STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF THE CITY OF ANDERSON, INDIANA, FOR AUTHORITY TO: (1) ISSUE LONG TERM DEBT TO FINANCE WATER SYSTEM IMPROVEMENTS; AND (2) ADJUST ITS RATES AND CHARGES	)))))	**CAUSE NO. 46171**

PUBLIC'S EXHIBIT NO. 2

TESTIMONY OF CARL N. SEALS

ON BEHALF OF

THE INDIANA OFFICE OF UTILITY CONSUMER COUNSELOR

April 3, 2025

Respectfully submitted,

INDIANA OFFICE OF UTILITY CONSUMER COUNSELOR

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CERTIFICATE OF SERVICE

This is to certify that a copy of the ***Public's Exhibit No. 2 – Testimony of Carl N. Seals on behalf of the OUCC*** has been served upon the following captioned proceeding by electronic service on April 3, 2025.

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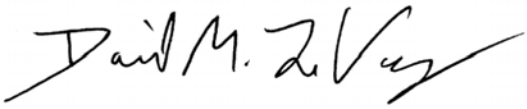

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TESTIMONY OF OUCC WITNESS OF CARL N. SEALS
CAUSE NO. 46171
CITY OF ANDERSON

I. INTRODUCTION

Q: Please state your name and business address.

A: My name is Carl Seals, and my business address is 115 West Washington Street, Suite 1500 South, Indianapolis, Indiana 46204.

Q: By whom are you employed and in what capacity?

A: I am employed by the Indiana Office of Utility Consumer Counselor ("OUCC") as Assistant Director of the Water/Wastewater Division. My qualifications and experience appear in Appendix A.

Q: Please describe the authority sought by the City of Anderson.

A: The City of Anderson ("Anderson" or "Petitioner") is seeking authority to increase its rates and charges over five phases and for authority to issue up to $130 million of long-term debt to fund several capital improvement projects, including the construction of the South Side Water Treatment Plant ("South Side Plant").

Q: What is the purpose of your testimony?

A: My testimony discusses Anderson's changing percentages of water loss over the past decade, Anderson's current and prospective customer demand, and Anderson's water production capacity. I discuss Anderson's request for roughly $28,161,000 of financing authority to construct a new water treatment plant it refers to as the South Side Plant. I explain why Anderson's existing and prospective customer demands do not support the need for that project and recommend the financing authority for the project be denied.

Q: What have you done to prepare your testimony?

A: I reviewed Anderson's petition and the testimonies and attachments of witnesses Neal McKee, Lori Young, Jennifer Wilson and Mark Beauchamp. I reviewed the final order in Cause No. 44510, which set Anderson's current rates. I reviewed Anderson's Annual Reports to the Indiana Utility Regulatory Commission ("IURC" or "Commission") for years 2014 through 2023. I wrote data requests and reviewed Anderson's responses. Finally, I reviewed reports Anderson provided to the Indiana Department of Environmental Management ("IDEM").

Q: If your testimony does not address a specific topic, issue, or item, should it be construed to mean you agree with Petitioner's proposal?

A: No. My silence on any issue should not be construed as an endorsement. Excluding any specific issues regarding Petitioner's proposal from my testimony is not an indication of approval. Rather, the scope of my testimony is limited to the specific items addressed.

Q: Does your testimony include attachments?

A: Yes. My testimony includes the following attachments:

- OUCC Attachment CNS-1, Utility Dashboard.
- OUCC Attachment CNS-2, Summary of water main and service line replacement projects.
- OUCC Attachment CNS-3, Responses to OUCC Data Request 6.
- OUCC Attachment CNS-4, Mueller Echologics Case Studies.
- OUCC Attachment CNS-5, Oneida, TN Case Study.

II. WATER LOSS

Q: What is "water loss" as it pertains to a utility's operations?

A: As used in annual reports to the IURC, "water loss" means the difference between the total volume of water pumped and purchased by the water utility and the total

volume of water sold to customers or used for backwash, flushing mains, street cleaning/sewer flushing, or other authorized consumption. Water loss may generally be attributed to leaks or inaccurate measurement of consumption.

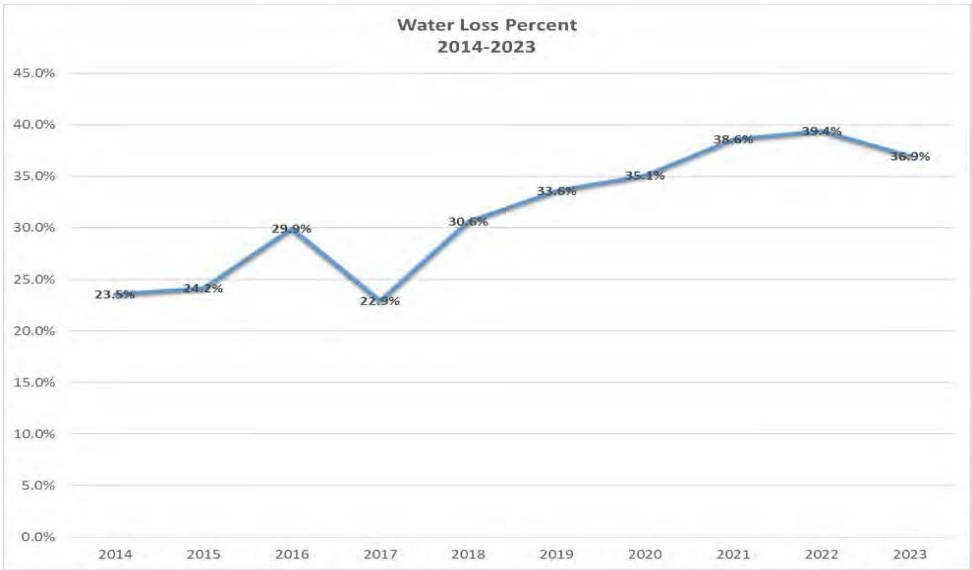
Q: How does water loss affect a utility's costs and operations?

A: Whether finished water is metered, used for operations or lost through leaks, the cost to produce the water is included in the utility's test year. The cost to produce water that is lost through leaks is a cost paid by all customers through higher rates. Water loss caused by inaccurate or slow meters presents a different dynamic. Water "lost" through under recording is nonetheless consumed, and therefore, the actual cost to produce that unrecorded water is not avoided by more accurate meters. However, removing inaccurate meters avoids subsidization among customers and allows the utility to both recognize that water is being lost through leaks and measure its success in mitigating that problem.

Q: What is Anderson's current water loss?

A: According to its last ten IURC annual reports (2014 through 2023), Anderson's water loss has ranged from a low of 22.9% in 2017 to a high of 39.4% in 2022, with a generally increasing trend as shown in the table below.[1] Anderson's last reported water loss (2023) was 36.9%.

[1] See also OUCC Attachment CNS-1.



Q: What has Anderson done to reduce its water loss?

A: Mr. McKee noted that Anderson has begun a leak detection program using software in conjunction with its Advanced Metering Infrastructure ("AMI"),[2] and Ms. Young stated that Anderson performed Water Loss Audits and Validations in 2020, 2022, and 2024.[3] Nevertheless, Petitioner's lost water has continued its generally increasing trend, as shown above.

Q: Is Anderson proposing to debt fund several water main and service line replacements projects to reduce water loss?

A: Yes. Section 3.1 Water System Improvements Alternatives in the Professional Engineering Report ("PER") (Attachment LAY-1) describes Anderson's proposal to complete ten water main and service line replacement projects. In Section 2.2.1 (Distribution System) of the PER, Anderson explained that its projects are focused on reducing water loss.

> The City's first priority is to replace sections of water mains and service lines associated with a high geographic density of leaks and

[2] Petitioner's Exhibit 1, page 7, lines 17-19.
[3] Petitioner's Exhibit 2, page 15, lines 14-17.

> areas with lead service lines and/or galvanized service lines with lead connectors. The City recorded 1,207 service line leaks and 505 main leaks between 2017 and 2022. Replacing service lines and water mains, particularly 2" galvanized steel water mains with history of leakage, is a high priority for public health protection and to reduce water loss. These high priority projects are needed to protect public health, improve pressure, flow, fire protection, and reliability throughout the service area.[4]

According to the PER, in those ten projects, Anderson proposes replacing approximately 115,485 L.F. or 21.9 miles of water mains and replacing 3,385 service lines from the main to the meter (approximately 15.1% of all its service lines), which were the source of 267 service line leaks and 81 water main leaks from 2017 to 2022. [5] The estimated construction cost of those ten projects is $70.8 million. OUCC Attachment CNS-2 includes summaries of those ten projects.

Q: Do you agree that those ten water main and service line replacement projects will reduce water loss and thus reduce the need for additional pumping capacity?

A: Yes. I agree with Petitioner that those ten projects will reduce water loss. Petitioner's proposal to invest $70.8 million in replacing sections of its water mains and service lines associated with a high geographic density of leaks, will result in reduction in the amount of water loss. A reduction in water loss will reduce the need for additional treatment and pumping capacity.

III. ANDERSON TREATMENT CAPACITY AND DEMANDS (SALES)

Q: What is Anderson's current total system treatment capacity?

A: Table 1.1.1.4 from the Preliminary Engineering Report attached to the Testimony

[4] Petitioner's Exhibit 2, Attachment LAY-1, 2024 Preliminary Engineering Report, page 2-5.
[5] Petitioner's Exhibit 2, Attachment LAY-1, 2024 Preliminary Engineering Report, Chapter 3.1 Water System Improvement Alternatives.

of Lori Young and set forth below shows the following, *2023* capacities.[6]

Table 1.1.1.4 Capacity Summary for Anderson Treatment Plants - 2023

Capacity	Wheeler	Lafayette	Total
Plant Peak Design (Wheeler on Groundwater Under the Direct Influence of Surface Water)*	6,480,000	10,000,000	16,480,000
Current "Safe" WTP Operating Capacity	6,480,000	**8,000,000**	14,480,000
Peak Well Capacity	**4,838,000**	10,870,000	15,708,000
"Safe" Well Capacity	**3,542,000**	8,860,000	12,402,000
Limiting Factor	*Supply*	*Plant*	*Total*
Operational Safe Capacity	**3,542,000**	**8,000,000**	**11,542,000**
Operational Peak Capacity	**4,838,400**	**10,000,000**	**14,838,400**
* Wheeler Plant design rating of 6.48 MGD based on surface water rate of 2 gpm/s.f.			
**"Safe" capacity is with largest well or filter out of service			
***Wheeler Wells consistently produce an average of 4.7 MGD, exceeding the calculated "Safe" Capacity			

Q: What is the Lafayette Treatment Plant's current capacity?

A: According to Petitioner's PER Table 1.1.1.4 provided above, the Lafayette Treatment Plant currently has an "Operational Safe Capacity" of 8 MGD and an "Operational Peak Capacity" of 10 MGD. The PER describes the Lafayette Treatment Plant filters as follows:

> Five (5) horizonal pressure filters, each rated at 1,400 gpm, are currently installed. All five (5) filters operate during peak design conditions. The plant was constructed with expandability to add three (3) more filters. All pipe sizing is based on the future peak design flow.[7]

Q: Does Anderson plan any increases to its treatment capacity in addition to its construction of the South Side Plant?

A: Yes. In Section 2.2.3 of the PER (Chapter 2–7), it states that "the Lafayette WTP is recommended to be expanded from 8 MGD to 14 MGD," a 6 MGD increase in

[6] Petitioner's Exhibit 2, Attachment LAY-1, page 1-10.
[7] Petitioner's Exhibit 2, Attachment LAY-1, page 1-17.

capacity. However, on pages 9 and 10 of her testimony, Ms. Young identified "significant waterworks improvements projects currently underway" that "will increase the Lafayette WTP water production and distribution by 4 MGD."[8] With the addition of 4 MGD treatment capacity at the Lafayette Treatment Plant,[9] Operational Safe Capacity will increase to 15,542,000 GPD[10] (15.5 MGD) and Operational Peak Capacity will increase to 18,838,000 GPD[11] (18.8 MGD).

Q: How does Anderson's treatment capacity compare to its maximum day pumpage over the past five years?

A: Maximum day pumpage of 13.1 MGD for the most recent, five-year period (2020-2024) period was established using Monthly Reports of Operations ("MROs") filed with the Indiana Department of Environmental Management ("IDEM"). These five years of MRO data were transferred to a spreadsheet to identify and highlight the top five days' pumpage or delivery from both plants during the period. This enabled comparison to Anderson's capacities. Notably, these five maximum days all occurred over an eight-day period in August 2022.

	A	AF	AG	AH	AI
1	**Day**	**July 2022**	**Aug 2022**	**Sept 2022**	**Oct 2022**
21	20	12,367,919	12,385,988	12,350,150	11,759,838
22	21	12,392,183	12,350,429	12,181,137	11,560,226
23	22	12,309,749	4,608,706	11,302,475	11,713,753
24	23	11,603,728	13,087,713	12,132,520	11,261,508
25	24	12,033,468	12,636,575	12,030,332	11,471,615
26	25	12,089,743	12,097,072	11,940,809	11,789,313
27	26	11,905,542	13,123,892	12,044,821	11,481,998
28	27	11,910,636	13,036,879	11,895,190	11,648,354
29	28	12,119,775	13,020,397	12,064,184	11,492,820
30	29	12,076,563	12,321,323	12,125,907	11,431,720
31	30	12,138,062	12,906,043	11,984,009	11,663,683
32	31	12,184,239	12,315,061	0	11,420,503

[8] Petitioner's Exhibit 2, pages 9-10.
[9] Petitioner's Exhibit 2, page 10, line 3.
[10] 11,542,000 + 4,000,000 = 15,542,000.
[11] 14,838,000 + 4,000,000 = 18,838,000.

Although the utility was unable to verify this *five-year* maximum day in response to OUCC Data Request 6-10, it nevertheless agreed that 13.1 MGD was the maximum day over the past *two and a half* years.[12]

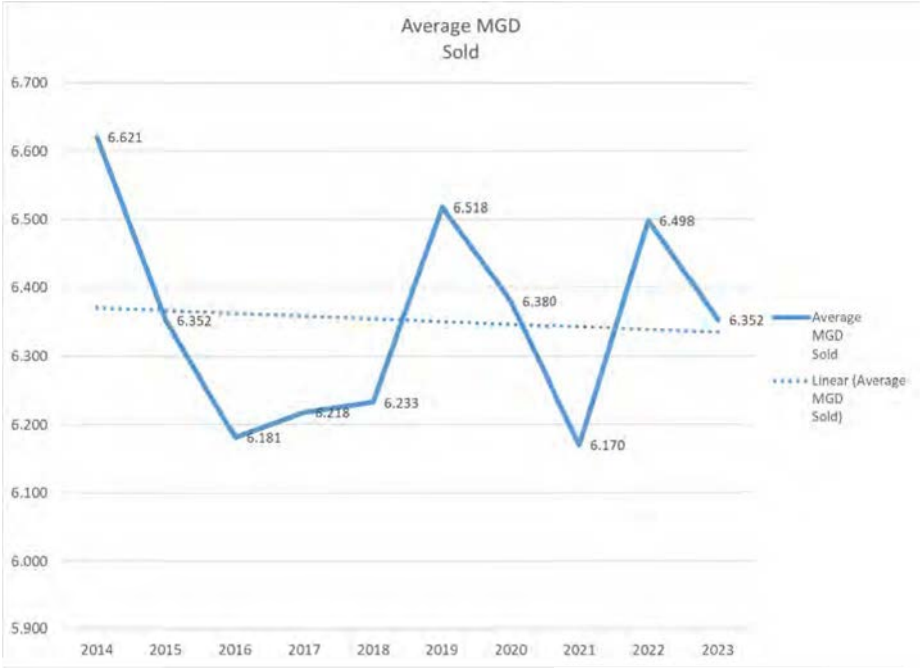
Q: What is Anderson's current average daily sales for the last ten years?

