Marine Biotoxin Management Plan

South Australian Shellfish Quality Assurance Program

Government of South Australia
Department of Primary Industries and Regions

Marine Biotoxin Management Plan Version 27 - November 2025

Disclaimer

All Enquiries

Department of Primary Industries and Regions

South Australian Shellfish Quality Assurance Program

E PIRSA.SASQAP@sa.gov.au

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1. Introduction

1.1 Background

The marine environment supports a wide range of phytoplankton species (microscopic plants) otherwise known as algae. Some species of algae may produce natural toxins that adversely affect humans, these species are known as toxic phytoplankton. Toxic phytoplankton are responsible for many cases of human illness throughout the world annually; the filtering bivalve shellfish (oysters, mussels etc.) concentrate the toxins in their flesh and when consumed raw or cooked the toxins are ingested into the human.

There are four significant human illness syndromes following the consumption of shellfish containing concentrated levels of the toxins.

The syndromes are:

- Paralytic Shellfish Toxins (PSP);
- Diarrehetic Shellfish Toxins (DSP);
- Amnesic Shellfish Toxins (ASP);
- Neurotoxic Shellfish Toxins (NSP).

Not infrequently, significant shellfish producing regions in the various parts of the world have harvesting restrictions imposed due to biotoxins. Such closures can cause significant economic losses to the aquaculture and wild catch industries.

In Australia there have been only a few documented cases of illness (none fatal) due to the consumption of shellfish contaminated with biotoxins.

The Biotoxin Management Plan (BMP) meets section 4 and other requirements of the Australian Shellfish Quality Assurance Program (ASQAP) Operations Manual. As such, it is audited by the Department of Agriculture, Forestry and Fisheries (DAFF) and so meets export requirements to all destinations having an agreement with DAFF.

Biotoxins in South Australia

The first surveillance for the presence of toxic phytoplankton in SA began in 1994 with the commissioning of a cyst survey of toxic algal species. This was conducted under the supervision of Professor Gustaaf Hallegraeff, a marine phytoplankton expert from the Institute for Marine and Antarctic Studies (IMAS) in Tasmania.

In South Australia there have been no recorded cases of human illness associated with the consumption of shellfish contaminated with biotoxins.

Dinophysis acuminata, which is known to produce DSP toxins in other regions of the world, is common and widespread in South Australian coastal waters.

Karenia spp. have been identified in areas where NSP has been detected in the form of brevetoxin.

There have been five biotoxin events within South Australia:

- Mount Dutton Bay Harvesting Area March 2004 and 2025 DSP 0.22 mg/kg
- Kellidie Bay East Harvesting Area March 2004 DSP 0.28 mg/kg
- Coorong Harvesting Area April 2014 DSP 0.21 mg/kg
- Stansbury, Coobowie, Port Vincent, American River, Franklin Harbour, Boston Bay, Lower Eyre, Bickers Island, Coorong and Proper Bay May 2025 NSP greater than 0.8mg/kg (up to 20mg/kg)

Pseudo-nitzschia sp. is regularly detected in routine phytoplankton samples across the state, levels are always well below the state's regulatory limit, and no recorded human illness has occurred. When cells have been detected above the regulatory limit, shellfish samples submitted for analyses have been negative.

It appears that the species of *Pseudo-nitzschia* detected in SA waters may be a non- toxic variety, shellfish tested after Action level 1 and 2 breaches has occurred and all have been samples negative for ASP.

SASQAP manages risks associated with the consumption of contaminated shellfish with a two-tiered approach.

Early warning and more frequent monitoring for the presence of elevated levels of toxic phytoplankton represent the first tier. Routine biotoxin monitoring as well as targeted or triggered response to elevated phytoplankton levels in the water column represent the second tier of this approach.

The frequency of monitoring, the phytoplankton species enumerated and classes of biotoxin analysed for are all based on risk assessment of the factors involved and past reported illness from biotoxins.

1.2 Scope

The BMP is designed primarily for, and is equally applicable to, both aquaculture and commercial wild shellfish harvesting. It may also be utilised as a model by responsible agencies for the protection of the public from the recreational gathering of shellfish.

The main farmed species involved in Aquaculture in SA are the Pacific Oyster *(Magallana gigas)* inter-tidal/sub-tidal culture and the Blue Mussel *(Mytilus galloprovincialis)* sub-tidal culture. The Native Oyster *(Ostrea angasi)* is also being produced decreasing each year.

The Goolwa Cockle or Pipi (*Plebidonax deltoides*) is also harvested in commercial numbers from the Coorong region of SA.

Commercial harvest of the Mud Cockle (*Katelysia sp*.) is regularly performed from certain classified areas on Eyre Peninsula.

Commercially harvested scallops have been adapted into the SASQAP program, (Scallop Management Plan for SA) harvesters are only allowed to harvest within classified areas unless they can demonstrate that the area is remote or offshore, or only sold with abductor mussel only.

The principal aim of the BMP is:

To minimise the risk of illness to consumers of South Australian shellfish due to biotoxin contamination through a framework of monitoring and contingency management.

It will achieve this by monthly biotoxin testing for ASP, DSP, PSP and NSP in the meat of shellfish from all relevant classified harvesting areas.

1.3 Review

This BMP will be reviewed on an annual basis. The plan will be given a 'version number' and the previous versions will be kept in the central SASQAP file.

2. Administration

2.1 Legislation

The *Primary Produce (Food Safety Schemes) Act 2004* (the Act) and the *Primary Produce (Food Safety Schemes) (Seafood) Regulations 2017* (the Regulations) allow PIRSA to act as the State Control Authority (SCA) to control the harvesting, sale, transport and relaying of shellfish within SA. This is a requirement under ASQAP.

SASQAP is located within PIRSA – Biosecurity – Food Safety Program.

