Sea wrack at Wynnum foreshore

A study of causes, impacts and management

Prepared by: EMAS-IAA, Department of Environment and Science

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*\* Department of Environment and Science, GPO Box 2454, Brisbane, Qld 4001, Australia*

*\*\* Australian Rivers Institute, Griffith University, Nathan Q 4111, Australia*

*\*\*\* Department of Health, PO Box 594, Archerfield, Qld 4108, Australia*

*\*\*\*\* Air quality consultant, Byron Bay NSW, Australia*

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# Introduction – setting the scene

The issue of odours in Wynnum and other Moreton Bay locations has been the subject of considerable media attention over several years. Community newsletters, city and local newspapers, a petition, and social media feature commentary and complaints from residents and refer to the odour problem in a range from “unpleasant” through “foul and disgusting”, to a “vile stench”.

Commentary has placed the blame on a variety of sources such as local industries and sewage, but the overwhelming responses have been that the problem lies with sea wracks putrefying. Sea wrack is the accumulation of organic material washed up on beaches and can include seagrass, macroalgae and blue-green algae. While complaints are distributed throughout the year, it is the summer months when the loss of amenity is at its peak, when both residents and visitors are more likely to be using the foreshore areas for recreation.

Although the issue is the result of natural processes, worsened by human activities such as increased loads of sewage, fertiliser etc., social media comments invariably ask what can be done to reduce and preferably eliminate the problem and why more isn’t being done. There also appears to be confusion as to which agency is responsible and what permits and approvals are required.

The purpose of the study is to collate currently available information on the causes, potential health concerns and management options for sea wracks.

To determine how and when the problem occurs the DES has engaged the services of several experts who can comment on odour and water quality, the processes which cause biological material to form and to accumulate on shorelines, and whether there are any health concerns and reasonable control options.

Anecdotal evidence suggests that the problem is an odour issue with records of complaints and media commentary. Given its complexity and subjectivity, assessment of odour impacts normally requires specialised advice (Refer to [Nuisance – odour](#_Nuisance_–_odour) section). The scope and timeframe of this project did not allow for a full odour study to be completed. This would include odour identification and quantification of the problem, as well as other aspects such as an assessment of the impacts of the odour on amenity in affected areas. However, analysis of the available information can guide us as to the likely source.

There have been anecdotal reports that blooms of the toxic cyanobacterium *Lyngbya majuscula* in northern Deception Bay have been increasing in severity and frequency since 1992 1. Documenting of algal blooms has been undertaken by DES 2,3 and some background information is available from DES 4. Studies indicate that *Lyngbya* *majuscula* blooms are at times a source of odours 5. Although seagrass and algal blooms appear the most likely source, it is possible that there are other local sources as well that can cause odour issues (i.e., sewage, local industries) on or near foreshores.

<https://ian.umces.edu/pdfs/ian_book_421.pdf>

2 <https://wetlandinfo.des.qld.gov.au/wetlands/assessment/monitoring/current-and-future-monitoring/lyngbya-monitoring-program.html>

3 <https://www.qld.gov.au/environment/coasts-waterways/marine-habitats/algae-blooms>

4 <https://environment.des.qld.gov.au/__data/assets/pdf_file/0025/90790/biological-assessment-background-information-on-freshwater-and-marine-microalgae-and-harmful-algal-blooms.pdf>

5 <https://moretonbayfoundation.org/lyngbya-majuscula-a-toxic-warning-sign-for-moreton-bay>

**Seagrass/algae wracks**

**What are the causes?**

Sea wracks are often found on the foreshore after strong winds (See Figure 1). The major source is from marine plants, such as seagrass, seaweed (= marine macroalgae) and filamentous algae. These plants may be ripped up during strong winds and pushed to the shore. In the case of filamentous algae, it may also be sloughed off the sea floor and be floating on the water surface until winds push it to the shoreline. Sea wracks can also include vegetation waste, e.g., branches, and other rubbish, like plastics.

**A picture containing outdoor, sky, ground, beach

Description automatically generated**

Figure :Sea wrack Thompsons Beach at Victoria Point

**Ecological Value**

Sea wracks play an important ecological role in natural areas through dune stabilisation, return of nutrient into the coastal environment and as key habitat for a variety of coastal birds, crabs, insects and other organisms essential to these coastal ecosystems.

