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ARTIFICIAL INTELLIGENCE-BASED EVALUATION OF PIPELINE STRUCTURES USING MULTI-SENSOR ROBOTS

by

MOHAMMAD SHAHER RABABEH

Presented to the Faculty of the Graduate School of
The University of Texas at Arlington in Partial
Fulfillment of the Requirements
for the Degree of

DOCTOR OF PHILOSOPHY

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Abstract

ARTIFICIAL INTELLIGENCE-BASED EVALUATION OF PIPELINE STRUCTURES USING MULTI-SENSOR ROBOTS

Mohammad Shaher Rababeh, Ph.D.
The University of Texas at Arlington, August 2023

Supervising Professor: Ali Abolmaali

All around the world, pipeline systems are safe, efficient, and cost-effective for transporting liquids such as stormwater and wastewater. However, different defects develop in pipeline structures with aging and use. Leaks and significant failures might create severe danger for the environment, and for humans in urban areas. This deterioration in pipelines happens under the influence of different factors. In general, observing and evaluating pipelines will allow us to understand its behavior under various conditions and how they are affected.

The most common way to assess and evaluate pipeline structures are inspections which can be performed utilizing different types of equipment and methods depending on the site condition and type of data desired or needed to be collected, major types of the inspections and its methods will be presented and discussed throughout this dissertation. The main multi sensor robotic boat was utilized in the inspections performed to collect the data set of this dissertation is the multi-sensor robotic boat designed and built by center of structural engineering simulation and pipeline inspection (CSER-PI) at the University of Texas at Arlington.

Several inspections were performed of sewer lines for the City of Mansfield and Trinity River authority the material of the inspected pipes were mainly reinforced concrete pipes (RCP), this collected data of approximately [7] miles formed the data set utilized for the research purpose of this dissertation.

One of the most significant problems in concrete pipes is corrosion due to the H_2S presence in the sewer pipe, corrosion in some of the cases such as the case of this dissertation can be the main factor causing the degradation of the pipe and pushing the pipe towards failure or the end of useful

service life. In this dissertation multiple types of models were constructed and utilized to analyze the data set and ultimately predict the corrosion rate in concrete pipe structures under various parameters.

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1 Introduction

1.1 Pipeline Inspection

Approximately half of the investment in the United States infrastructure is made in sewer and water supply networks; in 2019, that amounted to more than $3 billion (Shook et al.,1998). According to the Failure to Act report by ASCE in 2016, the deteriorating infrastructure will cost the U.S. economy $238 billion by 2025, as the underground assets that were installed long ago have been weakened by time and are at risk of leaks, breaks, and consequential damage to third parties, thus increasing the risk of failure.

Pipeline inspections have been performed since the 1960s and are still considered the primary method for assessing the condition and determining the remaining service life of pipelines. When robots were introduced for performing the inspections, closed circuit television (CCTV) was used to record different types of robots carrying out inspections. Andrews et al. 1998 conducted a study that employed a combination of CCTV and sonar, wherein the sonar device captured information below the water and the CCTV captured information above the water. Since then, some of the disadvantages of both systems have been overcome and replaced with technology and artificial intelligence (AI), and robotic systems have been modified and improved for pipeline inspections. Among these improvements is the addition of sensors, which has enhanced and improved the data collection process, reduced the human error element, and resulted in better, more accurate pipeline inspections.

According to Tur et al. (2010), inspection robots for pipeline structures are complex systems that involve many aspects, from structure design and motion mechanism to sensing capabilities, communication, and energy management. Their study also espoused that two primary kinds of sensors are needed for in-pipe inspection devices: those related to navigation and those that detect problems inside the pipe. Roth et al. (1998) found that some directions were followed to increase the capabilities of existing pipe robots for inspection and repair. Ismail et al. (2013) supported the use of robots for pipeline inspections because of their ability to mitigate or possibly even remove humans from work that is performed in dangerous environments. The rapidity of technological advancements in the use of robots for inspecting pipeline structures was touted by Nayak et al.

(2014), who emphasized the importance and complexity of the design process. Factors such as mobility, size and shape, stability, and other parameters have to be considered so that the robots are able to enter pipes of sizes and diameter that may be inaccessible or difficult for humans to enter or navigate.

1.2 Problem Statement

This research focuses on the use of multi-sensor robotics and artificial intelligence to predict the main parameter that directly impacts the service life of pipeline structures. Human error was a major factor in earlier inspections that were performed by utilizing closed circuit television (CCTV), as the defects observed in the pipes were analyzed and coded based on the observer’s judgment, guided by the National Association of Sewer Service Companies, or NASSCO. The addition of multi-sensors such as sonar and lidar enabled the detection of corrosion in ductile pipes and deformation in brittle pipes, structural and operational defects, the height of debris, etc. and indicated that the parameters impacting the pipeline’s service life are predictable, using artificial intelligence. According to Tur et al. (2010), a significant drawback of ultrasonic devices is their inability to simultaneously inspect both the flooded and dry parts of a pipe because the optimal operating frequencies in water and air are different. This research seeks to utilize MSI robots to perform inspections on various pipe conditions, employing artificial intelligence algorithms that use the collected dataset to analyze the pipeline and then predict the main parameter that significantly impacts its service life.

1.3 Research Objectives

This research presents the use of robots equipped with multi-sensors and integrated with artificial intelligence to predict the remaining service life of pipeline structures, using the corrosion of pipe wall thickness as the main parameter. The dataset was obtained from an MSI inspection of approximately seven miles of pipelines in two locations, the city of Mansfield, Texas, and the Trinity River Authority. Artificial intelligence algorithms were designed to analyze and evaluate the data and to identify the parameters and their impact on the service life of the pipelines, considering the corrosion of concrete in pipeline thickness. The long-term research goal is to predict the degradation of the pipes, using the main parameters directly impacting the pipelines' remaining service life.

1.4 Research Scope and limitations

This dataset for this research is based on the data collected by the UTA-CSER-PI multi-sensor robotic boat throughout inspections performed for two projects: one for the City of Mansfield and one for the Trinity River Authority (TRA). Samples were collected from reinforced concrete pipes (RCPs) with diameters of 30, 36, 39, 42, 48, and 54 inches and different lengths that were 9, 29, 31, 32, 33, 51, 52 years old.

1.5 Contributions of Dissertation

Contribution 1: Development of target specific MSI robots capable of performing pipeline inspections on pipes made of various materials and existing under varying conditions.

Contribution 2: Employment of a dataset and artificial intelligence algorithms to analyze and evaluate the pipelines.

Contribution 3: Determination of the most critical parameter for predicting a pipeline's service life and conduction of a sensitivity analysis to compare the performance of the pipe under various parameters.

Contribution 4: Analysis and prediction of the service life of each 5 ft. segment of corroded reinforced concrete pipe to facilitate the replacement or point repair for each segment, which will significantly reduce the cost and time of the repair.

1.6 Purpose of this Research

The purpose of this research was to develop a unique assessment tool for predicting the remaining service life of pipelines under various conditions. This was accomplished by collecting extensive sonar and lidar data on the integrity of the pipeline structure for use in developing an AI model to identify critical paraments and depict the degradation of the parameter impacting the service life. The data was collected from two projects performed by UTA CSER-PI: the Trinity River Authority and the City of Mansfield.

or TRA, and the City of Mansfield. Data from these two projects formed the dataset utilized in the analysis section of this research.

1.7 Organization of this Dissertation

This dissertation follows a seven-chapter format: Introduction, Background, Methodology, Inspection results, Results, Guidelines for Pipeline Inspections, and Conclusion. Chapter 2 discusses the literature review and includes a detailed background of the study: pipeline inspections, challenges in pipeline inspections, sensors utilized, etc. Chapter 3 describes the methodology of the research, including the specific objectives, hypothesis, and approach. Chapter 4 presents the inspection results in detail. Chapter 5 presents the Artificial Intelligence models development and the best model selection and discusses the results of the analysis, and Chapter 6 discusses the prescribed steps and processes for conducting inspections. Chapter 7 provides a discussion of the conclusions drawn from the study's findings, and recommendations for potential future research.

2 Background

2.1 Pipeline Structures

Sewer systems are comprised of pipelines and are considered by many to be one of the most critical infrastructure systems. Unfortunately, in the United States, sewer networks are deteriorating due to age, and many have reached the end of their service life. Tafuri et al. (2002) stated that “The structural integrity of these sewer pipelines is decreasing due to corrosion and deterioration,” and it is apparent that an extensive and proactive assessment of the pipeline’s condition is vital to ensuring its remaining service life. Interpreting the data efficiently is essential, including detecting the pipe defects and evaluating and assessing the level of deterioration to decide where maintenance and/or repair is needed (EPA 2006). This task is performed by the Environmental Protection Agency (EPA), as they assess the condition of pipelines to understand and perform maintenance that is needed to enhance their operation Lichte. (2006).

Pipeline inspections have been conducted since the 1960s, and later, CCTV recordings made it possible to observe different types of robots inspecting pipes. A study by the Trenchless Technology Network (TNN) in 2002 introduced several alternative technologies such as sonar, lidar, lasers, etc. that provide an extensive array of information. It is important to note that CCTV footage is most commonly used to classify the current condition of the pipe and note any defects Salihu et al. (2023), and those viewing or operating the CCTV footage should be trained and certified in identifying and classifying defects according to the pipeline grading system. According to Guo et al. (2009), the detection of defects depends on experience, working conditions, and other limitations. Zuo et al. (2019) mentioned that the lifespan of pipes can be increased with adequate maintenance and rehab programs.

According to Iurchenko et al. (2016), effective sewer maintenance must be both environmentally sound and sustainable, as the failure of pipeline structures in urban regions presents a range of environmental risks that affect the quality of the water, soil, and air due to the types of gases in sewers caused by the biodegrading of waste in the pipelines Salihu et al. (2023). Held et al. (2006) concluded that pipeline failures are due to the infiltration of wastewater in the ground. Alzraiee et al. (2015) presented those environmental factors, including groundwater, waste, and soil type, effect of sewers and stormwater pipes deterioration. Salman et al. (2012) espoused that the complexity of sewer rehabilitation in urban cities is due to the high number of sewer pipelines and limited resources. Salihu et al. (2023) presented that age, material, length, and size, along with other parameters, affect the deterioration of pipelines.

Held et al. (2006) observed that sewer pipeline failure leads to the infiltration of wastewater into the ground, eventually reaching and contaminating the groundwater, which is intended for drinking purposes. Zuo et al. (2019) emphasized that the longevity of pipes can be extended through effective maintenance and rehabilitation programs. To assess the condition of pipes, inspections are conducted using the widely used Closed-Circuit Television (CCTV) method. This method involves the use of cameras to capture continuous footage of the internal surface of sewer pipelines above the flow line Kaddoura. (2015). Specialists interpret the videos and footage, drawing conclusions about the sewer's condition. Each pipeline is evaluated individually and rated based on the frequency and severity of defects, typically using a five-grade scale Sarshar et al. (2009). As noted by Salman and Salem (2012), rehabilitating sewer systems in urban areas poses challenges due to the high number of pipelines and limited resources. Therefore, it is crucial to have an efficient and accurate tool for managing pipes based on their condition.

2.2 Multi-Sensor Inspection

The primary sensors used in pipeline inspections, lidar, sonar, and CCTV, each have advantages and disadvantages. Light detection and ranging, or lidar, allows for an accurate and precise location of an object’s distance. There are several sensors utilized in pipeline inspection. The main sensors are Lidar, Sonar, and CCTV. Each of these sensors have advantages and disadvantages. Light detection and ranging, or Lidar allows for accurate and precise location of an object’s distance. There are advantages and disadvantages in using Lidar. Lidar data can be collected quickly with high accuracy rates and data can be utilized during the day in addition to night while not affected by extreme weather conditions, such as sunlight. However, there are disadvantages to Lidar. Lidar consists of large datasets making it difficult to interpret, and also the laser beam may impact the eye in situations where the beam is powerful.

Second, sonar is a system utilized for detection of objects under water and measuring the water’s depth by emitting sound pulses. The main advantage for sonar is that it is utilized to find and identify objects under water in an efficient manner. There are also disadvantages to sonar which is that the sonar relies on the sound emitted by the target, which may cause noise and/or other interruptions. With closed-circuit television, or CCTV, a visual is provided to be able to view the footage and any abnormalities present in the pipeline. The downside to CCTV is that it may be costly, which creates a reluctancy. A study by Guo et al. (2008) mentioned that CCTV has become the most widespread technology used for pipeline inspection and that the footage provided by the CCTV during these types of inspections gives information of the condition of the pipes which are then utilized for analysis. Although, as mentioned in the study by Guo et al (2008), CCTV the footage recorded during inspection are viewed by human operations for detection and classification.

Guo et al. (2008) presents that automated pipeline defect classification has been limited by data techniques, image analysis and pattern recognition. The research study also mentioned the importance of pipe condition assessment so that various defects can be detected by the operator. With the use of advanced technologies and computer vision, the interpretation of inspection data will allow a guidance and selection for the pipeline inspection Guo et al. (2008).

2.3 Corrosion in Pipeline Structures

Historically, reactive management has been used to mitigate the deterioration of sewer pipes. Corrosion of concrete pipes is due to the acid and bacteria on the crown of the pipes Mansfield et al. (2023). Studies and extensive inspection from the 1980s demonstrated that the extent of the corrosion resulted in the reinforced bars to also be corroded, with a cost estimate from $100M to $1B. Several millions of dollars are being spent on the repair and maintenance of corroded pipeline structures Parande et al. (2005). Two major causes of corrosion in pipes include: conventional acid attack caused by low pH discharged into the sewer system and the hydrogen sulfide corrosion attack. The reason behind deterioration is the H_2S in the concrete pipes, which also attacks the concrete floor. Parande et al. (2005) mentions that "H_2S is the most corrosive agents that leads to the rapid deterioration of concrete pipelines in sewers." The research study also states that at normal sewage pH levels, one-quarter to one-third of dissolved sulfide exists as molecular H_2S, released to the air. Flat sewer slopes producing oxygen-deficient; steep slopes and high flow velocities are some of the factors affecting increased sulfide in the sewer. It is important to note that H_2S is released as a gas and will spread in the air Parande et al. (2005).

Throughout their service life, buried concrete sewer pipes face various structural and environmental stressors. Research conducted in the past has highlighted hydrogen sulfide (H_2S) corrosion as a major contributor to the degradation of these concrete pipes Alexander and Fourie (2011). When H_2S is present in wastewater and undergoes a chemical reaction with oxygen, O_2, it generates a highly corrosive substance called sulfuric acid, H_2SO_4. This, in turn accelerates the deterioration process of the concrete sewer pipes, leading to swift structural decay Zamanian et al. (2023).

2.4 Prediction Models

AI-based models utilize an unsupervised, multilinear regression technique in combination with Weibull analysis. The Weibull deterioration curve analysis reveals that concrete pipes have an estimated useful service life of 79 years, while vitrified clay pipes have a projected service life of 48 years Salihu et al. (2023). Studies have shown that regression models present R-squared values of 71.18% for vitrified clay sewer pipes, 71.47% for concrete sewer pipes, 81.51% for ductile iron sewer pipes, and 73.69% for concrete stormwater pipes. Sensitivity analyses have been conducted under different scenarios to illustrate the influence of various factors on sewer pipes. Among these factors, pipe diameter exerts a significant impact on sewer pipe deterioration, while it has minimal effect on stormwater pipes.

Several models utilizing artificial intelligence have been used for the prediction of the service life. In crafting a sustainable development plan under limited capital resources for concrete sewer maintenance, it is crucial to allocate funding and efforts effectively, guided by a comprehensive understanding of sewer condition Cheung et al. (1996). Accurate prediction of the life expectancy of existing concrete sewers is of paramount importance for infrastructure managers to prioritize evaluation efforts and funding allocations Mahmoodian et al. (2012).

To achieve precise predictions of a concrete sewer pipe's lifespan, it is essential to consider uncertainties Ahammed et al. (1997). Therefore, rather than relying solely on deterministic models, the introduction and development of probabilistic models and risk assessments are warranted. These approaches can account for various factors that may affect the deterioration process, leading to more reliable and informed decision-making in managing concrete sewer infrastructure (Kienow et al. 2004).

3 Methodology

3.1 Research Methodology

The methodology of this research was conceived by striving to answer the following questions:

- What is a robotic pipeline inspection?
- Why is it important?
- How is it performed?

First and foremost, a robotic pipeline inspection utilizes robots (crawlers or boats) to investigate a targeted pipeline and collect data via CCTV, sonar, and lidar that can be used to evaluate and analyze its condition by considering several parameters, such as visual observation, height of the debris, and corrosion/deformation. In addition to the parameters listed, the date of installation; diameter, slope, and length of the pipe are also considered. Three techniques are employed: CCTV, sonar, and lidar. CCTV data is utilized to determine structural, operational, and maintenance defects, using the National Association of Sewer Service Companies (NASSCO) PACP grading criteria. Sonar data reveals the height of debris accumulated in the pipe or the existence of cracks, and lidar data is used to indicate the deformation and/or corrosion on the pipe wall. These combined data ultimately reveal the most significant parameter, predict how its development will directly impact the remaining service life of the pipeline, and provide an opportunity to repair and/or replace the severely defective pipeline segments before they fail. Robotic pipeline inspections depend on several conditions: flow inside the pipe, type of pipe, size/diameter of the line, and the number of axis points (manholes). Figure 3-1 shows an overview of a robotic pipeline inspection.

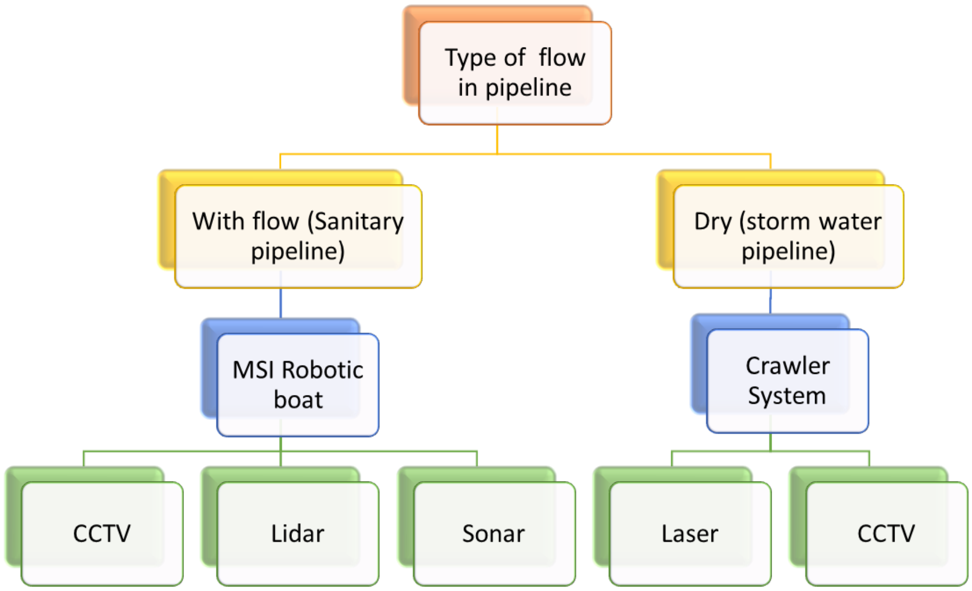

Figure 3-1 Overview of robotic pipeline inspection types

The crawler system and the MSI robotic boat system are implemented for pipeline inspections. For the crawler system, pipeline inspections are usually performed in line segments, with each line representing the manhole-to-manhole segment of the pipe. The inspections are performed from the upstream manhole to the downstream manhole, unless limitations due to site conditions, e.g., limited access and/or abnormalities in the flow conditions prevent it. The following steps are taken to initiate the crawler system. The crawler is connected to the inspector general and lowered into the upstream manhole, where its driven remotely to the downstream manhole, and is pulled up. MSI robotic boat pipeline inspections are also usually performed in line segments, and each line represents the manhole-to-manhole segment of the pipe. Most inspections are performed from the upstream manhole to the downstream manhole unless there are limitations due to site conditions, e.g., limited access and/or abnormalities in the flow conditions. The following steps are essential when utilizing the MSI robotic boat system. First, a parachute is connected to the boat, and the boat is connected to a winch. The parachute follows the boat to keep the boat under tension from both directions, which helps keep it in the center of the pipe and enhances the accuracy of the data collection process. The boat is dependent on the flow to the downstream manhole, where the parachute is pulled up at the end of the observation.

Several of the challenges inherent in pipeline inspections conducted by crawlers are limited access and complex curves in the pipes. Access, which is limited by the crawlers' inability to travel more than 1,000 ft. in one direction, can be remedied by providing more access points (manholes) and using each for two runs (in opposite directions). Complex curves in the pipes result in high friction on the winch cable driving the crawler, roller and tiger tails can be used to overcome the increased friction of the curve and prevent the cable from tearing or fracturing. Smaller wheels can also replace the original larger wheels of the crawler for pipelines with a diameter of less than 18 inches to enable greater maneuverability.

The MSI robotic boat has its own set of challenges, the most significant of which is the high risk of contaminants, such as hydrogen sulfide (H_2S). This hazard can be mitigated by utilizing a gas detector to take gas concentration readings at the bottom, middle, and top of the confined space inside the manhole to determine the amount of air blowing required to make it safe. For pipelines with a diameter larger than 60 inches, a boat with a larger-than-standard parachute is required to add stability and help it stay in the center while traveling. For pipelines with flow depths less than six inches, adjustable wheels must be installed on the lower part of the boat to protect the sonar sensor from dragging along the pipe and render more accurate results underwater.

3.2 Research Goal and Objectives

The goal of this research was to predict the rate of corrosion in concrete pipeline structures which would directly affect the remaining service life of pipelines by employing a multi-sensor robot integrated with artificial intelligence.

3.3 Equipment

The various types of equipment were used for this research study are shown in the figures below.

Figure 3-2 Crawler system utilizing CCTV and laser sensor.

Figure 3-3 The Counter and Counter stand mounted on truck bed.

Figure 3-3 represent the counter stand mounted on the truck and MSI winch cable.

Figure 3-4 The crawler system

Figure 3-4 illustrates the crawler, inspector general, and cable winch.

Figure 3-5 Multi Sensor robotic boat (MSI) designed and built by CSER/MSI

Figure 3-6 Multi Sensor robotic boat (MSI) second version for larger size pipes designed and built by CSER/MSI

Figure 3-7 Multi Sensor robotic boat (MSI) third version for large size pipes designed and built by CSER/MSI

Figure 3-8 Multi Sensor robotic boat (MSI) third version for smaller size pipes designed and built by CSER/MSI

Figure 3-5, 3-6, 3-7, 3-8 represents the different versions and types MSI Robotic Boat designed and built by CSER/MSI, that are used for different pipe types and sizes.

Figure 3-9 Multi Sensor robotic boat (MSI) design/build stages

Figure 3-10 Multi Sensor robotic boat (MSI) design/build stages

Figure 3-11 Multi Sensor robotic boat (MSI) design/build stages

Figures 3-6, 3-7, and 3-8 present the boat's structure. Figures 3-10 and 3-11 show two metal plates, with a sealed main cabin on the top plate. The boat has front and rear metal-welded guards, as shown in Figure 3-9, that are used to protect the CCTV and front lights, as well as the connection cables going into the main computer cabin. The heavy-duty front and back eyebolts connect the boat to the cable winch and parachute.

Figure 3-12 Multi Sensor robotic boat (MSI) design/build stages

Figure 3-13 Multi Sensor robotic boat (MSI) design/build stages

Figure 3-10 shows the sonar holder and protector at the bottom plate. Sonar and lidar sensors and HD CCTV were added to the MSI robotic boat, as illustrated in Figures 3-11 to 3-13.

Figure 3-14 Sonar sensor

Figure 3-15 LIDAR sensor

Figure 3-16 CCTV

Next, the cable winch and counter stand, also designed by CSER/MSI, as shown in Figure 3-14.

Figure 3-17 Cable winch and counter stand being operated.

The cable winch and counter stand were operated by pulling the winch rope through the counter stand and then connecting it to the boat. The counter recorded the length of the cable pulled by the boat inside the pipe to measure the number of feet from the boat to the upstream manhole. Other equipment utilized for the pipeline inspection included gas detectors that took gas concentration readings inside the manhole, a drift parachute that kept the boat stable (under tension) and created a platform of flow that enabled it to stay in the center of the pipe, generators that provided electricity for the MSI system, MSA Tri-pods, as shown in Figure 3-15 provided access to the manholes, air blowers that decreased the concentration of toxic gases in the confined spaces below the manholes, tiger tails, and manhole rollers, a flatbed truck for loading the equipment, a winch that was operated from on- board, and lastly PPE gear.

Figure 3-18 MSA Tripod

Throughout this research, several different versions of the boat were built. These are shown in Figure 3-16, with various sensors utilized throughout the process.

Figure 3-19 Various versions of the boat

Figure 3-20 Deployment snapshoot

Figure 3-21 Deployment snapshoot

Figure 3-22 Deployment snapshoot

Figures 3-17, 3-18, and 3-19 represent the MSI Robotic Boat's on-site deployment process and steps.

3.4 NASSCO Pipeline Assessment PACP, MACP, LACP

The sewer pipeline systems were visually inspected throughout this research by coding the pipes according to the Pipeline Assessment and Certification Program (PACP). The coding system utilizes CCTV videos of the typical line (manhole-to-manhole), and each pipeline has a table, scoring, codes, and pictures corresponding to structural and operation and maintenance (O&M) defects. Each defect is rated from 1 to 5, with five being the most significant and 1 being minor, and the defect code and other specific information, such as percentages or clock positions, correlate with a particular condition grade from a table in the PACP manual. The grade is assigned by PACP, not the operator, either manually, by looking it up in the PACP manual or automatically through NASSCO-certified software, and it is used to calculate a score for the entire segment by adding together all of the scores throughout the line, from manhole-to-manhole. Segment scores can also be used to develop consistent "likelihood of failure" (LoF) values, which can be used with "consequence of failure" (CoF) values to create risk assessments within an overall asset management program. For example, if a pipe exhibits structural defects such as cracks, fractures, or broken sections, the defect is assigned a condition grade based on what is observed and its severity level. A single crack, defined as a broken line that is not visibly open and runs lengthwise down the pipe, is coded as a crack longitudinal (CL), which is associated with a grade of 2. If the crack is open, it is defined as a fracture longitudinal (FL), and the condition grade increases to 3. If the pipe pieces become displaced, it is coded as broken (B), and the grade increases to a 4; however, if soil or a void is visible behind the broken pipe wall (BSV or BVV), it is a grade 5. A complete segment inspection might also include several structural and O&M defects.

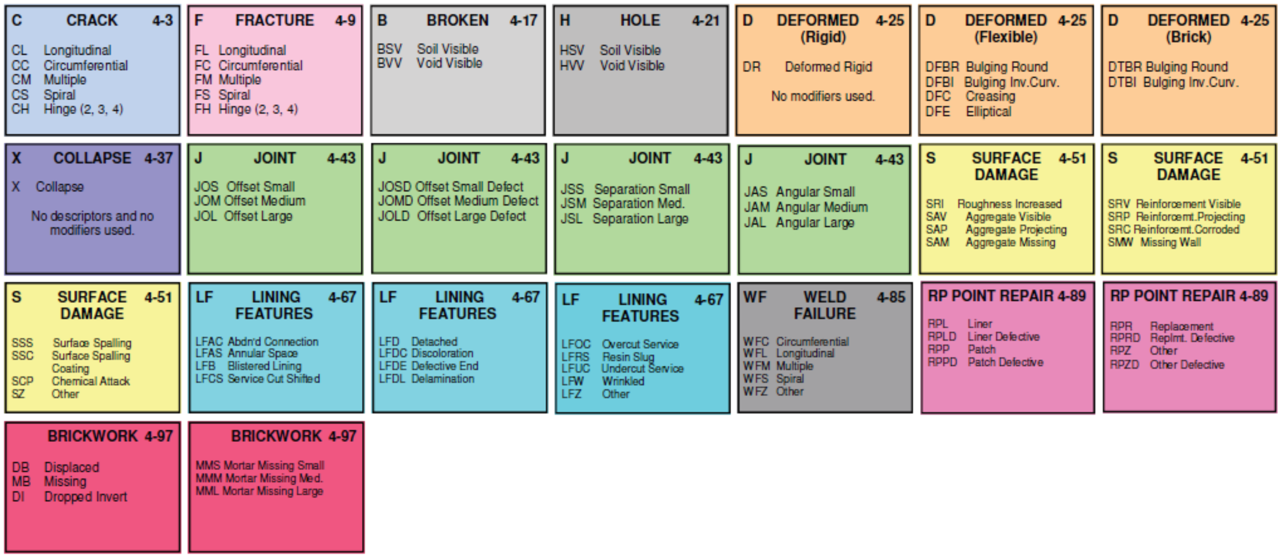

Figure 3-23 List of structural code in PACP coding

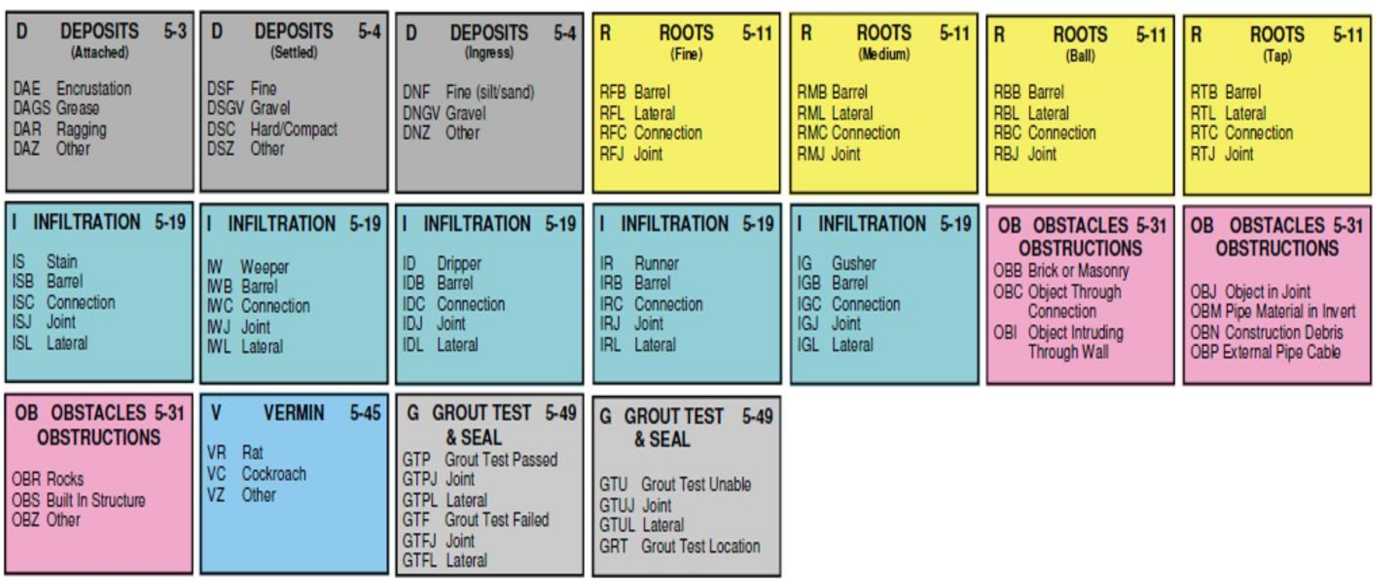

Figure 3-24 List of Operation and Maintenance codes used in PACP.

Figures 3-20 and 3-21 illustrate the lists of the structural code in the PACP code and the operation and maintenance codes used in PACP, respectively.

4 Results of Sensor Robotic Inspections for City of Mansfield and Trinity River Authority Projects

4.1 City of Mansfield Project

An advanced robotic multi-sensor inspection device equipped with sonar, lidar, and video capabilities was used to assess the condition of more than 3 miles (16,167 feet) of a concrete sanitary sewer pipeline in Mansfield, Texas. The data provided by the CCTV was analyzed, and the pipes were assessed and graded according to the NASSCO PACP rating system of 1 through 5, with 1 indicating excellent condition and 5 indicating a severely compromised state that portends failure. Three sections were assigned a rating of 4 due to missing aggregate and visible reinforcement, and one section was assigned a rating of 5 due to corrosion of the reinforcement. The O & M rating of 5 was due to very high efflorescence and indicated a need for immediate attention. The CCTV showed several locations with rough pipe surfaces, grease and other deposits, visible aggregates, tap factory activity, etc. The locations of the most critical sections (those with a structural PACP rating of 4 and above) are presented in Table 4-1. The efflorescence in each line that resulted in the O&M rating is tabulated in the PACP table. The graph presented in Figure 4.1 and 4.2 summarizes the PACP ratings by showing the percentage of both structural and O&M rating systems for each pipeline.

Table 4-1 Worst Structural Ratings Reported

SN	Distance from starting manhole (ft.)	Structural Rating	O&M Rating	Remarks
Line_11064				
1	45 to 50	5	-	Corroded Reinforcement found
2	55 to 60	4	-	Missing Aggregate
Line_11086				
1	275 to 280	4	-	Reinforcement Visible
Line_11089				
1	80 to 85	4	-	Reinforcement Visible

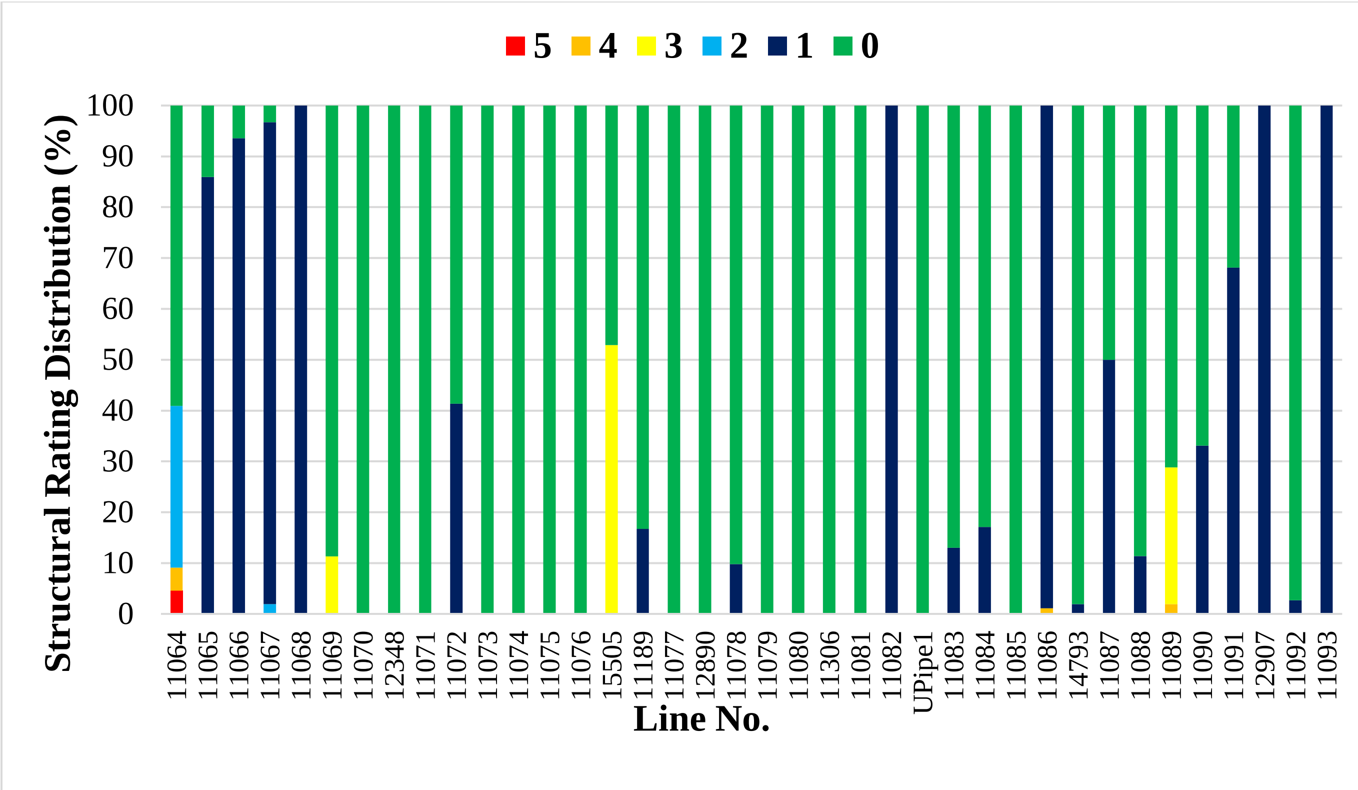

Figure 4-1 Structural rating for each line

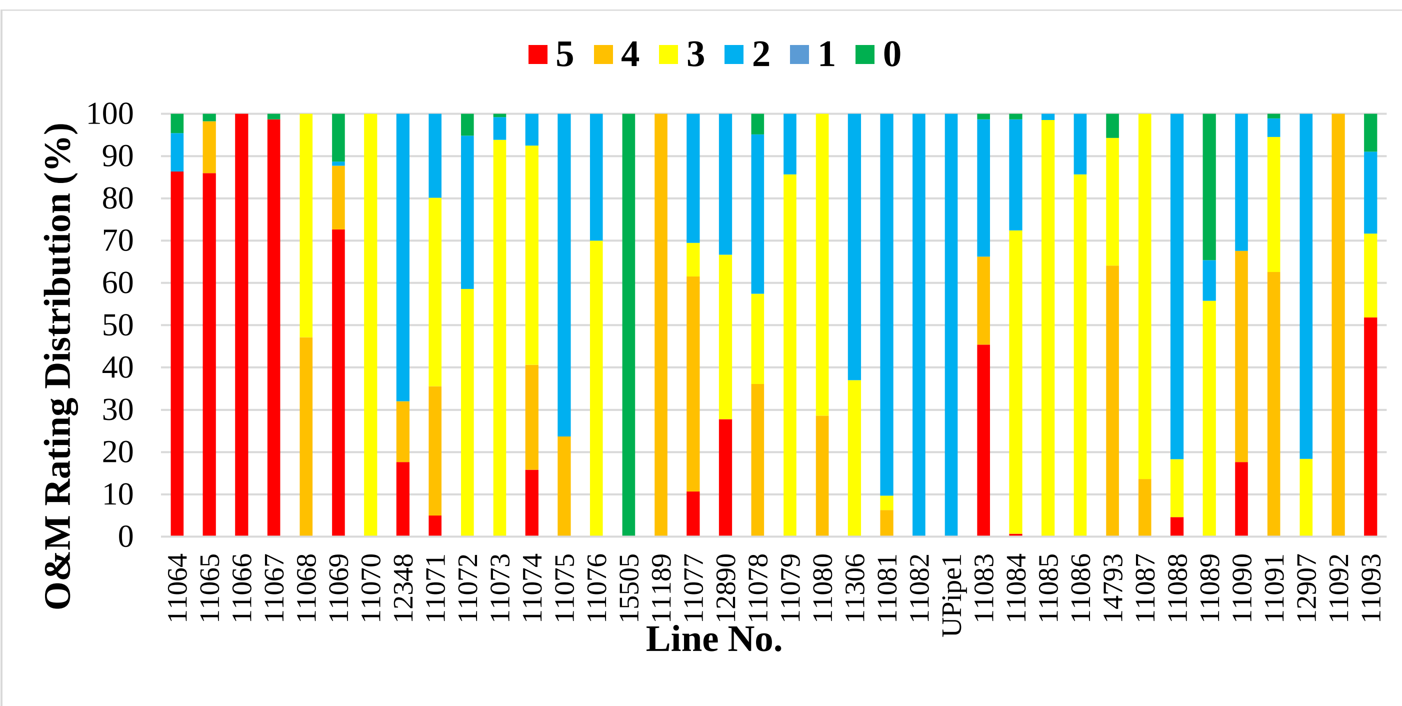

Figure 4-2 Operational & maintenance rating for each line

A. 2D lidar revealed that although there was almost an inch of corrosion in some areas, which might expose the rebars in the future, none of the pipes were corroded to the extent that they need immediate attention. The CCTV, however, revealed projecting aggregates in some sections that need be addressed soon. The graph below shows the average and minimum wall thickness of each line.

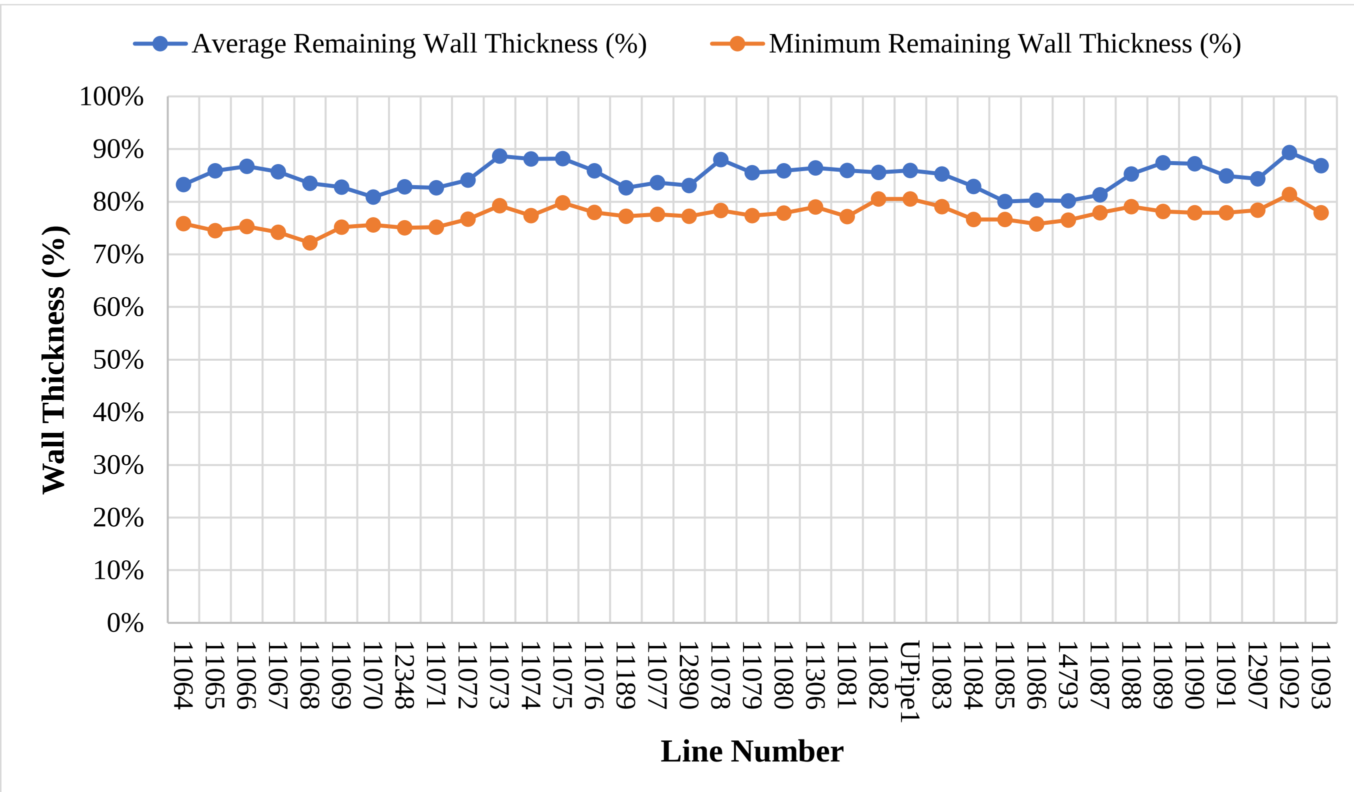

Figure 4-3 Average and minimum wall thickness of each line

B. Scanning sonar was used to map the underwater surface of the pipes and locate and measure any underwater debris, The debris height was used to calculate the percentage of pipe cross sections that were blocked, which causes decreased hydraulic efficiency. Of the 38 lines inspected, 35 were found to have minor problems with accumulated debris less than 5 inches high. Lines 11083 and 11084 and a few other sections had debris heights of more than 5 inches and less than 7 inches. The most critical sections, with consistently higher debris height and very high-water levels, were found in line 15505, the only flexible pipe encountered. The debris height gradually increased from the upstream manhole and decreased after approximately 80 feet. The graph below shows the average and maximum debris height for each line.

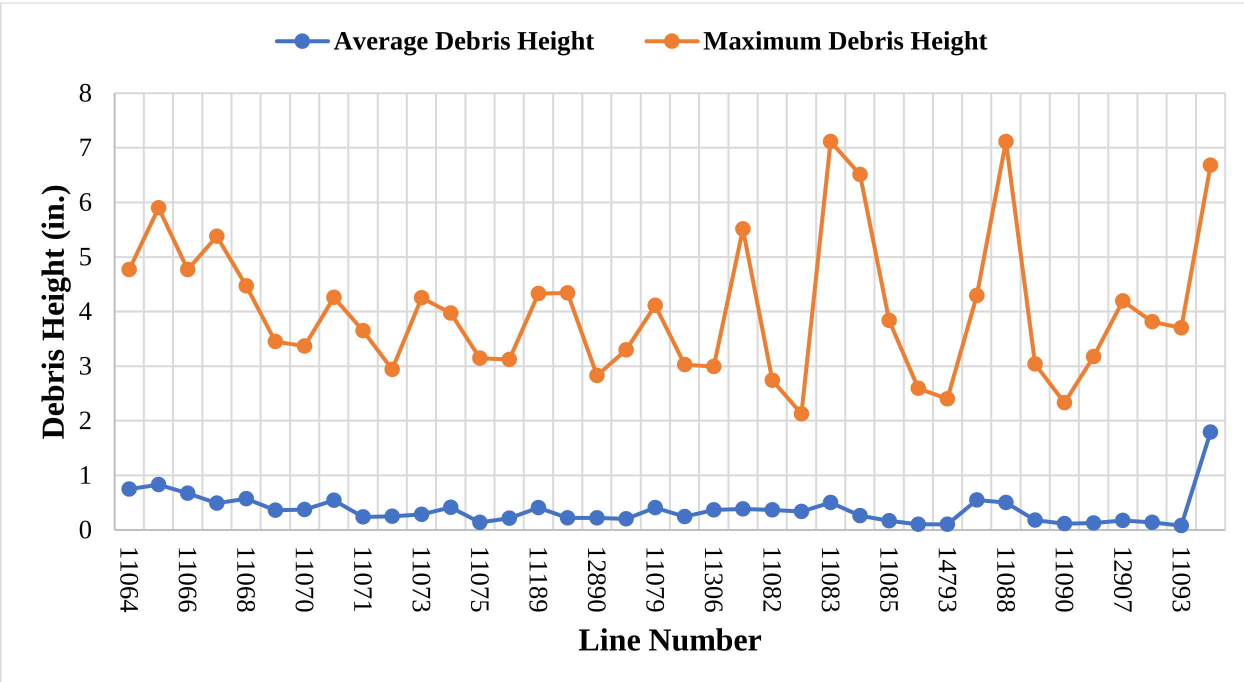

Figure 4-4 Debris Height Distribution for each line.

4.1.1 Overview of Inspected Pipelines

This section presents the findings of inspections performed on 38 sewer pipelines, totaling 16,167 ft., in the city of Mansfield, Texas. Figure 4-5 shows an area map of the pipelines, and Figure 4-6 shows the locations of the segments of the sanitary sewer pipelines that were inspected. Table 1 in Appendix A provides a summary of all the lines inspected during this project.

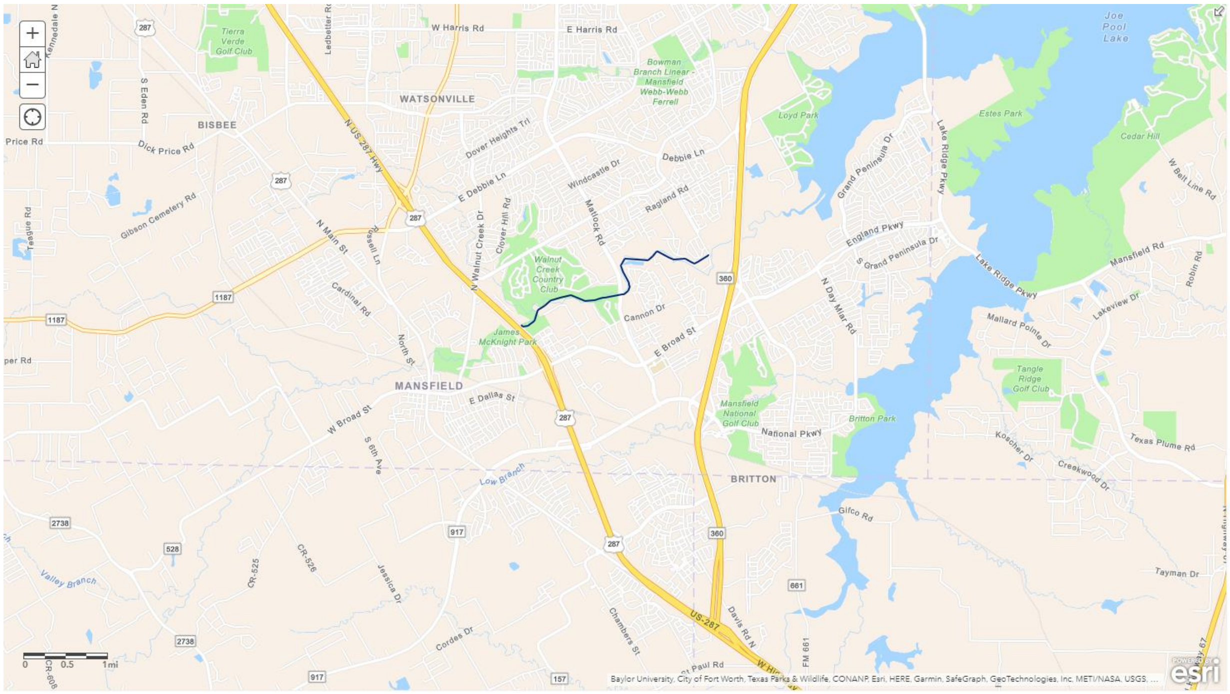

Figure 4-5 Location of sanitary sewer pipelines

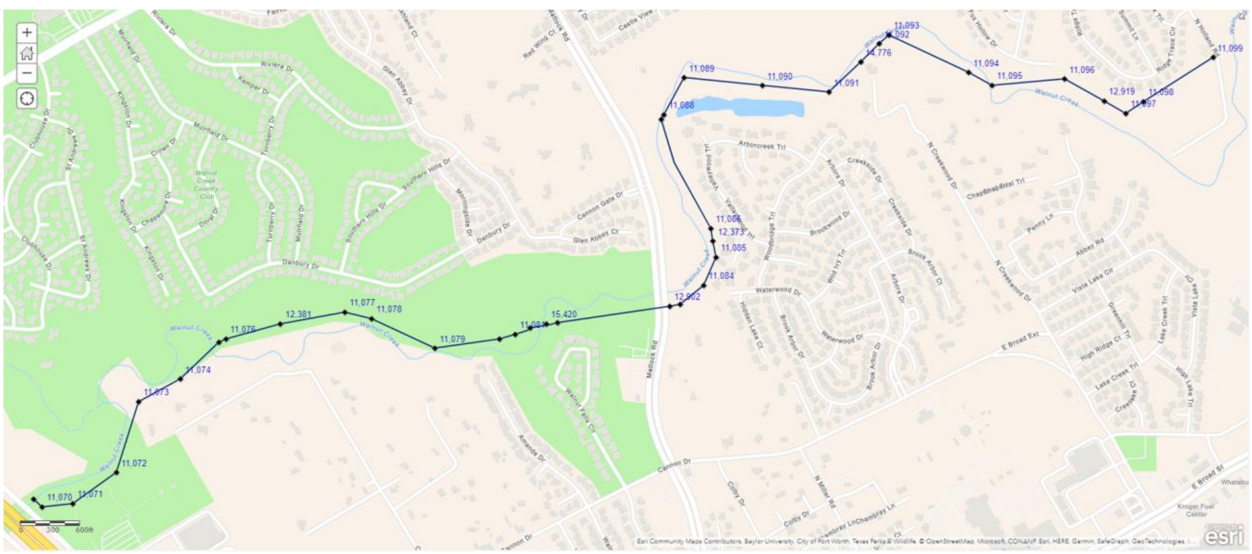

Figure 4-6 Location of sanitary sewer pipelines

4.1.2 Visual Observation

The CCTV data indicated minor structural and major operational and maintenance defects in the sewer lines. Several sections of the lines were revealed to have a rough surface, almost all of them have high efflorescence, and some have projecting or missing aggregates. Although most of the defects are not critical at this point, they need to be monitored, repaired, or replaced in a timely manner to ensure that the serviceability and structural integrity of the sewer pipeline meet the loading and environmental requirements.

The CCTV data was evaluated based on the NASSCO PACP manual, and the structural and maintenance defects in the lines were rated from 0 to 5, with 0 being excellent and 5 being the worst. Details of the inspection are presented for each line in the PACP format in Table 4-7. The distance was calculated from the upstream manhole to the downstream manhole, and the defect codes and dimensions complied with NASSCO's PACP standard. In addition to the defect table, the quick rating, overall rating, and rating index were calculated for both structural and O&M defects and are presented for each line. The following tables are a sample of the PACP grading for the first five of the 38 lines inspected in Mansfield.

