



# Creating and Using Effective Standard Operating Procedures

Thursday March 27, 2025 (1:00 to 2:00 pm EST)

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# Certificate of Completion

This session has **NOT** been submitted for pre-approval of Continuing Education Credits, but eligible attendees will receive a certificate of attendance for their personal record.

## To receive a certificate:

- You must attend the entire session
- You must register and attend using your real name and unique email address - group viewing credit will not be acceptable
- You must participate in polls
- Certificates will be sent via email within 30 days

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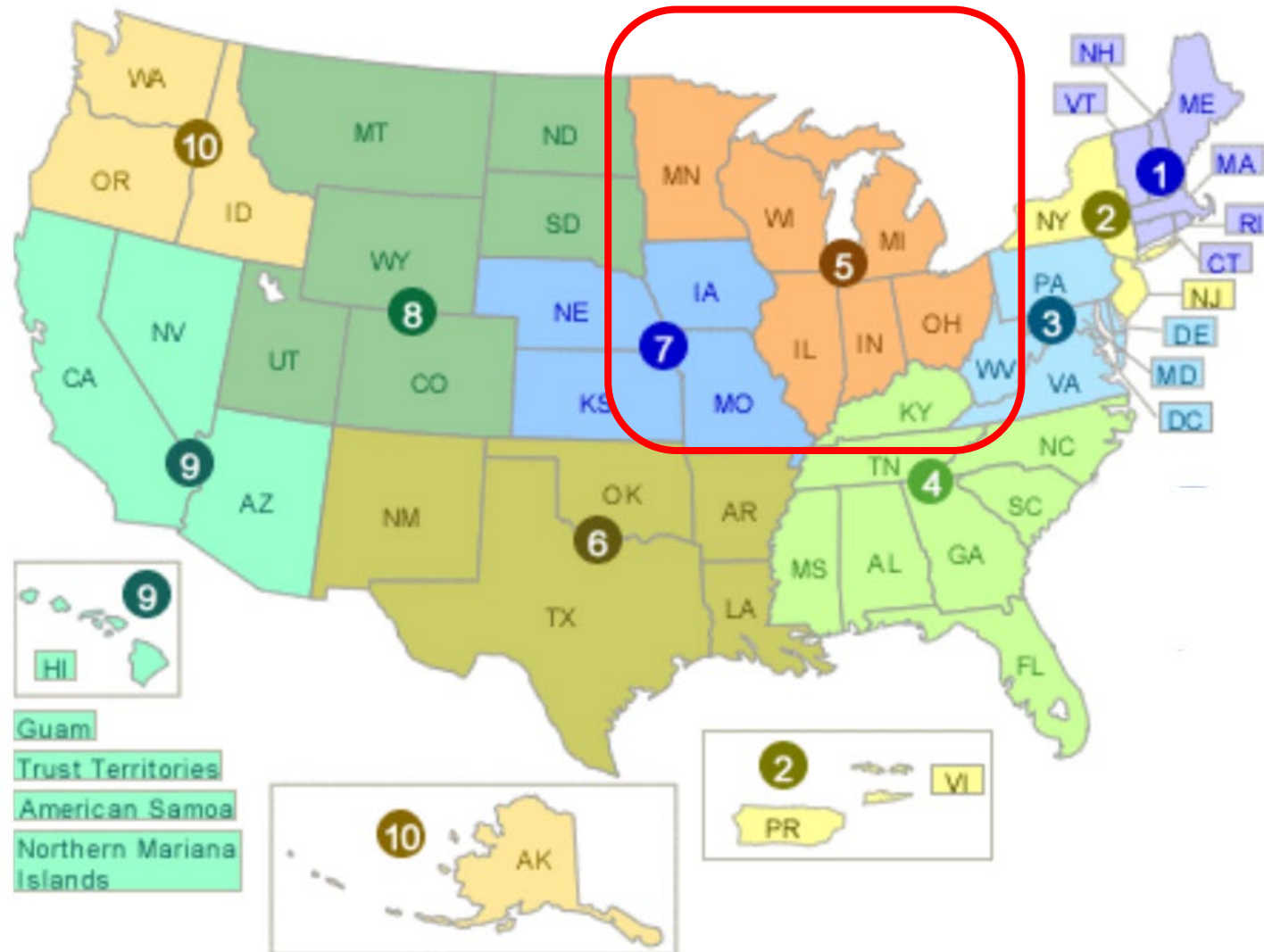
# About Us

