097	WS-218	19-23	198+67	16	198+83	200-11'				
10098	WS-218	19-22	198+83	16	198+99	200-11'				
10099	WS-218	19-21	198+99	16	199+15	200-11'				
10100	WS-218	19-20	199+15	16	199+31	200-11'				

Great Lakes Water Authority
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10101	WS-218	19-19	199+31	16	199+46	200-11'				
10102	WS-218	19-18	199+46	16	199+62	200-11'				
10103	WS-218	19-17	199+62	16	199+78	200-11'				
10104	WS-218	19-16	199+78	16	199+94	200-11'				
10105	WS-218	19-15	199+94	16	200+10	200-11'	9.0	20	20	
10106	WS-218	19-14	200+10	16	200+26	200-11'				
10107	WS-218	19-13	200+26	16	200+42	200-11'				
10108	WS-218	19-12	200+42	16	200+58	200-11'				
10109	WS-218	19-11	200+58	16	200+74	200-11'				
10110	WS-218	19-10	200+74	16	200+90	200-11'				
10111	WS-218	19-9	200+90	16	201+06	200-11'				
10112	WS-218	19-8	201+06	16	201+22	200-11'	9.0	5	5	
10113	WS-218	19-7	201+22	16	201+38	200-11'				
10114	WS-218	19-6	201+38	16	201+54	200-11'				
10115	WS-218	19-5	201+54	16	201+70	200-11'				
10116	WS-218	19-4	201+70	16	201+86	200-11'				
10117	WS-218	19-3	201+86	16	202+02	200-11'				
10118	WS-218	19-2	202+02	16	202+18	200-11'				
10119	WS-218	19-1	202+18	16	202+34	200-11'				
10120	WS-218	19-0	202+34	16	202+50	200-11'				16" x 18" MH. **MH 19.**
10121	WS-218	18-27	202+50	16	202+66	200-11'				
10122	WS-218	18-26	202+66	16	202+82	200-11'				
10123	WS-218	18-25	202+82	16	202+98	200-11'				
10124	WS-218	18-24	202+98	16	203+14	200-11'	1.5	5	5	
10125	WS-218	18-23	203+14	16	203+30	200-11'				
10126	WS-218	18-22	203+30	16	203+46	200-11'				
10127	WS-218	18-21	203+46	16	203+62	200-11'				
10128	WS-218	18-20	203+62	16	203+78	200-11'				
10129	WS-218	18-19	203+78	16	203+94	200-11'	1.5	5	5	
10130	WS-218	18-18	203+94	16	204+10	200-11'				
10131	WS-218	18-17	204+10	16	204+26	200-11'				
10132	WS-218	18-16	204+26	16	204+42	200-11'				
10133	WS-218	18-15	204+42	16	204+58	200-11'				
10134	WS-218	18-14	204+58	16	204+74	200-11'				
10135	WS-218	18-13	204+74	16	204+90	200-11'				
10136	WS-218	18-12	204+90	16	205+06	200-11'				
10137	WS-218	18-11	205+06	16	205+22	200-11'				
10138	WS-218	18-10	205+22	16	205+38	200-11'				
10139	WS-218	18-9	205+38	16	205+54	200-11'				
10140	WS-218	18-8	205+54	16	205+70	200-11'				
10141	WS-218	18-7	205+70	16	205+86	200-11'				
10142	WS-218	18-6	205+86	16	206+02	200-11'				
10143	WS-218	18-5	206+02	16	206+18	200-11'				
10144	WS-218	18-4	206+18	16	206+34	200-11'				
10145	WS-218	18-3	206+34	16	206+50	200-11'				
10146	WS-218	18-2	206+50	16	206+66	200-11'				Reported with less certainty from 0.0-3.0ft due to pause in the electromagnetic data.
N/A	WS-218	N/A	206+66	16	206+82	200-11'				16ft STD in pipe laying schedules. Pipe does not exist in data.
N/A	WS-218	N/A	206+82	16	206+98	200-11'				16ft STD in pipe laying schedules. Pipe does not exist in data.
N/A	WS-219	N/A	0+00	7	0+07	200-11'				7ft SP in pipe laying schedules. Pipe does not exist in data. Analysis Equation: Station 206+98.36BK (Contract WS-218) = 0+00.00AH (Contract WS-219).
10147	N/A	18-1	N/A	11	N/A	N/A				Not listed in pipe laying schedules. Data indicates ~11ft SP.
10148	WS-219	18-0	0+07	16	0+23	200-11'				16" x 18" MH with 1-1/2" OL. **MH 18.**
10149	WS-219	17-121	0+23	16	0+39	200-11'				
10150	WS-219	17-120	0+39	16	0+55	200-11'				
10151	WS-219	17-119	0+55	16	0+72	200-11'				
10152	WS-219	17-118	0+72	16	0+88	200-11'				
10153	WS-219	17-117	0+88	16	1+04	200-11'				
10154	WS-219	17-116	1+04	16	1+20	200-11'				
10155	WS-219	17-115	1+20	16	1+36	200-11'				
10156	WS-219	17-114	1+36	16	1+52	200-11'				
10157	WS-219	17-113	1+52	16	1+68	200-11'				
10158	WS-219	17-112	1+68	16	1+84	200-11'				
10159	WS-219	17-111	1+84	16	2+00	200-11'				
10160	WS-219	17-110	2+00	16	2+16	200-11'				
10161	WS-219	17-109	2+16	16	2+32	200-11'				
10162	WS-219	17-108	2+32	16	2+48	200-11'				
10163	WS-219	17-107	2+48	16	2+64	200-11'				
10164	WS-219	17-106	2+64	16	2+80	200-11'				
10165	WS-219	17-105	2+80	16	2+96	200-11'				
10166	WS-219	17-104	2+96	16	3+12	200-11'				
10167	WS-219	17-103	3+12	16	3+28	200-11'				
10168	WS-219	17-102	3+28	16	3+44	200-11'				
10169	WS-219	17-101	3+44	16	3+60	200-11'				
10170	WS-219	17-100	3+60	16	3+76	200-11'				
10171	WS-219	17-99	3+76	16	3+92	200-11'				
10172	WS-219	17-98	3+92	16	4+08	200-11'				
10173	WS-219	17-97	4+08	16	4+25	200-11'				
10174	WS-219	17-96	4+25	16	4+41	200-11'				
10175	WS-219	17-95	4+41	16	4+57	200-11'				
10176	WS-219	17-94	4+57	16	4+73	200-11'				
10177	WS-219	17-93	4+73	16	4+89	200-11'				
10178	WS-219	17-92	4+89	16	5+05	200-11'				
10179	WS-219	17-91	5+05	16	5+21	200-11'				
10180	WS-219	17-90	5+21	16	5+37	200-11'				
10181	WS-219	17-89	5+37	16	5+53	200-11'				
10182	WS-219	17-88	5+53	16	5+69	200-11'				
10183	WS-219	17-87	5+69	16	5+85	200-11'				
10184	WS-219	17-86	5+85	16	6+01	200-11'				
10185	WS-219	17-85	6+01	16	6+17	200-11'				
10186	WS-219	17-84	6+17	16	6+33	200-11'				
10187	WS-219	17-83	6+33	16	6+49	200-11'				
10188	WS-219	17-82	6+49	16	6+65	200-11'				
10189	WS-219	17-81	6+65	16	6+81	200-11'				
10190	WS-219	17-80	6+81	16	6+97	200-11'				
10191	WS-219	17-79	6+97	16	7+13	200-11'				
10192	WS-219	17-78	7+13	16	7+29	200-11'				
10193	WS-219	17-77	7+29	16	7+46	200-11'				
10194	WS-219	17-76	7+46	16	7+62	200-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
10195	WS-219	17-75	7+62	16	7+78	200-11'	12.5	5	5	
10196	WS-219	17-74	7+78	16	7+94	200-11'				
10197	WS-219	17-73	7+94	16	8+10	200-11'				
10198	WS-219	17-72	8+10	16	8+26	200-11'				
10199	WS-219	17-71	8+26	16	8+42	200-11'				
10200	WS-219	17-70	8+42	16	8+58	200-11'				
10201	WS-219	17-69	8+58	16	8+74	200-11'				
10202	WS-219	17-68	8+74	16	8+90	200-11'				
10203	WS-219	17-67	8+90	16	9+06	200-11'				
10204	WS-219	17-66	9+06	16	9+22	200-11'				
10205	WS-219	17-65	9+22	16	9+38	200-11'				
10206	WS-219	17-64	9+38	16	9+54	200-11'				
10207	WS-219	17-63	9+54	16	9+70	200-11'				
10208	WS-219	17-62	9+70	16	9+86	200-11'				
10209	WS-219	17-61	9+86	16	10+02	200-11'				
10210	WS-219	17-60	10+02	16	10+18	200-11'				
10211	WS-219	17-59	10+18	16	10+34	200-11'				
10212	WS-219	17-58	10+34	16	10+50	200-11'				
10213	WS-219	17-57	10+50	16	10+67	200-11'				
10214	WS-219	17-56	10+67	16	10+83	200-11'				
10215	WS-219	17-55	10+83	16	10+99	200-11'				
10216	WS-219	17-54	10+99	16	11+15	200-11'				
10217	WS-219	17-53	11+15	16	11+31	200-11'				
10218	WS-219	17-52	11+31	16	11+47	200-11'				
10219	WS-219	17-51	11+47	16	11+63	200-11'				
10220	WS-219	17-50	11+63	16	11+79	200-11'				
10221	WS-219	17-49	11+79	16	11+95	200-11'				
10222	WS-219	17-48	11+95	16	12+11	200-11'				
10223	WS-219	17-47	12+11	16	12+27	200-11'				
10224	WS-219	17-46	12+27	16	12+43	200-11'				
10225	WS-219	17-45	12+43	16	12+59	200-11'				
10226	WS-219	17-44	12+59	16	12+75	200-11'				
10227	WS-219	17-43	12+75	16	12+91	200-11'				
10228	WS-219	17-42	12+91	16	13+07	200-11'				
10229	WS-219	17-41	13+07	16	13+23	200-11'				
10230	WS-219	17-40	13+23	16	13+39	200-11'				
10231	WS-219	17-39	13+39	16	13+55	200-11'				
10232	WS-219	17-38	13+55	16	13+71	200-11'				
10233	WS-219	17-37	13+71	16	13+88	200-11'	1.5	5	5	
10234	WS-219	17-36	13+88	16	14+04	200-11'				
10235	WS-219	17-35	14+04	16	14+20	200-11'				
10236	WS-219	17-34	14+20	16	14+36	200-11'				
10237	WS-219	17-33	14+36	16	14+52	200-11'				
10238	WS-219	17-32	14+52	16	14+68	200-11'				
10239	WS-219	17-31	14+68	16	14+84	200-11'				
Not inspected from Station 14+84 to 23+47 due to high water level.										
