

Water Leak Detection

presented by Elisa Jones



Let's Talk about Leak Detection Dogs

- The concept of canine leak detection was first tested in 2017 by Australia's Water company.
- They conducted a trial with specially trained detection dogs to locate leaks in the underground water mains.
- The training was done by Steve Austin, an Australian dog trainer who trained dogs to detect different smells for use with feral animal control and narcotics detection.
- Tad Bohannon, CEO of Central Arkansas Water was in Great Britain in 2018 when he heard about a leak detection dog at United Utilities.
- He learned as much as he could about the dog and the concept and brought it back to central Arkansas.
- Central Arkansas Water began the hunt for a dog.
- Vessel, a black lab mix was identified as a star student in the Arkansas Paws in Prison program and was recommended to Central Arkansas water as an ideal candidate.
- Her specialized training to detect water distribution leaks was provided by local trainers Carrie Kessler and Tracy Owen.

Leak Detection Dogs in the US

- Vessel – Central Arkansas Water
- Charlie – Aqua Water Corporation - Texas
- Flo - Smith Engineering - Arkansas
- Guage - Rye Engineering - Tennessee
- Juble – Aqua Terra - Chicago Illinois
- Kona – Bama Leak Detection - Springville Alabama
- Piper and Draeger – Owned and Handled by Janet Donnelly in Oklahoma
- Snowi – Owned and handled by Carrie Kessler (Leak Detection Dogs) - Arkansas
- River – Owned by Mansfield Water - Texas
- Keena - Owned by DelCo Water - Ohio
- Shadow - Owned and handled by Daniel Levey (Nose on the Ground Water Leak Detection) - New York
- Duke – Owned and handled by Elisa Jones (Walnut Grove K9s) - Ohio



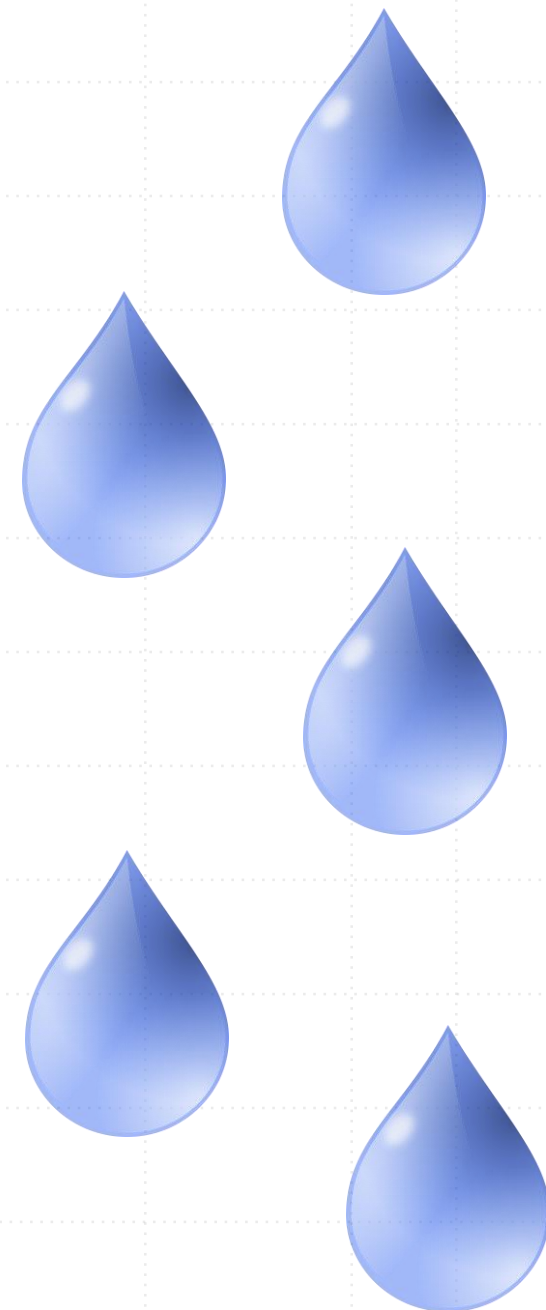


Water Sniffing K9s

Dogs that sniff out water leaks hidden beneath the surface, evading immediate detection.

