

Pb Dash

Designing dashboard support for Public Water Systems
managing the EPA's Lead & Copper Rule Revision

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Capstone Proposal
GEOG 596A – 4/28/23
Advisor: Dr. Fritz Kessler

About Me

- Bachelor's degree is in Business Management
 - Focus on information systems
- Involved with the water/wastewater field for 18 years
- Earned postbaccalaureate certificate in GIS from Penn State in 2013
- Responsible for daily operation and maintenance of a 750,000 gallons per day Wastewater Treatment Plant for The Town of Berlin, MD.



Presentation Overview

- Background on Lead and Copper Rule
- Lead and Copper Rule Revision
- Goals & Objectives
- Literature Review
- Pb Dash Concept
- Anticipated Outcomes
- Timeline

What is in your water?

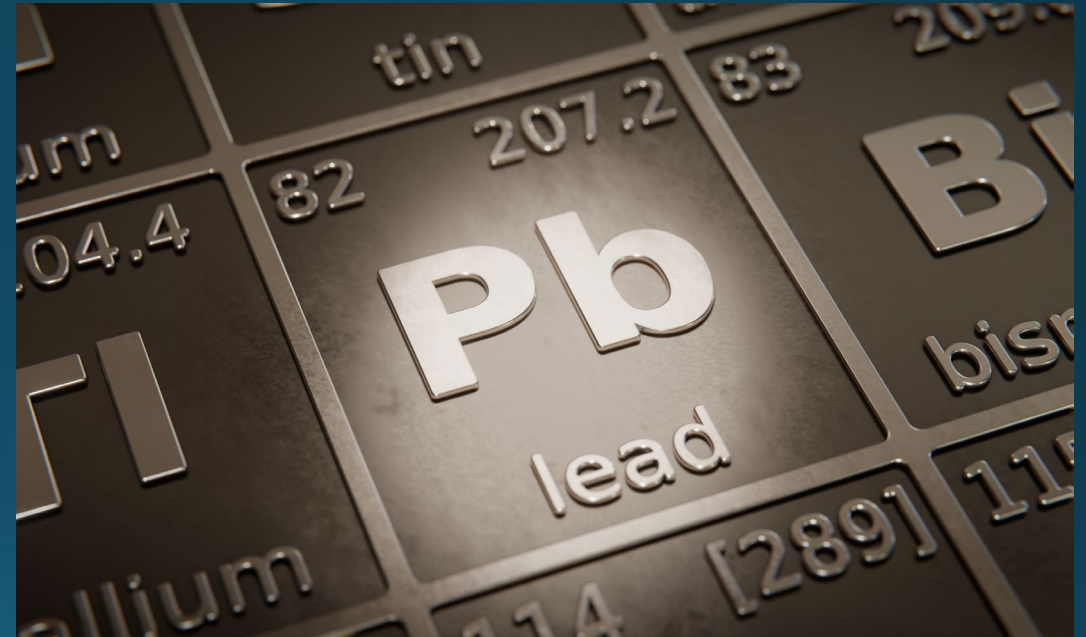


Close up photo of water drop, pexels.com

<https://images.pexels.com/photos/932320/pexels-photo-932320.jpeg?cs=srgb&dl=closeup-photo-of-water-drop-932320.jpg&fm=jpg>

Lead and Copper Rule

- Originally implemented in 1991
- Requires *Public Water Systems* (PWS) to monitor drinking water
- Requires action if lead concentrations exceed 15 ppb in more than 10% of customer taps sampled



<https://www.ae2s.com/TheUpdate/wp-content/uploads/2022/03/Lead-scaled.jpeg>

Consumer Confidence Report

- Published annually by *Public Water Systems*
- Communicates to consumers the quality of their drinking water
- Provides education on potential health effects of contaminants

TEST RESULTS						
Contaminant	Violation Y/N	Level Detected	Unit Measurement	MCLG	MCL	Likely Source of Contamination
Volatile Organic Contaminants						
TTHM (Distribution) (2021)	N	6	ppb	0	80	By-product of drinking water chlorination
HAA5 (Distribution) (2021)	N	1	ppb	0	60	By-product of drinking water chlorination
Inorganic Contaminants						
Nitrate (as Nitrogen) (2021)	N		ppm	10	10	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Highest level detected		6.00				
Copper (2021) (Distribution)	N	0.26	ppm	1.3	AL=1.3	Corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives
Barium (2021)	N	0.084	ppm	2	2	Discharge of drilling waste; Discharge from metal refineries; Erosion of natural deposits
Chromium (2021)	N	3.2	ppb	100	100	Discharge of steel and pulp mills; Erosion of natural deposits
Selenium (2021)	N	1.6	ppb	50	50	Discharge from petroleum and metal refineries; Erosion of natural deposits; Discharge from mines
Lead (2021) (Distribution)	N	5.5	ppb	0	AL=15	Corrosion of household plumbing systems, erosion of natural deposits
Radioactive Contaminants						
Combined Radium 226/228 (2020)	N	0.1-0.9	pCi/L	0	5	Erosion of natural deposits
Highest level detected		0.9				
Gross alpha excluding radon and uranium (2020)	N	2.1	pCi/L	0	15	Erosion of natural deposits

Additional Information for Lead

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. Town of Berlin is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flushing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from the Safe Drinking Water Hotline or at <http://www.epa.gov/safewater/lead>.

Note: Test results are for year 2021 or as otherwise indicated; all contaminants are not required to be tested for annually.

