MEMORANDUM

TO: Mayor and Members of the City Council

FROM: Rich Olson, City Manager
Amanda Boone, Director of Public Utilities

DATE: July 10, 2020

REF: Consideration / Presentation – AIA Grant (Water) – Closeout

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BACKGROUND:

In May of 2018, the Public Utilities Division was awarded $150,000 from the Division of Water Infrastructure for help with funding of a water loss detection program. The City contracted with Gutermann, Inc to provide training, equipment and documentation to implement and sustain a water loss reduction program.

ANALYSIS:

The awarded grant funds were used to purchase four Gutermann products. These four products were Zonescan 820, Aquascan 610, Multiscan and the Aquascope 3. Awarded grant funds also went towards training and support of this equipment.

To date, 35% of the City's water lines have been assessed. As previously reported, the leaks on Parsonage Street and Mill Street totaled over 1.5 million gallons a month. The assessment has also experienced some challenges to our water loss reduction program. The challenges are as follows:

1. *Limited staffing* – Only one employee has part time availability to commit to this program;
2. *Outdated meters* – The age of the meters does not allow us to adequately conduct a water audit comparing water generated to water sold;
3. *Repairs* – Some the equipment had to be sent in for repairs which delayed the progress; and
4. *Training and troubleshooting* – In addition to follow up training staff has identified inaccuracies with the pipe material in GIS.

As part of the grant, we have developed a comprehensive water loss reduction program. The manual for the program is attached.

Despite the aforementioned challenges, City staff believe this AIA grant has been a success, and continues yielding valuable data to support the proactive, cost-effective management of water distribution infrastructure. While leak detection and repairs are continual efforts, the grant's scope of work is complete and City staff wish to close it out. This will also allow the City to receive the remaining balance of the grant, which is $49,620.

Closeout of this grant also requires a documented presentation to the City Council; City staff have therefore prepared the following resolution for consideration following the presentation and any discussion Councilors may have.

STAFF RECOMMENDATION:

Following the presentation/discussion, by motion, adopt and authorize the mayor to execute the attached resolution.

Resolution # 2020 –7-03
Completion and Presentation of State Grant Project No. H-AIA-D-18-0132
Water Asset Inventory and Assessment

WHEREAS, the North Carolina General Statutes Chapter 159G has created Asset Inventory and Assessment (AIA) grants to assist eligible units of government with meeting their water infrastructure needs, and

WHEREAS, the North Carolina Department of Environmental Quality has awarded a State Reserve Grant in the amount of $150,000 to the City of Elizabeth City to perform asset inventory and assessment work, and

WHEREAS, the City of Elizabeth City's Public Utilities Department has received leak-detection equipment and training in support of grant objectives,

NOW THEREFORE BE IT RESOLVED, BY THE CITY COUNCIL OF THE CITY OF ELIZABETH CITY:

1. That this Council has received a full report on the equipment, training, and activities received and performed as a result of its AIA State Reserve Grant of $150,000.

2. That this Council finds the aforementioned AIA has yielded, and continues to yield, valuable data that enables the City's Public Utilities Department to undertake more timely, proactive, and strategic repairs and improvements to the City's water distribution infrastructure.

3. That this Council finds the AIA was completed in a proper, professional manner, and in compliance with this grant award's conditions and assurances.

4. That this Council hereby authorizes Mayor Bettie J. Parker, and successors so titled, to execute this resolution on its behalf, and to continue to represent this City in reference to this project, including the furnishing of any information or document executions which may be required by the North Carolina Department of Environmental Quality.

ADOPTED, this the 13th day of July 2020.

Bettie J. Parker
Mayor

April D. Onley
City Clerk

<u>CERTIFICATION BY RECORDING OFFICER</u>

The undersigned duly qualified and acting City Clerk of the City of Elizabeth City does hereby certify: That the above/attached resolution is a true and correct copy of the resolution authorizing the filing of an application with the State of North Carolina, as regularly adopted at a legally convened meeting of the City Council of the City of Elizabeth City duly held on the 13th day of July 2020; and, further, that such resolution has been fully recorded in the journal of proceedings and records in my office.

IN WITNESS WHEREOF, I have hereunto set my hand this 13th day of July 2020.

April Onley,
City Clerk

SEAL

Asset and Inventory Assessment Grant Closeout

Amanda C. Boone, PE
Public Utilities Director
City of Elizabeth City
July 13, 2020

Grant Background

- Amount:
  - $150,000
- Funder:
  - Division of Water Infrastructure, North Carolina Department of Environmental Quality
- Timeline:
  - Applied in Fall 2017, awarded in Spring 2018

Grant Purpose

- Fund water loss detection program on City-owned lines
- Purchase leak detection equipment and training services
- Assess water lines to locate leaks and conduct repairs
- Maintain record of water line conditions

Grant Impact

- 36% of City water lines assessed so far
- Over a dozen leaks located, many were unnoticeable by just looking at the surface
  - Ex: Two leaks on Parsonage St and on Mill St had been leaking over 1.5 million gallons per month
- Online map displays results to City staff and the public

Challenges

- Limited staffing capabilities → slower rate of assessment
- Outdated water meters → inaccurate data for the volume of water sold
- Repairs on leak detection equipment → delayed work
- Training and troubleshooting to optimize technology

City of Elizabeth City

Public Utilities Department

Leak Detection Policy and Plan

June 30, 2020

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1. Program Purpose

The Leak Detection Program aims to locate and maintain records of the City's water leaks. From 2008-2017, the City experienced an average water loss rate of 33%. Within this 10-year period, the water loss rate fluctuated between 26% and 40% but maintained an overall upward trend. Water loss may occur at any point between the wellfield and the point of delivery for customers. With aging infrastructure and damaging storms, the City must address this worsening problem. The Leak Detection Program enables City staff to identify leaks and plan capital improvement projects.

2. Water Loss Prevention

Detecting and repairing water leaks is an important component of water conservation. Water lost between treatment and delivery is a waste of water, money, and energy. By locating and repairing leaking water pipes, these losses within the system are greatly reduced.

According to the American Water Works Association (AWWA), water loss prevention in the past involved a target water loss rate (ex. 10% or less). However, the November 2019 AWWA Water Loss Control Committee Report recommends against percentage indicators due to their ineffective "one size fits all" approach. Instead, the AWWA recommends that utilities assess water loss with the three V's:

- **Volume** (MG/year or Gal/connect/day) of annual losses,
- **Value** ($) of annual losses in uncaptured revenue & excessive production costs, and
- **Validity** (Data Validity Score) through water audit data quality.

At present, the City cannot fully utilize the three V's approach. Current practices and capabilities must be improved in order to assess the City's water loss. Staff will take several steps to enhance our current efforts. First, staff will measure the diameter of water line holes to better estimate the volume of water lost. Second, staff will continue to use accumulated data on leak locations to identify and repair frequent issue areas. Third, staff will continue to upgrade water meters across the City. The majority of water meters are outdated and therefore do not provide accurate data for the volume of water sold. These steps will enable City staff to better understand the magnitude and distribution of its water loss problem.

