

The background of the slide is a light gray gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance.

# COMPLIANCE ISSUES IN RECENT OPFLOW ARTICLES

OTCO COMPLIANCE WORKSHOP

OCTOBER 16, 2019

Nick Pizzi  
Aqua Serv

# ABOUT OPFLOW

- THE PERIODICAL CALLED “OPFLOW” IS A MONTHLY MAGAZINE PUBLISHED BY THE AMERICAN WATER WORKS ASSOCIATION (AWWA). THE MAGAZINE PUBLISHES ARTICLES AND INFORMATION AIMED AT WATER AND WASTEWATER OPERATORS. THE AWWA WEBSITE STATES THAT:

“**OPFLOW** FEATURES HOW-TO ARTICLES AND CASE STUDIES ON WATER TREATMENT AND DISTRIBUTION. WRITTEN PRIMARILY FOR WATER OPERATORS, **OPFLOW** OFFERS PRACTICAL SOLUTIONS TO EVERYDAY PROBLEMS.”

- RECENT ARTICLES PUBLISHED OVER THE LAST YEAR CONTAIN A GOOD AMOUNT OF USEFUL INFORMATION THAT IS BOTH TIMELY AND INSTRUCTIVE FOR OPERATORS
  - THOSE ARTICLES ARE USED IN THIS MODULE, WHICH TAKES AN IN-DEPTH LOOK AT THAT INFORMATION



# CONSIDERING THE NOT SO HIDDEN COST OF ASSET MISMANAGEMENT

(AND ASSET MANAGEMENT REQUIREMENTS)

OPFLOW January, 2019



# RISK AND RESILIENCE

## REQUIRED BY AMERICA'S WATER INFRASTRUCTURE ACT (AWIA) OF 2018

- NEW REQUIREMENTS FOR DRINKING WATER UTILITIES:
  - RISK AND RESILIENCE ASSESSMENT
    - EACH UTILITY MUST CONDUCT A RISK AND RESILIENCE ASSESSMENT AND SUBMIT CERTIFICATION OF ITS COMPLETION TO THE USEPA BY CERTAIN DATES BASED ON POPULATION
      - >100,000 PEOPLE – MARCH 31, 2020
      - 50,000 TO 99,999 PEOPLE – DECEMBER 31, 2020
      - 3,301 TO 49,999 PEOPLE – JUNE 30, 2021
      - RECERTIFY EVERY FIVE YEARS
  - EMERGENCY RESPONSE PLAN
    - EACH UTILITY MUST DEVELOP OR UPDATE THE EMERGENCY RESPONSE PLAN AND CERTIFY COMPLETION TO USEPA NO LATER THAN 6 MONTHS AFTER THE RISK AND RESILIENCY ASSESSMENT CERTIFICATION
      - >100,000 PEOPLE – SEPTEMBER 30, 2020
      - 50,000 TO 99,999 PEOPLE – JUNE 30, 2021
      - 3,301 TO 49,999 PEOPLE – DECEMBER 31, 2021
      - REVIEW AND REVISE WITHIN 6 MONTHS OF THE RISK AND RESILIENCY 5 YEAR CERTIFICATION RENEWAL

# Certification Deadlines

<b>Population Served</b>	<b>Risk Assessment</b>	<b>Emergency Response Plan*</b>
<b>≥100,000</b>	<b>March 31, 2020</b>	<b>September 30, 2020</b>
<b>50,000-99,999</b>	<b>December 31, 2020</b>	<b>June 30, 2021</b>
<b>3,301-49,999</b>	<b>June 30, 2021</b>	<b>December 30, 2021</b>

# WHAT THE ASSESSMENTS MUST CONTAIN

## RISK AND RESILIENCE ASSESSMENT

- NATURAL HAZARDS AND MALEVOLENT ACTS
- RESILIENCE OF WATER INFRASTRUCTURE (PIPES, TANKS, PUMPS, WATER SOURCES, TREATMENT COMPONENTS)
- MONITORING PRACTICES
- FINANCIAL SYSTEMS (BILLING)
- CHEMICAL STORAGE AND HANDLING
- OPERATIONS AND MAINTENANCE

## EMERGENCY RESPONSE PLAN

- STRATEGIES TO IMPROVE RESILIENCE INCLUDING PHYSICAL AND CYBER SECURITY
- PLANS AND PROCEDURES TO RESPOND TO NATURAL HAZARDS AND MALEVOLENT ACTS
- ACTIONS AND EQUIPMENT TO LESSEN THE IMPACT OF A MALEVOLENT ACT OR NATURAL HAZARD INCLUDING ALTERNATIVE WATER SOURCES, RELOCATING WATER INTAKES, ETC
- STRATEGIES TO DETECT MALEVOLENT ACTS OR NATURAL HAZARDS THAT THREATEN THE SYSTEM

# SOME MORE NOTES ON THE ASSESSMENTS

- THE ASSESSMENT PLANS ARE TO BE PROVIDED TO THE USEPA AND ARE NOT REQUIRED BY THE ACT TO BE SUBMITTED TO LOCAL REGULATORS
- USEPA WILL DESTROY THE PREVIOUS VULNERABILITY ASSESSMENTS THAT WERE CREATED BACK IN 2002 AS REQUIRED BY THE BIOTERRORISM ACT OF 2002
- THE USEPA WEBSITE YOU CAN USE FOR RESOURCES AND TOOLS:
  - [HTTPS://WWW.EPA.GOV/WATERRESILIENCE/AMERICAS-WATER-INFRASTRUCTURE-ACT-2018-RISK-ASSESSMENTS-AND-EMERGENCY-RESPONSE-PLANS](https://www.epa.gov/waterresilience/americas-water-infrastructure-act-2018-risk-assessments-and-emergency-response-plans)



# ASSET MANAGEMENT

CONSIDER THE OPINIONS EXPRESSED IN A RECENT OPFLOW  
ARTICLE WRITTEN BY A CONSULTANT – KEN MORGAN

“UTILITIES ARE OFTEN CLOSE-MINDED ABOUT MANAGING THEIR  
ASSETS – THIS COSTS MONEY IN THE LONG RUN”



# ASSET MANAGEMENT CONTINUED

- “MOST WATER UTILITIES WILL REPLACE FAILED COMPONENTS THAT WEREN'T PROPERLY OPERATED AND MAINTAINED WITHOUT CONSIDERING HOW THEIR NEGLIGENCE HAS COST THEIR ORGANIZATIONS.”
  - “SUCH AN APPROACH IS THE MOST EXPENSIVE WAY TO MAINTAIN A UTILITY.”
- “SOME UTILITIES HAVE A REACTIVE CULTURE.”
  - “THEY HAVEN'T PURSUED NOR ACTIVELY ENGAGED IN ANY TYPE OF ASSET MANAGEMENT PLAN.”
  - “OTHER UTILITIES ARE REACTIVE AS A RESULT OF FAILING TO PLAN FOR THE GROWTH OF THEIR CUSTOMER BASE AND THE RESULTING WATER DEMAND. IN EITHER CASE, SUCH UTILITIES FIND THEMSELVES STUCK REACTING WHEN ASSETS FAIL RATHER THAN DETERMINING A METHODOLOGICAL ASSET MANAGEMENT APPROACH.”

\*Taken from OPFLOW January 7, 2019 – Ken Morgan

The background features a light gray gradient with several realistic water droplets of various sizes scattered in the corners. The droplets have highlights and shadows, giving them a three-dimensional appearance. In the center, there is a faint, circular watermark logo consisting of a stylized globe or sphere with internal lines.

# DETERIORATING INFRASTRUCTURE

EFFECT ON WATER QUALITY

OPFLOW – September 2019

# DETERIORATING DISTRIBUTION SYSTEMS AFFECT PUBLIC HEALTH

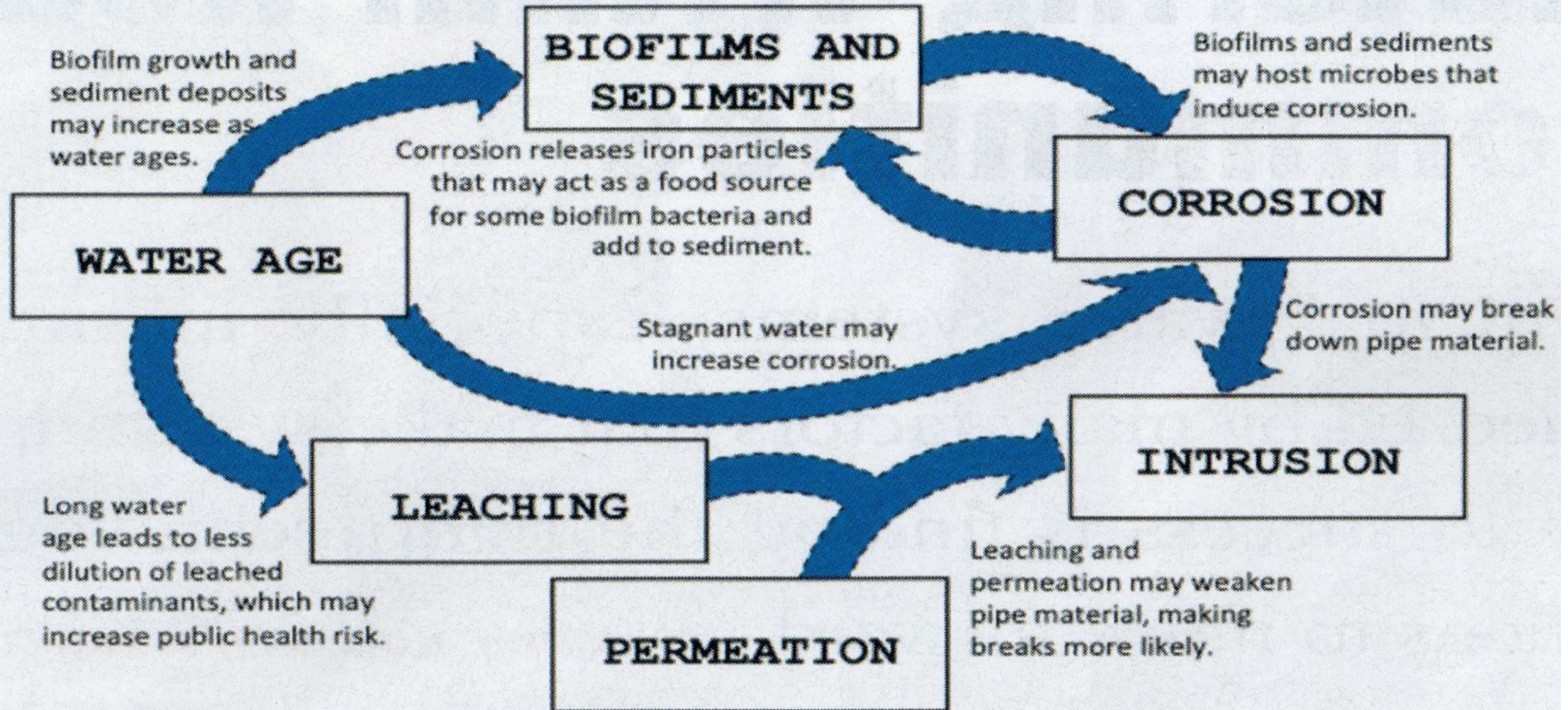
- DISTRIBUTION SYSTEM INFRASTRUCTURE ISSUES CAN AFFECT WATER RELIABILITY AND QUALITY AND COULD CONTRIBUTE TO WATERBORNE DISEASE OUTBREAKS
  - A LOT OF SYSTEM PIPING WAS INSTALLED MORE THAN 50 YEARS AGO WHICH MEANS IT IS OUT OF DATE – EXCEEDED LIFE EXPECTANCY
  - DETERIORATING SYSTEMS ARE PRONE TO PROBLEMS THAT ARE PUBLIC HEALTH ISSUES
  - THE MORE THESE SYSTEMS AGE, THE MORE QUICKLY THEY WILL CAUSE HEALTH PROBLEMS
    - MAIN BREAKS, BIOFILMS, PRESSURE LOSSES, ETC ARE BECOMING UNBEARABLE
  - ITS THEREFORE IMPORTANT TO BE ABLE TO ANALYZE HOW CONTAMINANTS ENTER THE SYSTEM DUE TO THIS NEGLECT
    - WHAT ARE THE PATHWAYS?
      - DO THEY AFFECT WATER QUALITY OR DO THEY AFFECT OTHER SYSTEMS THAT CAUSE WATER QUALITY DETERIORATION?