Lead and Copper Rule Revision

- Latest revision released in 2021
- Six Responses to LCRR
 - Sampling Procedures
 - Follow-up samples
 - Prioritization for schools and child-care facilities
 - Water service line inventory
 - Replacement goal of 3% average for every 2 years
 - Dispersal of water filters

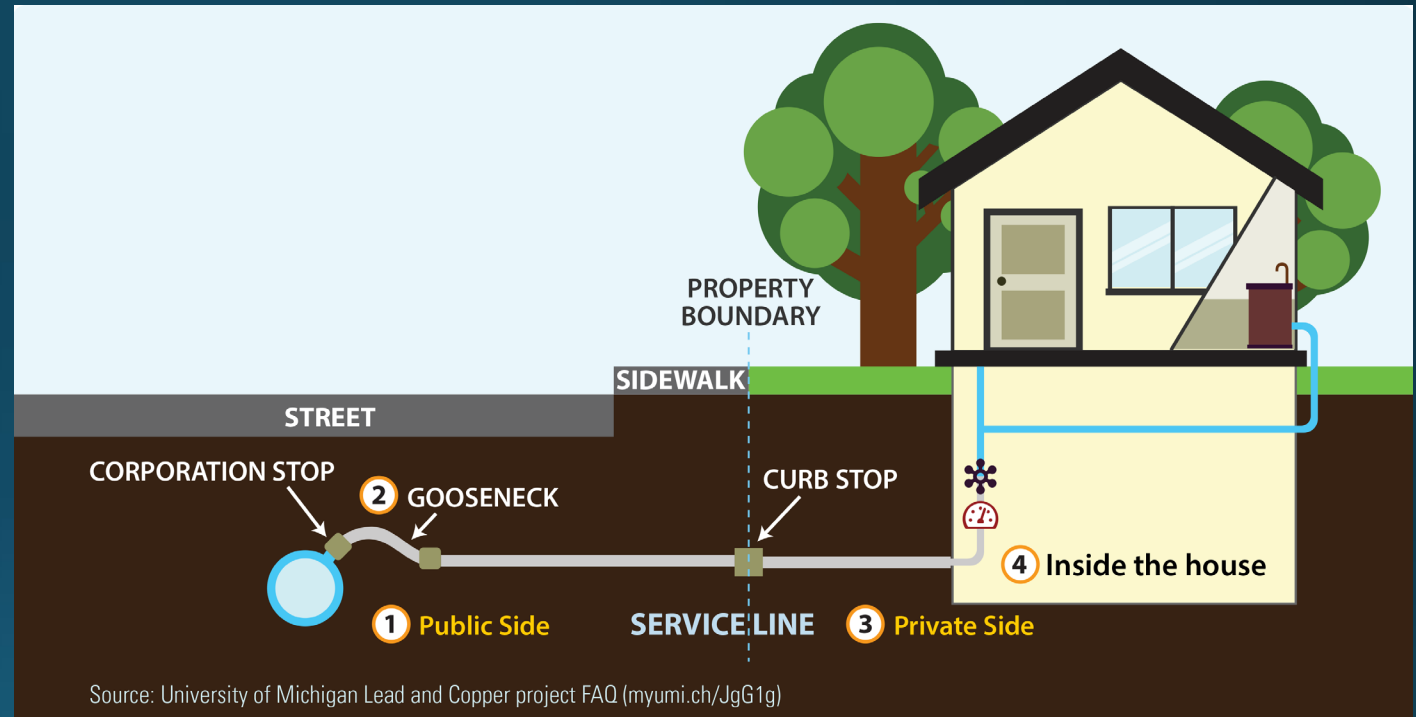
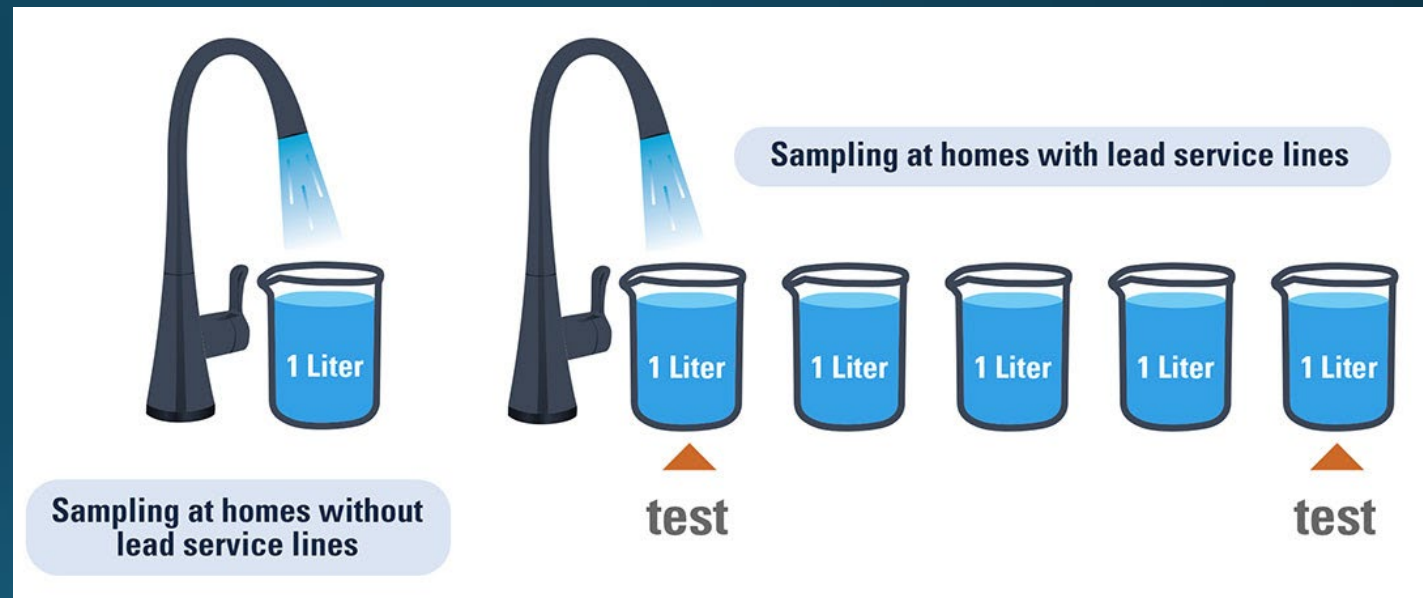


Illustration of water service line from water main to private property (<https://graham.umich.edu/project/revised-lead-and-copper-rule/images>)

LCRR: Six Responses

1. Standard Sampling Procedures

- Requirement to collect and test based on service line material
 - first-liter sample for homes without a LSL
 - First and fifth-liter sample for homes with a LSL
- Defines a trigger level of 90% requiring PWS to perform additional planning, monitoring, and treatment at 10 ppb
- Maintains 15 ppb action level



Example of first & fifth liter draw of water (<https://graham.umich.edu/project/revised-lead-and-copper-rule/images>)