1. Line 11064

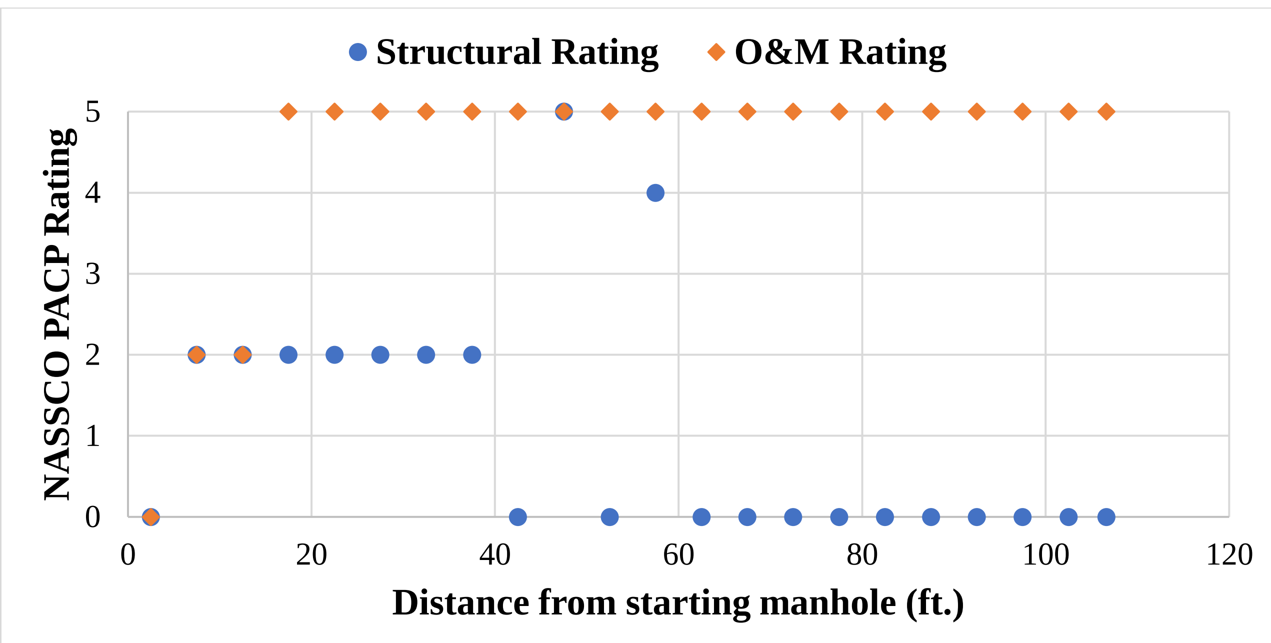

Figure 4-7 NASSCO's PACP rating for five ft. pipe segments in Line 11064

2. Line 11065

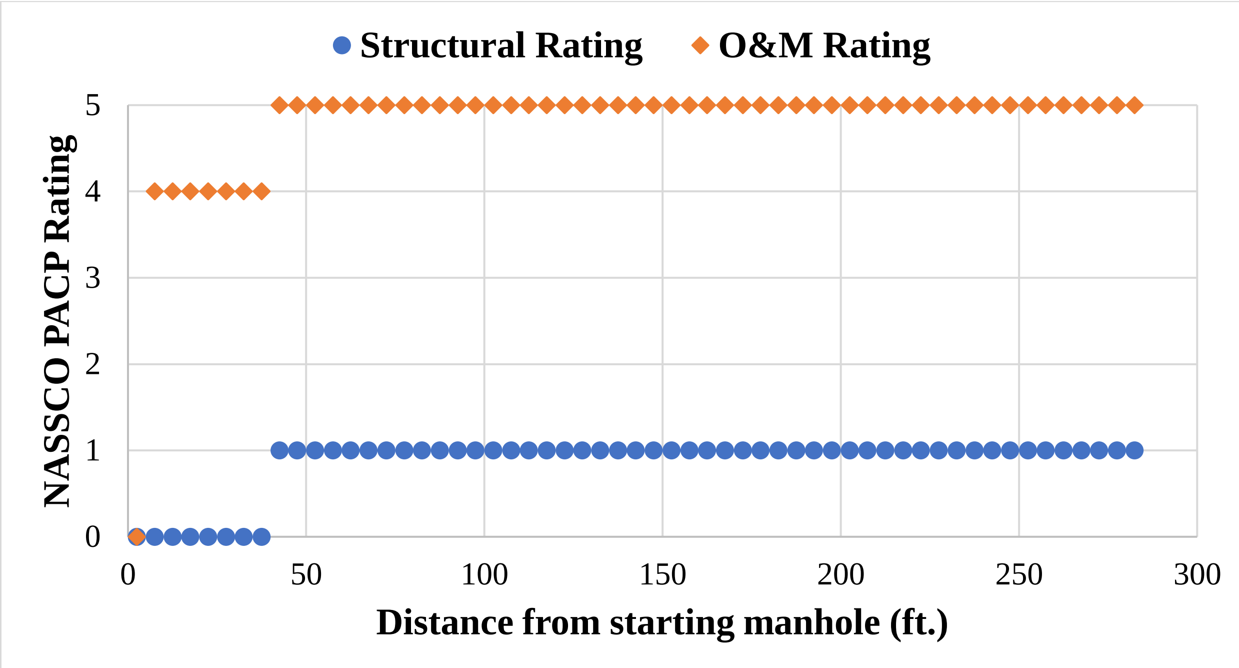

Figure 4-8 NASSCO's PACP rating for five ft. pipe segments in Line 11065

3. Line 11066

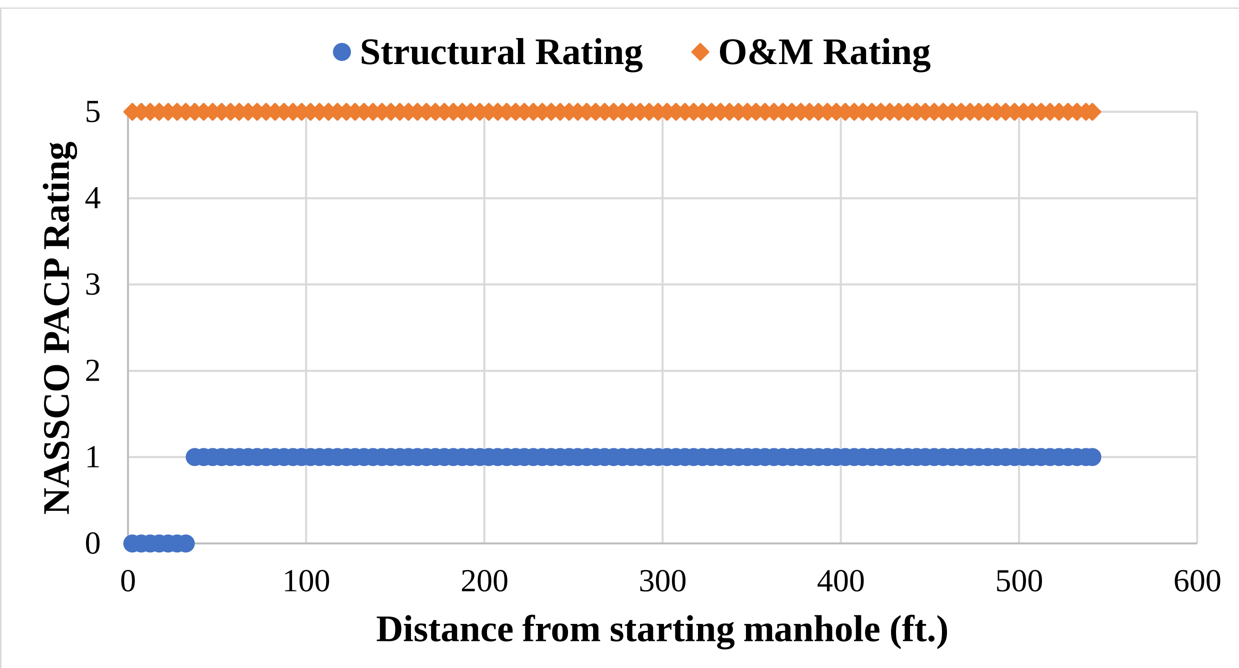

Figure 4-9 NASSCO's PACP rating for every five ft. pipe segment in Line 11066

4. Line 11067

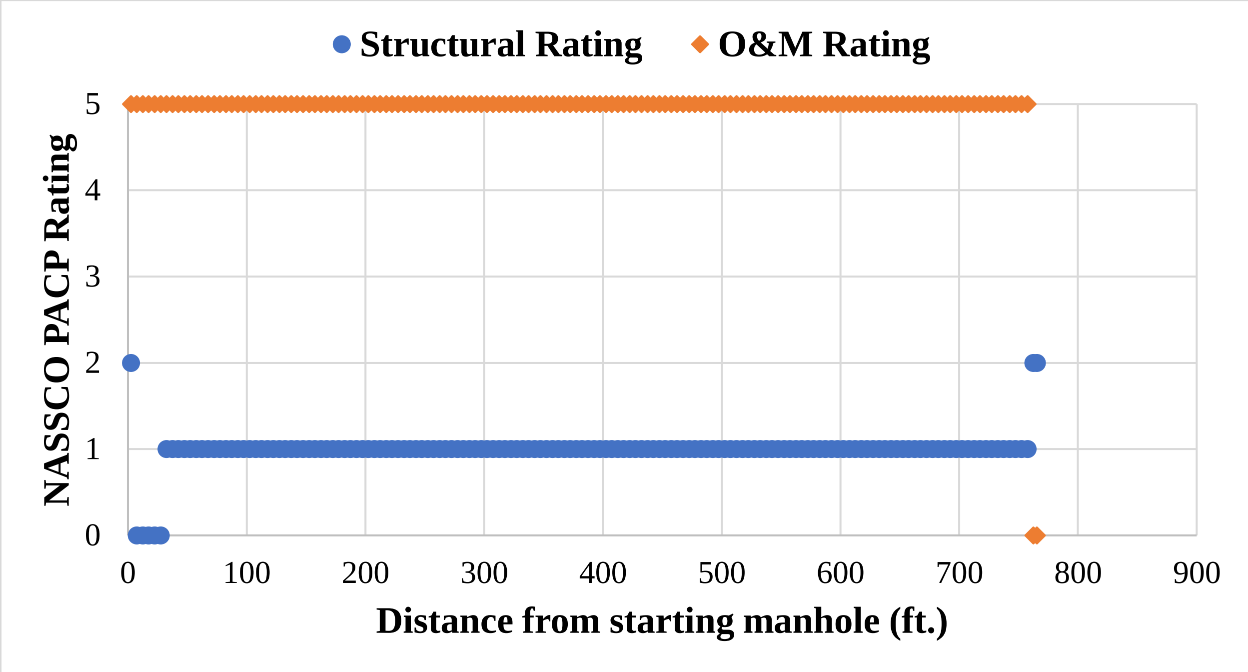

Figure 4-10 NASSCO's PACP rating for every five ft. pipe segment in Line 11067

5. Line 11068

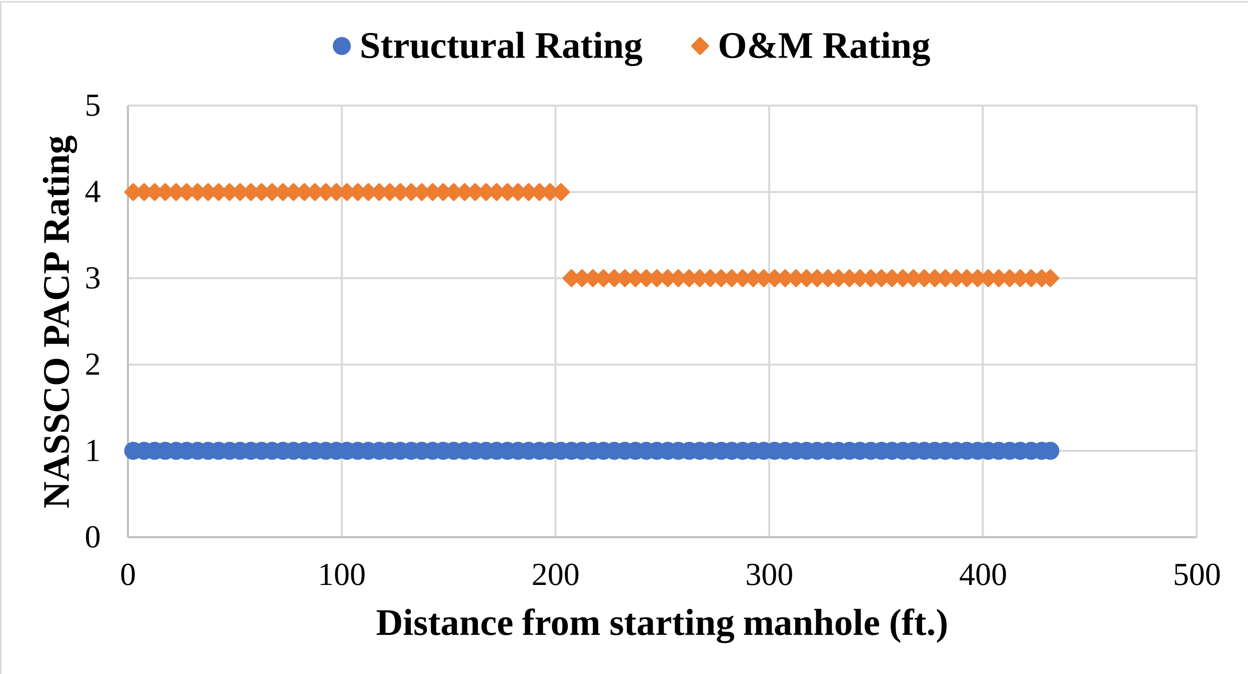

Figure 4-11 NASSCO's PACP rating for every five ft. pipe segment in Line 11068

6. Line 11069

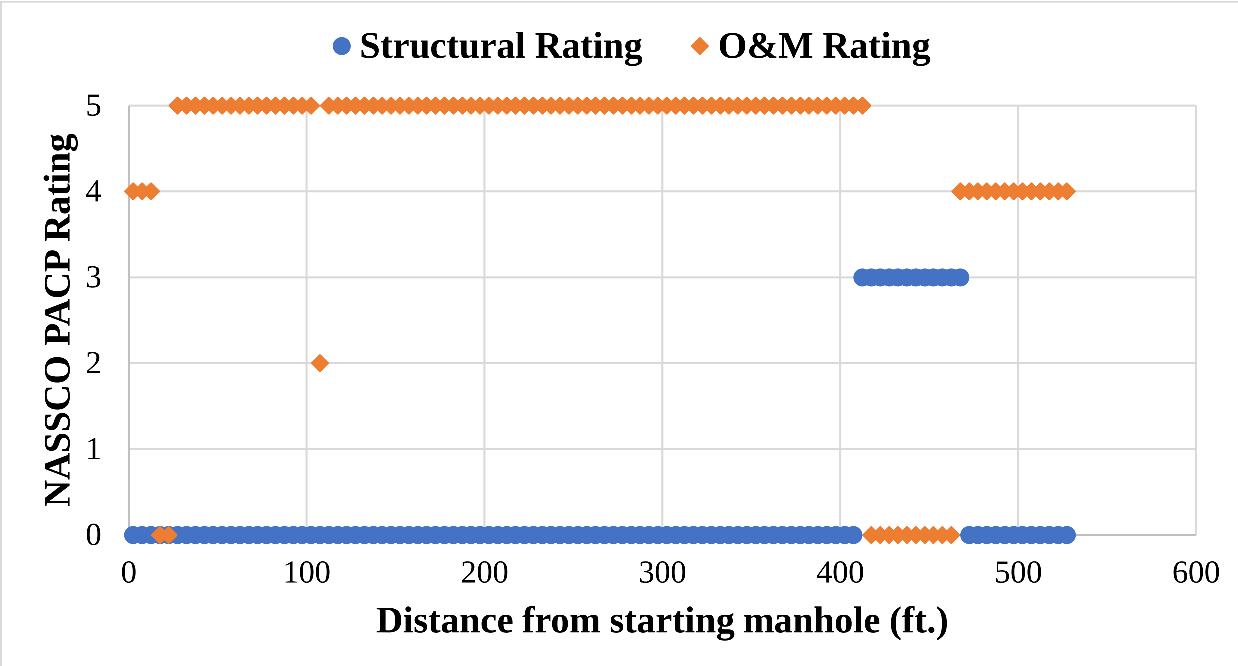

Figure 4-12 NASSCO's PACP rating for every five ft. pipe segments in Line_11069

7. Line 11070

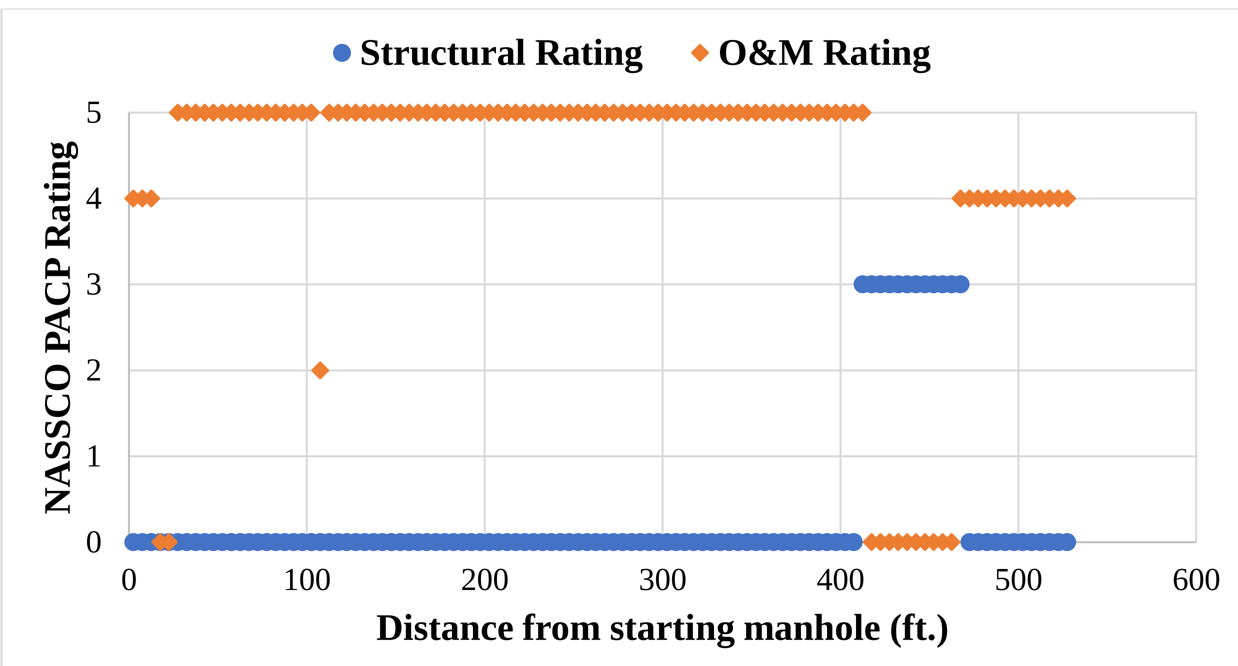

Figure 4-13 NASSCO's PACP rating for every five ft pipe segments in Line_11070

8. Line 12348

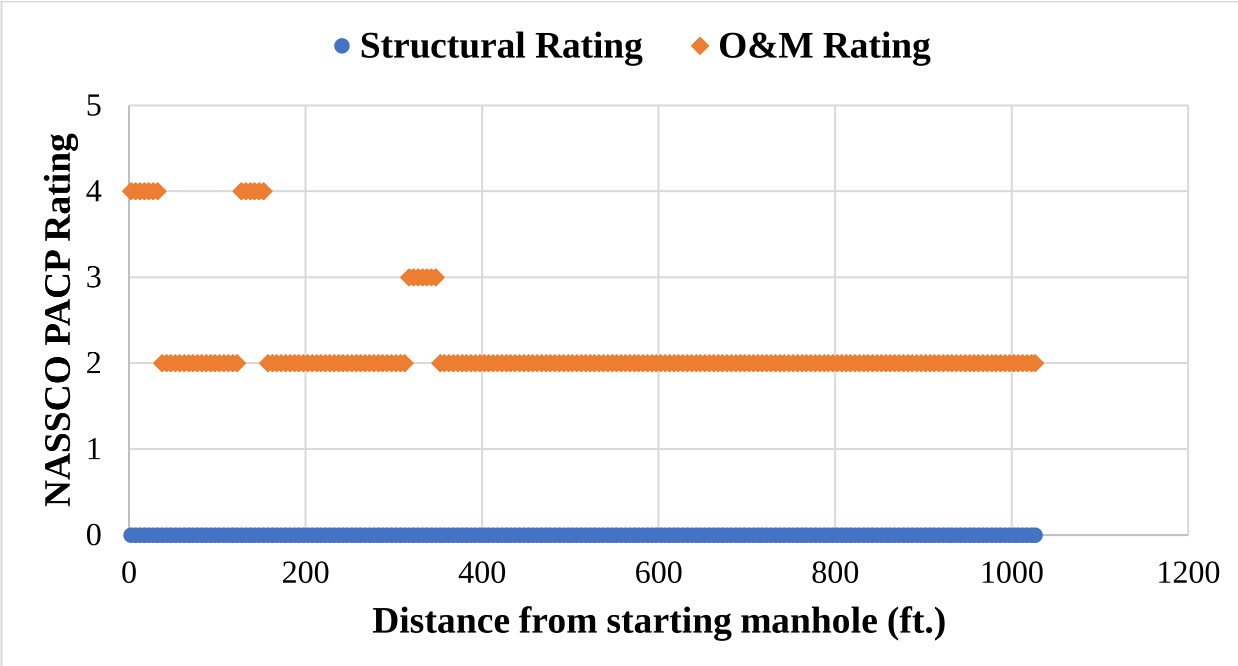

Figure 4-14 NASSCO's PACP rating for every five feet pipe segments in Line_12348

9. Line 11071

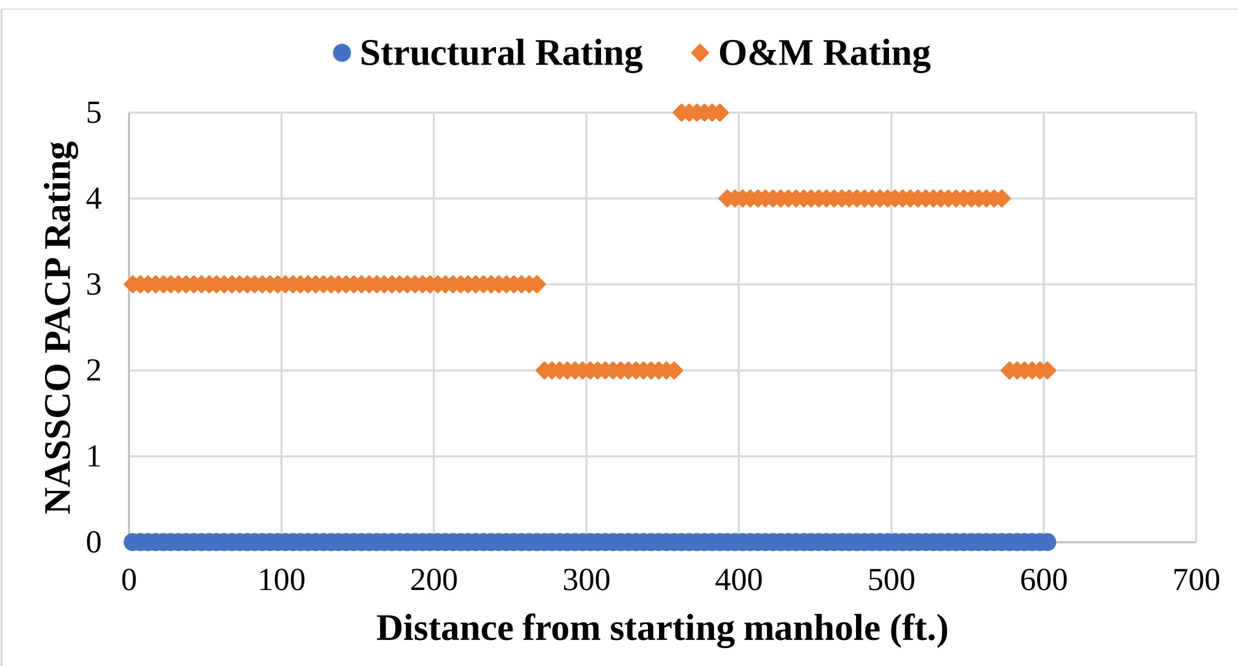

Figure 4-15 NASSCO's PACP rating for every five feet pipe segments in Line_11071

10. Line 11072

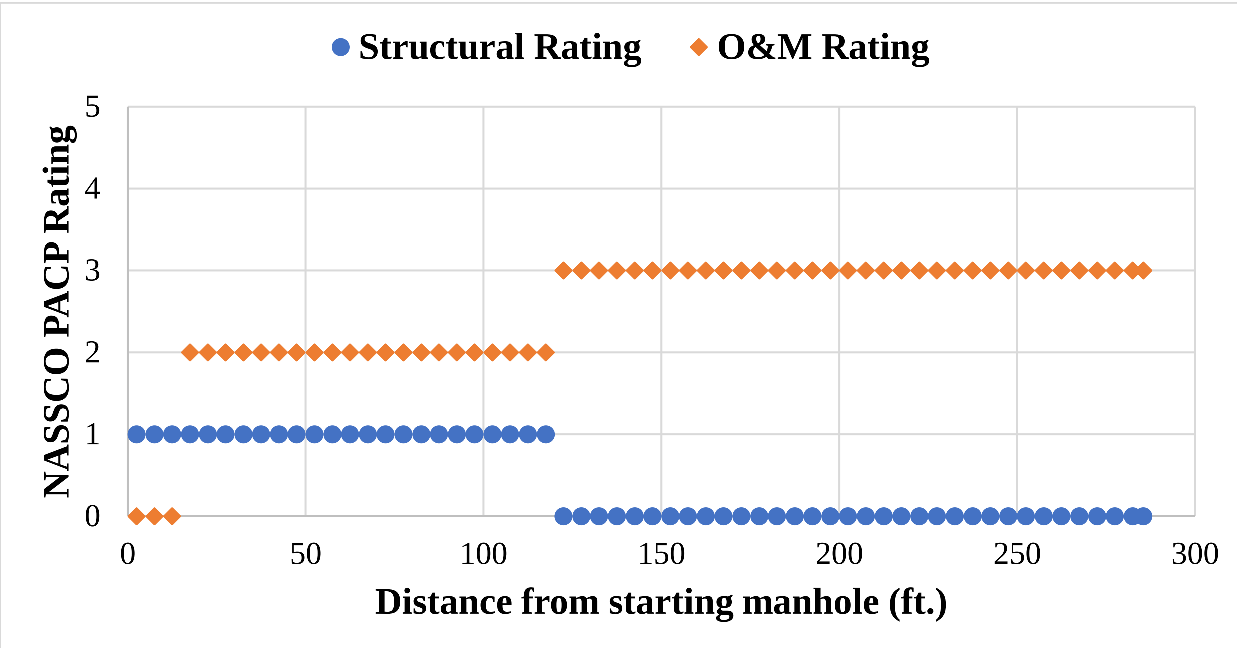

Figure 4-16 NASSCO's PACP rating for every five feet pipe segments in Line_11072

11. Line 11073

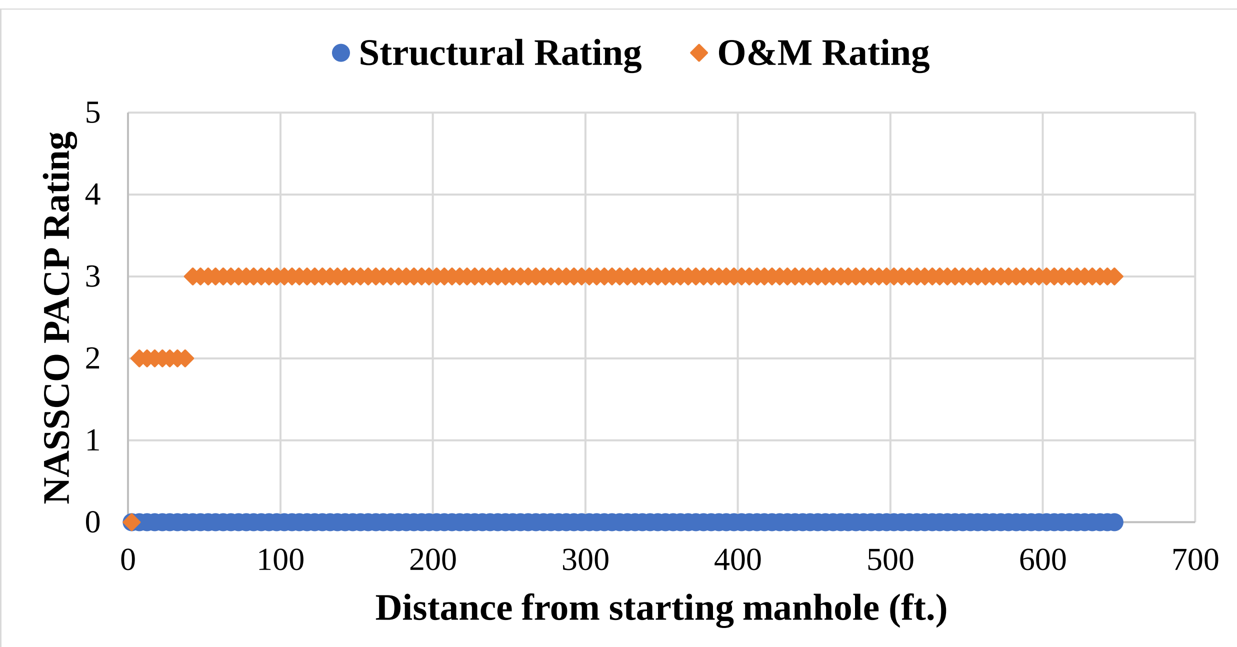

Figure 4-17 NASSCO's PACP rating for every five feet pipe segments in Line_11073

12. Line 11074

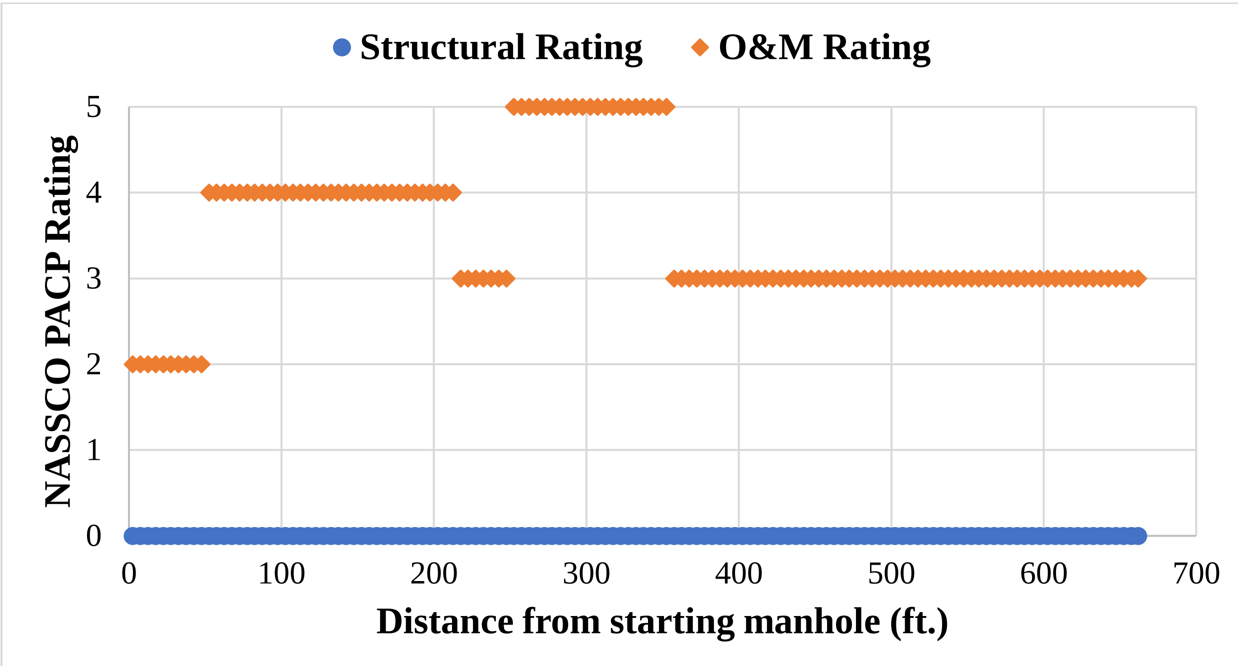

Figure 4-18 NASSCO's PACP rating for every five feet pipe segments in Line_11074

13. Line 11075

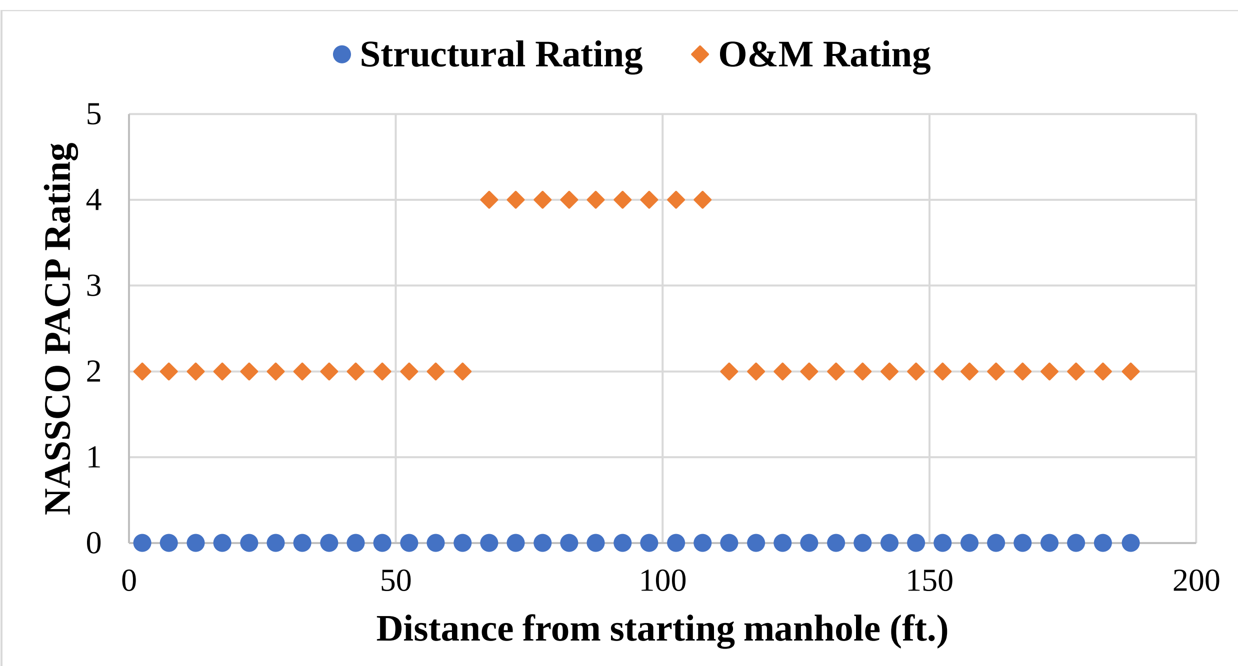

Figure 4-19 NASSCO's PACP rating for every five feet pipe segments in Line_11075

14. Line 11076

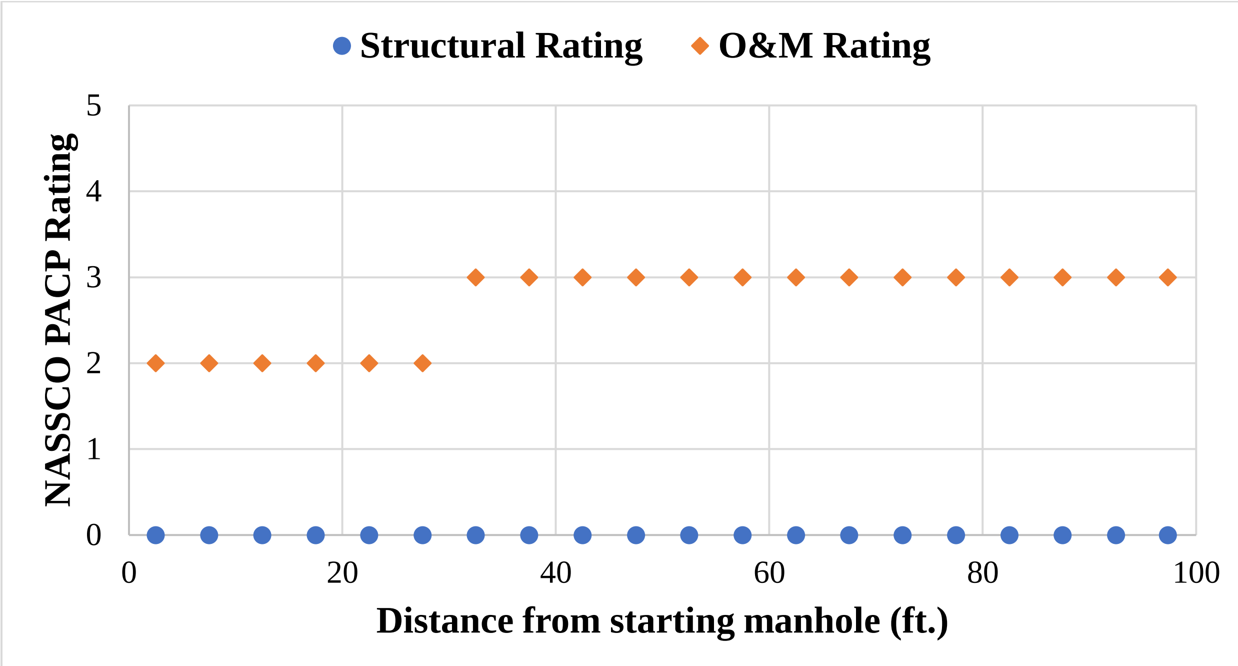

Figure 4-20 NASSCO's PACP rating for every five feet pipe segments in Line_11076

15. Line 15505

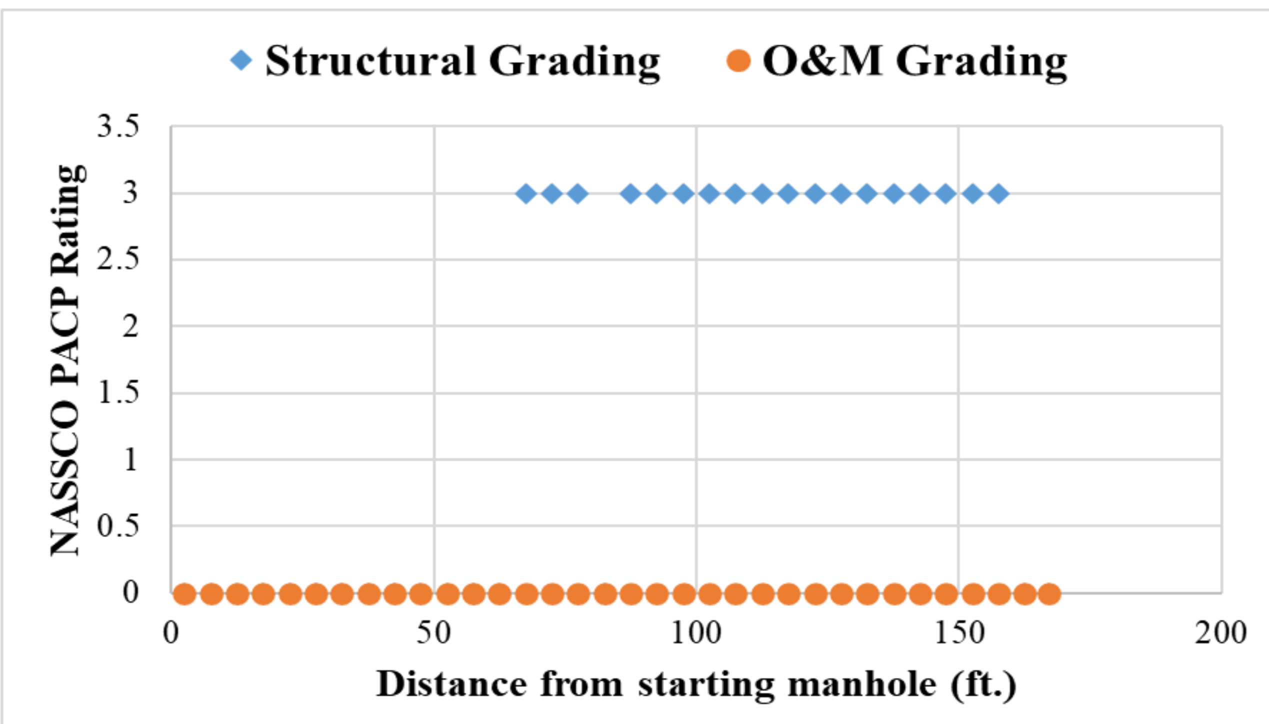

Figure 4-21 NASSCO's PACP rating for every five feet pipe segments in Line_15505

16. Line 11189

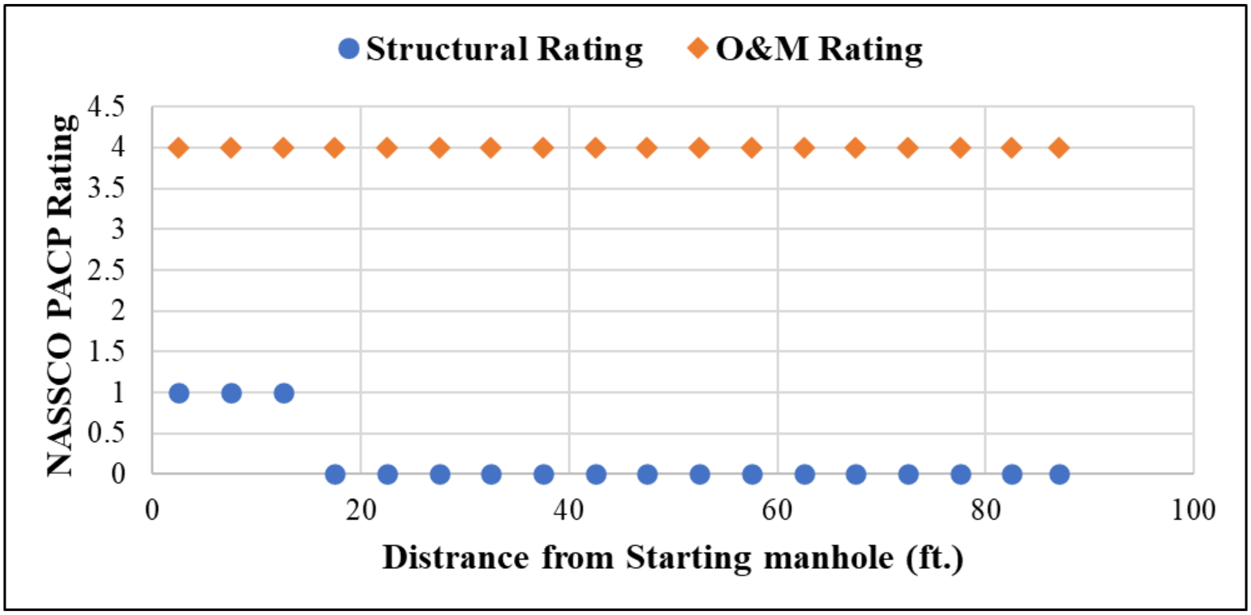

Figure 4-22 NASSCO's PACP rating for every five feet pipe segments in Line_11189

17. Line 11077

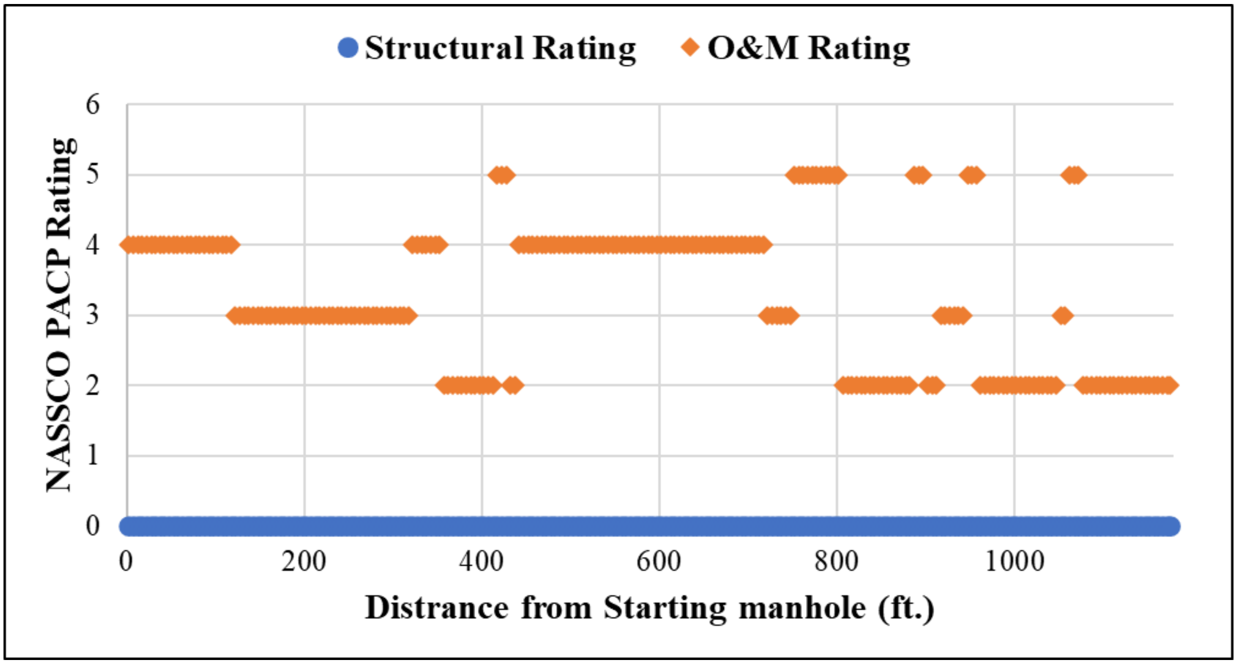

Figure 4-23 NASSCO's PACP rating for every five feet pipe segments in Line_11077

18. Line 12890

Figure 4-24 NASSCO's PACP rating for every five feet pipe segments in Line_12890

19. Line 11078

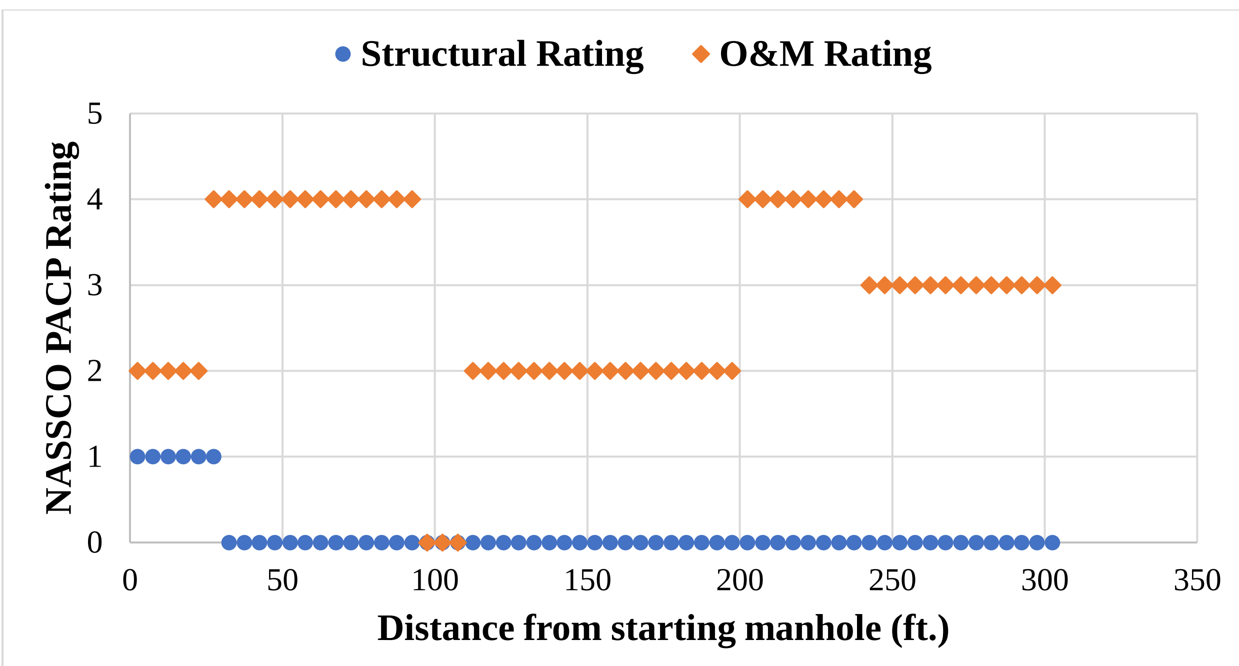

Figure 4-25 NASSCO's PACP rating for every five feet pipe segments in Line_11078

20. Line 11079

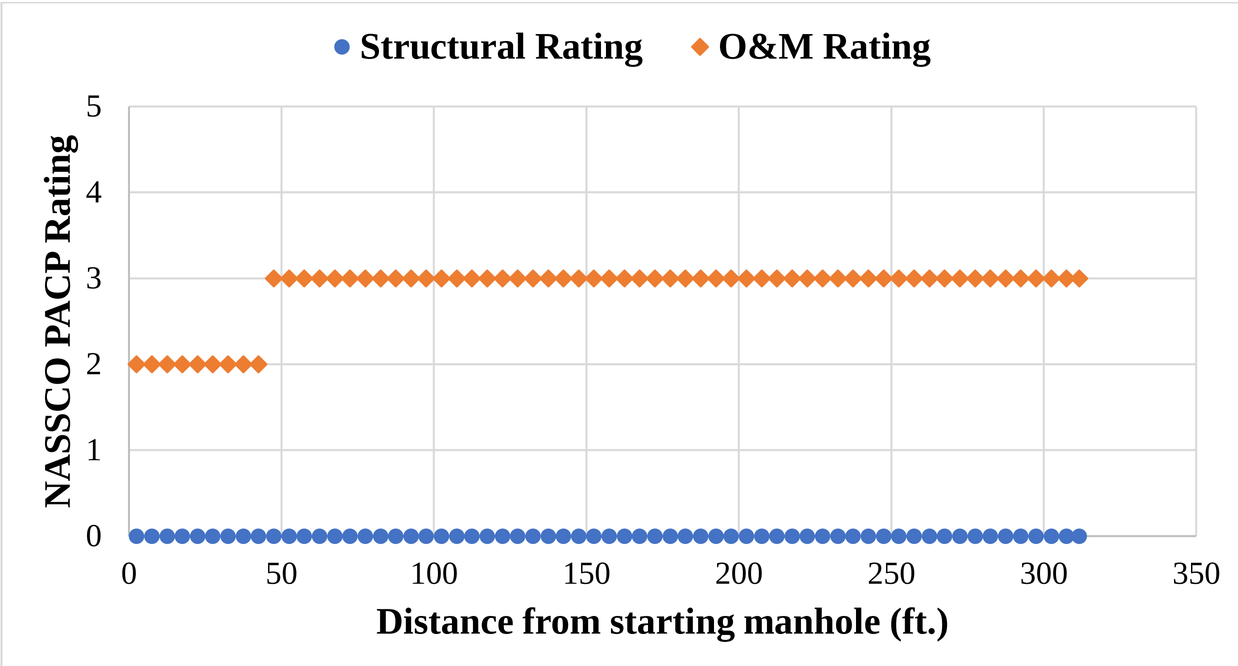

Figure 4-26 NASSCO's PACP rating for every five feet pipe segments in Line_11079

21. Line 11080

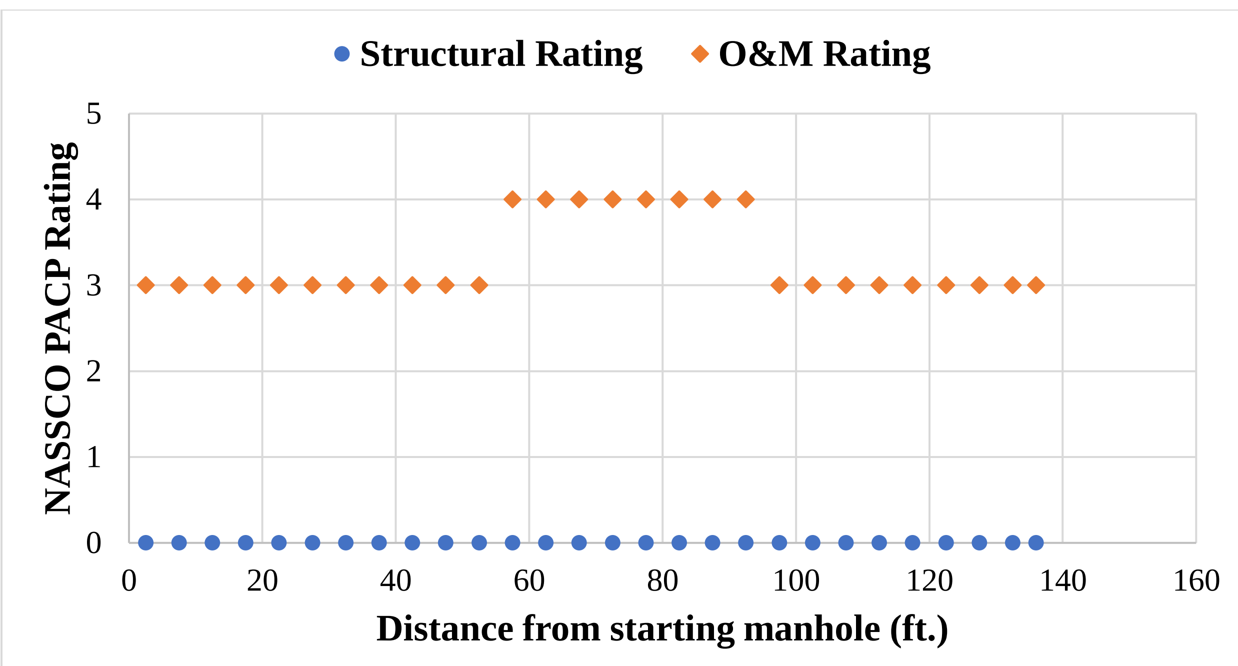

Figure 4-27 NASSCO's PACP rating for every five feet pipe segments in Line_11080

22. Line 11306

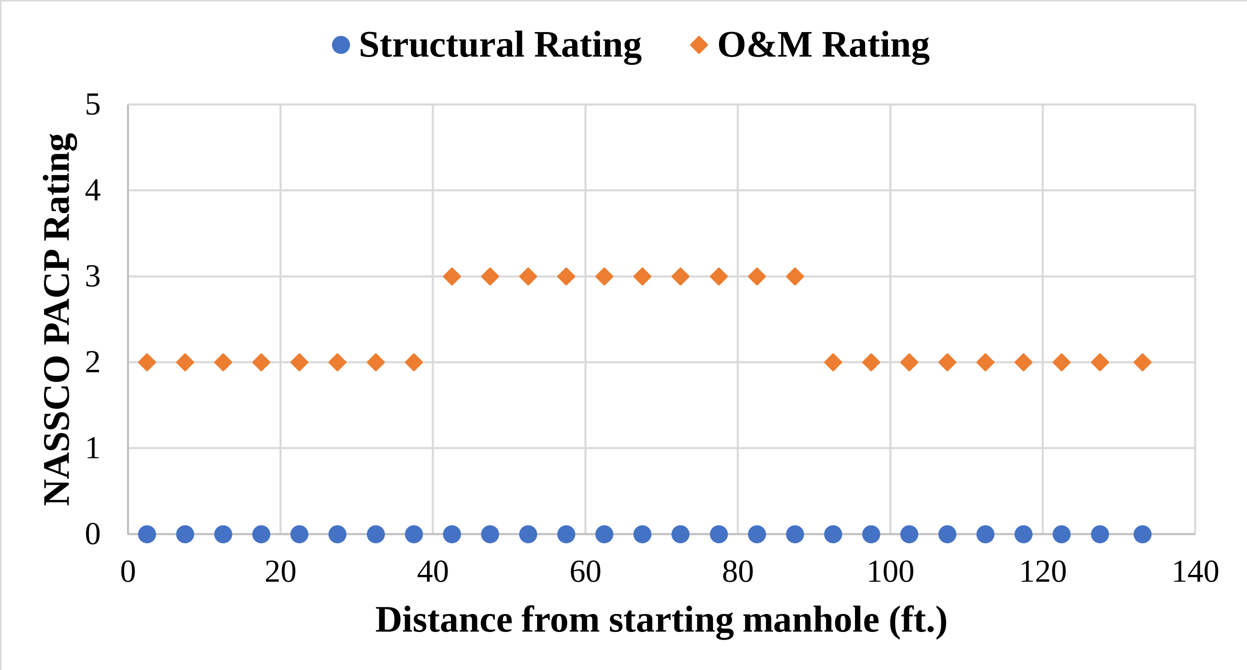

Figure 4-28 NASSCO's PACP rating for every five feet pipe segments in Line_11306

23. Line 11081

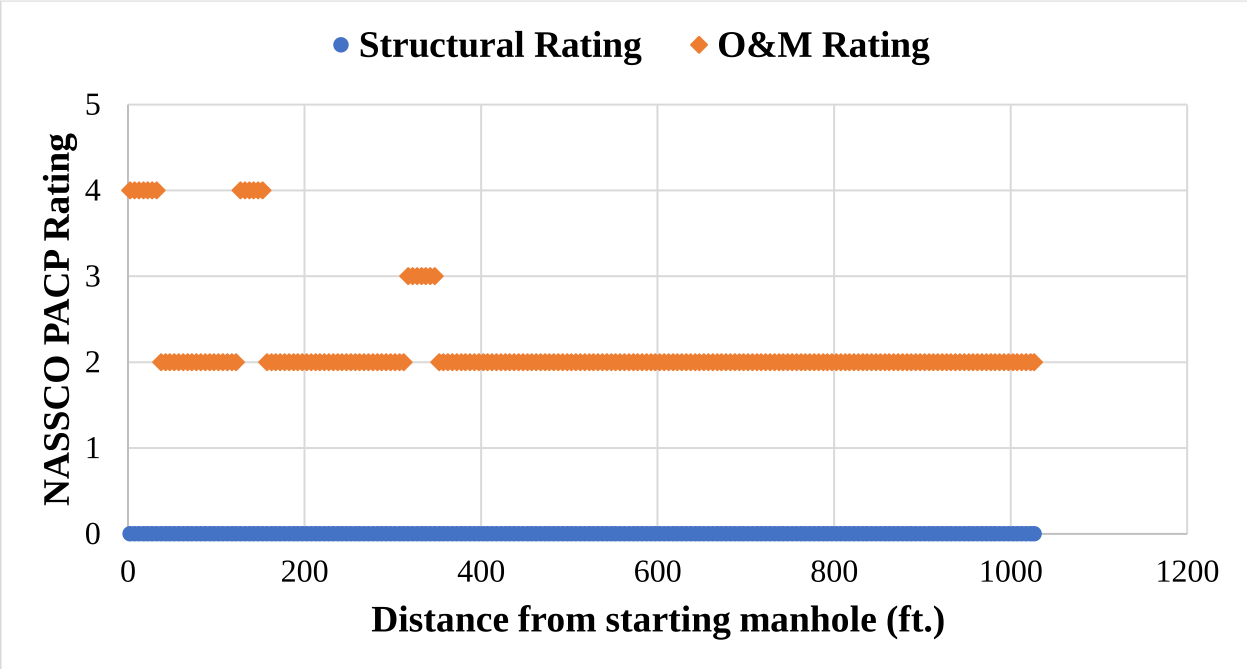

Figure 4-29 NASSCO's PACP rating for every five feet pipe segments in Line_11081

24. Line 11082

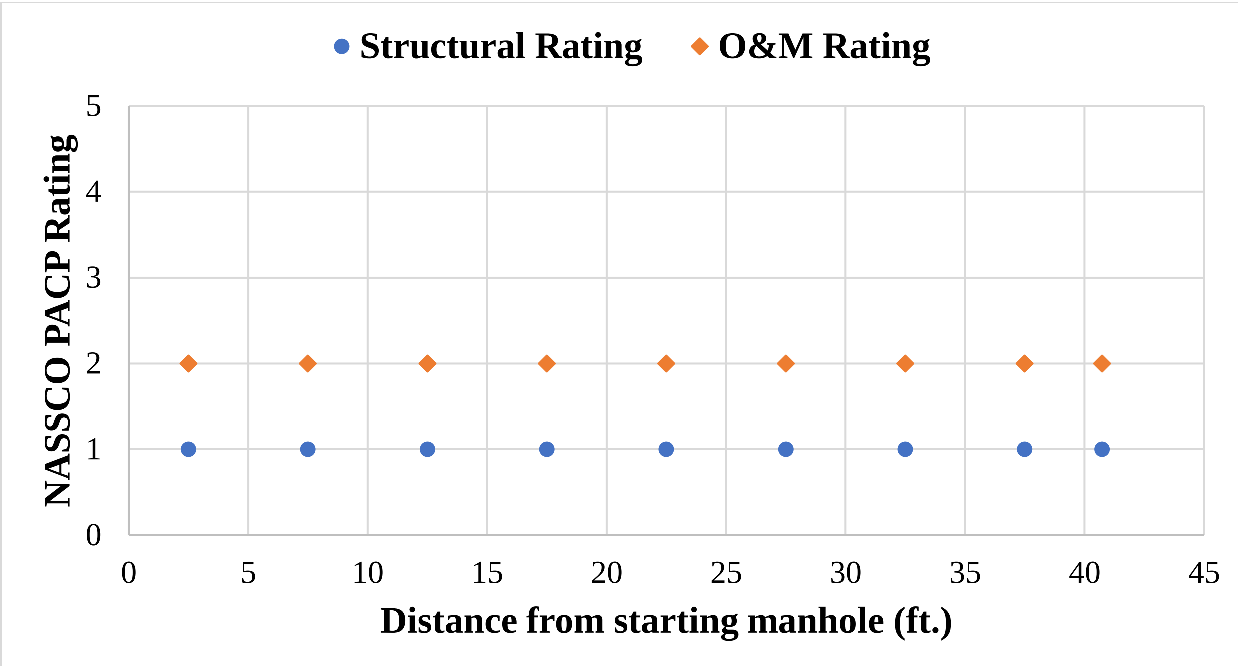

Figure 4-30 NASSCO's PACP rating for every five feet pipe segments in Line_11082

25. Line Unknown

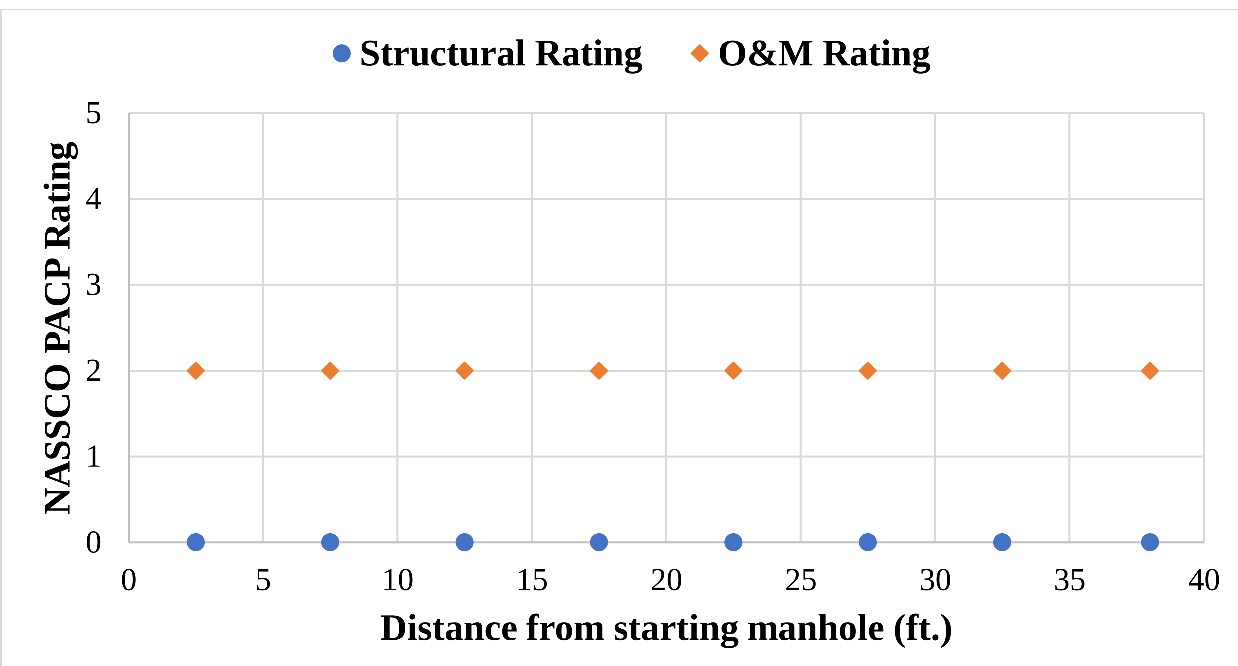

Figure 4-31NASSCO's PACP rating for every five feet pipe segments in UnknownPipe1

26. Line 11083

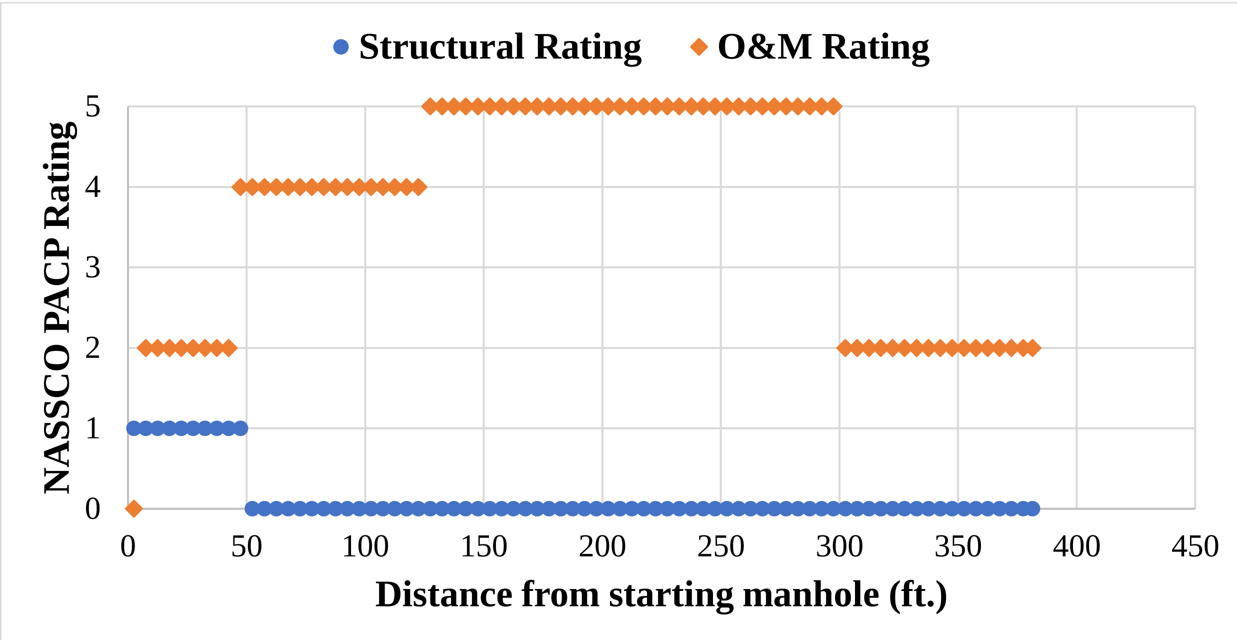

Figure 4-32 NASSCO's PACP rating for every five feet pipe segments in Line_11083

27. Line 11084

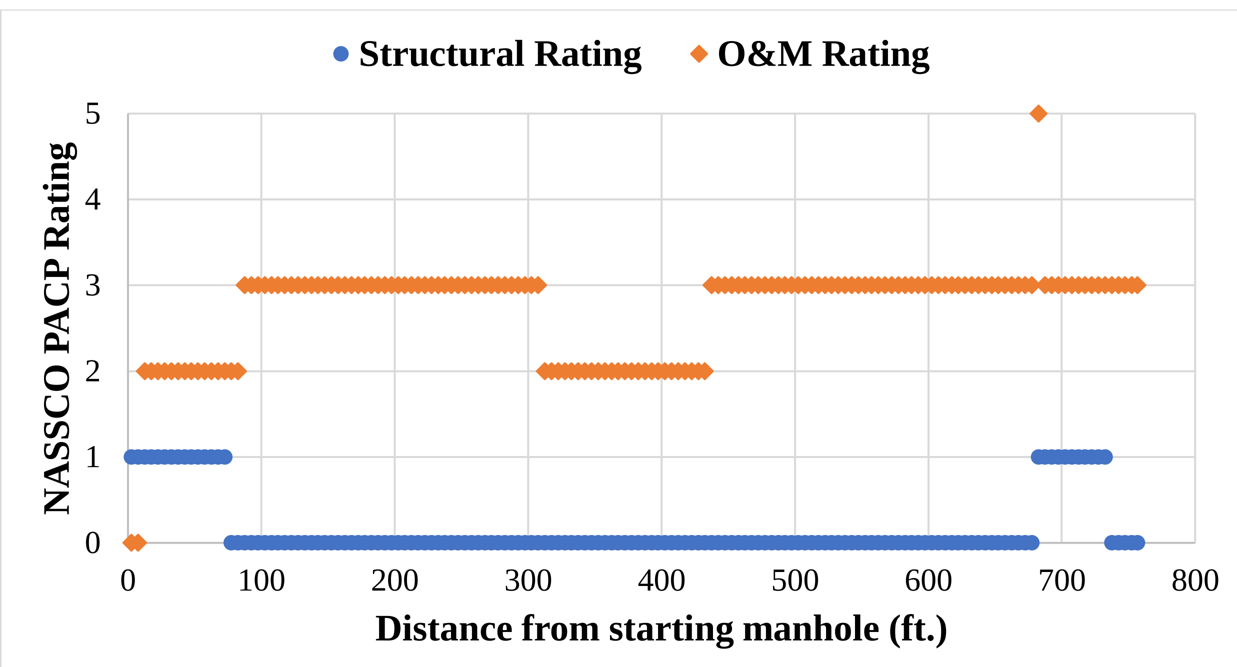

Figure 4-33 NASSCO's PACP rating for every five feet pipe segments in Line_11084

28. Line 11085

Figure 4-34 NASSCO's PACP rating for every five feet pipe segments in Line_11085

29. Line 11086

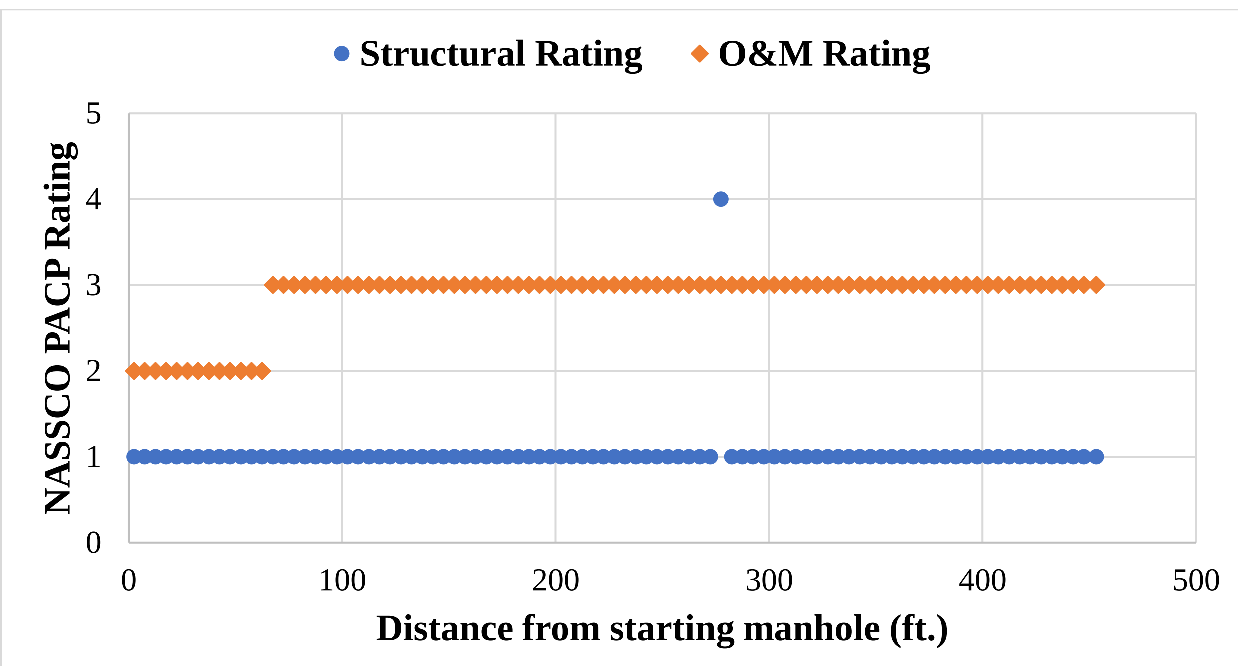

Figure 4-35 NASSCO's PACP rating for every five feet pipe segments in Line_11086

30. Line 14793

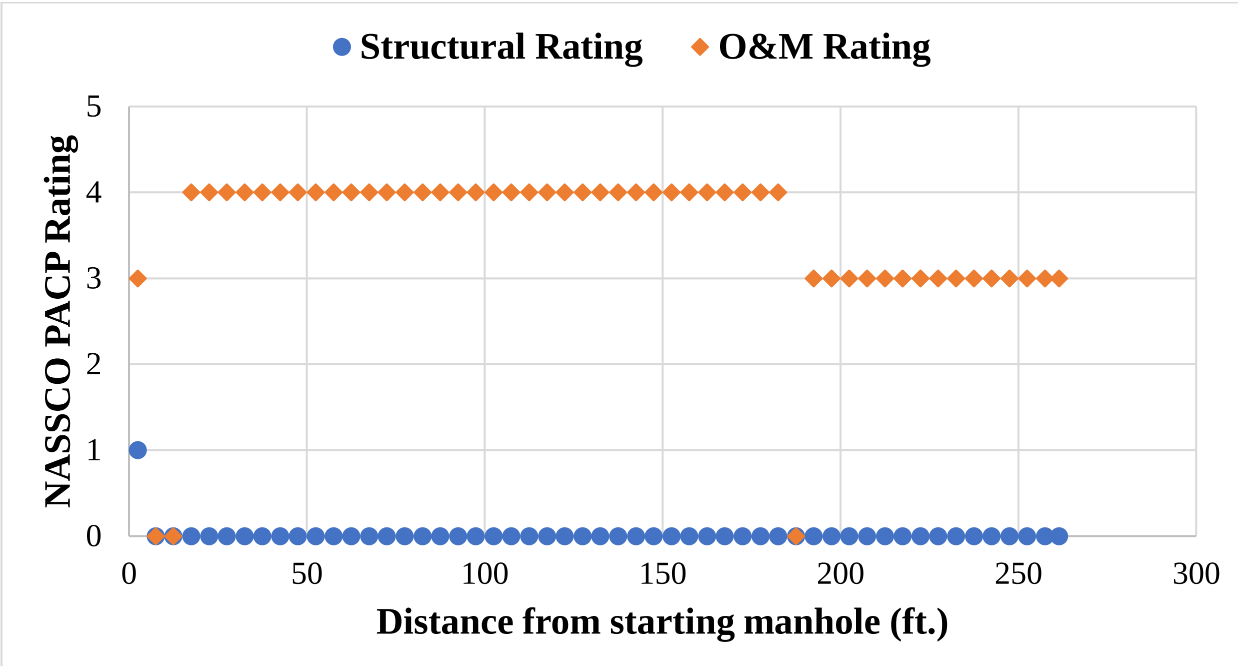

Figure 4-36 NASSCO's PACP rating for every five feet pipe segments in Line_14793

31. Line 11087

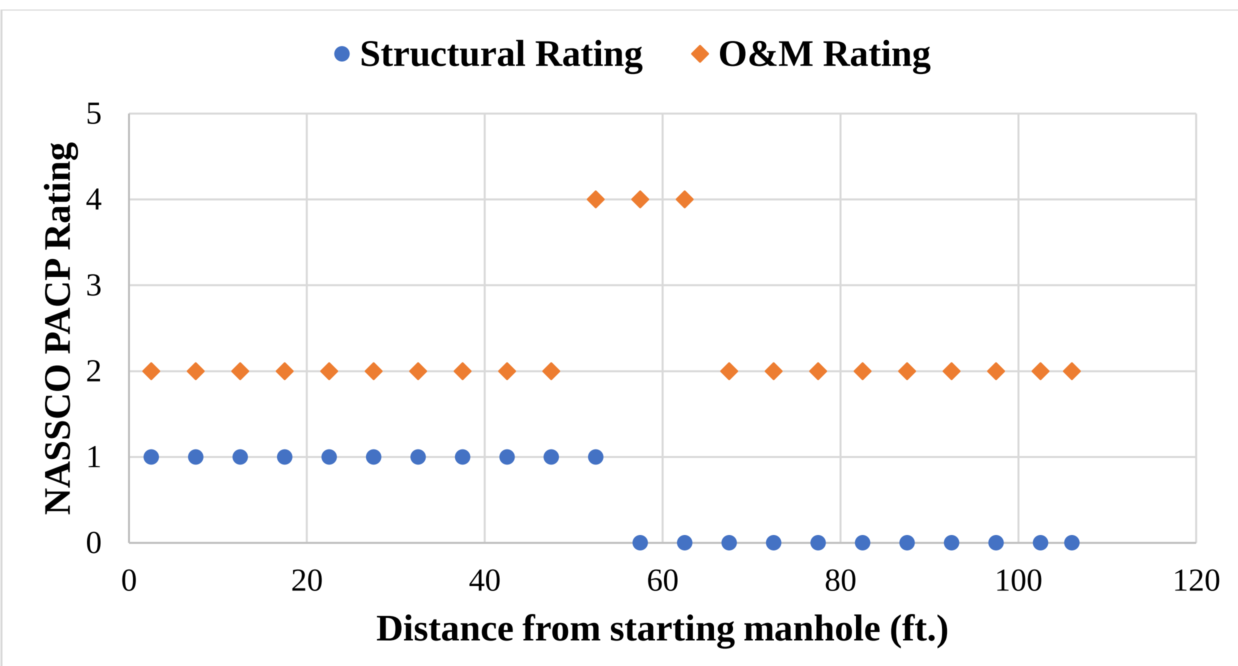

Figure 4-37 NASSCO's PACP rating for every five feet pipe segments in Line_11087

32. Line 11088

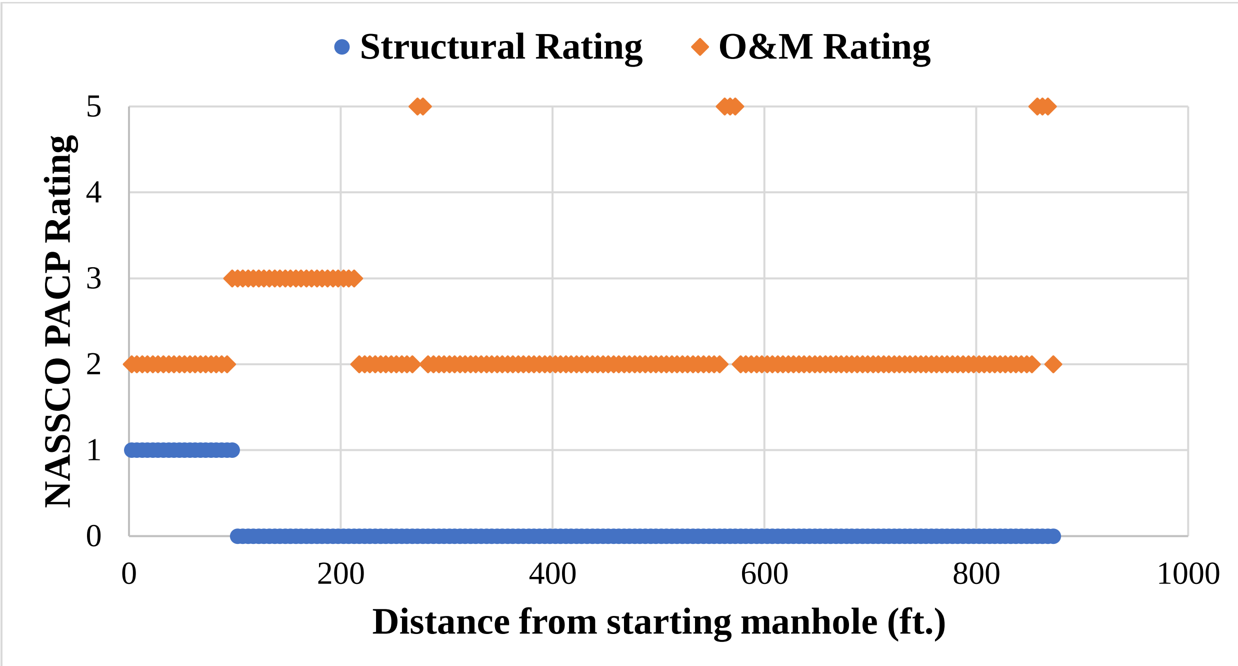

Figure 4-38 NASSCO's PACP rating for every five feet pipe segments in Line_11088

33. Line 11089

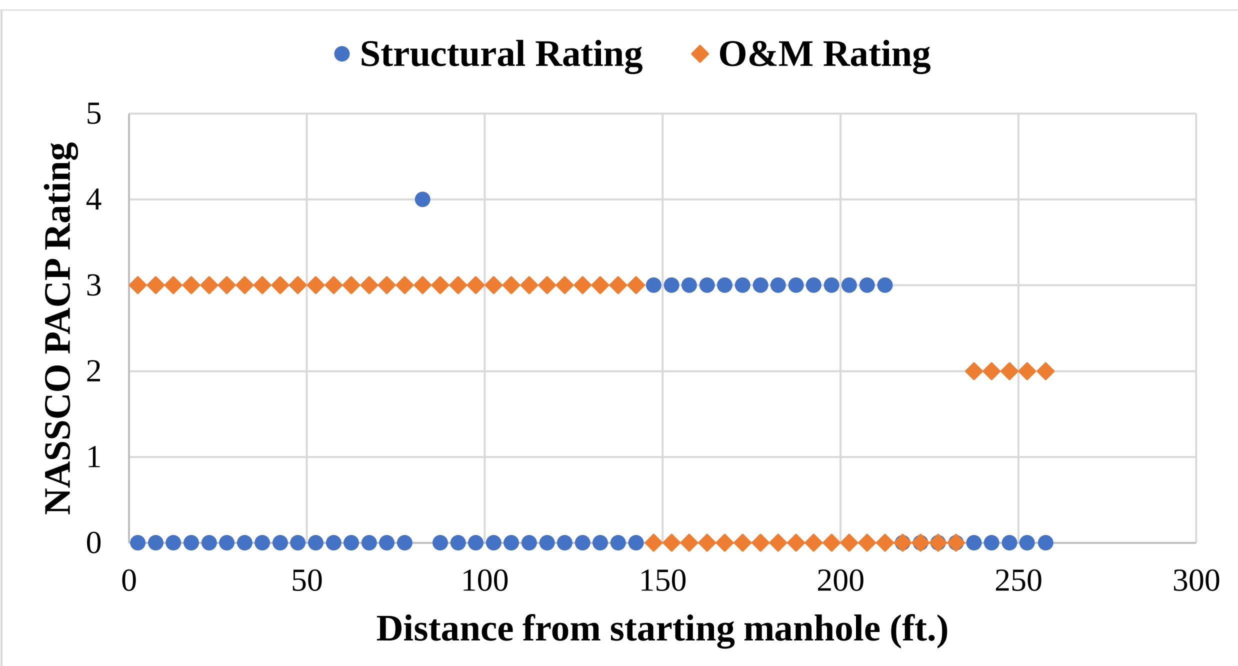

Figure 4-39 NASSCO's PACP rating for every five feet pipe segments in Line_11089

34. Line 11090

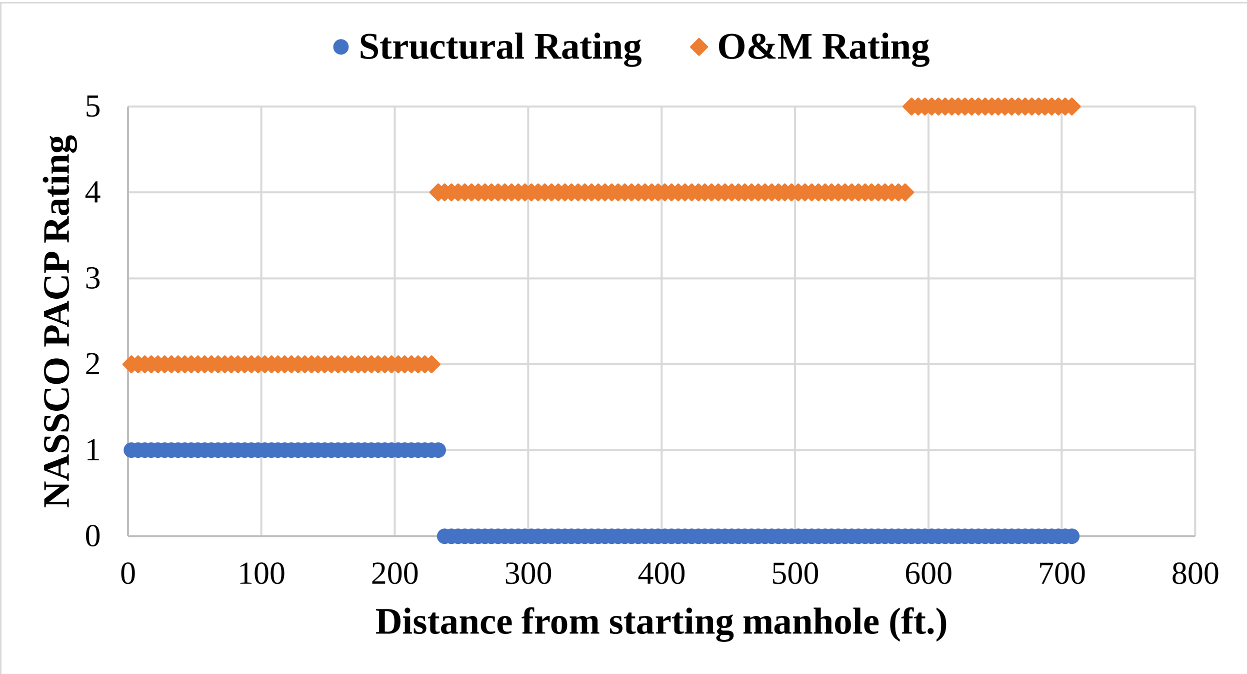

Figure 4-40 NASSCO's PACP rating for every five feet pipe segments in Line_11090

35. Line 11091

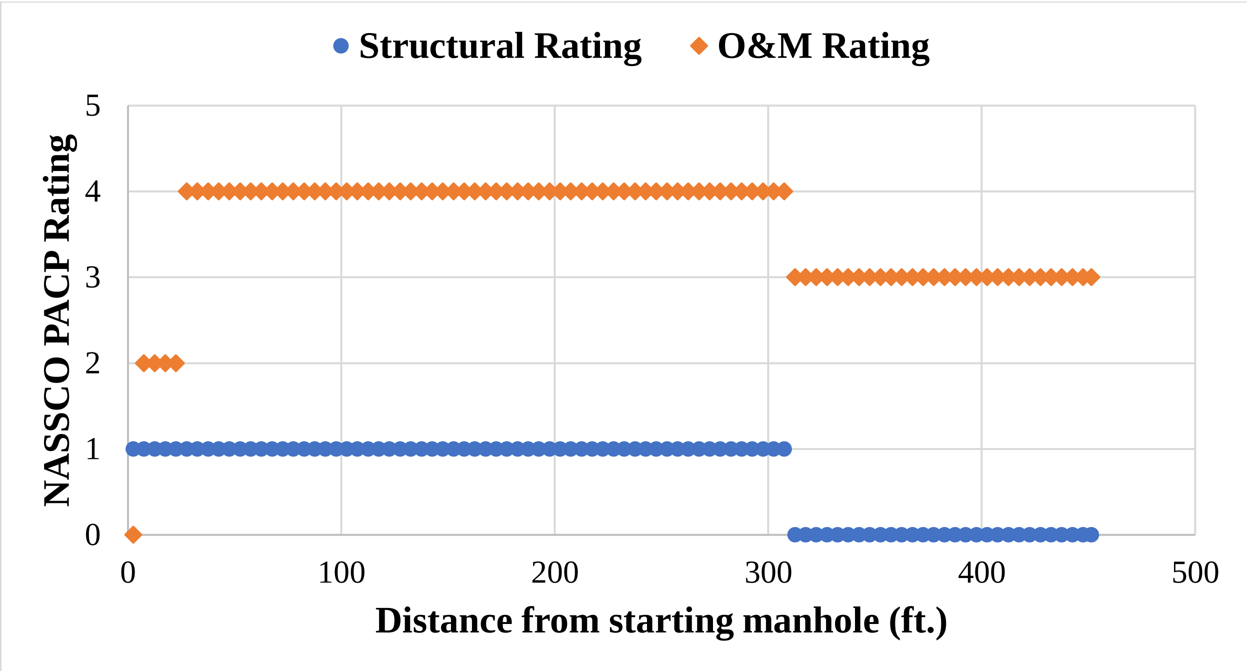

Figure 4-41 NASSCO's PACP rating for every five feet pipe segments in Line_11091

36. Line 12907

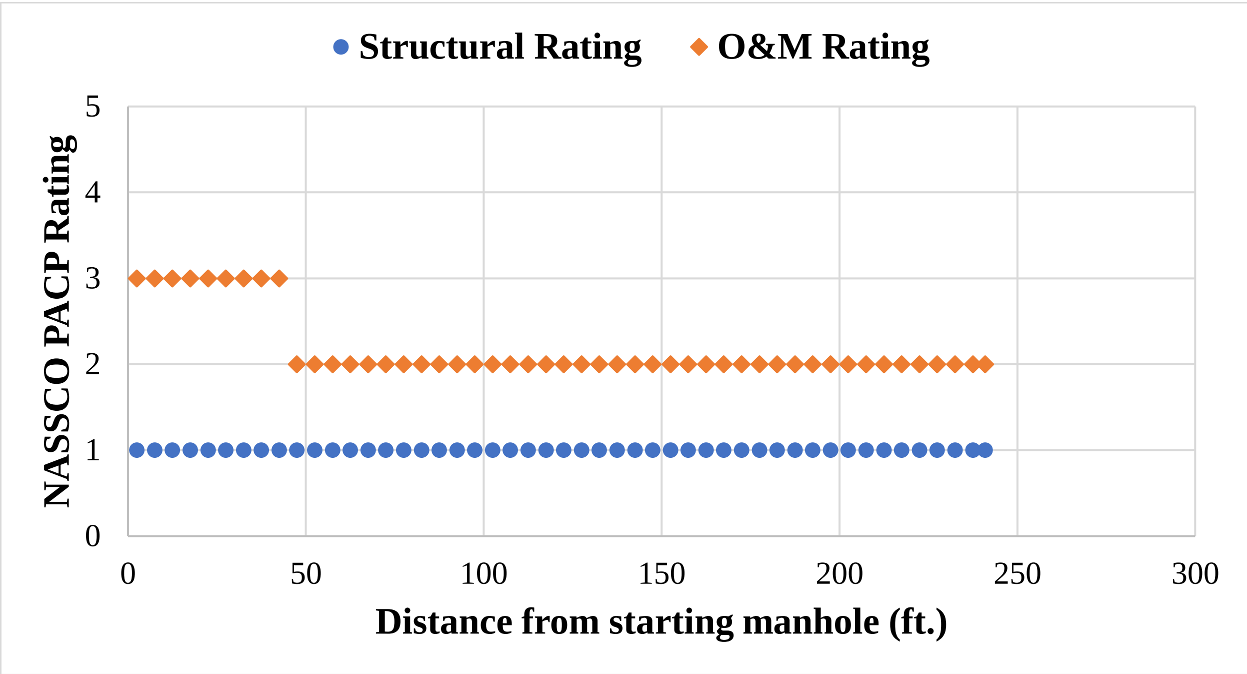

Figure 4-42 NASSCO's PACP rating for every five feet pipe segments in Line_12907

37. Line 11092

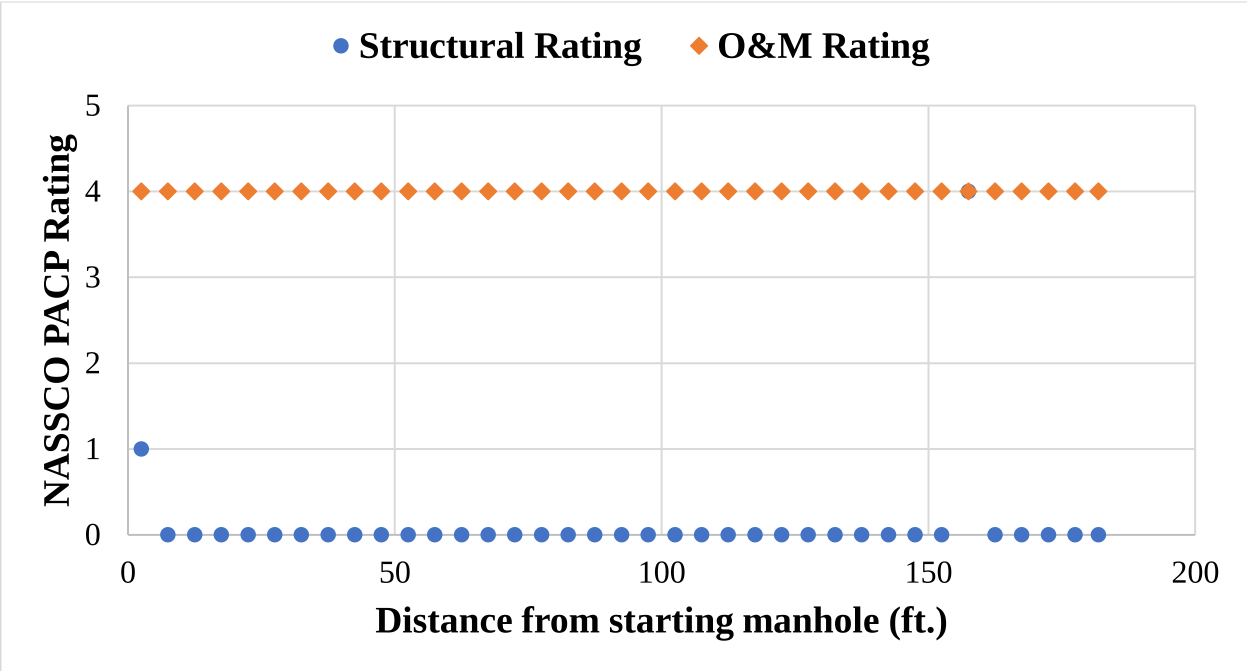

Figure 4-43 NASSCO's PACP rating for every five feet pipe segments in Line_11092

38. Line 11093

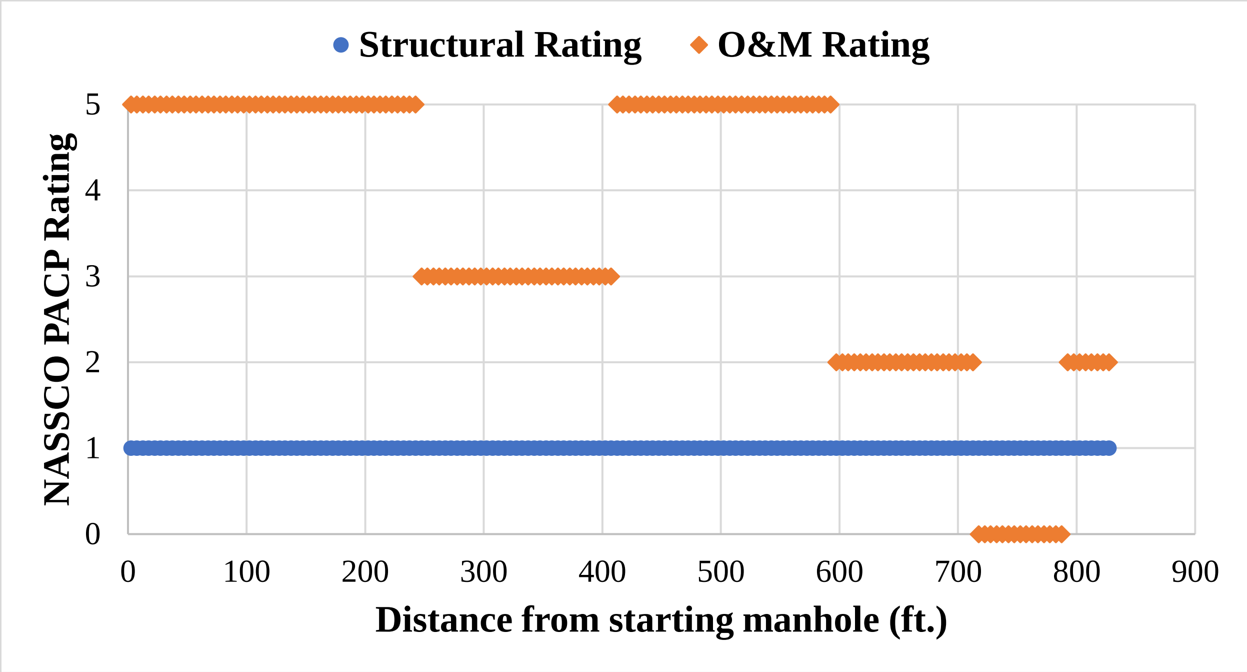

Figure 4-44 NASSCO's PACP rating for every five feet pipe segments in Line_11093

4.1.3 MSI Results

The robot was equipped with lidar and sonar sensors to provide additional quantitative data such as numerical measurements. The lidar sensor was used to map the surface of the pipe above the water line, and the data collected was used to calculate the amount of corrosion in the reinforced concrete pipes. (The loss of clear cover of concrete exposes the reinforcement and makes the pipes susceptible to corrosion and highly prone to failure.) The sonar sensor was installed at the bottom of the robotic boat to map the underwater surface of the pipe and provide valuable information about the condition of the pipe under water, such as debris and blockages. The height of the debris was calculated based on the sonar readings and was used to calculate the percentage of each pipe section that is blocked. The robotic boat accurately mapped the surface of each pipe, the loss of concrete was calculated based on the lidar data, and the result was overlapped with the sonar scan to provide a picture of the full cross section of the pipe. Plots from post-processed MSI data for flexible and rigid pipes are shown in Figures 4-45 and 4-46, respectively. Calculations were performed for each foot of the pipe segments, and graphs depicting the results are shown in the figures below.

