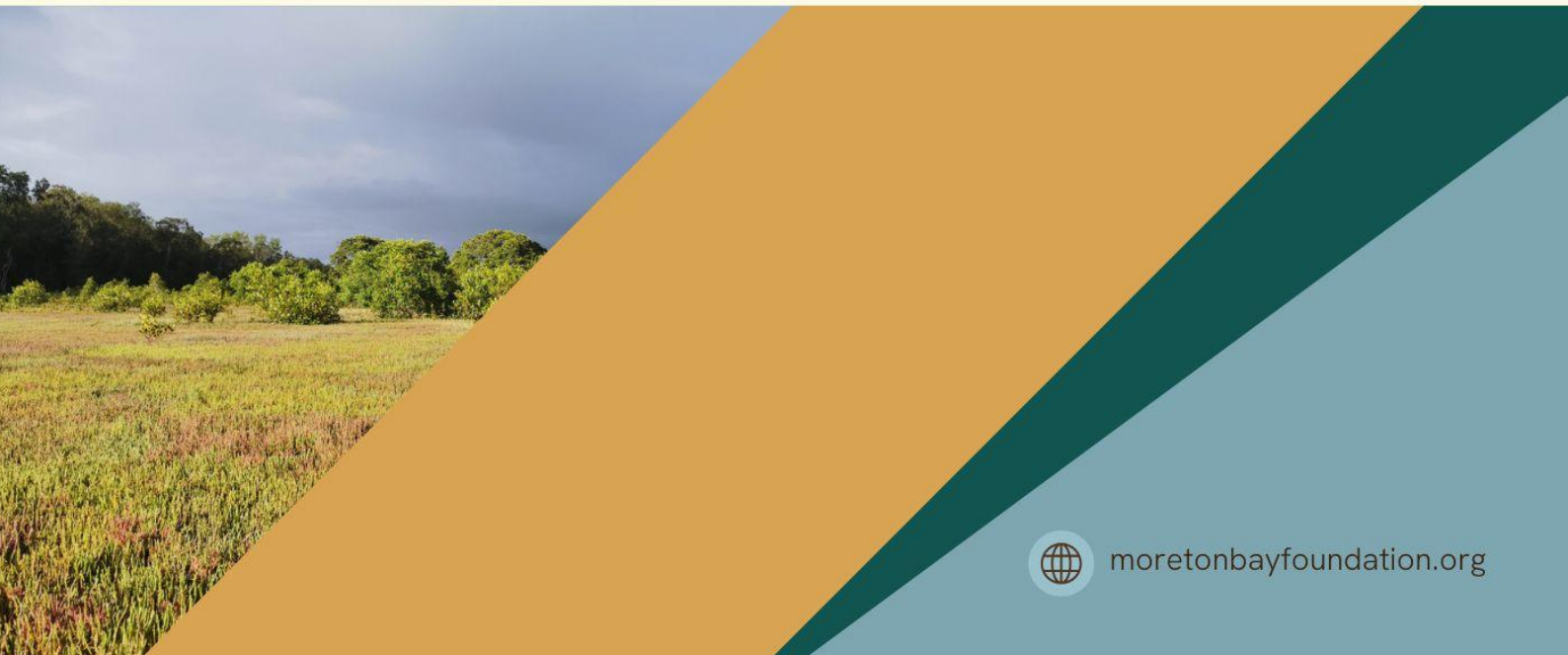
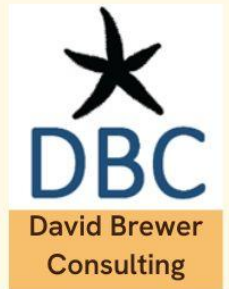




Sedimentation impacts in Moreton Bay: a priority knowledge synthesis

IMPACTS:

Saltmarshes



This impact statement is drawn from

Sedimentation Impacts in Moreton Bay, a priority knowledge-synthesis

The report was commissioned by The Moreton Bay Foundation in 2025 to summarise key evidence on how sedimentation affects Moreton Bay’s coastal and marine ecosystems, and the ecological and cultural values they support. The report brings together published and grey literature, conceptual models, and expert review to provide a clear, high-level understanding of sedimentation pressures, their impacts, and remaining knowledge gaps.