**Seagrass**

Seagrass is a collective term for a number of species of marine plant that grows in beds in shallow waters of Moreton Bay (Maxwell et al. 2019). It grows naturally over large areas of the Bay. Seagrass needs light and nutrients for growth. Seagrass beds provide important habitat and feeding areas for many animal species, including fish, crustaceans, turtles and dugongs. Because seagrass grows in shallow environments, it is particularly vulnerable to disruption from strong winds and waves. This action can rip leaves from the plants which can be carried to the shore and accumulate as rafts of seagrass. Similar effects can happen for macroalgae which also grow in the Bay.

**Lyngbya**

The toxic cyanobacterium (= blue-green alga) *Lyngbya majuscula* is found naturally throughout the world, particularly in tropical and subtropical marine waters. Like other algae, it photosynthesises so needs light and nutrients for growth. This species forms mats on the sea floor that can grow in shallow waters of Moreton Bay where the sea floor characteristics, water movement, light and nutrient conditions are suitable.

In recent decades, the amount of *Lyngbya majuscula* in Moreton Bay has, at times, reached bloom proportions, and thick, black mats are formed (Albert, 2005, Ahern et al., 2008, see Figure 2 and Figure 3). When this happens, it can smother and kill seagrass beds, and affect the fish and other animals relying on these habitats (Watkinson et al. 2005, Pittman and Pittman 2005). *Lyngbya majuscula,* also known as fireweed, can cause burning or tingling sensations on the skin if clumps are encountered during recreational fishing, boating, or swimming. Additionally, excessive growth can result in mats to slough off and float throughout the Bay. Depending on the wind and current conditions, mats can wash up on beaches where they slowly decompose, causing bad smells. Touching the drying mats should be avoided. This decomposing material is likely to create more odour problems in warmer months when higher temperatures promote more bacterial activity. *Lyngbya majuscule* is a component of sea wracks in the Wynnum area at times.

|  |  |
| --- | --- |
| A body of water with a city in the distance  Description automatically generated with medium confidence  Figure 2: Floating mat of Lyngbya majuscula | A picture containing outdoor, water, nature, ocean  Description automatically generated  Figure 3: Lyngbya majuscula mat floating on the surface |

**So why do we get more blooms of *Lyngbya majuscula* in Moreton Bay compared with the past?**

Blooms cannot form without sufficient nutrients. During rainfall events, rivers can transport nutrients into the Bay (O’Neil et al. 2012). These nutrients come from erosion, fertilisers, treated sewage, and stormwater sources, just to name a few. The amount of nutrients going into the Bay increased greatly after European settlement when towns were established, and agriculture replaced forests. In recent years, nutrients from sewage have been reduced (Saeck et al. 2013) but there are still large loads of nutrients coming from the catchments because of soil erosion and fertiliser runoff. Over time these nutrients gradually accumulate, especially in the muddy bottom waters of the Bay. So, the Bay is ‘primed’ for blooms to occur because of this nutrient accumulation. Combine this with the right climate conditions – calm, sunny, warm conditions, such as can occur for weeks at a time in summer, and blooms are much more likely to occur (Hamilton et al. 2007, 2009, Kehoe et al. 2012).

It also seems that once a bloom has been established in an area of the Bay, for example, Deception Bay, the likelihood of blooms re-occurring in that location are higher (Hanington et al. 2016). This may be because of the accumulation of both seedstock of the algae and nutrients from previous blooms.

**How do we control *Lyngbya majuscula*?**

Controlling *Lyngbya majuscula* blooms is difficult as many of the simpler solutions, such as the use of chemicals, can have negative effects on other animals and plants in the Bay (e.g., Mattthijs et al. 2012). In the longer term, reducing nutrients in the catchment can have an impact in reducing the scale and frequency of blooms (O’Neil et al. 2012). Monitoring blooms can provide an early warning of the potential for blooms to wash up on the beaches and mudflats of the western Bay.

# What are the impacts?

## Nuisance – odour

**What is odour? How do we sense and recognise it?**

Odour is not a substance, but rather it is the effect of a mixture of certain types of gaseous compounds, known as odorants, that trigger our sensory system. When odorants are present in sufficiently high concentrations in the air, we recognise the presence of an odour.