Unauthorized water loss may be caused by a variety of factors, including old or poorly constructed pipes, inadequate corrosion protection, poorly maintained valves, and mechanical damage. Leak detection has historically assumed that most leaks visibly reach the surface. However, major leaks can continue below ground for long periods of time and remain undetected by simply looking at the surface. Large leaks do not necessarily constitute the greatest volume of lost water. Small, undetected leaks can persist for a long period of time and lead to significant water loss.

Leak detection and repair generally result in an immediate reduction in water loss. In contrast, line replacement eliminates a root cause of leaks (i.e. aging infrastructure) to yield a longer lasting impact. A successful leak detection and repair program requires accurate, detailed, and consistent records to assess where recurring leaks and damages require line replacement in lieu of line repair. The water system should keep three sets of records: (1) regular reports on unaccounted-for water; (2) leak-repair report forms; and (3) updated maps of the distribution system showing the location, type, and class of each leak.

Minimizing water loss in the system has many benefits for customers and the City. These benefits include:

- Improved operational efficiency;

- Lowered water system operational costs;
- Reduced risk of contamination;
- Extended life of facilities;
- Reduced risk of property damage and water system liability;
- Reduced water outage events; and
- Improved public relations.

Additional benefits of a comprehensive leak detection and repair plan may be more difficult to quantify. These benefits include:

- Increased knowledge about the distribution system, leading to quicker response time in emergencies and clearer priorities for replacement and rehabilitation programs;
- More efficient use of system supplies and delayed capacity expansion;
- Increased firefighting capability;
- Improved inspection of hydrants and valves; and
- Updated distribution system maps.

Leak Types, Causes, and Indicators

The various types of leaks include service line leaks, valve leaks, and supply line leaks. Most water loss is due to supply line leaks. Leaks are often caused by a combination of multiple factors. One group of causes pertains to the distribution system components; these causes include line material, composition, age, and installation methods. Another group of causes relates to the water conditions; these causes include temperature, velocity, and pressure. Lastly, leaks may result from external conditions; these causes include stray electric currents, contact with other structures, traffic vibrations, frost loads, and freezing soil.

While underground leaks are harder to visually detect, they may be indicated by any of the following signs:

- An unusually wet spot in a landscaped area or pooling water on the ground;
- A green, moldy, soft, or mossy area surrounded by drier conditions;
- A notable drop in water pressure or flow volume;
- A sudden problem with rust, dirt, or air in the water supply;
- A dying area of irrigated vegetation that was formerly thriving;
- A heaving or cracking paved area;
- A sinkhole or pothole;
- An uneven floor grade or leaning of a structure; and
- An unexplained sudden increase in water use, consistently high water use, or water use that has been climbing at a fairly steady rate for several billing cycles.

3. Gutermann Technology

In September 2017, the City applied for an Asset and Inventory Assessment Grant from the North Carolina Department of Environmental Quality. The grant purpose was to fund a water loss detection program by assessing City-owned lines and maintaining records of line conditions. In May 2018, the City was awarded the grant for $150,000. With these funds, the City purchased equipment, training, and support from Gutermann. Gutermann is an award-winning global leader and innovator in water loss and leak detection technology. They have specialized in conventional acoustic leak detection equipment for over 60 years.

The suite of Gutermann technology purchased includes four products: ZoneScan, MultiScan, AquaScan, and AquaScope. Using this equipment, water leak locations are viewed on ZoneScan.net or the AquaScan tablet and then transferred to the GIS database. This system ensures that the City maintains updated records of leak locations to show where repairs are most urgently needed.

4. Leak Detection Team

Richard Perkins - Construction Specialist II
- Participates in training
- Handles all the equipment and field work

Bob Rice - Water Treatment Plant Operator
- Participates in training
- Handles all of the equipment and field work

Raymond Staten - Water Treatment Plant Superintendent
- Participates in training
- Assists in the field assessments when necessary

Julius Williams - Utility Systems Superintendent
- Participates in training
- Coordinates with crews to assist water valve cleaning for deployment of equipment
- Oversees repair and replacement of leaking water lines

Amy Durden - GIS Coordinator
- Participates in training
- Handles the GIS data from ZoneScan.net and the AquaScan tablet
- Communicates with Gutermann representative

Laura Smallman - GIS Technician
- Participates in training
- Handles the GIS data from ZoneScan.net and the AquaScan tablet
- Communicates with Gutermann representative

5. Assessment Schedule

Quad-Based Assessment

All City-owned water lines should be checked regularly with ZoneScan or MultiScan, as appropriate. Areas with potential leaks should be further examined with the AquaScope and AquaScan. Using the quad mapping system, a schedule should be followed to assess Quads A-L one at a time. Staff should take the following steps for the regular quad-based assessment each week:

1. Between Monday and Thursday (ideally Monday or Tuesday), the Construction Specialist II will deploy ZoneScan or MultiScan loggers overnight in a given quad. Loggers should not be placed on Friday to avoid leaving them out over a weekend.
2. Each day an assessment is completed, Construction Specialist II will bring the collected ZoneScan and MultiScan data to the GIS Coordinator and the GIS Technician. The GIS staff will regularly update their records and maps of assessment results.
3. If a leak is located based on correlation and reports on ZoneScan.net, the Construction Specialist II will verify the leak location and accuracy with the AquaScan 610 and the AquaScope.
4. If a leak is verified, the Utility Systems Superintendent will add the site to their problem areas sheet and create a work order. Additionally, the Construction Specialist II will share the AquaScan 610 or AquaScope data to the GIS Coordinator and the GIS Technician. The GIS staff will regularly update their records and map of assessment results.
5. Repeat Steps 1-4 over multiple days or weeks until all water lines in the quad are assessed.
6. Once a quad is complete, repeat Steps 1-5 in the subsequent quad.