This standalone document can be found in the full report. Where references are made to other sections, these are indicated by this symbol: †. A full list of external citations, data sources, and methods used in this document is included in the complete report, available at **moretonbayfoundation.org**

David Brewer Consulting (DBC) has prepared this report for The Moreton Bay Foundation under the contract titled ‘TMBF Priority Knowledge Synthesis: Sedimentation Impacts in Moreton Bay’. Information about the Moreton Bay Foundation can be found at: <https://moretonbayfoundation.org/>

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Saltmarshes: Sedimentation Impact Statement

Status and trend summary

Table 1 provides a qualitative assessment of the saltmarsh communities in Moreton Bay, highlighting key aspects of their current condition, future trajectory and the impact of sedimentation. Saltmarshes are important habitats that support a wide range of vertebrate and invertebrate species, including migratory birds, crabs, and molluscs. They also provide crucial ecosystem services like coastal protection. However, since European colonisation saltmarshes in Moreton Bay have been highly modified directly by conversion to other uses, and indirectly by catchment land-use changes, sea level rise and resultant sedimentation into the intertidal zone. Between 1955 and 2021, the total saltmarsh area in Moreton Bay experienced a net loss of 70.4% (6,670 ha). Their current condition is rated as ‘Poor’, with ‘High’ confidence. The contribution of sediment to this condition is ‘Moderate’, which is assigned with ‘High’ confidence.



*Saltmarsh in Moreton Bay
Photo credit: V. Bennion*

Land-use changes have continued to release significant volumes of sediment into the Bay. Increased sedimentation and rising sea levels have supported mangrove expansion into the higher tidal zones, including encroachment into the saltmarshes and supratidal forests. Excessive sediment loads have directly impacted some saltmarsh communities through smothering and reduced water clarity, affecting a range of benthic groups in these habitats. These reductions in saltmarsh communities have significant negative impacts on migratory birds, fish and invertebrates that are important for ecosystem and biodiversity maintenance as well as fishery production.

The trend for saltmarsh condition in Moreton Bay is rated as ‘Declining’ with ‘High’ confidence. The contribution of sedimentation to the condition trend is considered ‘Major’ and is assigned ‘High’ confidence given the strong available evidence for this decline due to the combination of high sediment loads, sea level rise and mangrove encroachment, in particular.

Table 1. Qualitative assessment of the overall status and trend in condition, and of the likely severity and direction of sedimentation-specific impacts, on saltmarshes in Moreton Bay.

Value condition assessment	Assessment	Confidence
Current condition	Poor	High
Contribution of sedimentation to the current condition	Moderate	High
Condition trend	Declining	High
Contribution of sedimentation to trend	Major	High

Overview

Saltmarshes in Moreton Bay are found in the high intertidal zone, specifically landward of mangrove communities, on low-gradient marine and estuarine plains (New South Wales Government, 2008a, b) (Figure 1). They are typically intermittently inundated by king or spring tides rather than daily tidal cycles (New South Wales Government, 2008a). They occupy elevations between the mean high tide and the highest astronomical tides (Lovelock *et al.*, 2019).

Saltmarshes are primarily treeless floral communities, consisting of low succulent herbs, salt-tolerant grasses, rushes, and sedges (New South Wales Government, 2008a, b). They may also include bare or sparsely vegetated hypersaline flats where cyanobacteria are dominant (Saintilan and Rogers, 2013). Moreton Bay's saltmarsh plant community exhibits a higher species richness than its mangroves, with approximately 20 species, which accounts for 20% of Australia's total saltmarsh species (Lovelock *et al.*, 2019).

Hypersaline areas, common in the western bay (e.g. Tinchi Tamba Wetlands, Geoff Skinner Reserve, Point Halloran Reserve), are dominated by highly salt-tolerant herbs such as *Sarcocornia quinqueflora* (Beaded glasswort or samphire), *Suaeda australis* (Austral seablite), and *Sporobolus virginicus* (Marine couch). Brackish communities, where groundwater reduces soil salinity (e.g. eastern Bay Islands), support saltmarsh communities with a range of reeds and herbs, notably *Juncus kraussii* (a grass-like rush), and tend to have low diversity (New South Wales Government, 2008a, b; Lovelock *et al.*, 2019; Bennion *et al.*, 2024a).