# CONTAMINATION MECHANISMS (PATHWAYS)

- INTRUSION
  - HAPPENS AS PRESSURE DROPS
- CORROSION
  - PROVIDES HOLES IN PIPE FOR INTRUSION, AND CORROSION SITES THAT ALLOW SLIMES TO ACCUMULATE AND HINDER CHLORINE
- BIOFILM FORMATION
  - A MASS OF ORGANIC MATTER CONTAINING MICROBES – CAUSE T&O AND  $\text{Cl}_2$  DEMAND
- SEDIMENT ACCUMULATION
  - CAN CONTAIN NUTRIENTS AND INCREASE HEAD LOSS
- WATER AGE INCREASE
  - EATS UP  $\text{Cl}_2$  RESIDUAL LEAVING WATER VULNERABLE TO BIOLOGICAL GROWTH, INCREASES DBP'S
- PERMEATION
  - THE PASSAGE OF CHEMICAL CONSTITUENTS THROUGH THE PIPE WALL OR THROUGH FITTINGS AND JOINTS
- LEACHING
  - DISSOLUTION OF MATERIAL INTO THE DRINKING WATER (NOT PERMEATION)

## Figure 2. Contamination Mechanisms

Contamination mechanisms may share causes and affect one another.



# DISEASE AND THE CONNECTION TO INFRASTRUCTURE REPLACEMENT

- WATERBORNE DISEASE ESTIMATES

- WHILE DIFFICULT TO ESTIMATE, EXPERTS AGREE THAT SOME ATTEMPT MUST BE MADE TO QUANTIFY OUTBREAKS PERHAPS THROUGH MODELING
- “ON THE LOCAL SCALE, INCREASED AWARENESS OF POTENTIAL CONNECTIONS BETWEEN INFRASTRUCTURE DETERIORATION AND PUBLIC HEALTH WILL HELP UTILITIES REDUCE THE RISK OF WATERBORNE OUTBREAKS”

- REHAB AND/OR REPLACE

- WATERBORNE DISEASE OUTBREAKS HAVE OCCURRED IN THE US BECAUSE OF INFRASTRUCTURE DETERIORATING, AND WILL LIKELY INCREASE
- **“EXPERTS ARE THINKING NOW THAT MANY OUTBREAKS WERE MISTAKENLY BLAMED ON OTHER ISSUES, BUT WERE ACTUALLY A RESULT OF NEGLECT”**
- UTILITIES NEED TO FIND THE FUNDING AND THE WILL TO PERFORM REHAB

There's too much emphasis on the attitude  
“if its not broke, don't fix it”

# LEGIONELLA

DISEASE OUTBREAKS AND PUBLIC RELATIONS

# LEGIONELLA – THE NO.1 CAUSE OF WATERBORNE DISEASE OUTBREAKS IN THE UNITED STATES

- THE LEGIONELLA BACTERIUM CAN CAUSE LEGIONELLOSIS WHICH MANIFESTS ITSELF AS EITHER AS LEGIONNAIRE'S DISEASE OR AS PONTIAC FEVER, AND HAS BECOME A SERIOUS CONCERN IN THIS COUNTRY
  - LEGIONNAIRE'S DISEASE IS A POTENTIALLY DEADLY PNEUMONIA
  - PONTIAC FEVER IS A MILD FLU-LIKE ILLNESS
- LEGIONELLA ARE BACTERIA THAT NATURALLY EXIST IN SOIL AND WATER IN SMALL ENOUGH NUMBERS THAT GENERALLY DON'T CAUSE DISEASE
- HOWEVER, CONDITIONS CAN ALLOW LEGIONELLA IN BUILDING PLUMBING SYSTEMS, AND RECREATIONAL WATERS SUCH AS IN HOT TUBS TO GROW IN LARGE ENOUGH NUMBERS THAT CAN THREATEN HUMAN HEALTH
  - WHEN THEY DO THIS, THEY ARE REFERRED TO AS "OPPORTUNISTIC PREMISE PATHOGENS"



# LEGIONELLA IS ON THE INCREASE IN THE US

- THE REPORTED RATE OF LEGIONNAIRE'S DISEASE INCREASED BY 550% BETWEEN 2000 AND 2017
  - THIS INDICATES THAT EXISTING APPROACHES TO PREVENTING THE DISEASE HAVE NOT BEEN EFFECTIVE
- EXPERTS THINK THAT THE UNDERLYING CAUSES TO THESE INCREASES ARE:
  - LONGER LIFE SPANS AND AN AGING POPULATION CREATE MORE VULNERABILITY TO DISEASE
  - OUR AGING WATER INFRASTRUCTURES CAN COMPROMISE OUR ABILITY TO DELIVER QUALITY WATER TO CONSUMERS
  - WE HAVE CONFLICTING FEDERAL REQUIREMENTS WHICH MAY BE ADDING TO THE PROBLEM
    - EFFICIENCY STANDARDS FOR WATER HEATERS, AS WELL AS LOW-FLOW SHOWERS, FAUCETS, AND TOILETS CAUSE PROBLEMS
      - ENERGY PROVIDERS CONVINCED PEOPLE TO SAVE MONEY BY LOWERING THE TEMPERATURE OF THEIR GAS OR ELECTRIC WATER HEATERS WHICH CREATES IDEAL TEMPERATURES FOR LEGIONELLA
        - UNIFORM PLUMBING CODE TELLS PEOPLE TO KEEP TEMP AT 122 DEG F TO PREVENT SCALDING, BUT LEGIONELLA IS ONLY INHIBITED AT TEMPS OF 140 DEG F OR MORE
      - LOW FLOW WATER DEVICES CREATES MORE WATER AGE IN HOME SYSTEMS
    - UTILITY EFFORTS TO COMPLY WITH DBP REGULATIONS MAY CAUSE THEM TO LOWER CHLORINE RESIDUALS

## A FEW NOTABLE LEGIONELLA CASES FROM 2018-2019

Month	Location	Illnesses	Deaths	Source
February 2018	Sarasota County, FL	13	0	Pool, spa
June-July 2018	Honolulu, HI	4	1	Hospital
June-July 2018	McHenry County, IL	9	0	Unknown
June-July 2018	Cleveland, OH*	11	1	Bldg. cooling system
July – 2018	New York, NY	20	1	Cooling tower
July – August - 2018	Hampton Beach, NH	18	1	Possible hot tub
September - 2018	Sioux Falls, SD	14	1	Not confirmed
Presently - 2019	North Carolina – State Fair	134	2	Hot Tub Display

# THE THREE THINGS LEGIONELLA NEEDS IN ORDER TO KILL YOU\*

1. FAVORABLE CONDITIONS OF A BUILDING OR PREMISE
  - a. DRINKING WATER THAT COMPLIES WITH REGULATIONS ISN'T STERILE
  - b. LEGIONELLA CAN TRAVEL THROUGH A WTP'S PROCESSES AND INTO THE DISTRIBUTION SYSTEM IN EVEN THE BEST TREATMENT SYSTEMS
  - c. LEGIONELLA BACTERIA SURVIVE IN A WIDE RANGE OF TEMPERATURES – AND ARE CAPABLE OF ENCAPSULATING THEMSELVES INTO AT LEAST 26 KNOWN SPECIES OF PROTOZOA
  - d. WHILE ENCAPSULATED, THEY ARE 50 TIMES MORE RESISTANT TO CHLORINE RESIDUAL
  - e. AT A TEMP RANGE OF 77 TO 108 DEGREES F, IT THRIVES
2. TRANSMISSION FROM THE WATER TO THE LUNGS VIA AN AEROSOL OR FROM ASPIRATION
  - a. AEROSOLS FROM SHOWER HEADS, WATER BASED HUMIDIFIERS, HOT TUBS, MISTERS, WATER-BASED BIRTHING TUBS, DECORATIVE FOUNTAINS ETC. CAN CAUSE THIS
3. SUSCEPTIBILITY OF THE EXPOSED INDIVIDUAL
  - a. THE TYPICAL SUSCEPTIBLE PERSON IS FOUND TO BE ELDERLY, A SMOKER, MALE, AND IMMUNO-COMPROMISED

# UTILITIES SHOULD ARM THEMSELVES WITH THIS RESOURCE AS A MEANS OF PROTECTION AGAINST LEGIONELLA CLAIMS BY THE PUBLIC

- THE AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR CONDITIONING ENGINEERS (ASHRAE) HAS DEVELOPED A STANDARD FOR LEGIONELLA
- **STANDARD 188** – REQUIRES THAT PROPERTY OWNERS EVALUATE THEIR BUILDING WATER SYSTEMS TO DETERMINE IF THEY NEED TO IMPLEMENT A WATER MANAGEMENT PROGRAM
  - A WATER MANAGEMENT PROGRAM CONSISTS OF A PLAN TO IDENTIFY, MONITOR, CONTROL, VALIDATE, AND DOCUMENT THE ACTIONS TAKEN TO CONTROL LEGIONELLA IN THE BUILDING WATER SYSTEM
- REMEMBER: IF A COMPLAINT OF LEGIONELLA ILLNESS COMES IN, IT WILL BE YOUR RECORDS AGAINST THEIR RECORDS

[https://www.techstreet.com/ashrae/standards/ashrae-188-2018?product\\_id=2020895](https://www.techstreet.com/ashrae/standards/ashrae-188-2018?product_id=2020895)