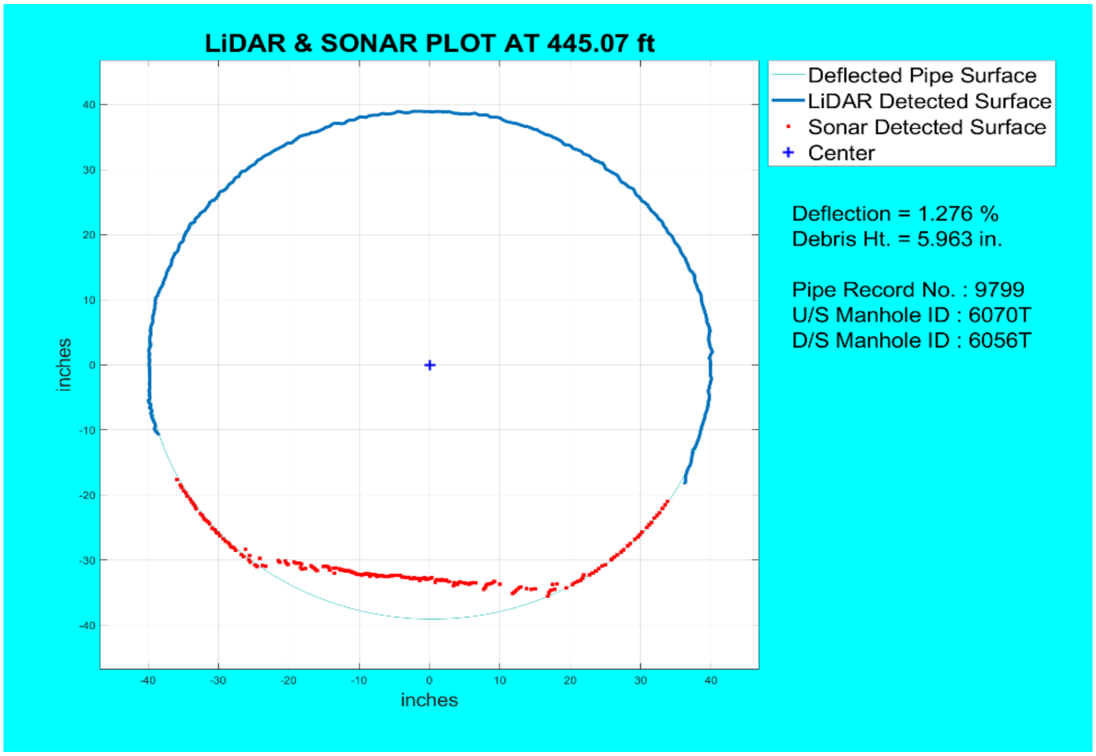

Figure 4-45 Plot from post-processed MSI data for flexible pipe

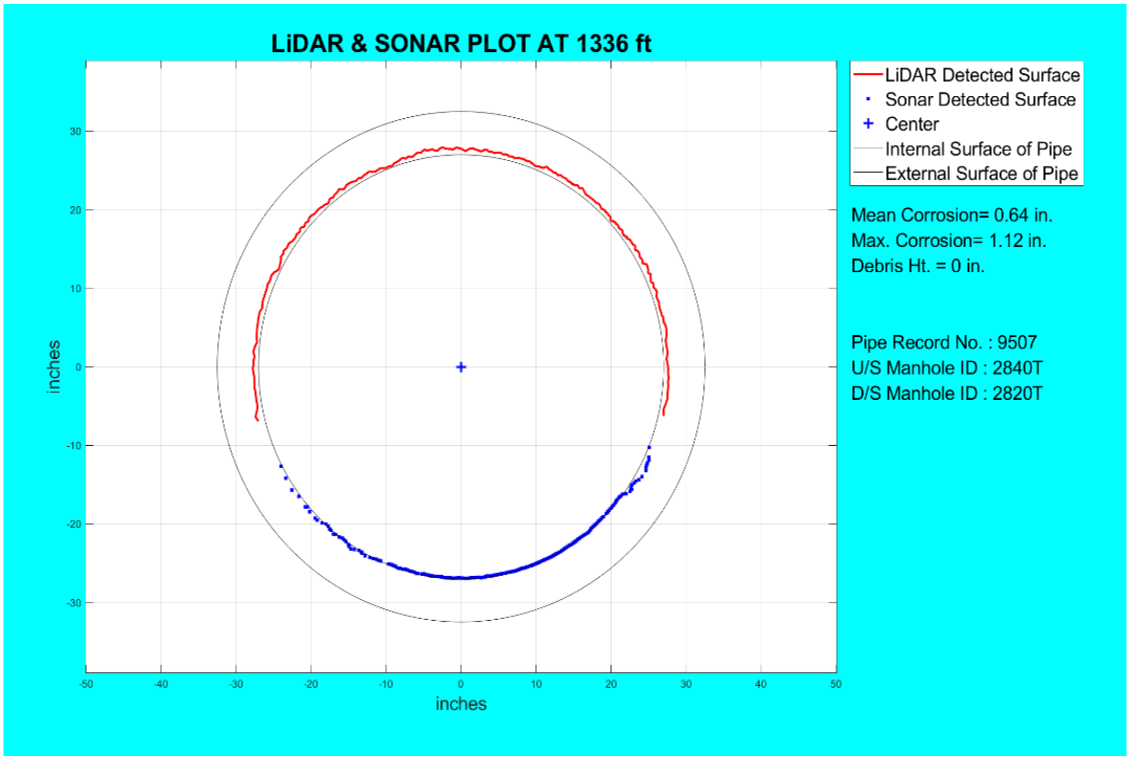

Figure 4-46 Plot from post-processed MSI data for rigid pipe

1. Line 11064

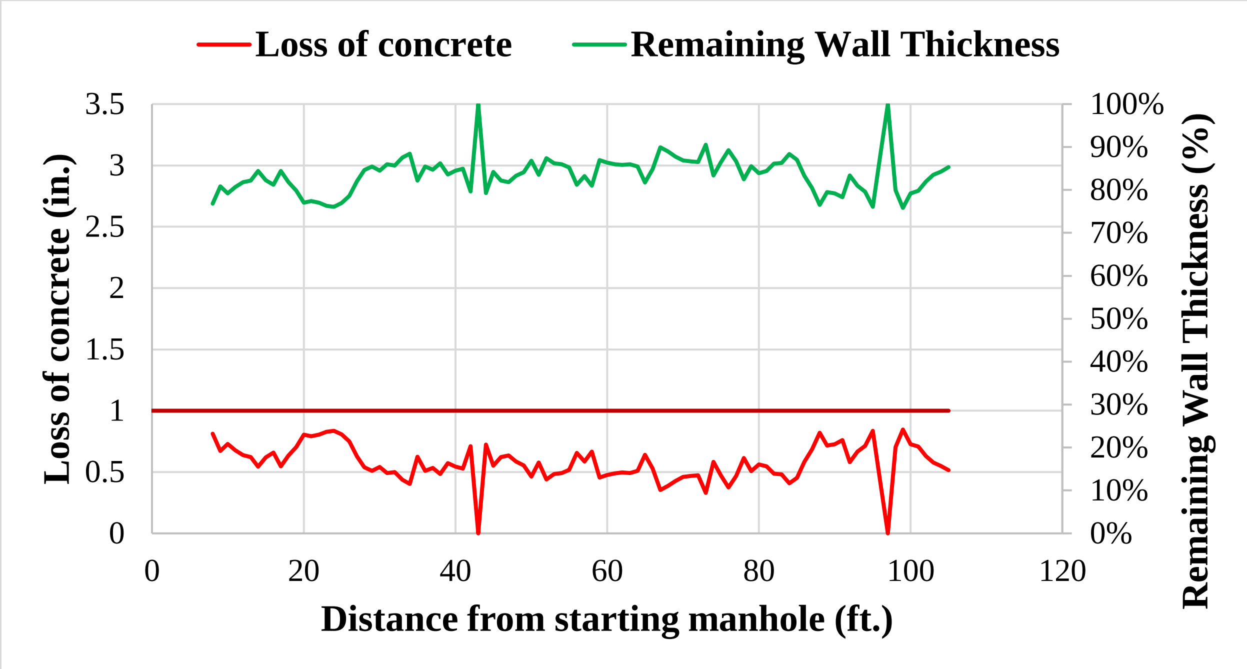

Figure 4-47 Loss of concrete and remaining wall thickness for line 11064

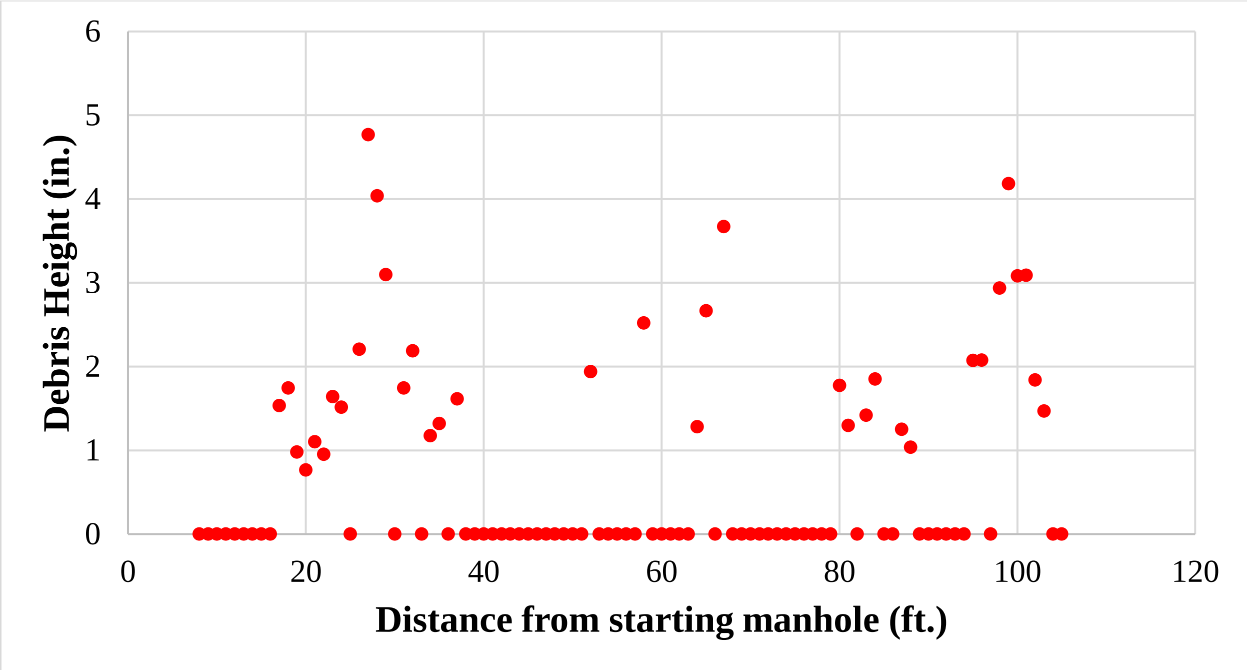

Figure 4-48 Height of debris in line 11064

2. Line 11065

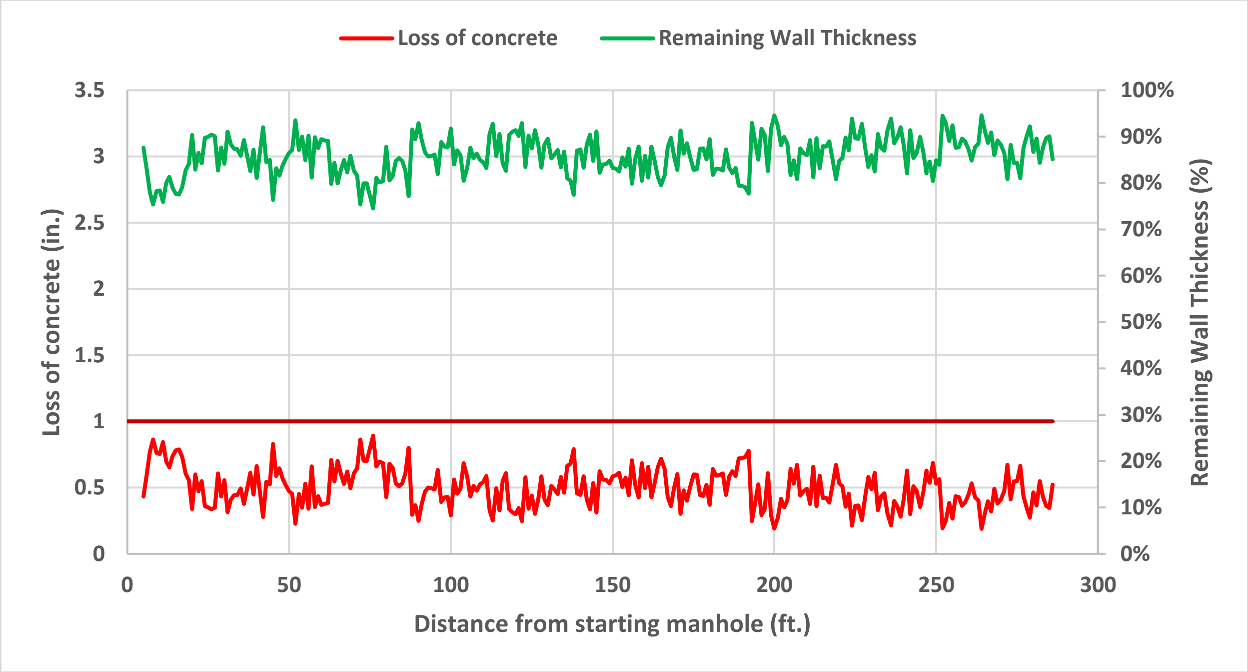

Figure 4-49 Loss of concrete and remaining wall thickness for line 11065

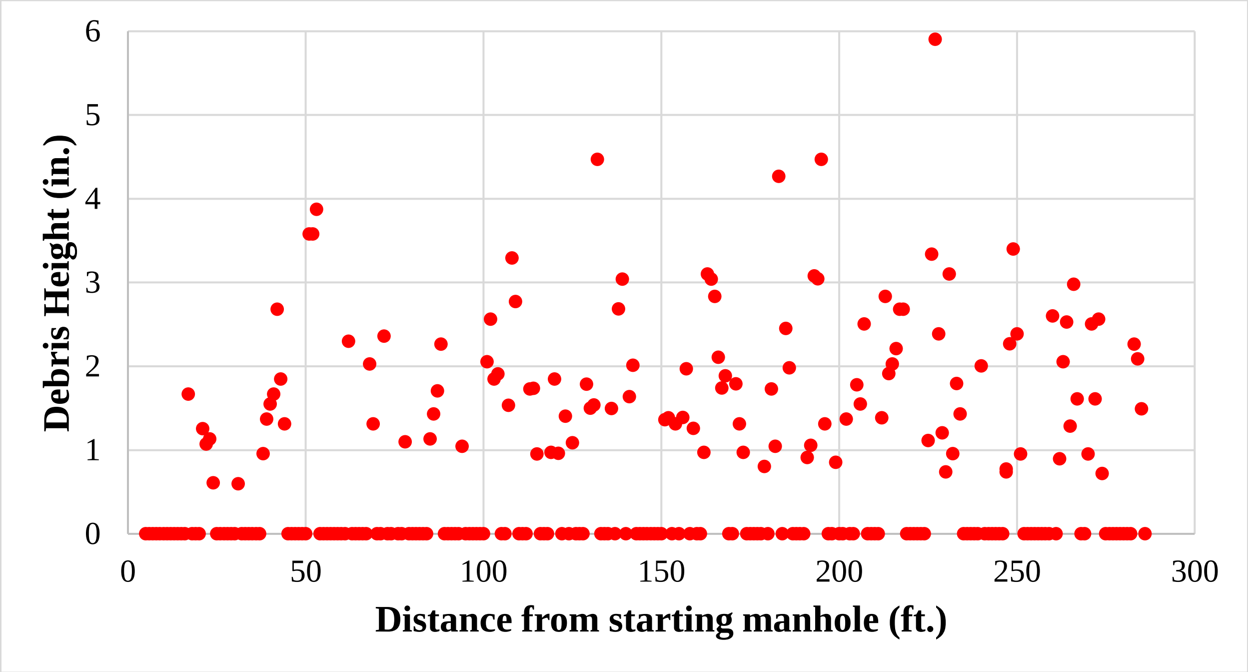

Figure 4-50 Height of debris in line 11065

3. Line 11066

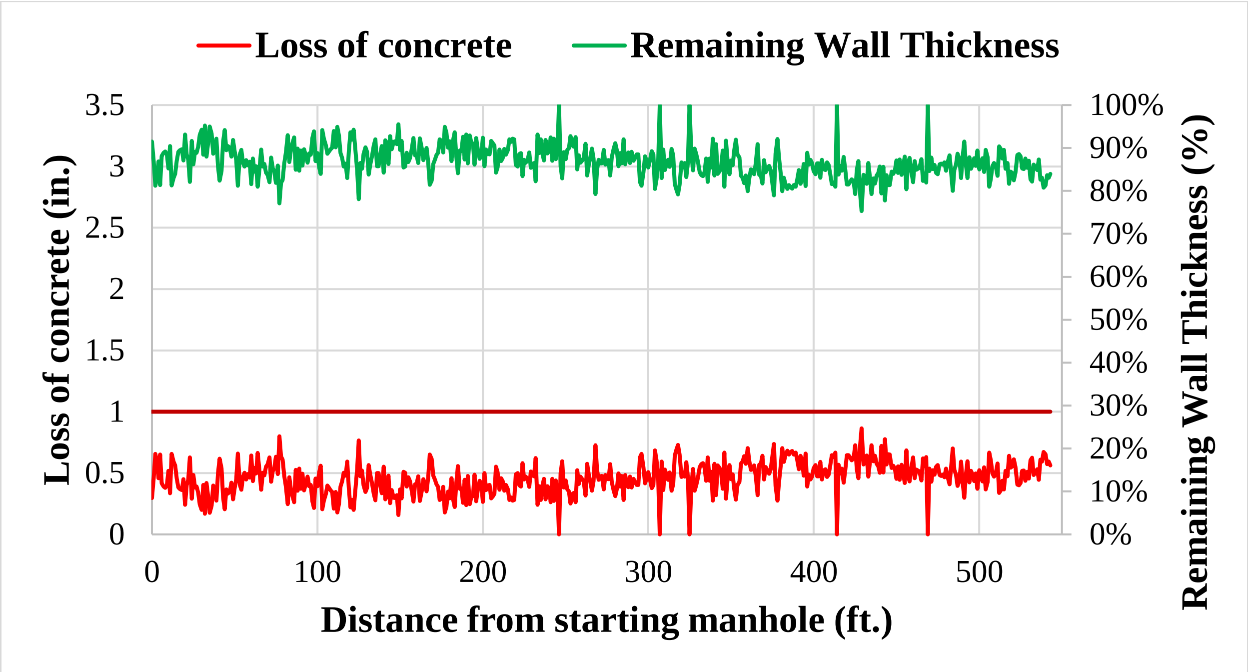

Figure 4-51 Loss of concrete and remaining wall thickness for line 11066

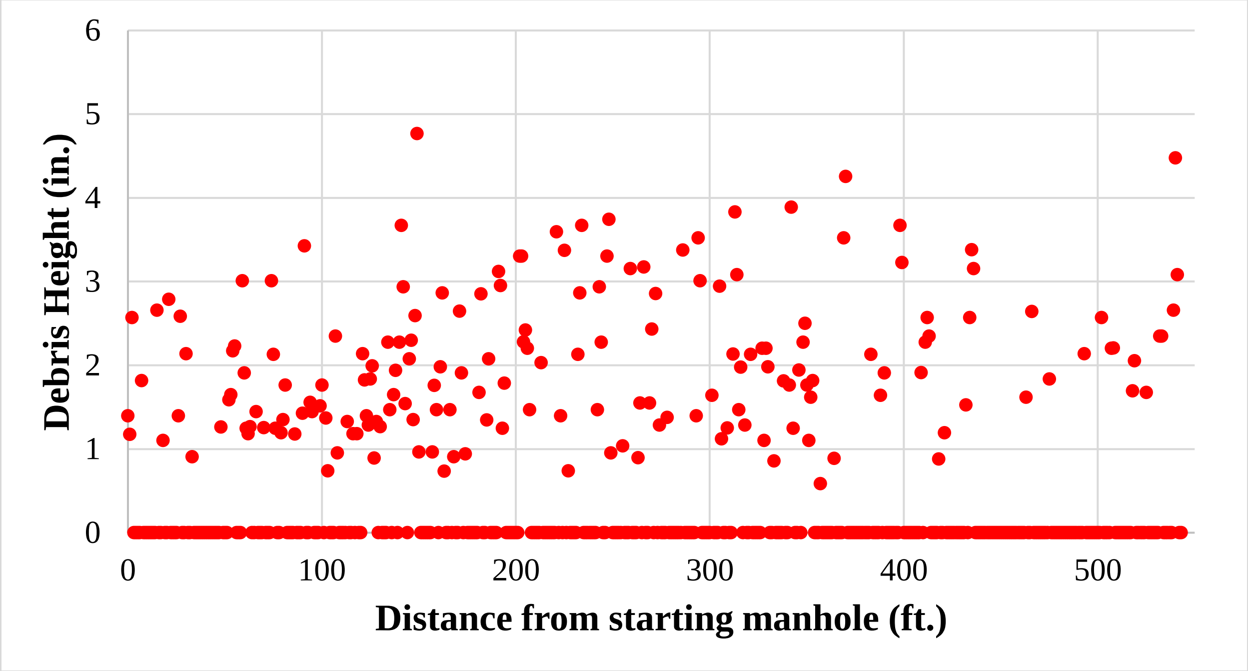

Figure 4-52 Height of debris in line 11066

4. Line 11067

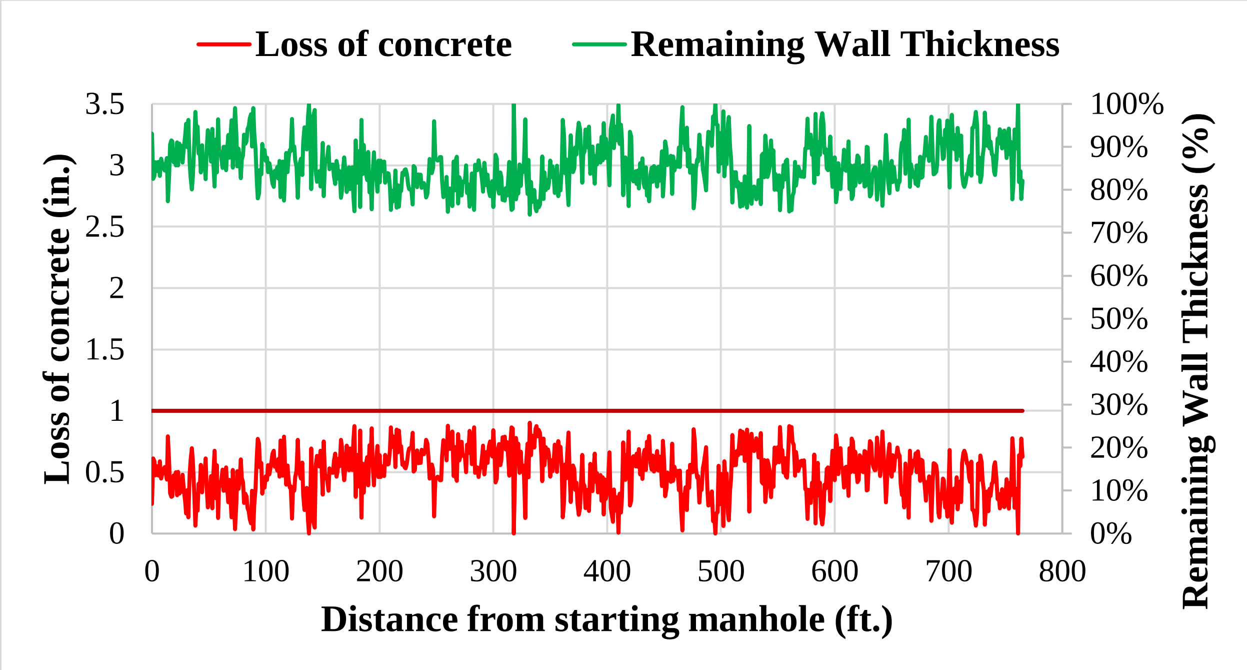

Figure 4-53 Loss of concrete and remaining wall thickness for line 11067

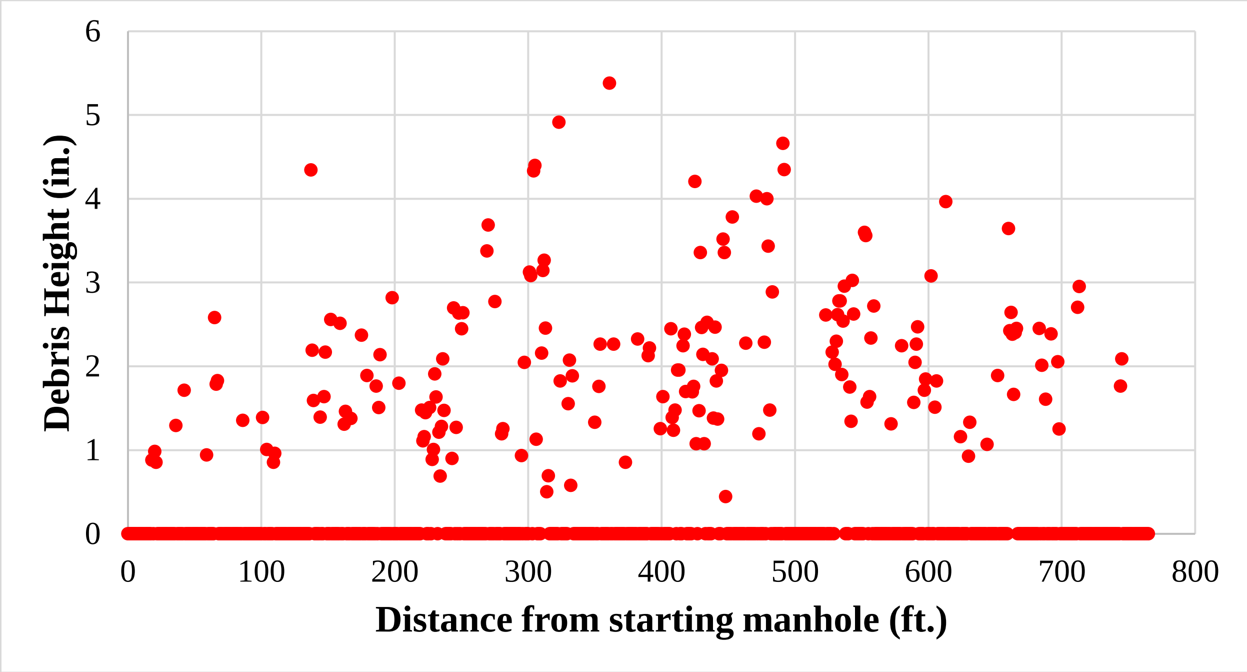

Figure 4-54 Height of debris in line 11067

5. Line 11068

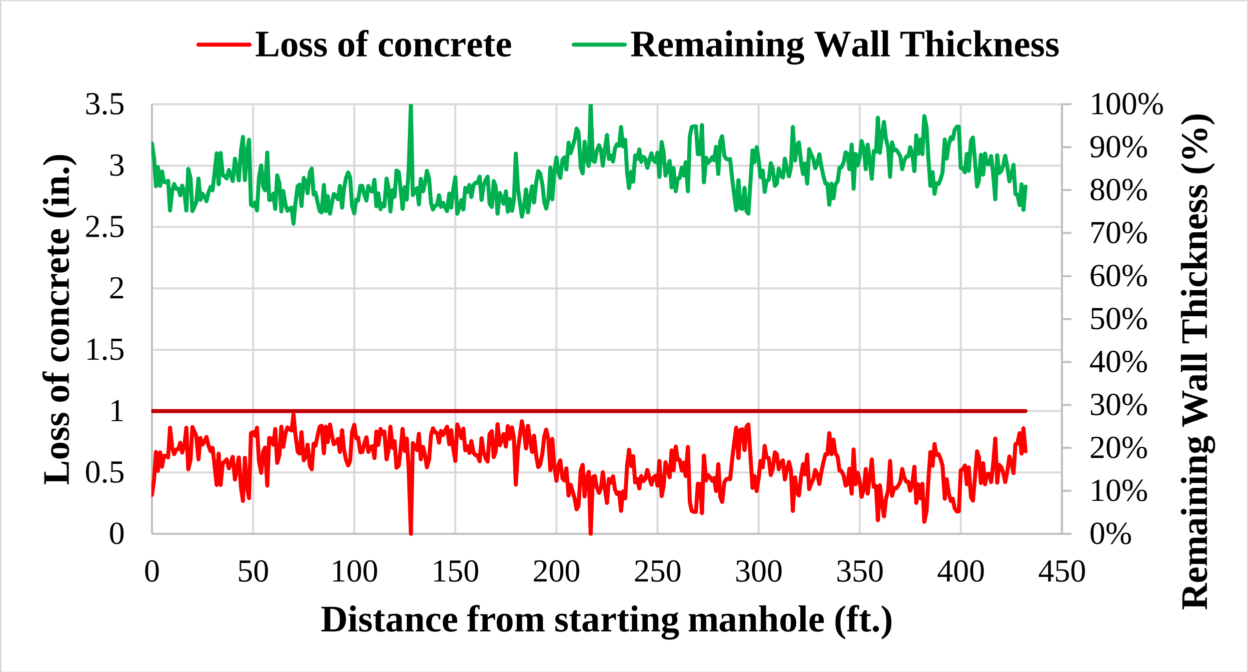

Figure 4-55 Loss of concrete and remaining wall thickness for line 11068

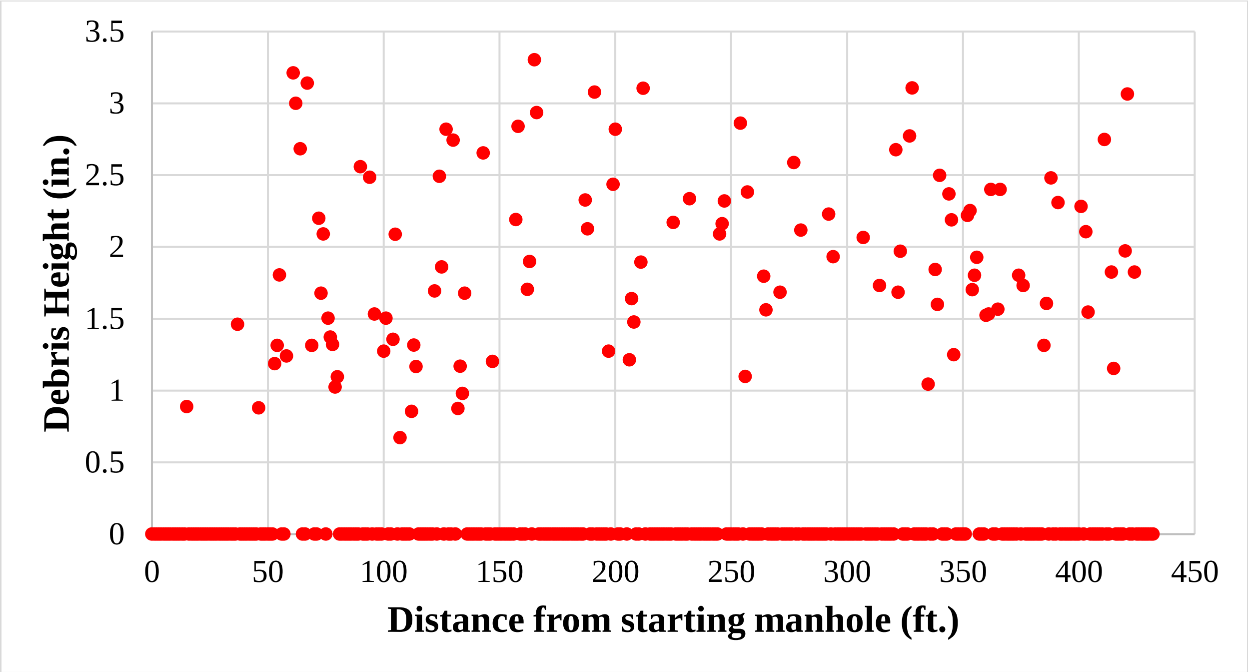

Figure 4-56 Height of debris in line 11068

6. Line 11069

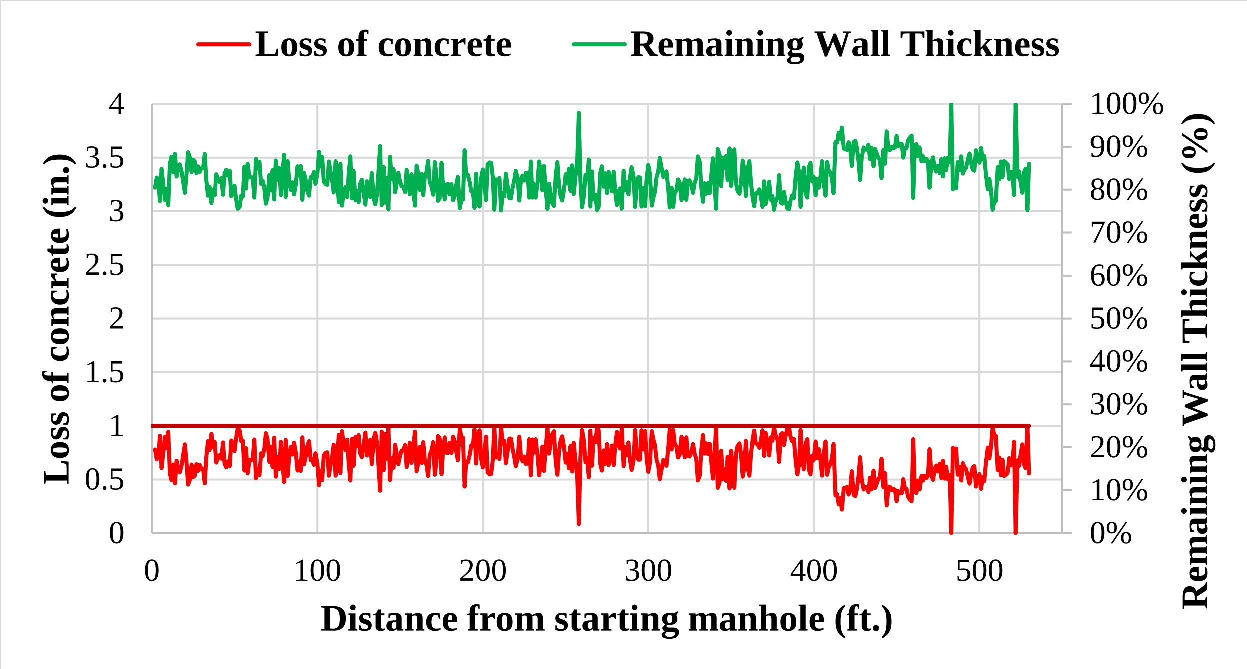

Figure 4-57 Loss of concrete and remaining wall thickness for line 11069

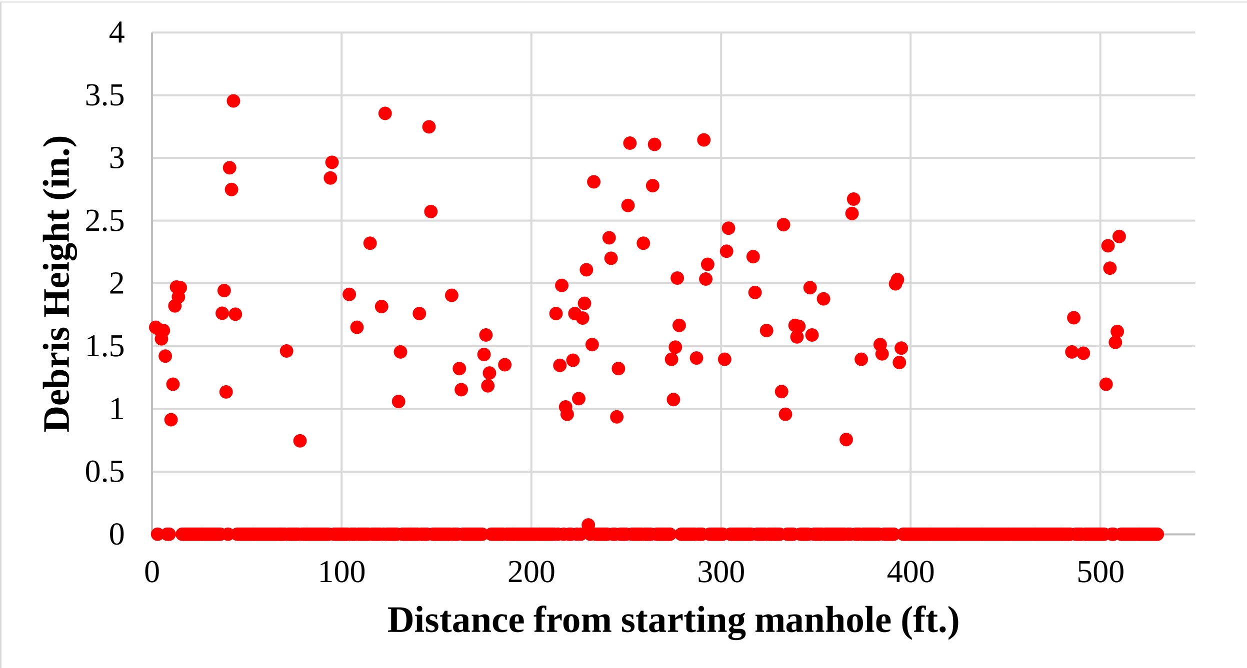

Figure 4-58 Height of debris in line 11069

7. Line 11070

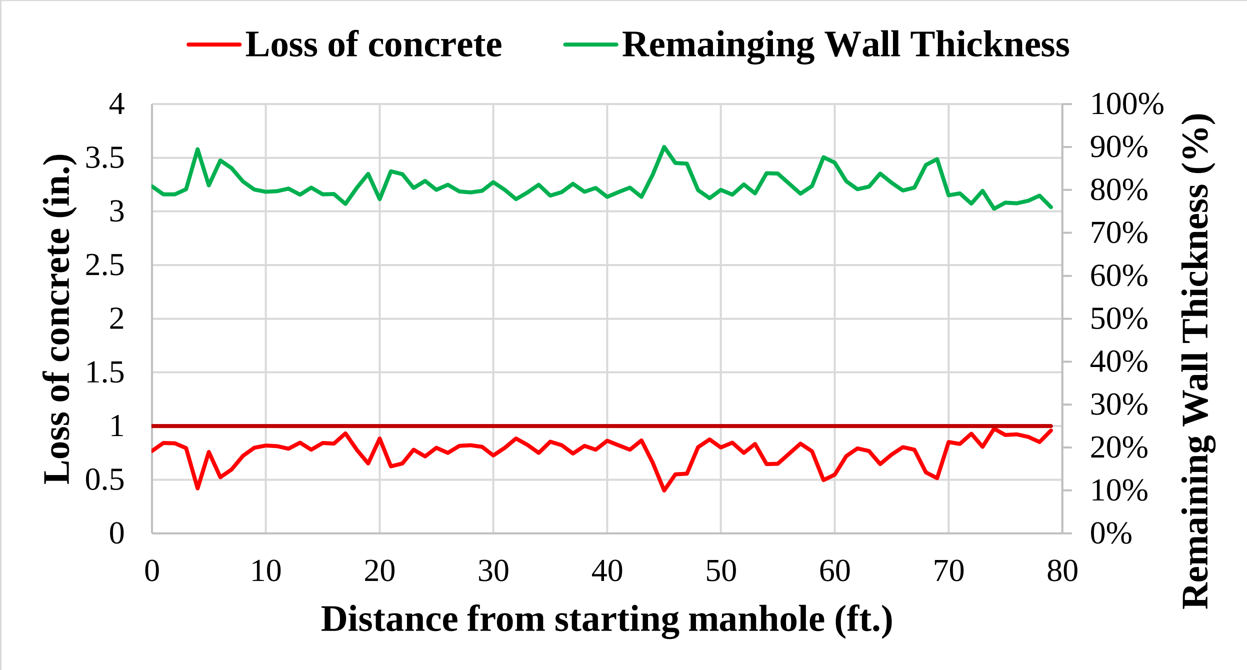

Figure 4-59 Loss of concrete and remaining wall thickness for line 11070

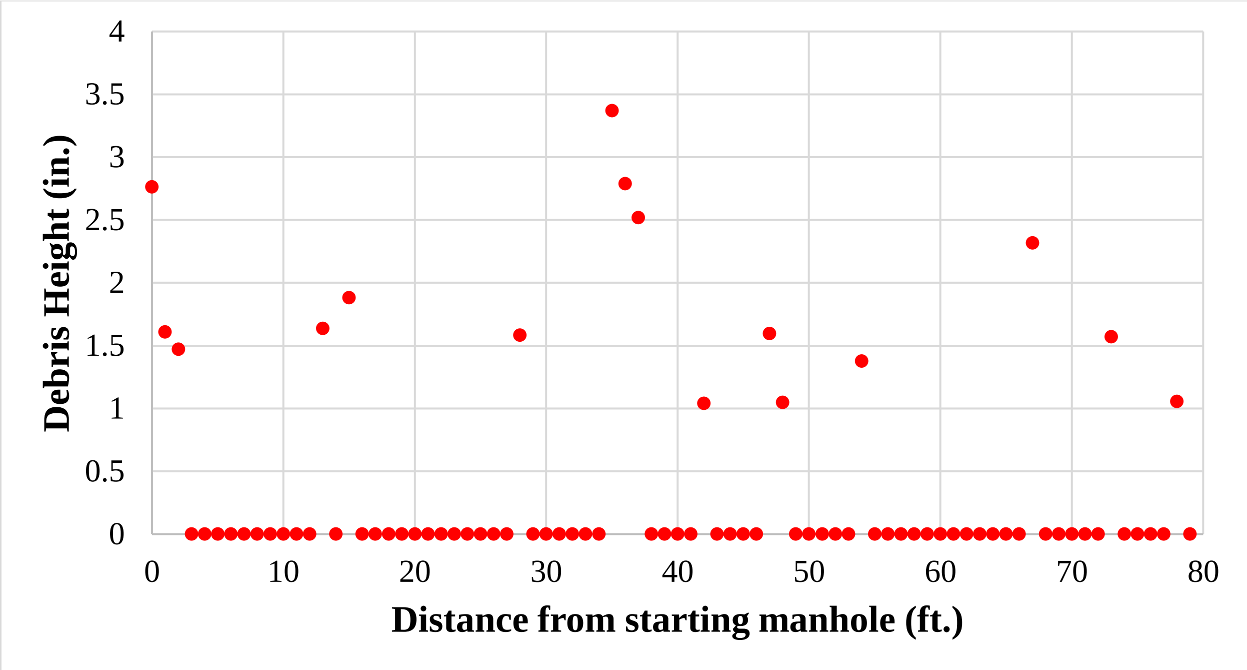

Figure 4-60 Height of debris in line 11070

8. Line 12348

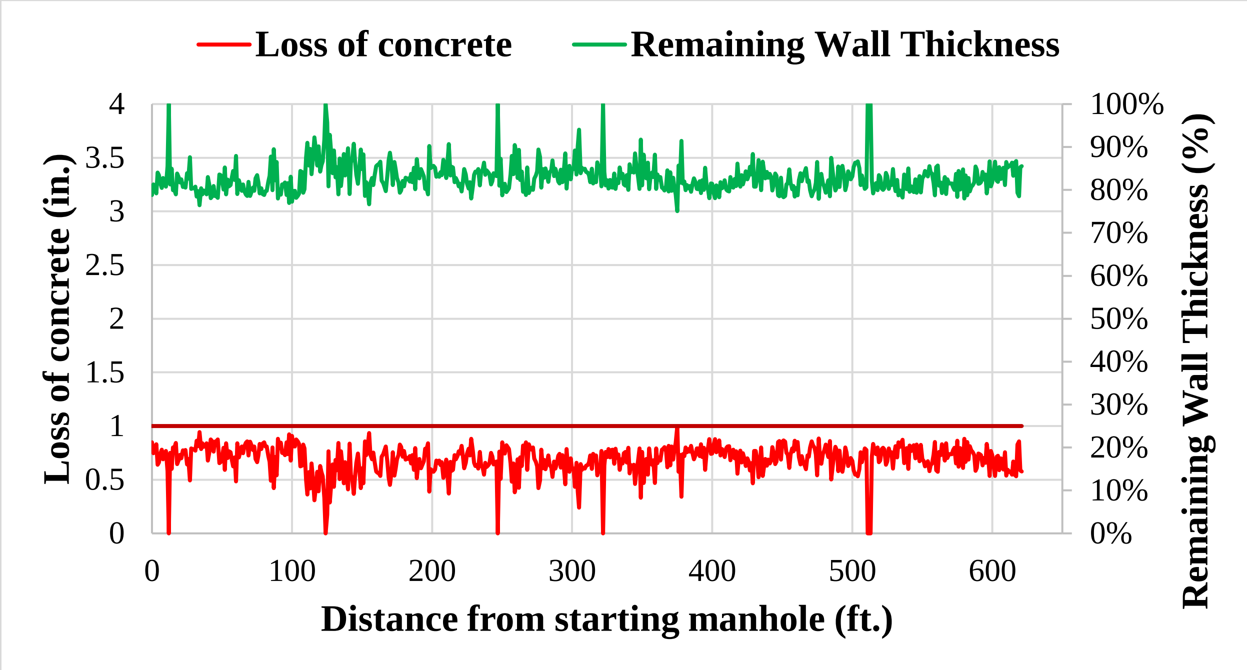

Figure 4-61 Loss of concrete and remaining wall thickness for line 12348

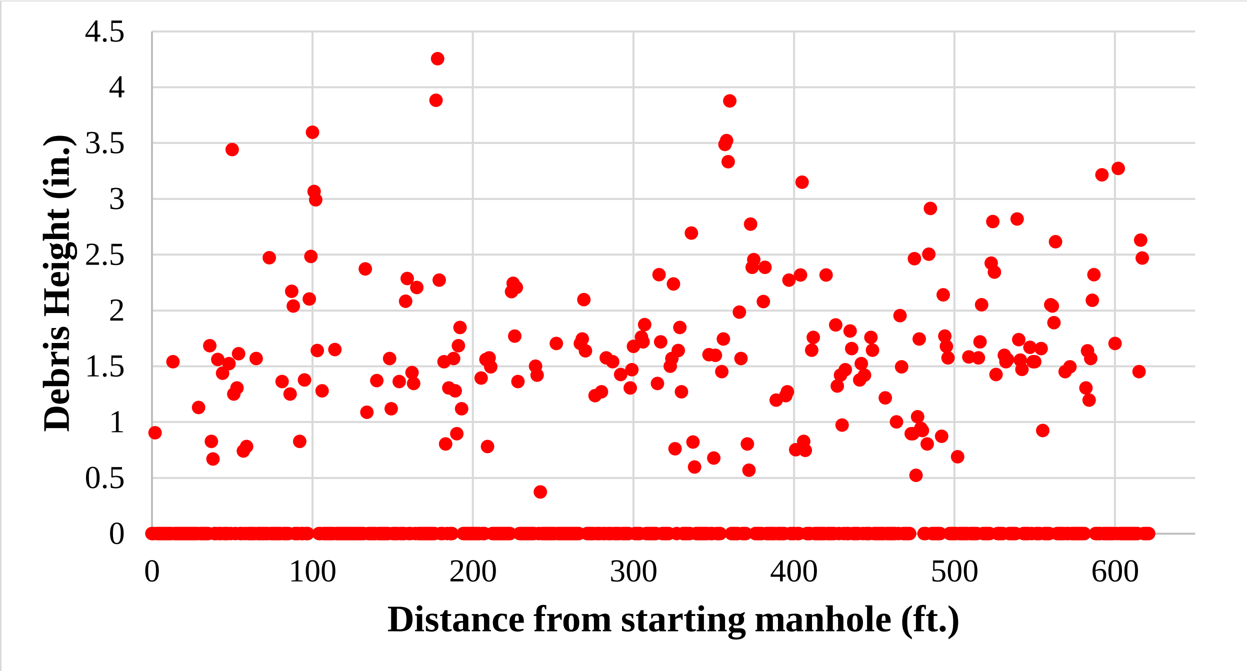

Figure 4-62 Height of debris in line 12348

9. Line 11071

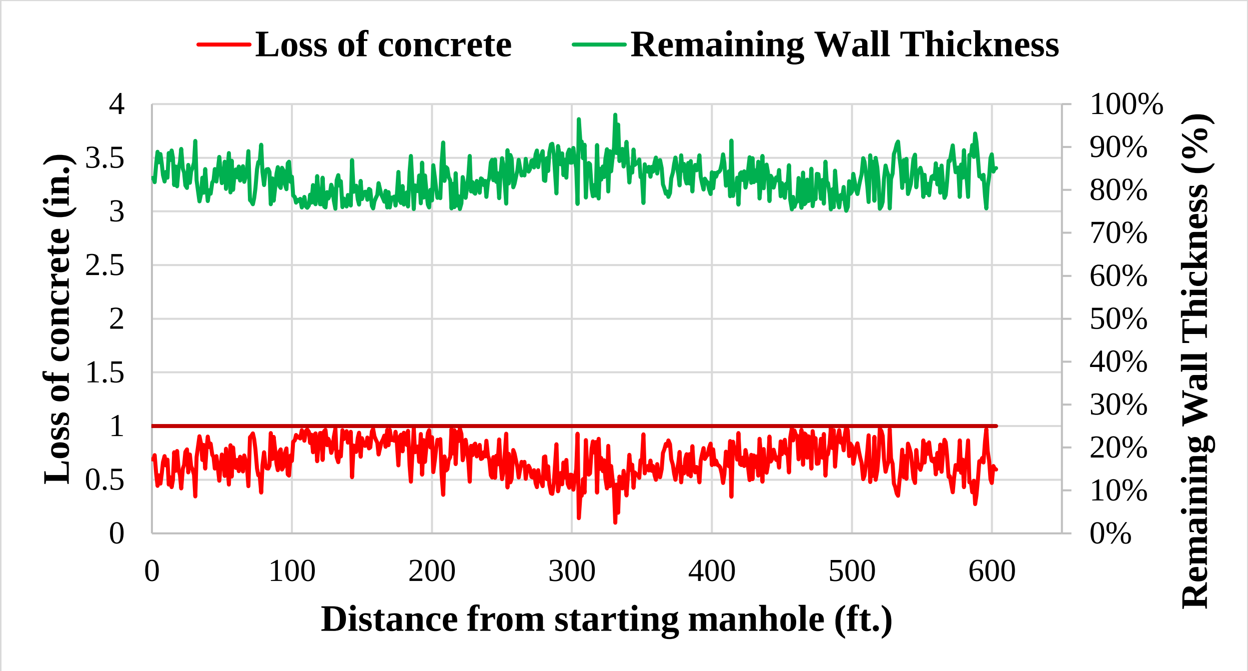

Figure 4-63 Loss of concrete and remaining wall thickness for line 11071

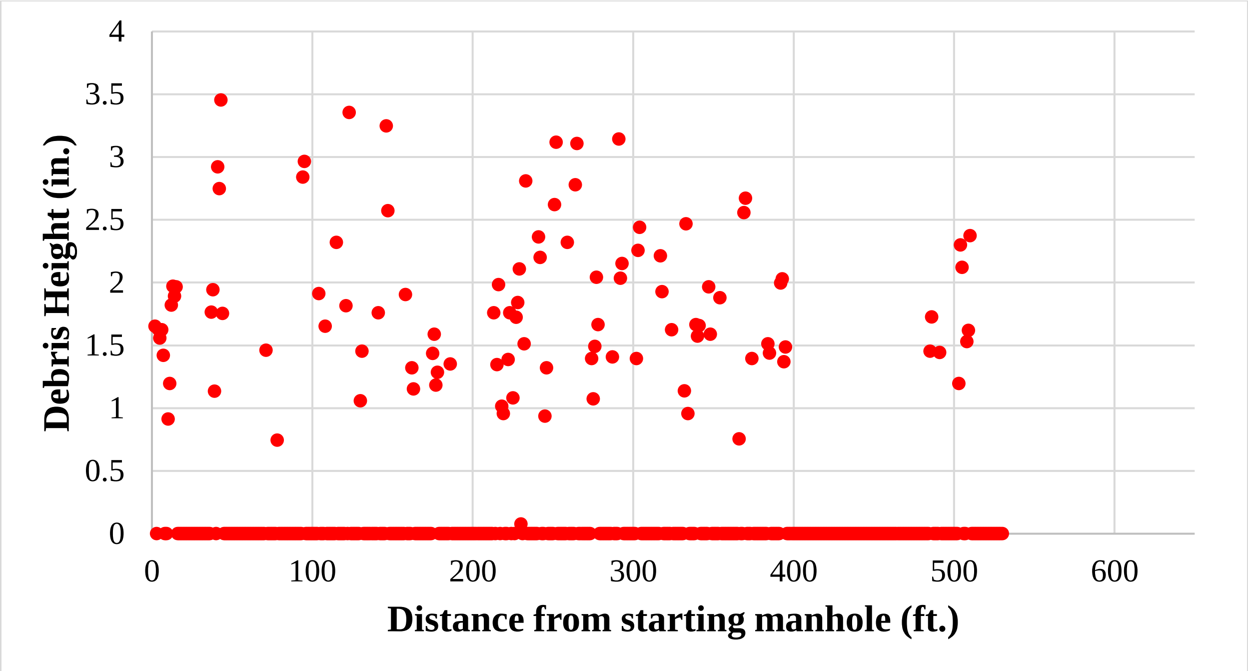

Figure 4-64 Height of debris in line 11071

10. Line 11072

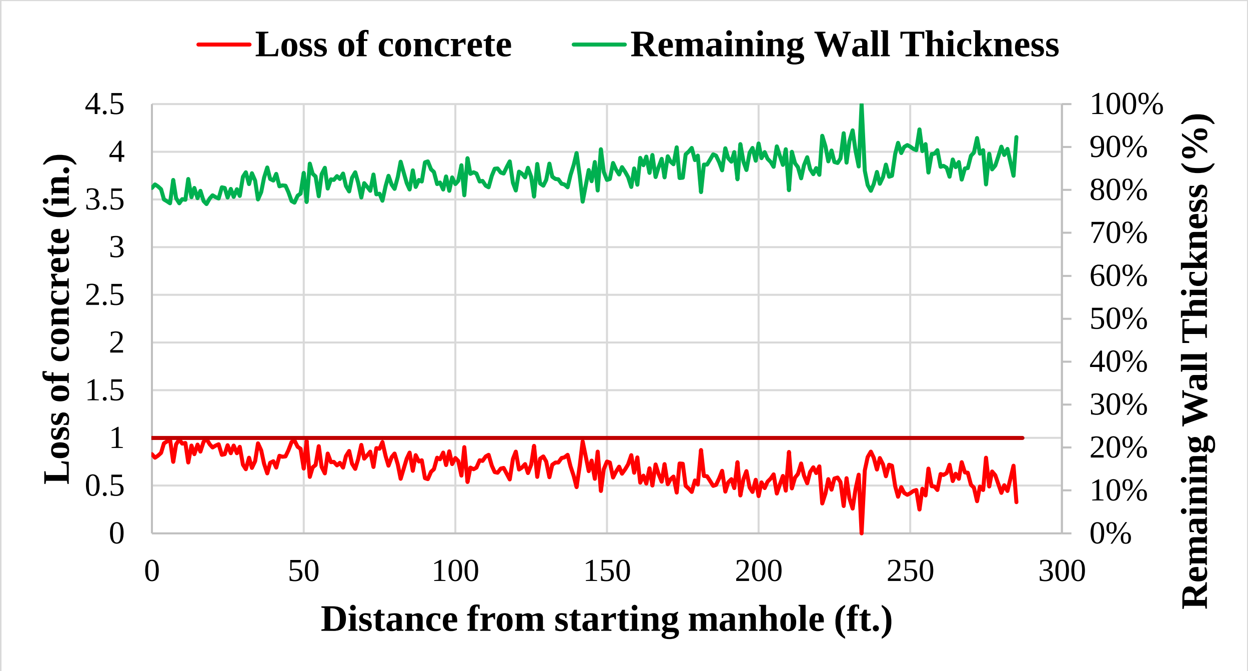

Figure 4-65 Loss of concrete and remaining wall thickness for line 11072

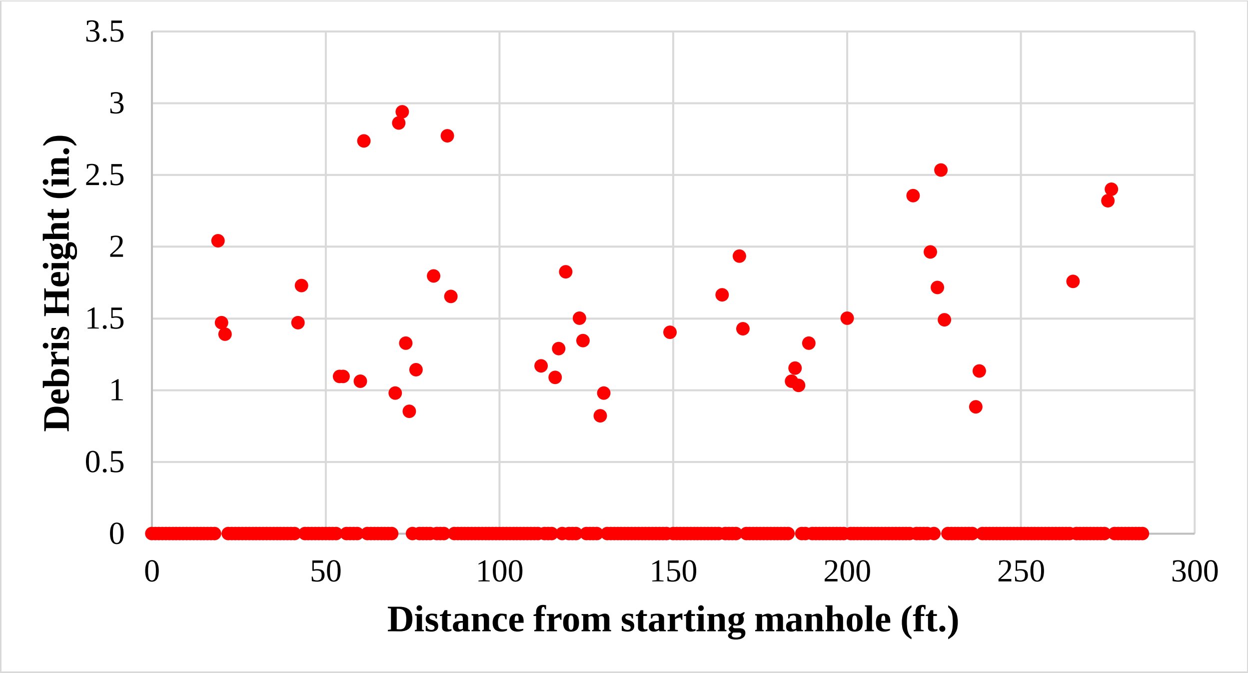

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Figure 4-66 Height of debris in line 11072

11. Line 11073

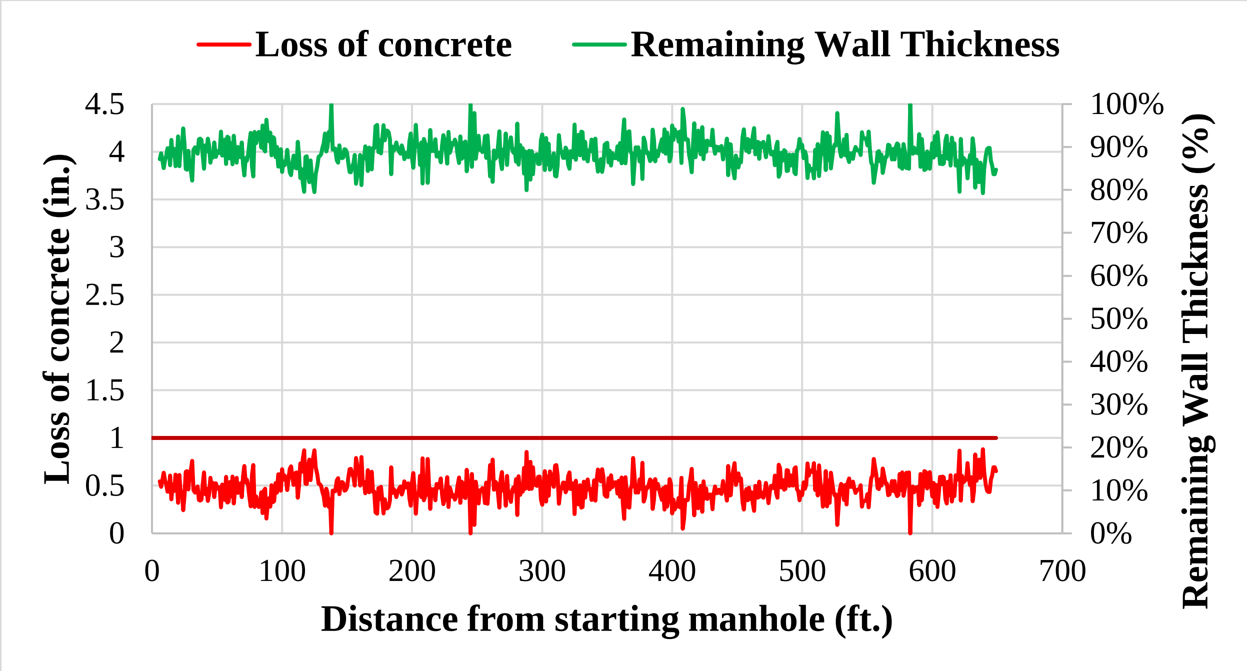

Figure 4-67 Loss of concrete and remaining wall thickness for line 11073

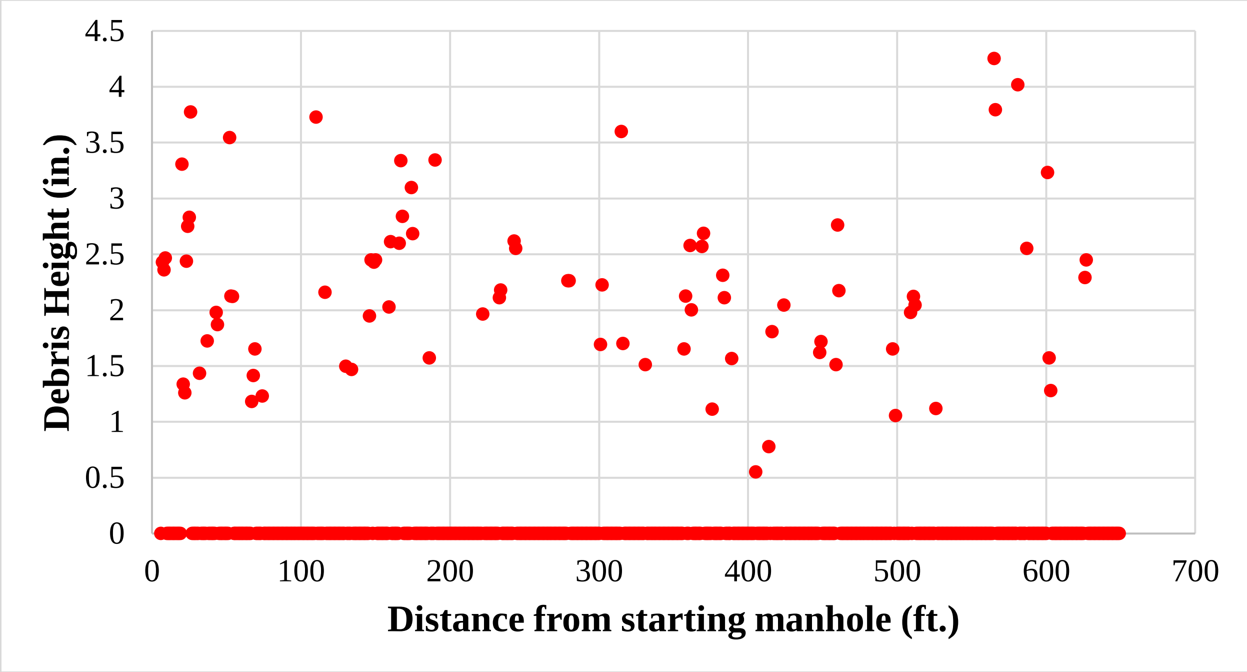

Figure 4-68 Height of debris in line 11073

12. Line 11074

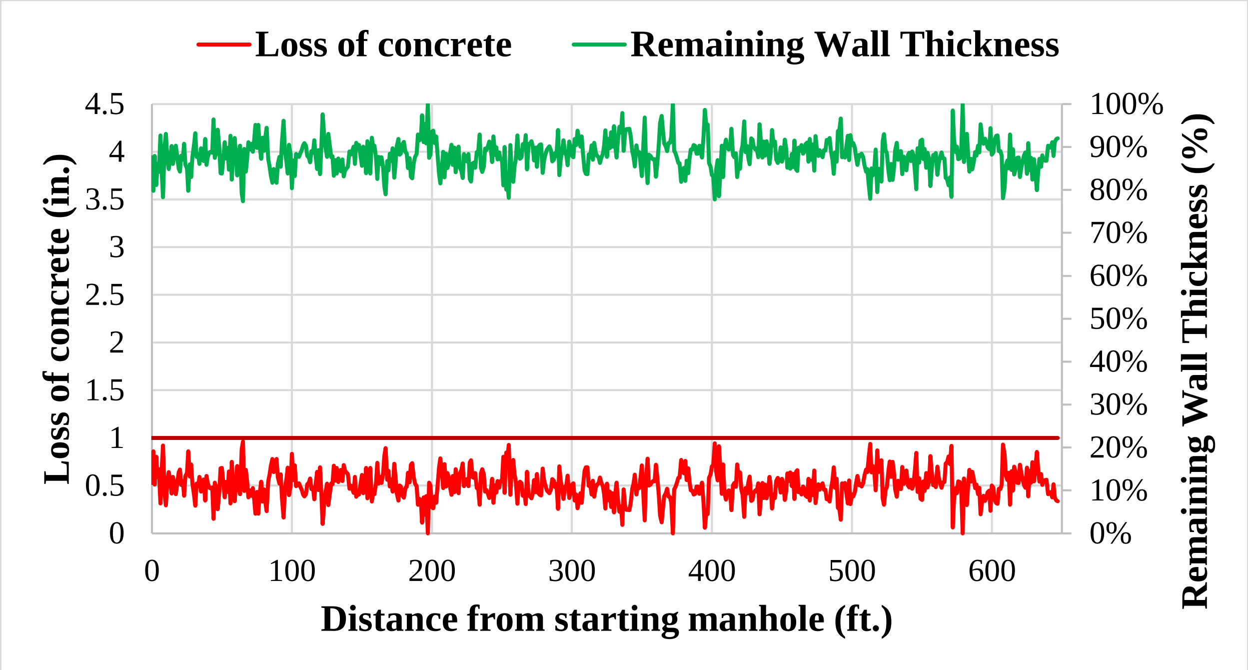

Figure 4-69 Loss of concrete and remaining wall thickness for line 11074

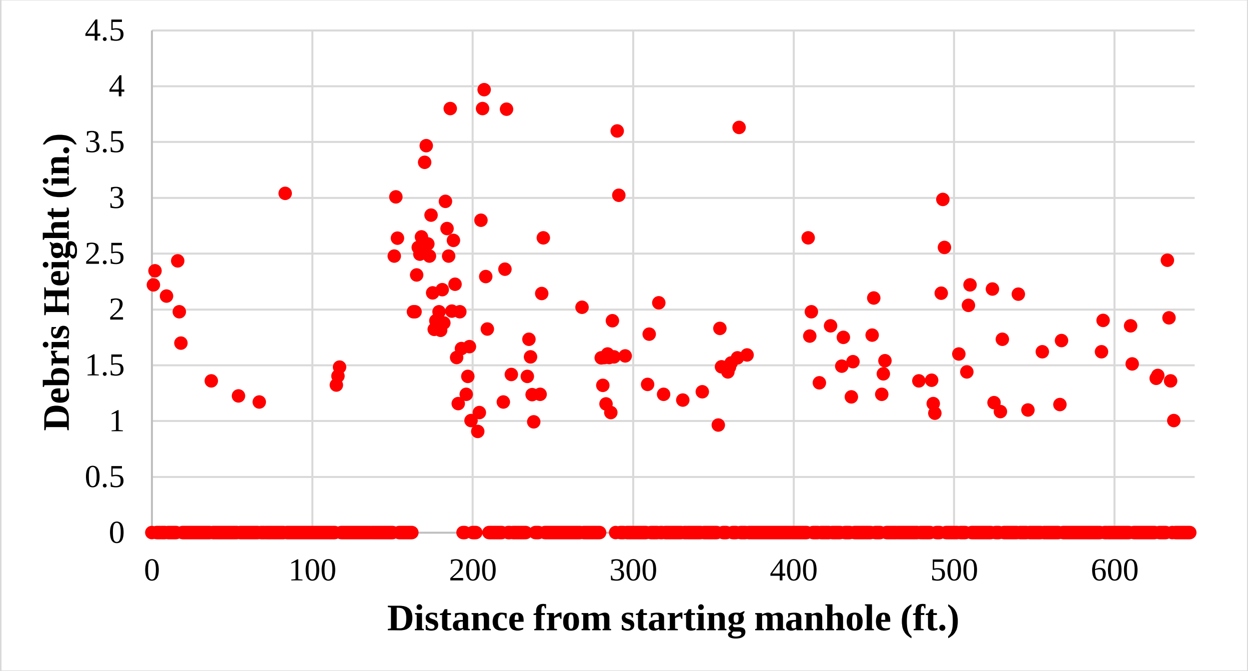

Figure 4-70 Height of debris in line 11074

13. Line 11075

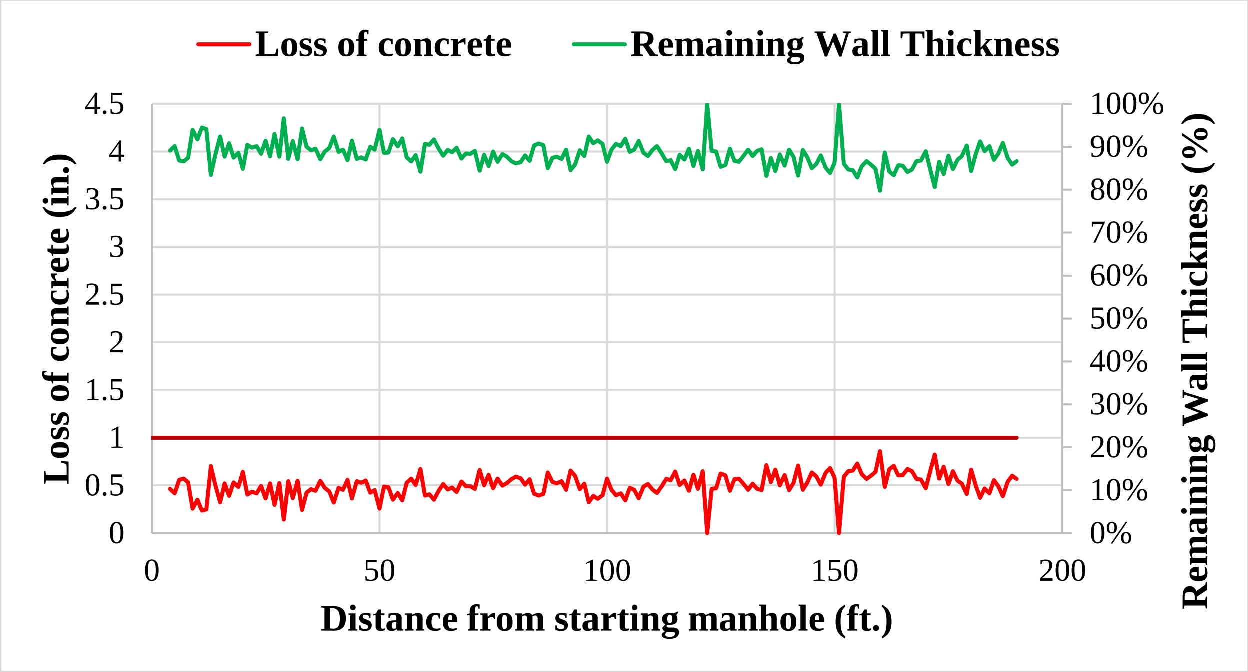

Figure 4-71 Loss of concrete and remaining wall thickness for line 11075

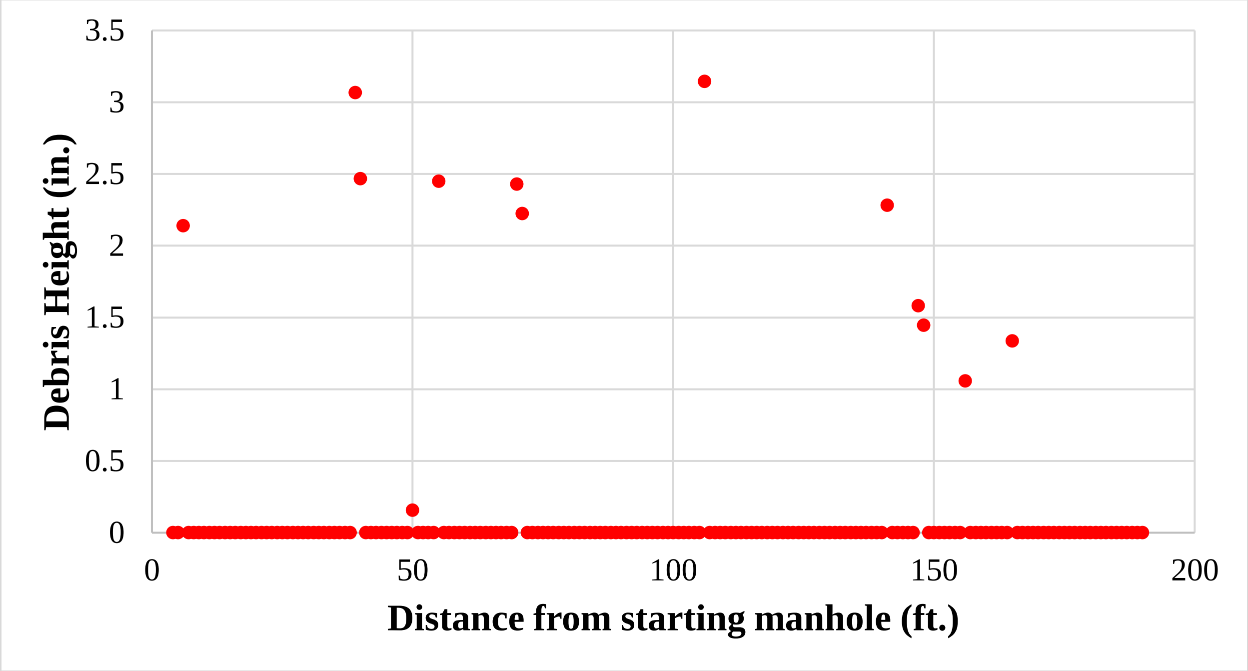

Figure 4-72 Height of debris in line 11075

14. Line 11076

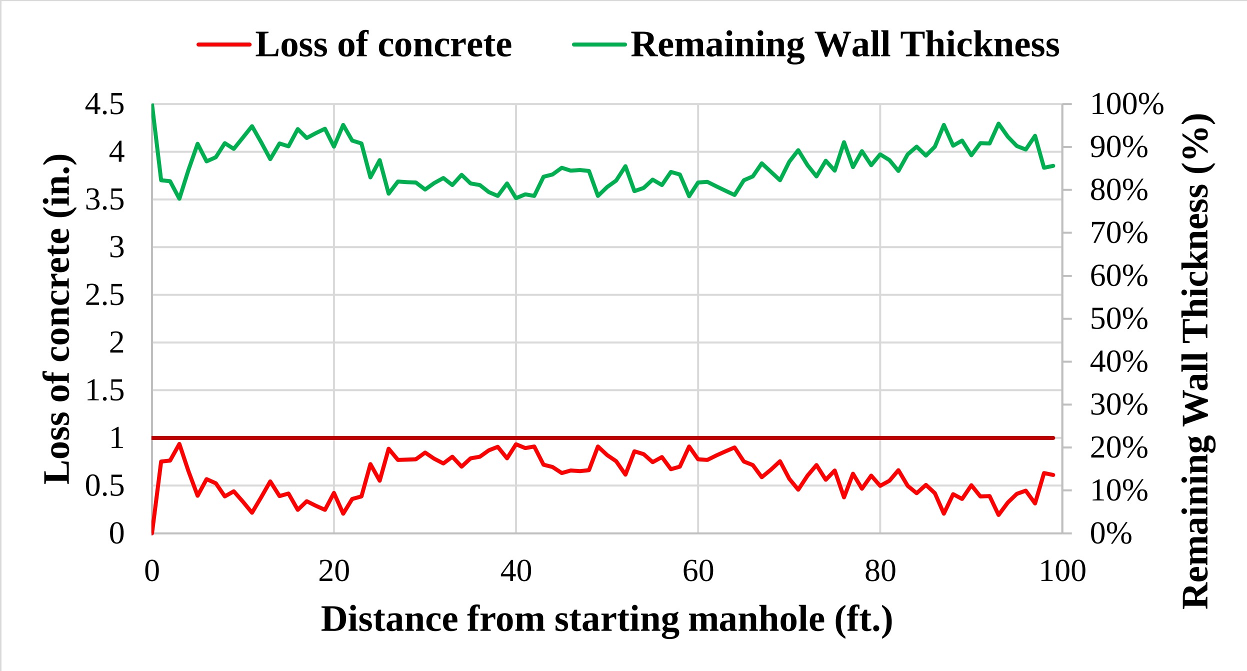

Figure 4-73 Loss of concrete and remaining wall thickness for line 11076

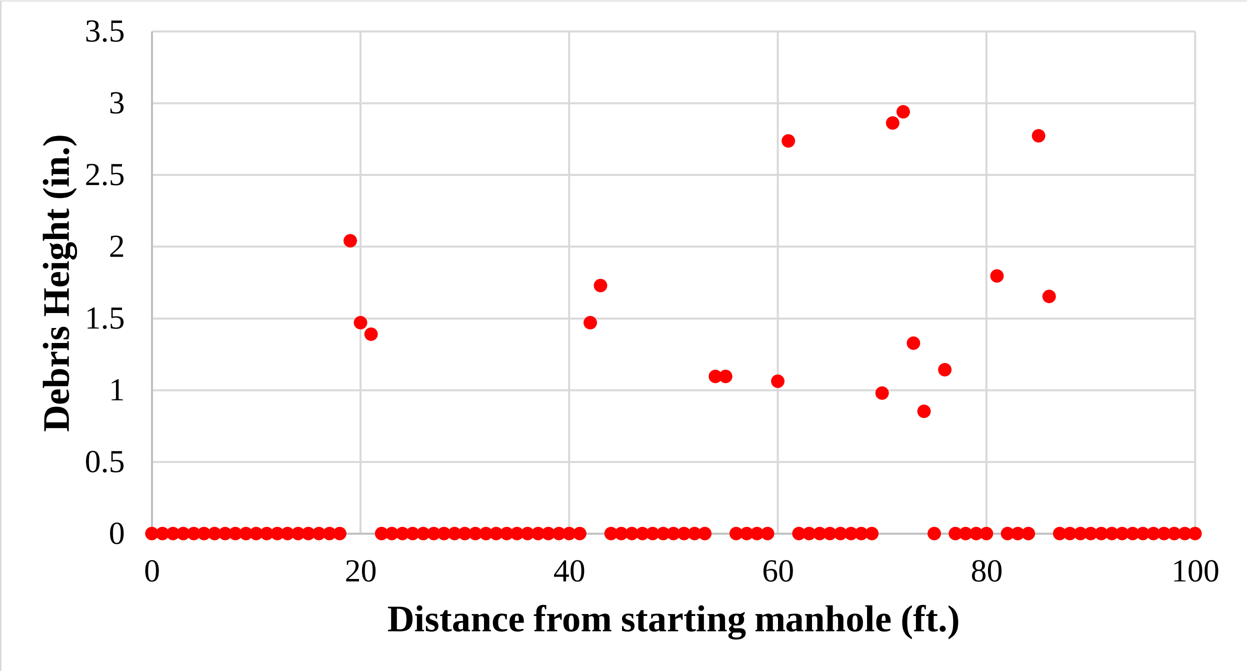

Figure 4-74 Height of debris in line 11076

15. Line 15505

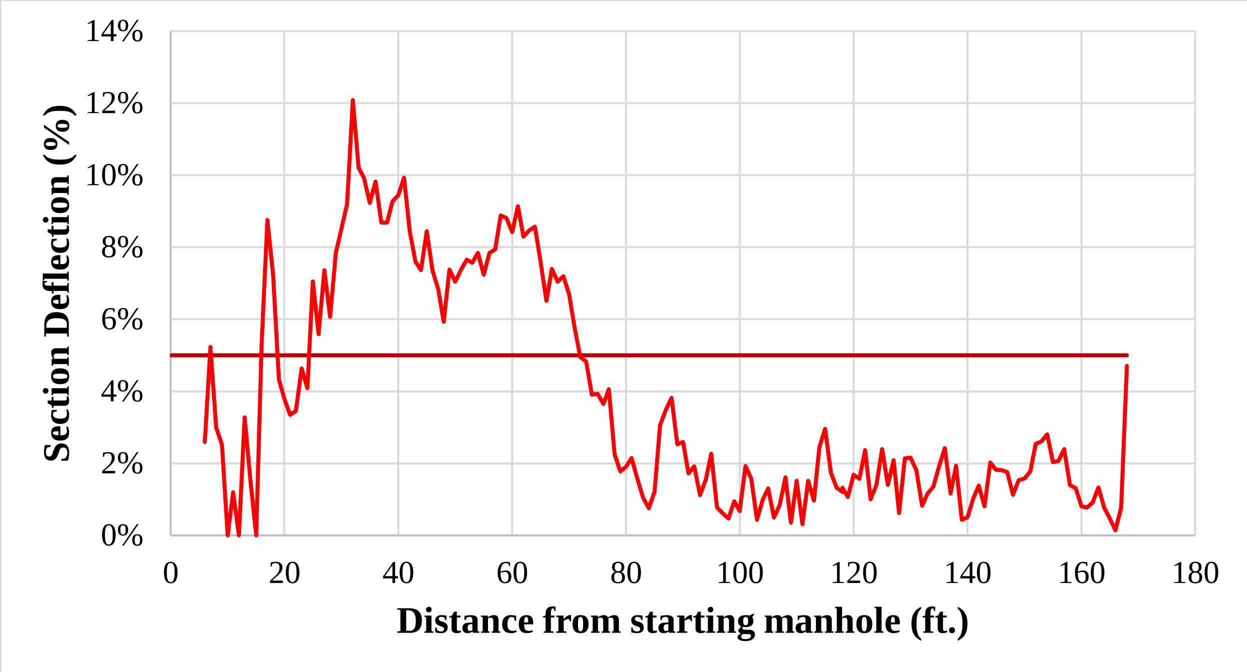

Figure 4-75 Slope deflection for line 15505 (flexible pipe)