They provide invaluable assistance in ensuring your non-revenue water loss control program is comprehensive and effective

Dogs can cover large areas quickly, reducing the time and effort. Their speed and agility allow for efficient data collection, making them invaluable assets in time-sensitive projects.





Wastewater Sniffing Dogs



Trained dogs recognize the smell of human fecal bacteria

They can discover broken sewer pipes, leaking septic tanks and illegal sewage discharges.



Conventional water sampling tests take 24 hours at a laboratory, and often must be duplicated to ensure their accuracy. Testing of sewer systems with dye or smoke takes days and is costly. But the dogs give an instant yes-or-no indication as to whether a particular location is contaminated with the bacteria.



Using dogs especially trained to detect human waste in the same way other dogs are trained to sniff out drugs or explosives.

They alert us to the presence of human-specific bacteria, E. coli, poop, No.2, whatever you want to call it.



Human fecal contamination is a serious environmental problem that can cause illnesses including intestinal problems; hepatitis; respiratory infections; and ear, nose, and throat problems. Contamination from the E. coli bacterium, naturally occurring in human intestines, becomes dangerous if it is present in the environment in high enough concentrations. It is the leading cause of beach and waterway closures in the U.S., and tracking down the source of such pollution is a high priority for local and state governments









Non-Revenue Water

- **Non-revenue water (NRW)** is water that has been produced and is "lost" before it reaches the customer.
- Why is this important??
 - Water is an important and precious commodity.
 - Water is traded bought and sold just like oil and coffee.
 - The cost of water is going up and will continue to go up.
- There is something that we can do though to slow the rising cost?
 - Stop water loss.



How Much Water is Lost

- Average loss is **15-50%**
- This is water that was pumped filtered ,treated, and then was being pumped to the end user but, it never got there.
- A water break can occur **every 2 minutes** in America
- these losses can add up to **1 trillion gallons a year**
- At \$5 a thousand gals that = **\$5,000,000,000**
- Much of this water loss is due to aging infrastructure.
- Approx 1.6 million miles of pipe in the ground, some are **over 150 years old.**
- Replacing over **2,000 miles of pipe a day** it would take **over 200 years.**
- New infrastructure is a goal, but stopping the leaks is the answer.



Case Study

- In the '90's during the construction the current EQ tanks an operator building was found from the buried 1950 wastewater plant
- It looked like they left for the night and just buried the building documents, furniture and all
- Water was running down the hillside... for at least 8 years.
- Water was tested for fluoride at the time and the test was inconclusive. Initially the Fluoride was detected but not in high enough levels to act.
- In the winter of 2023, the flow had notably increased. Water was tested again in the spring and the levels of fluoride increased significantly.
- There was speculation about a potential dedicated 4-inch line to the old plant which was behind the current houses
- Investigations turned towards the history of Juniper Hills Subdivision which started in 1957 and had a second phase built in 1970 when the current wastewater plant was built.
- In June of 2023, a leak detection dog was called in and had two hits, one in the area of the old treatment plant (determined after aerial photos were found) and one in the area of the old 4" line that no one knew about.
- OUPS was called.



