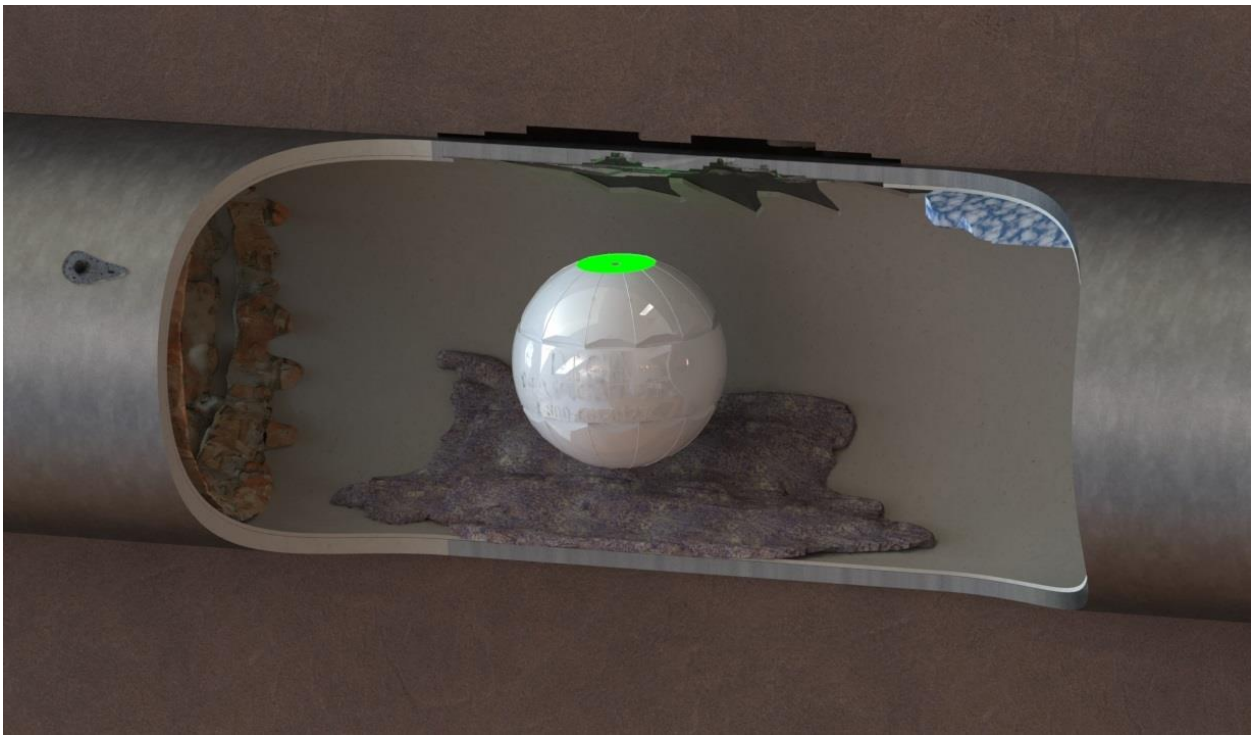
Pipeline Inspection and Condition Analysis Corp.

# FINAL REPORT



## Navigator Survey

Conducted For:
Municipality of Sampletown
Sampletown, AB

PICA Pipeline Inspection and Condition Analysis (USA)Corp.

# Executive Summary

Survey Date: 08/29/23
Report Date: 09/07/23
Line Surveyed: Water Distribution S Block
Service: Leak, Gas Pocket, Magnetometer

**Results**

Leak – One leak was detected at approximately XXXXXXXXXXXX" N and XXXXXXXXXXXXX"W.

Gas Pocket Survey – No gas pockets were detected.

Magnetometer Findings – Four magnetic points of interest were identified.

#1: 79 FT East from Tee - Object ID 413 (Fire Hydrant S04)
#2: 255 FT East from Tee - Object ID 413 (Fire Hydrant S04)
#3: 111 FT West from Tee - Object ID 196 (Fire Hydrant S05)
#4: 51 FT West from Tee - Object ID 196 (Fire Hydrant S05)

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## Our Commitment: Accurate, reliable, actionable results

PICA (Pipeline Inspection and Condition Analysis) is a US and Canadian-owned and operated corporation, with its head office located in Edmonton, Alberta. We have branch offices in the USA in Los Angeles, New Orleans, San Diego, Phoenix, Denver, and Charlotte, and in Canada in Montreal, Toronto, and Vancouver.