The sensation of odour results from complex processes in the human nervous system (specifically the olfactory nerves) and the brain. Different types of olfactory nerves in the upper portion of the nose are triggered by different odorous chemicals. A particular mixture of odorants will send a unique set of signals to the brain. These signals are then processed in ways that include the use of memory and emotion to recognise and interpret the odour. Humans can distinguish many thousands of different odours from each other.

Whether an odour is perceived as pleasant or unpleasant depends on the nature of the substance(s) causing it and, importantly, it also depends on the individual’s perception, which is strongly influenced by memory and the context that the odour occurs in. Although most people can agree whether certain odours are pleasant or not, this is not always so.

Perception is an important factor in explaining why some people living near odour sources are annoyed and others are not. The other important factor is how we vary in our physiological sensitivity to odour: some people may barely smell something that is strong and possibly offensive to others. Together these factors help to explain why a community might have variations in the degree to which individuals are annoyed by a particular odour problem.

**The source-receptor model of odour impact**

In analysing an odour issue, it is important to understand the basic physical factors involved. An odour has a source, which might be large or small in area, weak or strong, human-induced, or natural. The chemical nature of the source is also extremely important, as discussed below. People who smell an odour are referred to technically as ‘receptors’, that is, individuals who ‘receive’ the odour. This occurs after the odour has been carried by the wind from its source to where the receptor is, in a process known as atmospheric plume dispersion. Dispersion of an odour plume depends on weather conditions, particularly wind speed, wind direction and air turbulence. Dispersion can be modelled mathematically to simulate or predict where an odour plume will travel and how strong it will be.

The sources of odour are many and varied, reflecting the fact that there are thousands of gaseous compounds that can cause an odour response in people. However, in the case of natural odour sources that are caused by the breakdown of biological matter, there are some key aspects, which are relevant to the Moreton Bay sea wrack issue. Vegetation, including seaweeds and algae, are made of various organic substances, which are marked by the fact that they contain carbon, and include varying levels of some important elements such as nitrogen and sulfur. Dead vegetation can decompose in several ways chemically, but the main aspect of concern is whether there is a significant oxygen level or not. Where oxygen is present, the decay processes produce off-gases that are different from when there is little or no oxygen (anaerobic conditions). Anaerobic decomposition often produces very unpleasant gases containing nitrogen or sulfur (amines and sulfides, for example) that can cause strong, unpleasant odours even at very low concentrations. We can postulate that if there are thick layers of dead algae and seaweed – both within shallow waters or on beaches - there will be depleted oxygen and hence anaerobic conditions: hence, the potential for the most unpleasant types of odours.

**Impacts of odour**

The main aspect of odour problems is that people become annoyed by what they perceive to be unpleasant odours. We generally have a sense that some odours are more pleasant than others, for example percolating coffee or fresh flowers versus raw sewage or rotting garbage. However, it is known that even normally pleasant odours can become unpleasant if they are too strong, too often and not invited. On the other hand, some smells are always unpleasant even if only rarely and barely detected.

Odour annoyance in communities is often considered to be explainable by what are called the FIDOL factors:

* Frequency (how often the odour is detected),
* Intensity (how strong it is),
* Duration (how long it lasts)
* Offensiveness (the degree of unpleasantness)
* Location (e.g., odours affecting the home are generally perceived less favourably).

The FIDOL factors are, to varying degrees, often considered in technical odour assessment studies. However, there are also other factors, sometimes called ‘soft’ factors, that can influence the level of annoyance. The soft factors deal with variations in perception between individuals: they reflect a person’s past experiences, their expectations, their economic relationship to the source of the odour, their state of health, and so on. While the FIDOL factors are able to be quantified, the soft factors are more qualitative.

**Annoyance or nuisance?**

Nuisance is a term often used in relation to the impact of odour. It tends to be used somewhat more loosely than it should be; legally, ‘nuisance’ has a meaning under common law that is more than simply being annoyed. The essential legal requirement for odour to be a nuisance is that it must be a result of repeated annoyance that is an unreasonable impost on a person’s expectation of amenity, particularly at home.

Odour policies and regulations in Queensland and other jurisdictions are generally intended to provide a technical and legally defensible way of describing, quantifying, analysing, predicting and assessing the acceptability of an odour that is impacting, or might be expected to impact, on a community. Generally, the aim is to minimise the risk of odour nuisance occurring. Odour studies might also focus on analysing the odour source such that methods for controlling its odour emissions can be evaluated, designed and recommended.