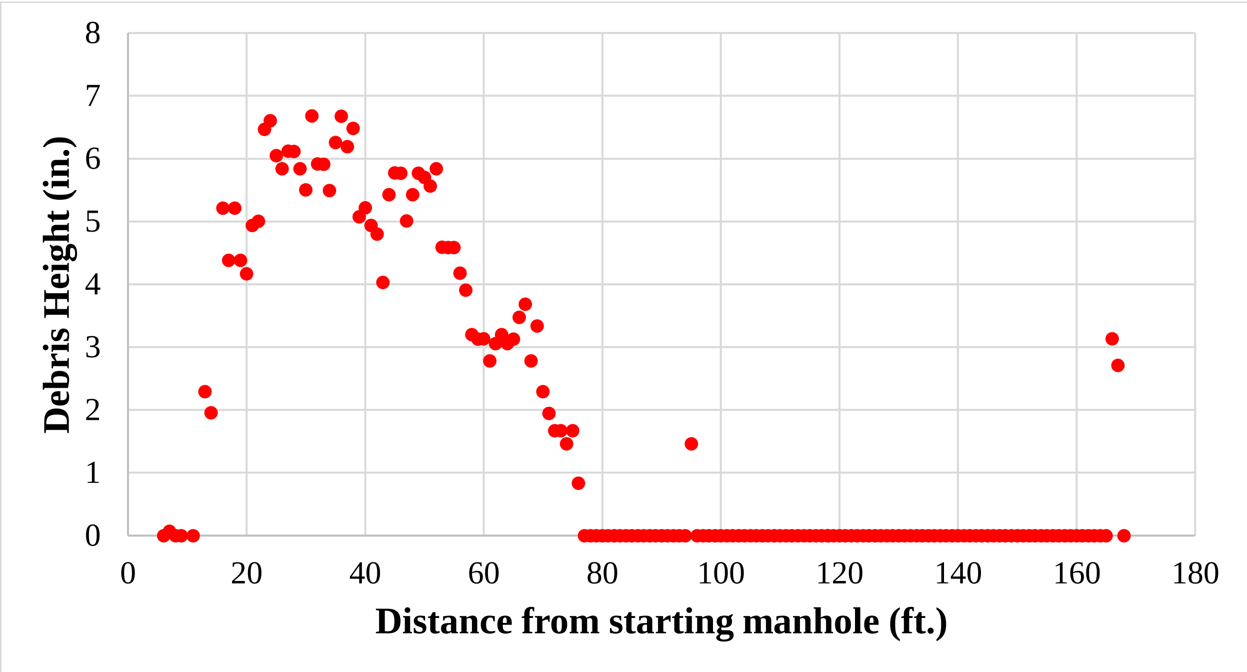

Figure 4-76 Height of debris in line 15505

16. Line 11189

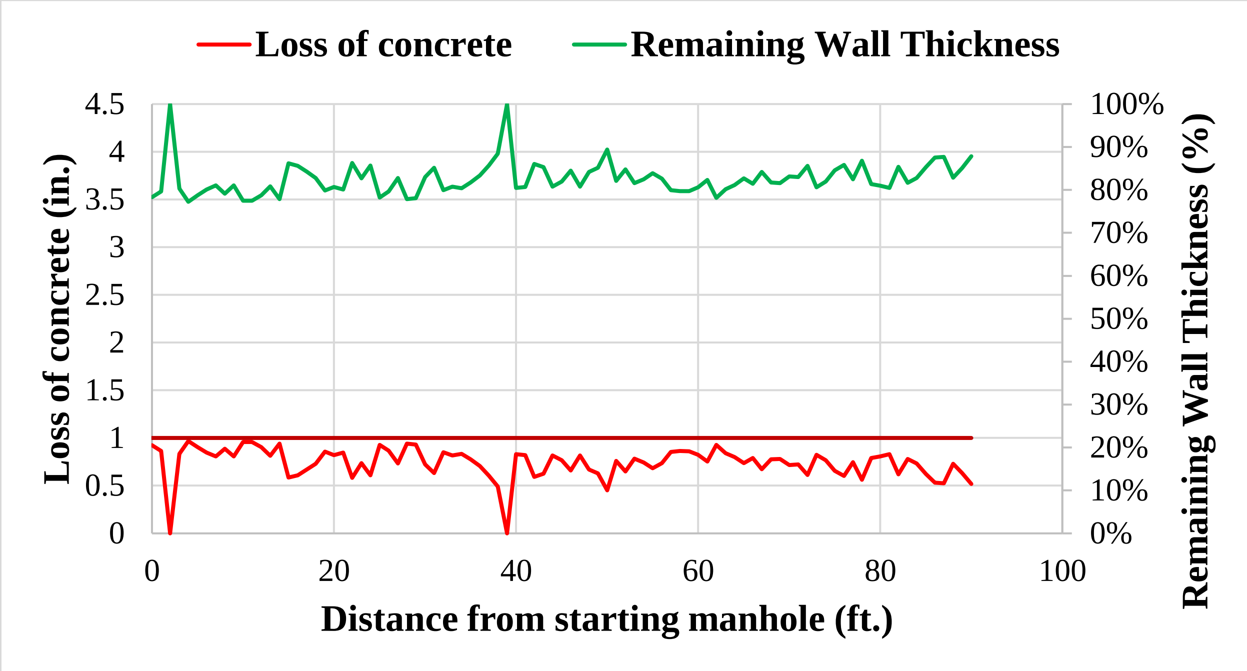

Figure 4-77 Loss of concrete and remaining wall thickness for line 11189

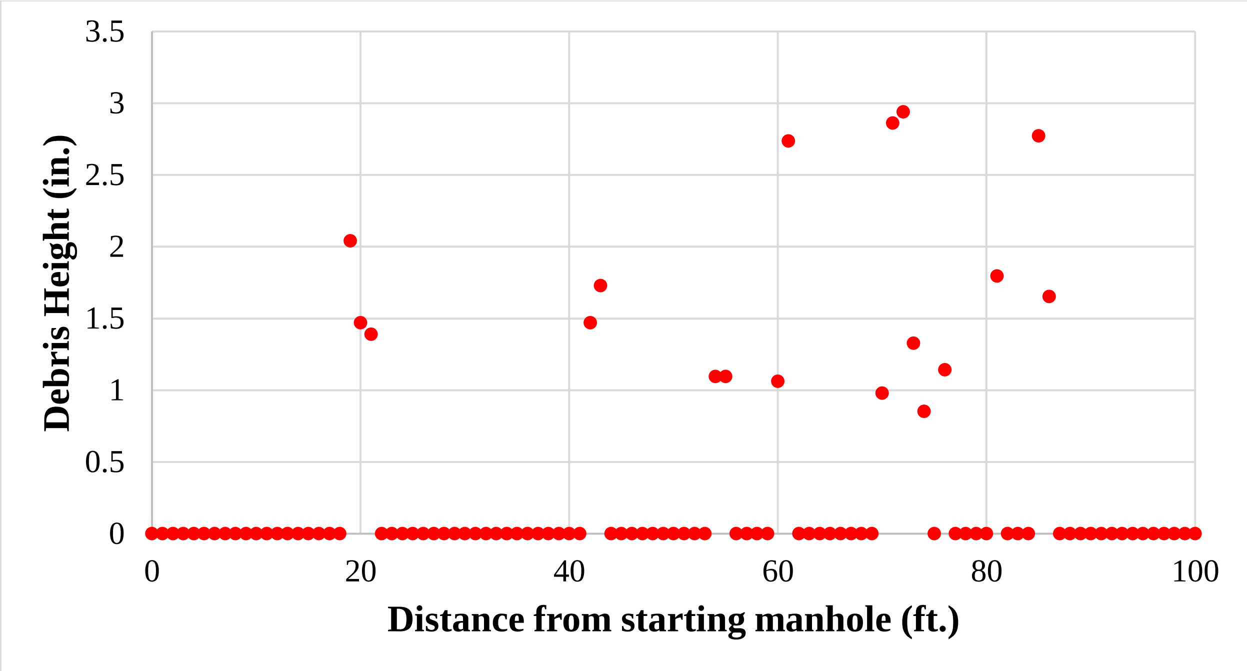

Figure 4-78 Height of debris in line 11189

17. Line 11077

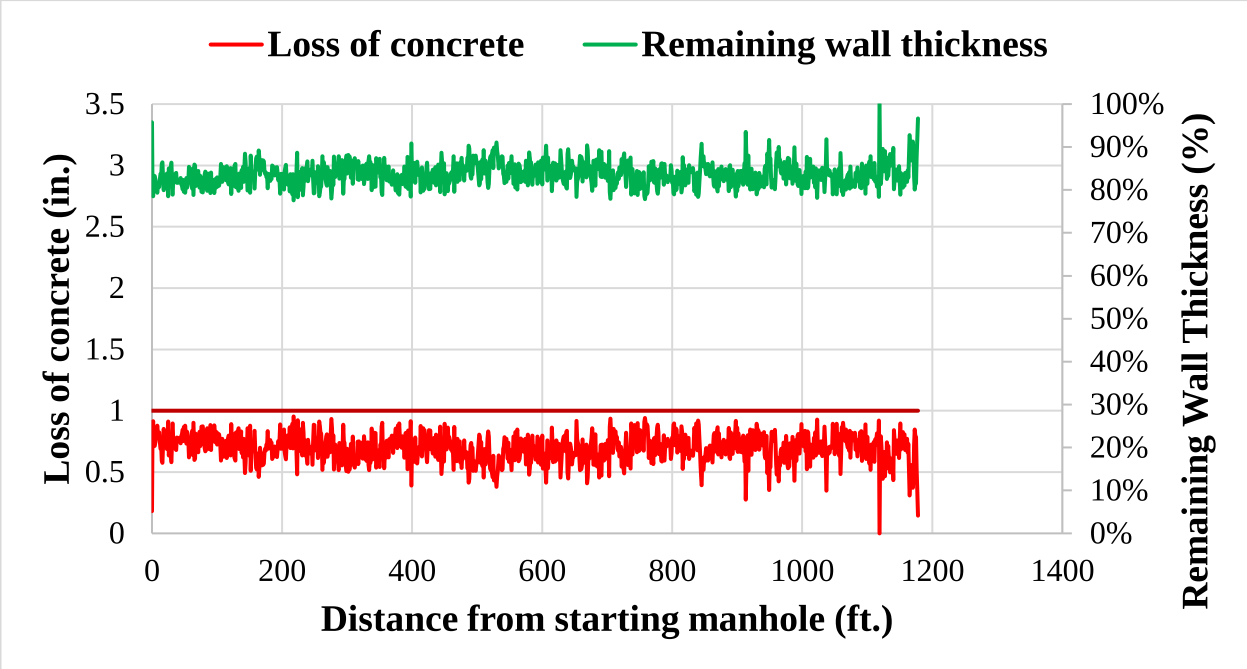

Figure 4-79 Loss of concrete and remaining wall thickness for line 11077

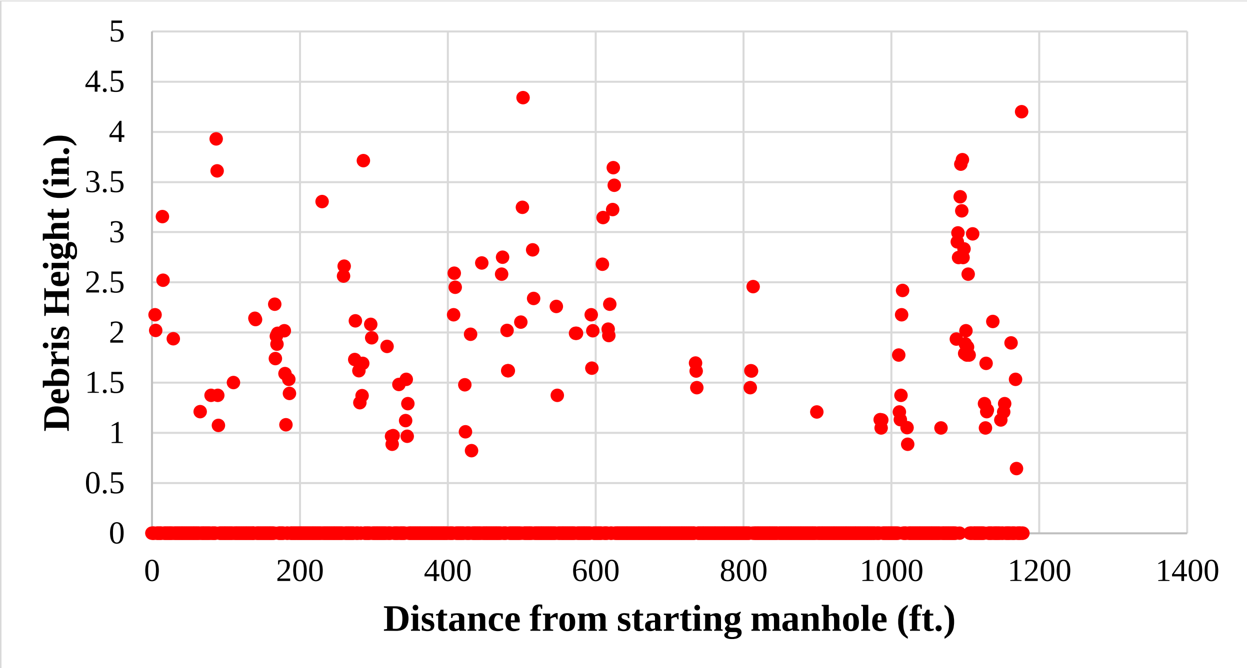

Figure 4-80 Height of debris in line 11077

18. Line 12890

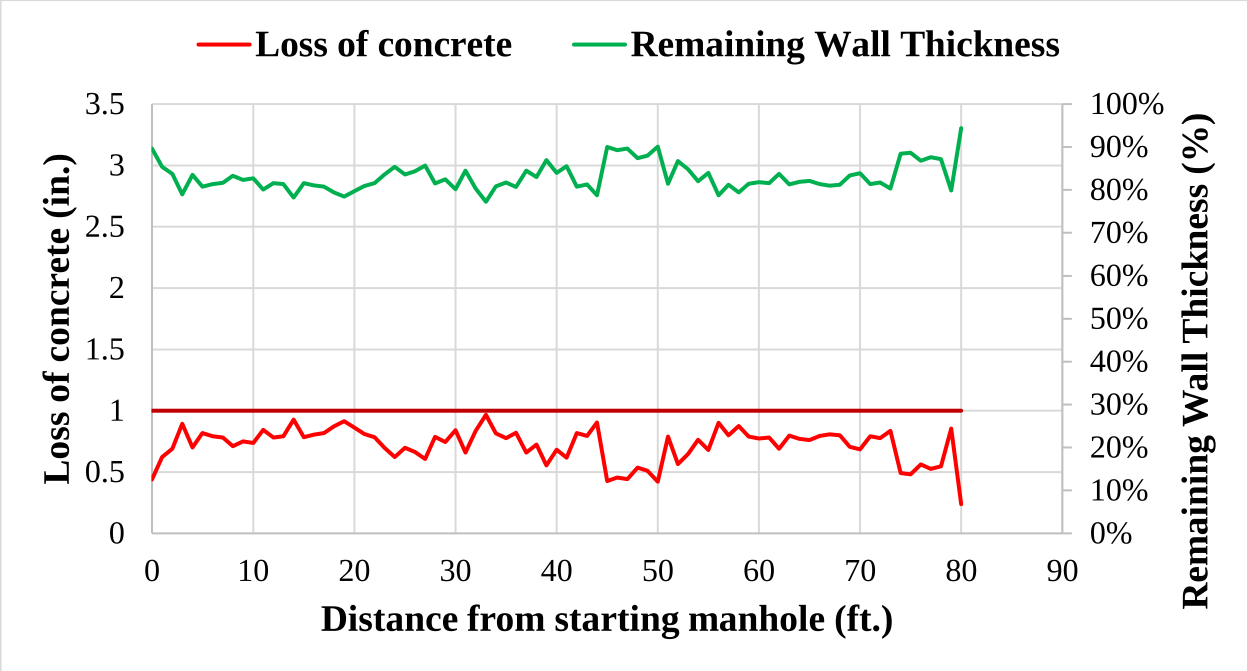

Figure 4-81 Loss of concrete and remaining wall thickness for line 12890

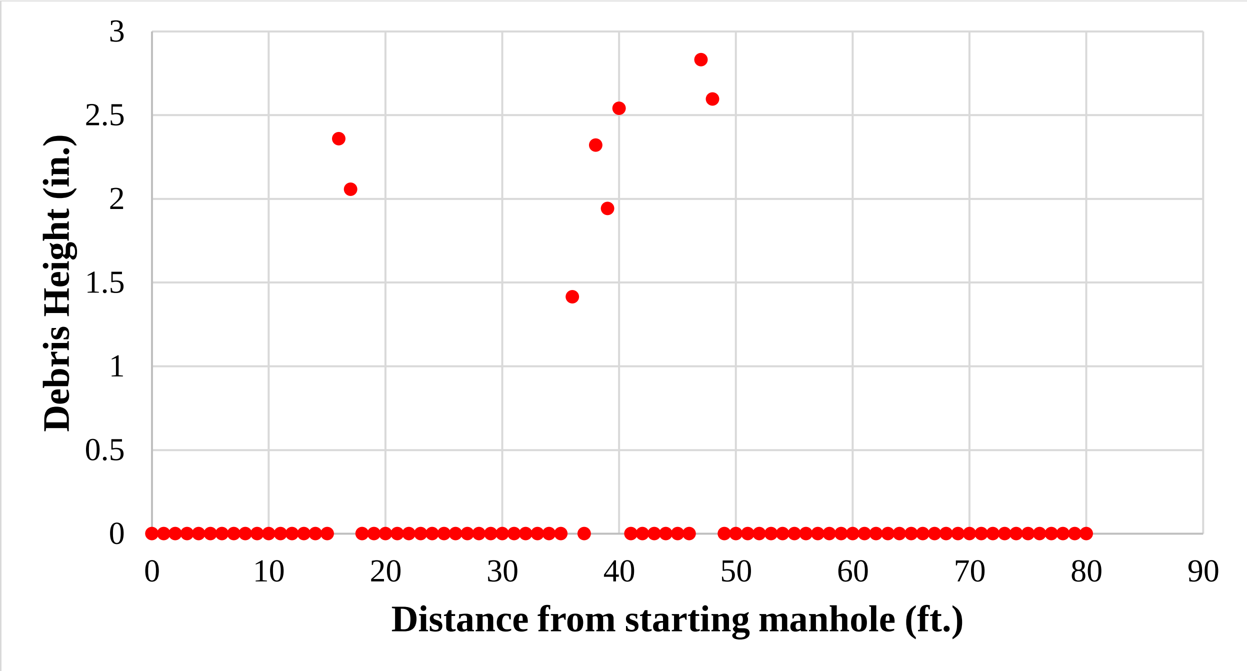

Figure 4-82 Height of debris in line 12890

19. Line 11078

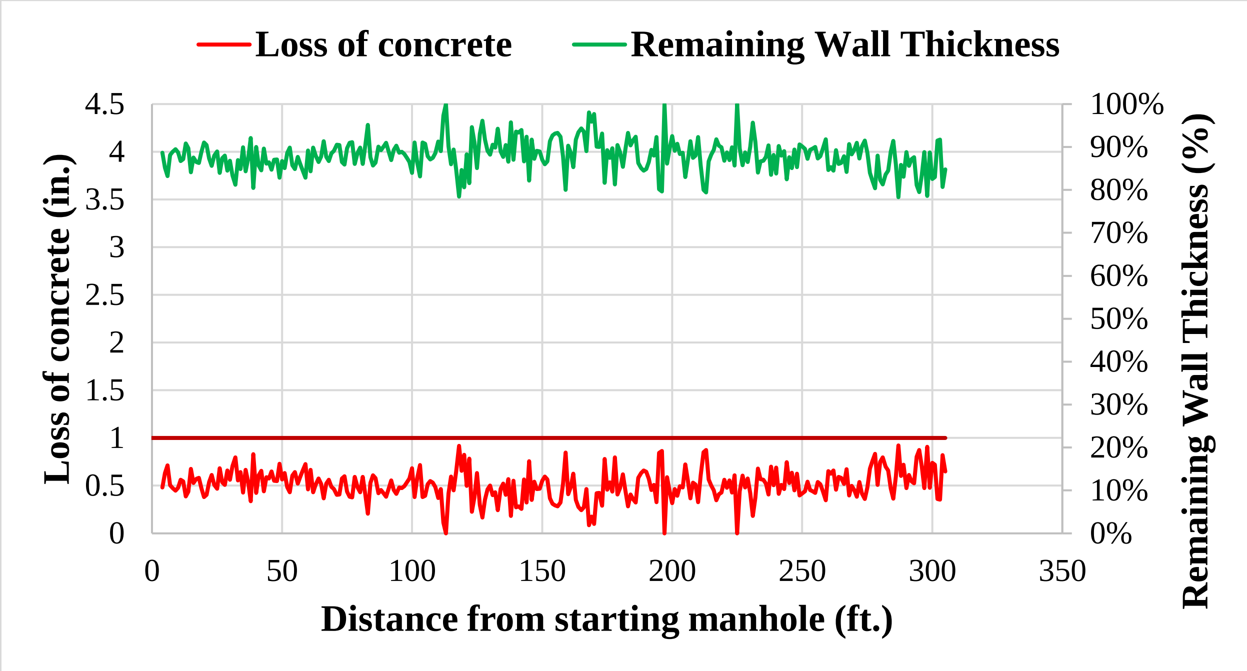

Figure 4-83 Loss of concrete and remaining wall thickness for line 11078

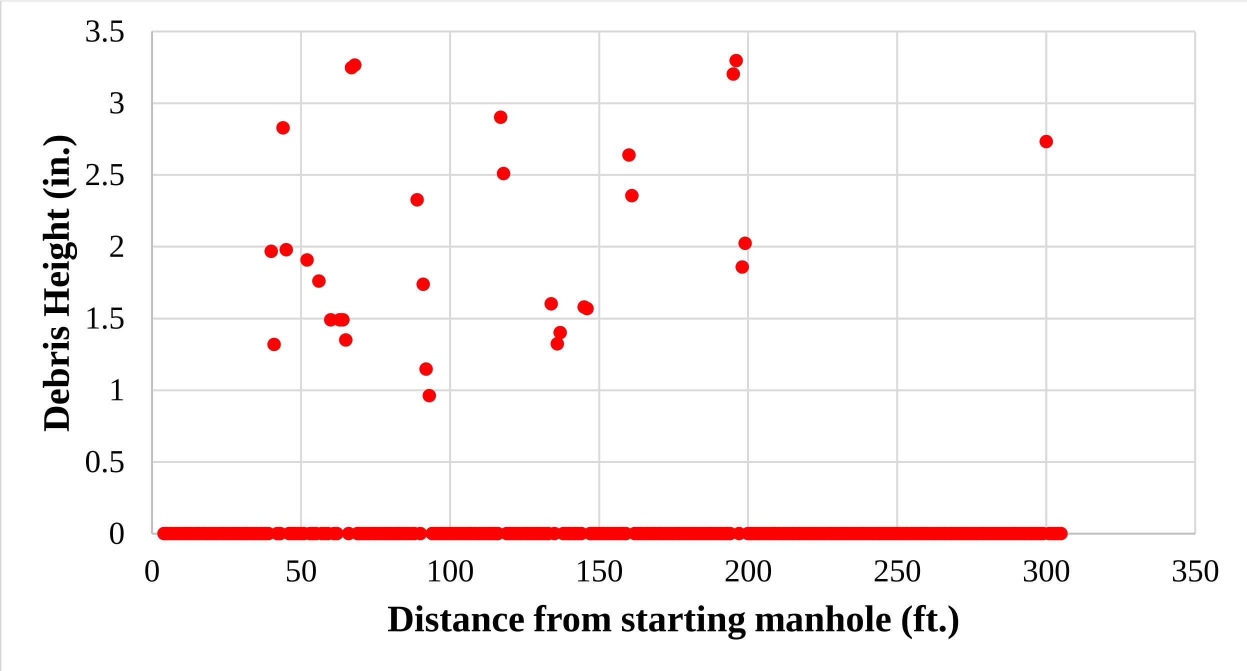

Figure 4-84 Height of debris in line 11078

20. Line 11079

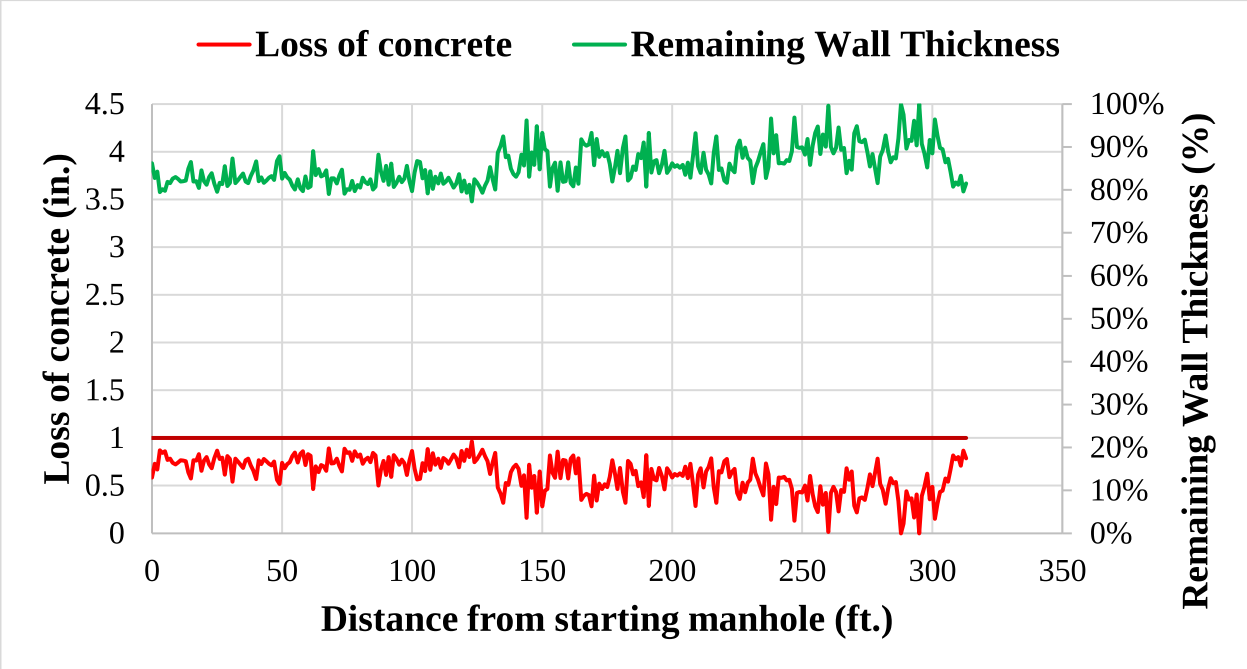

Figure 4-85 Loss of concrete and remaining wall thickness for line 11079

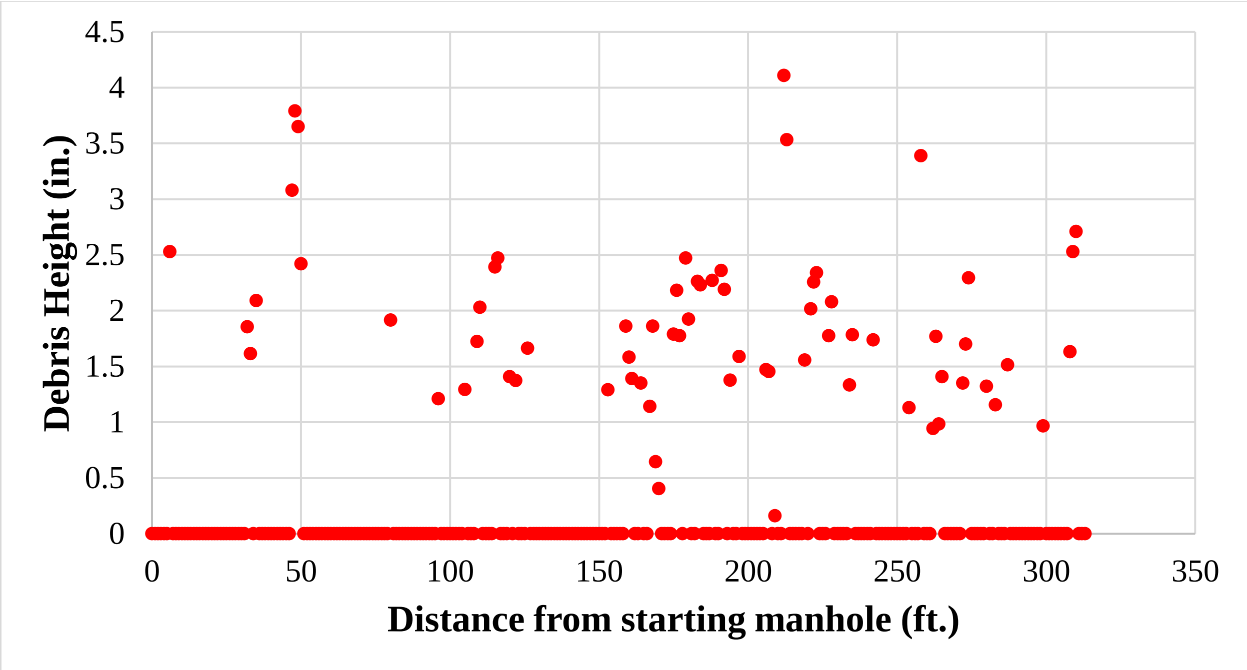

Figure 4-86 Height of debris in line 11079

21. Line 11080

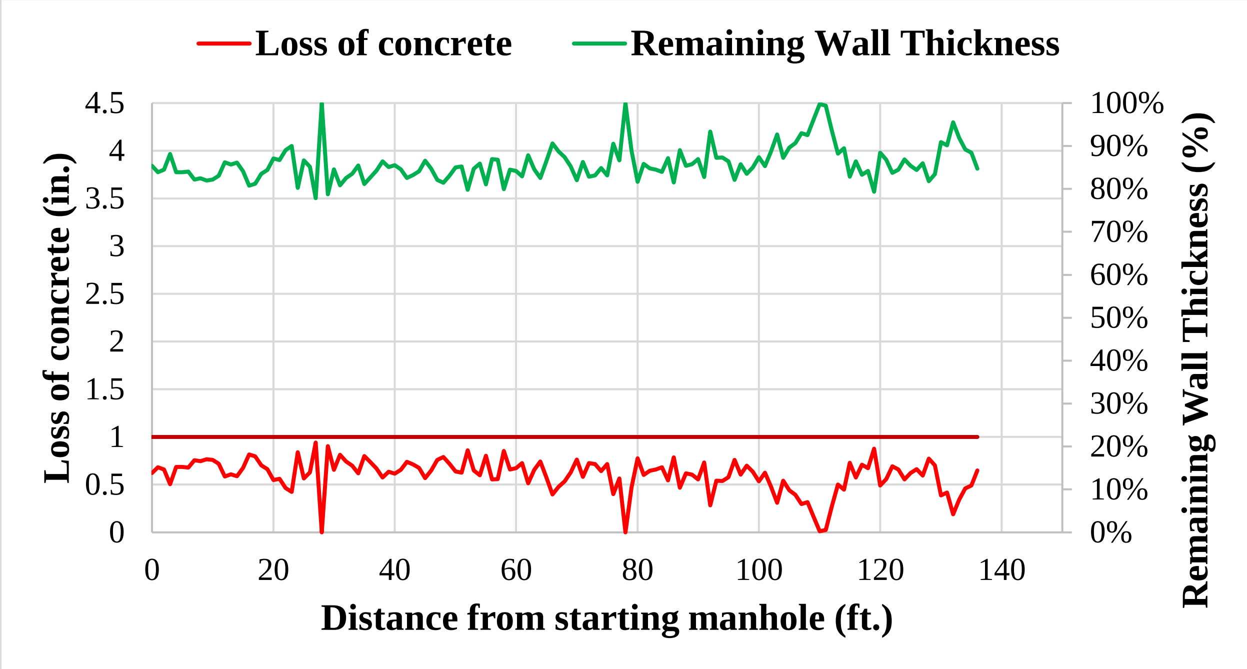

Figure 4-87 Loss of concrete and remaining wall thickness for line 11080

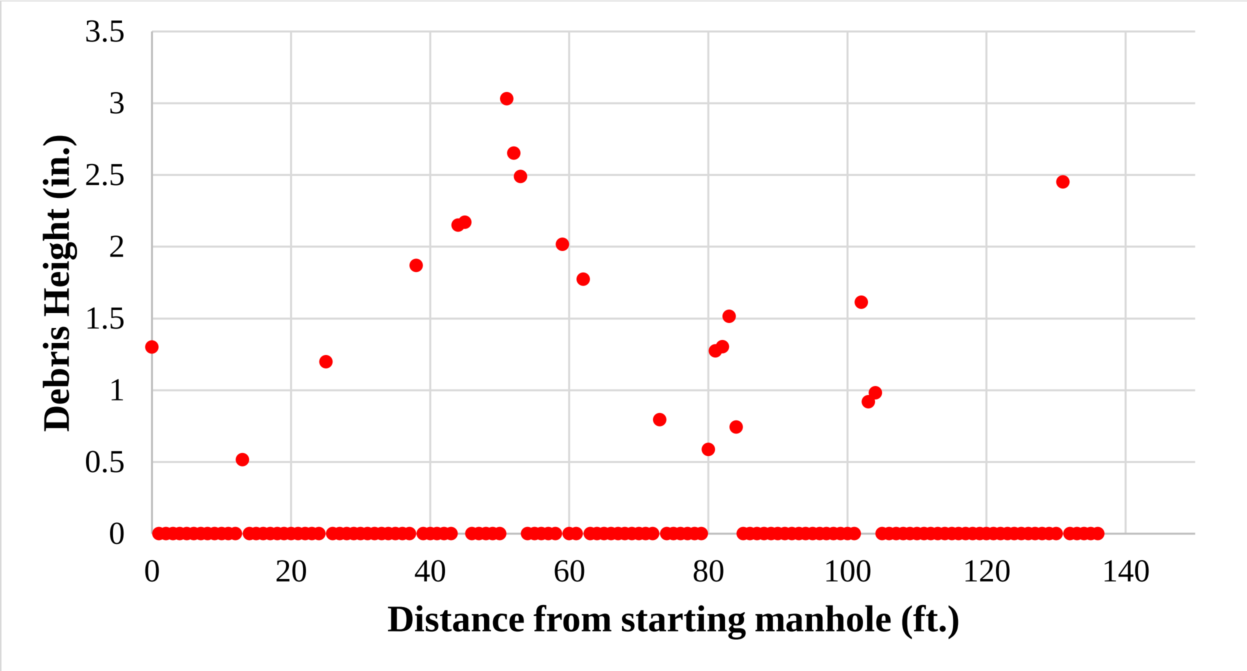

Figure 4-88 Height of debris in line 11080

22. Line 11306

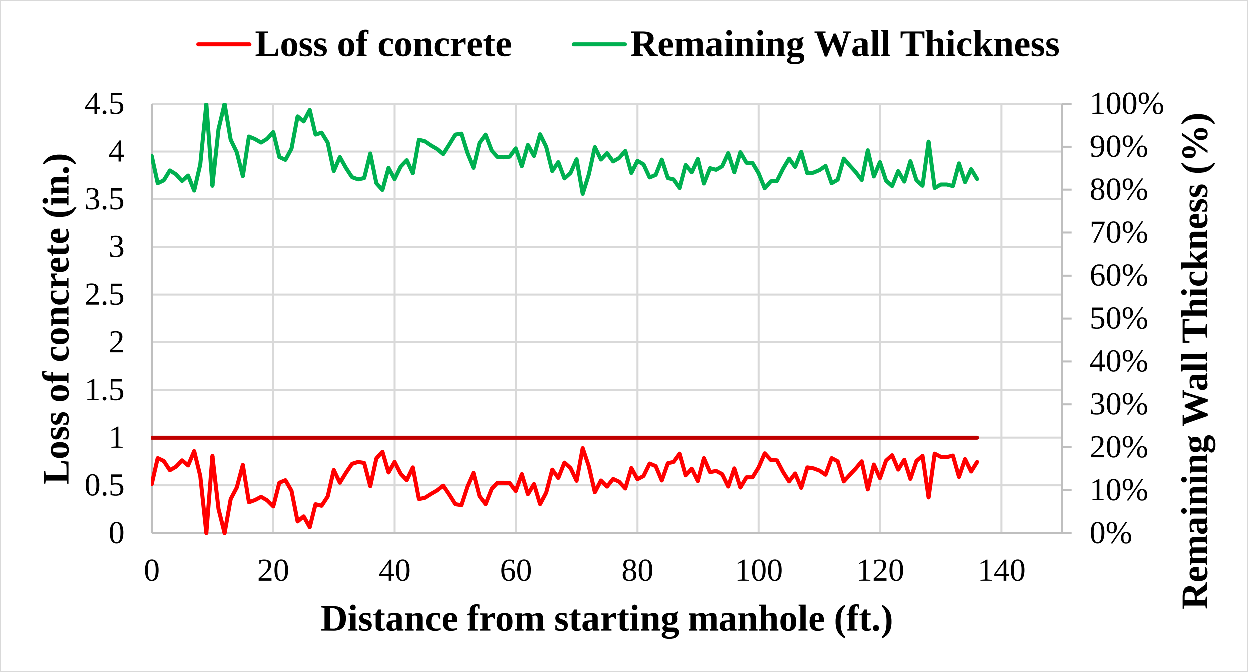

Figure 4-89 Loss of concrete and remaining wall thickness for line 11306

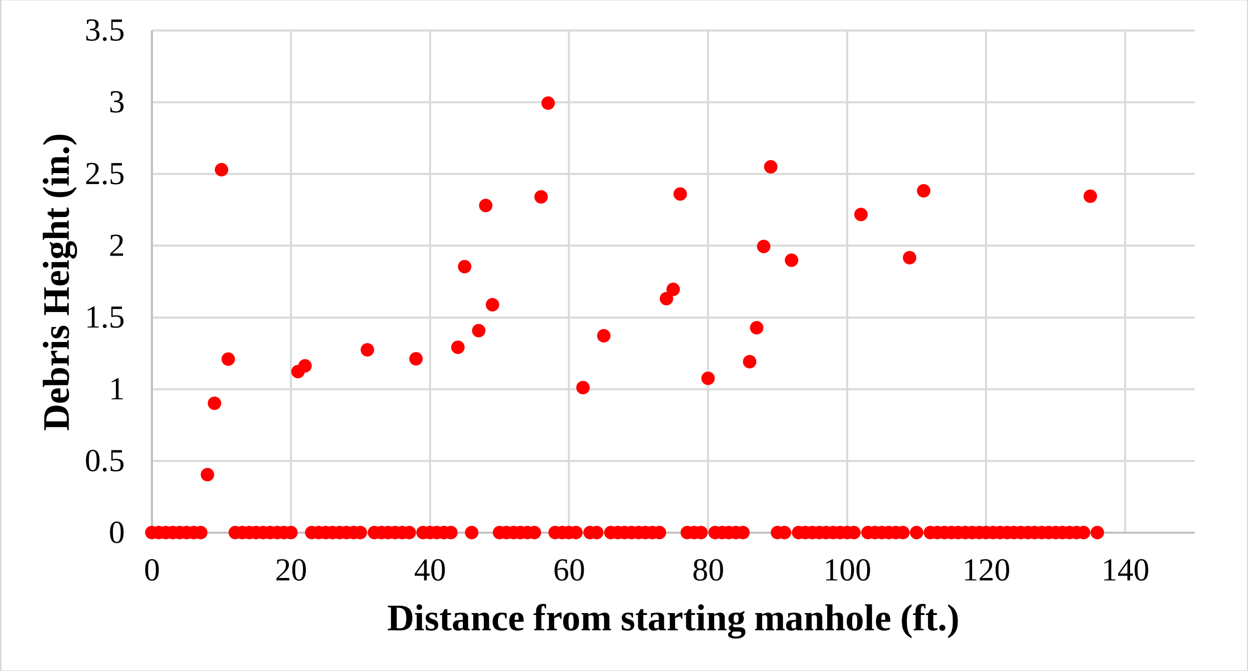

Figure 4-90 Height of debris in line 11306

23. Line 11081

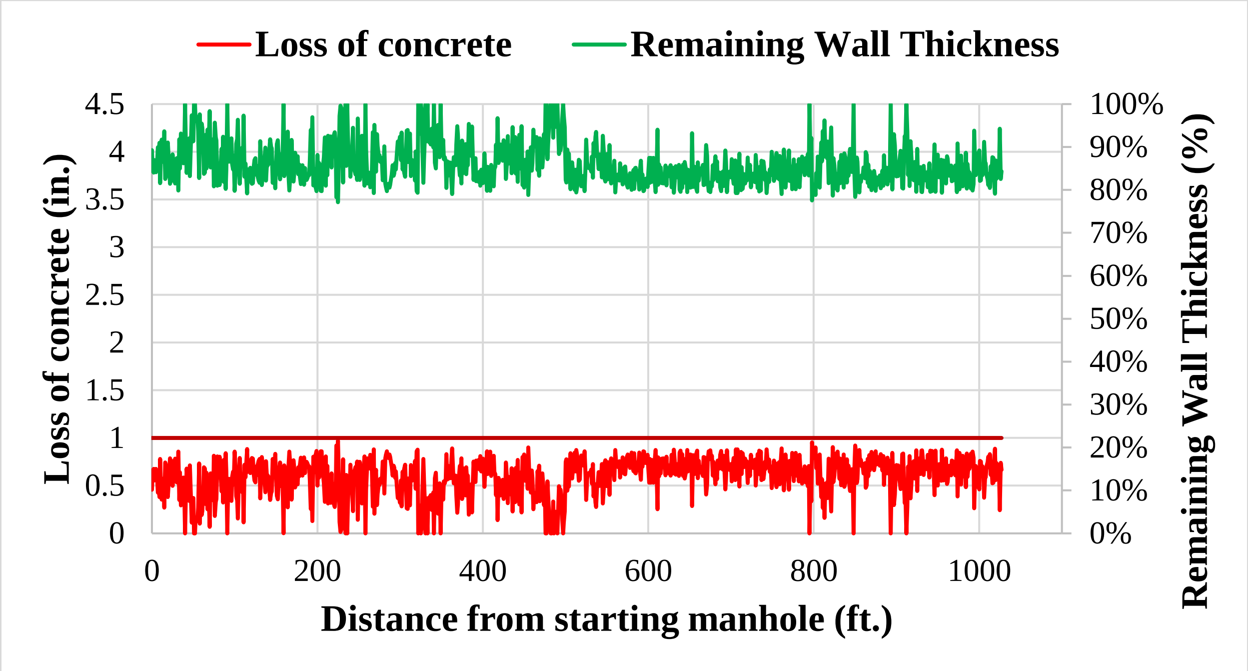

Figure 4-91 Loss of concrete and remaining wall thickness for line 11081

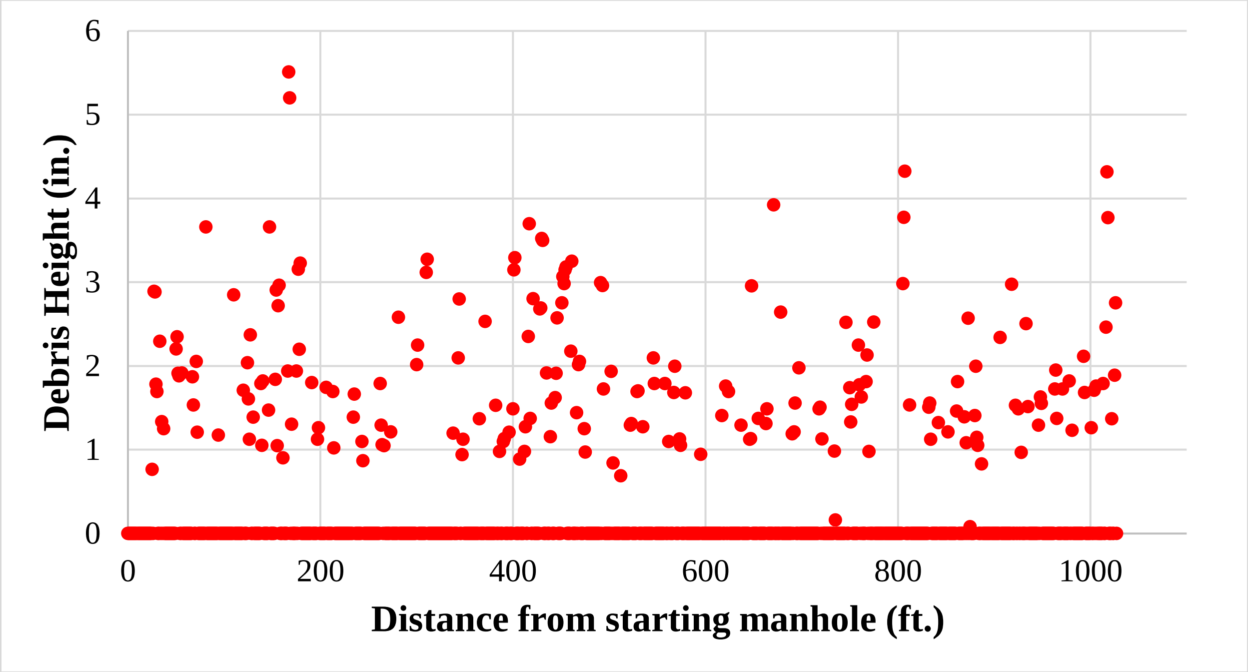

Figure 4-92 Height of debris in line 11081

24. Line 11082

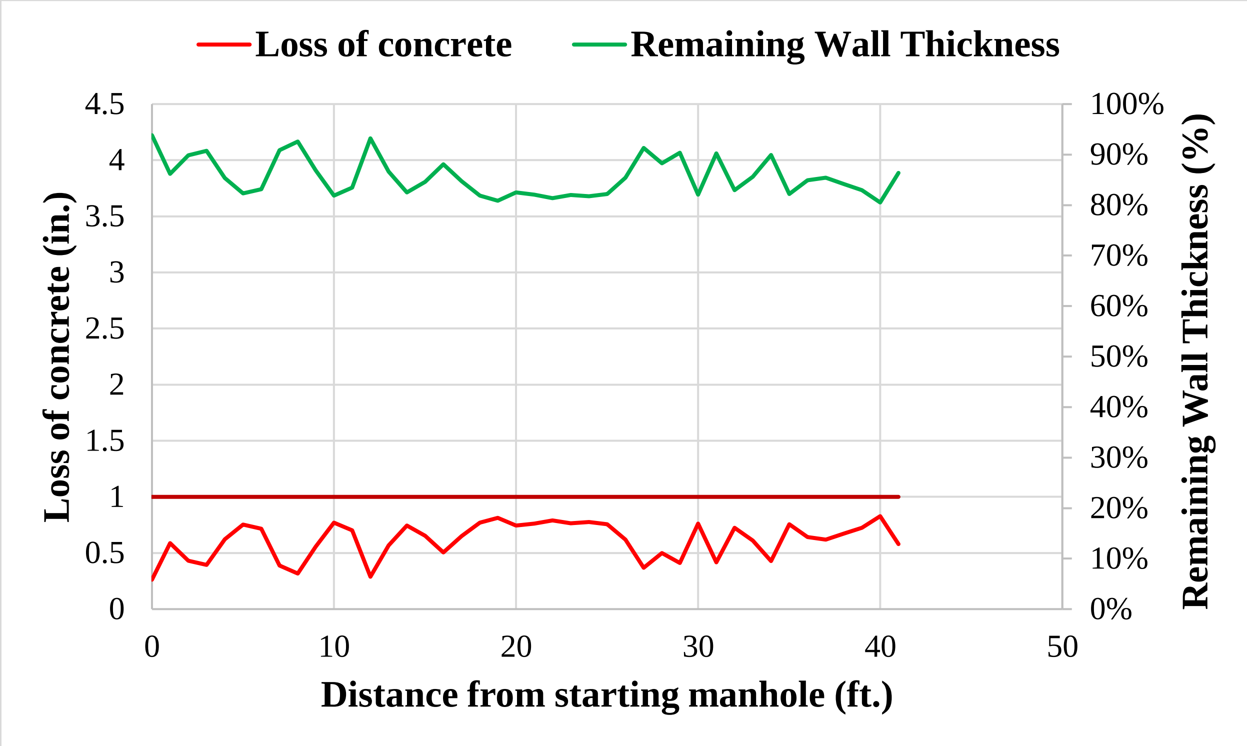

Figure 4-93 Loss of concrete and remaining wall thickness for line 11082

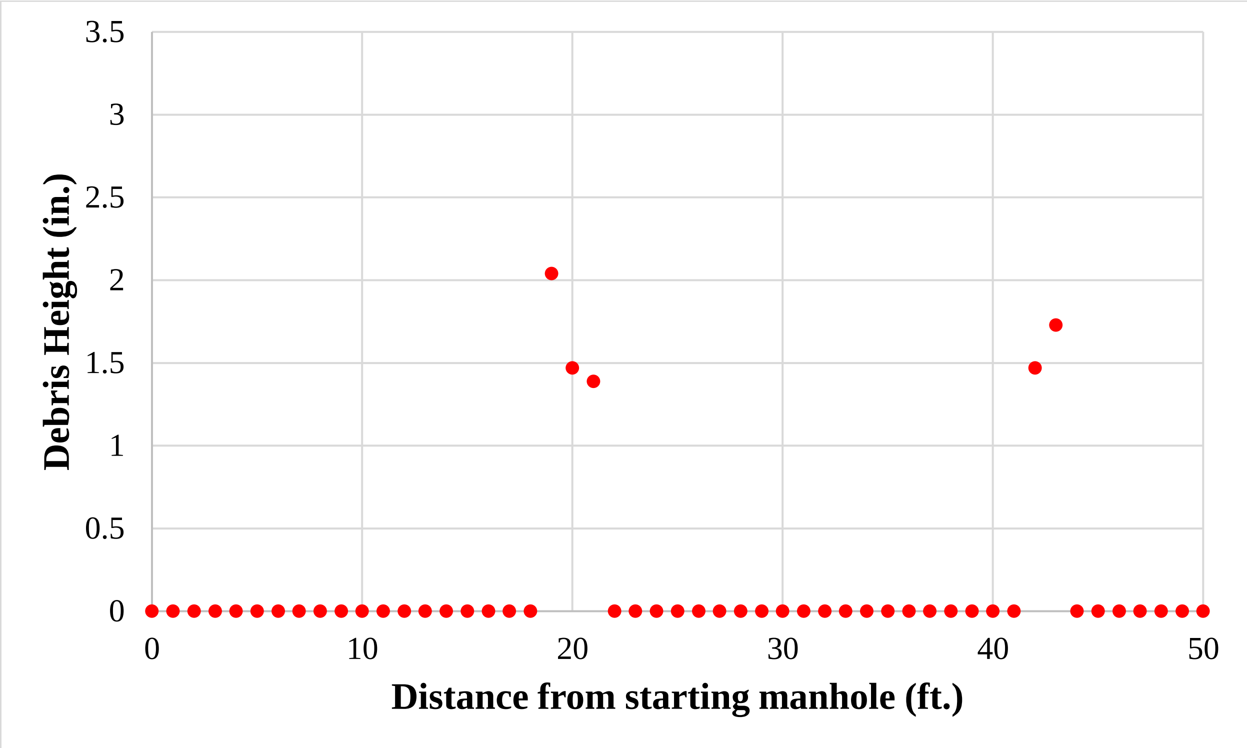

Figure 4-94 Height of debris in line 11082

25. Unknown Pipe 1

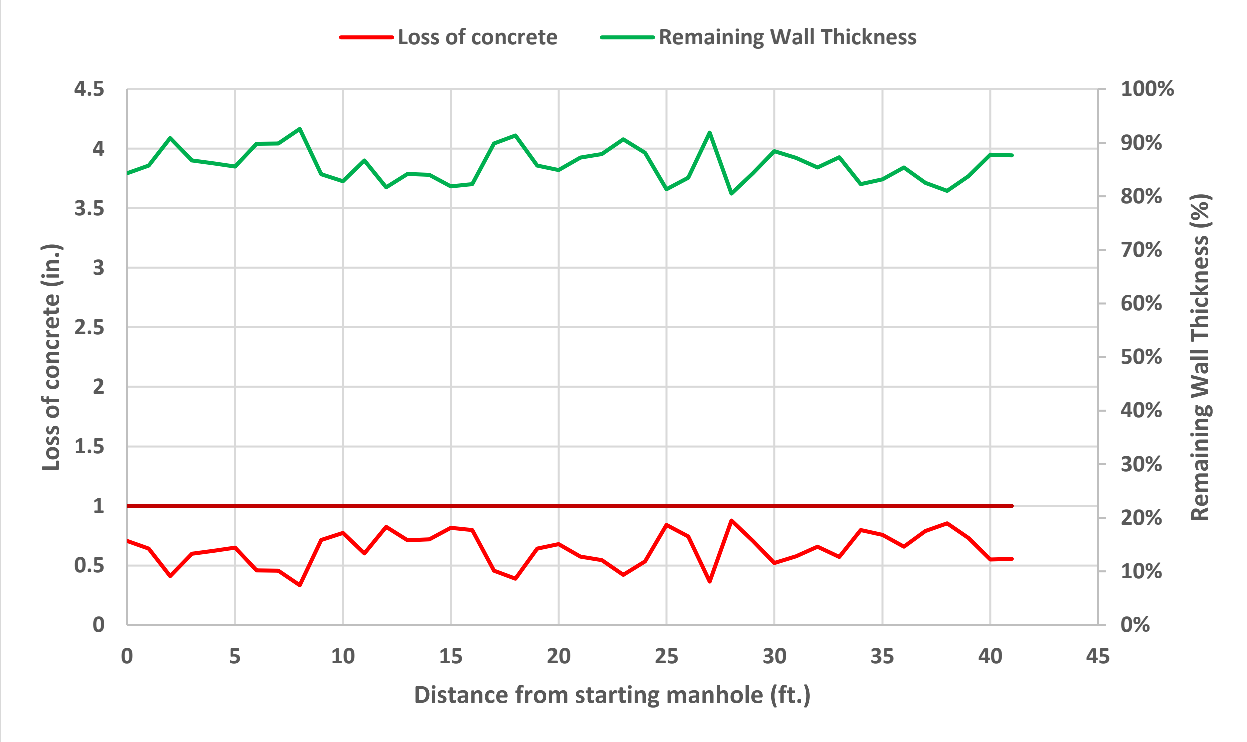

Figure 4-95 Loss of concrete and remaining wall thickness for unknown Pipe 1

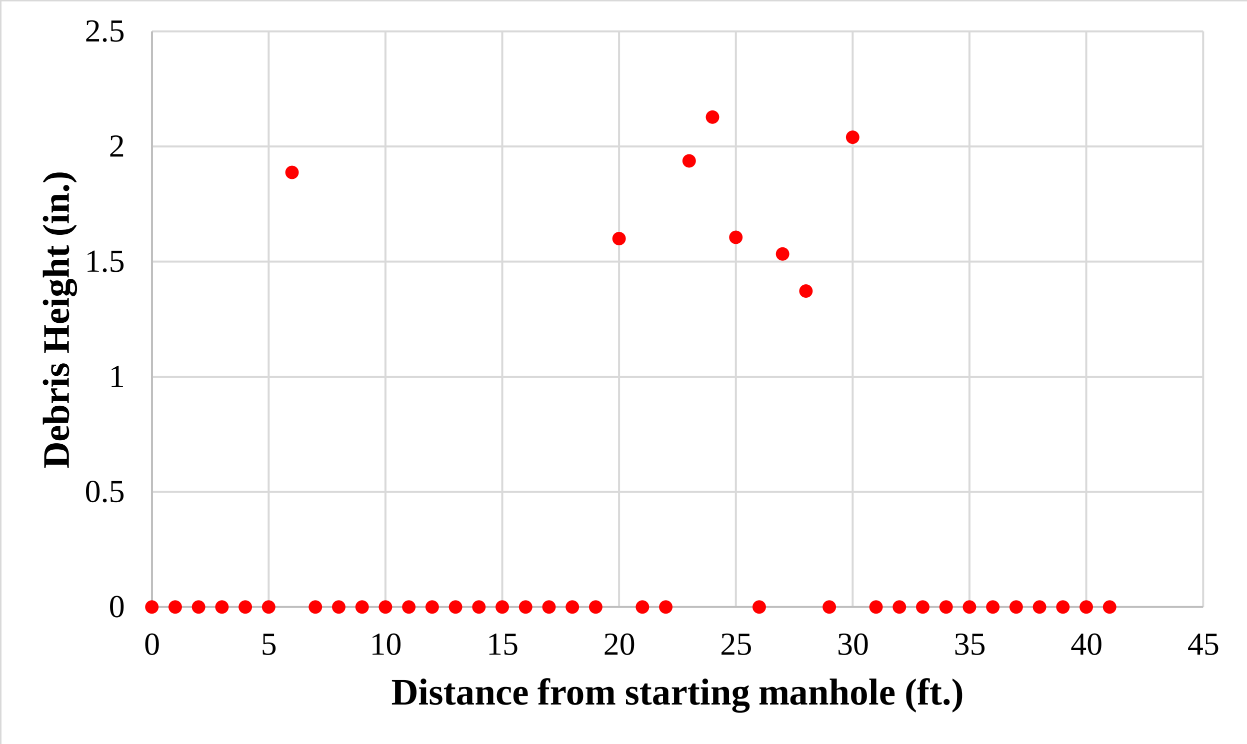

Figure 4-96 Height of debris in unknown Pipe 1

26. Line 11083

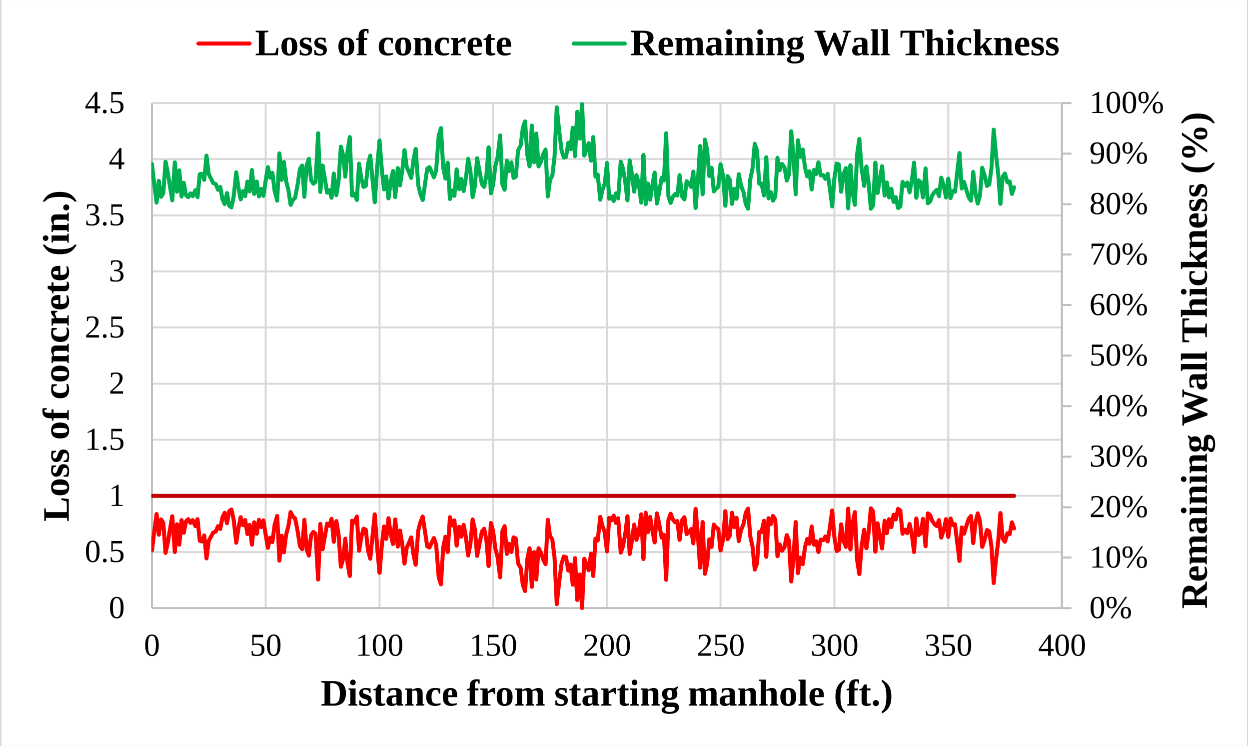

Figure 4-97 Loss of concrete and remaining wall thickness for line 11083

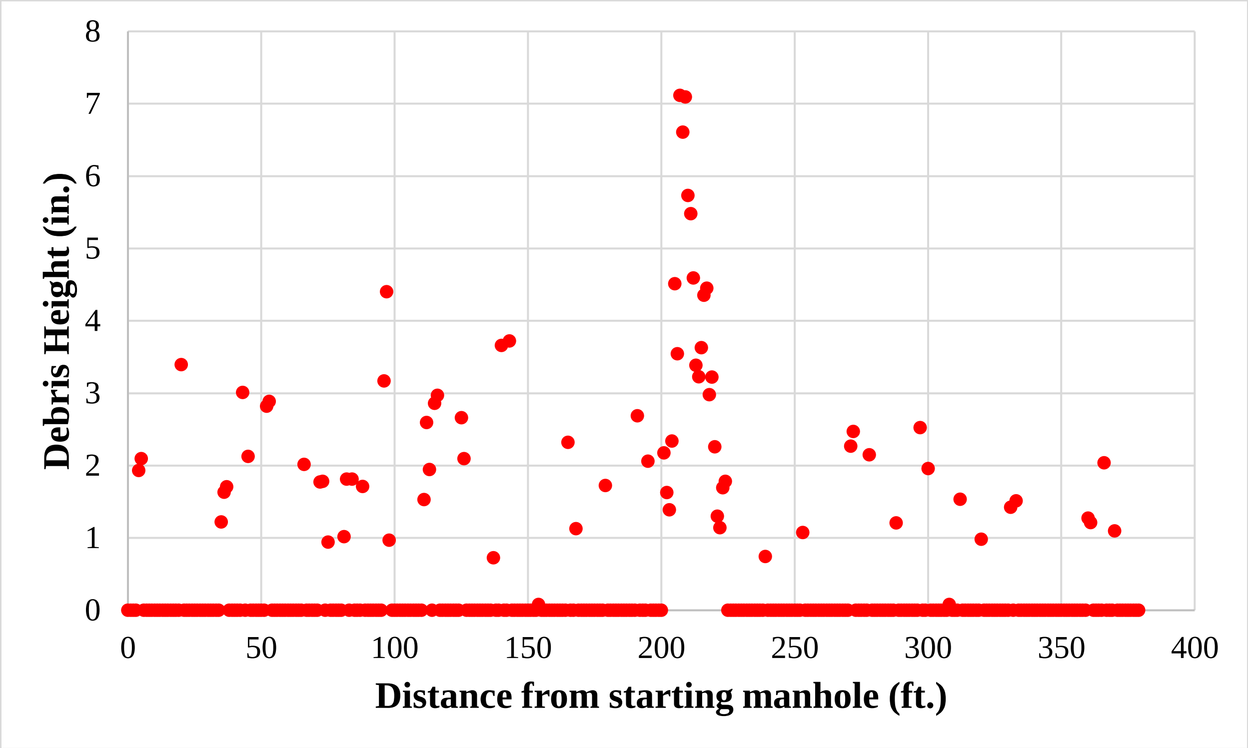

Figure 4-98 Height of debris in line 11083

27. Line 11084

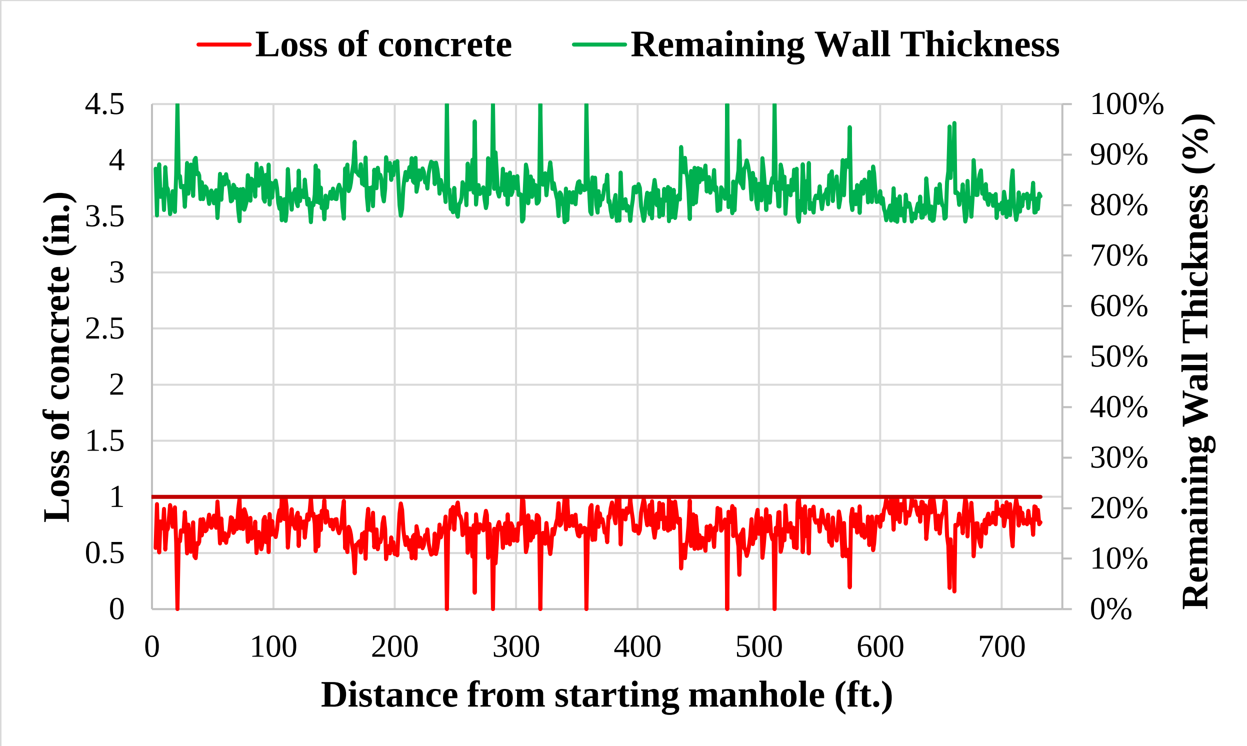

Figure 4-99 Loss of concrete and remaining wall thickness for line 11084

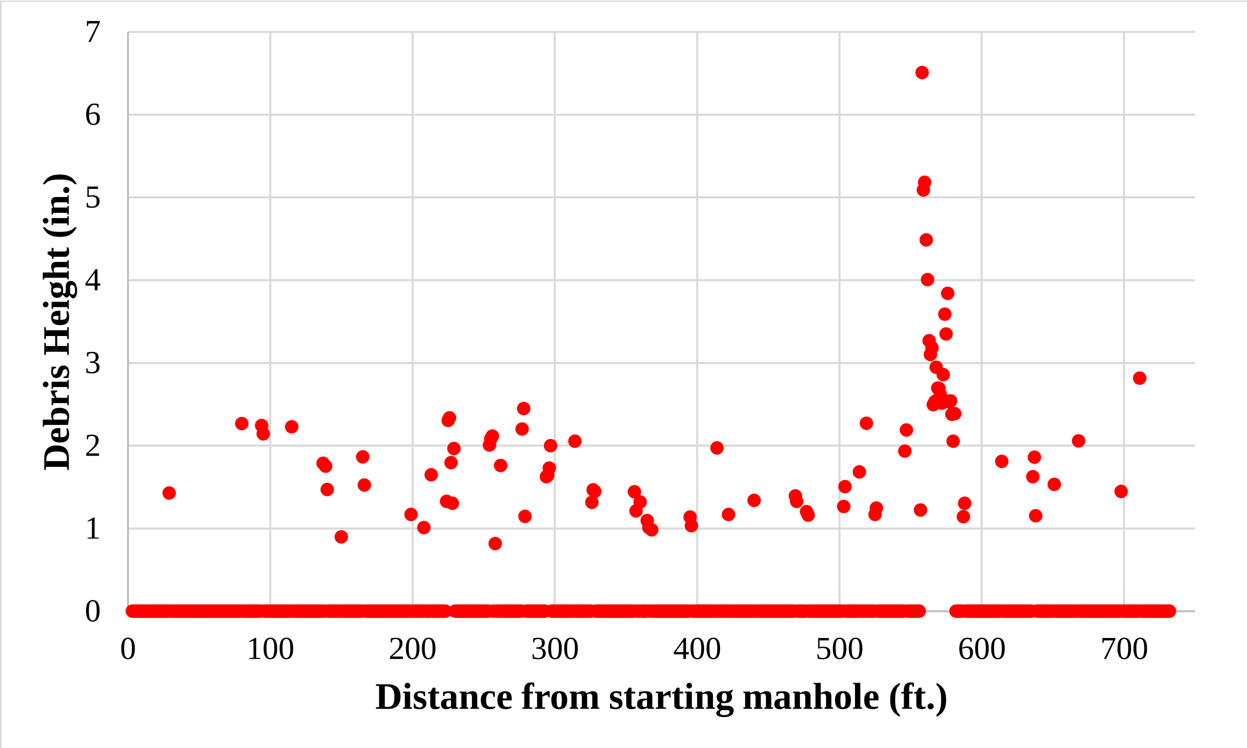

Figure 4-100 Height of debris in line 11084

28. Line 11085

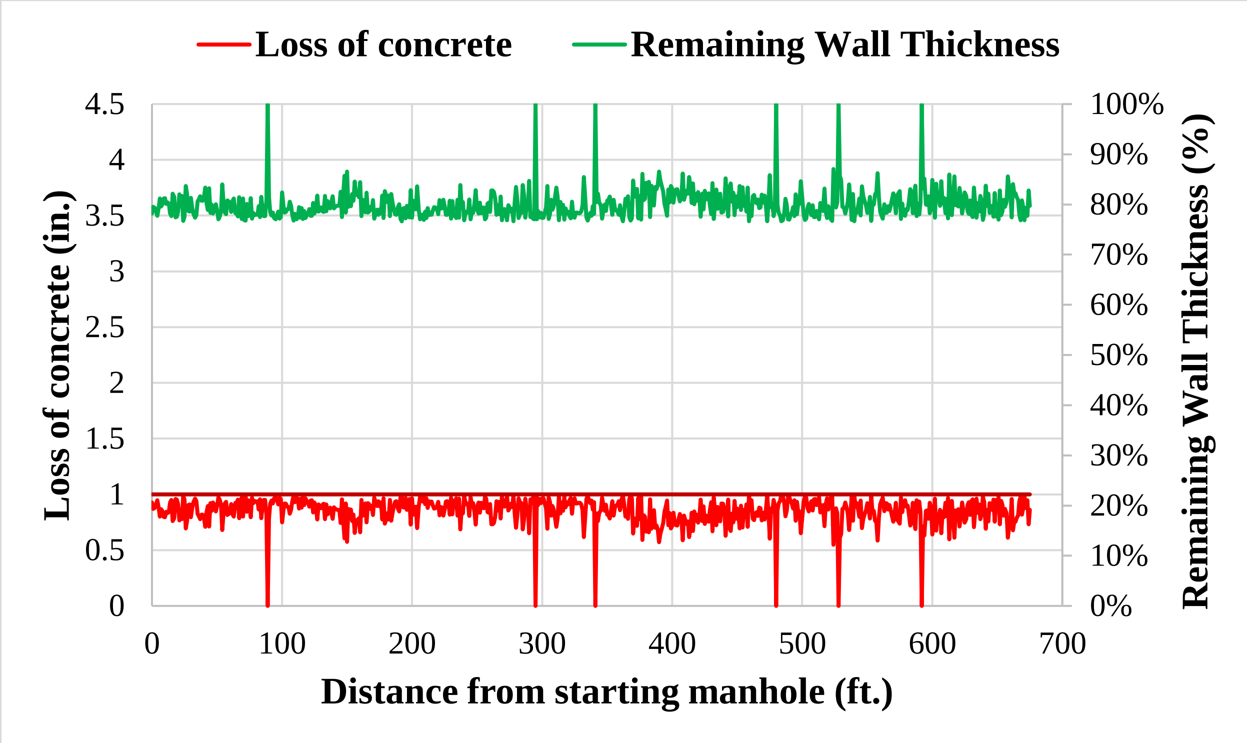

Figure 4-101 Loss of concrete and remaining wall thickness for line 11085

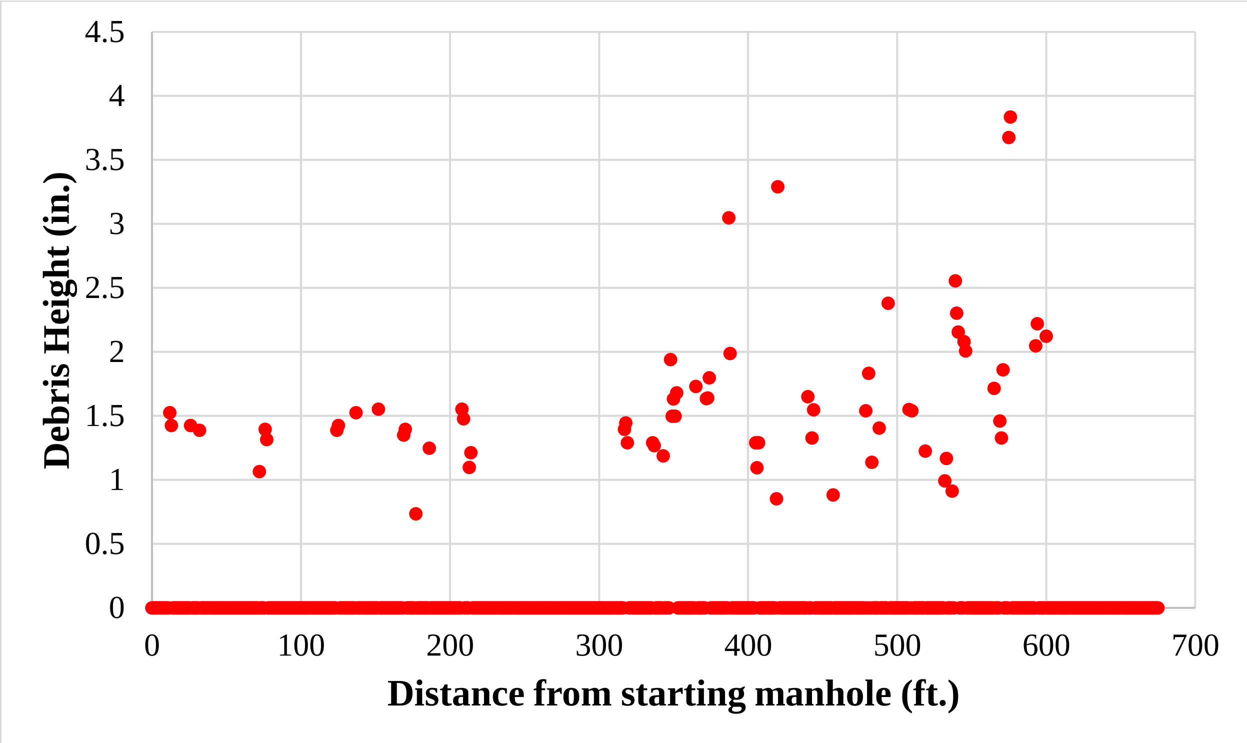

Figure 4-102 Height of debris in line 11085

29. Line 11086

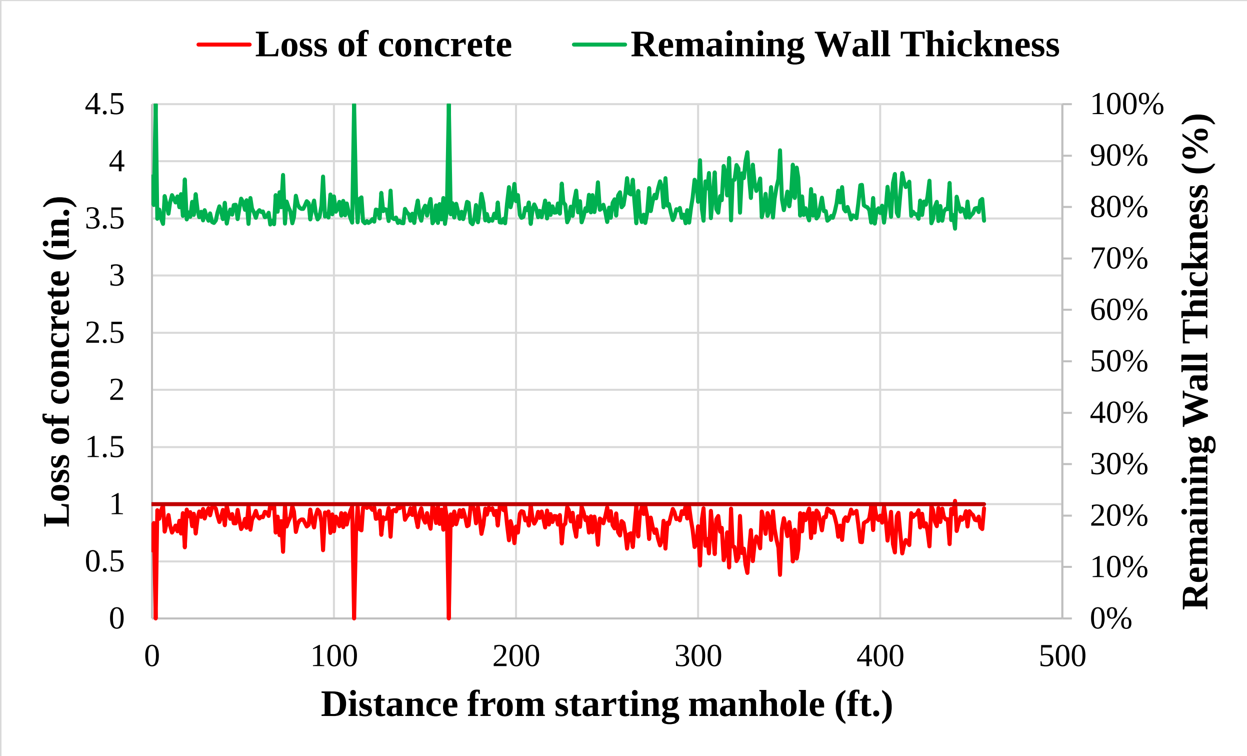

Figure 4-103 Loss of concrete and remaining wall thickness for line 11086

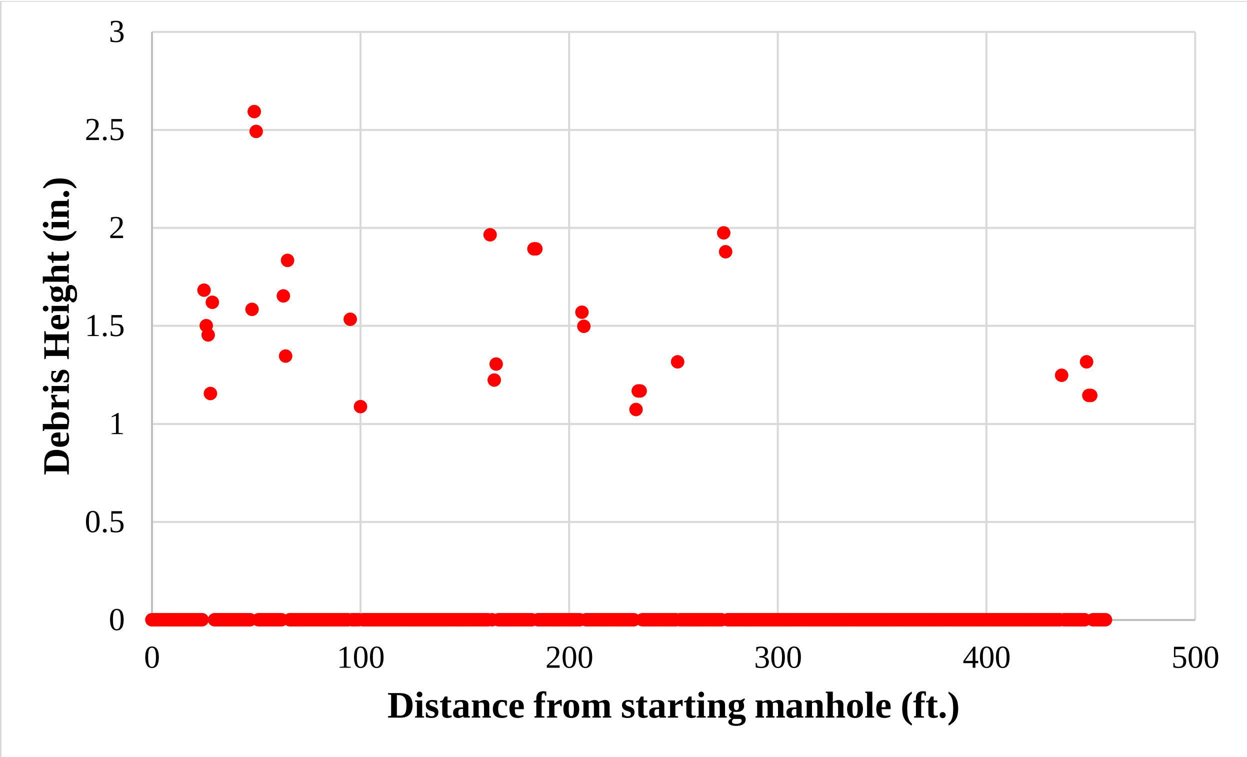

Figure 4-104 Height of debris in line 11086

30. Line 14793

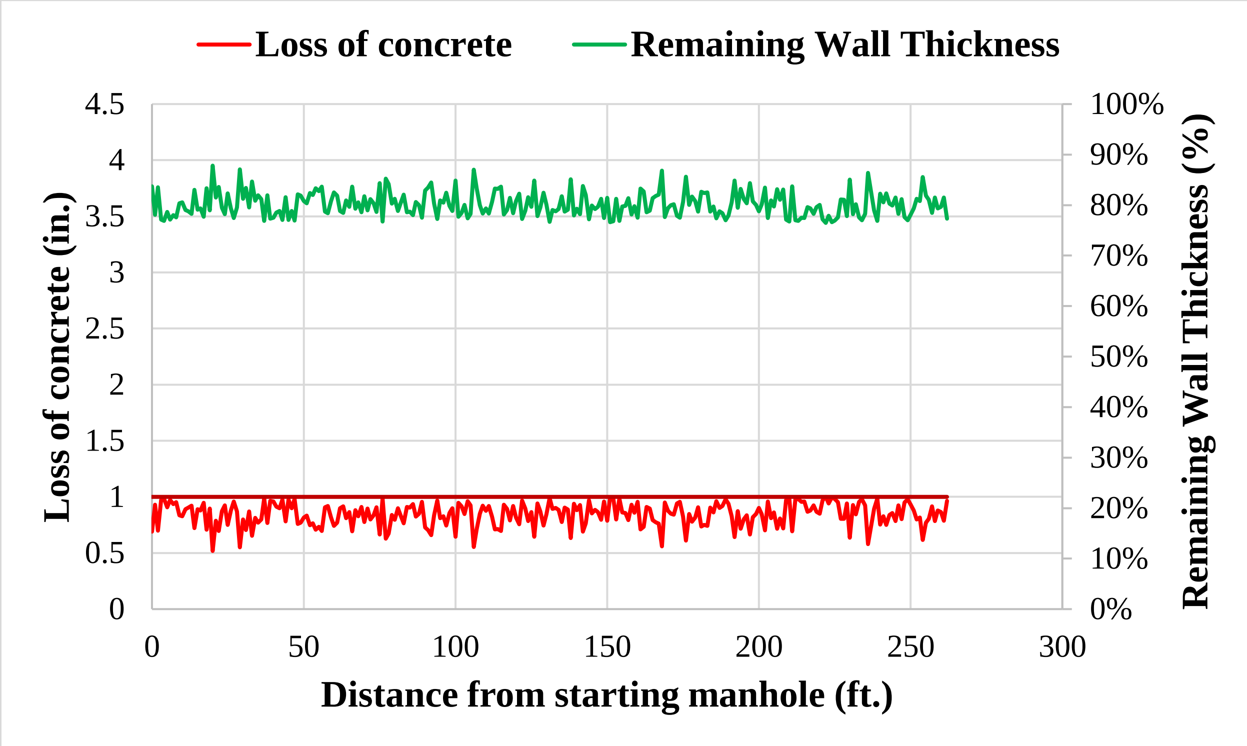

Figure 4-105 Loss of concrete and remaining wall thickness for line 14793

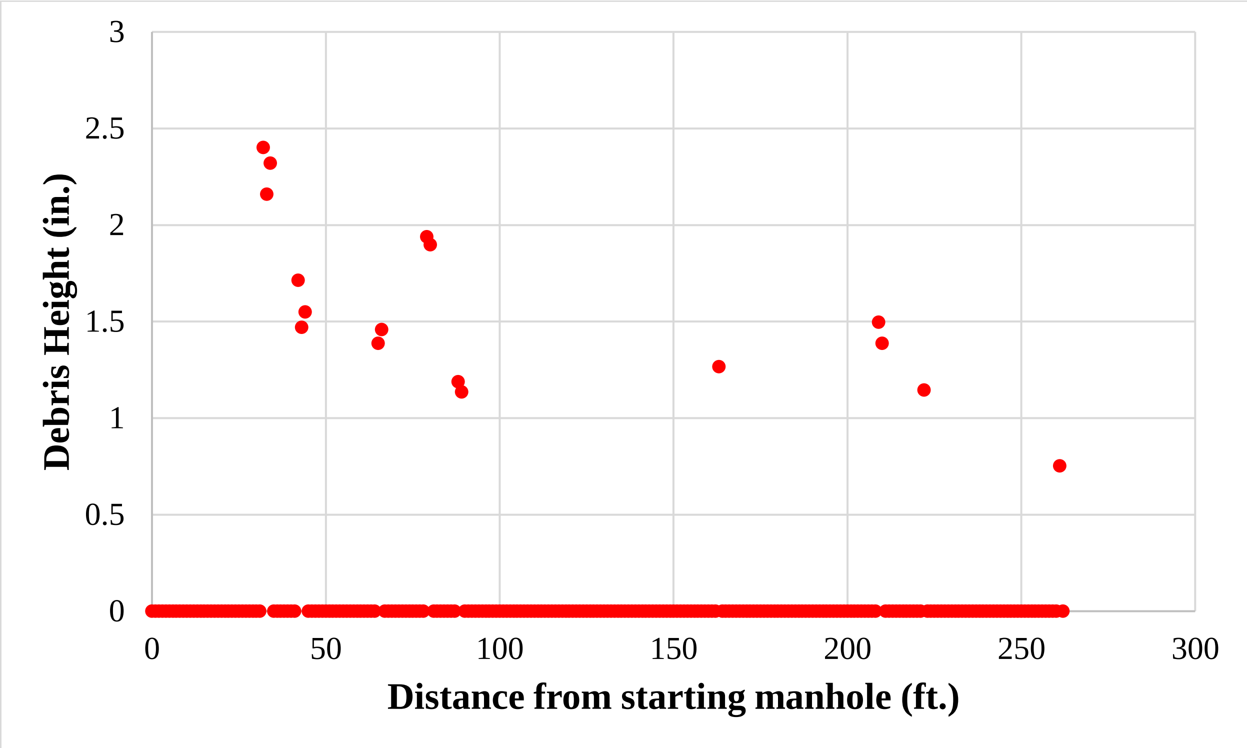

Figure 4-106 Height of debris in line 14793

31. Line 11087

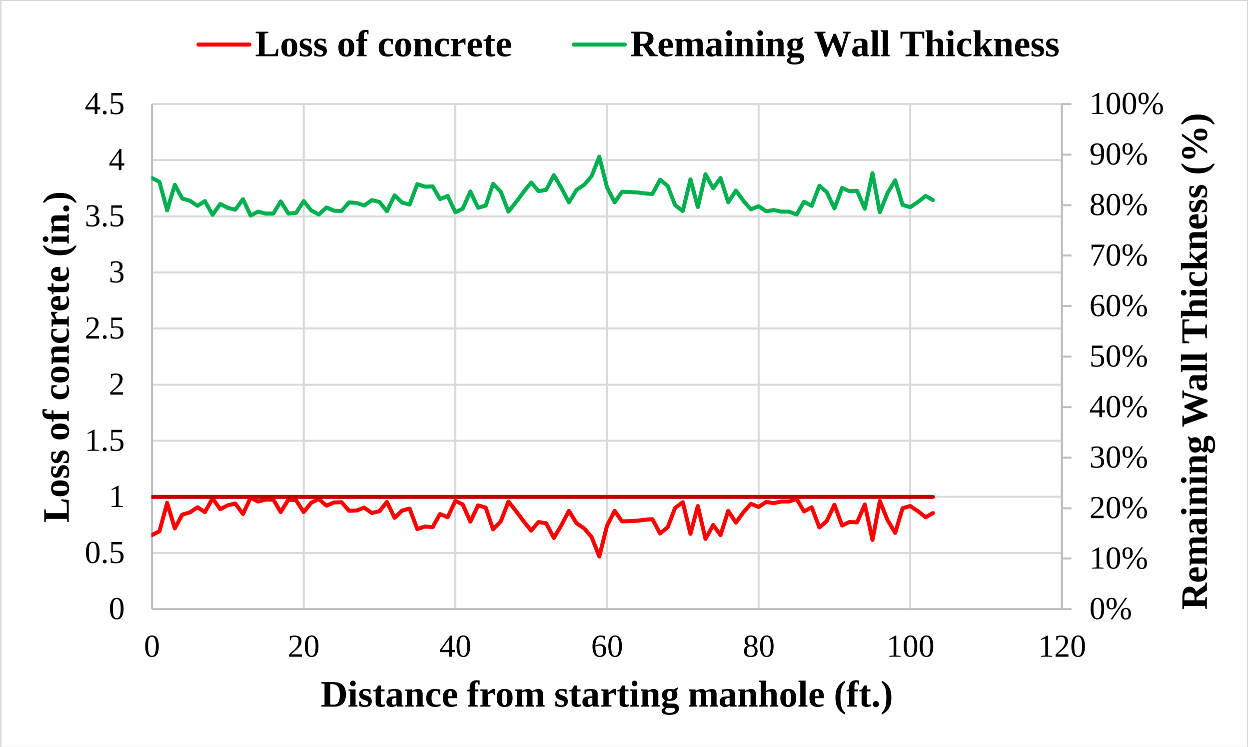

Figure 4-107 Loss of concrete and remaining wall thickness for line 11087

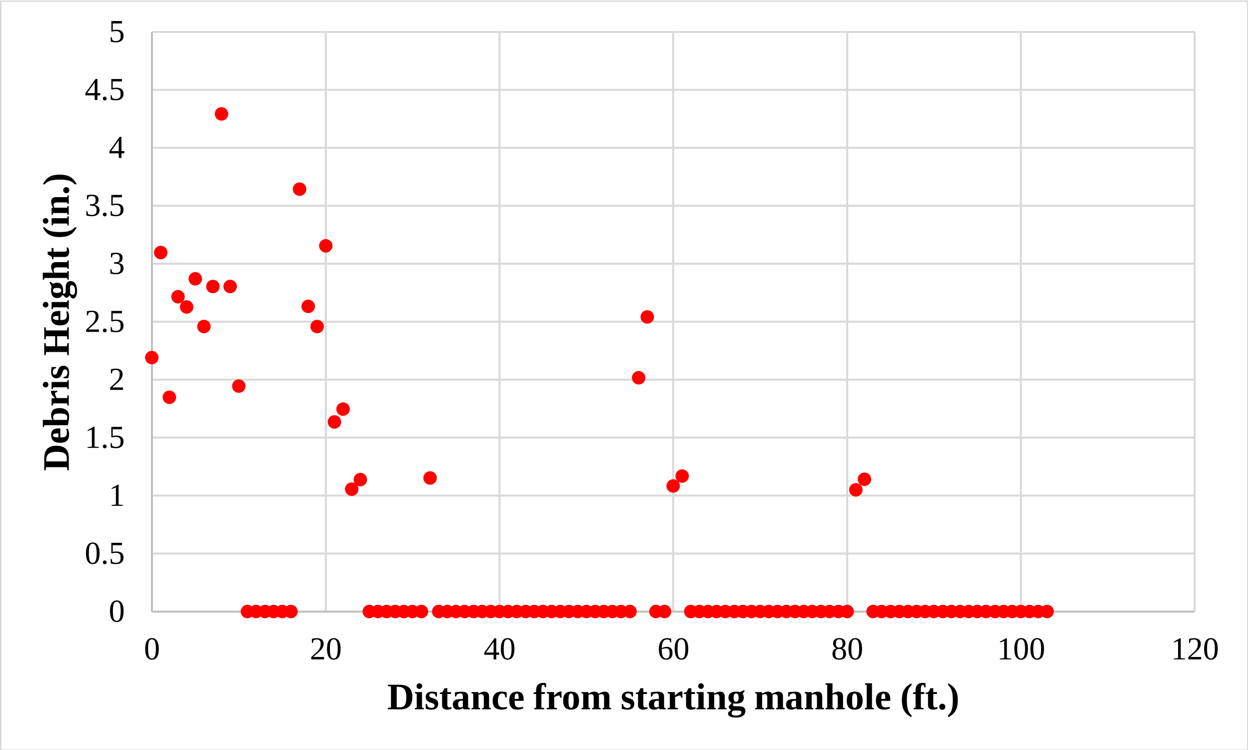

Figure 4-108 Height of debris in line 11087

32. Line 11088

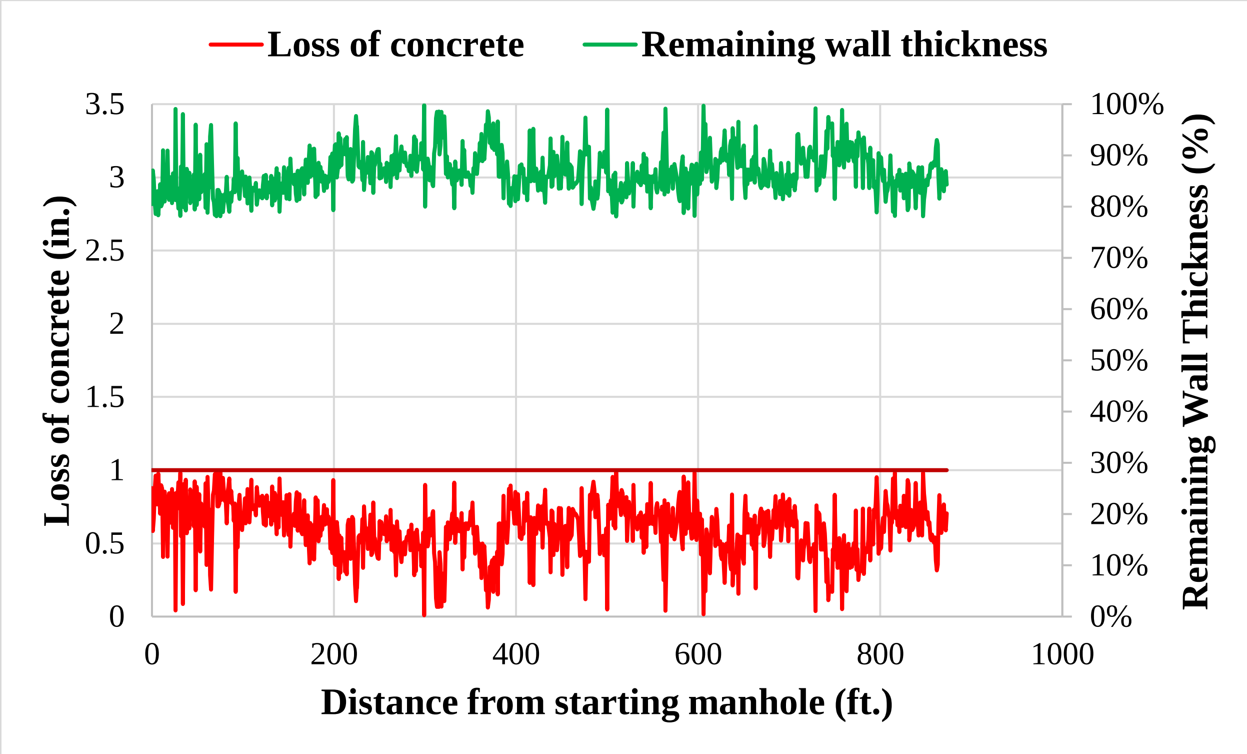

Figure 4-109 Loss of concrete and remaining wall thickness for line 11088

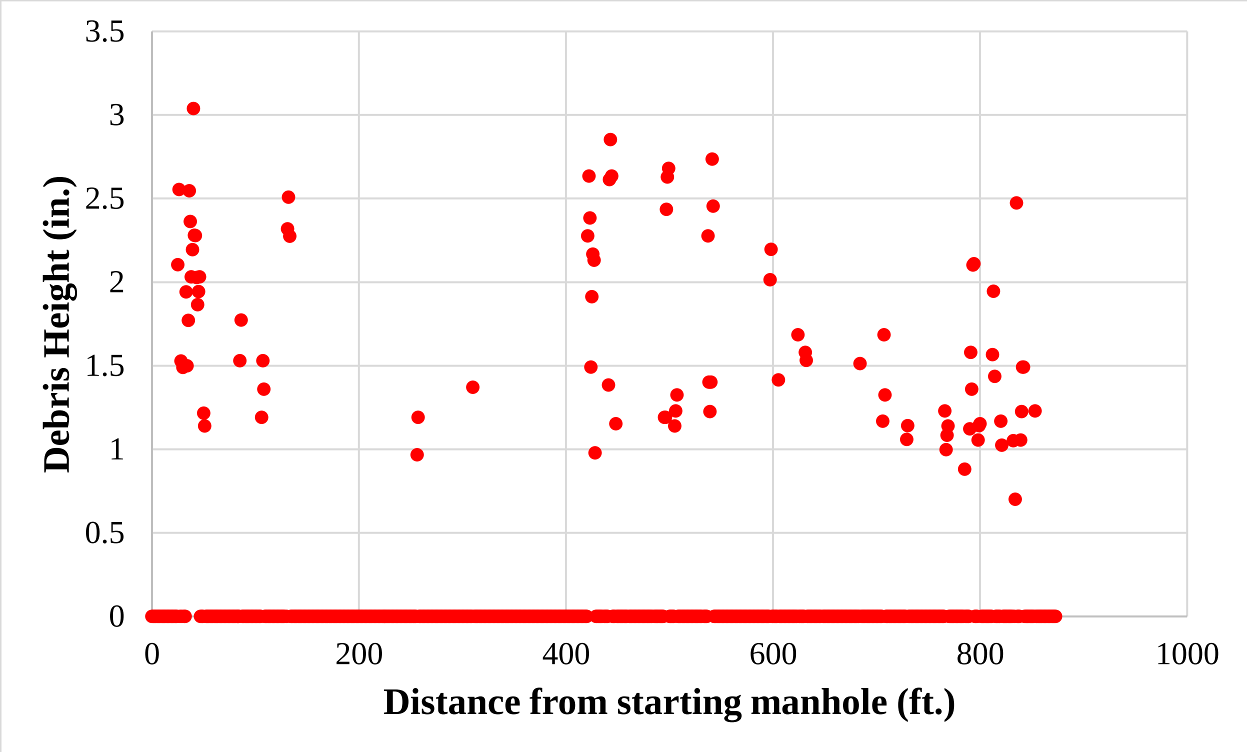

Figure 4-110 Height of debris in line 11088

33. Line 11089

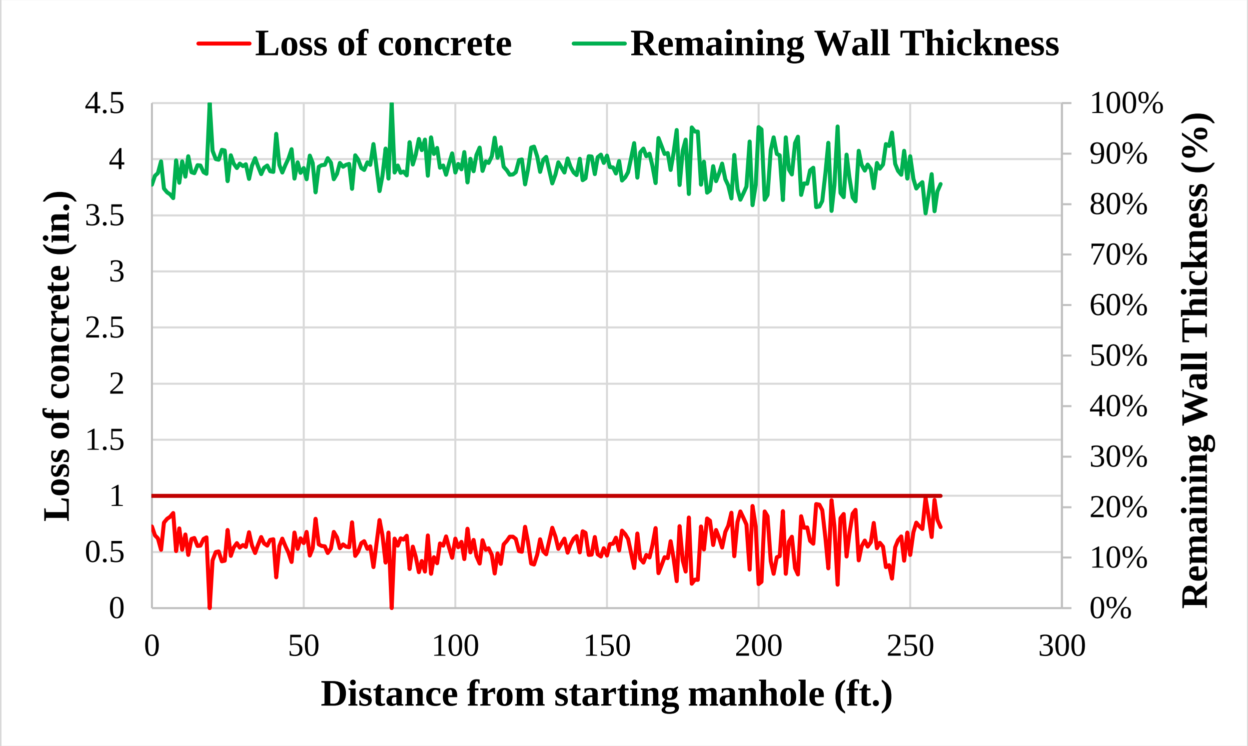

Figure 4-111 Loss of concrete and remaining wall thickness for line 11089

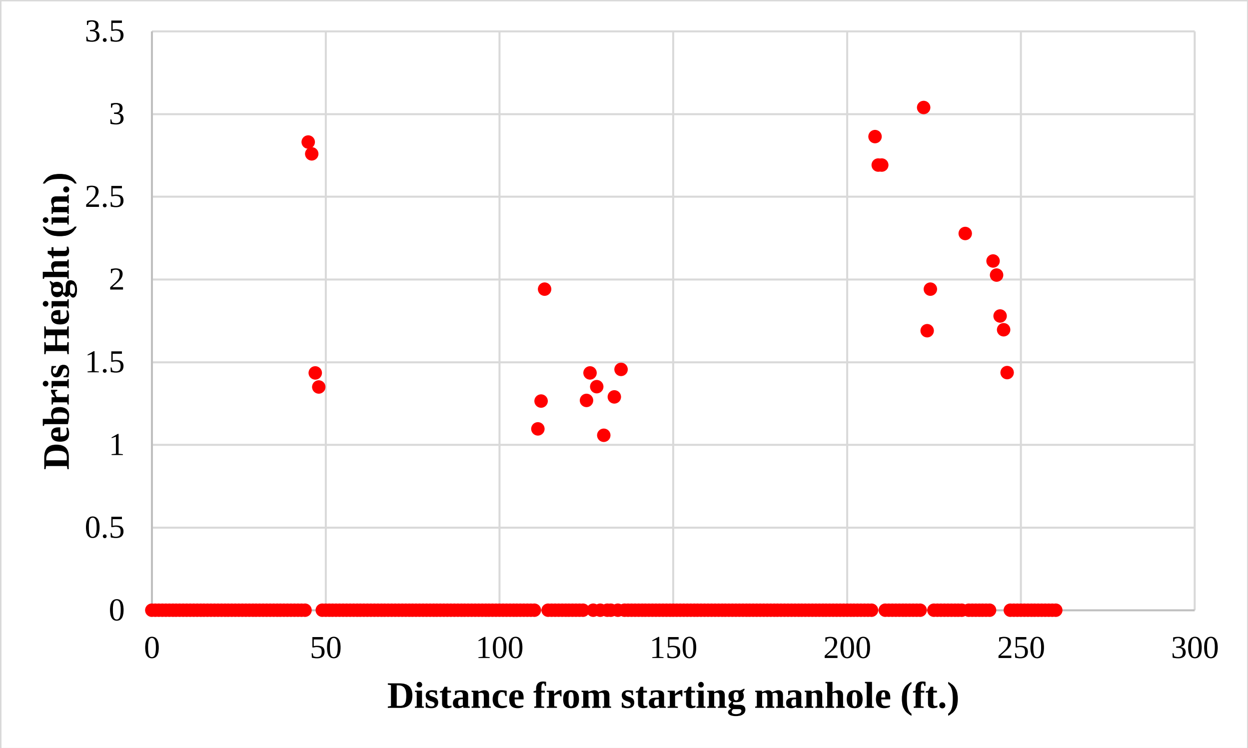

Figure 4-112 Height of debris in line 11089

34. Line 11090

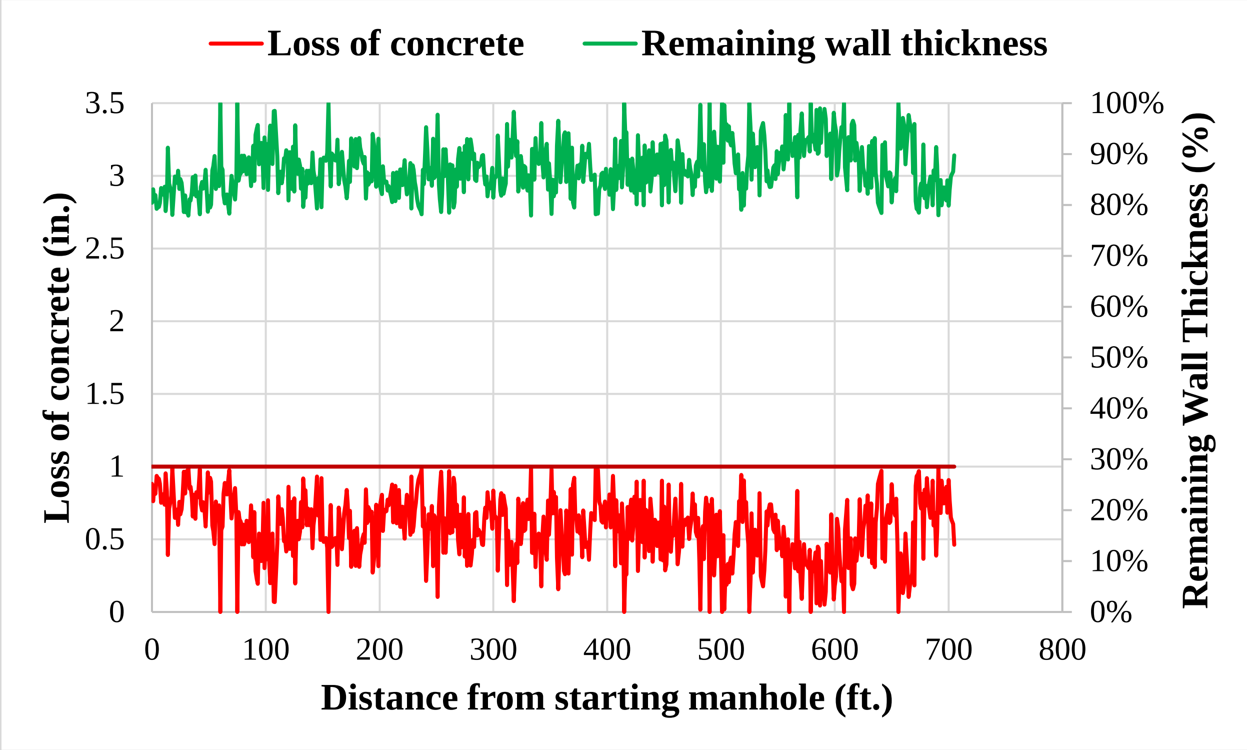

Figure 4-113 Loss of concrete and remaining wall thickness for line 11090

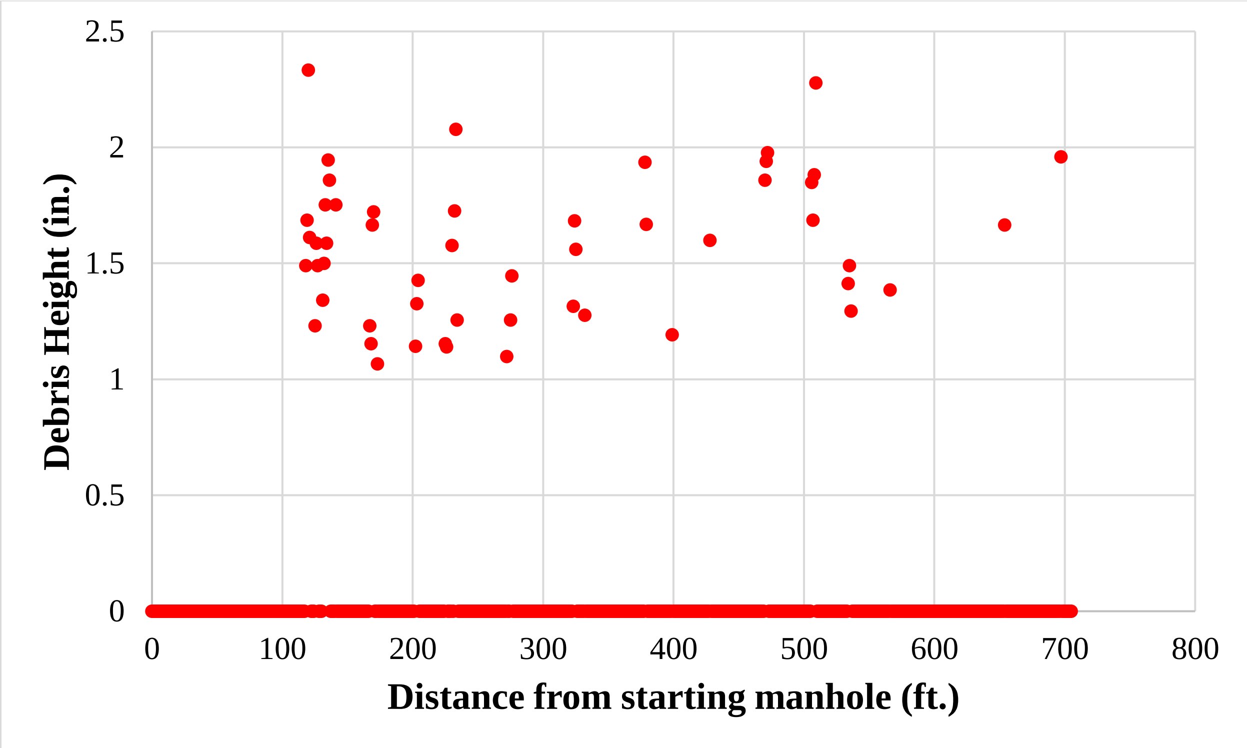

Figure 4-114 Height of debris in line 11090

35. Line 11091

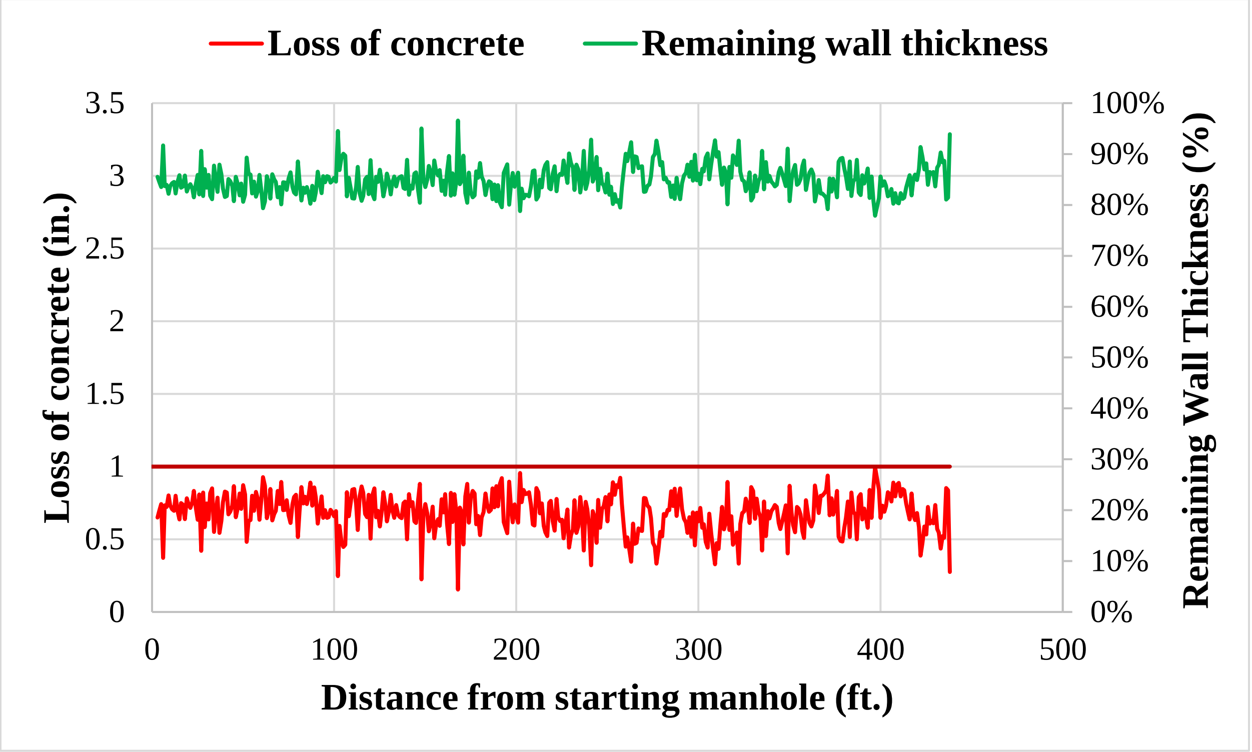

Figure 4-115 Loss of concrete and remaining wall thickness for line 11091

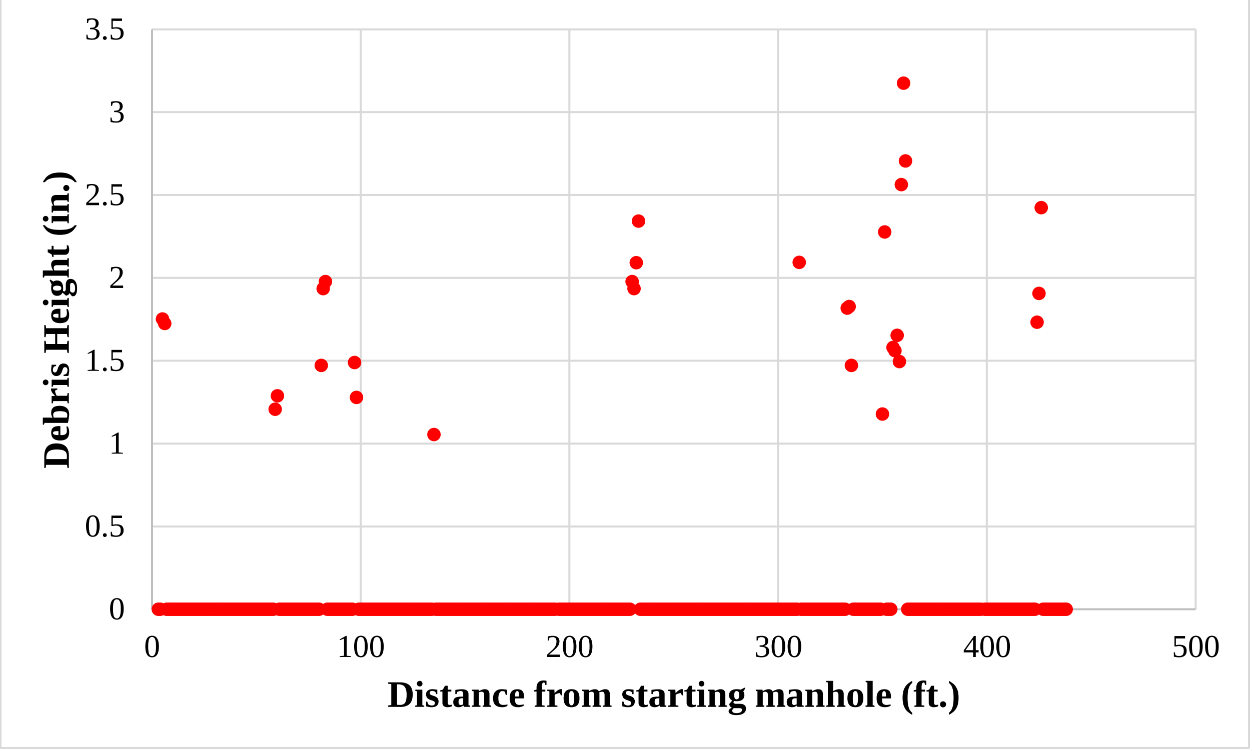

Figure 4-116 Height of debris in line 11091

36. Line 12907

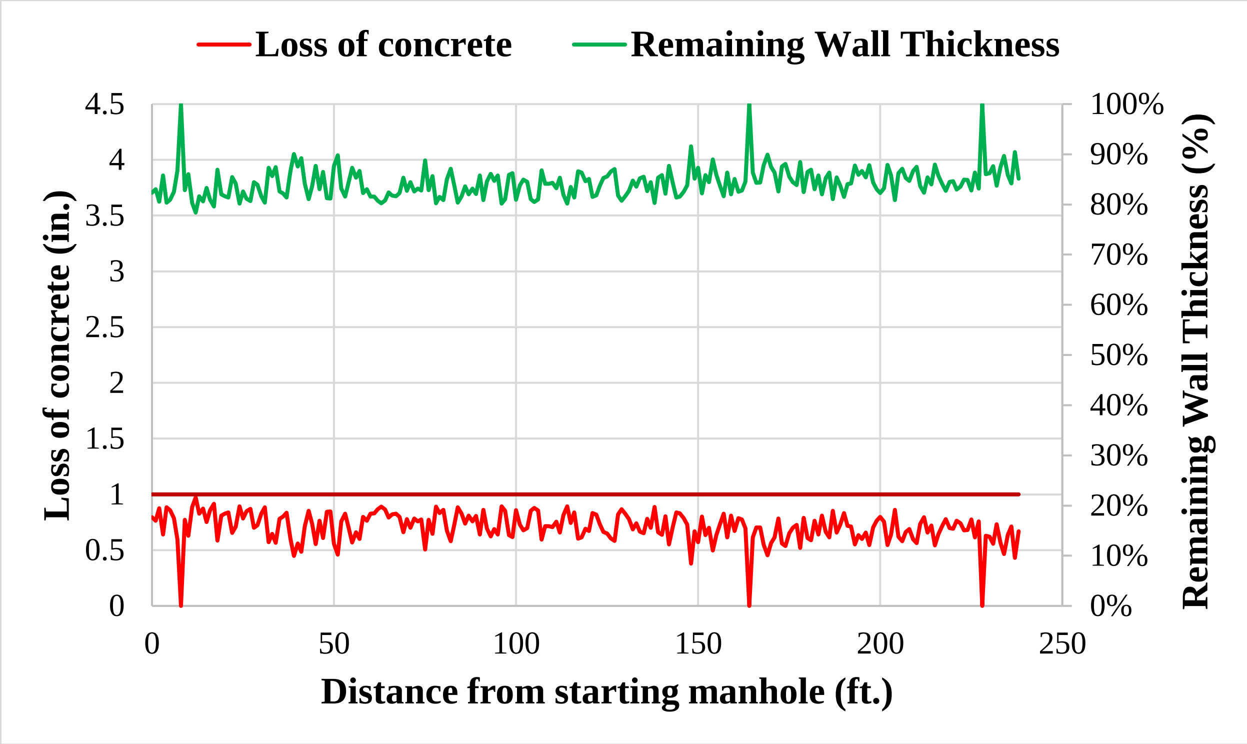

Figure 4-117 Loss of concrete and remaining wall thickness for line 12907

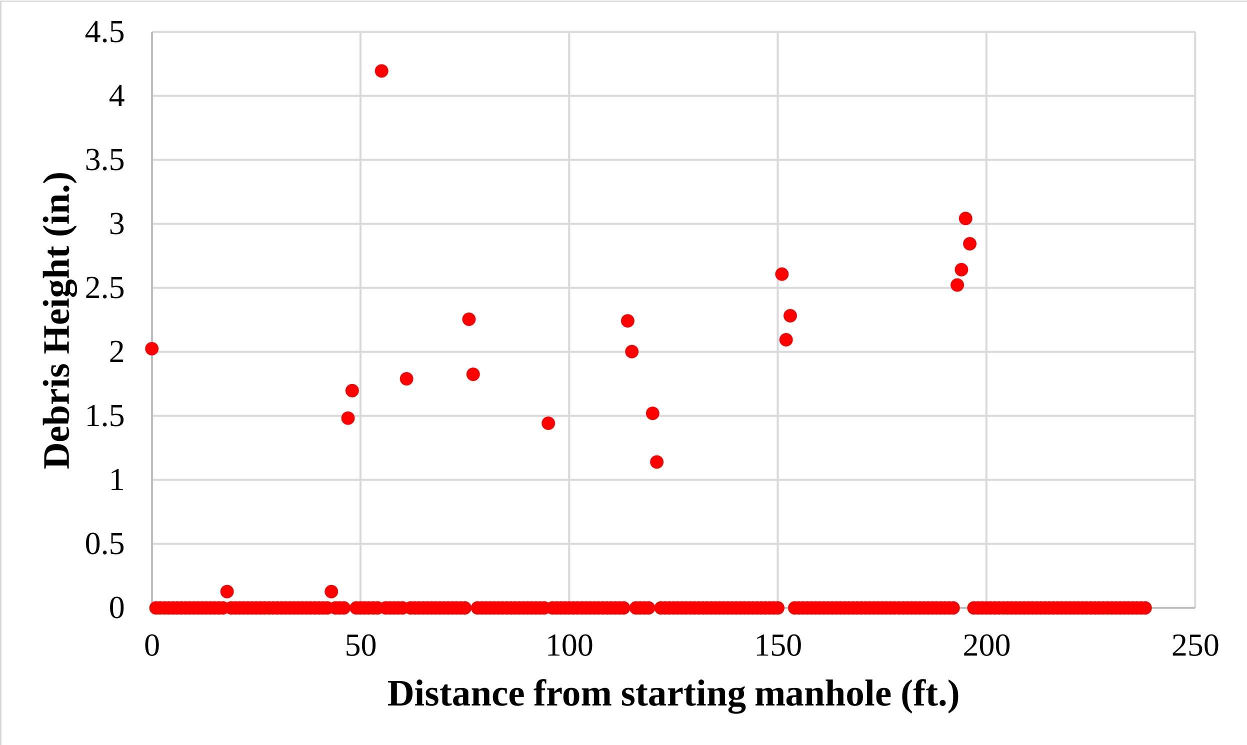

Figure 4-118 Height of debris in line 12907

37. Line 11092

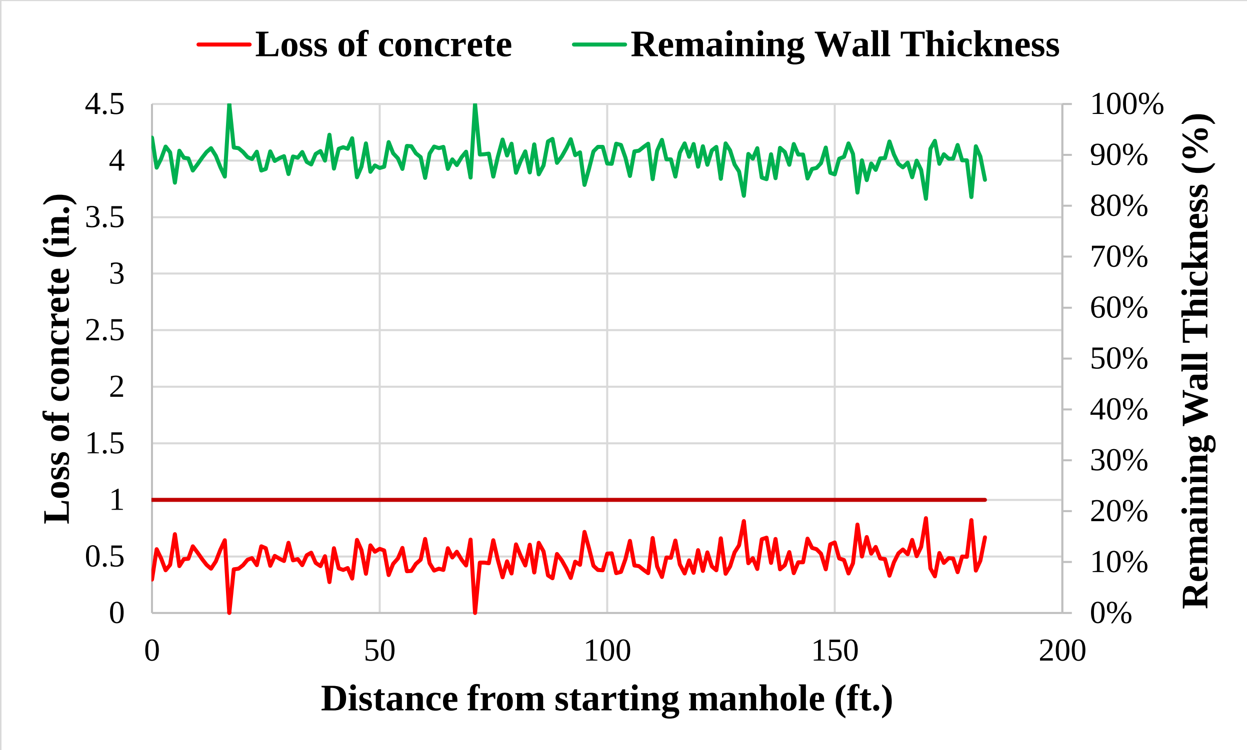

Figure 4-119 Loss of concrete and remaining wall thickness for line 11092

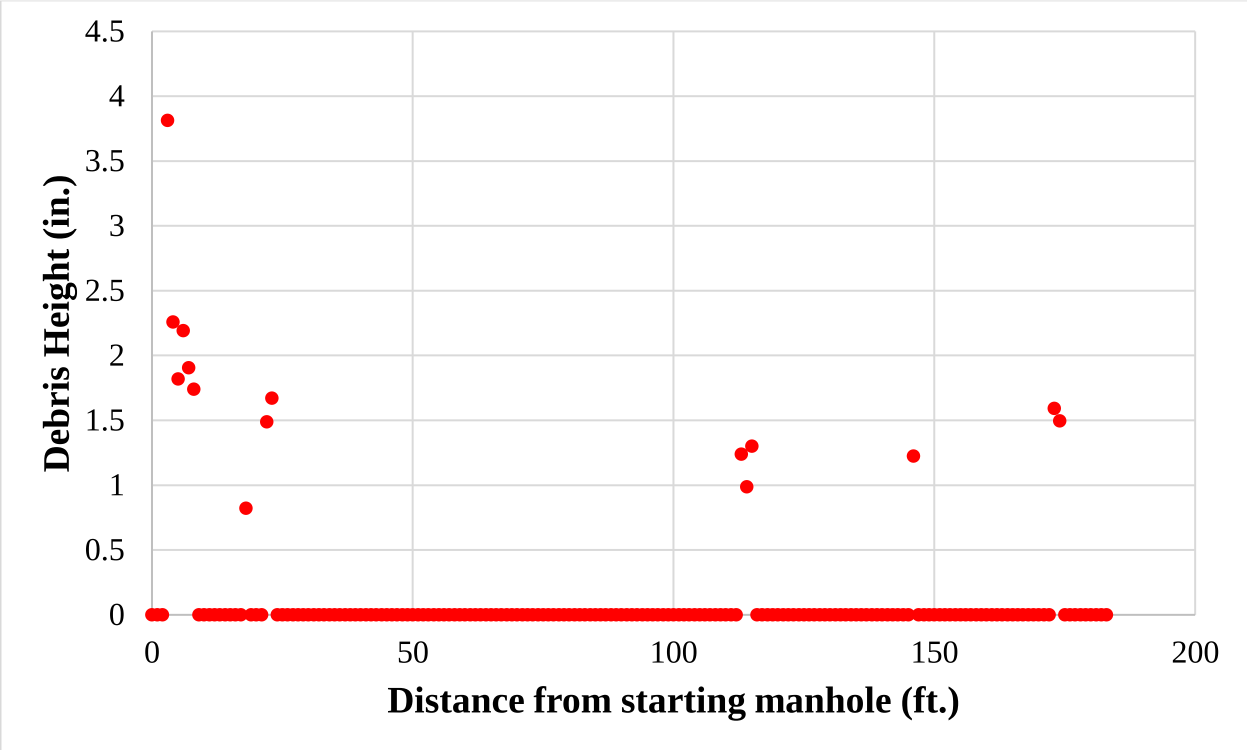

Figure 4-120 Height of debris in line 11092

38. Line 11093

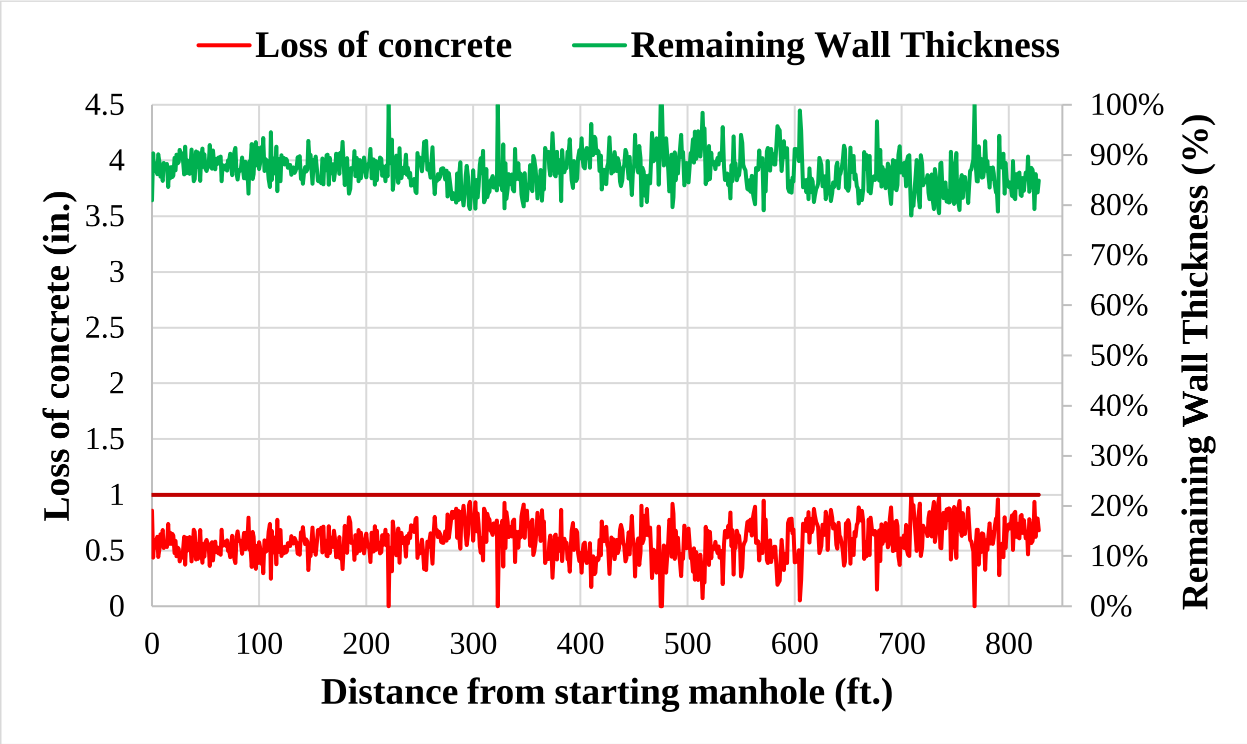

Figure 4-121 Loss of concrete and remaining wall thickness for line 11093

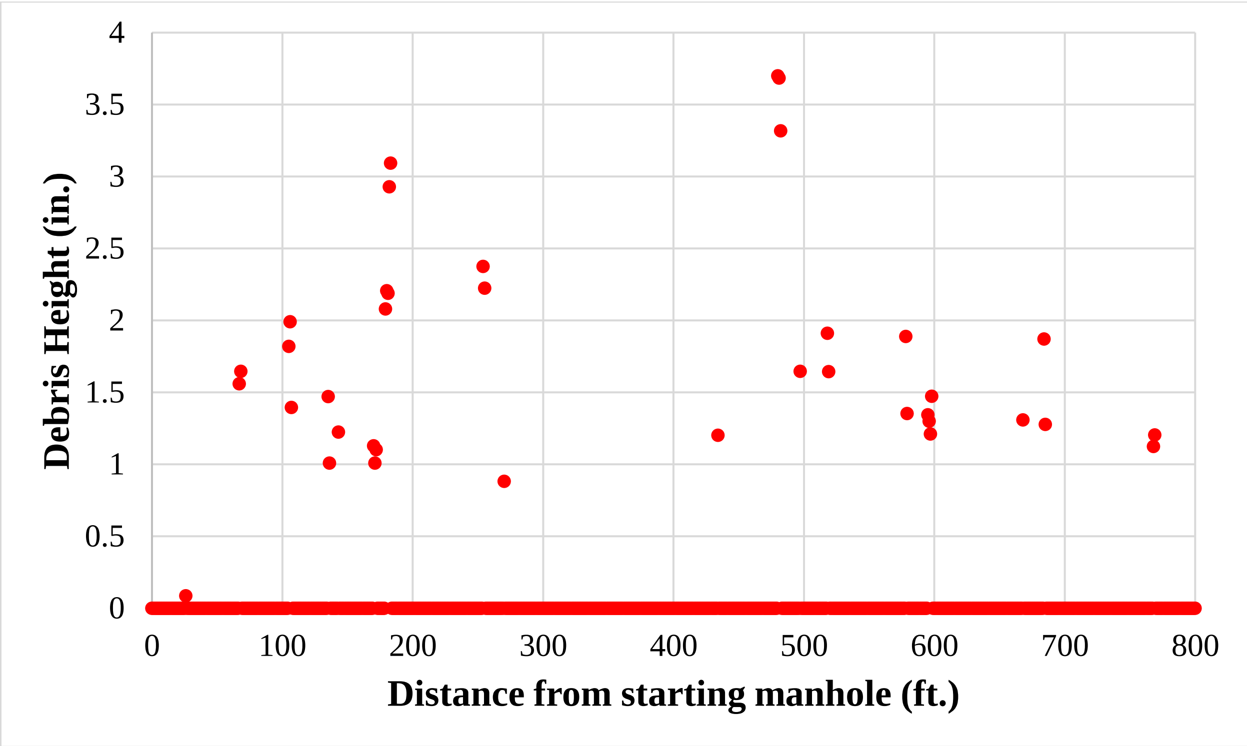

Figure 4-122 Height of debris in line 11093

4.2 Trinity River Authorization

An advanced robotic multi-sensor inspection device equipped with sonar, lidar, and video capabilities was used to assess the condition of approximately 3.5 miles (17,580.5 ft.) of concrete sanitary sewer pipelines in Arlington, Texas. The condition of the pipes were graded according to the NASSCO PACP rating system of 1 through 5, with 1 being the best and 5 indicating severe damage with strong potential for failure.

4.2.1 Overview of The Inspected pipes

The first phase of sewer pipeline inspections performed for the Trinity River Authority in Arlington, Texas consisted of inspecting 19 lines that totaled 17,580.5 ft., or approximately 3.5 miles.

Table 4-2 Summary of lines inspected in Phase I of the TRA project.

SN	Record No.	US MH ID	DS MH ID	Diameter (in.)	Pipe Material	Length (ft.)	
						GIS	CCTV
1	9502	2780T	2760T	54	RCP	1278	1165.25
2	9612	40T	2760T	39	RCP	1313	1273.82
3	9503	2800T	2780T	54	RCP	1003	997.55
4	9810	60T	40T	39	RCP	1000	996.42
5	9506	2820T	2800T	54	RCP	1001	1008
6	9846	80T	60T	39	RCP	1000	1001
7	9507	2840T	2820T	54	RCP	1970	1980
8	9231	100T	80T	39	RCP	1968	1971
9	9508	2850T	2840T	54	RCP	575	1575.65
10	9509	2860T	2850T	54	RCP	997	
11	9260	120T	100T	39	RCP	1582	1576.79
12	9510	2880T	2860T	54	RCP	366	370.46
13	9295	140T	120T	42	DIP	350	355.76
14	9511	2900T	2880T	54	RCP	604	600.57
15	9334	160T	140T	39	RCP	622	585.73
16	9512	2920T	2900T	54	RCP	397	394.38
17	9786	6032T	2920T	54	RCP	227.2	199.66
18	9799	6070T	6056T	78	FRP	614.2	609.76
19	9800	6080T	6070T	78	FRP	713.1	707.77

The area map for Phase 1 is depicted in Figure 4-123; the boundaries of the project are circled in red. Figure 4-124 shows the location of the sanitary sewer pipelines corresponding to the segments of Table 4-2.

