



PRIMER: DRINKING WATER INVESTIGATIONS ON U.S. NAVY SHIPS

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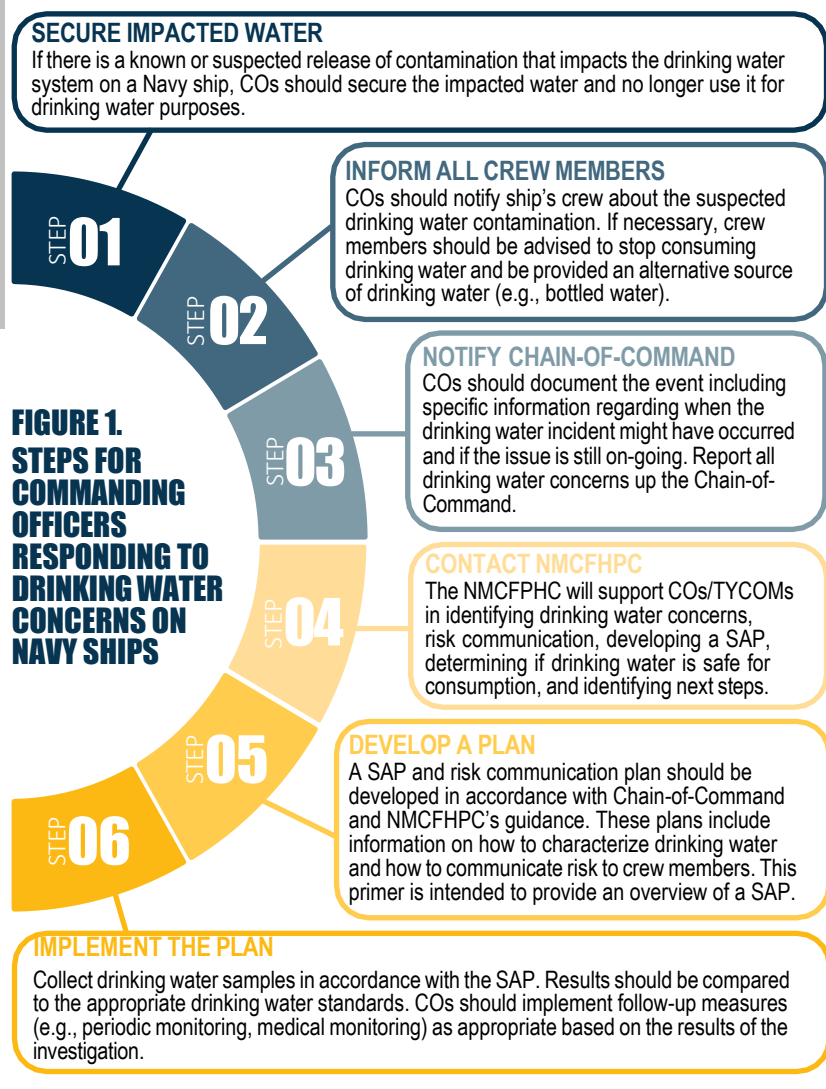
The purpose of this primer is to provide an overview of how to respond to drinking (potable) water issues aboard U.S. Navy ships. This primer is intended to provide an overview of the drinking water investigation process and provide an overview of the important information to consider when developing a drinking water sampling and analysis plan (SAP). Commanding officers (COs) are encouraged to reach out to the Navy and Marine Corps Force Health Protection Command (NMCFHPC) for additional resources, training, and technical support prior to conducting a drinking water investigation. *Note: This primer applies to drinking water produced on U.S. Navy ships and does not apply to drinking water supplied by shore installations or husbanding agencies.* This primer covers: (1) when drinking water should be tested, (2) how to conduct a drinking water investigation, (3) how to determine which chemicals to include in the analyses and selecting the appropriate laboratory for testing, (4) how to collect a drinking water sample, and (5) how to determine if additional action is required based on the results of the drinking water testing.



