2021 CHEMICAL SECURITY SEMINARS

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#ChemicalSecurity

CHEMICAL SECURITY SEMINARS

Case Study on Recent Disruptions in the Supply of Chlorine: Impact and Response

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Case Study on Recent Disruptions in the Supply of Chlorine: Impact on Water System Operations and the Response by Public and Private Partners

CISA Chemical Security Seminars
December 15, 2021

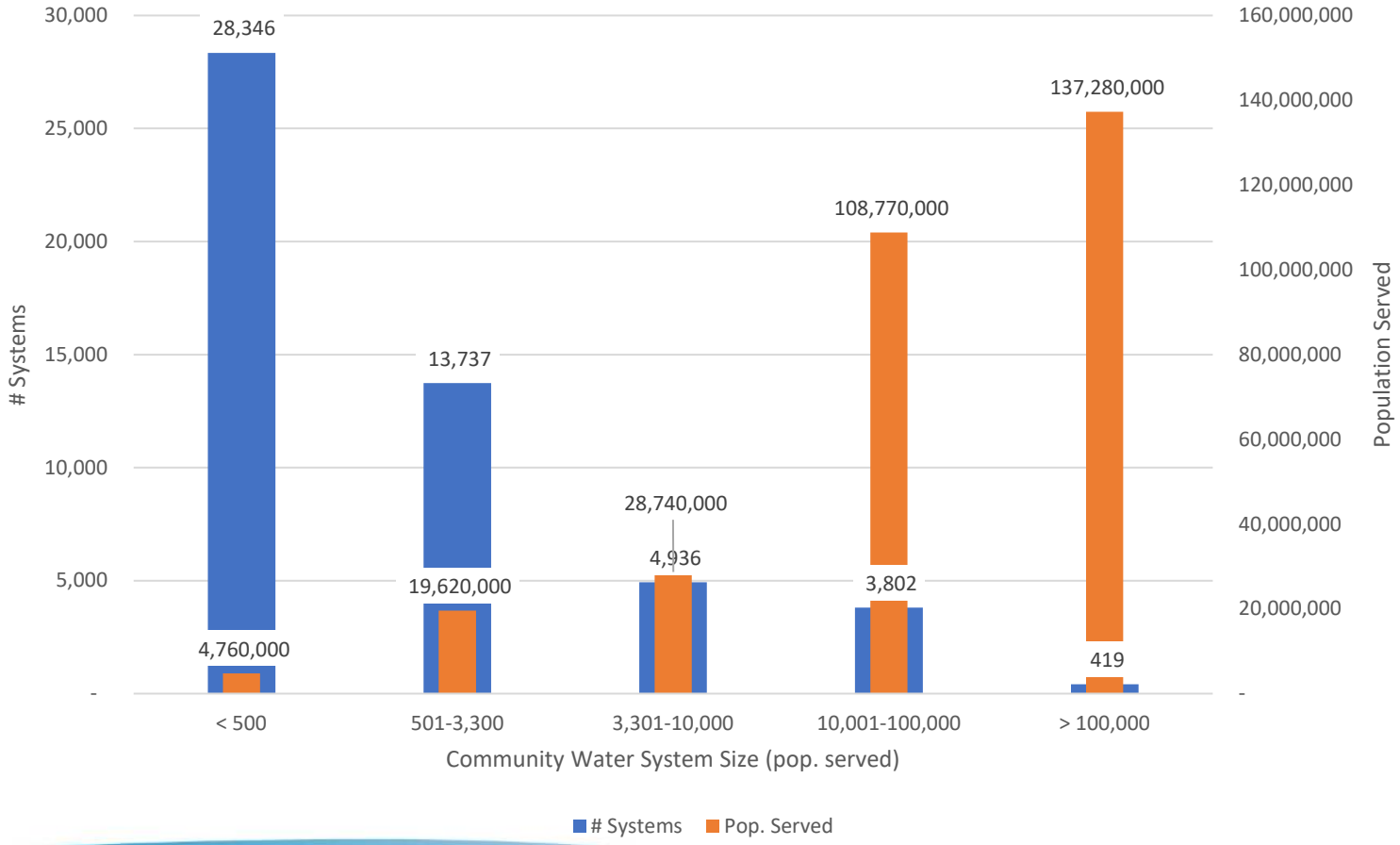
Presentation Outline

- Overview of the Water Sector
- Chlorine Manufacturing and Supply
- Chlorine Supply Disruptions 2020-2021
- Requirements and Constraints on Potential Solutions for Water Systems facing a Shortage
- Response
- Moving Forward

Overview of the Water Sector

Drinking Water Systems

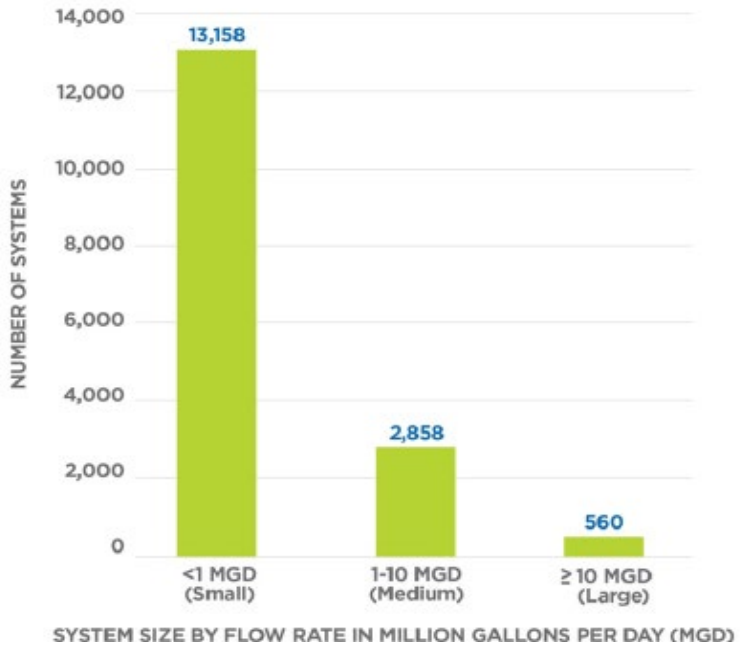
- 153,000 Public Water Systems
  - **51,000 Community Water Systems**
  - 18,000 Non-Transient Non-Community Water Systems
  - 84,000 Transient Non-Community Water System



Wastewater Systems

- 16,500 publicly owned treatment works (POTWs) serve 227 million people in the U.S.

