

Appendix C Environmental Risk Matrices

Coastal and marine waters		Clean waters		Marine Habitats and Assemblages							Threatened and Protected Species		Temporal				Geog. Extent	
		Ocean waters	Beaches	Shallow soft sediments	Deep soft sediments	Rocky Shores	Shallow Reefs	Deep Reefs	Pelagic Assemblages	Species and communities protected under FMA, e.g.	Species protected under TSA, e.g. Marine	L- Current 2 years	L- Next 10 years	L- Next 20 years	Trend	R- across the bioregion, L-location specific		
Resource use																		
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships, etc.)	Low	Minimal	Minimal	High	Low	Low	Moderate	Minimal	Minimal	High	X			↑	L - Outside the four ports (Hunter, Sydney Harbour, Botany Bay and Port Hacking)		
	Small commercial vessels (ferries, charter boats, etc.)	Low	Low	Minimal	Low	Low	Minimal	Minimal	Low	Minimal	Moderate	X			#	R		
Commercial fishing	Ocean Trap and Line	Minimal	Minimal	Minimal	Low	N/A	Low	Low	Low	Moderate	Moderate	X			↓	R - Just inside the 3 nautical mile limit		
	Ocean Trawl	Minimal	Minimal	Minimal	Moderate	N/A	Low	Low	Low	Moderate	Moderate	X			↓	R - Just inside the 3 nautical mile limit		
	Ocean Haul	Minimal	Minimal	Minimal	N/A	N/A	N/A	N/A	Moderate	Low	Moderate	X			↓	R - Just inside the 3 nautical mile limit		
	Sea urchin and turban shells	Minimal	N/A	N/A	N/A	N/A	Moderate	N/A	N/A	Minimal	Minimal	X			↓	R		
	Lobster	Minimal	N/A	N/A	Minimal	N/A	Low	Low	N/A	Minimal	Low	X			#	R		
	Abalone	Minimal	N/A	N/A	N/A	N/A	Low	N/A	N/A	Minimal	Minimal	X			↓	R		
Charter fishing	Line fishing	Minimal	Minimal	Minimal	Minimal	Minimal	Low	Low	Low	Low	Moderate	X			↑	R - all Drowned River Valleys		
Recreational fishing	Shore-based line and trap fishing	Minimal	Low	Low	N/A	Low	Moderate	N/A	Low	Moderate	Moderate	X			↓	R		
	Boat-based line and trap fishing	Minimal	Minimal	Low	Low	N/A	Moderate	Low	Low	Moderate	High	X			↓	R		
	Spearfishing	Minimal	Minimal	Minimal	Minimal	N/A	Low	N/A	Low	Low	Minimal	X			↑	R		
	Hand Gathering	Minimal	Low	Minimal	N/A	Moderate	Low	N/A	N/A	N/A	Minimal	X			↑	R		
Aboriginal Cultural fishing	Line fishing, spearfishing, hand gathering, traditional	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			#			
Charter activities	Whale and dolphin watching	Low	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Moderate	X			↑	L outside Sydney Harbour, Brisbane Waters and Port Hacking		
Bait and aquarium trade	Imported baits, imported fish and other aquatic sp.	Minimal	N/A	N/A	N/A	N/A	N/A	N/A	Low	Minimal	Minimal	Not Applicable - more relevant to Estuary						
Research and education	Collecting, sampling and tagging	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Not Applicable - more relevant to Estuary						
Recreation and tourism	Boating and boating infrastructure	Minimal	Minimal	Minimal	Minimal	Minimal	Low	Low	Minimal	Minimal	Moderate	X			#	R		
	Snorkelling and diving	Minimal	N/A	N/A	N/A	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			↑	R		
	Swimming and surfing	Minimal	Low	N/A	N/A	Minimal	Minimal	N/A	N/A	Minimal	Low	X			↑	R		
	Four wheel driving	Minimal	High	N/A	N/A	Minimal	N/A	N/A	Minimal	N/A	High	X			↑	R (locatins include Wanda Beach near Cronulla and Blacksmiths)		
	Shark meshing of swimming beaches	N/A	Minimal	Minimal	Minimal	N/A	Minimal	N/A	Low	High	High	X			#	R		
Dredging (includes placement)	management and modification, harbour	Minimal	Minimal	Minimal	Moderate	Minimal	Minimal	Minimal	Minimal	Minimal	Low	X			#	L - Hunter and Port Kembla		
Modified freshwater flows	Extraction, artificial barriers to estuarine flow	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			#	R		
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Not really relevant to continental shelf						
Service infrastructure	Pipelines, cables, trenching and boring	Low	Low	Low	Minimal	Low	Low	Minimal	Low	Minimal	Minimal	X			#	R		
Land-based impacts																		
Landuse intensification	Urban stormwater discharge	Low	Moderate	Low	Minimal	Low	Moderate	Minimal	Minimal	Low	High	X			#	R		
	Foreshore development	Minimal	High	Minimal	Minimal	Moderate	Minimal	Minimal	Minimal	Minimal	High	X			↑	R		
	Beach nourishment and grooming	N/A	Moderate	Low	N/A	N/A	N/A	N/A	Minimal	Minimal	Moderate	X			↑	R		
	Clearing riparian and adjacent habitat including wetland drainage	Minimal	Moderate	Low	Minimal	Minimal	Minimal	Minimal	minimal	Minimal	High	X			↑	R		
	Agricultural diffuse source runoff	Minimal	Minimal	Low	Low	Minimal	Low	Low	Moderate	Minimal	Minimal	X			↑	Illawarra, Lake Macquarie, Tuggerah Lakes and the Hawkesbury River		
	Industrial discharges	Low	Minimal	Low	Low	Minimal	Low	Minimal	Minimal	Minimal	Minimal	Minimal	X			↓	L - Caltex Botany Bay (soon to close). Desal when operating	
Point discharges	Thermal discharges	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Not applicable to the continental shelf						
	Sewage effluent and septic runoff	Low	Low	Low	Low	Moderate	Moderate	Moderate	Low	Minimal	Minimal	X			↑	L		
	Estuary entrance modifications	Minimal	High	Low	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			#	L		
Climate change 20 years																		
Climate change	Altered ocean currents & nutrient inputs	Minimal	Minimal	Minimal	Minimal	Minimal	Low	Minimal	Moderate	Minimal	Low	X			↑	R		
	Climate and sea temperature rise	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Low	X			↑	R		
	Ocean acidification	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Moderate	Minimal	Low	X			↑	R		
	Altered storm/cyclone activity	Low	Low	Low	Minimal	Low	Moderate	Minimal	Minimal	Minimal	Moderate	X			↑	R		
	Sea level rise	Minimal	Moderate	Minimal	Minimal	Low	Minimal	Minimal	Minimal	Minimal	High	X			↑	R		
Extreme storm events	Flooding, storm surge, tsunami, inundation	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Low							

Hawkesbury shelf – Coastal and marine waters

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		moderate	possible	The impact on water quality as a result of large commercial vessels was considered 'moderate'. This reflects the levels of impact of the defined stressors from this activity, including marine debris. It was considered 'possible' that this level of impact would occur.	L	R	I	low
	Small commercial vessels (ferries, charter boats, etc.)		minor	likely	The impacts on water quality from small commercial vessels was considered 'minor', and reflects issues due to marine debris and water pollution through oil and fuel spills. It was considered 'likely' that this level of impact would occur.	I	R	I	low
Charter activities	Whale and dolphin watching		minor	likely	The impacts on water quality from charter activities was considered 'minor', and reflects issues due to marine debris and water pollution through oil and fuel spills. It was considered 'likely' that this level of impact would occur.	I	L	I	low
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on ocean waters as a result of service infrastructure was considered 'minor' reflecting the level of associated water pollution. It is considered 'likely' that this level of impact could occur at a local level.	L	L	I	low
Land-based impacts									
Landuse intensification	Urban stormwater discharge		minor	almost certain	The impact on water quality as a result of urban stormwater discharge was considered 'minor' reflecting the level of diffusion that occurs within close vicinity of the discharges. It is considered 'almost certain' that contamination could occur at a level that may cause minor impacts.	A	L: All urban areas	I,M,L	low
Point discharges	Industrial discharges		moderate	possible	The impact on water quality from industrial discharges was considered 'moderate', and	A	Localised industrial areas	I,M,L	Low

				reflects issues due to water pollution through runoff that carries range of pollutants. It was considered 'possible' that this level of impact would occur, but under current management large discharges should be unlikely, and localised to areas with industry.		e.g. Port Kembla			
	Sewage effluent and septic runoff		minor	likely	The impacts on water quality from small sewage effluent and septic runoff was considered 'minor', and reflects issues due to water pollution (nutrients and toxicants). It was considered 'likely' that this level of impact would occur, but primarily in localised areas as the deep ocean outfalls off Sydney discharge into deep water, assisting dilution.	A	Localised (adjacent to local outfalls)	I,M,L	low
Climate change	20 Yrs								
	Altered storm/ cyclone activity		moderate	possible	Increased intensity of storms may lead to increased occurrence of large event river run off especially from Hunter and Hawkesbury. This could lead to increased impacts on nearshore communities, with moderate impacts possible.	A	NA	L	low
Climate change	50 Yrs								
Climate change	Altered ocean currents & nutrient inputs		minor	likely	Limited impacts of currents on oceanic water quality, with minor impacts likely.	I	NA	L	low
	Climate and sea temperature rise		moderate	likely	Larger temp increases expected to be synergistic with other effects, with moderate impacts likely.	I	NA	L	moderate
	Ocean acidification		major	likely	Significant acidification expected within 50 yrs, experiments show potential effects in synergy with temperature, with major impacts likely.	I	NA	L	high
	Altered storm/ cyclone activity		moderate	likely	Increased river run off especially from Hunter and Hawkesbury. Increased intensity of storms may lead to increased occurrence of large event river run off especially from Hunter and Hawkesbury. This could lead to increased impacts on nearshore communities, with moderate impacts likely.	I	NA	L	moderate

Extreme storm events	Flooding, storm surge, inundation		moderate	possible	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, with moderate impacts possible.	I	NA	L	low
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Beaches

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
	Small commercial vessels (ferries, charter boats, etc.)		minor	likely	The impacts on beaches from small commercial vessels was considered 'minor', and reflects issues due to marine debris and water pollution through oil and fuel spills. It was considered 'likely' that this level of impact would occur.	L	L	I	low
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact of shore-based recreational fishing on beach habitat and assemblages was considered 'minor'. This reflects the stressors associated with the activity, including debris such as bait bags, fishing gear. It was considered 'likely' that this level of impact would occur from shore-based recreational fishing due to the ability to fish along its length.	L	R	I	low
	Hand gathering		moderate	possible	The impact on beach habitat and assemblages as a result of hand gathering was considered 'moderate', and this reflects the level of activity and low abundance and overall life-history and ecological characteristics of these harvested species (i.e. pipis, beachworms), which have relatively moderate-low resilience. It was considered 'possible' that this level of impact would occur.	L	L	I	low
Recreation and Tourism	Swimming and surfing		minor	likely	The impact of swimming and surfing on beach habitat and assemblages was considered 'minor'. This reflects the range of stressors associated with the activity, including debris and trampling. It was considered 'likely' that this level of impact would occur due to the known level of activity in this bioregion that results in these stressors.	A	R	I	low
	Four wheel driving		major	likely	The impact on beach habitat and assemblages as a result of four wheel driving was considered	A	L. Localised	I	high

					'major', and this reflects the level of activity at a local level and low abundance and overall life-history and ecological characteristics of the species (e.g. pipis, beachworms) that are impacted from physical compaction and disturbance, and which have relatively moderate–low resilience. It was considered 'likely' that this level of impact would occur as there is little current management, but only at a local scale where the activity is allowed.		impacts on the few beaches that this activity is allowed.		
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on beach habitat and assemblages was considered 'minor'. This reflects the stressors associated with the activity, including physical disturbance. It was considered 'likely' that this level of impact would occur due to the known level of activity in this bioregion that results in these stressors, but only at a local level.	L	L	I	low
Land-based impacts									
Landuse intensification	Urban stormwater discharge		moderate	likely	The impact on beach habitat and associated assemblages as a result of urban stormwater discharge was considered 'moderate' reflecting the impacts from water pollution (nutrients, sediment and contaminants). It is considered 'likely' that contamination could occur at a level that may cause moderate impacts, but only at a local scale.	L	L. Limited to some beaches near major urban areas.	I,M,L	moderate
	Foreshore devel.		major	likely	The impact on beach habitat and associated assemblages as a result of foreshore development was considered 'major' reflecting the level of measurable change that occurs due to this activity, which completely alters the habitat. It is considered 'likely' that this level of impact would occur, although much of the impacts are legacy issues and new developments are likely to have less impacts.	I	R. All beaches where development has occurred.	I,M,L	high
	Beach nourishment and grooming		moderate	almost certain	The impact on beach habitat and associated assemblages as a result of beach nourishment and grooming was considered 'moderate' reflecting the habitat characteristics can be	I	L. All beaches where nourishment	I,M,L	moderate

				altered or removed, impacting biota and ecological processes. In addition, removal of organic material disrupts foodwebs. It was considered 'almost certain' that this level of impact could occur at a local scale, with nourishment occurring at Cronulla and Narrabeen when nearby channels are dredged.		occurs			
	Clearing riparian and adjacent habitat including wetland drainage		major	possible	The impact on beach habitat and associated assemblages as a result of clearing riparian and adjacent habitat was considered 'major' reflecting the habitat characteristics can be altered or removed, impacting biota and ecological processes. It was considered 'possible' that this level of impact could occur at a local scale, although removal of vegetation from beaches for urban area development unlikely under current management, but large legacy issues exist.	L	All beaches where development occurs	I,M,L	moderate
Hydrologic modifications	Estuary entrance modifications		major	almost certain	The impact on beach habitat and associated assemblages as a result of estuary entrance modifications was considered 'major' reflecting the level of measurable change that occurs due to this activity, with dredging, mechanical openings, construction of walls etc changing natural habitat characteristics and sand movement. Activities such as these are shoreline hardening and physical damage to beaches will 'almost certainly' impact beaches. While much of the impacts are legacy issues and new developments are likely to have less impacts, maintenance activities will have an ongoing impact on beach habitats.	I,A	Possible at all beaches in urban areas	I,M,L	high
Climate change	20 Years								
	Altered storm / cyclone activity		moderate	possible	Beaches with limited capacity to move due to sea walls etc., so moderate impacts are possible.	A	R	L	low
	Sea level rise		moderate	likely	Some beaches may be lost due to their limited capacity to extend inland (local certain circumstances), hence moderate impacts are likely.	A	R	L	moderate