11001	WS-219	17-6	23+47	16	23+63	200-11'				
11002	WS-219	17-5	23+63	16	23+79	200-11'				
11003	WS-219	17-4	23+79	16	23+95	200-11'				
11004	WS-219	17-3	23+95	16	24+11	200-11'				
11005	WS-219	17-2	24+11	16	24+27	200-11'				
11006	WS-219	17-1	24+27	16	24+43	200-11'				
11007	WS-219	17-0	24+43	16	24+59	200-11'				MH at Station 24+51. **MH 17.**
11008	WS-219	16-75	24+59	16	24+75	200-11'				
11009	WS-219	16-74	24+75	16	24+91	200-11'				
11010	WS-219	16-73	24+91	16	25+07	200-11'				
11011	WS-219	16-72	25+07	16	25+23	200-11'				
11012	WS-219	16-71	25+23	16	25+39	200-11'				
11013	WS-219	16-70	25+39	16	25+55	200-11'				
11014	WS-219	16-69	25+55	16	25+71	200-11'				
11015	WS-219	16-68	25+71	16	25+87	200-11'				
11016	WS-219	16-67	25+87	16	26+03	200-11'				
11017	WS-219	16-66	26+03	16	26+19	200-11'				
11018	WS-219	16-65	26+19	16	26+35	200-11'				
11019	WS-219	16-64	26+35	16	26+52	200-11'				
11020	WS-219	16-63	26+52	16	26+68	200-11'				
11021	WS-219	16-62	26+68	16	26+84	200-11'				
11022	WS-219	16-61	26+84	16	27+00	200-11'				
11023	WS-219	16-60	27+00	16	27+16	200-11'				
11024	WS-219	16-59	27+16	16	27+32	200-11'				
11025	WS-219	16-58	27+32	16	27+48	200-11'				
11026	WS-219	16-57	27+48	16	27+64	200-11'				
11027	WS-219	16-56	27+64	16	27+80	200-11'				
11028	WS-219	16-55	27+80	16	27+96	200-11'				
11029	WS-219	16-54	27+96	16	28+12	200-11'				
11030	WS-219	16-53	28+12	16	28+28	200-11'				
11031	WS-219	16-52	28+28	16	28+44	200-11'				
11032	WS-219	16-51	28+44	16	28+60	200-11'				
11033	WS-219	16-50	28+60	16	28+76	200-11'				
11034	WS-219	16-49	28+76	16	28+92	200-11'				
11035	WS-219	16-48	28+92	16	29+08	200-11'				
11036	WS-219	16-47	29+08	16	29+24	200-11'				
11037	WS-219	16-46	29+24	16	29+40	200-11'				
11038	WS-219	16-45	29+40	16	29+56	200-11'				
11039	WS-219	16-44	29+56	16	29+72	200-11'				
11040	WS-219	16-43	29+72	16	29+88	200-11'				
11041	WS-219	16-42	29+88	16	30+04	200-11'				
11042	WS-219	16-41	30+04	16	30+20	200-11'				
11043	WS-219	16-40	30+20	16	30+36	200-11'				
11044	WS-219	16-39	30+36	16	30+52	200-11'				
11045	WS-219	16-38	30+52	16	30+68	200-11'				
11046	WS-219	16-37	30+68	16	30+84	200-11'				
11047	WS-219	16-36	30+84	16	31+00	200-11'				
11048	WS-219	16-35	31+00	16	31+16	200-11'				
11049	WS-219	16-34	31+16	16	31+32	200-11'				
11050	WS-219	16-33	31+32	16	31+48	200-11'	5.5	5	5	
11051	WS-219	16-32	31+48	16	31+65	200-11'				
11052	WS-219	16-31	31+65	16	31+81	200-11'				
11053	WS-219	16-30	31+81	16	31+97	200-11'				
11054	WS-219	16-29	31+97	16	32+13	200-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
11055	WS-219	16-28	32+13	16	32+29	200-11'				
11056	WS-219	16-27	32+29	16	32+45	200-11'				
11057	WS-219	16-26	32+45	16	32+61	200-11'				
11058	WS-219	16-25	32+61	16	32+77	200-11'				
11059	WS-219	16-24	32+77	16	32+93	200-11'				
11060	WS-219	16-23	32+93	16	33+09	200-11'				
11061	WS-219	16-22	33+09	16	33+25	200-11'				
11062	WS-219	16-21	33+25	16	33+41	200-11'				
11063	WS-219	16-20	33+41	16	33+57	200-11'				
11064	WS-219	16-19	33+57	16	33+73	200-11'				
11065	WS-219	16-18	33+73	16	33+89	200-11'				
11066	WS-219	16-17	33+89	16	34+05	200-11'				
11067	WS-219	16-16	34+05	16	34+21	200-11'				
11068	WS-219	16-15	34+21	16	34+37	200-11'				
11069	WS-219	16-14	34+37	16	34+53	200-11'	1.5	5	5	
11070	WS-219	16-13	34+53	16	34+69	200-11'				
11071	WS-219	16-12	34+69	16	34+85	200-11'				
11072	WS-219	16-11	34+85	16	35+01	200-11'				
11073	WS-219	16-10	35+01	16	35+17	200-11'				
11074	WS-219	16-9	35+17	16	35+33	200-11'	3.5	5	5	
11075	WS-219	16-8	35+33	16	35+49	200-11'				
11076	WS-219	16-7	35+49	16	35+66	200-11'				
11077	WS-219	16-6	35+66	16	35+82	200-11'				
11078	WS-219	16-5	35+82	16	35+98	200-11'				
11079	WS-219	16-4	35+98	16	36+14	200-11'				
11080	WS-219	16-3	36+14	16	36+30	200-11'				
11081	WS-219	16-2	36+30	16	36+46	200-11'				
11082	WS-219	16-1	36+46	16	36+62	200-11'				
11083	WS-219	16-0	36+62	16	36+78	200-11'				MH at Station 36+70. **MH 16.**
11084	WS-219	15-63	36+78	16	36+94	200-11'				
11085	WS-219	15-62	36+94	16	37+10	200-11'				
11086	WS-219	15-61	37+10	16	37+26	200-11'				
11087	WS-219	15-60	37+26	16	37+42	200-11'				
11088	WS-219	15-59	37+42	16	37+58	200-11'				
11089	WS-219	15-58	37+58	16	37+74	200-11'				
11090	WS-219	15-57	37+74	16	37+90	200-11'				
11091	WS-219	15-56	37+90	16	38+06	200-11'				
11092	WS-219	15-55	38+06	16	38+22	200-11'				
11093	WS-219	15-54	38+22	16	38+38	200-11'				
11094	WS-219	15-53	38+38	16	38+54	200-11'				
11095	WS-219	15-52	38+54	16	38+70	200-11'				
11096	WS-219	15-51	38+70	16	38+86	200-11'				
11097	WS-219	15-50	38+86	16	39+02	200-11'				
11098	WS-219	15-49	39+02	16	39+18	200-11'				
11099	WS-219	15-48	39+18	16	39+34	200-11'				
11100	WS-219	15-47	39+34	16	39+50	200-11'				
11101	WS-219	15-46	39+50	16	39+67	200-11'				
11102	WS-219	15-45	39+67	16	39+83	200-11'				
11103	WS-219	15-44	39+83	16	39+99	200-11'				
11104	WS-219	15-43	39+99	16	40+15	200-11'				
11105	WS-219	15-42	40+15	16	40+31	200-11'				
11106	WS-219	15-41	40+31	16	40+47	200-11'				
11107	WS-219	15-40	40+47	16	40+63	200-11'				
11108	WS-219	15-39	40+63	16	40+79	200-11'				
11109	WS-219	15-38	40+79	16	40+95	200-11'				
11110	WS-219	15-37	40+95	16	41+11	200-11'				
11111	WS-219	15-36	41+11	16	41+27	200-11'				
11112	WS-219	15-35	41+27	16	41+43	200-11'				
11113	WS-219	15-34	41+43	16	41+59	200-11'				
11114	WS-219	15-33	41+59	16	41+75	200-11'				
11115	WS-219	15-32	41+75	16	41+91	200-11'				
11116	WS-219	15-31	41+91	16	42+07	200-11'				
11117	WS-219	15-30	42+07	16	42+23	200-11'				
11118	WS-219	15-29	42+23	16	42+39	200-11'				
11119	WS-219	15-28	42+39	16	42+55	200-11'				
11120	WS-219	15-27	42+55	16	42+71	200-11'				
11121	WS-219	15-26	42+71	16	42+87	200-11'				
11122	WS-219	15-25	42+87	16	43+03	200-11'				
11123	WS-219	15-24	43+03	16	43+19	200-11'				
11124	WS-219	15-23	43+19	16	43+35	200-11'				
11125	WS-219	15-22	43+35	16	43+51	200-11'				
11126	WS-219	15-21	43+51	16	43+68	200-11'				
11127	WS-219	15-20	43+68	16	43+84	200-11'				
11128	WS-219	15-19	43+84	16	44+00	200-11'				
11129	WS-219	15-18	44+00	16	44+16	200-11'				
11130	WS-219	15-17	44+16	16	44+32	200-11'				
11131	WS-219	15-16	44+32	16	44+48	200-11'				
11132	WS-219	15-15	44+48	16	44+64	200-11'				
11133	WS-219	15-14	44+64	16	44+80	200-11'				
11134	WS-219	15-13	44+80	16	44+96	200-11'				
