

Commonwealth of Virginia Harmful Algal Bloom Response Plan

INTRODUCTION

Phytoplankton are microscopic algae that are common members of freshwater and marine habitats. They represent a major source of food and oxygen for many of the inhabitants 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 and pets, as well as to birds, fish, and other inhabitants of aquatic habitats.

Usually, algae are absent or present in low concentrations that pose no environmental or human health threat. However, with certain environmental conditions, algae may proliferate to form dense concentrations of cells that potentially cause detrimental impacts through toxin production or other mechanisms. These are 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. Algal blooms by non-harmful algae are also common seasonally, with discolored water (green, red, brown, etc.) that do not pose animal or human health concerns. 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).

Human exposure to HAB toxins may occur by three modes of transmission; consumption, absorption through the skin or by respiration of aerosolized toxin. Consumption is the most concerning mode for public health due to the effect toxins may have on internal organs, and can be fatal. Consumption may include direct ingestion of certain fish/shellfish that have accumulated toxins, accidental ingestion while swimming in a bloom, or from a drinking water source contaminated with algal toxins. In general, children and pets are more vulnerable to HAB toxins as a result of their small size i.e. a small amount of ingested toxin may cause illness. Exposure due to the consumption of affected fish/shellfish is a commonly reported exposure mode, and such, is a primary concern given our ability to transport fish and shellfish from an affected area to consumers nationwide. Although shellfish and finfish may become toxic and cause human illness in the absence of a bloom, illness is usually associated with the presence of a visible bloom. The

most widely recognized human illnesses/toxins caused by HABs are:

- Amnesic shellfish poisoning (ASP)
- Ciguatera fish poisoning (CFP)
- Diarrhetic shellfish poisoning (DSP)
- Neurotoxic shellfish poisoning (NSP)
- Paralytic shellfish poisoning (PSP)
- Microcystin (freshwater cyanobacteria toxin)

Amnesic, Ciguatera, Diarrhetic, Neurotoxic, and Paralytic fish/shellfish syndromes are affiliated with marine and brackish water HAB species producing toxins that accumulate within the edible tissues of the organism, causing illness when consumed. Microcystin is a freshwater and brackish-water toxin produced by several algal species, but is not known to accumulate in edible tissues above guidance levels. For a more comprehensive list of HAB syndromes and their symptoms, please see visit the Task Force website at. HABs appear to be increasing in frequency, distribution and magnitude both regionally in the Chesapeake Bay, and worldwide (Anderson et al. 2012, O'Neil et al. 2012, Marshall and Egerton 2012). The reason for the increase is likely due to many factors including climatic changes, anomalous weather events, transport of nonindigenous marine species through the ballast water of ships, and nutrient pollution of coastal waters. Innovative surveillance methods and analytical techniques, as well as increased monitoring for HAB species and toxins, may also contribute to their perceived increase.

Nationally, significant cyanobacterial HAB events over the last decade have resulted in negative impacts upon fresh drinking water sources, recreational areas, human health and aquatic life. Virginia has not experienced large fresh water blooms to date. The Virginia HAB Task Force coordinates activities of state agencies and institutions involved in routine seasonal surveillance of public fresh waterbodies to evaluate the presence and prevalence of HAB species and associated toxins in drinking water sources and recreational areas.

The HAB response plan has four priority objectives. They include: summarize the methods of surveillance for and identification of HAB species in marine and fresh waterbodies; define the process for responding to and managing HAB events; identify government agencies authorized and responsible to provide a response and assistance during HAB events; and provide public notification processes and procedures which may be utilized to alert officials and the public of HAB activity in order to protect the health and well-being of humans and animals.

VIRGINIA HAB TASK FORCE

Virginia's response to potential HAB events began in the late 1990's with a focus on dinoflagellates of the *Pfiesteria* complex. This included conducting a human health survey, and responding to fish kills and observations of fish with lesions. These activities were coordinated by the Virginia *Pfiesteria* Task Force, now known as the Virginia HAB Task Force. In the approximately 20 years since its inception, the Task Force has expanded to include all HAB species and events that are relevant within the state. This has included coastal and marine HAB species associated with fish kills, potential shellfish biotoxins. More recently, this has included freshwater species associated with drinking and recreational concerns in Virginia's reservoirs, lakes and tributaries. The Task Force continues to facilitate the Commonwealth's response to emerging HAB events by sharing and disseminating information, and coordinating resources.