# LAB ANALYSIS AND STAFF ISSUES

STAFF RELATIONSHIP TO OPERATIONS

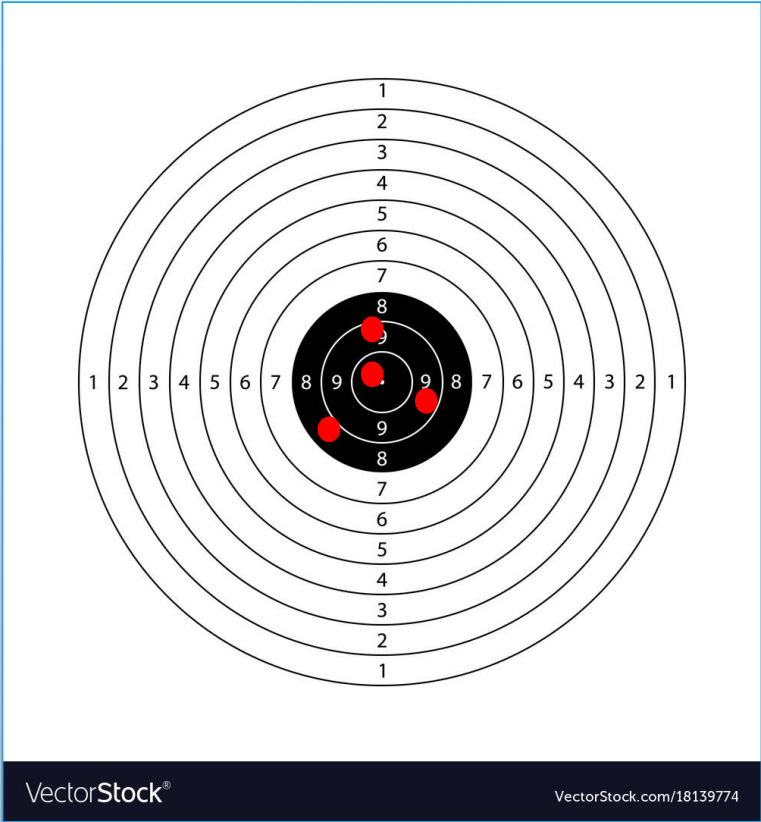
OPFLOW August 2019

# LABORATORY QA/QC

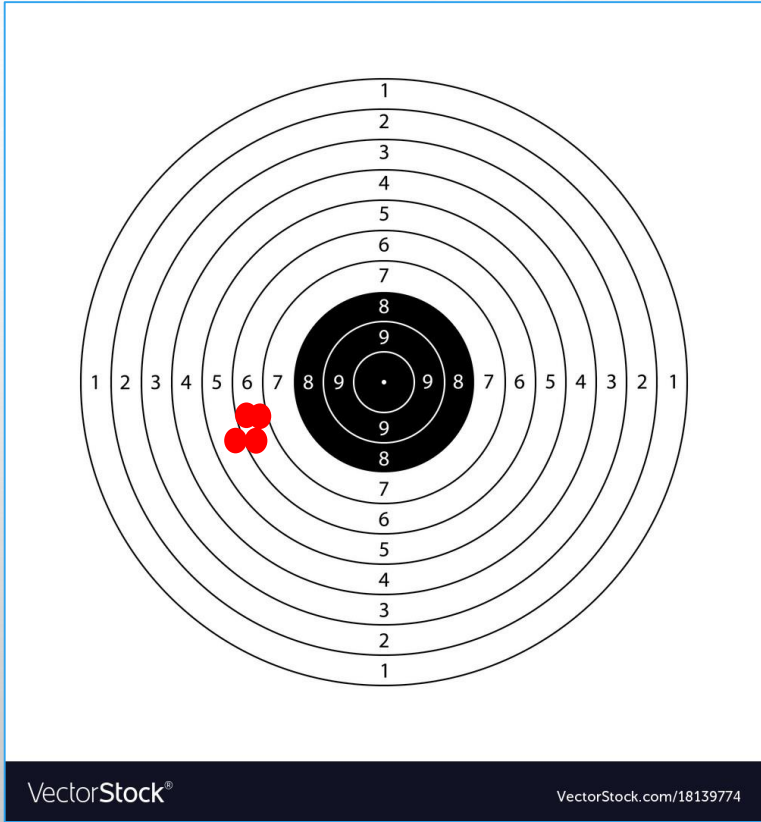
- THE OPFLOW ARTICLE MAKES A GOOD ARGUMENT FOR THE DEVELOPMENT OF A ROBUST QUALITY ASSURANCE/QUALITY CONTROL PROGRAM
- IT DEFINES QA/QC AS:
  - QA IS THE CONTINUOUS SELF-EXAMINATION OF THE RELIABILITY OF LAB RESULTS, AND CONTROLLING QUALITY THROUGH USE OF GOOD EQUIPMENT, HIGH-GRADE REAGENTS, AND SOUND SOP<sub>s</sub>
  - QC IS BROKEN DOWN INTO TWO STEPS:
    1. ACCURACY, WHICH IS THE DEGREE OF DIFFERENCE BETWEEN AN OBSERVED OR TESTED VALUE VERSUS THE KNOWN VALUE OF THE STANDARD
    2. THE ABILITY OF THE MEASUREMENT TO BE CONSISTENTLY REPRODUCED (ONE SAMPLE ANALYZED MORE THAN ONCE ACHIEVING THE SAME OR SIMILAR RESULT)

# ACCURACY AND PRECISION

ACCURATE – BUT NOT PRECISE



PRECISION - REPEATABLE



# RELATIONSHIP BETWEEN LAB STAFF AND OPERATING STAFF CAN BE AS IMPORTANT AS THE QA/QC

- EACH SHOULD KNOW THE JOB OF THE OTHER – IF YOU DON'T, THEN THE SIGNIFICANCE OF THE LAB TESTS AND RESULTS MAY BE MEANINGLESS
- LAB STAFF ESPECIALLY NEEDS TO KNOW IF A RESULT THEY GENERATE IN THE LAB WILL REQUIRE FURTHER ACTIONS ON SOMEONE'S PART
- OPERATING STAFF SHOULD KNOW HOW TO ASK THE LAB STAFF FOR PROCESS TESTS SO THEY CAN MAKE NECESSARY ADJUSTMENTS TO THEIR PROCESS STRATEGY

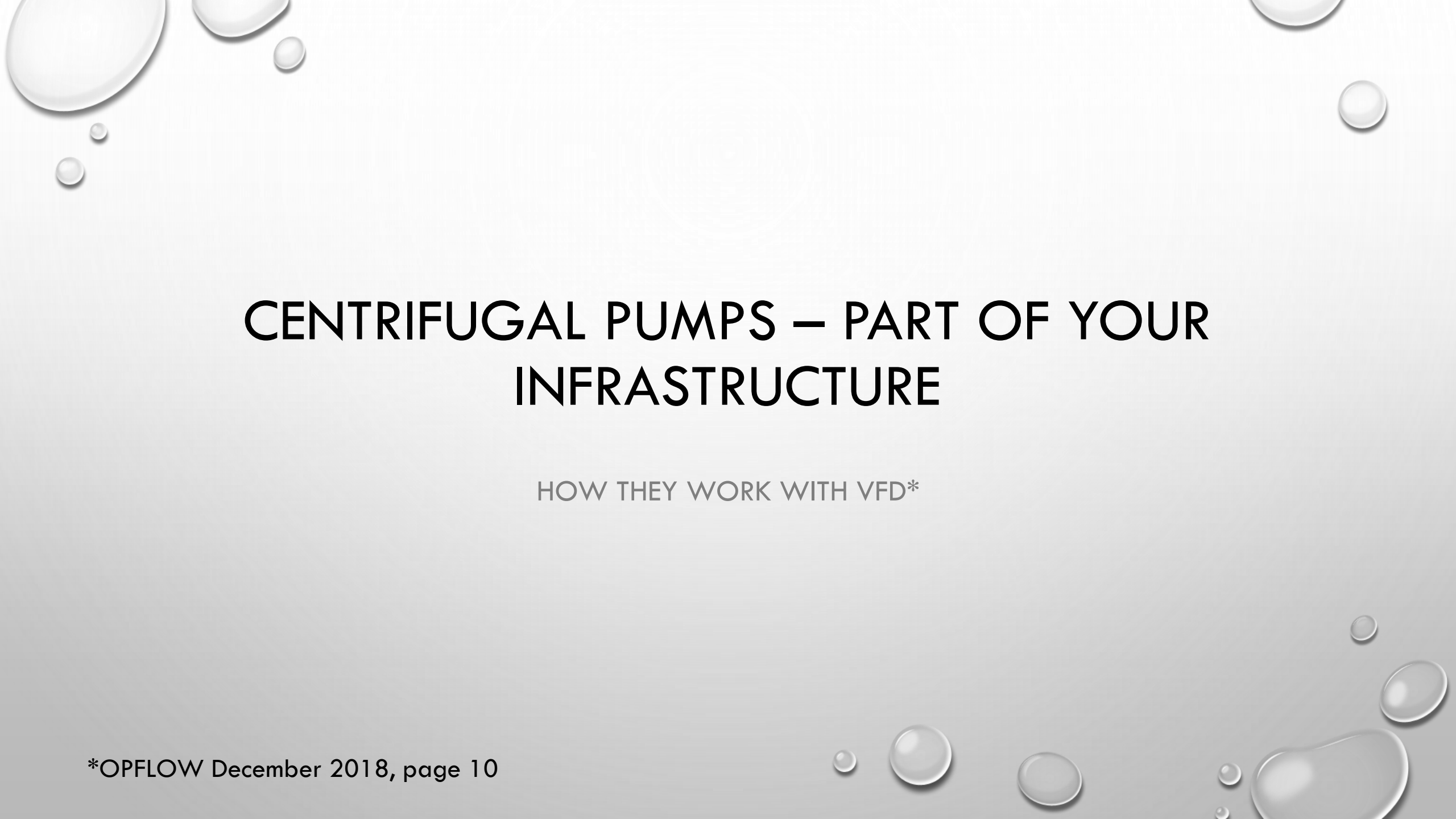


# LABORATORY ANALYSIS AND ISSUES

- ALL LARGE AND MEDIUM SIZED WTPs AND EVEN MANY SMALL ONES EMPLOY A FULL TIME LAB ANALYST
- THE LAB ANALYST OR STAFF SUPPORTS THE OPERATIONS STAFF IN THEIR EFFORTS TO PRODUCE DRINKING WATER THAT COMPLIES WITH SDWA REQUIREMENTS AT ALL TIMES
- THE LAB ITSELF CONTAINS THE INSTRUMENTATION AND HARDWARE NECESSARY TO PROCESS TWO TYPES OF SAMPLES:
  1. SAMPLES TAKEN AND ANALYZED FOR PROCESS CONTROL, E.G.,
    1. TURBIDITY OF BASINS AND FILTERS, CHLORINE RESIDUALS OF EFFLUENTS, PH'S OF RAW AND FINISHED WATER
    2. THESE TYPES OF SAMPLING AND ANALYSIS CAN PROVIDE FEEDBACK TO OPERATIONS SO THEY CAN MAKE ADJUSTMENTS – “ARE WE MEETING OUR PROCESS GOALS”?
  2. SAMPLES TAKEN AND ANALYZED FOR REGULATORY COMPLIANCE, E.G.,
    1. CFE AND IFE TURBIDITIES, PLANT TAP CHLORINE RESIDUALS, TTHMS, PB AND CU, CT VALUES, ETC.
    2. THESE SAMPLES AND ANALYSES PROVIDE PROOF TO REGULATORY AGENCIES ABOUT THE LEVEL OF COMPLIANCE

# LAB STAFF ISSUES

- A COMMON MISTAKE MADE BY LABORATORY STAFF HAPPENS WHEN THEY GET TOO CLOSE TO OPERATIONAL STAFF, PERHAPS BECOME FRIENDS, OR AT LEAST BECOME LOYAL TO THEM
  - THIS IS A NATURAL THING TO HAVE HAPPEN, AND SHOULD NOT BE DISCOURAGED
  - HOWEVER, WHEN WE GET CLOSE TO OTHERS, WE SOMETIMES REFUSE TO BELIEVE THEY CAN DO WRONG OR MAKE MISTAKES
  - WHEN LAB STAFF INEVITABLY PRODUCES AN ANALYSIS RESULT THAT IS OUT OF PARAMETER, THEY SOMETIMES DOUBT THEIR OWN PROCEDURE, OR RESULT, OR METHODOLOGY
  - THIS WASTES TIME AND CAN LEAD TO NON-COMPLIANCE ISSUES BEING OVERLOOKED
- THEREFORE: WE SHOULD UNDERSTAND THAT THE JOB OF THE LAB STAFF IS TO COME TO WORK TO FIND SOMETHING WRONG RATHER THAN THE THINGS THAT ARE RIGHT
  - YOU SHOULD HAVE CONFIDENCE IN YOUR ABILITY TO FIND OPERATIONAL FAILURE
  - YOU SHOULD REALIZE THAT OPERATORS ARE HUMAN AND CAN MAKE MISTAKES THROUGH FATIGUE, OMISSION, MALFEASANCE, NON-FEASANCE, ETC
  - IF YOUR FIRST INSTINCT IS TO SAY “MY GUYS WOULD NEVER DO THAT, OR THEY DON’T MAKE MISTAKES, THEREFORE MAYBE MY ANALYSIS IS FAULTY”, THEN YOU MAY BE PART OF THE PROBLEM

The background of the slide is a light gray gradient. It is decorated with several realistic water droplets of various sizes, some with highlights and shadows, located in the top-left, top-right, and bottom-right corners.