11135	WS-219	15-12	44+96	16	45+12	200-11'				
11136	WS-219	15-11	45+12	16	45+28	200-11'				
11137	WS-219	15-10	45+28	16	45+44	200-11'				
11138	WS-219	15-9	45+44	16	45+60	200-11'				
11139	WS-219	15-8	45+60	16	45+76	200-11'				
11140	WS-219	15-7	45+76	16	45+92	200-11'				
11141	WS-219	15-6	45+92	16	46+08	200-11'				
11142	WS-219	15-5	46+08	16	46+24	200-11'				
11143	WS-219	15-4	46+24	16	46+40	200-11'				
11144	WS-219	15-3	46+40	16	46+56	200-11'				
11145	WS-219	15-2	46+56	16	46+72	200-11'				
11146	WS-219	15-1	46+72	16	46+88	200-11'				
11147	WS-219	15-0	46+88	16	47+04	200-11'				MH at Station 46+96. **MH 15.**
11148	WS-219	14-94	47+04	16	47+20	200-11'				
11149	WS-219	14-93	47+20	16	47+36	200-11'				
11150	WS-219	14-92	47+36	16	47+52	200-11'				
11151	WS-219	14-91	47+52	16	47+69	200-11'				
11152	WS-219	14-90	47+69	16	47+85	200-11'				
11153	WS-219	14-89	47+85	16	48+01	200-11'				
11154	WS-219	14-88	48+01	16	48+17	200-11'				

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Electromagnetic Inspection Results
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Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
11155	WS-219	14-87	48+17	16	48+33	200-11'				
11156	WS-219	14-86	48+33	16	48+49	200-11'				
11157	WS-219	14-85	48+49	16	48+65	200-11'				
11158	WS-219	14-84	48+65	16	48+81	200-11'				
11159	WS-219	14-83	48+81	16	48+97	200-11'				
11160	WS-219	14-82	48+97	16	49+13	200-11'				
11161	WS-219	14-81	49+13	16	49+29	200-11'				
11162	WS-219	14-80	49+29	16	49+45	200-11'				
11163	WS-219	14-79	49+45	16	49+61	200-11'				
11164	WS-219	14-78	49+61	16	49+77	200-11'				
11165	WS-219	14-77	49+77	16	49+93	200-11'				
11166	WS-219	14-76	49+93	16	50+09	200-11'				
11167	WS-219	14-75	50+09	16	50+25	200-11'				
11168	WS-219	14-74	50+25	16	50+41	200-11'				
11169	WS-219	14-73	50+41	16	50+57	200-11'				
11170	WS-219	14-72	50+57	16	50+73	200-11'				
11171	WS-219	14-71	50+73	16	50+89	200-11'				
11172	WS-219	14-70	50+89	16	51+05	200-11'				
11173	WS-219	14-69	51+05	16	51+21	200-11'				
11174	WS-219	14-68	51+21	16	51+37	200-11'				
11175	WS-219	14-67	51+37	16	51+53	200-11'				
11176	WS-219	14-66	51+53	16	51+70	200-11'				
11177	WS-219	14-65	51+70	16	51+86	200-11'				
11178	WS-219	14-64	51+86	16	52+02	200-11'				
11179	WS-219	14-63	52+02	16	52+18	200-11'				
11180	WS-219	14-62	52+18	16	52+34	200-11'				
11181	WS-219	14-61	52+34	16	52+50	200-11'				
11182	WS-219	14-60	52+50	16	52+66	200-11'				
11183	WS-219	14-59	52+66	16	52+82	200-11'				
11184	WS-219	14-58	52+82	16	52+98	200-11'				
11185	WS-219	14-57	52+98	16	53+14	200-11'				
11186	WS-219	14-56	53+14	16	53+30	200-11'				
11187	WS-219	14-55	53+30	16	53+46	200-11'				
11188	WS-219	14-54	53+46	16	53+62	200-11'				
11189	WS-219	14-53	53+62	16	53+78	200-11'				
11190	WS-219	14-52	53+78	16	53+94	200-11'				
11191	WS-219	14-51	53+94	16	54+10	200-11'				
11192	WS-219	14-50	54+10	16	54+26	200-11'				
11193	WS-219	14-49	54+26	16	54+42	200-11'				
11194	WS-219	14-48	54+42	16	54+58	200-11'				
11195	WS-219	14-47	54+58	16	54+74	200-11'				
11196	WS-219	14-46	54+74	16	54+90	200-11'				
11197	WS-219	14-45	54+90	16	55+06	200-11'				
11198	WS-219	14-44	55+06	16	55+22	200-11'				
11199	WS-219	14-43	55+22	16	55+38	200-11'				
11200	WS-219	14-42	55+38	16	55+54	200-11'				
11201	WS-219	14-41	55+54	16	55+70	200-11'				
11202	WS-219	14-40	55+70	16	55+85	200-11'				
11203	WS-219	14-39	55+85	16	56+02	200-11'				16" OL at Station 55+93.
11204	WS-219	14-38	56+02	16	56+18	200-11'	7.5;10.5	5;5	10	
11205	WS-219	14-37	56+18	16	56+34	200-11'	3.5	5	5	
11206	WS-219	14-36	56+34	16	56+50	200-11'				
11207	WS-219	14-35	56+50	16	56+66	200-11'				
11208	WS-219	14-34	56+66	16	56+82	200-11'				
11209	WS-219	14-33	56+82	16	56+98	200-11'				
11210	WS-219	14-32	56+98	16	57+14	200-11'				
11211	WS-219	14-31	57+14	16	57+30	200-11'				
11212	WS-219	14-30	57+30	16	57+46	200-11'				
11213	WS-219	14-29	57+46	16	57+62	200-11'				
11214	WS-219	14-28	57+62	16	57+78	200-11'				
11215	WS-219	14-27	57+78	16	57+94	200-11'				
11216	WS-219	14-26	57+94	16	58+10	200-11'				
11217	WS-219	14-25	58+10	16	58+26	200-11'				
11218	WS-219	14-24	58+26	16	58+42	200-11'				
11219	WS-219	14-23	58+42	16	58+58	200-11'				
11220	WS-219	14-22	58+58	16	58+74	200-11'	2.0	5	5	
11221	WS-219	14-21	58+74	16	58+90	200-11'				
11222	WS-219	14-20	58+90	16	59+06	200-11'				
11223	WS-219	14-19	59+06	16	59+22	200-11'				
11224	WS-219	14-18	59+22	16	59+38	200-11'				
11225	WS-219	14-17	59+38	16	59+54	200-11'				
11226	WS-219	14-16	59+54	16	59+70	200-11'				
11227	WS-219	14-15	59+70	16	59+86	200-11'				
11228	WS-219	14-14	59+86	16	60+02	200-11'				
11229	WS-219	14-13	60+02	16	60+18	200-11'				
11230	WS-219	14-12	60+18	16	60+34	200-11'				
11231	WS-219	14-11	60+34	16	60+50	200-11'				
11232	WS-219	14-10	60+50	16	60+66	200-11'				12" BO at Station 60+58.
11233	WS-219	14-9	60+66	16	60+82	200-11'				
11234	WS-219	14-8	60+82	16	60+98	200-11'				
11235	WS-219	14-7	60+98	16	61+14	200-11'				
11236	WS-219	14-6	61+14	16	61+30	200-11'				
11237	WS-219	14-5	61+30	16	61+46	200-11'				
11238	WS-219	14-4	61+46	16	61+62	200-11'				
11239	WS-219	14-3	61+62	16	61+78	200-11'				
11240	WS-219	14-2	61+78	16	61+94	200-11'				
11241	WS-219	14-1	61+94	16	62+10	200-11'				
11242	WS-219	14-0	62+10	16	62+26	200-11'				MH at Station 62+18. **MH 14.**
11243	WS-219	13-57	62+26	16	62+42	200-11'				
11244	WS-219	13-56	62+42	16	62+58	200-11'				
11245	WS-219	13-55	62+58	16	62+74	200-11'				
11246	WS-219	13-54	62+74	16	62+90	200-11'				
11247	WS-219	13-53	62+90	16	63+06	200-11'				
11248	WS-219	13-52	63+06	16	63+22	200-11'				
11249	WS-219	13-51	63+22	16	63+38	200-11'				
11250	WS-219	13-50	63+38	16	63+54	200-11'				
11251	WS-219	13-49	63+54	16	63+70	200-11'				
11252	WS-219	13-48	63+70	16	63+86	200-11'				
11253	WS-219	13-47	63+86	16	64+02	200-11'				
11254	WS-219	13-46	64+02	16	64+18	200-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
11255	WS-219	13-45	64+18	16	64+34	200-11'	9.0	5	5	
11256	WS-219	13-44	64+34	16	64+50	200-11'				
11257	WS-219	13-43	64+50	16	64+67	200-11'				
11258	WS-219	13-42	64+67	16	64+83	200-11'				
11259	WS-219	13-41	64+83	16	64+99	200-11'				
11260	WS-219	13-40	64+99	16	65+15	200-11'				
11261	WS-219	13-39	65+15	16	65+31	200-11'				
Not inspected from Station 65+31 to Station 68+19 due to high water level.										