VIRGINIA HAB TASK FORCE MEMBERS

The Task Force is comprised of members from multiple agencies and institutions. Primary support members have immediate and direct roles during HAB events in addition to the coordination of surveillance and response activities. These members include the Virginia Department of Environmental Quality (VDEQ), Virginia Department of Health (VDH), Virginia Institute of Marine Science (VIMS), Old Dominion University (ODU), and the Virginia Marine Resources Commission (VMRC). Roles and responsibilities of primary support members are detailed in the following sections. The Virginia HAB Task Force Memoranda of Understanding (MOU) formally establishes the obligations of Primary Support Task Force Member Agencies and provides infrastructure for the group. There are also a number of agencies and academic institutions that may share a direct or indirect role during Task Force response efforts, known as secondary support members. A list of secondary support members is available on the Task Force website.

MONITORING AND RESPONSE TO HABs

Objective 1: Surveillance and Identification of HAB species

Accurate assessment of HABs and associated impacts on Virginia's natural resources requires a monitoring program for HABs and their impacts through an integrated plan for a rapid and effective response to HAB-related events, then acquiring the necessary equipment, resources and expertise to implement the plan. There is a continued need to understand the environmental influences (biotic and abiotic) associated with bloom initiation, transport and subsidence of HAB species in Virginia estuaries and free-flowing waters and lakes. Local algal blooms can be impacted by both nutrient additions as well as weather (temperature, precipitation, wind, etc.) patterns. Concurrent collection of environmental data along

with bloom sampling is integral to the response and monitoring plan.

Brackish and Marine Waters

Virginia has developed and implemented a multi-agency effort for monitoring and research on brackish and marine HAB organisms. This effort includes extensive participation by ODU and the VIMS, both of which have been active participants in Virginia's Chesapeake Bay Monitoring Program (CBMP). Phytoplankton identification and enumeration of all taxa, including HAB species is conducted by ODU as part of the VDEQ/CBMP phytoplankton monitoring program. This includes routine analyses of fixed stations throughout lower Chesapeake Bay and Virginia tidal tributaries that are collected by ODU and VDEQ. Representative stations within shellfish growing areas throughout the state are sampled by VDH Division of Shellfish Sanitation and analyzed for HABs. Ongoing research at VIMS includes bioassays assessing aquatic animal health effects and biotoxin characterization.

Freshwater

Approximately one dozen sites are selected for freshwater surveillance each year during summer months to evaluate the presence and concentration of HAB species. VDEQ's extensive network of water quality stations complement the freshwater HAB surveillance, should HAB events be detected during sampling events.

Objective 2: Responding to and Managing HAB Events

The Task Force prioritizes efforts for the detection of HAB species and toxins in waters supporting shellfish growing areas, drinking water sources, and public recreational uses.

Outside of the routine monthly monitoring, response driven collections and analyses are conducted as needed by the primary support members. Typically, fish kills and citizen water complaints will be directed to VDEQ for investigation, with VDH providing assistance and coordination with health professionals, and analysis of samples provided by ODU and VIMS.

A seven-day per week, 24 hour per-day HAB response capability is a joint effort between VMRC, VDH and VDEQ, with laboratory support by VIMS and ODU, facilitated by the HAB Hotline and online reporting form. A contact list of HAB Task Force Members is updated frequently to facilitate efficient communication of the primary and secondary support members.

During HAB events which present a human or animal health risk, the primary support members will follow protocols defined by their membership roles within their authority and will rely on the most current advisory guidance thresholds for issuing and lifting advisories for a given HAB species and toxins.

Privately owned waterbodies (man-made ponds and lakes) in either commercial or residential

communities as well as, stormwater basins may become impacted by algae blooms or HABs. In particular, stormwater basins are more likely to experience algal blooms because their purpose is to collect and retain sediments, nutrients, and other pollutants in order to protect streams and rivers downstream. Outreach and education regarding HABs may be provided to stormwater treatment owners, however the Task Force efforts and resources are not intended for use on private waterbodies or stormwater treatment works, unless there is a potential risk to public waters, as a result. The Task Force will use discretion with its resources for providing surveillance and response by working in conjunction with primary support members and local officials to ensure the protection of public health. Recommendations for preventing algae blooms and other resources for owners/operators of private waterbodies or stormwater treatment works are available at the Task Force website.

Objective 3: Identify Primary Support Members and Roles & Responsibilities

Primary support member sampling protocols and operational plans can be found on the Task Force website.