A: As calculated and shown in OUCC Attachment CNS-1, the average daily sales over the last ten years is 6.352 MGD, or a little less than half the maximum day over the past five years. At 6.352 MGD, the ten-year average daily sales is approximately 41%[13] of Anderson's *new* Operational Safe Capacity of 15.5 MGD. Put another way, the *new* Operational Safe Capacity of 15.5 MGD is approximately 2.4 times the average daily sales.[14]

Q: Are Anderson's water sales to customers increasing or decreasing?

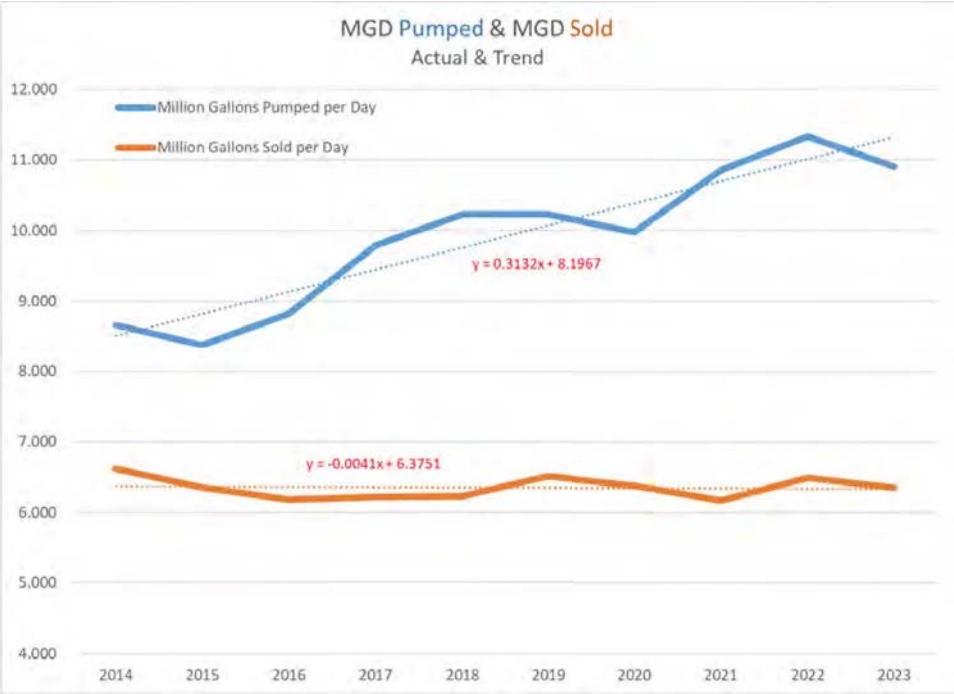
A: As shown below and in the Utility Dashboard appearing as OUCC Attachment CNS-1, average daily sales ("Average MGD Sales") are trending downward. The solid line shown connects actual sales points, while the dotted line is a linear regression showing the downward trend.

[12] OUCC Attachment CNS-2.
[13] 6.352 / 15.5 = .410 = 41%.
[14] 15.5 / 6.352 = 2.440.



Q: If Anderson is pumping more water while its average customer sales per day are declining, where is the water going?

A: An increase in total system pumpage combined with a decline in sales to customers indicates increasing water loss. The following chart depicting total system volumes pumped versus volumes sold shows this quite clearly. Essentially, the difference between the lines showing growing pumpage and declining sales volumes is the lost water. The equations shown adjacent to the dotted linear trend lines is telling: the X coefficient, or slope of the trend line for million gallons pumped is positive, indicating growth, while the negative X coefficient or slope of the sales trend line is negative and therefore declining.



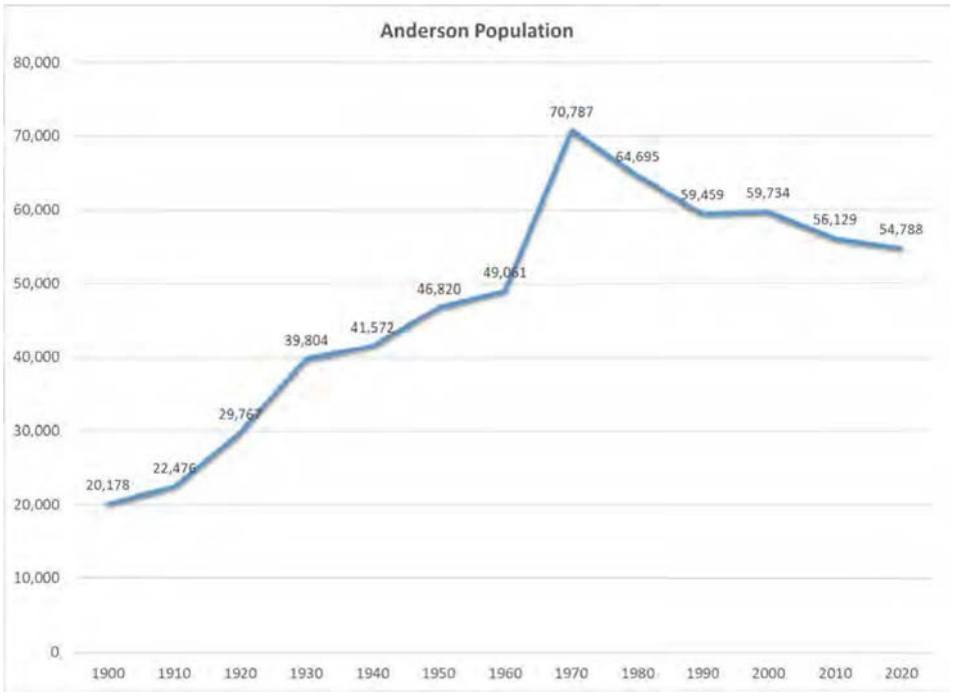
Q: Are there any other indications of a declining trend in water usage?

A: Yes. There are two trends that also suggest that Anderson may continue to experience declining customer water usage. One is the trend for gallons per customer per day shown on the Utility Dashboard in OUCC Attachment CNS-1. As can be seen in Chart A on that sheet, usage per customer per day appears to be trending downward based upon the last ten years' data.

Another possible indicator for decreasing customer usage is the historical decline in Anderson's population. 1900-2020 data from StatsIndiana[15] shows that Anderson's population peaked in 1970 at 70,787 people and by 2020 the population had declined by approximately 16,000 people to 54,788. Also, according to Table 2.1.1 Historical Projected Population Data in the PER[16], the population in Anderson

[15] http://www.stats.indiana.edu/population/PopTotals/historic_counts_cities.asp.
[16] Attachment LAY-1, City of Anderson, Drinking Water – 2024 Preliminary Engineering Report, Chapter 2 – 1.

will continue to decline to 49,272 by 2050, a decrease of another 5,516 people. This is shown in the following chart. It is logical, therefore, to assume that the combined pressures of 1) a declining population, 2) decreasing use per customer and 3) actual, experienced declines in sales volumes (as shown above) will cause Anderson to see continued decreasing usage, absent growth in the population or number of customers served.



IV. SOUTH SIDE PLANT

Q: Given the above analysis, is the South Side Treatment plant needed to serve customers?

A: No. As shown above, the South Side Treatment Plant is essentially being constructed to serve increasing levels of lost water, not to serve customers. This is analogous to a wastewater treatment utility expanding its treatment plant to handle increasing inflow and infiltration.

Q: What should Anderson do instead of building the South Side Treatment plant?

A: Anderson should complete the ten water main and service line replacement projects detailed above and continue to focus on finding and fixing its increasing levels of lost water.

Q: How might Anderson continue to address its lost water challenges?

A: Anderson might address its continuing lost water problem by utilizing newly available technologies to identify and locate leaks on its mains. As an example, Mueller, a well-established vendor in the water industry, offers a product known as Echologics. This product / service claims to enable better understanding of the structural integrity of buried assets using non-invasive acoustic signals and advanced software algorithms. Case studies offered by Mueller in support of its product are included as OUCC Attachment CNS-4. This is not an endorsement of the Muller Echologics offering but simply an example of the technology available to locate leaks that I have been made aware of.

Finally, another example of available leak detection technology is the use of Advance Metering Infrastructure ("AMI") approaches, which allow for Acoustic Leak Detection ("ALD") as set forth in OUCC Attachment CNS-5. According to the article appearing in WaterOnline,[17] this approach allowed Oneida, Tennessee to reduce non-revenue water from 51% to 38% over the first three months.

V. OUCC RECOMMENDATIONS

Q: Please summarize your recommendations in this Cause.

A: Based on all trends and data with respect to customer usage and population trends,

[17] https://www.wateronline.com.

Anderson's perceived need for additional water treatment capacity appears to be caused by its increasing water loss. Anderson has engaged in water audits and has a vigorous plan to replace a significant portion of its distribution system and water lines to reduce its water loss. Success should make adding its South Side Plant premature or unnecessary altogether. I recommend the Commission deny Anderson's request for $28,161,000 of financing authority for the South Side Water Treatment Plant.

Q: Does this conclude your testimony?

A: Yes.

APPENDIX A

Q: Please describe your educational background and experience.

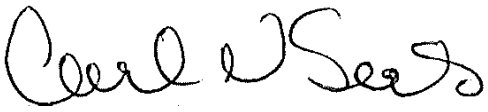
A: In 1981 I graduated from Purdue University, where I received a Bachelor of Science degree in Industrial Management with a minor in Engineering. I was recruited by the Union Pacific Railroad, where I served as mechanical and maintenance supervisor and industrial engineer in both local and corporate settings in St. Louis, Chicago, Little Rock and Beaumont, Texas. I then served as Industrial Engineer for a molded-rubber parts manufacturer in Shelbyville, Indiana before joining the Indiana Utility Regulatory Commission ("IURC") as Engineer, Supervisor and Analyst for more than ten years. It was during my tenure at the IURC that I received my Master of Health Administration degree from Indiana University. After the IURC, I worked at Indiana-American Water Company, initially in their rates department, then managing their Shelbyville operations for eight years, and later served as Director of Regulatory Compliance and Contract Management for Veolia Water Indianapolis. I joined Citizens Energy Group as Rate & Regulatory Analyst following the October 2011 transfer of the Indianapolis water utility and joined the Office of Utility Consumer Counselor in April 2016. In March 2020 I was promoted to my current position of Assistant Director of the Water and Wastewater Division.

Q: Have you previously testified before the Indiana Utility Regulatory Commission?

A: Yes, I have testified in telecommunications, water and wastewater utility cases before the Commission.

AFFIRMATION

I affirm the representations I made in the foregoing testimony are true to the best of my knowledge, information, and belief.



By: Carl N. Seals, Assistant Division Director

Cause No. 46171

Office of Utility Consumer Counselor (OUCC)

Date: April 3, 2025

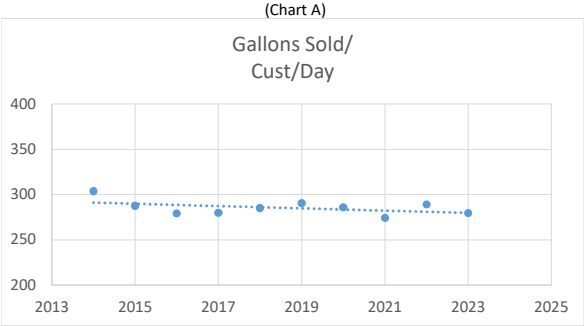
Utility Dashboard
City of Anderson
Cause No. 46171

Year	W-1 Customers Year-End	W-6 Total Pumped & Purchased	W-6 Total Sold	Non-Revenue (C - D)	W-6 System Usage	Water Loss (E - F)	Percent Loss (G / C)	Average MGD Sold	Gallons Sold/ Cust/Day	W-6 Main Breaks	
2014	21,801	3,161,102	2,416,732	744,370	0	744,370	23.5%	6.621	304	na	✓
2015	22,095	3,057,566	2,318,331	739,235	0	739,235	24.2%	6.352	287	na	✓
2016	22,132	3,229,051	2,262,426	966,625	0	966,625	29.9%	6.181	279	na	✓
2017	22,212	3,574,183	2,269,676	1,304,507	485,406	819,102	22.9%	6.218	280	83	✓
2018	21,873	3,732,686	2,275,025	1,457,661	313,953	1,143,708	30.6%	6.233	285	126	✓
2019	22,441	3,734,739	2,378,991	1,355,748	100,279	1,255,469	33.6%	6.518	290	88	✓
2020	22,329	3,651,360	2,335,104	1,316,256	34,607	1,281,649	35.1%	6.380	286	90	✓
2021	22,485	3,965,016	2,252,148	1,712,868	182,509	1,530,359	38.6%	6.170	274	97	✓
2022	22,493	4,137,232	2,371,770	1,765,462	133,972	1,631,490	39.4%	6.498	289	115	✓
2023	22,712	3,980,507	2,318,516	1,661,991	191,573	1,470,418	36.9%	6.352	280	74	✓

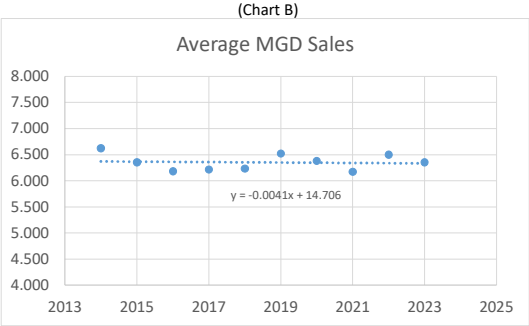
average mgd sales 10 yrs	6.352 mgd
avg annual cust growth	0.5%
avg new customers/year	101
average pumpage 10 yrs	9.919 mgd

All reported in thousand gallons unless otherwise noted
System usage includes water used for firefighting, backwashing, main flushing, etc.
Source: IURC Annual Reports 2019-2023

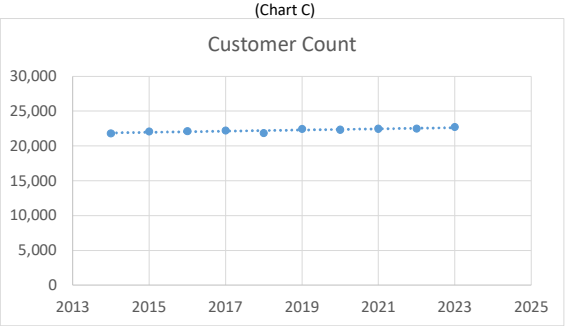
(Chart A)