# CENTRIFUGAL PUMPS – PART OF YOUR INFRASTRUCTURE

HOW THEY WORK WITH VFD\*

# CENTRIFUGAL PUMPS AND VFD

- **VERTICAL TURBINE PUMPS ARE CENTRIFUGAL PUMPS** SPECIALLY DESIGNED TO MOVE WATER FROM AN UNDERGROUND WELL OR RESERVOIR -
- VARYING PUMP SPEED ON VERTICAL TURBINE PUMPS CAN DELIVER HUGE GAINS, BUT THERE'S POTENTIAL FOR DISASTER\*
  - MARKETING LITERATURE AND SALES PEOPLE PROMISE ENERGY SAVINGS AND INCREASED PUMP LIFE BY INSTALLING VARIABLE FREQUENCY DRIVES ON YOUR CENTRIFUGAL PUMPS
  - DO THEY ALSO TELL YOU THAT A PUMP IS ONLY EFFICIENT AND PROTECTED FROM DAMAGE WHEN IT OPERATES WITHIN THE PUMP CURVE'S "SWEET SPOT"?
  - THE SWEET SPOT IS REFERRED TO AS THE "PREFERRED OPERATING RANGE" – (POR) – AND THE POR IS DEFINED AS 70% TO 120% OF THE PUMPS' BEST EFFICIENCY POINT (BEP) FLOW RATE AND IS DEPICTED BY THE GREEN ZONES IN THE FOLLOWING GRAPHS

**HEAVY BLUE LINE – 100% FULL SPEED PUMP HEAD AS FUNCTION OF FLOW. IMAGINE THE PUMP WITH A SOURCE TANK AND WATER FLOWING OUT OF A HYDRANT RIGHT NEXT TO PUMP WITH NO FURTHER PIPING. ZERO FLOW AT CLOSED VALVE – CALLED SHUT-OFF HEAD- , AND FLOW INCREASES AND HEAD DECREASES WHEN HYDRANT IS OPENED. THERE ARE LINES FOR 3 SPEEDS: 100%, 89%, 75%.**

**HEAVY GOLD LINE – FULL SPEED PUMP EFFICIENCY AS FUNCTION OF FLOW THROUGH PUMP. 3 LINES - - - ONE FOR EACH SPEED.**

**HEAVY BROWN LINE – SYSTEM HEAD CURVE. SYSTEM HEAD AS A FUNCTION OF FLOW IS SHOWN. IMAGINE PUMP IS NOW FLOWING INTO A DISTRIBUTION SYSTEM WITH A LONG LINE AND ITS FILLING AN ELEVATED TANK.**

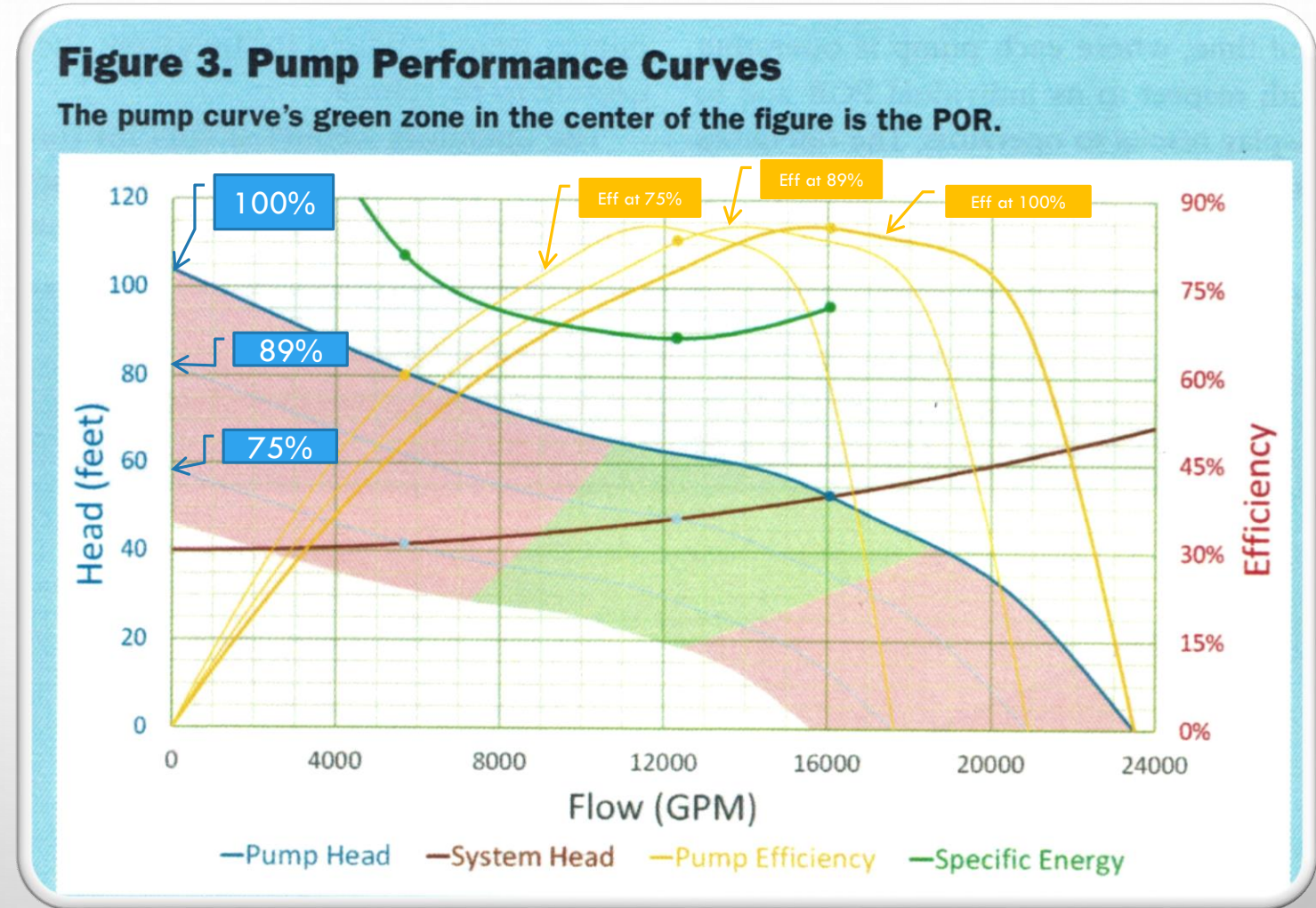
**HEAVY GREEN LINE- SPECIFIC ENERGY – ENERGY USED PER UNIT OF WATER. (VALUES NOT SHOWN ON GRAPH)**

**BLUE DOTS ARE THE 3 SPEEDS WHERE THE SYSTEM HEAD CURVE INTERSECTS WITH THE PUMP HEAD CURVE.**

**GOLD DOTS SHOW CORRESPONDING PUMP EFFICIENCY.**

**GREEN DOTS SHOW ENERGY CONSUMED PER UNIT OF WATER AT THOSE FLOW RATES AND EFFICIENCIES.**

FIGURE 3 PUMP CURVE FROM THE ARTICLE WHICH SHOWS THIS EXAMPLE OF A PUMP'S POR



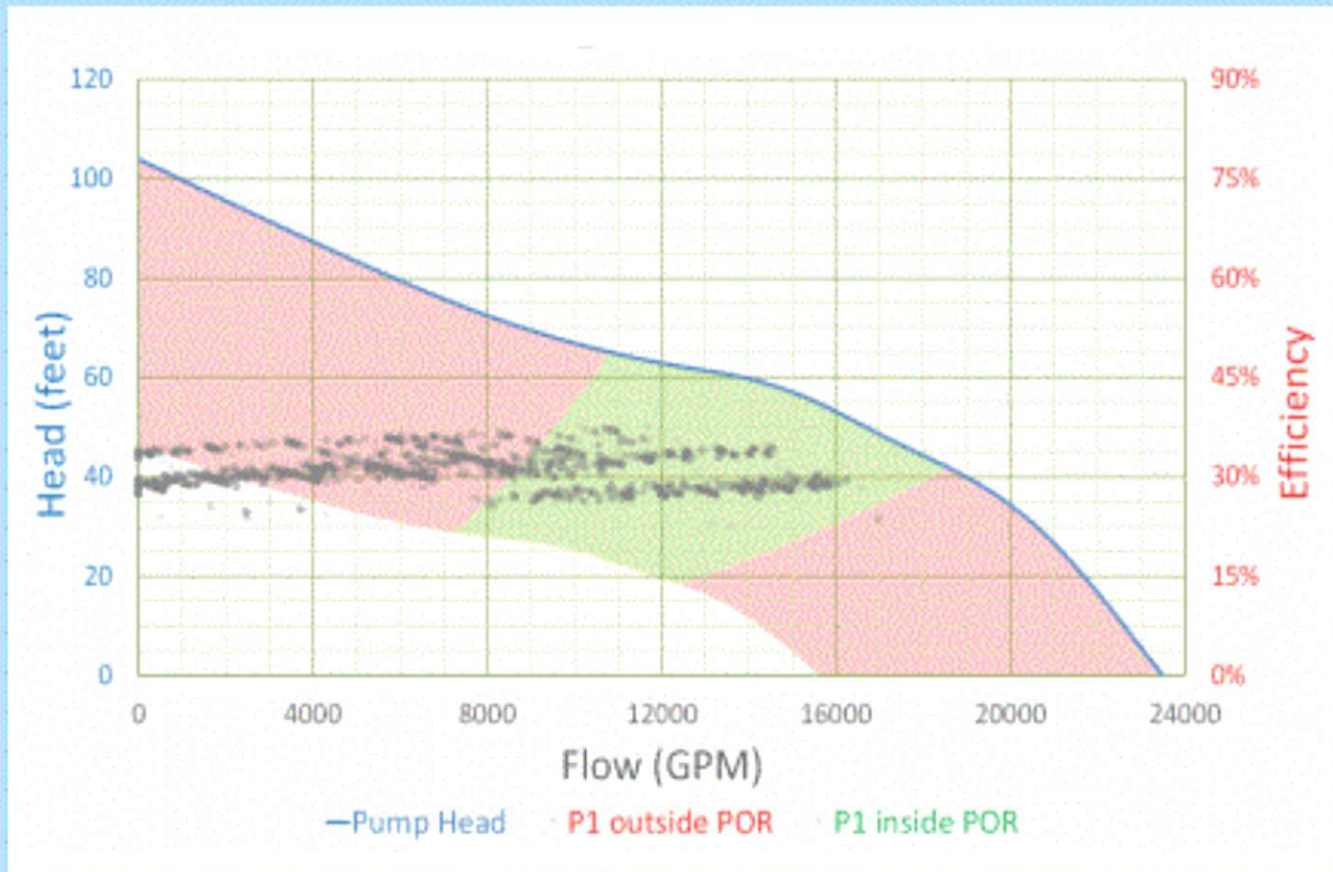
**GREEN ZONE** is “preferred operating range” or “sweet spot”.  
Defined as 70-120% of pump’s BEP flow rate.

**RED ZONE** area of premature wear on pump and high inefficiency

## CITY OF HOUSTON RAW WATER PUMP OPERATIONS

### Figure 1. Historical Operation in and out of POR

In this example, operators unknowingly operated the VFD pumps outside POR 61 percent of the time and at shutoff head 15 percent of the time.



THE CITY HAS 5 300-HP RAW WATER PUMPS, TWO OF WHICH HAVE VFD

- ALL PUMPS WERE INSPECTED
- ALL HAD SIMILAR AMOUNT OF HOURS (RUN TIMES)
- THE TWO VFD PUMPS WERE IN FAR WORSE CONDITION THAT THE OTHERS
- OPERATORS HAD UNKNOWINGLY OPERATED THEM OUTSIDE THE POR 61% OF TIME
- THE FIXED SPEED PUMPS OPERATED IN THE POR 100% OF TIME

# PUMP AFFINITY LAWS – DO YOU KNOW THEM?

- AFFINITY LAWS ARE A SET OF PHYSICAL LAWS FOR CENTRIFUGAL PUMP OPERATION THAT DEFINE HOW THE VARIOUS PUMP OPERATING CURVES CHANGE AS THE SPEED CHANGES.
- FOR A PUMP'S "FLOW VS. HEAD CURVE", FLOW IS DIRECTLY PROPORTIONAL TO SPEED, AND HEAD IS PROPORTIONAL TO THE SPEED SQUARED.
  - CONSIDER A PUMP STATION WITH A PUMP RUNNING AT 100% SPEED THAT PRODUCES 1,000 GPM AT 100 FEET OF HEAD WITH A SHUT OFF HEAD OF 120 FEET
    - IF YOU RUN IT AT 75% SPEED, AFFINITY LAW SAYS IT WILL PUT OUT 750 GPM AT 56 FEET OF HEAD
    - IF YOU RUN IT AT 50% SPEED, THE FLOW WILL BE 500 GPM AND THE HEAD WILL BE 25 FEET OF HEAD
    - IF THE STATIC HEAD OF THE PUMP STATION IS 75 FEET, RUNNING THE PUMP AT BELOW 79% WILL DEADHEAD THE PUMP.  $(0.79 \times 0.79) * (120') = 74.89$  FEET OF HEAD