Climate change	50 Years								
	Climate and sea temp rise		moderate	likely	Temperate increases expected to be greater with more effect on beach biota, and moderate impacts likely.	L	R	L	moderate
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	L	R	L	high
	Altered storm / cyclone activity		moderate	possible	Beaches with limited capacity to move due to sea walls etc., so moderate impacts are possible.	L	R	L	low
	Sea level rise		major	likely	Some beaches may be lost due to their limited capacity to extend inland in localised areas, with major impacts likely.	L	R	L	high
Extreme events	Flooding, storm surge, inundation		major	likely	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, with major impacts expected to be likely.	L	R	L	high

Shallow soft sediments

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timi ng I, M, L	Risk
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on shallow soft sediment habitat and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the stressor associated with the activity (reduction in harvested species) and the relatively high resilience of these species, which include blue-spotted flathead and whiting. It was considered 'likely' that this level of impact would occur from this activity due to the large amount of shore-based fishing effort throughout the bioregion and ability to fish the majority of habitat.	L	R	I	low
	Boat-based line and trap fishing		minor	likely	The impact on shallow soft sediment habitat and associated biota as a result of boat-based recreational fishing was considered 'minor'. This reflects the relatively high resilience and abundance of the likely harvested species, which includes yellowfin bream and whiting. It was considered 'likely' that this level of impact would occur from boat-based recreational fishing due to the amount of fishing effort in the bioregion and ability to fish the majority of habitat.	L	R	I	low
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on shallow soft sediment habitat and associated assemblages as a result of service infrastructure was considered 'minor' reflecting the level of physical disturbance. It is considered 'likely' that this level of impact could occur at a local level.	L	L	I	low
Land-based impacts									
Landuse intensification	Urban stormwater discharge		moderate	possible	The impact on shallow soft-sediment habitat and associated biota as a result of urban stormwater discharge was considered 'moderate' reflecting the facts that contaminants in urban stormwater have	L	L: Large rivers that deposit pollutants	I	Low

				been shown to alter grainsize, biota, microbial assemblages and ecological function. Heavy metal concentrations in shallow sediments offshore Sydney and Botany Bay were above background and near “low” trigger values. No measurable accumulation of metals in sediments off Newcastle, but some enrichment off Sydney indicating some export of contaminated sediments from estuary to offshore. It is therefore ‘possible’ that contamination could occur at a level that may cause effects.		into nearshore zone only, e.g. Port Jackson			
	Beach nourishment and grooming		minor	likely	The impact on shallow sediments habitat and associated biota as a result of beach nourishment and grooming was considered ‘minor’ reflecting the associated flow on effects from grooming in the intertidal zone and dynamic nature of the area where sand replenishment may occur. It was considered ‘likely’ that this level of impact would occur.	L	Groomed and nourished beaches only	L	Low
	Clearing riparian and adjacent habitat including wetland drainage		minor	likely	The impact on shallow sediments habitat and associated biota as a result of riparian clearing and wetland drainage was considered ‘minor’ reflecting the r. It was considered ‘likely’ that this level of impacts would occur.	L	L	I	low
	Agricultural diffuse source runoff		minor	likely	The impact on shallow soft-sediment habitat and associated biota as a result of agricultural diffuse source runoff was considered ‘minor’ reflecting the fact that contamination from sediments in agricultural runoff is mostly taken up in estuaries, unless in floods. Discharge from estuaries is dispersed and diluted in nearshore zone. It was considered ‘likely’ that agricultural runoff will reach shallow subtidal in floods and result in the identified level of impact.	A	Larger rivers with agricultural catchments which carry pollutants to nearshore zone only, e.g. Hawkesbury, Hunter	I	low
Point discharges	Industrial discharges		minor	likely	The impact on shallow soft-sediment habitat and associated biota as a result of industrial discharges was considered ‘minor’. This reflects that direct discharge does not occur on the open coast, although some impact on benthic biota in sediments is possible	A	Localised, offshore of Port Kembla.	I	low

					if contaminated sediments are transported from estuaries to nearshore in local areas. This level of impact was considered 'likely'.				
	Sewage effluent and septic runoff		minor	likely	The impact on shallow soft-sediment habitat and associated biota as a result of industrial discharges was considered 'moderate'. This reflects that direct discharge does occur on the open coast, with moderate impacts on sediment biota and ecology near to discharge point. Sewage from nearshore discharges always carries pollutants and pathogens. This level of impact was considered 'likely'.	A	L. Confined to nearshore discharge points, e.g. Norah Head, Burwood, Wollongong		moderate
Hydrologic modifications	Estuary entrance modifications		minor	likely	Enhances the mobilisation of potentially contaminated sediments to shallow nearshore zone. Entrance and channel dredging always impacts sediments	A	Hunter River	I,M,L	low
Climate change	20 Years								
	Altered storm/cyclone activity		minor	likely	Disturbance of shallow soft sediments likely, but only minor impacts expected against background variation.	A	R	L	low
Climate change	50 Years								
	Climate and sea temperature rise		moderate	possible	Temperate increases expected to be greater with some effect on shallow soft sediment biota, and moderate impacts possible.	L	R	L	low
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	L	R	L	high
	Altered storm/cyclone activity		moderate	likely	Disturbance of shallow soft sediments likely, with moderate impacts expected against background variation.	I	R	L	moderate
	Sea level rise		minor	likely	Some shallow soft sediment habitat may be lost due to changes in adjacent nearshore beach morphology, hence minor impacts are likely.	A	R	L	moderate
Extreme events	Flooding, storm surge, inundation		minor	possible	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, with moderate impacts expected to be possible.	L	R	L	low

Deep soft sediments

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries		major	likely	The impact on deep soft-sediment habitat and associated biota as a result of large commercial vessels was considered 'major'. This reflects that while most ships anchor outside edge of 3 nm, the long chains allow swinging and impacts inside 3nm through direct substantial physical disturbance from chains, and the level of mooring activity within the bioregion associated with the major ports. It was considered 'likely' that this level of impact would occur.	L	L: offshore of Hunter and Illawarra	I	high
	Small commercial vessels (ferries, charter boats, etc.)		minor	likely	The impact on deep soft-sediment habitat and associated biota as a result of small commercial vessels was considered 'minor'. This reflects the primary consequences are loss of marine debris and water pollution through oil and fuel spills. It was considered 'likely' that this level of impact would occur.	L	R	I	low
Commercial fishing	Ocean Trap and Line		minor	likely	The impact on deep soft sediment habitat and associated biota as a result of ocean trap and line was considered 'minor'. This reflects the fact that this habitat is common throughout the region and has characteristics that result in a moderate to high inherent capacity to respond to disturbances, which are limited with the gear type used in this fishery. It also reflects the moderate-high resilience of the harvested species, the fact that only around 10% of the ocean trap and line catch is taken in the state coastal waters of the bioregion, and only a small proportion of that is taken on soft-sediment habitats in depths >25 m. This level of impact was considered 'likely'.	A	R	I	low
	Ocean Trawl		moderate	likely	The impact on deep soft sediment habitat and associated biota as a result of ocean trawl was considered 'moderate'. This reflects the fact that while the habitat is common throughout the region and has characteristics that result in a moderate inherent capacity to respond to disturbances, the gear type used can result in measurable impacts on benthic biota and result in moderate levels of bycatch. It	L	L	I	moderate

					was considered 'likely' that this level of impact would occur, which is influenced by the fact that ~ 14% of the state ocean trawl catch is taken in the state coastal waters of this bioregion.				
Recreational fishing	Boat-based line and trap fishing		minor	likely	The impact on in deep soft sediment habitats and associated biota as a result of boat-based recreational fishing on deep soft-sediment habitats was considered 'minor'. This reflects the relatively high resilience and abundance of the likely harvested species, which includes yellowfin bream and whiting. It was considered 'likely' that this level of impact would occur from boat-based recreational fishing due to the amount of fishing effort and ability to fish the majority of habitat.	L	R	I	low
Dredging	Navigation & entrance management and modification, harbour maintenance		moderate	likely	The impact on deep soft sediment habitat and associated biota was considered to be 'moderate' resulting from physical disturbance and sediment re-suspension and re-distribution relating to spoil dumping, which are likely to contain contaminated sediments. It was considered 'likely' that this level of impact would occur.	A	L. Hunter, Illawarra and Sydney		moderate
Land-based impacts									
	Agricultural diffuse source runoff		minor	likely	The impact on deep soft-sediment habitat and associated biota as a result of agricultural diffuse source runoff was considered 'minor' reflecting the fact that contamination from sediments in agricultural runoff is mostly taken up in estuaries, unless in floods. Discharge from estuaries is dispersed and can be distributed into deeper habitats. It was considered 'likely' that agricultural runoff will reach deep subtidal areas in floods and result in the identified level of impact.	L	L. Offshore of larger rivers with agricultural catchments which discharge in floods e.g. Hawkesbury, Hunter	I	low
Point discharges	Industrial discharges		minor	likely	The potential impact on deep soft-sediment habitat and associated biota as a result of industrial discharges was considered 'minor'. This reflects that direct discharge does not occur on the open coast, although some impact on benthic biota in sediments is possible if contaminated sediments are transported from estuaries to nearshore in local areas. This level of impact was considered	A	L. Offshore from dredged ports with industrial inputs – Hunter, Sydney, Illawarra,	I	low

					'likely'. Evidence shows that industrial pollutants reach deep sediments via dumped dredge spoil. Possible				
	Sewage effluent and septic runoff		minor	almost certain	The potential impact on deep soft-sediment habitat and associated biota as a result of sewage effluent was considered 'minor'. This is localised impact in area surrounding discharge area. Discharges at deep ocean outfalls always carry pollutants and pathogens so impact is 'almost certain'.	A	Confined to deep ocean outfalls	I,M,L	moderate
Climate change	50 years								
	Climate and sea temperature rise		moderate	possible	Greater temp increases affect biota, but impacts to be minor in deep soft sediments	A	NA	L	low
	Ocean acidification		major	likely	Oceanic organisms expected to be more sensitive to change, with major impacts likely to occur.	L	NA	L	high
	Altered storm/cyclone activity		moderate	likely	Disturbance of deep soft sediments that is likely to result in moderate impacts	I	NA	L	moderate
	Sea level rise		minor	likely	Water depth may potentially affect biota, but impacts to be minor in deep soft sediments	A	NA	L	low

Rocky shores

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries	161	moderate	unlikely	The potential impact on rocky shore habitat and associated biota as a result of activities of large commercial vessel was considered 'moderate', derived primarily from oil and fuel spills. It was considered 'unlikely' that this level of impact would occur.	L	L	I	low
	Small commercial vessels (ferries, charter boats, etc.)	162	minor	likely	The impact on rocky shore habitat and associated biota as a result of activities of small commercial vessel was considered 'minor', derived primarily from oil and fuel spills. It was considered 'likely' that this level of impacts result.	L	L	I	low
Recreational fishing	Shore-based line and trap fishing	170	minor	likely	The impact on rocky shore habitat and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the impact of the defined stressors from shore-based fishing on intertidal reefs (e.g. trampling, marine debris) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	L	I	low
	Hand gathering	172a	moderate	likely	The impact on rocky shore habitats as a result of hand gathering was considered 'moderate. This reflects the levels of impact of the defined stressor of physical disturbance from this activity on intertidal reefs (e.g. trampling, bait collection) against background variations. It was considered 'likely' that this level of impact would result due to the level of activity in this bioregion.	L	R	I	moderate
Service infrastructure	Pipelines, cables, trenching and boring	185	minor	likely	The impact on rocky shore habitat and associated assemblages as a result of service infrastructure was considered 'minor' reflecting the level of physical disturbance. It is considered 'likely' that this level of impact could occur at a local level.	L	L	I	low
Land-based impacts									
Landuse	Urban	186	moderate	possible	The impact on rocky shore habitat and associated	L	L: in very close	I,M,L	low

intensification	stormwater discharge				biota as a result of urban stormwater discharge was considered 'moderate' reflecting the fact that contaminants in urban stormwater have been shown to alter biota, microbial assemblages and can result in local production of nuisance macroalgae. It is considered 'possible' that this level of impact could occur.		proximity to outlets that cross rocky shores		
	Foreshore develop.	187	major	possible	The impact on rocky shore habitat and associated assemblages as a result of foreshore development was considered 'major' reflecting the level of measurable change that occurs due to this activity, which changes habitat characteristics, removes natural surroundings, and adds in new structures (e.g. walls, paths). It is considered 'possible' that this level of impact would occur. Legacy issue – new foreshore development on rocky shores is unlikely to occur with current management settings e.g. zonings, SEPP 71, CZMPs etc. These controls contain restrictions for new coastal development and are unlikely to allow major adverse environmental impacts, thus reducing the likelihood to unlikely or rare.	L	L: All rocky shores where development has occurred/is occurring	I,M,L	moderate
	Sewage effluent and septic runoff	193	major	possible	The potential impact on rocky shore habitat and associated biota as a result of sewage effluent was considered 'major'. This is a localised impact in an area surrounding discharge area. Discharges generally carry pollutants so impact is 'possible'.	I, see SA reports	L: Only areas near STP discharges, e.g. Norah Head, Diamond Bay	I,M,L	moderate
Climate change	20 Years								
	Altered storm/ cyclone activity	198	moderate	possible	Altered wave climate may affect organisms on rocky shore, with moderate impacts possible.	L	R	L	low
	Sea level rise		moderate	possible	Some rocky shores may be lost due to their limited capacity to extend inland (local certain circumstances), hence moderate impacts are likely.	L	R	L	low
Climate change	50 Years								
	Ocean acidification	197	moderate	likely	Many calcifying organisms, but substantial natural variation may lead to resilience for some	L	R	L	moderate

				rocky shore biota, although moderate impacts likely.					
	Altered storm/ cyclone activity		moderate	possible	Altered wave climate may affect organisms on rocky shore, with moderate impacts possible.	L	R	L	low
	Sea level rise		moderate	likely	Limited capacity for biota to move in most places. Shore platforms particularly vulnerable to modest increases in sea level, leading to displacement of habitat and biota, with moderate impacts likely.	L	R	L	moderate
Extreme events	Flooding, storm surge, inundation		minor	likely	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, but impacts expected to be minor.	L	R	L	low