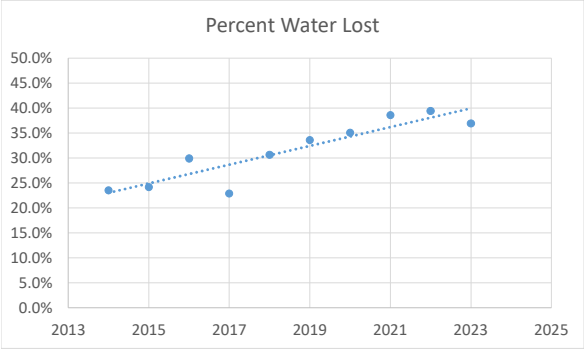
(Chart B)



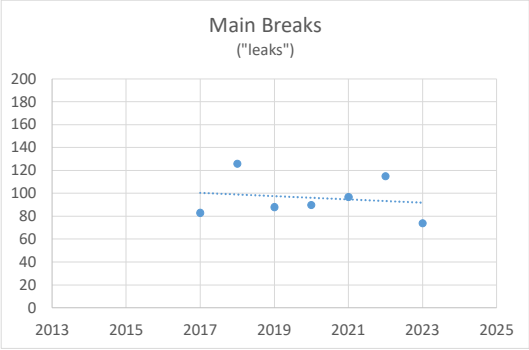
(Chart C)



(Chart D)



(Chart E)



Dashed lines shows results of linear regression (trend) over period shown

PER Table	Chapter 3.1 Water System Improvement Alternatives Project Description	Linear Feet of Water Main Proposed to be Replaced	Total 2" water mains to be Eliminated (L.F.)	Service Lines to be Replaced Main to Meter	Service Line Leaks 2017-2022	Water Main Leaks 2017-2022	Estimated Construction Cost
Table 3.1.2 Alt. 2:	Cross Street Water Transmission Main Project	9,500	0	52	0	0	6,093,480
Table 3.1.3 Alt. 3:	8th Street Water Main & Service Line Replacement	15,680	4,490	272	35	1	8,567,364
Table 3.1.4 Alt. 4:	North Cross A Water Main and Service Line Replacement Project	14,125	10,127	336	22	17	6,947,472
Table 3.1.5 Alt. 5:	North Cross B Water Main and Service Line Replacement Project	12,195	16,335	378	17	32	7,351,838
Table 3.1.6 Alt. 6:	West Central Water Main and Service Line Replacement Project	27,080	11,085	643	74	11	12,179,662
Table 3.1.7 Alt. 7:	Park Place Service Area Water Main and Service Line Replacement Project	9,530	12,995	667	44	10	10,467,144
Table 3.1.8 Alt. 8:	Belmont Service Area Water Main and Service Line Replacement Project	14,885	10,980	234	17	3	6,054,461
Table 3.1.9 Alt. 9:	Brentwood Service Area Water Main and Service Line Replacement Project	2,610	0	118	17	3	1,959,888
Table 3.1.10 Alt. 10:	Indian Meadows Area Water Main and Service Line Replacement Project	5,860	5,860	370	27	4	5,848,694
Table 3.1.11 Alt. 11:	Historic District Water Main and Service Line Replacement Project	4,020	2,120	315	14	0	5,314,800
	Totals:	115,485	73,992	3,385	267	81	70,784,803
		5,280	5,280	22,441			
		21.9	14.0	15.1%			

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

PETITION OF THE CITY OF ANDERSON, INDIANA, FOR AUTHORITY TO: (1) ISSUE LONG TERM DEBT TO FINANCE WATER SYSTEM IMPROVEMENTS; AND (2) ADJUST ITS RATES AND CHARGES	**)**	**CAUSE NO. 46171**

CITY OF ANDERSON'S
RESPONSE TO OUCC DATA REQUEST SET NO. 6

The City of Anderson ("Anderson"), by counsel, hereby provides its response to OUCC Data Request Set No. 6 as follows:

Q-6-1: Please refer to Table LAY-2 included in Ms. Younger's [sic] testimony reproduced below. What do the numbers in parentheses in the first column of Table LAY-2 indicate? Is this intended to indicate quantity, and if so, why do there appear to be more (or less) annual entries in some cases than quantities shown in parentheses?

TABLE LAY-2 SERVICE FLEET REPLACEMENT PLAN

Description	2025	2026	2027	2028	2029
(1) Single Axle Dump Truck	$140,000.00	$150,000.00	$154,000.00		
(3) 4X4 crew cab pick-up trucks	$90,000.00	$93,000.00	$96,000.00	$99,000.00	$102,000.00
(1) crew service truck	$40,000.00		$44,000.00		$48,400.00
(1) hydro excavator			$310,000.00		
(1) Backhoe		$150,000.00	$150,000.00		
(1) trenchless boring machine		$100,000.00			
(1) combination valve exerciser/vac unit		$75,000.00			
(3) hydraulic units (for service trucks to power tools, etc.)			$20,600.00		
Total Cost of Equipment					**$1,862,000.00**
Annual Average Cost					**$372,400.00**

Response: **The numbers in parentheses are used to indicate the number of items to be purchased each year, for years where funds are identified. The value for each item in the column for each year is intended to be the total cost for items to be purchased that year. Trucks are purchased through the State QPA for vehicle purchase. For clarification, these costs were based on actual costs in approximately 2020, when trucks were last purchased. The hydraulic units are a transition to a safer and more flexible equipment system. These will be**

replacement items on the existing equipment to replace pull-behind compressor trailers.

Responsible Party: City, Lori A. Young, P.E.

Q-6-2: Please provide detailed estimates for the "Raw Water Mains" included in the cost for the proposed south side 6 mgd plant. If the cost was not the result of detailed estimates, please provide calculations leading to the proposed amount of $2,000,000.

Response: **There is not a detailed estimate for the "Raw Water Mains." The location of the water treatment plant and wells was not known at the time the PER cost estimate was developed. An estimate of $2,000,000 was approximated based on 10,000 L.F. of raw water main at average total cost of $200 per linear foot. When a final well field property is defined and water treatment plant location selected, a more specific raw water main cost estimate shall be developed based on preliminary design. Due to the uncertainty at the time of estimates, a 30% construction contingency was recommended for this project. Additional contingency planned in the overall funding may be used if the final well and water treatment plant locations and design result in higher cost for raw water mains.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-3: Please provide detailed estimates for the "Connection to Anderson Distribution System Water Mains" included in the cost for the proposed south side 6 mgd plant. If the cost was not the result of detailed estimates, please provide calculations leading to the proposed amount of $3,000,000.

Response: **There is not a detailed estimate for the "Connection to Anderson Distribution System Water Mains." The location of the water treatment plant was not known at the time estimates were prepared for the Preliminary Engineering Report. An estimate of $3,000,000 was approximated based on 12,000 L.F. of water main at average total cost of $250 per linear foot. When a final water treatment plant location selected, a more specific water main cost estimate shall be developed based on preliminary design. Due to the uncertainty, a 30% construction contingency was recommended for this project. Additional contingency planned in the overall funding may be used if the final water treatment plant location and design results in a higher cost for finished water mains.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-4: Please provide detailed estimates for "Site Piping & Valves" included in the cost for the proposed south side 6 mgd plant. . If the cost was not the result of detailed estimates, please provide calculations leading to the proposed amount of $1,000,000.

Response: **There was not a detailed cost estimate prepared for the water treatment plant site piping. Site piping will be dependent upon the final water treatment plant site selection, along with raw water main routing from the wells and discharge piping to the distribution system. The estimate of $1,000,000 was based on site piping costs on other water treatment plant bids we have experienced. Anderson's Lafayette WTP Project, 2017 bid was $935,000 and the site piping for that project was more extensive than expected for the proposed south side project. When a final water treatment plant location selected, a more specific site piping cost estimate shall be developed based on preliminary design. Due to the uncertainty, a 30% construction contingency was recommended for this project. Additional contingency planned in the overall funding may be used if the final water treatment plant design results in a higher site piping cost.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-5: Please provide detailed estimates for "New Iron and Manganese Removal Unit, Complete" included in the cost for the proposed south side 6 mgd plant. If the cost was not the result of detailed estimates, please provide calculations leading to the proposed amount of $3,000,000.

Response: **The "New Iron and Manganese Removal Unit Complete" cost was based on bids for a similar unit received in 2021. That project included one new IRU of equal size, and the bid price ranged from $1,118,800 - $1,317,450 per unit. The historical bid amount was used to prepare the cost estimate of $1,500,000 per unit, complete.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-6: Please provide detailed estimates for "Water Treatment Plant Electrical, Complete" included in the cost for the proposed south side 6 mgd plant. If the cost was not the result of detailed estimates, please provide calculations leading to the proposed amount of $700,000.

Response: **The preliminary cost estimate for electrical is not based on a detailed estimate. This estimate was based on bid results for other comparable water treatment plants. The electrical cost estimate of $700,000 does not include the following:**

- **SCADA System Connections & Coordination $50,000**
- **Emergency Generator $250,000**
- **Well Field Electrical $950,000**

Preliminary conceptual estimate for electrical was based on bids for similar projects:

- **Anderson's Lafayette WTP Project, Bid 2017, Electrical Bid $852,517**
  - **This was a larger overall project**
- **Charlestown State Park WTP Project, Bid 2021, Electrical Bid $550,000**
  - **This project was smaller in overall scope**

Responsible Party: City, Lori A. Young, P.E.

Q-6-7: Please show all calculations and assumptions used to create Table 2.2.1 appearing in the PER.

Response: **Please see Attachment DR 6-7. Historical water pumpage data was evaluated from 2005-2014, and 2019-2022.**

Column "(A) Projected Avg Day-Regression", provides the calculated projected average daily pumpage based on linear regression of data from 2005-2014 and 2019-2022. Resulting formula for the projection:

Y = 20,577 (X) + 7,711,372
Y = Total Daily Water Pumpage (gallons/day)
X = Number of months since start of study period

Based on overall review of data and engineering judgment, the projection formula was adjusted in column "(B) Projected Average (Adjusted 15,000 gpd/mo)", to calculate 15,000 gpd/month average increase from 2005 – 2022. This rate of increase was projected for the next 20 years at the same average rate of increase as experienced from 2005 – 2022. Continued future growth based on historical growth results in annual pumpage increase of 180,000 gpd. Adjusted formula used for the graph:

Y = 15,000 (X) + 7,734,072
Y = Total Daily Water Pumpage (gallons/day)
X = Number of months since start of study period

The projected 20-Year Projected Demand for the year 2024 was rounded to 14.4 MGD Average, and 18.0 MGD Peak Day.

Responsible Party: City, Lori A. Young, P.E.

Q-6-8: Does Table 2.2.1 include in calculations a continued increase in the level or rate of lost or non-revenue water through 2042? Please explain.

Response: **No. The table is based on total water pumpage such that the historical lost or non-revenue water rates are anticipated to be approximately the same as for the study period.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-9: Please verify that Figure 2.1.1 is simply a graphical representation of the data appearing in Table 2.2.1 of the PER. If this is not the case, please show all calculations and assumptions used to create Figure 2.1.1.

Response: **Yes, Figure 2.1.1 is simply a graphical representation of the data appearing in Table 2.2.1 of the PER. See also spreadsheet table provided in response to Q-6-9.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-10: Please list the dates and volumes (mgd) of the ten highest total system maximum days over the last five years.

Objection: **The City objects to Data Request 6-10 to the extent that it calls for an analysis, compilation, or calculation that the City has not performed and objects to performing. The City does not track the requested information over a five (5) year period.**

Response: **Subject to and without waiver of the foregoing Objection, the City does not track running peak days over five years. The five highest days in the past two and a half years are as follows:**

Date	Pumpage
8/26/2022	13.1 MGD
7/13/2022	12.6 MGD
9/15/2022	12.4 MGD
6/30/2022	12.3 MGD
12/29/2022	12.1 MGD

Responsible Party: City, Lori A. Young, P.E.

Q-6-11: Has Anderson hydraulically modeled the proposed addition of the 6 mgd Southside treatment plant? Please explain.

Response: **No, not yet. Anderson plans to perform modeling when the site is selected and pumping capacity finalized based on available water resources.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-12: If Anderson has hydraulically modeled the proposed addition of the 6 mgd South side treatment plant, how and to what extent does the addition of this plant mitigate the need for the addition of 30-inch and 36-inch transmission mains from the Lafayette Plant to serve the Flagship Industrial Park discussed on pages 25-28 of Ms. Young's testimony in Cause No. 46147?

Response: **The addition of the 30" and 36" water transmission mains are designed to provide greater transmission capacity from the Lafayette WTP to the entire distribution system. The new mains will allow Anderson to maximize water production at the Lafayette WTP and be able to convey that water to the entire system. While these mains will benefit the Flagship Industrial Park, they will equally benefit the entire distribution system.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-13: Where do the 30-inch and 36-inch transmission mains discussed on pages 25-28 of Ms. Young's testimony in Cause No. 46147 appear in Cause No. 46171, i.e. which project or projects does this represent?

Response: **The 30-inch and 36-inch water main projects are funded through ARPA and TIF funds. The City of Anderson is not borrowing money or raising rates to fund these projects. They are not included in Cause 46171.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-14: Please provide a map in PDF format showing locations of Anderson's top 10 customers listed on Table 1.3.2 of the PER.

Response: **Please see Attachment DR 6-14. Note, Anderson Community Schools are billed together/one customer but the location of schools in noted on the map in green.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-15: Reference Ms. Young's testimony at page 7. Please list starting dates for each of the test wells in the "Disputed Area."

Response: **Test wells were drilled on the Beerbower Property on 2/19/2019 and 3/6/2019. Refer also to PER, Appendix A, Project Memorandum prepared by Eagon & Associates, Inc.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-16: Have test wells drilled in the Disputed Area shown the possibility for further development? Please explain.

Response: Yes. The test wells on the Beerbower Property warrant further future investigation. The property owner was not willing to grant permission for additional investigation in 2019. Refer also to PER, Appendix A, Project Memorandum prepared by Eagon & Associates, Inc.

Responsible Party: City, Lori A. Young, P.E.

Q-6-17: Page 9 of Ms. Young's testimony states that "Anderson anticipates final determination of the well locations and water treatment plant in the next six (6) months." However, Figure 5.1b in the PER delineates a project area for the "South Side WTP and Well Field." Please explain the apparent discrepancy.

Response: The Memo Revision 5.1b. was subsequent to the PER submitted to SRF in March 2024. The Memo revision provided updated information based on test well drilling accomplished in 2024, subsequent to the PER submittal to SRF. Anderson is continuing to investigate and verify the well field at the Cooper Property.

Responsible Party: City, Lori A. Young, P.E.

Q-6-18: If Anderson maintains and monitors system pressure gauges throughout its distribution system, please identify these locations on a pdf map (showing pressure zones if possible) and list the average or typical pressures reported during normal operations at each location.