Request-Based Assessment

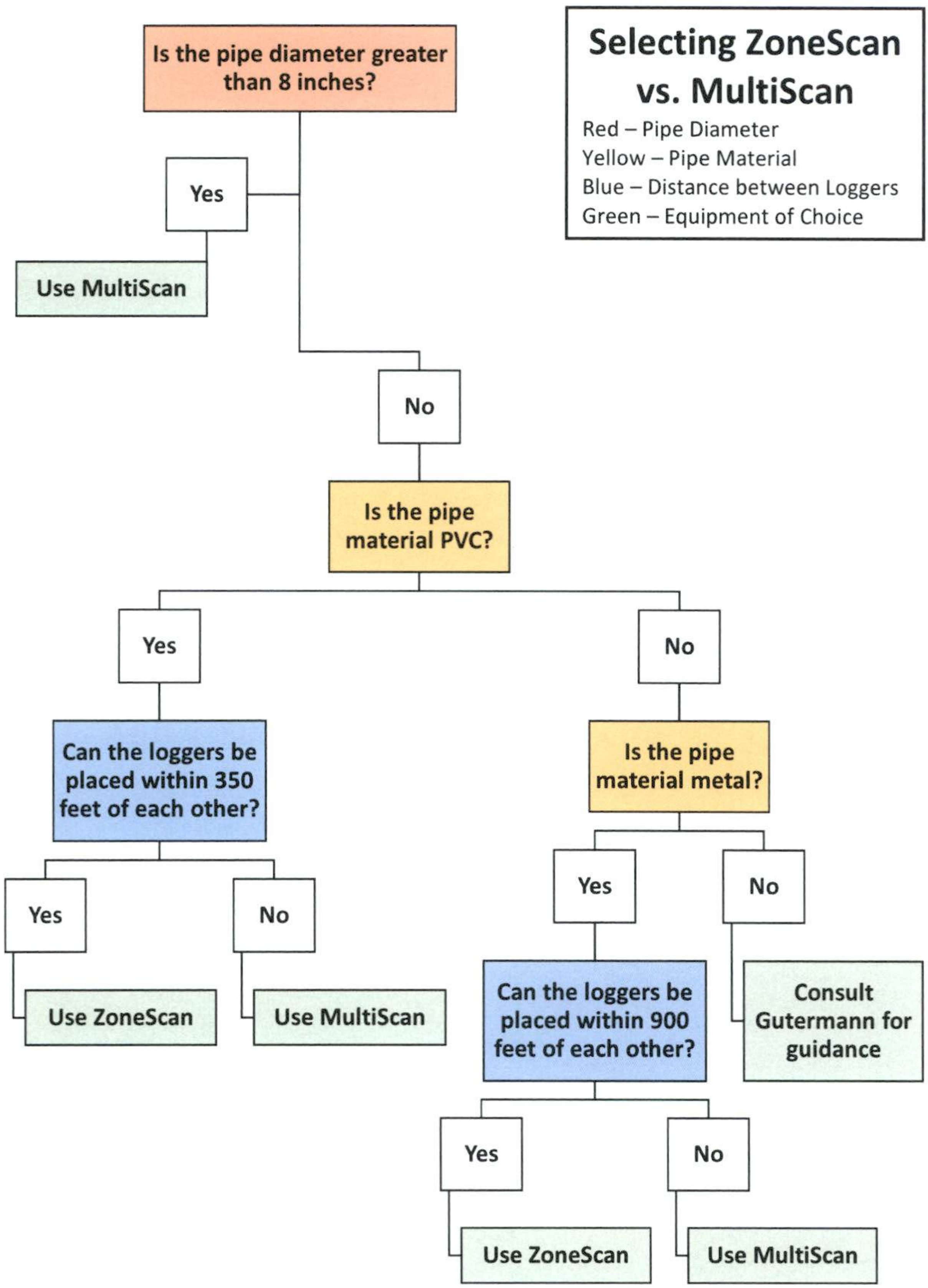
Beyond the routinely scheduled water line assessment, other staff or community members might request that the City confirm suspected leaks. Staff should take the following steps for such unscheduled assessments:

1. The Construction Specialist II will verify the leak location and accuracy with the AquaScan 610 and the AquaScope.
2. If a leak is verified, the Utility Systems Superintendent will add the site to their problem areas sheet and create a work order.
3. Each day an assessment is completed, the Construction Specialist II will share the collected data with the GIS Coordinator and the GIS Technician. The GIS staff will regularly update their records and map of assessment results.

6. Standard Operating Procedures: General

The Gutermann suite of leak detection equipment includes four devices: ZoneScan, MultiScan, AquaScan, and AquaScope. The leak detection process involves a three-step strategy which clarifies when each device should be used. First, water loss will be localized to a specific area or zone using either ZoneScan or MultiScan. Second, the position of the leak will be located using AquaScan. Third, the leak will be pinpointed prior to excavation and repair using AquaScope.

The following decision tree guides staff through selecting between ZoneScan and MultiScan for localizing leaks. As the graphic shows, the decision is based on three factors: pipe diameter (red boxes), pipe material (yellow boxes), and distance between loggers (blue boxes).


Selecting ZoneScan vs. MultiScan
Red – Pipe Diameter
Yellow – Pipe Material
Blue – Distance between Loggers
Green – Equipment of Choice
Is the pipe diameter greater than 8 inches?
Yes
Use MultiScan
No
Is the pipe material PVC?
Yes
Can the loggers be placed within 350 feet of each other?
Yes
Use ZoneScan
No
Use MultiScan
No
Is the pipe material metal?
Yes
Can the loggers be placed within 900 feet of each other?
Yes
Use ZoneScan
No
Use MultiScan
No
Consult Gutermann for guidance

7. Standard Operating Procedures: ZoneScan

ZoneScan Description

The ZoneScan correlating radio loggers monitor and analyze noise characteristics in the water distribution system to detect and locate potential leaks. The loggers are deployed during the day, left overnight, and collected the next day. A total of 40 loggers are available to be deployed in any given area. The loggers can be placed on valves, hydrants or meters. Each logger should be placed at least 25 feet apart from another to prevent an overlap in their signals. As the decision tree in *Section 6. Standard Operating Procedures: General* outlines, the maximum distance between ZoneScan loggers is 350 feet for PVC pipes and 900 feet for metal pipes. The loggers operate best during low-flow hours, typically 2AM to 4AM. The ZoneScan equipment is displayed and labeled in *Appendix A*.

ZoneScan Equipment and Supplies

- ZoneScan/MultiScan tablet
- 40 ZoneScan loggers (black wire)
- ZoneScan communication link
- Measuring wheel
- Logger deployment chart
- Cleaning cloths
- Wire brush
- Dewatering pump
- Auger
- String
- Hook and rod
- Binder clips
- Valve key
- Valve turning binder

ZoneScan Field Directions

1. Confirm whether to use ZoneScan or MultiScan based on pipe diameter, pipe material, and feasible distance between loggers (see decision tree in *Section 6. Standard Operating Procedures: General*).
    a. Determine the pipe diameter and material based on existing GIS data. Be aware that the GIS database may incorrectly label some pipes as PVC. If needed, confirm the pipe diameter based on valve turns using the valve key. Record findings in the valve turning binder.
    b. Assess the area to locate potential sites for placing ZoneScan loggers. Use the measuring wheel to ensure loggers are appropriately spaced. Loggers may be placed on valves, hydrants, or meters.
2. Once the logger placements are determined, clean the logger placement sites.
    a. To place a logger on a water valve, clean the valve of water and dirt.
        i. Use the auger and cleaning cloths to clean the valve box of dirt and debris until the top of the valve stem is exposed. For metal to metal connections, use the wire brush to clean the top of the valve so the logger will have a clean, firm contact.
        ii. If the valve is underwater, use the dewatering pump to remove water until the top of the valve is clear.
    b. To place a logger on a hydrant, directly sit the logger on the hydrant.
    c. To place a logger on a meter, clear out water and dirt from the meter box.
        i. If the pipe material is metal and the City-side pipe is reasonably accessible, clean inside the meter box until the City-side of the water line is accessible for metal-to-metal contact with the logger.
        ii. If the pipe material is not metal or the City-side of a metal pipe is not reasonably accessible, clean inside the meter box until the water meter shut-off valve is accessible enough to hold the binder clips.
        iii. If the meter is underwater, use the dewatering pump to remove water.
        iv. If dirt and debris are in the meter box, clean with the auger and cleaning cloths.
3. Turn on the ZoneScan communication link.
4. Using the ZoneScan/MultiScan tablet, open the ZoneScan app to create the Area.
    a. Name the Area by quad and date (Example: Quad D 01.03.2020). The date should correspond to the day the data will be collected, not the day the logger is placed.
    b. Select "Program Loggers."
        i. Check the boxes for all 40 loggers. Not all 40 loggers will necessarily be used, but it is better to prepare all in advance by selecting all 40 on the tablet.
        ii. Check the boxes for both "Noise Level Measurements" and "Correlation."
    c. Once programmed, the app will automatically bring up the map for deployment. At this point, turn off the communication link.
    d. In the ZoneScan app on the tablet, select Deploy.