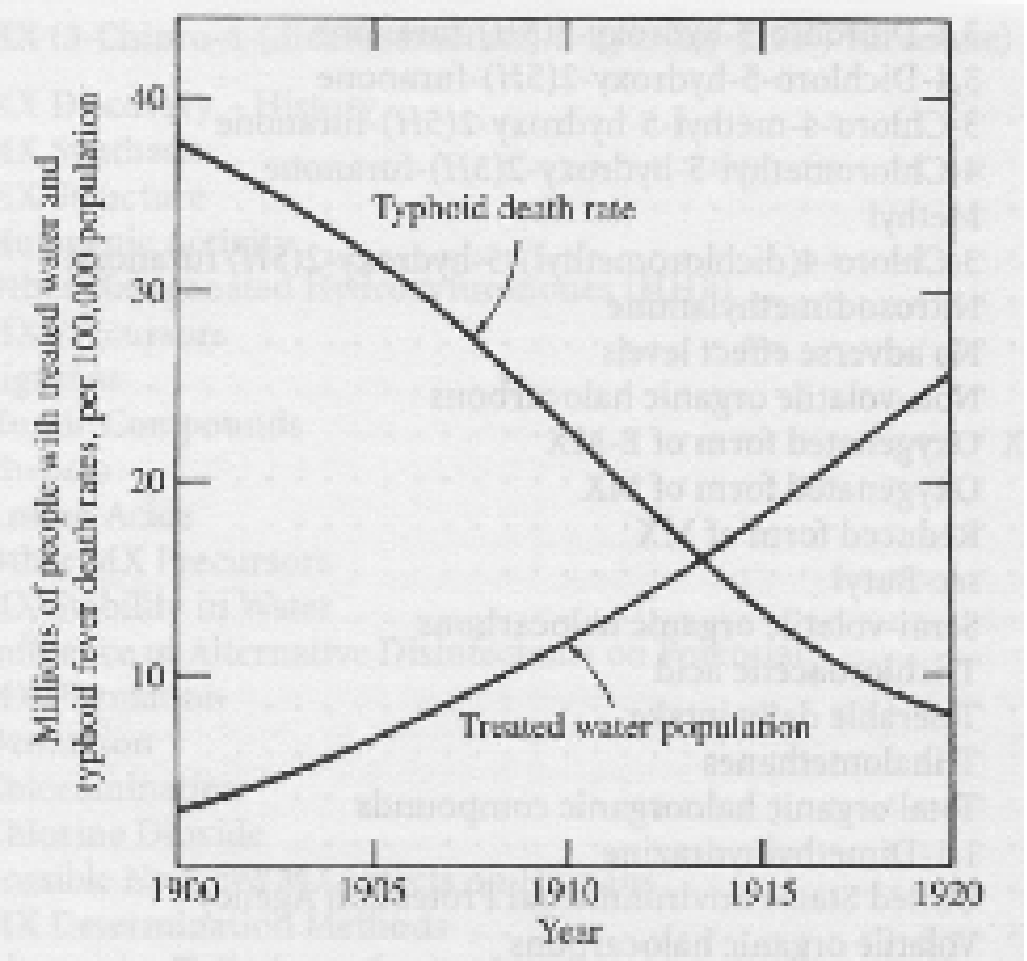
Number of POTWs by Flow Rate



Source: Department of Homeland Security. Water and Wastewater Systems Sector Specific Plan – 2015.

Water Disinfection, a Cornerstone of Public Health

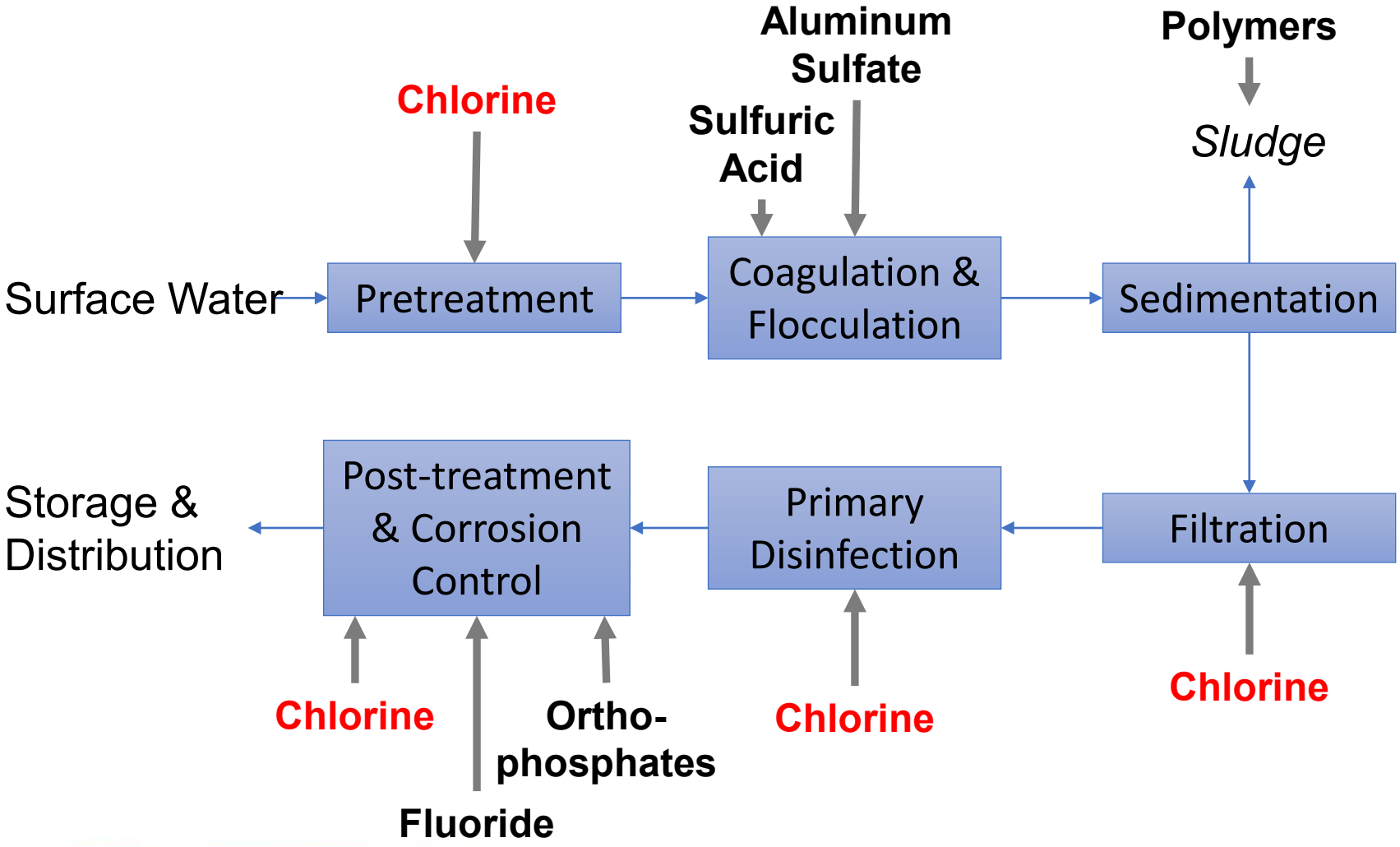
- 1908 – U.S. first use of chlorine for drinking water disinfection in Jersey City and Chicago.
- 1918 – More than 1,000 U.S. cities chlorinate their drinking water
- 1972 – Passage of the Clean Water Act
- 1974 – Passage of the Safe Drinking Water Act