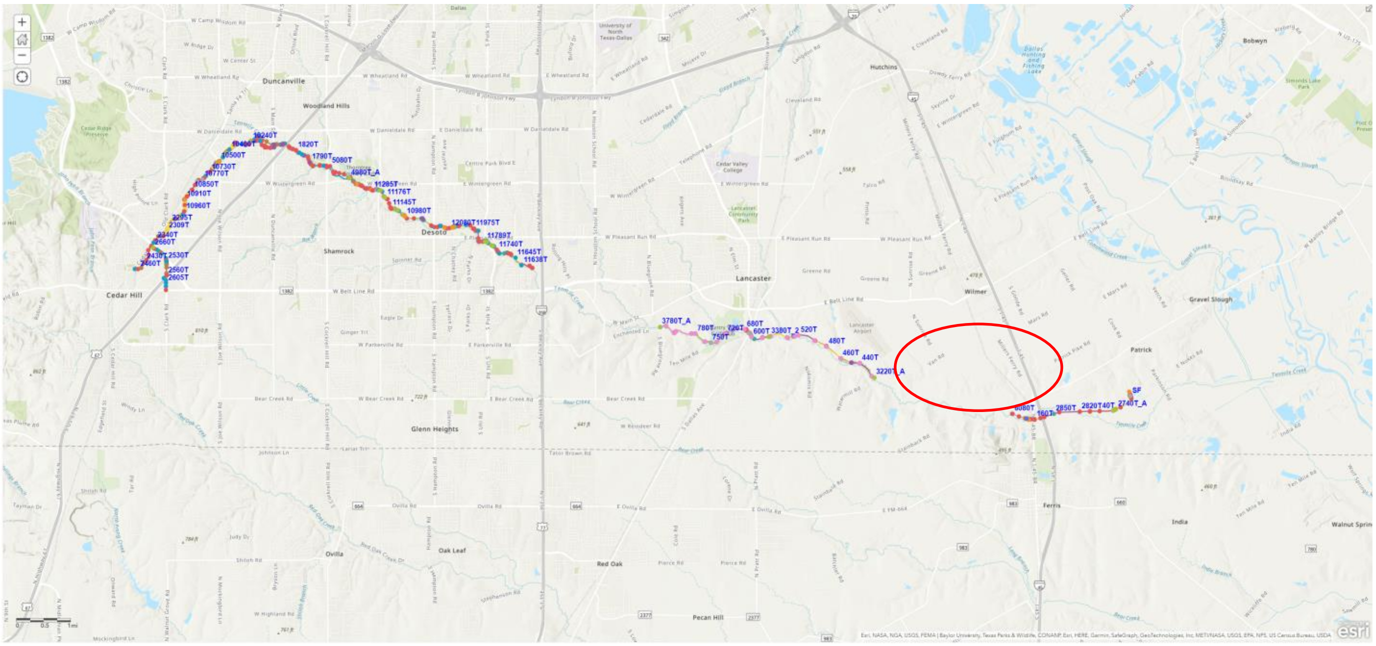

Figure 4-123 Area map for Phase 1 of the TRA project

Figure 4-124 Locations of sanitary sewer pipelines in Phase I

4.2.2 Visual Observation

The CCTV data indicates that several sections of the sewer line have damaged surfaces, exposed and critically corroded rebars, missing concrete covers, etc. Severe structural defects observed portend immediate failure of the system and must be repaired or replaced as soon as possible to ensure their serviceability and structural integrity and to meet loading and environmental requirements.

The details of the inspections are presented in the PACP format for each line. The distance was calculated from one manhole to the next. The defect codes and dimensions comply with the NASSCO's PACP standard. In addition to the defect table, the quick rating, overall rating, and rating index were calculated for both the structural and O&M defects and are presented for each line. Appendix I contains snapshots that were taken at every five feet of all the lines.

1. Line 9502

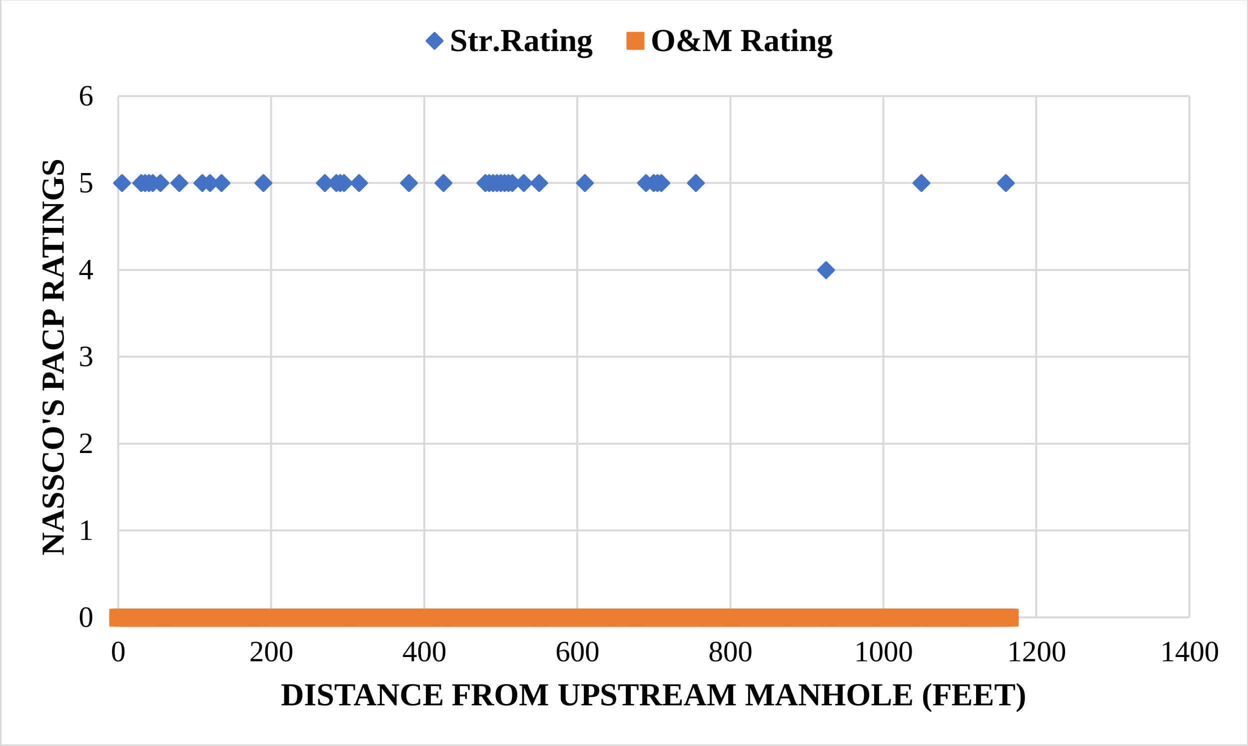

Figure 4-125 NASSCO's PACP rating for every 5 ft. pipe segment in line 9502.

2. Line 9612

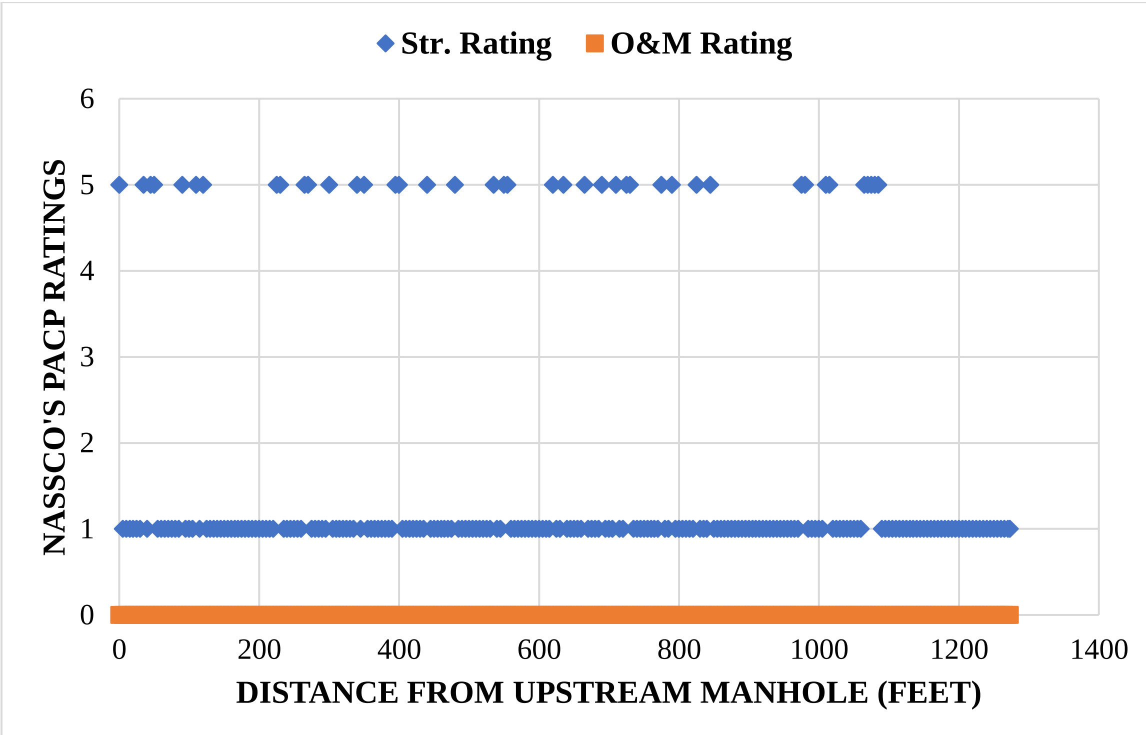

Figure 4-126 NASSCO's PACP rating for every 5 ft. pipe segment in line 9612.

3. Line 9503

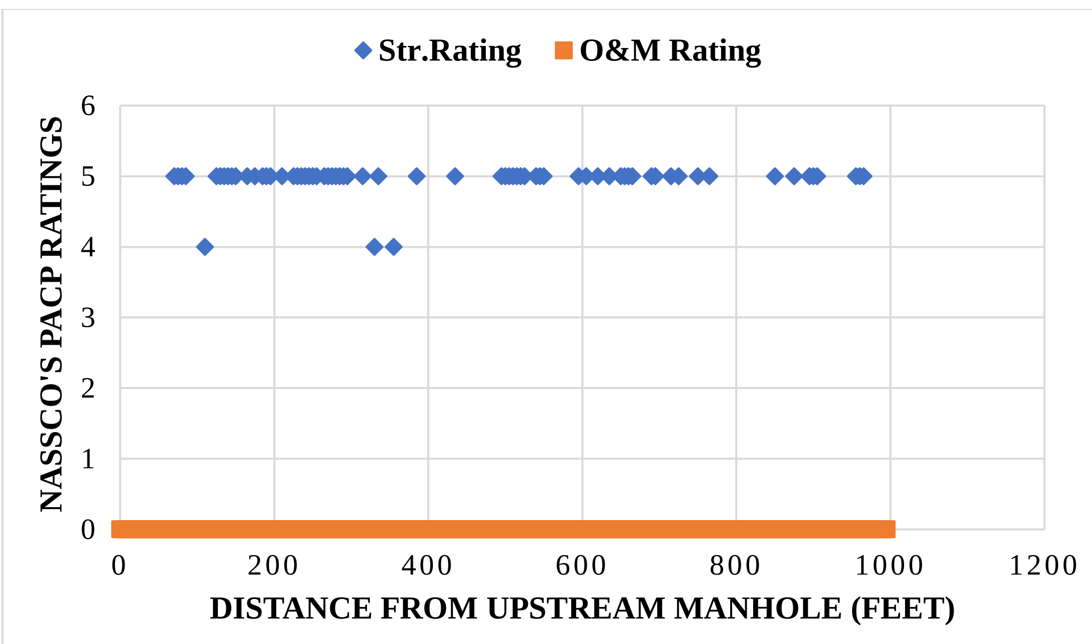

Figure 4-127 NASSCO's PACP rating for every 5 ft. pipe segment in line 9503.

4. Line 9810

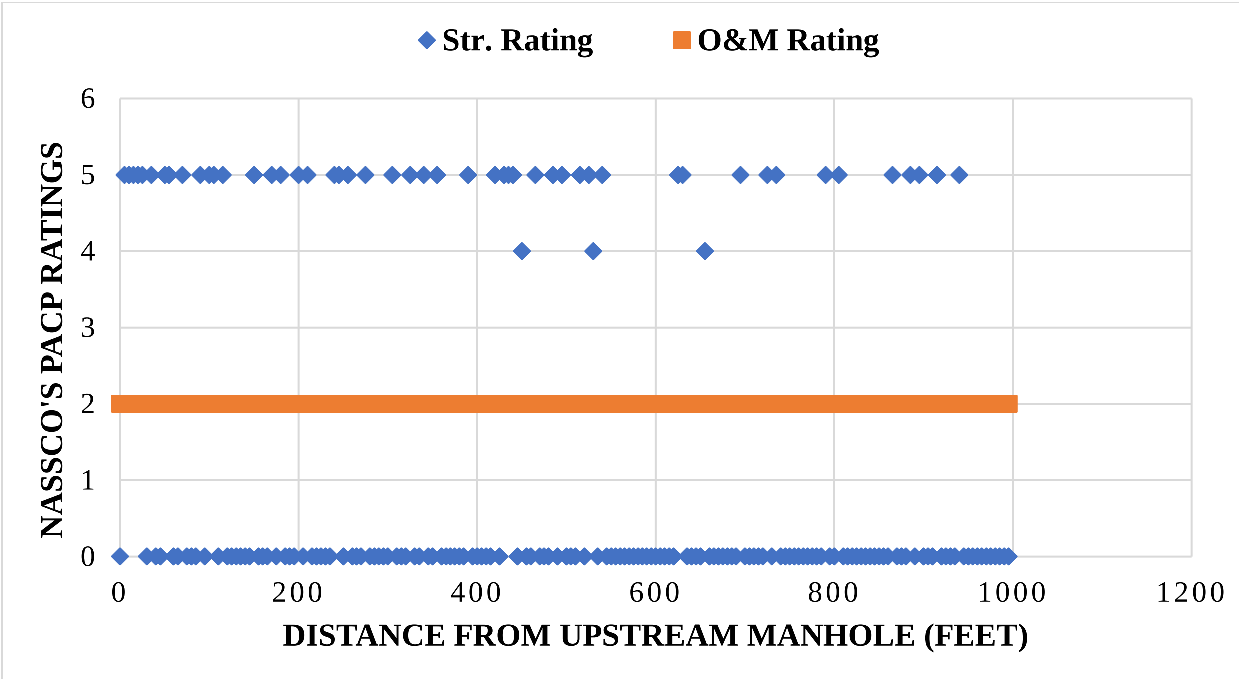

Figure 4-128 NASSCO's PACP rating for every 5 ft. pipe segment in line 9810.

5. Line 9506

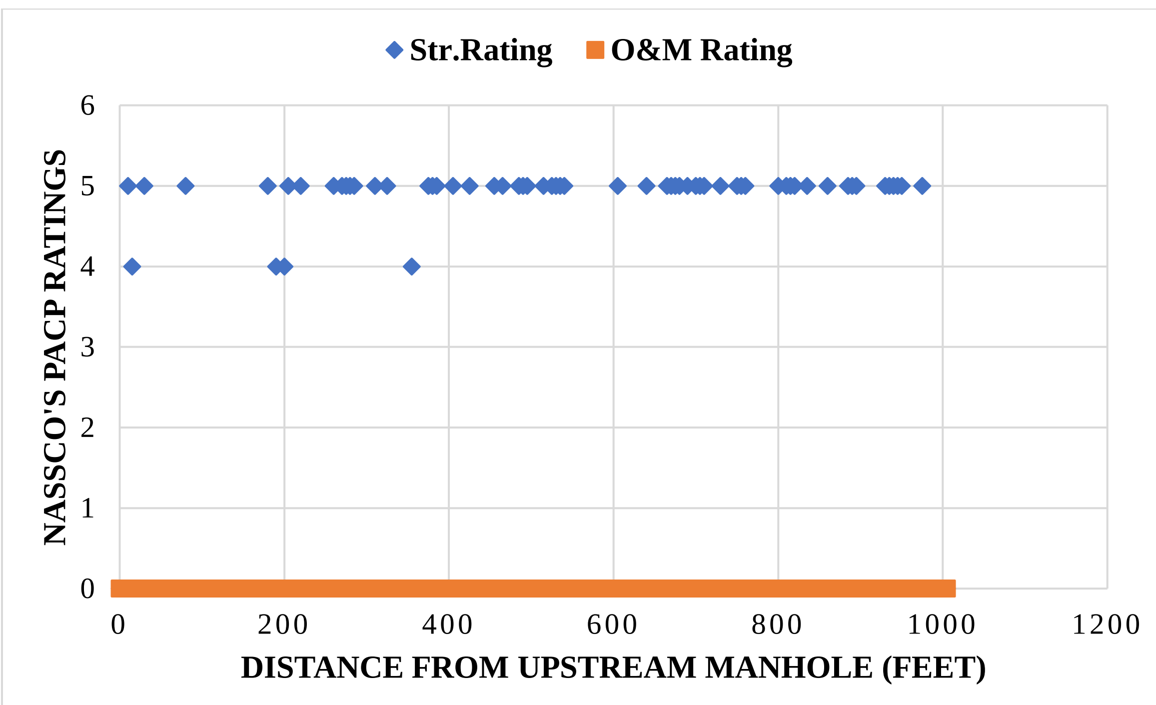

Figure 4-129 NASSCO's PACP rating for every 5 ft. pipe segment in line 9506.

6. Line 9846

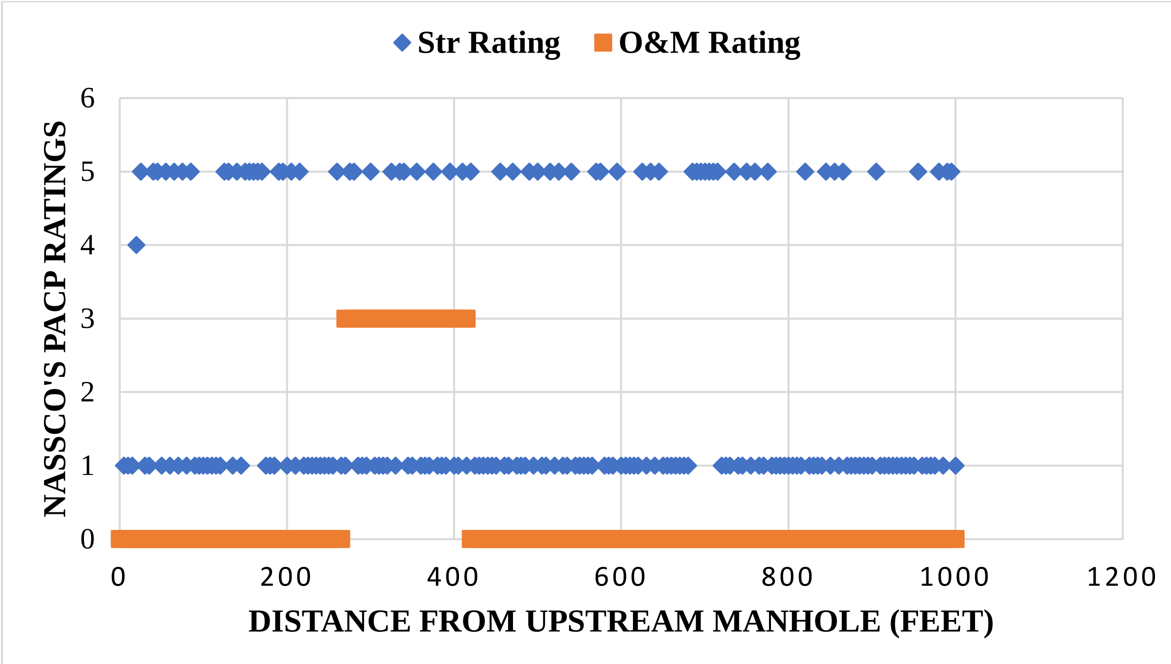

Figure 4-130 NASSCO's PACP rating for every 5 ft. pipe segment in line 9846.

7. Line 9507

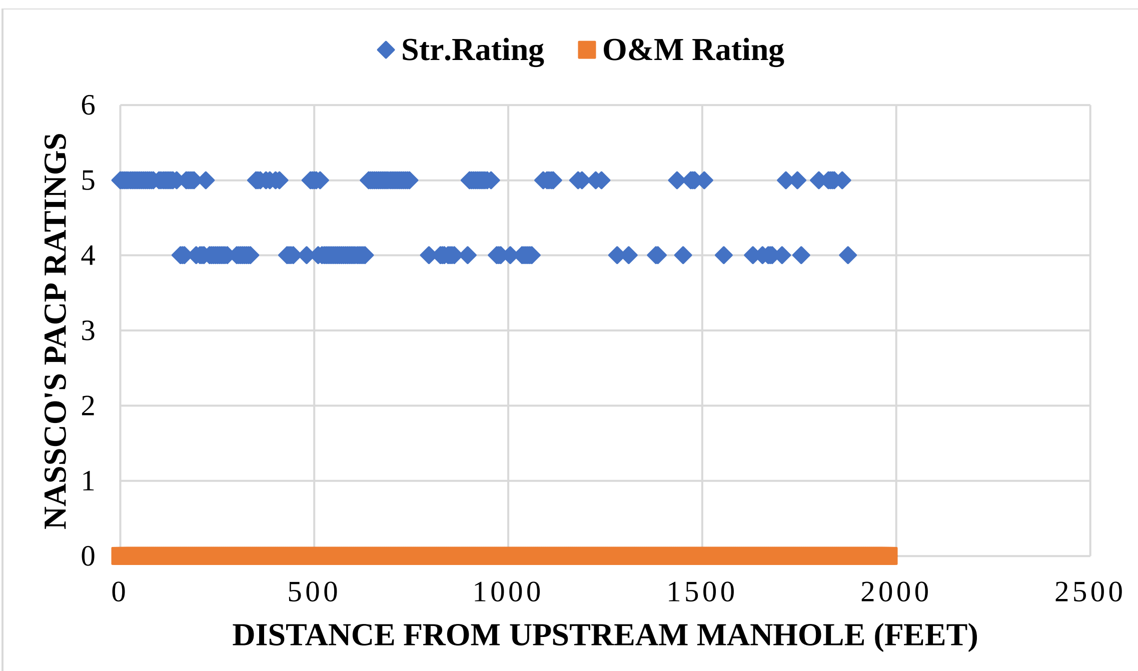

Figure 4-131 NASSCO's PACP rating for every 5 ft. pipe segment in line 9507.

8. Line 9231

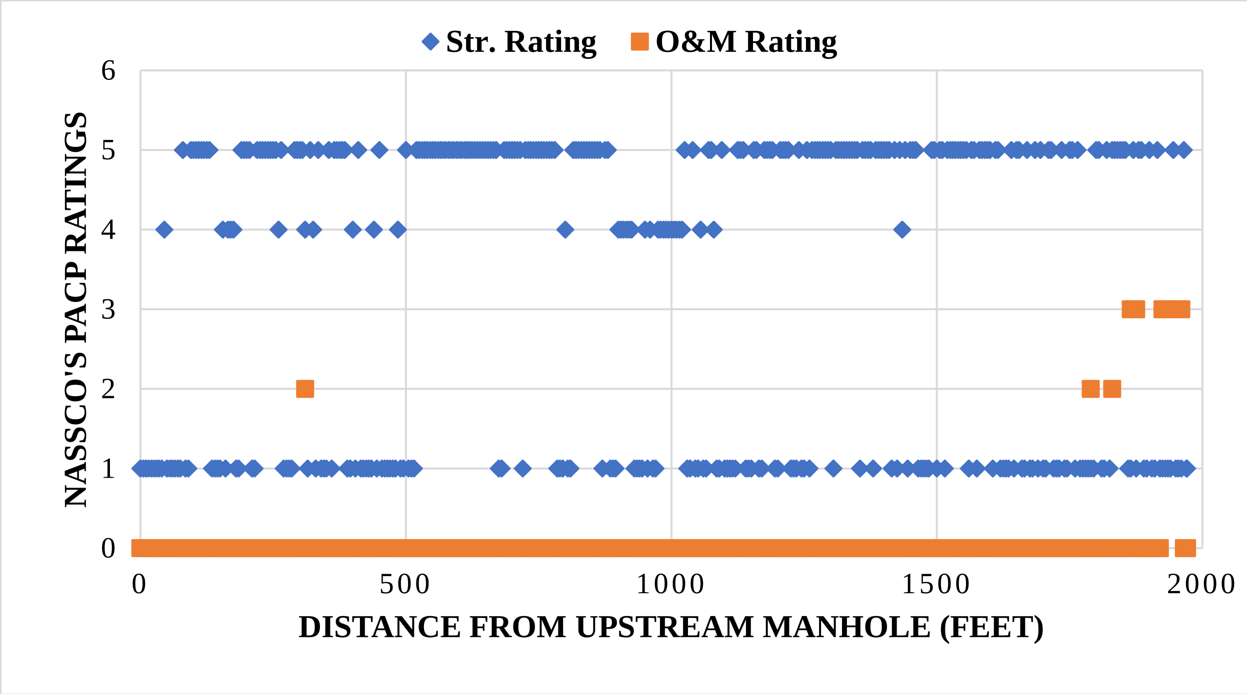

Figure 4-132 NASSCO's PACP rating for every 5 ft. pipe segment in line 9231.

9. Line 9509-9508

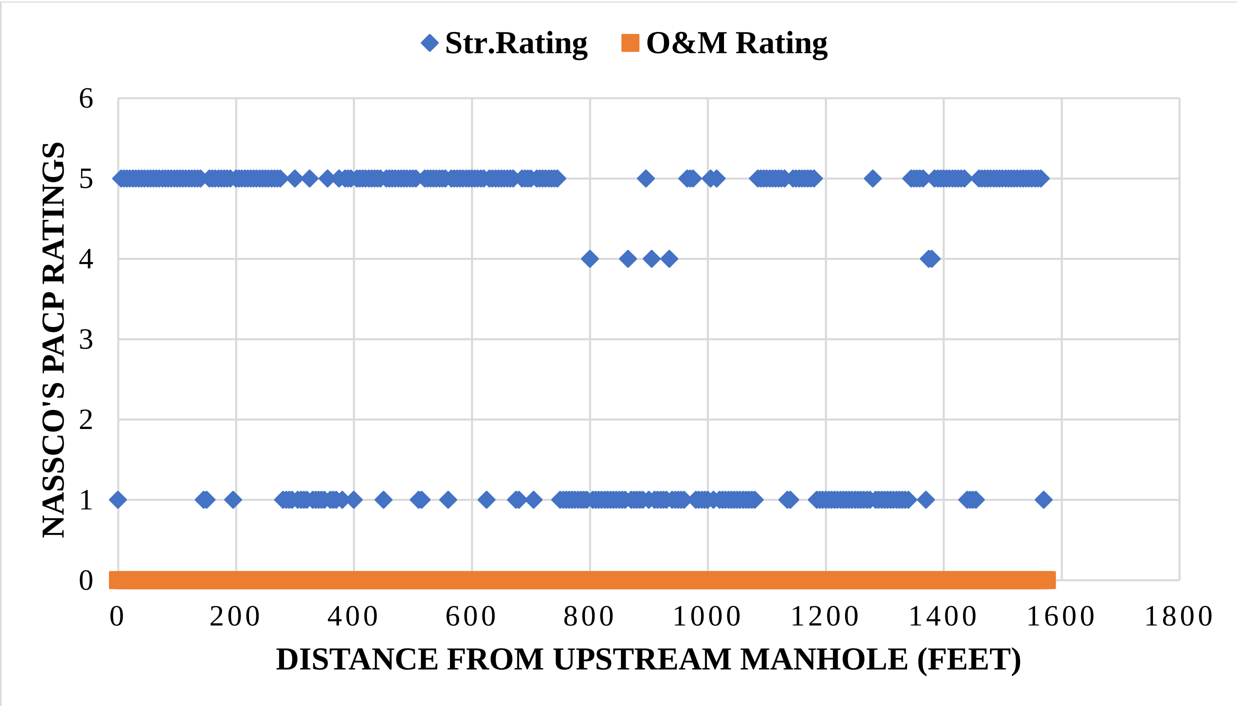

Figure 4-133 NASSCO's PACP rating for every 5 ft. pipe segment in line 9509-9508

10. Line 9260

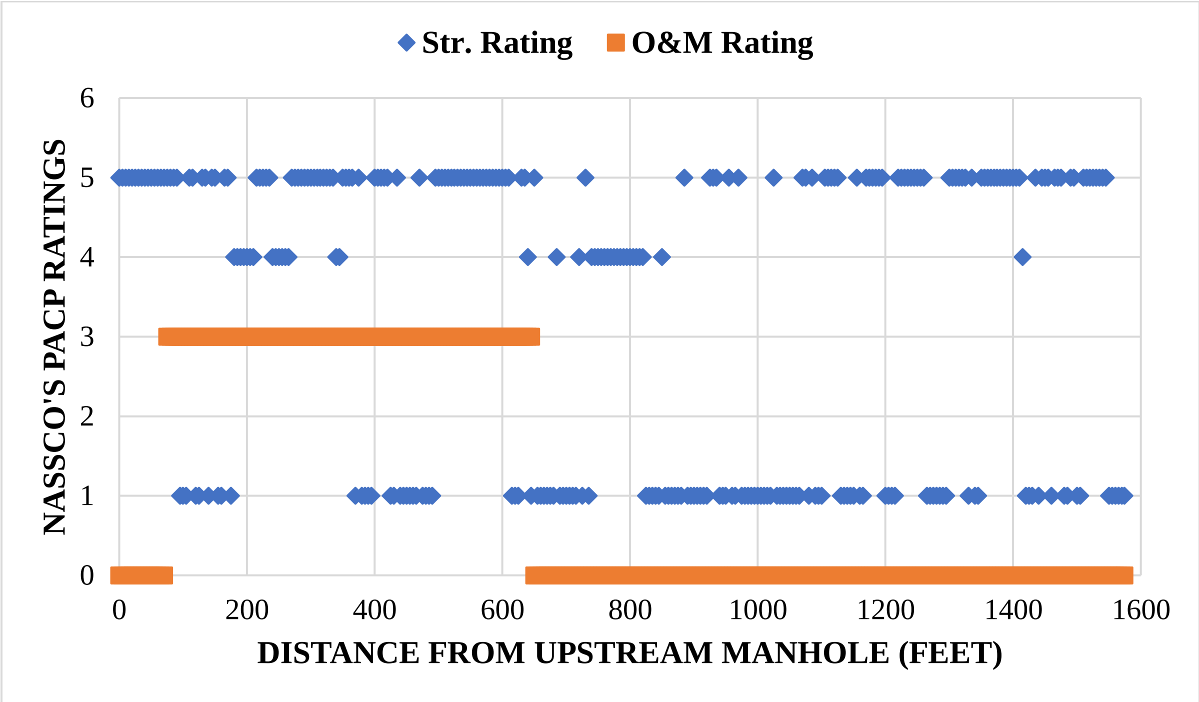

Figure 4-134 NASSCO's PACP rating for every 5 ft. pipe segment in line 9260.

11. Line 9510

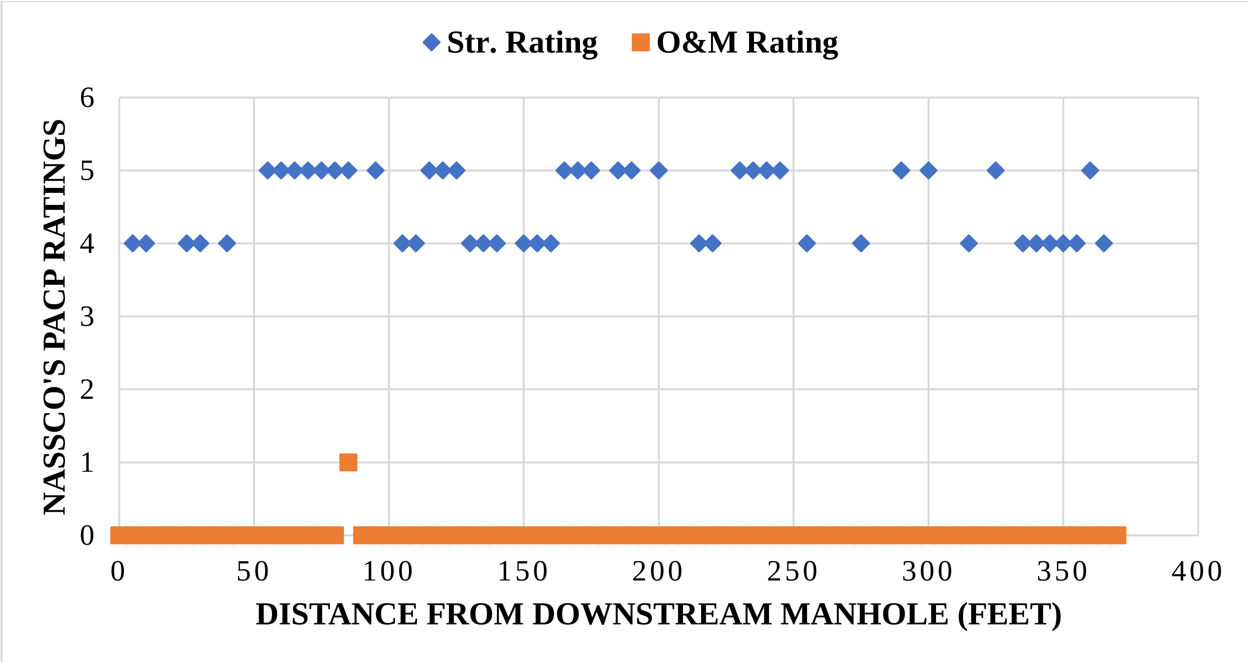

Figure 4-135 NASSCO's PACP rating for every 5 ft. pipe segment in line 9510.

12. Line 9295

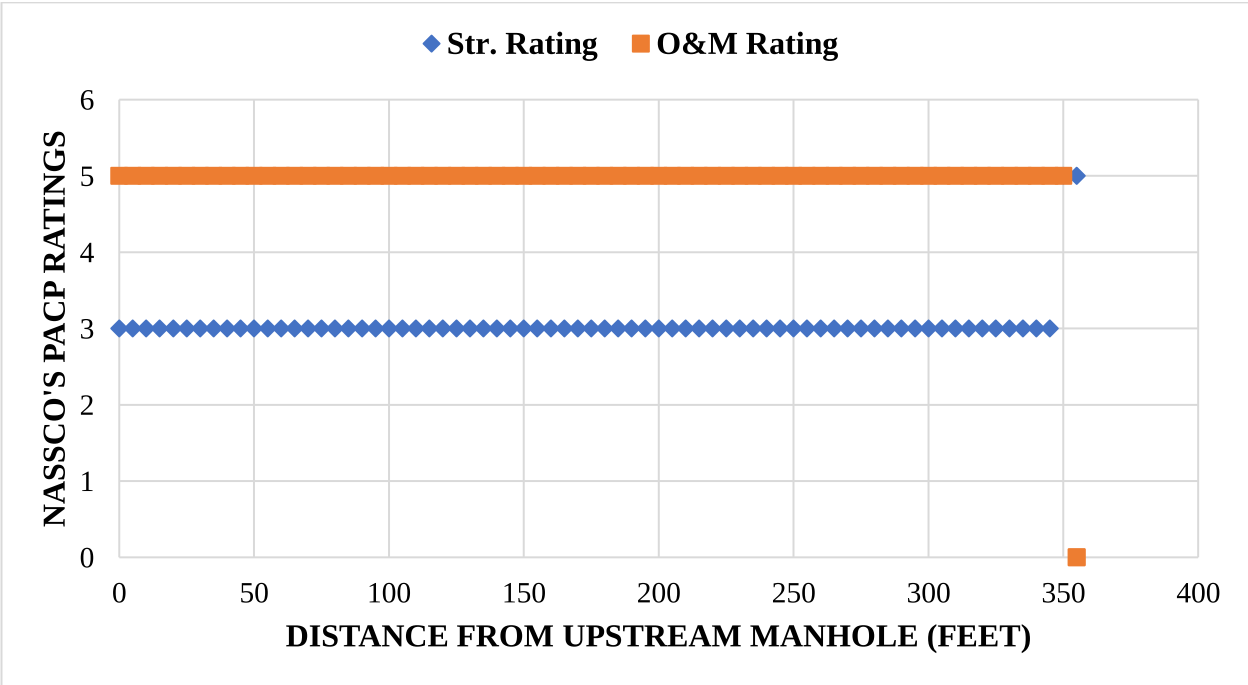

Figure 4-136 NASSCO's PACP rating for every 5 ft. pipe segment in line 9295.

13. Line 9511

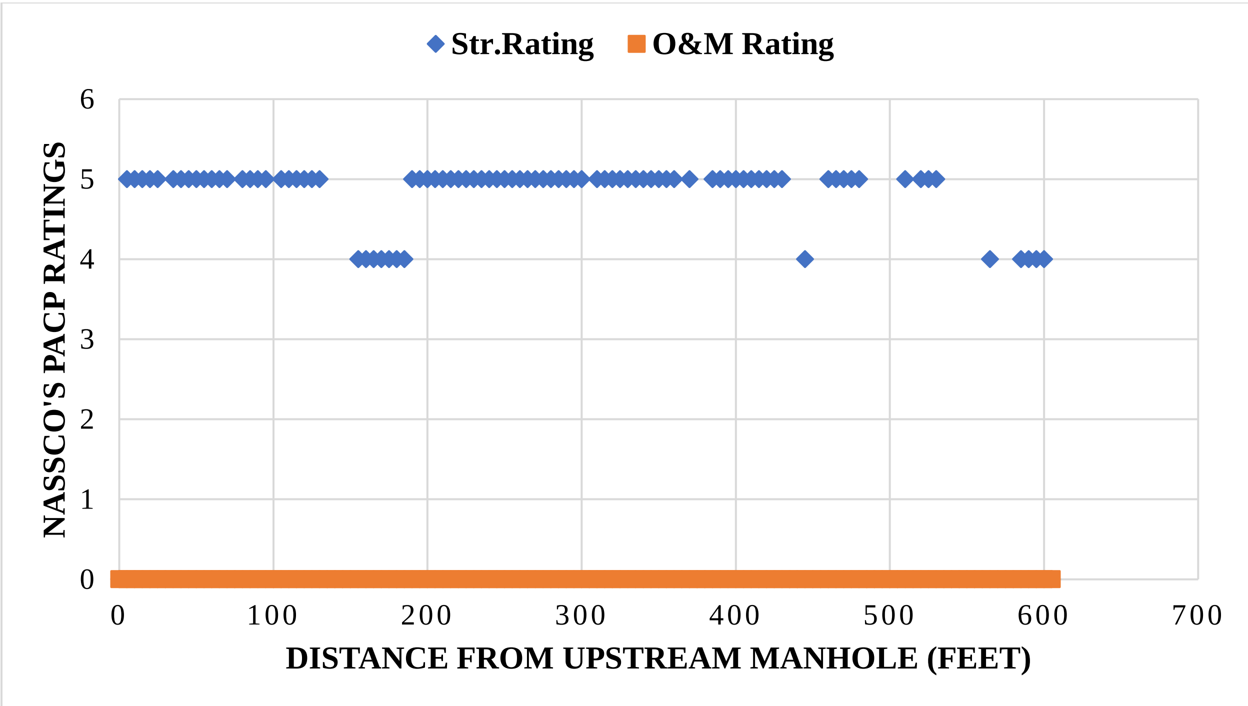

Figure 4-137 NASSCO's PACP rating for every 5 ft. pipe segment in line 9511.

14. Line 9334

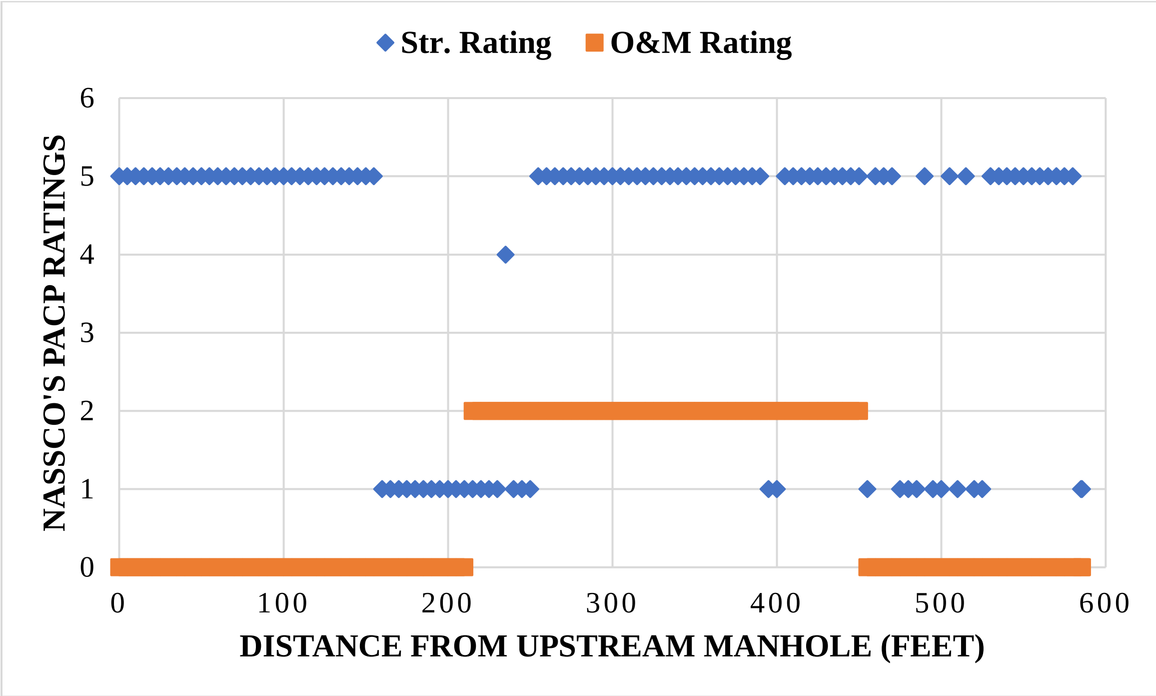

Figure 4-138 NASSCO's PACP rating for every 5 ft. pipe segment in line 9334.

15. Line 9512

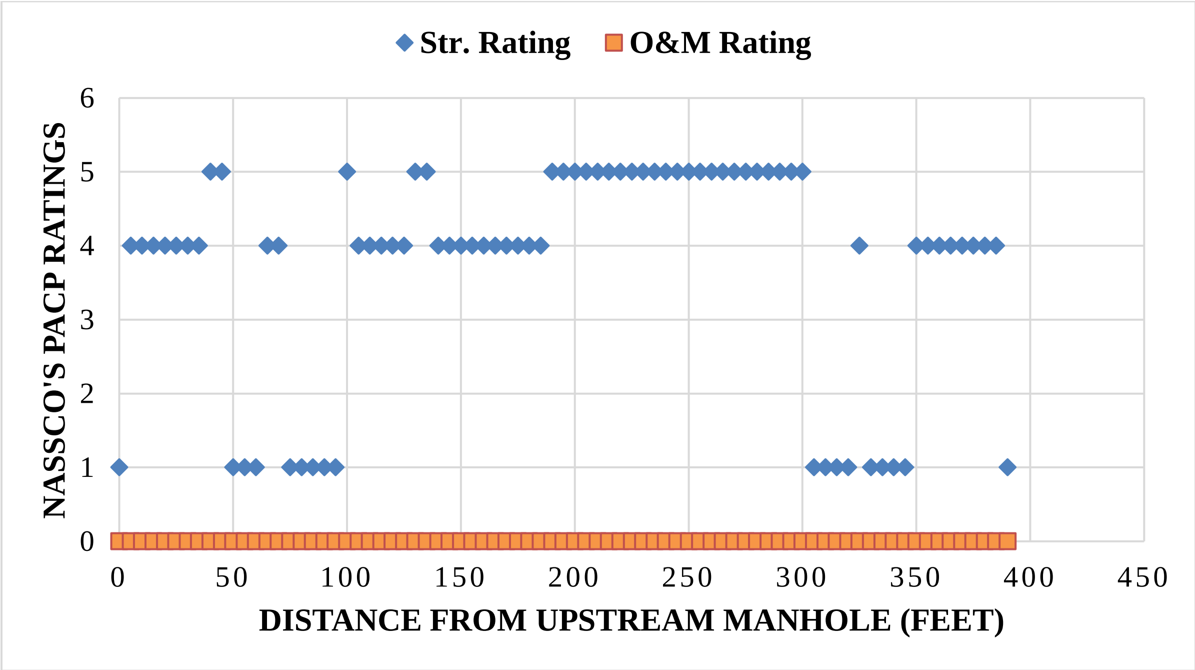

Figure 4-139 NASSCO's PACP rating for every 5 ft. pipe segment in line 9512.

16. Line 9786

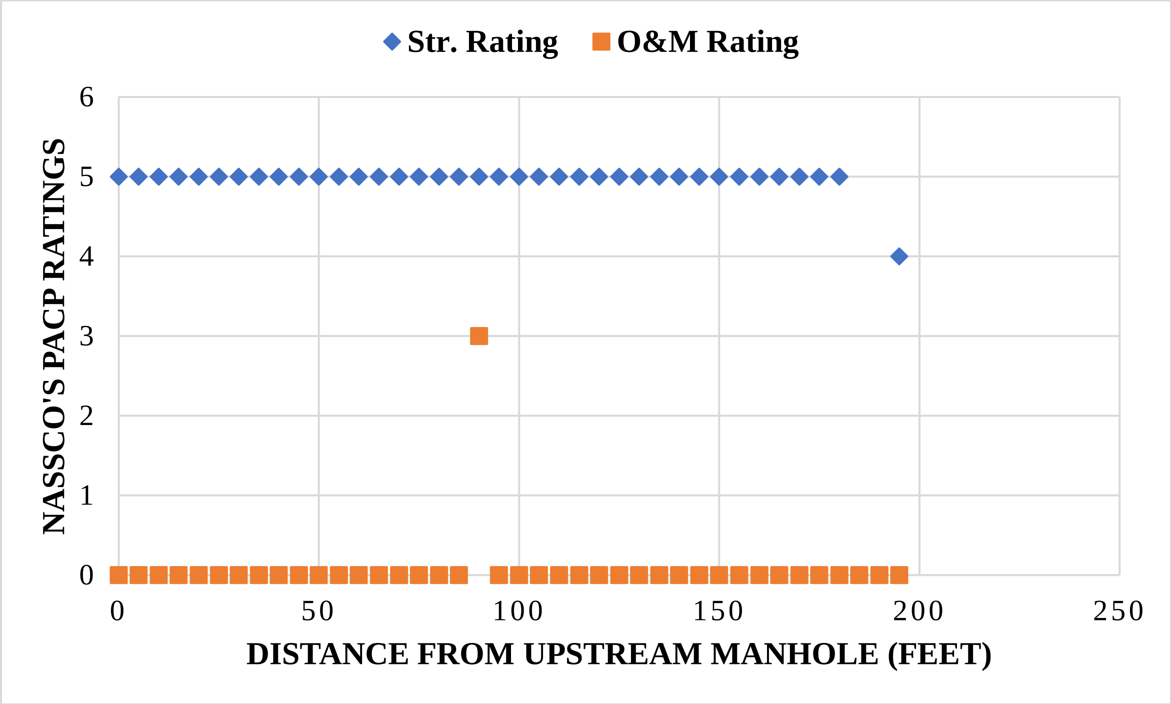

Figure 4-140 NASSCO's PACP rating for every 5 ft. pipe segment in line 9786.

17. Line 9799

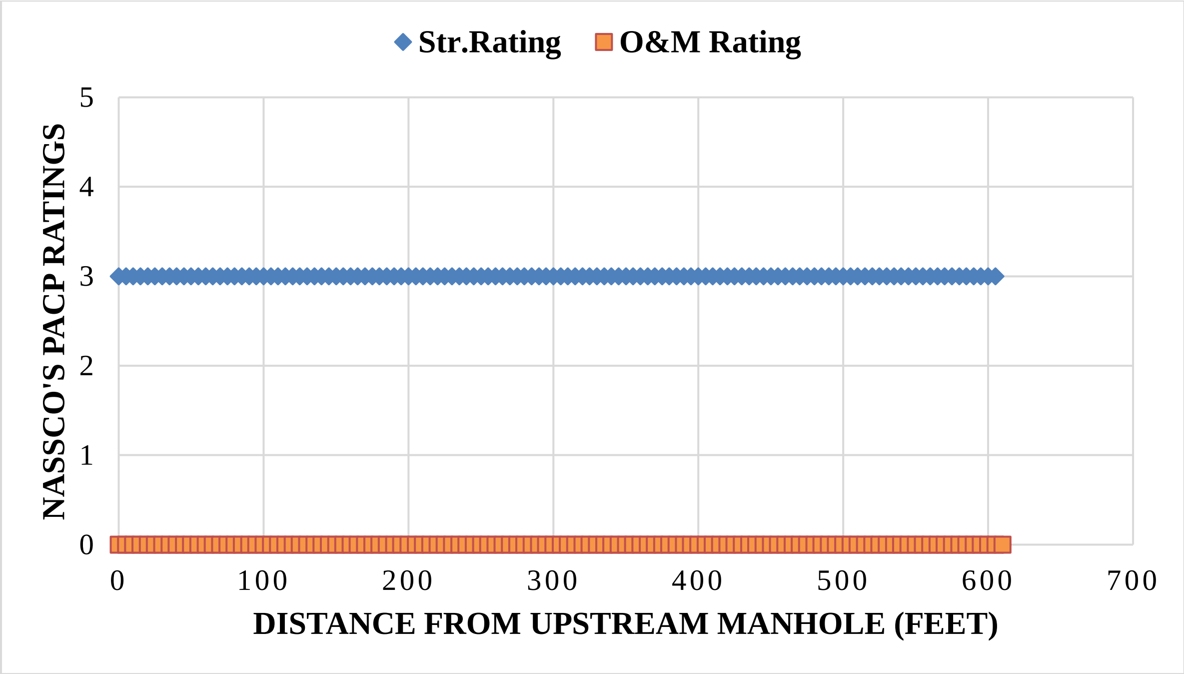

Figure 4-141 NASSCO's PACP rating for every 5 ft. pipe segment in line 9799.

18. Line 9800

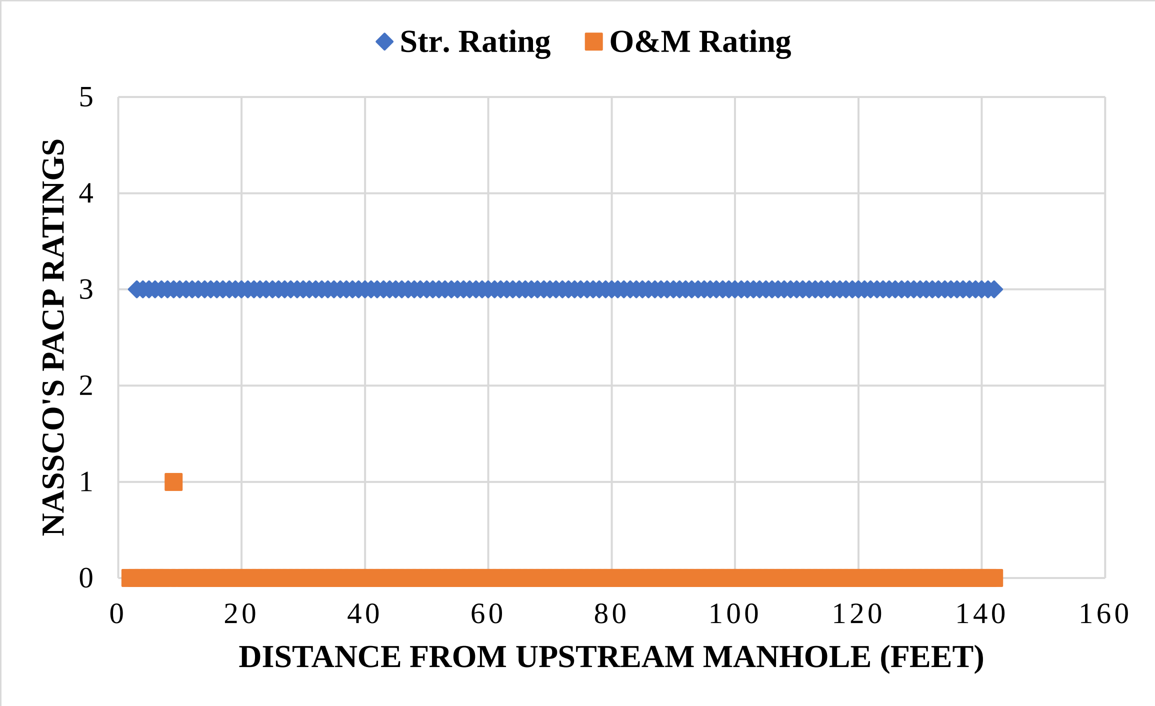

Figure 4-142 NASSCO's PACP rating for every 5 ft. pipe segment in line 9800.

4.2.3 MSI Results

The UTA CSER’s inspection robot is equipped with lidar and sonar sensors that provide numerical measurements and other information that enhance the quantitative data derived from other devices. The lidar sensor mapped the surface of the pipe above the water line, and the data it collected was used to calculate the loss of thickness in the reinforced concrete pipe walls. (The loss of concrete’s clear cover leaves reinforcements exposed, making them susceptible to corrosion and highly prone to failure.) The lidar data was used to calculate the deflection of flexible pipes like ductile iron (DI) and fiber reinforced pipe (FRP), to ensure that they did not exceed the deflection limits established by ASTM and AWWA (7.5% and 5%, respectively).

The sonar sensor was installed at the bottom of the Robot to map the underwater surface of the pipe, since CCTV and lidar can only provide information on the surface that is above water. The sonar can detect debris or blockages present under the water level inside the pipe, and the height of the debris, calculated based on the sonar readings, is used to calculate the percentage of blockage in the pipe.

The UTA CSER robot used for inspections is highly accurate in mapping the surface of the pipes, and the lidar sensors provided data that facilitated calculating the loss of concrete or deflection for both rigid and flexible pipes. The results for each pipe segment were overlapped with the correlating sonar scan to present the full cross section of the pipe. Examples of plots from post- processed MSI data for flexible and rigid pipes are shown in Figure 4-143 and Figure 4-144, respectively. Calculations were performed for each foot of pipe segment, and graphs are presented hereafter for each inspected line.

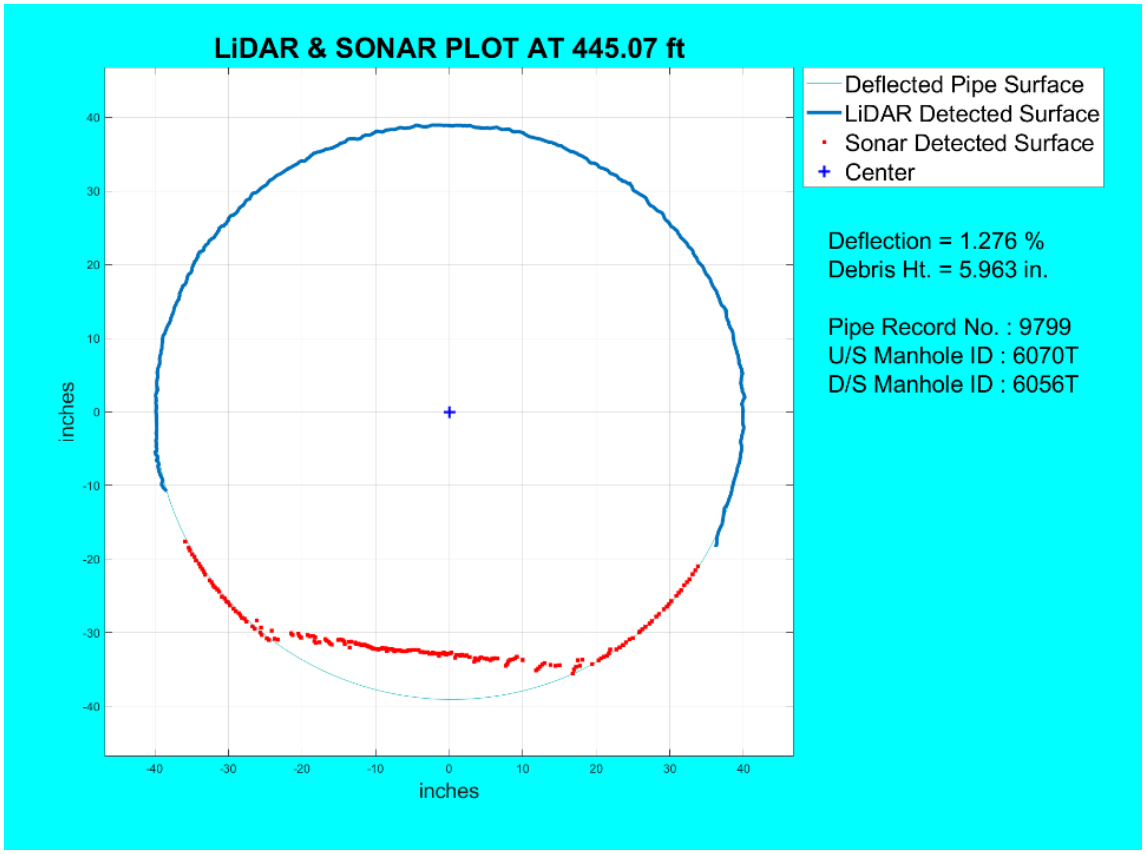

Figure 4-143 Example plot from post-processed MSI data for flexible pipe.

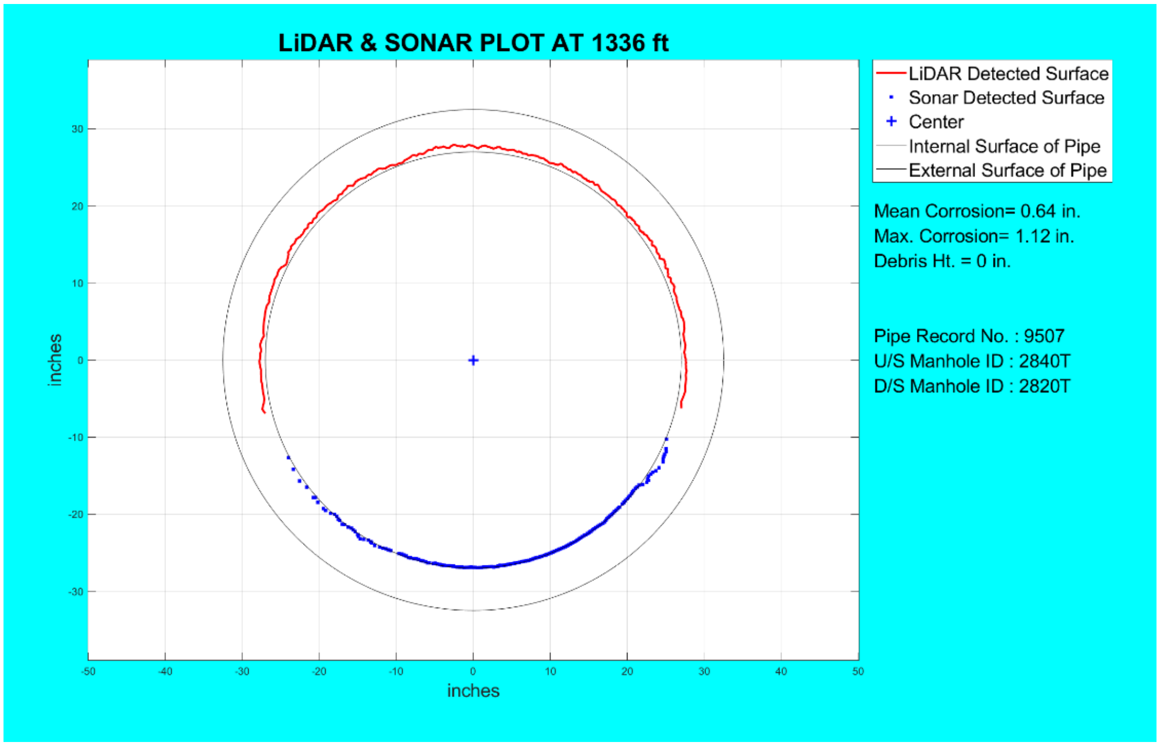

Figure 4-144 Example plot from post-processed MSI data for rigid pipe.

1. Line 9502

Line record no.:	9502		Pipe Material	RCP
US MH ID:	2780T		Inspection Date	12-09-2022
DS MH ID:	2760T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	1165 ft.

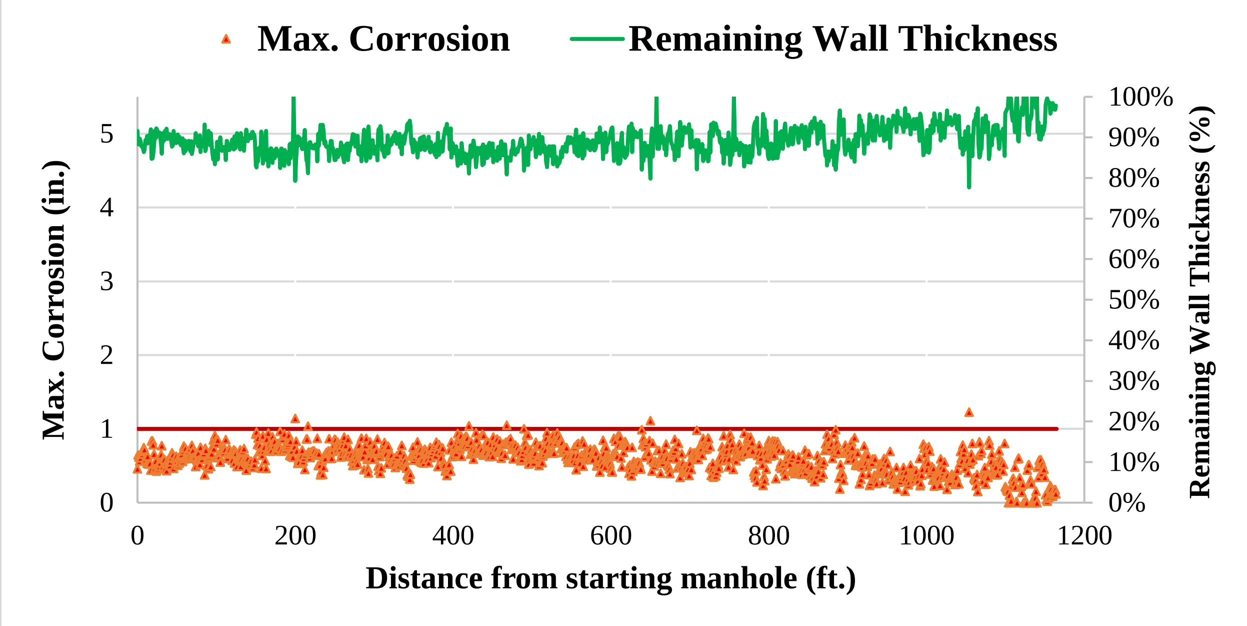

Figure 4-145 Maximum corrosion and remaining wall thickness (%) for line 9502

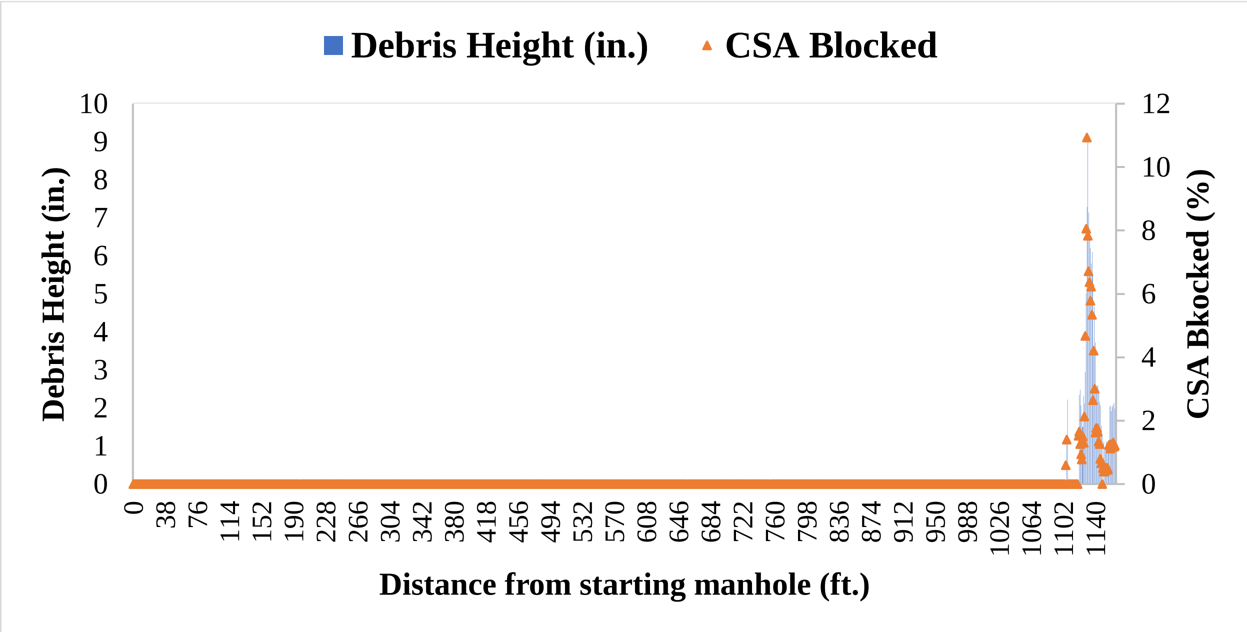

Figure 4-146 Debris height and CSA blocked for line 9502.

2. Line 9612

Line record no.:	9612		Pipe Material	RCP
US MH ID:	40T		Inspection Date	01/20/2023
DS MH ID:	2760T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	1182 ft.

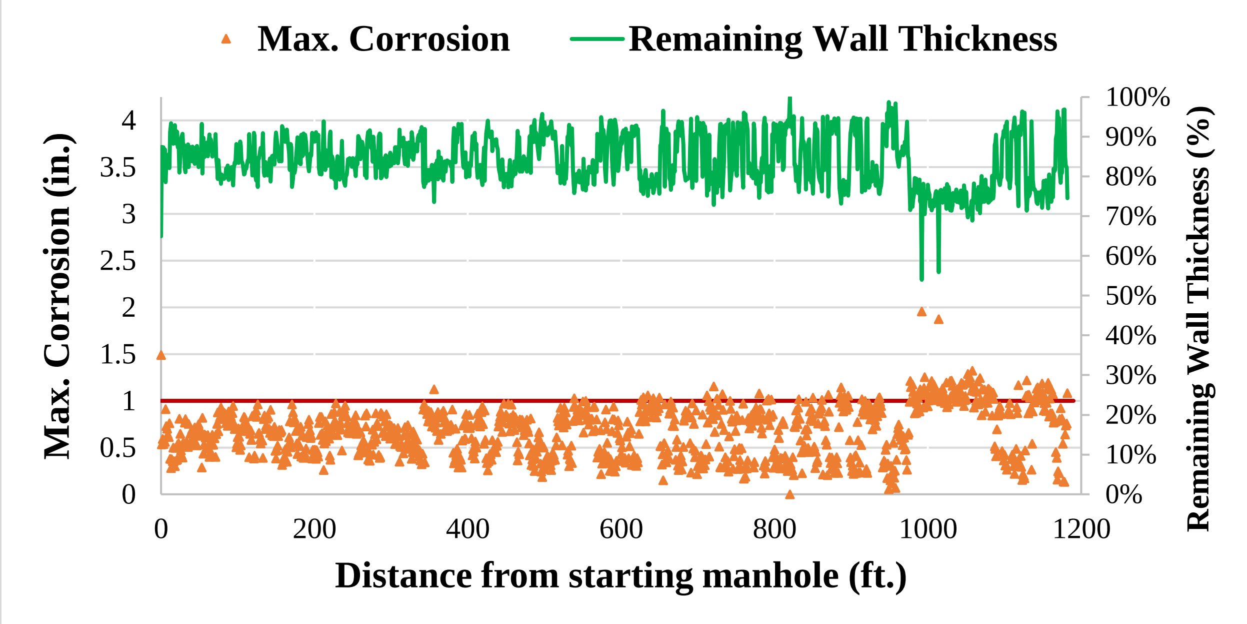

Figure 4-147 Maximum corrosion and remaining wall thickness (%) for line 9612

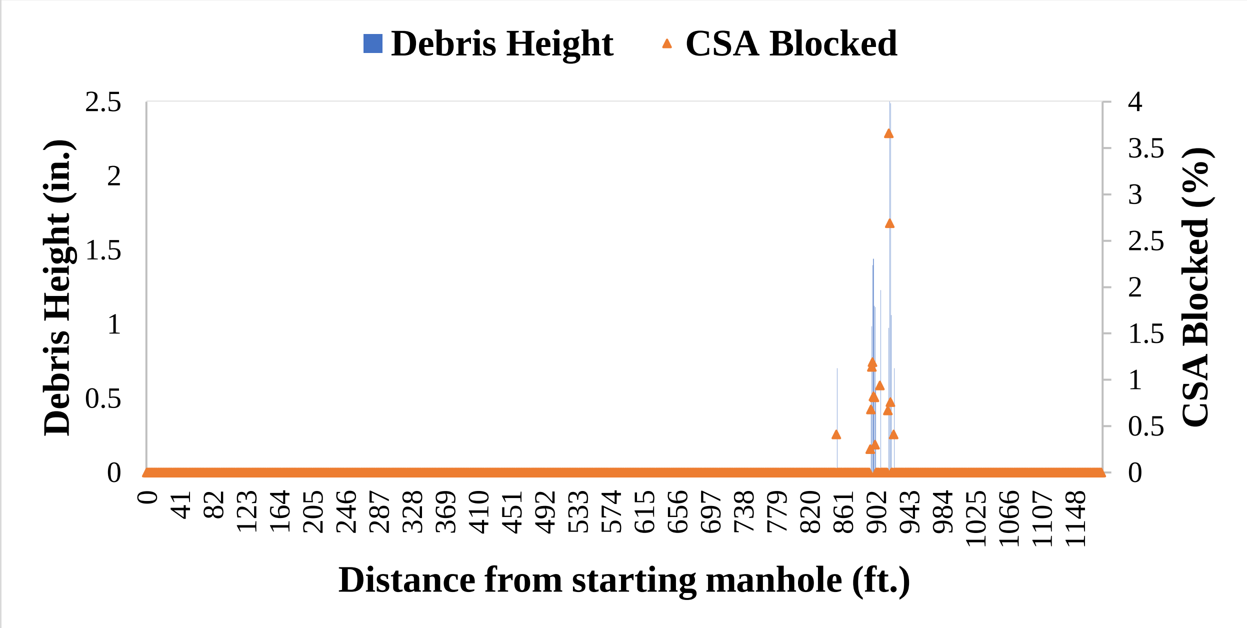

Figure 4-148 Debris height and CSA blocked for line 9612.

3. Line 9503

Line record no.:	9503		Pipe Material	RCP
US MH ID:	2800T		Inspection Date	12/09/2022
DS MH ID:	2780T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	997 ft

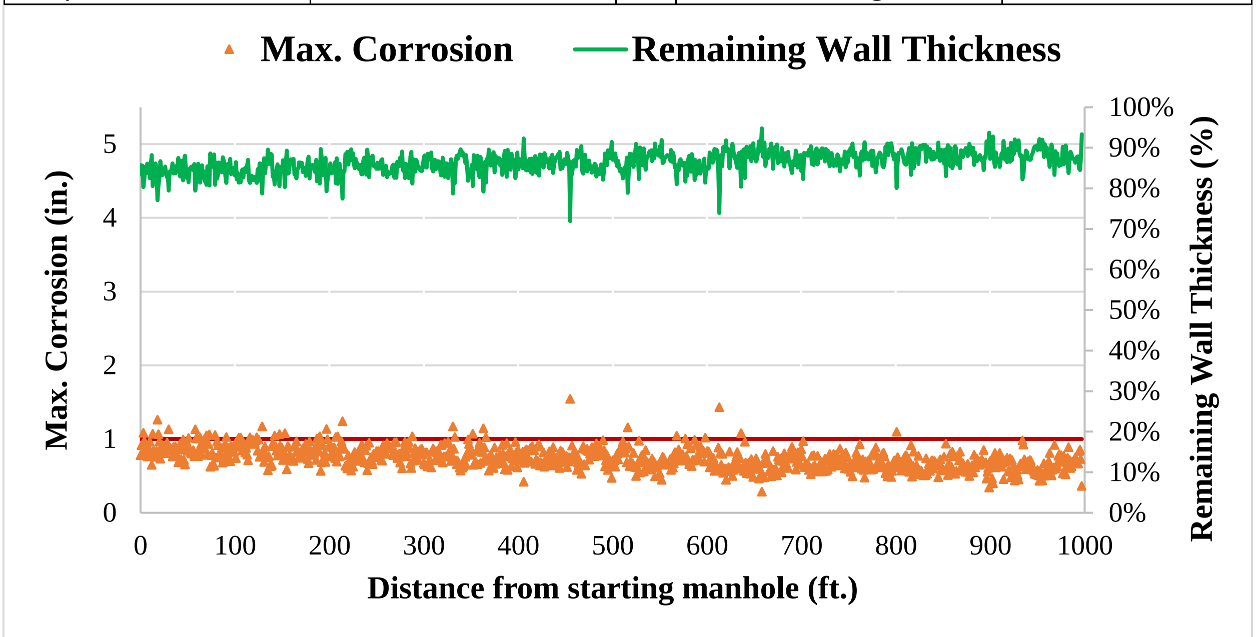

Figure 4-149 Maximum corrosion and remaining wall thickness (%) for line 9503

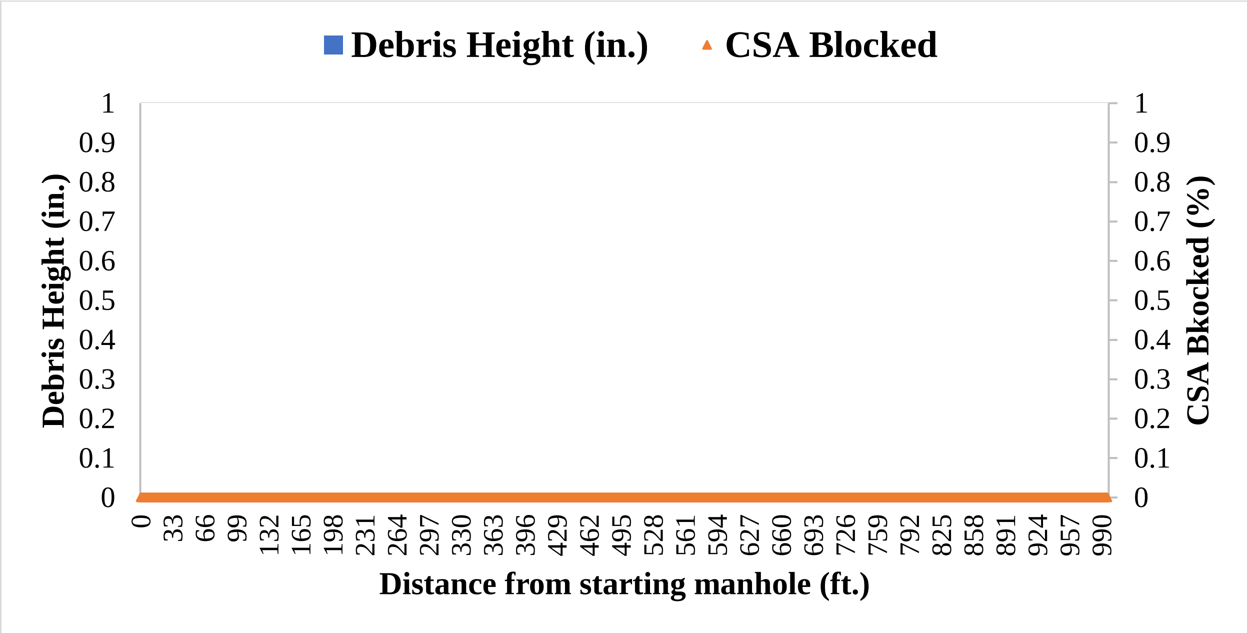

Figure 4-150 Debris height and CSA blocked for line 9503.

4. Line 9810

Line record no.:	9810		Pipe Material	RCP
US MH ID:	60T		Inspection Date	01/20/2023
DS MH ID:	40T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	996 ft.

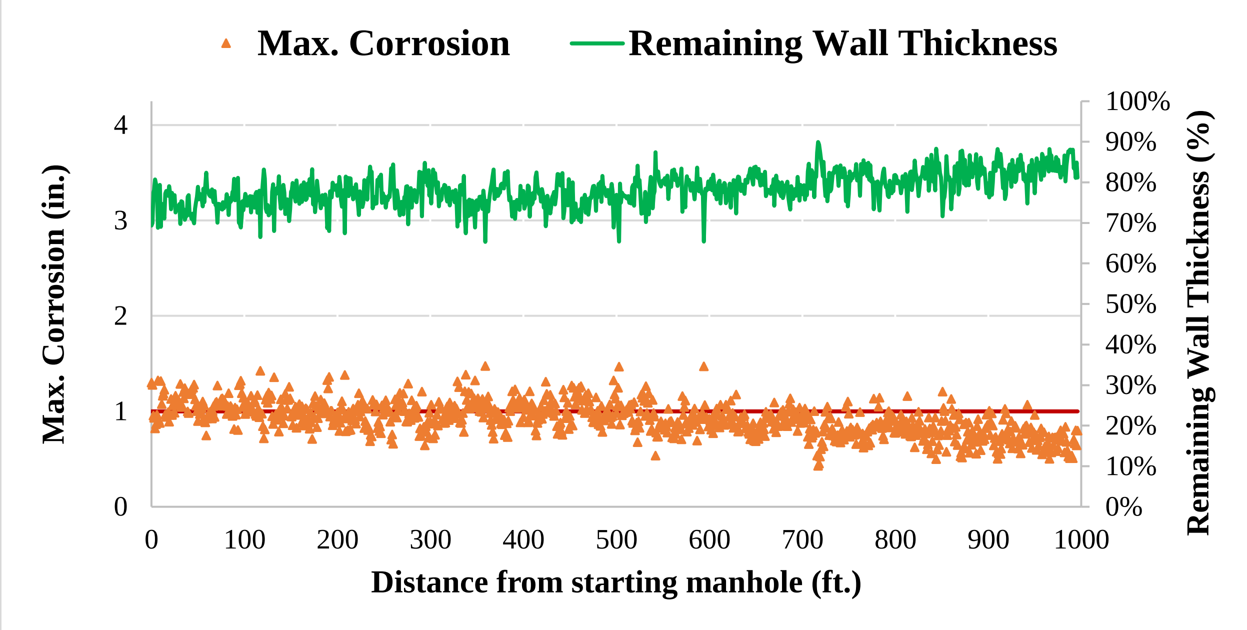

Figure 4-151 Maximum corrosion and remaining wall thickness (%) for line 9810

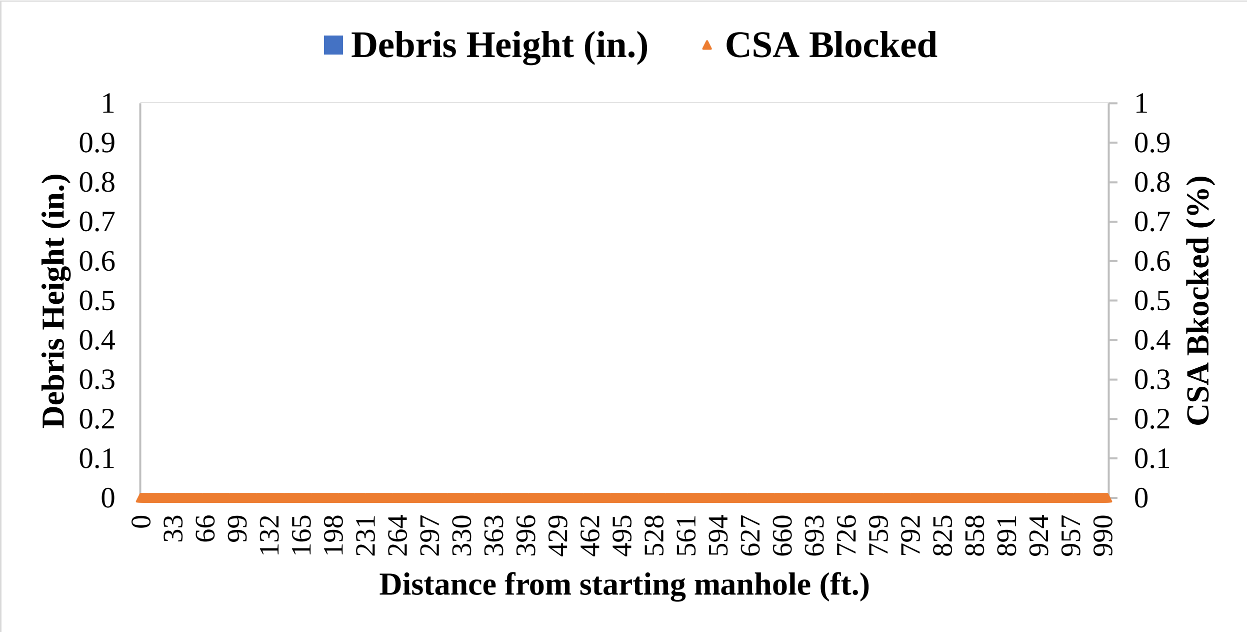

Figure 4-152 Debris height and CSA blocked for line 9810.

5. Line 9506

Line record no.:	9506		Pipe Material	RCP
US MH ID:	2820T		Inspection Date	12/09/2022
DS MH ID:	2800T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	1008 ft

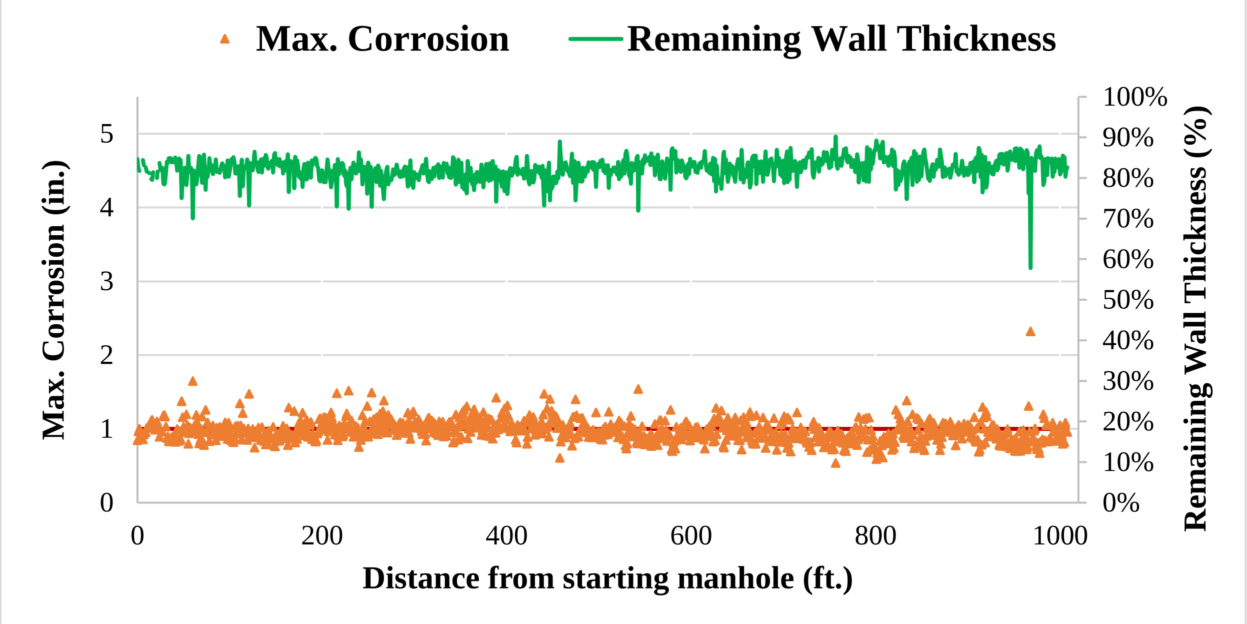

Figure 4-153 Maximum corrosion and remaining wall thickness (%) for line 9506

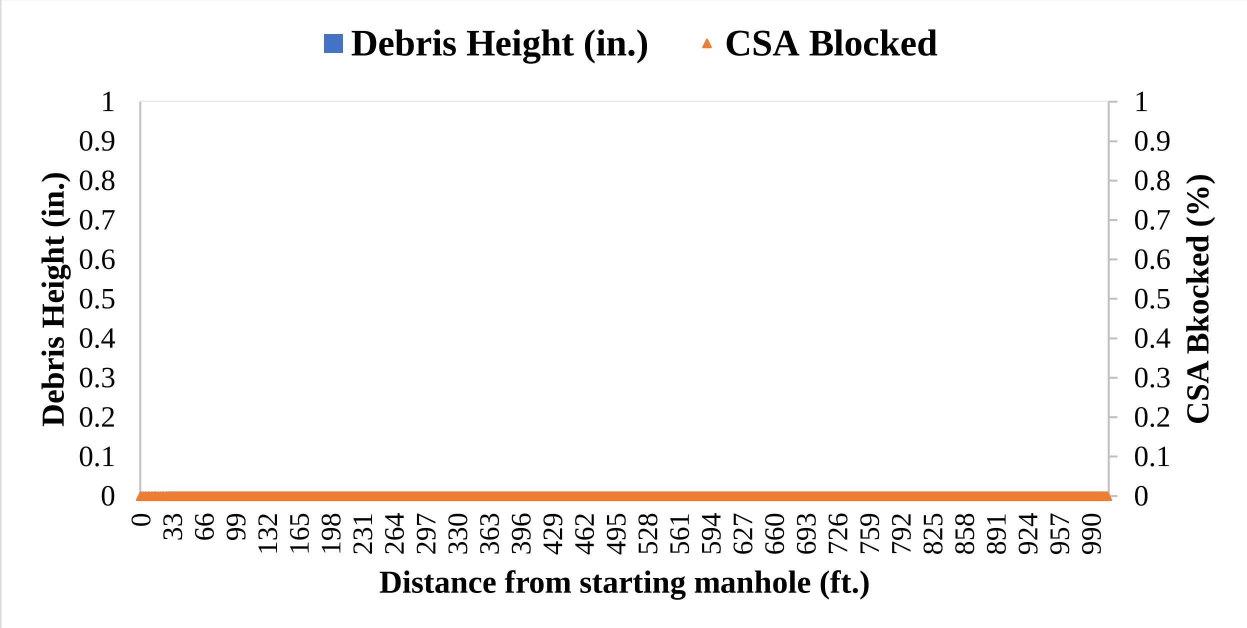

Figure 4-154 Debris height and CSA blocked for line 9506.

6. Line 9846

Line record no.:	9846		Pipe Material	RCP
US MH ID:	80T		Inspection Date	01/20/2023
DS MH ID:	60T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	1001 ft

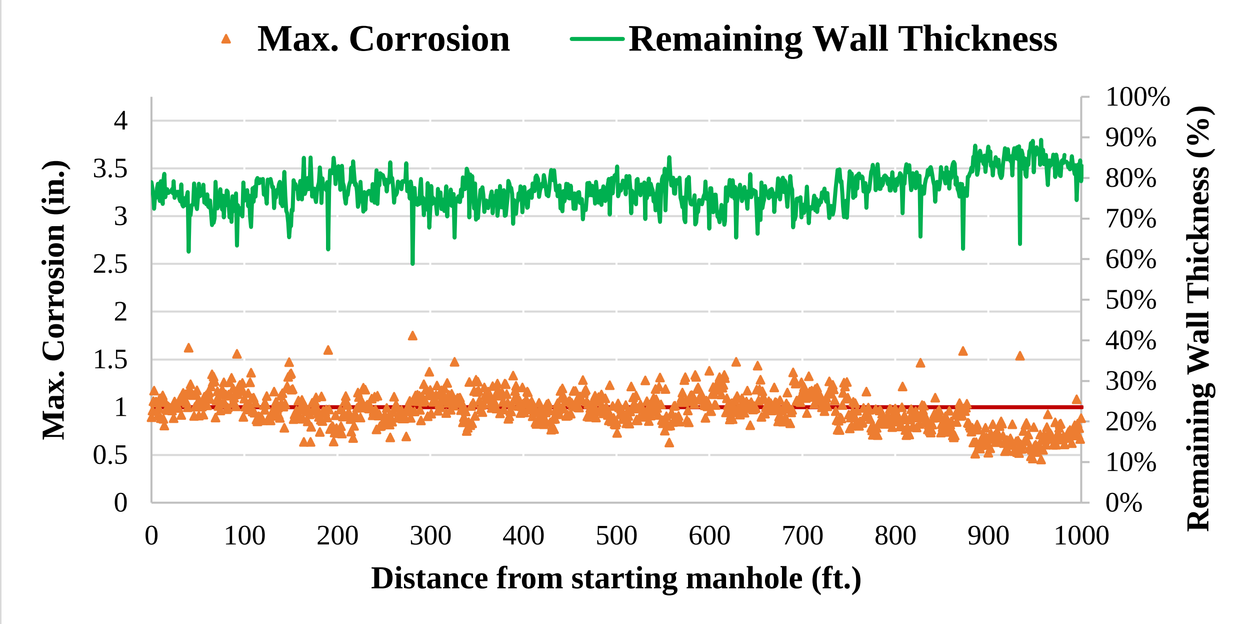

Figure 4-155 Maximum corrosion and remaining wall thickness (%) for line 9846

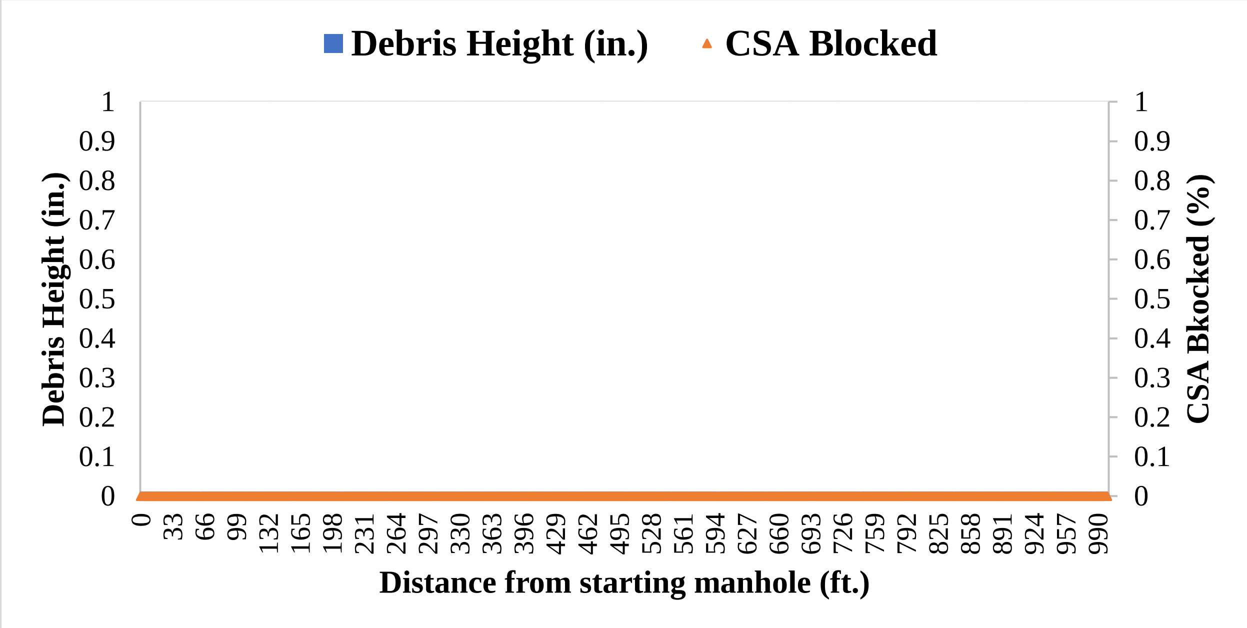

Figure 4-156 Debris height and CSA blocked for line 9846.

7. Line 9507

Line record no.:	9507		Pipe Material	RCP
US MH ID:	2840T		Inspection Date	12/02/2022
DS MH ID:	2820T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	1980 ft

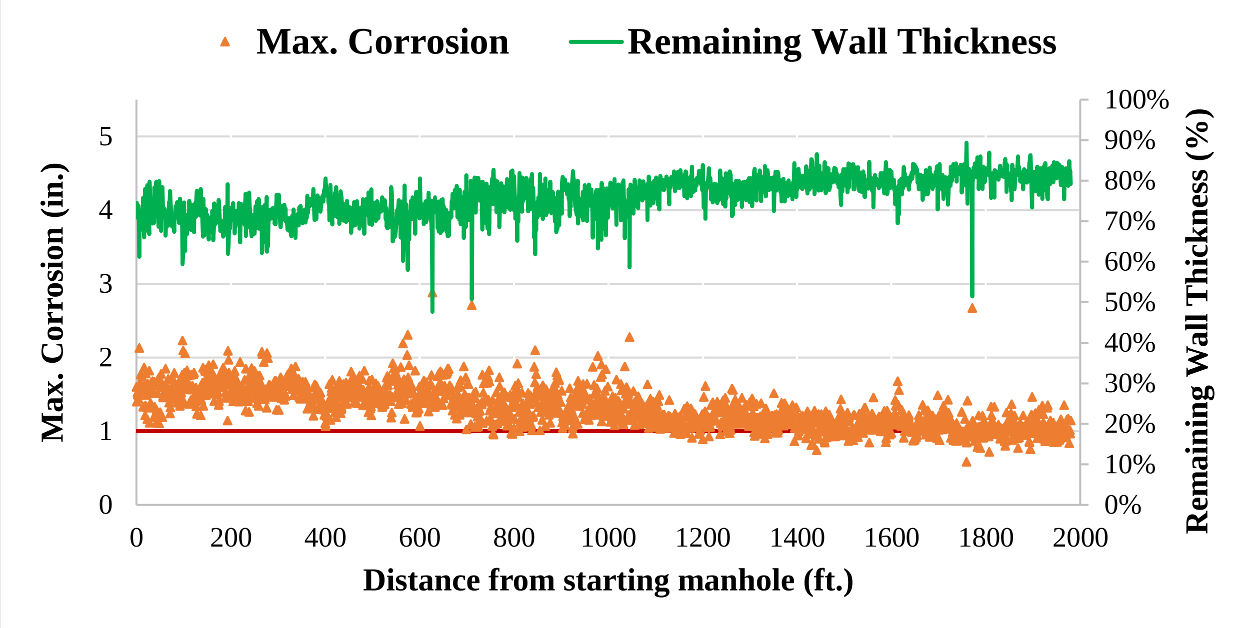

Figure 4-157 Maximum corrosion and remaining wall thickness (%) for line 9507

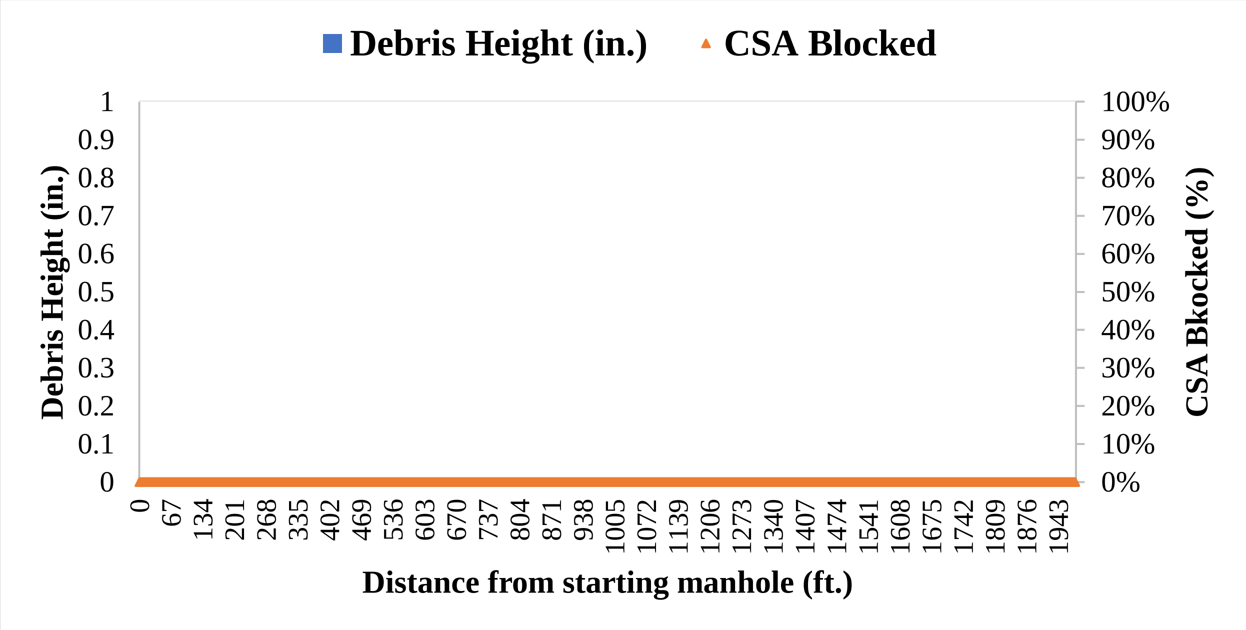

Figure 4-158 Debris height and CSA blocked for line 9507.