PIRSA and DAFF are joint signatories on a Memorandum of Understanding to control the post-harvest handling of shellfish in SA.

Current marine mollusc aquaculture licences contain conditions that enforce and restrict culture of bivalve molluscs to those areas classified by SASQAP under ASQAP guidelines.

PIRSA has responsibility and authority under the Act and the Regulations to ensure food safety.

2.2 Biotoxin Contingency Plans

The application of the BMP requires that each harvesting area has an effective Biotoxin Contingency Plan. This should supplement the general Marine Biotoxin Plan with "harvesting area specific" information.

The Contingency Plan should contain:

- The marine biotoxin sampling sites (map) for each area and reasons for their location.
- The frequency of shellfish and phytoplankton monitoring for the harvesting area: where these differ from those outlined in Section 3 of this document.
- Risk analysis / assessment for the area based on previous results biotoxin events and results of any supplementary data *e.g.* cyst surveys.

As such it represents an action plan that is reviewed annually within the harvesting area for the control of biotoxins.

3. Monitoring

3.1 Phytoplankton Monitoring

Marine biotoxins can accumulate in bivalve shellfish when toxic phytoplankton are filtered from the water and ingested in large numbers. These toxins, which are not usually destroyed by cooking, represent a hazard to consumers eating the affected shellfish.

Phytoplankton blooms are 'patchy' are not representative of what is present in the water column and only represent a moment in time. Shellfish bio-accumulate toxins through filtration and show what has been in the water for the past few days.

SASQAP utilises water sampling as an early warning detection system for the potential presence of biotoxins in shellfish. However, this is supplemented in the warmer months, when toxic algal blooms are known to occur, supported with routine biotoxin analyses.

3.1.1 Sampling

The specific location of sampling sites for phytoplankton monitoring is extremely important if meaningful conclusions are to be drawn from interpretation of the results. This also applies to the depth from which the samples are taken.

The actual criteria used to determine sampling sites are complex and are regionally specific. Whenever elevated levels of toxic phytoplankton are detected, it is important to immediately arrange for collection of more disperse samples from the harvesting area. These should not only occur more frequently (see below) but from a greater number of sites and depths. This will allow the distribution and extent of the "bloom" to be assessed. At such times it is important to monitor adjacent areas if they were not monitored at that time.

The following criteria are used by SASQAP to determine the location of routine water sampling sites for phytoplankton monitoring:

- The history of phytoplankton and marine biotoxin activity in the area.
- The site must be representative of water at the harvesting area; it should be close to the harvesting area if possible.
- The site should optimally be from an area where sampling can occur on an incoming tide.
- The site should be optimally 4m deep (at least) at low tide. Not always achievable in SA.
- Environmental conditions such as major currents tidal patterns, circulations patterns, prevailing winds summer and winter and water temperatures.
- Presence of and stocking rates of other aquaculture activities in the area.
- The site must be accessible in all tidal and most wind conditions.
- The predominant summer wind conditions must be considered.
- Sampling sites should be located where experience has shown marine biotoxins are most likely to occur.
- The depth of sampling must cover the entire depth of shellfish harvested.
- If multiple harvesting area occur in a harvesting area multiple sampling sites must be utilise where different bodies of water or different environmental factors affect the individual areas.

- The site location should be reviewed annually. This review should include analysis results of monitoring over previous 12 months as well as all history.

In the case of intertidal oyster culture, the sites may need to be in deeper water adjacent to the aquaculture zone so that samples can be collected when the tide is low. In some regions, bivalve aquaculture can cover a considerable area. It will be necessary in these cases to sample from multiple sites initially. An assessment of the phytoplankton data subsequently may allow the number of sampling sites to be decreased if phytoplankton composition and abundance is highly correlated between sites.

For shellfish online culture, the water samples should be collected so the entire depth of line is sampled.

> *Highly physical and mostly shallow surf zones, most HAB species such as Gymnodinium catenatum, Alexandrium (PSP), Dinophysis (DSP) but also fish-killing Karenia and raphidophytes would be destroyed in such environments and hence these are not good representative sample sites. Pseudo-nitzschia diatoms (ASP) are better able to handle turbulence. In my view, sampling surf zones is only relevant if these areas directly feed into oyster farms; otherwise it is better to sample the deep water column that feeds the surf zone.* Gustaaf Hallegraeff per coms.

Samples should be taken on the incoming tide so that they represent the water the shellfish are about to filter rather than the water they have already filtered.

The suitability and number of sampling sites in a particular area will be reviewed in the light of experience and the changing needs of the biotoxin monitoring program.

Sampling sites for each area are described in maps in the biotoxin contingency plan for each harvesting area and specified in Appendix 4.

Sampling frequency

For water sampling and enumeration of toxic phytoplankton to be an effective monitoring tool it needs to be at done at intervals that maximise the detection of toxic phytoplankton before the appearance of biotoxins in shellfish.

Based on monitoring data from SA waters we have found that the risk of occurrence of toxic phytoplankton is higher in summer when temperatures are higher and there is a greater availability of light due to longer day lengths and higher angles of incidence of sunlight. In addition, areas along the southeast coast, Kangaroo Island and the eastern coastline of Eyre Peninsula are affected by nutrient rich waters produced by cold-water upwellings during summer leading into Autum.

SA also witnesses low densities of certain tropical and sub-tropical species of toxic phytoplankton that are transported from Western Australia via the Leeuwin current.

Arctic invaders from Tasmania's West coast are also present in routine samples when certain weather conditions occur (Flinders Current). All these factors need to be taken into consideration.

To date there has been five demonstrated biotoxin events in farmed shellfish harvesting areas within SA, although toxic phytoplankton have been detected in higher concentrations during the warmer months.

Such incidences have all been detected by regular testing and no illness from biotoxin events has been recorded, this may change in the future due to climate change.