PICA was incorporated in 2008 to provide world-class In-Line Inspection services for the municipal water market, the municipal wastewater market, and the power generation market. To accomplish this goal, PICA has borrowed years of experience gained from its sister company, Russell NDE (Non-Destructive Evaluation) Systems Inc. (founded in 1972), which designs and manufactures the In-Line Inspection Tools that PICA uses.

PICA has a dedicated team of scientists who have advanced the science of Remote Field Testing (RFT), Near Field Testing (NFT), and Leak detection and Prescreening (Navigator) for pipeline condition analysis further than any other NDT techniques available. As a result, our technology provides accurate and reliable information that pipeline owners can use to make repair, rehabilitation, or replacement decisions. Our commitment is that after our inspection you will thoroughly understand the condition of your pipeline infrastructure.

## Navigator Operations

PICA conducted a Navigator screening survey for The Municipality of Sampletown on August 29, 2023. The purpose of the survey was to identify leaks and gas pockets with the addition of a magnetometer survey. The following table provides the details of the Navigator operations.

| | |
|---|---|
| Pipeline Identification | Water Distribution S Block |
| Launch Location | XXXXXXXX°, XXXXXXXXXX° |
| Retrieve Location | XXXXXXXXX°, XXXXXXXXXX° |
| Pipe Material | Ductile Iron |
| Pipeline Length | 558 M, 1,829 FT |
| Pipe Diameter | 150 MM 6” and 203 MM 8” |
| Pipe Wall Thickness | 0.25 Inch[1] |
| Pipe Liner | N/A |
| Survey Fluid | Potable Water |
| Trial Run Duration (hours) | 0:30 |
| Data Run 1 Duration (hours) | 0:25 |
| Data Run 2 Duration (hours) | N/A |
| Flow Rate Data Run 1 | 898 GPM |
| Flow Rate Data Run 2 | N/A |
| Average Pressure | 78 PSI |
| PICA Project Manager | David Burton |
| Municipality of Sampletown Project Manager | XXXXXXXXXX |

[1] Wall thickness is assumed based on reference and research using AWWA C151 Class 250 6” DIP.

PICA
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## Location overview

## Navigator Description

PICA's Navigator is an autonomous, free swimming, adjustable buoyancy, screening tool used to detect leaks, gas pockets, and magnetic features. For the two runs conducted, the Navigator was adjusted to neutral buoyancy. This allows that in a pipe with flow, the Navigator will travel in the fluid column. Navigators can be weighted to float so that if they discharge into a reservoir or tank, the device can be retrieved from the surface. The Navigator has a LED flashing light on top so that it can be easily seen when floating.

The Navigator has the following features:

- Multiple pipeline inspection runs and data sets can be stored on board.
- Data is uploaded immediately after the run(s).
- All data sets are recorded on one, removable, non-volatile micro-SD card.
- For new runs, simply replace the SD Card. Labeling the run and micro-SD associated with the data collection is imperative.
- Each Navigator is pressure tested before being sent to the field.
- For potable lines, the resin used in making the Navigator is potable-safe.
- A test ball with the same buoyancy except without electronics is packed in the shipment and run before deploying the Navigator to prove passage.
- Navigators use an enhanced audio transducer that should be "best in class" for detecting leaks and gas pockets.
- The two half-shells screw together and are sealed with an O-ring. Making access to the micro-SD card and battery charging port easy.
- The flashing LED light changes color when:
    - Flashing Blue – Waiting for SD card insertion
    - Inserted micro - SD Card…Flashing green, indicating that the recording has started.
- Charging time is 5 hours. Running time is 24 hours, allowing time to screen long pipelines or to add multiple runs in the same or different pipelines.
- The data is uploaded immediately, and data analysis can start immediately, leading to quicker turnaround for reports.