Response: Anderson does not maintain and monitor pressure gauges throughout the distribution system.

Responsible Party: City, Lori A. Young, P.E.

Q-6-19: On page 7 of Ms. Young's testimony, she states that "Anderson began a hydrogeological investigation study in 2017, which is still ongoing." What factors have caused this investigation to take several years to still not complete?

Response: Anderson has been working with Eagon and Associates to perform hydrogeological investigation. Since 2017, Eagon & Associates stated that one hundred six (106) properties have been evaluated for testing. Seventy-six (76) of those are located south of Anderson. Thirty-four (34) test wells have been completed. The process of contacting property owners, negotiating an agreement to perform test well drilling, and getting to the point of performing the test well drilling and analysis takes a long time. Anderson has been working at this consistently, but due to the challenges encountered, it has taken a significant period of time.

Responsible Party: City, Lori A. Young, P.E.

Q-6-20: How much has been spent each year, since the last rate case, on hydrogeological investigations?

Response: **The City will supplement this response when the requested information is obtained.**

Q-6-21: Reference page 14 of Ms. Young's testimony, please provide a pdf copy of the "long-term tank maintenance contract with Suez for regular inspections and tank maintenance."

Response: **The City will supplement this response when the requested information is obtained.**

Q-6-22: Why are unrelated projects listed as "Alternatives" in the PER?

Objection: **The City objects to Data Request 6-22 on the grounds that it is vague and ambiguous.**

Response: **See Objection.**

Q-6-23: Reference page 15 of Ms. Young's testimony, please describe how the Water Loss Audits and Validations performed in 2020, 2022 and 2024 have assisted Anderson in reducing lost or non-revenue water over the same period.

Response: **Following discussions after the 2020 water loss audit, the City of Anderson improved the meter testing and calibration for finished/treated water at the Wheeler Plant. Utility staff worked to find sites where the City could better install meter testing. Two of the three Wheeler Plant meters were replaced in 2022 and at that time, the City started annual testing. Data validity for this component of the audit increased from 2020 to 2024. Volume of water supplied is one of the key factors in calculating water loss.**

The Utility staff have better data for unbilled, unmetered water. The annual street cleaning/sewer flushing and firefighting volumes are now tracked. In 2020 these volumes were estimated, however, by 2024 the City has been using a specific number provided and calculated by these entities.

Responsible Party: City, Lori A. Young, P.E.

Q-6-24: For the following questions, please reference the following passage from page 4 of the order in Cause No. 44510:

He [Mr. Curry] indicated that through the replacement of wells in the Lafayette Well Field, Anderson will gain a reliable 8,000,000 gpd of water supply and production capability should function well for the next 25 to 30 years. However, the Wheeler Treatment Plant should be considered a short-term asset in terms of its remaining useful life. (emphasis added.)

a. What has changed since this evaluation suggesting a 25-30 year capability?

Response: Four new wells have been constructed to replace existing wells, as was the objective when Mr. Curry made this statement. The four wells constructed include "Tucker #1", "Tucker #2", Hall Well, and Hannah #2. Upon final construction of the wells, they each have a capacity of 900 – 1,400 gpm. The planned capacity was 1,400 gpm each, but the actual well capacity was slightly lower for some of the wells. The statement that these wells should provide capacity for the next 25-30 years is correct.

b. At the time of this testimony and order approximately ten years ago, the Wheeler Plant was considered a short-term asset. Please state the reasons for the continued operation of the Wheeler Plant in 2025.

Response: The Wheeler Plant has been maintained in operation because Anderson has not been able to replace it yet. This is a known need and the current effort is to replace the Wheeler Plant and well field.

Responsible Party: City, Lori A. Young, P.E.

Q-6-25: Please explain how the proposed water main replacement projects are expected to improve the current water losses. Please state all assumptions and show any calculations.

Response: **The proposed water main replacement projects include replacement and/or retirement of approximately 80,000 L.F. of 2" galvanized water mains, which is approximately 20% of the 2" galvanized water mains in the distribution system. The Anderson Water Department experiences on-going leaks from the 2" galvanized water mains and these are priority to eliminate to help reduce lost water and better serve customers. The project is also planned to replace approximately 3,300 service lines, which are predominantly galvanized steel material. The city has had 234 leaks on service lines in these areas from 2017 to 2022. Replacement and elimination of the 2" galvanized water lines and service lines will reduce lost water.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-26: Please state the expected reductions in percent water loss through 2042 with the proposed main replacement projects. Please state all assumptions and show any calculations.

Response: **There is no calculated precise, or specific expected percentage of water loss reduction through 2024.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-27: Please state the anticipated percentage of water loss after all water main replacement projects. Please state all assumptions and show any calculations.

Response: **There is no calculated precise, or specific expected percentage of water loss reduction through 2024.**

Responsible Party: City, Lori A. Young, P.E.

Q-6-28: Please state how each water main project is expected to affect the percentage of water loss? Please indicate which projects are expected to be most effective. Please state all assumptions and show any calculations.

Response: **There is no calculated precise, or specific expected percentage of water loss reduction through 2024. Please refer to PER Chapter 4, Part 4.2, which identified proposed water main projects and the number of 2" galvanized water mains to be eliminated and number of service lines to be replaced.**

Responsible Party: City, Lori A. Young, P.E.

CERTIFICATE OF SERVICE

I certify that a copy of the foregoing has been served upon the following by electronic mail this 10th day of February, 2025:

Indiana Office of Utility Consumer Counselor
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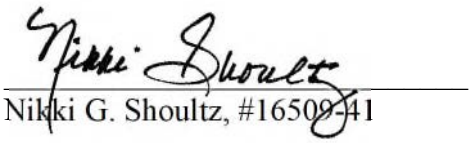

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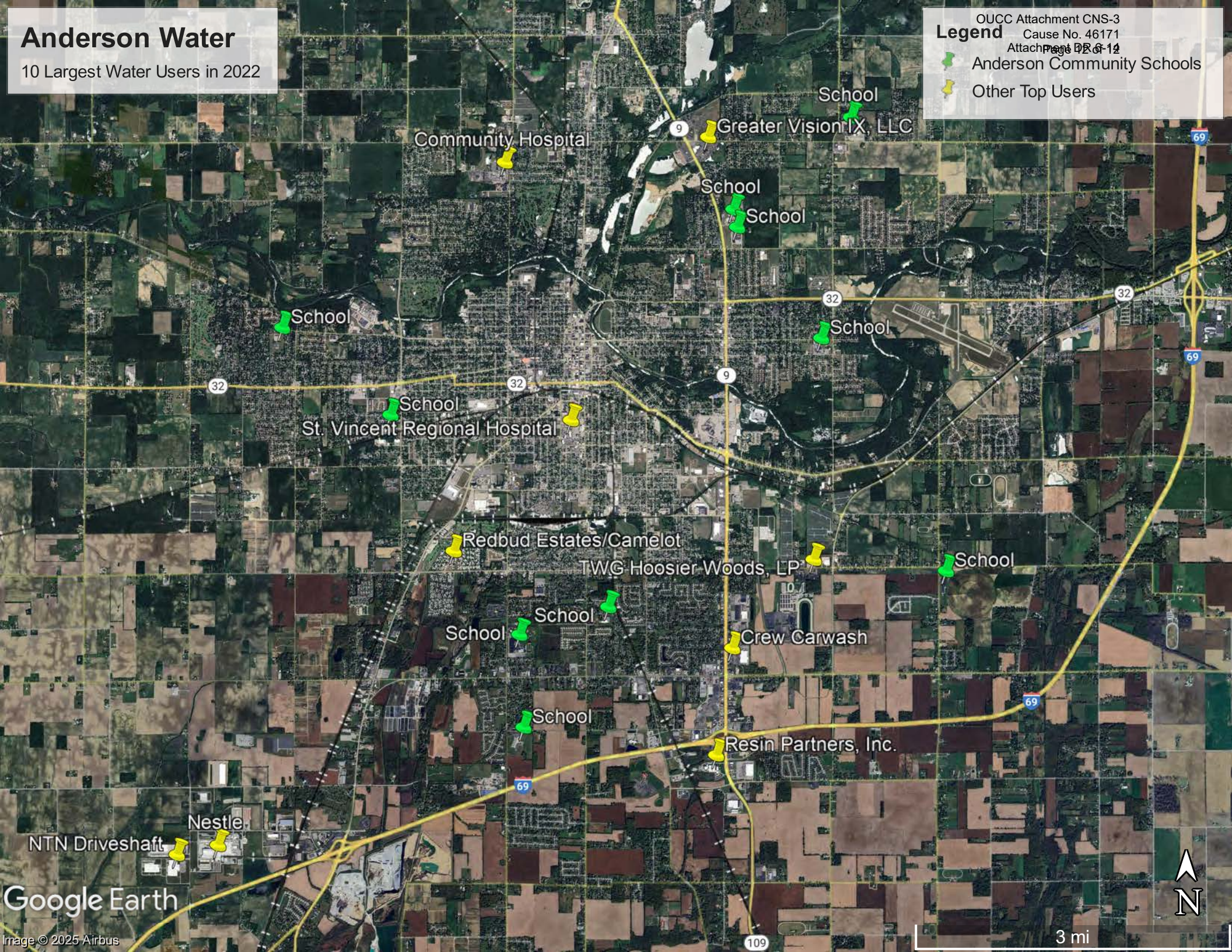
Table 2.2.1 and Figure 2.1.1 Calculations

Anderson Water Department - Projected 20 Year Water Pumpage											
Month	Year	Avg Day Pumpage	Peak Day Pumpage	PF	(A) Projected Avg Day-Regression	(B) Projected Average (Adjusted 15,000 gpd/mo)	Projected Peak	Projected Peak Day (125% Avg.)	2024 Peak Capacity	2024 "Safe" Operating Capacity	Design Capacity w/Groundwater
1	2005	7,908,770	8,873,526	1.12	7,731,950	7,749,072	9,686,340	9,664,937	14,838,400	12,700,000	18,120,000
13	2006	7,853,652	9,162,974	1.17	7,978,879	7,929,072	9,911,340	9,973,599	14,838,400	12,700,000	18,120,000
25	2007	8,502,600	10,954,453	1.29	8,225,809	8,109,072	10,136,340	10,282,261	14,838,400	12,700,000	18,120,000
37	2008	8,657,813	9,901,430	1.14	8,472,738	8,289,072	10,361,340	10,590,923	14,838,400	12,700,000	18,120,000
49	2009	9,130,071	11,012,980	1.21	8,719,668	8,469,072	10,586,340	10,899,584	14,838,400	12,700,000	18,120,000
61	2010	9,025,003	10,317,483	1.14	8,966,597	8,649,072	10,811,340	11,208,246	14,838,400	12,700,000	18,120,000
73	2011	9,438,244	11,529,613	1.22	9,213,527	8,829,072	11,036,340	11,516,908	14,838,400	12,700,000	18,120,000
85	2012	9,169,319	10,665,532	1.16	9,460,456	9,009,072	11,261,340	11,825,570	14,838,400	12,700,000	18,120,000
97	2013	9,169,319	10,665,532	1.16	9,707,385	9,189,072	11,486,340	12,134,232	14,838,400	12,700,000	18,120,000
109	2014	10,143,209	11,551,369	1.14	9,954,315	9,369,072	11,711,340	12,442,894	14,838,400	12,700,000	18,120,000
121	2015				10,201,244	9,549,072	11,936,340	12,751,556	14,838,400	12,700,000	18,120,000
133	2016				10,448,174	9,729,072	12,161,340	13,060,217	14,838,400	12,700,000	18,120,000
145	2017				10,695,103	9,909,072	12,386,340	13,368,879	14,838,400	12,700,000	18,120,000
157	2018				10,942,033	10,089,072	12,611,340	13,677,541	14,838,400	12,700,000	18,120,000
169	2019				11,188,962	10,269,072	12,836,340	13,986,203	14,838,400	12,700,000	18,120,000
181	2020	10,524,691	11,810,403	1.12	11,435,892	10,449,072	13,061,340	14,294,865	14,838,400	12,700,000	18,120,000
193	2021	10,879,545	12,070,227	1.11	11,682,821	10,629,072	13,286,340	14,603,527	14,838,400	12,700,000	18,120,000
205	2022	10,819,609	12,486,632	1.15	11,929,751	10,809,072	13,511,340	14,912,188	14,838,400	12,700,000	18,120,000
217	2023				12,176,680	10,989,072	13,736,340	15,220,850	14,838,400	12,700,000	18,120,000
229	2024				12,423,610	11,169,072	13,961,340	15,529,512	14,838,400	12,700,000	18,120,000
241	2025				12,670,539	11,349,072	14,186,340	15,838,174	14,838,400	12,700,000	18,120,000
253	2026				12,917,469	11,529,072	14,411,340	16,146,836	14,838,400	12,700,000	18,120,000
265	2027				13,164,398	11,709,072	14,636,340	16,455,498	14,838,400	12,700,000	18,120,000
277	2028				13,411,328	11,889,072	14,861,340	16,764,159	14,838,400	12,700,000	18,120,000
289	2029				13,658,257	12,069,072	15,086,340	17,072,821	14,838,400	12,700,000	18,120,000
301	2030				13,905,186	12,249,072	15,311,340	17,381,483	14,838,400	12,700,000	18,120,000
313	2031				14,152,116	12,429,072	15,536,340	17,690,145	14,838,400	12,700,000	18,120,000
325	2032				14,399,045	12,609,072	15,761,340	17,998,807	14,838,400	12,700,000	18,120,000
337	2033				14,645,975	12,789,072	15,986,340	18,307,469	14,838,400	12,700,000	18,120,000
349	2034				14,892,904	12,969,072	16,211,340	18,616,130	14,838,400	12,700,000	18,120,000
361	2035				15,139,834	13,149,072	16,436,340	18,924,792	14,838,400	12,700,000	18,120,000
373	2036				15,386,763	13,329,072	16,661,340	19,233,454	14,838,400	12,700,000	18,120,000
385	2037				15,633,693	13,509,072	16,886,340	19,542,116	14,838,400	12,700,000	18,120,000
397	2038				15,880,622	13,689,072	17,111,340	19,850,778	14,838,400	12,700,000	18,120,000
409	2039				16,127,552	13,869,072	17,336,340	20,159,440	14,838,400	12,700,000	18,120,000
421	2040				16,374,481	14,049,072	17,561,340	20,468,101	14,838,400	12,700,000	18,120,000
433	2041				16,621,411	14,229,072	17,786,340	20,776,763	14,838,400	12,700,000	18,120,000
445	**2042**				**16,868,340**	**14,409,072**	**18,011,340**	**21,085,425**	**14,838,400**	12,700,000	18,120,000
457	2043				17,115,270	14,589,072	18,236,340	21,394,087	14,838,400	12,700,000	18,120,000
469	2044				17,362,199	14,769,072	18,461,340	21,702,749	14,838,400	12,700,000	18,120,000
481	2045				17,609,129	14,949,072	18,686,340	22,011,411	14,838,400	12,700,000	18,120,000

Anderson Water

10 Largest Water Users in 2022



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UNDERSTAND THE STRUCTURAL STRENGTH OF BURIED ASSETS USING NON-INVASIVE ACOUSTIC SIGNALS AND ADVANCED ALGORITHMS TO ASSIGN GOOD, MODERATE AND POOR GRADE BASED ON THE ACTUAL CONDITION OF THE PIPE. THESE INSIGHTS ENABLE UTILITIES TO PRIORITIZE REPLACEMENT AND REHABILITATION PROGRAMS, AND OPTIMIZE CAPITAL INVESTMENT.