Shallow rocky reefs

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries		minor	likely	The impact on shallow reef habitat and associated biota as a result of activities of large commercial vessel was considered 'moderate', derived primarily from oil and fuel spills. It was considered 'likely' that this level of impact would occur.	L	R	I	low
Commercial fishing	Ocean Trap and Line		minor	likely	The impact on shallow reef habitat and associated biota as a result of ocean trap and line activities was considered 'minor', and this level of impact was considered 'likely'. This primarily reflects the fact that very little ocean trap and line catch and effort is targeted at this habitat type in this bioregion.	A	R	I	low
	Ocean Trawl		minor	likely	The impact on shallow reef habitat and associated biota as a result of ocean trawl was considered 'minor'. This reflects the fact that little ocean trawl catch and effort is targeted at this habitat type. This level of impact was considered 'likely'.	L	R	I	low
	Sea urchin and turban shells		moderate	likely	The impact on shallow reef habitat and associated biota as a result of this fishery was considered 'moderate', and this level of impact was considered 'likely'. This primarily reflects the removal of the species that have life history characteristics that result in mod-low resilience, and fact that commercial catches of sea urchins and turban shell from the bioregion have averaged around <5% and 25% of the statewide catch respectively within the last 5 years.	A	R	I	moderate
Charter fishing	Line fishing		moderate	possible	The impact on shallow reef habitat and associated biota as a result of charter fishing was considered 'moderate' reflecting the impact of the defined stressors from this activity on shallow reefs (e.g. harvest, by-catch, marine debris) against background variations. It was considered 'possible' that this level of impact would occur from this activity due to the amount of charter fishing effort at a local scale adjacent to the major estuaries.	L	L	I	low

Recreational fishing	Shore-based line and trap fishing	moderate	likely	The impact on shallow reef habitat and associated biota as a result of shore-based recreational line fishing was considered 'moderate' reflecting the impact of the defined stressors from this activity on shallow reefs (e.g. harvest, by-catch, marine debris) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	A	R	I	moderate
	Boat-based line and trap fishing	moderate	likely	The impact on shallow reef habitat and associated biota as a result of boat-based recreational line fishing was considered 'moderate' reflecting the impact of the defined stressors from this activity on shallow reefs (e.g. harvest, by-catch, marine debris, physical disturbance from anchors) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of boat-based fishing effort throughout the bioregion.	A	R	I	moderate
	Spearfishing	minor	likely	The impact on shallow reef habitat and associated biota as a result of spearfishing was considered 'minor' reflecting the impact of the key stressor from this activity on shallow reefs (e.g. harvest) against background variations. This reflects the life-history characteristics of several of these reef associated harvested species (including red morwong, rock cale, leatherjackets, girellids), which indicates relatively low resilience. It was considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of effort throughout the bioregion.	L	L	I	low
	Hand gathering	minor	likely	The impact on shallow reef habitat and associated biota as a result of hand gathering was considered 'minor' reflecting the impact of the key stressor from this activity on shallow reefs (e.g. harvest) against background variations. This reflects the life-history characteristics of several of these reef associated harvested species (including lobster, crabs, abalone, whelks, octopus, sea urchins and cunjevoi) which indicates relatively moderate-low resilience. It was	L	L	I	low

					considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of effort throughout the bioregion.				
Recreation and tourism	Boating and boating infrastructure		minor	likely	The impact on shallow reef habitat and associated biota as a result of boating and related infrastructure was considered 'minor' reflecting the impact of the key stressor from this activity on shallow reefs (e.g. physical disturbance) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of effort throughout the bioregion.	L	L	I	low
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on shallow reef habitat and associated assemblages as a result of service infrastructure was considered 'minor' reflecting the level of physical disturbance. It is considered 'likely' that this level of impact could occur at a local level.	L	L	I	low
Land-based impacts									
Landuse intensification	Urban stormwater discharge		moderate	likely	The impact on shallow rocky reef habitat and associated biota as a result of urban stormwater discharge was considered 'moderate' reflecting the fact that contaminants in urban stormwater have been shown to alter biota, microbial assemblages and can result in local production of nuisance macroalgae. It is considered 'likely' that this level of impact could occur.	L	R	I	moderate
	Agricultural diffuse source runoff		minor	likely	The impact on shallow reef habitat and associated biota as a result of agricultural diffuse source runoff was considered 'minor' reflecting the fact that contamination from sediments in agricultural runoff is mostly taken up in estuaries, unless in floods. However, discharge from estuaries is dispersed and can be distributed into coastal habitats. It was considered 'likely' that agricultural runoff will reach shallow reefs at a local scale in floods and result in the identified level of impact.	L	L: Offshore of main estuaries	I	low
Point discharges	Industrial discharges		moderate	possible	The impact on shallow reef habitat and associated biota as a result of industrial discharge was considered 'moderate' reflecting the fact that contamination from sediments in agricultural runoff is mostly taken up in	L	L	I	low

					estuaries, unless in floods. Discharge from estuaries is dispersed and can be distributed into deeper habitats. It was considered 'possible' that agricultural runoff will reach subtidal areas in floods and result in the identified level of impact.				
	Sewage effluent and septic runoff		moderate	likely	The impact on shallow reef habitat and associated biota as a result of sewage effluent was considered 'moderate'. This is localised impact in area surrounding discharge area around larger outfalls, with this level of impact considered 'likely'.	A	L	I	moderate
Climate change	20 Years								
Climate change	Altered ocean currents & nutrient inputs		moderate	possible	Reduction of nutrients may affect growth of habitat forming macro-algae on shallow reef habitat, with moderate impacts possible.	I	R	L	low
	Altered storm/cyclone activity		moderate	likely	Storms can disturb kelp and associated biota on shallow reef habitat, with moderate impacts likely.	I	R	M	moderate
Climate change	50 Years								
Climate change	Altered ocean currents & nutrient inputs		moderate	likely	Reduction of nutrients may affect growth of habitat forming macro-algae resulting in moderate impacts on shallow reef habitat.	I	R	L	moderate
	Ocean acidification		moderate	likely	Larger pH changes may affect sensitive organisms such as urchins and molluscs, with moderate impacts likely.	L	R	L	moderate
	Altered storm/cyclone activity		moderate	likely	Storms can disturb kelp and associated biota on shallow reef habitat, with moderate impacts likely.	I	R	L	moderate
Extreme events	Flooding, storm surge, inundation		minor	likely	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, but impacts expected to be minor.	I	R	L	low

Deep rocky reefs

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries		major	possible	The impact on deep reef habitat and associated biota as a result of large commercial vessels was considered 'major'. This reflects that while most ships anchor outside edge of 3 nm, the long chains allow swinging and impacts inside 3nm through direct substantial physical disturbance from chains, and the level of mooring activity within the bioregion associated with the major ports. It was considered 'possible' that this level of impact would occur at a local level.	I	L: offshore of Hunter and Illawarra	I	moderate
Commercial fishing	Ocean Trap and Line		moderate	possible	The impact on deep reef habitat and associated biota as a result of ocean trap and line fishing was considered 'moderate'. This reflects the moderate resilience, stock status and abundance of the harvested species, which includes snapper, the fact that this habitat is common throughout the region, and the limited disturbance from the gear type used in this fishery. It also reflects the fact that only around 10% of the ocean trap and line catch is taken in the state coastal waters of the bioregion. This level of impact was considered 'possible'.	L	R	I	low
	Ocean Trawl		moderate	possible	The impact on deep reef habitat and associated biota as a result of ocean trawl was considered 'moderate'. This reflects the fact that while the habitat is common throughout the region and has characteristics that result in a moderate inherent capacity to respond to disturbances, the gear type used can result in measurable impacts on benthic biota and result in moderate levels of bycatch. It was considered 'possible' that this level of impact would occur, which is influenced by the fact that around 14% of the state ocean trawl catch is taken in the state coastal waters of this bioregion	L	R	I	low
	Lobster		minor	likely	The impact of lobster fishing on deep reefs and associated biota was considered 'minor' reflecting the gear type, species targeted, low levels of by-	A	R	I	low

					catch, and small levels of catch and effort from this fishery on this habitat inside 3 nm in this bioregion. It was considered 'likely' that this level of impact would occur.				
Recreational fishing	Boat-based line and trap fishing		moderate	possible	The impact on deep reef habitat and associated biota as a result of boat-based recreational fishing on deep reef habitats was considered 'moderate'. This reflects the moderate resilience and abundance of the likely harvested species, which includes snapper. It was considered 'possible' that this level of impact would occur due to the amount of fishing effort and ability to fish the majority of habitat.	L	R	I	low
Recreation and tourism	Boating and boating infrastructure		minor	likely	The impact on deep reef habitat and associated biota as a result of boating and related infrastructure was considered 'minor' reflecting the impact of the key stressor from this activity on shallow reefs (e.g. physical disturbance) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of effort throughout the bioregion.	L	R	I	low
Land-based impacts									
	Agricultural diffuse source runoff		minor	likely	The impact on deep reef habitat and associated biota as a result of agricultural diffuse source runoff was considered 'minor' reflecting the fact that contamination from sediments in agricultural runoff is mostly taken up in estuaries, unless in floods. It was considered 'likely' that agricultural runoff will reach deep reefs at a local scale in floods and result in the identified level of impact.	L	L	I	low
	Sewage effluent and septic runoff		moderate	likely	The potential impact on deep reef habitat and associated biota as a result of sewage effluent was considered 'moderate', with measurable change in benthic assemblages near Sydney deep water ocean outfalls. This localised level of impact is considered 'likely'.	A	L: Only around Bondi and North Head outfalls	I	moderate
Climate	50 years								

change									
	Ocean acidification		moderate	likely	Larger pH changes may affect sensitive organisms such as urchins and molluscs, with moderate impacts likely.	L	R	L	moderate

Pelagic assemblages

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
	Small commercial vessels (ferries, charter boats, etc.)		minor	likely	The impacts on pelagic assemblages from small commercial vessels was considered 'minor', and reflects issues due to marine debris and water pollution through oil and fuel spills. It was considered 'likely' that this level of impact would occur.	L	L	I	low
Commercial fishing	Ocean Trap and Line		minor	likely	The impact on pelagic assemblages as a result of ocean trap and line was considered 'minor'. This reflects the fact that these assemblages have characteristics that result in a moderate to high inherent capacity to respond to disturbances, with catch of pelagic species limited with the gear types used in this fishery. This level of impact was considered 'likely'.	A	R	I	low
	Ocean Trawl		minor	likely	The impact on pelagic assemblages as a result of ocean trawl was considered 'minor'. This reflects the fact that these assemblages have characteristics that result in a moderate to high inherent capacity to respond to disturbances, with catch of pelagic species limited with the gear types used in this fishery. This level of impact was considered 'likely'.	A	R	I	low
	Ocean Haul		moderate	likely	The impact on pelagic assemblages as a result of the ocean haul fishery (through the purse-seine fishery) was considered 'moderate' due to the observed decline in sweep landings. The targeting by purse-seiners of sweep from Wollongong resulted in localised depletions. This level of impact was considered 'likely'.	L	L	I	moderate
Charter fishing	Line fishing		minor	likely	The impact on pelagic assemblages as a result of charter fishing was considered 'minor' reflecting the limited impact of the defined stressors from this activity (e.g. harvest, by-catch) against background	L	L – adjacent to major estuaries	I	low

					variations, and moderate to high resilience characteristics of the assemblages. It was considered 'likely' that this level of impact would occur from this activity due to the amount of charter fishing effort at a local scale adjacent to the major estuaries.				
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on pelagic assemblages as a result of shore-based line and trap fishing was considered 'minor' reflecting the limited impact of the defined stressors from this activity (e.g. harvest, by-catch) against background variations, and moderate to high resilience characteristics of the assemblages. It was considered 'likely' that this level of impact would occur from this activity due to the amount of fishing effort at a local scale adjacent to the major estuaries.	L	R	I	low
	Boat-based line and trap fishing		minor	likely	The impact on pelagic assemblages as a result of boat-based line and trap fishing was considered 'minor' reflecting the limited impact of the defined stressors from this activity (e.g. harvest, by-catch) against background variations, and moderate to high resilience characteristics of the assemblages. It was considered 'likely' that this level of impact would occur from this activity due to the amount of fishing effort at a local scale adjacent to the major estuaries.	L	R	I	low
	Spearfishing		minor	likely	The impact on pelagic assemblages as a result of spearfishing was considered 'minor' reflecting the limited impact of the defined stressors from this activity (e.g. harvest) against background variations, and moderate to high resilience characteristics of the assemblages. It was considered 'likely' that this level of impact would occur from this activity due to the amount of fishing effort at a local scale adjacent to the major estuaries.	L	R	I	low
Recreation and tourism	Shark meshing of swimming beaches		minor	likely	The impact on pelagic assemblages as a result of shark meshing of swimming beaches was considered 'minor', and this level of impact was considered 'likely'. This primarily reflects the fact that the	A	R: restricted to beaches where meshing occurs, but this is	I	low

					activity is known to result in limited catch of pelagic assemblages.		widespread throughout the bioregion		
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on pelagic assemblages as a result of service infrastructure was considered 'minor' reflecting the level of physical disturbance. It is considered 'likely' that this level of impact could occur at a local level.	L	L	I	min
Land-based impacts									
	Agricultural diffuse source runoff		moderate	likely	The impact on pelagic assemblages as a result of agricultural diffuse source runoff was considered 'moderate' reflecting the fact that contamination from sediments in agricultural runoff can stimulate algal blooms following floods that impacts water column biota, including phytoplankton and zooplankton. It was considered 'likely' that this level of impacts would occur.	L	L: Near large agricultural rivers, Hunter, Hawkesbury	I	moderate
	Sewage effluent and septic runoff		minor	likely	The impact on pelagic assemblages as a result of sewage effluent and septic runoff was considered 'minor' reflecting the fact that water pollution from this source is diluted on the open coast. It was considered 'likely' that this level of impact would occur.	A	L	I	low
Climate change	20 Years								
Climate change	Altered ocean currents & nutrient inputs		moderate	likely	Reduction of nutrients may result in changes in primary production, with moderate impacts likely..	L	R	L	moderate
	Ocean acidification		moderate	likely	Only small pH changes over this time frame, but calciphores, pteropods are vulnerable, with moderate impacts likely.	I	R	L	moderate
Climate change	50 Years								
Climate change	Altered ocean currents & nutrient inputs		moderate	likely	Changes to primary production associated with increased intensity of the EAC. This could lead to changes in upwelling regimes and either increases or decreases in nutrient concentrations and ratios, with moderate impacts likely.	L	R	L	moderate
	Climate and sea		moderate	possible	Larger temp increases affect biota, with moderate	A	R	L	low

	temperature rise			impacts possible.					
	Ocean acidification		major	likely	Larger pH changes will occur, with coccolicophores, pteropods vulnerable, and major impacts likely.	I	R	L	high