The **Environmental Finance Center Network (EFCN)** is a university- and non-profit-based organization creating innovative solutions to the difficult how-to-pay issues of environmental protection and water infrastructure.

The EFCN works collectively and as individual centers to address these issues across the entire U.S, including the 5 territories and the Navajo Nation. The EFCN aims to assist public and private sectors through training, direct professional assistance, production of durable resources, and innovative policy ideas.



# Nationwide reach of EFC Network





# Great Lakes Environmental Infrastructure Center

*Environmental Finance Center for EPA Region 5*

**Serve small communities (population of less than 10,000) throughout EPA Region 5:** Indiana, Illinois, Michigan, Minnesota, Ohio, Wisconsin, and 35 federally recognized American Indian governments.

**Training, Research, and Technical Assistance** with a mission to help water and wastewater utilities increase technical, managerial, and financial capacity (TMF).

**Examples:** Asset management, infrastructure funding, financial management, compliance and operations

## GLEIC Staff

Tim Colling P.E., Director

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John Sullivan P.E. , Senior Research Engineer

Greg Pearson, MBA Water & Wastewater Systems Trainer





**Standard operating procedures (SOPs) are used for critical tasks that must be performed the same way each time to ensure safety, public health, and compliance with regulations.**



# Today we will cover

1. How to analyze tasks to determine when an SOP is necessary
2. Walk through the 9 components of an SOP document using an actual example for repairing main breaks.
3. Tips for creating and testing SOPs

## Resources

[Sample SOPs](#) | [Editable SOP Template](#) | [Reference links](#)



# Standard Operating Procedure (SOP)

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**Official written document that provides a step-by-step guide for completing critical tasks**