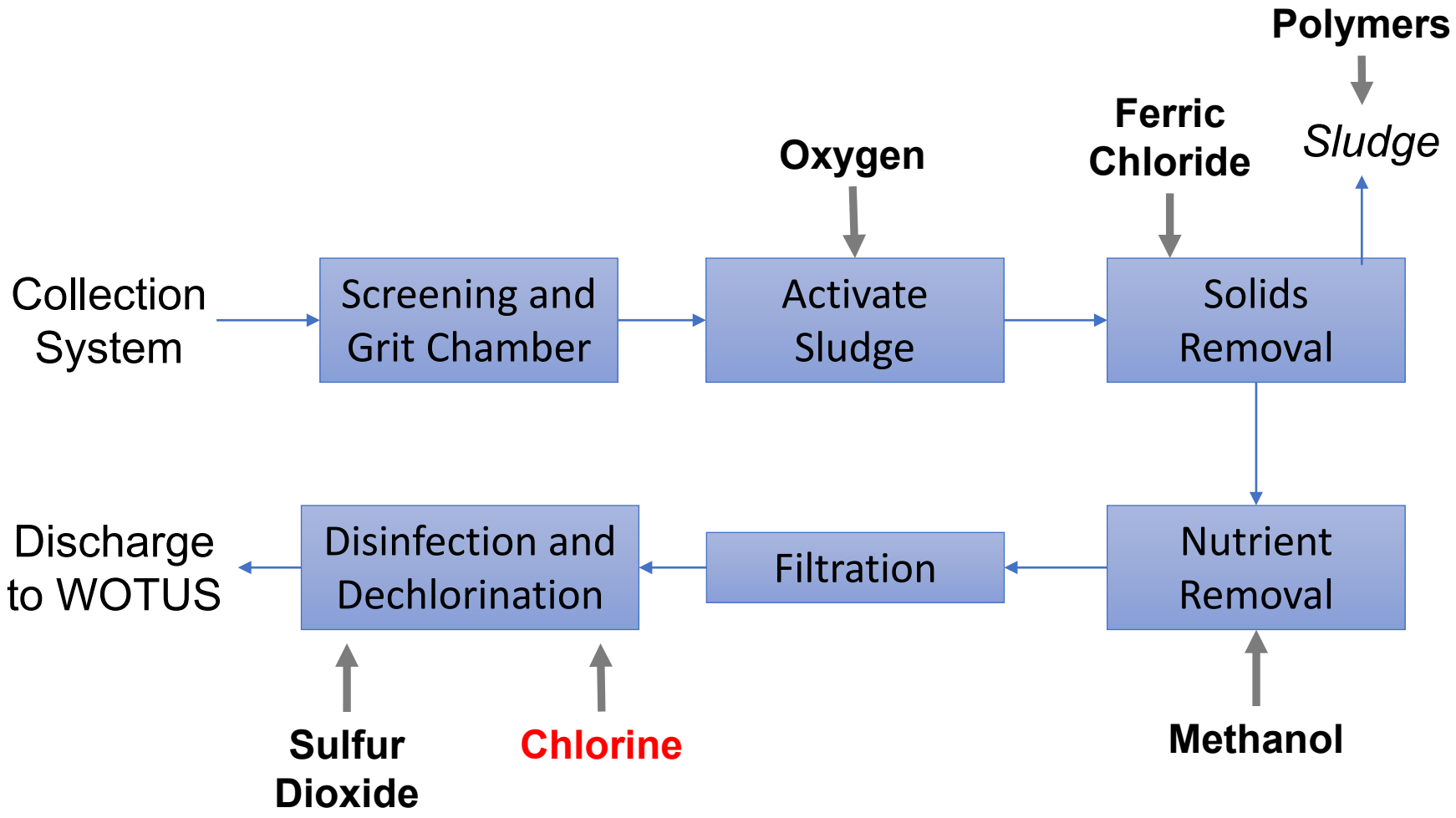
The Safe Drinking Water Act (SDWA)

- Passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supplies
- Amended in 1986 and 1996 to improve source water protection and regulate additional contaminants
- SDWA authorizes EPA to set national, health-based standards for drinking water to protect against both naturally-occurring and man-made contaminants
- EPA, states, and public water systems work together to make sure the standards are met

Notional Drinking Water Treatment Plant



Notional Wastewater Treatment Plant



Forms of Chlorine used for Water Disinfection

Chlorine (Liquified Gas)

Sodium Hypochlorite (Liquid)

Calcium Hypochlorite (Solid)

Chlorine and Hypochlorite Manufacturing and Supply

Manufacturing Process and Precursors

Chloralkali Process: Electrolytic Production of Chlorine & Sodium Hydroxide

Brine	→	Chlorine Gas	+	Hydrogen Gas	+	Sodium Hydroxide
$2NaCl + 2H_20$		Cl_2		H_2		$2NaOH$
		↓		↘		↙
		Anode				Cathode

