

Virginia Department of Health
Office of Environmental Health Services
Division of Shellfish Safety and Waterborne Hazards
Marine Biotoxin Control Plan
2023

Executive Summary

Molluscan bivalve shellfish are filter feeders and can concentrate toxic algae from the water when present in shellfish growing waters. Some toxins produced by certain algae species can cause illness and death in humans. To protect the consumer, the Shellfish Authority must evaluate the concentration of biotoxin that may be present in the shellfish against the levels established in the NSSP Model Ordinance to determine what action, if any, should be taken.

There have been no cases of biotoxin poisoning attributed to shellfish from Virginia waters, or those of its neighboring states. There have also been no toxin concentrations measured in shellfish from Virginia waters reaching or exceeding the NSSP action levels.

This document outlines the components of Virginia's Marine Biotoxin Contingency Plan, describing how the Authority is prepared to mitigate risk and protect public health if a biotoxin event occurs in Virginia's classified shellfish growing areas. This includes an extensive monitoring and early warning system, as well as defining the procedures and resources necessary to initiate an emergency shellfish sampling program; close growing areas and embargo shellfish; prevent harvesting of contaminated species; provide for product recall; disseminate information; coordinate control actions; and establish reopening criteria.

Introduction

Phytoplankton are microscopic algae that are common members of freshwater and marine habitats. They represent the major source of food and oxygen for many of the organisms present in lakes, rivers, estuaries, and oceans. Among the several thousand species of phytoplankton that exist worldwide, approximately 70 to 80 of these are known toxin producers. These toxins are potentially harmful to humans through direct ingestion, inhalation of aerosolized toxins, or through consuming fish or shellfish that have accumulated toxins from their environment and/or food sources. Toxins produced by phytoplankton can also be potentially harmful to birds, fish, and other inhabitants of aquatic habitats.

Usually, toxin-producing algae are absent or present in low concentrations that pose no environmental or human health threat. However, with certain environmental conditions, toxin producing algae may proliferate to form dense concentrations of cells on water surfaces referred to as "harmful algal blooms" (HABs). HABs have been documented in the coastal waters of both the eastern and western United States, as well as other coastal areas throughout the world. In Virginia, HABs may occur throughout the year, with the majority occurring from early spring through the fall months. To date there are at least 38 potential toxin producing species that have been recorded in Virginia waters and the lower Chesapeake Bay, with the possibility of other toxic species becoming established (Marshall et al. 2008, Marshall and Egerton 2012). Algal blooms by non-harmful algae are also common seasonally, with discolored water (green, red, brown, etc.) that do not pose health concerns.

The heat-stable toxins produced by some HAB species may accumulate in certain shellfish and finfish, causing illness when ingested. Human illness is usually associated with the presence of a bloom, although shellfish and finfish may become toxic and cause human illness in the absence of a bloom. To address the issue of biotoxins and protect the public from shellfish poisonings, the National Shellfish Sanitation Program (NSSP) requires a Marine Biotoxin Contingency Plan.

To date there have been no cases of biotoxin poisoning attributed to shellfish from Virginia waters, or those of its neighboring states. There have also been no toxin concentrations measured in shellfish from Virginia waters reaching or exceeding the closure criteria listed in the NSSP Model Ordinance (Section II, IV, @.04,C.(1)). Those criteria are as follows:

- a) PSP (Paralytic shellfish poisoning): 80µg saxitoxin/100g shellfish meat (0.8 ppm)
- b) NSP (Neurotoxic shellfish poisoning): 20 MU/100g or 0.8mg brevetoxin/kg (0.8 ppm)
- c) AZP (Azaspiracid shellfish poisoning): 0.16mg azaspiracid/kg (0.16 ppm)
- d) DSP (Diarrhetic shellfish poisoning): 0.16mg okadaic acid/kg (0.16 ppm)
- e) ASP (Amnesic shellfish poisoning): 2 mg domoic acid/100g (20 ppm)

Contingency Plan

Virginia has developed and implemented a multi-agency effort for monitoring, response, and research on estuarine HAB organisms. This effort includes extensive participation by VDH, DEQ, ODU and VIMS in performing sampling and analyses. It also includes the Virginia Marine Resources Commission (VMRC) which serves multiple roles. If the DEQ or VDH is not able to access a boat necessary for the evaluation of suspected HAB events and fish kills, the VMRC Law Enforcement Division will provide a vessel for the evaluation. If requested by the VDH, the VMRC will post announcements of HAB events or fish kills that are of public concern but do not impact human health. If a HAB or fish kill event requires the closure of a waterway within the jurisdiction of the VMRC, the agency will enforce that closure. The VMRC will also work with VDH to post signs alerting the public of HAB events and the risks of coming into contact with affected waters, as needed. These groups are members of the Virginia HAB Taskforce, whom share current bloom status and data throughout the year.