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LONDON, ONTARIO PROTECTS CRITICAL WATER NETWORK WITH PIPE CONDITION ASSESSMENT

Case Study

OVERVIEW

Many water asset managers are adopting a pyramid approach to pipe condition assessment. On a selected group of assets, the concept uses cost effective methods to collect information where possible, and progress to high resolution and high cost inspection options where needed. This approach formed the structure of the City of London, Canada's ("the City") project plan for its Elgin large diameter pipeline. Following the successful inspection of the 15.5 miles of steel and PCCP transmission mains, the City was able to confirm that the watermains were in good to excellent condition and that they did not require any short or medium term capital renewal projects allowing the City to allocate their limited budget towards watermains that had a greater level of degradation and need for renewal.

Solution	Echologics ePulse®
Client	City of London, Ontario
Location	Canada
Type of Pipeline	Water Transmission Mains
Diameter	35″- 41″
Pipe Material	Steel, PCCP

Home to more than 380,000 residents, the City recognized the need for a proactive approach toward maintaining a healthy water network as the city continues to develop, along with an increase in transportation projects. Many of these movements were taking place along the Elgin Pipeline corridor, an important large diameter watermain network that provides approximately 25% of the City's water from Lake Erie.

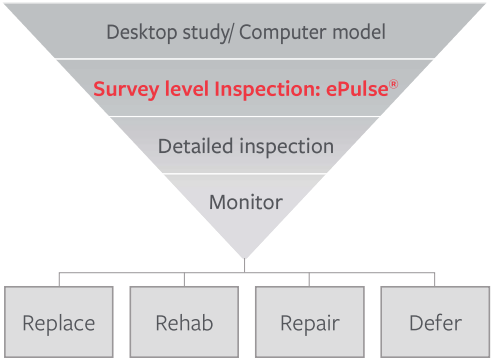

FIGURE 1: INVERTED PYRAMID APPROACH TO AN EVIDENCE-BASED CONDITION ASSESSMENT

SITUATION

Taylor Eckert, Project Engineer for the City London said, *"We had some major projects, including a road widening and pipe life-cycle replacement. By getting ahead of these projects with inspection and understanding pipe's condition, it gave us the opportunity to piggyback on the larger transportation projects and save on replacement investment."*

The assumption was that the pipeline was in good condition, however they needed to confirm this assumption with evidence-based information to mitigate the likelihood of failure and extend the life of these high-risk assets, while at the same time, meeting legislative requirements. The City sought solutions from Echologics ePulse® condition assessment technology & EchoWave leak detection services.

MUELLER

SOLUTION

Following a comprehensive evaluation process, ePulse was chosen to assess the minimum average structural stiffness of approximately 9 miles of large diameter PCCP mains and EchoWave leak detection was completed on 6.5 miles of large diameter steel mains. This segment, installed in the 1990's, consisted of water mains with diameters ranging from 35″to 41″. The goal was to conduct a due diligence inspection to determine the current pipe condition and put forth recommendations for the City to make evidence-based asset management decisions to replace, rehabilitate, defer, or monitor specific lengths of this pipeline.

"As water pipes increase in diameter, they also increase in criticality and complexity. Transmission pipes are site specific installations. Each transmission pipe has been designed to ensure safe operation given local loading and operating considerations. Decades after a transmission pipe has been installed, design standards, actual loading conditions and consequences of failure may change significantly. Hence, understanding the current structural state and operating requirements of each transmission pipe is a critical step towards making evidence-based asset management decisions," said Alain Lalonde, Regional Manager, Water Management Solutions of Mueller.

ePulse technology combines acoustic data measured in the field with information about a pipe's construction to calculate the average minimum remaining structural pipe wall stiffness over the measured segment. The methodology employed is known as the cross-correlation method. As a pipe degrades, the velocity at which sound waves travel through the pipe decreases linearly, forming the basis for the technology. The pipe assessment is performed by bracketing a section of pipe between two sensors that are attached to an existing valve or pothole. An out-of-bracket noise is then created by tapping on a valve or directly on the pipe via a daylighting pothole.

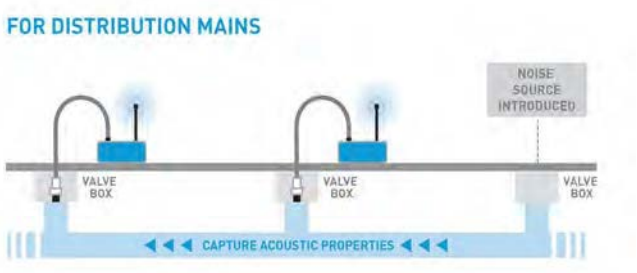

FIGURE 3: EPULSE® FOR DISTRIBUTION & TRANSMISSION MAINS ABOVE ILLUSTRATES THE TYPICAL FIELD SETUP FOR AN EPULSE FIELD MEASUREMENT.

FIGURE 2: OVERVIEW OF LONDON, ONTARIO ELGIN FEEDER MAIN

The field team measures the distance between the two sensors and proprietary software calculates the time taken for the acoustic signal to propagate between the two sensors. The wall stiffness is determined using the measured sound wave propagation speed through the pipe and comparing that value to the wave speed of a new perfect condition concrete pipe. This calculation takes into account the pipe and water properties for the specific classes of concrete pipe tested. For this particular project, all pipe properties were determined from drawings provided by the City.

Michelle Morris, Transportation Design Engineer for the City of London said, *"When looking into areas such as ease and resolution of inspection and low operational risk, ePulse checked all the boxes. Echologics also worked with us to formulate a grading scheme to quantify the pipe's condition and detailed next steps which should be taken for segments exhibiting each particular grading."* When asked how the exercise had contributed to the City's overall asset management plan, Michelle added, *"Having this concrete data and grade scheme in place, we can easily add this into our database which will help with ths scope of work for future by establishing a baseline with historical data."*

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Echologics field engineers also worked with the City's water engineers to ensure a smooth migration of inspection data into their existing GSI database – making it more accessible and easier to understand by the asset management team.

For a more comprehensive assessment of the Elgin Pipeline, Echologics, as the prime contractor, also teamed up with several expert sub-consultants to conduct in-depth high-resolution testing and review. A case of such collaboration was between Echologics and Simpson Gumpertz & Heger Inc. (SGH). ePulse provided the average remaining structural stiffness of each length of water pipe tested, and identified lengths of pipe where significant structural deterioration had occurred. These findings were paired with Simpson Gumpertz & Heger Inc. (SGH)'s structural evaluation and failure risk analysis result, to identify at-risk sections of the pipeline.

Other collaborators who were equally critical in the project include AECOM Canada, CorrPro, and Rock Solid Group, engaged to provide support in their own area of expertise.

RESULTS

Based on high resolution ePulse analysis and stiffness measurement, there was sufficient data to show that close to 80% of the tested mains appeared to be in good condition and will not require further investigation. However, periodic inspection and maintenance work are encouraged. The remaining 20% showed some signs of deterioration and will require attention in the future.

The added advantage of this acoustic technology is the ability to conduct leak detection simultaneously. No leaks were discovered at the time of the survey on the Elgin Pipeline. The fact that no existing leaks were found on this pipeline was an early indicator that no immediate or emergency rehabilitation or repair actions was required.

After the six-week period, the City could move forward with peace of mind, knowing that this critical pipeline is in good condition and focus on forecasting and projecting budget and predication of the lifecycle of the pipes respectively.

Following this transmission pipe inspection, the City engaged in further transmission pipe assessment projects with Echologics and found value in adding Echologics approach to their toolset along with higher resolution pipe assessment technologies. When recommending additional investments in Echologics transmission pipe inspections to the City council, the City's technical team shared, *"After evaluation of the RFP, the City's evaluation team determined Echologics provided the best value and their technology presented the least amount of operational risk."*

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PUB SINGAPORE HARNESSES SMART TECHNOLOGY TO FUEL ITS ASSET RENEWAL PROGRAMME

Case Study

OVERVIEW

PUB, Singapore's National Water Agency, manages a potable water network of 5,500 km (3,400 miles) of mains that deliver water to 1.5 million customer accounts. Regular asset renewal and maintenance is one of PUB's key focus areas to strengthen network resilience by anticipating and responding to leaks and damage with minimal disruption to their operations.

PUB has been implementing an ongoing pipeline replacement programme since the 1980s, with an objective to reduce the leakage rate and maintain a level of less than six leaks every 100km per year.

Solution	Echologics LeakFind-er-ST™
Client	PUB Singapore
Location	Singapore
Type of Pipeline	Water Distribution Mains
Diameter	4″ - 16″ (100 mm - 300 mm)
Pipe Material	Cast Iron

SITUATION

In recent years, PUB has adopted a pre-emptive leak management approach to pro-actively replace older or leak-prone pipes under the Pipe Renewal Programme. For this project, PUB used pipe condition assessment technology and data analytics to determine the health status of the pipes to prioritise pipe replacement efforts for cast iron (CI) mains, which are generally more prone to leak failure.

PUB identified 450km of CI mains across Singapore that were between 100 and 400mm in diameter, for leak failure risk analysis. The objective was to determine the risk of failure of these selected mains, formulate a replacement plan based on a geographic scope and risk level for pipeline prioritisation, and eventually replace all CI mains.

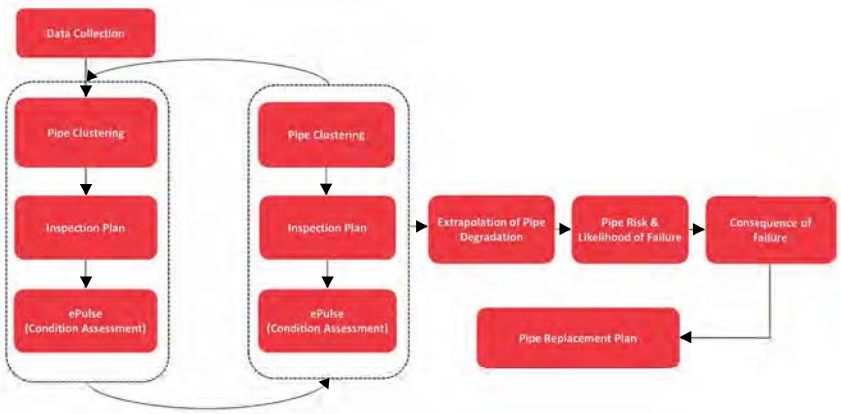

FIGURE 1: PROJECT CYCLE BREAKDOWN

Following an open bid, PUB appointed Echologics® to develop a prioritisation plan through a combination of desktop study and field data capture on 80km of the CI network using its proprietary non-intrusive and non-destructive pipe condition assessment tool, ePulse®. To assist with the desktop model, Echologics engaged Suez, whose Netscan analytics software has been proven to work well with ePulse through prior collaborations in France.

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ACTION

A multi-staged approach, combining condition-driven asset management (CDAM) and asset management desktop models (AMDM) was put into effect for this project.

Echologics and SUEZ engineers began the process by collecting physical, operational and environmental data. A series of statistical methodologies were applied to determine the likelihood of failure (LoF) and identify pipe clusters for pipe condition assessment. The selection and assessment of 80km of mains was divided into three phases to increase the likelihood of surveyed pipes that best represent each cluster and the network as a whole. At this juncture, ePulse was deployed.

ePulse combines acoustic data measured in the field with information about a pipe's construction to determine its current structural wall thickness. The technology calculates the percentage of wall thickness loss by drawing comparison of the measured thickness to the design thickness of the pipe.

While some assessment approaches rely on excavating and examining a small section of pipe, ePulse takes a different approach, employing acoustics to establish the actual condition of an entire pipe segment. Completely non-invasive and using existing valves or fire hydrants as contact points, assessments are completed above ground with no impact on the network.

As an added benefit, ePulse is also able to detect and pinpoint existing leaks while conducting field measurements. The position of the leak is then determined based on the time delay of the noise reaching each sensor and the distance between sensor points. This unparalleled benefit allows the assessment cost to be offset by the savings inherent in leakage reduction.

With the help of Netscan, the ePulse data was extrapolated to the remainder of the CI mains, which in turn generated a specific value for each pipe segment to interpret the likelihood of failure, and subsequently, the risk of failure.

Netscan is an innovative asset management tool, based on a collaborative web platform that maximises the benefits of pipe investment plans. It uses advanced modeling and predictive analysis to prioritise pipe renewal.

FIGURE 2: ECHOLOGICS FIELD SPECIALISTS GATHERING ACOUSTIC PROPERTIES OF A PIPE SEGMENT USING A LEAKFINDERST CORRELATOR

In order to determine the LoF, SUEZ employed a linear extension of the Yule model. The parametric nature of this model used eight years of historic burst data for rounds of calibration and validation, which was combined with various other parameters, before arriving at a LoF forecast.

Concurrently, a consequence of failure (CoF) model was developed with PUB's water supply network team, to identify CoF criteria and its associated weighting. Thereafter, an individual CoF score for each pipe segment was computed and attributed to the model.

Finally, the consequence of failure was converted to a likelihood of failure threshold, used to determine the risk of failure.

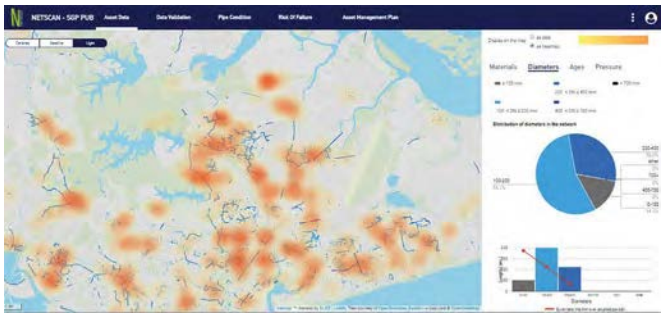

FIGURE 3: SUEZ NETSCAN USER INTERFACE, FOCUSES ON NETWORK CHARACTERISTICS AND LEAK HISTORY

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RESULTS

Of the 80km of CI pipeline tested using ePulse, the field crew identified approximately half that had lost more than 30% of its original wall thickness. This data was then extrapolated to the entire 450km data set, and likelihood of failure analysis was performed. By integrating the result gathered with the consequence of failure, the crew was able to determine which pipe segments had exceeded its risk threshold, and therefore needed to be replaced.

PUB was able to use the results to develop a comprehensive pipe replacement programme over the next five years. A significant percentage of the original CI network planned for replacement were able to be deferred as the pipes were still in good condition.