5. Place one logger on each desired valve, hydrant, or meter for assessment.
    a. Ensure that the loggers you physically deploy matches the logger numbers on the tablet.
        i. Record the placement (valve, meter, hydrant) of the logger in the logger deployment chart.
        ii. If a logger must be placed at a water meter, use one of the following two options.
            1. If the pipe material is metal and the City-side pipe is accessible, place the logger directly on the City-side of the water line.
            2. If the pipe material is not metal or the City-side of a metal pipe is inaccessible, place binder clips on the meter shut-off valve. Place the loggers on the binder clips for metal-to-metal contact.
        iii. If a valve is very deep (not within arm's reach), use string to lower down the logger until you feel the magnetic connection.
        iv. If the valve is exceptionally deep (not within string's reach), use the hook and rod to lower the logger down until you feel the magnetic connection.
    b. Stand overtop of the location of the logger with the tablet, ensure your GPS location looks accurate, and select Deploy for each logger.
    c. Once done, click the button at side of tablet to turn off screen. Pack up all equipment and supplies.
6. Collect loggers the next day.
    a. The following morning, go to collect each of the loggers.
    b. If you do not remember the exact logger location, use the ZoneScan app on the tablet to verify their locations.
    c. Use ZoneScan app on tablet to select Collect. Either collect individually or select "Collect All." Collect All may be preferred for efficiency.
    d. Remove loggers (from valve, meter, or hydrant) and clean loggers with cleaning cloth.
    e. Place cleaned loggers back into the case in numerical order.
    f. Once done, click button at side of tablet to turn off screen. Pack up all equipment and supplies.
7. Upload collected data to the cloud.
    a. Return either to the office, water plant, or another secure location.
    b. Place the communication link next to the loggers.
    c. Turn on the communication link.
    d. Open the ZoneScan app on the tablet and select "Upload Data."
    e. Ensure that only the loggers used during this data collection are selected for data uploading.
    f. Once done, click button at side of tablet to turn off screen. Turn off communication link. Pack up all equipment and supplies.

8. Standard Operating Procedures: MultiScan

MultiScan Description

The MultiScan Multi-Point Correlator uses highly sensitive acoustic correlation measurements to indicate potential leak locations. Ideally, the sensors will be programmed overnight during low-flow hours, typically 2AM-4AM. If needed (especially for emergency work), the sensors can be programmed for a parallel measurement over a few minutes during the daytime. A total of 10 loggers are available to be deployed in any given area. The loggers should be placed at least 25 feet apart from each other to prevent an overlap in their signals. The loggers can be placed on valves, hydrants or meters. As the above decision tree in *Section 6. Standard Operating Procedures: General* outlines, the maximum distance between MultiScan loggers is 450 feet for PVC pipes and 1200 feet for metal pipes. The MultiScan equipment is displayed and labeled in *Appendix B*.

MultiScan Equipment and Supplies

- MultiScan/ZoneScan tablet
- 10 MultiScan loggers (blue wire)
- MultiScan communication link
- Logger deployment chart
- Measuring wheel
- Cleaning cloths
- Wire brush
- Dewatering pump
- Auger
- String
- Hook and rod
- Binder clips
- Valve key
- Valve turning binder

MultiScan Field Directions

1. Confirm whether to use MultiScan or ZoneScan based on pipe diameter, pipe material, and feasible distance between loggers (see decision tree in *Section 6. Standard Operating Procedures: General*).
    a. Determine the pipe diameter and material based on existing GIS data. Be aware that the GIS database may incorrectly label some pipes as PVC. If needed, confirm the pipe diameter based on valve turns using the valve key. Record findings in the valve turning binder.
    b. Assess the area to locate potential sites for placing MultiScan loggers. Use the measuring wheel to ensure loggers are appropriately spaced. Loggers may be placed on valves, hydrants, or meters.
2. Once the logger placements are determined, clean the logger placement sites.
    a. To place a logger on a water valve, clean the valve of water and dirt.
        i. Use the auger and cleaning cloths to clean the valve box of dirt and debris until the top of the valve stem is exposed. For metal to metal connections, use the wire brush to clean the top of the valve so the logger will have a clean, firm contact.
        ii. If the valve is underwater, use the dewatering pump to remove water until the top of the valve is clear.
    b. To place a logger on a hydrant, directly sit the logger on the hydrant.
    c. To place a logger on a meter, clear out water and dirt from the meter box.
        i. If the pipe material is metal and the City-side pipe is reasonably accessible, clean inside the meter box until the City-side of the water line is accessible for metal-to-metal contact with the logger.
        ii. If the pipe material is not metal or the City-side of a metal pipe is not reasonably accessible, clean inside the meter box until the water meter shut-off valve is accessible enough to hold the binder clips.
        iii. If the meter is underwater, use the dewatering pump to remove water.
        iv. If dirt and debris are in the meter box, clean with the auger and cleaning cloths.
3. Turn on MultiScan communication link.
4. Using the MultiScan/ZoneScan tablet, open the MultiScan app to create the Area.
    a. Name the Area by quad and date (Example: Quad D 01.03.2020). The date should correspond to the day the data will be collected, not the day the logger is placed.
    b. Select "Program Loggers."
        i. Check the boxes for all 10 loggers. Not all 10 loggers will necessarily be used, but it is better to prepare all in advance by checking all 10 on tablet.
    c. Select the desired duration of recording.
        i. If for quick use: set to 30 minutes (leave enough time to place all of the loggers).
        ii. If for overnight use: set time for reading at 2AM, click program.