## Fieldwork Details

The Navigator was inserted into the fire hydrant pictured below. The flow was calculated using the flow meter attached to the catch mechanism and averaged 898 GPM with an average PSI of 78. A dummy device was inserted at 10:10 AM and flushed out of the system at 10:40 AM. The Navigator for data collection run #1 was launched at 11:16 AM and the Navigator was retrieved from the catch device at 11:41 AM.

**Launch Hydrant**

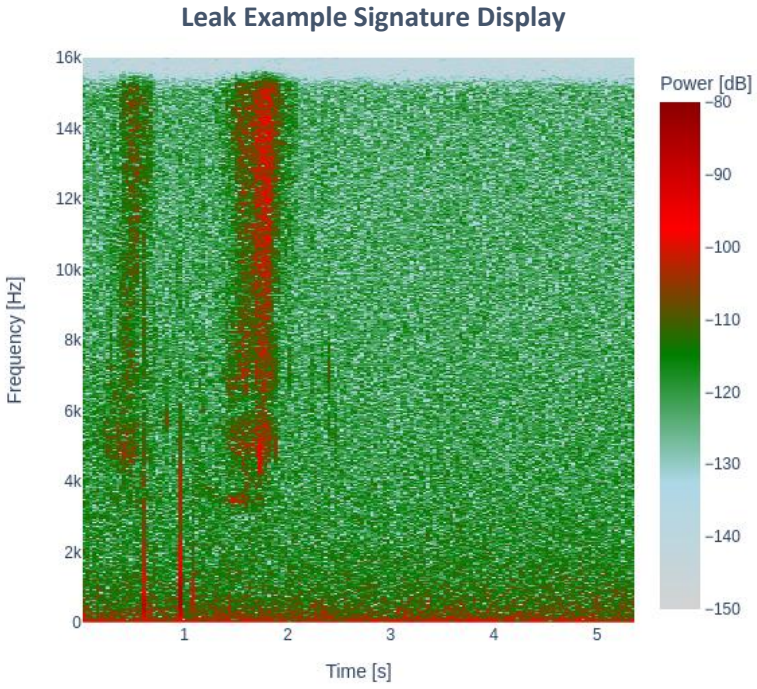
**Navigator**

**Retrieve Hydrant/Catch Mechanism**

## Leak Detection Survey

When there is a leak in a pressurized pipe, the water gets forced out due to the pressure difference between the inside of the pipe and the outside environment. The escape of water from the pressurized system into the lower-pressure environment produces vibrations as the fluid interacts with the pipe material at the leak point. The strength and frequency of these vibrations vary based on factors such as the size of the leak and the water pressure. These vibrations generate sound waves. Once created, these sound waves propagate along the pipe, through the water, and even into the surrounding medium (such as the soil around an underground pipe or the air in a room for an indoor pipe). The sound can be amplified or dampened based on factors like the pipe's material, the temperature and properties of the water, and the characteristics of the surrounding medium. If the sound waves reach a point where they can be detected they will be perceived as the characteristic sound - often a hissing, gurgling, or whooshing sound. In the spectral representation, the acoustic manifestation of the leakage can be discerned as a distinct peak, characterized by rapid descent in intensity at the peripheries due to the progressive attenuation of the acoustic signal. The frequency of a leak will usually be broadband, from tens of Hz up to tens of kHz. A leak was detected by the Navigator at approximately XXXXXXXXX"N and XXXXXXXXX"W.

To determine the approximate location of the leak the following methodology was used, the pipe length was determined to be 1860 FT from the images of the inspection path provided by the customer at the time. The inspected pipe was indicated to be an 8” section followed by a 6” section, with the size changing at the second tee located at Hwy XXX & XXXXX, approximately 500 FT from launch point. The average Navigator speed was calculated dividing the total length by the total inspection time in pipe. The speed was then adjusted to represent the slower travel in 8” relative to the 6” section. Using the two speed values and the features that could be discerned in the acoustic and magnetic data sets, an approximate preliminary location was provided to the customer.