8. Line 9231

Line record no.:	9231		Pipe Material	RCP
US MH ID:	100T		Inspection Date	12/09/2022
DS MH ID:	80T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	1971

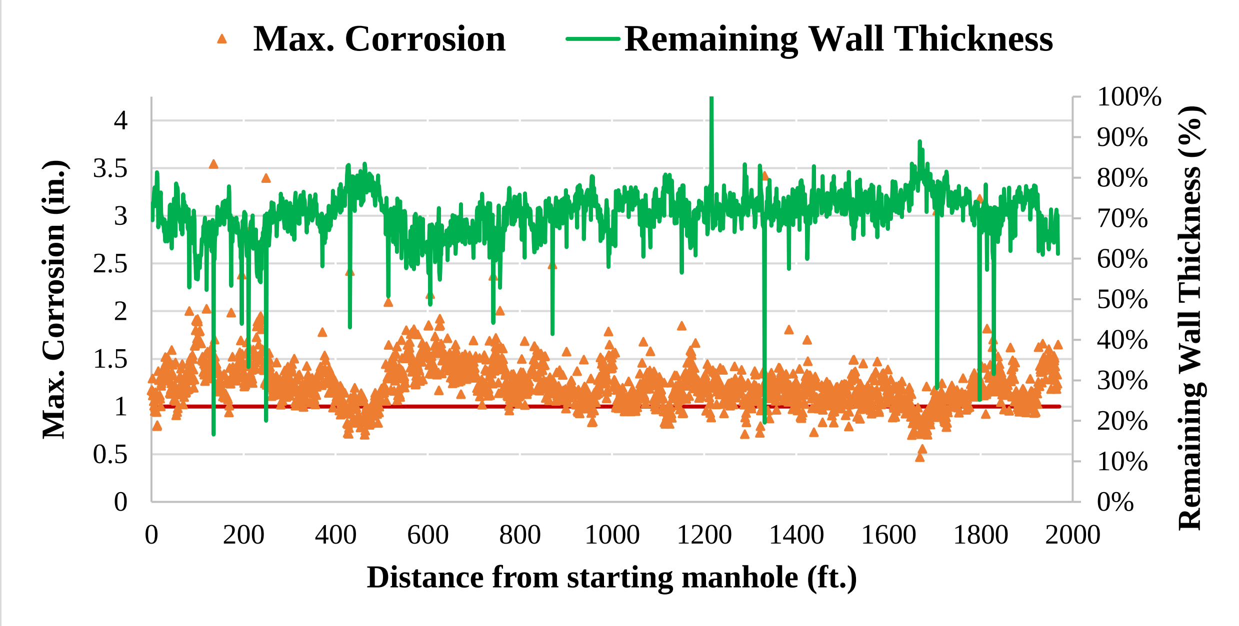

Figure 4-159 Maximum corrosion and remaining wall thickness (%) for line 9231

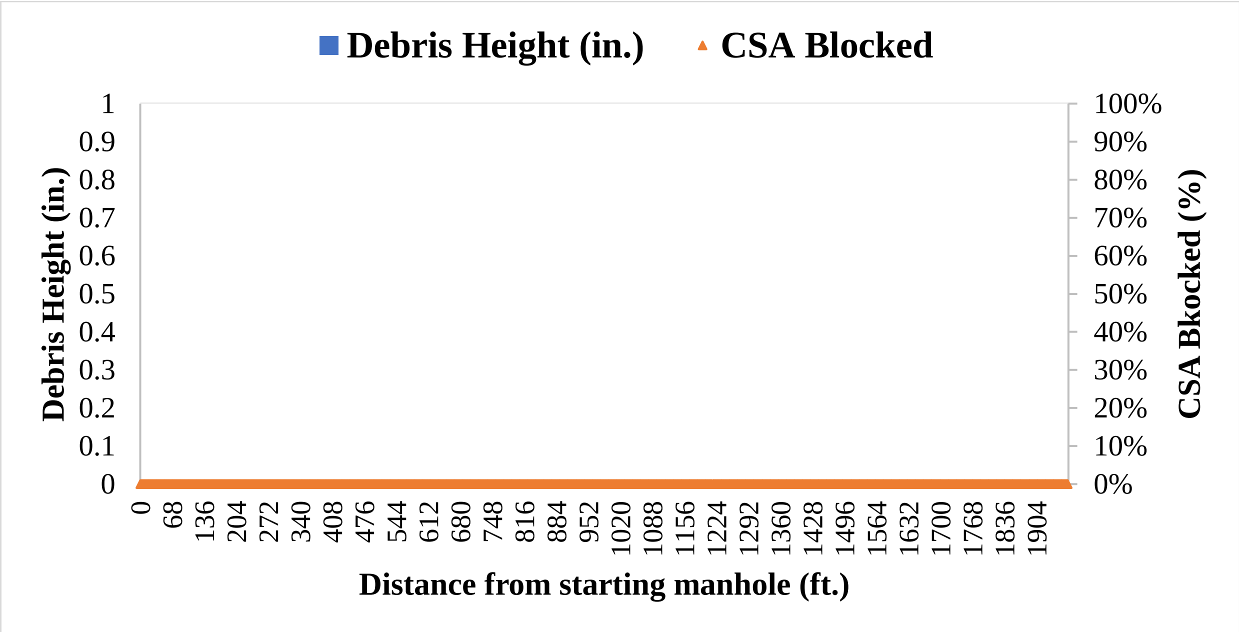

Figure 4-160 Debris height and CSA blocked for line 9231.

9. Line 9509-9508

Line record no.:	9509-9508		Pipe Material	RCP
US MH ID:	2860T		Inspection Date	11/30/2022
DS MH ID:	2840T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	1575 ft

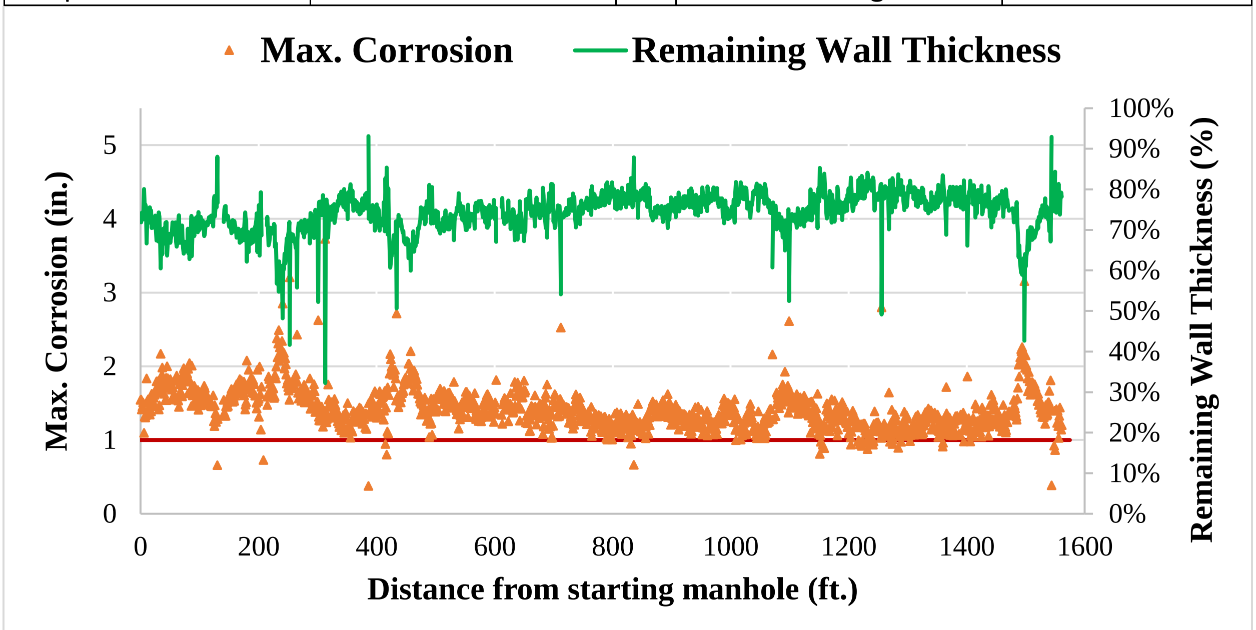

Figure 4-161 Maximum corrosion and remaining wall thickness (%) for line 9509-9508

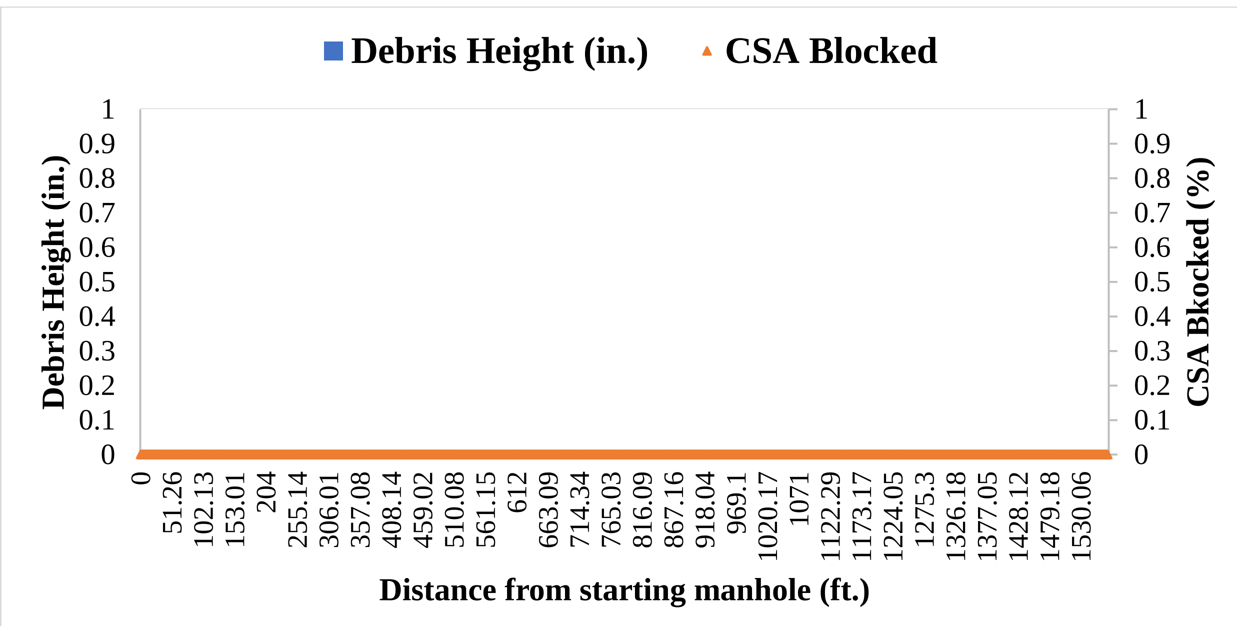

Figure 4-162 Debris height and CSA blocked for line 9509-9508.

10. Line 9260

Line record no.:	9260		Pipe Material	RCP
US MH ID:	120T		Inspection Date	02/24/2023
DS MH ID:	100T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	1569 ft

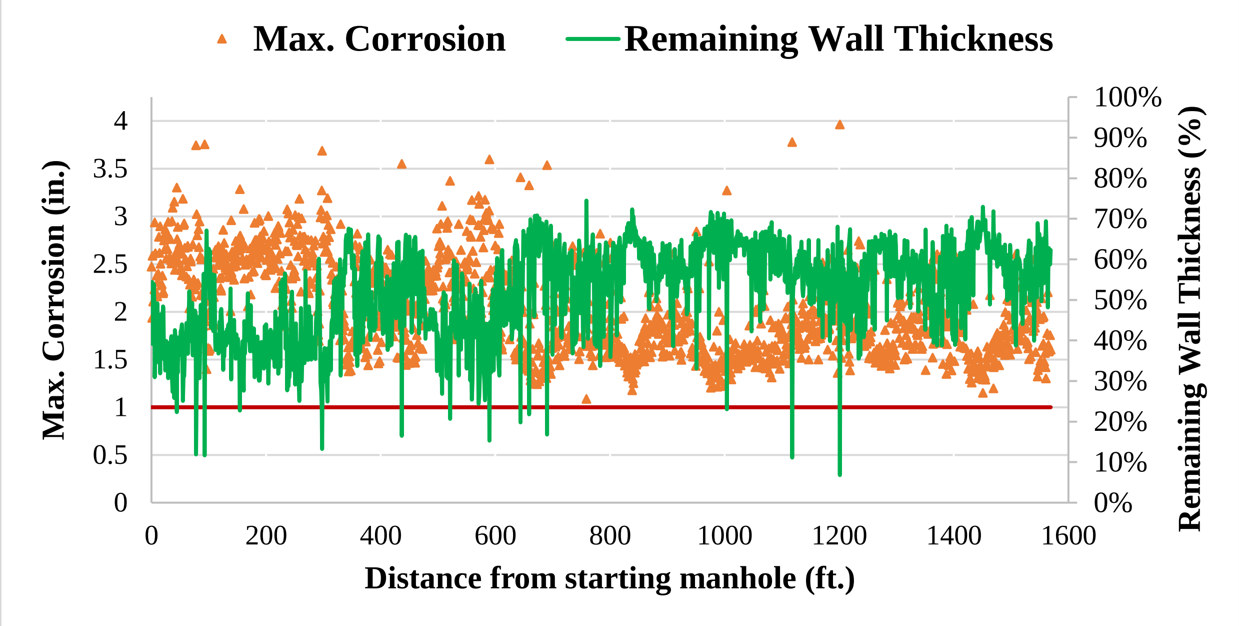

Figure 4-163 Maximum corrosion and remaining wall thickness (%) for line 9260

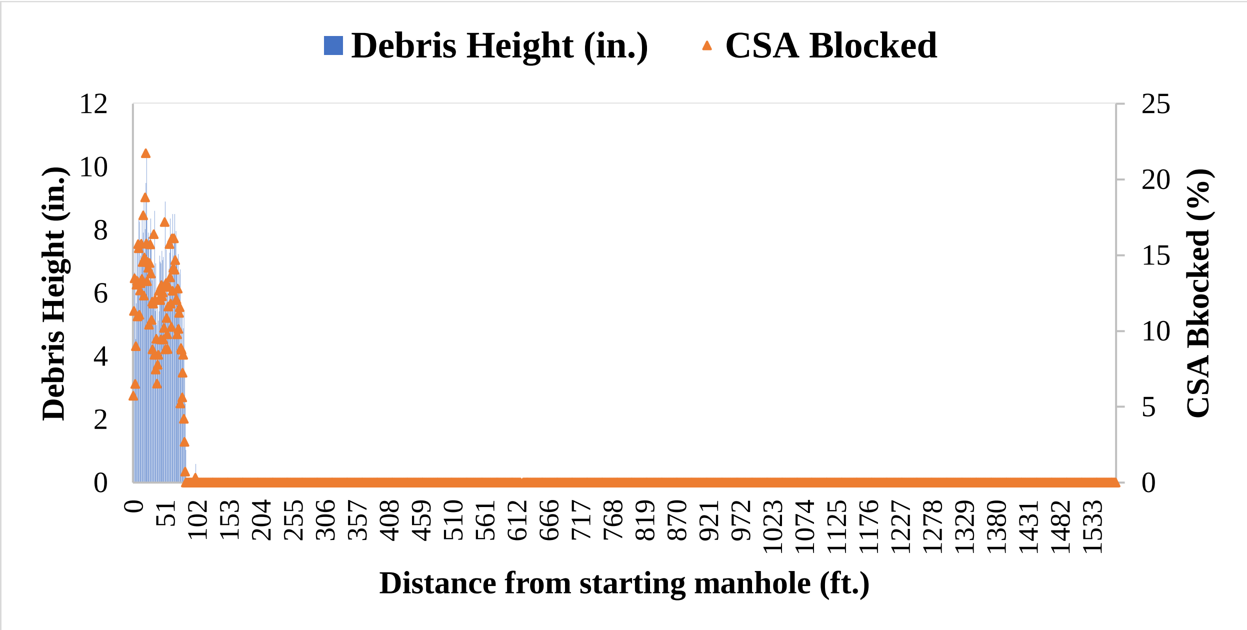

Figure 4-164 Debris height and CSA blocked for line 9260.

11. Line 9510

Line record no.:	9510		Pipe Material	RCP
US MH ID:	2880T		Inspection Date	11/30/2022
DS MH ID:	2860T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	371 ft

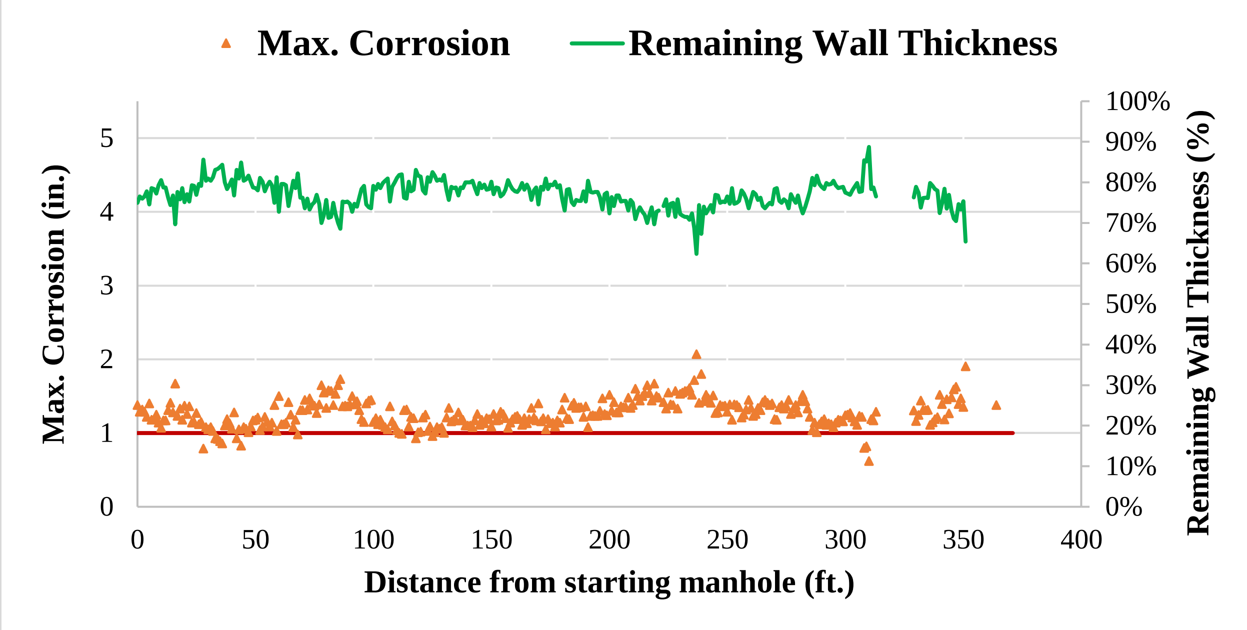

Figure 4-165 Maximum corrosion and remaining wall thickness (%) for line 9510

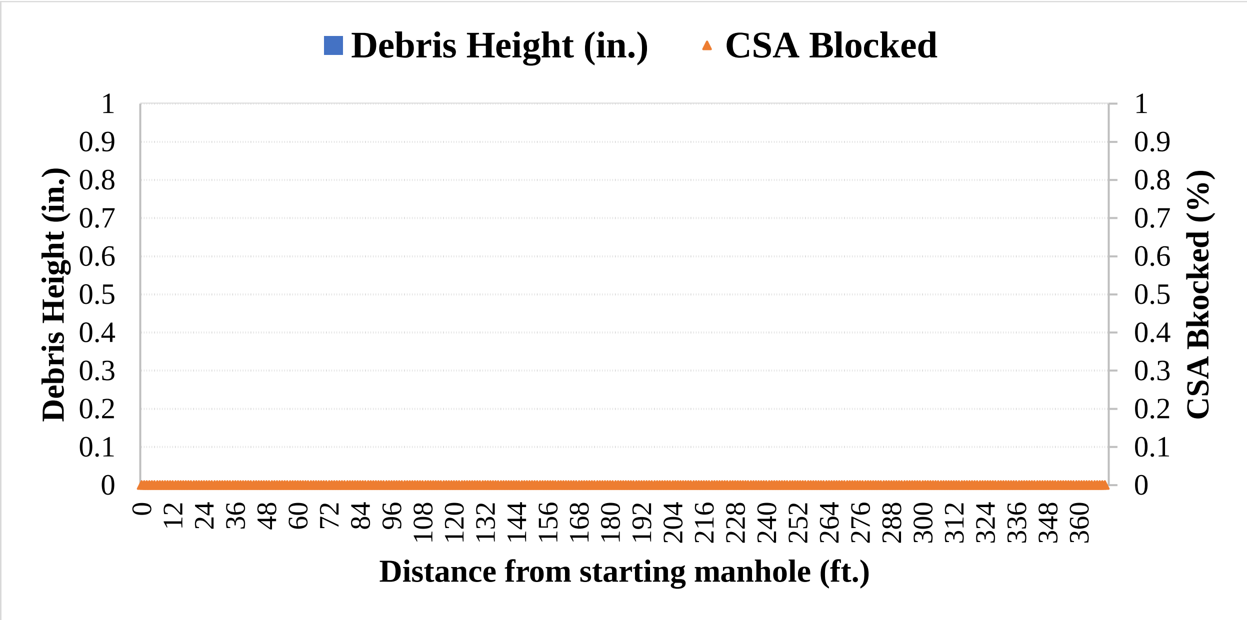

Figure 4-166 Debris height and CSA blocked for line 9510.

12. Line 9295

Line record no.:	9295		Pipe Material	DI
US MH ID:	140T		Inspection Date	02/24/2023
DS MH ID:	120T		Pipe Diameter	42
Inspection Direction	Downstream		MSI Length	356 ft

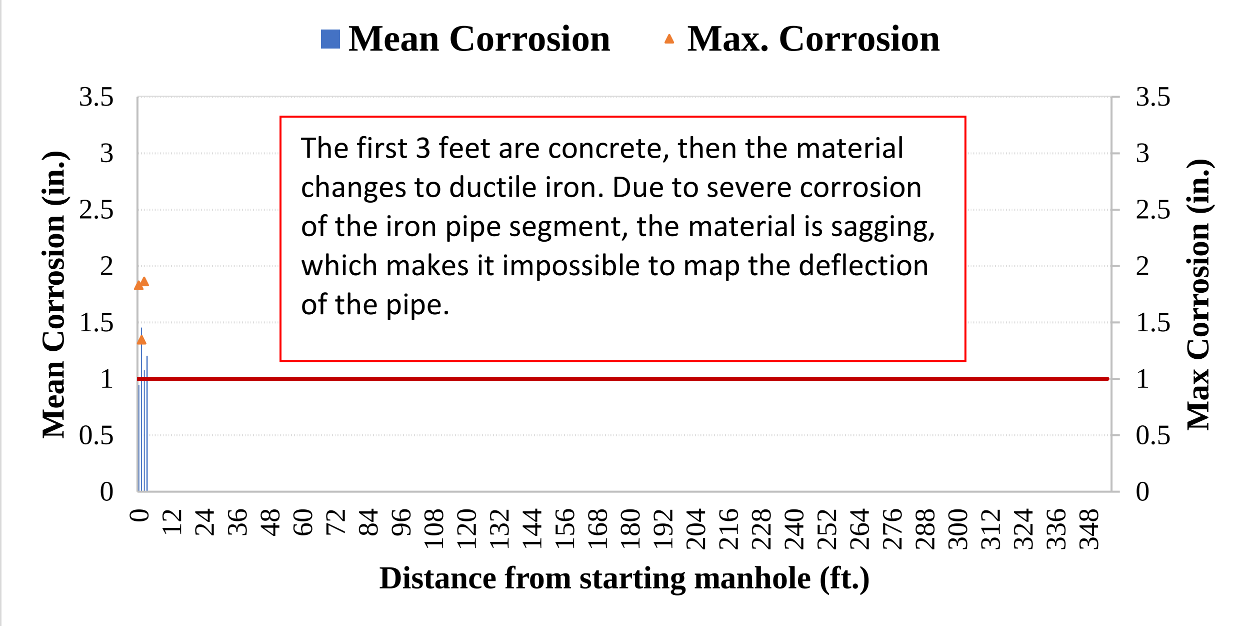

Figure 4-167 Mean and maximum corrosion for line 9295

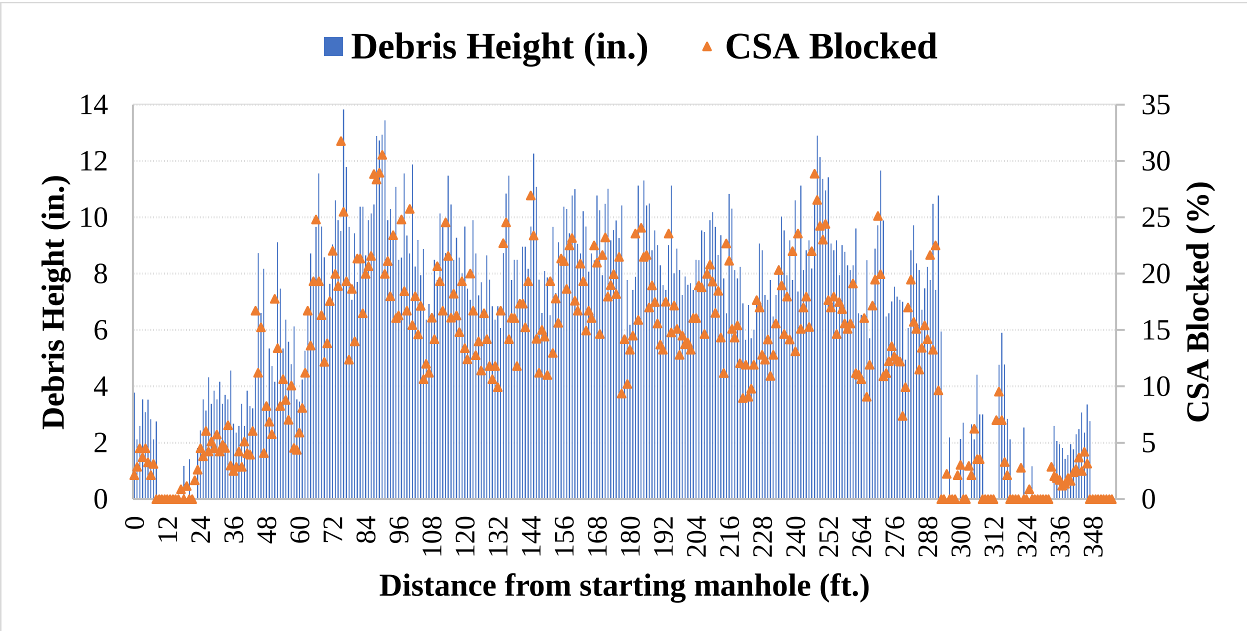

Figure 4-168 Debris height and CSA blocked for line 9295.

13. Line 9511

Line record no.:	9511		Pipe Material	RCP
US MH ID:	2900T		Inspection Date	11/30/2022
DS MH ID:	2880T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	600.57 ft

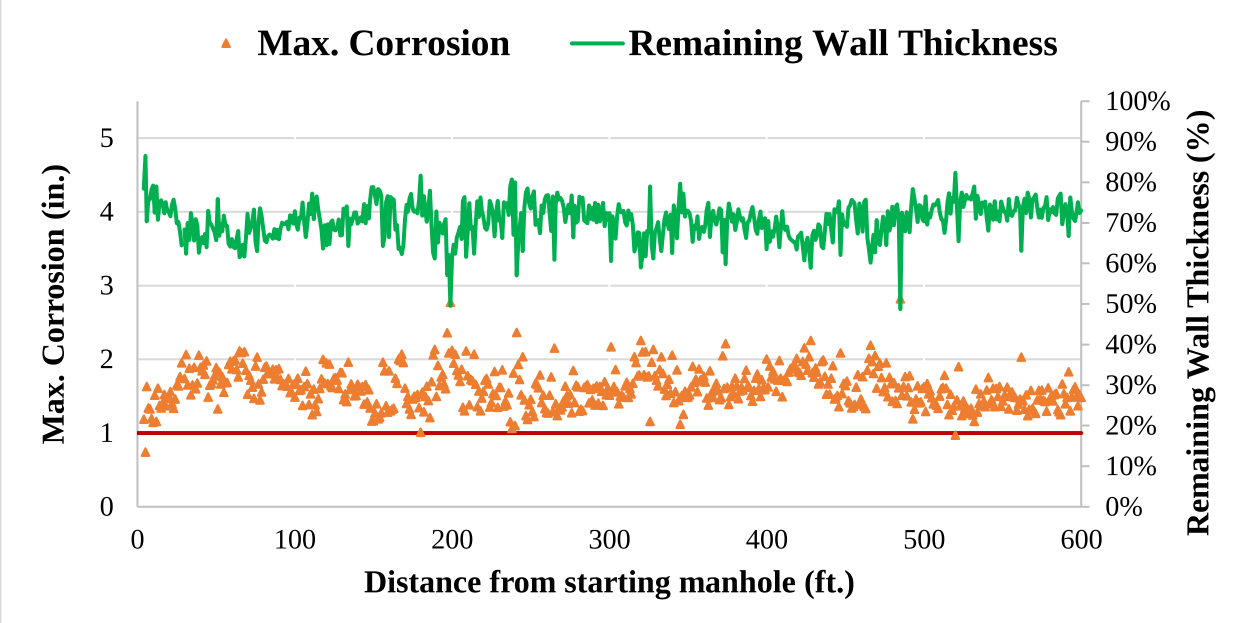

Figure 4-169 Maximum corrosion and remaining wall thickness (%) for line 9511

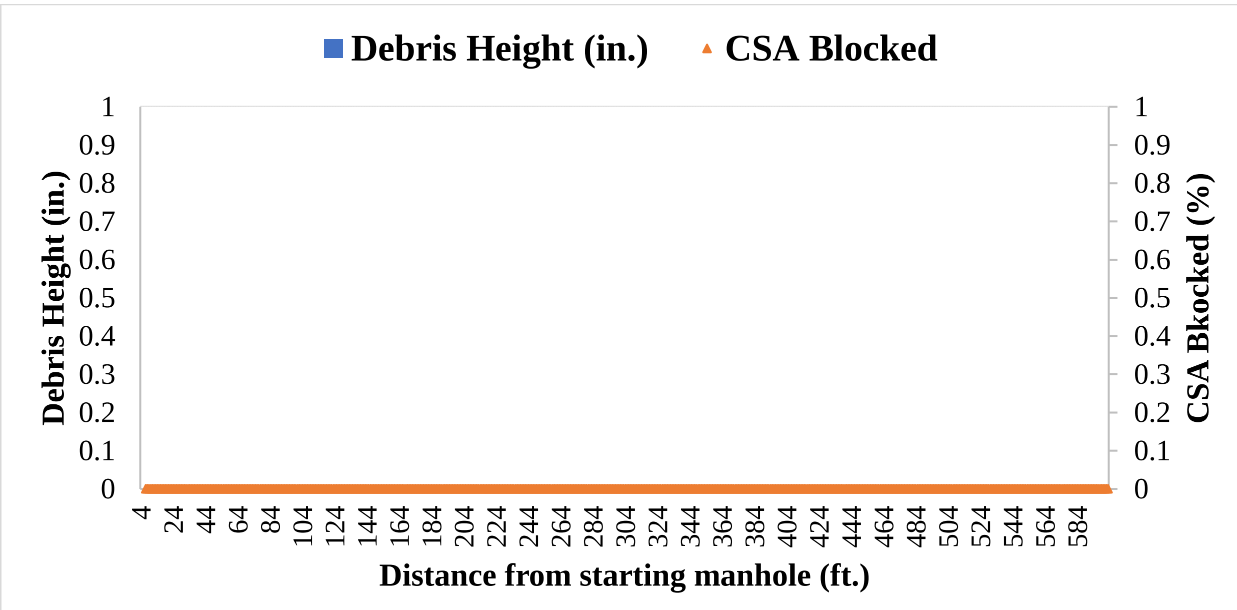

Figure 4-170 Debris height and CSA blocked for line 9511.

14. Line 9334

Line record no.:	9334		Pipe Material	RCP
US MH ID:	160T		Inspection Date	02/24/2023
DS MH ID:	140T		Pipe Diameter	39
Inspection Direction	Downstream		MSI Length	586 ft

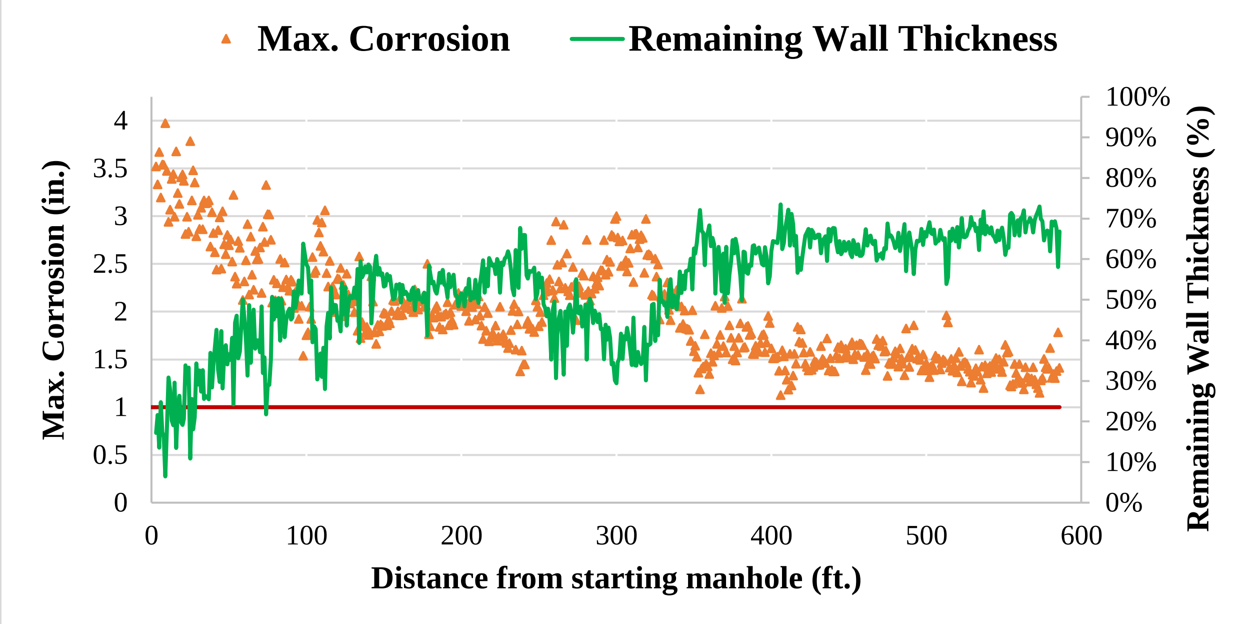

Figure 4-171 Maximum corrosion and remaining wall thickness (%) for line 9334

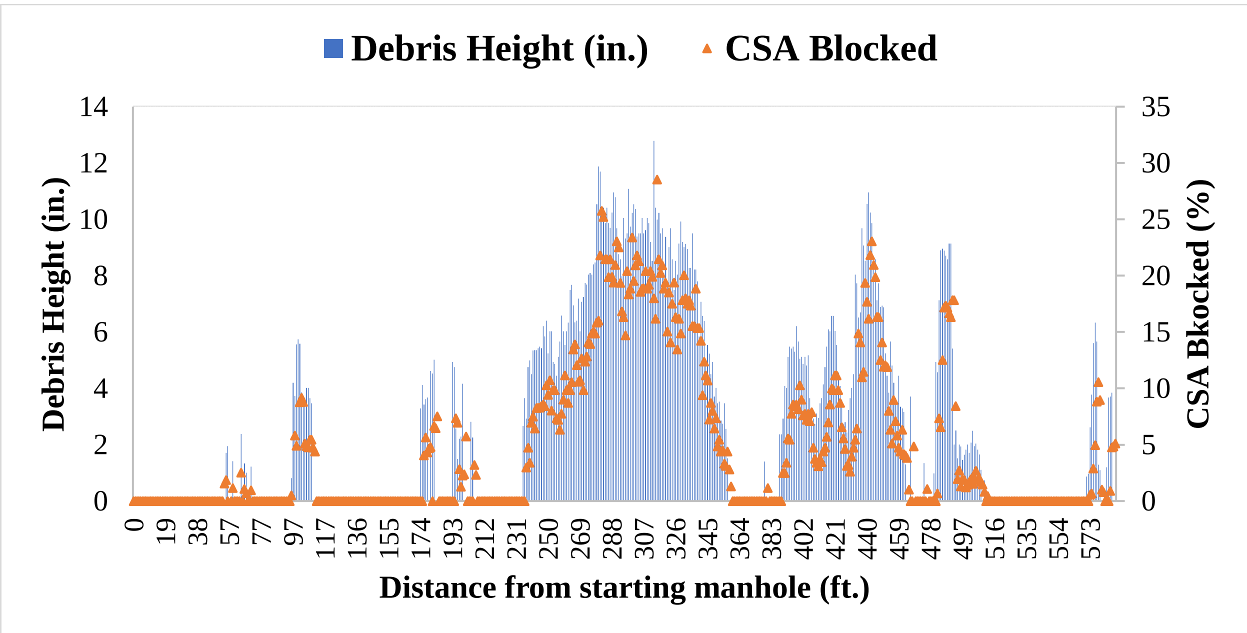

Figure 4-172 Debris height and CSA blocked for line 9334.

15. Line 9512

Line record no.:	9512		Pipe Material	RCP
US MH ID:	2920T		Inspection Date	10/26/2022
DS MH ID:	2900T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	394 ft

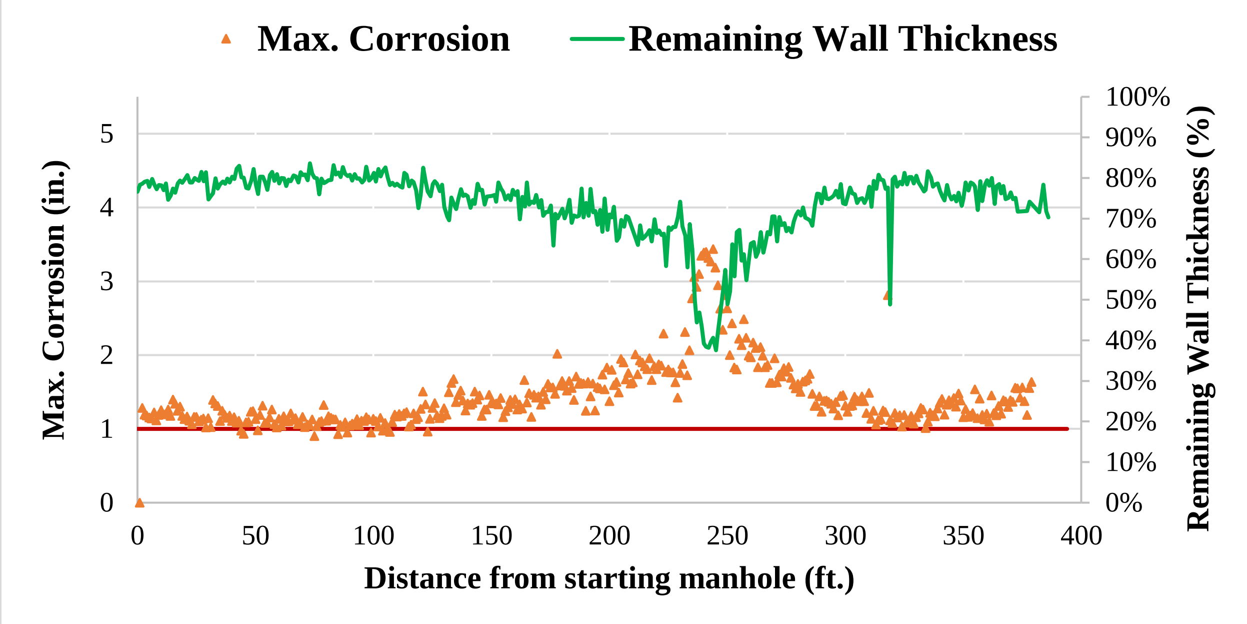

Figure 4-173 Maximum corrosion and remaining wall thickness (%) for line 9512

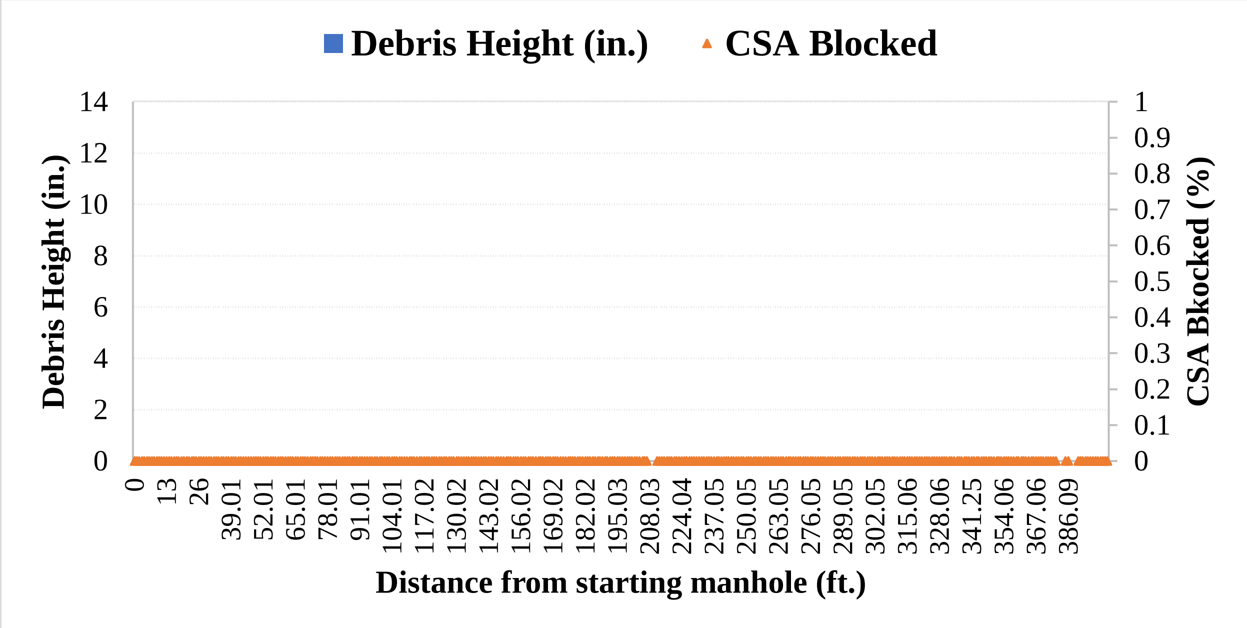

Figure 4-174 Debris height and CSA blocked for line 9512.

16. Line 9786

Line record no.:	9786		Pipe Material	RCP
US MH ID:	6032T		Inspection Date	10/26/2022
DS MH ID:	2920T		Pipe Diameter	54
Inspection Direction	Downstream		MSI Length	199 ft

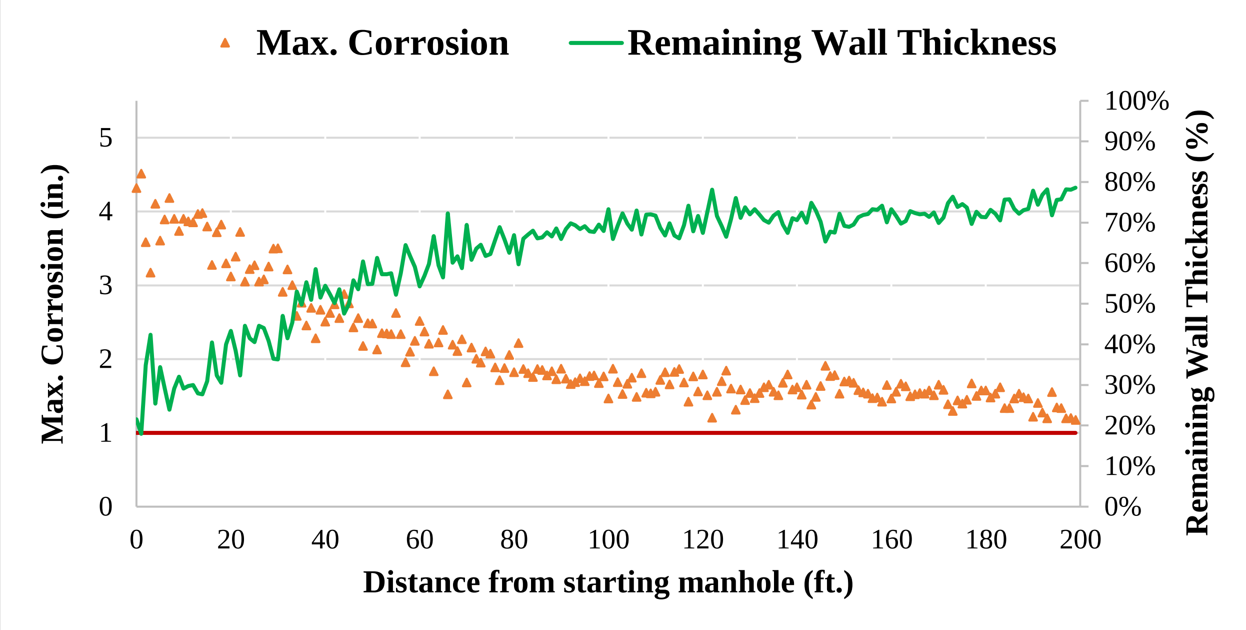

Figure 4-175 Maximum corrosion and remaining wall thickness (%) for line 9786

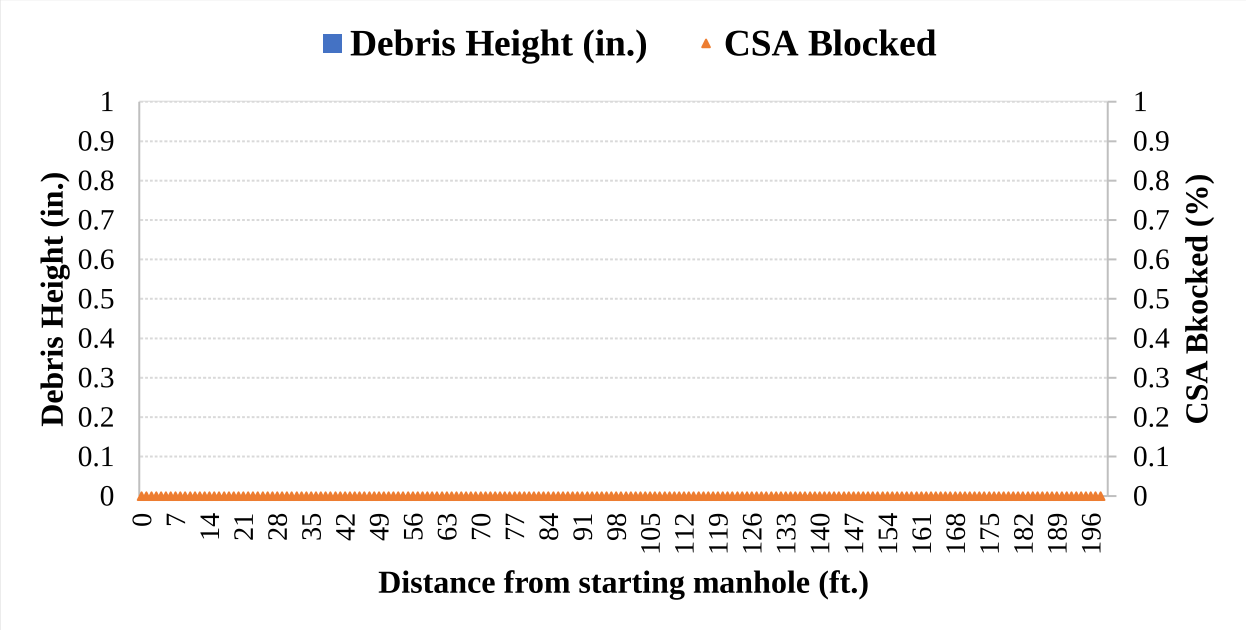

Figure 4-176 Debris height and CSA blocked for line 9786.

17. Line 9799

Line record no.:	9799		Pipe Material	FRP
US MH ID:	6070T		Inspection Date	10/26/2022
DS MH ID:	6056T		Pipe Diameter	78
Inspection Direction	Downstream		MSI Length	607 ft

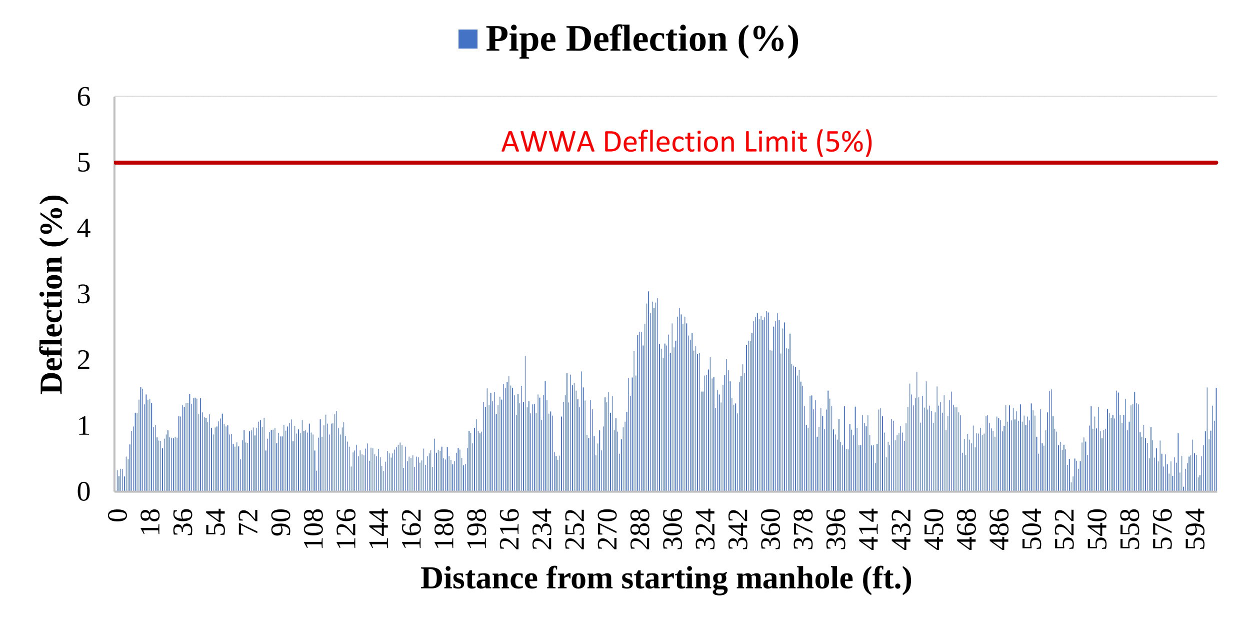

Figure 4-177 Pipe deflection for line 9799

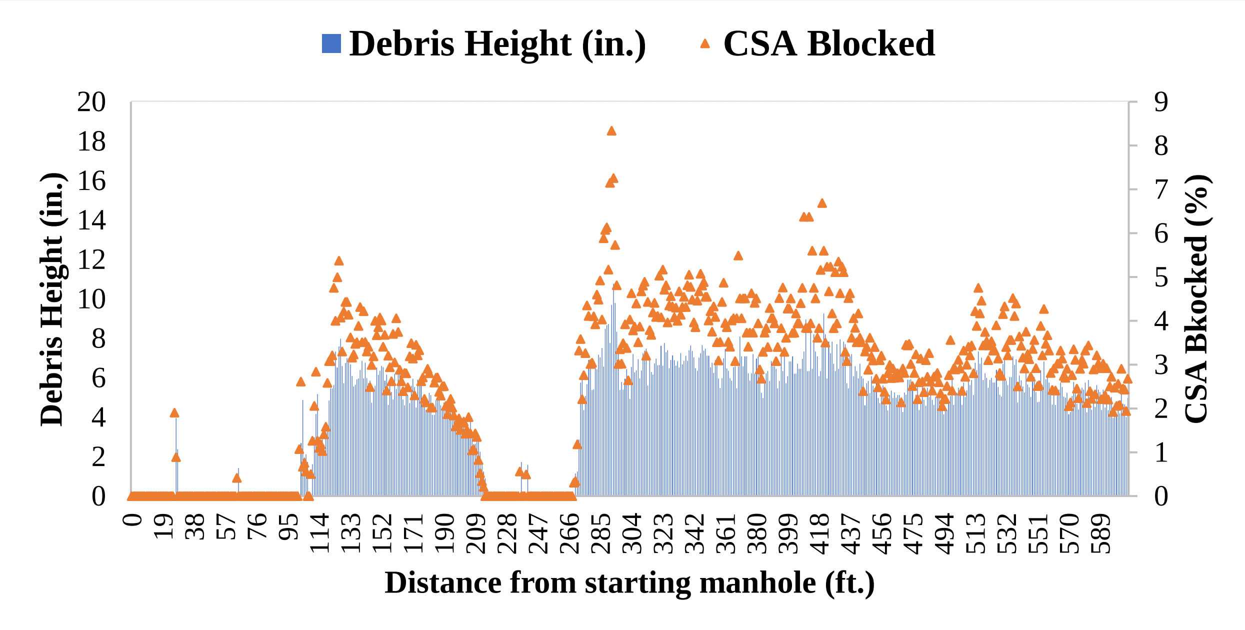

Figure 4-178 Debris height and CSA blocked for line 9799.

18. Line 9800

Line record no.:	9800		Pipe Material	FRP
US MH ID:	6080T		Inspection Date	10/26/2022
DS MH ID:	6070T		Pipe Diameter	78
Inspection Direction	Downstream		MSI Length	689 ft

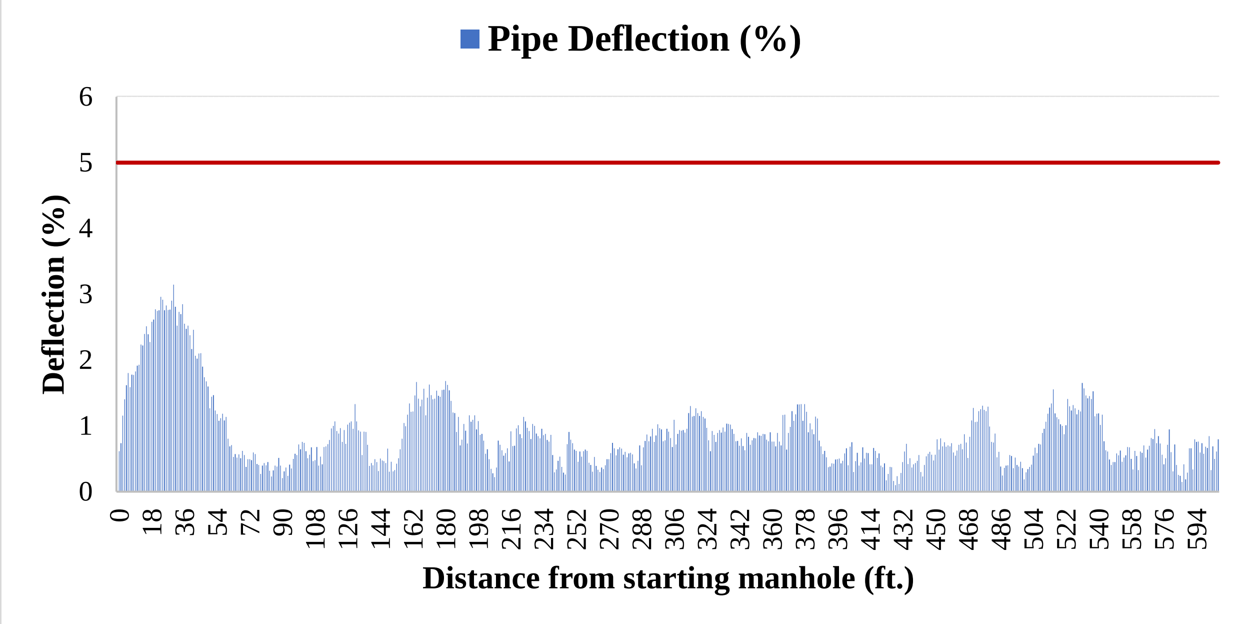

Figure 4-179 Pipe deflection for line 9800

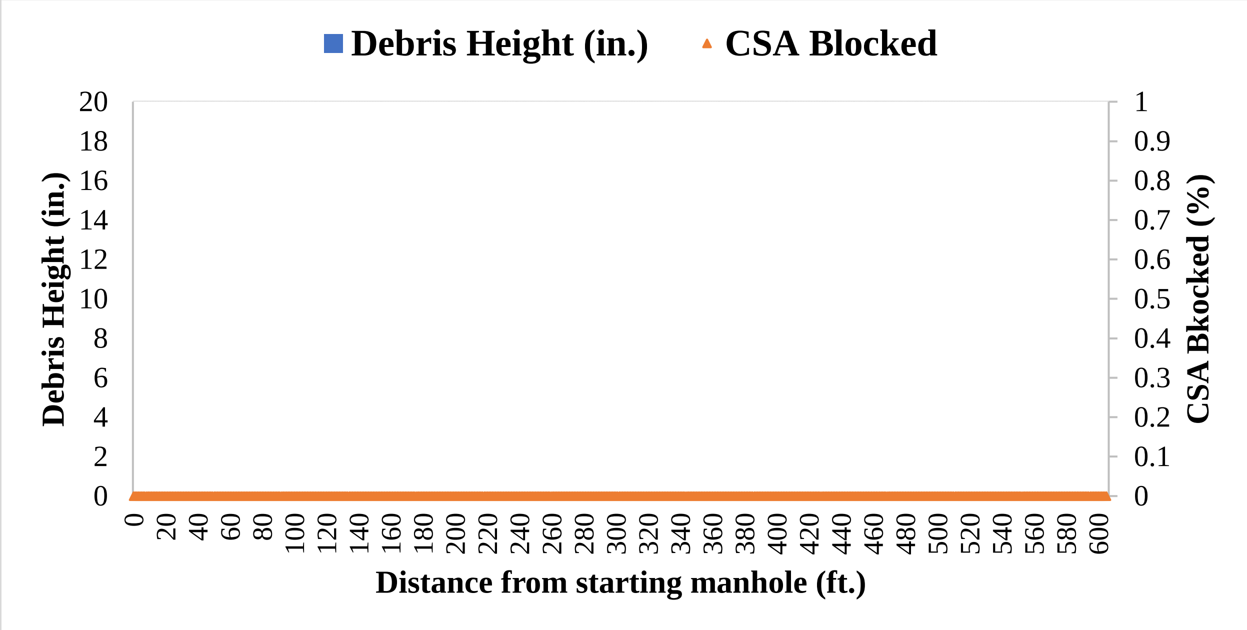

Figure 4-180 Debris height and CSA blocked for line 9800.

5 Development of a Supervised Machine Learning Model based on Artificial Intelligence

5.1 Overview

This chapter provides a comprehensive overview of the supervised machine learning algorithms used to develop a model that can predict corrosion by evaluating validation and performance metrics. The identification and selection of the variables are discussed and the correlation among the independent variables is assessed. The dataset was divided into training and testing sets, and preprocessing steps such as filtration and standardization were performed. Statistical programming language R 4.3.1 was employed for the data analysis, preprocessing, and construction. Multiple models were created and tested, and the best model was selected.

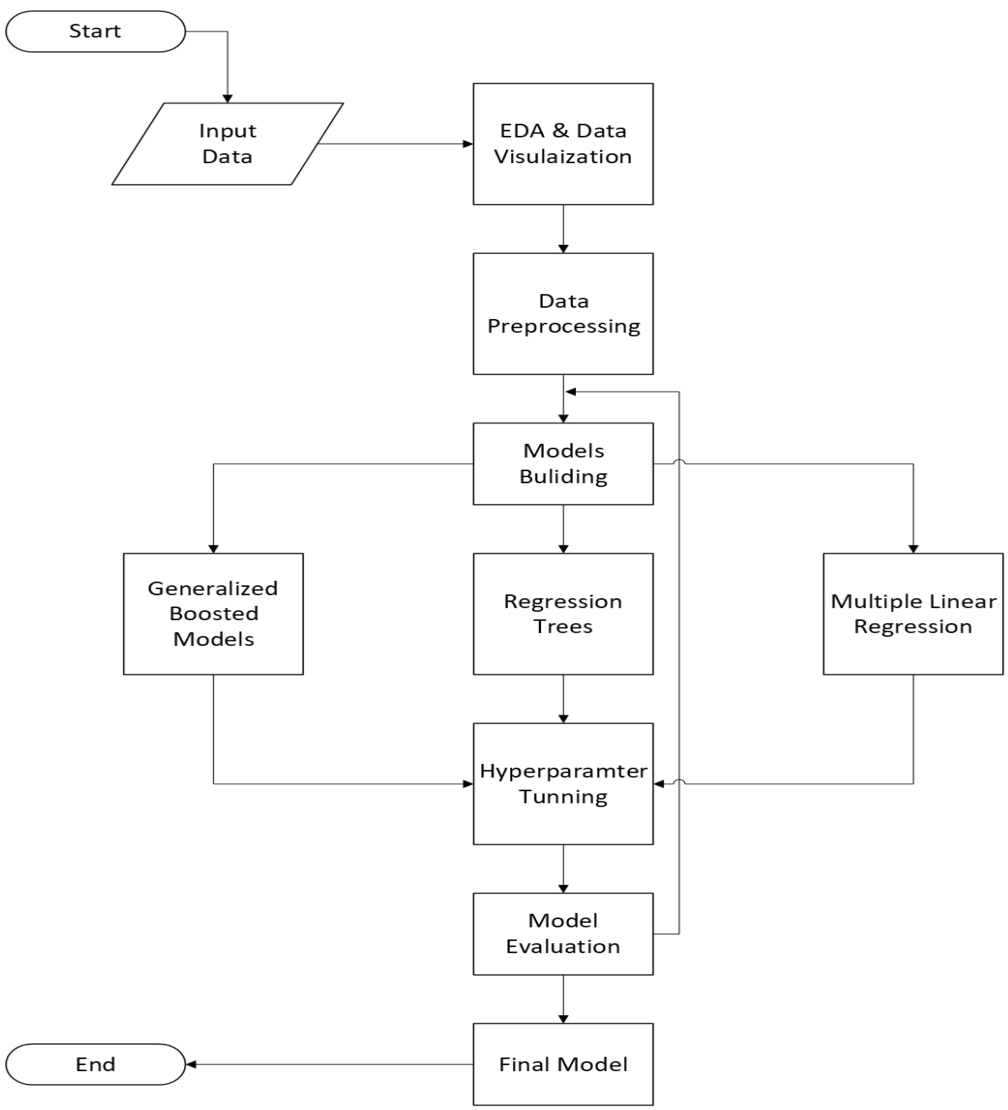

Figure 5-1 Flowchart of model development

5.2 Descriptions of Variables

5.2.1 Dependent Variable

A PACP evaluation of the CCTV data collected on the Trinity River Authority and the City of Mansfield sewer pipes revealed that corrosion is the primary cause of degradation. A few other structural defects, such as cracks, holes, broken parts, and joint offsets, were observed, but corrosion was identified as the predominant structural defect responsible for the overall deterioration.

5.2.2 Independent Variables

The following independent variables were selected for this study based on their potential influence on the research outcomes.

5.2.2.1 Diameter

Previous research has identified a pipe's diameter as a physical property that correlates robustly with corrosion. Rajani and Makar (2000) avowed that small-diameter pipes deteriorate faster than those with a larger diameter, due to the influence of the corroded area on the structural resistance of the pipeline. Rajani and Tesfamariam (2007) demonstrated that the extent of bedding loss also significantly impacts smaller-diameter pipes. Larger pipes are more susceptible to external loads and are more prone to corrosion at points of contact with the soil because of their larger surface area. The range of pipe diameters investigated for this study is presented in Table 5.1.

Table 5-1 Diameters of Pipelines in Inches

Trinity River Authority	City of Mansfield
30	36
36	39
39	42
42	48
-	54

5.2.2.2 Age

Multiple studies have indicated that the age of a pipe has a significant impact on its overall condition and that the number of breakages that occur annually increase exponentially with the age of the pipe Al-Barqawi and Zayed (2006); Davis et al. (2007); Wang et al. (2010).

5.2.2.3 Depth of Flow

Depth of flow is another independent variable that affects corrosion rate, as shown in Figure 5-2 Wells et al. (2009).

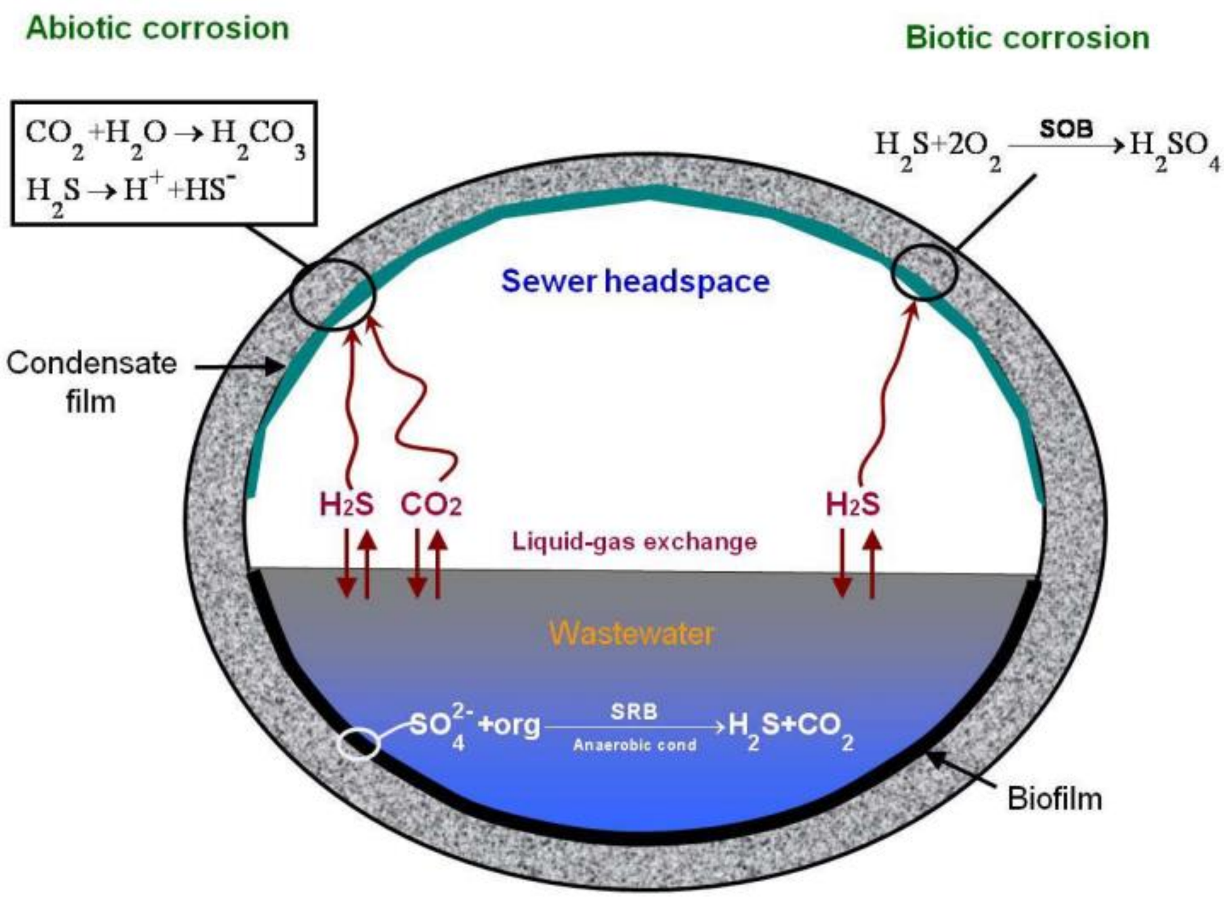

Figure 5-2 Corrosion process in sewer lines (Wells et al., 2009)

5.2.2.4 Pipe Slope

Sewer pipes with flat slopes experience reduced velocity that results in wastewater being retained longer in the pipes. This increases the likelihood of hydrogen sulfide gas being generated and converted to sulfuric acid and accelerates the rate of corrosion in cementitious pipes like concrete and mortar Ana et al. (2009); Ayoub et al. (2004). Jeong et al. (2005) found that pipes with steeper slopes deteriorate more rapidly; thus, the slope of the pipe was considered an independent variable in this research.

5.2.2.5 Length of Pipe

Shorter pipelines are commonly used in urban areas, where the risk of breakage is greater. Longer pipelines, however, are predominantly found in rural areas characterized by stable conditions, as it is more likely that issues will occur along their length Wang et al. (2009).

5.2.2.6 Debris Height

The height of the debris is treated as an independent variable in this study.

5.2.2.7 Distance From Upstream Manhole

In this study, we consider the distance from the upstream manhole as a variable independent of other factors. This choice is rooted in the analysis of CCTV videos and the categorization of structural defects based on PACP standards. Through this analysis, it has become evident that in many instances, when pipe sections observed are located closer to manholes, there is a greater likelihood of experiencing elevated corrosion rates and heightened exposure of reinforcements.

5.3 Data Description & Preprocessing

The dataset used to develop the artificial intelligence model consisted of merged data obtained from the City of Mansfield and Trinity River Authority projects. A total of 35,044 data points were collected for every foot of pipeline inspected, and after removing outliers for maximum corrosion, debris height, and age, 34,974 data points were available. Since each precast pipeline is 8 to10 ft. long, the characteristics and condition of each pipe were based on each 5 ft. of line inspected; thus, the 34,974 data points yielded to 6,994 for this research study.

Eight (8) of the 15 variables initially present (maximum corrosion, debris height, slop, distance from upstream, depth of flow, total length of pipe, age, and pipe diameter) were included in the dataset. All of them are numerical and were chosen based on their high correlation with the nine different readings for each line. Some readings, such as maximum corrosion and debris height, were collected through site inspections; structural data was observed from the collected CCTV footage. Corrosion was designated as a dependent variable; the remaining seven variables served as independent variables. A list of the variables and their roles are presented in Table (5-3) below.

Table 5-2 Variables Considered in the Model

Dependent Variable (Y)	Independent Variable (X_1)	Independent Variable (X_2)	Independent Variable (X_3)	Independent Variable (X_4)	Independent Variable (X_5)	Independent Variable (X_6)	Independent Variable (X_7)
Corrosion (in)	Debris Height	Slope	Distance from Upstream	Depth of Flow	Total Length of Pipe	Age	Pipe Diameter

Several pre-processing steps were involved in preparing the data for the development of a new model. The outliers in maximum corrosion, debris height, and age were removed, as were any missing values caused by sensor reading errors, which constituted a small percentage of the data. Once the data was filtered from the outliers, the data was standardized according to the following equation, and a moving average with a window size of 5 ft. was applied to each data point. These pre-processing steps ensured that the data was ready for the subsequent stages of the analysis.

$$z = \frac{x - \mu}{\sigma}$$

z = the standardized value of a data point.

x = the original value of the data point.

μ = the mean of the feature.

σ = the standard deviation of the feature.

5.4 Explanatory Data Analysis

Explanatory data analysis (EDA) focuses on acquiring a deeper understanding of the data, identifying anomalies or errors, and generating hypotheses for further investigation by employing a range of techniques and visualizations to delve into the data and detect patterns and reveal meaningful insights Tukey, (1977). By performing EDA, we established familiarity with the dataset and its underlying structure so that we could apply machine learning methods or more advanced descriptive statistics, which entail computing summary metrics such as mean, median, standard deviation, and percentiles. These statistics provide valuable information about the central tendency, variability, and distribution of the data Samuel & Stanley, (1991).

Table 5-3 Statistical Summary for Averaged Data

Variable	vars	N	Mean	Standard deviation	Median	min	max	range
Corrosion (in)	1	6994	0.911748	0.449547482	0.781039	0	3.242249	3.242249
Debris Height (in)	2	6994	0.275268	1.056779083	0	0	11.86226	11.86226
Slope	3	6994	0.217113	0.059799535	0.2	0.12	0.331	0.211
Distance from US	4	6994	0.513648	0.301726011	0.508956	0.00101	1.543662	1.542652
Depth of Flow	5	6994	9.077745	3.139121641	7.8	3.9	21.6	17.7
Total Length MSI	6	6994	960.5239	515.8126864	996	41	1980	1939
Age	7	6994	35.68084	8.42661114	32	9	52	43
Pipe Diameter	8	6994	43.19588	7.031525519	39	30	54	24

Data visualization is another integral component of EDA, as visual representations such as histograms and box plots offer graphical insights into the data and facilitate the identification of patterns, outliers, relationships between variables, and potential trends. Furthermore, EDA uses correlation coefficients or matrices to explore relationships between variables and enables the identification of solid correlations or predictive relationships among them.

The heat map presented in Figure 5-3 illustrates the correlation among various variables in the dataset after it has undergone averaging and standardization. The map represents correlations using colors, with positive correlations depicted in blue, negative correlations in red, and neutral correlations in white. The intensity of the color indicates the strength of the correlation, with darker colors representing stronger correlations.

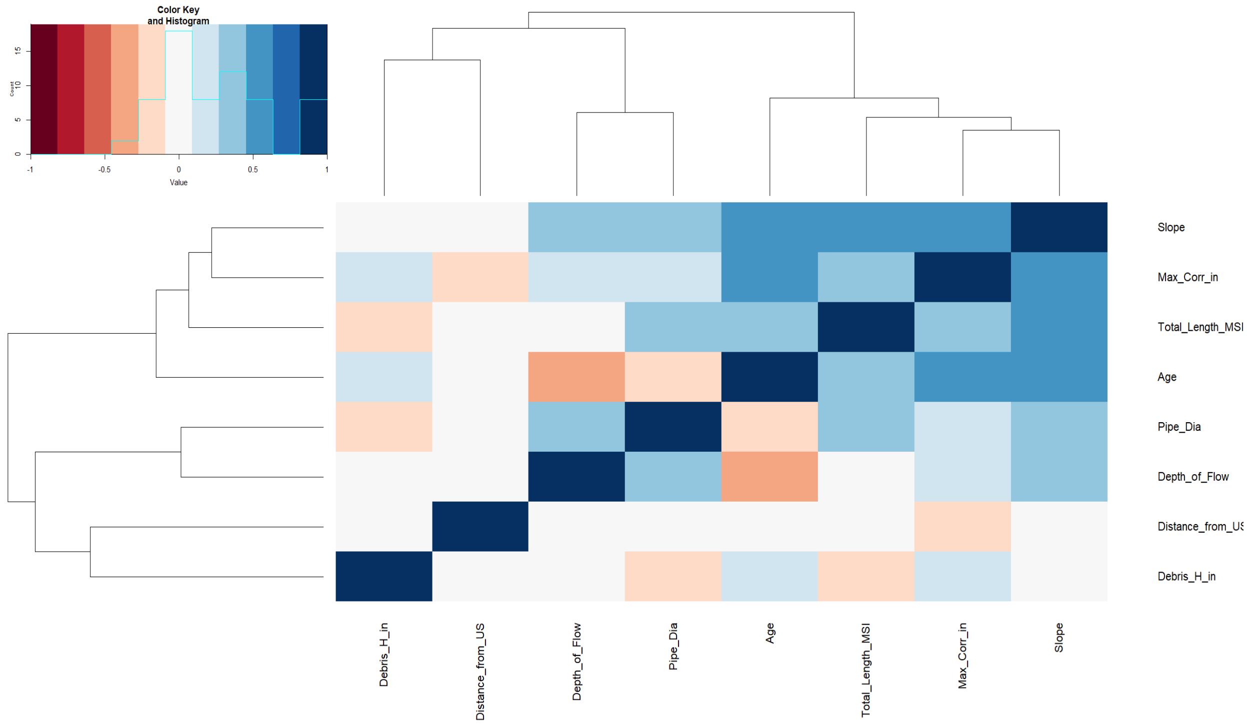

Figure 5-3 Correlation heatmap standardized data

It is evident from the heat map that the dependent variable, corrosion, exhibits the strongest positive correlation with the independent variable, slope, followed by the independent variables, age and length of the pipe. Conversely, the most pronounced negative correlation was observed between corrosion and the distance from the upstream manhole. This finding supports the rationale behind including the distance from the upstream manhole as one of the independent variables, as it appears to have a significant role in influencing corrosion.

The box plots shown in Figure 5-4 illustrates the variables, with each box representing the interquartile range (between the 25th and 75th percentiles); the middle line represents the median. Outliers are shown as individual points outside the box, revealing the variable distributions. An examination of the figure reveals that the pipe diameter distribution is concentrated in the lower half of the data, indicating a close grouping of the data points; conversely, the length of the slope exhibits a wider spread and less concentration of data points.

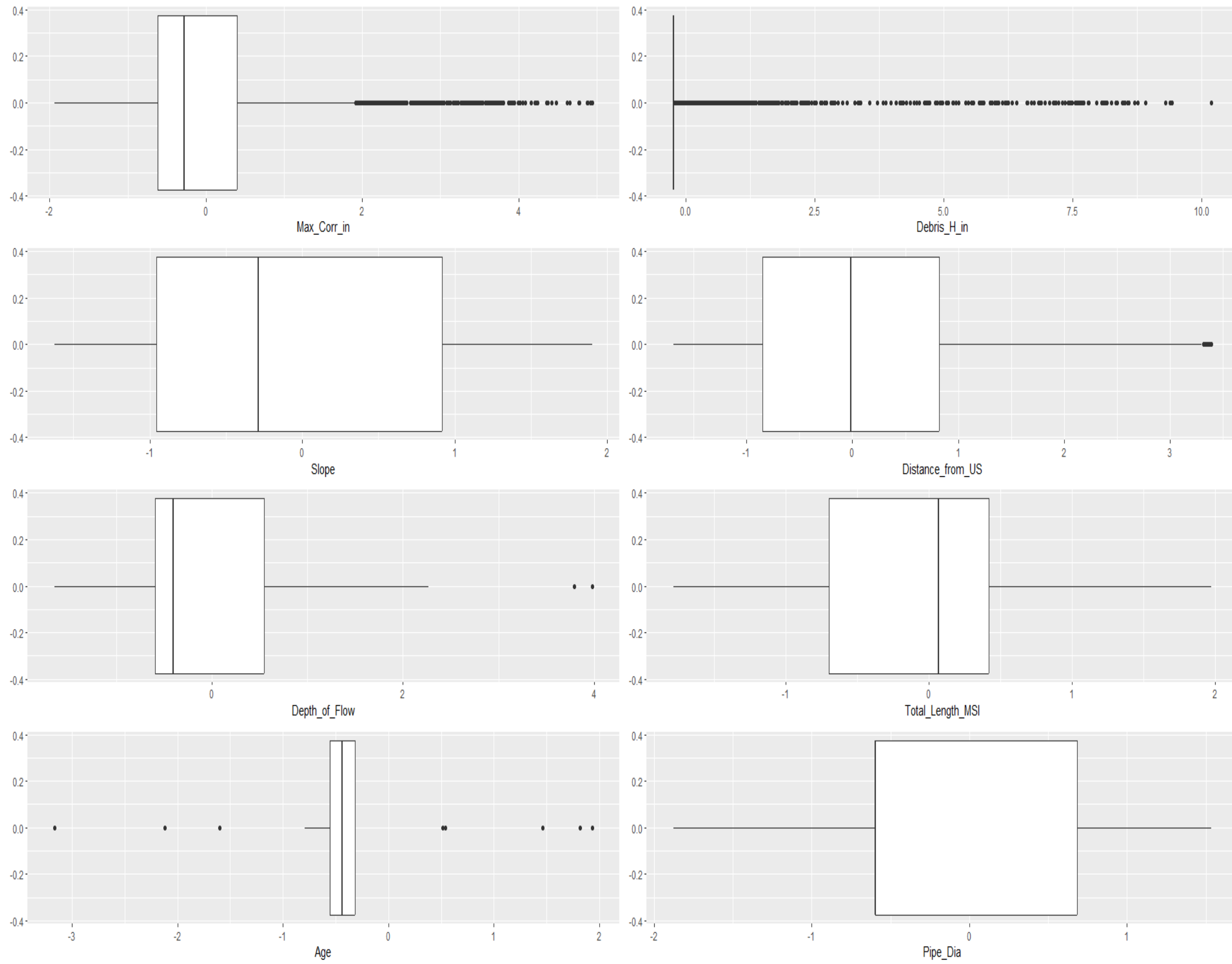

Figure 5-4 Box plots of variables

Figure 5-5 illustrates the regression between the dependent and predictor variables and demonstrates both positive and negative correlations. Specifically, there is a positive correlation between the slope and corrosion, as well as between age and corrosion. Conversely, the correlation between the distance from the upstream manhole and corrosion is negative. This observation helps explain why this particular variable was included in the analysis.

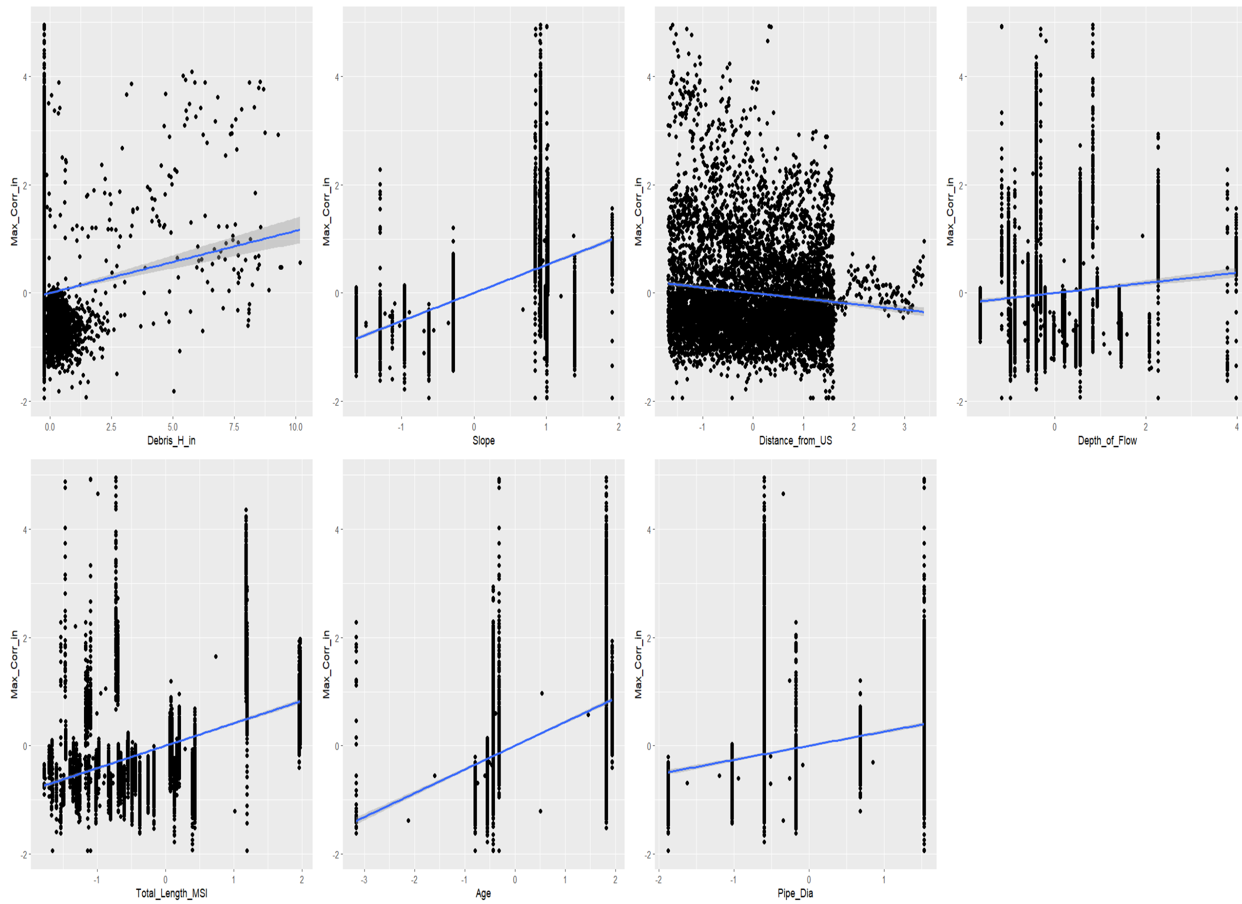

Figure 5-5 Multiple linear regression

5.5 Construction of Models

Multiple regression models were developed and evaluated to identify the most effective model for predicting the corrosion rate. They encompassed a variety of regression techniques and methodologies for analyzing the relationship between input variables and how rapidly the pipes corroded. The goal was to identify the model that provides the most accurate and reliable predictions of corrosion by rigorously evaluating and comparing the models.

5.5.1 Multiple linear regression

Multiple linear regression is a statistical modeling technique employed to examine the relationships between a dependent variable and two or more independent variables. It builds upon the principles of simple linear regression, which focuses on a single independent variable by accommodating multiple predictors Jobson, (1991); Montgomery et al. (2021).

The objective of utilizing multiple linear regression is to develop a mathematical equation that effectively represents the relationship between the dependent variable and the independent variables. This equation can be expressed as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n$$

In this equation, Y denotes the dependent variable, while X_1, X_2, ..., X_n represent the independent variables. The intercept term is denoted by β_0, and β_1, β_2, ..., β_n correspond to the regression coefficients associated with each independent variable.

The coefficients (β values) in the multiple linear regression model indicate the anticipated change in the dependent variable with a one-unit alteration in the respective independent variable, assuming all other independent variables remain constant. The model calculates the coefficients by minimizing the sum of the squared differences between the observed values of the dependent variable and the predicted values obtained using the independent variables. By estimating these coefficients, the multiple linear regression model provides insights into the relationships and impacts of the independent variables on the dependent variable and explains how changes in independent variables influence the dependent variable, while accounting for the influence of other variables in the model.

5.5.2 Multiple linear regression with interactions

Multiple linear regression with interactions is an extension of the standard multiple linear regression model, as it incorporates interaction terms between independent variables. In this approach, the model considers both the main effects of the independent variables and the combined effects or interactions among them. In multiple linear regression with interactions, the model equation is expanded to include interaction terms that are created by multiplying two or more independent variables together, and the interaction terms capture the joint effect or interaction between the respective independent variables Aiken & West, (1991).

The expanded model equation can be expressed as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \beta_{ij} x_i x_j$$

where:

Y is the dependent variable being predicted.

X_1, X_2, ..., X_n are the independent variables.

β_0, β_1, β_2, ..., βn are the regression coefficients representing the main effects of the independent variables.

β_{ij} represents the regression coefficient for the interaction term between the i-th and j-th independent variables.

X_i*X_j represents the interaction between the i-th and j-th independent variables.

5.5.3 Polynomial regression with interactions

Polynomial regression with interactions expands on the standard polynomial regression model by incorporating interaction terms between the polynomial features. This methodology enables modeling both the polynomial relationships among independent variables and their interactions.

The model equation incorporates polynomial terms created by raising the independent variables to various powers (e.g., squared, cubed, etc.) that allow for capturing nonlinear associations between the independent variables and the dependent variable. When interactions are included, the model equation is augmented with additional terms that represent the product of two or more polynomial features, and the interaction terms account for the combined effects or interactions among the polynomial features Draper, & Smith (1998).

The expanded model equation can be expressed as:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n + \beta_{ij}(xi^K * XJ^I)$$

The dependent variable is denoted as Y, and X_1, X_2, ..., X_n represent the independent variables. The intercept term is represented by β_0, while β_1, β_2, ..., β_n are the coefficients associated with the polynomial features of the independent variables. The interaction terms are denoted by β_{12}, β_{13}, ..., β_{ij}, capturing the coefficients associated with the interactions among the variables.

By incorporating polynomial terms and interaction terms, polynomial regression with interactions enables the capture of nonlinear relationships and the exploration of how the interactions among the polynomial features influence the dependent variable. This approach provides flexibility in modeling complex relationships that extend beyond what can be represented by linear models.

5.5.4 Random forest regression

A regression tree is a type of supervised machine learning model that utilizes a tree structure to construct a regression model and categorizes data into smaller subsets until the final response variable can be predicted. This non-parametric regression model does not yield an equation but instead relies on independent variables to determine the outcome variable.

When constructing a regression tree, machine learning algorithms systematically divide the data into smaller nodes, based on the features used in the training set, and the process continues until the leaf stage is reached and further division is not possible. The objective of node splitting is to optimize the information gained at each split, which is often a key consideration in dividing a node into multiple nodes. The final response variable is determined by averaging the variables present in the leaf node. The regression tree is a widely used regression machine learning algorithm, due to its simplicity and accuracy. The corrosion prediction model that was constructed based upon random forest regression exhibited the best model validation results Breiman, (2001).

5.5.5 Generalized boosted regression models.

The advanced machine learning approach for constructing generalized boosted regression models (GBM) merges boosting principles with regression. GBM operates as an ensemble method by sequentially building a group of weak regression models and combining them to form a robust predictive model. The weak regression models, which are often decision trees, are trained in a step-by-step manner, with each subsequent model focusing on capturing patterns that the previous models may have missed and minimizing errors or residuals left behind by previous models. By continually incorporating additional weak models and assigning more weight to data points with larger residuals, the ensemble progressively enhances the overall predictive performance Friedman, (2001).

The term "generalized" in GBMs highlights its adaptability in handling a wide range of regression problems. It can effectively address diverse response variables, including continuous, categorical, and even survival data, by appropriately selecting the loss function and adjusting the algorithm.

GBM is esteemed for its ability to capture intricate non-linear relationships, manage interactions, and seamlessly handle missing values. It finds extensive applications in predictive modeling and has demonstrated success in various domains, such as finance, healthcare, and marketing.

5.6 Evaluation and Selection of Models

The selection of the best predictive model is based on model performance metrics, which are quantitative measures used to assess their effectiveness and accuracy Liu et al. (2011).

5.6.1 The coefficient of determination (R^2)

The coefficient of determination, also known as the multiple correlation coefficient, is a widely accepted concept in classical regression analysis Rao (1973). It is defined as the proportion of variance that is explained by the regression model, which makes it a valuable metric for evaluating its ability to predict the dependent variable based on the independent variables Nagelkerke, (1991). The coefficient of determination can be calculated using the following equation:

$$R^2 = 1 - \frac{SSR}{SST}$$

SSR is the residual sum of squares, using the following equation:

$$SSR = \sum_i (y_i - f_i)^2$$

SST is the total sum of squares, using the following equation:

$$SST = \sum_i (y_i - y)^2$$

where y_i is i^{th} observed value.

f_i is i^{th} predicted value.

$\bar{y}$ is the mean of the observed data.

The validation metric is referred to as the unadjusted R^2 because it assumes an equal level of predictive capability among all independent variables Pokharel, (2021).

5.6.2 Adjusted coefficient of determination

One limitation of R^2 is that its value increases and approaches such as additional explanatory variables, regardless of their relevance, are included in the model and can lead to overestimation of the model's performance. To mitigate this issue, a correction for the degrees of freedom is applied to R^2, resulting in an adjusted R-squared metric denoted as R_i or adjusted R'. The adjusted R-squared considers the number of variables in the model and provides a more reliable measure of the model's goodness of fit Srivastava et al. (1995).

$$R^2{}_{adj} = 1 - \frac{(1 - R^2)(N - 1)}{N - p - 1}$$

Where:

R^2= Unadjusted R^2.