LCRR: Six Responses

2. Follow-Up Samples

- Find-and-fix approach
 - Any samples that exceed 10 ppb trigger level require additional planning, monitoring, and treatment
 - Any individual tap samples exceeding 15 ppb require second sample collected within 30 days

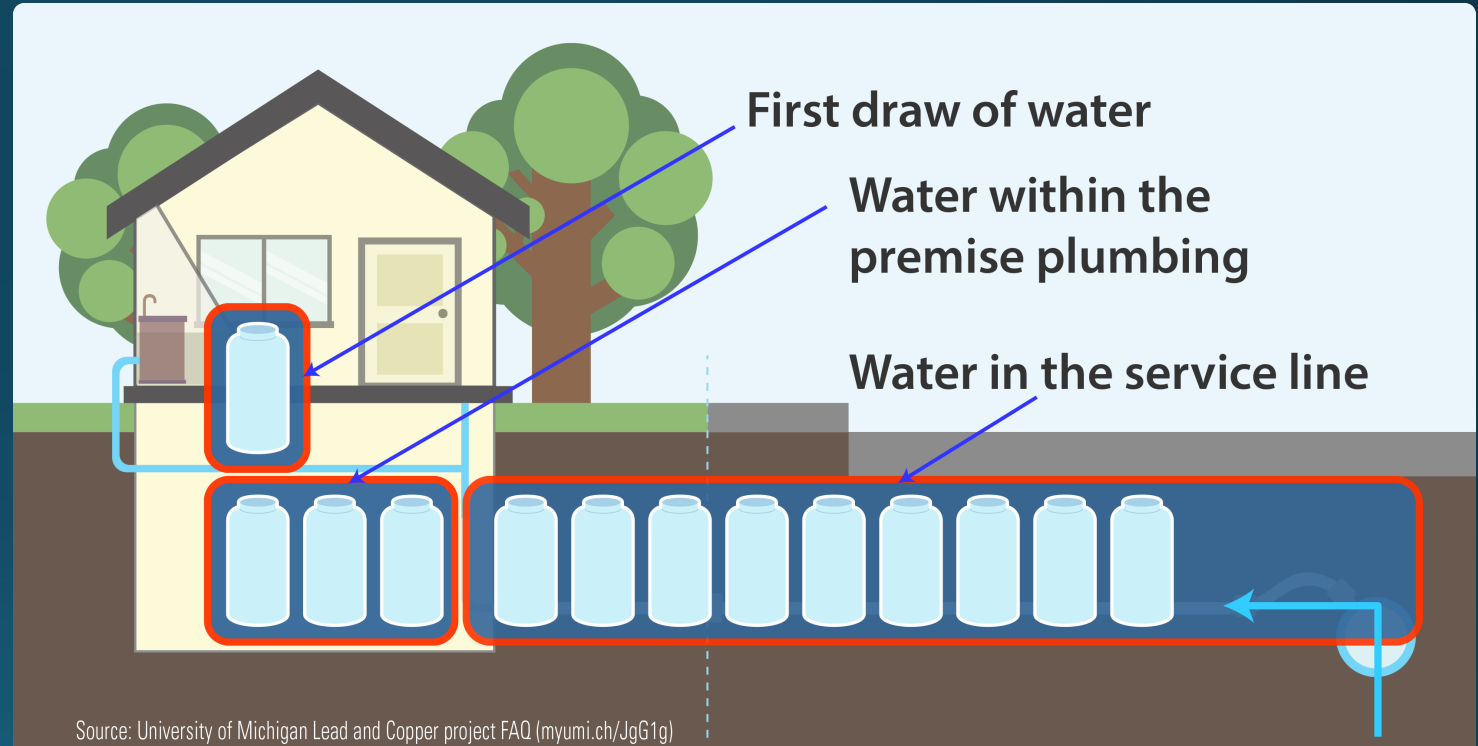


Illustration of first & fifth liter draw of water in service line (<https://graham.umich.edu/project/revised-lead-and-copper-rule/images>)

LCRR: Six Responses

3. Prioritizing Children

- Prioritize at-risk populations
- Requirement for 20% of schools and child-care facilities to be sampled and tested each year



Example of school water fountain that could contain lead solder (https://nylcv.org/wp-content/uploads/4597707006_973db8e73a_o.jpg)

LCRR: Six Responses

4. Lead Service Line Inventory

- Create inventory of service lines, both sides
- Update annually
- Share with public
- Notify customers with lead service lines annually

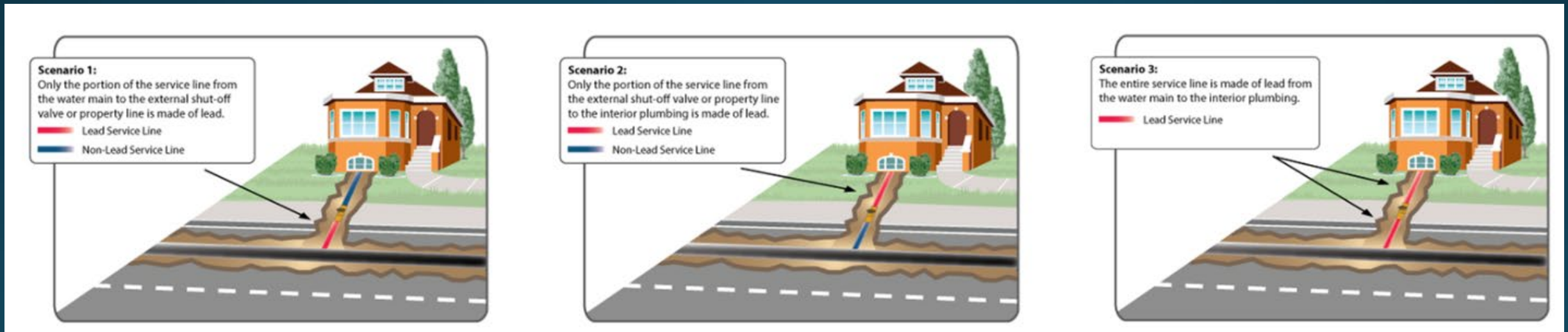


Lead gooseneck (seattlemedium.com)

LCRR: Six Responses

5. Replacement Goal

- Replace PWS side AND customer side of service line
- If customer replaces their side of the service line, PWS is required to replace their side within 45 days.