Manufacturing Process and Precursors

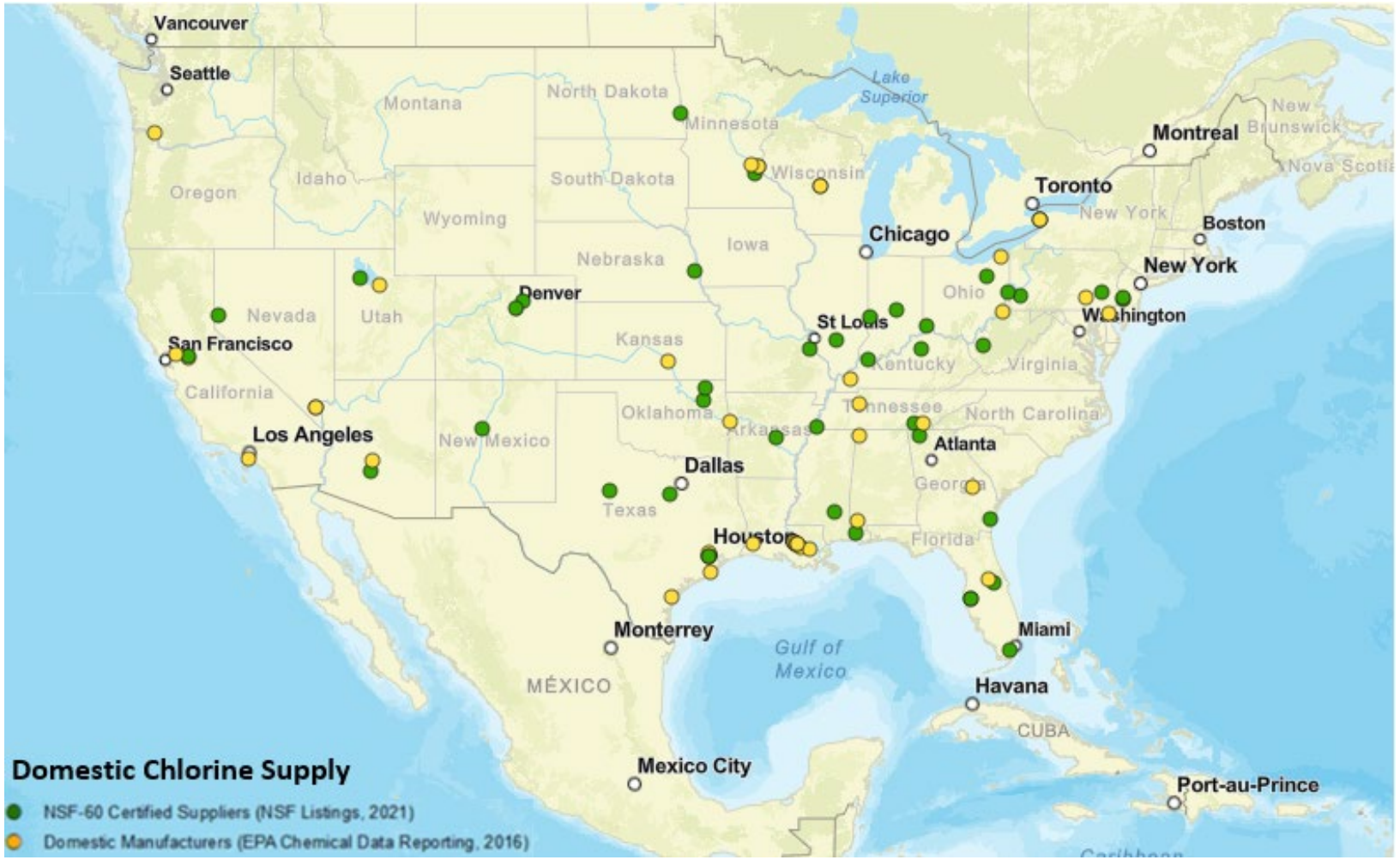
Sodium Hypochlorite Production

Chlorine Gas	+	Sodium Hydroxide	→	Sodium Hypochlorite	+	Sodium Chloride	+	Water
Cl_2		2NaOH		NaOCl		NaCl		H_2O

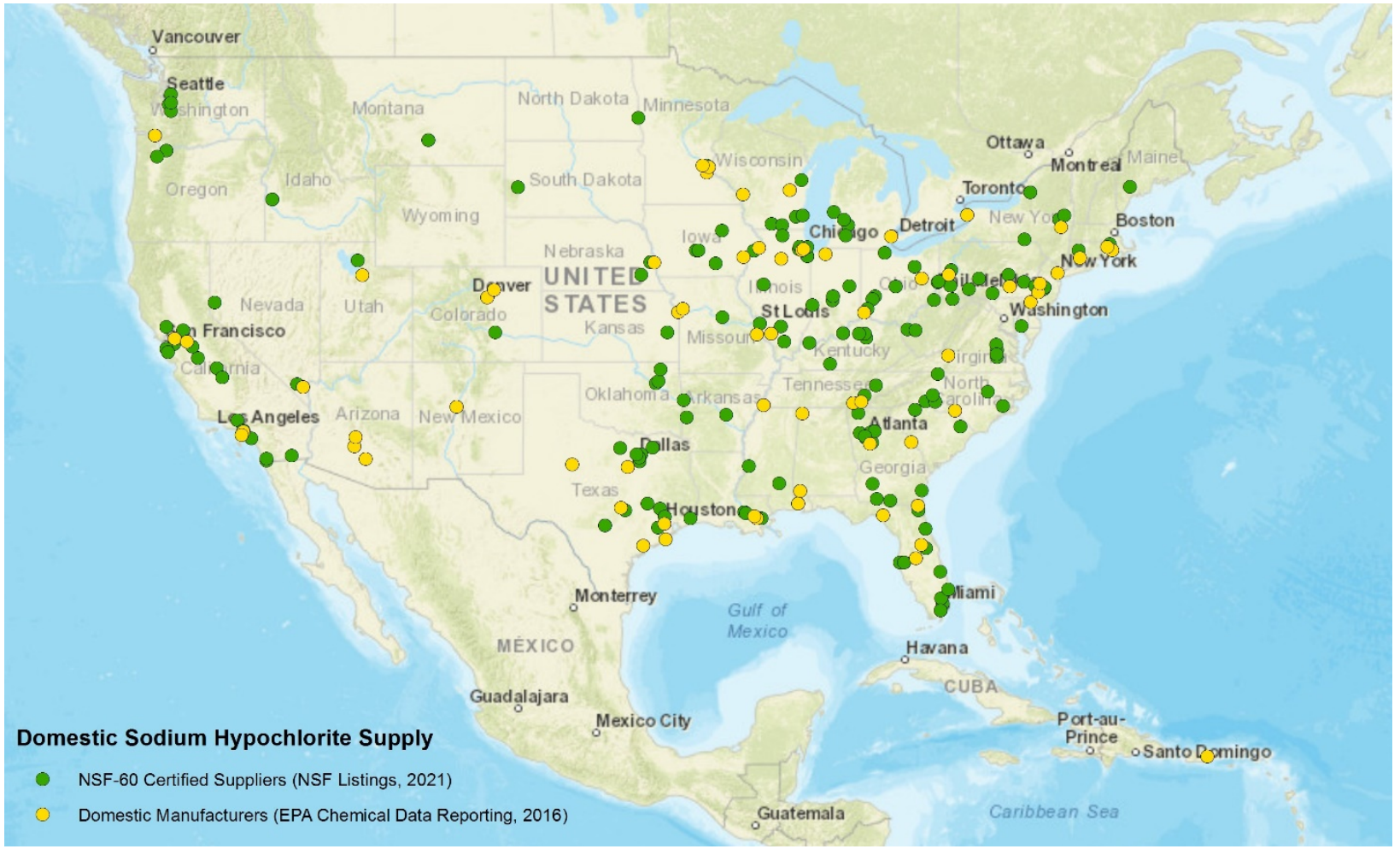
Calcium Hypochlorite Production

Chlorine Gas		Calcium Hydroxide		Calcium Hypochlorite		Calcium Chloride		Water
$2Cl_2$	+	$2Ca(OH)_2$	→	$Ca(ClO)_2$	+	$CaCl_2$	+	$2H_2O$