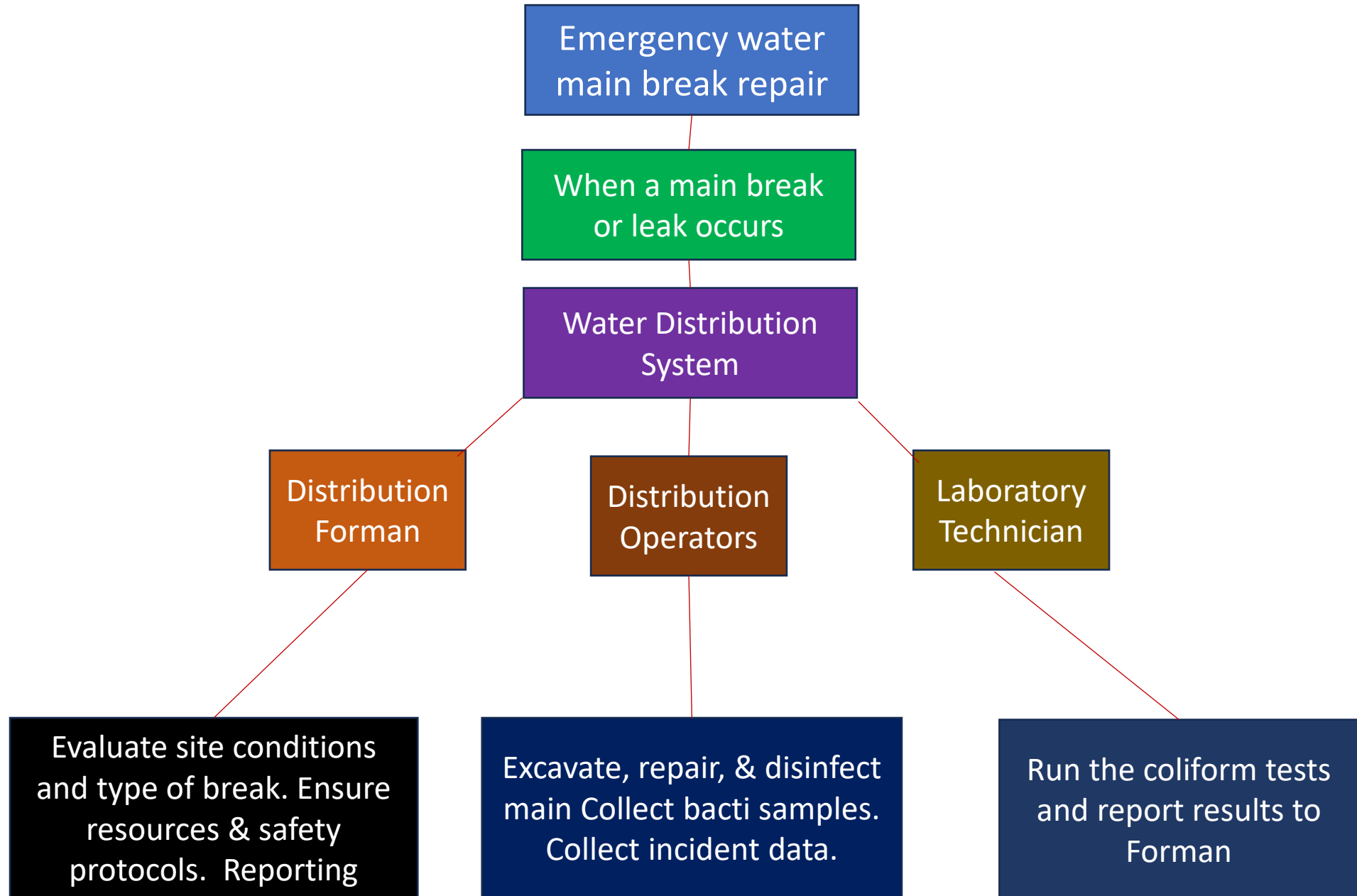
- Standardizes task procedure so it is done the same way each time
  - Referenced to industry standards.
  - Includes safety considerations, lists tools, and identifies decision-points
- 





# SOPs provide answers to the five basic question types

- What
- When
- Where
- Who
- How



# When is an SOP Needed?

*Think about the consequences of failing to do a task correctly to determine if an SOP is needed.*

1. Public and/or Environmental Health
2. Regulatory compliance
3. Safety (operators and public)
4. Outages and breakdowns
5. High cost to repair or recover



Poll #1

**Which of the following tasks do you think represents the **greatest** need for an SOP?**

- a) Installing a new water service
- b) Collecting accurate water meter readings
- c) Recording flow and pressure data during daily rounds
- d) Adjusting chemical dosages at a surface water treatment plant

# Which of the following tasks do you think represents the **greatest** need for an SOP?

- a) Installing a new water service – operators may have different approaches to make service connections while meeting standards.
- b) Collecting accurate water meter readings – not immediately critical to health, safety or compliance
- c) Recording flow and pressure data during daily rounds – while system pressure may be critical to health and safety, the method used to record this data is not.
- d) Adjusting chemical dosages at a surface water treatment plant.**  
Extremely critical to public health, compliance, and safety. Failing to correctly adjust chemical dosages could result in: (i) pathogens or harmful chemicals in drinking water, (ii) failure to comply with regulations, and (iii) operators being exposed to corrosive or harmful chemicals

# SOP Bloopers and outtakes #1 – “*The Impelled Impeller!*”

An overly confident installer decides to skip the SOP step to confirm the direction of shaft rotation before connecting the pump.