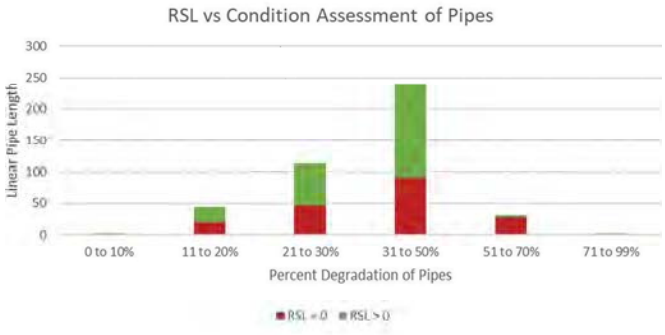

FIGURE 4: REMAINING SERVICE LIFE PER PIPE DEGRADATION

CONCLUSION

A failure risk analysis which combines CDAM and AMDM, proves to be an extremely effective tool when it comes to determining asset renewal and replacement needs. The seamless integration of technologies - ePulse and Netscan, has empowered PUB to make informed decisions on its underground pipe network, enabling continued provision of a reliable and sustainable water supply to its customers now and into the future.

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SUNRISE WATER AUTHORITY TURNS TO CONDITION ASSESSMENT

Condition Assessment

OVERVIEW

Water main replacement programs are expensive, time consuming and disruptive, so it is important for a utility to know as much as it can about the condition of its pipes before beginning a replacement program. However, assessing pipe condition is not always a simple matter of using historical records and customer complaints to find potential problem areas.

After finding sections of good pipe among the bad during a replacement project, one Oregon utility searched for a non-invasive condition assessment solution to help make informed, data-driven decisions, and found their solutions with the Echologics ePulse® acoustic technology.

Solution	Echologics ePulse®
Client	Sunrise Water Authority
Location	USA
Type of Pipeline	Water Distribution Mains
Pipe Material	Ductile Iron

SITUATION

Happy Valley is a suburb of Portland, OR, notable for its explosive growth in the past 25 years—its population has increased by more than 1,217%, from 1,519 in 1990 to an estimated 18,493 in 2015, according to the U.S. Census Bureau. Located on the lush southern flank of Mount Scott, Happy Valley has been among the fastest-growing cities in the state for many years thanks to its scenic locale and proximity to Portland.

ECHOLOGICS FIELD ENGINEERS ASSESS THE CONDITION OF DUCTILE IRON PIPE

Sunrise Water Authority provides water service to approximately 44,000 of Happy Valley's residents. While much of the 200 miles of pipe in the utility's district was installed relatively recently due to the increase in residential development, Sunrise has encountered problems with some of its older pipe.

"A couple years ago, we started experiencing some pipe failure on ductile iron pipe that was only about 35 to 40 years old," said Dan Fraijo, operations superintendent for Sunrise. *"There was heavy corrosion on the bottom portion of the pipe. We went in, dug it all up, replaced 1,500′ of it and discovered it wasn't the whole 1,500′ that was bad—just portions of it."*

Rather than waste time and money by replacing perfectly good pipe during future projects, Sunrise decided to search for a condition assessment solution that could distinguish between pipe that needs to be replaced and pipe that is still useful.'

ACTION

Sunrise contacted us about using ePulse® condition assessment technology to determine how to effectively approach and implement forthcoming pipe replacement projects. *"They knew the pipe was in bad condition, but they wanted to confirm it before they replaced any this time around,"* said Corey Keefer, Echologics Western Region Sales Manager. *"We've been talking to them for a while about our technology, and their objective in doing the assessment was to confirm the pipe that truly needed replacement."*

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Our ePulse® condition assessment technology is a non-invasive acoustic solution that assesses a pipe's condition and simultaneously detects leaks. It considers information about the pipe material, the time frame in which it was installed, the diameter of the pipe and the original wall thickness to help determine the condition of the pipe—poor, moderate or good.

Sunrise selected the ePulse® technology to evaluate four miles of the approximately 25 miles of pipe it determined could have corrosion problems similar to those that necessitated the previous replacement project.

"We knew this pipe was installed in the late '70s, and it was class-50 pipe that wasn't as thick of pipe wall as what we spec now," Fraijo said. *"Also, back in the '70s, we didn't have standards that support proper installation of ductile iron pipe. When you put ductile iron pipe in the ground, you want a good rock bedding and to surround it with the same material. Back then, they just laid the ductile iron on the dirt, backfilled in sand, and where those two dissimilar materials meet, it caused heavy corrosion on the bottom of the pipe."*

RESULTS

The Echologics field team conducted its ePulse® condition assessment survey of four miles of pipe over eight days in April 2016. A short time later, we delivered a report that detailed the state of the tested pipe. This report revealed that, as with Sunrise's previous project, some segments of pipe require replacement while others are in good condition.

"By doing this, we saved literally millions of dollars by not having to replace all of those pipes," Fraijo said. *"Out of that four miles of pipe, we've developed a budget to start replacing pipe that they said was high-hazard. Before we contracted Echologics, we anticipated just going through and replacing subdivision after subdivision because we knew that era of pipe had issues."*

EPULSE® CONDITION ASSESSMENT TECHNOLOGY IS NON-INVASIVE AND SEARCHES FOR LEAKS SIMULTANEOUSLY.

"They ended up finding out that some of the pipe was bad, but the benefit to this was that they found a couple of things," Keefer said. *"One, there was still good pipe in there, which they would have gone ahead and just replaced do to a lack of actual information about the condition of the asset, and two, because we do leak detection at the same time we're doing the acoustic condition assessment, we were able to check the whole system for leaks, so even in the areas where we did confirm the pipe was in poor condition, at least they had the peace of mind that there weren't any current leaks."*

Since the report was delivered, Sunrise has conducted a number of spot checks to verify our findings, and the results have shown the report to be accurate. In fact, Fraijo hopes to work with us to test another five miles of pipe in the near future.

"The folks were just awesome to work with," Fraijo said. *"Just super knowledgeable, timely—they did what they said they were going to do, and they held our hands through the whole thing. It was a pleasure to work with them."*

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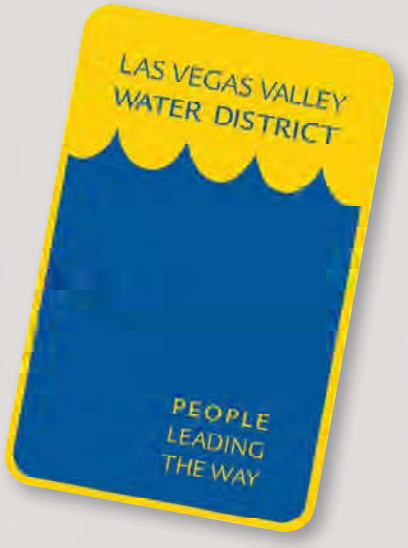
WINNING BIG IN LAS VEGAS WITH ACOUSTIC CONDITION ASSESSMENT

Condition Assessment



The assessment found that the majority of the pipeline, which LVVWD initially expected to replace at the cost of nearly $10,300,000, was still in good structural condition, as it contained more than 95 percent of its original wall thickness.

Solution	Echologics ePulse®
Client	LWWD
Location	USA
Type of Pipeline	Water Distribution Mains
Diameter	16″ - 24″
Pipe Material	Cast Iron

SITUATION

The Las Vegas Valley Water District (LVVWD) began providing water to the Las Vegas Valley in 1954. Over the years, the city's water delivery system has grown to more than 4,500 miles of pipeline, 350,000 service connections, and a reservoir system capable of storing more than 900 million gallons of water. Today, the district provides water to more than one million people in Las Vegas and Clark County Southern Nevada.

According to the USEPA, 700 water main breaks occur every day in the U.S., amounting to approximately 250,000 breaks each year. And, on average, 14 percent of treated water is lost to leaks. The LVVWD has a relatively young water infrastructure that experiences very few main-breaks per mile as compared to other major utilities, and has less than 6 percent losses. However, some of its pipes have started to fail more often due to corrosion and other factors.

A particularly troublesome section of pipe was part of a 6.5 mile span of 16-24″ mortar lined steel cylinder pipeline that ran underneath some of the city's most popular thoroughfares. The pipe was installed in the 1950's without any cathodic protection or corrosion control and had experienced three main breaks over the past 5 years. While examining a break that occurred underneath a section of the famous Las Vegas Boulevard, crews noticed that the pipe walls had been worn thin due to corrosion. Seeing the pipe's deteriorated condition, LVVWD expected that it may have to replace the entire 6.5 mile span of pipe—a major expense that could cost the LVVWD as much as $300 per foot of pipe (a total cost of nearly $10,300,000) and would disrupt busy roadways.

MUELLER

ACTION

To prioritize sections of pipe that were in most need of repair, LVVWD turned to us, a leader in the development of water infrastructure diagnostic technologies for water loss management, leak detection and pipe condition assessment. A subsidiary of Mueller Water Products, Inc., we help utilities across North America cost-effectively prioritize water system repairs and replacement and detect leaks for improved water conservation. Its technology uses a proprietary acoustic-based leak detection system that non-invasively assesses the structural condition of selected pipes.

LVVWD was already familiar with us, as its distribution maintenance crew regularly uses the company's acoustic listeners and correlators to detect leaks on smaller sized pipes throughout its system. However, before leveraging us for such a large scale assessment project, Ryan Benner, Maintenance Engineer for LVVWD, and Charles Scott, the district's Engineering Project Manager, wanted to gauge the accuracy of our condition assessment capabilities.

LVVWD had us assess the condition of a section of 6″ asbestos cement pipe that had been scheduled to be abandoned. After the test, the unearthed sections of pipe were sent to a lab specializing in asbestos cement pipe testing. The lab results were compared to the condition assessment report provided by us and found to be nearly identical. As a result, LVVWD selected us to conduct the assessment project.

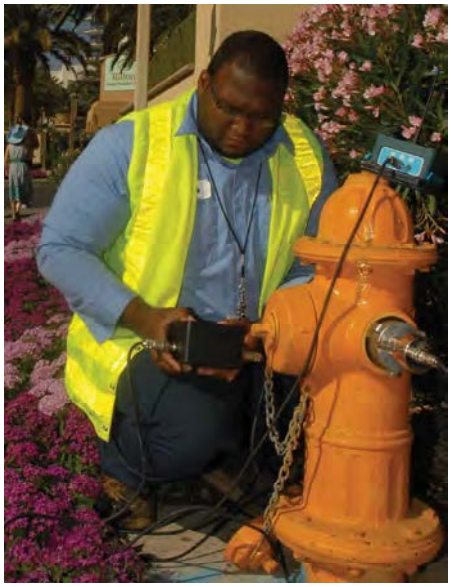
RESULTS

Our team and LVVWD assessed the entire 6.5 mile span of pipe in only two weeks. The assessment found that the majority of the pipeline, which LVVWD initially expected to replace at the cost of nearly $10,300,000, was still in good structural condition, as it contained more than 95 percent of its original wall thickness.

In addition, a number of previously unidentified leaks were identified by us, and LVVWD was able to quickly repair them, helping to reduce non-revenue water and prevent future water system and roadway damage. Ultimately, only 15-20 percent of the pipes in the system were found to have lost a significant amount (more than 15 percent) of their original wall thickness to corrosion and other factors, and were prioritized for renewal.

By working with us, LVVWD was able to efficiently address non-revenue water and prioritize system replacement by getting a thorough, non-invasive assessment of the pipeline's structural integrity—without breaking ground or disrupting the city's busy streets that are vital to its tourism industry. And, by identifying that only a fraction of the system was in poor condition and needed to be prioritized for renewal, the district was able to avoid needlessly spending millions of dollars on the premature replacement of the entire pipeline.

LVVWD has since initiated a similar program that leverages the same acoustic-based leak detection system to assess the condition of a section of asbestos cement pipe. To date, most of the pipeline has been confirmed to be in good condition and LVVWD has been able to locate and prioritize several sections of degraded pipe for rehabilitation.



BY IDENTIFYING THAT ONLY A FRACTION OF THE SYSTEM WAS IN POOR CONDITION AND NEEDED TO BE PRIORITIZED FOR RENEWAL, THE DISTRICT WAS ABLE TO AVOID NEEDLESSLY SPENDING MILLIONS OF DOLLARS ON THE PREMATURE REPLACEMENT OF THE ENTIRE PIPELINE.

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BREAKING UP WITH THE "BREAK MAP": CUTTING CAPITAL COSTS WITH PIPELINE CONDITION ASSESSMENT TOOLS

Condition Assessment

OVERVIEW

Water resources and city services go back to the early history of the Minnesota city of Edina, a "first-ring" suburb of Minneapolis founded in the 1850s.

Named after the local water-powered Edina Mill, the community in the 1920s was divided in conflict between residents demanding more city services and those committed to maintaining Edina's rural character, causing part of the town to secede. Today, the residential neighborhoods of a reunited Edina have retained the bucolic charm of a small town — but with efficient city services and proactive public works management of a much larger city.

Solution	Echologics ePulse®
Client	City of Edina
Location	USA
Type of Pipeline	Water Distribution Mains
Diameter	8″ - 10″
Pipe Material	Cast Iron, Ductile Iron

SITUATION

For decades, Edina's public works department made pipe replacement decisions based on service life estimates and a "break map" history of locations of pipeline breaks and leaks. Area-wide replacement of miles of expensive water main pipe was standard procedure until Edina discovered the cost-saving benefits of pipeline condition assessment technology in 2014. *"We planned on spending somewhere between $800,000 to $1 million on water main replacement on that first project, but performing non-invasive condition assessment testing on our existing pipe enabled Echologics to cut that cost in half,"* says Chad Millner, Director of Engineering for the Edina Engineering Department.

OUR EPULSE® ACOUSTIC CONDITION ASSESSMENT TECHNOLOGY HELPS UTILITIES EXTEND THEIR CAPITAL PROGRAMMING BY IDENTIFYING OLDER WATER MAINS THAT ARE STILL CAPABLE OF AN ADDITIONAL 20 OR 30 YEARS OF SERVICE LIFE.

SOLUTION

Consulting engineers retained by the Edina Engineering Department used Echologics ePulse® condition assessment technology to determine the structural integrity of Edina's 8" and 10" ductile iron or cast-iron water mains. Non-destructive and nonintrusive, the acoustic-based ePulse® technology enables utilities to assess the condition of water mains without taking mission-critical pipelines out of service.

"The ePulse® technology is a proven condition assessment and leak detection tool that measures the remaining average wall thickness of water mains," says consulting engineer Dave Hutton with Short Elliott Hendrickson (SEH), an engineering firm working for Edina. *"This makes ePulse® technology an outstanding tool that helps utilities to extend their capital programming. Identifying older water mains that are still capable of an additional 20 or 30 years of service life is a proactive way to avoid premature and unnecessary replacement, saving capital dollars that can be applied to other projects."*

MUELLER

The ePulse® technology involves inducing low-frequency acoustic pressure waves measured by sophisticated acoustic sensors connected to exterior pipe appurtenances or the pipe itself. The pressure waves cause the pipe wall to "flex" on a microscopic level, affecting the speed of the pressure wave detected by the acoustic sensors.