Chloralkali Manufacturing and Supply Facilities



Hypochlorite Manufacturing and Supply Facilities



Domestic Production and Import Dependence

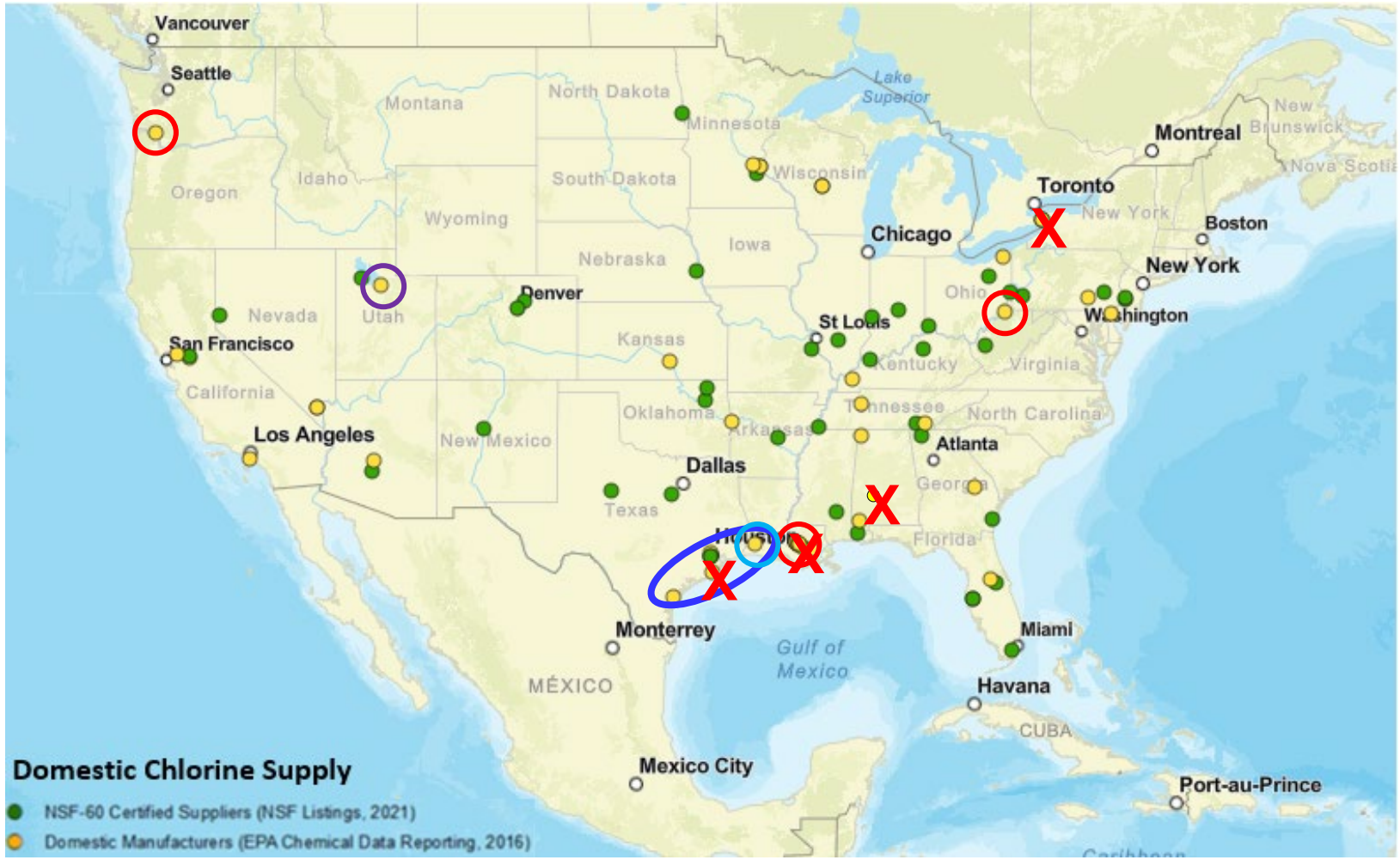
- Sodium Chloride
  - U.S. produces 74% of what it consumes
  - Chile and Canada are the primary importers to the U.S.
- Chlorine
  - U.S. produces 99% of what it consumes
  - Canada is the primary importer to the U.S.
- Sodium Hypochlorite
  - U.S. produces 93% of what it consumes
  - Canada is the primary importer to the U.S.
- Calcium Hypochlorite
  - U.S. produces most of what it consumes
  - U.S. exports are 16x greater than imports to the U.S.

Demand for Chlorine Products and Precursors

- Sodium Chloride
  - Highway deicing – 43%
  - Chemical production (primarily chloralkali chemicals) – 37%
- Chlorine
  - Production of organic chemicals – 77%
  - Water treatment – 5%
- Sodium Hypochlorite
  - Cleaning and disinfection, including water treatment – 59%
- Calcium Hypochlorite
  - Swimming pool sanitation – 37%
  - Water treatment – 25%

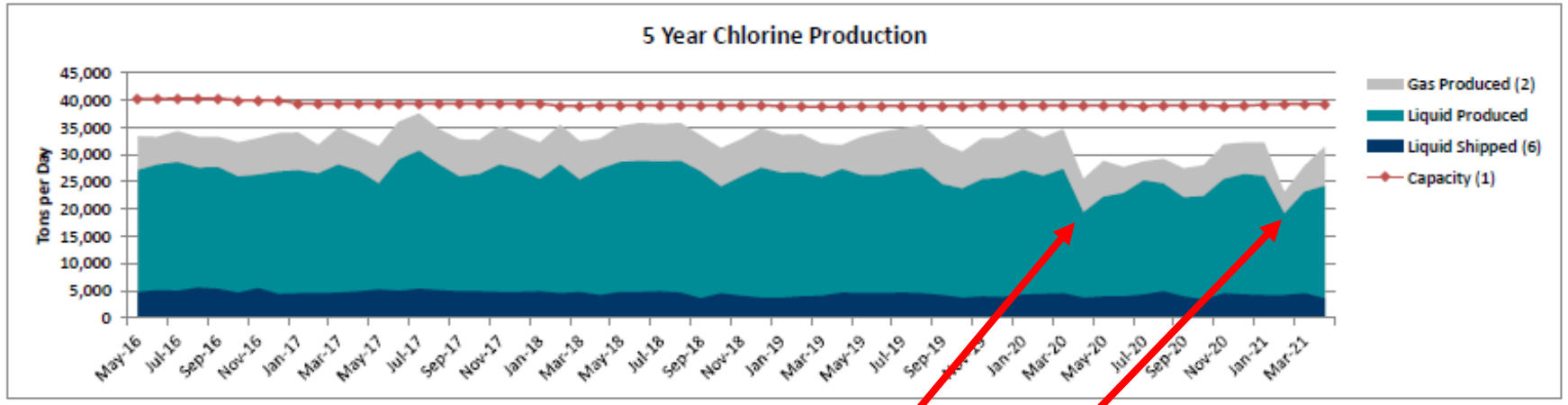
Chlorine and Hypochlorite Supply Disruptions 2020-2021