   d. Select "Correlation."
   e. Once programmed, the app will automatically bring up the map for deployment. At this point, turn off the communication link.
   f. In the MultiScan app on the tablet, select Deploy.
5. Place one logger on each desired valve, hydrant, or meter for assessment.
   a. Ensure that the logger you physically deploy matches the logger number on the tablet.
      i. Record the placement (valve, meter, hydrant) of the logger in the logger deployment chart.
      ii. If a logger must be placed at a water meter, use one of the following two options.
         1. If the pipe material is metal and the City-side pipe is accessible, place the logger directly on the City-side of the water line.
         2. If the pipe material is not metal or the City-side of a metal pipe is inaccessible, place binder clips on the meter shut-off valve. Place the loggers on the binder clips for metal-to-metal contact.
      iii. If a valve is very deep (not within arm's reach), use string to lower down the logger until you feel the magnetic connection.
      iv. If the valve is exceptionally deep (not within string's reach), use the hook and rod to lower the logger down until you feel the magnetic connection.
   b. Stand overtop of the location of the logger with the tablet, ensure your GPS location looks accurate, and select Deploy for each logger.
   c. Once done, click button at side of tablet to turn off screen. Pack up all equipment and supplies.
6. Collect the loggers. If for quick use, collect once the duration of recording is complete. If for overnight use, collect the next morning.
   a. If you do not remember the exact logger location, use the MultiScan app on the tablet to verify their locations.
   b. Remove loggers (from valve, meter, or hydrant) and clean loggers with cleaning cloth.
   c. Place cleaned loggers back into case the in numerical order.
   d. Once done, click button at side of tablet to turn off screen. Pack up all equipment and supplies.
7. Upload collected data to the cloud.
   a. Return either to the office, water plant, or another secure location.
   b. Place the communication link next to the loggers.
   c. Turn on the communication link.
   d. Open the MultiScan app on tablet. Select "Read Loggers." Select "Upload Data."
   e. Ensure that only the loggers used during this data collection are selected for data uploading.
   a. Once done, click button at side of tablet to turn off screen. Turn off communication link. Pack up all equipment and supplies.

9. Standard Operating Procedures: AquaScan

AquaScan Description

AquaScan 610 is a leak noise correlator used to more accurately determine a leak location. Once a leak has been localized with ZoneScan or MultiScan, this equipment offers a quick analysis to pinpoint the leak location. This technology yields a pinpointing precision of 1 centimeter per 100 meters of pipe distance, which minimizes excavation costs for pipe repair or replacement. The two loggers should be placed at least 25 feet apart to prevent an overlap in their signals. The maximum distance between AquaScan loggers is 400 feet for PVC pipes and 1000 feet for metal pipes. The loggers can be placed on valves, hydrants or meters. The AquaScan equipment is displayed and labeled in *Appendix C*.

AquaScan Equipment and Supplies

- 2 AquaScan loggers (one with red wire attached, one with yellow wire attached)
- 2 flagged antennae (one with red labeled flag, one with yellow labeled flag)
- 2 wires (to connect a logger to its antenna)
- AquaScan communication link
- AquaScan headphones
- AquaScan tablet
- Measuring wheel
- Logger deployment chart
- Cleaning cloths
- Wire brush
- Dewatering pump
- Auger
- String
- Hook and rod
- Binder clips
- Valve key
- Valve turning binder

AquaScan Field Directions

1. Confirm pipe diameter and material to determine desired distance between loggers.
    a. Determine the pipe diameter and material based on existing GIS data. Be aware that the GIS database may incorrectly label some pipes as PVC. If needed, confirm the pipe diameter based on valve turns using the valve key. Record findings in the valve turning binder.
    b. Assess the area to locate potential sites for placing AquaScan loggers. Use the measuring wheel to ensure loggers are appropriately spaced. Loggers may be placed on valves, hydrants, or meters.
2. Once the logger placements are determined, clean the logger placement sites.
    a. To place a logger on a water valve, clean the valve of water and dirt.
        1. Use the auger and cleaning cloths to clean the valve box of dirt and debris until the top of the valve stem is exposed. For metal to metal connections, use the wire brush to clean the top of the valve so the logger will have a clean, firm contact.
        2. If the valve is underwater, use the dewatering pump to remove water until the top of the valve is clear.
    b. To place a logger on a hydrant, directly sit the logger on the hydrant.
    c. To place a logger on a meter, clear out water and dirt from the meter box.
        1. If the pipe material is metal and the City-side pipe is reasonably accessible, clean inside the meter box until the City-side of the water line is accessible for metal-to-metal contact with the logger.
        2. If the pipe material is not metal or the City-side of a metal pipe is not reasonably accessible, clean inside the meter box until the water meter shut-off valve is accessible enough to hold the binder clips.
        3. If the meter is underwater, use the dewatering pump to remove water.
        4. If dirt and debris are in the meter box, clean with the auger and cleaning cloths.
3. Turn on both loggers.
4. Hold the button on loggers to calibrate for pipe material. Continue to hold the button until the red light is:
    a. Solid, if pipe material is metal; or
    b. Flashing, if pipe material is PVC.
5. Place the loggers on each desired site valve, hydrant, or meter.
    a. Ensure that antennae are above ground.
    b. Record the placement (valve, meter, hydrant) of the logger in the logger deployment chart.
    c. If a logger must be placed at a water meter, use one of the following two options.
        1. If the pipe material is metal and the City-side pipe is accessible, place the logger directly on the City-side of the water line.

    2. If the pipe material is not metal or the City-side of a metal pipe is inaccessible, place binder clips on the meter shut-off valve. Place the loggers on the binder clips for metal-to-metal contact.
  d. If a valve is very deep (not within arm's reach), use string to lower down the logger until you feel the magnetic connection.
  e. If the valve is exceptionally deep (not within string's reach), use the hook and rod to lower the logger down until you feel the magnetic connection.

6. Use the measuring wheel to measure the distance between loggers. Position yourself at approximately the midpoint between the two loggers while holding the AquaScan communication link and AquaScan tablet.
7. Turn on the AquaScan communication link and tablet.
8. On the AquaScan tablet, enter the password: aquascan.
9. Double tap AquaScan icon.
10. Prepare for new correlation.
    a. Under the "Correlate" tab, open the pipe icon to add the pipe segment. Click "Add Segment," enter the length (measured distance between the loggers), pipe material (based on previous knowledge; if unknown, use GIS information), and the pipe diameter (based on previous knowledge or valve turns).
    b. Tap the "Prepare New Correlation" button to set the information. App will automatically adjust sound velocity.
    c. Under the "Filter" tab click "Auto."
    d. Under the "Correlate" tab, press the red record button. At this point, the loggers should begin to listen for the leak using different frequencies.
11. Allow loggers to run, usually will take 3-5 minutes. Once a correlation is reached, check the signal quality for a 75% or better signal. If signal quality is below 75%, reposition yourself between the two loggers until optimal signal quality is achieved.
12. Verify accuracy of results by repeating Steps 10 & 11 for a second and third time. If the leak location is inconsistent, then continue to rerun until a more precise leak location is found.
13. To save the data, press the save icon. Name file (Street or Intersection Name and Date). The data file will automatically save as a PDF in the Downloads folder. A sample of this data file is shown in *Appendix G*.
14. When testing is complete, retrieve and clean loggers with the cleaning cloth. Turn off loggers, communication link, and tablet before storing.
15. Return to the GIS office and plug the tablet into a computer. Drag desired PDF file from tablet's folder onto the GIS>Leak Detection>610 Reports folder on the computer.