Thicker pipe walls are more resistant to this pipe flexing, causing the pressure wave to travel faster, indicating a pipe wall in good condition. Deterioration and corrosion resulting in a thinner pipe wall causes the acoustic pressure wave to travel measurably slower, identifying worn pipe and sections in danger of failure and in need of replacement. Applying advanced algorithms to the captured acoustic data enable measuring the average minimum wall thickness, which is compared to the original thickness of the pipe determine the average percentage of wall loss.

RESULTS

The first-year capital savings convinced the Edina Engineering Department to make condition assessment testing part of their ongoing pipeline maintenance program, typically deployed before initiating annual street reconstruction projects scheduled for summer months. Condition assessments have revealed pipelines with as much as 50% wall thickness loss, and may have contributed to Edina avoiding catastrophic water main failures for the past few years. Edina has adopted a policy of automatic replacement of any pipes with 30% or more pipe-wall loss, because even marginally reduced pipe wall integrity creates substantial risk of broken water mains from ground movement caused by frost during severe Minnesota winters.

"Condition assessment data gives us an accurate picture of the overall status of our water distribution system, and is now a critical factor in deciding where to strategically spend our capital dollars," says Edina's Chad Millner. *"We immediately recognized its value when we were testing this technology a few years ago, and now our city council also recognizes the real bottom-line benefits of using condition assessment technology, especially in these days of limited utility budgets."*

Non-invasive "survey-level" technologies like ePulse® condition assessment are gaining popularity with utilities as an economic alternative to high-resolution inspections than using expensive technologies that require removing pipelines from service, or inserting devices and equipment into an active pipeline. Budget cutting as a result of water conservation measures, reduced revenues, and other economic factors are compelling both large and small utilities and municipalities to seek new ways to maintain their water distribution systems at less cost.

"Utilities are grappling with aging water distribution infrastructures coming to the end of their service lives, but their real challenge is making diligent choices as to which pipelines they are going to replace and when," says Michael Livermore, our regional sales manager. *"Utilities today simply cannot afford to operate without the vital decision-making information delivered by advanced pipeline condition assessment technology. It's no longer merely an option. It's a necessity."*

"Smaller municipalities and utilities are embracing this technology simply because it gives them a big advantage for a very small cost," says Dave Hutton of SEH. *"Yes, you spend a little money up-front for the condition assessment testing, but you save more money on the backend by avoiding replacement costs. It's like those car-repair TV commercials many years ago that said, 'Pay me now — or pay me later."*

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DOYON UTILITIES REAPS COST SAVINGS WITH CONDITION ASSESSMENT

Condition Assessment

OVERVIEW

In Fairbanks, Alaska, the matter of water main replacement is not to be taken lightly. The city – the second-largest in the state – is located just south of the Arctic Circle and is commonly called the coldest city in the United States according to AccuWeather, with an average monthly low temperature of -16.9 degrees Fahrenheit. Its lengthy, brutal winters freeze the ground for much of the year, so replacing piping there can be an extremely cost- and labor-intensive undertaking.

Given this, one local utility with a limited budget chose to utilize acoustic condition assessment from us in the summer of 2016 to determine the state of two sections of its pipe, and the results of the survey are already paying dividends.

Solution	Echologics ePulse®
Client	Doyon Utility
Location	USA
Type of Pipeline	Water Distribution Mains

SITUATION

Doyon Utilities is a privately held company that owns and operates the water and electrical utilities for three U.S. Army bases in Alaska: Fort Wainwright in Fairbanks, Fort Greely in Delta Junction and the Fort Richardson portion of Joint Base Elmendorf–Richardson in Anchorage. Doyon Utilities was awarded government contracts for these installations in 2008, and since then, the operators of these utilities have been attempting to assess the condition of their water network. At Fort Wainwright, that duty falls to Capital Programs Manager Mac Nason.

EPULSE® TECHNOLOGY DIDN'T REQUIRE AND EXCAVATION TO ACCESS THE WATER MAIN WHICH WAS CRITICAL FOR THIS PROJECT.

"For military installations across the U.S.—very much like municipalities—the investment into the infrastructure has varied over the last 50 years," says Nason. *"We've been working to get current condition data on this infrastructure that we now own and operate under the contract with the U.S. Department of Defense. I've got a lot of historic information, and I've built capital improvement plans based on that."*

One of Nason's projects involved the rehabilitation of two lengthy stretches of troublesome water main, but a simple replacement program proved to be a non-starter.

"The piping that we looked at with this project was along Neely Road and Luzon Avenue, two separate stretches on the installation," says Nason. *"They'd been having some problems, particularly on the Luzon Avenue stretches, with pipe leaks and other serious issues. Based on historic documents, I developed three projects to do the standard 'renewal through replacement.'"* But with an estimated dollar amount *"in the neighborhood of $25 million,"* the projects were considered unaffordable.

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THE ECHOLOGICS FIELD TEAM LOCATED A LEAK ON THE WATER MAIN WHICH PROVIDED ADDITIONAL PROJECT VALUE.

ACTION

Nason went back to the drawing board to devise a new way to address the problem. At a recent conference of the Alaska Water Wastewater Management Association, he attended a presentation given by us, which demonstrated its ePulse® technology. ePulse® technology is a noninvasive acoustic technique that assesses pipe condition, detects leaks and determines the pipe's remaining service life.

"We take all the information about what the pipe material is, the time frame it was installed and the diameter of the pipe, and then we factor in what the wall thickness was when it was put in new, or what the specs are of that type of pipe," explains Corey Keefer, Echologics Western Region Sales Manager. *"The speed of sound that travels through the pipe is going to be much less rapid if it's degraded or if the pipe is in bad condition. There's a lot that goes on behind the scenes from the engineering side, and all the information that comes out from the data gives us a final report on what the condition of the pipe is – good, moderate or poor condition."*

Nason was intrigued by the possibility of using ePulse® technology. He met with Echologics engineers and spoke with employees of the Anchorage Water & Wastewater Utility, which had successfully deployed Echologics technologies on pipe condition assessment projects in the past. Nason subsequently suggested using ePulse® technology to the Army, and the project was approved.

"Our one customer at Fort Wainwright is the Army, so there's a lot more direct involvement between us and them when it comes to capital projects," says Nason. *"They were very much in favor of using condition assessment to target what we were going to have to actually do for capital improvements."*

RESULTS

An Echologics condition assessment team traveled to Fort Wainwright in late August 2016. From August 29 to September 2, they tested more than two miles of pipe in segments.

"The field crew they sent was all of two people," says Nason, who adds that the technology they used was unobtrusive. *"It doesn't take any excavation and we didn't have to shut anything down. You keep the lines in service."*

The survey paid immediate dividends when a significant leak was discovered in one of the base's fire hydrants. *"They found a 30-gpm leak in a fire hydrant along Neely Road,"* says Nason. *"They passed that information to our operations and maintenance guys, and they were able to get on that right away."*

The cost savings from this discovery alone helped to justify the expense of the survey. "An estimated combined water loss of 30 gpm is roughly 43,000 gallons per day, so that's about $150,000 per year, just off of that one leak. This is based on their rates and the cost of water," says Keefer. "Off of that one leak they found, it paid for the entire service that we did."

Doyon Utilities was provided with a thorough report of the inspection's findings shortly thereafter. The survey revealed that much of the pipe was still in good to moderate condition, but two segments were found to be in poor condition. Determining the precise areas where service is needed has helped Nason significantly reduce the amount that will need to be spent on the pipeline rehabilitation project. *"Off the top of my head, I'm thinking we're going to see at least a 50%, if not, greater cost reduction by being able to target specifics, versus going in and removing it all and replacing it,"* he says.

Nason was impressed by our service and plans to continue working with the company as the Fort Wainwright infrastructure assessment project enters its next phase.

"This was the first time that we had used Echologics, and it was definitely a very worthwhile experience working with them," he says. *"As I get my condition assessment program going, Echologics is at the top of my list to use."*

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PIPELINE ASSESSMENT TECHNOLOGY HELPS ANGLIAN WATER LOVE EVERY DROP

Condition Assessment

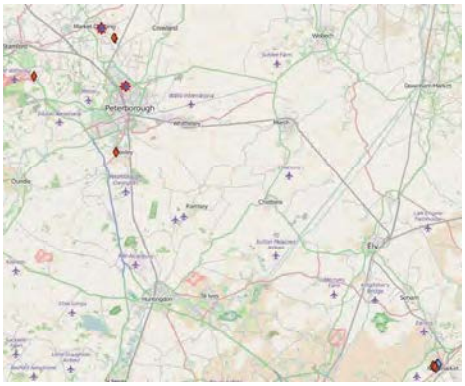
OVERVIEW

Keeping its network of more than 38000 km (2,000 miles) of water mains in working order is extremely important for Anglian Water.

The utility serves the East of England, an area that is among the driest in the country; receiving only approximately 600 mm (23.6 in.) of rain each year on average—significantly less than elsewhere in England. Anglian Water's 27,500-sq-km (10,618-sq-mile) service area is the largest of any water and sewerage utility in England and Wales.

Solution	Echologics ePulse®
Client	Anglian Water
Location	UK
Type of Pipeline	Water Distribution Mains

SITUATION



"Some areas have a lower annual rainfall than Jerusalem," said Fionn Boyle, Optimisation Project Engineer for Anglian Water. *"That's why it's vital that we look after the water that we've got."*

The region's topography provides little assistance for the utility. *"Large parts of our region are typically flat and low-lying, with approximately a quarter of the land actually below sea level,"* said Boyle. *"With few hills around to help out with gravity, Anglian Water has to rely on pumping water from place to place, and that uses lots of energy."*

In response to a projection of future significant population growth in the area, the utility evaluated 7.2 km (4.5 miles) of an existing line between a reservoir and a treatment facility to determine if it could stand up to increased stress. With the population of Anglian Water's region is expected to grow by close to 20% by 2035, against a 2010 baseline, the existing system could not support the forecast demand.

To alleviate stress on the existing pipeline, Anglian Water devised a plan to install an additional 7.2 km (4.5 miles) of water main between the reservoir and the plant. However, the utility also had to address problems with the pipe that was already in ground.

As there is a higher than average number of breaks on the existing pipe due to corrosive soil conditions, the main had to either be rehabilitated or replaced. Due to Anglian Water's commitment to reduce its carbon footprint, rehabilitation was the selected route.

While conducting the rehabilitation, Anglian Water discovered a 198-meter (650-ft) stretch of pipe that could potentially be exempted from the project. If the utility could prove its condition was suitable for continued use. A costly and complicated rehabilitation could then be avoided.

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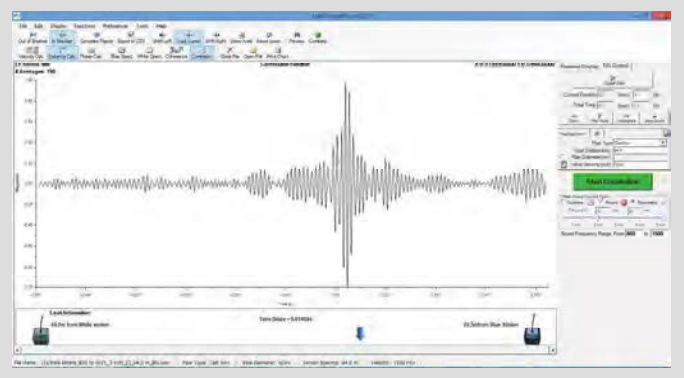
Adding to the work complexity and risk of adverse environmental impact, the section ran under an environmental protection area, where it was found to suddenly sink and rise in level on either side.

"We had an exceptionally difficult scheme to deliver, and the environmental impact of having to dig down on the main to replace it was going to be massive," said Boyle. *"We don't take decisions like that lightly, so we knew we needed to make sure it was the right one."*



ACTION

To evaluate possible solutions, Anglian Water consulted the Water Innovation Network—a business network it operates in conjunction with Allia, a not-for-profit organisation. After a pilot testing, Anglian Water chose Echologics' ePulse pipeline condition assessment technology to determine if the main needed rehabilitation.

ePulse is a non-invasive acoustic solution that assesses pipe condition and simultaneously detects leaks. It considers information about the pipe material, the time frame of installation, the diameter of the pipe, and the original wall thickness, to help determine the condition and the remaining service life (RSL) of the pipe.

"We chose Echologics' ePulse because of the ease of use and the reliability of the results," said Boyle.

"We couldn't get a system inside the main to carry out the assessment and still have a cost-effective solution. With ePulse, we were able to spend on the assessment and still have a business case that showed a benefit, as well as ensuring we had a positive environmental impact."

THE RESULT

The test was conducted with no major problems in less than a day using existing fittings. The assessment results suggested that the main was at or near the 50-year RSL required of new assets by Anglian Water. Therefore, the utility decided to forgo rehabilitation and instead, installed valve arrangements outside the protected area so that workers would have easy access to the pipe in the event of a break.

The ePulse acoustic assessment result had influenced Anglian Water in making the most appropriate investment decision. A cost savings of over $150,000 (€122,000) was achieved, along with the added benefits of reducing its environmental impact, carbon footprint and, impact on local customers- reducing the estimated time on site from several months to just four weeks.

Anglian Water is now looking at other cases where Echologics' technology can be used to save resources, as well as reduce the company's environmental impact. Additionally, it is considering a wider-scale condition assessment programme in order to promote sustainability across its system.

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ECHOLOGICS® EPULSE® ACOUSTIC TECHNOLOGY HELPS GERMAN WATER UTILITY ASSESS ASSET HEALTH AND PREDICT NETWORK FAILURES

Condition Assessment

OVERVIEW

Faced with infrastructure reaching its end of life, it became critical for the Netzgesellschaft Dusseldorf to find a way to anticipate failures, so that they could prioritise maintenance and keep up with daily operations, while managing the necessary capital expenditures.

Solution	Echologics ePulse LeakFinderST
Client	Netzgesellschaft
Location	Germay
Type of Pipeline	Transmission and Distribution
Diameter	24″ - 47″
Pipe Material	Steel and Cast Iron

SITUATION

Netzgesellschaft Düsseldorf mbH (NGD), a wholly owned subsidiary of Stadtwerke Düsseldorf AG, is responsible for network operation for the North Rhine-Westphalia capital of Düsseldorf in the area of energy and water supply.

NGD identified a significant amount of transmission and distribution mains made of steel and cast iron that were installed between 1950 and 1965. These pipes were said to be strongly prone to corrosion. Due to the absence of historical data and limited capacity of underground work to assess its structural condition and remaining service life, NGD searched a cost-effective solution to prioritize its pipeline rehabilitation and replacement decisions. The utility's asset management team turned to Echologics® ePulse® condition assessment technology from Mueller Water Products.

"We chose the ePulse because of its unmatched ability to locate leaks non-invasively while assessing factual pipe condition versus theoretical," said NGD Asset Manager, Markus Wall.

NGD and Echologics field crews collaboratively selected a 22mi section, critical to the city's supply network to kick-start the project.

SOLUTION

ePulse technology can assess the condition of distribution and transmission mains, while simultaneously searching for leaks without the need for large excavations or service disruptions.