Saltmarshes in Moreton Bay typically butt against a supratidal forest at their landward edge in natural settings; often consisting of *Casuarina glauca* (Swamp she-oak) and *Melaleuca quinquenervia* (Broad-leaved paperbark).

Population status

The saltmarsh communities of Moreton Bay were officially listed as a Vulnerable ecological community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2013 due to losses in recent decades (New South Wales Government 2008a, b; Lovelock *et al.*, 2019). The importance of the Bay's wetlands, including saltmarshes, for migratory waterbirds has also led to listing Moreton Bay as a Ramsar site (Lovelock *et al.*, 2019).

Overall, saltmarsh areas in Moreton Bay are in decline. Human activities and natural processes like mangrove encroachment, potentially exacerbated by climate change and sea-level rise, pose ongoing challenges to their extent and health (Lovelock *et al.*, 2019). Saltmarshes have experienced substantial loss, with an estimated 70.4% decline in area from 1955 to 2021, a 6,670 ha overall net loss (Queensland Government, 2024) (Figure 2).

Mangrove expansion into saltmarsh communities is consistent with rising sea levels and increased sediment loads, as increased inundation and sedimentation favours mangrove growth (Lovelock *et al.*, 2019). Mangrove expansion is responsible for approximately half of the saltmarsh area loss since 1955 (Queensland Government, 2024; Lovelock *et al.*, 2019). Anthropogenic activities such as permanent urban development create coastal squeeze on saltmarsh communities as they block expansion above the high-water mark. Urban development and infilling, as well as agricultural grazing, are responsible for the other half of the saltmarsh area loss since 1955 (Queensland Government, 2024; Laegdsgaard, 2006; New South Wales Government, 2008a, b; Lovelock *et al.*, 2019). Altered tidal flows from artificial structures like seawalls and stormwater discharge also pose threats to saltmarsh communities by changing hydrological flows, salinity regimes and increasing nutrient levels (New South Wales Government, 2008a).

Value

Ecological value

Despite the threats, saltmarshes remain important habitats that support a wide range of vertebrate and invertebrate species, including migratory birds, crabs, and molluscs (Saintilan and Rogers, 2013; Lovelock *et al.*, 2019). They support crab larvae in abundance and a diverse macrofauna and meiofauna, which serve as a trophic base for transient nektonic predators (fish and prawns) during high tide (Lovelock *et al.*, 2019).

Conspicuous invertebrates like crustaceans and molluscs (e.g. the gastropod, *Phallomedusa solida*, previously *Salinator Phallomedusa*) dominate the epibenthic macrofauna in saltmarshes (Laegdsgaard, 2006). These invertebrates and meiofauna (nematodes, harpacticoid copepods) form a crucial resource for the foraging species that visit during high tide (Lovelock *et al.*, 2019).

Saltmarshes also provide unique feeding and habitat opportunities for several threatened or vulnerable species of mammals and birds, including microbats, the Water mouse (*Xeromys myoides*) and migratory shorebirds. The Water mouse and migratory shorebirds use saltmarshes as important nesting habitats (Saintilan and Rogers, 2013; Traill *et al.*, 2011) and are particularly vulnerable to saltmarsh loss.

Saltmarshes also enhance water quality by acting as filters for pollutants, nutrients, and sediments (Lovelock *et al.*, 2019). They are important sites for nitrogen retention in soils and plant biomass and for denitrification, where nitrogen in water and soil is converted to nitrogen gas (Lovelock *et al.*, 2019). They also show the capacity to retain a significant percentage of nitrates, soluble phosphorus, and ammonium from tidal water (Lovelock *et al.*, 2019).



Figure 1. Saltmarsh communities in Moreton Bay. Photo credit. V. Bennion.



Figure 2. Changes in saltmarsh extent between 1955 and 2021 within Moreton Bay. Taken from Accad et al. (2023).

Cultural value

Overall, Moreton Bay's saltmarshes provide important cultural benefits and contribute to the well-being of coastal inhabitants. They hold significant cultural value, particularly for the Quandamooka People, the Traditional Custodians of the region, who have nurtured these lands and seas for over 50,000 years (Dean *et al.*, 2019; Fischer *et al.*, 2019; Adams *et al.*, 2024). This cultural importance is rooted in a deep, multi-millennial connection to the land and sea, fostering a custodial ethic where environmental management is a customary responsibility (Fischer *et al.*, 2019; Nasplezes *et al.*, 2019).