Locations of Chloralkali Supply Disruptions



Impact on Chloralkali Production

- Apr. 20: 24% drop in production at start of the pandemic
- Feb. 21: 28% drop in production following temporary closures resulting from winter storm Uri

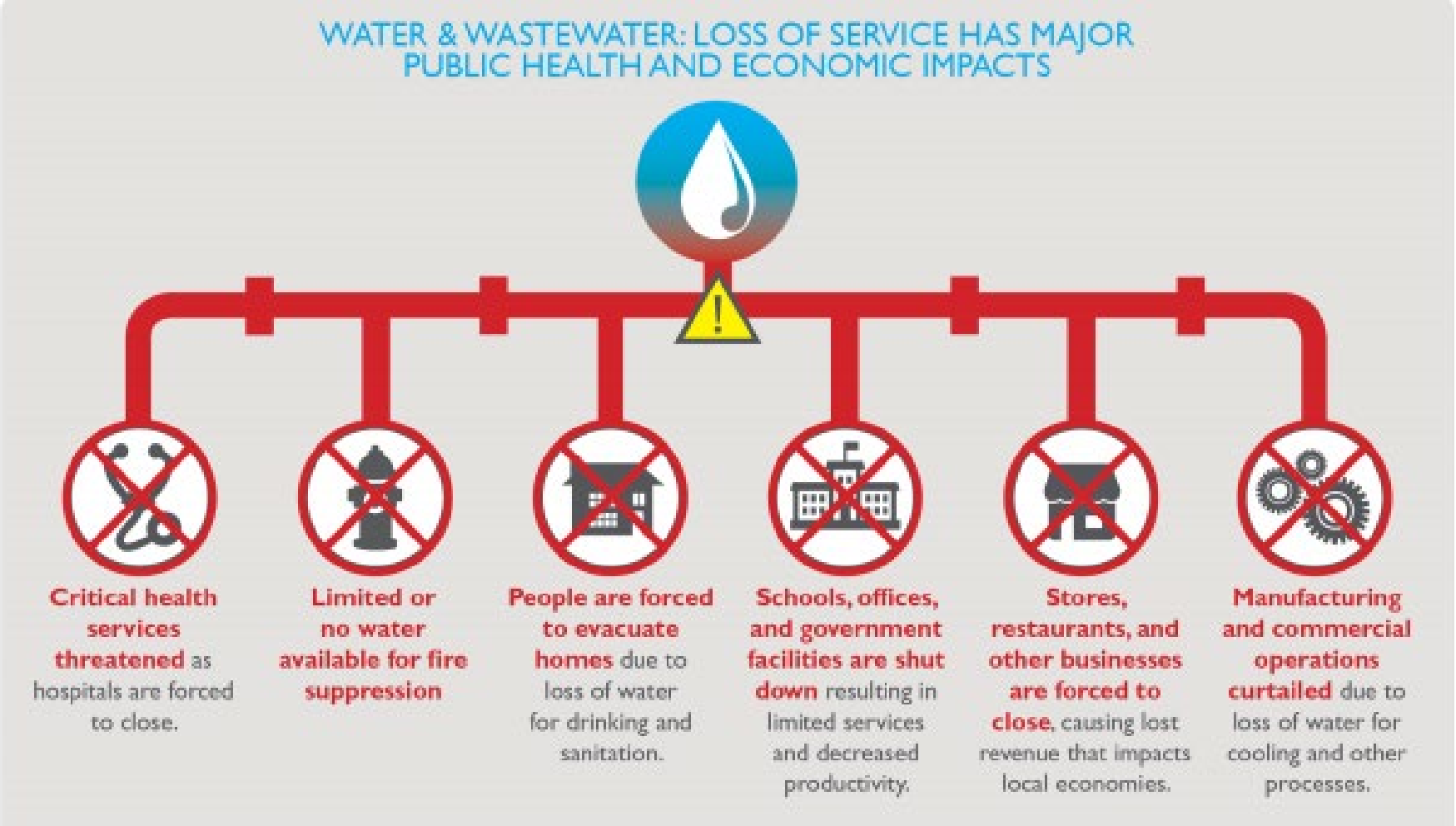


Source: Chlorine Institute web portal, visited May 2021

Impacts on Water Sector

- Severely decreased allocations of chlorine and hypochlorite for drinking water and wastewater systems:
  - California; Oregon; Washington; Alaska; Utah; Missouri; Ohio; Pennsylvania; New York; Massachusetts; Louisiana; Florida
- Decreased production of other water treatment chemicals
  - The coagulants ferric chloride and polyaluminum chloride
- Drinking water systems unable to disinfect water and maintain a residual disinfectant in the distribution system:
  - Boil water notice
  - Shut-down system and arrange for bottled water
- Wastewater systems unable to disinfect effluent:
  - Contaminate drinking water sources with pathogens
  - Shutdown water reuse facilities

Impacts on Critical Customers



Requirements & Constraints on Potential Solutions

Potential Solutions to a Chlorine Shortage

- Use a chlorine product without the required drinking water treatment chemical certification
- Increase on-site storage of chlorine
- Switch to another disinfectant
- None of the above results in:
  - Boil water notice
  - Shut down drinking water and reuse facilities
  - Discharge of wastewater effluent that has not been disinfected

Drinking Water Treatment Chemical Certification

NSF/ANSI/CAN – Standard 60

- Required by state law for chemicals added to public drinking water
- Product testing
  - Testing at “Maximum Use Level” to determine the concentration of impurities imparted to treated water
  - Compare residual impurity concentrations against “Single Product Allowable Concentrations”
- Facility inspection and audits
- Certification of the product and the facility