Threatened and protected fish and sharks

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Commercial fishing	Ocean Trap and Line		moderate	likely	The impact on threatened and protected fish and sharks as a result of ocean trap and line was considered 'moderate', and this level of impact was considered 'likely'. This primarily reflects the fact that ocean trap and line catch and effort occurs in coastal waters in the bioregion, and observer work has identified some interaction with white sharks, grey nurse sharks or black cod in coastal waters.	A	R	I	moderate
	Ocean Trawl		moderate	likely	The impact on threatened and protected fish and sharks as a result of ocean trawl was considered 'moderate', and this level of impact was considered 'likely'. This primarily reflects the fact that ocean trawl catch and effort occurs in coastal waters of the bioregion, and observer work has identified some interaction with white sharks and grey nurse sharks in coastal waters.	L	R	I	moderate
	Ocean Haul		minor	likely	There is limited evidence to indicate that ocean haul activities impact on threatened and protected fish and sharks in the bioregion, with only minor impacts likely.	L	R	I	low
Charter fishing	Line fishing		minor	likely	The impact on threatened and protected fish and sharks as a result of charter fishing was considered 'minor' reflecting the impact of the defined stressors from this activity (e.g. by-catch). It was considered 'likely' that this level of minor impact would occur..	L	R	I	low
Recreational fishing	Shore-based line and trap fishing		moderate	likely	The impact on threatened and protected fish and sharks as a result of shore-based recreational line fishing was considered 'moderate' reflecting the impact of the incidental catch from this activity. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort on both beaches and rocky shores throughout the bioregion.	L	R	I	moderate
	Boat-based line		moderate	likely	The impact on threatened and protected fish and sharks	L	R	I	mod

	and trap fishing				as a result of boat-based recreational line fishing was considered 'moderate' reflecting the impact of the incidental catch from this activity. It was considered 'likely' that this level of impact would occur from this activity due to the amount of boat-based fishing effort throughout the bioregion.				
	Spearfishing and hand gathering		minor	likely	The impact on threatened and protected fish and sharks as a result of spearfishing was considered 'minor', and this level of impact was considered 'likely'. This primarily reflects the fact that limited catch of grey nurse sharks and black cod in coastal waters is known to occur from this activity.	L	L	I	low
	Shark meshing of swimming beaches		major	likely	The impact on threatened and protected sharks as a result of shark meshing of swimming beaches was considered 'major', and this level of impact was considered 'likely'. This primarily reflects the fact that the activity is known to result in catch of white sharks and grey nurse sharks at levels that has resulted in it being identified as a key threatening process given the population status of these species.	A	R: restricted to beaches where meshing occurs, but this is widespread throughout the bioregion	I	high
	Land-based impacts								
Landuse intensification	Urban stormwater discharge		minor	likely	The impact on threatened and protected fish and sharks as a result of urban stormwater discharge was considered 'minor', and this level of impact was considered 'likely'. This primarily reflects possible entanglement and ingestion of plastics.	L	R	I	low

Threatened and protected marine mammals, reptiles and birds

Resource use	Activity		C 1-5	L 1-5	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries		major	likely	Increasing whale abundance together with increasing recreation and commercial shipping significantly increase risk of vessel strike especially on entering and leaving major ports during whale migration season. Naïve calves and species that must remain on the surface following feeding dives (Sperm whale) are particularly vulnerable. Recovering populations of Southern Right Whale that nurse, enter and leave shallow bays and estuaries have low resilience to vessel strike, and wildlife disturbance which cause subsequent change behaviour. The impact of noise on marine mammals is well documented in the literature but poorly researched within the bioregion. Data show 10 year history of interactions.	L	R: but most likely near major ports and shipping routes	I	high
	Small commercial vessels (ferries, charter boats, etc.)		moderate	likely	Increasing whale abundance together with increasing small commercial shipping significantly increase risk of vessel strike especially on entering and leaving major ports during whale migration season. Naïve calves and species that must remain on the surface following feeding dives are particularly vulnerable. Recovering populations of Southern Right Whale that nurse, enter and leave shallow bays and estuaries have low resilience to vessel strike, and wildlife disturbance which cause subsequent change behaviour. The impact of noise on marine mammals is well documented in the literature but poorly researched within the bioregion.	A	R: but most likely near major harbours	I	moderate
Commercial fishing	Ocean Trap and Line		moderate	likely	The impact of OTL on threatened species is rated moderate because large whale entanglements occur regularly. The majority of entanglements are in line and trap gear, and are	L	R: but most likely near major harbours	I	moderate

				recorded in the NPWS marine incident database. These entanglements are the largest known anthropogenic threat to cetaceans recorded in the database (Lloyd and Ross 2015). Entanglements occur statewide, but are reported in significant numbers in the bioregion. Accidental bycatch from entanglement in gear, and ingestion of baited hooks etc may be extensive (Ogi, 1984; Perrin et al., 1994). Seabird mortality reported to the Australian Bird and bat banding Scheme (ABBBS) as being recovered in fishing gear or `human objects'/debris is relatively low. However, for some species (such as Little penguin) it represented a major cause of mortality (Norman, 2007).				
Ocean Trawl		moderate	likely	Interactions between trawl fishing and marine mammals and reptiles is well documented internationally and nationally e.g. South Australia. There is no reason to suspect levels are lower in this region than elsewhere. Poor reporting on by-catch i.e. seals within the bioregion and elsewhere leads to under reporting. The threat is rated as likely to occur based on documented evidence from other regions.	I	R: but most likely near major harbours	I	moderate
Ocean Haul		moderate	likely	Entrapment of wildlife reported elsewhere. Likelihood is based on potential disturbance of nesting or roosting shorebirds/seabirds from noise and light caused by beach hauling activities with significance of impact dependant on species (SMEC 2001).	I	R	I	moderate
Lobster		moderate	possible	Large whale entanglements in trap lines and floats occur regularly and increasingly, which poses a moderate threat to whales. The likelihood that this impact is derived from the Lobster fishery is rated as possible given the occurrence in Western Australia (Groom &	A	R: but most likely near major harbours	I	low

					Coughran 2014).				
Charter fishing	Line fishing		moderate	likely	Incidental catch of seabirds on lines and entanglement from discarded gear is well documented from within estuaries outside the bioregion and are likely to occur similarly in the continental shelf of this bioregion. Literature suggests a capture rate of 0.36 (95% c.i.: 0.09 to 0.66) birds per 100 fisher hours. Data in the bioregion is insufficient to assess full impact.	I	R: but most likely near major harbours	I	moderate
Recreational fishing	Shore-based line and trap fishing		moderate	likely	Discarded fishing gear and debris from rec fishers poses a threat to turtles and seabirds through ingestion and entanglement. This is ranked likely given the high level of rec fishing that occurs in this bioregion. The NPWS marine incident database holds records of turtle mortality from marine debris ingestion.	I	R	I	min
	Boat-based line and trap fishing		major	likely	Discarded fishing gear and debris from recreational fishers poses a major threat to turtles and seabirds through ingestion and entanglement. The NPWS marine incident database holds records of turtle mortality from marine debris ingestion. Interactions with marine mammals and reptiles is more likely to occur on the continental shelf in this bioregion due to high level of recreational fishing. This is rated as likely to occur given the high level of rec fishing that occurs in this bioregion.	L	R: but most likely near major harbours	I	high
Charter activities	Whale and dolphin watching		moderate	likely	The threat to cetaceans from whale and dolphin watching activities is rated as moderate. High levels of whale tourism in the bioregion. There is limited research on impacts e.g. noise, disturbance, displacement, stress, reduced fitness, behavioural change	L	R: but most likely near major harbours	I	moderate
Recreation and tourism	Boating and boating infrastructure		moderate	likely	Increasing whale and marine turtle abundance together with increasing recreational vessel usage significantly increase risk of vessel strike especially on entering and leaving major ports during whale migration season, and within estuaries and coastal lakes. Naïve calves and species that tend to remain on the surface	L	R: but most likely near major harbours	I	moderate

				(marine turtles) are particularly vulnerable. Recovering populations of Southern Right Whale that nurse in shallow bays and estuaries and listed marine turtle species have low resilience to vessel strike, and disturbance from vessels which cause subsequent change behaviour, potentially reducing fitness of the population. The impact of noise and disturbance on marine wildlife is well documented in the literature but poorly researched within the bioregion. Disturbance of shorebirds at major roost and feeding sites may impact on breeding success and reduce migration capacity. Development of infrastructure including marinas will have consequences for marine fauna including noise and other disturbance.					
	Swimming and surfing		minor	likely	Interaction with some large whale species (common with SRWs) and potential infringement of approach distance regulations	I		I	low
	Four wheel driving		major	likely	Largely unregulated/ permitted and generally restricted to certain beaches. Damage to nesting and foraging habitat for shorebirds, damage to nesting habitat for turtles. Disturbance of shorebirds at major roost and feeding sites may impact on breeding success and reduce migration capacity.	A	L: restricted to relevant ocean beaches	I	high
	Shark meshing of swimming beaches		major	almost certain	Accidental entanglement of cetaceans and turtles. Managed under Joint Management Agreement reviewed 5-yearly.	A	Illawarra to Newcastle	I	high
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		moderate	possible	The impact of noise and disturbance on marine wildlife is well documented in the literature but poorly researched within the bioregion. Data are inadequate to make a clear assessment of the threat in this bioregion therefore it is rated as possible.	I	R: but most likely near major harbours and estuaries	I	low
Land-based impacts									
Landuse intensification	Urban stormwater discharge		major	likely	Evidence of microplastics, marine debris and other contaminants impacting marine turtles, dolphins, seabirds. Some data from necropsies	A	HSBR	I	high

				by Taronga Zoo in bioregion on ingestion of debris in threatened species.					
	Foreshore develop.		major	Almost certain	Impacts high on nesting shorebirds and turtles. Permanent loss of near shore habitat. Possible impacts on inshore dolphins. Again, legacy of existing development – unlikely to be replaced under current mgmt. settings.	A	HSBR	I	high
	Beach nourishment and grooming		moderate	Almost certain	Impacts high on nesting shorebirds and turtles. Impacts on foraging shorebirds. Number of beaches this occurs on fairly low. Threat would need to be reassessed if this changes.	A	HSBR	I	moderate
	Clearing riparian and adjacent habitat including wetland drainage		major	likely	Loss of wetlands and habit for migratory shorebirds likely to lead to local extinctions and additional declines to already threatened species. Activities that may lead directly to loss of wetland with existing management settings e.g. NSW Wetlands Policy, SEPP 14 coastal wetlands, zoning and land use controls, but threat may be from unauthorised activities/lack of compliance.	A	HSBR	I	high
Climate change	20 years								
Climate change	Altered ocean currents & nutrient inputs		minor	likely	Changes to EAC likely to impact turtles and foraging whales and dolphins. Swimming against changes current likely to impact fitness of migrating species. Changes to nutrients and subsequent fish abundance likely to impact higher order predators (seabirds, marine mammals, turtles)	I	R	M	low
	Climate and sea temperature rise		minor	likely	Higher sea temp likely to change distribution and abundance of marine turtles further into bioregion (NPWS data showing increasing numbers and nesting). Changes in temp likely to impact turtles nesting success and change the sex composition of population preliminary data being collected by NPWS. Changing climate triggers may impact whale migration and feeding behaviour in NSW waters. Changing dynamics of coastal wetlands likely to impact Ramsar Sites (shorebird protection sites) and	I	R	M	low

				internationally listed shorebird species.					
	Ocean acidification		minor	likely	Indirect effects from loss of habitat, decreased food availability for marine fauna	I	R	M	low
	Altered storm/cyclone activity		moderate	likely	Beach deterioration will impact shorebirds and seabird foraging. Increased pollution and marine debris. Increased mortality of marine fauna after extreme weather events	I	R	M	moderate
	Sea level rise		major	4	Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Loss of intertidal foraging habitat including seagrass.	I	R	M	high
Extreme events	Flooding, storm surge, inundation		minor	likely	Some loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Impacts on intertidal foraging habitat, including seagrass.	I	R	M	low
Climate change	50 years								
Climate change	Altered ocean currents & nutrient inputs		major	likely	Changes to EAC likely to impact turtles and foraging whales and dolphins. Swimming against changes current likely to impact fitness of migrating species. Changes to nutrients and subsequent fish abundance likely to impact higher order predators (seabirds, marine mammals, turtles)	I	R	L	high
	Climate and sea temperature rise		major	likely	Sea temp likely to change distribution and abundance of marine turtles further into bioregion. Changes in temp likely to impact turtles nesting success and change the sex composition of turtles. Temp may impact migration of whales. Dynamics of coastal wetlands likely to change impacting shorebirds	I	R	L	high
	Ocean acidification		major	likely	Indirect effects from loss of habitat, decreased food availability for marine fauna	I	R	L	High
	Altered storm/cyclone activity		moderate	likely	Beach deterioration will impact shorebirds and seabird foraging. Increased pollution and marine debris. Increased mortality of marine fauna after extreme weather events	I	R	L	moderate
	Sea level rise		major	likely	Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Loss of intertidal foraging habitat, including	L	R	L	high

					seagrass.				
Extreme events	Flooding, storm surge, inundation		moderate	likely	Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Impacts on intertidal foraging habitat, including seagrass.	I	R	L	moderate