12001	WS-219	13-18	68+19	16	68+35	200-11'				
12002	WS-219	13-17	68+35	16	68+51	200-11'				
12003	WS-219	13-16	68+51	16	68+67	200-11'				
12004	WS-219	13-15	68+67	16	68+83	200-11'				
12005	WS-219	13-14	68+83	16	68+99	200-11'				
12006	WS-219	13-13	68+99	16	69+15	200-11'				
12007	WS-219	13-12	69+15	16	69+31	200-11'	7.0;9.5	5;5	10	2" OL at Station 69+23.
12008	WS-219	13-11	69+31	16	69+47	200-11'				
12009	WS-219	13-10	69+47	16	69+63	200-11'				
12010	WS-219	13-9	69+63	16	69+79	200-11'				
12011	WS-219	13-8	69+79	16	69+95	200-11'				
12012	WS-219	13-7	69+95	16	70+11	200-11'				
12013	WS-219	13-6	70+11	16	70+27	200-11'				
12014	WS-219	13-5	70+27	16	70+43	200-11'				
12015	WS-219	13-4	70+43	16	70+59	200-11'				
12016	WS-219	13-3	70+59	16	70+75	200-11'				
12017	WS-219	13-2	70+75	16	70+91	200-11'				
12018	WS-219	13-1	70+91	16	71+07	200-11'				
12019	WS-219	13-0	71+07	16	71+23	200-11'				
12020	WS-219	12-56	71+23	16	71+39	200-11'				MH at Station 71+31. **MH 13.**
12021	WS-219	12-55	71+39	16	71+55	200-11'				
12022	WS-219	12-54	71+55	16	71+71	200-11'				
12023	WS-219	12-53	71+71	16	71+87	200-11'				
12024	WS-219	12-52	71+87	16	72+03	200-11'				
12025	WS-219	12-51	72+03	16	72+19	200-11'				
12026	WS-219	12-50	72+19	16	72+35	200-11'				
12027	WS-219	12-49	72+35	16	72+51	200-11'				
12028	WS-219	12-48	72+51	16	72+68	200-11'				
12029	WS-219	12-47	72+68	16	72+84	200-11'				
12030	WS-219	12-46	72+84	16	73+00	200-11'				
12031	WS-219	12-45	73+00	16	73+16	200-11'				
12032	WS-219	12-44	73+16	16	73+32	200-11'				
12033	WS-219	12-43	73+32	16	73+48	200-11'				
12034	WS-219	12-42	73+48	16	73+64	200-11'				
12035	WS-219	12-41	73+64	16	73+80	200-11'				
12036	WS-219	12-40	73+80	16	73+96	200-11'				
12037	WS-219	12-39	73+96	16	74+12	200-11'				
12038	WS-219	12-38	74+12	16	74+28	200-11'				
12039	WS-219	12-37	74+28	16	74+44	200-11'				
12040	WS-219	12-36	74+44	16	74+60	200-11'				
12041	WS-219	12-35	74+60	16	74+76	200-11'				
12042	WS-219	12-34	74+76	16	74+92	200-11'				
12043	WS-219	12-33	74+92	16	75+08	200-11'				
12044	WS-219	12-32	75+08	16	75+24	200-11'				
12045	WS-219	12-31	75+24	16	75+40	200-11'				
12046	WS-219	12-30	75+40	16	75+56	200-11'				
12047	WS-219	12-29	75+56	16	75+72	200-11'				
12048	WS-219	12-28	75+72	16	75+88	200-11'				
12049	WS-219	12-27	75+88	16	76+04	200-11'				
12050	WS-219	12-26	76+04	16	76+20	200-11'				
12051	WS-219	12-25	76+20	16	76+36	200-11'				
12052	WS-219	12-24	76+36	16	76+52	200-11'				
12053	WS-219	12-23	76+52	16	76+68	200-11'				
12054	WS-219	12-22	76+68	16	76+84	200-11'				
12055	WS-219	12-21	76+84	16	77+00	200-11'				
12056	WS-219	12-20	77+00	16	77+16	200-11'				
12057	WS-219	12-19	77+16	16	77+32	200-11'				
12058	WS-219	12-18	77+32	16	77+48	200-11'				
12059	WS-219	12-17	77+48	16	77+64	200-11'				
12060	WS-219	12-16	77+64	16	77+80	200-11'				
12061	WS-219	12-15	77+80	16	77+97	200-11'				
12062	WS-219	12-14	77+97	16	78+13	200-11'				
12063	WS-219	12-13	78+13	16	78+29	200-11'				
12064	WS-219	12-12	78+29	16	78+45	200-11'				
12065	WS-219	12-11	78+45	16	78+61	200-11'				
12066	WS-219	12-10	78+61	16	78+77	200-11'				
12067	WS-219	12-9	78+77	16	78+93	200-11'				
12068	WS-219	12-8	78+93	16	79+09	200-11'				
12069	WS-219	12-7	79+09	16	79+25	200-11'				
12070	WS-219	12-6	79+25	16	79+41	200-11'				
12071	WS-219	12-5	79+41	16	79+57	200-11'				
12072	WS-219	12-4	79+57	16	79+73	200-11'				
12073	WS-219	12-3	79+73	16	79+89	200-11'				
12074	WS-219	12-2	79+89	16	80+05	200-11'				
12075	WS-219	12-1	80+05	16	80+21	200-11'				
12076	WS-219	12-0	80+21	16	80+37	200-11'				MH at Station 80+29. **MH 12.**
12077	WS-219	11-82	80+37	16	80+53	200-11'				
12078	WS-219	11-81	80+53	16	80+69	200-11'				
12079	WS-219	11-80	80+69	16	80+85	200-11'				
12080	WS-219	11-79	80+85	16	81+01	200-11'				
12081	WS-219	11-78	81+01	16	81+17	200-11'				
12082	WS-219	11-77	81+17	16	81+33	200-11'				
12083	WS-219	11-76	81+33	16	81+49	200-11'				
12084	WS-219	11-75	81+49	16	81+65	200-11'				
12085	WS-219	11-74	81+65	16	81+81	200-11'				
12086	WS-219	11-73	81+81	16	81+97	200-11'				
12087	WS-219	11-72	81+97	16	82+13	200-11'				
12088	WS-219	11-71	82+13	16	82+29	200-11'				
12089	WS-219	11-70	82+29	16	82+45	200-11'				
12090	WS-219	11-69	82+45	16	82+61	200-11'				
12091	WS-219	11-68	82+61	16	82+77	200-11'				
12092	WS-219	11-67	82+77	16	82+93	200-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12093	WS-219	11-66	82+93	16	83+09	200-11'				
12094	WS-219	11-65	83+09	16	83+26	200-11'	8.5	5	5	
12095	WS-219	11-64	83+26	16	83+42	200-11'				
12096	WS-219	11-63	83+42	16	83+58	200-11'				
12097	WS-219	11-62	83+58	16	83+74	200-11'				
12098	WS-219	11-61	83+74	16	83+90	200-11'				
12099	WS-219	11-60	83+90	16	84+06	200-11'				
12100	WS-219	11-59	84+06	16	84+22	200-11'				
12101	WS-219	11-58	84+22	16	84+38	200-11'				
12102	WS-219	11-57	84+38	16	84+54	200-11'				
12103	WS-219	11-56	84+54	16	84+70	200-11'				
12104	WS-219	11-55	84+70	16	84+86	200-11'				
12105	WS-219	11-54	84+86	16	85+02	200-11'				
12106	WS-219	11-53	85+02	16	85+18	200-11'				
12107	WS-219	11-52	85+18	16	85+34	200-11'				
12108	WS-219	11-51	85+34	16	85+50	200-11'				
12109	WS-219	11-50	85+50	16	85+66	200-11'				
12110	WS-219	11-49	85+66	16	85+82	200-11'				
12111	WS-219	11-48	85+82	16	85+98	200-11'				
12112	WS-219	11-47	85+98	16	86+14	200-11'				
12113	WS-219	11-46	86+14	16	86+30	200-11'				
12114	WS-219	11-45	86+30	16	86+46	200-11'				
12115	WS-219	11-44	86+46	16	86+62	200-11'				
12116	WS-219	11-43	86+62	16	86+78	200-11'				
12117	WS-219	11-42	86+78	16	86+94	200-11'				
12118	WS-219	11-41	86+94	16	87+10	200-11'				
12119	WS-219	11-40	87+10	16	87+26	200-11'				
12120	WS-219	11-39	87+26	16	87+43	200-11'				
12121	WS-219	11-38	87+43	16	87+59	200-11'				
12122	WS-219	11-37	87+59	16	87+75	200-11'				
12123	WS-219	11-36	87+75	16	87+91	200-11'				
12124	WS-219	11-35	87+91	16	88+07	200-11'				
12125	WS-219	11-34	88+07	16	88+23	200-11'				
12126	WS-219	11-33	88+23	16	88+39	200-11'				
12127	WS-219	11-32	88+39	16	88+55	200-11'				
12128	WS-219	11-31	88+55	16	88+71	200-11'				
12129	WS-219	11-30	88+71	16	88+87	200-11'				
12130	WS-219	11-29	88+87	16	89+03	200-11'				
12131	WS-219	11-28	89+03	16	89+19	200-11'				
12132	WS-219	11-27	89+19	16	89+35	200-11'				
12133	WS-219	11-26	89+35	16	89+51	200-11'				
12134	WS-219	11-25	89+51	16	89+67	200-11'				
12135	WS-219	11-24	89+67	16	89+83	200-11'				
12136	WS-219	11-23	89+83	16	89+99	200-11'				
12137	WS-219	11-22	89+99	16	90+15	200-11'				
12138	WS-219	11-21	90+15	16	90+31	200-11'				
12139	WS-219	11-20	90+31	16	90+47	200-11'				
12140	WS-219	11-19	90+47	16	90+63	200-11'				
12141	WS-219	11-18	90+63	16	90+79	200-11'				
12142	WS-219	11-17	90+79	16	90+95	200-11'				
12143	WS-219	11-16	90+95	16	91+11	200-11'				
12144	WS-219	11-15	91+11	16	91+27	200-11'				
12145	WS-219	11-14	91+27	16	91+43	200-11'				
12146	WS-219	11-13	91+43	16	91+59	200-11'				
12147	WS-219	11-12	91+59	16	91+75	200-11'				
12148	WS-219	11-11	91+75	16	91+91	200-11'				
12149	WS-219	11-10	91+91	16	92+07	200-11'				
12150	WS-219	11-9	92+07	16	92+23	200-11'				
12151	WS-219	11-8	92+23	16	92+39	200-11'				
12152	WS-219	11-7	92+39	16	92+55	200-11'				
12153	WS-219	11-6	92+55	16	92+71	200-11'				
12154	WS-219	11-5	92+71	16	92+87	200-11'				
12155	WS-219	11-4	92+87	16	93+03	200-11'				
12156	WS-219	11-3	93+03	16	93+19	200-11'				
12157	WS-219	11-2	93+19	16	93+35	200-11'				
12158	WS-219	11-1	93+35	16	93+51	200-11'				
12159	WS-219	11-0	93+51	16	93+67	200-11'				MH at Station 93+59. **MH 11.**
12160	WS-219	10-90	93+67	16	93+83	200-11'				
12161	WS-219	10-89	93+83	16	94+00	200-11'				
12162	WS-219	10-88	94+00	16	94+16	200-11'				
12163	WS-219	10-87	94+16	16	94+32	200-11'				
12164	WS-219	10-86	94+32	16	94+48	200-11'				
12165	WS-219	10-85	94+48	16	94+64	200-11'				
12166	WS-219	10-84	94+64	16	94+80	200-11'				
12167	WS-219	10-83	94+80	16	94+96	200-11'				
12168	WS-219	10-82	94+96	16	95+12	200-11'				
12169	WS-219	10-81	95+12	16	95+28	200-11'				
12170	WS-219	10-80	95+28	16	95+44	200-11'				
12171	WS-219	10-79	95+44	16	95+60	200-11'				
12172	WS-219	10-78	95+60	16	95+76	200-11'				
12173	WS-219	10-77	95+76	16	95+92	200-11'				
12174	WS-219	10-76	95+92	16	96+08	200-11'				
12175	WS-219	10-75	96+08	16	96+24	200-11'				
12176	WS-219	10-74	96+24	16	96+40	200-11'				
12177	WS-219	10-73	96+40	16	96+56	200-11'				
12178	WS-219	10-72	96+56	16	96+72	200-11'				
12179	WS-219	10-71	96+72	16	96+88	200-11'				
12180	WS-219	10-70	96+88	16	97+04	200-11'				
12181	WS-219	10-69	97+04	16	97+20	200-11'				
12182	WS-219	10-68	97+20	16	97+36	200-11'				
12183	WS-219	10-67	97+36	16	97+52	200-11'				
12184	WS-219	10-66	97+52	16	97+68	200-11'				
12185	WS-219	10-65	97+68	16	97+84	200-11'				
12186	WS-219	10-64	97+84	16	98+00	200-11'				
12187	WS-219	10-63	98+00	16	98+16	200-11'				
12188	WS-219	10-62	98+16	16	98+32	200-11'				
12189	WS-219	10-61	98+32	16	98+48	200-11'				
12190	WS-219	10-60	98+48	16	98+64	200-11'				
12191	WS-219	10-59	98+64	16	98+80	200-11'				
12192	WS-219	10-58	98+80	16	98+96	200-11'				

Great Lakes Water Authority
120-inch PCCP Main- West of Failure

Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12193	WS-219	10-57	98+96	16	99+12	200-11'				Suspected miscount in pipe numbering.