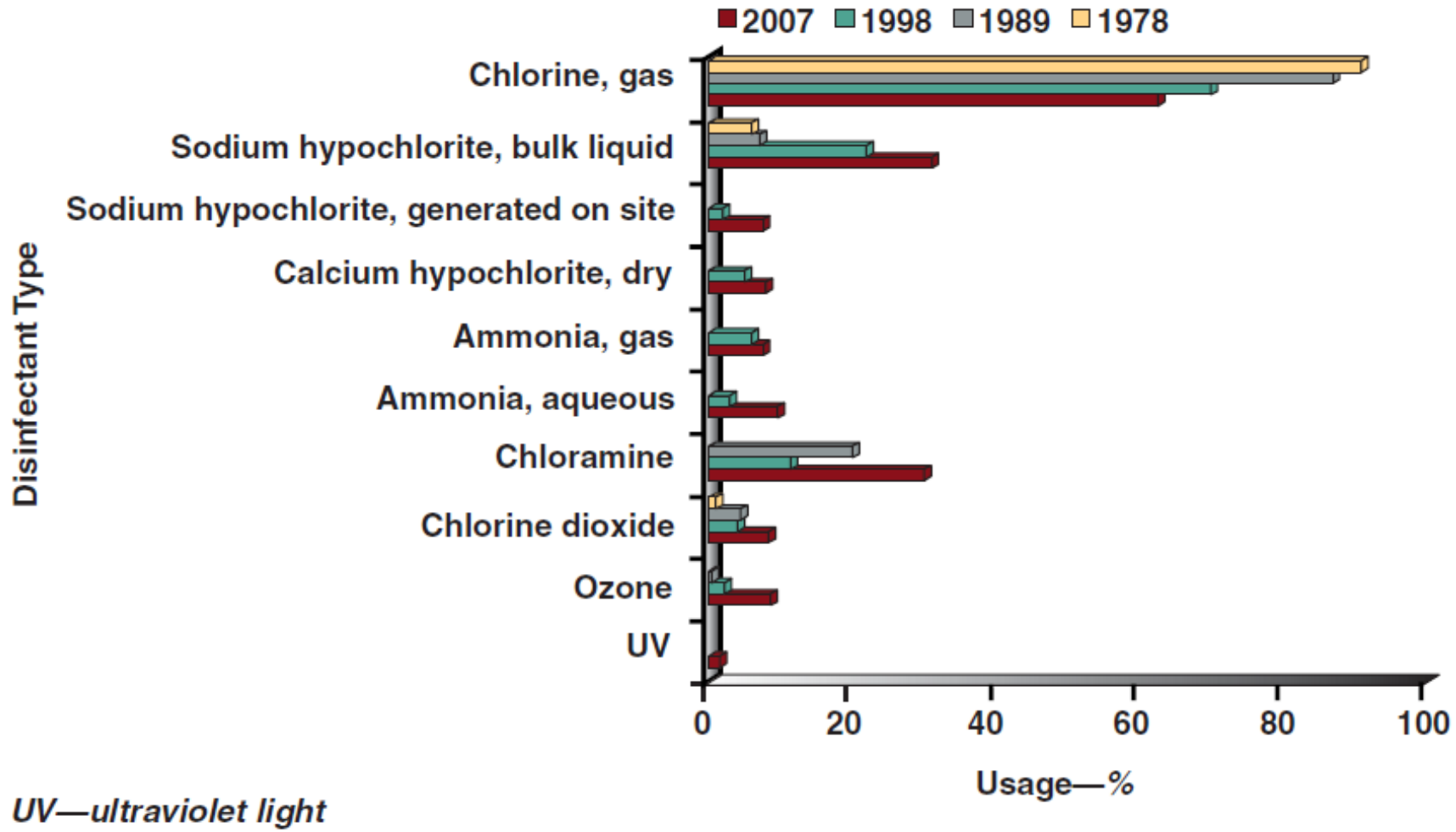
Use of a treatment chemical without NSF-60 certification is at the discretion of the state

Storage Capacity and Limitations

- Water treatment chemical storage capacity vary widely:
  - For shelf-stable chemicals (e.g., most coagulants), typical on-site storage ranges from **one** to **six months**
  - For chemicals with short shelf-life (e.g., sodium hypochlorite), typical on-site storage ranges from **one week** to **one month**
- Factors that influence on-site storage capacity:
  - Chemical quality and degradation concerns
  - Worker/community safety and homeland security concerns
  - Regulatory thresholds
  - Method of chemical delivery
  - Space

In general, increasing on-site storage is not a near-term solution to a supply disruption

Chemicals used for Water Disinfection



UV—ultraviolet light

Source: American Water Works Disinfection Survey – 2008.

Steps to Alter a Treatment Process

- Contact state drinking water primacy agency
- Conduct pilot testing
- Document required system modifications
- Update system operating permit
- Procure equipment and modify system

Entire process can take a month to longer than a year

Water systems that have built-in operational resilience may be able to make a process change within days

The Safe Drinking Water Act (SDWA) Section 1441

- Water systems can apply to EPA for a Certification of Need (CON) for a water treatment chemical that is not reasonably available
- A CON authorizes the Department of Commerce (DOC) to issue orders to suppliers to provide a treatment chemical to water systems
- SDWA 1441 **cannot** be used to address:
  - Cost increases or unfair business practices
  - Missed or delayed deliveries resulting from transportation issues
  - A true supply-side shortage
  - Poor customer service and communication