Estuaries		Clean waters	Estuarine Habitats and Assemblages									Threatened and Protected Species		Temporal				Geog. Extent
		Estuarine waters	Saltmarsh	Mangrove	Seagrass	Beach and Mudflats	Shallow and Soft Sediments	Rocky Shores	Subtidal Reefs	Pelagic Assemblages	Species and communities protected under FMA, e.g Fish, Sharks, seagrass and saltmarsh	Species protected under TSA, e.g. Marine Mammals, reptiles and Birds	1- Current 2years	Next 10 years	Next 20 years	Trend ↕ #		
Resource use																		
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships, etc.)	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Low	Low	moderate	High	X			↑	L- Port Kembla, Hunter, Botany Bay and Port Jackson	
	Small commercial vessels (ferries, charter boats, etc.)	Low	Low	High	Low	Moderate	Moderate	Low	Low	Low	low	Moderate	X			↑	L: Hunter, Botany Bay and Port Jackson	
Commercial fishing	Estuary General	Minimal	Minimal	Minimal	Low	Low	Low	Minimal	Minimal	Moderate	Low	Moderate	X			↓	L - Tuggerah, Hawkesbury,	
	Estuary Prawn Trawl	Minimal	Minimal	Minimal	Low	Minimal	Moderate	N/A	N/A	Moderate	Low	Moderate	X			↓	L - Hunter and Hawkesbury, Lake Illawarra	
Charter fishing	Line fishing	Minimal	Minimal	Minimal	Low	Minimal	Low	Minimal	Low	Low	Low	Moderate	X			↑	L - Sydney Harbour, Lake Macquarie, Pittwater, Hawkesbury River, Port Jackson	
Recreational fishing	Shore-based line and trap fishing	Minimal	Minimal	Low	Low	Low	Moderate	Low	Moderate	Moderate	Low	High	X			↑	R	
	Boat-based line and trap fishing	Minimal	Minimal	Low	Low	Minimal	Moderate	Minimal	Moderate	Moderate	Low	High	X			↑	R	
	Spearfishing	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Low	Low	Minimal	Minimal	X			↑	L - Hawkesbury River, Botany Bay, Sydney Harbour	
	Hand gathering	Minimal	Minimal	Minimal	Low	Low	Minimal	Low	Minimal	N/A	Minimal	Minimal	X			↑	R	
	Fish stocking (mulloway, prawns, Australian bass)	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	N/A	Minimal	Minimal	Minimal	Minimal		X		↑	L - (previously in Georges River)
Aboriginal Cultural fishing	Line fishing, spearfishing, hand gathering, traditional fishing methods, related cultural traditions	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			↓	L	
Charter activities	Whale and dolphin watching	Minimal	N/A	N/A	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	N/A	Minimal	Not an issue inside these estuaries					
Aquaculture	Oyster aquaculture	Minimal	Low	Low	Moderate	Low	Minimal	Low	Minimal	Minimal	Low	Moderate	X			↓	L -Georges, Hawkesbury, Brisbane Waters	
Bait and aquarium trade	Imported baits, imported fish and other aquatic species	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal						
Research and education	Collecting, sampling and tagging	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			#	R	
Recreation and tourism	Boating and boating infrastructure	Moderate	Minimal	Low	High	High	High	Moderate	Moderate	Moderate	High	Moderate	X			↑	R	
	Snorkelling and diving	Minimal	N/A	N/A	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			↑	L - Sydney, Botany Bay and Lake Macquarie	
	Swimming and surfing	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			↑	R	
	Four wheel driving	Minimal	Moderate	Minimal	Minimal	Moderate	Minimal	Minimal	Minimal	Minimal	moderate	High	X			#	L	
Dredging (including Placem	Navigation & entrance management and modification,	Moderate	Low	Minimal	Moderate	Moderate	High	Minimal	Low	Moderate	Moderate	Low	X			#	R	

Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g.	Moderate	High	Low	Low	Low	Minimal	Low	Low	Moderate	High	Low	X			#	R	
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal	Low	Moderate	Low	Moderate	Low	Low	Low	Low	Low	Moderate	Low	X			#	L - Lake Macquarie and Tuggerah Lakes	
Service infrastructure	Pipelines, cables, trenching and boring	Low	Moderate	Moderate	moderate	low	Low	Minimal	Minimal	minimal	Low	Low	X			↓	R	
Land-based impacts																		
Landuse Intensification	Urban stormwater discharge	High	High	Low	High	High	High	Moderate	High	High	High	High	X			↑	R	
	Foreshore development	Low	Moderate	Moderate	Moderate	High	High	Moderate	Minimal	Minimal	Moderate	High			X	↑	R	
	Beach nourishment and grooming	Low	N/A	N/A	Moderate	Moderate	Low	N/A	N/A	Minimal	Minimal	Moderate	X			#	L - Grooming in Tuggerah Lake, Lake Macquarie and Towra Point	
	Clearing riparian and adjacent habitat including wetland drainage	High	High	Moderate	Low	Low	low	Low	Minimal	Moderate	High	High	X			#	R	
	Agricultural diffuse source runoff	High	Moderate	Moderate	Moderate	Moderate	moderate	Low	Low	Moderate	moderate	Moderate	X			#	L - Hunter River, Hawkesbury River, Lake Macquarie and Tuggerah Lakes	
Point Discharges	Industrial discharges	High	Low	Moderate	Low	Moderate	Moderate	Low	Minimal	Moderate	Low	Low	X			#	R	
	Thermal discharges	High	Minimal	Minimal	High	Low	Low	Low	Low	High	Miminal	Low	X			#	L - Lake Macquarie and Lake Illawarra	
	Sewage effluent and septic runoff	High	Low	Low	Moderate	Low	Moderate	Low	low	Moderate	Moderate	Moderate	X			↑	R	
Hydrologic Modifications	Estuary entrance modifications	Moderate	High	High	High	Moderate	Moderate	Low	Low	Moderate	High	Moderate	X			#	L: All estuaries except drowned river valleys	
Climate change (20 years)																		
Climate change	Altered ocean currents & nutrient inputs	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	X			↑	R	
	Climate and sea temperature rise	Minimal	Minimal	Minimal	Minimal	Low	Minimal	Minimal	Minimal	Minimal	Minimal	Low	X			↑	R	
	Ocean acidification	Minimal	Minimal	Minimal	Low	Low	Minimal	Low	Minimal	Moderate	Minimal	Low	X			↑	R	
	Altered storm/cyclone activity	Low	Minimal	Minimal	Low	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Moderate	X			↑	R
	Sea level rise	Minimal	High	Moderate	Low	Low	Minimal	Low	Minimal	Minimal	Minimal	High	High	X			↑	R
Extreme storm events	Flooding, storm surge, inundation	Low	Low	Minimal	Low	Low	Minimal	Minimal	Minimal	Minimal	Low	Minimal	X			↑	R	
Climate change (50 years)																		
Climate change	Altered ocean currents & nutrient inputs	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal	Moderate	Minimal	Moderate			X	↑	R	
	Climate and sea temperature rise	Low	High	Moderate	Moderate	Moderate	Low	Low	Low	Low	High	High			X	↑	R	
	Ocean acidification	Low	High	High	High	High	High	High	High	High	High	High			X	↑	R	
	Altered storm/cyclone activity	Moderate	Moderate	Low	Moderate	Low	Minimal	Low	Minimal	Minimal	Moderate	Moderate			X	↑	R	
	Sea level rise	Minimal	High	moderate	Low	Low	Low	Low	Low	Low	Minimal	High	High			X	↑	R
Extreme storm events	Flooding, storm surge, inundation	Moderate	Moderate	Low	Moderate	Low	Minimal	Low	Minimal	Minimal	Moderate	Moderate			X	↑	R	

Hawkesbury shelf – Estuarine waters

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and port activities and industries (trade and cruise ships)		major	possible	The impact on estuarine waters as a result of large commercial vessels was considered 'major' reflecting the level of impact of the defined stressors of antifouling paints and oil spills. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	A	L: Main ports only: Sydney Harbour, Botany Bay and Port Kembla	I	moderate
	Small commercial vessels (ferries, charter boats)		minor	likely	The impact on estuarine waters as a result of small commercial vessels was considered 'minor' reflecting the level of impact of the defined stressors of antifouling paints and fuel spills. It was considered 'likely' that this level of impact would occur from this activity due to the amount of vessel activity in the identified estuaries.	L	L: Many large estuaries, particularly Sydney Harbour, Hawkesbury, Hunter	I	low
Recreation and tourism	Boating and boating infrastructure		moderate	likely	The impact on estuarine waters as a result of boating and boating infrastructure was considered 'moderate' reflecting the level of impact of the defined stressors of antifouling paints and fuel spills. It was considered 'likely' that this level of impact would occur from this activity due to the amount of vessel activity in the larger estuaries.	A	L: marinas, mooring areas in larger estuaries	I	moderate
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		moderate	likely	The impact on estuarine waters as a result of dredging was considered 'moderate' reflecting the level of impact of the defined stressors of sediment re-suspension from operations and dewatering in barges leading to turbidity and potential toxin release. It was considered 'likely' that this level of impact would occur from this activity due to the amount of dredging activity	A	L: Most large estuaries, particularly Hunter River	I	moderate

					in the identified estuaries.				
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates)		moderate	likely	Impacts /ASS leaching reducing. Improvements – to flood gates fish passage. Moderate impacts likely to occur.	L	L: Hunter	I	moderate
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		moderate	possible	Moderate water pollution possible. None at present	L	L	I	low
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	The impact on water quality as a result of service infrastructure was considered ‘minor’ reflecting the level of associated water pollution. It is considered ‘likely’ that this level of impact could occur at a local level.	L	Botany Bay	I	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	almost certain	Stormwater has high levels of nutrients, potential toxics (heavy metals) and suspended sediments. It also transports marine debris. Nutrients are present as bioavailable dissolved inorganic forms. Almost certain to occur.	A	All estuaries with urban runoff	I,M,L	high
	Foreshore development		minor	likely	Specific foreshore development impacts on water quality was considered to be minor against background variability.	L	R	I	low
	Beach nourishment and grooming		minor	likely	Local impacts on water quality based on beach berm modification, with minor impacts likely.	L	L: Coastal lagoons	I,M,L	low
	Clearing riparian and adjacent habitat including wetland drainage		major	likely	Local impacts isolated to affected system only. Clearing and draining leads to water pollution such as acid runoff and blackwater events after floods, when they occur will impact estuarine water quality. Likely to occur.	A	L: Hunter, Hawkes, Port Jackson, Botany Bay, Lake Illawarra, Coastal lagoons	L	high
	Agricultural diffuse source runoff		major	almost certain	Agricultural runoff contains nutrients, suspended sediments (turbidity) and potentially agricultural chemicals. Runoff from agriculture always transports sediment and nutrients. Major impacts almost certain to occur.	A	L: Restricted to estuaries with agricultural catchments. E.g. Hawkes,	I,M,L	high

							Hunter, Tuggerah, Macquarie.		
Point Discharges	Industrial discharges		major	likely	Impacts water quality through contamination with wide range of industrial contaminants including nutrients and contaminants. Runoff from industrial areas is likely to transport nutrients, contaminants and enriched sediments. Major impacts almost certain to occur.	A	L: Estuaries with industrial discharges and industrial landuse, e.g. Hunter, Lake Mac, Hawkes, Port Jackson, Port Kembla.	I,M,L	high
	Thermal discharges		major	almost certain	Increases in water temp within the affected system. Thermal discharges always impact water quality by changing natural temperature and dissolved oxygen. Moderate impacts almost certain to occur.	A	L: Lake Mac, Lake Illawarra	I,M,L	high
	Sewage effluent and septic runoff		major	almost certain	Increased nutrients and contaminants; decreased salinity; pathogens. Sewage discharge and sewer overflow is always contaminated and a major impact is almost certain to occur.	A	L: Hunter River, Lake Mac, Tuggerah, Hawkes	I,M,L	high
Hydrologic Modifications	Estuary entrance modification		moderate	almost certain	Changes in tidal height, residence times, and volumes of freshwater inflowing impacts salinity and inundation. Entrance modification always impacts water quality. Moderate impacts almost certain to occur.	A	Lake Mac, Hawkes, Hunter, Tuggerah, Lake Illawarra, coastal lagoons	L	moderate
Climate change	20 years								
	Altered storm/cyclone activity		moderate	possible	Intensity of storms re suspending sediments	L	Drowned river valleys	M	low
Extreme events	Flooding, storm surge, inundation		moderate	possible	Vegetation death causes decreasing water quality (limited to coastal lagoons)	A	Coastal lagoons and Wave dominated	M	low
Climate change	50 years								
	Climate and sea temp. rise		minor	likely	Limited water quality effects, mainly in drowned river valleys Limited water quality effects	I	Drowned river valleys	L	low

	Ocean acidification		minor	likely	Limited water quality effects, mainly in drowned river valleys Limited water quality effects	I	Drowned river valleys	L	low
	Altered storm/cyclone activity		moderate	likely	Intensity of storms re-suspending sediments and increasing catchment runoff Intensity of storms re suspending sediments	I	Drowned river valleys	L	moderate
Extreme events	Flooding, storm surge, inundation		moderate	likely	Intensity of storms re suspending sediments	I	Coastal lagoons and wave dominated	L	moderate