Duke Oxford Search



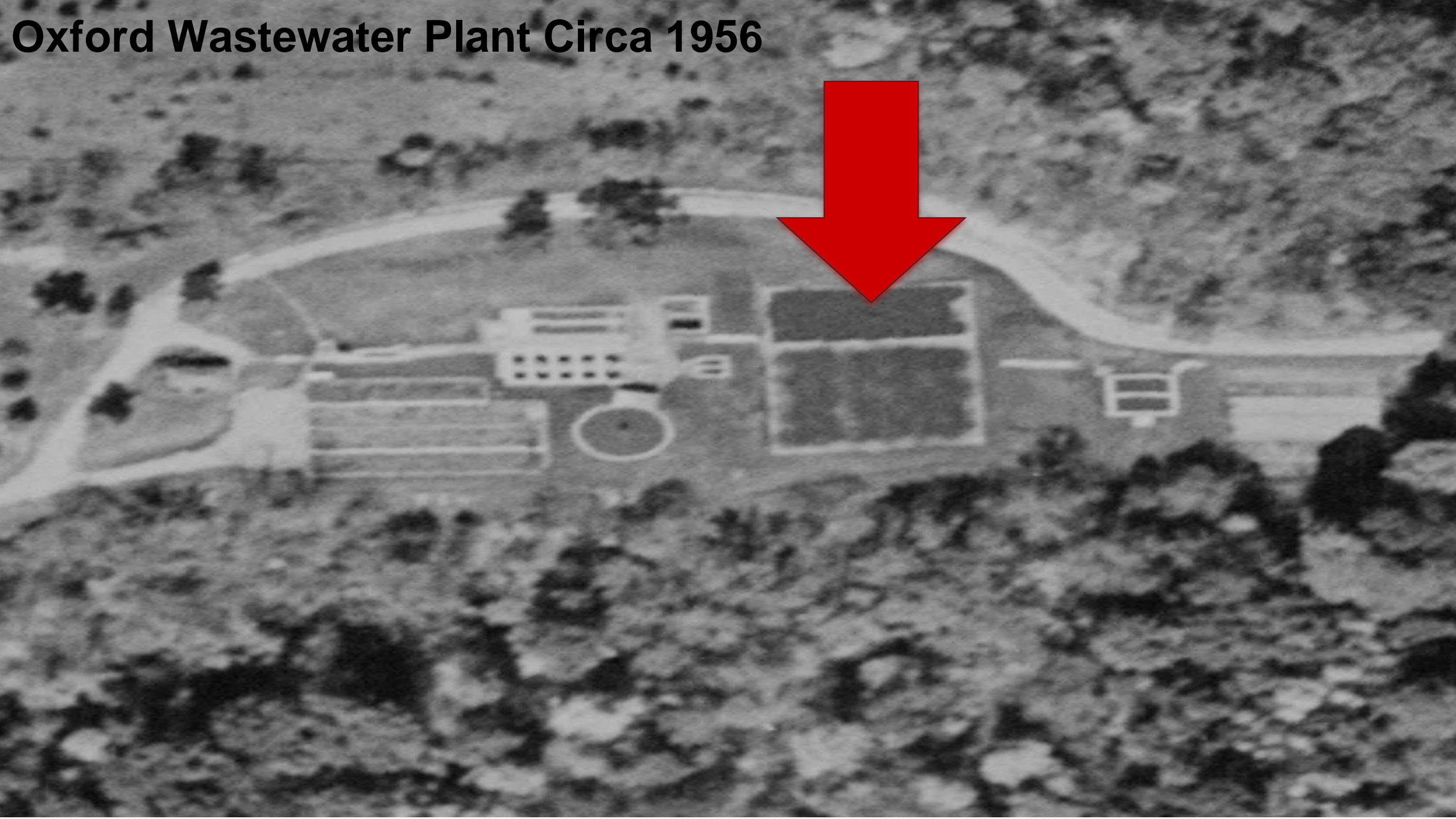
Oxford Wastewater Plant Circa 1970



Oxford Wastewater Plant Circa 1956



Oxford Wastewater Plant Circa 1956







The Dig



Elisa's Background

- Ohio Class 3 Water and Wastewater Operator since 2012
- City of Hamilton OH from 1999-2013 as Chemist doing water and wastewater lab work
- Warren County OH 2013-2014 as Chief Water Plant Operator
- City of Oxford Ohio – 2014- present as wastewater laboratory technician
- Training dogs since 1996
- Competing with dogs since 2018
- Started scent sport with a dog that I rescued in 2016. She would do obedience things but only with a treat in her nose.
- Worked with Sport Nosework Instructors, Police K9 instructors, Military Instructors.
- Nosework would lead me here, giving this presentation on detection dogs