The use of fortnightly sampling frequency is the norm in Australia during summer where the occurrences of regular biotoxin events have not been demonstrated.

Internationally phytoplankton testing is a supportive role to flesh testing, and testing occurs weekly. It is unlikely that the shellfish industries in SA can sustain a weekly monitoring program based on water sampling or shellfish sampling at this stage. This may change in the future with the onset of climate change and ocean warming.

Once more biotoxin data has been accumulated; a biotoxin risk assessment of the area will be produced. Risk assessments are evolving, and amendments may be made as data is collected. The current risk assessment is dated September 2021.

Sample frequency may change based on the risk assessment, the criteria for sample frequency is outlined below.

Low risk. No history of biotoxin events. Monthly testing until data supports no testing.

Medium risk. Area affected by algal blooms and biotoxins detected on regular basis. Fortnightly testing.

High risk. Area affected by frequent biotoxin closures. Weekly testing.

Based on advice from DAFF, sampling frequency in SA shall be:

- Fortnightly water sampling supported by monthly monitoring for biotoxins throughout the year.
- Monthly water sampling shall occur in the colder months (April - September).

Each harvesting area will be sampled for phytoplankton roughly 20 times per year (this is not always possible due to weather conditions). Sampling frequency will increase to weekly or higher if Action Level 1 breaches occur or if biotoxins are detected in shellfish. When this occurs, weekly sampling will occur until a definite and sustained trend of safe levels is maintained.

Where biotoxins in levels of concern have been demonstrated in shellfish, weekly water sampling shall continue for a minimum of one-month (4 weekly samples) after the occurrence of the second of two negative (below health standard) biotoxin tests have allowed opening of the harvesting area, or an area shows an increase in the abundance of a particular toxic phytoplankton species, additional samples are collected to help determine any trends.

Such information on population trends is used to decide whether other interventions are necessary.

Methodology

The method of collected samples must be quality controlled and be uniform across sampling events, if meaningful conclusions are to be drawn from the results.

The Standard Operating Procedures for Sample Collection (P-301) contains the exact methodology for collection of phytoplankton samples.

This method is used to train sample collectors to minimise variation in technique.

Phytoplankton sampling should be aimed at providing quantitative results to support management decisions. For this reason, integrated water samples are preferred over net tows.

The use of a Niskin or Kemmerer sampling bottles is recommended for samples at depths greater than 4 m.

Net tows are used when it is necessary to concentrate cells for the purpose of identification, culture initiation or to determine biotoxin content. They may also be used in determination of the extent of a “bloom” event.

3.1.2 Testing

Enumeration of phytoplankton is performed as detailed in the method, Identification and Enumeration of Marine Phytoplankton by the Filtration Method (P-050).

The following types of phytoplankton enumerations are performed at the SASQAP Laboratory, Port Lincoln.

Appendix 5 contains a list of toxin-producing phytoplankton species known to be present in South Australian waters which are monitored. SASQAP must always be able to identify those species listed in *Appendix 5*.

Appendix 6 contains a list of phytoplankton species that have been associated with toxic blooms in other parts of the world.

SASQAP must be aware of all species listed in *Appendix 6* and be confident of identifying them should they appear in a sample.

SASQAP must review this list at least annually and transfer species to the most appropriate list accordingly. This is especially true if a particular phytoplankton species is later shown to be a toxin producing organism and therefore a risk to public health.

3.1.3 Reporting

All results are recorded into an electronic database, which must be secure from interference.

The procedure for entering results into the databases is outlined in standard operating procedure Handling, Storage and Disposal of Specimens (G-008).

3.2 Biotoxin Monitoring

Shellfish sampling for biotoxin analyses needs to occur to confirm the presence of a particular toxin following detection of elevated levels of toxic phytoplankton. This is termed a 'triggered response'. Shellfish also bio-accumulate toxins through the filtration process.

Routine biotoxin monitoring also occurs at high-risk times to support the lack of biotoxin in shellfish without the presence of elevated levels of toxic phytoplankton. This is termed 'routine biotoxin monitoring'.

3.2.1 Sampling

Routine Biotoxin Monitoring

All types of toxins except NSP, which is tested in export areas and where *Karenia spp*. are identified, will be on a monthly basis unless the history of the area through a risk analysis indicates otherwise.

Shellfish collected must be at the site for a minimum of two weeks prior to the collection date. Optimally this should be several months.

Sample size should always be a minimum of 20-30 full size harvestable shellfish. Larger numbers of smaller shellfish may be collected if they represent all that is available.

The outcome is to have approximately 100 grams of shucked, drained shellfish meat for testing. This may be divided before testing.

Shellfish samples must be transported so they arrive at the testing laboratory within 24 hours of collection.

- They must be frozen, cold, packed with ice packs (not wet ice) - to maintain a temperature of 10°C or less.

NOTE: Biotoxin testing will occur once a month per year, 12 annually for all harvesting areas within the state.

Harvesting areas listed for EU Export will require fortnightly from October to March.

Section 3 outlines the biotoxin tests required and the regulatory limits, Neurotoxic shellfish toxins are not routinely tested in South Australia unless warranted i.e. a new *Karenia* species detected in phytoplankton samples.

Procedure for processing biotoxin samples

Procedure (P-301) outlines the processing requirements for biotoxins.

Triggered Response Testing

Consideration should be given to what is the most appropriate species to test for maximum detection of toxin. Some species have been shown to accumulate toxin at different rates. (Burgess, 2002). Usually however, the species of bivalve shellfish grown and harvested in an area will be collected for biotoxin testing.

Sometimes a sentinel species of bivalve, (*e.g.* blue mussels or razorfish) will be tested in lieu of farmed shellfish, because of their greater propensity to accumulate biotoxins or because of their normal location within the water column. The results of biotoxin testing on these sentinel species enables the toxin producing potential of a particular phytoplankton species to be inferred while cell numbers are relatively low.