Saltmarsh

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and port activities and industries (trade and cruise ships)		major	possible	The impact on saltmarsh and associated biota as a result of large commercial vessels was considered 'major' reflecting the level of impact of potential oil spills and the low resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	A	L: Main ports only, but particularly Botany Bay and Hunter River	L	moderate
	Small commercial vessels (ferries, charter boats)		moderate	possible	The impact on saltmarsh and associated biota as a result of small commercial vessels was considered 'moderate' reflecting the level of impact of potential fuel spills. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified estuaries.	A	L: Many large estuaries, particularly Hunter, Hawkesbury, Sydney Harbour	I	low
Aquaculture	Oyster aquaculture		minor	likely	The impact on saltmarsh and associated biota as a result of oyster aquaculture was considered 'minor' reflecting the level of physical disturbance at specific sites. It was considered 'likely' that this level of impact would occur from this activity due to the amount of activity in the identified estuaries.	A	L	I	low
Recreation and tourism	Four wheel driving		major	possible	Extensive physical destruction and soil compaction. Possible but under current management there is limited access to saltmarsh area for four wheel drives – and limited saltmarsh where there is access. Major impacts possible in localised areas.	A	Stockton-Hunter, Coastal lagoons only		moderate
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		minor	likely	The impact on saltmarsh as a result of dredging was considered 'minor' reflecting the level of impact of the defined stressors of sediment re-suspension from operations and dewatering in barges leading to	L	L: Most large estuaries, particularly Hunter River	I	low

					turbidity and potential toxin release. It was considered 'likely' that this level of impact would occur from this activity due to the amount of dredging activity in the identified estuaries.				
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates), urban drainage, impervious surfaces		major	likely	Changed water table and inundation regimes results in very broad overall impacts. Major impacts considered likely.		Hunter Hawks Coastal lagoons		high
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		major	possible	Major impacts are possible over time frame		Limited coastal samples		moderate
Service infrastructure	Pipelines, cables, trenching and boring		moderate	likely	Physical disturbance, sedimentation and water pollution at time of construction. Almost certain but pulsed impacts for a short time. Moderate impacts considered likely.		Highly modified estuaries urban, industrial)	I	moderate
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	almost certain	Increased nutrients and sediments and reduced salinities impact biota and ecological processes occurring on saltmarsh. Urban runoff carries nutrients, pollution and marine debris	L,A	All estuaries (where present)	M,L	high
	Foreshore development		major	possible	Direct habitat removal and destruction in some areas. Development of foreshore historically meant removing/infilling of saltmarsh. Possible under current management.	L,A	All estuaries (where present)	I,M,L	moderate
	Clearing riparian and adjacent habitat including wetland drainage		major	likely	Damage to habitat during removal and clearing, altering water tables and connectivity, especially with freshwater wetlands. Removal/clearing of adjacent habitats under current management is still likely, especially in rural catchments.	A	All estuaries	I,M,L	high
	Agricultural diffuse source runoff		moderate	likely	Elevated nutrients impacts health of saltmarsh and impacts on-going ecological processes. Agricultural runoff carries nutrients and sediment, ground water carries nutrients and is likely to enter salt-	I	Hawkes, Hunter, Tuggerah, Macquarie	M,L	moderate

					marshes via overland flow				
Point Discharges	Industrial discharges		moderate	possible	Increased nutrient loads and contaminant concentrations would negatively impact ecology. Unlikely under current management. Unlikely for industrial discharge to be into saltmarsh	L,I	All estuaries (where present)	M,L	low
	Sewage effluent and septic runoff		major	unlikely	Increases in nutrients and lowered salinity would affect ecological processes. Unlikely under current management.	L,I	All estuaries (where present)	M,L	low
Hydrologic Modifications	Estuary entrance modifications		major	likely	Changes estuary water from estuarine/brackish to more marine, results in increased frequency of inundation and mangrove encroachment. Likely in all modified estuaries	A	All estuaries (where present)	I, M, L	high
Climate change	20 years								
	Sea level rise		major	almost certain	Likely to be inundated, limited chances to expand range, high chance of sea level rise.	A	NA	M	high
Extreme events	Flooding, storm surge, inundation		moderate	possible	Increased nutrient and sediment runoff may be significant, with moderate impacts possible.	I	NA	M	low
Climate change	50 years								
	Climate and sea temperature rise		major	likely	Experimental studies show response and expected change is greater than thresholds. Resilient systems	I	NA	L	high
	Ocean acidification		major	likely	Experimental studies show response and expected pH change is greater than thresholds.	I	NA	L	high
	Altered storm/cyclone activity		major	likely	Resilient, tolerant of abiotic stress. Increased nutrient and sediment runoff may be significant.	I	NA	L	moderate
	Sea level rise		major	almost certain	Saltmarsh likely to be inundated, limited chances to expand range, high chance of sea level rise, with major impacts almost certain.	L	NA	L	high
Extreme events	Flooding, storm surge, inundation		moderate	likely	Increased nutrient and sediment runoff may be significant, with moderate impacts likely.	I	NA	L	moderate

Mangroves

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and port activities and industries (trade and cruise ships)		major	possible	The impact on mangroves and associated biota as a result of large commercial vessels was considered 'major' reflecting the level of impact of potential oil spills and the low resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	A	L: Main ports only, but particularly Botany Bay		moderate
	Small commercial vessels (ferries, charter boats)		major	almost certain	The impact on mangroves and associated biota as a result of small commercial vessels was considered 'major' reflecting the impact of the physical disturbance from Rivercats which undermines mangroves and causes them to fall. It was considered 'almost certain' that this level of impact would occur from this activity at this local scale.	A	L: Upper Parramatta River only	I	high
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on mangroves habitat and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the impact of the defined stressors from shore-based fishing on mangroves (e.g. trampling, marine debris) against background variations and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	R	I	low
	Boat-based line and trap fishing		minor	likely	The impact on habitat and associated biota as a result of boat-based recreational fishing was considered 'minor' reflecting the impact of the defined stressors from this activity on mangroves (e.g. harvest, marine debris)	L	R	I	low

					against background variations and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this activity.				
Aquaculture	Oyster aquaculture		minor	likely	The impact on mangrove and associated biota as a result of oyster aquaculture was considered 'minor' reflecting the level of physical disturbance at specific sites. It was considered 'likely' that this level of impact would occur from this activity due to the amount of activity in the identified estuaries.	A	L	I	low
Recreation and tourism	Boating and infrastructure		minor	likely	The impact on mangroves and associated biota as a result of boating and infrastructure was considered 'minor' reflecting the low level of impact of the defined stressors from the activity (e.g. fuel spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	R: Most large estuaries, particularly Hunter River Hawkesbury River, Georges River, Lake Macquarie and Port Hacking	I	low
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates), urban drainage, impervious surfaces		moderate	possible	Some distance from impacts freshwater inflow changes, with moderate impacts only possible.	A	R	I	low
Service infrastructure	Pipelines, cables, trenching and boring		moderate	likely	Localised impacts during construction, physical/sediments/water pollution	A	Hunter, Tug Kembla Hawks,	Highly modified estuaries only	moderate
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		moderate	possible	Discharges might carry nutrients and sediment to mangrove beds, marine debris can be caught in pneumatophores,	I,L	Estuaries with mangroves near urban	I,M,L	low

				and impacts moderate, but only possible to occur.		areas			
	Foreshore development		major	possible	Where it occurs, entire mangrove stands can be totally or partially removed. Under current management, loss of mangroves to foreshore development is possible	L	Estuaries with mangroves near urban areas	I	moderate
	Clearing riparian and adjacent habitat including wetland drainage		minor	likely	Damage to habitat during removal and clearing, altering water tables and connectivity, especially with freshwater wetlands, with impacts moderate. Clearing adjacent habitats is likely under current management, particularly in agricultural catchments.	I,L	Estuaries with mangroves	I	moderate
	Agricultural diffuse source runoff		moderate	likely	Nutrient enrichment can impact mangrove growth, reproduction and health. Agricultural runoff carries nutrients and sediment, ground water carries nutrients and is likely to enter mangroves via overland flow	L	Hawkes, Hunter, Tuggerah, Macquarie.	I	moderate
Point Discharges	Industrial discharges		major	possible	Sediment in mangrove forest can be contaminated and impact associated fauna through toxicity and bioaccumulation. It is possible that, under current management, industrial runoff carries nutrients, contaminants and enriched sediments	I,L	Hunter, Illawara, LM, Tug, Port Jackson, Kembla.	I,M,L	moderate
	Sewage effluent and septic runoff		moderate	possible	Impacts mangrove health if exposed to enriched and contaminated runoff, chronically lowered salinity and the unknown impact of microplastics. Sewage runoff carries pollutants, freshwater and pathogens and microplastics, with impacts moderate and possible.	I,L	Hunter, Brisbane, Hawkes,	I,M,L	low
Hydrologic Modifications	Estuary entrance modifications		almost certain	likely	Changes estuary water from estuarine/brackish to more marine, results in increased frequency of inundation. Results in mangrove establishment in inappropriate places. Ongoing management allows openings and other modifications	L,A	All except DRV's	I,M,L	high
Climate change	20 year								

	Sea level rise		moderate	almost certain	May not be able to expand in some estuaries	A	NA	M	moderate
Climate change	50 year								
	Climate and sea temperature rise		moderate	likely	Resilient systems, though some moderate effects likely	I	NA	L	moderate
	Ocean acidification		major	likely	Resilient, though major impact on molluscs and other calcifying organisms likely	I	NA	L	high
	Altered storm/cyclone activity		minor	likely	Tolerant to abiotic stress and like sheltered locations, so only minor impacts likely	L	NA	L	low
	Sea level rise		moderate	almost certain	May not be able to expand in some estuaries, and hence moderate impacts are almost certain to occur	A	NA	L	moderate
Extreme events	Flooding, storm surge, inundation		minor	likely	Tolerant to abiotic stress and like sheltered locations, so only minor impacts likely	L	NA	L	low

Seagrass

Resource use	Activity		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		major	possible	The impact on seagrass and associated biota as a result of large commercial vessels was considered 'major' reflecting the level of impact of defined stressors from the activity on seagrass (e.g. oil spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only, but particularly Botany Bay and Sydney Harbour	I	moderate
	Small commercial vessels (ferries, charter boats)		moderate	possible	The impact on seagrass and associated biota as a result of small commercial vessels was considered 'moderate' reflecting the level of impact of the defined stressors from the activity (e.g. fuel spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Several large estuaries, particularly Botany Bay, Sydney Harbour, Hawkesbury		low
Commercial fishing	Estuary General		minor	likely	The impact on seagrass habitat and associated biota as a result of the estuary general fishery was considered 'minor' reflecting the low level of impact of the defined stressors from the activity on seagrass (e.g. harvest, by-catch, physical disturbance) and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this	L	L: estuaries where commercial fishing allowed only	I	low

				activity at a local scale under current management arrangements.					
	Estuary Prawn Trawl		minor	likely	The impact on seagrass habitat and associated biota as a result of the estuary prawn trawl fishery was considered 'minor' reflecting the low level of impact of the defined stressors from the activity on seagrass (e.g. physical disturbance, sediment res-suspension). It was considered 'likely' that this level of impact would occur from this activity at a local scale, and in Hawkesbury only.		L: Hawkesbury only		low
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on seagrass habitat and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the impact of the defined stressors from shore-based fishing (e.g. harvest, by-catch, trampling, marine debris) against background variations and life history characteristics of harvested species. It was considered 'possible' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	R	I	low
	Boat-based line and trap fishing		moderate	possible	The impact on seagrass habitat and associated biota as a result of boat-based recreational fishing was considered 'moderate' reflecting the impact of the defined stressors from the activity on seagrass (e.g. harvest, by-catch, physical disturbance, marine debris) against background variations and life history characteristics of harvested species. It was considered 'possible' that this level of impact would occur from this activity.	L	R	I	low
	Hand gathering		moderate	possible	Relates principally to impacts associated with prawning, with moderate impacts possibly occurring at a local scale	L	L	I	low

Aquaculture	Oyster aquaculture		major	possible	The impact on seagrass and associated biota as a result of oyster aquaculture was considered 'moderate' reflecting the level of defined stressors from the activity (physical disturbance resulting from propellers, sediment re-suspension, and shading from boats/structures resulting in light limitation). and the low resilience of components of the habitat to these impacts (i.e. <i>Posidonia</i>). It was considered 'likely' that this level of impact would occur from this activity at the local scale.	A	L – principally in Brisbane Waters	I	moderate
Recreation and tourism	Boating and boating infrastructure		major	almost certain	The impact on seagrass and associated biota as a result of boating and infrastructure was considered 'major' reflecting the level of defined stressors from the activity (e.g. physical disturbance resulting from propellers, anchoring, moorings, sediment re-suspension and shading from boats/jetties resulting in light limitation) and the low resilience of components of the habitat to these impacts (i.e. <i>Posidonia</i>). It was considered 'likely' that this level of impact would occur from this activity at the local scale.	A	R: All estuaries, but particularly Lake Macquarie, Hawkesbury River, Sydney Harbour, Port Hacking	I	high
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		major	possible	The impact on seagrass and associated biota as a result of dredging was considered 'major' reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance, re-suspension) and the moderate resilience of the habitat to these impacts. Physical disturbances and removal in generally small areas for discrete projects such as jetties, marinas. It was considered 'possible' that this level of impact would occur from this activity due to the amount of dredging activity in the identified estuaries.	L	All estuaries with dredging	I	moderate

Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates)		minor	likely	Changes to salinity regimes and sediment movement within estuaries considered to result in minor impacts.	L	R	I	low
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		moderate	likely	Subsidence affects seagrass viability at depth. Difficult to manage, coal mines still mine under seagrass beds, with moderate impacts likely.	L	L: Lake Macquarie, Tuggerah	I	moderate
Service infrastructure	Pipelines, cables, trenching and boring		moderate	likely	Removal of <i>Posidonia</i> leads to damage, but overall impacts moderate and likely to occur.		Botany Bay, Lake Macquarie, Port Jackson, Port Hacking		moderate
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	almost certain	Nutrient enrichment, freshwater, sedimentation, physical removal, affects seagrass diversity and abundance. Major impacts are almost certain at a local scale.	A	All estuaries and some coastal lagoons	I,M,L	high
	Foreshore development		moderate	likely	Physical damage to beds, change in light climate and introducing new surfaces into a waterway impacts seagrass dynamics, impacts from changed water flows from groynes. Development adjacent or near nearshore areas impacts seagrass, where present, and impacts moderate and likely to occur.	A	All estuaries where nearshore development (including moorings, marinas, jetties), in particular Lake Mac, Bot Bay,	I,M,L	moderate
	Beach nourishment and grooming		moderate	likely	Removal of seagrass wrack from living beds has potential damage living seagrass and remove associated biota, with impacts moderate and likely to occur at a local scale.	A	Tuggerah, Lake Macquarie, Port Jackson		moderate
	Clearing riparian and adjacent habitat including wetland drainage		minor	likely	Changed water table and nutrient/carbon dynamics, with minor impacts likely.	I	Estuaries with seagrass		low