Example of PWS and customer owned side of water service. (<https://www.epa.gov/il/advice-chicago-residents-about-lead-drinking-water>)

LCRR: Six Responses

6. Water Filters

- Includes requirement for PWS to distribute pitchers and six months worth of filters to the customer when replacing a LSL.
- Avoids contamination from disturbance of service line



REDUCES MORE CONTAMINANTS* AND 99% OF LEAD**

The diagram shows a cross-section of a water filter. Inside the filter, there are four circular icons representing contaminants: Cadmium (Cd), Chlorine (Cl), Lead (Pb), and Mercury (Hg). Lines connect these icons to their respective labels: CADMIUM, CHLORINE, LEAD, and MERCURY. The filter is shown in a blue color with a textured interior.

*vs. previous Longlast.
**See certifications. Substances reduced may not be in all users' water.

Brita Pitcher with filter and information graphic (Amazon.com)

Pb Dash Objectives & Goals

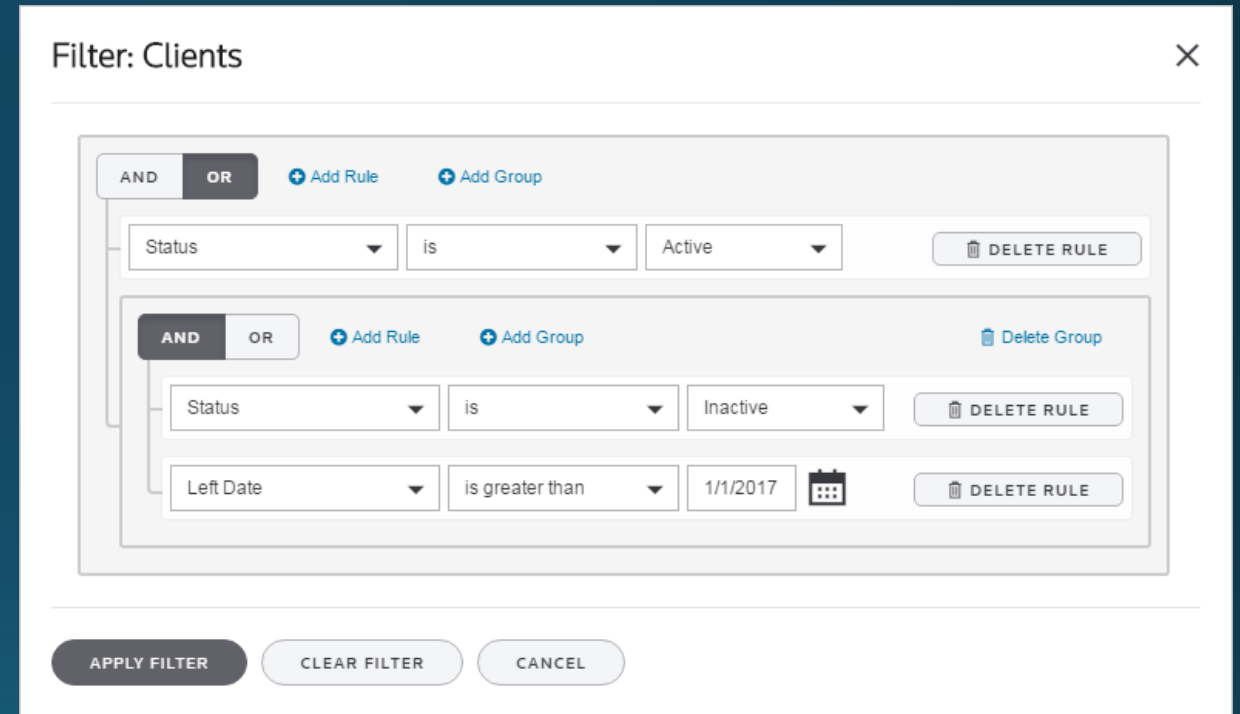
- Assist PWS
 - Geographically visualize material of water service lines
 - Create a living database for service line material
 - Prioritize properties for LSL replacement
- Create customized dashboard: Pb Dash
- Ensure public health & safety and quality of water
- Pd Dash will initially be used in-house

Literature Review

Intuitive User Environment

Elias and Bezerianos (1970)

- Dashboard should offer an intuitive user environment for searching & exploring data representations
- Data filters can alter display and allow comparison of different categories



The screenshot shows a 'Filter: Clients' dialog box. At the top, there are radio buttons for 'AND' and 'OR', with 'OR' selected. To the right are '+ Add Rule' and '+ Add Group' buttons. The filter rules are as follows:

- Rule 1: Status is Active (with a 'DELETE RULE' button).
- Rule 2: Status is Inactive (with a 'DELETE RULE' button).
- Rule 3: Left Date is greater than 1/1/2017 (with a calendar icon and a 'DELETE RULE' button).

At the bottom of the dialog, there are three buttons: 'APPLY FILTER', 'CLEAR FILTER', and 'CANCEL'. A 'Delete Group' button is also visible on the right side of the second rule's container.

Example of a data filter. (<https://onvio.us/ua/help/-images/core/filter-data-example.png>)

Literature Review

Optimize Functionality

Heer, et al. (2008)

- Novice users act as consumers:
 - interact with data within the possibilities offered
 - rarely extend existing functionality to suit their analysis needs
- Provide contextual information, including legends, scales, labels, popups, titles...

Cully and Jaco (2019)

- Web-based dashboards allows easy access to data

Literature Review

Indicators

Allio (2012)

- Too many indicators can be overwhelming
 - Limit indicators to most powerful/useful
- Provide context for indicators
 - Labels, sources, titles, etc.