DRINKING WATER REGULATIONS

Drinking water systems in the United States are regulated under the United States Environmental Protection Agency (EPA) Safe Drinking Water Act (SDWA). The SDWA gave EPA the authority to establish drinking water quality standards and monitor entities (i.e., state governments, local authorities, and drinking water suppliers) who enforce those standards. EPA established maximum contaminant levels (MCLs) for over 90 chemicals. MCLs are part of the National Primary Drinking Water Regulations (NPDWR), which are legally enforceable water quality standards and treatment techniques that are used in public water systems. Drinking water regulations under the SDWA do not directly apply to drinking water produced on Navy ships. NMCFHPC recommends using the SDWA as a starting point for developing a SAP when conducting a drinking water investigation. Specific requirements under the SDWA may not be directly applicable to Navy ships or may require modifications based on tasks considered essential to the operational mission and other priorities.

Prior to initiating a drinking water investigation, COs (and their Engineering and Medical Departments) should work with their Chain-of-Command (TYCOM) and the NMCFHPC to develop a site-specific SAP. In the event there is a drinking water concern, COs should follow the steps identified in Figure 1.



CONTACT INFORMATION

If there is a known or suspected drinking water issue while aboard a Navy ship, please contact your TYCOM and the NMCFHPC at (757) 953-0950. We are committed to the health and safety for all Navy and Marine Corps personnel and their families. Our mission is to provide leadership and expertise to ensure mission readiness through disease prevention and health promotion in support of the National Military Strategy.



CHEMICAL ANALYSIS

The SAP should identify a list of chemicals to be tested for. Chemicals identified in the SAP should be based on site-specific conditions and the suspected chemicals potentially impacting drinking water. If it is not known which chemicals are impacting drinking water, chemicals regulated under EPA's NPDWRs could serve as an initial starting point for developing the sampling and analysis plan. These chemicals include but are not limited to:

- Biological Contaminants
- General Chemistry (e.g., turbidity, conductivity, pH, fluoride, chloride, total dissolved solids [TDS])
- Total Cyanide
- Fluoride
- Metals
- Semi-Volatile Organic Compounds (SVOCs)
- Volatile Organic Compounds (VOCs)
- Total Trihalomethanes (TTHMs)
- Total Haloacetic Acids (HAA5)

The analytical list can be expanded as needed to include any other chemicals that are known or suspected to be impacting the drinking water supply.

ANALYTICAL METHODS

Analytical methods are procedures used to measure the amount (or concentration) of a chemical in a drinking water sample. Analytical methods generally describe how the analytical laboratory will: (1) collect, preserve, and store drinking water samples, (2) identify and measure chemicals in drinking water samples, (3) meet quality control criteria, and (4) report the results. Analytical methods are developed by EPA and other organizations for the purposes of standardizing how drinking water samples are analyzed. EPA-approved drinking water analytical methods are summarized in the table below.

Table 1. EPA-Approved Drinking Water Analytical Methods

Analytical Group	Analytical Method
Biological Contaminants	Varies ¹
General Chemistry	Varies ¹
Total Cyanide	EPA 335.4
Fluoride	EPA 300.0/300.1
Metals	EPA 200.8/245.1
SVOCs	EPA 525.2/525.3
VOCs	EPA 524.2
TTHMs	EPA 524.2
HAA5	EPA 524.2

Notes:

¹ The analytical method for biological contaminants and general chemistry vary based on the individual chemical/parameter. It is recommended that field personnel work with the analytical laboratory to identify the appropriate analytical method for these analytical groups.