Monitoring:

A total of 75 stations are monitored throughout the growing areas, with monthly water samples collected and analyzed for the presence/abundance of potentially toxin-forming algal species. This includes collections from a partnership of contributing organizations (Figure 1). Six stations within the Chesapeake Bay mainstem are sampled 12 times per year from Jan-December as part of the Chesapeake Bay Monitoring Program (CBMP). 10 additional stations are sampled in the James, York and Rappahannock River from March-October as part of the CBMP. 62 stations within classified shellfish growing areas are sampled by VDH DSSWH monthly from March-October.

In addition to monthly routine fixed station sampling, reactionary post hoc bloom samples are collected by multiple agencies throughout the year based on visual sighting of blooms, fish kill events, etc. and processed for phytoplankton analysis. Additional higher frequency (daily-weekly) sampling occurs at a limited number of locations as part of ongoing research programs (ODU and VIMS), with HAB data shared between taskforce members.

Sampling protocols:

Two surface (<1m) water samples (100-1000ml) are collected from blooms and fixed stations. One water sample is preserved with Lugol's solution (ca. 3-4 ml/1000ml); with no preservative added to the second water sample. Each water sample should be labeled with station number, collection date and time, indicated. The unpreserved water samples should be stored in a cooler, but not on direct ice, with little jostling, and separated from the preserved samples and the Lugol's solution.

Phytoplankton analysis:

Lugol's preserved samples are analyzed by DSSWH marine science staff and/or the ODU phytoplankton analysis laboratory. A settling chamber method (Palmer-Maloney/ Sedgwick-Rafter/ Utermohl chamber or equivalent) is used to examine an adequate volume of water via light microscopy (100-400X) to characterize the presence of HAB species. All bloom forming or potentially toxic species are quantified in each sample. Densities of particular HAB species that exceed guidance thresholds can lead to additional monitoring/management actions as described below and illustrated in the flow chart (Figure 2). These thresholds are based on collaboration between Virginia (DEQ, VDH, ODU, VIMS) and Maryland (MDE, DNR, DHMH), and are summarized in the *Harmful Algal Bloom Management in the Chesapeake and Coastal Bays* (MD Sea Grant 2014).

Table 1: Working guidance thresholds for estuarine/marine algal species potentially associated with shellfish poisoning in Virginia waters.

Algal species	Shellfish Related Illness	Main Toxin	NSSP shellfish growing area closure level (toxin w/in meat)	Virginia/Maryland level of concern (cell density in water column)
<i>Alexandrium tamarense</i> species complex	PSP	saxitoxin	80µg /100g	presence
<i>Karenia brevis</i>	NSP	brevetoxin	0.8mg /kg	presence
<i>Dinophysis</i> spp.	DSP	okadaic acid	0.16 mg/kg	≥ 10 cells/ml
<i>Pseudo-nitzschia</i> spp.	ASP	domoic acid	2mg/100g	≥ 1,000 cells/ml

Toxin analyses and growing area closure/reopening protocols:

Samples with phytoplankton densities exceeding the above thresholds are analyzed for toxin concentration within the water column using ELISA/PP2A analyses. Unpreserved water samples (fresh <24hrs, frozen, filtered) are analyzed using appropriate toxin kits/methods. In addition, shellfish samples from the growing area can be collected when phytoplankton analyses indicate significant bloom concerns. The following toxin analyses are conducted by DSSWH on water and/or shellfish samples:

Table 2: Algal toxin analyses (ELISA) associated with HAB species potentially present in Virginia shellfish growing areas.