# IMPORTANCE OF TESTING PUMPS

- A VFD DRIVE FOR A SINGLE PUMP TURNS THAT PUMP INTO MANY PUMPS, ONLY ONE OF WHICH IS OPTIMAL FOR CURRENT CONDITIONS
- PUMPS BEGIN TO WEAR THE MOMENT THEY ARE PLACED INTO SERVICE
  - THEY WEAR FASTER WHEN YOU OPERATE THE PUMP INCORRECTLY
  - THIS CREATES A VICIOUS CYCLE – IF THE PUMP IS UNKNOWINGLY OPERATED INCORRECTLY, THE PREFERRED OPERATING RANGE BECOMES ALTERED, WHICH THEN ACCELERATES PUMP WEAR WHICH THEN CONTINUES TO CHANGE THE POR ETC. ETC. ETC.
- THE POR CHANGES AS THE PUMP WEARS, SO .....
- HAVE YOU HAD YOUR PUMPS (NOT THE MOTORS) TESTED LATELY? ARE YOU OPERATING THEM CORRECTLY? YOU SHOULD CONSIDER SOFTWARE THAT TRACKS PUMP PERFORMANCE



# PFAS

A GROWING ISSUE

OPFLOW May 2019, page 10



# PFAS

- PER- AND POLYFLUOROALKYL SUBSTANCES HAVE SURFACED AS A THREAT TO HUMAN HEALTH.
- AS MORE OF THESE CHEMICALS FIND THEIR WAY INTO WATER SUPPLIES, WATER TREATMENT PLANT OPERATORS AROUND THE WORLD WILL BE TASKED WITH REMOVING THEM.
  - THIS IS THE SAME KIND OF THING THAT HAS BEEN GOING ON WITH ALGAL PROBLEMS
    - OPERATORS ARE TASKED WITH CLEANING UP SOMEONE ELSE'S POLLUTION

# PFAS

- AFTER WORLD WAR II, MANY CHEMICAL COMPOUNDS WERE MANUFACTURED TO MAKE LIFE EASIER, BETTER, OR SAFER.
- BUT TIME AND INFORMATION HAVE REVEALED UNINTENDED CONSEQUENCES, AS EXEMPLIFIED BY PER- AND POLYFLUOROALKYL SUBSTANCES (PFASs).
  - THESE CHEMICALS HAVE BEEN USED TO ENHANCE MANY EVERYDAY PRODUCTS.
- UNFORTUNATELY, THEIR USE HAS LED TO A SERIOUS EMERGING CONTAMINATION ISSUE IN MANY PUBLIC WATER SUPPLIES AROUND THE WORLD, AND THEIR MOBILITY AND PREVALENT USE COULD AFFECT ANY NUMBER OF COMMUNITIES IN THE FUTURE.
  - IT'S IMPORTANT FOR OPERATORS TO BE PREPARED TO DEAL WITH THESE COMPOUNDS IF THE NEED ARISES
- PFAS, SOMETIMES REFERRED TO AS PERFLUORINATED COMPOUNDS, ARE A CLASS OF MAN-MADE CHEMICALS.
  - THESE CHEMICALS CONSIST PRIMARILY OF CARBON AND FLUORINE ATOMS CHAINED TOGETHER WITH OTHER GROUPS OF ATOMS THAT YIELD USEFUL PROPERTIES.
  - MORE THAN 3,000 PFASs ARE THOUGHT TO BE CURRENTLY USED IN INDUSTRY.

# PFAS HEALTH ISSUES

- THE SAME PROPERTIES THAT MAKE THESE LARGELY UNREGULATED CHEMICALS ATTRACTIVE FOR INDUSTRIAL AND CONSUMER APPLICATIONS HAVE FOSTERED PFAS BIOACCUMULATION IN HUMANS AND PERSISTENCE IN THE ENVIRONMENT—AND NOW HAVE CONTAMINATED MANY DRINKING WATER SOURCES. WE KNOW THESE CHEMICALS ACCUMULATE IN VARIOUS TISSUES OF LIVING ORGANISMS AND SOME ARE TOXIC, BUT WE KNOW RELATIVELY LITTLE ELSE ABOUT MANY OF THEM. FORTUNATELY, THAT'S RAPIDLY CHANGING BECAUSE OF GROWING SCRUTINY FROM HEALTH AGENCIES, UTILITIES, AND THE PUBLIC.
- THE US ENVIRONMENTAL PROTECTION AGENCY (USEPA) HAS ESTABLISHED PUBLIC HEALTH ADVISORIES FOR PFOA AND PFOS, BUT NO ENFORCEABLE FEDERAL STANDARDS CURRENTLY EXIST FOR THESE COMPOUNDS. SEVERAL STATES HAVE IMPLEMENTED MORE STRINGENT GUIDELINES AND, IN SOME CASES, ENFORCEABLE MAXIMUM CONTAMINANT LEVELS (MCLS), RESULTING IN THE NEED FOR TREATMENT TO REMOVE THEM FROM DRINKING WATER SUPPLIES.



# LAKE STRATIFICATION, DEAD ZONES, TREATMENT

THE DIFFERENCES BETWEEN DEAD ZONES AND TURNOVER

HOW DOES THIS RESULT IN MANGANESE CONTAMINATION

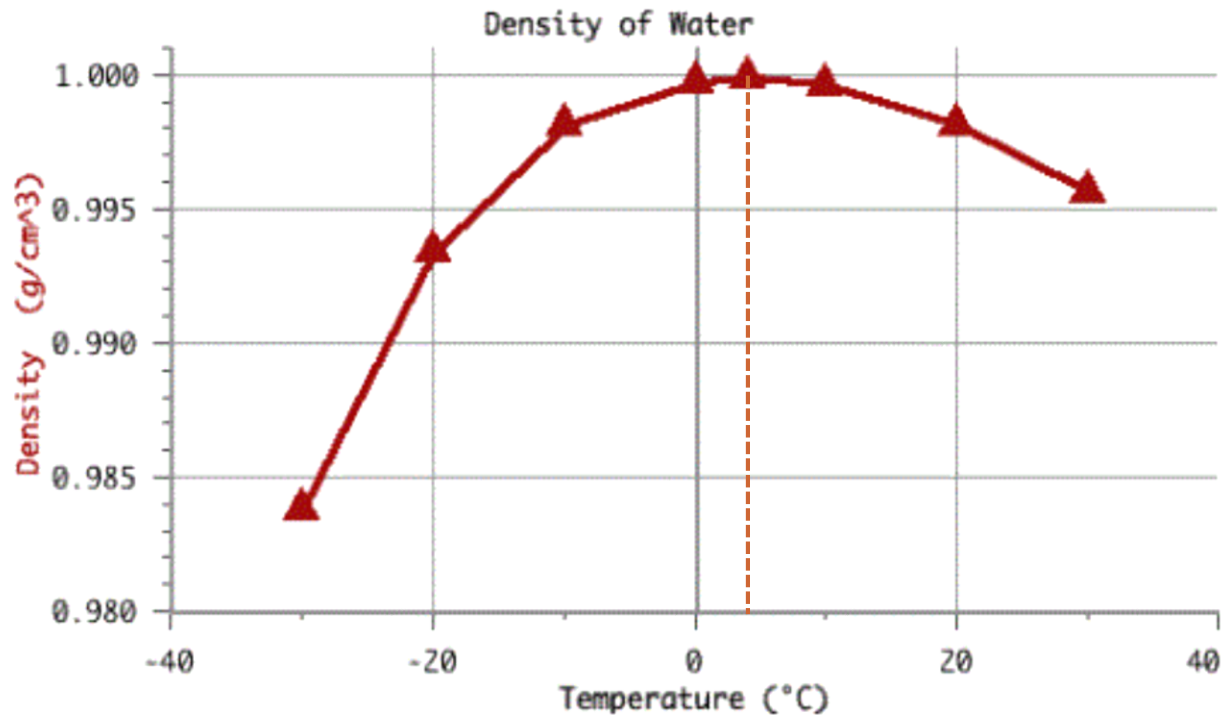


# LAKE ERIE STRATIFICATION, TURNOVER, AND DEAD ZONE ISSUES

- LAKE ERIE WATER TENDS TO SHOW A DIFFERENCE IN WATER TEMPERATURE DEPENDENT ON THE DEPTH OF THE WATER AND THE TIME OF YEAR
- IT GOES THROUGH A PROCESS WHERE IT FORMS DISTINCT LAYERS WITH DIFFERENT TEMPERATURES – THIS IS CALLED STRATIFICATION
- THESE DIFFERENT STRATA HAVE DIFFERENT DENSITIES DUE TO THE DIFFERENCE IN TEMPERATURE. THEY WONT MIX
- THIS HAPPENS TWICE EACH YEAR
  - IN THE WINTER, ICE IS THE COLDEST (AT 0 DEG C) AND LESS DENSE SO IT FLOATS TO THE TOP, AND THE SLIGHTLY WARMER (AT 4 DEG C) WATER UNDERNEATH IT (WHICH IS MORE DENSE) SINKS TO THE BOTTOM
  - IN THE SUMMER, THE OPPOSITE HAPPENS. WATER WARMED BY THE SUN IS LESS DENSE AND IT FLOATS ON TOP. THE SUN CAN ONLY PENETRATE SO FAR, AND SO THE LOWER LAYER OF WATER STAYS COLD, IS THEREFORE MORE DENSE, AND IT SINKS TO THE BOTTOM
    - COLD WATER AT THE BOTTOM HAS ORGANIC MATERIAL IN IT THAT EATS UP THE OXYGEN – IT BECOMES ANOXIC
- TWO PROBLEMS CAN OCCUR:
  - IN APRIL AND NOVEMBER, AS THE WATER TEMPERATURES OF THE STRATA BEGIN TO EQUALIZE, THE WATER BEGINS TO MIX, OR “TURNS OVER” AND YOU CAN GET HIGH TURBIDITY THAT IS DIFFICULT TO COAGULATE, HAS A CHLORINE DEMAND, AND MAYBE TASTE AND ODOR
  - IN THE MONTHS OF AUGUST AND SEPTEMBER THE CURRENTS OR WINDS CAN BRING THE ANOXIC LAYER OVER OR ONTO YOUR INTAKE AND YOU WILL EXPERIENCE A “DEAD ZONE” EVENT. MANGANESE FROM THE LAKE BOTTOM COME TO YOUR INTAKE AT A LOW PH – NOT GOOD

# WATER TEMPERATURE VS DENSITY

WATER IS MOST DENSE AT 4  
DEGREES CELSIUS, OR 39.4  
DEGREES FAHRENHEIT



Graph 4

# DIFFERENCE BETWEEN TURNOVER VS DEAD ZONE

## TURNOVER

- USUALLY HAPPENS IN SPRING AND FALL AS THE TWO SEPARATE LAYERS BEGIN TO REACH TEMPERATURE EQUALITY, AND SO THE WATER STARTS TO MIX
- CHARACTERIZED BY HIGH TURBIDITY, NO OR LITTLE CHANGE IN WATER TEMP, CHLORINE DEMAND
- AT BACON ROAD CAN BE ACCOMPANIED BY SNOW MELT ON GRAND RIVER BRINGING LOW ALKALINITY WATER
- TREATMENT: INCREASE  $\text{KMNO}_4$ , ADD CAUSTIC AT RAPID MIX AND SOME CHLORINE THERE TOO – INCREASE COAGULANT
- EQUALIZED WATER TEMP MEANS THAT ALMOST ALL WTPs ON THE LAKE WILL SEE TURNOVER

## DEAD ZONE

- USUALLY HAPPENS IN MIDDLE OF SUMMER DURING HOT DRY SPELLS WITH LOW TO NO WIND
- CHARACTERIZED BY QUICK DROP IN TEMPERATURE FROM ABOUT 25 DEG C TO THE TEENS, DROP IN PH BUT NOT ALKALINITY
  - AT 15-19 DEG C YOU HAVE A MIX OF ANOXIC WATER COMING IN, AND AT 14 DEG C IT IS DEAD
- TREATMENT: ADD CAUSTIC BUT PREFERABLY SODA ASH – MUST GET PH UP, INCREASE CHLORINE FEED INTO RAPID MIX, HIGH COAGULANT AND LOTS OF PAC – TAKE GREAT CAUTION WITH  $\text{KMNO}_4$  DUE TO LOW PH
  - CONSIDER SERIES FLOW AT AQUARIUS
- GREAT DIFFERENCE IN WATER TEMPERATURE BETWEEN STRATA MEANS THAT THERE WILL BE VERY LITTLE MIXING, AND SO A DEAD ZONE CAN REMAIN INTACT AND HIT ONE INTAKE WHILE NOT PASSING OVER ANOTHER INTAKE DOWN THE ROAD