SELECTING AN ANALYTICAL LABORATORY

There are thousands of analytical laboratories in the U.S. However, not every laboratory is qualified to analyze drinking water samples. Many analytical laboratories specialize in specific media (e.g., soil, groundwater, drinking water, air), analytical groups, or individual analytical methods. Drinking water samples must be analyzed by an analytical laboratory accredited to analyze samples using EPA-approved drinking water analytical methods. At a minimum, the analytical laboratory must:

- Be currently certified/accredited from state or local authority to analyze drinking water samples;
- Be able to analyze drinking water samples in accordance with approved analytical methods under the SDWA (visit: <https://www.epa.gov/dwanalyticalmethods/approved-drinking-water-analytical-methods> for more information about approved-EPA analytical methods); and
- Be able to analyze drinking water samples within the appropriate holding times and achieve all project needs (e.g., meet requested turnaround time, achieve data quality objectives).

Prior to sampling, field personnel should contact the analytical laboratory and verify the laboratory is capable of analyzing drinking water samples in accordance with SDWA requirements and plan-specific data quality objectives. Visit EPA's [State Certification Programs Certified Laboratories to Conduct Drinking Water Analysis](#) webpage for help finding an accredited analytical laboratory in your state.

Ships should also consider the sampling, laboratory, and ashore compliance requirements identified in Chief of Naval Operations Instruction OPNAV-M 5090.1 series Environmental Readiness Program Manual which contains the Navy's policy guidebook for Environmental Readiness. For more information, visit: https://www.secnave.navy.mil/doni/SECNAV_Manuals1/5090.1.pdf.



COLLECTING DRINKING WATER SAMPLES

This section introduces the general methods and procedures for collecting drinking water samples. Sample collection and handling procedures may vary depending on where samples are collected (e.g., sink faucet, drinking water storage tank), what chemicals are being tested for, and site-specific requirements and/or conditions. Collecting good quality drinking water samples requires training. The ship's crew should ensure they are properly trained on how to collect drinking water samples prior to sample collection. The ship's crew should conduct drinking water sampling in accordance with the SAP.

SAMPLING EQUIPMENT AND SUPPLIES

- Sample Containers
(Provided by Analytical Laboratory)
- Field Logbook
- Clipboard
- Nitrile Gloves
- Personal Protective Equipment (PPE)
- Chain-of-Custody
- Chain-of-Custody Seals
- Bubble Wrap
- Packing Tape
- Cooler (Provided by Analytical Laboratory)
- Ice and/or Ice Packs
- Paper Towels
- Trash Bags
- 1-Gallon Sealable Bags



Visit EPA's [Quick Guide to Drinking Water Sample Collection](#) for more information on how to collect drinking water samples including information about containers, preservatives, holding times and special instructions for specific chemical groups.

STEP 1

Contact the analytical laboratory and place a bottle order. The bottle order should include: sample media (e.g., drinking water), number of samples, and desired chemical analysis. Inspect all sample containers to ensure bottles are intact and have not been damaged. Ensure bottles are pre-filled with preservatives, as needed.

STEP 2

48 Hours Prior to Sampling: Notify the ship's crew of upcoming sampling event and ensure all sampling locations are accessible.

24 Hours Prior to Sampling: Prepare sample bottle labels and gather all sampling equipment/supplies. Sample labels will be provided by the analytical laboratory.

STEP 3

Ensure drinking water sample location (e.g., faucet, tank valve) is clean and free of any debris. Remove the faucet aerator or filter (if applicable). Once removed, purge the faucet using cold water by running the water for a minimum of 5 minutes prior to sampling. After 5 minutes, reduce the flow to prevent splashing while sampling.

STEP 4

Gather the sample bottles for the current location. While wearing gloves, remove the sample container caps immediately before sampling. Be sure to avoid contact with the rim or inside of the bottle while opening containers. Do not set the cap (open side down) on any surface. Best practice is to hold the cap in a gloved, non-sampling hand.

STEP 5

Hold the open sample bottle under the faucet tilted towards the flow, allowing water to run down the inside wall of the bottle. Fill the bottle. Do not overfill or allow water to spill over. *Note: Specific chemicals and/or analytical methods may have additional sampling steps or procedures required. Consult with the analytical laboratory prior to sampling.*

STEP 6

Document any observations (e.g., color, odor, particulates, sheen) associated with the water. Once the bottle is full, cap the sample container. Wipe the exterior of the bottle with a paper towel. Disposable sampling equipment (e.g., used paper towels, gloves) should be placed in a trash bag, sealed, and disposed of as shipboard waste.