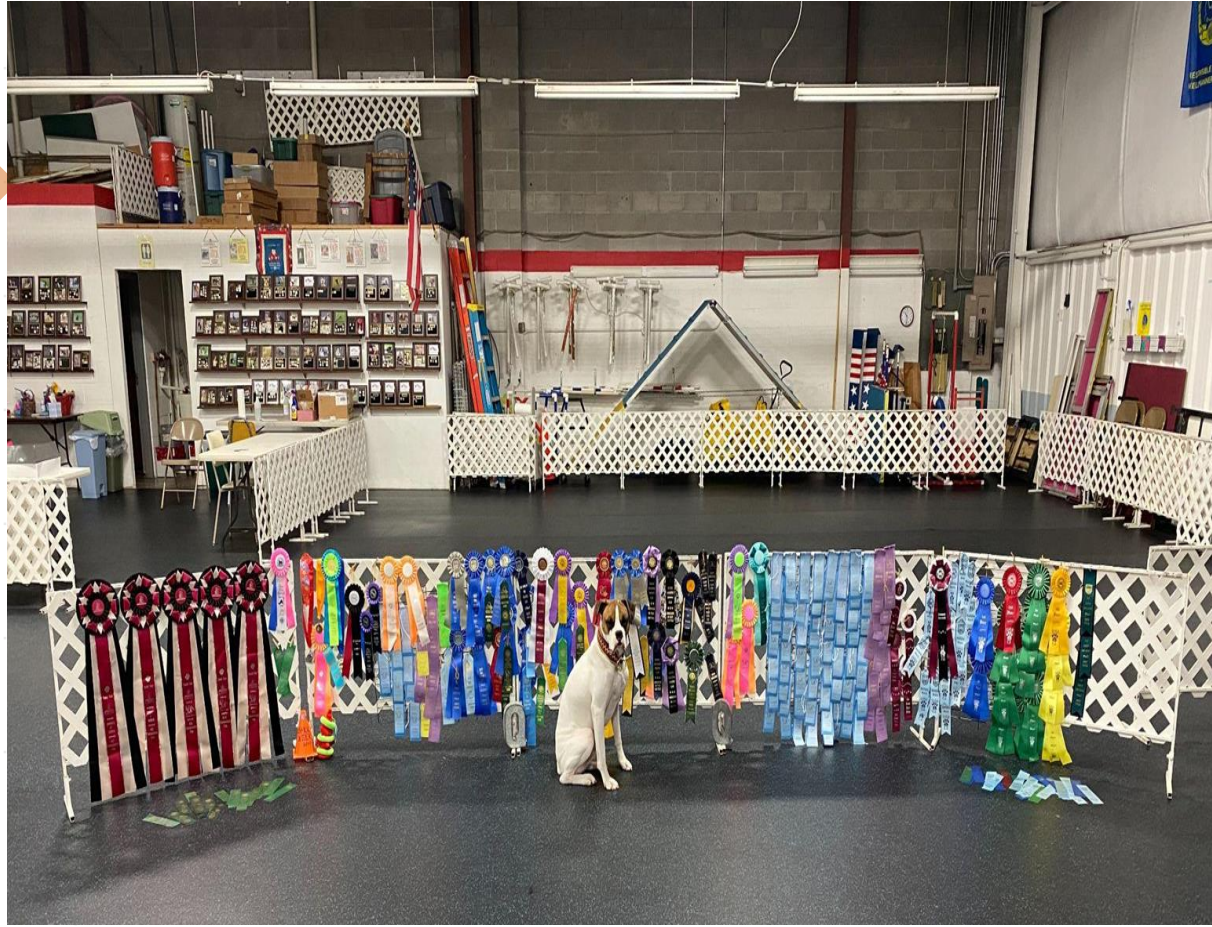


Let's Talk About Duke

- Duke is a boxer
- Purchased him on Facebook when he was 4 months old.
- COVID created a unique challenge with training
- Most training was done in the evenings after work, to prepare for competitions
- Started competing detection sports in 2020
- Competes in traditional obedience, Rally Obedience and Agility
- Over 100 titles
- 75 in sent detection



Duke's 2021 Awards



Duke's 2022 Awards



How I got into K9 Water Leak Detection?

- I learned of water leak detection dogs from an article written by Megan Shortridge, Ohio EPA

Canine Leak Detection -
A Tool in the Fight Against Non-revenue Water

By: Megan Shortridge,
Ohio Environmental Protection Agency, Division of Drinking
and Ground Waters, Southwest District Office

More than 2 million miles of underground pipes stretch largely unseen beneath our cities and villages, supplying drinking water without which, modern life as we know it would cease to function. It is no secret that America's water infrastructure is aging – an estimated six billion gallons of treated water is lost daily in the United States, with main breaks averaging one every two minutes⁽¹⁾.