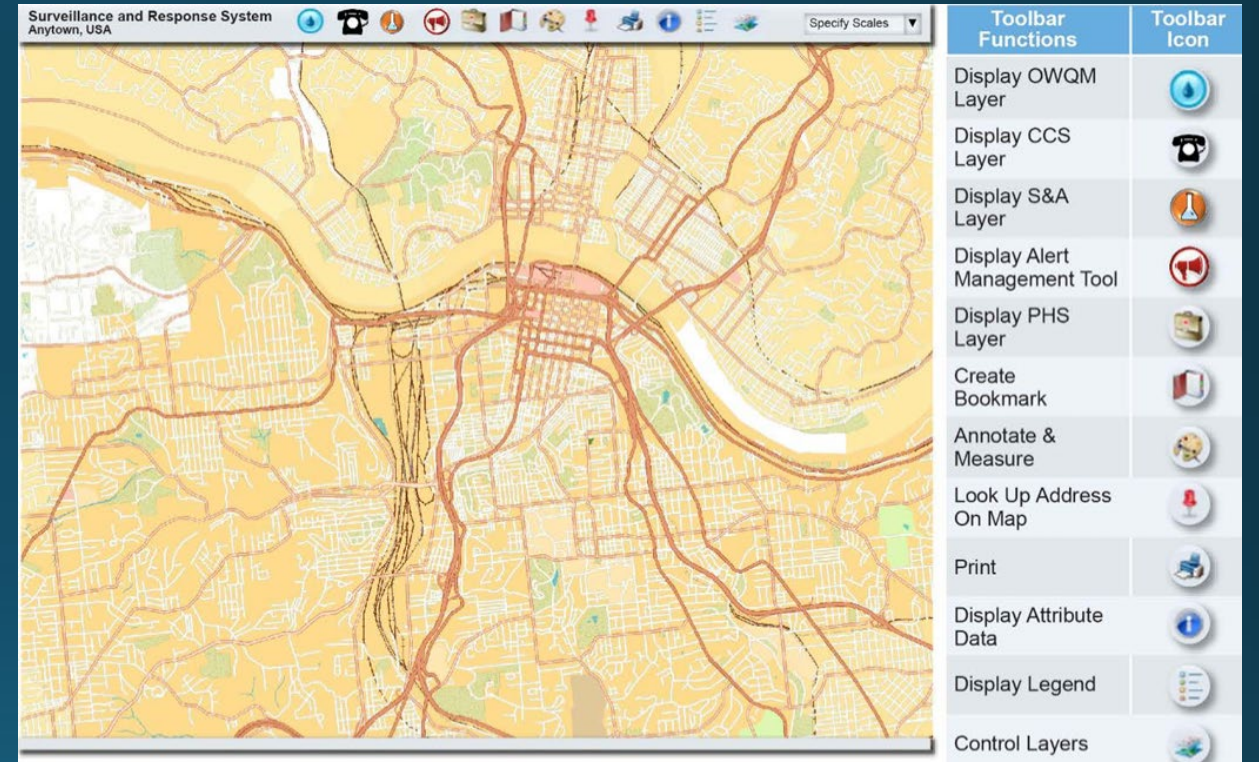


Example of an overwhelming dashboard with many indicators (thirdcoastbimmers.com)

Pb Dash Concept

1. Geospatial Presentation

- Takes advantage of spatial attributes
- Ability to interact with the map
 - Add/edit attribute data
 - Visualize details not immediately apparent
- Visual of service lines or material throughout the water distribution system

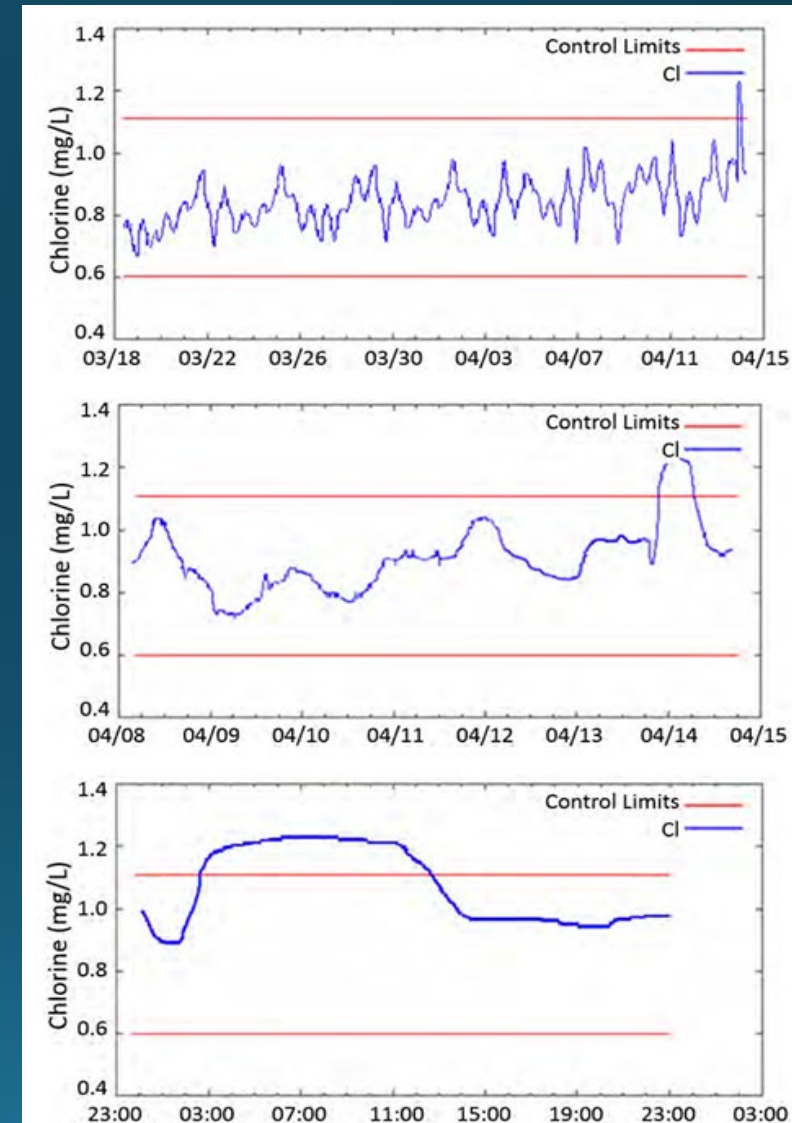


Basemap and Toolbar in a Geospatial Display, (NSCEP, 2015)

Pb Dash Concept

2. Trends Over Time

- Useful to demonstrate trends over time in a time-series plot
- Useful for:
 - Tracking number of completed LSL replacements
 - Dispersal of water filters
 - Cost of remediation over time