**Odour impact assessment**

For many situations, but especially involving the planning of a new industrial or agricultural activity that might generate odour, a formal odour impact assessment would be relevant. Such an assessment is often more involved and complicated than a typical air quality assessment. Whereas air quality monitoring and modelling can focus on specific chemical compounds (EPP Air 2019 air pollutants), ‘odour’ is a human sensation caused by a complex and dynamic mix of chemical compounds that is often not well defined. Nevertheless, scientists have developed a widely accepted standard method for measuring the strength (concentration) of any odour, known as dynamic olfactometry, which is based on a very tightly controlled use of the human response to odours using carefully designed equipment and methodology that conforms to an international standard. There are also accepted methods for modelling and predicting how much odour might affect an area around the odour source and what level of annoyance, if any, might be expected.

However, in the current situation there is no need to conduct such an assessment: it is well documented and accepted that objectionable odours are experienced from time to time by residents or visitors near the shoreline. Furthermore, there is relatively little value that could be added at this stage by attempting to measure and model the odour exposure in affected areas. However, chemical fingerprinting of the odour could possibly assist in understanding potential ways to reduce impact.

Although there is a relationship between odour strength (concentration) and its level of impact (annoyance), there is much subjectivity in how any individual will perceive the odour impact. For a given amount of odour exposure as determined by measurements or models, surveys of affected communities around the world show that there is significant variation in how different members of a community perceive the seriousness of the impact. Such surveys are often a useful alternative or supplement to measurement and modelling.

Where there is an existing odour exposure issue causing annoyance and complaints, the ultimate purpose of odour studies is to identify ways to solve the problem and test the effectiveness of proposed solutions. In typical cases involving industrial and agricultural odours, it is relatively straightforward to quantify the odour emissions, identify engineering options and design solutions.

In this case, there are major technical issues with trying to quantify the problem and, regardless, ready engineering solutions are not yet available. It is therefore appropriate that the key focus should be on understanding the nature of the odour sources, their causes, and what can be done to mitigate them. Given that there is a natural component to odours from shorelines, the ultimate objective here would be not to eliminate odours entirely but to mitigate the more serious effects that can be traced to processes that are exacerbated by human activities.

A recent study (Smith, 2017) investigated odourous compounds emitted from L. majuscula biomass. Common compounds included methyl sulphides and n-nonane, decane, 1,2-dichloroethane; 1,2,4-trimethylbenzene; 4-bromofluorobenzene and acetone. Smith (2017) states that the odour emitting properties of L. majuscula biomass are well known, and handling such material for sampling, transport, or processing of small amounts for microscopic examination can produce strong, pungent stench-like odours with a slight smell of the marine environment.

Additional anecdotal information from persons working in Moreton Bay suggests stagnant-shallow, dredged or sediment-associated bulk biomass material most frequently emits the strongest odours. Considering the nature of anaerobic processes in marine environments, particularly those associated with decay of bulk algal or cyanobacterial biomass, production of volatile sulphides, alcohols, alkenes, and potentially volatile fatty acids is not unexpected.

## Health and toxicity

The most relevant health issue associated with sea wracks in Moreton Bay is growth of the potentially toxigenic *Lyngbya majuscula* on sediment or attached to marine plants such as seagrass, periodically forming blooms under favourable environmental conditions (Albert et al. 2005; Saeck et al. 2019). In the Bay, mats of *Lyngbya majuscula* can be found free-floating in the water and stranded on mangroves and sea wrack (see Figure 4). This species produces three major toxins (dermatoxins) that can cause acute dermatitis: aplysiatoxin (AT), debromoaplysiatoxin (DAT) and lyngbyatoxin-A (LTX-A).

Symptoms of ‘seaweed dermatitis’ can occur within minutes to hours of contact with *Lyngbya majuscula* and include itching, burning and reddening of the skin, sometimes followed by deep peeling and blistering (Grauer & Arnold, 1961). Typically, symptoms last from 2 ̶ 12 days (Serdula et al., 1982) with the most affected area the inguinal region (genitals, perineal and perianal areas), probably due to prolonged exposure of the skin to fragments of *Lyngbya majuscula* trapped in swimming costumes. Lips and eyes are often affected (Osbourne, 2021) and the respiratory tract can also be irritated (Anderson et al, 1988; Lernout et al 2011, cited in Osborne 2021). Fishermen exposed to dried *Lyngbya majuscula* during removal of dried material from their nets and crab pots have also reported eye and skin irritation (Grauer and Arnold, 1961; Dennison and Abal, 1999).