The pump is turned on rotating backwards leading to extensive damage to impellers, casings, bearings, and shaft.

Outages, high repair costs





# SOP Bloopers and outtakes #2 “*A shocking oversight!*”

A well pump 480-volt starter needs to be replaced; however, the lockout, tagout kit has been left back at the utility shop.

To save time, the operator simply turns off the switch at the panel and begins working; however, while installing the unit, another operator comes to the pump panel, and seeing switch off, flips it back on.



## Safety incidents and OSHA compliance

### Notes:

- Preventable incidents are different than freak accidents.
- Violating safety principles can be deceptive.

# SOP Bloopers and outtakes #3 “*From override to hit the road!*”

An employee overrode a waste treatment alarm resulting in a 10,000-gallon discharge of hexavalent chromium into the Huron River

The incident made national news, and the employee was let go.

**Environmental and public health,  
compliance violations**

Public Interest

**Tribar employee overrode alarm 460 times  
before Huron River spill**



# Potential problems with SOPs

- (1) SOPs which are no longer relevant.
- (2) Impractical or poorly written SOPs
- (3) Having SOPs for too many tasks.

Unnecessary or irrelevant SOPs can lead employees to begin disregarding even critical SOPs; and interfere with operator initiative. Poorly written SOPs could lead to errors.



## (4) Good SOPs which are not used

- Lack of knowledge how or skill to perform task (Don't know how - training)
- Insufficient resources necessary for the task (Know how, but don't have the tools-budgeting)
- Lack of clear direction and expectations (Know how and have tools, but didn't know they were supposed to perform the task – management communication improvement)
- Lack of motivation (had the tools and resources, and knew they were supposed to – but did not want to do it – culture or employee problems).

# Maintaining SOPs

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**A new operator needs to determine the procedure to add solution and adjust the sodium hypochlorite feed system used for disinfection, but the only SOP available contains instructions for the old gas chlorinator. What could have prevented this situation?**

- a. A procedure to periodically review and update SOPs
- b. A policy to develop SOPs for new critical equipment installations.
- c. A practice of onboarding staff on critical O&M procedures.
- d. All of the above.



# Poll #2

**An operator needs to adjust the sodium hypochlorite system but the only SOP available is for the old gas chlorinator. What could have prevented this?**

- a. A procedure to periodically review and update SOPs
- b. A policy to develop SOPs for new critical equipment installations.
- c. A practice of onboarding staff on critical O&M procedures.

**d. All of the above.**

- Procedures should be in place to review and update SOPs whenever there are changes.
- SOPs are key components of employee training and onboarding.



# A suggested format for developing an SOP

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- Total of 9 components
- 2 are administrative (title page and document control page)
- 7 content components related to the tasks described in the SOP
- Example: Emergency Repair of Water Mains SOP



# SOP Suggested Format

**Title Page:** *Use a standard naming procedure and clearly identify the task. Optional file number and date of creation.*

**Document Control Page:** *Track revisions, list approval information & record employee acknowledgements.*

## ***SOP Contents***

1. **Definitions:** *Define any acronyms or terms used in SOP.*
2. **Responsibilities:** *List responsibilities of key personnel.*
3. **Scope/Purpose:** *Describe what the SOP is intended to cover*
4. **Health and Safety:** *List hazards, worksite setup, training, and PPE*
5. **Procedures:** *List the required tools and step by step procedures.*
6. **Data Recording:** *Data collection from the procedure.*
7. **References:** *Standards*



- **An SOP template has been included along with instructions and two sample SOPs.**
- **Feel free to edit according to the needs of your utility.**

# SOP Suggested Format

**Title Page:** *Use a standard naming procedure that clearly identifies the task. (File number and date of creation)*



# Title Page



Logo indicates that this is an official document

## EMERGENCY REPAIR OF WATER MAINS SOP

- Title clearly indicates what the SOP is about using operational terms.