STEP 7

Ensure all samples are labeled. Labels include: sample ID, sample location, sampler's initials, and the date/time of collection. Fill out and sign the Chain-of-Custody provided by the analytical laboratory. The Chain-of-Custody includes: client info, sample ID, sample date/time, chemical analysis to be completed, and requested turnaround time.

STEP 8

Wrap glass sample containers in bubble wrap and tape. Immediately place all sample bottles into a cooler (provided by lab) on ice. Keep the cooler closed at all times to ensure temperature stability. Deliver or ship samples to the analytical laboratory as soon as possible to ensure all holding times are met.



KEY TERMS

DETECT

If a chemical was detected, the lab will report a concentration, or amount, that was present in the sample. A detection does not mean there is a cause for concern. Chemicals can be present in water at concentrations that do not pose any harm to human health.

NON-DETECT

If a chemical is identified as non-detect, the lab did not identify and report a measurable amount of that chemical in the sample.

QUALIFIER

The lab may assign a qualifier to a result. If the qualifier column is blank, the analytical laboratory did not assign a qualifier and did not find anything notable during analysis. The qualifier provides additional information about the result. The most common qualifiers are U and J. A "U" qualifier indicates the lab did not find the chemical at a measurable amount (i.e., the result was non-detect). A "J" qualifier indicates the reported concentration is an approximation.

UNITS

A unit represents the concentration, or amount, of chemical found in water. Results are typically reported in milligrams per liter (mg/L) or micrograms per liter (ug/L).

METHOD DETECTION LIMIT (MDL)

MDL represents the lowest amount of a chemical that can be detected in a sample using a specific analytical method. MDLs can vary depending on the laboratory and equipment.

METHOD REPORTING LIMIT (MRL)

MRL represents the lowest concentration (or amount) of a chemical the analytical lab can reliably report. MRLs will vary between analytical labs.

LABORATORY REPORTS

After a drinking water sample is collected, the sample is sent to the analytical laboratory for testing. When the test results are available, the analytical laboratory creates a laboratory report. Analytical results show the amount of a chemical present in a specific drinking water sample at the time of collection. The purpose of the laboratory report is to summarize the:

- Test results for all chemicals analyzed;
- Key observations made during the testing phase;
- Procedures and methods used;
- Results of quality control samples; and
- Potential interferences that could impact or skew the analytical results.

There are many factors that can cause laboratory results to vary. These factors may include differences in when samples were collected, the way the samples were collected, differences in the laboratory equipment and/or technicians, and specific characteristics of the chemicals being tested. Laboratory reports should be sent to a data validator for data validation, when necessary or as recommended by NMCFHPC. The purpose of data validation is to check analytical methods and results for accuracy and quality before using the data for evaluating drinking water conditions and making risk management decisions.

MAXIMUM CONTAMINANT LEVELS (MCLs)

MCLs are the maximum level of a contaminant (or chemical) that can be present in drinking water for systems regulated under the SDWA. The purpose of MCLs is to protect public health by limiting the amount of contaminant present in drinking water. The limit is usually expressed as a concentration in mg/L or ug/L in water.

Many chemicals are found at detectable levels in drinking water. A detection does not mean there is cause for concern. Lab results are compared to MCLs to determine if additional actions are needed to ensure drinking water is protective of human health (see example below). If a chemical is detected at a concentration below the MCL, exposure to this chemical does not pose an unacceptable risk to human health. In other words, even if a chemical is detected, as long as concentrations are below MCLs, drinking water can safely be consumed.

MCLs are not applicable to drinking water produced on Navy ships. Appropriate drinking water standards should be developed as part of the SAP; however, MCLs serve as an initial standard for quickly identifying chemicals that could pose a risk to human health. For more information about MCLs, visit: <https://www.epa.gov/ground-water-and-drinking-water/national-primary-drinking-water-regulations>.