Although the major risk of exposure to toxic *Lyngbya majuscula* is by direct skin contact during swimming, other exposure risks may exist for bayside residents. Fragments of *Lyngbya majuscula* aerosolised by wind and in sea sprays may cause respiratory, facial and eye irritation in beachfront visitors as has occurred overseas (Hashimoto, 1979; Anderson et al, 1988). A comprehensive laboratory study of the potential health effects of exposure to harmful aerosols and leachates from *Lyngbya* mats collected in Moreton Bay detected filaments of *Lyngbya majuscula* in aerosols from wind-driven sea spray. Therefore, in natural environments increased wave action and higher wind speeds (> 20 km/h) can cause aerolisation of *Lyngbya majuscula* filaments floating in the water. In the laboratory aerolisation was not detected in dried mats and it was concluded that the risk of exposure to *Lyngbya majuscula* in aerosols was low unless blooms were present under conditions of gale force winds or at wind speeds > 50 km/h (Smith, 2017).

Smith (2017) measured DAT and LTX-A in mats collected in northern and southern locations around Moreton Bay and found amounts of DAT (4 – 102 µg/g dry weight biomass) and LTX-A (360 – 423 µg/g dry weight biomass) considerably higher than previously reported in the Bay and elsewhere in the world. In a study conducted in 2019–2020 (B. Sendall, unpublished) DAT and LTX-A were detected in floating and beached mats of *Lyngbya majuscula* surveyed in the south-western (Birkdale, Redland Bay, Victoria Point, Wynnum) and north-western areas of the Bay (Deception Bay, Pumicestone Passage), at 0.2 – 886 µg/g and 2 – 382 µg/g dry weight, respectively. Seawater surrounding the mats was not assessed for toxins during the study. However, in the laboratory Smith (2017) demonstrated that toxins are easily leached from *Lyngbya majuscula* into surrounding seawater and into underlying sand. Therefore, proximity to floating mats and contact with leachate from beached, drying or decaying mats and the underlying sand must be considered as significant health risks.

Smith (2017) calculated the risks of dermal (skin) exposure to DAT and LTX-A as a LOAEL (lowest observed adverse effect level) which defines the lowest concentration or amount of toxin that causes an adverse health effect; in 90% of mats of *Lyngbya majuscula* from Moreton Bay, toxin levels were above the upper limit of the LOAEL range. Because of the difficulty in determining the amount of toxin required to cause dermatitis, there are no health safety ‘trigger’ values for recreational exposure to *Lyngbya majuscula* toxins in water or in floating or beached mats. DAT and LTX-A are sensitive to UV light (Moikeha et al. 1971; Hashimoto 1979); additionally, a local study on the subject showed that toxins were not detected in the water column surrounding large blooms (Osborne, 2004), suggesting that toxins might also be biodegradable in the environment (Osborne, 2021). However, the laboratory studies conducted by Smith (2017) indicate that toxins are leached from mats into the water column, reinforcing the need for caution near floating mats.

A picture containing outdoor, grass, rock, pond

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Figure : Accumulated sea wrack at the Wynnum foreshore

Graphical user interface

Description automatically generatedBecause of the high risk of eye and skin irritation, adults and children are discouraged from touching wracks washed up on the shore. Although it is extremely unlikely that humans would deliberately ingest *Lyngbya majuscula,* overseas there have been reports of burning on the lips and mouth following ingestion of *Lyngbya majuscula*, as well as three reports of deaths (Osborne, 2021). Dogs should also be prevented from contact and ingestion of wrack material as they may be attracted to the odours emitted by decaying mats. Worldwide dogs have become very ill or have died after consuming toxic cyanobacteria mats at the edges of lakes and rivers (Quiblier et al 2013), and although there are no reports of ingestion by dogs of *Lyngbya majuscula* mats, there is a potential risk of poisoning.