SOP #311

- SOP is numbered and dated.

Rev: 0.0

- Includes information about current version.

Date: 01/31/2018

# SOP Suggested Format

**Title Page:** *Use a standard naming procedure and clearly identify the task. Optional file number and date of creation.*

**Document Control Page:** *Track revisions, list approval information, & record employee acknowledgements.*





# Document Control

EMERGENCY REPAIR OF WATER MAINS

SOP VERSION CONTROL

Revision No	Revision Date	Page No(s)	Description	Approved by

STAFF ACKNOWLEDGEMENT

I certify that the requirements of this SOP have been communicated to me and that I am trained in its use. A copy of this page will be distributed to the employee training record file.

Name	Date

- Header identifies the SOP topic throughout the document.
- Provides a section to document revisions.
- Used to document staff training

# SOP Suggested Format

**Title Page:** *Use a standard naming procedure and clearly identify the task. Optional file number and date of creation.*

**Document Control Page:** *Track revisions, list approval information & record employee acknowledgements.*

## ***SOP Contents***

**1. Definitions:** *Define any acronyms or terms used in SOP.*



# Definitions

1 DEFINITIONS AND ACRONYMS	
AWWA	American Water Works Association
EAM	enterprise asset management
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
mg/L	milligram per liter

Use this section to spell out any acronyms used in the SOP.

Define any potentially unfamiliar terms that will be used in the SOP that operations staff need to know.

Note: Acronyms can have more than one meaning  
**ERP** (Emergency Response Plan) or (Enterprise Resource Planning)?  
**CCR** (Consumer Confidence Report), (Covenants, Conditions, and Restrictions), or (Cash Conversion Rate)?

# SOP Suggested Format

**Title Page:** *Use a standard naming procedure and clearly identify the task. Optional file number and date of creation.*

**Administrative Page:** *Document control page to track revisions. Can list approval information & employee acknowledgements.*

## ***SOP Contents***

1. **Definitions:** *Define any acronyms or terms used in SOP.*
2. **Responsibilities:** *List responsibilities of key personnel.*



# Responsibilities

## 2 KEY PERSONNEL AND RESPONSIBILITIES

- Water Distribution Foreman:
  - Oversee main repair and disinfection
  - Determine and implement any follow-up activities
  - Document the break, including the type, repair conditions and activities, process used for disinfection and all sampling results, in the enterprise asset management (EAM) system
- Water Distribution Operator (2-4):
  - Conduct repairs and field disinfection process
  - Collect and analyze samples for disinfectant residual and document results
  - Collect bacteriological samples and deliver to the water quality laboratory for analysis
- Laboratory Technician:
  - Analyze bacteriological samples and report results to Water Distribution Foreman

**Forman** oversees and documents the repair in the EAM system.

**Operators** conduct repair and collect samples.

**Lab techs** analyze sample and report to Forman.

- Use a bulleted list for each personnel category to indicate core responsibilities.
- Use succinct language and operational terms.



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## ***SOP Contents***

1. **Definitions:** *Define any acronyms or terms used in SOP.*
2. **Responsibilities:** *List responsibilities of key personnel.*
3. **Scope/Purpose:** *Describe what the SOP is intended to cover*



# Scope and purpose

## 3 SCOPE/PURPOSE

The purpose of this SOP is to outline the procedures for repairing a main break, including any necessary flushing, disinfection and water quality testing to be conducted before a main is placed back into service. The procedures presented herein are based on the *Water Research Foundation Report #4307 – Effective Microbial Control Strategies for Main Breaks and Depressurization* (2014) and should be used in conjunction with AWWA Standard C651 – Disinfecting Water Mains. As not all breaks can be repaired in the same manner, crews should use their best judgment when implementing the procedures below.

Outlines main break repair procedures according to a particular standard (to ensure microbial control and protect public health).