Saltmarshes are integral to cultural identity, heritage, and well-being, with places holding symbolic meanings, often reflected in Aboriginal place names or archaeological sites like middens and fish traps, which are tangible expressions of their connection to Country (Pinner *et al.*, 2019; Lovelock *et al.*, 2019; Beeston *et al.*, 2023).

Economic value

As noted above (see Ecological value section), saltmarshes support a wide range of vertebrate and invertebrate species that are important food sources for fish and invertebrates, including commercially valuable species like whiting and mullet, and the Giant mud crab (*Scylla serrata*) (Saintilan and Rogers, 2013; Kovacs *et al.*, 2019; Lovelock *et al.*, 2019).

These wetlands are also important for carbon sequestration, with average rates of 9 g C m⁻² year⁻¹ for *Sarcocornia quinqueflora*-dominated marshes and notably higher rates of 207 g C m⁻² year⁻¹ for *Juncus kraussii* marshes, comparable to some of the highest global rates (Lovelock *et al.*, 2014, 2019).

Saltmarshes contribute to coastal protection against flooding and erosion by buffering storm waves and stabilising sediments (Lovelock *et al.*, 2019; Pannoza *et al.*, 2023). Like mangroves, they also contribute to climate change mitigation and offer potential for income through carbon markets (Lovelock *et al.*, 2019; Beeston *et al.*, 2023).

History

Saltmarsh communities in Moreton Bay have undergone significant historical changes, primarily characterised by substantial decline since European settlement.

In the latter Holocene (last 2000 years), saltmarshes in Australia increased in extent relative to mangroves (Saintilan and Rogers, 2013). Paleoenvironmental studies indicate that in northern Australian macrotidal estuaries, the process of estuarine infilling led to the replacement of mangroves by saltmarsh and salt flats (Woodroffe *et al.*, 2016).

Since European colonisation, mangroves and saltmarshes in Moreton Bay have been highly modified indirectly by land-use changes in the catchment and conversion to other uses, reversing the earlier trend of saltmarsh expansion (Saintilan and Rogers, 2013; Lovelock *et al.*, 2019). Increased sediment supply from land-use changes has driven a major transition in the Bay, primarily from sandy habitats to more mud-dominated ones, particularly in the western Bay (Grinham *et al.*, 2024), which can alter species composition and ecosystem functioning (Lovelock *et al.*, 2019) (see Impacts of

Sedimentation section below). As noted previously, between 1955 and 2021, the total saltmarsh area in Moreton Bay experienced a net loss of 70.4%, with only 2,345 hectares remaining stable (Queensland Government, 2024).

Mangrove encroachment enhanced by high sedimentation rates accounted for almost half of this saltmarsh loss (see Population status section above). This encroachment is consistent with rising sea levels, which increase the frequency of inundation in the high intertidal zone, favouring mangrove establishment and growth (see Impacts of sedimentation section below) (Lovelock *et al.*, 2019).

Anthropogenic activities were also responsible for almost half of saltmarsh losses, largely due to urban development and grazing (Kovacs *et al.*, 2019; Lovelock *et al.*, 2019). Historical reclamation for agricultural, industrial, port, and residential purposes led to significant losses in saltmarsh area (Lovelock *et al.*, 2019).

Any observed small gains in saltmarsh area typically resulted from mangrove dieback or saltmarsh colonising *Melaleuca* or *Eucalyptus* patches where inundation patterns had changed (Queensland Government, 2024; Kovacs *et al.*, 2019).

Despite protection measures, saltmarshes continue to be lost, and large-scale restoration efforts have been limited (Lovelock *et al.*, 2019). The expansion of landward development also restricts opportunities for saltmarshes to migrate inland in response to sea-level rise (Lovelock *et al.*, 2019).

Impacts of sedimentation

Saltmarshes are important habitats that support a wide range of vertebrate and invertebrate species, including migratory birds, crabs, and molluscs (see Ecological value section above). They also provide crucial ecosystem services, such as coastal protection (Lovelock *et al.*, 2019). Of considerable concern is that saltmarsh losses can diminish feeding and roosting sites for migratory shorebirds, some of which are critically endangered (Lovelock *et al.*, 2019). Figure 3 provides a conceptual model of the key impacts of sedimentation on saltmarshes in Moreton Bay.