A minimum of 10 full size shellfish (100 grams) should be collected for analysis for single class of biotoxin. These shellfish must be at the site for a minimum of two weeks prior to the first detection of the trigger value that initiated testing. This means that in a biotoxin event shellfish must only be tested that have been at that site for the entire duration of the event.

3.2.2 Testing

SASQAP has a contract arrangement with Analytical Services Tasmania. The laboratory uses AOAC and APHA approved methods, and their service delivery and expertise has been excellent.

- Domoic Acid and Lipophilic Toxins in Shellfish using LC-MS/MS.
- Paralytic Shellfish Poisoning (PSP) Toxins by LC-MS/MS (Boundy Method).

All shellfish samples will be shucked and frozen for despatch to Tasmania overnight and followed by a result within 3-7 days.

The exact protocol for this activity has been detailed (G-008) and needs to be followed in detail. A list of external agencies that offer biotoxin and other phytoplankton services are listed in Appendix 3.

All toxicity testing methods that are not AOAC or APHA approved will be regarded as screening methods only.

There are four groups of biotoxins that accumulate in shellfish and cause ill health to humans.

These are:

Paralytic Shellfish Poisons (PSP)

Produced by certain dinoflagellates including *Alexandrium sp* and *Gymnodinium catenatum*

Regulatory Level	**0.6 mg/Kg**
Test of choice	***LC-FD (Lawrence method)***
Limit of reporting	***0.025 mg/kg***

Amnesic Shellfish Poisons (ASP)

Specific agent is Domoic Acid. Diatoms belonging to the genus *Pseudo-nitzschia* produce this toxin. Most species of *Pseudo-nitzschia* are not toxic. However, it is difficult to differentiate between toxic and non-toxic species using conventional light microscopy. In practice, all *Pseudo-nitzschia sp* are assumed to be toxic if identification cannot be positively determined and meat testing for ASP is used to resolve the issue.

Regulatory Level **20 mg/Kg**
Test of Choice ***LCMSMS***
Limit of reporting ***0.025 mg/kg***

Diarrhetic Shellfish Poisons (DSP)

Dinoflagellates with the potential to produce DSP include *Dinophysis acuminata*, *D. caudata*, *D. acuta, D. fortii* and *Prorocentrum lima*. (This list is not meant to be exhaustive).

Regulatory level **0.16 mg/Kg**
Test of Choice ***LCMSMS***
Limit of reporting ***0.025 mg/kg***

Neurotoxic Shellfish Poisons (NSP)

Prior to 2025, NSP had not been found in Australia. *Karenia brevis, K. papilionacea, K.selliformis and K. bidigitata* have been associated with NSP illness outside of Australia (New Zealand).

Regulatory level **200 MU/kg**
Equivalent level **0.8 mg/kg**
Test of Choice ***Bioassay following ether extraction***

There are some toxins of concern in other parts of the world for which full risk assessments have not been completed by FSANZ. The regulatory levels for these toxins have not been set, a voluntary closure will occur in shellfish harvesting areas when these toxins are found at levels of concern, for example:

Toxin Group	Maximum Limit (New Zealand Specifications for Bivalve Molluscan Shellfish and European Union (Directive 2002/225/EC))
*Yessotoxin (YTX, 45 OH YTX, homo YTX and 45 OH-homo YTX)	1 mg/kg
AzASTiracid Poison (AZA1, AZA2, AZA3)	0.16 mg/kg

* Note: that the toxicity of yessotoxin is yet to be confirmed.

3.2.3 Reporting

- Upon receipt of biotoxin results (e-mail), results will be entered into the database.
- Attach all worksheets to hard copies of final reports and file within growing area file in the central file.

3.3 Emergency Sampling

Emergency sampling will be instigated when the levels of a particular species of toxic phytoplankton exceed the Action Level 1 values listed in Appendix 5. Emergency sampling will also be instigated if any other information suggests that the risk of biotoxin contamination of shellfish is increasing. At this time, the number of sampling stations and frequency of sampling will be increased. The following emergency water and shellfish sampling protocol shall be followed during a marine biotoxin bloom event.

- Relevant groups will be notified (see Section 5.0).
- Investigation of biotoxins in areas where potentially toxic phytoplankton levels are rising.
- Sampling strategy will be conducted according to that stated in the biotoxin contingency plan for the growing area. The extra sites to be sampled are designated in the plans along with the routine sites.
- Additional water sampling will be established to determine the spatial extent of the toxicity. The number will vary depending on the size and configuration of shellfish farming sites. But at least three should be taken.
- Additional samples should be taken from adjacent areas to adequately monitor the possible spread of the bloom to these areas.
- Shellfish meat samples will be taken from representative locations within the affected area to determine the extent of contamination and trends in biotoxin concentrations. To monitor these trend samples of shellfish may need to be collected weekly. If biotoxin levels are sufficiently high that a closure is imposed and the restriction on shellfish harvesting is likely to be prolonged, sampling may be done less frequently, and preformed when there is a decline in phytoplankton levels.
- The sampling strategy must ensure that the criteria for re-opening apply throughout the whole area.
- Results of analyses should be known within no more than 7 days of sampling.
- Sampling will be ongoing until the levels of biotoxins in two successive samples are below prescribed levels and the trend in biotoxin concentration is decreasing.

3.4 External Agencies

Appendices 2 and 3 lists the organisations that can provide analytical services for phytoplankton analysis of water samples, biotoxin analysis of shellfish meat and chemical analysis of seawater for nutrients.