## LAKE ERIE STRATIFICATION, TURNOVER, AND DEAD ZONE ISSUES

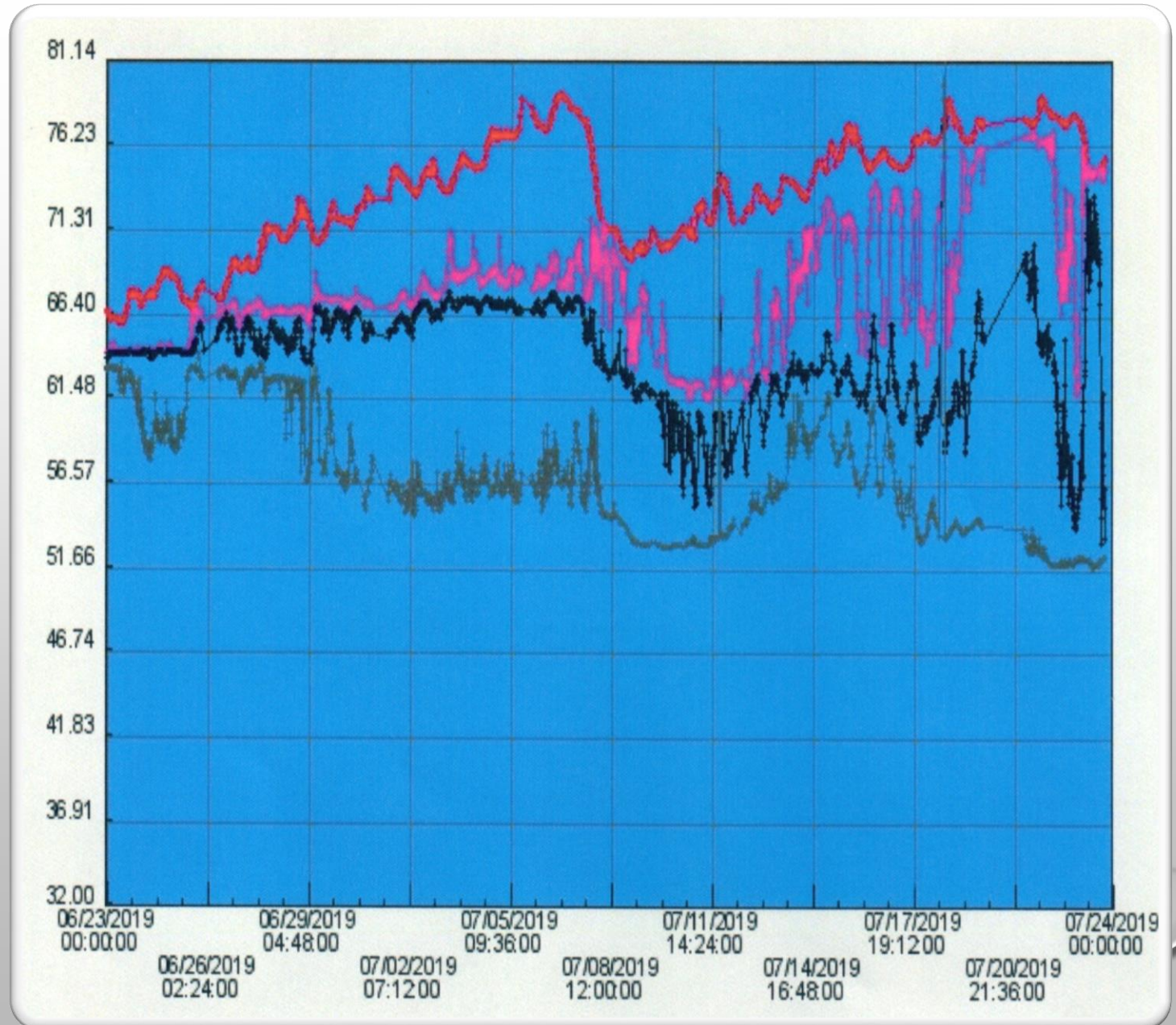
GRAPH ON THE RIGHT SHOWS WATER TEMPERATURES AT CLEVELAND INTAKE AT FOUR DIFFERENT DEPTHS EACH DAY FOR 1 MONTH – THIS IS DEAD ZONE APPROACHING

- RED LINE IS AT THE SURFACE
- PINK LINE IS AT 30' DEPTH
- BLACK LINE IS AT 37' DEPTH
- GREY LINE IS NEAR LAKE BOTTOM

## Unoxidized Mn and pH

Remember: pH has a direct effect on the amount of time it takes to oxidize Manganese

- At pH 7.0, it will take weeks and you will have yellow water in system
  - At pH 7.4 – 7.5 it will takes 20 minutes or so
  - At pH 8, it only takes a few minutes
- 
- Therefore: use caustic in rapid mix to keep pH up



# DEAD ZONE MANGANESE, PH AND TREATMENT

- **WHERE DOES THE MANGANESE COME FROM?** IT COMES FROM THE  $\text{KMNO}_4$  YOU ADD, FROM SEPTIC SLUDGE IN SEDIMENTATION BASINS, AND FROM THE LAKE BOTTOM ESPECIALLY WHEN TURNOVER OR DEAD ZONE WATER COMES TO YOUR INTAKE.
  - MANGANESE INGESTION IN HUMANS CAN CAUSE **MANGANISM** – A CENTRAL NERVOUS SYSTEM DISEASE
  - FOR THIS REASON, MANGANESE WILL LIKELY HAVE AN MCL ASSOCIATED WITH IT IN THE FUTURE
- **HOW DO YOU REMOVE MANGANESE?** YOU MUST OXIDIZE IT FROM THE ELEMENTAL STATE TO THE FLOCCULATED STATE WHICH TURNS IT INTO  $\text{MNO}_2$ , OR MANGANESE DIOXIDE WHICH IS A SOLID FLOC PARTICLE THAT WILL SETTLE AND FILTER – IT IS A PRECIPITATE. OBVIOUSLY THIS MUST TAKE PLACE BEFORE FILTRATION OTHERWISE IT WILL GET INTO YOUR SYSTEM AND TURN YELLOW OUT THERE RATHER THAN WHERE IT BELONGS, WHICH IS THE FLOCCULATOR.
- **WHAT IS THE SINGLE MOST IMPORTANT FACTOR THAT REGULATES THE SPEED AT WHICH MN TURNS TO  $\text{MNO}_2$ ?** THE ANSWER IS PH. TIME IS NEEDED FOR THE MN TO OXIDIZE INTO  $\text{MNO}_2$ . IF THE PH IS LOW, THE TIME IT TAKES WILL BE WEEKS RATHER THAN MINUTES. PERFECTLY FINE LOOKING WATER CAN LEAVE THE PLANT ONLY TO TURN YELLOW OVER TIME IN THE SYSTEM IF THE MN HAS NOT YET OXIDIZED.
  - YOU CAN'T AFFORD TO TRY TO RAISE THE PH IN THE CLEARWELL – YOU MUST DO IT IN THE RAPID MIXER. SO THERE IS NO CLEAR CUT **DOSE** OF CAUSTIC TO FEED AT WHICH MN WILL BE REMOVED – YOU MUST GO BY THE PH IN THE RAPID MIX/FLOCCULATION ZONES. IF YOU HAVE A PH OF 7 OR 7.1 OR EVEN 7.2 IN YOUR FINISHED WATER, AND THERE IS STILL MN IN IT, YOU ARE SCREWED. GET THE PH UP WHILE YOU STILL HAVE THE WATER ON THE PRE-FILTER SIDE.
  - THIS SHOULD BE STANDARD PROCEDURE EVERY AUG THROUGH SEPT – HAVE THE CAUSTIC READY TO GO AND TELL THE OPERATORS TO WATCH OUT FOR A DROP IN RAW WATER TEMPERATURE AND PH. IF THEY SEE IT, PUT ON THE CAUSTIC RIGHT AWAY. INCREASE COAGULANT.  $\text{MNO}_2$  WILL ONLY SETTLE READILY IF YOU ADD MORE COAGULANT.

The background of the slide is a light gray gradient. In the top-left and bottom-right corners, there are several realistic-looking water droplets of various sizes, some overlapping. The main text is centered on the page.

# **FILTER OPTIMIZATION**

REGULATIONS AND SOME DO'S AND DON'TS

# OPTIMIZED FILTERS

- WTPs THAT BELONG TO THE PARTNERSHIP FOR SAFE WATER – HAVE THE TURBIDITY GOAL FOR EACH FILTER IS TO BE NEVER ABOVE 0.1 NTU
- COLLECT AND EVALUATE THE DATA FOR EACH FILTER:
  - Ripening duration
  - Initial turbidity
  - Initial headloss
  - Filter run length
  - Unit filter run volume
  - Solids retention analysis
  - Bed expansion rate
  - Backwash water turbidity
- CONTINUALLY TWEAK THE SOP FOR FILTER BACKWASH

# IDEAS FOR OPTIMIZING FILTERS

- TURBIDITY DATA IS AUTOMATICALLY SAVED FOR EACH FILTER – YOU SHOULD EXAMINE THE DATA OF EACH AND ESPECIALLY EXAMINE THE START-UP PHASE
  - DO ALL FILTERS RIPEN IN THE SAME TIME PERIOD, OR IS ONE OR MORE LOOKING DIFFERENT FROM THE REST?
    - LOOK AT INITIAL TURBIDITY AS WELL AS HEAD LOSS AND SEE TENDENCIES
- IS EACH FILTER ABLE TO PRODUCE THE RUN LENGTH GOAL YOU HAVE SET, OR IS THERE ONE OR MORE THAT IS DIFFERENT?
  - ARE YOU UNIT FILTER RUN VOLUMES THE SAME FROM FILTER TO FILTER OR IS THERE A VARIANCE?
- IS THERE A DIFFERENCE FROM ONE FILTER TO THE NEXT AS FAR AS SOLIDS RETAINED IN THE BED?
  - COMPARE SOLIDS RETENTION AT EACH LAYER OF EACH BED FOR VARIANCES
- DON'T LET YOURSELF BECOME COMPLACENT WHEN YOUR EFFLUENT TURBIDITIES ARE ALL GOOD. YOU MUST KEEP AHEAD OF DEVELOPING PROBLEMS BEFORE THEY RESULT IN HIGHER TURBIDITY

# FILTER REGULATIONS

## **BASIS FOR REGULATIONS:**

- THE INTERIM ENHANCED SURFACE WATER TREATMENT RULE (IESWTR) GOVERNS THE QUALITY OF FILTERED WATER
- THE REGULATIONS ARE WRITTEN AS A MEANS OF PROTECTING THE CONSUMER AGAINST PATHOGEN PASSAGE THROUGH THE FILTERS AND ON TO THE CUSTOMER
  - FILTERS MUST REMOVE WHAT DISINFECTION CANNOT DESTROY
- PRETREATMENT AND FILTRATION FOR TURBIDITY REMOVAL HAS A TREATMENT TECHNIQUE THAT SERVES AS A SURROGATE FOR THE REMOVAL OF PATHOGENS

## **• IESWTR REQUIRES THAT THE WTPS MEET SPECIFIC TURBIDITY GOALS**

- EACH FILTER ONLINE MUST BE MONITORED FOR TURBIDITY CONTINUOUSLY, AND TURBIDITY MUST BE RECORDED AT INTERVALS NO MORE THAN 15 MINS APART
  - INDIVIDUAL FILTER EFFLUENT (IFE) TURBIDITY MUST BE LESS THAN 1.0 NTU IN FIRST 4 HOURS OF RUN, THEN LESS THAN 0.5 NTU FOR REMAINDER
- THE COMBINED FILTER EFFLUENT (CFE) MUST BE LESS THAN 0.3 NTU 95% OF TIME, AND NEVER OVER ONE NTU

The background features a light gray gradient with several realistic water droplets of various sizes scattered in the corners. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text is centered on the page.