Saltmarshes rely on sediment supply for vertical accretion and lateral expansion, which is crucial for them to keep pace with rising sea levels and prevent drowning (Bennion *et al.*, 2024a; PannoZZo *et al.*, 2023). A high density of saltmarsh plant material enhances the trapping and binding of mineral sediments delivered by tidal water. This process supports the accumulation of plant material that increases surface elevation (Bennion *et al.*, 2024a).

However, since European settlement, Moreton Bay's saltmarshes have experienced dramatic increases in sediment loads, largely due to land clearing in the catchment (Kemp *et al.*, 2019; Lovelock *et al.*, 2019; Saeck *et al.*, 2019b). An increased supply of sediment to the coast has led to higher rates of sediment accretion in intertidal habitats (Lovelock *et al.*, 2019). For example, in the western Bay, Bennion *et al.*, (2024a) describe an increase in sedimentation in saltmarsh from 1 mm y⁻¹ in 2008 to 1.7 mm y⁻¹ in 2024.

Mangroves are known for their ability to enhance sediment deposition through their above-ground root systems and stems, which in turn promotes their growth and expansion (Adame *et al.*, 2010). This process provides new substrata suitable for mangrove establishment (Kelleway and Williams, 2008). As mangroves expand, they colonise areas previously occupied by saltmarsh, leading to a direct displacement of these communities (see Population status section above) (Kovacs *et al.*, 2019).

This encroachment is also consistent with the expected impacts of rising sea levels, where increased inundation frequency in the high intertidal zone aids the movement of mangrove propagules and creates more favourable conditions for mangrove growth in these higher areas (Lovelock *et al.*, 2019).

Excessive sediment deposition can directly smother saltmarsh plants, leading to minimal or slow recovery (McAtee *et al.*, 2020). It also negatively impacts invertebrate communities, reducing their abundance and diversity. Infaunal invertebrates may shift from saltmarsh-associated groups to more terrestrial and mobile species (Ellis *et al.*, 2004; McAtee *et al.*, 2020).

High mud content from increased fine sediment can lead to reduced water clarity and light availability in the water column, limiting benthic productivity and potentially shifting it towards pelagic productivity (Lockington *et al.*, 2017; Saeck *et al.*, 2019b).

Recommendations

1. Control sediment sources to reduce sediment loads from catchments, through actions like restoring regional stream channel networks and revegetating riparian zones (Leigh *et al.*, 2013; Grinham *et al.*, 2024). Managing stormwater discharge is also important to limit the introduction of silt and nutrients (New South Wales Government 2008a, b).
2. Restore natural hydrological patterns to improve water flow and tidal exchange and promote a more balanced sediment movement within the ecosystem (Beeston *et al.*, 2023). Maintaining appropriate tidal flushing is also vital, though continuous inundation can cause dieback and potentially encourage mangrove encroachment (New South Wales Government 2008a; Laegdsgaard, 2006).
3. Implement strong legislative habitat protection and planning measures to allow for the landward migration of saltmarshes. This includes establishing buffer zones and preventing development that blocks their movement (Kelleway and Williams, 2008; Saintilan and Rogers, 2013; Lovelock *et al.*, 2019; Jinks *et al.*, 2020). Maintaining or increasing saltmarsh plant cover can also enhance sediment trapping (Bennion *et al.*, 2024a).
4. Minimise disturbance by controlling human access to prevent physical damage like trampling and wheel ruts. These impacts alter the topography and lead to issues such as mangrove incursion (New South Wales Government, 2008a, b; Kelleway and Williams, 2008).