4 Closure and Opening Protocol

4.1 Closing Criteria

The Minister or the Minister's delegate will close a shellfish growing area to the harvesting and movement of all shellfish immediately (or within 24 hours) based on the following criteria:

- A toxic species of phytoplankton is detected in the harvesting area above Action level 2 for any species of toxic phytoplankton. These are listed in full in Appendix 5.
- Marine biotoxins are detected in shellfish exceeding the prescribed regulatory concentrations for that class of biotoxin. These are listed in full in Appendix 8.
- Cases of human illness have been confirmed or suspected to come from shellfish consumption. Advice of such cases would normally be notified to SASQAP from the SA Health and would be accepted as fitting the case definitions for PSP, DSP, ASP and NSP. SA Health contacts are listed in Appendix 1.

Industry Instigated Closure

Industry may choose to instigate a voluntary closure based on criteria such as toxins in adjacent areas, rising levels of toxin in shellfish, rising levels of toxic phytoplankton, or any other criteria deemed important enough to necessitate a closure.

When sufficient data exists to establish that certain shellfish species or shellfish products do not accumulate marine biotoxins, then these species may be exempt from biotoxin closures.

For example, scallops are not a biotoxin risk when sold with the roe off.

Specific shellfish species may also be exempt from marine biotoxin closures when adequate data exists to demonstrate that the species complies with standard 1.4.1 of the Food Standards Code, however, regular testing must be conducted on the species in question during the open status. i.e.: Biotoxin tests show that mussels have PSP toxins above the maximum levels in standard 1.4.1, whereas oysters are consistently showing no PSP. In this case the harvesting area could be closed for mussel harvest whilst allowing the harvesting of oysters to continue.

4.2 Closure Protocol

Upon determination that conditions for a closure exist the Minister or Minister's delegate will:

- Complete a closure notice detailing date, time and reason if appropriate. The document is saved in specific growing area closure file in Objective (Objective is the PIRSA-wide Electronic Document and Records Management System) and the closure spreadsheet, also stored in Objective, is updated immediately along with the SASQAP closure file situated on the PIRSA website – SASQAP shellfish harvesting statuses.
- Notify all growers, officials, and processors by e-mail a copy of the closure.
- A SMS text message is also sent via e-mail to all growers to ensure they are notified as soon as possible.
- Should the e-mail report that a grower did not receive the closure notice, a follow up e-mail or phone call may need to be made.

- The closure document will be stamped, signed, dated and then be filed in Objective, Seafood, Compliance and Monitoring Folder.
- Notify the specific harvesting area Liaison Officer by phone or visit immediately.

4.3 Opening Criteria

The decision to re-open a harvesting area will consider the following information.

- Biotoxin testing of the edible portion of shellfish meat from representative sites, on two consecutive tests a minimum of a week apart is below the regulatory level and decreasing or static for the type of biotoxin originally present.
- No cases of human illness, notified to SA Health and consistent with the case definitions for PSP, DSP, ASP and NSP, shall have resulted from the consumption of shellfish harvested since the date of collection of the first clearance sample from within or adjacent to the closed area.

Resumption of harvesting shall be accompanied by increased monitoring for at least 4 weeks following any closure event.

Where appropriate, shellfish from adjacent areas shall be sampled and the results shall have been evaluated for their relationship to the area to be opened.

4.4 Opening Protocol

Upon determination that conditions to open an area exist, the Minister or Minister's delegate will open the closed area by:

- Completing an open notice detailing date, time and reason if appropriate. The document is saved in specific closure file and the closure spreadsheet is updated immediately along with the SASQAP closure file situated on the PIRSA website – SASQAP shellfish harvesting statuses.
- Notify all growers, officials, and processors by e-mailing a copy of the open notice.
- A text message sent via e-mail to all growers.
- Should the e-mail report that a grower did not receive the open notice, a follow up e-mail or phone call may need to be made.
- The open notice will be stamped, signed, and dated and then be filed in the closure folder.

SASQAP shall, on each re-opening event prepare documents including the data, environmental conditions and factors leading to the decisions to aid in the future risk analysis.

5. Reporting and Notification

5.1 Communication

A network of liaison officers has been established in each shellfish harvesting area. The liaison officers are elected from the group of growers in a local harvesting area. They provide a communication link between industry and government.

A Memorandum of Understanding has been signed between the SA Health (formerly the SAHC) and PIRSA. This document defines the responsibilities of both organisations in respect to marine biotoxin events.

Required actions during a biotoxin incident will be coordinated through the SASQAP Program Leader, and Food Safety Program.

5.2 Early Warning of Bloom Events

Environmental phenomena such as water discolouration, visible algal blooms, and abnormal behaviour of shellfish or marine scavengers and mortalities of marine biota (which may indicate the presence of toxic phytoplankton) should be rapidly communicated to the SASQAP Program Leader.

There are three main elements in responding to a possible toxic algal incident.

- The initial report - This can come from local SASQAP Liaison Officers, who are likely to receive information from the local communities relating to unusual environmental disturbances. More often the initial warning will come from the routine phytoplankton monitoring program. Occasionally, reports of human illness due to possible consumption of toxic shellfish will be received by the SA Health. All such information must be reported to the SASQAP Program Leader promptly.
- Official notification - The SASQAP Program Leader must report the incidents to the relevant statutory authorities / government agencies in writing within 24 hours.
- Evaluation - The possible biotoxin incident or toxic phytoplankton bloom is assessed so that an appropriate scale of response can be initiated. The initial assessment should include weather and tidal conditions, location and distribution of the toxic phytoplankton and the species identification.

5.3 Media Release

The public should be made aware of a harvesting area closure in areas especially where there is a perceived risk from recreational fishing of shellfish.

This needs to be controlled or misinformation may be released to the public. This procedure should follow established protocols and should include the release of media statements by the Environmental Health Branch of SA Health in consultation with the SASQAP Program Leader and Food Safety Program.