SDWA Section 1441 Process and Timeline

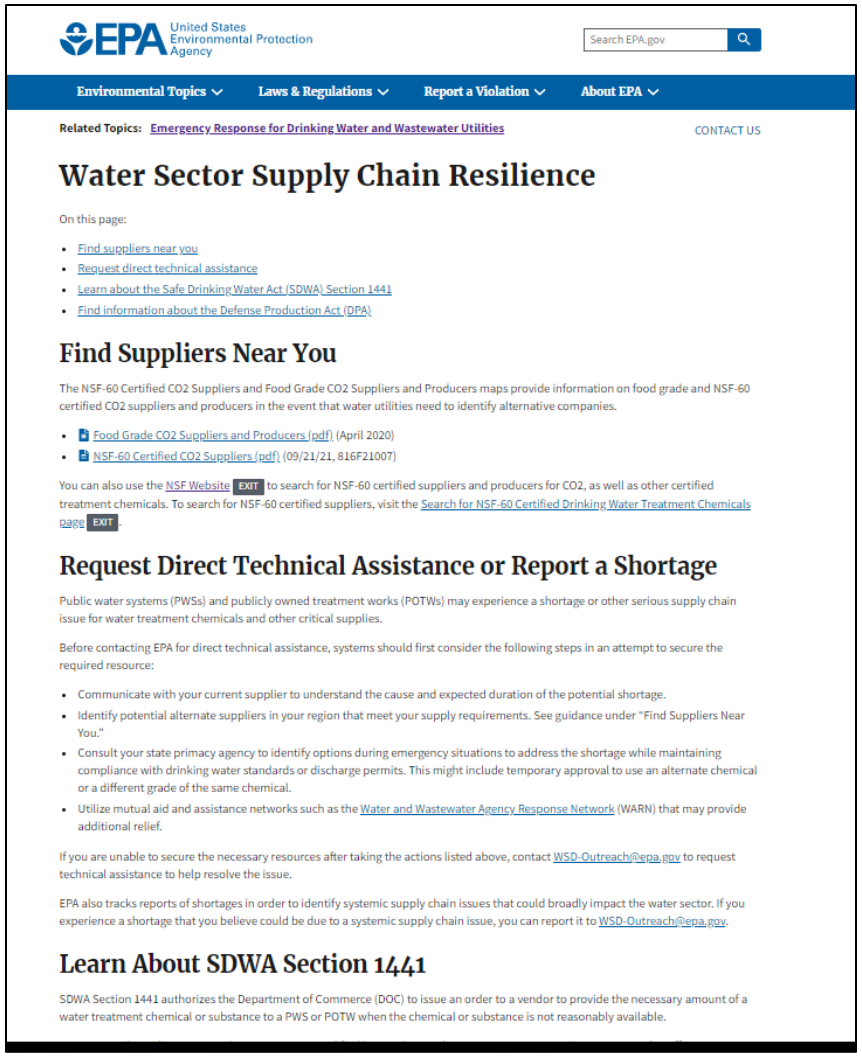
- Upon receipt, EPA conducts a technical review of the application and meets with the applicant, manufacturer, repackager, and state agencies
- The application is summarized in a Federal Register Notice (FRN) with a 14-day comment period
- EPA will determine whether to issue a CON within 30-days of FRN publication
- If issued, the CON will be provided to DOC for implementation, and DOC must issue an order within 7 days
- Following issuance of orders, an “agreement” must be established between the system and supplier
- Time from application to supplier agreement: **1 to 2 months**

Before Submitting a SDWA 1441 Application

- Water systems are first encouraged to:
  - Coordinate with their state primacy agency
  - Communicate with current suppliers
  - Contact alternate suppliers
  - Reach out to mutual aid and assistance networks
- If those steps fail to resolve the issue, water systems can:
  - Contact technical assistance providers (e.g., NRWA)
  - Contact U.S. EPA to request technical assistance

Dealing with supply challenges will require coordination among water and chemical sector partners

Water Sector Supply Chain Resilience Resources



EPA United States Environmental Protection Agency

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Related Topics: Emergency Response for Drinking Water and Wastewater Utilities

CONTACT US

Water Sector Supply Chain Resilience

On this page:

- Find suppliers near you
- Request direct technical assistance
- Learn about the Safe Drinking Water Act (SDWA) Section 1441
- Find information about the Defense Production Act (DPA)

Find Suppliers Near You

The NSF-60 Certified CO2 Suppliers and Food Grade CO2 Suppliers and Producers maps provide information on food grade and NSF-60 certified CO2 suppliers and producers in the event that water utilities need to identify alternative companies.

- Food Grade CO2 Suppliers and Producers (pdf) (April 2020)
- NSF-60 Certified CO2 Suppliers (pdf) (09/21/21, 816F21007)

You can also use the NSF Website EXIT to search for NSF-60 certified suppliers and producers for CO2, as well as other certified treatment chemicals. To search for NSF-60 certified suppliers, visit the Search for NSF-60 Certified Drinking Water Treatment Chemicals page EXIT.

Request Direct Technical Assistance or Report a Shortage

Public water systems (PWSs) and publicly owned treatment works (POTWs) may experience a shortage or other serious supply chain issue for water treatment chemicals and other critical supplies.

Before contacting EPA for direct technical assistance, systems should first consider the following steps in an attempt to secure the required resource:

- Communicate with your current supplier to understand the cause and expected duration of the potential shortage.
- Identify potential alternate suppliers in your region that meet your supply requirements. See guidance under "Find Suppliers Near You."
- Consult your state primacy agency to identify options during emergency situations to address the shortage while maintaining compliance with drinking water standards or discharge permits. This might include temporary approval to use an alternate chemical or a different grade of the same chemical.
- Utilize mutual aid and assistance networks such as the Water and Wastewater Agency Response Network (WARN) that may provide additional relief.

If you are unable to secure the necessary resources after taking the actions listed above, contact WSD-Outreach@epa.gov to request technical assistance to help resolve the issue.

EPA also tracks reports of shortages in order to identify systemic supply chain issues that could broadly impact the water sector. If you experience a shortage that you believe could be due to a systemic supply chain issue, you can report it to WSD-Outreach@epa.gov.

Learn About SDWA Section 1441

SDWA Section 1441 authorizes the Department of Commerce (DOC) to issue an order to a vendor to provide the necessary amount of a water treatment chemical or substance to a PWS or POTW when the chemical or substance is not reasonably available.

https://www.epa.gov/waterutilityresponse/water-sector-supply-chain-resilience

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EPA

Response

Getting The Message Out

- Set ground rules:
  - Solution-oriented discussions
  - Adherence to antitrust laws
  - Save in-depth root cause analysis for after the incident is resolved
- Gather decision makers using existing networks
- Convey urgency by stating potential consequences
- Make clear the assistance requested
- Hold a teleconference to address questions
- Make available a way to discuss for business-sensitive issues confidentially

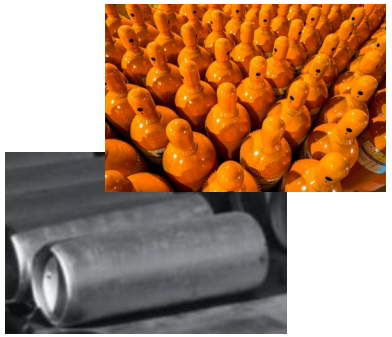
Getting the Message Right

What chemical?

What package?

Where is it needed?

Chlorine



Sodium Hypochlorite

THE CHLORINE INSTITUTE

Making the Call to Action Clear

- Make the next steps easy to follow:
  - Point of contact
  - Response deadline
- Make the message easy to pass along within organizations:
  - Brief written summary
  - Address FAQs
- Provide supplemental information as requested

Moving Forward

The Value of Public-Private Partnerships

- Cultivate relationships before emergency situations
  - Sent monthly production reports to EPA beginning March 2020
  - EPA scheduled to speak to industry leaders in March 2022
- Two-way communication is essential
- Informal after-action discussions; learn from past incidents