Virginia Department of Environmental Quality (VDEQ)

VDEQ serves with VDH as a co-lead for coordinating Task Force activities. VDEQ's responds to suspected HAB events and fish kills that may be the result of a HAB. DEQ collects HAB samples which are analyzed by ODU and VIMS and provides data on water quality conditions associated with blooms. HAB responses can occur during DEQ's routine monitoring when a bloom is detected but more often DEQ responds to reports of blooms via reports from others (watermen, citizens, etc.).

VDEQ develops an annual operational plan for VDEQ staff response to suspected HABs and tidal fish kills (see the Task Force website). All suspected HABs or fish kills in estuarine waters are referred to an initial HAB responder. The Tidewater, Piedmont, and Northern Regional Offices of DEQ ensures a HAB response. If a name and number is available, the first step is to call the person who reported the fish kill or algae bloom to get first-hand information. Once the responder has determined that the event should be investigated as a possible HAB event, the responder gathers response equipment and proceeds to the site.

The initial HAB responder will always take a complete package of HAB response equipment and supplies. This package of equipment and supplies will be staged and ready to go. If a site investigation confirms a possible HAB event, the responder will contact VIMS and ODU to arrange for sample delivery and to notify them of the event. The responder will also contact the VDH HAB contact and VDEQ management for initiation of the HAB communication protocol. Next, the responder will determine the extent

of the alga bloom or fish kill and take appropriate samples for verification of the presence of HABs.

If the responder or VDEQ management feels it necessary, a follow-up response will be conducted. The follow-up response crew will deliver samples to the appropriate agencies. Every effort should be made to perform a follow-up response the next morning. The follow-up response will be for the collection of HAB organism samples, chlorophyll, water quality samples.

Virginia Department of Health

VDH serves as a co-lead with DEQ for coordinating Task Force activities and includes primary support members from three VDH offices, each with specific roles and responsibilities to Task Force operations. These offices are responsible for issuing human health advisories for HABs in recreational waters, shellfish growing area closures, and coordinating with water treatment operators in source waters where HABs are detected at unsafe levels.

Office of Environmental Health Services - Division of Shellfish Sanitation

DSS is responsible for the routine collection of water and/or sediment samples from shellfish growing areas, as well as bloom response sampling including shellfish collections if necessary. DSS conducts and/or coordinates analyses of phytoplankton and biotoxins, and may establish shellfish harvest restrictions, utilizing the methods and criteria as described by their marine biotoxin contingency plan and the National Shellfish Sanitation Program Manual of Operations.

Approximately sixty fixed stations within shellfish growing areas are sampled by VDH-DSS monthly from March through October. Additional bloom samples are collected as necessary when and where discolored water or fishkills are observed throughout the year. Surface (~0.5m) lugol's preserved samples (500ml) destined for phytoplankton species analysis are collected, along with non-preserved samples for potential toxin screening (ELISA, LCMS-MS, etc.). Field parameters include station location, date, water temperature; salinity; dissolved oxygen and secchi depth are taken for each collection and recorded on the sample bottle.

Phytoplankton samples are delivered to VDH:DSS Norfolk Field Office or to the Phytoplankton Analysis Laboratory at ODU. Non-preserved samples must be kept on ice and delivered to the lab within 24hrs. Samples (fresh, frozen or filtered) for toxin analyses associated with potential shellfish biotoxin events are to be delivered to VIMS Department of Aquatic Health Sciences for toxin analyses.

Office of Epidemiology - Division of Environmental Epidemiology (DEE)

HUMAN DISEASE SURVEILLANCE FOR HEALTH EFFECTS FROM HABs

Health Effects

Health concerns center on direct exposure to HAB toxins in water related activities or professions, and illnesses associated with eating contaminated shellfish or fish. If it were determined that health effects result from exposure to these events, then appropriate investigations would consider the following:

1. What are the health effects?
2. How are they manifested?
3. What is the pathogenesis?
4. What are the risk factors for developing health effects?
5. How can exposure or health effects be prevented?
6. How can health effects be treated?
7. How can exposure be measured?
8. How can illness be definitively diagnosed?
9. Is there a dose response?
10. Which HABs are responsible?

HUMAN DISEASE SURVEILLANCE - Passive Surveillance

Increasing Awareness

The Division of Environmental Epidemiology (DEE) will develop information on health effects from HABs and distribute it to medical care providers and local health departments via the Virginia Epidemiology Bulletin, the VDH website, and other venues (e.g. meetings, conference calls). DEE will make information on HABs available to the public via brochures and the VDH website.