## Detailed Location Analysis

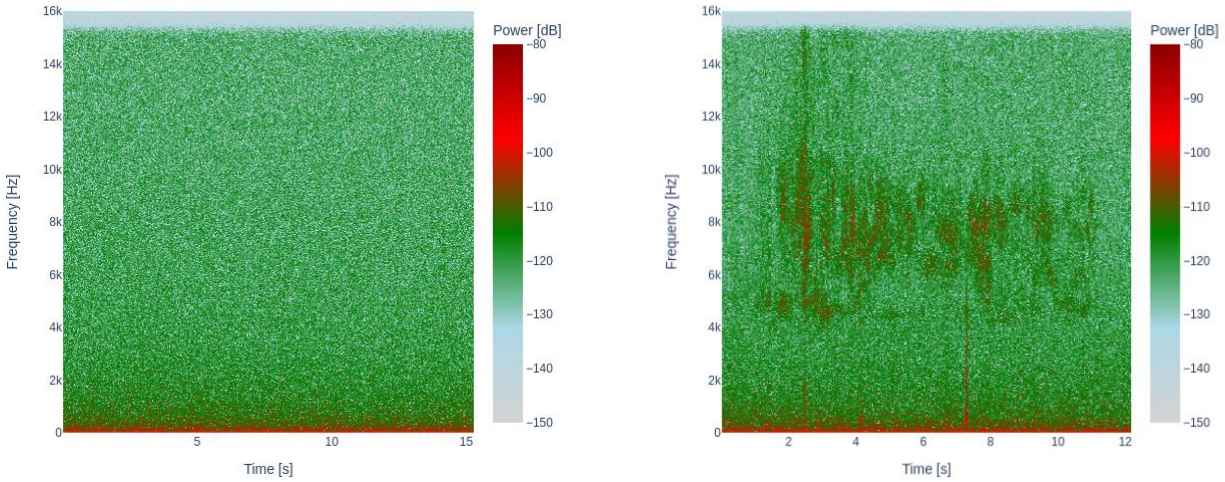
A detailed KMZ file was obtained a few days after the fieldwork was completed from the customer. Exact pipe length was calculated to be 1807.8 FT. The data was then reanalyzed in full detail with feature correlation across KMZ, acoustic, and magnetic data sets. Additional insight was gained into the speed of the Navigator travel throughout the inspection run. The data from both magnetic and acoustic sets indicated a speed change within the 6” pipe that was not expected in the preliminary analysis. Local speeds were calculated using the detailed analysis of the data, with the new location for the leak being adjusted approximately 41 FT East (heading 72°) of the preliminary location.

No other acoustic anomalies were found during the inspection.

## Gas Pocket Survey

The air or gas pockets in pipes produce a signature that will be clearly distinguishable from a leak. The signature will not have a characteristic peak. The frequency range of the signature will be lower, typically under ten kHz. The distance a pocket can encompass can be much longer than a leak. The location of the pockets will often be correlated with high points along the profile of the pipe. No gas pockets were detected by the Navigator.

**Clear/No Indication (Left) Gas/Air Pocket Sample Signature (Right)**



## Magnetometer

The Earth's magnetic field can be harnessed to inspect metallic pipes. As this natural magnetic field interacts with a pipe's structure, features like joints, bends, and inconsistencies in thickness alter the magnetic field flow in specific ways. A device called a magnetometer, built into the Navigator, detects these changes. Joints create distinct signatures, while variations in thickness may indicate wear or damage. By analyzing these magnetic patterns, we can gain an idea of the pipe's internal structure and condition without physically accessing or visually inspecting it. A magnetometer in a free-floating approach introduces variables such as unpredictable positioning and orientation within the pipe making it difficult to correlate magnetic anomalies with specific physical attributes of the pipe, such as exact locations of joints or precise measurements of wall thickness. This data can only yield qualitative insights rather than precise, quantifiable data about the pipe's condition. Consecutive runs are used to correlate significant indications and to improve condition determinations.

The variable speed within similar diameter pipe adds complexity in the interpretation of magnetic data.