12194	WS-219	10-55	99+12	16	99+29	200-11'				
12195	WS-219	10-54	99+29	16	99+45	200-11'				
12196	WS-219	10-53	99+45	16	99+61	200-11'				
12197	WS-219	10-52	99+61	16	99+77	200-11'				
12198	WS-219	10-51	99+77	16	99+93	200-11'				
12199	WS-219	10-50	99+93	16	100+09	200-11'				
12200	WS-219	10-49	100+09	16	100+25	200-11'				
12201	WS-219	10-48	100+25	16	100+41	200-11'				
12202	WS-219	10-47	100+41	16	100+57	200-11'				
12203	WS-219	10-46	100+57	16	100+73	200-11'				
12204	WS-219	10-45	100+73	16	100+89	200-11'				
12205	WS-219	10-44	100+89	16	101+05	200-11'				
12206	WS-219	10-43	101+05	16	101+21	200-11'				
12207	WS-219	10-42	101+21	16	101+37	200-11'				
12208	WS-219	10-41	101+37	16	101+53	200-11'				
12209	WS-219	10-40	101+53	16	101+69	200-11'				
12210	WS-219	10-39	101+69	16	101+85	200-11'				
12211	WS-219	10-38	101+85	16	102+01	200-11'				
12212	WS-219	10-37	102+01	16	102+17	200-11'				
12213	WS-219	10-36	102+17	16	102+33	200-11'				
12214	WS-219	10-35	102+33	16	102+49	200-11'				
12215	WS-219	10-34	102+49	16	102+65	200-11'				
12216	WS-219	10-33	102+65	16	102+81	200-11'				
12217	WS-219	10-32	102+81	16	102+97	200-11'				
12218	WS-219	10-31	102+97	16	103+13	200-11'				
12219	WS-219	10-30	103+13	16	103+29	200-11'				
12220	WS-219	10-29	103+29	16	103+45	200-11'				
12221	WS-219	10-28	103+45	16	103+61	200-11'				
12222	WS-219	10-27	103+61	16	103+77	200-11'				
12223	WS-219	10-26	103+77	16	103+93	200-11'				
12224	WS-219	10-25	103+93	16	104+09	200-11'				
12225	WS-219	10-24	104+09	16	104+25	200-11'				
12226	WS-219	10-23	104+25	16	104+41	200-11'				
12227	WS-219	10-22	104+41	16	104+58	200-11'				
12228	WS-219	10-21	104+58	16	104+74	200-11'				
12229	WS-219	10-20	104+74	16	104+90	200-11'				
12230	WS-219	10-19	104+90	16	105+06	200-11'				
12231	WS-219	10-18	105+06	16	105+22	200-11'				
12232	WS-219	10-17	105+22	16	105+38	200-11'				
12233	WS-219	10-16	105+38	16	105+54	200-11'				
12234	WS-219	10-15	105+54	16	105+70	200-11'				
12235	WS-219	10-14	105+70	16	105+86	200-11'				
12236	WS-219	10-13	105+86	16	106+02	200-11'				
12237	WS-219	10-12	106+02	16	106+18	200-11'				
12238	WS-219	10-11	106+18	16	106+34	200-11'				
12239	WS-219	10-10	106+34	16	106+50	200-11'				
12240	WS-219	10-9	106+50	16	106+66	200-11'				
12241	WS-219	10-8	106+66	16	106+82	200-11'				
12242	WS-219	10-7	106+82	16	106+98	200-11'				
12243	WS-219	10-6	106+98	16	107+14	200-11'				
12244	WS-219	10-5	107+14	16	107+30	200-11'				
12245	WS-219	10-4	107+30	16	107+46	200-11'				
12246	WS-219	10-3	107+46	16	107+62	200-11'				
12247	WS-219	10-2	107+62	16	107+78	200-11'				
12248	WS-219	10-1	107+78	16	107+94	200-11'				
12249	WS-219	10-0	107+94	16	108+10	200-11'				MH at Station 108+02. **MH 10.**
12250	WS-219	9-71	108+10	16	108+26	200-11'				
12251	WS-219	9-70	108+26	16	108+42	200-11'				
12252	WS-219	9-69	108+42	16	108+58	200-11'				
12253	WS-219	9-68	108+58	16	108+74	200-11'				
12254	WS-219	9-67	108+74	16	108+90	200-11'				
12255	WS-219	9-66	108+90	16	109+06	200-11'				
12256	WS-219	9-65	109+06	16	109+22	200-11'				
12257	WS-219	9-64	109+22	16	109+38	200-11'				
12258	WS-219	9-63	109+38	16	109+54	200-11'				
12259	WS-219	9-62	109+54	16	109+70	200-11'				
12260	WS-219	9-61	109+70	16	109+86	200-11'				
12261	WS-219	9-60	109+86	16	110+03	200-11'				
12262	WS-219	9-59	110+03	16	110+19	200-11'				
12263	WS-219	9-58	110+19	16	110+35	200-11'				
12264	WS-219	9-57	110+35	16	110+51	200-11'				
12265	WS-219	9-56	110+51	16	110+67	200-11'				
12266	WS-219	9-55	110+67	16	110+83	200-11'				
12267	WS-219	9-54	110+83	16	110+99	200-11'	8.5	5	5	
12268	WS-219	9-53	110+99	16	111+15	200-11'				
12269	WS-219	9-52	111+15	16	111+31	200-11'				
12270	WS-219	9-51	111+31	16	111+47	200-11'				
12271	WS-219	9-50	111+47	16	111+63	200-11'				
12272	WS-219	9-49	111+63	16	111+79	200-11'				
12273	WS-219	9-48	111+79	16	111+95	200-11'				
12274	WS-219	9-47	111+95	16	112+11	200-11'				
12275	WS-219	9-46	112+11	16	112+27	200-11'				
12276	WS-219	9-45	112+27	16	112+43	200-11'				
12277	WS-219	9-44	112+43	16	112+59	200-11'				
12278	WS-219	9-43	112+59	16	112+75	200-11'				
12279	WS-219	9-42	112+75	16	112+91	200-11'				
12280	WS-219	9-41	112+91	16	113+07	200-11'				
12281	WS-219	9-40	113+07	16	113+23	200-11'				
12282	WS-219	9-39	113+23	16	113+39	200-11'				
12283	WS-219	9-38	113+39	16	113+55	200-11'				
12284	WS-219	9-37	113+55	16	113+71	200-11'	8.5	5	5	
12285	WS-219	9-36	113+71	16	113+87	200-11'				
12286	WS-219	9-35	113+87	16	114+03	200-11'				
12287	WS-219	9-34	114+03	16	114+19	200-11'				
12288	WS-219	9-33	114+19	16	114+35	200-11'				
12289	WS-219	9-32	114+35	16	114+51	200-11'				
12290	WS-219	9-31	114+51	16	114+67	200-11'				
12291	WS-219	9-30	114+67	16	114+83	200-11'				
12292	WS-219	9-29	114+83	16	114+99	200-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12293	WS-219	9-28	114+99	16	115+15	200-11'				