# LEAD ISSUES

REGS, TREATMENT, HEALTH

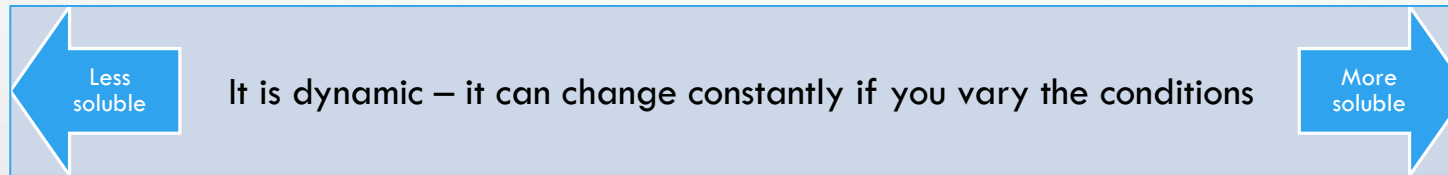
# MANAGE WATER QUALITY TO CONTROL LEAD IN DRINKING WATER

- THE BASICS:
  - LEAD TYPICALLY DOESN'T COME FROM THE WATER PLANT
  - CUSTOMERS ARE LESS LIKELY TO HAVE LEAD IN THEIR DRINKING WATER IF:
    - THE UTILITY DOES AWAY WITH LEAD SERVICE LINES
    - CUSTOMERS DON'T HAVE PLUMBING FIXTURES MADE WITH LEAD-BEARING MATERIALS
  - BUT BECAUSE THERE IS BOUND TO BE LEAD OUT IN THE SYSTEM, YOU MUST MANAGE WATER QUALITY TO MINIMIZE THE CHANCE THAT CUSTOMERS WILL GET IT
    - EACH UTILITY HAS AN OPTIMUM COURSE OF CORROSION CONTROL TREATMENT (CCT)
    - LEAD AND COPPER RULE REQUIRES THAT A UTILITY IDENTIFY AND FOLLOW ITS CCT STRATEGY



# LEAD SOLUBILITY BASICS

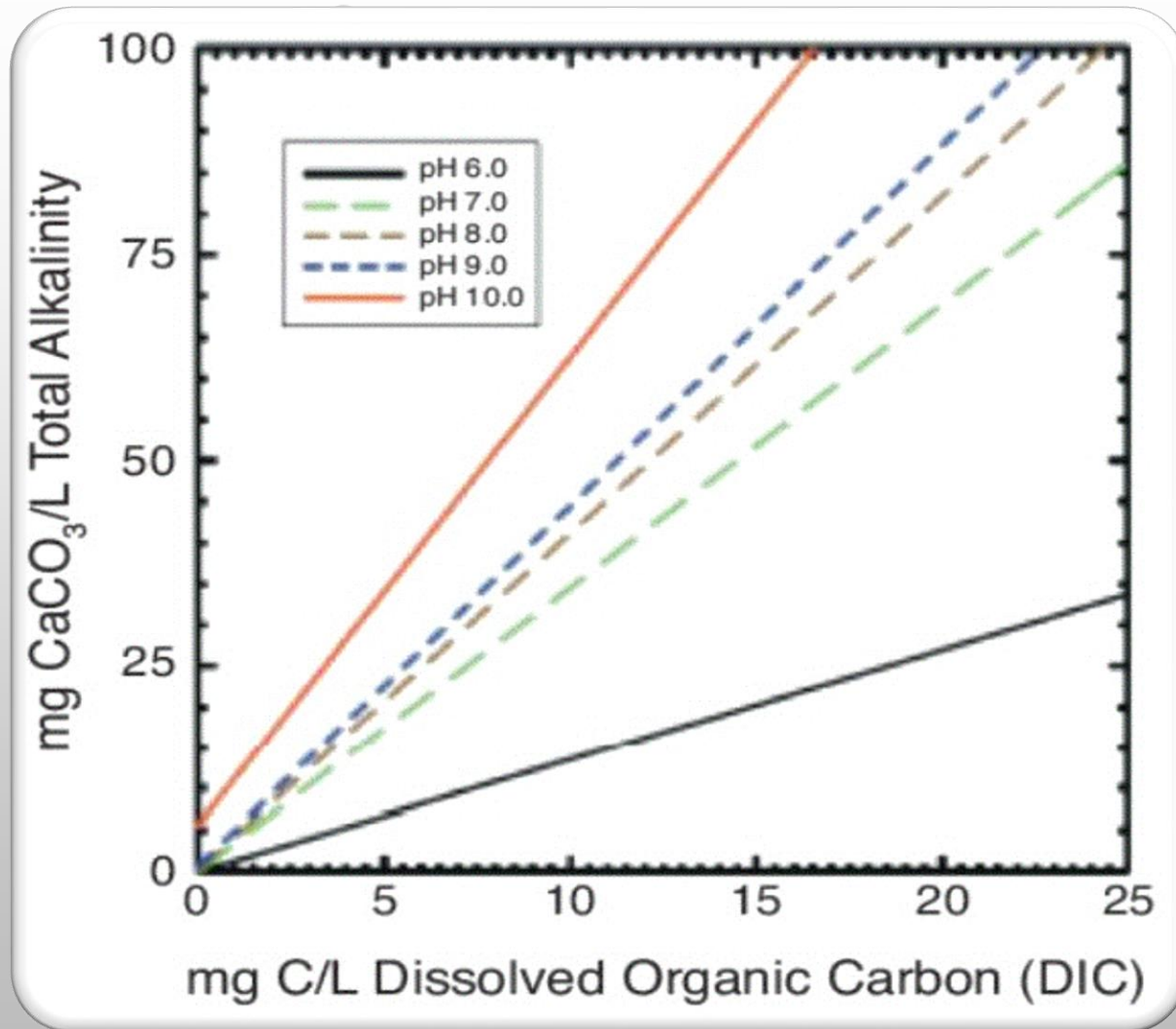
- SOLUBILITY IS THE EXTENT TO WHICH A SUBSTANCE WILL DISSOLVE IN WATER



- LEAD SOLUBILITY IS COMPLEX
  - IT IS CONTROLLED BY THE INTERACTIONS BETWEEN WATER QUALITY AND LEAD SERVICE LINES AND LEAD BEARING BRASSES AND SOLDERS
  - AT TYPICAL WATER PH, THE LEAD WILL OXIDIZE AND FORM A LEAD-BEARING SCALE ON THE PIPE OR FIXTURE
  - THE AMOUNT OF LEAD THAT SUBSEQUENTLY LEACHES FROM THIS SCALE IS CONTROLLED BY THE PHYSICAL TOUGHNESS OF THE SCALE AND ITS RELATIVE SOLUBILITY
  - THE RIGHT COMBINATION OF PH, DIC FROM THE ALKALINITY, TEMPERATURE, IONIC STRENGTH OF WATER, AND ORTHOPHOSPHATE WILL PREVENT THAT SCALE FROM DISSOLVING LEAD INTO THE WATER

# WHY ORTHOPHOSPHATES WORK FOR LEAD

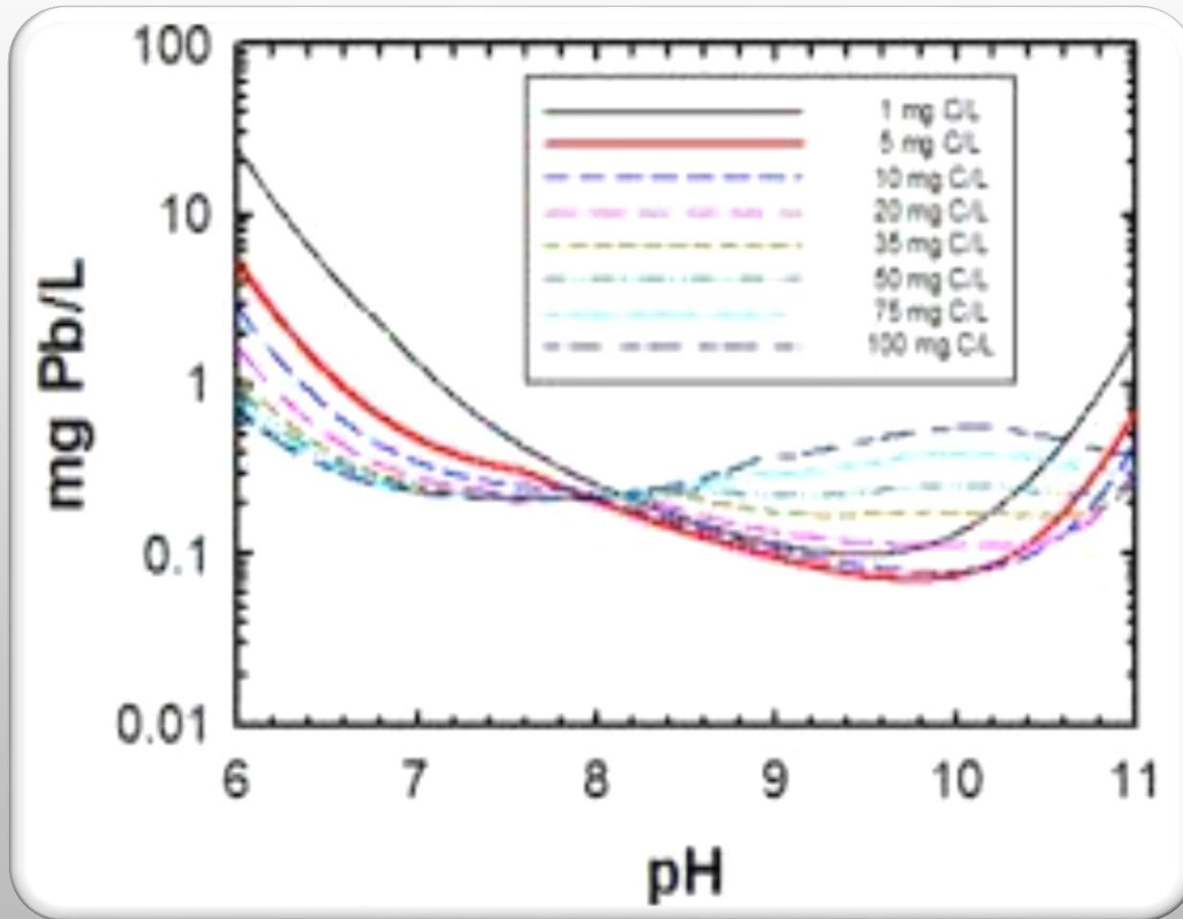
- CHEMISTS TELL US THAT THERE ARE THREE OXIDATION STATES FOR LEAD:
  1.  $Pb(0)$  THIS IS THE PURE FORM OF LEAD METAL - IT IS UNOXIDIZED
  2.  $Pb(II)$  THIS IS ONE OF THE OXIDIZED STATES OF LEAD
  3.  $Pb(IV)$  THIS IS THE OTHER OXIDIZED STATE
- AT  $PH_s$  AND DIC LEVELS OF LAKE ERIE WATER, AND IN THE PRESENCE OF CHLORINE,  $Pb(II)$  WILL FORM  $Pb(II)$  CARBONATE WHICH IS A RELATIVELY INSOLUBLE LEAD BEARING SCALE
- IF ENOUGH ORTHOPHOSPHATE IS ADDED TO THIS WATER, A  $Pb(II)$  PHOSPHATE SCALE WILL FORM
  - $Pb(II)$  PHOSPHATE SCALES ARE TOUGHER THAN  $Pb(II)$  CARBONATE SCALES
    - THIS  $Pb(II)$  PHOSPHATE SCALE IS MAINTAINED BY CONTINUOUS FEED OF ORTHOPHOSPHATE
  - IF YOU DISCONTINUE FEED, THE SCALE WILL DISSOLVE AND SEND  $Pb$  TO THE CUSTOMER TAPS