	Agricultural diffuse source runoff		moderate	almost certain	Nutrient enrichment, turbidity and sedimentation impacts seagrass health and ability to survive. Agricultural runoff carries nutrients and sediment, ongoing and difficult to manage, with moderate impacts almost certain.	A	Estuaries with seagrass and agriculture catchment, e.g. Hawkes, Hunter, Tuggerah, Macquarie.	I,M,L	moderate
Point Discharges	Industrial discharges		moderate	possible	Nutrients and contaminants impact seagrass health. Under current management, industrial discharge possibly carries nutrient and contaminants, and impacts moderate and possible.	A	Estuaries with seagrass and either current or historical industrial discharges, e.g. Port Jackson, Lake Mac, Bris Water, Botany Bay, Illawarra, coastal lagoons	I,M,L	low
	Thermal discharges		major	almost certain	<i>Zostera</i> is killed by elevated water temperatures. Species richness impacts, associated biota impacts, limited to local impacts. On-going discharges exist, with major impacts almost certain at a local scale.	A	Lake Mac, Port Jackson, Lake Illawarra	I,M,L	high
	Sewage effluent and septic runoff		major	possible	Nutrient enrichment from sewage discharge in seagrass beds negatively impacts health through smothering and nitrogen toxicity. Occurs primarily as overflows, with major impacts possible.	L, I	All estuaries	I,M,L	moderate
Hydrologic Modifications	Estuary entrance modifications		major	possible	Changes in tidal dynamics alter salinity regimes and current dynamics and impacts seagrass. Entrance modification impacts tidal prism, with major impacts possible.	A	Lake Mac, Tugg, Bris, Botany Bay, Hacking, Illawarra, coastal lagoons		high
Climate change	20 Years								
	Ocean acidification		moderate	possible	Seagrass and associated organisms sensitive to pH changes. Large	L	NA	M	low

					changes unlikely in time frame.				
	Altered storm/cyclones		moderate	possible	Sensitive to decreased salinity (<i>Zostera</i>), Wave action. Large changes unlikely in time frame.	L	NA	M	low
	Sea level rise		minor	almost certain	Lower limit is determined by water depth and turbidity. Large changes unlikely in time frame.	A	NA	M	low
Extreme events	Flooding, storm surge, inundation		moderate	possible	Increased turbidity, decreased water depth. Large changes unlikely in time frame.	L	NA	M	low
Climate change	50 Years								
	Climate and sea temp rise		moderate	likely	Seagrass species likely to be sensitive to increases in maximum temp. Moderate impacts likely in time frame.	I	NA	L	moderate
	Ocean acidification		major	likely	Seagrass and associated organisms sensitive to pH changes. Significant changes likely in time frame.	I	NA	L	high
	Altered storm/cyclones		moderate	likely	Sensitive to decreased salinity (<i>Zostera</i>). Increased wave action. Moderate impacts likely in time frame.	I	NA	L	moderate
	Sea level rise		minor	likely	Lower limit is determined by water depth and turbidity. Minor changes likely in time frame.	A	NA	L	low
Extreme storm events	Flooding, storm surge, inundation		moderate	likely	Increased turbidity, with sensitivity to decreased salinity (<i>Zostera</i>). Increased wave action. Moderate impacts likely in time frame.	L	NA	L	moderate

Beaches and mudflats

Resource use	Activity		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		major	possible	The impact on beaches and mudflats and associated biota as a result of large commercial vessels was considered 'major' reflecting the level of impact of potential oil spills and the low resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only	L	moderate
	Small commercial vessels (ferries, charter boats)		moderate	almost certain	The impact on beaches and mudflats and associated biota as a result of small commercial vessels was considered 'moderate' reflecting the impact of the physical disturbance from Rivercats which results in erosion and community composition change from vessel wake. It was considered 'almost certain' that this level of impact would occur from this activity at this local scale.	A	L: Upper Parramatta River	I	moderate
Commercial fishing	Estuary General		moderate	possible	The impacts on beaches and mudflats and associated biota were considered 'moderate' that specifically relate to harvest of nippers and physical disturbance in Port Hacking, and this level of impact was 'possible' to occur.	I	L: Port Hacking	I	low
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on beaches and mudflats and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the impact of the defined stressors from the activity (e.g. harvest, trampling, marine debris) against background variations and life history characteristics of harvested species. It was considered 'likely' that this level	L	R	I	low

				of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.					
	Hand gathering		moderate	possible	The impact on beaches and mudflats and associated biota as a result of hand gathering was considered 'moderate' reflecting the impact of the defined stressors from the activity (e.g. harvest, trampling), particularly of nippers, against background variations and life history characteristics of harvested species. The impacts were considered possible at a local scale due to the level of activity in estuaries in the bioregion	L	L	I	low
Aquaculture	Oyster aquaculture		moderate	possible	The impact on beaches and mudflats and associated biota as a result of oyster aquaculture was considered 'moderate' reflecting the level of physical disturbance at specific sites. It was considered 'possible' that this level of impact would occur from this activity due to the amount of activity in the identified estuaries.	A	L	I	low
Recreation and tourism	Boating and boating infrastructure		major	almost certain	The impact on beaches and mudflats and associated biota as a result of boating and infrastructure was considered 'major' reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance, antifouling, bank erosion, fuel spills) and the moderate resilience of the habitat to these impacts. It was considered 'almost certain' that this level of impact would occur from this activity at this local scale.	A	L: Higher impacts in Hawkesbury, Georges, Lake Macquarie, Hunter River	I	high
	Four wheel driving		major	possible	The impact on beaches and mudflats and associated assemblages as a result of four wheel driving was considered 'major', and this reflects the level of activity at a local level and low abundance and overall life-history and ecological characteristics of the species that are impacted from	L	L	I	moderate

					physical compaction and disturbance, and which have relatively moderate–low resilience. It was considered ‘possible’ that this level of impact would occur as there is little current management, but only at a local scale where the activity occurs.				
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		moderate	likely	The impact on beaches and mudflats and associated biota as a result of dredging was considered ‘moderate’ reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance, antifouling, bank erosion, fuel spills) and the moderate resilience of the habitat to these impacts. Entrance dredging of wave dominated estuaries and artificial opening of coastal lagoons changes removes habitat, exposes beaches and flats. Habitats occur in adjacent areas and difficult to manage sediments. It was considered ‘likely’ that this level of impact would occur from this activity at this local scale.	L	L: Most large estuaries, particularly Hunter River and Botany Bay	I	moderate
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, floodgates)		minor	likely	The impacts on beaches and mudflats from modified freshwater flows was considered to be minor due to the high resilience of the habitat, and this was considered likely.	L	R	I	low
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		moderate	possible	The impacts on beaches and mudflats from mining and extractive industries was considered to be moderate due to the high resilience of the habitat, and this was considered possible	L	L	I	low
Service infrastructure	Pipelines, cables, trenching and boring		moderate	possible	Physical disturb and water pollution/sedimentation occurs, with moderate impacts possible.	L	Highly modified estuaries	L	low
Land-based impacts									
Land-use Intensification	Urban stormwater discharge		major	almost certain	Nutrients increase eutrophication, sediment affects water clarity (and hence effectiveness of benthic microalgae), associated contaminants and carbon disrupt ecological	A	All estuaries with sandy/muddy shorelines	I,M,L	high

				processes. Metal contamination disrupts biota, microbial assemblages and ecological processes. Ecological and recreational health impacted. Urban runoff carries sediment, nutrients and debris. Major impacts almost certain to occur.				
	Foreshore development	major	almost certain	Physically destroys habitats and biota, changed wave patterns damage habitat and alter grain size. Common now and increasingly likely with climate change. Major impacts almost certain to occur.	A	All estuaries with sandy/muddy shorelines	I,M,L	high
	Beach nourishment and grooming	moderate	likely	Deposition of sediment on estuary beaches, changes habitat structure. Beach nourishment mobilised sediments, grooming impacts habitat. Moderate impacts likely to occur.	I,L	Tugg, Brisbane Water, Hawkes, Pitt, Port Jackson, Botany Bay, Hacking, Kembla, Illawarra, coastal lagoons.	I	moderate
	Clearing riparian and adjacent habitat including wetland drainage	minor	likely	Changed water table and nutrient/carbon dynamics considered to result in minor impacts that are likely.	I	Estuaries with flats	I	low
	Agricultural diffuse source runoff	moderate	almost certain	Nutrients increase eutrophication, sediment affects water clarity (and hence effectiveness of benthic microalgae), associated contaminants and carbon disrupt ecological processes. Ecological health impacted, with moderate impacts almost certain to occur.	A	Estuaries with agriculture catchments, e.g. Hawkesbury, Hunter, Lake Macquarie, Tuggerah, Illawarra	I,M,L	moderate
Point Discharges	Industrial discharges	moderate	almost certain	Can impact beach biota and ecological processes. Industrial discharge always carries nutrients and contaminants, with moderate impacts almost certain to occur.	I,L	Estuaries with industrial discharges and landuse, e.g. Hunter, Hawkes, Botany, Lake Mac.	I,M,L	moderate
	Thermal discharges	minor	almost certain	Alters typical biota, changing natural condition in specific areas. Existing, on-going discharges, with minor impacts almost certain.	A	Lake Mac, Illawarra, Port Jackson	I,M,L	low

	Sewage effluent and septic runoff		major	unlikely	Impacts ecological health of beaches in vicinity of overflows and discharge points, but moderate impacts unlikely under current management.	A	Lake Macquarie, Hawkesbury, Hunter,	I,M,L	low
Hydrologic Modifications	Estuary entrance modifications		moderate	almost certain	Tidal prism is impacted, changes water quality, impacts habitat and altered current dynamics modify beach characteristics. Modification of entrance berms will always affect estuarine beaches and mudflats in specific system, with moderate impacts almost certain.	I, L	Hunter, Tuggerah, Illawarra	I,M,L	moderate
Climate change	20 Years								
	Climate and sea temp. rise		moderate	possible	Species resilient to increases in maximum temp. Altering key species thresholds.	L	NA	L	low
	Ocean acidification		moderate	possible	Molluscs sensitive to pH changes. Bivalves and calcifying organisms are most vulnerable.	I	NA	L	low
	Sea level rise		minor	likely	Some impact if intertidal flats become submerged, wildlife disturbance likely.	A	NA	L	low
Climate change	50 Years								
	Climate and sea temp. rise		moderate	likely	Temperate increases expected to be greater with more effect on beach biota, and moderate impacts likely.	I	NA	L	moderate
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	L	NA	L	high
	Altered storm/cyclone activity		minor	likely	Beaches with limited capacity to move due to infrastructure etc., so moderate impacts are possible.	I	NA	L	low
	Sea level rise		minor	likely	Some impact if intertidal flats become submerged, with minor impacts likely.	A	NA	L	low
Extreme events	Flooding, storm surge, inundation		minor	likely	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, with minor impacts likely to occur.	I	NA	L	low

Subtidal (Shallow) soft sediments

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		moderate	possible	The impact on shallow soft-sediments and associated biota as a result of large commercial vessels was considered 'moderate' reflecting the level of defined stressors from the activity on seagrass (e.g. physical disturbance, oil spills) and the moderate resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only: Sydney Harbour, Botany Bay and Port Kembla	I	moderate
	Small commercial vessels (ferries, charter boats)		moderate	likely	The impact on shallow soft-sediments and associated biota as a result of small commercial vessels was considered 'moderate' reflecting the impact of the physical disturbance from Rivercats which results in sediment resuspension and change in community composition from vessel wake. It was considered 'likely' that this level of impact would occur from this activity at the local scale.	L	Upper Parramatta River	I	moderate
Commercial fishing	Estuary General		moderate	possible	The impact on shallow soft-sediments and associated biota as a result of the estuary general fishery was considered 'moderate' reflecting the low level of impact of the defined stressors from the activity (e.g. harvest, by-catch, physical disturbance) and life history characteristics of harvested species. It was considered 'possible' that this level of impact would occur from this activity at a local scale.	L	L: In estuaries where commercial fishing occurs	I	low
	Estuary Prawn Trawl		moderate	likely	The impact on habitat and associated biota as a result of the estuary prawn trawl fishery was considered	L	L: Hunter and Hawkesbury	I	moderate

					'moderate' reflecting the level of impact of the defined stressors from the activity on shallow soft sediments (e.g. harvest, by-catch, physical disturbance) and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this activity at a local scale.				
Recreational fishing	Shore-based line and trap fishing		moderate	likely	The impact on habitat and associated biota as a result of shore-based recreational fishing was considered 'moderate' reflecting the impact of the defined stressors from shore-based fishing on shallow soft sediments (e.g. harvest, by-catch, marine debris) against background variations and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion, which can be highly concentrated.	L	R	I	moderate
	Boat-based line and trap fishing		moderate	likely	The impact on habitat and associated biota as a result of boat-based recreational fishing was considered 'moderate' reflecting the impact of the defined stressors from the activity on shallow soft sediments (e.g. harvest, by-catch, physical disturbance, marine debris) against background variations and life history characteristics of harvested species. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion, which can be highly concentrated.	L	R	I	moderate
Recreation and tourism	Boating and boating infrastructure		major	likely	The impact on shallow soft-sediments and associated biota as a result of boating and infrastructure was considered 'major' reflecting the level of defined stressors from the activity (e.g. antifouling, physical disturbance	A	R: All estuaries, but particularly Lake Macquarie, Hawkesbury River, Sydney	I	high

					resulting from propellers, anchoring, moorings) and the low resilience of components of the habitat to these impacts (e.g. soft corals and sponges). It was considered 'likely' that this level of impact would occur from this activity at the local scale.		Harbour, Port Hacking		
Dredging	Navigation & entrance management, modification and maintenance etc.		major	likely	The impact on shallow soft-sediments and associated biota as a result of dredging was considered 'major' reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance, resuspension) and the moderate resilience of the habitat to these impacts. Physical disturbances and removal in generally small areas for discrete projects such as jetties, marinas. Likely to occur at a local scale.	A	L: Wherever dredging occurs	L	high
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	Physical disturbance and sedimentation, water pollution during construction phase, with minor impacts likely to occur	A	Modified estuaries only		low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	likely	Transports nutrient, heavy metals, organic carbon, enriched sediment to natural sediment habitats. Metal and organic contamination disrupts biota, microbial assemblages and ecological processes. Urban runoff carries pollutants, with major impacts likely.	A	All estuaries in urban areas	I,M,L	high
	Foreshore development		major	likely	Changes flow patterns, results in stormwater discharge, modifies natural habitats and processes. Shoreline development always impacts nearshore habitats in estuaries, with major impacts likely.	A	All estuaries with urban development	I	high
	Beach nourishment and grooming		moderate	possible	Beach nourishment sands can end up causing short term disruption to benthic biota, with moderate impacts possible.	A	All estuaries with urban development		low
	Clearing riparian and adjacent habitat		moderate	possible	Changes organic matter and nutrient delivery to estuary, reduces flood	I	All estuaries with developed	I,M,L	low