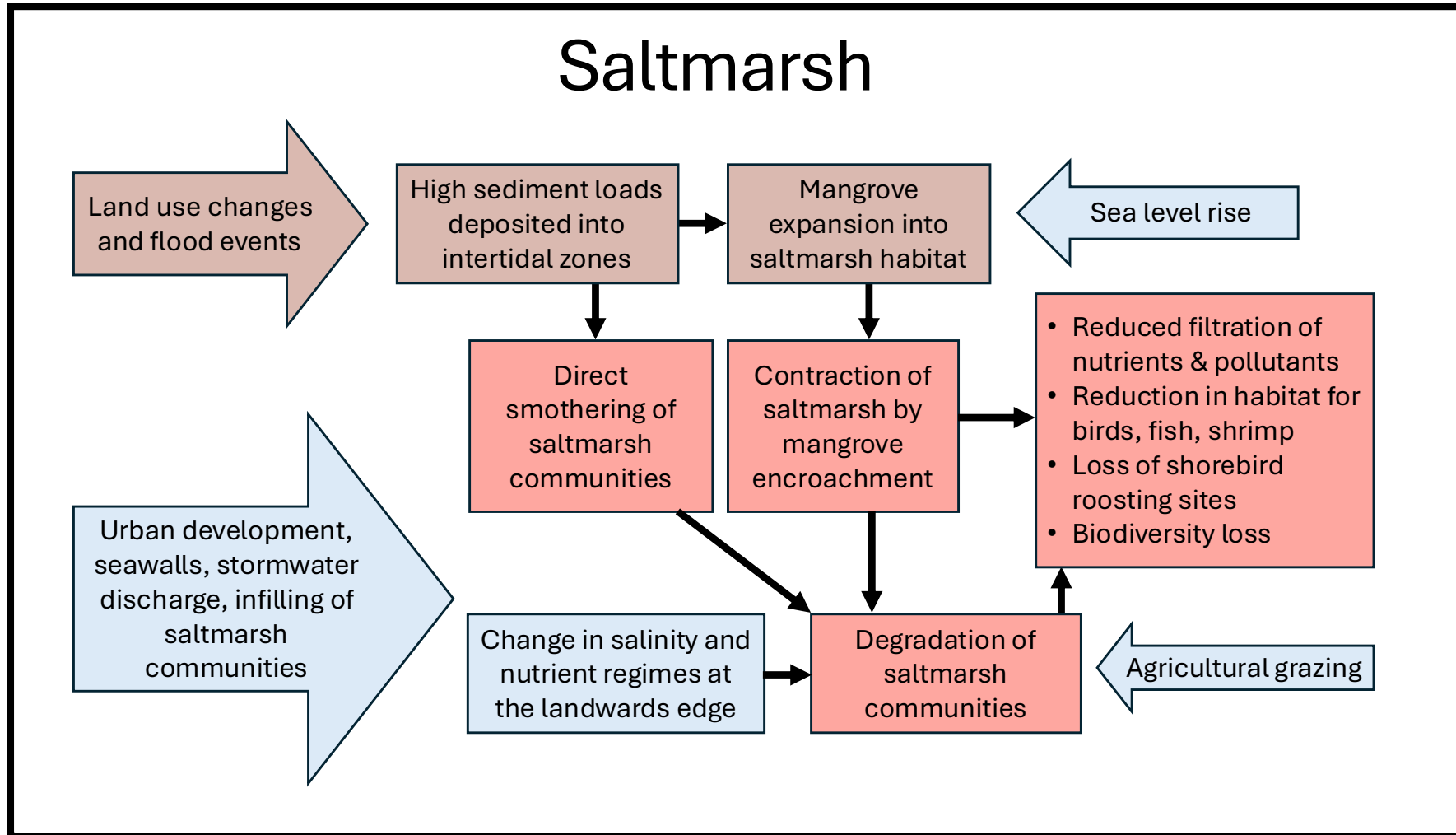
5. Implement continuous monitoring and adaptive management of restoration projects, as impacts can vary based on the depth and composition of applied sediment (New South Wales Government, 2008a; McAtee *et al.*, 2020).

Expert review

Vicki Bennion (School of the Environment, University of Queensland) kindly provided an expert review of the Saltmarsh: Sedimentation Impact Statement.

Conceptual model - Impacts of sedimentation on saltmarshes

Figure 3. Conceptual model that qualitatively describes the major impacts of sedimentation on saltmarsh communities in Moreton Bay. Brown boxes signify sedimentation-related processes; blue boxes signify other relevant and interacting consequential inputs or impacts; red boxes signify adverse impacts/outcomes.



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This standalone document corresponds to **Section 5.4** of the full report. A full list of external citations, data sources, and methods used in this document is included in the complete report, available at

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Cover Images:

Saltmarsh communities in Moreton Bay. Photos credit: V. Bennion



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