Chemical	MCL (mg/L)	Lab Result (mg/L)	Qualifier	Exceeds MCL?	Typical Source	Potential Health Effects
Benzene	0.0050	0.0010	U	No	Leaching from gas storage tanks	Increased risk of cancer
TTHM	0.080	0.10		Yes	Byproduct of drinking water treatment	Liver, kidney, central nervous system problems

1 Represents the amount (i.e., concentration) of chemical in the drinking water sample

2 The lab will often assign a qualifier to results. The qualifier provides more information about the sample. The "U" qualifier indicates lead was not detected above the MRL.

3 If the chemical concentration reported by the lab is greater than the MCL, this is an exceedance. Additional investigation and/or action may be required to ensure drinking water is fit (i.e., safe) for human consumption.

4 Under the NPDWRs, EPA identified typical sources and potential health effects for all regulated chemicals.



NAVY AND MARINE CORPS FORCE HEALTH PROTECTION COMMAND IMPROVING READINESS THROUGH PUBLIC HEALTH ACTION

ADDITIONAL RESOURCES

This section identifies additional resources to be considered when developing a SAP, evaluating drinking water conditions while at sea, and how to document and communicate drinking water quality. These resources serve as tools for initiating a drinking water investigation. COs should consult with the NMCFHPC for additional resources, training, and technical support prior to conducting a drinking water investigation.

NAVY POLICY AND GUIDANCE

- Naval Ships' Technical Manual (NSTM) [Chapter 533 Potable Water Systems \(S9086-SE-STM-010/CH-533\)](#).
- Naval Facilities Engineering Command (NAVFAC) [Potable Water Quality Management Guidance Document](#).
- Chief of Naval Operations Instruction (OPNAVINST) 5090.1 [Environmental Readiness Program Manual](#)
- Commander Navy Installations Command [Navy Overseas Drinking Water Program Ashore Manual](#).
- Chief, Bureau of Medicine and Surgery (BUMED) [Manual of Naval Preventive Medicine, Chapter 6, Water Quality Afloat](#).
- BUMED Instruction 6240.10D [Department of the Navy Medical Drinking Water Program](#).
- Department of Defense (DoD) Manual 4715.05, Volume 3, [Overseas Environmental Baseline Guidance Document: Water](#).
- Navy Overseas Drinking Water (ODW) Program [Factsheet](#).



OTHER POLICY, GUIDANCE, AND RESOURCES

- EPA [Groundwater Water and Drinking Water](#) Resource Page.
- EPA Understanding the Safe Drinking Water Act [Factsheet](#).
- EPA National Primary Drinking Water Regulations [Webpage](#).
- EPA National Primary Drinking Water Regulations Maximum Contaminant Levels [Factsheet](#).
- EPA [Methods Approved to Analyze Drinking Water Samples to Ensure Compliance with Regulations](#).
- EPA Quick Guide to Drinking Water Sample Collection [Guidance](#).
- EPA Sampling and Analysis Plan [Guidance and Template Version 4, General Projects \(R9QA/009.1\)](#).
- EPA Drinking Water Requirements for States and Public Water Systems, [Drinking Water Regulations](#).
- EPA Revised Public Notification Handbook 3rd Revision to Document: [EPA 816-R-23-002](#).
- Centers for Disease Control and Prevention (CDC) Drinking Water [Webpage](#).
- CDC [Drinking Water Advisory Communication Toolbox](#).

CHEMICAL-SPECIFIC RESOURCES

- Agency for Toxic Substances and Disease Registry (ATSDR) [Toxicological Profiles](#).
- EPA [Lead and Copper Rule](#).
- EPA [Radionuclides Rule](#).
- NMCFHPC Copper in Drinking Water [Factsheet](#).
- NMCFHPC Lead in Drinking Water [Factsheet](#).
- NMCFHPC Drinking Water-Bacteriological Monitoring [Factsheet](#).