10. Standard Operating Procedures: AquaScope

AquaScope Description

AquaScope 3 is a leak locator and acoustic listening device. This equipment verifies a known leak location determined from any of the previous three pieces of equipment. AquaScope is used in the final step of pinpointing the leak location before planning for repairs. The AquaScope equipment is displayed and labeled in *Appendix D*.

AquaScope Equipment and Supplies

- AquaScope amplifier unit
- AquaScope headphones
- Amplifier wire
- Elephant foot
- Hand probe attachment (3 rods)
- Metal probe
- Blue spray paint

AquaScope Field Directions

1. Based on desired application, select one of the following attachments:
    a. Elephant foot for concrete pavement or hard surfaces;
    b. Metal probe for hydrants or meter pits; or
    c. Hand probe attachment for grass, soil, or soft surfaces.
2. Use wire to connect amplifier with the selected attachment.
3. Ensure amplifier is on and wear headphones.
4. Drag the attachment along the surface to follow the increasing signal number until you reach the highest signal number. If the headphones carry a focused low rumble sound, then a leak is present. The leak is location is closest to the maximum signal number.
5. While moving the attachment along the surface, you may turn on the filter by holding down the light blue plus and minus buttons simultaneously. Depending upon your preference, adjust the hertz level with the light blue plus and minus buttons.
6. While moving attachment along surface, you may adjust the volume level with the dark blue plus and minus buttons. The volume can be adjusted regardless of whether the filter is on or off.
7. Use blue spray paint to mark the water leak location.
8. Remove attachments and store all equipment.
9. For any leaks located with AquaScope, coordinate with GIS staff to add the site to their records and map of identified leaks.

11. Standard Operating Procedures: ZoneScan.net

ZoneScan.net Description

This website displays results from ZoneScan and MultiScan data uploads (*Appendix E*). The website automatically calculates for correlations when the data is added. If all the dots are green but one is red and indicates no correlation, then something is likely wrong with that valve. Alternatively, this display might mean that the leak is on the customer-side of the water line, not the City-side. If the dots are gray, then the data upload was unsuccessful. To fix this problem, try re-uploading the data on the tablet to the cloud based on the ZoneScan or MultiScan field directions.

Generating ZoneScan.net Reports

A report based on ZoneScan or MultiScan data can be generated from correlation dots to show key information including the leak score and leak location (*Appendix F*). The steps to generate a report are:

1. On ZoneScan.net, select an area under ZoneScan or MultiScan.
2. Double click a correlation on the right hand side of the screen.
3. Click the print icon.
4. Another pop-up will confirm which correlation you want a report for, make sure the correct one is selected and click "Open."
5. A new window will open, select "Print" at the top of the page.
6. At this point, you can choose to print the report or save it to your computer as a PDF.

Exporting Results to ArcGIS Desktop Software

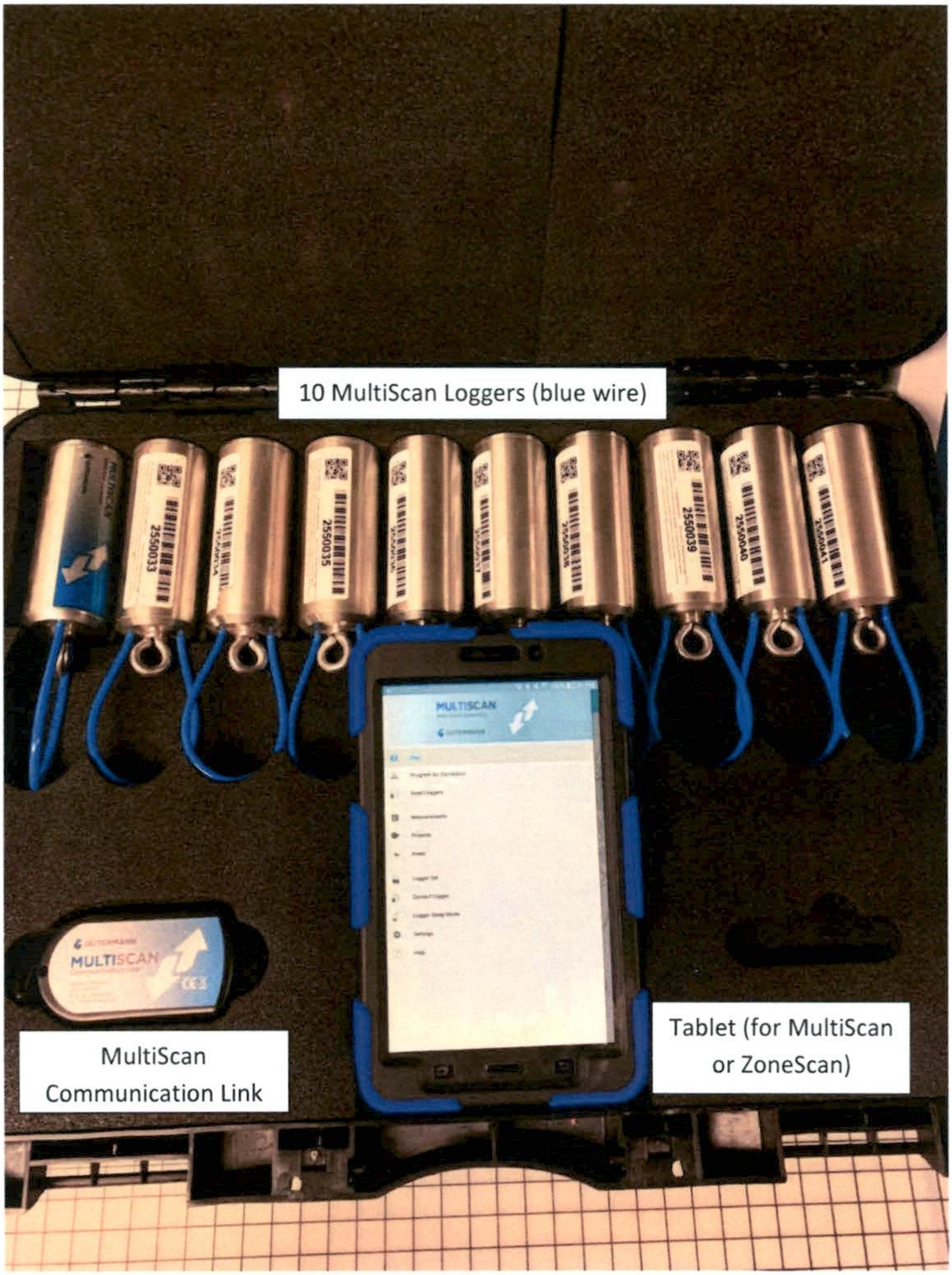
1. On ZoneScan.net, right click on any logger in the list.
2. Select "Export List as CSV."
3. Clean up the CSV File before importing to ArcGIS Pro.
    a. Open the Excel CSV file.
    b. Delete the following columns: Spread and Start time.
    c. Insert a column in the beginning (column A). Name the column header AreaName. In each row for this column, put the name of the area it shows in ZoneScan.net.
        i. Example: Data from "Quad D 1.16.20" will have a corresponding AreaName of "Quad D 1.16.20."
    d. Insert another column at the end. Name the column header Placement.
        i. In each row for this column, enter the placement site. The options are: hydrant, service, or valve.
        ii. Refer to the logger deployment chart from the Construction Specialist II which shows where each logger was placed.

e. Modify column headers "Leak Scores" and "Min. Noise" to ready "LeakScores" and "MinNoise." Headers cannot have spaces.
f. Save as CSV with no spaces in the document name.