Toxin	Test	Limits of test
Saxitoxin	Abraxis Saxitoxin (PSP) ELISA, Microtiter Plate #52255B	0.02-0.4 ng/ml (water) 2-40 µg/100g (shellfish)
Brevetoxin	Abraxis Brevetoxin (NSP) ELISA, Microtiter Plate #520026	0.01-2 ng/ml (water) 4.5-900 µg/100g (shellfish)
Okadaic acid	Abraxis Okadaic Acid (DSP) ELISA, Microtiter Plate #520021	0.1-5 ng/ml (water) 100-5000 µg/100g (shellfish)
Domoic acid	Abraxis Domoic Acid (ASP) ELISA, Microtiter Plate #ON0021	0.5-10 ng/ml (water) 100-2000 µg/100g (shellfish)

ELISA tests of seawater/phytoplankton samples can be conducted quickly (within 24hrs when needed) by DSSWH/ODU staff and provide guidance for management decisions, including the need to collect shellfish samples, and when appropriate, may lead to a precautionary closure of the growing area directly. **Toxin concentrations in meat samples that exceed the NSSP thresholds will result in immediate closure of the growing area.** Guidance to the size of the closure will be based on phytoplankton and/or seawater toxin analyses. Shellfish recalls, if necessary, will be established following NSSP guidelines and established VDH policies. Results from ELISA tests with concentrations in meat samples below the NSSP thresholds can also trigger additional sampling and analysis of toxins by LCMS-MS.

LCMS-MS (or equivalent) analysis of shellfish samples will be conducted when initial ELISA results indicate that biotoxins are present in significant concentrations. Shellfish samples (≥ 12 individuals) will be collected from the growing area and analyzed for the appropriate toxin identified by initial phytoplankton analysis/ELISA results. NSSP approved methods will be used to verify reopening status. Growing areas can be reopened once concentrations **below** the NSSP closure threshold are measured from consecutive shellfish collections ≥ 7 days apart.

Administrative procedures:

VDH serves with DEQ as a co-lead for coordinating Task Force. VDH: Office of Environmental Health Services - Division of Shellfish Safety and Waterborne Hazards (DSSWH) is responsible for the routine collection of water samples from shellfish growing areas, as well as bloom response sampling including sediment and shellfish collections if necessary. DSSWH conducts and/or coordinates the sampling and analyses of phytoplankton and biotoxins, and may establish shellfish harvest restrictions, utilizing the methods and criteria presented in Figure 2, and described in the National Shellfish Sanitation Program Model Ordinance. DSSWH is also responsible for managing human disease surveillance for health effects from HABs, including coordination with CDC's OHHABs program, outbreak investigations, and documenting human and animal exposures.

Examples of procedures and documents to close growing areas and embargo shellfish, prevent harvesting of contaminated species, provide for product recall, disseminate information and coordinate control actions are included below in Appendix 1. Appendix 2 includes a contact list of individuals and agencies both within the Virginia HAB Taskforce, as well as neighboring states and federal partners.