To face these challenges, many water systems are investing in asset management programs to move away from a fail and fix mode of operation in favor of long-term planning⁽¹⁾.

Establishing a water leak detection program is a major tool in the water industry's asset management toolbox⁽²⁾. While many workers enter their distribution systems armed with pipe locators and ground microphones^(3, 4), one man in Arkansas brings out a bright-eyed, black Labrador retriever mix named Vessel.

Dogs are built for scent work; the part of their brains dedicated to olfaction is about 40 times greater than our own. They have been used to detect narcotics, explosives, insect infestations, natural gas leaks, invasive species, and even cancer. Despite their innate talent for using their nose, dogs like Vessel need specialized training to interpret what they smell. Odor moves in the environment in complex ways – it pools, rises, falls, gets blown around, and disperses, making it challenging for dogs to follow an odor plume to the source. Training in scent work helps dogs develop the default search patterns, problem-solving, and most importantly, drive, that gets them as close to the odor source as possible^(5, 6, 7).

Vessel with her handler, Timothy Preator of Central Arkansas Water (CAW) in the field.

continued on next page

IN AMERICAN WATER WORKS ASSOCIATION

OHIO SECTION 15

After reading the article on Vessel, I started with an internet search.

I read as much as I could get my hands on about Leak Detection dog.

Could I do Water Leak Detection with my Scent Sport dog?

Several months, emails and phone calls later....Carrie Kessler asked me if I could train a guy (Dan) in New York with his 10-week-old Black Lab and invited me to spend a weekend in Arkansas training with her.

I put together a remote training program, I emailed the first 3 lessons to Carrie Kessler and Dan. The remote training program was introduced.

The remote training program is an 15-18 week course that takes the dog and handler team through a series of exercises to increase drive and



Types of Water Leak Detections

- There are so many ways to leak detect the three main types are:
 1. Chemical
 2. Pressure
 3. Sound
- Chemical leak detections involves putting a dye or traceable gas into a system. This is most commonly seen when simply trying to see if a toilet has a small leak.
- Pressure can be a very obvious way to know you have a leak. But it will not pinpoint a leak. You may have customer complaints with lower-than-normal pressure, or you may be cycling your pumps more often.



Sound

- There are many devices that use sound to find a water leaks. Permanently installed devices can monitor changes to the system. Other devices can be brought out into the field to actively search for a leak.
- They generally work by picking up the sound of water escaping through valves, cracks holes and joints in the water distribution system.
- The big problem with sound is that sound is very subjective. Two people can be listening to the same sound and hear something different.
- Sound can also vary from leak to leak. Leaks can sound different because of pipe size, pipe material (cast, ductile iron, copper and of course the dreaded plastic), backfill (sand, clay, dirt, gravel), pressure of the water line, and hole size.



Sonoscopes




- These devices are readily available, and mass produced
- Very inexpensive cost around **\$20**.
- No special training is needed, no batteries are required.
- **THEY ARE TOUGH**
- You need to physically touch the line, valve, hydrant or fixture to listen for leak. There are adapters to reach into valve boxes.
- You do need silence to hear a leak and again sound is subjective



Acoustic Microphones

- There are many brands, some include Aquascope, Geophone, Fisher Labs and Mueller
- Price range **\$400 - \$11,000**
- They are very sensitive microphones.
- They come with a number of different adapters from a cup shaped microphone placed on the ground, to long prods that can be pushed into the earth or a magnet for valves and hydrants
- Usually require the use of a headset (Do Not Turn Them Up To 11) Your ears won't thank you.
- If you can find a valve or hydrant in the suspected area, you can potentially hear a leak from a couple 100 feet away (if your Lucky)



- 
- More expensive devices will have an analog meter or a computer screen to give a visual of what the microphone is listening to.
 - Let's not forget that these devices are subjective when it comes to listening to the sound.
 - The meter attempts to bypass this problem, but you still need to be trained in what to look for.
 - When you find a spot that you think is a leak the device does not say leak found.
 - It is up to the user to interpret the info.
 - It can cost as much as **\$10,000** to properly train someone-travel, teacher, time, gathering real life experience.