4. Open ArcGIS Pro.
    a. Go to your Catalog pane and drag in the CSV file from where you have it saved on your device.
    b. Right click on the CSV under Contents pane and select "Display XY Data."
        i. X field = Longitude
        ii. Y field = Latitude
        iii. Ensure that Coordinate System is set to GCS_WGS_1984.
        iv. Click Run.
    c. Verify the points are in the right location.
5. Under Geoprocessing, search for the "Append" tool.
    a. Set the Input Dataset to CSV file.
    b. Set the Target Dataset to ZoneScan feature class or MultiScan feature class, depending upon the equipment used.
    c. Set the Schema Type as the appropriate option depending on the field names of both datasets.
    d. Run the tool.
6. View the results and ensure all points were added to the existing feature class.
7. Display ZoneScan symbology in graduated colors to distinguish leak locations.
    a. ≤39 = green dot
        i. Label: 0-39
    b. ≤69 = yellow/orange dot
        i. Label: 40-69
    c. ≤100 = red dot
        i. Label: 70-100
8. Publish updated GIS layers to ArcGIS Online.
    a. In the Contents pane, select the layers Other Leaks, ZoneScan, and MultiScan and right click.
    b. Under sharing, select "Overwrite Web Layer."
    c. Choose to overwrite the web layer "LeakDetection." If needed, use the search toolbar to locate it.
    d. Click Publish.
    e. Once complete, the layers will automatically update in all of the web maps.