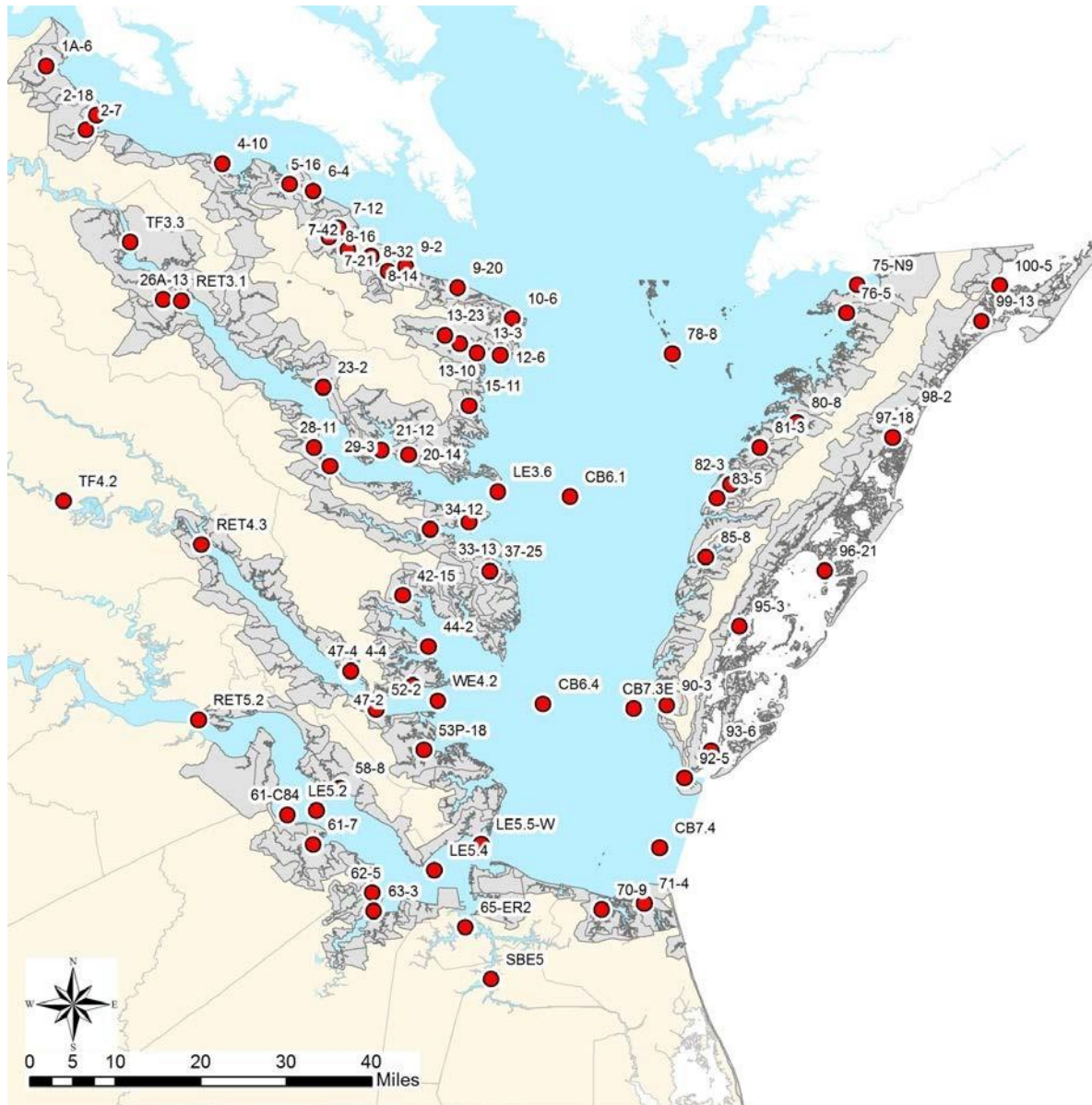


Figure 1: Phytoplankton monitoring stations in Virginia monitored for potential biotoxin producing algal species.