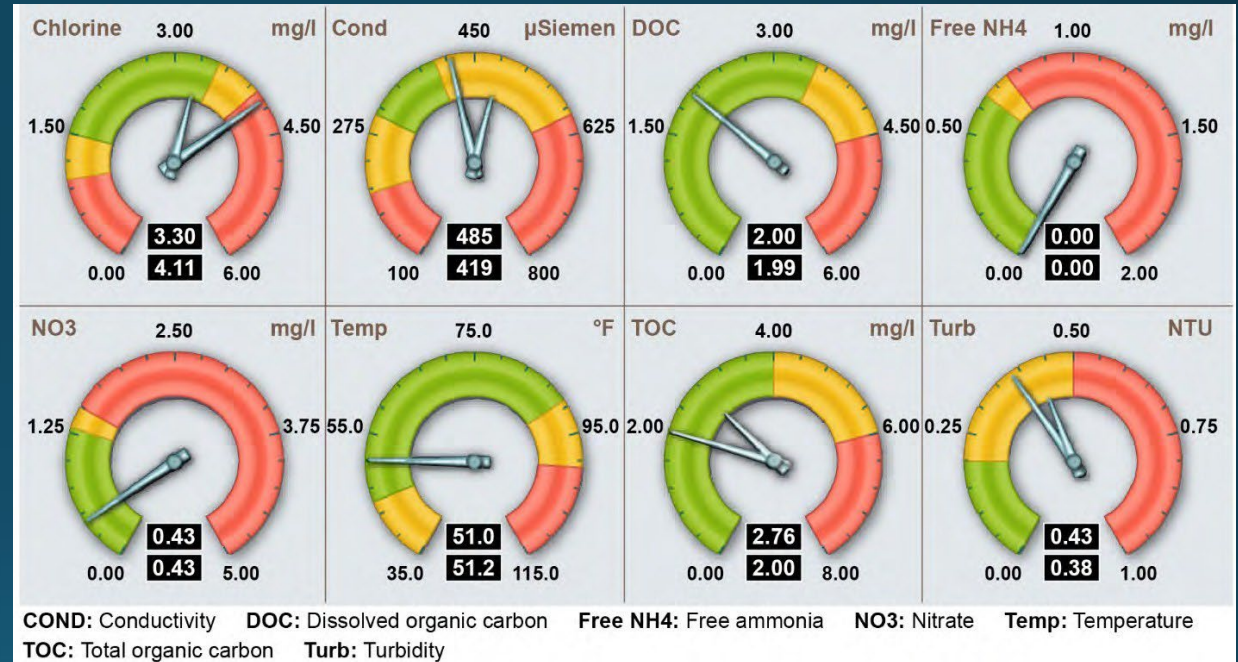


Example of a Time-Series Plot Over Different Time Periods, (NSCEP, 2015)

Pb Dash Concept

3. Gauge Display

- Monitoring current conditions of multiple parameters
- Best for aggregated laboratory sample results of pre-construction and post-construction samples

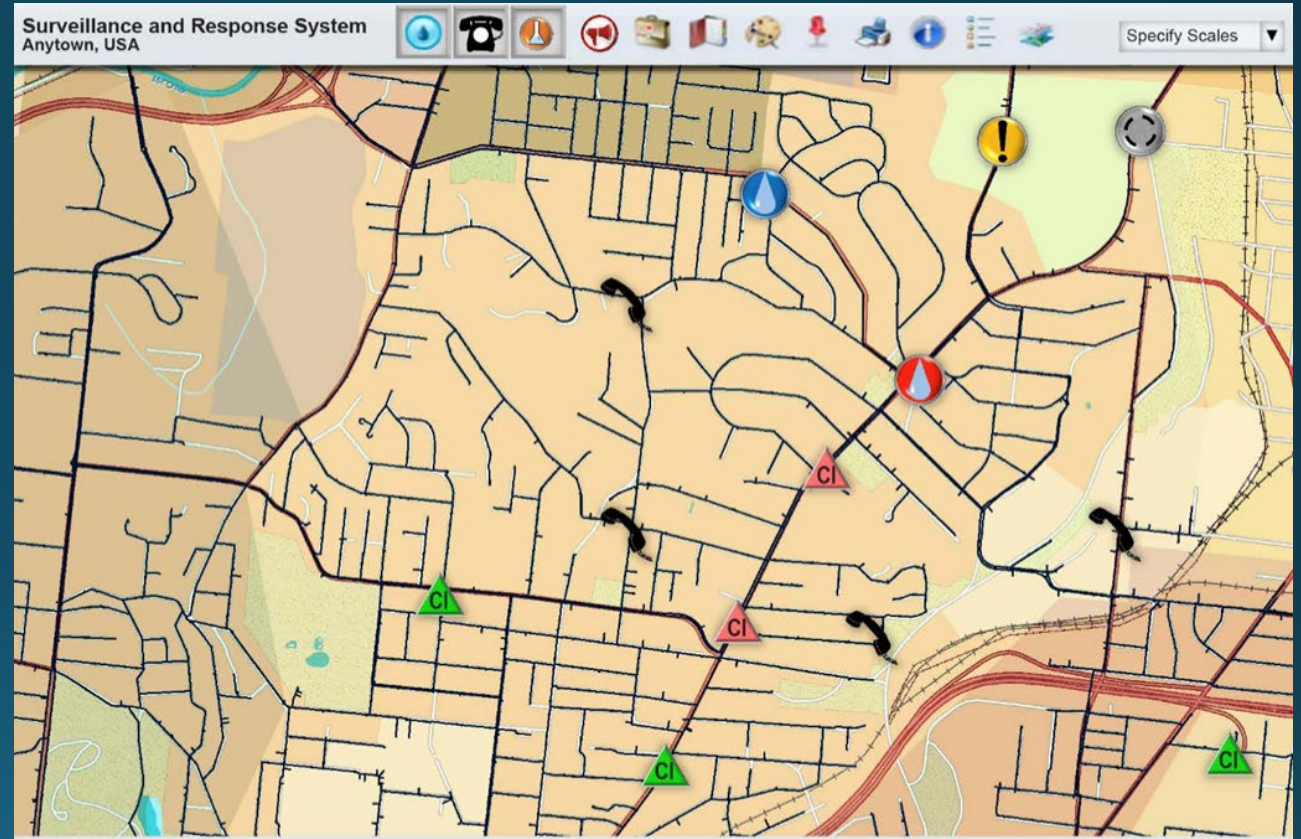


Example of a Gauge Display, (NSCEP, 2015).