- Briefly explain what the SOP accomplishes in a short paragraph
- For this section, you can state what task is being accomplished and **why** it is important to follow the precise procedure outlined in the SOP.
- Is the SOP necessary for safety reasons, to protect public health, to comply with regulations, to adhere to a particular standard?

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## ***SOP Contents***

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2. **Responsibilities:** *List responsibilities of key personnel.*
3. **Scope/Purpose:** *Describe what the SOP is intended to cover*
4. **Health and Safety:** *List hazards, worksite setup, training, and PPE*



# Health and Safety

**4. HEALTH AND SAFETY:** In this section you should list and describe any hazards associated with the task or repair. In addition, list required worksite design, special training or skills that are required, and the types of personal protective equipment (PPE) that will be needed (Refer to the example SOP for the full text).

☐ **Hazards** – provides detailed descriptions of each type of expected hazard and worksite design factors.

- Traffic Hazards
- Heavy Construction/Mechanized Equipment Hazards
- Trenching and Confined Space Hazards
- Hazardous Chemicals

☐ **Worksite design (equipment and setup)** - signage, cones, flashers, lighting, shoring, etc.

☐ **Training requirements** – ability to recognize and respond to potential hazards.

☐ **PPE** – hard hats, safety glasses, work gloves, etc.



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5. **Procedures:** *List the required tools and step by step procedures.*



# 5. Procedures

**Equipment Required:** Provides a complete detailed list of equipment, tools, parts and materials, system maps, etc.

**Step by Step procedures** (This example is based on AWWA Standard C651-15)

1. **Upon arrival at the site, evaluate the site for safety** (including the appropriate PPE) and set up the appropriate traffic control . . . .
2. **If necessary, isolate the pipe section** by slowly adjusting valve settings, maintaining positive pressure .....
3. **Excavate the break.** Provide the necessary benching, sloping and/or shoring depending on depth.....
4. **Repair the pipe** using the appropriate materials (i.e., fittings, joints, gaskets, clamps .....

---- and so on -----

**List and describe step by step procedures sequentially using an outline form.**

**Use clear active language:**  
***“Evaluate the site for safety and set up appropriate traffic control measures”***



## 5. Procedure **decision-points**

The AWWA Standard C651-15 divides main repair steps by type of break and pressure conditions.

Main Break Type	Type 1	Type 2	Type 3	Type 4
Description	Controlled pipe repair without depressurization	Controlled pipe repair with depressurization after shutdown	Uncontrolled pipe break with possible water contamination or loss of sanitary conditions during repair	Uncontrolled pipe break with a likelihood of water contamination or loss of sanitary conditions during repair
Pressure Conditions	Positive pressure maintained during break and repair	Pressure maintained during break and excavation, followed by controlled shutdown for repair	Loss of pressure at break site / possible local depressurization (less than 20 psi) adjacent to the break (e.g., severe erosion requires pressure to be reduced prior to exposing the pipe)	Loss of pressure at break site / widespread depressurization (less than 20 psi) in the system (e.g., pipe blowout and loss of pressure prior to shutdown)

**Clearly indicate any decision points:**  
*“If needed, disinfect the pipe in accordance with the described method outlined in AWWA Standard C651”*

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## 6. Data Recording & Management

Following a main break, enter all necessary information into the EAM system.”

- Date and Time
- Apparent Cause
- Type of Break
- Pipe Data, etc.

- Indicates how and where data will be stored (in the Enterprise Asset Management system)
- Lists the type of data to be collected.

*SOPs may require operators to collect and record various types of data. This creates a written record that can be used for asset management, future maintenance planning, and to evaluate the SOP*

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# References

## 7 REFERENCES

AWWA. (2015). *C651-14 Disinfecting Water Mains*. AWWA

AWWA. (2011). *C652-11 Disinfection of Water Storage Facilities*. AWWA

Kirmeyer, G. J., Thomure, T. M., Rahman, R., Marie, J. L., LeChevallier, M. W., Yang, J., ... & Schneider, O. (2014). *Effective Microbial Control Strategies for Main Breaks and Depressurization*. Denver, CO: Water Research Foundation.