12294	WS-219	9-27	115+15	16	115+32	200-11'				
12295	WS-219	9-26	115+32	16	115+48	200-11'				
12296	WS-219	9-25	115+48	16	115+64	200-11'				
12297	WS-219	9-24	115+64	16	115+80	200-11'				
12298	WS-219	9-23	115+80	16	115+95	200-11'				
12299	WS-219	9-22	115+95	16	116+11	200-11'				
12300	WS-219	9-21	116+11	16	116+27	200-11'				
12301	WS-219	9-20	116+27	16	116+44	200-11'				
12302	WS-219	9-19	116+44	16	116+60	200-11'				
12303	WS-219	9-18	116+60	16	116+76	200-11'				
12304	WS-219	9-17	116+76	16	116+92	200-11'				
12305	WS-219	9-16	116+92	16	117+08	200-11'				
12306	WS-219	9-15	117+08	16	117+24	200-11'				
12307	WS-219	9-14	117+24	16	117+40	200-11'				
12308	WS-219	9-13	117+40	16	117+56	200-11'				
12309	WS-219	9-12	117+56	16	117+72	200-11'				
12310	WS-219	9-11	117+72	16	117+88	200-11'				
12311	WS-219	9-10	117+88	16	118+04	200-11'				
12312	WS-219	9-9	118+04	16	118+20	200-11'				
12313	WS-219	9-8	118+20	16	118+36	200-11'				
12314	WS-219	9-7	118+36	16	118+52	200-11'				
12315	WS-219	9-6	118+52	16	118+68	200-11'				12" BO at Station 118+60.
12316	WS-219	9-5	118+68	16	118+84	200-11'	7.0	10	10	
12317	WS-219	9-4	118+84	16	119+00	200-11'				
12318	WS-219	9-3	119+00	16	119+16	200-11'				
12319	WS-219	9-2	119+16	16	119+32	200-11'				
12320	WS-219	9-1	119+32	16	119+48	200-11'				
12321	WS-219	9-0	119+48	16	119+64	200-11'				MH at Station 119+56. **MH-9.**
12322	WS-219	8-106	119+64	16	119+80	200-11'				
12323	WS-219	8-105	119+80	16	119+96	200-11'				
12324	WS-219	8-104	119+96	16	120+12	200-11'				
12325	WS-219	8-103	120+12	16	120+28	200-11'				
12326	WS-219	8-102	120+28	16	120+44	200-11'				
12327	WS-219	8-101	120+44	16	120+60	200-11'				
12328	WS-219	8-100	120+60	16	120+76	200-11'				
12329	WS-219	8-99	120+76	16	120+92	200-11'				
12330	WS-219	8-98	120+92	16	121+08	200-11'				
12331	WS-219	8-97	121+08	16	121+24	200-11'				
12332	WS-219	8-96	121+24	16	121+40	200-11'				
12333	WS-219	8-95	121+40	16	121+56	200-11'				
12334	WS-219	8-94	121+56	16	121+72	200-11'				
12335	WS-219	8-93	121+72	16	121+88	200-11'				
12336	WS-219	8-92	121+88	16	122+04	200-11'				
12337	WS-219	8-91	122+04	16	122+20	200-11'				
12338	WS-219	8-90	122+20	16	122+36	200-11'				
12339	WS-219	8-89	122+36	16	122+52	200-11'				
12340	WS-219	8-88	122+52	16	122+68	200-11'				
12341	WS-219	8-87	122+68	16	122+84	200-11'				
12342	WS-219	8-86	122+84	16	123+00	200-11'				
12343	WS-219	8-85	123+00	16	123+16	200-11'				
12344	WS-219	8-84	123+16	16	123+32	200-11'				
12345	WS-219	8-83	123+32	16	123+48	200-11'				
12346	WS-219	8-82	123+48	16	123+64	200-11'				
12347	WS-219	8-81	123+64	16	123+81	200-11'				
12348	WS-219	8-80	123+81	16	123+97	225-11'				
12349	WS-219	8-79	123+97	16	124+13	225-11'				
12350	WS-219	8-78	124+13	16	124+29	225-11'				
12351	WS-219	8-77	124+29	16	124+45	225-11'				
12352	WS-219	8-76	124+45	16	124+61	225-11'				
12353	WS-219	8-75	124+61	16	124+77	225-11'				
12354	WS-219	8-74	124+77	16	124+93	225-11'				
12355	WS-219	8-73	124+93	16	125+09	225-11'				
12356	WS-219	8-72	125+09	16	125+25	225-11'				
12357	WS-219	8-71	125+25	16	125+41	225-11'				
12358	WS-219	8-70	125+41	16	125+57	225-11'				
12359	WS-219	8-69	125+57	16	125+73	225-11'				
12360	WS-219	8-68	125+73	16	125+89	225-11'				
12361	WS-219	8-67	125+89	16	126+05	225-11'				
12362	WS-219	8-66	126+05	16	126+21	225-11'				
12363	WS-219	8-65	126+21	16	126+37	225-11'				
12364	WS-219	8-64	126+37	16	126+53	225-11'				
12365	WS-219	8-63	126+53	16	126+69	225-11'				
12366	WS-219	8-62	126+69	16	126+85	225-11'				
12367	WS-219	8-61	126+85	16	127+01	225-11'				
12368	WS-219	8-60	127+01	16	127+17	225-11'				
12369	WS-219	8-59	127+17	16	127+33	225-11'				
12370	WS-219	8-58	127+33	16	127+49	225-11'				
12371	WS-219	8-57	127+49	16	127+65	225-11'				
12372	WS-219	8-56	127+65	16	127+81	225-11'				
12373	WS-219	8-55	127+81	16	127+97	225-11'				
12374	WS-219	8-54	127+97	16	128+13	225-11'				
12375	WS-219	8-53	128+13	16	128+29	225-11'				
12376	WS-219	8-52	128+29	16	128+45	225-11'				
12377	WS-219	8-51	128+45	16	128+61	225-11'				
12378	WS-219	8-50	128+61	16	128+77	225-11'				
12379	WS-219	8-49	128+77	16	128+93	225-11'				
12380	WS-219	8-48	128+93	16	129+09	225-11'				
12381	WS-219	8-47	129+09	16	129+26	225-11'				
12382	WS-219	8-46	129+26	16	129+42	225-11'				
12383	WS-219	8-45	129+42	16	129+58	225-11'				
12384	WS-219	8-44	129+58	16	129+74	225-11'				
12385	WS-219	8-43	129+74	16	129+90	225-11'				
12386	WS-219	8-42	129+90	16	130+06	225-11'				
12387	WS-219	8-41	130+06	16	130+22	225-11'				
12388	WS-219	8-40	130+22	16	130+38	225-11'				
12389	WS-219	8-39	130+38	16	130+54	225-11'				
12390	WS-219	8-38	130+54	16	130+70	225-11'				
12391	WS-219	8-37	130+70	16	130+86	225-11'				
12392	WS-219	8-36	130+86	16	131+02	225-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12393	WS-219	8-35	131+02	16	131+18	225-11'				
12394	WS-219	8-34	131+18	16	131+34	225-11'				
12395	WS-219	8-33	131+34	16	131+50	225-11'				
12396	WS-219	8-32	131+50	16	131+66	225-11'				
12397	WS-219	8-31	131+66	16	131+82	225-11'				
12398	WS-219	8-30	131+82	16	131+98	225-11'				
12399	WS-219	8-29	131+98	16	132+14	225-11'				
12400	WS-219	8-28	132+14	16	132+30	225-11'				
12401	WS-219	8-27	132+30	16	132+46	225-11'				
12402	WS-219	8-26	132+46	16	132+62	225-11'				
12403	WS-219	8-25	132+62	16	132+78	225-11'				
12404	WS-219	8-24	132+78	16	132+94	225-11'				
12405	WS-219	8-23	132+94	16	133+10	225-11'				
12406	WS-219	8-22	133+10	16	133+26	225-11'				
12407	WS-219	8-21	133+26	16	133+42	225-11'				
12408	WS-219	8-20	133+42	16	133+58	225-11'				
12409	WS-219	8-19	133+58	16	133+74	225-11'				
12410	WS-219	8-18	133+74	16	133+90	225-11'				
12411	WS-219	8-17	133+90	16	134+06	225-11'				
12412	WS-219	8-16	134+06	16	134+22	225-11'				
12413	WS-219	8-15	134+22	16	134+38	225-11'				
12414	WS-219	8-14	134+38	16	134+54	225-11'				
12415	WS-219	8-13	134+54	16	134+70	225-11'				
12416	WS-219	8-12	134+70	16	134+86	225-11'				
12417	WS-219	8-11	134+86	16	135+05	225-11'				Equation: 135+02.20BK = 135+04.60AH.
12418	WS-219	8-10	135+05	16	135+21	225-11'				
12419	WS-219	8-9	135+21	16	135+37	225-11'				12" BO at Station 135+29.
12420	WS-219	8-8	135+37	16	135+52	225-11'				
12421	WS-219	8-7	135+52	16	135+69	225-11'				
12422	WS-219	8-6	135+69	16	135+85	225-11'				
12423	WS-219	8-5	135+85	16	136+01	225-11'				
12424	WS-219	8-4	136+01	16	136+17	225-11'				
12425	WS-219	8-3	136+17	16	136+33	225-11'				
12426	WS-219	8-2	136+33	16	136+49	225-11'				
12427	WS-219	8-1	136+49	16	136+65	225-11'				
12428	WS-219	8-0	136+65	16	136+81	225-11'				MH at Station 136+73. **MH 8.**
N/A	WS-219	N/A	136+81	9	136+89	225-11'				9ft SP in pipe laying schedules. Pipe does not exist in data.
N/A	WS-219	N/A	136+89	9	136+98	225-11'				9ft SP in pipe laying schedules. Pipe does not exist in data.