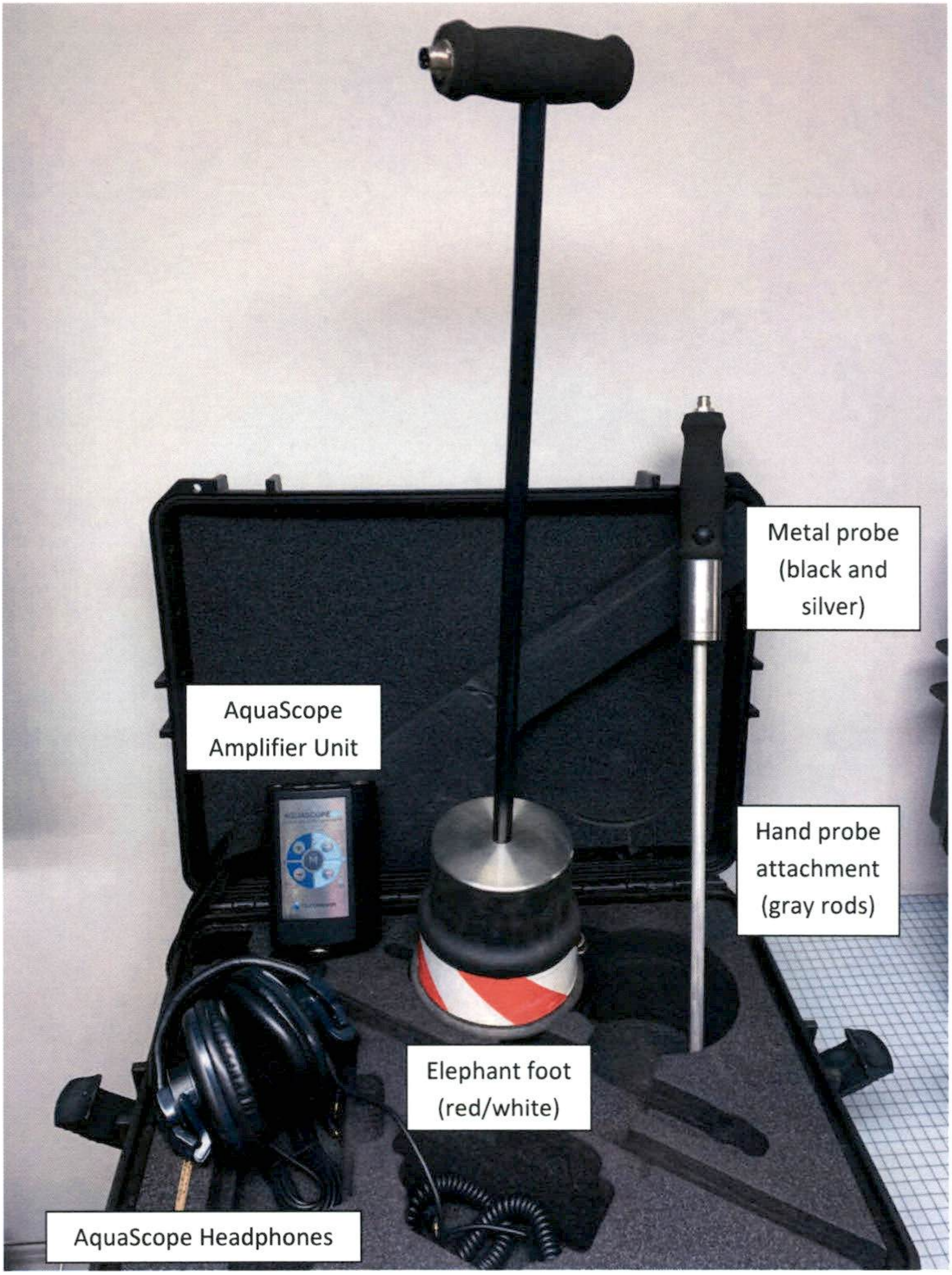
Appendix A – ZoneScan Equipment

Appendix B – MultiScan Equipment

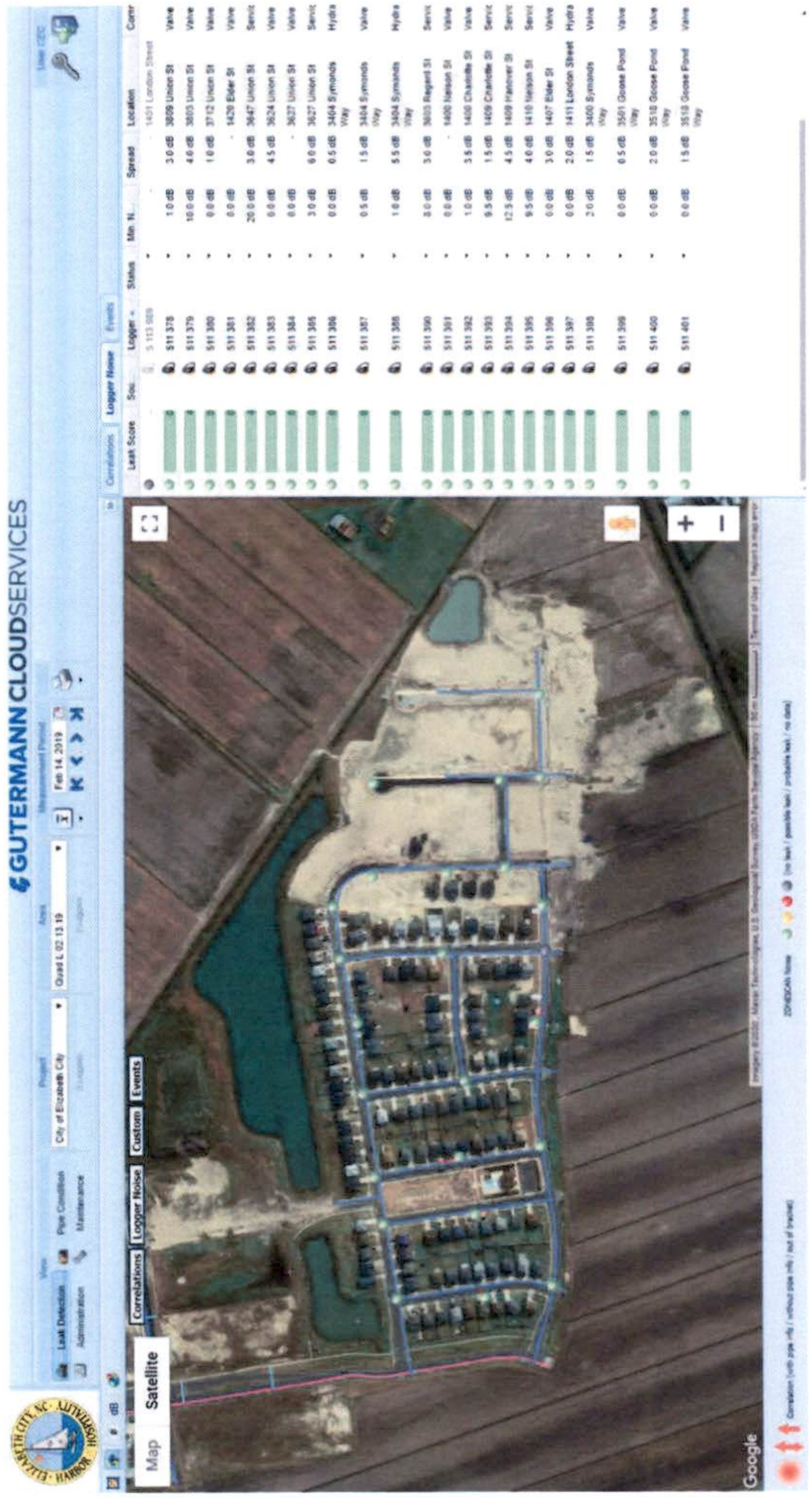


Appendix C – AquaScan Equipment

Appendix D – AquaScope Equipment



Appendix E – ZoneScan.net Screen Capture



Appendix F – ZoneScan.net Report

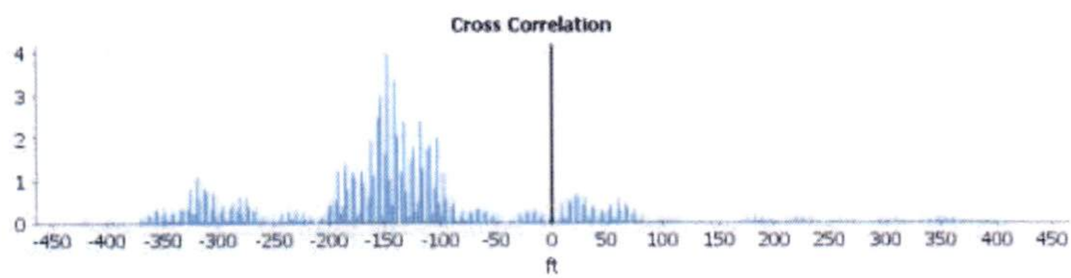
ZONESCAN NET Correlation Report

City of Elizabeth City 2019-05-21 (Report created on 2019-10-17 11:06 AM)

Correlation

Quality	Location	Logger 1	Logger 2	Dist. L1	Dist. L2	Center Dist.	Pipe Len.	Comments
70	108 S McMorrine St	511387	511388	74.3 ft	182.6 ft	-148.0 ft	256.8 ft	Crew went out with 610, determined there is a leak. Marked leak location with spray paint, work order placed 10/09/19

Graphs



Appendix G – AquaScan Report

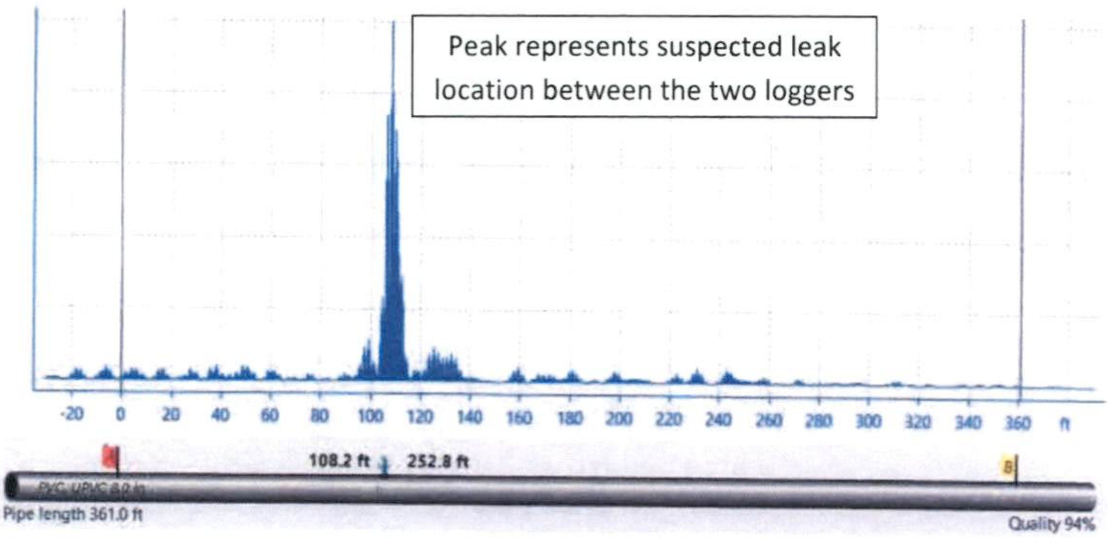
Aquascan TM2 - AQ_2019-10-10kramer&poindexter

By Tree

Pipe Sections:

No.	Velocity	Length	Diameter	Material
1	1,585 ft/s	361.0 ft	7.874 in	PVC, UPVC

Correlation



Spectrum