CORRELATORS

- Correlators can cost **\$5,000** for a used set to **\$30,0000**. They can go all the way up to “please let us come give you a demo”, with a gentleman that had a **\$60,000** set up.
- Correlators are a pair of sophisticated sensors the communicate wirelessly to each other.
- Mostly placed on a main valve or hydrant. They relay that info back to a handheld device, which provides a detailed diagram of where suspected leaks might be.
- These are sensitive pieces of equipment.
- You do not want to drop them or leave them where someone may take one.
- Require a lot of training as to how operate them.
- In any set up you need to enter quite a bit of information and you cannot skimp out on details.

Problems Safety and Danger

- The weather can make a big impact. WIND! RAIN! ICE!
- The noise that these three can produce will most certainly make you give up for the day.
- Location- If you have ditches that run parallel with your water lines sometimes you can have water in them. The surface water will produce a noise as well.
- Traffic- By far the most dangerous and problematic part of leak detection.
- You can hear a car coming from ½ mile away.
- Busy roads can be frustrating.
- The concentration involved in finding a leak can make things dangerous.
- You are often looking down to see where you are going to place your microphone.
- Remind people to be safe when they are detecting and always have a look out man when possible.

The Industries Answer to Traffic

- **Go out at night WHAT!?.**
- There are less vehicles on the road. Notice I did not say zero vehicles.
- All it takes is one car not to see you. My grandpa always said “Nothing good ever happened after midnight.”
- The copper services are being eaten up and valves have disintegrating bolts.
- What is your pipe made of?
- Even if you have a beautiful day, no wind, and you can close the road for 5 miles in each direction detecting plastic is difficult.
- More and more often plastic is going into the ground.
- If it is plastic, you are locating on good luck and a prayer.
- Every subcontractor and salesperson will say their device works on plastic. But we all know the truth!