12429	N/A	7-84C	N/A	5	N/A	N/A				Not listed in pipe laying schedules. Data indicates ~5ft SP.
12430	N/A	7-84B	N/A	2	N/A	N/A				Not listed in pipe laying schedules. Data indicates ~2ft SP.
12431	N/A	7-84A	N/A	2	N/A	N/A				Not listed in pipe laying schedules. Data indicates ~2ft SP.
12432	WS-219	7-83	136+98	16	137+14	225-11'				
12433	WS-219	7-82	137+14	16	137+30	225-11'				
12434	WS-219	7-81	137+30	16	137+46	225-11'				
12435	WS-219	7-80	137+46	16	137+62	225-11'				
12436	WS-219	7-79	137+62	16	137+78	225-11'				
12437	WS-219	7-78	137+78	16	137+94	225-11'				
12438	WS-219	7-77	137+94	16	138+10	225-11'				
12439	WS-219	7-76	138+10	16	138+26	225-11'				
12440	WS-219	7-75	138+26	16	138+42	225-11'				
12441	WS-219	7-74	138+42	16	138+58	225-11'				
12442	WS-219	7-73	138+58	16	138+74	225-11'				
12443	WS-219	7-72	138+74	16	138+90	225-11'				
12444	WS-219	7-71	138+90	16	139+06	225-11'				
12445	WS-219	7-70	139+06	16	139+22	225-11'				
12446	WS-219	7-69	139+22	16	139+39	225-11'				
12447	WS-219	7-68	139+39	16	139+55	225-11'				
12448	WS-219	7-67	139+55	16	139+71	225-11'				
12449	WS-219	7-66	139+71	16	139+87	225-11'				
12450	WS-219	7-65	139+87	16	140+03	225-11'				
12451	WS-219	7-64	140+03	16	140+19	225-11'				
12452	WS-219	7-63	140+19	16	140+35	225-11'				
12453	WS-219	7-62	140+35	16	140+51	225-11'				
12454	WS-219	7-61	140+51	16	140+67	225-11'				
12455	WS-219	7-60	140+67	16	140+83	225-11'				
12456	WS-219	7-59	140+83	16	140+99	225-11'				
12457	WS-219	7-58	140+99	16	141+15	225-11'				
12458	WS-219	7-57	141+15	16	141+31	225-11'				
12459	WS-219	7-56	141+31	16	141+47	225-11'				
12460	WS-219	7-55	141+47	16	141+63	225-11'				
12461	WS-219	7-54	141+63	16	141+79	225-11'				
12462	WS-219	7-53	141+79	16	141+95	225-11'				
12463	WS-219	7-52	141+95	16	142+11	225-11'				
12464	WS-219	7-51	142+11	16	142+27	225-11'				
12465	WS-219	7-50	142+27	16	142+43	225-11'				
12466	WS-219	7-49	142+43	16	142+59	225-11'				
12467	WS-219	7-48	142+59	16	142+75	225-11'				
12468	WS-219	7-47	142+75	16	142+91	225-11'				
12469	WS-219	7-46	142+91	16	143+07	225-11'				
12470	WS-219	7-45	143+07	16	143+23	225-11'				
12471	WS-219	7-44	143+23	16	143+39	225-11'				
12472	WS-219	7-43	143+39	16	143+55	225-11'				
12473	WS-219	7-42	143+55	16	143+71	225-11'				
12474	WS-219	7-41	143+71	16	143+87	225-11'				
12475	WS-219	7-40	143+87	16	144+03	225-11'				
12476	WS-219	7-39	144+03	16	144+19	225-11'				
12477	WS-219	7-38	144+19	16	144+35	225-11'				
12478	WS-219	7-37	144+35	16	144+51	225-11'				
12479	WS-219	7-36	144+51	16	144+68	225-11'				
12480	WS-219	7-35	144+68	16	144+84	225-11'				
12481	WS-219	7-34	144+84	16	145+00	225-11'				
12482	WS-219	7-33	145+00	16	145+16	225-11'				
12483	WS-219	7-32	145+16	16	145+32	225-11'				
12484	WS-219	7-31	145+32	16	145+48	225-11'				
12485	WS-219	7-30	145+48	16	145+64	225-11'				
12486	WS-219	7-29	145+64	16	145+80	225-11'				
12487	WS-219	7-28	145+80	16	145+96	225-11'				
12488	WS-219	7-27	145+96	16	146+12	225-11'				
12489	WS-219	7-26	146+12	16	146+28	225-11'				
12490	WS-219	7-25	146+28	16	146+44	225-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12491	WS-219	7-24	146+44	16	146+60	225-11'				
12492	WS-219	7-23	146+60	16	146+76	225-11'				
12493	WS-219	7-22	146+76	16	146+92	225-11'				
12494	WS-219	7-21	146+92	16	147+08	225-11'				
12495	WS-219	7-20	147+08	16	147+24	225-11'				
12496	WS-219	7-19	147+24	16	147+40	225-11'				
12497	WS-219	7-18	147+40	16	147+56	225-11'				
12498	WS-219	7-17	147+56	16	147+72	225-11'				
12499	WS-219	7-16	147+72	16	147+88	225-11'				
12500	WS-219	7-15	147+88	16	148+04	225-11'				
12501	WS-219	7-14	148+04	16	148+20	225-11'				
12502	WS-219	7-13	148+20	16	148+36	225-11'				
12503	WS-219	7-12	148+36	16	148+52	225-11'				
12504	WS-219	7-11	148+52	16	148+68	225-11'				
12505	WS-219	7-10	148+68	16	148+84	225-11'				
12506	WS-219	7-9	148+84	16	149+00	225-11'				
12507	WS-219	7-8	149+00	16	149+16	225-11'				
12508	WS-219	7-7	149+16	16	149+32	225-11'				
12509	WS-219	7-6	149+32	16	149+48	225-11'				
12510	WS-219	7-5	149+48	16	149+64	225-11'				
12511	WS-219	7-4	149+64	16	149+80	225-11'				
12512	WS-219	7-3	149+80	16	149+97	225-11'				
12513	WS-219	7-2	149+97	16	150+13	225-11'				
12514	WS-219	7-1	150+13	16	150+29	225-11'				
12515	WS-219	7-0	150+29	16	150+45	225-11'				MH at Station 150+36. **MH 7.**
12516	WS-219	6-60	150+45	16	150+61	225-11'				
12517	WS-219	6-59	150+61	16	150+77	225-11'				
12518	WS-219	6-58	150+77	16	150+93	225-11'				
12519	WS-219	6-57	150+93	16	151+09	225-11'				
12520	WS-219	6-56	151+09	16	151+25	225-11'				
12521	WS-219	6-55	151+25	16	151+41	225-11'				
12522	WS-219	6-54	151+41	16	151+57	225-11'				
12523	WS-219	6-53	151+57	16	151+73	225-11'				
12524	WS-219	6-52	151+73	16	151+89	225-11'				
12525	WS-219	6-51	151+89	16	152+05	225-11'				
12526	WS-219	6-50	152+05	16	152+21	225-11'				
12527	WS-219	6-49	152+21	16	152+37	225-11'				
12528	WS-219	6-48	152+37	16	152+53	225-11'				
12529	WS-219	6-47	152+53	16	152+69	225-11'				
12530	WS-219	6-46	152+69	16	152+85	225-11'				
12531	WS-219	6-45	152+85	16	153+01	225-11'				
12532	WS-219	6-44	153+01	16	153+17	225-11'				
12533	WS-219	6-43	153+17	16	153+33	225-11'				
12534	WS-219	6-42	153+33	16	153+49	225-11'				
12535	WS-219	6-41	153+49	16	153+65	225-11'				
12536	WS-219	6-40	153+65	16	153+81	225-11'				
12537	WS-219	6-39	153+81	16	153+97	225-11'				
12538	WS-219	6-38	153+97	16	154+13	225-11'				
12539	WS-219	6-37	154+13	16	154+29	225-11'				
12540	WS-219	6-36	154+29	16	154+46	225-11'	3.5	5	5	
12541	WS-219	6-35	154+46	16	154+62	225-11'				
12542	WS-219	6-34	154+62	16	154+78	225-11'				
12543	WS-219	6-33	154+78	16	154+94	225-11'				
12544	WS-219	6-32	154+94	16	155+10	225-11'				
12545	WS-219	6-31	155+10	16	155+26	225-11'				
12546	WS-219	6-30	155+26	16	155+42	225-11'				
12547	WS-219	6-29	155+42	16	155+58	225-11'				
12548	WS-219	6-28	155+58	16	155+74	225-11'				
12549	WS-219	6-27	155+74	16	155+90	225-11'				
12550	WS-219	6-26	155+90	16	156+06	225-11'				
12551	WS-219	6-25	156+06	16	156+22	225-11'				
12552	WS-219	6-24	156+22	16	156+38	225-11'				
12553	WS-219	6-23	156+38	16	156+54	225-11'				
12554	WS-219	6-22	156+54	16	156+70	225-11'				
12555	WS-219	6-21	156+70	16	156+86	225-11'				
12556	WS-219	6-20	156+86	16	157+02	225-11'				
12557	WS-219	6-19	157+02	16	157+18	225-11'				
12558	WS-219	6-18	157+18	16	157+34	225-11'				
12559	WS-219	6-17	157+34	16	157+50	225-11'				
12560	WS-219	6-16	157+50	16	157+66	225-11'				
12561	WS-219	6-15	157+66	16	157+82	225-11'				
12562	WS-219	6-14	157+82	16	157+98	225-11'				
12563	WS-219	6-13	157+98	16	158+14	225-11'				
12564	WS-219	6-12	158+14	16	158+30	225-11'				
12565	WS-219	6-11	158+30	16	158+46	225-11'				
12566	WS-219	6-10	158+46	16	158+63	225-11'				
12567	WS-219	6-9	158+63	16	158+79	225-11'				
12568	WS-219	6-8	158+79	16	158+95	225-11'				
12569	WS-219	6-7	158+95	16	159+11	225-11'				
12570	WS-219	6-6	159+11	16	159+27	225-11'				
12571	WS-219	6-5	159+27	16	159+43	225-11'				
12572	WS-219	6-4	159+43	16	159+59	225-11'				
12573	WS-219	6-3	159+59	16	159+75	225-11'				
12574	WS-219	6-2	159+75	16	159+91	225-11'	1.5	5	5	
N/A	WS-219	N/A	159+91	16	160+07	225-11'				Pipe removed for replacement.