5.4 Patrol of Harvesting Areas (Surveillance)

The compliance unit of PIRSA – Fisheries and Aquaculture undertake surveillance to ensure that harvesting does not occur during closure events. They may also need to patrol or issue signage at access points, such as boat ramps, advising the public of the closure and the reason for it and

to advise against consuming shellfish from within the closed area. Signage should be removed once areas are re-opened.

DAFF is also contacted to ensure no shellfish have been allowed to leave the country.

It may be necessary to hold public meetings with relevant groups (including regional recreational fishing committees) and community leaders to discuss means of ensuring that recreational shellfish harvesting ceases.

6. Investigation of Poisoning due to Toxic Shellfish

6.1 Notification

All suspected cases of toxic shellfish poisoning are notifiable as cases of suspected food borne illness to the Environmental Health Branch of the SA Health. It is the responsibility of SA Health to ensure that general practitioners are aware of the need to notify suspected cases so that these can be followed up.

6.2 Investigation

Where toxic shellfish are suspected of being the cause of an illness, it is the responsibility of the SA Health to determine the source of the contamination and the method of handling of the shellfish.

This investigation may require an exchange of information between SASQAP and SA Health.

Copies of completed case investigation reports shall be sent to the SASQAP Program Leader and maintained in a central file.

6.3 Immediate action to be taken when food poisoning from Toxic Shellfish is suspected or confirmed

- Restrictions. Where investigation suggests that toxic shellfish may be the cause of the incident, SASQAP must place immediate temporary restrictions on harvesting by growers and commercial and recreational fishers pending the results of more detailed investigations.
- Control of the movement of harvested shellfish. SA Health shall determine the pattern of movements of all harvested shellfish from the suspected area of biotoxin contamination. This trace back of possibly contaminated product should be facilitated by the requirement on growers to correctly label their shellfish stock and the requirement on processors to keep records of all shellfish transactions and movements.
- Notification. Notices should be displayed in prominent places near the areas of harvesting. The notices should warn the public that shellfish are unsuitable for human consumption. News media should be used to inform the public of precautions to be taken to prevent harvest of contaminated shellfish from recreational harvesting areas.
- Restrictions on harvesting areas should be accompanied by immediate additional sampling in the affected area to determine the precise levels of toxin present. Samples of shellfish as well as water samples should be taken.
- The level of toxin in molluscs should be determined at appropriate intervals. There is no acceptable method of detoxifying the shellfish and the harvesting of shellfish must cease until regular monitoring demonstrates that the level of toxin has fallen below the regulatory limits (Appendix 8).

- Interagency communication. Immediately following an outbreak, liaison needs to be established with the following organisations and individuals.

    - PIRSA - Fisheries and Aquaculture
    - SA Health
    - DAFF
    - Laboratory personnel involved in phytoplankton analyses (Appendix 2)
    - Laboratory personnel involved in biotoxin analyses (Appendix 3)
    - All commission agents and shellfish processors
    - SARDI Aquatic Sciences.

- Product recall / detention procedures should be instigated immediately with cooperation through SA Health, PIRSA and industry.
- It may be possible to reduce the size of the area subject to harvesting restrictions depending on the outcome of the test results.
- During investigation of suspected cases of illness additional sampling will be necessary. These samples may comprise the remains of meals, samples of commercial product from the same batches of product as that consumed, and samples taken from the areas where the suspect shellfish was harvested. Samples taken need to be sufficiently large (at least 100 gm flesh weight) to allow analysis for alternative aetiological agents such as bacterial, viral of chemical contamination.
- The costs of investigating toxic shellfish poisoning incidents are likely to be significant PIRSA and SA Health should negotiate the costs likely to occur and what funding arrangements form either agency are available.

7 Product Control

7.1 Product Withdrawals/ Recalls

When harvesting areas are closed due to the presence of marine biotoxins, product may need to be withdrawn, recalled or detained. Normally, regular phytoplankton monitoring of each of the harvesting areas will provide an early indication of biotoxin contamination so that harvesting restrictions can be applied before shellfish with unsafe levels of biotoxins are to reach the consumer. Occasionally, such early warning may prove inadequate.

When sampling suggests that shellfish with unsafe levels of biotoxins have been harvested from a particular area, product will need to be withdrawn/recalled.

The withdrawal/recall will include product harvested since the date of the *last sample* that had satisfactory biotoxin levels indicated by either the presence of toxic phytoplankton below the prescribed levels for initiating closures (Action 2 level in Appendix 5) or the measured levels of biotoxin in shellfish flesh were below the regulatory limit in Appendix 8.

Withdrawal/Recall of product harvested from areas closed due to the presence of marine biotoxins is the responsibility of the growers, carriers, manufacturers, processors, distributors, and retailers of affected product. The withdrawal/recall shall be instigated within 24 hours of the harvest area closure. Each handling or packing premises should be required to have an effective

withdrawal/recall plan in place. SA Health is legally empowered to recall or detain product under the Food Act and would exercise that power when necessary.

All sales to restaurants and retail outlets (domestic and export) must be traceable not only to the harvest area but to the licensed grower or commercial fisher. All packaging carries an identification label or tag in accordance with the following:

A durable, waterproof tag is affixed to each container of shellfish by the harvester, showing the following information:

- Species of shellfish
- Food Safety Accreditation Number
- Aquaculture Licence number
- Name and address (optional) of business
- Date of shellfish harvest
- Name of the area as specified by SASQAP where the shellfish were harvested
- Quantity of shellfish in the shipment e.g. dozen or bag (optional as may appear on sales invoice)

The tag is applied to a container of shellfish at the time of harvest once the shellstock are cleaned.

These details are inscribed on all documentation and packaging to the final point of consumption and accompany individual consignments.

Where product has gone beyond the distribution chain to consumers, consumers who have purchased the product will need to be warned.

For a recall to be effective, advertising should occur in all areas where the product is distributed. This may require a media release or paid advertising in newspapers, on radio or on television.