- List of standards being used in the procedure.

- Reference materials used to develop SOP

## Examples of other types of standards

- ANSI – American National Standards Institute
- WEF – Water Environment Federation
- 10 States Standards (water and wastewater)
- OSHA standards (Occupational Safety and Health Admin
- EPA (standard methods for examination of water/wastewater)

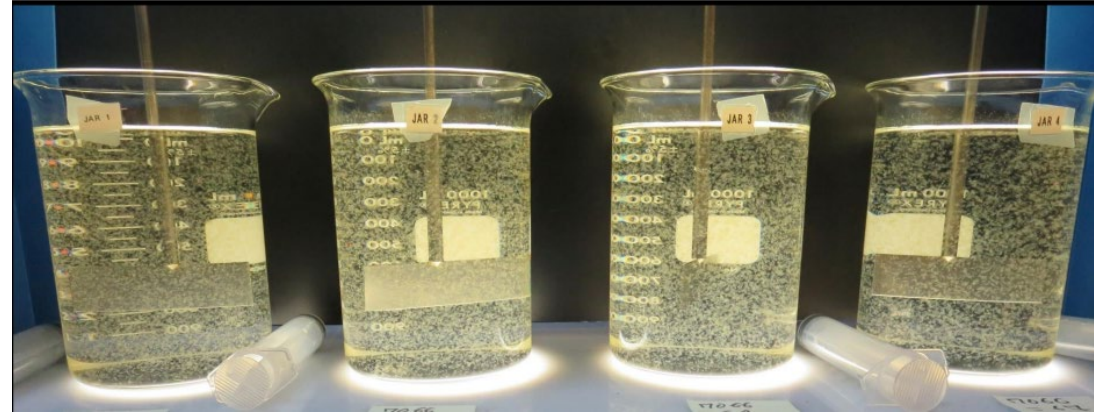


# Scenario

A SOP is being developed for the jar-testing procedure used in a surface water plant to determine the optimal coagulant dosage. The effluent turbidity goal for the plant is 0.1 NTU.

Let's think through factors that will be involved in this task.

1. Different coagulants and water quality
2. Mixing speeds and settling times.
3. Evaluating the results.



## SOP elements

- What standards will be referenced?
- The level of skill required.
- Are there safety hazards?
- What tools, PPE, and resources are needed for the task?
- **What should the title be?**



### Poll 3

**Which of the following would be the best title for our SOP?**

- a. Minimizing finished water turbidity.
- b. Determining coagulant dosage.
- c. Jar-testing procedure for coagulant dosage
- d. How to run a jar test

## Poll 3

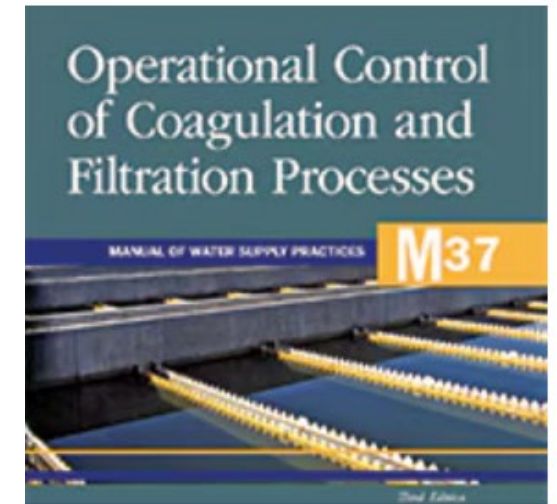
**Which of the following would be the best title for our SOP?**

- a. Minimizing finished water turbidity.
- b. Determining coagulant dosage.
- c. Jar-testing procedure for coagulant dosage**
- d. How to run a jar test

**Chemical Hazards and Toxic Substances**



<https://www.osha.gov/chemical-hazards>



# Testing an SOP

1. Have different people perform the task based on the instructions.
2. Observe persons performing the task in different settings.