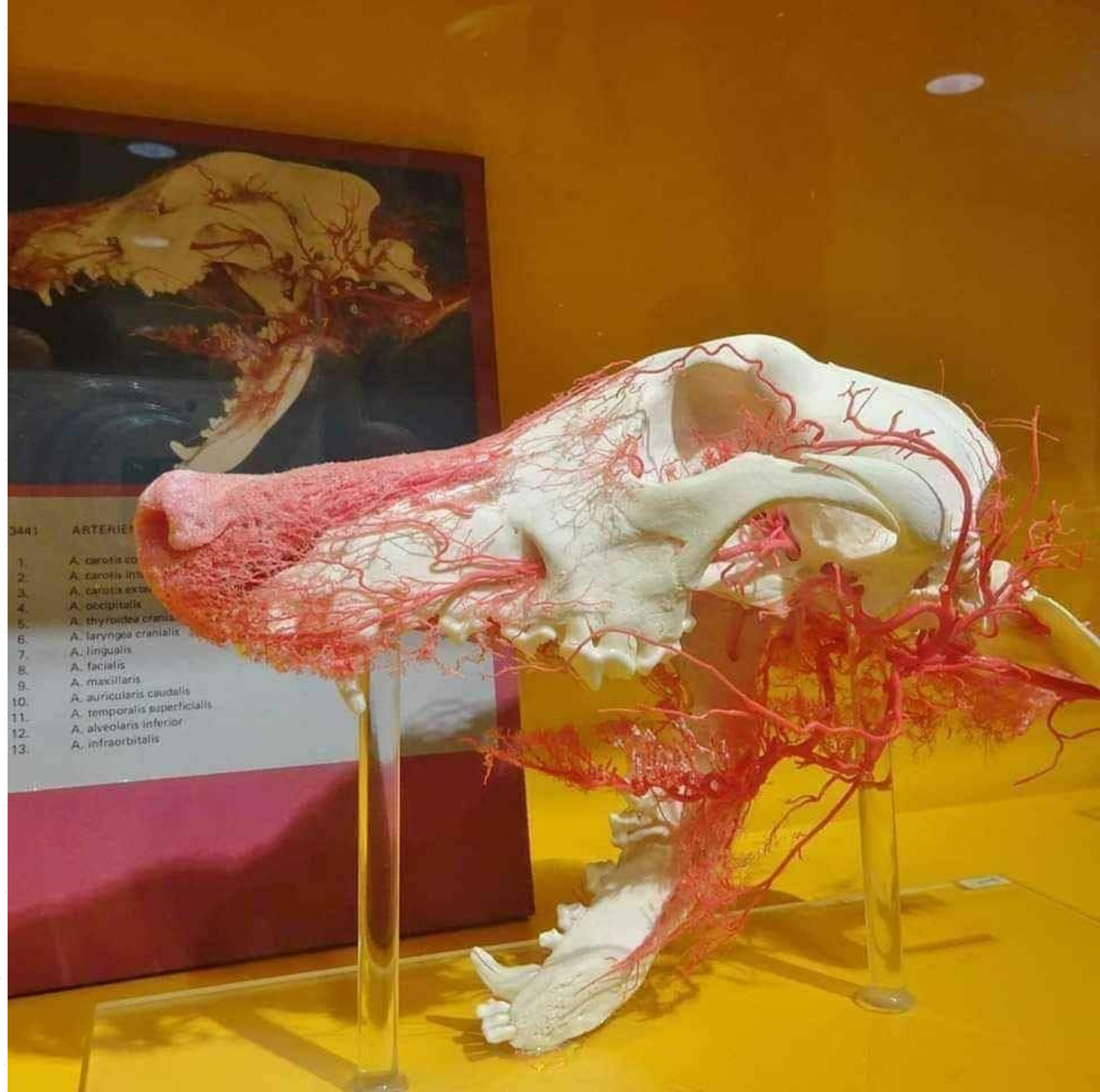
A New Bag of Tricks



- A 30% increase in water and sewer bills and water becoming more important around the world
- Water needs to be protected and leaks need to be found.
- There are lots of them out there and they are not all spraying water 50ft in the air like a geyser.
- Introducing mans best friend the dog.
- Dogs are nature's own Bio sensor. You may ask “Dont they make a device for smelling different scents?,” Answer: “yes they do.”
- They have developed e-noses but these need to be programmed they are very delicate and super expensive.
- Even if you had all the money in the world you would, you still come up short when you go nose to nose against a dog.

Dogs Nose

- Dogs have 300 MILLION OLFACTORY RECEPTORS TO LOCATE THE ODOR PLUM FROM THE TREATED WATER AND THEN HE WORKED THE ODOR PLUM TO THE HIGHEST LEVEL OF CONCENTRATION. He is smelling the chlorine, the fluoride, the whole chemical profile of the water
- THAT TOPS OUR 60 MILLION OLFACTORY RECEPTORS WHICH MEAN THAT WE CAN ONLY SMELL THE WATER WHEN WE TAKE A DRINK. We are smelling the water...sometimes we smell the chlorine.
- Dogs can smell **1-2 ppt. That's equals 1 drop in 20 Olympic pools.**
- Dogs can recognize and pick out a smell within a **30th of a mill second.**
- Can smell a person from **12 miles away** when conditions are right.




The Well-Trained Dog

- For a well-trained dog plastic, concrete and asphalt are not a problem. They are using their nose to find the gasses that are given off by the water. These gasses make their way to the surface.
- Wind, if it's not too strong, can help with directing the scent into a line or cone to follow.
- They are not listening for anything other than “good boy” when they have alerted to a water leak.
- Dogs can distinguish from treated and untreated water, potable water and wastewater.
- Weather conditions: a properly geared dog can tackle a lot of the elements that would put sound equipment back up on the shelf.
- Wearing special dog boots, the dog can tackle hot pavement or snowy/freezing conditions. Coats, cool coats are also part of our essential gear. We are also equipped with goggles for thick overgrown hedgerows and blinding sun.
- A well-trained dog can work alongside traffic. It is up to you to keep your partner safe. It will not be the sound of traffic stopping a dog from sniffing out the leak.