Figure 5: Typical HAB warning sign

Sea wrack is also a possible source of potentially harmful bacteria. In both marine and freshwater environments faecal indicator bacteria (FIBs) can provide an early warning that water has been contaminated with sewage, suggesting that bacteria harmful to humans (such as *E. coli*) might be present. These indicator bacteria can be at high levels in both wet and dry sea wrack (Imamura et al., 2011) so it is important that wrack is not handled by the public. Additionally, certain types of bacteria are known to produce hydrogen sulfide, or ‘rotten egg’ gas; this gas is released as the sea wrack rots, causing an offensive odour. If present in very high concentrations, hydrogen sulfide released from disturbed wracks could be harmful to humans (Stewart et al., 2009). As beached wrack decays, anaerobic conditions promote the growth of bacteria which produce and release volatile compounds into the air, some of which may be responsible for odours and/or are potentially harmful. Some volatile compounds can cause eye and respiratory irritation, similar to symptoms generally attributed to exposure to *Lyngbya majuscula*-dominated sea wrack (Smith, 2017). However, as anaerobic decomposition is a natural phenomenon and cannot be practically prevented, avoidance of decaying mats is the only option to minimise exposure risk.

There are significant occupational risks associated with exposure to toxins produced by *Lyngbya majuscula,* particularly to workers tasked with cleaning up sea wrack containing large quantities of this organism. It is generally accepted that dry material represents a higher risk than wet material due to potential inhalation of fragments of *Lyngbya majuscula,* such that wetting of material prior to removal is recommended where possible (Stewart et al., 2009). However, given that wet material readily leaches significant amounts of lyngbyatoxins, care must be taken in removing the biomass and underlying sand. Wetted material is prone to emission of odorous and/or potentially harmful airborne compounds as it decays so care must be taken against inhalation of such compounds. It is recommended that mats are encapsulated with biodegradable polymers during collection, transport and disposal, and then buried in landfill as soon as possible (Smith, 2017). If bloom material is present in the water, clean-up should be scheduled at locations and in weather conditions that minimise the generation of water sprays (in calm conditions and away from powered boats) (Stewart et al., 2009). General guidance for persons working with *Lyngbya majuscula* can be found at Worksafe Queensland.

In the event of either recreational or occupational skin contact with *Lyngbya majuscula,* washing the affected area with fresh water can minimise the symptoms of dermatitis. Relief from dermatitis can be sought with the application of cool compresses, and the use of analgesics and antihistamines (Izumi and Moore, 1987). Severe dermatitis or symptoms of respiratory or eye irritation should be treated by a medical professional.

# Management options

**Reducing nutrient runoff**

The formation of wracks on Moreton Bay foreshores consisting of seagrass is a natural phenomenon caused by strong winds ripping up seagrass and macroalgae and pushing it to the coast. However, anecdotal evidence suggests that an increase in the abundance of wracks derived from *Lyngbya majuscula* has occurred in recent decades. This could be driven by increased nutrients from catchment runoff to the Bay. Reducing this runoff requires catchment remediation (as described in “[Seagrass/algae wracks – what are the causes?](#_Seagrass/algae_wracks_–)”). Improved land management practices in Moreton Bay catchments such as riparian corridor revegetation, stabilising riverbanks, and managing fertiliser application can all help to reduce nutrient runoff, and ultimately reduce blooms over time. The large number of rock groynes and other artificial structures designed to stabilise the foreshore also may contribute to wrack accumulation in certain areas, particularly in areas commonly frequented by the public.

However, reducing nutrient loads is a long-term solution requiring significant work over many years to see substantial changes in the nutrient pool supporting ongoing *Lyngbya majuscula* blooms in the Bay. In the short term, the accumulation of this material on the Wynnum foreshore will continue to have an impact either as a potential environmental or health risk due to the presence of Harmful Algal Blooms (HAB), a nuisance or health risk due to associated odour, or aesthetically as a reduction in amenity value due to the unsightly nature of the material.

Whilst catchment runoff is thought to be the major source of nutrients, point sources, in particular sewage treatment plants are also releasing nutrients to river systems and the Bay. These are lower level but constant releases, as compared to the event-based releases resulting from catchment runoff. Major investment into the upgrading of sewage treatment plants has resulted in a significant reduction of nutrients released. However, the expected population growth in South East Queensland will require additional plants, or the expansions of existing ones. This is likely to produce an increase in nutrient levels being released in future.