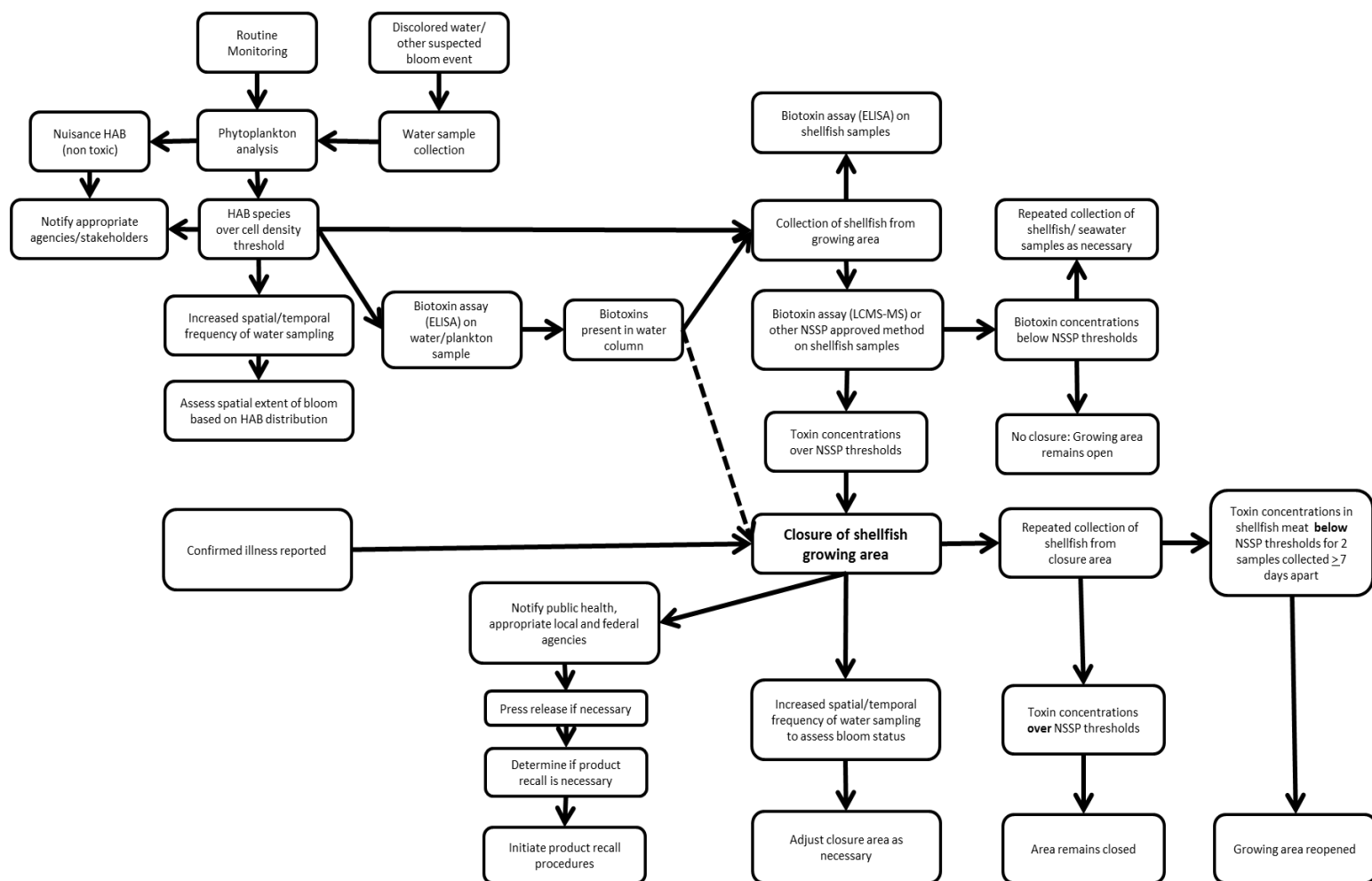


Figure 2: Virginia Biotoxin Contingency Plan flow chart and decision tree. Dashed line indicates water column biotoxins can be used to establish precautionary closure by VDH prior to collection/analysis of shellfish samples.

Appendix 1: **Template Documents**

EMERGENCY REGULATION

**NOTICE AND DESCRIPTION OF EMERGENCY SHELLFISH AREA CONDEMNATION
NUMBER 0XX-XXX, TEMPLATE COVE**

EFFECTIVE JANUARY 24, 20XX THROUGH FEBRUARY 13, 20XX

Pursuant to Title 28.2, Chapter 8, §§ 28.2-803 through 28.2-808, § 32.1-20, and § 2.2-4002, B.16 of the Code of Virginia:

1. Pursuant to § 28.2-809, § 32.1-13, § 32.1-20 and § 2.2-4002 B.16, and § 2.2-4028 of the Code of Virginia an emergency closure on waters of the York River in Template Cove is hereby established, effective 24 January 20XX. It shall be unlawful for any person, firm, or corporation to take shellfish from this area for any purpose except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the Code of Virginia. The boundaries of this area are shown on the map titled "Template Cove, Emergency Condemned Shellfish Area Number 0XX-XXXX, 24 January 20XX" which is part of this notice.
2. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

BOUNDARIES OF EMERGENCY CONDEMNED AREA NUMBER 0XX-XXXX

The condemned area shall include that portion of the York River near Template Cove inland of a line drawn between latitude / longitude map coordinate (37°15'50.5",-76°25'12.0"), map coordinate (37°15'37.4",-76°24'56.5"), map coordinate (37°15'25.1",-76°25'26.0"), and map coordinate (37°15'34.5",-76°25'36.6").

Recommended by: _____
Director, Division of Shellfish Safety

Ordered by: _____ State
Health Commissioner Date

FOR IMMEDIATE RELEASE

January 24, 20XX

For More Information Contact

Larry Hill, Eastern Region PIO (757) 683-9175

VIRGINIA DEPARTMENT OF HEALTH CLOSES AREA TO SHELLFISH HARVESTING

(RICHMOND, Va.)— The Virginia Department of Health announced today that shellfish harvesting waters near **Template Cove in the York River in Gloucester County** are closed to the harvest of oysters and clams effective January 24, 20XX. This closure is a result of notification of a **potential marine biotoxin shellfish poisoning** Outbreak in Central Virginia with an epidemiological link to shellfish harvested from this area.

Preliminary testing of shellfish and seawater sampling indicate the presence of Domoic acid which is associated with Amnesic Shellfish Poisoning. Domoic acid is a naturally occurring neurotoxin produced by certain types of algae that can be harmful to humans if contaminated shellfish is consumed. Marine biotoxins are not destroyed by cooking or freezing and may have serious and potentially fatal effects.