N= Total sample size.

P= Number of predictors.

5.6.3 Mean squared error (MSE) / root mean squared error (RMSE)

In mathematical terms, RMSE is the square root of the average of the squared errors, while MSE represents the average of the squared errors. Both MSE and RMSE serve as cost functions for regression models, quantifying the average error between the predicted values and the actual values. The unit of RMSE matches that of the target variable, making it a meaningful measure. Therefore, in regression analysis, a lower RMSE value is desirable, as it indicates that the predicted values align closely with the actual values, reflecting higher accuracy (Pokharel, 2021).

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(y_i - f_i)^2$$

$$RMSE = \sqrt{MSE}$$

Where: n = Number of data.

Y_i = Actual value.

f_i = Predicted value.

5.6.4 Probability of observing data (p-value)

The p-value is the probability of observing the data or more extreme data under the assumption that the null hypothesis is true Biau et al. (2019). It quantifies the level of significance or the strength of evidence against the null hypothesis. In general, when the p-value falls below a predefined significance level (often set at 0.05), the outcome is deemed statistically significant, leading to the rejection of the null hypothesis. Conversely, if the p-value exceeds the significance level, there is inadequate evidence to reject the null hypothesis Hung et al. (1997).

5.7 Model selection

After evaluating multiple regression models and analyzing their performance metrics, the random forest regression model was found to be the top performer and most accurate. Figure 5-6 showcases the decision tree obtained from implementing random forest regression, using the merged dataset from the TRA and City of Mansfield. It is important to note that the default number of trees was utilized for this model.

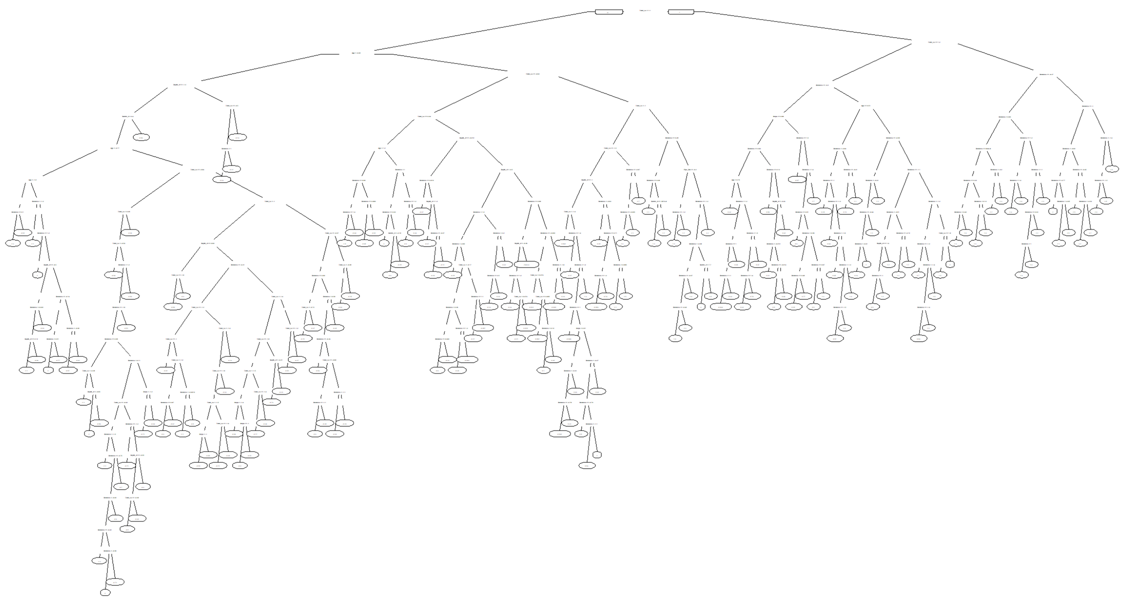

Figure 5-6 Random Forest regression

Figure 5-7 demonstrate the actual versus the predicted corrosion rates resulted from all models performed.

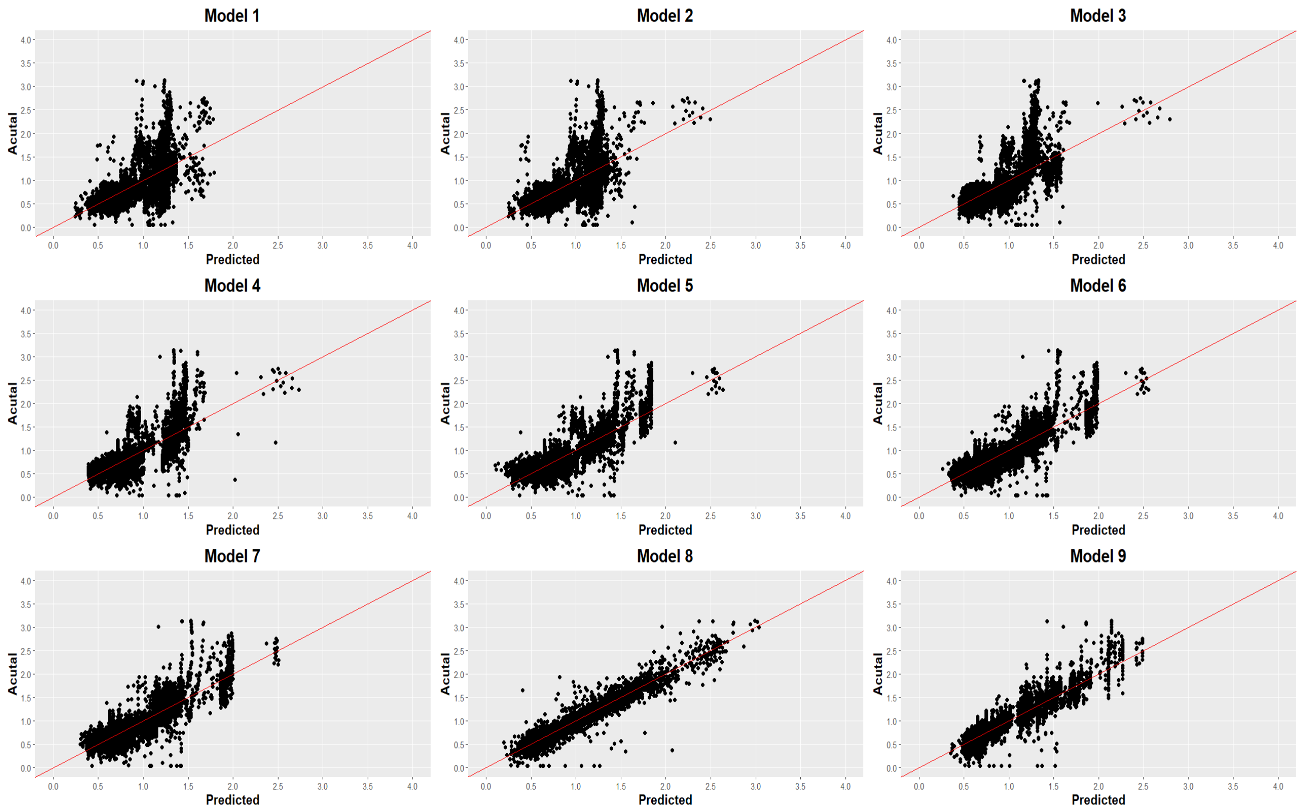

Figure 5-7 Actual vs Predicted corrosion rate different models performed

Figure 5-8 demonstrates the result of predicting the corrosion rate resulted from performing random forest regression, which is the model with the best performance matrices as can also be noted from Table 5-4.

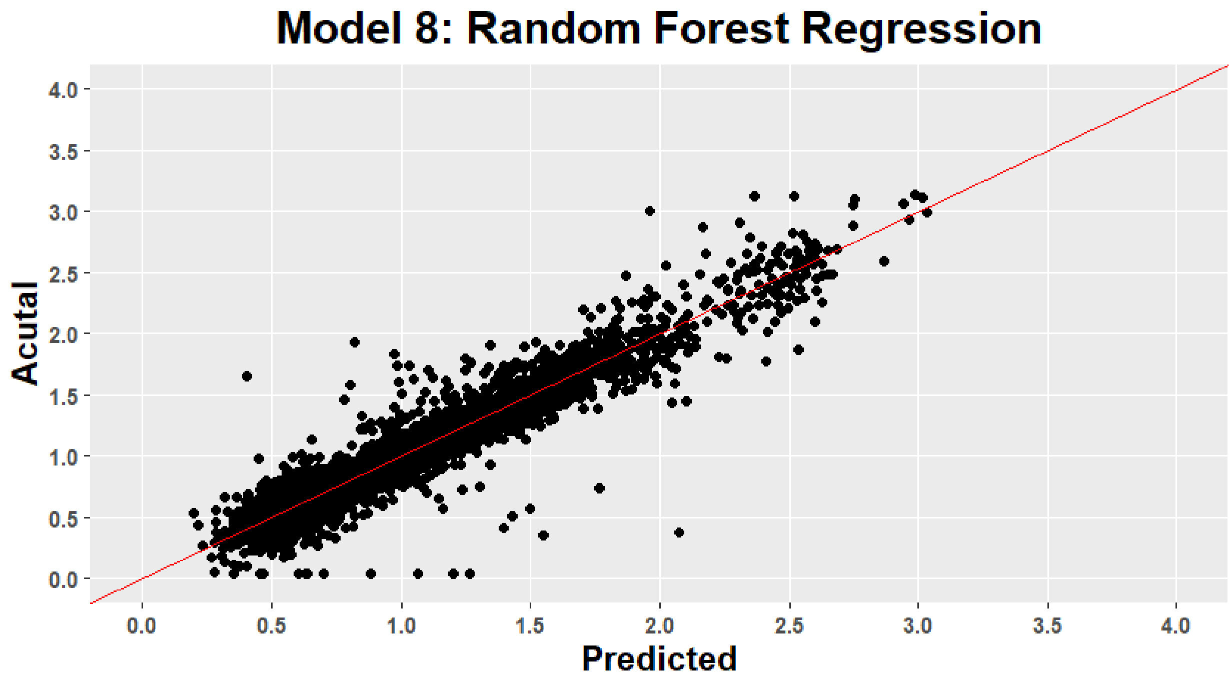

Figure 5-8 Predicted Vs Actual Corrosion Rate for model 8.

Figure 5-9 shows that random forest regression reveals the relative influence of each independent variable. The analysis indicated that the total length of the pipe had the most influence on predicting the corrosion rate in our case studies, followed by slope and age.

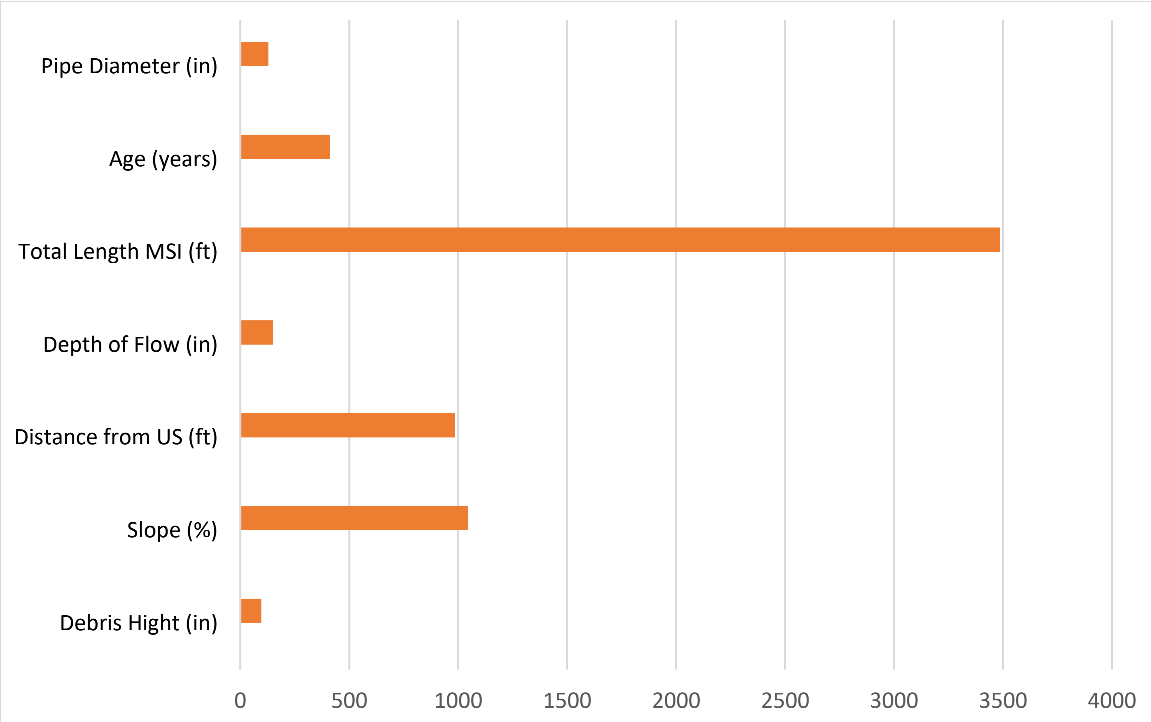

Figure 5-9 Relative influence of independent variables, based on random forest regression tree.

Table below 5-4, provides information on all the models used to analyze the data set.

Table 5-4 Models Summary-Standardized Data

Model#	Model	R-squared	Adj. R-squared	p-value	RMSE	MAE
1	Multiple Linear Regression	0.4057	0.4051	<0.001***	0.7360	0.5147
2	Multiple Linear Regression with Interactions	0.4203	0.4194	<0.001***	0.7280	0.5057
3	Polynomial Regression with interactions – Degree 2	0.4960	0.4947	<0.001***	0.6792	0.4832
4	Polynomial Regression with interactions – Degree 3	0.5851	0.5836	<0.001***	0.6177	0.4177
5	Polynomial Regression with interactions – Degree 4	0.6878	0.6863	<0.001***	0.5400	0.3741
6	Polynomial Regression with interactions – Degree 5	0.7392	0.7377	<0.001***	0.5069	0.3464
7	Polynomial Regression with interactions – Degree 6	0.7421	0.7404	<0.001***	0.5082	0.3465
8	**Random Forest**	**0.9131**	**0.9130**	**<0.001*****	**0.2813**	**0.1871**
9	GBM: Generalized Boosted Regression Models	0.8424	0.8423	<0.001***	0.3813	0.2626
10	Lasso Regression	0.3424	0.3417	<0.001***	0.7978	0.5471
11	Ridge Regression	0.4019	0.4013	<0.001***	0.7387	0.5168

6 Guidelines

6.1 Recommendations and Guidelines for Inspection Procedures and Methods

Pipeline inspections are vital and complicated. One size does not fit all, and the selection of the most effective procedure is dependent on a wide range of considerations. Engineering firms, researchers, and students who perform pipeline inspections as part of their work or research apply their knowledge and guidelines provided by the Occupational Safety and Health Association (OSHA) to assess the site conditions and parameters and select the procedure that will provide the most reliable data.

Safety is of high importance in pipe inspections, and it is essential that those responsible for deploying the robot take advantage of OSHA's training and have earned the Confined Space Entry Certificate. The safety and regulations for confined space entry (29 CFR 1910.146) were designed to protect users and employees and are relevant for both employers and employees, as employers are tasked with ensuring that the pipelines access points (manholes) are confined spaces, which would need special training and equipment. The equipment used must also be approved by OSHA and includes but is not limited to a harness and tripod with a deployment winch backed up by a safety winch; personal protective equipment (PPE) such as a hard hat, safety vest, and safety boots; multi-gas detectors; and air blowers.

Figure 6-1 Confined space entry

Figure 6-2 Multi gas detector

Figure 6-3 Air blower used prior to confined space entry

Pipeline inspections must be scheduled in advance, but one of the most important factors, weather, is rarely predictable and can cause challenges before, during, and after the inspection. Rain is an example of weather that can adversely affect site conditions, and greater accumulations worsen its effect. If it rains on an unpaved site shortly before or on the day the inspection is planned, mud may cause the truck and/or van to get stuck, team members performing the inspections may not be able to move around the site safely, and the ground may be too unstable for a safe entry setup. Another factor is that heavy rainfall and infiltration from the groundwater can affect the pipe's flow, causing flow levels to rise to the extent that the deployment team cannot perform the inspection.

Site accessibility is another major factor in pipe inspections, and the location of manholes in small spaces and/or areas where large vehicles such as trucks and vans cannot reach them requires careful consideration. The location and surroundings of the targeted manhole must be assessed prior to an inspection to decide whether the site should be cleared to facilitate vehicle access or whether smaller vehicles, such as utility terrain vehicles (UTVs) should be employed.

When traffic control and/or road closures are needed, government officials need to be contacted as soon as the need is apparent. Coordination and communication with the stakeholders (owners, consultants, subcontractors) is also vitally important to prevent misunderstandings that could result in delaying the inspection.

When all of the above conditions have been met, it is highly recommended that the team leader perform a preliminary walk or recon to actually stand on the site to assess its condition and ensure that it meets all the safety specifications. It is recommended that most, if not all, of the targeted manholes be opened to make sure that there are no abnormalities that require special attention. Figure 5-5 illustrates an old, corroded pipe that is no longer in service but is blocking the manhole from which the team needs to deploy. In this case, professional cleaning will have to be performed prior to the inspection.


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Figure 6-4 Example of an obstacle found in manholes

The deployment team needs to take gas readings and assess the flow inside the manhole to ensure that is workable, as it can vary in a short amount of time (from morning to afternoon). The team leader should talk with the person who has been assigned to enter the manhole about what they may encounter, as unexpected conditions, such as a multiple-line intersection, also known as a junction box, can cause confusion. Regulations set forth by OSHA need to be followed during the deployment, beginning with a trained and certified person entering the manhole.

The conditions observed by the person who enters the manhole determine the general deployment method: Option A, which goes with the flow from upstream to downstream, or Option B, which goes against the flow from downstream to upstream. The selection depends on various parameters, the most crucial of which are flow speed and depth. If the flow speed is sufficient to take the boat from the upstream manhole (Point A) to the downstream manhole (Point B), then option A is preferred. Option B is only chosen in abnormal situations where the flow velocity is shallow, and the water depth is too low. Options A and B are similar, except for the first step of deployment, which will be explained later in the guidelines.

<u>Option A Methods and Procedures</u>

Step 1. The team leader asks the person who has descended into the manhole to look for any abnormalities in the pipe. Once the pipe has been deemed workable, the team leader gives the green light to continue the inspection.

Step 2. The size of the parachute is determined based on the flow height estimated by the person in the manhole.

Step 3. The MSI robotic system is checked that is working and recording to confirm that everything is working correctly prior to sending it.

Step 4. The back of the boat is tied to the counter winch cable and the boat is lowered, parachute first, to the person inside the manhole.

Step 5. The person in the manholes ensures that the parachute stays above the water until the boat is correctly positioned in the pipe.

Step 6. After making sure that there are no tangles and/or twists in the parachute that could cause the boat to flip, the parachute is deployed in front of the boat.

Step 7. Once the parachute is deployed, it pulls the boat firmly with the approximate velocity of the pipe's flow. If the flow velocity is high, it is expected that the boat will launch at a higher speed, making it more challenging to pull it back in the event of mistakes.

Step 8. After the boat is launched and everything looks good, the tiger tail is sent to the person in the manhole so that he can position it to protect the winch cable from sharp angles.

Step 9. The person in the manhole ascends from the manhole, and a roller is put on the top of the manhole to eliminate any friction on the lid.

Step 10. It is highly recommended that the boat be tracked as it enters or passes by every intermediate manhole between the upstream (deployment) manhole to the downstream (pull-out) manhole as it might get stuck due to any blockage or debris build up.

Step 11. After the boat reaches the downstream manhole, a rope or hook is used to retrieve it and end the run. Rarely, in abnormal situations, a person needs to enter the confined space to collect the boat.

<u>Option B Methods and Procedures</u>

The procedures outlined for Option A are the same as for Option B, except that after Step 1, the person in the manhole informs the team leader that the flow velocity is too low to carry the boat the length of the pipe. The team leader then decides whether to continue with Option B. The differences between Option A and Option B are small. For Option B, the size of the parachute is smaller than for Option A, and it can be substituted by any small floating object that can be connected to the winch cable. The cable is sent with the flow to the other end of the line, where it will be collected, then is tied to the front of the boat instead of the back. No parachute is necessary because the deployment is performed from the downstream manhole to the upstream manhole against the flow, and the tension that pulls the boat originates from the cable winch.

Figure 6-5 Parachutes

Some of the challenges most commonly encountered during inspection procedures are described below, along with recommendations for overcoming them, but it not an exclusive list. Unexpected and new obstacles that require an engineer's judgement are always possible.

1. If the area surrounding the upstream manhole is too confined and/or tight to align the cable winch with the direction of the flow, it is recommended that the cable winch be parked in the opposite direction of the flow and that a 90-degree deployment be performed. The critical point in such deployment is utilizing manhole rollers and more than one tiger tail to decrease the friction to 90 degrees.
2. If the depth of the flow is relatively low (below 10% of the pipe's diameter), a larger-sized parachute will collapse and the loss of tension in front of the boat will result in it not being centered and unable to reach the downstream manhole. When the flow velocity is sufficient to carry the boat, it is recommended that the smallest parachute possible be used; however, if even the smallest parachute proves to be insufficient, tying the front (nose) of the smallest parachute to reduce its size even more might help. To summarize, low flow levels require a smaller parachute and vice versa.
3. When the flow levels are so low that the boat is not expected to be buoyant, wheels can be attached to the bottom of the boat to prevent the sonar sensors (or any other sensors or wires) on the boat's bottom from dragging on the bottom of the pipe and being damaged.
4. While tracking a boat passing through manholes, as specified in Step 10, the observer may note that the boat has gotten stuck. The following are some reasons that this can occur, as well as recommended solutions.
    a. The boat stops because of a sharp bends that develop very high friction on the back cable. The solution to this is to ask the winch operator to release the cable from the wheel of the winch to the extent possible so that a fiberglass rod or other similar tool can be used to free the boat. If the situation is more involved and this is not possible, then a person may need to enter the space to free the boat.
    b. The boat gets stuck in a high level of debris that has built up in the pipe. (When this is the cause, the boat is stuck, but the winch cable still floats in front of it.) The only solution to this scenario is for a person to enter the area to assess whether it is possible to clean up the debris so that the boat can proceed or whether the line needs a deep cleaning that requires using machinery. In this case, the inspection will have to be discontinued.
    c. If it appears that the boat got stuck between two intermediate manholes, the procedure is to open all the previous manholes in the order that they were passed

through to locate the cable. At this point, a confined space entry will be necessary to investigate the cause of the stop and/or blockage to decide whether the obstacle can be removed, or the boat needs to be pulled up and the inspection ended.

6.2 Recommendations and Guidelines for Procedure Obtained from Site Experience

The data derived from the site inspections performed for the TRA and City of Mansfield projects were utilized for this dissertation and research. The three boats utilized for the inspections were designed and built by UTA CSER-PI in accordance with the site conditions. It was noted that the speed at which the boat travelled, and the intervals of the sensors' scans varied for Option A, which is based on upstream-to-downstream runs, as each pipe has its own flow depth and speed characteristics. Typically, the flow speed is relatively high in large-diameter sewer pipes, and since the boat travels with the flow, holding it back to keep it at a lower velocity is not recommended, as it will cause stability problems for the boat as it travels downstream, specifically as it encounters curves. For this reason, the boat needs to move at the speed of the flow, which in most cases is more than 32 ft/min., which according to NASSCO. Any defects should be coded per the PACP on a maximum speed of 32 ft/min if it is being done during inspection.

We did not perform the PACP coding during the inspection; however, we collected all the data, including the CCTV recordings, on-site and took them to the office to perform the analysis. We increased the speed of the boat traveling downstream to correlate with the flow rate, which kept the boat stable and enabled it to collect accurate data, but it should be noted that this only works if the sensors' specifications or speed of scanning can be adjusted to a smaller interval of scans, so that the scanning is done at a faster speed, to keep up with the speed of the boat. Otherwise, the scan would miss sections, due to the difference in the speed of scanning and the speed of the boat. The following are some recommendations for scan intervals for flow speeds higher than 32ft/min.

- If the boat is traveling at a 50ft/min., the recommended lidar scan interval is 0.3-0.5 seconds.
- If the boat speed is 100ft/min., the recommended lidar scan interval is 0.1 seconds. Readings for the same section may be duplicated and averaged at the end, increasing the accuracy of the data collection process.

- Higher speeds are possible for the CCTV, but the camera used for the recording should be capable of higher frame rates with higher speeds.

6.3 Conclusion

The inspections performed for this research showed that the scan interval can be adjusted for the site conditions and needs. High boat speeds and short scan intervals that can be implemented without affecting the quality of the data collected result in more time-efficient inspections and thus higher productivity levels.

7 Conclusion

7.1 Conclusion

Concrete sewer pipeline inspections were conducted for the City of Mansfield and Trinity River Authority (TRA), yielding valuable insights for enhancing the overall inspection process. The recommendations and proposed methodologies for Multi Sensor Inspection (MSI) encompassed various stages. These included pre-inspection preparations, crucial communication and coordination among stakeholders and officials whenever necessary, meticulous on-site procedures and setup, the utilization of specialized inspection equipment, and the consideration of different deployment options.

Upon completion of the inspections, a comprehensive analysis was undertaken on the collected data, leading to significant results. Moreover, the study aimed to construct predictive models for corrosion rates in concrete pipes using artificial intelligence techniques. The selection of the optimal model was based on rigorous performance metrics evaluation.

In the context of the data analysis, it was evident that all the variables taken into consideration played vital roles. Among these, specific parameters emerged as particularly influential in determining corrosion rates. These included pipe length, slope, age of the pipes, distance from the upstream manhole, and the presence of structural defects in the inspected lines. Notably, the evaluation of defects revealed that 26% of the points exhibited grade 1 defects, 1.6% had grade 2 defects, another 1.6% displayed grade 3 defects, 5% exhibited grade 4 defects, and 20% were marked by grade 5 defects. These findings collectively contribute to an enhanced understanding of factors impacting corrosion rates and provide valuable insights for future maintenance and management strategies.

Table 7-1 represents a comparison between the corrosion rates observed during on-site inspections and the corrosion rates predicted by the random forest regression model developed. The outcomes demonstrated remarkable promise, as evidenced by the contents of the table.

Table 5-1 Corrosion rate Actual vs predicted.

Corrosion actual (in)	Corrosion predicted (in)
2112 points (30.1%) of inspected line segments had corrosion more than 1 inch.	**2120 points (30.3%) of inspected line segments had corrosion more than 1 inch.**
705 points (10%) of inspected line segments had corrosion more than 1.5 inch.	**699 points (9.99%) of inspected line segments had corrosion more than 1.5 inch.**
183 points (2.61%) of inspected line segments had corrosion more than 2 inch.	**178 points (2.54%) of inspected line segments had corrosion more than 2 inch.**

7.2 Future Work

This future work of this research study is promising. The potential expansion of this research is to improve the MSI robots and additional sensors such as H_2S gas detectors to the design of the robotic system. Since prediction of corrosion has been an essential part of this research, including new parameters to evaluate correlation to the prediction of the corrosion will be an extension to the study Also, expansion of the sample size to various pipe diameters and parameters and predicting the corrosion under these parameters will be analyzed and assessed as well as utilizing other models to evaluate the fit to our study.

References

Guo, W., Soibelman, L., & Garrett, J. H. (2009). Automated defect detection for Sewer Pipeline Inspection and condition assessment. *Automation in Construction*, *18*(5), 587–596. https://doi.org/10.1016/j.autcon.2008.12.003

Salihu, C., Mohandes, S. R., Kineber, A. F., Hosseini, M. R., Elghaish, F., & Zayed, T. (2023a). A deterioration model for sewer pipes using CCTV and artificial intelligence. *Buildings*, *13*(4), 952. https://doi.org/10.3390/buildings13040952

Salihu, C., Mohandes, S. R., Kineber, A. F., Hosseini, M. R., Elghaish, F., & Zayed, T. (2023a). A deterioration model for sewer pipes using CCTV and artificial intelligence. *Buildings*, *13*(4), 952. https://doi.org/10.3390/buildings13040952

Parande, A. K., Ramsamy, P. L., Ethirajan, S., Rao, C. R. K., & Palanisamy, N. (2006, March). Deterioration of reinforced concrete in sewer environments. In *Proceedings of the Institution of Civil Engineers-Municipal Engineer* (Vol. 159, No. 1, pp. 11-20). Thomas Telford Ltd.

Li, X., Khademi, F., Liu, Y., Akbari, M., Wang, C., Bond, P. L., ... & Jiang, G. (2019). Evaluation of data-driven models for predicting the service life of concrete sewer pipes subjected to corrosion. *Journal of environmental management*, *234*, 431-439.

Mahmoodian, M., & Alani, A. M. (2013). Multi-failure mode assessment of buried concrete pipes subjected to time-dependent deterioration, using system reliability analysis. *Journal of failure analysis and prevention*, *13*, 634-642.

Sulikowski, J., & Kozubal, J. (2016). The durability of a concrete sewer pipeline under deterioration by sulphate and chloride corrosion. *Procedia Engineering*, *153*, 698-705.

Wang, Y., Li, P., Liu, H., Wang, W., Guo, Y., & Wang, L. (2022). The Effect of Microbiologically Induced Concrete Corrosion in Sewer on the Bearing Capacity of Reinforced Concrete Pipes: Full-Scale Experimental Investigation. *Buildings*, *12*(11), 1996.

Kuliczkowska, E., & Parka, A. (2019). The structural integrity of corroded concrete sewers. *Engineering Failure Analysis*, *104*, 409-421.

Vladeanu, G., & Matthews, J. (2019). Wastewater pipe condition rating model using multicriteria decision analysis. *Journal of Water Resources Planning and Management*, *145*(12), 04019058.

Mirats Tur, J. M., & Garthwaite, W. (2010). Robotic devices for water main in-pipe inspection: A survey. *Journal of Field Robotics*, *27*(4), 491-508.

Roth, H., Schilling, K., Futterknecht, S., Weigele, U., Reisch, M., & Ravensburg-Weingarten, F. (1998, July). Inspection- and repair robots for waste water pipes—A challenge to sensorics and locomotion. In IEEE International Symposium on Industrial Electronics, 1998

Guo, W., Soibelman, L., & Garrett Jr, J. H. (2009). Automated defect detection for sewer pipeline inspection and condition assessment. *Automation in Construction*, *18*(5), 587-596.

A.N. Tafuri, A. Selvakumar, Wastewater collection system infrastructure research needs, U.S Environmental Protection Agency, Edinson, 2002, p. 26.

Zamanian, S., Hur, J., & Shafieezadeh, A. (2021). Significant variables for leakage and collapse of buried concrete sewer pipes: A global sensitivity analysis via Bayesian additive regression trees and Sobol'indices. *Structure and infrastructure engineering*, *17*(5), 676-688.

Iurchenko, V.; Lebedeva, E.; Brigada, E. Environmental safety of the sewage disposal by the sewerage pipelines. Procedia Eng. 2016, 134, 181–186.

Held, I.; Wolf, L.; Eiswirth, M.; Hötzl, H. Impacts of Sewer Leakage on Urban Groundwater: Review of a Case Study in Germany; Springer: Dordrecht, The Netherlands, 2006; pp. 189–204.

Zuo, J.; Ye, X.; Hu, X.; Yu, Z. Urban Pipe Assessment Method and Its Application in Two Chinese Cities; Springer: Cham, Switzerland, 2019; pp. 195–231.

Kaddoura, K. Automated Sewer Inspection Analysis and Condition Assessment. Ph.D. Thesis, Concordia University, Montreal, QC, Canada, 2015.

Sarshar, N.; Halfawy, M.; Hengmeechai, J. Video processing techniques for assisted CCTV inspection and condition rating of sewers. J. Water Manag. Model. 2009, 21, 1–20.

Salman, B.; Salem, O. Modeling failure of wastewater collection lines using various section-level regression models. J. Infrastruct. Syst. 2012, 18, 146–154.

Salihu, C.; Hussein, M.; Mohandes, S.R.; Zayed, T. Towards a comprehensive review of the deterioration factors and modeling for sewer pipelines: A hybrid of bibliometric, scientometric, and meta-analysis approach. J. Clean. Prod. 2022, 351, 131460.

Alzraiee, H.; Bakry, I.; Zayed, T. Destructive analysis-based testing for cured-in-place pipe. J. Perform. Constr. Facil. 2015, 29, 04014095.

Salman, B.; Salem, O. Risk assessment of wastewater collection lines using failure models and criticality ratings. J. Pipeline Syst. Eng. Pract. 2012, 3, 68–76.

Srivastava, A. K., Srivastava, V. K., & Ullah, A. (1995). The coefficient of determination and its adjusted version in linear regression models. *Econometric reviews*, *14*(2), 229-240.

Nagelkerke, N. J. (1991). A note on a general definition of the coefficient of determination. *biometrika*, *78*(3), 691-692.

Tukey, J. W. (1977). *Exploratory data analysis* (Vol. 2, pp. 131-160).

Ana, E., Bauwens, W., Pessemier, M., Thoeye, C., Smolders, S., Boonen, I., & De Gueldre, G. (2009). An investigation of the factors influencing sewer structural deterioration. *Urban Water Journal*, *6*(4), 303-312.

Ayoub, G. M., Azar, N., Fadel, M. E., & Hamad, B. (2004). Assessment of hydrogen sulphide corrosion of cementitious sewer pipes: a case study. *Urban Water Journal*, *1*(1), 39-53.

Jeong, H. S., Baik, H. S., & Abraham, D. M. (2005). An ordered probit model approach for developing markov chain based deterioration model for wastewater infrastructure systems. In *Pipelines 2005: Optimizing Pipeline Design, Operations, and Maintenance in Today's Economy* (pp. 649-661).

Rajani, B., & Makar, J. (2000). A methodology to estimate remaining service life of grey cast iron water mains. *Canadian Journal of Civil Engineering*, *27*(6), 1259-1272.

Rajani, B., & Tesfamariam, S. (2007, June). Estimating time to failure of cast-iron water mains. In *Proceedings of the Institution of Civil Engineers-Water Management* (Vol. 160, No. 2, pp. 83-88). Thomas Telford Ltd.

Al-Barqawi, H., & Zayed, T. (2006). Assessment model of water main conditions. In *Pipelines 2006: Service to the Owner* (pp. 1-8).

Wang, C. W., Niu, Z. G., Jia, H., & Zhang, H. W. (2010). An assessment model of water pipe condition using Bayesian inference. *Journal of Zhejiang University-SCIENCE A*, *11*, 495-504.

Davis, P., Burn, S., Moglia, M., & Gould, S. (2007). A physical probabilistic model to predict failure rates in buried PVC pipelines. *Reliability Engineering & System Safety*, *92*(9), 1258-1266.

Jobson, J. D., & Jobson, J. D. (1991). Multiple linear regression. *Applied multivariate data analysis: Regression and experimental design*, 219-398.

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. sage.

Draper, N. R., & Smith, H. (1998). *Applied regression analysis* (Vol. 326). John Wiley & Sons.

Breiman, L. (2001). Random forests. *Machine learning*, *45*, 5-32.

Alizard, F., & Biau, D. (2019). Restricted nonlinear model for high-and low-drag events in plane channel flow. *Journal of Fluid Mechanics*, *864*, 221-243.

Hung, H. J., O'Neill, R. T., Bauer, P., & Kohne, K. (1997). The behavior of the p-value when the alternative hypothesis is true. *Biometrics*, 11-22.

M. Lichte, PWSA long-term CSO control program, Pittsburgh Water and Sewer Authority, Pittsburgh, 2006.

Nayak, A., & Pradhan, S. K. (2014). Investigations of design issues related to in-pipe inspection robots. *Int. J. Emerg. Tech. Adv. Eng.*, *4*(3), 819-824.

Alexander, M. G., & Fourie, C. (2011). Performance of sewer pipe concrete mixtures with portland and calcium aluminate cements subject to mineral and biogenic acid attack. *Materials and structures*, *44*, 313-330.

Zamanian, S., & Shafieezadeh, A. (2023, June). Age-dependent failure probabilities of corroding concrete sewer pipes under traffic loads. In *Structures* (Vol. 52, pp. 524-535). Elsevier.

Zamanian, S., & Shafieezadeh, A. (2023). Temporal global sensitivity analysis of concrete sewer pipes under compounding corrosion and heavy traffic loads. *Structure and Infrastructure Engineering*, *19*(8), 1108-1121.

Ahammed, M. (1997). Prediction of remaining strength of corroded pressurised pipelines. *International journal of pressure vessels and piping*, *71*(3), 213-217.

Kienow, K. K., & Kienow, K. E. (2004). Evaluation of sanitary sewer sulfide, odor, and corrosion potential. In *Pipeline Engineering and Construction: What's on the Horizon?* (pp. 1-17).

Wells, T., Melchers, R. E., & Bond, P. (2009). Factors involved in the long term corrosion of concrete sewers. *Australasian corrosion association proceedings of corrosion and prevention, Coffs Harbour, Australia*, *11*.

Pokharel, A. (2021). *Application of Supervised Machine Learning Algorithms for Developing Service Life Prediction Model of Sewer Pipes* (Doctoral dissertation, The University of Texas at Arlington).

Appendix A

Table 1: Summary of lines inspected during City of Mansfield project.

SN	UNQ ID.	US MH	DS MH	Length (ft.)	Pipe Material

				Field	GIS	
1	11064	11069	11070	108.24	115	RCP
2	11065	11070	11071	284.96	310	RCP
3	11066	11071	11072	542.49	545	RCP
4	11067	11072	11073	765.96	750	RCP
5	11068	11073	11074	432.44	480	RCP
6	11069	11074	11075	530.89	540	RCP
7	11070	11075	11076	79.52	78	RCP
8	12348	11076	12381	621.05	573	RCP
9	11071	12381	11077	604.67	663	RCP
10	11072	11077	11078	286.04	282	RCP
11	11073	11078	11079	648.93	705	RCP
12	11074	11079	11080	664	665	RCP
13	11075	11080	11081	190.48	163	RCP
14	11076	11081	15419	99.68	132	RCP
15	15505	15419	15420	169.34	167	HOBAS
16	11189	15420	11082	89.13	100	RCP
17	11077	11082	12902	1175.62	1150	RCP
18	12890	12902	11083	85.36	105	RCP
19	11078	11083	11084	305.03	308	RCP
20	11079	11084	11085	313.36	306	RCP
21	11080	11085	12373	136.99	165	RCP
22	11306	12373	11086	136.24	132	RCP
23	11081	11086	11087	1027.89	1092	RCP
24	11082	11087	11088	41.46	58	RCP
25	UnknownPipe1	11088	UnknownMH2	41.08	-	RCP
26	11083	UnknownMH2	11089	382.89	424	RCP
27	11084	11089	11090	758.32	795	RCP
28	11085	11090	11091	674.96	684	RCP
29	11086	11091	14776	456.75	438	RCP
30	14793	14776	11092	262.86	266	RCP
31	11087	11092	11093	107.03	131	RCP
32	11088	11093	11094	875.53	896	RCP
33	11089	11094	11095	260.41	267	RCP
34	11090	11095	11096	710.01	739	RCP
35	11091	11096	12919	452.74	457	RCP
36	12907	12919	11097	241.95	254	RCP
37	11092	11097	11098	183.72	211	RCP
38	11093	11098	11099	829.66	834	RCP

1. Line 11064

Table 2: Details for Line_11064

Asset Number	11064
U/S Manhole ID	11069

Pipe Material	Concrete
Inspection Date	05/01/2023

D/S Manhole ID	11070		Pipe Diameter	30 inches
Inspection Direction	Downstream		Pipe Length (Field)	108.24 ft.

Table 3: PACP Defect Table for Line_11064

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
8.38	SAV	S01					8	4		2	0
8.38	DAGS	S02			10		8	4		0	2
15.54	DAZ	S03			30		9	3	High efflorescence	0	5
38.52	SAV	F01									
46.63	SRC						3			5	0
56.8	SAM						8	9		4	0
108.2	DAZ	F03									
108.2	DAGS	F02									
108.2	AMH										

	ST	O&M
Overall Rating:	21	135
Rating Index:	2.63	3.46

	ST	O&M
Quick Rating:	5141	5B2C
Overall Quick Rating:	5C41	

2. Line 11065

Table 4: Details for Line_11065

Asset Number	11065		Pipe Material	Concrete
U/S Manhole ID	11070		Inspection Date	05/01/2023
D/S Manhole ID	11071		Pipe Diameter	30 inches
Inspection Direction	Downstream		Pipe Length (Field)	284.96 ft

Table 5: PACP Defect Table for Line_11065

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
7.09	DAGS	S01			30		11	2		0	4
40	DAGS	F01								0	0

40	DAZ	S02			40		9	3	**High Efflorescence**	0	5
40	SRI	S03								1	0
284.96	SRI	F03								0	0
284.96	DAZ	F02								0	0
284.96	AMH									0	0

	ST	**O&M**
Overall Rating:	49	273
Rating Index:	1.00	4.88

	ST	**O&M**
Quick Rating:	1H00	5H47
Overall Quick Rating:	5H47	

3. Line 11066

Table 6: Details for Line_11066

Asset Number	11066
U/S Manhole ID	11071
D/S Manhole ID	11072
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	05/01/2023
Pipe Diameter	30 inches
Pipe Length (Field)	542.49 ft

Table 7: PACP Defect Table for Line_11066

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAZ	S01			35		9	3	High Efflorescence	0	5
39.76	SRI	S02								1	0
542.49	SRI	F02								0	0
542.49	DAZ	F01								0	0
542.49	AMH									0	0

	ST	**O&M**
Overall Rating:	101	540
Rating Index:	1.00	5.00

	ST	**O&M**
Quick Rating:	1S00	5T00
Overall Quick Rating:	5T1S	

4. Line 11067

Table 8: Details for Line_11067

Asset Number	11067

Pipe Material	Concrete

U/S Manhole ID	11072		Inspection Date	5/1/2023
D/S Manhole ID	11073		Pipe Diameter	30 inches
Inspection Direction	Downstream		Pipe Length (Field)	765.96 ft

Table 9: PACP Defect Table for Line_11067

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SAV									2	0
2.63	DAZ	S01			40		9	4	High Efflorescence	0	5
30.33	SRI	S02								1	0
759.18	SRI	F02								0	0
759.18	DAZ	F01								0	0
759.18	SAV	S03								2	0
765.96	SAV	F03								0	0
765.96	AMH									0	0

	ST	O&M
Overall Rating:	150	755
Rating Index:	1.01	5.00

	ST	O&M
Quick Rating:	221Z	5Z00
Overall Quick Rating:	5Z22	

5. Line 11068:

Table 10: Details for Line_11068

Asset Number	11068		Pipe Material	Concrete
U/S Manhole ID	11073		Inspection Date	5/1/2023
D/S Manhole ID	11074		Pipe Diameter	30 inches
Inspection Direction	Downstream		Pipe Length (Field)	432.44 ft

Table 11: PACP Defect Table for Line_11068

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										

0	MWL				20						
3.39	SRI	S01								1	0
3.39	DAGS	S02			30					0	4
204.82	DAGS	F02								0	0
204.82	DAZ	S03			20		9	3	Efflores cence	0	3
231.95	DAZ	F03								0	0
244.58	DAZ	S04			15		3	1	Efflores cence	0	3
251.55	DAZ	F04								0	0
251.55	DAGS	S05			20		9	3		0	3
432.44	DAGS	F05								0	0
432.44	SRI	F01								0	0
432.44	AMH									0	0

	ST	O&M
Overall Rating:	86	289
Rating Index:	1.00	3.48

	ST	O&M
Quick Rating:	1P00	4G3G
Overall Quick Rating:	4G3G	

6. Line 11069:

Table 12: Details for Line_11069

Asset Number	11069
U/S Manhole ID	11074
D/S Manhole ID	11075
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	36 inches
Pipe Length (Field)	530.89 ft

Table 13: PACP Defect Table for Line_11069

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAGS	S01			30		9	2		0	4
10.34	DAGS	F01								0	0
26.65	DAZ	S02			35		9	2	Efflorescence	0	5
102.02	DAZ	F02								0	0
102.02	DAZ	S03			10		11	2	Efflorescence	0	2

113.33	DAZ	F03								0	0
113.33	DAZ	S04			35		10	3	Effloresc ence	0	5
131.42	DAR				10		12	1		0	2
404.45	VC									0	0
411.99	VC									0	0
414.06	DAZ	F04								0	0
414.06	LFDE	S05					9	3	Lining have corroded	3	0
414.06	VC									0	0
468.33	LFDE	F05								0	0
469.84	DAZ	S06			30		10	3	Effloresc ence	0	4
530.89	DAZ	F06								0	0
530.89	AMH									0	0

	ST	O&M
Overall Rating:	33	437
Rating Index:	3.00	4.75

	ST	O&M
Quick Rating:	3A00	5N4A
Overall Quick Rating:	5N4A	

7. Line 11070:

Table 14: Details for Line_11070

Asset Number	11070
U/S Manhole ID	11075
D/S Manhole ID	11076
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	36 inches
Pipe Length (Field)	79.52 ft

Table 15: PACP Defect Table for Line_11070

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAGS	S01			20		9	3	With Effloresc ence	0	3
78.95	TFD		15				9	10		0	3
78.95	DAGS	F01								0	0
78.95	AMH									0	0

	ST	O&M
Overall Rating:	0	48
Rating Index:	-	3.00

	ST	O&M
Quick Rating:	0000	3B00
Overall Quick Rating:	3B00	

8. Line 12348:

Table 16: Details for Line_12348

Asset Number	12348
U/S Manhole ID	11076
D/S Manhole ID	12381
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	36 inches
Pipe Length (Field)	621.05 ft

Table 17: PACP Defect Table for Line_12348

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAGS	S01			10		9	3		0	2
24.49	DAGS	F01								0	0
24.49	DAZ	S02			30		10	2	Efflorescence	0	4
109.66	DAZ	F02								0	0
109.66	DAZ	S03			10		10	2	Efflorescence	0	2
516.86	DAZ	F03								0	0
516.86	DAZ	S04			35		9	3		0	5
620.88	DAZ	F04								0	0
620.88	TBI		15		10		9	10		0	2
620.88	TFC		15				2	3		0	0
621.05	AMH									0	0

	ST	O&M
Overall Rating:	0	347
Rating Index:	-	2.78

	ST	O&M
Quick Rating:	0000	5C4B
Overall Quick Rating:	5C4B	

9. Line 11071:

Table 18: Details for Line_11071

Asset Number	11071		Pipe Material	Concrete
U/S Manhole ID	12381		Inspection Date	5/1/2023
D/S Manhole ID	11077		Pipe Diameter	36 inches
Inspection Direction	Downstream		Pipe Length (Field)	604.67 ft

Table 19: PACP Defect Table for Line_11071

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
3.02	DAZ	S01			20		10	2	Efflorescence	0	3
269.08	DAZ	F01								0	0
269.08	DAZ	S02			10		10	2	Efflorescence	0	2
358.02	DAZ	F02								0	0
358.02	DAZ	S03			35		9	3	Efflorescence	0	5
387.22	DAZ	F03								0	0
387.22	DAZ	S04			20		10	2	Efflorescence	0	4
571.89	DAZ	F04								0	0
571.89	DAZ	S05			10		10	2	Efflorescence	0	2
604.67	DAZ	F05								0	0
604.67	AMH									0	0

	ST	**O&M**
Overall Rating:	0	387
Rating Index:	-	3.20

	ST	**O&M**
Quick Rating:	0000	564F
Overall Quick Rating:	564F	

10. Line 11072:

Table 20: Details for Line_11072

Asset Number	11072		Pipe Material	Concrete
U/S Manhole ID	11077		Inspection Date	5/1/2023
D/S Manhole ID	11078		Pipe Diameter	36 inches
Inspection Direction	Downstream		Pipe Length (Field)	286.04 ft

Table 21: PACP Defect Table for Line_11072

Dist. (ft.)	Code Group/ Description	Continuous defect	value		Joint	Circumferential	Remarks	Defect Rating	
			Dimension	%				Str	O&M

			1st	2nd			At/ From	To			
0	AMH										
0	MWL				30						
1.14	SRI	S01								1	0
15.27	DAGS	S02			10		11	2		0	2
117.02	DAGS	F02								0	0
117.02	SRI	F01								0	0
117.02	DAZ	S03			15		9	3	Efflorescence	0	3
286.04	DAZ	F03								0	0
286.04	TFC		15				9	10		0	0
286.04	AMH									0	0

	ST	**O&M**
Overall Rating:	3	142
Rating Index:	1.00	2.63

	ST	**O&M**
Quick Rating:	1300	3E2C
Overall Quick Rating:	3E2C	

11. Line 11073:

Table 22: Details for Line_11073

Asset Number	11073
U/S Manhole ID	11078
D/S Manhole ID	11079
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	39 inches
Pipe Length (Field)	648.93 ft

Table 23: PACP Defect Table for Line_11073

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
6.76	DAGS	S01			10		10	3		0	2
44.63	DAGS	F01								0	0
44.63	DAGS	S02			20		10	3	With Efflorescence	0	3
648.93	DAGS	F02								0	0
648.93	VC									0	0
648.93	AMH									0	0

	ST	**O&M**

	ST	**O&M**

Overall Rating:	0	379
Rating Index:	-	2.94

Quick Rating:	0000	3W28
Overall Quick Rating:	3W28	

12. Line 11074:

Table 24: Details for Line_11074

Asset Number	11074
U/S Manhole ID	11079
D/S Manhole ID	11080
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	39 inches
Pipe Length (Field)	664 ft

Table 25: PACP Defect Table for Line_11074

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAE	S01			10		9	3	Efflorescence	0	2
53.71	DAE	F01								0	0
53.71	DAE	S02			30		9	3		0	4
212.93	DAE	F02								0	0
212.93	DAE	S03			20		10	3		0	3
250.05	DAE	F03								0	0
250.05	DAE	S04			35		9	3		0	5
354.06	DAE	F04								0	0
354.06	DAE	S05			20		10	3		0	3
661.77	DAE	F05								0	0
664	AMH									0	0

	ST	**O&M**
Overall Rating:	0	462
Rating Index:	-	3.47

	ST	**O&M**
Quick Rating:	0000	5C4E
Overall Quick Rating:	5C4E	

13. Line 11075:

Table 26: Details for Line_11075

Asset Number	11075
U/S Manhole ID	11080
D/S Manhole ID	11081
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	39 inches
Pipe Length (Field)	190.48 ft

Table 27: PACP Defect Table for Line_11075

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	DAE	S01			10		9	3	Efflorescence	0	2
68	DAE	F01								0	0
68	DAE	S02			30		9	3		0	4
71.96	VC									0	0
108.89	DAE	F02								0	0
108.89	DAE	S03			10		9	3		0	2
190.48	DAE	F03								0	0
190.48	AMH									0	0

	ST	**O&M**
Overall Rating:	0	88
Rating Index:	-	2.38

	ST	**O&M**
Quick Rating:	0000	472E
Overall Quick Rating:	472E	

14. Line 11076:

Table 28: Details for Line_11076

Asset Number	11076
U/S Manhole ID	11081
D/S Manhole ID	15419
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/1/2023
Pipe Diameter	39 inches
Pipe Length (Field)	99.68 ft

Table 29: PACP Defect Table for Line_11076

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						

0	DAE	S01			10		10	3	Efflorescence	0	2
34.11	DAE	F01								0	0
34.11	DAE	S02			20		9	2	Efflorescence	0	3
99.68	DAE	F02								0	0
99.68	VC									0	0
99.68	AMH									0	0

	ST	O&M
Overall Rating:	0	53
Rating Index:	-	2.65

	ST	O&M
Quick Rating:	0000	3A27
Overall Quick Rating:	3A27	

15. Line 15505:

Table 30: Details for Line_15505

Asset Number	15505
U/S Manhole ID	15419
D/S Manhole ID	15420
Inspection Direction	Downstream

Pipe Material	HOBAS GRP
Inspection Date	5/22/2023
Pipe Diameter	42 inches
Pipe Length (Field)	169.34 ft

Table 31: PACP Defect Table for Line_15505

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				50						
65.89	SCP						12			3	0
72.86	SCP						9	12		3	0
77.76	LFDC						11	3		3	0
87.56	SCP	S01					11	1		3	0
157.28	SCP	F01								0	0
169.34	AMH									0	0

	ST	O&M
Overall Rating:	23	0
Rating Index:	1.35	-

	ST	O&M
Quick Rating:	3B00	0000
Overall Quick Rating:	3B00	

16. Line 11189:

Table 32: Details for Line_11189

Asset Number	11189
U/S Manhole ID	15420
D/S Manhole ID	11082
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/22/2023
Pipe Diameter	39 inches
Pipe Length (Field)	89.13 ft

Table 33: PACP Defect Table for Line_11189

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				25						
1.32	SRI	S01					9	3		1	0
1.32	DAE	S02			30		9	3		0	4
13.19	SRI	F01								0	0
89.13	DAE	F02								0	0
89.13	TFA		15				9	10		0	0
89.13	TFA		15				2	3		0	0
89.13	AMH									0	0

	ST	O&M
Overall Rating:	2	72
Rating Index:	1.00	4.00

	ST	O&M
Quick Rating:	1200	4B00
Overall Quick Rating:	4B12	

17. Line 11077:

Table 34: Details for Line_11077

Asset Number	11077
U/S Manhole ID	11082
D/S Manhole ID	12902
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/22/2023
Pipe Diameter	39 inches
Pipe Length (Field)	1175.62 ft

Table 35: PACP Defect Table for Line_11077

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH					0					
0	MWL				20	0					
0.57	DAE	S01			30		9	3		0	4
115.89	VC									0	0
283.59	DAE	F01								0	0
283.59	DAE	S02			20		9	3		0	3
316	DAE	F02								0	0
316	DAE	S03			30		9	3		0	4
352.56	DAE	F03								0	0
352.56	DAE	S04			10		9	3		0	2
379.88	ISSRB				5		9	10		0	2
418.32	DAE	F04								0	0
418.32	DAE	S05			40		9	3		0	5
425.67	DAE	F05								0	0
425.67	DAE	S06			10		9	3		0	2
441.31	DAE	F06								0	0
441.31	DAE	S07			30		9	3		0	4
718.11	DAE	F07								0	0
718.11	DAE	S08			20		9	3		0	3
754.67	DAE	F08								0	0
754.67	DAE	S09			35		9	3		0	5
801.02	DAE	F09								0	0
801.02	DAE	S10			10		9	3		0	2
882.8	DAE	F10								0	0
882.8	DAE	S11			40		9	3		0	5
898.63	DAE	F11								0	0
898.63	DAE	S12			10		9	3		0	2
913.14	DAE	F12								0	0
913.14	DAE	S13			20		9	3		0	3
942.53	DAE	F13								0	0
942.53	DAE	S14			40		9	3		0	5
958.17	DAE	F14								0	0
958.17	DAE	S15			10		9	3		0	2
1050.13	DAE	F15								0	0
1050.13	DAE	S16			20		10	2		0	3

1059.74	DAE	F16								0	0
1059.74	DAE	S17			40		9	3		0	5
1073.11	DAE	F17								0	0
1073.11	DAE	S18			10		9	3		0	2
1175.62	DAE	F18								0	0
1175.62	TFA						2	3		0	0
1175.62	AMH									0	0

	ST	O&M
Overall Rating:	0	790
Rating Index:	-	3.36

	ST	O&M
Quick Rating:	0000	5C4V
Overall Quick Rating:	5C4V	

18. Line 12890:

Table 36: Details for Line_12890

Asset Number	12890	Pipe Material	Concrete
U/S Manhole ID	12902	Inspection Date	5/22/2023
D/S Manhole ID	11083	Pipe Diameter	39 inches
Inspection Direction	Downstream	Pipe Length (Field)	85.36 ft

Table 37: PACP Defect Table for Line_12890

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
2.45	DAE	S01			10		10	3		0	2
15.45	VC									0	0
28.45	DAE	F01								0	0
28.45	DAE	S02			20		9	3		0	3
62.37	DAE	F02								0	0
62.37	DAE	S03			40		9	3		0	5
85.36	DAE	F03								0	0
85.36	TFA		15				2	3		0	0
85.36	TFA		15				9	10		0	0
85.36	AMH									0	0

	ST	O&M
Overall Rating:	0	56
Rating Index:	-	3.29

	ST	O&M
Quick Rating:	0000	5537
Overall Quick Rating:	5537	

19. Line 11078:

Table 38: Details for Line_11078

Asset Number	11078
U/S Manhole ID	11083
D/S Manhole ID	11084
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	305.03 ft

Table 39: PACP Defect Table for Line_11078

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				40						
0	SRI	S01					10	2		1	0
0	DAE	S02			10		9	3		0	2
26.72	DAE	F02								0	0
26.72	SRI	F01									
26.72	DAE	S03			30		9	3		0	4
91.92	DAE	F03								0	0
113.02	DAE	S04			10		9	3		0	2
201.21	DAE	F04								0	0
201.21	DAE	S05			30		9	3		0	4
236.07	DAE	F05								0	0
236.07	DAE	S06			20		11	3		0	3
305.03	DAE	F06								0	0
305.03	AMH									0	0

	ST	O&M
Overall Rating:	5	168
Rating Index:	1.00	2.95

	ST	O&M
Quick Rating:	1500	4C3A
Overall Quick Rating:	4C3A	

20. Line 11079:

Table 40: Details for Line_11079

Asset Number	11079
U/S Manhole ID	11084

Pipe Material	Concrete
Inspection Date	5/11/2023

D/S Manhole ID	11085
Inspection Direction	Downstream

Pipe Diameter	39 inches
Pipe Length (Field)	313.36 ft

Table 41: PACP Defect Table for Line_11079

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
2.26	DAE	S01			10		10	3	Efflorescence	0	2
47.11	DAE	F01								0	0
47.11	DAE	S02			20		10	3	Efflorescence	0	3
313.36	DAE	F02								0	0
313.36	AMH									0	0

	ST	O&M
Overall Rating:	0	177
Rating Index:	-	2.85

	ST	O&M
Quick Rating:	0000	3I29
Overall Quick Rating:	3I29	

21. Line 11080:

Table 42: Details for Line_11080

Asset Number	11080
U/S Manhole ID	11085
D/S Manhole ID	12373
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	136.99 ft

Table 43: PACP Defect Table for Line_11080

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	DAE	S01			20		11	3	Efflorescence	0	3
55.4	DAE	F01								0	0

55.4	DAE	S02			30		10	2	Efflorescence	0	4
94.22	DAE	F02								0	0
94.22	DAE	S03			20		10	3	Efflorescence	0	3
136.99	DAE	F03								0	0
136.99	AMH									0	0

	ST	O&M
Overall Rating:	0	92
Rating Index:	-	3.29

	ST	O&M
Quick Rating:	0000	483C
Overall Quick Rating:	483C	

22. Line 11306:

Table 44: Details for Line_11306

Asset Number	11306
U/S Manhole ID	12373
D/S Manhole ID	11086
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	136.24 ft

Table 45: PACP Defect Table for Line_11306

Dist. (ft.)	Code Group/ Description	Continuous defect	value: Dimension 1st	value: Dimension 2nd	value: %	Joint	Circumferential At/ From	Circumferential To	Remarks	Defect Rating Str	Defect Rating O&M
0	AMH										
0	MWL				20						
0	DAE	S01			10		11	3	Efflorescence	0	2
44.28	DAE	F01								0	0
44.28	DAE	S02			20		10	3	Efflorescence	0	3
87.43	DAE	F02								0	0
87.43	DAE	S03			10		11	3	Efflorescence	0	2
136.24	DAE	F03								0	0
136.24	TFC		15				10	11		0	0
136.24	AMH									0	0

	ST	O&M
Overall Rating:	0	65
Rating Index:	-	2.32

	ST	O&M
Quick Rating:	0000	392B
Overall Quick Rating:	392B	

23. Line 11081:

Table 46: Details for Line_11081

Asset Number	11081
U/S Manhole ID	11086
D/S Manhole ID	11087
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	1027.89 ft

Table 47: PACP Defect Table for Line_11081

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	DAE	S01			30		11	3	Efflorescence	0	4
32.98	DAE	F01								0	0
32.98	DAE	S02			10		10	3	Efflorescence	0	2
125.87	DAE	F02								0	0
125.87	DAE	S03			30		10	3	Efflorescence	0	4
154.51	DAE	F03								0	0
154.51	DAE	S04			10		11	3	Efflorescence	0	2
318.82	DAE	F04								0	0
318.82	DAE	S05			20		11	3	Efflorescence	0	3
348.78	DAE	F05								0	0
348.78	DAE	S06			10		9	3	Efflorescence	0	2
940.42	VC									0	0
1027.89	DAE	F06								0	0
1027.89	TBI		15	2	5		9			0	2
1027.89	AMH									0	0

	ST	O&M
Overall Rating:	0	442

	ST	O&M
Quick Rating:	0000	4A36

Rating Index:	-	2.15

Overall Quick Rating:	4A36

24. Line 11082:

Table 48: Details for Line_11082

Asset Number	11082
U/S Manhole ID	11087
D/S Manhole ID	11088
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	41.46 ft

Table 49: PACP Defect Table for Line_11082

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					9	3		1	0
0	DAE	S02			10		12	3	Efflorescence	0	2
41.46	DAE	F02								0	0
41.46	SRI	F01								0	0
41.46	AMH									0	0

	ST	O&M
Overall Rating:	8	16
Rating Index:	1.00	2.00

	ST	O&M
Quick Rating:	1800	2800
Overall Quick Rating:	2818	

25. Line UnknownPipe1:

Table 50: Details for Line UnknownPipe1

Asset Number	UnknownPipe1
U/S Manhole ID	11088
D/S Manhole ID	UnknownMH2

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	No Information

Inspection Direction	Downstream		Pipe Length (Field)	41.08 ft

Table 51: PACP Defect Table for Line_UnknownPipe1

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	TFA		15				9	10		0	0
0	DAE	S01			10		9	3	Efflorescence	0	2
41.08	DAE	F01								0	0
41.08	TFA		15				10			0	0
41.08	VC									0	0
41.08	AMH									0	0

	ST	O&M
Overall Rating:	0	16
Rating Index:	-	2.00

	ST	O&M
Quick Rating:	0000	2800
Overall Quick Rating:	2800	

26. Line 11083:

Table 52: Details for Line_ 11083

Asset Number	11083		Pipe Material	Concrete
U/S Manhole ID	UnknownMH2		Inspection Date	5/11/2023
D/S Manhole ID	11089		Pipe Diameter	39 inches
Inspection Direction	Downstream		Pipe Length (Field)	382.89 ft

Table 53: PACP Defect Table for Line_ 11083

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	TFA		15				10	0		0	0
3.21	SRI	S01					9	3		1	0
5.66	DAE	S02			10		9	12	Efflorescence	0	2
45.79	DAE	F02								0	0

45.79	SRI	F01								0	0
45.79	DAE	S03			30		9	3	Efflorescence	0	4
129.64	DAE	F03								0	0
129.64	DAE	S04			35		9	3	Efflorescence	0	5
297.91	DAE	F04								0	0
297.91	DAE	S05			10		9	3	Efflorescence	0	2
382.89	DAE	F05								0	0
382.89	AMH									0	0

	ST	**O&M**
Overall Rating:	9	288
Rating Index:	1.00	3.79

	ST	**O&M**
Quick Rating:	1900	5E4B
Overall Quick Rating:	5E4B	

27. Line 11084:

Table 54: Details for Line_ 11084

Asset Number	11084
U/S Manhole ID	11089
D/S Manhole ID	11090
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	758.52 ft

Table 55: PACP Defect Table for Line_ 11084

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				10						

0	SRI	S01					9	3		1	0
14.85	DAE	S02			10		11	3		0	2
74.89	SRI	F01								0	0
86.01	DAE	F02								0	0
86.01	DAE	S03			20		10	3		0	3
308.17	DAE	F03								0	0
308.17	DAE	S04			10		10	1		0	2
432.72	DAE	F04								0	0
432.72	DAE	S05			20		9	3		0	3
681.26	LD				10					0	1
681.26	OBI				5	J	9			0	5
681.26	SRI	S06					9	3		1	0
730.44	SRI	F06								0	0
758.52	DEA	F05								0	0
758.52	TFA		15				10	11		0	0
758.52	TFA		15				2	3		0	0
758.52	AMH									0	0

	ST	O&M
Overall Rating:	25	414
Rating Index:	1.00	2.74

	ST	O&M
Quick Rating:	1D00	513U
Overall Quick Rating:	513U	

28. Line 11085:

Table 56: Details for Line_ 11085

Asset Number	11085
U/S Manhole ID	11090
D/S Manhole ID	11091
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	674.96 ft

Table 57: PACP Defect Table for Line_ 11085

Dist. (ft.)	Code Group/ Description	Continuous defect	value: Dimension 1st	value: Dimension 2nd	value: %	Joint	Circumferential At/ From	Circumferential To	Remarks	Defect Rating Str	Defect Rating O&M
0	AMH										
0	MWL				10						
0	DAE	S01			20		10	2	Efflorescence	0	3
663.84	DAE	F01								0	0
663.84	DAE	S02			10		10	2		0	2

674.96	DAE	F02								0	0
674.96	TFA		15				1	2		0	0
674.96	AMH									0	0

	ST	O&M
Overall Rating:	0	403
Rating Index:	-	2.99

	ST	O&M
Quick Rating:	0000	3Y22
Overall Quick Rating:	3Y22	

29. Line 11086:

Table 58: Details for Line_ 11086

Asset Number	11086
U/S Manhole ID	11091
D/S Manhole ID	14776
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	456.75 ft

Table 59: PACP Defect Table for Line_ 11086

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
2.45	SRI	S01					9	3		1	0
2.45	DAE	S02			10		9	3	Efflorescence	0	2
69.72	DAE	F02								0	0
69.72	DAE	S03			20		9	3	Efflorescence	0	3
277.56	SRV						9	11		4	0
332.39	DAE	F03								0	0
339.93	DAE	S04			20		9	3	Efflorescence	0	3

433.39	TBI		8	4	10		1				0	2
456.75	DAE	F04									0	0
456.75	SRI	F01									0	0
456.75	AMH										0	0

	ST	O&M
Overall Rating:	95	256
Rating Index:	1.03	2.84

	ST	O&M
Quick Rating:	411Q	3N2A
Overall Quick Rating:	413N	

30. Line 14793:

Table 60: Details for Line_ 14793

Asset Number	14793
U/S Manhole ID	14776
D/S Manhole ID	11092
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	39 inches
Pipe Length (Field)	262.86 ft

Table 61: PACP Defect Table for Line_ 14793

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SSC						12			1	0
0	DAE				20		9	3		0	3
16.96	DAE	S01			30		9	3		0	4
183.35	DAE	F01								0	0
191.45	DAE	S02			20		9	3		0	3
262.86	DAE	F02								0	0
262.86	TFA		15				8	9		0	0
262.86	TFA		15				1	2		0	0
262.86	AMH									0	0

	ST	O&M
Overall Rating:	1	177

	ST	O&M
Quick Rating:	1100	4E3B

Rating Index:	1.00	3.69

Overall Quick Rating:	4E3B

31. Line 11087:

Table 62: Details for Line_ 11087

Asset Number	11087
U/S Manhole ID	11092
D/S Manhole ID	11093
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	42 inches
Pipe Length (Field)	107.03 ft

Table 63: PACP Defect Table for Line_ 11087

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					10	3		1	0
0	DAE	S02			10		10	2		0	2
53.32	DAE	F02								0	0
53.32	SRI	F01								0	0
53.32	DAE	S03			30		9	3		0	4
61.24	DAE	F03								0	0
61.24	DAE	S04			10		9	3		0	2
107.03	DAE	F04								0	0
107.03	AMH									0	0

	ST	O&M
Overall Rating:	11	48
Rating Index:	1.00	2.18

	ST	O&M
Quick Rating:	1A00	422C
Overall Quick Rating:	422C	

32. Line 11088:

Table 64: Details for Line_ 11088

Asset Number	11088
U/S Manhole ID	11093
D/S Manhole ID	11094
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/15/2023
Pipe Diameter	42 inches
Pipe Length (Field)	875.53 ft

Table 65: PACP Defect Table for Line_ 11088

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					9	3		1	0
0	DAE	S02			10		9	3		0	2
99.95	DAE	F02								0	0
99.95	SRI	F01								0	0
99.95	DAE	S03			20		9	3		0	3
214.14	DAE	F03								0	0
214.14	DAE	S04			10		9	2		0	2
271.8	DAE	F04								0	0
271.8	DAE	S05			40		9	3		0	5
279.15	DAE	F05								0	0
279.15	DAE	S06			10		9	3		0	2
563.49	DAE	F06								0	0
563.49	DAE	S07			40		9	3		0	5
572.35	DAE	F07								0	0
572.35	DAE	S08			10		9	3		0	2
857.63	DAE	F08								0	0
857.63	DAE	S09			40		9	3		0	5
865.74	DAE	F09								0	0
865.74	DAE	S10			10		9	3		0	2
874.78	DAE	F10								0	0
874.78	DAGS				10		3			0	2
875.53	AMH									0	0

	ST	O&M
Overall Rating:	20	390
Rating Index:	1.00	2.22

	ST	O&M
Quick Rating:	1C00	553C
Overall Quick Rating:	553C	

33. Line 11089:

Table 66: Details for Line_ 11089

Asset Number	11089
U/S Manhole ID	11094
D/S Manhole ID	11095
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/15/2023
Pipe Diameter	42 inches
Pipe Length (Field)	260.41 ft

Table 67: PACP Defect Table for Line_ 11089

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	DAE	S01			20		9	3	Efflorescence	0	3
84.61	SRV						2	3		4	0
142.27	DAE	F01								0	0
142.27	DAE				10		10			0	2
147.92	LFCS	S02					8	4		3	0
183.72	VC									0	0
210.48	LFCS	F02								0	0
210.48	VC									0	0
237.24	DAE	S03			10		9	3		0	2
260.41	DAE	F03								0	0
260.41	TFA		15				2	3		0	0
260.41	AMH									0	0

	ST	**O&M**
Overall Rating:	43	96
Rating Index:	3.07	2.82

	ST	**O&M**
Quick Rating:	413A	3D26
Overall Quick Rating:	413G	

34. Line 11090:

Table 68: Details for Line_ 11090

Asset Number	11090
U/S Manhole ID	11095
D/S Manhole ID	11096
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/15/2023
Pipe Diameter	42 inches
Pipe Length (Field)	710.01 ft

Table 69: PACP Defect Table for Line_ 11090

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					10	3		1	0
25.44	DAE	S02			10		11	2		0	2

230.26	DAE	F02								0	0
230.26	SRI	F01								0	0
230.26	DAE	S03			30		9	3		0	4
585.64	DAE	F03								0	0
585.64	DAE	S04			40		9	3		0	5
710.01	DAE	F04								0	0
710.01	AMH									0	0

	ST	O&M
Overall Rating:	46	491
Rating Index:	1.00	3.58

	ST	O&M
Quick Rating:	1H00	5D4M
Overall Quick Rating:	5D4M	

35. Line 11091:

Table 70: Details for Line_ 11091

Asset Number	11091
U/S Manhole ID	11096
D/S Manhole ID	12919
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	42 inches
Pipe Length (Field)	452.74 ft

Table 71: PACP Defect Table for Line_ 11091

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					10	3		1	0
7.45	DAE	S02			10		11	3		0	2
29.71	DAE	F02								0	0
29.71	DAE	S03			30		9	3		0	4
308.4	DAE	F03								0	0
308.4	SRI	F01								0	0
308.4	DAE	S04			20		9	2		0	3
452.74	DAE	F04								0	0
452.74	TFA		15				12	1		0	0
452.74	AMH									0	0

	ST	O&M
Overall Rating:	62	319
Rating Index:	1.00	3.58

	ST	O&M
Quick Rating:	1K00	4J3D
Overall Quick Rating:	4J3D	

36. Line 12907:

Table 72: Details for Line_ 12907

Asset Number	12907		Pipe Material	Concrete
U/S Manhole ID	12919		Inspection Date	5/11/2023
D/S Manhole ID	11097		Pipe Diameter	42 inches
Inspection Direction	Downstream		Pipe Length (Field)	241.95 ft

Table 73: PACP Defect Table for Line_ 12907

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					9	3		1	0
0	DAE	S02			20		9	3		0	3
43.15	DAE	F02								0	0
43.15	DAE	S03			10		9	12		0	2
241.95	DAE	F03								0	0
241.95	SRI	F01								0	0
241.95	AMH									0	0

	ST	O&M
Overall Rating:	48	107
Rating Index:	1.00	2.18

	ST	O&M
Quick Rating:	1H00	392G
Overall Quick Rating:	392G	

37. Line 11092:

Table 74: Details for Line_ 11092

Asset Number	11092		Pipe Material	Concrete
U/S Manhole ID	11097		Inspection Date	5/11/2023
D/S Manhole ID	11098		Pipe Diameter	42 inches
Inspection Direction	Downstream		Pipe Length (Field)	183.72 ft

Table 75: PACP Defect Table for Line_ 11092

Dist. (ft.)	Code Group/	Continuous defect	value		Joint	Circumferential	Remarks	Defect Rating	
			Dimension	%				Str	O&M

	Description		1st	2nd			At/ From	To			
0	AMH										
0	MWL				20						
1.51	SRI						12			1	0
3.77	DAE	S01			30		9	3		0	4
158.47	SRV						9	10		4	0
183.72	DAE	F01								0	0
183.72	VC									0	0
183.72	AMH									0	0

	ST	O&M
Overall Rating:	5	144
Rating Index:	2.50	4.00

	ST	O&M
Quick Rating:	4111	4F00
Overall Quick Rating:	4F11	

38. Line 11093:

Table 76: Details for Line_ 11093

Asset Number	11093
U/S Manhole ID	11098
D/S Manhole ID	11099
Inspection Direction	Downstream

Pipe Material	Concrete
Inspection Date	5/11/2023
Pipe Diameter	42 inches
Pipe Length (Field)	829.66 ft

Table 77: PACP Defect Table for Line_ 11092

Dist. (ft.)	Code Group/ Description	Continuous defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SRI	S01					9	3		1	0
0	DAE	S02			35		9	3		0	5
241.38	DAE	F02								0	0
241.38	DAE	S03			20		9	3		0	3
413.04	DAE	F03								0	0
413.04	DAE	S04			35		9	3		0	5
594.12	DAE	F04								0	0
594.12	DAE	S05			10		9	3		0	2
714.15	DAE	F05								0	0
790.46	DAE	S06			10		9	3		0	2
806.1	VC									0	0

829.66	DAE	F06								0	0
829.66	SRI	F01								0	0
829.66	AMH									0	0

	ST	O&M
Overall Rating:	166	586
Rating Index:	1.00	3.91

	ST	O&M
Quick Rating:	1Z00	5O3E
Overall Quick Rating:	5O3E	

Appendix B

1. Line 9502

Table 78 Details for line 9502

Line record no.:	9502		Pipe Material	RCP

US MH ID:	2780T
DS MH ID:	2760T
Inspection Direction	Downstream

Inspection Date	12/09/2022
Pipe Diameter	54
Inspected Length	1165.25 ft.

Table 79 PACP defect table for line 9502

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	SZ						8	4	Efflorescence		
0	MGO		0.46	0					Max Corrosion 0.46 in. & Debris Ht. 0 in.		
5.09	SRC						1	4	Corroded steel patches	5	
10	MGO		0.59	0					Max Corrosion 0.59 in. & Debris Ht. 0 in.		
20	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
30	MGO		0.65	0					Max Corrosion 0.65 in. & Debris Ht. 0 in.		
33.17	SRC	S01					10	12	Corroded steel patches	5	
40	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
41.08	SRC	F01								5	
48.05	SRC						2	4		5	
50	MGO		0.57	0					Max Corrosion 0.57 in. & Debris Ht. 0 in.		
59.17	SRC						10	1		5	

60	MGO		0.59	0					Max Corrosion 0.59 in. & Debris Ht. 0 in.		
70	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
80	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
82.35	SRC						12	1		5	
90	MGO		0.46	0					Max Corrosion 0.46 in. & Debris Ht. 0 in.		
100	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
110	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
112.68	SRC						2	4		5	
120	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
122.1	SRC						9	11		5	
130	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		
139.25	SRC						12			5	
140	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
150	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
160	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
170	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
180	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		

190	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
191.82	SRC						2	4		5	
200	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
210	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
220	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
230	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
240	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
250	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
260	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
270	MGO		0.62	0					Max Corrosion 0.62 in. & Debris Ht. 0 in.		
271.34	SRC						2	4		5	
280	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
289.43	SRC	S02					12	2		5	
290	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
296.97	SRC	F02								5	
300	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
310	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		

315.81	SRC						1	4		5	
320	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
330	MGO		0.52	0					Max Corrosion 0.52 in. & Debris Ht. 0 in.		
340	MGO		0.5	0					Max Corrosion 0.5 in. & Debris Ht. 0 in.		
350	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
360	MGO		0.55	0					Max Corrosion 0.55 in. & Debris Ht. 0 in.		
370	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
380	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
380.63	SRC						9	12		5	
390	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		
400	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
410	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
420	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
425.48	SRC						8	11		5	
430	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
440	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		

450	MGO		0.63	0					Max Corrosion 0.63 in. & Debris Ht. 0 in.		
460	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
470	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
480	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
481.63	SRC						12			5	
487.47	SRC	S03					12	4		5	
490	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
492.18	SRC	F03								5	
497.83	SRP	S04					10	4		5	
500	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
510	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
515.36	SRP	F04								5	
520	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
530	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
533.64	SRC						12			5	
540	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
550	MGO		0.62	0					Max Corrosion 0.62 in. & Debris Ht. 0 in.		
550.41	SRC						8	11		5	
560	MGO		0.59	0					Max Corrosion 0.59 in. & Debris Ht. 0 in.		

570	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
580	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		
590	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
600	MGO		0.47	0					Max Corrosion 0.47 in. & Debris Ht. 0 in.		
610	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
610.89	SRC						10	4		5	
620	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
630	MGO		0.51	0					Max Corrosion 0.51 in. & Debris Ht. 0 in.		
640	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
650	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
660	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
670	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
680	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
690	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
691.16	SRC						9	1		5	

700	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
700.77	SRC	S05					12	2		5	
710	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
711.14	SRC	F05								5	
720	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
730	MGO		0.35	0					Max Corrosion 0.35 in. & Debris Ht. 0 in.		
740	MGO		0.57	0					Max Corrosion 0.57 in. & Debris Ht. 0 in.		
750	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
755.04	SRC						12	3		5	
760	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
770	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
780	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
790	MGO		0.61	0					Max Corrosion 0.61 in. & Debris Ht. 0 in.		
800	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
810	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
820	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		

830	MGO		0.65	0					Max Corrosion 0.65 in. & Debris Ht. 0 in.		
840	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		
850	MGO		0.51	0					Max Corrosion 0.51 in. & Debris Ht. 0 in.		
860	MGO		0.41	0					Max Corrosion 0.41 in. & Debris Ht. 0 in.		
870	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
880	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
890	MGO		0.19	0					Max Corrosion 0.19 in. & Debris Ht. 0 in.		
900	MGO		0.67	0					Max Corrosion 0.67 in. & Debris Ht. 0 in.		
910	MGO		0.51	0					Max Corrosion 0.51 in. & Debris Ht. 0 in.		
920	MGO		0.53	0					Max Corrosion 0.53 in. & Debris Ht. 0 in.		
925.95	SRV						12			4	
930	MGO		0.53	0					Max Corrosion 0.53 in. & Debris Ht. 0 in.		
940	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		
950	MGO		0.39	0					Max Corrosion 0.39 in. & Debris Ht. 0 in.		
960	MGO		0.27	0					Max Corrosion 0.27 in. & Debris Ht. 0 in.		

970	MGO		0.41	0					Max Corrosion 0.41 in. & Debris Ht. 0 in.		
980	MGO		0.51	0					Max Corrosion 0.51 in. & Debris Ht. 0 in.		
990	MGO		0.37	0					Max Corrosion 0.37 in. & Debris Ht. 0 in.		
1000	MGO		0.57	0					Max Corrosion 0.57 in. & Debris Ht. 0 in.		
1010	MGO		0.22	0					Max Corrosion 0.22 in. & Debris Ht. 0 in.		
1020	MGO		0.35	0					Max Corrosion 0.35 in. & Debris Ht. 0 in.		0
1030	MGO		0.28	0					Max Corrosion 0.28 in. & Debris Ht. 0 in.		
1040	MGO		0.27	0					Max Corrosion 0.27 in. & Debris Ht. 0 in.		
1050	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
1052.9	SRC						12			5	
1060	MGO		0.34	0					Max Corrosion 0.34 in. & Debris Ht. 0 in.		
1070	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
1080	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
1090	MGO		0.38	0					Max Corrosion 0.38 in. & Debris Ht. 0 in.		
1100	MGO		0.22	0					Max Corrosion 0.22 in. & Debris Ht. 0 in.		

1110	MGO		0.33	0					Max Corrosion 0.33 in. & Debris Ht. 0 in.		
1120	MGO		0.22	0					Max Corrosion 0.22 in. & Debris Ht. 0 in.		
1130	MGO		0.51	7.28					Max Corrosion 0.51 in. & Debris Ht. 7.28 in.		
1140	MGO		0	3.72					Max Corrosion 0 in. & Debris Ht. 3.72 in.		
1150	MGO		0.35	1.11					Max Corrosion 0.35 in. & Debris Ht. 1.11 in.		
1160	MGO		0.09	2.02					Max Corrosion 0.09 in. & Debris Ht. 2.02 in.		
1164.3	SRC						10	2		5	
1165.2	MSA								Reached end of the line		

2. Line 9612

Table 80 Details for line 9612

Line record no.:	9612		Pipe Material	RCP
US MH ID:	40T		Inspection Date	01/20/2023
DS MH ID:	2760T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	1313 ft.

Table 81 PACP defect table for line 9612

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							

0	AMH	0										
0	MWL				20							
0	MWM	S01			90							
0	SRI	S02					8	4			1	
0	MGO		1.49	0						Max Corrosion 1.49 in. & Debris Ht. 0 in.	1	
3.23	SRC						12				5	
10	MGO		0.61	0						Max Corrosion 0.61 in. & Debris Ht. 0 in.	1	
10.27	MWM	F01									1	
20	MGO		0.37	0						Max Corrosion 0.37 in. & Debris Ht. 0 in.	1	
21.11	SSC	S03					12				1	
30	MGO		0.51	0						Max Corrosion 0.51 in. & Debris Ht. 0 in.	1	
35.95	SRC						12				5	
40	MGO		0.69	0						Max Corrosion 0.69 in. & Debris Ht. 0 in.	1	
43.55	SRC						12				5	
48.87	SRC						12				5	
50	MGO		0.63	0						Max Corrosion 0.63 in. & Debris Ht. 0 in.	1	
60	MGO		0.48	0						Max Corrosion 0.48 in. & Debris Ht. 0 in.	1	
70	MGO		0.6	0						Max Corrosion 0.6 in. & Debris Ht. 0 in.	1	
80	MGO		0.85	0						Max Corrosion 0.85 in. & Debris Ht. 0 in.	1	
90	MGO		0.81	0						Max Corrosion 0.81 in. & Debris Ht. 0 in.	1	
91.26	SRC						12				5	

100	MGO		0.61	0					Max Corrosion 0.61 in. & Debris Ht. 0 in.	1	
110	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.	1	
113.49	SRC						12			5	
120	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.	1	
124.13	SRC						12			5	
130	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.	1	
140	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.	1	
150	MGO		0.38	0					Max Corrosion 0.38 in. & Debris Ht. 0 in.	1	
160	MGO		0.38	0					Max Corrosion 0.38 in. & Debris Ht. 0 in.	1	
170	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.	1	
180	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
190	MGO		0.61	0					Max Corrosion 0.61 in. & Debris Ht. 0 in.		
200	MGO		0.47	0					Max Corrosion 0.47 in. & Debris Ht. 0 in.		
210	MGO		0.65	0					Max Corrosion 0.65 in. & Debris Ht. 0 in.		
220	MGO		0.41	0					Max Corrosion 0.41 in. & Debris Ht. 0 in.		
227.52	SRC	S04					8	12		5	

230	MGO		0.63	0					Max Corrosion 0.63 in. & Debris Ht. 0 in.		
233.98	SRC	F04								5	
240	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
250	MGO		0.65	0					Max Corrosion 0.65 in. & Debris Ht. 0 in.		
260	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
266.31	SRC						8	12		5	
270	MGO		0.37	0					Max Corrosion 0.37 in. & Debris Ht. 0 in.		
272.39	SRC						10	11		5	
280	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
290	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
300	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
300.92	SRC						12			5	
310	MGO		0.62	0					Max Corrosion 0.62 in. & Debris Ht. 0 in.		
320	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
330	MGO		0.59	0					Max Corrosion 0.59 in. & Debris Ht. 0 in.		
340	MGO		0.32	0					Max Corrosion 0.32 in. & Debris Ht. 0 in.		
341.83	SRC						11	1		5	

350	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
354.75	SRC						10	1		5	
360	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
370	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
380	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
390	MGO		0.39	0					Max Corrosion 0.39 in. & Debris Ht. 0 in.		
395.02	SRC						12			5	
400	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
402.62	SRC						12			5	
410	MGO		0.57	0					Max Corrosion 0.57 in. & Debris Ht. 0 in.		
420	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
430	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		
440	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		
444.22	SRC						12			5	
450	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
460	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
470	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		

480	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
483.36	SRC						12			5	
490	MGO		0.45	0					Max Corrosion 0.45 in. & Debris Ht. 0 in.		
500	MGO		0.27	0					Max Corrosion 0.27 in. & Debris Ht. 0 in.		
510	MGO		0.36	0					Max Corrosion 0.36 in. & Debris Ht. 0 in.		
520	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
530	MGO		0.42	0					Max Corrosion 0.42 in. & Debris Ht. 0 in.		
538.1	SRC						12			5	
540	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
550	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
554.07	SRC	S05					12			5	
558.82	SRC	F05								5	
560	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
570	MGO		0.46	0					Max Corrosion 0.46 in. & Debris Ht. 0 in.		
580	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
590	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
600	MGO		0.43	0					Max Corrosion 0.43 in. & Debris Ht. 0 in.		

610	MGO		0.39	0					Max Corrosion 0.39 in. & Debris Ht. 0 in.		
620	MGO		0.3	0					Max Corrosion 0.3 in. & Debris Ht. 0 in.		
623.49	SRC						12			5	
630	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
638.7	SRC						12			5	
640	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
650	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
660	MGO		0.38	0					Max Corrosion 0.38 in. & Debris Ht. 0 in.		
665.13	SRC						12			5	
670	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
680	MGO		0.35	0					Max Corrosion 0.35 in. & Debris Ht. 0 in.		
690	MGO		0.55	0					Max Corrosion 0.55 in. & Debris Ht. 0 in.		
691.37	SRC						12			5	
700	MGO		0.3	0					Max Corrosion 0.3 in. & Debris Ht. 0 in.		
710	MGO		0.37	0					Max Corrosion 0.37 in. & Debris Ht. 0 in.		
713.62	SRC						12			5	
720	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
726.18	SRC						12			5	

730	MGO		0.29	0					Max Corrosion 0.29 in. & Debris Ht. 0 in.		
732.07	SRC						12			5	
740	MGO		0.24	0					Max Corrosion 0.24 in. & Debris Ht. 0 in.		
750	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
760	MGO		0.17	0					Max Corrosion 0.17 in. & Debris Ht. 0 in.		
770	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
777.5	SRC						12			5	
780	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
790	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
791.18	SRC						12			5	
800	MGO		0.48	0					Max Corrosion 0.48 in. & Debris Ht. 0 in.		
810	MGO		0.38	0					Max Corrosion 0.38 in. & Debris Ht. 0 in.		
829.78	SRC						12			5	
830	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
840	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
846.89	SRC						12			5	
850	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		

860	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
870	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
880	MGO		0.35	0					Max Corrosion 0.35 in. & Debris Ht. 0 in.		
890	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
900	MGO		0.34	1.12					Max Corrosion 0.34 in. & Debris Ht. 1.12 in.		
910	MGO		0.23	0					Max Corrosion 0.23 in. & Debris Ht. 0 in.		
920	MGO		0.27	2.49					Max Corrosion 0.27 in. & Debris Ht. 2.49 in.		
930	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
940	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
950	MGO		0.18	0					Max Corrosion 0.18 in. & Debris Ht. 0 in.		
960	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
970	MGO		0.48	0					Max Corrosion 0.48 in. & Debris Ht. 0 in.		
978.98	SRC						12			5	
980	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
982.02	SRC									5	

990	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1000	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
1010	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1010.1	SRC	S06					12	1		5	
1019.0	SRC	F06								5	
1020	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
1030	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1040	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1050	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1060	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
1067.1	SRP	S07					11	1		5	
1070	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
1075.9	SRP	F07								5	
1080	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1083.9	SRC						12			5	
1087.8	SRP						12			5	
1090	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
1100	MGO		0.42	0					Max Corrosion 0.42 in. & Debris Ht. 0 in.		

1110	MGO		0.42	0					Max Corrosion 0.42 in. & Debris Ht. 0 in.		
1120	MGO		0.32	0					Max Corrosion 0.32 in. & Debris Ht. 0 in.		
1130	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
1140	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
1150	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1160	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
1170	MGO		0.24	0					Max Corrosion 0.24 in. & Debris Ht. 0 in.		
1180	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
1272.8	SSC	F03								1	
1272.8	SRI	F02								1	
1272.8	AMH										

3. Line 9503

Table 82 Details for line 9503

Line record no.:	9503		Pipe Material	RCP
US MH ID:	2800T		Inspection Date	12/09/2022
DS MH ID:	2780T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	997.55

Table 83 PACP defect table for line 9503

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	MWM	S01					11	1			
0	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
10	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
20	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
30	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
40	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
50	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
60	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
70	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
74.99	SRC						8	11		5	
79.7	SRC	S02					8	12		5	
80	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
88.75	SRC	F02								5	
90	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		

100	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
110	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
114	SRV						8	9		4	
120	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
126.43	SRC	S03					8	3		5	
130	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
140	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
150	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
151.68	SRC	F03								5	
160	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
168.08	SRC						8			5	
170	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
176.75	SRC						8	11		5	
180	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
188.99	SRP	S04					12	4		5	
190	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
195.4	SRP	F04								5	
200	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
210	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		

213.3	SRP						9	3		5	
220	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
226.3	SRC	S05					12	4		5	
230	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
233.84	SRC	F05								5	
236.48	SRP	S06					8	12		5	
240	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
248.16	SRP	F06								5	
250	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
253.25	SRC	S07					12	4		5	
258.9	SRC	F07								5	
260	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
267	SRC						12	2		5	
270	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
273.41	SRC	S08					8	1		5	
280	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
281.89	SRC	F08								5	
283.4	SRC	S09					12	3		5	
290	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
291.5	SRC	F09								5	
300	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
310	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
317.5	SRC						4			5	

320	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
330	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
332.39	SRV						1	3		4	
338.23	SRC						11	12		5	
340	MGO		0.65	0					Max Corrosion 0.65 in. & Debris Ht. 0 in.		
350	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
355.38	SRV						10	12		4	
360	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
370	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
380	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
389.11	SRC						12	4		5	
390	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
400	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
410	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
420	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
430	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
436.03	SRC						8	9		5	

440	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
450	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
460	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
470	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
480	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
490	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
496.32	SRC						12	4		5	
500	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
504.99	SRC	S10					2	4		5	
510	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
513.09	SRC	F10								5	
519.69	SRC	S11					8	11		5	
520	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
527.23	SRC	F11								5	
530	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
540	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
544	SRC	S12					12	4		5	
550	MGO		0.53	0					Max Corrosion 0.53 in. & Debris Ht. 0 in.		
553.23	SRC	F12								5	

560	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
570	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
580	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
590	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
595.06	SRC						9			5	
600	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
607.12	SRC						12	2		5	
610	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
620	MGO		0.45	0					Max Corrosion 0.45 in. & Debris Ht. 0 in.		
621.82	SRC						2	4		5	
630	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
635.38	SRC						3	4		5	
640	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
650	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
654.6	SRC	S13					12	4		5	
660	MGO		0.48	0					Max Corrosion 0.48 in. & Debris Ht. 0 in.		
661.39	SRC	F13								5	
667.61	SRC						12	3		5	
670	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		

680	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
690	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
690.22	SRC	S14					12	4		5	
697.57	SRC	F14								5	
700	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
710	MGO		0.53	0					Max Corrosion 0.53 in. & Debris Ht. 0 in.		
718.48	SRC						12	4		5	
720	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
727.9	SRC						9	11		5	
730	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
740	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
750	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
752.21	SRC						12	4		5	
760	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
767.29	SRC						12	4		5	
770	MGO		0.63	0					Max Corrosion 0.63 in. & Debris Ht. 0 in.		
780	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
790	MGO		0.61	0					Max Corrosion 0.61 in. & Debris Ht. 0 in.		

800	MGO		0.67	0					Max Corrosion 0.67 in. & Debris Ht. 0 in.		
810	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
820	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
830	MGO		0.51	0					Max Corrosion 0.51 in. & Debris Ht. 0 in.		
840	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
850	MGO		0.59	0					Max Corrosion 0.59 in. & Debris Ht. 0 in.		
853.78	SRC						8	10		5	
860	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
870	MGO		0.63	0					Max Corrosion 0.63 in. & Debris Ht. 0 in.		
876.39	SRC						8	10		5	
880	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
890	MGO		0.68	0					Max Corrosion 0.68 in. & Debris Ht. 0 in.		
896.17	SRC	S15					12	4		5	
900	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
905.59	SRC	F15								5	
910	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
920	MGO		0.57	0					Max Corrosion 0.57 in. & Debris Ht. 0 in.		