Pb Dash Concept

4. Thematic Mapping

- Using appropriate symbolization methods
- Different symbols to represent different variables
- Different colors for differing values of the same variable

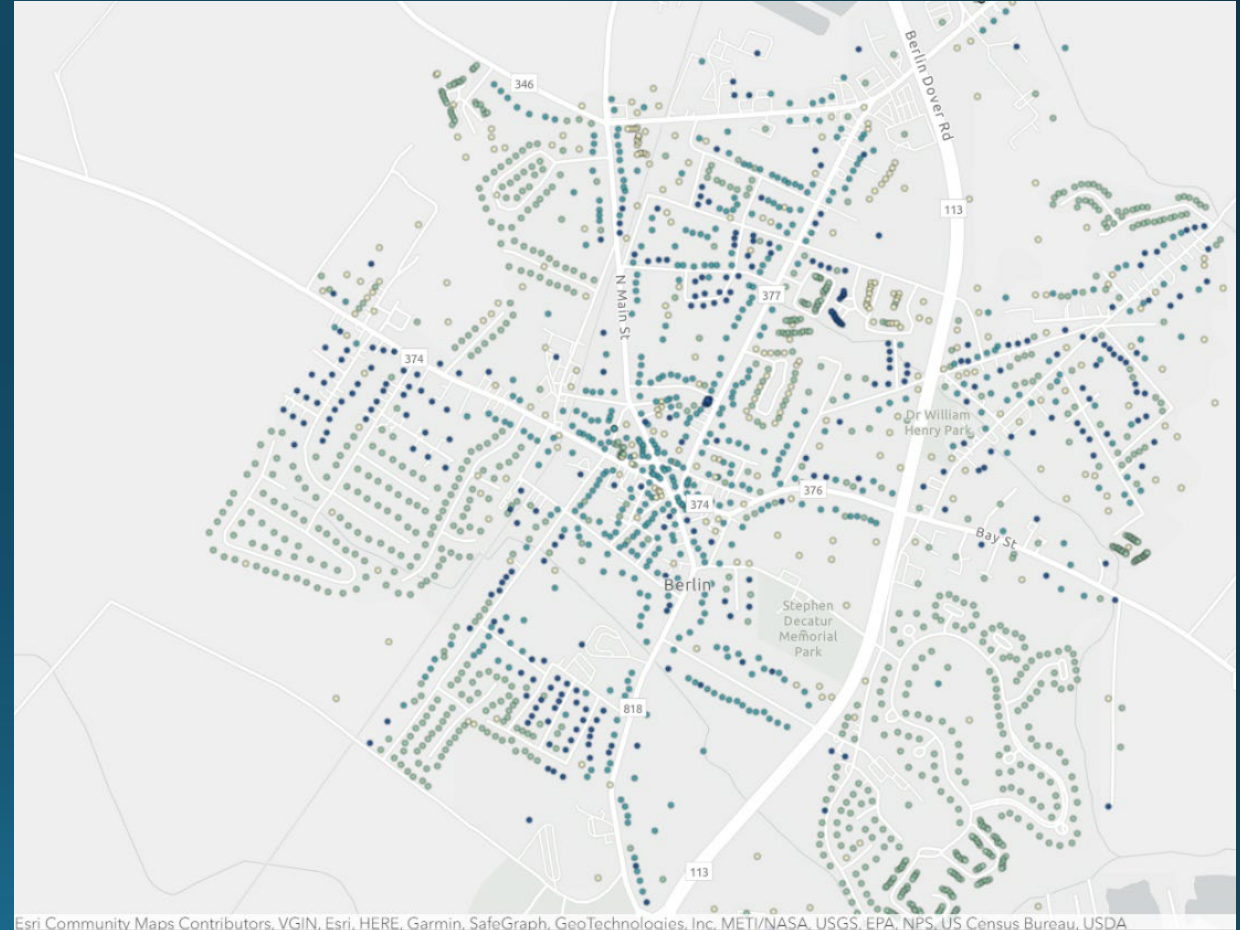


Example of Thematic Mapping using symbology, (NSCEP, 2015).

Pb Dash Concept

5. Geospatial Display

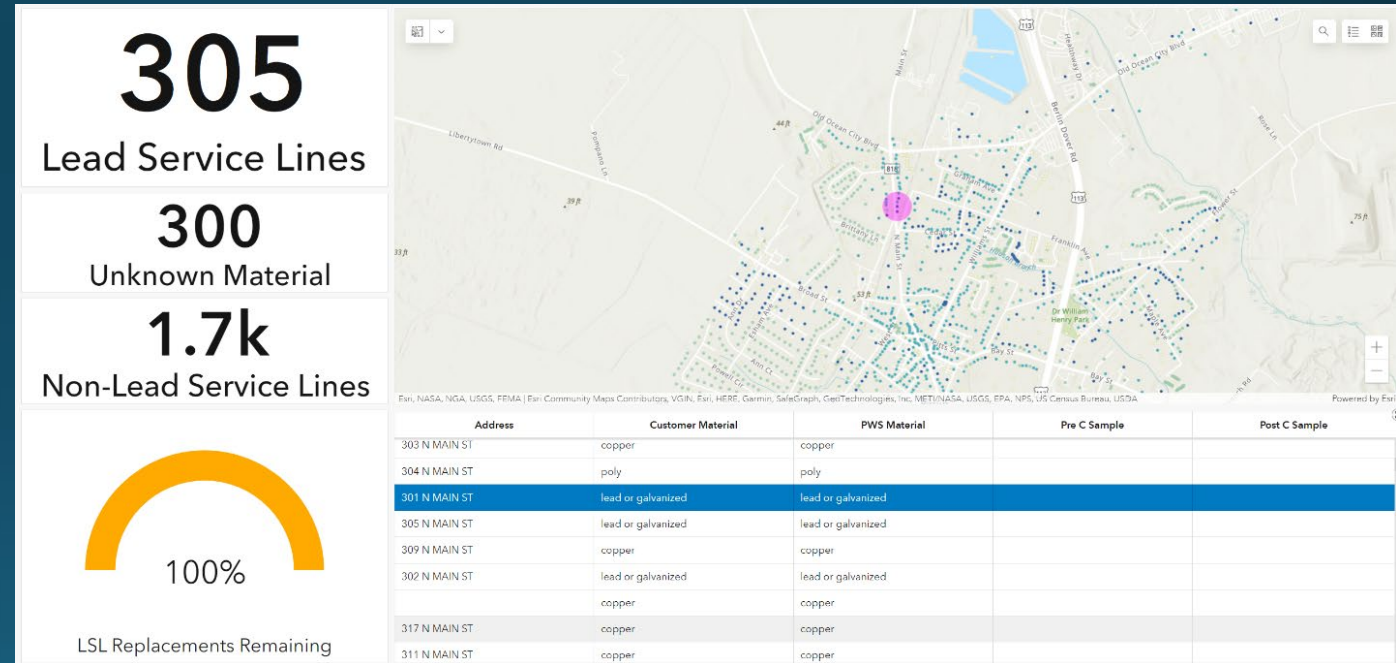
- Shows pattern in spatial data
- Additional information will include customer information, sampling data, and distribution of water filters
- Colorblind safe symbology