This must occur as soon as possible, preferably within 24 hours of an area closure. If necessary, SA Health will issue a media statement advising the public not to consume shellfish harvested from the affected area.

Where appropriate shellfish and shellfish products should be held by the processor until biotoxin test results from the area show that levels are safe (i.e. below the regulatory limits).

8. References

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Hallegraff, G.M. **2001**. Aquaculturists' Guide to Harmful Australian Microalgae. CSIRO Australia, Hobart, Tasmania.

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P-050: Identification and Enumeration of Marine Phytoplankton by the Filtration Method. South Australian Shellfish Quality Assurance Program (SASQAP) Quality Manual: Standard Methods.

P-301: Standard Operating Procedures for the Collection of Samples for Submission to the SASQAP Laboratory. South Australian Shellfish Quality Assurance Program (SASQAP) Quality Manual: Standard Methods.

G-008: Handling, Storage and Disposal of Specimens. South Australian Shellfish Quality Assurance Program (SASQAP) Quality Manual: Standard Methods.

Appendix 1 Contacts

Agency and Personnel Contacts		
Agency	**Title**	**Phone**
DAFF	Assistant Director, Dairy, Eggs & Fish Export Program	(02) 6272 4978
DAFF	SA DAFF Officer	(08) 8201 6117
PIRSA – SASQAP	SASQAP General Manager	(08) 8688 3409
PIRSA – Fisheries and Aquaculture	Aquaculture General Manager	(08) 82075332
PIRSA – Fisheries and Aquaculture	Regional Manager West	(08) 8688 3497
SA Health	Senior Scientist	(08) 8226 7153
SA Health	Supervisor Environmental Services Unit	(08) 8226 7155
SA Health	Regional Environmental Health Officer	(08) 8621 2320
Food and Environment Lab	Manager Food & Environmental Lab.	(08) 8222 3194

Appendix 2 Approved laboratories for phytoplankton enumeration and identification

List of external services provided for phytoplankton enumeration and identifications		
Agency	**Address**	**Capability**
Microalgal Services	338 Jasper Road Ormond Victoria 3204	Phytoplankton Counting/ identification Electron microscopy Cyst surveys
Cawthron Institute New Zealand	98 Halifax Street East Private Bag 2 Nelson New Zealand	Phytoplankton counting and identification
Australian Water Quality Centre SA Water Corporation	Hodgson Road Bolivar South Australia 5110	Phytoplankton counting Nutrients

Appendix 3 Approved laboratories for biotoxin analysis

List of external services providers for Biotoxin and Chemical Analysis of Shellfish Tissue		
Agency	**Address**	**Capability**
Analytical Services Tasmania	18 St Johns Avenue, New Town, Tasmania, 7008	PST by HPLC (Lawrence Method) DST & AST by LCMSMS (Liphophilic analysis)
Cawthron Institute New Zealand	98 Halifax Street East Private Bag 2 Nelson New Zealand	DST – HPLC-MS PST HPLC Domoic acid - HPLC

Appendix 4 Phytoplankton sampling sites

Phytoplankton Sampling Sites			
Location	**Location Code**	**Longitude**	**Latitude**
Denial Bay	DB10A	32 07 626	133 35 954
St Peters Island	SP 02A	32 12 957	133 41 302
Smoky Bay – Waterwitch site	SMB13A	32 20 305	133 53 710
Smoky Bay – Smoky Bay site	SMB10A	32 22 558	133 53 311
Haslam	HA 90A	32 31 832	134 11 686
Streaky Bay – Eba Island	STB16A	32 38 525	134 14 419
Streaky Bay – The Hummocks	STB12A	32 43 104	134 12 085
Streaky Bay – Blancheport (entrance)	STB11A	32 44 228	134 13 793
Port Douglas	PD 90A	34 32 770	135 22 703
Mt Dutton Bay	MDB90A	34 34 465	135 26 203
Kellidie Bay	KEL07A	34 36 490	135 29 443
Bickers Island	BI 03A	34 45 054	135 57 199
Proper Bay	PB 06A	34 47 300	135 52 845
Boston Bay	BB 13A	34 39 430	135 53 916
Lower Eyre	LE01A	34 39 464	135 56 994
Louth Bay	LTH01A	34 36 148	135 56 603
Franklin Harbour	SWB90A	33 45 130	136 54 293
Port Vincent	PV 05A	34 45 856	137 53 493
Coobowie	CW 04A	35 03 489	137 45 147
Stansbury	ST 05A	34 53 907	137 49 533
Western Cove	WK 03A	35 43 657	137 39 437
American River	AR 03A	35 46 682	137 47 451
Venus Bay	VB 01A	33 13 342	134 40 354

GPS format: Degrees minutes seconds

Appendix 5 Phytoplankton species known to be present in SA and associated action levels

South Australian Marine Biotoxin Plan Phytoplankton Action Levels			
Phytoplankton Species	**Type of Toxin**	**Action Level 1** Level in water sample to initiate flesh testing	**Action Level 2** Level in water to initiate closure pending flesh testing results
Alexandrium minutum[2]	PSP	200 cells/L	500 cells/L
Alexandrium ostenfeldii[2]	PSP	200 cells/L	500 cells/L
Alexandrium catenella[2]	PSP	200 cells/L	500 cells/L
Alexandrium tamarense[2]	PSP	200 cells/L	500 cells/L
Pseudo-nitzschia delicatissima group	ASP	500,000 cells/L	500,000 cells/L
Pseudonitzschia Serita group *P. multiseries and P. australis*	ASP	50,000 cells/L	500,000 cells/L
Gymnodinium catenatum	PSP	1000 cells/L (Mussels)	5000 cells/L
		2000 cells/L (Other shellfish)	
Dinophysis acuminata	DSP	4000 cells/L	5000 cells/L
Dinophysis acuta	DSP	1000 cells/L	2000 cells/L
Dinophysis caudata	DSP	1000 cells/L	2000 cells/L
Dinophysis fortii	DSP	1000 cells/L	2000 cells/L
Prorocentrum lima	DSP	500 cells/L	1000 cells/L
Karenia spp	NSP	>1 cells/L	To be determined

[1] The cell levels within each toxin group are cumulative, e.g 600 cells/L of both *D.acuminata* and *D. acuta* would mean a total of 1200 cells/L.