930	MGO		0.45	0					Max Corrosion 0.45 in. & Debris Ht. 0 in.		
940	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
950	MGO		0.58	0					Max Corrosion 0.58 in. & Debris Ht. 0 in.		
957.98	SRC	S16					11	4		5	
960	MGO		0.55	0					Max Corrosion 0.55 in. & Debris Ht. 0 in.		
967.59	SRC	F16								5	
970	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
980	MGO		0.52	0					Max Corrosion 0.52 in. & Debris Ht. 0 in.		
990	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
995.29	MWM	F01									
996.79	AMH										

4. Line 9810

Table 84 Details for line 9810

Line record no.:	9810		Pipe Material	RCP
US MH ID:	60T		Inspection Date	01/20/2023
DS MH ID:	40T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	996.42 ft.

Table 85 PACP defect table for line 9810

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%					Str	O&M

			1st	2nd			At/ From	To			
0	AMH										
0	MWL				20						
0	MWM	S01			95						
0	DAE	S02			10		11	1			2
0	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
7.35	SRC						8	10		5	
10	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
10.55	SRC						11	4		5	
18.84	SRC						8	10		5	
20	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
24.68	SRC						8	11		5	
29.58	SRC						8	9		5	
30	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
35.05	SRC						3	4		5	
40	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
50	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
51.63	SRC						12	3		5	
55.02	SRC						8	3		5	
60	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
70	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
71.41	SRC						8	10		5	
80	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		

90	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
93.65	SRC						10	12		5	
100	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
100.81	SRC						9	12		5	
108.53	SRC						11	4		5	
110	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
116.83	SRC						11	4		5	
120	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
130	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
140	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
150	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
150.55	SRC						7	12		5	
160	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
170	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
174.11	SRC						10	2		5	
180	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
181.65	SRC						9	2		5	
184.66	SRC						9	1		5	
190	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		

200	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
200.11	SRC						2	4		5	
210	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
212.17	SRC						7	9		5	
220	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
230	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
240	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
241.19	SRC						10	12		5	
246.28	SRP						8	11		5	
249.67	SRC						11	2		5	
250	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
256.45	SRP						9	2		5	
260	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
270	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
278.69	SRC						9	12		5	
280	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
290	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
300	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
309.78	SRC						9	3		5	

310	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
320	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
329.19	SRC						12	3		5	
330	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
340	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
344.07	SRC						3	5		5	
350	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
359.9	SRV						1	5		4	
360	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
370	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
380	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
390	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
393.06	SRC						11	12		5	
400	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
410	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
420	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
424.16	SRC						7	12		5	

430	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
434.9	SRC	S03					11	1		5	
440	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
441.68	SRC	F03								5	
450	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
450.16	SRV						8	10		4	
460	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
466.93	SRC						8	11		5	
470	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
480	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
487.66	SRC						8	11		5	
490	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
495.95	SRC						8	10		5	
500	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
510	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
517.99	SRC						12			5	
520	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
526.1	SRC						8	10		5	
530	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
533.26	SRV						8	9		4	

540	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
541.36	SRC						12			5	
550	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
560	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
570	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
580	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
590	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
600	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
610	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
620	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
627.09	SRC						10	1		5	
630	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
632.56	SRC						8	12		5	
640	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
650	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
656.3	SRV						8	9		4	
660	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		

670	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
680	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
690	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
695.68	SRC						7	12		5	
700	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
710	MGO		0.72	0					Max Corrosion 0.72 in. & Debris Ht. 0 in.		
720	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
725.83	SRC						9			5	
730	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
737.7	SRC						12			5	
740	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
750	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
760	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
770	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
780	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
790	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
793.29	SRC						12			5	

800	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
809.87	SRC						12			5	
810	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
820	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
830	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
840	MGO		0.69	0					Max Corrosion 0.69 in. & Debris Ht. 0 in.		
850	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
860	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
866.02	SRC						9	11		5	
870	MGO		0.53	0					Max Corrosion 0.53 in. & Debris Ht. 0 in.		
880	MGO		0.56	0					Max Corrosion 0.56 in. & Debris Ht. 0 in.		
886.75	SRC						9	12		5	
890	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
891.27	SRC						12			5	
900	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
910	MGO		0.5	0					Max Corrosion 0.5 in. & Debris Ht. 0 in.		
919.54	SRC						8	12		5	

920	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
930	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
940	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
942.15	SRC						9	10		5	
950	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
960	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
970	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		
980	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
990	MGO		0.54	0					Max Corrosion 0.54 in. & Debris Ht. 0 in.		
996.04	MWM	F01									
996.04	DAE	F02									2
996.04	AMH										

5. Line 9506

Table 86 Details for line 9506

Line record no.:	9506		Pipe Material	RCP
US MH ID:	2820T		Inspection Date	12/09/2022
DS MH ID:	2800T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	1008 ft

Table 87 PACP defect table for line 9506

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				15						
0	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
10	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
12.58	SRC						12	4		5	
18.62	SRV						2	3		4	
20	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
30	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
32.21	SRC						1	4		5	
40	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
50	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
60	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
70	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
80	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
84.97	SRC						12	3		5	
90	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		

100	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
110	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
120	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
130	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
140	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
150	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
160	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
170	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
180	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
181.45	SRC						3	4		5	
190	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
190.87	SRV						2	4		4	
200	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
204.81	SRV						8	10		4	
207.83	SRC						3	4		5	
210	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
220	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		

221.58	SRC						8	10		5	
230	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
240	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
250	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
260	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
262.85	SRC						7	12		5	
270	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
272.84	SRC						1	4		5	
279.24	SRC						8	9		5	
280	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
283.01	SRC						2	4		5	
288.67	SRC						12			5	
290	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
300	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
310	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
310.15	SRC						2	4		5	
320	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
326.54	SRC						12	3		5	
330	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		

340	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
350	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
355.75	SRV						3	4		4	
360	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
370	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
378.17	SRC	S01					2	4		5	
380	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
388.35	SRC	F01								5	
390	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
400	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
405.87	SRC						2	4		5	
410	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
420	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
428.29	SRC						12			5	
430	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
440	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
450	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
459.38	SRC						8	11		5	

460	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
468.62	SRC						1	4		5	
470	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
480	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
488.4	SRC	S02					2	4		5	
490	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
496.32	SRC	F02								5	
500	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
510	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
517.42	SRC						8	9		5	
520	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
525.52	SRP	S03					1	4		5	
530	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
532.12	SRP	F03								5	
536.64	SRC						1	4		5	
540	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
541.16	SRC						12	4		5	
550	MGO		0.79	0					Max Corrosion 0.79 in. & Debris Ht. 0 in.		
560	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		

570	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
580	MGO		0.7	0					Max Corrosion 0.7 in. & Debris Ht. 0 in.		
590	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
600	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
605.04	SRC						3	4		5	
610	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
620	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
630	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
640	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
641.78	SRC						2	4		5	
650	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
660	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
669.67	SRC	S04					8	11		5	
670	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
677.96	SRC	F04								5	
680	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
684.37	SRC						2	4		5	

690	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
694.54	SRC						12	2		5	
700	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
703.59	SRC	S05					8	11		5	
710	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
711.5	SRC	F05								5	
720	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
730	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
733.74	SRC						8	11		5	
740	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
750	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
752.58	SRC	S06					2	4		5	
760	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
763.13	SRC	F06								5	
770	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
780	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
790	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
800	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
801.57	SRC						1			5	

810	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
811.37	SRC						3	4		5	
813.07	SRC	S07					10	12		5	
820	MGO		0.74	0					Max Corrosion 0.74 in. & Debris Ht. 0 in.		
821.17	SRC	F07								5	
830	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
837.37	SRC						12	1		5	
840	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
850	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
860	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
864.89	SRC						12	3		5	
870	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
880	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
885.61	SRC	S08					8	11		5	
890	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
892.4	SRC	F08								5	
895.03	SRC						2	4		5	
900	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
910	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		

920	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
930	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
931.02	SRP	S09					8	4		5	
940	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
950	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
954.2	SRP	F09								5	
960	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
970	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
978.7	SRC						8	4		5	
980	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
990	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
1000	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1009.41	AMH										

6. Line 9846

Table 88 Details for line 9846

Line record no.:	9846		Pipe Material	RCP
US MH ID:	80T		Inspection Date	01/20/2023

DS MH ID:	60T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	1001 ft

Table 89 PACP defect table for line 9846

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		S tr	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
0	MWM	S01					12				
0	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
7.62	SRI	S02					10	2		1	
10	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
20	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
21.66	SRV						9	10		4	
25.41	SRC						8	10		5	
29.15	SRC						12			5	
30	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
40	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
42.26	SRC						8	11		5	
46	SRC						8	3		5	
50	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
59.19	SRC						1	4		5	
60	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
60.89	SZ	S03					11	1		1	

69.56	SRC						8	10		5	
70	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
79.73	SRC						8	10		5	
80	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
86.33	SRC						8	4		5	
90	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
100	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
110	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
120	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
126.08	SRP						8	12		5	
130	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
133.06	SRC						11	5		5	
140	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
142.29	SRC						7	10		5	
150	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
151.52	SRC						7	9		5	
155.86	SRC						12			5	
160	MGO		2.52	0					Max Corrosion 2.52 in. & Debris Ht. 0 in.		
162.07	SRC						8	10		5	
167.92	SRC						8	11		5	
170	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
174.89	SRC						8	10		5	

180	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
190	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
193.73	SRP						8	1		5	
196.93	SRC						2	4		5	
200	MGO		0.75	0					Max Corrosion 0.75 in. & Debris Ht. 0 in.		
208.05	SRC						8	10		5	
210	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
216.91	SRC						8	1		5	
220	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
230	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
240	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
250	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
260	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
262.7	SRC						11	1		5	
270	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
271.93	DAGS	S04					10	2			3
277.21	SRC						2	4		5	
280	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
280.22	SRC						8	10		5	
283.99	SRC						12			5	
290	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		

300	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
303.02	SRC						8	9		5	
310	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
320	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
329.97	SRC						8	10		5	
330	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
337.88	SRC						9	2		5	
340	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
344.85	SRC						8	4		5	
350	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
356.16	SRC						8	9		5	
360	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
370	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
375.38	SRC						8	11		5	
380	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
390	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
399.12	SRP						8	4		5	
400	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
410	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
412.12	SRC						9	3		5	
416.08	DAGS	F04									3
416.08	SZ	F03								1	

420	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
421.36	SRC						12	4		5	
430	MGO		0.77	0					Max Corrosion 0.77 in. & Debris Ht. 0 in.		
432.47	SZ	S05					11	1		1	
440	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
450	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
459.04	SRP						8	10		5	
460	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
470	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
474.12	SRC						9	4		5	
480	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
490	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
496.73	SRP						9	4		5	
500	MGO		0.84	0					Max Corrosion 0.84 in. & Debris Ht. 0 in.		
504.26	SRC						8	12		5	
510	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
519.9	SRC						8	11		5	
520	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
526.69	SRC						8	12		5	
530	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
540	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		

541.95	SRC						9			5	
550	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
560	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
570	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
571.35	SRC					J	8	12		5	
579.82	SRC						9	12		5	
580	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
590	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
595.46	SRC						8	10		5	
600	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
610	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
620	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
625.43	SRC						8	11		5	
630	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
638.24	SRC						11	3		5	
640	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
647.85	SRC						12	4		5	
650	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
660	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
670	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		

680	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
685.72	SRC						8	3		5	
689.49	SRC	S06					8	9		5	
690	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
700	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
710	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
719.83	SRC	F06								5	
720	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
730	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
735.28	SRC						8	9		5	
739.61	SRP						11	4		5	
740	MGO		0.76	0					Max Corrosion 0.76 in. & Debris Ht. 0 in.		
750	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
754.31	SRC						8	4		5	
760	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
762.98	SRC						8	11		5	
770	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
779	SRC						8	11		5	
780	MGO		0.78	0					Max Corrosion 0.78 in. & Debris Ht. 0 in.		
790	MGO		0.83	0					Max Corrosion 0.83 in. & Debris Ht. 0 in.		
800	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		

810	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
820	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
823.28	SRC						10	1		5	
830	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
840	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
846.08	SRC						12	1		5	
850	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
857.95	SRC						10	11		5	
860	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
869.63	SRC						8	12		5	
870	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
880	MGO		0.8	0					Max Corrosion 0.8 in. & Debris Ht. 0 in.		
890	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
900	MGO		0.52	0					Max Corrosion 0.52 in. & Debris Ht. 0 in.		
907.32	SRC						11	12		5	
910	MGO		0.73	0					Max Corrosion 0.73 in. & Debris Ht. 0 in.		
920	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
930	MGO		0.64	0					Max Corrosion 0.64 in. & Debris Ht. 0 in.		

940	MGO		0.82	0					Max Corrosion 0.82 in. & Debris Ht. 0 in.		
950	MGO		0.6	0					Max Corrosion 0.6 in. & Debris Ht. 0 in.		
959.51	SRC						8	2		5	
960	MGO		0.71	0					Max Corrosion 0.71 in. & Debris Ht. 0 in.		
970	MGO		0.61	0					Max Corrosion 0.61 in. & Debris Ht. 0 in.		
980	MGO		0.66	0					Max Corrosion 0.66 in. & Debris Ht. 0 in.		
983.82	SRC						9	12		5	
990	MGO		0.62	0					Max Corrosion 0.62 in. & Debris Ht. 0 in.		
990.04	SRC						8	12		5	
997.76	SRC						11	1		5	
1000	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
1001.5	SZ	F05								1	
1001.5	SRI	F02								1	
1001.5	MWM	F01									
1001.5	AMH										

7. Line 9507

Table 90 Details for line 9507

Line record no.:	9507		Pipe Material	RCP
US MH ID:	2840T		Inspection Date	12/02/2022
DS MH ID:	2820T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	1980 ft

Table 91 PACP defect table for line 9507

Dist. (ft.)	Code Group	Cont. defect	value	Joi nt	Circumfere ntial	Remarks	Defect Rating

			Dimension		%					Str	O&M
			1st	2nd			At/ From	To			
0	AMH										
0	MWL				20						
0	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
0	SRP	S01					7	5		5	
10	MGO		1.57	0					Max Corrosion 1.57 in. & Debris Ht. 0 in.		
20	MGO		1.78	0					Max Corrosion 1.78 in. & Debris Ht. 0 in.		
30	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
40	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
50	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
60	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
70	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
80	MGO		1.79	0					Max Corrosion 1.79 in. & Debris Ht. 0 in.		
87.56	SRP	F01								5	
89.44	SRP						7	11		5	
90	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
100	MGO		1.66	0					Max Corrosion 1.66 in. & Debris Ht. 0 in.		
100.19	SRP	S02					7	5		5	

110	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		
120	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
130	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
135.05	SRP	F02								5	
136.36	SRP						12	4		5	
140	MGO		1.66	0					Max Corrosion 1.66 in. & Debris Ht. 0 in.		
147.1	SRP						12	4		5	
150	MGO		1.66	0					Max Corrosion 1.66 in. & Debris Ht. 0 in.		
156.53	SRV	S03					2	4		4	
160	MGO		1.8	0					Max Corrosion 1.8 in. & Debris Ht. 0 in.		
170	MGO		1.64	0					Max Corrosion 1.64 in. & Debris Ht. 0 in.		
170.09	SRP	S04					12	4		5	
180	MGO		1.75	0					Max Corrosion 1.75 in. & Debris Ht. 0 in.		
182.34	SRP	F04								5	
183.85	SRP	S05					8	12		5	
190	MGO		1.68	0					Max Corrosion 1.68 in. & Debris Ht. 0 in.		
193.08	SRP	F05								5	
193.84	SRV						8	4		4	
199.11	SRV	F03								4	
200	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
206.84	SRV	S06					1	4		4	

210	MGO		1.72	0					Max Corrosion 1.72 in. & Debris Ht. 0 in.		
218.33	SRV	F06								4	
220	MGO		1.94	0					Max Corrosion 1.94 in. & Debris Ht. 0 in.		
220.78	SRP						8	12		5	
230	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
230.96	SRV	S07					8	4		4	
240	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
250	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
260	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
270	MGO		1.94	0					Max Corrosion 1.94 in. & Debris Ht. 0 in.		
278.25	SRV	F07								4	
280	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
290	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
300	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
300.49	SRV	S08					8	4		4	
310	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
320	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		

330	MGO		1.57	0					Max Corrosion 1.57 in. & Debris Ht. 0 in.		
339.87	SRV	F08								4	
340	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
350	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
354.38	SRC	S09					1	4		5	
360	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
364.18	SRC	F09								5	
370	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
379.44	SRC						1	4		5	
380	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
389.99	SRC						2	4		5	
390	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
400	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
400.17	SRC						9	12		5	
410	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
411.85	SRC						8	11		5	
420	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
430	MGO		1.68	0					Max Corrosion 1.68 in. & Debris Ht. 0 in.		
433.52	SRV						11	2		4	
438.61	SRV	S10					1	4		4	

440	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
449.91	SRV	F10								4	
450	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
460	MGO		1.71	0					Max Corrosion 1.71 in. & Debris Ht. 0 in.		
470	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
480	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
482.7	SRV						9	12		4	
490	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
492.31	SRP	S11					12	4		5	
500	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
504.75	SRP	F11								5	
508.33	SRP						7	11		5	
510	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
511.15	SRV	S12					7	4		4	
518.88	SRP						7	4		5	
520	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
530	MGO		1.73	0					Max Corrosion 1.73 in. & Debris Ht. 0 in.		
540	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
550	MGO		1.74	0					Max Corrosion 1.74 in. & Debris Ht. 0 in.		

560	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
570	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
580	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
590	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
600	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
610	MGO		1.51	0					Max Corrosion 1.51 in. & Debris Ht. 0 in.		
620	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
630	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
631.37	SRV	F12								4	
640	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
644.56	SRC	S13					2	4		5	
650	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		
660	MGO		1.85	0					Max Corrosion 1.85 in. & Debris Ht. 0 in.		
670	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
680	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		

690	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
700	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
709.38	SRP						12	4		5	
710	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
720	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
730	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
740	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
746.69	SRC	F13								5	
750	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
760	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
770	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
780	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
790	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
796.62	SRV						11	4		4	
800	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
810	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		

820	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
826.58	SRV	S14					8	4		4	
830	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
837.14	SRV	F14								4	
840	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
848.82	SRV	S15					1	4		4	
850	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
860	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
862.39	SRV	F15								4	
870	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
880	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
890	MGO		1.8	0					Max Corrosion 1.8 in. & Debris Ht. 0 in.		
897.43	SRV						10	2		4	
900	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
901.58	SRC	S16					1	4		5	
910	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
920	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
930	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		

940	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
946.05	SRC	F16								5	
950	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
958.49	SRC						2	4		5	
960	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
970	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
972.43	SRV	S17					2	4		4	
980	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
984.68	SRV	F17								4	
990	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
1000	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
1009.74	SRV						2	4		4	
1010	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
1020	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
1030	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
1038.5	SRV	S18					2	4		4	
1040	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
1050	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		

1060	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1060.9	SRV	F18								4	
1070	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
1080	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
1090	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
1093.2	SRP						11	4		5	
1100	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
1100.9	SRP						9	12		5	
1108.4	SRC	S19					1	4		5	
1110	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1117.3	SRC	F19								5	
1120	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
1130	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1140	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
1150	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1160	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1170	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		

1180	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
1182.3	SRC						1	4		5	
1190	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1191.0	SRC						8	12		5	
1200	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
1210	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
1220	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
1228.6	SRP						12	4		5	
1230	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
1240	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
1240.7	SRC						2	4		5	
1250	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1260	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
1270	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
1280	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
1284.6	SRV						1	4		4	
1290	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		

1300	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1310	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
1311.2	SRV						9	11		4	
1320	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1330	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
1340	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1350	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1360	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1370	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
1380	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
1380.7	SRV	S20					2	4		4	
1387.5	SRV	F20								4	
1390	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1400	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
1410	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
1420	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		

1430	MGO		0.81	0					Max Corrosion 0.81 in. & Debris Ht. 0 in.		
1435.7	SRC						12	4		5	
1440	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
1450	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
1450.6	SRV						2	4		4	
1460	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
1470	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1471.9	SRC	S21					1	4		5	
1480	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1481.3	SRC	F21								5	
1490	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1500	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
1507.5	SRC						2	4		5	
1510	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1520	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
1530	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1540	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		

1550	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1555.0	SRV						11	12		4	
1560	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1570	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1580	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
1590	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1600	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
1610	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
1620	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1630	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1630.9	SRV						1	4		4	
1640	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
1650	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
1658.8	SRV						2	4		4	
1660	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1670	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
1674.7	SRV	S22					2	4		4	

1680	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
1681.1	SRV	F22								4	
1690	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1700	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1707.6	SRV						2	4		4	
1710	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1719.7	SRC						2	4		5	
1720	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
1730	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
1740	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1746.5	SRC						1			5	
1750	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
1755.5	SRV						2	4		4	
1760	MGO		0.85	0					Max Corrosion 0.85 in. & Debris Ht. 0 in.		
1770	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1780	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1790	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		

1800	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
1803.2	SRC						1	4		5	
1810	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1820	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
1826.4	SRC	S23					2	4		5	
1830	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
1840	MGO		0.87	0					Max Corrosion 0.87 in. & Debris Ht. 0 in.		
1840.5	SRC	F23								5	
1850	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1860	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
1862.0	SRC						1	4		5	
1870	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
1876.3	SRV						8	11		4	
1878.59	SRV						2	4		4	
1880	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
1890	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1900	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1910	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		

1920	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1930	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
1940	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
1950	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
1960	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
1970	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
1980	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1980.1	AMH										

8. Line 9231

Table 92 Details for line 9231

Line record no.:	9231		Pipe Material	RCP
US MH ID:	100T		Inspection Date	12/09/2022
DS MH ID:	80T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	1971

Table 93 PACP defect table for line 9231

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				15						

0	SRI	S01					7	5		1	
0	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
10	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
20	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
30	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
40	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
49.75	SRV						7	12		4	
50	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
60	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
70	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
80	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
83.3	SRC						8	10		5	
90	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
95.54	SRC	S02					8	4		5	
100	MGO		1.92	0					Max Corrosion 1.92 in. & Debris Ht. 0 in.		
110	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
120	MGO		2.03	0					Max Corrosion 2.03 in. & Debris Ht. 0 in.		
130	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
132.66	SRC	F02								5	
140	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
150	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
156.22	SRV						8	9		4	
160	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
166.96	SRV	S03					8	10		4	

170	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
176	SRV	F03								4	
179.39	SRV						3	4		4	
180	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
190	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
193.34	SRC	S04					8	4		5	
200	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
205.21	SRC	F04								5	
209.17	SRC						8	11		5	
210	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
220	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
224.62	SRP						8	12		5	
227.82	SRC	S05					8	4		5	
230	MGO		1.89	0					Max Corrosion 1.89 in. & Debris Ht. 0 in.		
240	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
247.04	SRC	F05								5	
250	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
252.32	SRC						8	11		5	
257.22	SRC						2	4		5	
260	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
261.74	SRV						8	4		4	
267.01	SRC						8	11		5	
270	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
280	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
290	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
292.45	SRP						8	1		5	
297.16	SRV						1	3		4	
299.99	SRC						8	12		5	

300	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
304.32	SRC						8	11		5	
308.47	SRC						1	4		5	
310	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
314.69	DAGS				10		1				2
314.69	SRV						12	2		4	
320	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
322.98	SRC						8	4		5	
328.44	SRV						2	4		4	
330	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
338.43	SRC						8	4		5	
340	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
350	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
356.33	SRC						12	4		5	
360	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
366.32	SRC	S06					8	10		5	
370	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
380	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
383.28	SRC	F06								5	
389.31	SRC						8	11		5	
390	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
400	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
404	SRV						8	12		4	
410	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
411.35	SRC						8	4		5	
420	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
430	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		

440	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
443.57	SRV						8	10		4	
450	MGO		0.91	0					Max Corrosion 0.91 in. & Debris Ht. 0 in.		
452.43	SRC						1	4		5	
454.88	SRP						8	12		5	
460	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
470	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
480	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
488.8	SRV						11			4	
490	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
500	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
503.49	SRP						9	3		5	
510	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
520	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
520.08	SRC	S07					8	4		5	
530	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
540	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
550	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
560	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
570	MGO		1.81	0					Max Corrosion 1.81 in. & Debris Ht. 0 in.		
580	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
586.03	SRC	F07								5	
590	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
591.49	SRC	S08					8	4		5	
600	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		

610	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
620	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
630	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
640	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
650	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
660	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
670	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
672.71	SRC	F08								5	
680	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
685.71	SRC	S09					8	4		5	
690	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
700	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
710	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
715.86	SRC	F09								5	
720	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
727.92	SRP	S10					8	12		5	
730	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
740	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
750	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
760	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
770	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
780	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
781.43	SRP	F10								5	

790	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
800	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
803.29	SRV						1	4		4	
810	MGO		1.69	0					Max Corrosion 1.69 in. & Debris Ht. 0 in.		
816.1	SRC	S11					8	11		5	
820	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
830	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
840	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
850	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
860	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
867.73	SRC	F11								5	
870	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
877.53	SRC						11	1		5	
880	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
881.67	SRC						8	4		5	
884.12	SRC						8	1		5	
890	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
900	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
900.89	SRV						8	4		4	
907.87	SRV	S12					8	4		4	
910	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
920	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
928.41	SRV	F12								4	
930	MGO		0.93	0					Max Corrosion 0.93 in. & Debris Ht. 0 in.		
940	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		

950	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
951.02	SRV						8	11		4	
960	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
960.63	SRV						8	11		4	
970	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
977.59	SRV	S13					8	10		4	
980	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
990	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1000	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
1010	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1020	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1022.43	SRV	F13								4	
1027.14	SRC						2	4		5	
1030	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
1040	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
1042.59	SRC						2	4		5	
1050	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
1057.67	SRV						8	10		4	
1060	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
1070	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1070.11	SRP						8	4		5	
1079.34	SRC						8	4		5	
1080	MGO		1.25	0					Max Corrosion 1.25 in. & Debris Ht. 0 in.		
1083.3	SRV						8	10		4	
1090	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1097.05	SRC						1	4		5	

1100	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1110	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
1120	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.		
1125.32	SRC						11	12		5	
1130	MGO		0.88	0					Max Corrosion 0.88 in. & Debris Ht. 0 in.		
1132.66	SRC						12	4		5	
1137.37	SRC						11	1		5	
1140	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
1150	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1155.46	SRP						8	4		5	
1160	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
1164.32	SRC						8	10		5	
1170	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
1179.77	SRC	S14					8	4		5	
1180	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1190	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1193.15	SRC	F14								5	
1200	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
1209.54	SRC	S15					8	11		5	
1210	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1217.27	SRC	F15								5	
1220	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
1221.98	SRC						8	10		5	
1230	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1240	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
1244.4	SRC						12	4		5	

1250	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1255.9	SRC						8	10		5	
1260	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
1268.52	SRP	S16					8	12		5	
1270	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1274.36	SRP	F16								5	
1278.89	SRC	S17					8	10		5	
1280	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
1288.5	SRC	F17								5	
1290	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1291.51	SRP	S18					8	4		5	
1298.48	SRP	F18								5	
1300	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1302.44	SRC						8	10		5	
1310	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
1313.37	SRP						8	2		5	
1315.82	SRC	S19					8	11		5	
1320	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
1330	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
1340	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
1350	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
1352	SRC	F19								5	
1360	MGO		1.27	0					Max Corrosion 1.27 in. & Debris Ht. 0 in.		
1363.49	SRC						8	4		5	
1368.2	SRC						2	4		5	
1370	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
1371.78	SRC	F20					8	10		5	
1376.3	SRC	S20								5	

1380	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
1386.67	SRC	S21					8	10		5	
1390	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1397.97	SRC	F21								5	
1400	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
1404.57	SRP						8	4		5	
1407.77	SRC	S22					8	10		5	
1410	MGO		0.89	0					Max Corrosion 0.89 in. & Debris Ht. 0 in.		
1412.48	SRC	F22								5	
1420	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
1420.21	SRC						9	12		5	
1430	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
1434.91	SRP						8	12		5	
1439.81	SRV						1	3		4	
1440	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
1442.82	SRC						8	11		5	
1450	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1450.73	SRC	S23					8	10		5	
1460	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1463.74	SRC	F23								5	
1470	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1480	MGO		0.95	0					Max Corrosion 0.95 in. & Debris Ht. 0 in.		
1490	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1492	SRC	S24					8	12		5	
1497.47	SRC	F24								5	
1500	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1508.21	SRC						8	11		5	
1510	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		

1512.16	SRC						2	4		5		
1520	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.			
1524.6	SRC	S25					8	4		5		
1529.12	SRC	F25								5		
1530	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.			
1534.59	SRC	S26					8	4		5		
1540	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.			
1550	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.			
1559.65	SRC	F26								5		
1560	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.			
1565.68	SRC	S27					8	11		5		
1570	MGO		1.27	0					Max Corrosion 1.27 in. & Debris Ht. 0 in.			
1572.65	SRC	F27								5		
1580	MGO		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.			
1580.56	SRC						11	3		5		
1588.85	SRC	S28					8	11		5		
1590	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.			
1595.45	SRC	F28								5		
1600	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.			
1604.12	SRC						8	12		5		
1610	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.			
1612.97	SRC						8	10		5		
1619.19	SRC						8	4		5		
1620	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.			
1630	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.			
1640	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.			
1643.69	SRC						8	10		5		
1650	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.			

1650.09	SRC	S29					8	4		5	
1657.82	SRC	F29								5	
1660	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
1670	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
1677.42	SRC						8	4		5	
1680	MGO		0.9	0					Max Corrosion 0.9 in. & Debris Ht. 0 in.		
1689.48	SRC						8	10		5	
1690	MGO		0.86	0					Max Corrosion 0.86 in. & Debris Ht. 0 in.		
1696.07	SRC						8	10		5	
1700	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1710	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
1711.71	SRC						2	4		5	
1719.06	SRC						9	2		5	
1719.62	SCP						9	3		5	
1720	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
1730	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1738.28	SRC						8	10		5	
1740	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
1750	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
1750.53	SRC	S30					8	4		5	
1757.12	SRC	F30								5	
1760	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1765.22	SRP						8	12		5	
1770	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1780	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
1790	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
1792.3	DAGS				10		12			2	2

1800	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1803.85	SRC						8	12		5	
1809.51	SRC						2	4		5	
1810	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1820	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
1820.06	SRC						8	9		5	
1830	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1830.61	AMH						2	4		1	
1830.99	MWL				10		12			1	2
1834.76	SRI	S31					8	12		1	
1840	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
1850	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1857.18	MGO	F31									
1860	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1865.09	MGO						8	11			
1868.86	SRV	S32			20		11	1		4	3
1870	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		3
1872.63	MGO						8	10			3
1878.09	MGO	F32			20						3
1880	MGO		0.99	0					Max Corrosion 0.99 in. & Debris Ht. 0 in.		
1880.54	SRC	S33					8	10		5	
1889.4	MGO	F33									
1890	SRC		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.	5	
1900	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
1902.97	MGO						8	2			
1910	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1915.59	MGO						8	10			
1920	SRC		0.94	0					Max Corrosion 0.94 in. & Debris Ht. 0 in.	5	
1925.96	MGO	S34			20		11	1			3

1930	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		3
1940	SRV		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.	4	3
1945.36	MGO						8	10			3
1950	SRV		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.	4	3
1960	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		3
1963.08	SRV	F34			20					4	3
1969.48	SRV						8	11		4	
1970	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
1970.99	MGO	F01									
1970.99	AMH										

9. Line 9509-9508

Table 94 Details for line 9509-9508

Line record no.:	9509-9508		Pipe Material	RCP
US MH ID:	2860T		Inspection Date	11/30/2022
DS MH ID:	2840T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	1575.65 ft

Table 95 PACP defect table for line 9509-9508

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
1.13	SRI	S01					8	4		1	
7.34	SRP	S02					1	4		5	
10	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		

17.33	SRP	F02								5	
19.97	SRP	S03					8	4		5	
20	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
30	MGO		1.81	0					Max Corrosion 1.81 in. & Debris Ht. 0 in.		
40	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
50	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
60	MGO		1.81	0					Max Corrosion 1.81 in. & Debris Ht. 0 in.		
70	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
80	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
90	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
95.34	SRP	F03								5	
97.79	SRP	S04					1	4		5	
100	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
105.89	SRP	F04								5	
108.34	SRC	S05					1	4		5	
110	MGO		1.58	0					Max Corrosion 1.58 in. & Debris Ht. 0 in.		
120	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
130	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		

140	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
144.71	SRC	F05								5	
150	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
157.15	SRC	S06					1	4		5	
160	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
170	MGO		1.69	0					Max Corrosion 1.69 in. & Debris Ht. 0 in.		
180	MGO		2.08	0					Max Corrosion 2.08 in. & Debris Ht. 0 in.		
190	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
192.57	SRC	F06								5	
200	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
204.07	SRP	S07					8	4		5	
210	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
220	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
230	MGO		2	0					Max Corrosion 2 in. & Debris Ht. 0 in.		
240	MGO		2.34	0					Max Corrosion 2.34 in. & Debris Ht. 0 in.		
250	MGO		1.72	0					Max Corrosion 1.72 in. & Debris Ht. 0 in.		
260	MGO		1.81	0					Max Corrosion 1.81 in. & Debris Ht. 0 in.		

270	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
276.05	SRP	F07								5	
280	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
290	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
300	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
303.18	SRC						2	4		5	
310	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
320	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
326.36	SRC						1	4		5	
330	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
340	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
350	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
355.38	SRP						1	4		5	
360	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
370	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
377.8	SRC						8	9		5	
380	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
388.35	SRC	S08					12	2		5	

390	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
396.64	SRC	F08								5	
400	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
407.76	SRP	S09					8	4		5	
410	MGO		1.58	0					Max Corrosion 1.58 in. & Debris Ht. 0 in.		
420	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
430	MGO		1.9	0					Max Corrosion 1.9 in. & Debris Ht. 0 in.		
433.57	SRP	F09								5	
435.46	SRC	S10					2	4		5	
440	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
448.84	SRC	F10								5	
450	MGO		1.78	0					Max Corrosion 1.78 in. & Debris Ht. 0 in.		
459.77	SRP	S11					8	4		5	
460	MGO		1.84	0					Max Corrosion 1.84 in. & Debris Ht. 0 in.		
470	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
480	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
490	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
500	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
504.99	SRP	F11								5	

508.57	SRC						12	3		5	
510	MGO		1.64	0					Max Corrosion 1.64 in. & Debris Ht. 0 in.		
520	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
521.19	SRC	S12					1	4		5	
530	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
540	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
550	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
557	SRC	F12								5	
560	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
569.06	SRC	S13					3	4		5	
570	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
580	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
590	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
590.54	SRC	F13								5	
593.93	SRP	S14					1	4		5	
600	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
610	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
615.22	SRP	F14								5	
620	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		

624.83	SRP						8	12		5	
630	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
630.11	SRP	S15					8	4		5	
640	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
650	MGO		1.8	0					Max Corrosion 1.8 in. & Debris Ht. 0 in.		
660	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
670	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
674.2	SRP	F15								5	
680	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
689.46	SRP	S16					1	4		5	
690	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
700	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
700.39	SRP	F16								5	
710	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
714.15	SRC	S17					3	4		5	
720	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
730	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
740	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
748.63	SRC	F17								5	

750	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
760	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
770	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
780	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
790	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
800	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
800.07	SRV						1	3		4	
810	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
820	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
830	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
840	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
850	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
860	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
866.21	SRV						8	4		4	
870	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		

880	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
890	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
898.81	SRC						8	10		5	
900	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
907.1	SRV						3	4		4	
910	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
920	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
930	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
938.94	SRV						2	4		4	
940	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
950	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
960	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
968.72	SRC	S18					2	4		5	
970	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
977.57	SRC	F18								5	
980	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
990	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		

1000	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
1007.3	SRC						8	10		5	
1010	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1017.1	SRP						2	4		5	
1020	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
1030	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
1040	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1050	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
1060	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1070	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
1080	MGO		1.57	0					Max Corrosion 1.57 in. & Debris Ht. 0 in.		
1089.3	SRC	S19					1	4		5	
1090	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
1100	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
1110	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
1120	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
1122.1	SRC	F19								5	

1124.7	SRC	S20					8	4		5	
1130	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
1133.2	SRC	F20								5	
1140	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
1147.3	SRP	S21					8	4		5	
1150	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
1158.0	SRP	F21								5	
1160	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1161.29	SRP	S22					12	4		5	
1170	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
1180	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
1183.9	SRP	F22								5	
1190	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
1200	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1210	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
1220	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
1230	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
1240	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		

1250	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
1260	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
1270	MGO		0.98	0					Max Corrosion 0.98 in. & Debris Ht. 0 in.		
1280	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
1281.5	SRP						2	4		5	
1290	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
1300	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
1310	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
1320	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
1330	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
1340	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1347.2	SRC	S23					1	4		5	
1350	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1360	MGO		0.96	0					Max Corrosion 0.96 in. & Debris Ht. 0 in.		
1365.1	SRC	F23								5	
1370	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1378.3	SRV	S24					3	4		4	

1380	MGO		1.26	0					Max Corrosion 1.26 in. & Debris Ht. 0 in.		
1386.4	SRV	F24								4	
1389.4	SRP	S25					8	4		5	
1390	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
1400	MGO		1.21	0					Max Corrosion 1.21 in. & Debris Ht. 0 in.		
1400.2	SRP	F25								5	
1402.1	SRP	S26					12	4		5	
1410	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
1420	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1430	MGO		1.23	0					Max Corrosion 1.23 in. & Debris Ht. 0 in.		
1435.8	SRP	F26								5	
1440	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
1450	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
1460	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
1462.2	SRC	S27					1	4		5	
1470	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
1480	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
1485.2	SRC	F27								5	
1487.6	SRP	S28					8	4		5	

1490	MGO		2.06	0					Max Corrosion 2.06 in. & Debris Ht. 0 in.		
1500	MGO		2.15	0					Max Corrosion 2.15 in. & Debris Ht. 0 in.		
1510	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
1520	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
1530	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
1540	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
1550	MGO		0.92	0					Max Corrosion 0.92 in. & Debris Ht. 0 in.		
1560	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
1569.4	SRP	F28								5	
1570	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
1571.8	SRI	F01									
1575.4	AMH										

10. Line 9260

Table 96 Details for line 9260

Line record no.:	9260		Pipe Material	RCP
US MH ID:	120T		Inspection Date	02/24/2023
DS MH ID:	100T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	1576.79

Table 97 PACP defect table for line 9260

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	SRP	S01					8	4		5	
0	SRI	S02								5	
0	MGO		2.47	4.69					Max Corrosion 2.47 in. & Debris Ht. 4.69 in.		
10	MGO		2.16	8.27					Max Corrosion 2.16 in. & Debris Ht. 8.27 in.		
20	MGO		2.19	9.49					Max Corrosion 2.19 in. & Debris Ht. 9.49 in.		
30	MGO		2.78	6.41					Max Corrosion 2.78 in. & Debris Ht. 6.41 in.		
40	MGO		3.15	5.14					Max Corrosion 3.15 in. & Debris Ht. 5.14 in.		
50	MGO		2.67	6.19					Max Corrosion 2.67 in. & Debris Ht. 6.19 in.		
60	MGO		2.55	7.53					Max Corrosion 2.55 in. & Debris Ht. 7.53 in.		
70	MGO		2.29	6.96					Max Corrosion 2.29 in. & Debris Ht. 6.96 in.		
77.26	DAGS	S03			20		11	1	White Deposits		3
80	MGO		2.8	4.89					Max Corrosion 2.8 in. & Debris Ht. 4.89 in.		
90	MGO		2.17	0					Max Corrosion 2.17 in. & Debris Ht. 0 in.		

93.65	SRP	F01								5	
100	MGO		1.59	0.59					Max Corrosion 1.59 in. & Debris Ht. 0.59 in.		
110	MGO		1.86	0					Max Corrosion 1.86 in. & Debris Ht. 0 in.		
114.38	SRC						8	11		5	
119.47	SRC						1	4		5	
120	MGO		2.52	0					Max Corrosion 2.52 in. & Debris Ht. 0 in.		
130	MGO		2.6	0					Max Corrosion 2.6 in. & Debris Ht. 0 in.		
131.71	SRC						1	4		5	
137.74	SRC						8	11		5	
140	MGO		2.41	0					Max Corrosion 2.41 in. & Debris Ht. 0 in.		
146.04	SRC						1	4		5	
150	MGO		2.64	0					Max Corrosion 2.64 in. & Debris Ht. 0 in.		
153.01	SRC						1	4		5	
160	MGO		2.71	0					Max Corrosion 2.71 in. & Debris Ht. 0 in.		
169.97	SRC	S04					8	11		5	
170	MGO		2.36	0					Max Corrosion 2.36 in. & Debris Ht. 0 in.		
173.55	SRC	F04								5	
180	MGO		2.93	0					Max Corrosion 2.93 in. & Debris Ht. 0 in.		
184.85	SRV	S05					8	10		4	
190	MGO		2.79	0					Max Corrosion 2.79 in. & Debris Ht. 0 in.		
200	MGO		2.38	0					Max Corrosion 2.38 in. & Debris Ht. 0 in.		

210	MGO		2.61	0					Max Corrosion 2.61 in. & Debris Ht. 0 in.		
217.07	SRP	S06					8	12		5	
220	MGO		2.55	0					Max Corrosion 2.55 in. & Debris Ht. 0 in.		
230	MGO		2.19	0					Max Corrosion 2.19 in. & Debris Ht. 0 in.		
238.37	SRP	F06								5	
240	MGO		2.83	0					Max Corrosion 2.83 in. & Debris Ht. 0 in.		
250	MGO		2.74	0					Max Corrosion 2.74 in. & Debris Ht. 0 in.		
260	MGO		2.72	0					Max Corrosion 2.72 in. & Debris Ht. 0 in.		
270	MGO		2.54	0					Max Corrosion 2.54 in. & Debris Ht. 0 in.		
271.91	SRC	S07					8	4		5	
280	MGO		2.57	0					Max Corrosion 2.57 in. & Debris Ht. 0 in.		
290	MGO		2.01	0					Max Corrosion 2.01 in. & Debris Ht. 0 in.		
300	MGO		2.79	0					Max Corrosion 2.79 in. & Debris Ht. 0 in.		
310	MGO		2.78	0					Max Corrosion 2.78 in. & Debris Ht. 0 in.		
320	MGO		2.19	0					Max Corrosion 2.19 in. & Debris Ht. 0 in.		
330	MGO		2.92	0					Max Corrosion 2.92 in. & Debris Ht. 0 in.		
335.78	SRC	F07								5	

340	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
346.34	SRV	F05								4	
350	MGO		1.79	0					Max Corrosion 1.79 in. & Debris Ht. 0 in.		
350.29	SRC						8	4		5	
357.64	SRC	S08					1	4		5	
360	MGO		2.56	0					Max Corrosion 2.56 in. & Debris Ht. 0 in.		
368.95	SRC	F08								5	
370	MGO		1.95	0					Max Corrosion 1.95 in. & Debris Ht. 0 in.		
376.49	SRC						8	11		5	
380	MGO		2.42	0					Max Corrosion 2.42 in. & Debris Ht. 0 in.		
390	MGO		2.32	0					Max Corrosion 2.32 in. & Debris Ht. 0 in.		
400	MGO		2.01	0					Max Corrosion 2.01 in. & Debris Ht. 0 in.		
403.81	SRP						8	12		5	
408.71	SRC	S09					8	10		5	
410	MGO		2.15	0					Max Corrosion 2.15 in. & Debris Ht. 0 in.		
420	MGO		2.37	0					Max Corrosion 2.37 in. & Debris Ht. 0 in.		
424.54	SRC	F09								5	
430	MGO		2.15	0					Max Corrosion 2.15 in. & Debris Ht. 0 in.		
436.97	SRC						8	11		5	
440	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		

450	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
460	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
470	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
470.32	SRC						1	4		5	
480	MGO		2.37	0					Max Corrosion 2.37 in. & Debris Ht. 0 in.		
490	MGO		2.39	0					Max Corrosion 2.39 in. & Debris Ht. 0 in.		
497.27	SRC						1	4		5	
500	MGO		2.5	0					Max Corrosion 2.5 in. & Debris Ht. 0 in.		
503.11	SRC	S10					8	4		5	
510	MGO		2.05	0					Max Corrosion 2.05 in. & Debris Ht. 0 in.		
520	MGO		2.41	0					Max Corrosion 2.41 in. & Debris Ht. 0 in.		
530	MGO		2.48	0					Max Corrosion 2.48 in. & Debris Ht. 0 in.		
540	MGO		2.65	0					Max Corrosion 2.65 in. & Debris Ht. 0 in.		
550	MGO		2.85	0					Max Corrosion 2.85 in. & Debris Ht. 0 in.		
560	MGO		2.96	0					Max Corrosion 2.96 in. & Debris Ht. 0 in.		
570	MGO		2.91	0					Max Corrosion 2.91 in. & Debris Ht. 0 in.		

580	MGO		2.86	0					Max Corrosion 2.86 in. & Debris Ht. 0 in.		
590	MGO		3.6	0					Max Corrosion 3.6 in. & Debris Ht. 0 in.		
600	MGO		2.69	0					Max Corrosion 2.69 in. & Debris Ht. 0 in.		
610	MGO		1.79	0					Max Corrosion 1.79 in. & Debris Ht. 0 in.		
611.83	SRC	F10								5	
620	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
630	MGO		2.43	0					Max Corrosion 2.43 in. & Debris Ht. 0 in.		
630.49	SRC						8	10		5	
635.58	SRC						12	4		5	
640	MGO		2.43	0					Max Corrosion 2.43 in. & Debris Ht. 0 in.		
644.62	SRV						10	12		4	
646.51	DAGS	F03			20						3
650	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
652.35	SRC						8	4		5	0
660	MGO		1.88	0					Max Corrosion 1.88 in. & Debris Ht. 0 in.		
670	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
680	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
686.83	SRV						8	10		4	0
690	MGO		3.53	0					Max Corrosion 3.53 in. & Debris Ht. 0 in.		

700	MGO		2.7	0					Max Corrosion 2.7 in. & Debris Ht. 0 in.		
710	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
720	MGO		1.58	0					Max Corrosion 1.58 in. & Debris Ht. 0 in.		
720.75	SRV						8	10		4	
730	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
734.88	SRC						11	1		5	
740	MGO		2.58	0					Max Corrosion 2.58 in. & Debris Ht. 0 in.		
743.74	SRV	S11					8	10		4	
750	MGO		2.11	0					Max Corrosion 2.11 in. & Debris Ht. 0 in.		
760	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
770	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
780	MGO		1.89	0					Max Corrosion 1.89 in. & Debris Ht. 0 in.		
790	MGO		1.66	0					Max Corrosion 1.66 in. & Debris Ht. 0 in.		
800	MGO		1.85	0					Max Corrosion 1.85 in. & Debris Ht. 0 in.		
810	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
820	MGO		1.93	0					Max Corrosion 1.93 in. & Debris Ht. 0 in.		
822.5	SRV	F11								4	

830	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
840	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
850	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
850.95	SRV						8	10		4	
860	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
870	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
880	MGO		1.9	0					Max Corrosion 1.9 in. & Debris Ht. 0 in.		
889.2	SRC						8	12		5	
890	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
900	MGO		1.68	0					Max Corrosion 1.68 in. & Debris Ht. 0 in.		
902.77	SRC						11	12		5	
910	MGO		2.61	0					Max Corrosion 2.61 in. & Debris Ht. 0 in.		
920	MGO		1.94	0					Max Corrosion 1.94 in. & Debris Ht. 0 in.		
926.89	SRC	S12					8	12		5	
930	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
939.33	SRC	F12								5	
940	MGO		1.8	0					Max Corrosion 1.8 in. & Debris Ht. 0 in.		

950	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
955.34	SRC						8	10		5	
960	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
970	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
970.42	SRC						10	12		5	
980	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
990	MGO		2	0					Max Corrosion 2 in. & Debris Ht. 0 in.		
1000	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
1010	MGO		1.57	0					Max Corrosion 1.57 in. & Debris Ht. 0 in.		
1020	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
1025.82	SRC						2	4		5	
1030	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
1040	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
1050	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
1060	MGO		2.04	0					Max Corrosion 2.04 in. & Debris Ht. 0 in.		
1070	MGO		2.06	0					Max Corrosion 2.06 in. & Debris Ht. 0 in.		

1071.6	SRC						8	10		5	
1078.77	SRC						8	10		5	
1080	MGO		1.91	0					Max Corrosion 1.91 in. & Debris Ht. 0 in.		
1085.74	SRC						11	2		5	
1090	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
1100	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		
1105.15	SRC						8	12		5	
1110	MGO		2.05	0					Max Corrosion 2.05 in. & Debris Ht. 0 in.		
1113.06	SRC	S13					8	4		5	
1120	MGO		1.95	0					Max Corrosion 1.95 in. & Debris Ht. 0 in.		
1129.64	SRC	F13								5	
1130	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
1140	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
1150	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
1156.21	SRC						8	12		5	
1160	MGO		1.97	0					Max Corrosion 1.97 in. & Debris Ht. 0 in.		
1170	MGO		1.84	0					Max Corrosion 1.84 in. & Debris Ht. 0 in.		

1170.72	SRC	S14					8	10		5	
1180	MGO		1.6	0					Max Corrosion 1.6 in. & Debris Ht. 0 in.		
1190	MGO		2.37	0					Max Corrosion 2.37 in. & Debris Ht. 0 in.		
1199.74	SRC	F14								5	
1200	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
1210	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
1220	MGO		2.44	0					Max Corrosion 2.44 in. & Debris Ht. 0 in.		
1222.91	SRC	S15					8	4		5	
1230	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
1240	MGO		2.11	0					Max Corrosion 2.11 in. & Debris Ht. 0 in.		
1242.13	SRC	F15								5	
1249.67	SRC	S16					8	10		5	
1250	MGO		1.98	0					Max Corrosion 1.98 in. & Debris Ht. 0 in.		
1260	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
1261.17	SRC	F16								5	
1270	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		

1280	MGO		1.81	0					Max Corrosion 1.81 in. & Debris Ht. 0 in.		
1290	MGO		1.89	0					Max Corrosion 1.89 in. & Debris Ht. 0 in.		
1300	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
1301.11	SRC	S17					8	10		5	
1310	MGO		1.68	0					Max Corrosion 1.68 in. & Debris Ht. 0 in.		
1320	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
1320.14	SRC	F17								5	
1326.17	SRC						8	10		5	
1330	MGO		1.94	0					Max Corrosion 1.94 in. & Debris Ht. 0 in.		
1335.6	SRC						8	12		5	
1340	MGO		1.92	0					Max Corrosion 1.92 in. & Debris Ht. 0 in.		
1350	MGO		2.44	0					Max Corrosion 2.44 in. & Debris Ht. 0 in.		
1351.8	SRC	S18					8	4		5	
1360	MGO		1.96	0					Max Corrosion 1.96 in. & Debris Ht. 0 in.		
1365.93	SRC	F18								5	
1370	MGO		2.07	0					Max Corrosion 2.07 in. & Debris Ht. 0 in.		
1373.66	SRC	S19					8	4		5	

1380	MGO		2.52	0					Max Corrosion 2.52 in. & Debris Ht. 0 in.		
1390	MGO		2.3	0					Max Corrosion 2.3 in. & Debris Ht. 0 in.		
1400	MGO		2.52	0					Max Corrosion 2.52 in. & Debris Ht. 0 in.		
1410	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
1413.79	SRC	F19								5	
1419.26	SRV						8	10		4	
1420	MGO		2.54	0					Max Corrosion 2.54 in. & Debris Ht. 0 in.		
1430	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
1439.99	SRP						10	4		5	
1440	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
1448.65	SRC	S20					12	4		5	
1450	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
1455.81	SRC	F20								5	
1460	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
1465.42	SRC						10	12		5	
1470	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		

1471.27	SRC	S21					8	10		5	
1477.86	SRC	F21								5	
1480	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
1490	MGO		2	0					Max Corrosion 2 in. & Debris Ht. 0 in.		
1492.37	SRC	S22					8	4		5	
1497.83	SRC	F22								5	
1500	MGO		1.92	0					Max Corrosion 1.92 in. & Debris Ht. 0 in.		
1510	MGO		1.72	0					Max Corrosion 1.72 in. & Debris Ht. 0 in.		
1514.04	SRC	S23					8	4		5	
1520	MGO		2.38	0					Max Corrosion 2.38 in. & Debris Ht. 0 in.		
1530	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
1540	MGO		2.55	0					Max Corrosion 2.55 in. & Debris Ht. 0 in.		
1548.52	SRC	F23								5	
1550	MGO		1.92	0					Max Corrosion 1.92 in. & Debris Ht. 0 in.		
1560	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
1570	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		

1574.34	SRI	F02								1	
1574.34	AMH										

11. Line 9510

Table 98 Details for line 9510

Line record no.:	9510		Pipe Material	RCP
US MH ID:	2880T		Inspection Date	11/30/2022
DS MH ID:	2860T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	370.46 ft

Table 99 PACP defect table for line 9510

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				40						
0	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
5.66	SRV	S01					1	4		4	
10	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
13.19	SRV	F01								4	
20	MGO		1.37	0					Max Corrosion 1.37 in. & Debris Ht. 0 in.		
27.52	SRV						12	2		4	
30	MGO		1.05	0					Max Corrosion 1.05 in. & Debris Ht. 0 in.		
32.98	SRV						2	3		4	

40	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
42.21	SRV						1	4		4	
50	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
56.91	SRC	S02					8	11		5	
60	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
61.06	SRC	F02								5	
65.39	SRP						1	4		5	
70	MGO		1.31	0					Max Corrosion 1.31 in. & Debris Ht. 0 in.		
71.42	SRC	S03					2	4		5	
80	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
85.18	SRC	F03								5	
85.18	VC										1
87.06	SRV						8	11		4	
90	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
95.92	SRC						12	4		5	
100	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
106.28	SRV						8	10		4	
110	MGO		1.04	0					Max Corrosion 1.04 in. & Debris Ht. 0 in.		
111.18	SRV	S04					3	4		4	
119.09	SRV	F04								4	
119.09	SRC	S05					12	4		5	
120	MGO		1.02	0					Max Corrosion 1.02 in. & Debris Ht. 0 in.		
125.5	SRC	F05								5	
127.38	SRV	S06					2	4		4	

130	MGO		1	0					Max Corrosion 1 in. & Debris Ht. 0 in.		
140	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
142.27	SRV	F06								4	
150	MGO		1.09	0					Max Corrosion 1.09 in. & Debris Ht. 0 in.		
151.5	SRV	S07					3	4		4	
160	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
167.33	SRV	F07								4	
167.33	SRC	S08					12	4		5	
170	MGO		1.4	0					Max Corrosion 1.4 in. & Debris Ht. 0 in.		
178.07	SRC	F08								5	
178.07	SRC						9	4		5	
180	MGO		1.32	0					Max Corrosion 1.32 in. & Debris Ht. 0 in.		
185.99	SRC						8	11		5	
190	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
192.2	SRP						11	4		5	
200	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
204.26	SRP						8	1		5	
210	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
215.76	SRV	S09					3	4		4	
220	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
222.35	SRV	F09								4	
224.43	SRV						8	11		4	

230	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
231.21	SRC	S10					1	4		5	
240	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		
247.23	SRC	F10								5	
250	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
258.53	SRV						8	10		4	
260	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
270	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
279.64	SRV						2	4		4	
280	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
290	MGO		1.16	0					Max Corrosion 1.16 in. & Debris Ht. 0 in.		
291.32	SRP						11	4		5	
300	MGO		1.24	0					Max Corrosion 1.24 in. & Debris Ht. 0 in.		
306.2	SRP						8	12		5	
310	MGO		0.62	0					Max Corrosion 0.62 in. & Debris Ht. 0 in.		
319.39	SRV						2	4		4	
320	MGO										
328.44	SRC						8	11		5	
330	MGO										
336.54	SRV	S11					8	4		4	
340	MGO										
350	MGO										
359.15	SRV	F11								4	
360	MGO										
361.6	SRP						12	4		5	

368.76	SRV						8	4		4	
370	MGO										
370.46	AMH										

12. Line 9295

Table 100 Details for line 9295

Line record no.:	9295		Pipe Material	RCP/DI
US MH ID:	140T		Inspection Date	02/24/2023
DS MH ID:	120T		Pipe Diameter	39/42
Inspection Direction	Downstream		Inspected Length	356 ft

Table 101 PACP defect table for line 9295

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				15						
0	SAP						8	4			
0	MGO		1.3	3.77					Max Corrosion 1.3 in. & Debris Ht. 3.77 in.		
2.45	MMC								Material Changed to Iron Pipe		
3.02	DAGS	S01			80		8	4	High Grease attached		5
3.02	SCP	S02					8	4	Pipe Layer Falling	3	
10	MGO		0.44	0					Max Corrosion 0.44 in. & Debris Ht. 0 in.		
20	MGO		1.06	1.41					Max Corrosion 1.06 in. & Debris Ht. 1.41 in.		
30	MGO		0.95	3.54					Max Corrosion 0.95 in. & Debris Ht. 3.54 in.		

40	MGO		0.89	2.59					Max Corrosion 0.89 in. & Debris Ht. 2.59 in.		
50	MGO		1.26	4.72					Max Corrosion 1.26 in. & Debris Ht. 4.72 in.		
60	MGO		0.61	3.46					Max Corrosion 0.61 in. & Debris Ht. 3.46 in.		
70	MGO		1.47	7					Max Corrosion 1.47 in. & Debris Ht. 7 in.		
80	MGO		0.94	9.43					Max Corrosion 0.94 in. & Debris Ht. 9.43 in.		
90	MGO		1.35	12.93					Max Corrosion 1.35 in. & Debris Ht. 12.93 in.		
100	MGO		0.64	8.73					Max Corrosion 0.64 in. & Debris Ht. 8.73 in.		
110	MGO		0.68	7.78					Max Corrosion 0.68 in. & Debris Ht. 7.78 in.		
120	MGO		1.05	9.67					Max Corrosion 1.05 in. & Debris Ht. 9.67 in.		
130	MGO		0.69	6.84					Max Corrosion 0.69 in. & Debris Ht. 6.84 in.		
140	MGO		0.7	6.84					Max Corrosion 0.7 in. & Debris Ht. 6.84 in.		
150	MGO		1.29	7.87					Max Corrosion 1.29 in. & Debris Ht. 7.87 in.		
160	MGO		1.25	11.01					Max Corrosion 1.25 in. & Debris Ht. 11.01 in.		
170	MGO		0.93	7.95					Max Corrosion 0.93 in. & Debris Ht. 7.95 in.		

180	MGO		0.99	6.18					Max Corrosion 0.99 in. & Debris Ht. 6.18 in.		
190	MGO		0.91	9.01					Max Corrosion 0.91 in. & Debris Ht. 9.01 in.		
200	MGO		0.91	7.9					Max Corrosion 0.91 in. & Debris Ht. 7.9 in.		
210	MGO		1.23	10.19					Max Corrosion 1.23 in. & Debris Ht. 10.19 in.		
220	MGO		1.36	8.25					Max Corrosion 1.36 in. & Debris Ht. 8.25 in.		
230	MGO		0.77	7.07					Max Corrosion 0.77 in. & Debris Ht. 7.07 in.		
240	MGO		1.06	10.6					Max Corrosion 1.06 in. & Debris Ht. 10.6 in.		
250	MGO		1.06	11.37					Max Corrosion 1.06 in. & Debris Ht. 11.37 in.		
260	MGO		1.17	8.13					Max Corrosion 1.17 in. & Debris Ht. 8.13 in.		
270	MGO		1.41	9.72					Max Corrosion 1.41 in. & Debris Ht. 9.72 in.		
280	MGO		1.46	4.95					Max Corrosion 1.46 in. & Debris Ht. 4.95 in.		
290	MGO		1.53	10.48					Max Corrosion 1.53 in. & Debris Ht. 10.48 in.		
300	MGO		2.31	2.13					Max Corrosion 2.31 in. & Debris Ht. 2.13 in.		
310	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		

320	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
330	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
340	MGO		1.88	1.95					Max Corrosion 1.88 in. & Debris Ht. 1.95 in.		
350	MGO		1.7	0					Max Corrosion 1.7 in. & Debris Ht. 0 in.		
350.11	DAGS	F01			80						5
350.11	SCP	F02								3	
350.11	MMC								Material Changed to RCP		
350.11	SRP	S03					8	4		5	
355.01	SRP	F03								5	
355.01	AMH										

13. Line 9511

Table 102 Details for line 9511

Line record no.:	9511		Pipe Material	RCP
US MH ID:	2900T		Inspection Date	11/30/2022
DS MH ID:	2880T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	600.57 ft

Table 103 PACP defect table for line 9511

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				20						
8.95	SRP	S01					8	4		5	

10	MGO		1.14	0					Max Corrosion 1.14 in. & Debris Ht. 0 in.		
20	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
25.04	SRP	F01								5	
30	MGO		1.74	0					Max Corrosion 1.74 in. & Debris Ht. 0 in.		
37.08	SRP	S02					12	4		5	
40	MGO		1.89	0					Max Corrosion 1.89 in. & Debris Ht. 0 in.		
50	MGO		1.89	0					Max Corrosion 1.89 in. & Debris Ht. 0 in.		
60	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
70	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
72	SRP	F02								5	
74.26	SRC						3	4		5	
80	MGO		1.73	0					Max Corrosion 1.73 in. & Debris Ht. 0 in.		
84.63	SRP	S03					12	4		5	
90	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
96.5	SRP	F03								5	
98.38	SRC						8	10		5	
100	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
108.94	SRP	S04					2	4		5	
110	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		

120	MGO		1.95	0					Max Corrosion 1.95 in. & Debris Ht. 0 in.		
130	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
132.87	SRP	F04								5	
140	MGO		1.66	0					Max Corrosion 1.66 in. & Debris Ht. 0 in.		
150	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
158.87	SRV	S05					1	4		4	
160	MGO		1.84	0					Max Corrosion 1.84 in. & Debris Ht. 0 in.		
170	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
180	MGO		1.01	0					Max Corrosion 1.01 in. & Debris Ht. 0 in.		
186.57	SRV	F05								4	
190	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
192.41	SRP	S06					1	4		5	
200	MGO		2.12	0					Max Corrosion 2.12 in. & Debris Ht. 0 in.		
210	MGO		1.78	0					Max Corrosion 1.78 in. & Debris Ht. 0 in.		
214.27	SRP	F06								5	
217.66	SRP	S07					2	4		5	
220	MGO		1.57	0					Max Corrosion 1.57 in. & Debris Ht. 0 in.		
230	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		

240	MGO		1.1	0					Max Corrosion 1.1 in. & Debris Ht. 0 in.		
250	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
260	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		
270	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
280	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
290	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
300	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
304.53	SRP	F07								5	
310	MGO		1.64	0					Max Corrosion 1.64 in. & Debris Ht. 0 in.		
314.51	SRP	S08					1	4		5	
320	MGO		2.25	0					Max Corrosion 2.25 in. & Debris Ht. 0 in.		
330	MGO		1.72	0					Max Corrosion 1.72 in. & Debris Ht. 0 in.		
340	MGO		2.06	0					Max Corrosion 2.06 in. & Debris Ht. 0 in.		
350	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
350.13	SRP	F08								5	
352.39	SRP	S09					8	4		5	
360	MGO		1.77	0					Max Corrosion 1.77 in. & Debris Ht. 0 in.		

361.24	SRP	F09								5	
363.32	SRV						1	4		4	
370	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		
374.25	SRC						3	4		5	
380	MGO		1.75	0					Max Corrosion 1.75 in. & Debris Ht. 0 in.		
386.3	SRP	S10					1	4		5	
390	MGO		1.51	0					Max Corrosion 1.51 in. & Debris Ht. 0 in.		
400	MGO		2.01	0					Max Corrosion 2.01 in. & Debris Ht. 0 in.		
410	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
420	MGO		1.83	0					Max Corrosion 1.83 in. & Debris Ht. 0 in.		
430	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		
431.91	SRP	F10								5	
440	MGO		1.53	0					Max Corrosion 1.53 in. & Debris Ht. 0 in.		
447.36	SRV						2	4		4	
450	MGO		1.64	0					Max Corrosion 1.64 in. & Debris Ht. 0 in.		
460	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
462.62	SRP	S11					2	4		5	
470	MGO		1.61	0					Max Corrosion 1.61 in. & Debris Ht. 0 in.		
480	MGO		1.43	0					Max Corrosion 1.43 in. & Debris Ht. 0 in.		

481.65	SRP	F11								5	
490	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
500	MGO		1.63	0					Max Corrosion 1.63 in. & Debris Ht. 0 in.		
510	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
514.44	SRC						8	9		5	
520	MGO		0.97	0					Max Corrosion 0.97 in. & Debris Ht. 0 in.		
520.47	SRP	S12					1	4		5	
530	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
530.45	SRP	F12								5	
540	MGO		1.58	0					Max Corrosion 1.58 in. & Debris Ht. 0 in.		
550	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
560	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
569.65	SRV						3	4		4	
570	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
580	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
585.85	SRV	S13					2	4		4	
590	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
600	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
602.25	SRV	F13								4	

607.15	AMH										

14. Line 9334

Table 104 Details for line 9334

Line record no.:	9334		Pipe Material	RCP
US MH ID:	160T		Inspection Date	02/24/2023
DS MH ID:	140T		Pipe Diameter	39
Inspection Direction	Downstream		Inspected Length	585.73 ft

Table 105 PACP defect table for line 9334

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				30						
0	SRP	S01					8	4	HIGH H2S CONCENTRATION	5	
0	MGO		5.29	0					Max Corrosion 5.29 in. & Debris Ht. 0 in.		
10	MGO		3.47	0					Max Corrosion 3.47 in. & Debris Ht. 0 in.		
20	MGO		3.44	0					Max Corrosion 3.44 in. & Debris Ht. 0 in.		
30	MGO		3.01	0					Max Corrosion 3.01 in. & Debris Ht. 0 in.		
40	MGO		2.82	0					Max Corrosion 2.82 in. & Debris Ht. 0 in.		
50	MGO		2.7	0					Max Corrosion 2.7 in. & Debris Ht. 0 in.		
60	MGO		2.32	1.42					Max Corrosion 2.32 in. & Debris Ht. 1.42 in.		

70	MGO		2.67	0.12					Max Corrosion 2.67 in. & Debris Ht. 0.12 in.		
80	MGO		2.12	0					Max Corrosion 2.12 in. & Debris Ht. 0 in.		
90	MGO		2.33	0					Max Corrosion 2.33 in. & Debris Ht. 0 in.		
100	MGO		1.75	5.57					Max Corrosion 1.75 in. & Debris Ht. 5.57 in.		
110	MGO		2.93	0					Max Corrosion 2.93 in. & Debris Ht. 0 in.		
120	MGO		2.35	0					Max Corrosion 2.35 in. & Debris Ht. 0 in.		
130	MGO		2.11	0					Max Corrosion 2.11 in. & Debris Ht. 0 in.		
140	MGO		1.76	0					Max Corrosion 1.76 in. & Debris Ht. 0 in.		
150	MGO		1.99	0					Max Corrosion 1.99 in. & Debris Ht. 0 in.		
158.37	SRP	F01								5	
159.12	SRI	S02					8	4		1	
160	MGO		1.96	0					Max Corrosion 1.96 in. & Debris Ht. 0 in.		
170	MGO		2.23	0					Max Corrosion 2.23 in. & Debris Ht. 0 in.		
180	MGO		1.85	4.62					Max Corrosion 1.85 in. & Debris Ht. 4.62 in.		
190	MGO		1.98	0					Max Corrosion 1.98 in. & Debris Ht. 0 in.		

200	MGO		2.06	0					Max Corrosion 2.06 in. & Debris Ht. 0 in.		
210	MGO		2.08	0					Max Corrosion 2.08 in. & Debris Ht. 0 in.		
216.22	DAZ	S03			10		10	2	WHITE DEPOSITS		2
220	MGO		1.77	0					Max Corrosion 1.77 in. & Debris Ht. 0 in.		
230	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
236.57	SRV						9	11		4	
240	MGO		1.45	4.51					Max Corrosion 1.45 in. & Debris Ht. 4.51 in.		
250	MGO		1.85	5.24					Max Corrosion 1.85 in. & Debris Ht. 5.24 in.		
258.43	SRP	S04					8	4	PARTS OF REBARS MISSING	5	
260	MGO		2.14	5.54					Max Corrosion 2.14 in. & Debris Ht. 5.54 in.		
270	MGO		2.17	7.07					Max Corrosion 2.17 in. & Debris Ht. 7.07 in.		
280	MGO		2.18	11.88					Max Corrosion 2.18 in. & Debris Ht. 11.88 in.		
290	MGO		2.43	10.78					Max Corrosion 2.43 in. & Debris Ht. 10.78 in.		
300	MGO		3	10.23					Max Corrosion 3 in. & Debris Ht. 10.23 in.		
310	MGO		2.81	9.87					Max Corrosion 2.81 in. & Debris Ht. 9.87 in.		
320	MGO		2.59	9.38					Max Corrosion 2.59 in. & Debris Ht. 9.38 in.		

330	MGO		2.14	9.2					Max Corrosion 2.14 in. & Debris Ht. 9.2 in.		
340	MGO		2.07	5.85					Max Corrosion 2.07 in. & Debris Ht. 5.85 in.		
350	MGO		1.59	4.02					Max Corrosion 1.59 in. & Debris Ht. 4.02 in.		
360	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
370	MGO		2.16	0					Max Corrosion 2.16 in. & Debris Ht. 0 in.		
373.18	DAGS	S05			10		2	4			2
380	MGO		1.88	0					Max Corrosion 1.88 in. & Debris Ht. 0 in.		
390	MGO		1.64	2.92					Max Corrosion 1.64 in. & Debris Ht. 2.92 in.		
390.71	SRP	F04								5	
400	MGO		1.61	5.06					Max Corrosion 1.61 in. & Debris Ht. 5.06 in.		
409.55	SRC	S06					8	4		5	
410	MGO		1.29	3.11					Max Corrosion 1.29 in. & Debris Ht. 3.11 in.		
420	MGO		1.67	6.58					Max Corrosion 1.67 in. & Debris Ht. 6.58 in.		
430	MGO		1.44	3.65					Max Corrosion 1.44 in. & Debris Ht. 3.65 in.		
434.61	DAGS	F05			10						2
440	MGO		1.37	10.54					Max Corrosion 1.37 in. & Debris Ht. 10.54 in.		
450	MGO		1.52	6.88					Max Corrosion 1.52 in. & Debris Ht. 6.88 in.		

452.89	DAZ	F03			10						2
452.89	SRC	F06								5	
460	MGO		1.52	3.35					Max Corrosion 1.52 in. & Debris Ht. 3.35 in.		
460.24	SRP	S07					8	4		5	
470	MGO		1.67	0					Max Corrosion 1.67 in. & Debris Ht. 0 in.		
470.98	SRP	F07								5	
480	MGO		1.58	0.98					Max Corrosion 1.58 in. & Debris Ht. 0.98 in.		
490	MGO		1.53	9.14					Max Corrosion 1.53 in. & Debris Ht. 9.14 in.		
490.57	SRC						8	1		5	
500	MGO		1.46	2.01					Max Corrosion 1.46 in. & Debris Ht. 2.01 in.		
505.27	SRC						11	2		5	
510	MGO		1.46	0.73					Max Corrosion 1.46 in. & Debris Ht. 0.73 in.		
517.33	SRC						8	11		5	
520	MGO		1.36	0					Max Corrosion 1.36 in. & Debris Ht. 0 in.		
530	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
531.84	SRC	S08					1	2		5	
540	MGO		1.41	0					Max Corrosion 1.41 in. & Debris Ht. 0 in.		
550	MGO		1.48	0					Max Corrosion 1.48 in. & Debris Ht. 0 in.		
560	MGO		1.45	0					Max Corrosion 1.45 in. & Debris Ht. 0 in.		

570	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
580	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		
582.53	SRC	F08								5	
584.22	SRI	F02								1	
585.54	AMH										

15. Line 9512

Table 106 Details for line 9512

Line record no.:	9512		Pipe Material	RCP
US MH ID:	2920T		Inspection Date	10/26/2022
DS MH ID:	2900T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	394.38 ft

Table 107 PACP defect table for line 9512

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				10				Water Level		
0	MGO		1.29	0					Max Corrosion 1.29 in. & Debris Ht. 0 in.		
4.41	SRI	S01					8	4		1	
6.4	SRV	S02					10		longitudinal reinforcement visible	4	
10	MGO		1.2	0					Max Corrosion 1.2 in. & Debris Ht. 0 in.		
16.39	SRV						10	12		4	

16.39	SRV	F02								4	
19.22	SRV	S03					3			4	
20	MGO		1.11	0					Max Corrosion 1.11 in. & Debris Ht. 0 in.		
25.43	SRV	F03								4	
30	MGO		1.39	0					Max Corrosion 1.39 in. & Debris Ht. 0 in.		
30.9	SRV	S04					2	4		4	
40	MGO		1.08	0					Max Corrosion 1.08 in. & Debris Ht. 0 in.		
40.13	SRV	F04								4	
43.9	SRC	S05					7	1	Corrosion	5	
48.42	SRC	F05								5	
50	MGO		1.19	0					Max Corrosion 1.19 in. & Debris Ht. 0 in.		
60	MGO		1.17	0					Max Corrosion 1.17 in. & Debris Ht. 0 in.		
60.11	SRC						8	1			
69.53	SRV	S06					9	12		4	
70	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
73.11	SRV	F06								4	
80	MGO		1.15	0					Max Corrosion 1.15 in. & Debris Ht. 0 in.		
90	MGO		1.06	0					Max Corrosion 1.06 in. & Debris Ht. 0 in.		
100	MGO		1.03	0					Max Corrosion 1.03 in. & Debris Ht. 0 in.		
101.18	SRC						7	11		5	
106.84	SRV	S07					9	12		4	
110	MGO		1.18	0					Max Corrosion 1.18 in. & Debris Ht. 0 in.		
113.05	SRV	F07								4	

119.27	SRV						2	5		4	
120	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
123.42	SRV	S08					7	11		4	
130	MGO		1.49	0					Max Corrosion 1.49 in. & Debris Ht. 0 in.		
132.84	SRV	F08								4	
132.84	SRC	S09					7	5		5	
137.17	SRC	F09								5	
140	MGO		1.35	0					Max Corrosion 1.35 in. & Debris Ht. 0 in.		
143.96	SRV	S10					7	5		4	
150	MGO		1.34	0					Max Corrosion 1.34 in. & Debris Ht. 0 in.		
160	MGO		1.33	0					Max Corrosion 1.33 in. & Debris Ht. 0 in.		
170	MGO		1.5	0					Max Corrosion 1.5 in. & Debris Ht. 0 in.		
180	MGO		1.52	0					Max Corrosion 1.52 in. & Debris Ht. 0 in.		
190	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
192.2	SRV	F10								4	
192.2	SRP	S11					12	5		5	
200	MGO		1.59	0					Max Corrosion 1.59 in. & Debris Ht. 0 in.		
202.75	SRP	F11								5	
202.75	SRC	S12					7	5		5	
210	MGO		0	0					Max Corrosion 0 in. & Debris Ht. 0 in.		
220	MGO		1.85	0					Max Corrosion 1.85 in. & Debris Ht. 0 in.		

230	MGO		1.42	0					Max Corrosion 1.42 in. & Debris Ht. 0 in.		
230.45	SRP	S13					7	5	Most of Steel is corroded	5	
240	MGO		3.35	0					Max Corrosion 3.35 in. & Debris Ht. 0 in.		
250	MGO		2.81	0					Max Corrosion 2.81 in. & Debris Ht. 0 in.		
257.77	SRP	F13								5	
260	MGO		1.99	0					Max Corrosion 1.99 in. & Debris Ht. 0 in.		
270	MGO		1.62	1.24					Max Corrosion 1.62 in. & Debris Ht. 1.24 in.		
280	MGO		1.55	0					Max Corrosion 1.55 in. & Debris Ht. 0 in.		
290	MGO		1.44	0					Max Corrosion 1.44 in. & Debris Ht. 0 in.		
300	MGO		1.46	0					Max Corrosion 1.46 in. & Debris Ht. 0 in.		
302.05	SRC	F12								5	
310	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
320	MGO		1.12	0					Max Corrosion 1.12 in. & Debris Ht. 0 in.		
326.55	SRV						12	2		4	
330	MGO		1.07	0					Max Corrosion 1.07 in. & Debris Ht. 0 in.		
340	MGO		1.28	0					Max Corrosion 1.28 in. & Debris Ht. 0 in.		

350	MGO		1.38	0					Max Corrosion 1.38 in. & Debris Ht. 0 in.		
351.42	SRV	S14					12	5		4	
360	MGO		1.13	0					Max Corrosion 1.13 in. & Debris Ht. 0 in.		
370	MGO		1.3	0					Max Corrosion 1.3 in. & Debris Ht. 0 in.		
380	MGO										
388.54	SRV	F14								4	
390	MGO										
394	SRI	F01								1	
394.38	AMH										

16. Line 9786

Table 108 Details for line 9786

Line record no.:	9786		Pipe Material	RCP
US MH ID:	6032T		Inspection Date	10/26/2022
DS MH ID:	2920T		Pipe Diameter	54
Inspection Direction	Downstream		Inspected Length	199.66 ft

Table 109 PACP defect table for line 9786

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				15						
0	SRP	S01					7	5	High Corrosion	5	
0	MGO		4.32	0					Max Corrosion 4.32 in. & Debris Ht. 0 in.		

10	MGO		3.9	0					Max Corrosion 3.9 in. & Debris Ht. 0 in.		
20	MGO		3.12	0					Max Corrosion 3.12 in. & Debris Ht. 0 in.		
30	MGO		3.5	0					Max Corrosion 3.5 in. & Debris Ht. 0 in.		
40	MGO		2.51	0					Max Corrosion 2.51 in. & Debris Ht. 0 in.		
50	MGO		2.48	0					Max Corrosion 2.48 in. & Debris Ht. 0 in.		
60	MGO		2.52	0					Max Corrosion 2.52 in. & Debris Ht. 0 in.		
70	MGO		1.68	0					Max Corrosion 1.68 in. & Debris Ht. 0 in.		
80	MGO		1.82	0					Max Corrosion 1.82 in. & Debris Ht. 0 in.		
90	MGO		1.87	0					Max Corrosion 1.87 in. & Debris Ht. 0 in.		
92.63	DAZ						10	1	Efflorescence		3
100	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
110	MGO		1.56	0					Max Corrosion 1.56 in. & Debris Ht. 0 in.		
120	MGO		1.79	0					Max Corrosion 1.79 in. & Debris Ht. 0 in.		
130	MGO		1.54	0					Max Corrosion 1.54 in. & Debris Ht. 0 in.		
140	MGO		1.62	0					Max Corrosion 1.62 in. & Debris Ht. 0 in.		

146.34	SRP	F01								5	
147.65	SRP	S02					12	4		5	
150	MGO		1.7	0					Max Corrosion 1.7 in. & Debris Ht. 0 in.		
160	MGO		1.47	0					Max Corrosion 1.47 in. & Debris Ht. 0 in.		
165.18	SRP	F02								5	
170	MGO		1.65	0					Max Corrosion 1.65 in. & Debris Ht. 0 in.		
171.59	SRP	S03					1	4		5	
180	MGO		1.58	0					Max Corrosion 1.58 in. & Debris Ht. 0 in.		
182.33	SRP	F03								5	
190	MGO		1.22	0					Max Corrosion 1.22 in. & Debris Ht. 0 in.		
195.7	SRV						2	3		4	
199.47	AMH										

17. Line 9799

Table 110 Details for line 9799

Line record no.:	9799		Pipe Material	FRP
US MH ID:	6070T		Inspection Date	10/26/2022
DS MH ID:	6056T		Pipe Diameter	78
Inspection Direction	Downstream		Inspected Length	609.66 ft

Table 111 PACP defect table for line 9799

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL				15						
0	ADP										
0	LFDC	S01					8	4	Discoloration	3	

0	MGO		0		0.33				Ovality 0.33 %" & Debris Ht. 0 in.		
10	MGO		0		1.19				Ovality 1.19 %" & Debris Ht. 0 in.		
20	MGO		0		0.98				Ovality 0.98 %" & Debris Ht. 0 in.		
22.23	SSC		0		0.82		12		Ovality 0.82 %" & Debris Ht. 0 in.	3	
30	MGO		0		0.82				Ovality 0.82 %" & Debris Ht. 0 in.		
40	MGO		0		1.49				Ovality 1.49 %" & Debris Ht. 0 in.		
50	MGO		0		1.06				Ovality 1.06 %" & Debris Ht. 0 in.		
60	MGO		0		0.99				Ovality 0.99 %" & Debris Ht. 0 in.		
70	MGO		0		0.94				Ovality 0.94 %" & Debris Ht. 0 in.		
80	MGO		0		0.98				Ovality 0.98 %" & Debris Ht. 0 in.		
90	MGO		0		0.84				Ovality 0.84 %" & Debris Ht. 0 in.		
100	MGO		0		0.95				Ovality 0.95 %" & Debris Ht. 0 in.		
110	MGO		1.62		0.32				Ovality 0.32 %" & Debris Ht. 1.62 in.		
112.3	SSC	S02					8	4		3	
120	MGO		4.84		1.17				Ovality 1.17 %" & Debris Ht. 4.84 in.		
128.32	SSC	F02								3	
130	MGO		6.75		0.6				Ovality 0.6 %" & Debris Ht. 6.75 in.		
140	MGO		6.86		0.67				Ovality 0.67 %" & Debris Ht. 6.86 in.		
150	MGO		6.15		0.58				Ovality 0.58 %" & Debris Ht. 6.15 in.		
160	MGO		6.19		0.46				Ovality 0.46 %" & Debris Ht. 6.19 in.		
170	MGO		5.59		0.41				Ovality 0.41 %" & Debris Ht. 5.59 in.		
180	MGO		4.27		0.51				Ovality 0.51 %" & Debris Ht. 4.27 in.		

190	MGO		4.75		0.51				Ovality 0.51 %" & Debris Ht. 4.75 in.		
200	MGO		3.76		0.89				Ovality 0.89 %" & Debris Ht. 3.76 in.		
210	MGO		3.25		1.31				Ovality 1.31 %" & Debris Ht. 3.25 in.		
220	MGO		0		1.17				Ovality 1.17 %" & Debris Ht. 0 in.		
230	MGO		0		1.33				Ovality 1.33 %" & Debris Ht. 0 in.		
240	MGO		0		1.15				Ovality 1.15 %" & Debris Ht. 0 in.		
250	MGO		0		1.78				Ovality 1.78 %" & Debris Ht. 0 in.		
260	MGO		0		0.82				Ovality 0.82 %" & Debris Ht. 0 in.		
270	MGO		1.15		1.36				Ovality 1.36 %" & Debris Ht. 1.15 in.		
280	MGO		5.38		1.06				Ovality 1.06 %" & Debris Ht. 5.38 in.		
290	MGO		8.73		2.22				Ovality 2.22 %" & Debris Ht. 8.73 in.		
300	MGO		5.94		2.17				Ovality 2.17 %" & Debris Ht. 5.94 in.		
310	MGO		6.38		2.79				Ovality 2.79 %" & Debris Ht. 6.38 in.		
320	MGO		6.62		2.09				Ovality 2.09 %" & Debris Ht. 6.62 in.		
330	MGO		6.89		1.27				Ovality 1.27 %" & Debris Ht. 6.89 in.		
340	MGO		7.64		1.32				Ovality 1.32 %" & Debris Ht. 7.64 in.		
350	MGO		7.12		2.41				Ovality 2.41 %" & Debris Ht. 7.12 in.		
360	MGO		7		2.15				Ovality 2.15 %" & Debris Ht. 7 in.		
370	MGO		8.09		2.17				Ovality 2.17 %" & Debris Ht. 8.09 in.		
380	MGO		6.97		1.02				Ovality 1.02 %" & Debris Ht. 6.97 in.		
390	MGO		6.59		0.95				Ovality 0.95 %" & Debris Ht. 6.59 in.		

400	MGO		6.83		0.71				Ovality 0.71 %" & Debris Ht. 6.83 in.		
410	MGO		8.96		0.71				Ovality 0.71 %" & Debris Ht. 8.96 in.		
420	MGO		7.75		1.25				Ovality 1.25 %" & Debris Ht. 7.75 in.		
430	MGO		6.46		0.86				Ovality 0.86 %" & Debris Ht. 6.46 in.		
440	MGO		6.58		1.42				Ovality 1.42 %" & Debris Ht. 6.58 in.		
450	MGO		6.09		1.04				Ovality 1.04 %" & Debris Ht. 6.09 in.		
460	MGO		4.35		1.52				Ovality 1.52 %" & Debris Ht. 4.35 in.		
470	MGO		5.25		0.79				Ovality 0.79 %" & Debris Ht. 5.25 in.		
480	MGO		4.87		1.16				Ovality 1.16 %" & Debris Ht. 4.87 in.		
490	MGO		5.04		1.32				Ovality 1.32 %" & Debris Ht. 5.04 in.		
500	MGO		4.62		1.15				Ovality 1.15 %" & Debris Ht. 4.62 in.		
510	MGO		5.86		1.25				Ovality 1.25 %" & Debris Ht. 5.86 in.		
520	MGO		6.23		0.71				Ovality 0.71 %" & Debris Ht. 6.23 in.		
530	MGO		5.04		0.47				Ovality 0.47 %" & Debris Ht. 5.04 in.		
540	MGO		4.75		1.14				Ovality 1.14 %" & Debris Ht. 4.75 in.		
550	MGO		6.02		1.17				Ovality 1.17 %" & Debris Ht. 6.02 in.		
560	MGO		5.13		1.31				Ovality 1.31 %" & Debris Ht. 5.13 in.		
570	MGO		5.24		0.51				Ovality 0.51 %" & Debris Ht. 5.24 in.		
580	MGO		5.39		0.42				Ovality 0.42 %" & Debris Ht. 5.39 in.		
590	MGO		5.27		0.35				Ovality 0.35 %" & Debris Ht. 5.27 in.		
600	MGO		4.17		0.71				Ovality 0.71 %" & Debris Ht. 4.17 in.		
609.57	LFDC	F01								3	

613.34	AMH										

18. Line 9800

Table 112 Details for line 9800

Line record no.:	9800		Pipe Material	FRP
US MH ID:	6080T		Inspection Date	10/26/2022
DS MH ID:	6070T		Pipe Diameter	78
Inspection Direction	Downstream		Inspected Length	707.77 ft

Table 113 PACP defect table for line 9800

Dist. (ft.)	Code Group	Cont. defect	value			Joint	Circumferential		Remarks	Defect Rating	
			Dimension		%		At/ From	To		Str	O&M
			1st	2nd							
0	AMH										
0	MWL			15							
0	LFDC	S01					8	4	Discoloration	3	
0	MGO		0	0.61					Ovality 0.61 %" & Debris Ht. 0 in.		
10	MGO		0	1.92					Ovality 1.92 %" & Debris Ht. 0 in.		
20	MGO		0	2.77					Ovality 2.77 %" & Debris Ht. 0 in.		
30	MGO		0	3.14					Ovality 3.14 %" & Debris Ht. 0 in.		
33.19	LD			5					Line Down		1
40	MGO		0	2.16					Ovality 2.16 %" & Debris Ht. 0 in.		
50	MGO		0	1.26					Ovality 1.26 %" & Debris Ht. 0 in.		
55.23	MWL			20					Water level Change		
60	MGO		0	0.8					Ovality 0.8 %" & Debris Ht. 0 in.		
70	MGO		0	0.38					Ovality 0.38 %" & Debris Ht. 0 in.		

80	MGO		0	0.44					Ovality 0.44 %" & Debris Ht. 0 in.		
90	MGO		0	0.21					Ovality 0.21 %" & Debris Ht. 0 in.		
100	MGO		0	0.65					Ovality 0.65 %" & Debris Ht. 0 in.		
110	MGO		0	0.39					Ovality 0.39 %" & Debris Ht. 0 in.		
120	MGO		0	0.92					Ovality 0.92 %" & Debris Ht. 0 in.		
130	MGO		0	1.33					Ovality 1.33 %" & Debris Ht. 0 in.		
140	MGO		0	0.4					Ovality 0.4 %" & Debris Ht. 0 in.		
150	MGO		0	0.46					Ovality 0.46 %" & Debris Ht. 0 in.		
160	MGO		0	1.34					Ovality 1.34 %" & Debris Ht. 0 in.		
170	MGO		0	1.43					Ovality 1.43 %" & Debris Ht. 0 in.		
180	MGO		0	1.68					Ovality 1.68 %" & Debris Ht. 0 in.		
190	MGO		0	1.03					Ovality 1.03 %" & Debris Ht. 0 in.		
200	MGO		0	0.88					Ovality 0.88 %" & Debris Ht. 0 in.		
210	MGO		0	0.71					Ovality 0.71 %" & Debris Ht. 0 in.		
220	MGO		0	1.01					Ovality 1.01 %" & Debris Ht. 0 in.		
230	MGO		0	0.88					Ovality 0.88 %" & Debris Ht. 0 in.		
240	MGO		0	0.29					Ovality 0.29 %" & Debris Ht. 0 in.		
250	MGO		0	0.74					Ovality 0.74 %" & Debris Ht. 0 in.		
260	MGO		0	0.41					Ovality 0.41 %" & Debris Ht. 0 in.		
270	MGO		0	0.49					Ovality 0.49 %" & Debris Ht. 0 in.		
280	MGO		0	0.52					Ovality 0.52 %" & Debris Ht. 0 in.		

290	MGO		0	0.77					Ovality 0.77 %" & Debris Ht. 0 in.		
300	MGO		0	0.77					Ovality 0.77 %" & Debris Ht. 0 in.		
310	MGO		0	0.93					Ovality 0.93 %" & Debris Ht. 0 in.		
320	MGO		0	1.15					Ovality 1.15 %" & Debris Ht. 0 in.		
330	MGO		0	0.89					Ovality 0.89 %" & Debris Ht. 0 in.		
340	MGO		0	0.77					Ovality 0.77 %" & Debris Ht. 0 in.		
350	MGO		0	0.81					Ovality 0.81 %" & Debris Ht. 0 in.		
360	MGO		0	0.76					Ovality 0.76 %" & Debris Ht. 0 in.		
370	MGO		0	0.98					Ovality 0.98 %" & Debris Ht. 0 in.		
380	MGO		0	0.9					Ovality 0.9 %" & Debris Ht. 0 in.		
390	MGO		0	0.52					Ovality 0.52 %" & Debris Ht. 0 in.		
400	MGO		0	0.58					Ovality 0.58 %" & Debris Ht. 0 in.		
410	MGO		0	0.67					Ovality 0.67 %" & Debris Ht. 0 in.		
420	MGO		0	0.4					Ovality 0.4 %" & Debris Ht. 0 in.		
430	MGO		0	0.12					Ovality 0.12 %" & Debris Ht. 0 in.		
440	MGO		0	0.47					Ovality 0.47 %" & Debris Ht. 0 in.		
450	MGO		0	0.56					Ovality 0.56 %" & Debris Ht. 0 in.		
460	MGO		0	0.59					Ovality 0.59 %" & Debris Ht. 0 in.		
470	MGO		0	1.08					Ovality 1.08 %" & Debris Ht. 0 in.		
480	MGO		0	0.99					Ovality 0.99 %" & Debris Ht. 0 in.		
490	MGO		0	0.4					Ovality 0.4 %" & Debris Ht. 0 in.		

500	MGO		0	0.3					Ovality 0.3 %" & Debris Ht. 0 in.		
510	MGO		0	0.96					Ovality 0.96 %" & Debris Ht. 0 in.		
520	MGO		0	1					Ovality 1 %" & Debris Ht. 0 in.		
530	MGO		0	1.22					Ovality 1.22 %" & Debris Ht. 0 in.		
540	MGO		0	1.19					Ovality 1.19 %" & Debris Ht. 0 in.		
550	MGO		0	0.58					Ovality 0.58 %" & Debris Ht. 0 in.		
560	MGO		0	0.62					Ovality 0.62 %" & Debris Ht. 0 in.		
570	MGO		0	0.8					Ovality 0.8 %" & Debris Ht. 0 in.		
580	MGO		0	0.6					Ovality 0.6 %" & Debris Ht. 0 in.		
590	MGO		0	0.66					Ovality 0.66 %" & Debris Ht. 0 in.		
600	MGO		0	0.67					Ovality 0.67 %" & Debris Ht. 0 in.		
610	MGO		0	1.09					Ovality 1.09 %" & Debris Ht. 0 in.		
620	MGO		0	0.64					Ovality 0.64 %" & Debris Ht. 0 in.		
630	MGO		0	1.17					Ovality 1.17 %" & Debris Ht. 0 in.		
640	MGO		0	1.11					Ovality 1.11 %" & Debris Ht. 0 in.		
650	MGO		0	1.79					Ovality 1.79 %" & Debris Ht. 0 in.		
660	MGO		0	1.19					Ovality 1.19 %" & Debris Ht. 0 in.		
670	MGO		0	0.97					Ovality 0.97 %" & Debris Ht. 0 in.		
680	MGO		0	0.67					Ovality 0.67 %" & Debris Ht. 0 in.		
690	MGO										
700	MGO										
707.2	LFDC	F01								3	
707.2	AMH										