Note any areas of misunderstanding or need for revision.

Determine if decision-points need to be added for variables.



Hmmm .... There's something strange about that SOP sign!

# Exercise to develop SOP skills

1. Have each of your staff members create step by step instructions for a simple Lego block house or other shape.
2. Ask them to use clear, active language.
3. Have them name the SOP with a clear title.
4. Have the employees trade their SOP with a partner and see if they are able to build the exact same shape created by the other person by following the instructions.



**Consider this scenario as if it were occurring at your utility**

- 1. A utility has two operators and one manager. One of the operators has been working for only two weeks, mostly shadowing the senior operator. The manager is on vacation overseas, and today the senior operator called in sick.**
- 2. At around 11 am on a hot summer day there is a power surge that knocks out power to one half of the town where the main well (well #1) and disinfection system is located. A backup generator is also at this location.**
- 3. At the current rate of usage, the storage tank will be empty within two hours, which will lead to problems with water service, public health, and fire flow.**

**What does the new operator need to do to find the information to get the generator working and the well and disinfection system back on-line?**



# Which of the following would the operator need to do if this were your utility? (Poll 4)

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- a) Thumb through the O&M manual and look through the files.
- b) Instructions have been placed on the wall at the well.
- c) The operator has a binder that contains SOPs and has practiced them.
- d) The operator would have to contact the vacationing manager or sick operator.





# Which of the following would the operator need to do if this were your utility? (Poll 4)

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- c) The operator has a binder that contains SOPs and has practiced them.**
- d) The operator would have to contact the vacationing manager or sick operator.



# SOP Tips for long-term successful implementation

- Involve staff in development and test new SOPs
- Make the SOP digital as well as printed, and easily accessible
- Provide training using SOPs, and as part of onboarding.
- Budget time for employees to enter data required to be collected.
- Ensure that employees have the necessary training and equipment to successfully carry out tasks.
- Create processes to review and update SOPs (update whenever there are equipment or process changes, and review at least annually).



I don't always write great SOPs



But when I do I remember what  
I learned in that EFCN training!

# For more resources and contact

## **Environmental Finance Center Network**

<https://efcnetwork.org/>

- Funding guides
- Request technical assistance
- Register for training events
- Tools, resources, videos, articles

## **Great Lakes Environmental Infrastructure Center**

at Michigan Tech

<https://gleic.org/>

## **Instructor contact,**

Greg Pearson, MBA

[gpearson@mtu.edu](mailto:gpearson@mtu.edu)

## **Resources:**

- Example SOPs
- SOP template



# Additional resources and standards

**American Water Works Association (AWWA)** <https://www.awwa.org/standards/#latest-standards>

**American National Standards Institute (ANSI)** <https://www.ansi.org/>

**Water Environment Federation (WEF)** <https://www.wef.org/topics/practice-areas/water-and-wastewater-treatment/>

**OSHA Standards (and Regulations).** <https://www.osha.gov/laws-regs>

**EPA Standard Laboratory Methods.** <https://www.epa.gov/labs/laboratory-methods>

**AWWA Small Systems Resources.** <https://www.awwa.org/small-systems/#Resources>

**10 States Recommended Standards for Waterworks (2012).**

<https://www.health.state.mn.us/communities/environment/water/docs/tenstates/waterrev2012.pdf>

**10 States Recommended Standards for Wastewater Facilities (2014).**

<https://www.health.state.mn.us/communities/environment/water/docs/tenstates/tenstatestan2014.pdf>

**USEPA Effective Utility Management Practices.** <https://www.epa.gov/sustainable-water-infrastructure/effective-water-utility-management-practices>



# Thank you for participating

**Please share one thing you enjoyed learning about today in the chat.**