[2] *Alexandrium* species may be difficult to identify when numbers are low. If any doubt exists, they should be treated as potentially toxic.

[3] Species within the Pseudo-nitzschia groups are difficult to identify under the light microscope. Generally due to their life cycle, and changes in morphological characteristics, therefore all *Pseudo-nitzschia sp*. will be treated as potentially toxic.

Appendix 6 Potentially Toxic Algal Species

The species listed in the IOC-UNESCO Taxonomic Reference List of Harmful Microalgae have been associated with toxic blooms (some unconfirmed) in other areas of the world. It is recommended that the monitoring officer be aware of these species.

Lundholm, N.; Bernard, C.; Churro, C.; Escalera, L.; Hoppenrath, M.; Iwataki, M.; Larsen, J.; Mertens, K.; Murray, S.; Probert, I.; Salas, R.; Tillmann, U.; Zingone, A. (Eds) (2009 onwards). IOC-UNESCO Taxonomic Reference List of Harmful Microalgae. Accessed at https://www.marinespecies.org/hab on 2025-11-19. doi:10.14284/362

Appendix 7 Toxic Shellfish Poisoning Case Definition

The following case definition covers all forms of shellfish poisoning.
A more detailed and updated comprehensive definition for each toxin group can be found at:
http://www.whoi.edu/redtide/illness/illness.html.

Surveillance Case Definition for all Forms of Toxic Shellfish Poisoning

Suspected case (general clinical case definition)
Vomiting or diarrhoea occurring within 24 hours of consuming shellfish; or any of the following neurological symptoms occurring within 24 hours of consuming shellfish:

Neurosensory
Paraesthesia, i.e. numbness or tingling around the mouth, face or extremities
Alternation of temperature sensations such as a prickly feeling on the skin during a bath / shower or exposure to sun, or difficulty distinguishing hot or cold objects.
Neuromotor/neurocerebellar:
Weakness such as trouble rising from seat or bed
Difficulty swallowing
Difficulty breathing
Paralysis
Clumsiness
Unsteady walking
Dizziness/vertigo
Slurred/unclear speech
Double vision;
Or one or more of the following neurological signs/symptoms occurring within 48 hours of consuming shellfish:
Confusion
Memory loss
Disorientation
Seizure
Coma

Reference: Cawthron Report No. 645 Australian Marine Biotoxin Management Plan for Shellfish Farming November 2001 Appendix 11 – 2

Appendix 8 Marine biotoxin regulatory closure limits

Marine Biotoxin Regulatory Closure Limits		
Type of biotoxin	**Food Standards Code Regulatory Limit+**	**Method of analysis**
Paralytic Shellfish Poison (PSP)	≥0.8 mg/Kg of saxitoxin	HPLC* Lawrence method
Amnesic Shellfish Poison (ASP)	≥ 20 mg Domoic Acid / Kg edible shellfish flesh	**LC-MS/MS*** HPLC
Diarrhetic Shellfish Poison (DSP)	≥ 0.16 mg / Kg edible shellfish flesh ≥ 0.16mg / Kg Export	**LCMS*** / LCMS Hydrolysis
Neurotoxic Shellfish Poison (NSP)	≥ 200 mouse units (MU) / kg edible shellfish flesh	**Ether extraction and mouse bioassay*** (6 hours max observation time) **LC-MS/MS***

+ Maximum levels of non-metal contaminants as of November 2025. Refer to Schedule 1.4.1 of the Australia and New Zealand Food Standards Code

* Indicates Test of Choice.

Note **:** LCMS Hydrolysis allows increased levels of Okadaic Acid and DTX-1 toxins to be demonstrated. The regulatory level of toxins within this group shall be the total of all LCMS results including that released by hydrolysis. The analyses will be performed at the Cawthron Institute and there may be some delays with providing the hydrolysis results subsequent to routine LCMS.

Appendix 9 Biotoxin testing regime

SASQAP Biotoxin Testing Regime	
Growing/ Harvesting Areas	**Analytical Services Tasmania**
Coffin Bay - Port Douglas - PD-sb	✓
Coffin Bay - Mt Dutton Bay - MDB-sb	✓
Coffin Bay -Kellidie East - KEL-7sb	✓
Coffin Bay - Kellidie West - KEL-9sb	✓
Coffin Bay Harvesting Area COB-sb	✓
Denial Bay - DB-sb	✓
Denial Bay - St Peters Island - SP-sb	✓
Smoky Bay - SMB-10sb	✓
Smoky Bay - Waterwitch - SMB-13sb	✓
Haslam - HA-sb	✓
Streaky Bay - Blancheport - STB-8sb	✓
Streaky Bay - The Hummocks - STB-12sb	✓
Streaky Bay - Eba Island - STB-16sb	✓
Venus Bay - VB-sb	✓
Port Lincoln – Boston Bay	✓
Port Lincoln – Bickers Island	✓
Port Lincoln – Lower Eyre	✓
Port Lincoln – Proper Bay	✓
Franklin Harbour - SWB-sb	✓
Central Yorke - Port Vincent - PV-sb	✓
Stansbury - ST-sb	✓
Coobowie - CW-sb	✓
Nepean Bay - American River - AR-sb	✓
Nepean Bay - Western Cove - WK-sb	✓
Coorong - COR-sb	✓