12575	N/A	6-1	N/A	8	N/A	N/A				Replacement pipe.
12576	N/A	6-0	N/A	8	N/A	N/A				Replacement pipe with MH. **MH-6.**
12577	WS-219	5-24	160+07	16	160+23	225-11'				
12578	WS-219	5-23	160+23	16	160+39	225-11'				
12579	WS-219	5-22	160+39	16	160+54	225-11'				
12580	WS-219	5-21	160+54	16	160+70	225-11'				
12581	WS-219	5-20	160+70	16	160+86	225-11'				
12582	WS-219	5-19	160+86	16	161+02	225-11'				
12583	WS-219	5-18	161+02	16	161+17	225-11'				16" BO at Station 161+09.
12584	WS-219	5-17	161+17	16	161+34	225-11'				
12585	WS-219	5-16	161+34	16	161+50	225-11'				
12586	WS-219	5-15	161+50	16	161+65	225-11'				
12587	WS-219	5-14	161+65	16	161+81	225-11'				
12588	WS-219	5-13	161+81	16	161+97	225-11'	1.5	5	5	
12589	WS-219	5-12	161+97	16	162+13	225-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12590	WS-219	5-11	162+13	16	162+29	225-11'				
12591	WS-219	5-10	162+29	16	162+45	225-11'				
12592	WS-219	5-9	162+45	16	162+61	225-11'				
12593	WS-219	5-8	162+61	16	162+77	225-11'				
12594	WS-219	5-7	162+77	16	162+93	225-11'				
12595	WS-219	5-6	162+93	16	163+09	225-11'				
12596	WS-219	5-5	163+09	16	163+25	225-11'				
12597	WS-219	5-4	163+25	16	163+41	225-11'				
12598	WS-219	5-3	163+41	16	163+57	225-11'				
12599	WS-219	5-2	163+57	16	163+73	225-11'				
12600	WS-219	5-1	163+73	16	163+89	225-11'				
12601	WS-219	5-0	163+89	16	164+05	225-11'				MH at Station 163+97. **MH 5.**
12602	WS-219	4-69	164+05	16	164+21	225-11'				
12603	WS-219	4-68	164+21	16	164+37	225-11'				
12604	WS-219	4-67	164+37	16	164+53	225-11'				
12605	WS-219	4-66	164+53	16	164+70	225-11'				
12606	WS-219	4-65	164+70	16	164+86	225-11'				
12607	WS-219	4-64	164+86	16	165+02	225-11'				
12608	WS-219	4-63	165+02	16	165+18	225-11'				
12609	WS-219	4-62	165+18	16	165+34	225-11'				
12610	WS-219	4-61	165+34	16	165+50	225-11'				
12611	WS-219	4-60	165+50	16	165+66	225-11'				
12612	WS-219	4-59	165+66	16	165+82	225-11'				
12613	WS-219	4-58	165+82	16	165+98	225-11'				
12614	WS-219	4-57	165+98	16	166+14	225-11'				
12615	WS-219	4-56	166+14	16	166+30	225-11'				
12616	WS-219	4-55	166+30	16	166+46	225-11'				
12617	WS-219	4-54	166+46	16	166+62	225-11'				
12618	WS-219	4-53	166+62	16	166+78	225-11'				
12619	WS-219	4-52	166+78	16	166+94	225-11'				
12620	WS-219	4-51	166+94	16	167+10	225-11'				
12621	WS-219	4-50	167+10	16	167+26	225-11'				
12622	WS-219	4-49	167+26	16	167+42	225-11'				
12623	WS-219	4-48	167+42	16	167+58	225-11'				
12624	WS-219	4-47	167+58	16	167+74	225-11'				
12625	WS-219	4-46	167+74	16	167+90	225-11'				
12626	WS-219	4-45	167+90	16	168+06	225-11'				
12627	WS-219	4-44	168+06	16	168+22	225-11'				
12628	WS-219	4-43	168+22	16	168+38	225-11'				
12629	WS-219	4-42	168+38	16	168+54	225-11'				
12630	WS-219	4-41	168+54	16	168+71	225-11'				
12631	WS-219	4-40	168+71	16	168+87	225-11'				
12632	WS-219	4-39	168+87	16	169+03	225-11'				
12633	WS-219	4-38	169+03	16	169+19	225-11'				
12634	WS-219	4-37	169+19	16	169+35	225-11'				
12635	WS-219	4-36	169+35	16	169+51	225-11'				
12636	WS-219	4-35	169+51	16	169+67	225-11'				
12637	WS-219	4-34	169+67	16	169+83	225-11'				
12638	WS-219	4-33	169+83	16	169+99	225-11'				
12639	WS-219	4-32	169+99	16	170+15	225-11'				
12640	WS-219	4-31	170+15	16	170+31	225-11'				
12641	WS-219	4-30	170+31	16	170+47	225-11'				
12642	WS-219	4-29	170+47	16	170+63	225-11'				
12643	WS-219	4-28	170+63	16	170+79	225-11'				
12644	WS-219	4-27	170+79	16	170+95	225-11'				
12645	WS-219	4-26	170+95	16	171+11	225-11'				
12646	WS-219	4-25	171+11	16	171+27	225-11'				
12647	WS-219	4-24	171+27	16	171+43	225-11'				
12648	WS-219	4-23	171+43	16	171+59	225-11'				
12649	WS-219	4-22	171+59	16	171+75	225-11'				
12650	WS-219	4-21	171+75	16	171+91	225-11'				
12651	WS-219	4-20	171+91	16	172+07	225-11'				
12652	WS-219	4-19	172+07	16	172+23	225-11'				
12653	WS-219	4-18	172+23	16	172+39	225-11'				
12654	WS-219	4-17	172+39	16	172+55	225-11'				
12655	WS-219	4-16	172+55	16	172+72	225-11'				
12656	WS-219	4-15	172+72	16	172+88	225-11'				
12657	WS-219	4-14	172+88	16	173+04	225-11'				
12658	WS-219	4-13	173+04	16	173+20	225-11'				12" BO at Station 173+11.
12659	WS-219	4-12	173+20	16	173+36	225-11'				
12660	WS-219	4-11	173+36	16	173+52	225-11'				
12661	WS-219	4-10	173+52	16	173+68	225-11'				
12662	WS-219	4-9	173+68	16	173+84	225-11'				
12663	WS-219	4-8	173+84	16	174+00	225-11'				
12664	WS-219	4-7	174+00	16	174+16	225-11'				
12665	WS-219	4-6	174+16	16	174+32	225-11'				
12666	WS-219	4-5	174+32	16	174+48	225-11'				
12667	WS-219	4-4	174+48	16	174+64	225-11'				
12668	WS-219	4-3	174+64	16	174+80	225-11'				
12669	WS-219	4-2	174+80	16	174+96	225-11'				
12670	WS-219	4-1	174+96	16	175+12	225-11'				
12671	WS-219	4-0	175+12	16	175+28	225-11'				MH at Station 175+19. **MH 4.**
12672	WS-219	3-78	175+28	16	175+44	225-11'				
12673	WS-219	3-77	175+44	16	175+60	225-11'				
12674	WS-219	3-76	175+60	16	175+76	225-11'				
12675	WS-219	3-75	175+76	16	175+92	225-11'				
12676	WS-219	3-74	175+92	16	176+08	225-11'				
12677	WS-219	3-73	176+08	16	176+24	225-11'				
12678	WS-219	3-72	176+24	16	176+40	225-11'				
12679	WS-219	3-71	176+40	16	176+56	225-11'				
12680	WS-219	3-70	176+56	16	176+72	225-11'				
12681	WS-219	3-69	176+72	16	176+88	225-11'				
12682	WS-219	3-68	176+88	16	177+04	225-11'				
12683	WS-219	3-67	177+04	16	177+20	225-11'				
12684	WS-219	3-66	177+20	16	177+36	225-11'				
12685	WS-219	3-65	177+36	16	177+53	225-11'				
12686	WS-219	3-64	177+53	16	177+69	225-11'				
12687	WS-219	3-63	177+69	16	177+85	225-11'				
12688	WS-219	3-62	177+85	16	178+01	225-11'				
12689	WS-219	3-61	178+01	16	178+17	225-11'				

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Electromagnetic Inspection Results
Pipe Sections that Exhibit Electromagnetic Anomalies Consistent with Broken Wire Wraps

Pure Reference Number	Contract	Internal Pipe Marking	Low Station	Pipe Length (feet)	High Station	Reported Class	Break Region Location (feet from Low Station)	Number of Broken Wire Wraps by Region	Total Number of Broken Wire Wraps	Comments
12690	WS-219	3-60	178+17	16	178+33	225-11'				
12691	WS-219	3-59	178+33	16	178+49	225-11'				
12692	WS-219	3-58	178+49	16	178+65	225-11'				
12693	WS-219	3-57	178+65	16	178+81	225-11'				
12694	WS-219	3-56	178+81	16	178+97	225-11'				
12695	WS-219	3-55	178+97	16	179+13	225-11'				
12696	WS-219	3-54	179+13	16	179+29	225-11'				
12697	WS-219	3-53	179+29	16	179+45	225-11'				
12698	WS-219	3-52	179+45	16	179+61	225-11'				
12699	WS-219	3-51	179+61	16	179+77	225-11'				
12700	WS-219	3-50	179+77	16	179+93	225-11'				
12701	WS-219	3-49	179+93	16	180+09	225-11'				
12702	WS-219	3-48	180+09	16	180+25	225-11'				
12703	WS-219	3-47	180+25	16	180+41	225-11'				
12704	WS-219	3-46	180+41	16	180+57	225-11'				
12705	WS-219	3-45	180+57	16	180+73	225-11'				
12706	WS-219	3-44	180+73	16	180+89	225-11'				
12707	WS-219	3-43	180+89	16	181+05	225-11'				
12708	WS-219	3-42	181+05	16	181+21	225-11'				
12709	WS-219	3-41	181+21	16	181+37	225-11'				
12710	WS-219	3-40	181+37	16	181+53	225-11'				
12711	WS-219	3-39	181+53	16	181+69	225-11'				
12712	WS-219	3-38	181+69	16	181+85	225-11'				
12713	WS-219	3-37	181+85	16	182+02	225-11'				
12714	WS-219	3-36	182+02	16	182+18	225-11'				
12715	WS-219	3-35	182+18	16	182+34	225-11'				
12716	WS-219	3-34	182+34	16	182+50	225-11'	1.5	5	5	
12717	WS-219	3-33	182+50	16	182+66	225-11'				
12718	WS-219	3-32	182+66	16	182+82	225-11'				
12719	WS-219	3-31	182+82	16	182+98	225-11'				
12720	WS-219	3-30	182+98	16	183+14	225-11'				
12721	WS-219	3-29	183+14	16	183+30	225-11'				
12722	WS-219	3-28	183+30	16	183+46	225-11'				
12723	WS-219	3-27	183+46	16	183+62	225-11'				
12724	WS-219	3-26	183+62	16	183+78	225-11'	9.5	20	20	
12725	WS-219	3-25	183+78	16	183+94	225-11'				
12726	WS-219	3-24	183+94	16	184+10	225-11'				
12727	WS-219	3-23	184+10	16	184+26	225-11'	8.0	5	5	
12728	WS-219	3-22	184+26	16	184+42	225-11'				
12729	WS-219	3-21	184+42	16	184+58	225-11'				
12730	WS-219	3-20	184+58	16	184+74	225-11'				
12731	WS-219	3-19	184+74	16	184+90	225-11'				
12732	WS-219	3-18	184+90	16	185+06	225-11'				
12733	WS-219	3-17	185+06	16	185+22	225-11'				
12734	WS-219	3-16	185+22	16	185+38	225-11'				
12735	WS-219	3-15	185+38	16	185+54	225-11'				
12736	WS-219	3-14	185+54	16	185+70	225-11'				
12737	WS-219	3-13	185+70	16	185+86	225-11'				
12738	WS-219	3-12	185+86	16	186+03	225-11'				
12739	WS-219	3-11	186+03	16	186+19	225-11'				
12740	WS-219	3-10	186+19	16	186+35	225-11'				
12741	WS-219	3-9	186+35	16	186+51	225-11'				
12742	WS-219	3-8	186+51	16	186+67	225-11'				
12743	WS-219	3-7	186+67	16	186+83	225-11'				
12744	WS-219	3-6	186+83	16	186+99	225-11'				Equation: 186+98.75BK = 0+00.00AH.
12745	WS-219	3-5	0+00	16	0+16	225				
12746	WS-219	3-4	0+16	16	0+32	225				
12747	WS-219	3-3	0+32	16	0+48	225				
12748	WS-219	3-2	0+48	16	0+64	225				Partially inspected. Not inspected from 13.0-16.0ft.
Towards Failure Location										