By attaching acoustic sensors to existing contact points, such as fire hydrants, valves or direct contact with a pipe, a sound wave is then induced in the pipeline and travels along the pipe. The acoustic sensors capture the time it takes the sound wave to travel between two sensor stations.

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Site plan indicating the pipe segments surveyed, which are color coded in three categories:

green (good),
yellow (moderate),

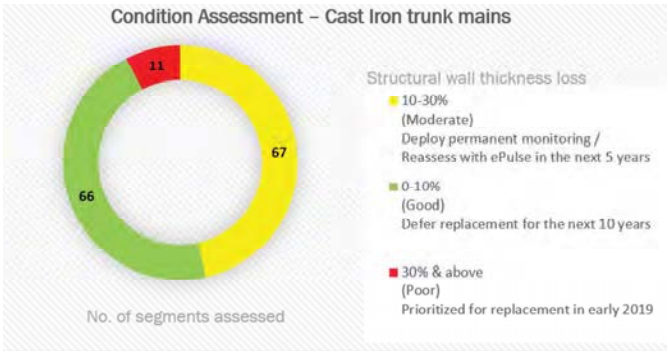
red (poor).

As the sound wave travels, it pushes water molecules toward each other. As water is incompressible, the molecules push outward on the pipe wall. This places a microscopic flex on the pipe wall — and greater the flex, the weaker the pipe. With ePulse technology, it's possible to measure the actual strength of the pipe wall which is an ideal measure of actual pipe condition.

This results supported NGD's cast iron replacement decisions by rapidly assessing the structural condition across the pipe network to prioritize areas with the worst degradation for immediate pipe replacement.

For the steel pipe sections, broadband electromagnetic measurements (BEM) was also used to characterize the pitting distribution on each section of pipe. Pipe measurements and other pipe condition datasets were then paired with a structural analysis to determine the condition of each pipe.

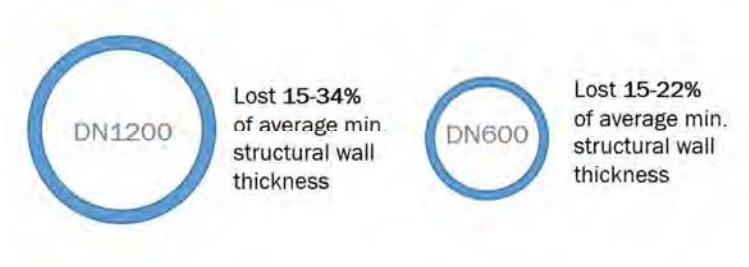
RESULTS



Cast iron trunk main selection: ePulse condition assessment

A total of 27.7km section was assessed using ePulse technology with three leaks successfully pinpointed.

On the left, is a summary of decisions made by NGD, considering Echologics' experience:



Steel trunk main selection: ePulse condition assessment and BEM

900m of DN600 and 500m of DN1200 Steel mains were assessed using ePulse technology. On the left, is a summary of findings:

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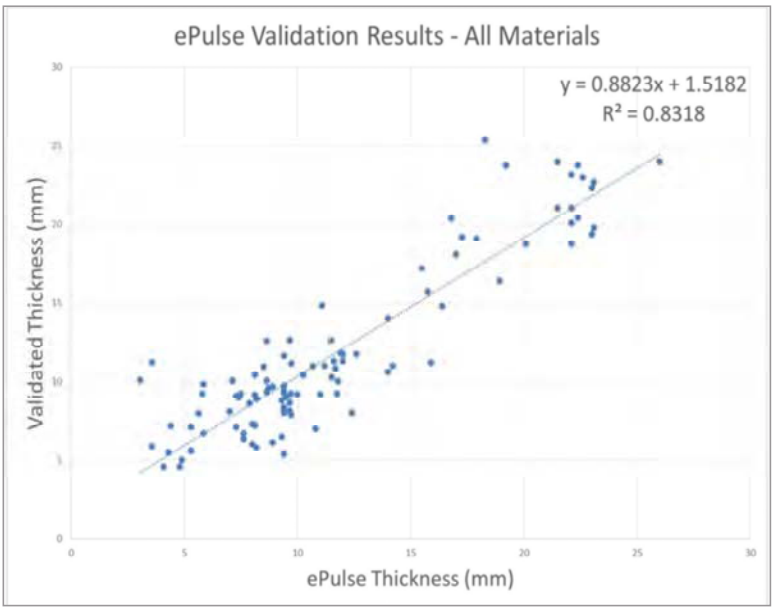
The minimal average remaining structural wall thickness calculation aligned with the pitting distribution and the minimal wall thickness values gathered through the BEM measurements, provided a useful dataset for NGD to make informed replacement decisions.



ePulse® validation results for all materials. Echologics provided 104 sets of ePulse validation results. R2 is the Determination Coefficient indicating how well the validation results were predicted from the ePulse results.

"At NGD, we seek resilient water systems to anticipate and monitor changes to pipe condition. The data-driven insights we gathered from ePulse have not only helped us safeguard the long-term availability of clean water for all customers and stakeholders in this city, but also efficiently allocate operational resources," concluded Mr. Wall.

Netzgesellschaft Düsseldorf mBH plans to re-measure the moderate pipes with ePulse technology after five years to evaluate the change in structural remaining wall thickness.

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OPTIMIZING PIPELINE REHABILITATION PROGRAM

Condition Assessment

OVERVIEW

New Jersey American Water embarked on a pilot project that would soon transform its methodology for pipeline rehabilitation. The utility, which serves a population of nearly 3 million, tested an acoustic-based technology that enabled it

to perform a non-intrusive condition assessment of several stretches of its pit cast iron mains. The results of that pilot project were profound and changed the way the utility reviewed and determined its strategies for cleaning and lining (C&L) rehabilitation.

Solution	Echologics ePulse®
Client	New Jersey/ American Water
Location	USA
Type of Pipeline	Water Distribution Mains
Diameter	4″ - 12″
Pipe Material	Cast Iron

RESULT

With more than half of New Jersey American Water's distribution system installed before the 1960s, it was imperative for the utility to collect accurate data about the true condition of its pipes in order to determine the best course of action for rehabilitation. The impetus for piloting the new technology was a disruptive and costly break of one particular rehabilitated water main, which had recently being cleaned and lined. Prior to the use of ePulse® acoustic-based testing, New Jersey American Water would determine which mains to rehab by looking at typical fire flows, number of breaks recorded, type of pipe and other historic data. It would then clean and line the targeted pipes without a complete understanding of the remaining service life (RSL).

IN ORDER TO BETTER ACCURATELY DETERMINE THE STRUCTURAL INTEGRITY OF ITS AGING PIPELINES AND THE METHODS FOR ADDRESSING THEM, NEW JERSEY AMERICAN WATER HAS SINCE INTEGRATED EPULSE® TO ITS METHODOLOGY TOOLBOX AND NOW USES IT ANNUALLY.

"What we had found was that many times when you rehab the pipe, the tuberculation inside the pipe is primarily what's holding it together," said Michael Wolan, Engineering Manager for New Jersey American Water. *"The graphitization of the pipe was not something that we were able to determine by our other methods, so the pipe may have been past its useful life or getting near to it when we went in to clean and line it."*

In order to better accurately determine the structural integrity of its aging pipelines and the methods for addressing them, New Jersey American Water has since integrated ePulse® to its methodology toolbox and now uses it annually. This has improved how the utility estimates the number of useful years left in its pipe segments, enabling Wolan and his team to make more educated decisions about its pipeline rehabilitation programming. *"It's giving us more data and more data is always good for making effective decisions,"* Wolan said.

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INTEGRATING INTO THE PROGRAM

Developed by us, ePulse® is a non-intrusive, non-disruptive method for assessing the conditions of water mains through the use of acoustic sensors. Without taking pipelines out of service, ePulse® can collect data that indicates average minimum wall thickness of targeted pipe segments, as well as check for leaks in the distribution system. This information is then used by utilities for addressing water distribution problems through rehabilitation or replacement methods. Rehabilitation is the most ideal, as it minimizes disruption to customers and extends the life of existing pipe assets while improving water quality and flows.

Since the initial 2014 pilot project, which tested pit cast iron pipeline segments between 4″ to 12″ inches in diameter in the state's Millburn and Maplewood areas, New Jersey American Water has deployed the acoustic-based testing in the West Orange, Westfield, Clark, Maplewood, Chatham, North Plainfield and Hillside communities. The utility now mandates that any pipeline marked for rehabilitation be tested with ePulse® prior to determining the lining methods for the project. New Jersey American Water does two types of lining for its cast iron mains, polyurea-based and cement mortar.

"We primarily try to have the acoustic condition assessment testing performed either in the fall of the previous year, or in the early months of the year," Wolan said. *"For example, if you look at the 2017 season for rehabilitation; cleaning and lining generally starts around April and ends by the end of October."*

New Jersey American Water periodically verifies its acoustic testing results by also sending out metallurgical samples for testing. During the pilot project in 2014, the utility had wanted to verify that the areas ePulse® identified as structurally deficient were indeed such. The physical pipe samples proved to align with the data collected by us, and the utility continues to find similar results today.

NJAW NOW MANDATES THAT ANY PIPELINE MARKED FOR REHABILITATION BE TESTED WITH EPULSE® PRIOR TO DETERMINING THE LINING METHODS FOR THE PROJECT.

A VALUABLE PROGRAM TOOL

Currently New Jersey American Water employs acoustic-based testing for its cast iron pipes, and recently performed a first pilot of transite (asbestos cement, or AC) pipe testing in its coastal north section district. Similar to the cast iron validation testing, coupons will be taken to verify our results. The technology has performed well with AC pipelines in other cities, according to John Marciszewski, Echologics Director of Business Development, and its results have matched up with the results of phenolphthalein dye tests that reveal remaining structural thickness.

Since the 2014 pilot, which tested roughly about 20,000 feet of cast iron mains, the utility has tested a further 200,000 feet in New Jersey American Water's North delivery area, and 100,000 feet in the South delivery area, said Marciszewski. The utility now tests generally between 50,000 and 80,000 feet of pipe segments in any given year.

Wolan said the utility still very much uses the RSL data gathered via other methods in its toolbox, but the integration of ePulse® acoustic-based testing has proven to be valuable. *"We are using it broadly now in our rehabilitation methodology for determining the type of liner we use, and we're very satisfied with the results we have been getting,"* he said of our technology. *"We do tend to put our toes in the water carefully, like with the pilot, but once we're convinced that the technology has value to the company, our customers and our stakeholders, then it's a technology that we're willing to embrace and use on a broad basis."*

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Case Study

Reversing Water Loss In A Rural Municipality

Source: Kamstrup 03/28/2025

In June of 2019, the town of Oneida, Tennessee was experiencing an impossible situation. With increasing state regulations and massive water loss, the water department was taken over by the local government.

Oneida produces 400 million gallons of water a year and saw a 51% water loss, meaning that over 200 million gallons a year were being lost to leaks. The loss cost the city $186,000 annually and caused the water treatment plant to operate on 12- to 14-hour days to keep up with demand.

Oneida was put on notice by the EPA, like many rural municipalities with limited resources and aging infrastructure, Oneida was overwhelmed by increasing expectations and was out of ideas.

Topography Challenges In Oneida, Tennessee

Many municipalities will relate to the complex set of conditions that Oneida must embrace to provide quality water on tap. It's remote, rural, and breathtakingly beautiful all at once. The diverse topography contains a mixture of mountains and valleys with elevations ranging from 800 to 2,000 feet. The same rugged topography that makes Oneida a recreational paradise makes it an obstacle course for water distribution and maintenance.

Oneida faces a complex set of conditions to provide quality water on tap. The diverse and rugged topography creates an obstacle course for water distribution and maintenance.

The town of Oneida sits along the northern middle border of Tennessee with the closest metropolis 60 miles away in Knoxville. Oneida's economy is also in transition, the area is a mix of working farms, manufacturing, and low- to mid-income housing with a tax base of 5,000 customers who are concerned with the cost and accessibility of water.

Oneida's water system includes two water supply reservoirs, one water and wastewater treatment plant, and an aging water distribution system. Routine droughts are also impacting the water supply. The water department is run by locals from the town of Oneida. From the field technician to the plant manager to the mayor Jack Lay, the Oneida water department reflects the community. It's a mix of generations, some of whom are related - all of them public servants and water customers alike.

Acoustic Leak Detection Paying Water Bills

During the initial three-month period after the Kamstrup meters were installed, Oneida uncovered and repaired a single leak that had been running for five months at an estimated cost of $21,000 per year.

The relationship between Kamstrup and Oneida was established with the arrival of a new General Manager, Stephen Owens to the Oneida water department. As a veteran water steward, Owens came out of retirement to help the town and set the precedence that before the city could overhaul its infrastructure, it needed to fix the leaks.

Owens sought an AMI partner (Advanced Metering Infrastructure) with ALD experience (Acoustic Leak Detection) to help detect leaks for the city. Owens started with Kamstrup, an impressive company he encountered years earlier at a tradeshow.

The city of Oneida became Kamstrup's first fully ALD system in the U.S.

Turning The Lights On

Oneida installed 4,600 Kamstrup meters and erected 12 collectors in the EPA's designated five week timeframe. A huge success with no more than four, or .08% meters non-operational upon arrival.

Once the meters were installed, Oneida shifted its focus to activating the ALD system. "It lit up like a Christmas tree," which was a relief for the water department as it gave them information, and direction and pinpointed exact locations to start fixing leaks.

In the first three months after the Kamstrup meters were installed, Oneida's non-revenue water was reduced by 23%. The city's 51% water loss was reduced to 38% loss, and the water treatment plant operation was reduced by three hours per day. With leak detection on its side, Oneida has transitioned to recovery and are steadily upgrading their infrastructure, utilizing a two-man crew to fix an average of five to six leaks per day.

The Results

- Non-revenue water loss reduced 23% in three months
- Water treatment plant operation reduced by three hours a day
- Oneida aims to repair two miles of pipe per year and reduce their water loss to under 15%

Fixing One Leak Saved Approximately $165,000

One of the advantages of the Kamstrup ALD system is the easy ability to spot abnormalities. One particular leak that was detected in Oneida was on the residential side. A spike in the system indicated a leak with water loss at a rate of 228 gallons per hour. The city notified the homeowner, fixed the problem and identified the source as a busted spigot behind a house. The city estimates this leak detection and solution saved the homeowner approximately $165,000.

From Fixing Leaks To Managing Assets

The water department has become adept at using the Kamstrup ALD system. They are doing the hard work of methodically addressing leaks and repairing their infrastructure. The city aims to repair two miles of pipe per year and reduce their water loss to under 15%. With leaks and loss under control, the Oneida water treatment plant continues to improve its operating time.

Oneida is now a showcase for municipal water management in Tennessee. In the spring of 2022, the city was awarded additional grant money for infrastructure improvement due to their proactive efforts and transformation.

As partners in leak detection and water management, Kamstrup and Oneida actively share intelligence and insights. The project has exceeded every expectation. In the words of Oneida's Stephen Owens, "We think the system performs even better than Kamstrup thought it would."

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