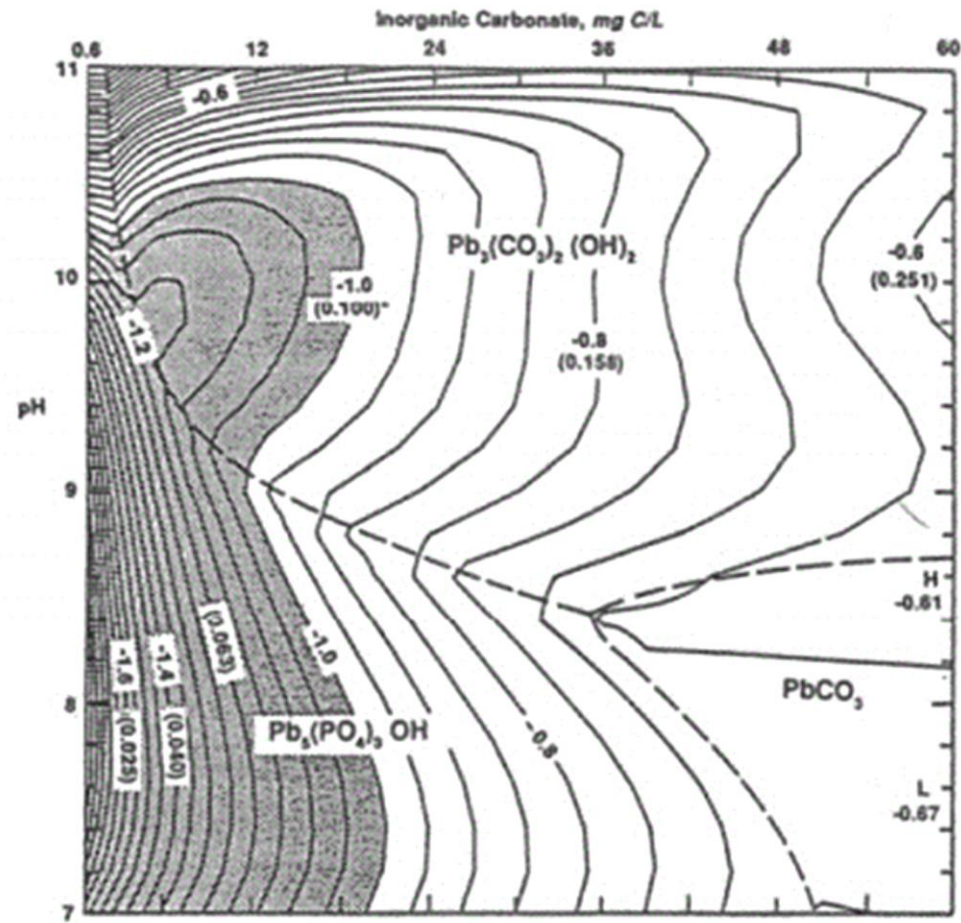
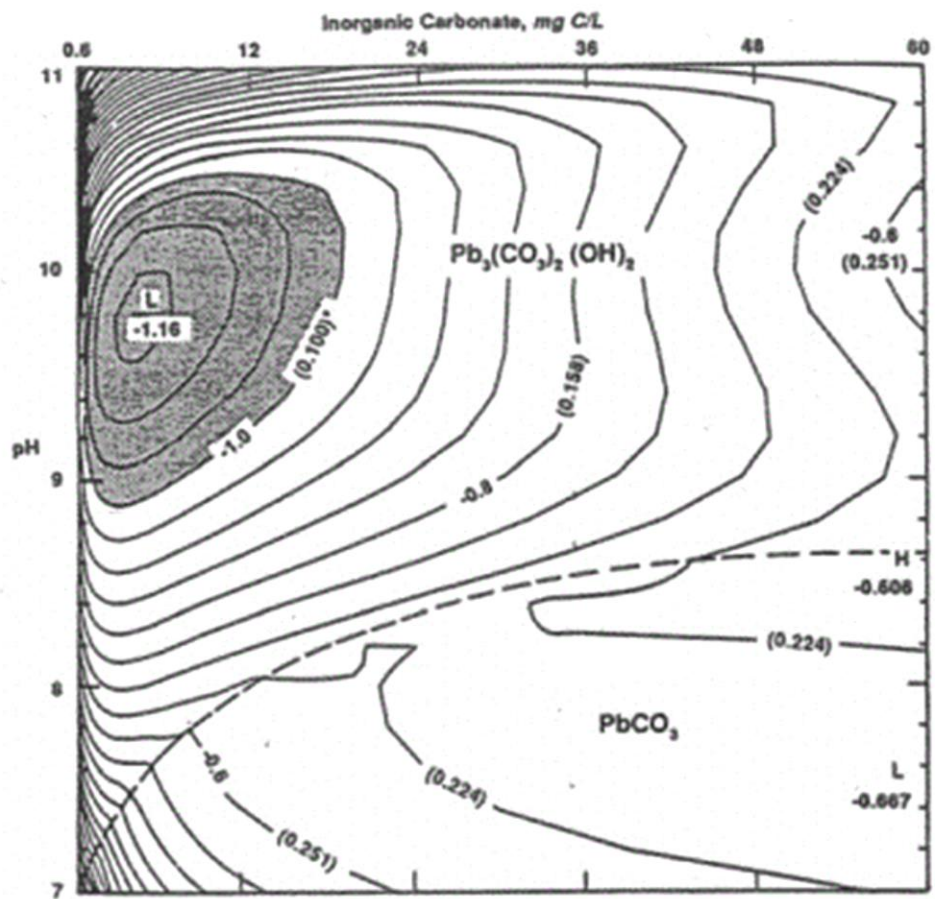
# LAKE COUNTY, OH EXAMPLE: ALKALINITY AND DIC RELATIONSHIP

THIS CHART SHOWS LEAD SOLUBILITY AT CONSTANT TEMPERATURE AND AS A FUNCTION OF PH AND VARIOUS DIC LEVELS

- LEAD SOLUBILITY IS ON THE Y AXIS IN LOGARITHMIC SCALE
- PH IS ON THE X AXIS
- THE CHART SHOWS THAT THE LAKE COUNTY PLANTS WOULD HAVE TO MAINTAIN A PH OF OVER 10 TO REACH THE MINIMUM SOLUBILITY POINT FOR LEAD



**BASED ON AN ALKALINITY OF 85 MG/L, LAKE COUNTY DIC LEVEL IS AROUND 22 MG/L**



LEAD SOLUBILITY CHARTS WITH AND WITHOUT ORTHOPHOSPHATE  
 EXAMPLE FOR WATER WITH IONIC STRENGTH 0.005, TEMPERATURE 25 DEGREES C  
 CHART ON RIGHT WITH 0.5 MG/L  $PO_4$

# OHIO'S LEAD AND COPPER RULE

- THE OHIO ADMINISTRATIVE CODE STIPULATES IN SECTIONS 3758-81-80 TO SECTIONS 3145-81-90 THAT OHIO PUBLIC WATER SUPPLIES MUST FOLLOW THE MANDATES OF THE NPDWR FOR LEAD AND COPPER
  - THESE REGULATIONS ESTABLISH A TREATMENT TECHNIQUE THAT INCLUDES REQUIREMENTS FOR
    - CORROSION CONTROL TREATMENT,
    - SOURCE WATER TREATMENT,
    - LEAD SERVICE LINE REPLACEMENT,
    - PUBLIC EDUCATION.
  - LEAD AND COPPER ACTION LEVELS, MEASURED IN SAMPLES COLLECTED AT CONSUMERS' TAPS, MAY TRIGGER THESE REQUIREMENTS.
  - THE LEAD ACTION LEVEL IS EXCEEDED IF, AT ANY TIME DURING THE MONITORING PERIOD, THE CONCENTRATION OF LEAD IN MORE THAN TEN PER CENT OF TAP WATER SAMPLES COLLECTED DURING ANY MONITORING PERIOD CONDUCTED IN ACCORDANCE WITH RULE 3745-81-86 OF THE ADMINISTRATIVE CODE IS GREATER THAN 0.015 MILLIGRAM PER LITER, I.E., IF THE NINETIETH PERCENTILE LEAD LEVEL IS GREATER THAN 0.015 MILLIGRAM PER LITER.

# OHIO'S LEAD AND COPPER RULE

- IF THE LEAD ACTION LEVEL IS EXCEEDED, A UTILITY WILL NEED TO PUT A CORROSION CONTROL TREATMENT SYSTEM IN PLACE
- CORROSION CONTROL TREATMENT REQUIREMENTS
  - ALL WATER SYSTEMS SHALL INSTALL AND OPERATE OPTIMAL CORROSION CONTROL TREATMENT AS DEFINED IN RULE 3745-81-01 OF THE ADMINISTRATIVE CODE.
  - SMALL AND MEDIUM SIZED SYSTEMS ARE DEEMED TO BE IN COMPLIANCE WITH CCT REQUIREMENTS IF THEY DON'T EXCEED THE ACTION LEVELS (AL)
  - LARGE SYSTEMS, AND SMALLER SYSTEMS THAT HAVE EXCEEDED THE AL, ARE REQUIRED TO FOLLOW SEVERAL STEPS THAT EVENTUALLY LEAD TO AN APPROVED CCT FOR THE SYSTEM

The background features a light gray gradient with several realistic water droplets of varying sizes scattered in the corners. The droplets have highlights and shadows, giving them a three-dimensional appearance.

# AGING WORKFORCE

HOW IT CAN AFFECT THE OPERATOR CERTIFICATION RULE

CAN YOU STAY IN COMPLIANCE WHEN KEY PEOPLE RETIRE OR LEAVE?



# WATER WORKFORCE TURNOVER

- LATEST REPORT FOR WATER WORKFORCE STATES THAT:
  - WATER INFRASTRUCTURE REPAIRS AND REPLACEMENTS SHOULD PROVIDE MANY LONG-TERM JOBS FOR INDIVIDUALS NOW AND IN THE FUTURE
  - BUT MANY OF THE PEOPLE WHO HAVE THE KNOWLEDGE AND EXPERIENCE ARE RETIRING JUST AS THEY ARE NEEDED, SO MANY NEW PEOPLE WILL NEED TO BE EMPLOYED
    - THE REPORT SAYS THERE ARE 1.7 MILLION WORKERS IN THE BUSINESS – DESIGNERS, OPERATORS, REGULATORS, CONSTRUCTORS, TECHNICIANS, ELECTRICIANS ETC.
- **THE REPORT STATES THAT 50% OF THE EXISTING WORKFORCE WILL BE ELIGIBLE TO RETIRE IN 5 YEARS**
  - THE PEOPLE WHO ARE LEAVING REPRESENT THE LAST LINKS TO “MANUAL OPERATIONS”
  - DON’T LET THIS KNOWLEDGE BANK LEAVE WITHOUT WRITING DOWN THAT INFO

# WATER WORKFORCE TURNOVER

- FOR THIS TOPIC, MANUAL OPERATIONS IS DEFINED AS THE PRODUCTION OF DRINKING WATER THROUGH MEANS THAT INVOLVE HAND-ON MANIPULATION OF TRADITIONAL WATERWORKS TOOLS WITHOUT THE USE OF MODERN METHODS AND DEVICES THAT HAVE BEEN DEVELOPED IN THE LAST, SAY, 25 YEARS
- WHILE IT IS UNLIKELY THAT OPERATORS WOULD WANT TO GO BACK TO USING THOSE TOOLS, THE WAY THAT THEY HAD TO LEARN THEM AND USE THEM TAUGHT THEM THE CRITICAL THINKING PATHWAYS THAT MAY BE LACKING NOW
- EXAMPLES OF MANUAL METHODS AND TOOLS:
  - MAKING REAGENTS FROM SCRATCH, BACKWASHING A FILTER WITHOUT ELECTRONIC CONTROL OF THE 5 FILTER VALVES, MEASURING FLOW RATE IN A PIPE BY USING A VENTURI GAUGE, REBUILDING A PUMP AND INSTALLING PACKING GLANDS, READING AN OLD DIAL METER
  - CAN YOUR OPERATORS NAME THE FIVE TRADITIONAL FILTER VALVES?
    - INFLUENT, EFFLUENT, WASH WATER SUPPLY, WASH-WATER DRAIN, AND SURFACE WASH. A SIXTH VALVE MAY BE NECESSARY FOR FILTER TO WASTE