Considering the above, the following points of interests were identified:

#1: 79ft east from Tee - Object ID 413 (Fire Hydrant S04)

#2: 255ft east from Tee - Object ID 413 (Fire Hydrant S04)

#3: 111ft west from Tee - Object ID 196 (Fire Hydrant S05)

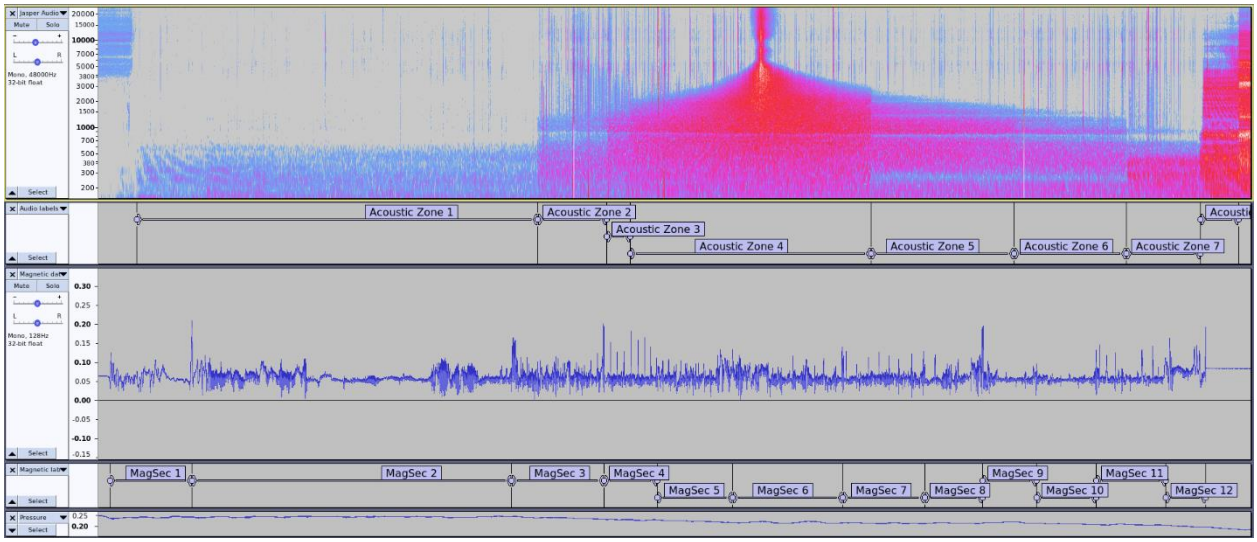
#4: 51 ft west from Tee - Object ID 196 (Fire Hydrant S05)

## Conclusion

The Navigator found a leak at approximately xxxxxxxx"N and xxxxxxxx"W and four areas of interest based on the magnetometer findings. The collected acoustic and magnetometer data is of excellent quality and does not have any significant external or internal noise sources that would interfere with or prevent analysis.

## Leak Signature Image

The images below provide a visualization of the data collected. The acoustic data is shown on top with the magnetometer data below. The indication of the beginning of the data collection is shown with the complete profile of the data collection shown in the following image.



## Best Efforts

While planning, collecting, and analyzing the data and producing this report it is important for clients to understand the limitations and operating conditions encountered by the Navigator. By acknowledging that the interpretations are based on the experience and judgment of the PICA team, and that the accuracy or completeness of those interpretations is not guaranteed. Furthermore, stating that all opinions, interpretations, and analyses are provided on a "best effort" basis reinforces the idea that the PICA team has made their best attempt to provide valuable insights based on the data and their expertise, but there may still be inherent uncertainties and limitations in the process. It is ultimately up to the client to evaluate the information and draw their own conclusions, considering the context and specific needs of their situation.

This approach promotes transparency and encourages the client to exercise independent judgment when utilizing the information presented in the report. It also helps manage expectations and ensures that the responsibility for decision-making based on the report lies with the client.

PICA recommends repeat runs where the data from each run can be compared, and differences highlighted. PICA has a program whereby an owner can purchase a Navigator, thereby saving future shipping costs. PICA can run the client-owned Navigator on their behalf and if the client wishes to run it themselves, after PICA has trained them on how to charge the battery and insert/remove the SD Card and up-load the data files, that is the most cost-effective way to gather screening data. In all cases, the client pays for the data analysis as a separate cost item.