Finding a Leak detection Dog

- WHAT I LOOK FOR IN A GOOD DETECTION DOG?
- The environmental soundness of the dog...
 - Is the dog taking in the world with its nose?
 - Is the dog curious?
 - Is the dog too shy?
 - What is the dog afraid of?
 - Cars, Trucks, heavy equipment
 - Loud noises
 - People
 - High grass
 - Water... Wet grass, rain
 - Slick surfaces
- It is easier to bring high energy dog down than to bring a low energy dog up
- Is the dog trainable?
- Does the dog want to learn?
- Is the dog good with children?

- 
- Does the team that I am working with have the patience and tenacity to complete all the exercises.
 - Are they doing the series of exercises as outlined?
 - Is the dog learning to problem solve
 - Is the handler learning how to problem solve
 - Is the handler adjusting to what the dog is doing?
 - Is the handler trying to help the dog?
 - Is the handler staying far enough away from the dog that they can see the whole dog.
 - Is the dog queuing off the handler?
 - If I, as the trainer, and you as the handler, have done our jobs correctly, we will have created an understanding between ourselves and the dog.
 - The dog will know that we can't smell the water and that they need to tell us where the water odor is the strongest.
 - We will have also developed proficiency or conditioned the dog in the behavior to develop reliability.
 - We will know that when we have the dog on the street and we tell them to "find the leak" that they will give it all they have to find the leak if there is one.

Dog Breeds

- What breed of dog makes a good detection dog?
 - No laughing at this...the best breed for the job is the breed that is happy to work every day this the dog that you want by your side
 - A dog that not only has the behaviors but the cognitive ability
 - A dog that is well socialized and temperamentally sound
 - A dog that is physically able to do the work.
 - A Papillon or a Chihuahua while they may have the drive and are happy to do the work, they might not be physically able to do the work. Walking miles, a day is probably not realistic for that breed.

To Hunt or not to Hunt?

- When you have a canine partner, you are their advocate. You must determine...
- Is it safe for me to bring out the dog?
- What are the hazards?
- Does my dog have the ability to navigate the current conditions?
 - Snow
 - Wind
 - Rain
 - Temperature
 - Heat
 - Humidity
- Can you as the handler navigate the same conditions?

Training a Leak Detection Dog

Dogs can start training as soon as 8-9 weeks old

I start training a dog by searching for food in boxes

This gets the dog to use its nose to investigate the boxes and find the food.

I try to create as many scenarios as I can think of using boxes and treats until the dog is at least 6 months old

6 MONTHS! YES 6 MONTHS... WHY???

Because at about 6 month old the dog is fully mature.

Once the dog is 6 months old we start searching for water.

The dog is using its brain to solve problems that we ask it to solve.

We are capitalizing on the dog's ability to smell





InstaOt

DOGS are Great PR

- Having a dog join your municipality as a teammate
- Great way to put a face on your water or wastewater department
- The public might not be able to remember the guy who turned the water off to the whole town during a catastrophic water main break last weekend, but they will remember the dog that sniffs out water main leaks
- They won't forget the person that was walking the water sniffing dog throughout the entire neighborhood.
- Taking the dog into schools to talk about water conservation and how we are stewards of a valuable resource will make an impact on the next generation



- Think about how fast municipalities are growing....more people, more housing more more more. People want safe drinking water.
- It is becoming more and more expensive to treat water and get that safe drinking water to the customer.
- Household budgets are too tight to pass that non-revenue water cost on to the customer. In my opinion utilities and municipalities must explore every way to reduce the non-revenue water.



The power the K9 – Handler team works in unison to expertly and efficiently find the precise locations of the leaking pipes.

Once the K9 expert detects a potential leak, the diligent handlers take note of the exact spot. This crucial information enables water companies or contractors to conduct further investigation and proceed with targeted excavation and repairs.

This synergy between the K9 and human exemplifies how specialized dog training enhance the ability to reduce non- revenue water loss and

Dogs can cover large areas quickly, reducing the time and effort required to locate a broken mains. Their speed and agility allow for efficient data collection, making them invaluable assets in time-sensitive projects.

This is an effective and efficient leak detection services that optimize your resources and minimize financial losses.



QUESTIONS???