Example of colorblind safe symbology used to differentiate properties by service line material

Anticipated Outcomes

- Tool for prioritizing funding and resources to remediate lead service lines
- Allow PWS operator to have hands-on-control over replacements, ability to update data as needed
- Current inventory of water service lines



Proof of concept for Pb Dash; Interactive attribute table highlights and zooms to coordinating property on the map.

Timeline

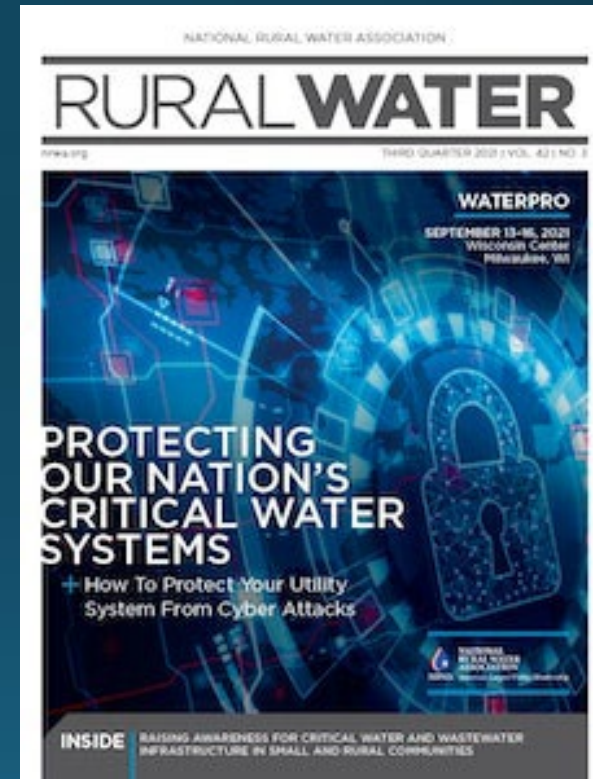
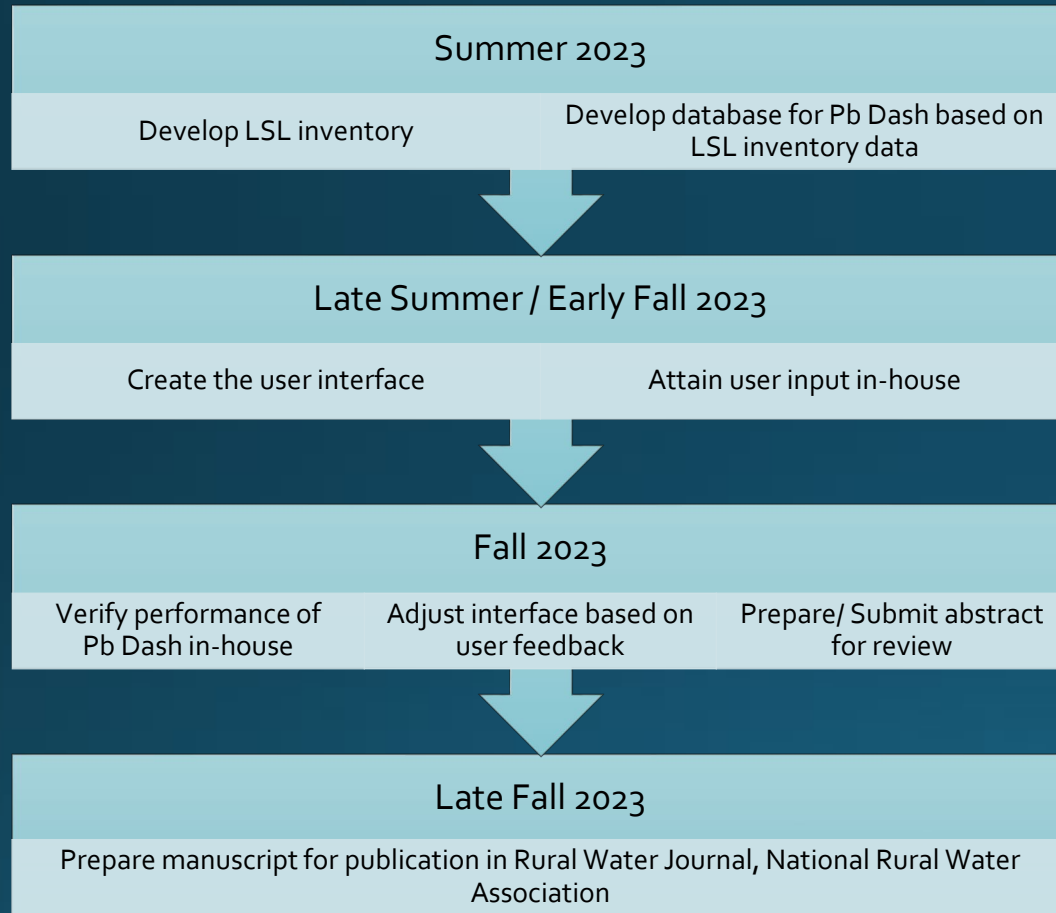


Image of Rural Water Journal (<https://content.nrwa.org/>)

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Thank You!

- Questions?
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