Maps of the affected areas are posted on the Division of Shellfish Sanitation's home page at www.vdh.virginia.gov/Shellfish/. The affected shellfish are bivalve mollusks including oysters and clams, but not crabs or fin fish.

For more information on shellfish closures, see the frequently asked questions on shellfish condemnations at www.vdh.virginia.gov/EnvironmentalHealth/Shellfish/faq/.

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Event Notification-OEHS Division of Shellfish Safety and Waterborne Hazards (DSSWH)

Date: Friday, January 24, 20XX, 7:00pm

VDH received reports on January 23, 20XX of gastrointestinal illness from persons who had consumed raw oysters (January 12 and 17, 20XX) at two separate facilities located within Virginia.

The epidemiology and laboratory evidence indicates a link between consumption of raw oysters from the York River Lease XXXX in Template Cove and gastrointestinal illness identified as Diarrhetic Shellfish Poisoning (DSP). Preliminary laboratory testing of oyster and seawater samples from Template Cove indicate the presence of Okadaic Acid, a naturally occurring toxin produced by certain types of algae that can cause DSP.

Typical symptoms of DSP include abdominal pain, nausea and vomiting, diarrhea, headache, fever, and chills, with a short onset time and symptoms lasting up to three days.

VDH, Division of Shellfish Safety has issued Emergency Shellfish Condemnation # XXX-XXX "Template Cove" in the York River near the mouth of the Example River effective Friday January 24, 20XX. Click on the emergency closure referenced on the Division's home page at <http://www.vdh.virginia.gov/shellfish>.

VDH, Division of Shellfish Safety is conducting a recall of shellstock oysters from Example Oyster Company (VAXXXXSS) in Hayes, Virginia, due to reports of oyster-associated biotoxin illness. This recall includes oysters harvested from lease number XXXX in the York River in Virginia for the harvest period of January 8, 20XX to January 24, 20XX. Example Oyster Company (VA1602SS) is the only shellfish dealer currently identified in this recall and is in the process of contacting their customers.

At this time, preliminary information obtained from the shellfish dealer indicates distribution only in Virginia and Washington, D.C. VDH has contacted the Washington DC Department of Health. OEHS has emailed information to the respective health districts identifying known food establishments where the product affected by the recall may have been delivered.

Notification was sent to the Interstate Shellfish Sanitation Conference and FDA

Media Release has been disseminated

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Danielle Schools
Division of Shellfish Sanitation
Office of Environmental Health Services
Virginia Department of Health
(804) 864-7484

Notice of Recall –Virginia –issued 1/24/20XX

The Virginia Department of Health (VDH), Division of Shellfish Safety is conducting a recall of shellstock oysters from **Example Oyster Company** (VAXXXXX) in **Template**, Virginia, due to reports of oyster-associated **biotoxin illness**. This recall includes oysters harvested from lease number **XXXX** in the **Example River** in Virginia for the harvest period of January 8, 20XX to January 24, 20XX. **Example Oyster Company** (VAXXXXX) is the only shellfish dealer currently identified in this recall and is in the process of contacting their customers.

VDH received reports of gastrointestinal illness from persons after consuming oysters (January 12 and 17, 20XX) at two separate facilities located within Virginia, which served the implicated oysters. **Preliminary testing of shellfish and seawater sampling indicate the presence of Domoic acid which is associated with Amnesic Shellfish Poisoning (ASP). Domoic acid is a naturally occurring neurotoxin produced by certain types of algae that can be harmful to humans if contaminated shellfish is consumed.**

At this time, preliminary information obtained from the shellfish dealer indicates distribution in Virginia and Washington, D.C. only. VDH will contact state shellfish authorities with additional details of distribution as it becomes available.

Symptoms of ASP can include nausea, diarrhea, headaches, confusion/disorientation, seizures, and most severely, permanent short-term memory loss, coma, or death. Onset of these symptoms can occur within 24 to 48 hours of consumption. If you suspect that may have become ill from consuming raw oysters, please contact your [local health department](#).

For more information or questions related to this recall, contact the Virginia Department of Health, Division of Shellfish Safety at (804) 864-7480.

Virginia Department of Health
Allens Island
Emergency Condemned Shellfish Area
Number 046-081A
24 January 2020

0 1000 2000
Feet