**Response to sea wracks washed onto beaches**

The first elements of a typical response is being made aware of the location and extent of a potential problem, identifying the risks through observation and analysis and minimising risk through public awareness.

Sea wracks have important ecological value and the preferred approach for managing sea wracks is to let natural processes (tides) remove them from beaches. Sea wracks can generate unpleasant odours and occasionally can pose a risk to infrastructure or human health. In some cases, sea wracks will be removed, generally with earth moving equipment. Typical arrangements in Queensland include that Local Governments respond to reports about sea wrack, including for amenity, nuisance and public health.

Physical removal is undertaken with heavy machinery. This is an expensive operation and requires a good understanding of the potential health risks to workers and the public and how to mitigate them. Physical removal tends to only takes place during the warmer months (October to March). There also must be a safe location available for the disposal of the removed material.

The main steps to resolution are outlined below.

1. **Initiation**

As people may see the issue of sea wrack/HAB from different perspectives (environmental, health, nuisance, aesthetic) it is important that the inquirer can easily contact the appropriate agency through existing channels. For most matters relating to algae washed up on beaches and foreshores and associated odours or public health concerns, the best point of contact for the community is the relevant local council.

If a community member has concerns about a significant pollution event, they can contact the Department of Environment and Science Pollution Hotline.

If the enquiry relates to the removal of marine plants on the foreshore, organisations and the community can contact the Department of Agriculture and Fisheries Call Centre.

1. **Information**

Depending on the nature of the inquiry, the local response officer can provide the requested information or advice, direct the inquirer to the agency web site, or to the relevant agency’s expert. Inquiries should be handled at a local level unless there are regional aspects to the issue.

1. **Inspection and Identification**

If a report is received of sea wrack (and potentially HAB) the local response officer should confirm the location and details followed by a site inspection. The inspection by an experienced officer should be able to determine if it is a potential environmental or health risk (HAB) or a nuisance or aesthetic issue (odour and/or visually unpleasant). If HAB is suspected, samples could be taken for laboratory analysis to confirm its presence and potential toxicity.

Councils in South East Queensland generally inspect beaches using their work teams or in response to complaints received. If sea wrack has accumulated, Environmental Health Officers may also carry out sampling and testing to determine if it is potential environmental or health risk or a nuisance/odour issue.

1. **Communication**

The results of the analysis should be communicated to the inquirer. If the presence of HAB is confirmed the local response agency should provide advice to the local community through established media and social media channels. Standard warning signs (see Figure 5) should also be erected and plans to address the issue be developed, implemented and communicated.

1. **Resolution**

If not removed by natural processes (wind, waves and tides) within a reasonable time and if it poses a risk to infrastructure or health, then consideration should be given to the removal and disposal of sea wrack subject to permits and approval. If analysis confirms the presence of HAB then removal should be undertaken by persons trained in the health and safety aspects of working with HAB.

All marine plants are protected under Queensland law through provisions of the Fisheries Act 1994. The destruction, damage or disturbance of marine plants without prior approval is prohibited. Some activities are permitted under the Accepted Development Requirements for operational work that is the removal, destruction or damage of marine plants: [daf-adr-marine-plants.pdf](https://www.daf.qld.gov.au/__data/assets/pdf_file/0005/1258394/daf-adr-marine-plants.pdf). This includes providing for the removal from beaches and foreshores of unattached, decomposing marine plant material that has become a public health issue; and algae or cyanobacteria that is toxic or has become a public health issue.

Smith (2017) recommends that persons working with such *Lyngbya majuscula* material, including collected, piled and potentially composting biomass, should use an organic vapour scrubbing respirator to reduce potential exposure to such compounds. A full-face organic vapour-scrubbing respirator is recommended when working with bulk wet biomass to protect the face and eyes from exposure to vapours.

If on inspection or identification the wrack contains harmful algae such as Lyngbya majuscula then it presents a health and safety issue, and warnings should be communicated to the public to prevent contact with the wrack. Depending on the level of risk it may be appropriate to begin procedures to remove the wrack. That could include the use of earth moving equipment. It has also been suggested that interrupting the build-up early, for example with a boat, could prevent further floating material from being blocked and would reduce the size of the sea wrack at the beach in Wynnum significantly.