Reporting

Physicians will be urged to report suspected HAB health effects to their local health departments who will in turn notify DEE. The HAB Hotline (888-238-6154) will be monitored for reports of suspected HAB related illness from the public.

Documenting Human and Animal Exposures

Local health departments and DEE may utilize a screening form provided for evaluating each suspected case and will provide guidance to physicians on diagnostic testing and case management. Human and animal surveillance forms supplied by the Centers for Disease Control and Prevention (CDC) will be completed by the local health departments and DEE will review the data for indications of increased

risk. Completed surveillance reports will be documented within the CDC's One Health Harmful Algal Bloom System (OHHABS) database.

HUMAN DISEASE SURVEILLANCE - Active Surveillance and Outbreak Investigation

Triggers for initiating active surveillance:

- Confirmed HAB due to an organism known to cause human illness
- Cluster of human or other mammal illnesses associated with a recent HAB.

Active surveillance activities:

to be conducted by VDH district, regional and/or central office epidemiologists and other staff

- Review records in local hospitals and medical practices
- Utilize media to notify public to report cases, if necessary
- Develop line list of potential cases, establish database with demographic, exposure and clinical information
- Summarize and analyze data.

Outbreak investigations:

Investigations will be conducted by VDH district, regional and central office epidemiologists and other staff in accordance with standard epidemiologic methods for data collection, analyses, report writing, summary findings, and recommendations.

Reports and Confidentiality

Summary reports of surveillance and outbreak investigations will be provided to all interested parties. Patient confidentiality will be protected and no personal identifying information will be released.

Office of Drinking Water (ODW)

The Office of Drinking Water (ODW) regulates waterworks with surface water intakes supplying drinking water to approximately 76% of Virginia residents. ODW may be informed of a potential HAB in multiple ways, such as:

- A HAB Taskforce member notifies the ODW.
- The waterworks owner or operator notifies the ODW of a bloom seen near intake or taste and odor problems detected.
- A taste and odor complaint consistent with an algae bloom is received by the ODW.

The ODW will coordinate with the waterworks to confirm that an algae bloom is impacting the drinking water supply, and to determine if that algae bloom is harmful in nature. If the ODW determines that there is

sufficient evidence to suggest that a potential HAB may impact a waterworks, the ODW will inform the HAB Taskforce and issue an Event Notification to inform VDH senior leadership. The ODW will then coordinate the emergency response with the waterworks and the Virginia Department of Emergency Management (VDEM). The ODW will provide technical assistance to the waterworks, and public education information to waterworks and their customers, as needed.

Old Dominion University (ODU)

Old Dominion University (ODU) is responsible for the phytoplankton species composition analyses, including enumeration of all potentially toxic taxa, from routine water samples collected by VDH:DSS and additional bloom collections by VDEQ and other VA HAB Task Force members. Molecular and electron microscopic analyses will also be conducted as needed. All HAB events relating to shellfish growing areas will be coordinated with VDH:DSS in a timely manner to inform shellfish management decisions. ODU is also responsible for the phytoplankton analyses and toxin screening (ELISA) of freshwater blooms sampled by VDEQ, VDH:DEE and other VA HAB Task Force members, with coordination with VDH:DEE regarding cyanobacterial toxins and other freshwater HAB events.

Virginia Institute for Marine Science (VIMS)

VIMS is responsible for identification and enumeration of HAB species using microscopic and molecular genetic methods on samples collected for monitoring by VIMS personnel, and those collected in response to blooms and fish or shellfish kills by VIMS and other HAB Task Force. VIMS utilizes bioassays to assess impacts of HAB species on aquatic animal health. VIMS also conducts biotoxin analyses by ELISA and/or LC-MS/MS in response to blooms, and fish or shellfish kills, as needed. VIMS is responsible for pathological analyses of finfish with lesions, and animals from fish and shellfish kill events.

Virginia Marine Resources Commission (VMRC)

The VMRC is a member of the Virginia HAB task force and plays multiple roles in the response operational plan. If the DEQ 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.

Objective 4: Notification During HAB Events

Monitoring data collected will be displayed on a web-based HAB Map and routinely updated as-needed during the HAB season (early spring to fall). Event notifications, public notifications, and the issuance and lifting of advisories which limit public access to HAB waterbodies may be issued based on the most current guidance for HAB species and toxin thresholds. Signage which may be placed to warn the public of a HAB event are available in pdf on the Task Force website, or signs may be obtained from VDH:DEE by calling the HAB Hotline.