Brisbane City Council inspects beaches in the Wynnum region on a regular basis and will remove sea wracks from a number of beaches, as described in the Environmental Management Plan Moreton Bay Marine Park Permit (2017), between October and March if required.

Sunshine Coast Council generally doesn’t remove seagrass or algae from beaches. However, actions are taken occasionally if the sea wracks are potentially hazardous and could impact on infrastructure or public safety.

Noosa Shire Council had very significant sea wracks of brown algae (Hincksia sordida) on Main Beach in 2017 lasting for several weeks. The most significant previous events were between 2002-05 and lasted for several months. In both cases, this had significant impacts on tourism. The council utilises a levy applied to local businesses adjacent to Noosa Main Beach and is well positioned to manage future events through physical removal of the wracks and thereby minimise impacts on tourism and local businesses.

Minor events of algae also impact Laguna Bay/Main Beach and are managed on a complaint-driven basis, and in the same manner as the major events.

In addition, Noosa council undertakes algae surveys and additional nutrient sampling during the winter-spring-summer season to better understand the sources and processes which can result in algal blooms. This program provides valuable information and is likely to assist the council in decision-making and planning.

The Moreton Bay Regional Council published a Harmful Algal Bloom Response Plan in 2018. It is replicated in the World Health Organization Guidelines on recreational water quality [[1]](#footnote-1). Volume 1: coastal and fresh waters.

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| --- | --- | --- |
| Level | Detection | Response |
| 1 | Isolated small to moderate quantities of bloom material | No action to remove material, but signs to inform the public of potential harmful algal bloom may be appropriate. Stakeholder communications begun. |
| 2 | Large quantities of bloom material washing ashore near to areas of high public use | Activate or install signs immediately. Issue media release. Physically remove material from foreshores. |
| 3 | Very large quantities of material washed ashore near to areas of high public use | Same response as for Level 2, but closure of beaches may also be required, particularly where large amounts of blooms are growing close to the water’s edge. |

Where there are no health or safety issues, decisions should be made to determine if the wrack should be left to (low-cost) natural processes (e.g., several tide cycles) or (expensive) removal undertaken. Input to the decision making could be the number of complaints, the times of complaints (month, season). Complaints should be a trigger to start procedures to inspect, identify and respond to the issues raised.

# Conclusions

The formation of sea wrack is a natural process in which organic material which can include seagrass and toxic marine algae, as well as other debris, is driven onto certain beaches and foreshores by high winds. The wrack can accumulate as an unsightly mass that decomposes causing odours and potentially a health and safety hazard. The toxic marine cyanobacteria forms when there are suitable climatic conditions and sufficient nutrient supply, which is difficult to control. This material may contribute substantially to sea wrack during these times. Nutrient accumulation in the Bay is an historical artefact of catchment clearing and progressive agricultural and urban development.

Often the mass is returned to the marine environment by the cycle of tides which may resolve the problem. However, under certain conditions it is left stranded above the high-water mark where it starts to decompose and may produce offensive odours. These odours are more noticeable during the warmer summer months when it is more likely to reduce local amenity value to the local population and visitors. Higher temperatures promoting bacterial activity, more frequent onshore winds and higher levels of outdoor activity combine to exacerbate the impacts during the warmer months.

There are existing processes in place for the community to report algae on beaches and provisions in place for councils to remove dead algae when they cause a public health concern.

# Recommendations

1. Review, revise and publish the updated Harmful Algal Bloom Response Plan and Operational Procedures to set out the appropriate procedures and clarify implementation roles and responsibilities.
2. Consider the development of a central website/webpages, providing advice and information to the community on the causes and management of sea wrack, clear health and safety guidance and how to report events This will ensure the provision of consistent information to the community and improved reporting. The reporting function will standardise information capture and provide links to appropriate contact numbers and/or web forms to submit complaints. This will enable response agencies to act more quickly and effectively. The site should inform users on what feedback to expect, and what responses and timeframes are typical.
3. To raise public awareness about sea wracks, continue to use various communication channels such as:

* Warning/information signs at beaches, jetties, marine recreation sites etc.
* Information on relevant websites and social media channels
* Brisbane City Council “Report it” App
* Mainstream news media and advertising, including local newspapers and television
* Displays at community and scientific events

1. Improve monitoring and scientific information

* Consistent compilation of complaints and locations
* Monitoring to understand trends in sea grass and harmful algae in the Bay

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