HAB COMMUNICATION SEQUENCE

The following outline should be followed with all due speed. Depending on seriousness of event, conference calls or face-to-face meetings can be scheduled.

1. Report of HAB or related health event received by any Task Force member:
 - a. Ensure receipt of suspected HAB report to Primary Support Task Force members by:
 - HAB Hotline (888-238-6154), or
 - Submit an online report (Task Force website)
2. Primary Support Members will refer reported information directly as follows:
 - a. Health event: VDH
 - b. Fish kill or algal bloom: VDEQ
 - c. Shellfish mortalities or fish with lesions: VIMS
3. Rapidly distribute a summary of report via an email distribution list to Primary Support members.
 - a. Notify federal agencies and other states if potential for multistate impact or media attention.
 - b. Include summary of knowledge to date and brief outline of plans for investigation.
4. Rapidly initiate investigation. Samples will be collected for water quality conditions, phytoplankton analysis (preserved and unpreserved samples), and molecular and toxin analyses. Additional sample requirements (i.e., fish and shellfish samples) will be determined during the event.
5. Rapidly report initial findings to Primary Support members. Secondary support members will be contacted as needed.

- a. Include samples taken, time of delivery to which laboratory and estimated time of test results.
 - b. Provide suggested plans for further investigation and/or control.
6. Rapidly report laboratory results to Task Force members and others as needed.
 7. Distribute final report to all interested parties in a timely manner.

HARMFUL ALGAL BLOOM PUBLIC INFORMATION PROCEDURES

Notification of Public and Media

The Public Relations Coordinator (PRC) for the VDH Office of Epidemiology will be notified promptly of any HAB related events that may impact public health or cause public concern and will coordinate the development and distribution of public awareness messages with all agencies represented on the HAB Task Force. VDH will rely on the technical expertise of ODU and VIMS in preparing all such releases to the public and media.

VDH central office and local health departments will notify the public and regional media about an event, which can include a fish/shellfish kill, algal bloom, or other water-related condition that may involve HABs and have an impact upon public health or may cause significant public concern. The PRC will coordinate with VDH Regional Public Information Officers (PIOs) to develop media announcements outlining the location of the HAB and clearly defining any prevention messages, including possible consumption advisories and swimming restrictions, to protect public health. This information will be made available on the Task Force website as well.

In the event of a fish/shellfish kill, algal bloom or other HAB-related situation that does not impact human health, but may be the source of public concern, VDH will provide information to the public about the situation via media release and/or posting on the VDH website depending upon the significance of the event. Template media releases are available on Task Force website. Announcements of events not impacting human health will be coordinated with all agencies represented on the Task Force.

If a HAB related event requires the closure or issuance of a public advisory of a waterway to protect public health, the Commissioner of Health or an appropriately authorized entity will order the closure and involved state agencies and the media will be notified. VMRC or DGIF will enforce the closure on their respective waterways. VDH will supply signs, which will be clearly posted to alert the public of the risks associated with contact with the water in that area. DGIF, VMRC and/or VDH local health departments will post the signs. Template advisory and closure signs are available in pdf on the Task Force website or signs may be

obtained by calling the HAB Hotline.

VDH will develop informative flyers on HABs which will include directions for individuals who may have been exposed to HABs during an event. These materials will be distributed to local health departments and other agencies.

VDH will share all media alerts, printed materials and other public information messages with involved agencies and will collaborate on message development in the event of a HAB related event. Information regarding monitoring results of HAB blooms will be displayed on a map updated weekly during events on the Task Force website.

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Acronym List

ASP	Amnesic shellfish poisoning
CBMP	Chesapeake Bay Monitoring Program
CDC	Centers for Disease Control and Prevention
CFP	Ciguatera fish poisoning
DGIF	Department of Game and Inland Fisheries
DSP	Diarrhetic shellfish poisoning
HAB	Harmful Algal Bloom
MOU	Memoranda of Understanding
NSP	Neurotoxic shellfish poisoning
ODU	Old Dominion University
PSP	Paralytic shellfish poisoning
VDEQ	Virginia Department of Environmental Quality
VDH	Virginia Department of Health
VDH-DEE	Virginia Department of Health - Division of Environmental Epidemiology
VDH-DSS	Virginia Department of Health - Division of Shellfish Sanitation
VDH-ODW	Virginia Department of Health - Office of Drinking Water
VIMS	Virginia Institute of Marine Science
VMRC	Virginia Marine Resources Commission