	including wetland drainage				mitigation and debris. Clearing occurs where development occurs and land use changes, with moderate impacts possible.		shorelines		
	Agri. diffuse source runoff		major	possible	Enriches natural habitats in systems with nutrients, organic carbon from agricultural catchments. Agricultural runoff delivers nutrient enriched sediment, with major impacts considered possible.	A	Hawkes, Hunter, Macquarie, Tuggerah	I,M,L	moderate
Point Discharges	Industrial discharges		major	possible	Contaminated sediments impacting natural biota and processes. Under current management, industrial runoff possibly generates nutrient enriched sediments that results in major impacts.	A	Hunter, Kembla	I,M,L	moderate
	Thermal discharges		moderate	possible	Some changes in benthos documented at a local scale, with moderate impacts possible.	A	Macquarie, Illawarra	IML	low
	Sewage effluent and septic runoff		major	possible	Possibly impacts sediment habitats. Sewage carries pollutants and pathogens, with impacts major.	I	Hawkesbury Coastal Lagoons,	I,M,L	moderate
Hydrologic Modifications	Estuary entrance modification		moderate	almost certain	Impacts sediments by removing and altering sediment habitat and biota, changing salinity thru tidal prism. Entrance management, construction for development and shoreline hardening in some estuaries, with moderate impacts almost certain.	A	Estuaries where dredging occurs, where shoreline development occurs	I,M,L	moderate
Climate change	50 Years								
	Climate and sea temp rise		minor	likely	Temperate increases expected to be greater with more effect on soft sediment biota, with minor impacts likely.	I	NA	L	low
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	I	NA	L	high
	Sea level rise		minor	almost certain	Some shallow soft sediment habitat may be lost due to changes in adjacent nearshore beach morphology, hence minor impacts are almost certain..	A	NA	L	low

Rocky shores

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		major	possible	The impact on rocky shores and associated biota as a result of large commercial vessels was considered 'major' reflecting the level of impact of potential oil spills and the low resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only	I	moderate
	Small commercial vessels (ferries, charter boats)		moderate	possible	The impact on rocky shores and associated biota as a result of small commercial vessels was considered 'moderate' reflecting the level of impact of the defined stressors from the activity (e.g. fuel spills, physical disturbance) and the low resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity at the local scale.	L	L: Several large estuaries, particularly Botany Bay, Sydney Harbour, Hawkesbury River	I	low
Recreational fishing	Shore-based line and trap fishing		minor	likely	The impact on habitat and associated biota as a result of shore-based recreational fishing was considered 'minor' reflecting the level of impact of the defined stressors from shore-based fishing on rocky shores (e.g. trampling, marine debris) against background variations. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	R	I	low
	Hand gathering		moderate	possible	The impact on rocky shore habitats as a result of hand gathering was considered 'moderate. This reflects the levels of	L	R	I	low

					impact of the defined stressor of physical disturbance from this activity on intertidal reefs (e.g. trampling, bait collection) against background variations. It was considered 'possible' that this level of impact would result due to the level of activity in this bioregion.				
Aquaculture	Oyster aquaculture		minor	likely	The impact on rocky shores and associated biota as a result of oyster aquaculture was considered 'minor' reflecting the level of physical disturbance at specific sites. It was considered 'likely' that this level of impact would occur from this activity due to the amount of activity in the identified estuaries.	A	L	I	low
Recreation and tourism	Boating and boating infrastructure		moderate	likely	The impact on rocky shores and associated biota as a result of boating and infrastructure was considered 'moderate' reflecting the level of defined stressors from the activity (e.g. physical disturbance through infrastructure) and the low resilience of components of the habitat to these impacts. It was considered 'likely' that this level of impact would occur from this activity at the local scale.	L	R: All estuaries, but particularly Lake Macquarie, Hawkesbury River, Sydney Harbour, Port Hacking	I	moderate
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, floodgates)		minor	likely	The impacts on rocky shores from modified freshwater flows was considered to be 'minor' due to the mod-high resilience of the habitat, and this was considered 'likely'.	L	R	I	low
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		minor	likely	None present, but minor impacts likely over timeframe.	L	L	M	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	likely	Nutrient and sediment pollution can influence species diversity abundance. Stormwater runoff always delivers nutrients and sediment, with major impacts likely.	I	L: Limited to estuaries with sizeable rocky shore habitats.	I,M,L	moderate
	Foreshore development		moderate	likely	Alters or removes natural habitat and biota. Development on rocky shores always results in rocky shore habitat	L	L: Limited to estuaries with sizeable rocky	I,M,L	moderate

					alteration, and hence impact is at least major. Limited current management due to land tenures, so this level of impact is likely.		shore habitats where development has occurred		
	Clearing riparian and adjacent habitat including wetland drainage		minor	likely	The impacts on rocky shores from clearing adjacent habitat was considered to be 'minor' due to lack of habitat association, and this was considered 'likely'.	L	R		low
	Agricultural diffuse source runoff		moderate	possible	Nutrient and sediment pollution can influence species diversity abundance, with moderate impacts possible.	I	L: Hunter, Hawkes, Macquarie, Illawarra	IML	low
Point Discharges	Industrial discharges		major	unlikely	Nutrient, toxicant and sediment pollution can influence species diversity abundance, so impact could be major. Unlikely under current management.	I	L: All with industrial inputs		low
	Thermal discharges		minor	likely	Thermal pollution can cause eutrophication, changes to algal assemblages and decreased fish diversity, with minor impacts likely.	L	L: Macquarie, Illawarra	I	low
	Sewage effluent and septic runoff		moderate	possible	Nutrient pollution can influence species diversity abundance, but impact considered to be moderate. Possible under current management, and area would be localised.	I	L: Limited to estuaries where sewer overflows discharge over rocky shores, e.g. Lake Macquarie	I,M,L	low
Hydrologic Modifications	Estuary entrance modifications		minor	likely	Tidal prism is impacted, which changes water quality, but impacts considered to be minor and likely to occur.	L	R	I	low
Climate change	20 years								
	Ocean acidification		moderate	possible	Bivalves and calcifying organisms are most vulnerable.	I	NA	M	low
	Sea level rise		minor	likely	Assumes most organisms can move up the shore, but minor impacts likely.	A	NA	M	low
Climate change	50 years								
	Climate and sea temperature rise		minor	likely	Temperate increases expected to be greater with more effect on rocky shore biota, and minor impacts likely.	L	NA	L	low
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	L	NA	L	high

	Altered storm/cyclone activity		minor	likely	Rocky shore biota with limited capacity to move due to infrastructure etc., so minor impacts are possible.	I	NA	L	low
	Sea level rise		minor	almost certain	Sea level rise could change depths over rocky reefs in estuaries.	L	NA	L	low
Extreme events	Flooding, storm surge, inundation		minor	likely	Likely to have higher levels of disturbance, particularly in conjunction with higher sea levels, with minor impacts likely to occur.	I	NA	L	low

Subtidal reefs

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		minor	likely	The impact on subtidal reefs and associated biota as a result of large commercial vessels was considered 'minor' reflecting the level of impact of defined stressors from the activity on seagrass (e.g. oil spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'likely' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only, but particularly Botany Bay and Sydney Harbour	I,M	low
	Small commercial vessels (ferries, charter boats)		minor	likely	The impact on subtidal reefs and associated biota as a result of small commercial vessels was considered 'minor' reflecting the level of impact of the defined stressors from the activity (e.g. fuel spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'likely' that this level of impact would occur from this activity due to the amount of vessel activity at the local scale.	L	L: Several large estuaries, particularly Sydney Harbour and Hawkesbury River	I,M	low
Recreational fishing	Shore-based line and trap fishing		moderate	likely	The impact on shallow reef habitat and associated biota as a result of shore-based recreational line fishing was considered 'moderate' reflecting the impact of the defined stressors from this activity on shallow reefs (e.g. harvest, by-catch, physical disturbance from anchors, marine debris) against background variations. It also reflects the life-history characteristics of several of the reef associated harvested species (including red morwong, rock cale, leatherjackets, girellids), which indicates relatively low resilience. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	R	I	moderate
	Boat-based line and trap fishing		moderate	likely	The impact on shallow reef habitat and associated biota as a result of boat-based	L	R	I	moderate

					recreational line fishing was considered 'moderate' reflecting the impact of the defined stressors from this activity on shallow reefs (e.g. harvest, by-catch, marine debris, physical disturbance from anchors) against background variations. It also reflects the life-history characteristics of several of the reef associated harvested species (including red morwong, rock cale, leatherjackets, girellids), which indicates relatively low resilience. It was considered 'likely' that this level of impact would occur from this activity due to the level of access and amount of boat-based fishing effort throughout the bioregion.				
	Spearfishing		moderate	possible	The impact on shallow reef habitat and associated biota as a result of spearfishing was considered 'minor' reflecting the impact of the key stressor from this activity on shallow reefs (e.g. harvest) against background variations. It was considered 'likely' that this level of impact would occur from this activity at a local scale.	L	L: Targeted shallow estuarine reefs, including mouth of Hawkesbury	I	low
Recreation and tourism	Boating and boating infrastructure		moderate	likely	The impact on subtidal reefs and associated biota as a result of boating and infrastructure was considered 'moderate' reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance through anchoring, antifouling) and the limited distribution of the habitat and moderate resilience to these impacts. It was considered 'likely' that this level of impact would occur from this activity due to the amount of vessel activity at the local scale.	I	L: Several large estuaries, particularly Sydney Harbour and Hawkesbury River		moderate
Dredging	Navigation & entrance management and modification, harbour maintenance etc.		minor	likely	This was considered minor and likely under current management in larger estuaries.	A	L: Wherever dredging occurs	I	low
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs,		minor	likely	Impacts of freshwater inflow changes and habitats and biota, and considered to have minor impacts that are likely to occur.	L	R	I	low

	floodgates)								
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, coal		minor	likely	Minor impacts are likely over time frame.	L	L	M	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	possible	Nutrient enrichment, turbidity, heavy metals and freshwater all affect reef biota negatively at a major level. Changes in landuse possibly affect subtidal reefs in some estuaries, where present, and major impact considered to be possible.	L	Port Hacking, Lake Mac, Hawkes, Pitt, Port Jackson	M,L	high
	Agricultural diffuse source runoff		moderate	possible	Agricultural runoff transports nutrients and sediment to estuaries with moderate impacts possible on habitat and biota due to increases in nutrients. It was considered possible that this level of impact would occur.	L	Estuaries with agriculture catchment, e.g. Hawkesbury, Lake Macquarie, Tuggerah	M,L	low
	Thermal discharges		minor	likely	Thermal pollution can cause changes to algal assemblages and decreased fish diversity, with minor impacts likely.	I			low
	Sewage effluent and septic runoff		moderate	possible	Moderate impact on habitats and biota through available nutrient increase or contamination, at local areas only, if not diluted. Sewage discharge and septic overflow transports nutrients and pathogens to estuaries	I,L	Hawkes	M,L	low
Hydrologic Modifications	Estuary entrance modif.		minor	likely	Tidal prism is impacted, and changes water quality, but impacts considered to be minor	I	L	I	low
Climate change	50 Years								
	Climate and sea temp rise		minor	likely	Temperate increases expected to be greater with more effect on rocky shore biota, and minor impacts likely	L	NA	L	low
	Ocean acidification		major	likely	Larger pH changes may affect sensitive organisms such as echinoderms and molluscs, with major impacts likely.	I	NA	L	high
	Sea level rise		minor	almost certain	Sea level rise could change depths over rocky reefs in estuaries, with minor impacts almost certain.	L	R	I	low

Pelagic assemblages

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		moderate	possible	The impact on pelagic assemblages as a result of large commercial vessels was considered 'moderate' reflecting the level of impact of the defined stressors of antifouling paints and oil spills, physical disturbance. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	A	L: Main ports only: Sydney Harbour, Botany Bay and Port Kembla	I	low
	Small commercial vessels (ferries, charter boats)		moderate	possible	The impact on pelagic assemblages as a result of small commercial vessels was considered 'moderate' reflecting the level of impact of the defined stressors of antifouling paints and oil spills, and sediment resuspension. It was considered 'possible' that this level of impact would occur from this activity due to the amount of small vessel activity in most estuaries.	A	L: Main estuaries where small commercial vessels occur.	I	low
Commercial fishing	Estuary General		moderate	likely	The impact on pelagic assemblages as a result of estuary general fishery was considered 'moderate'. This reflects the impact of the defined stressors from this activity (e.g. harvest, by-catch) against background variations, and moderate resilience characteristics of many species. This level of impact was considered 'likely' to occur due to the amount of effort within the fished estuaries.	L	L: In estuaries where commercial fishing occurs	I	moderate
	Estuary Prawn Trawl		moderate	likely	The impact on pelagic assemblages as a result of estuary prawn trawl was considered 'moderate'. This reflects the impact of the defined stressors from this activity (e.g. harvest, by-	L	L: Hunter and Hawkesbury estuaries.	I	moderate

					catch) against background variations, and moderate resilience characteristics of many species. This level of impact was considered 'likely' to occur from this activity due to the amount of fishing effort within the Hunter and Hawkesbury estuaries.				
Recreational fishing	Shore-based line and trap fishing		moderate	likely	The impact on pelagic assemblages as a result of shore-based recreational fishing was considered 'moderate' reflecting the impact of the defined stressors from the activity (e.g. harvest, by-catch) against background variations and life history characteristics of harvested species which have characteristics of high resilience. It was considered 'likely' that this level of impact would occur from this activity due to the amount of shore-based fishing effort throughout the bioregion.	L	R	I	low
	Boat-based line and trap fishing		moderate	likely	The impact on pelagic assemblages as a result of boat-based recreational fishing was considered 'moderate' reflecting the impact of the defined stressors from the activity (e.g. harvest, by-catch) against background variations and life history characteristics of harvested species which have characteristics of high resilience. It was considered 'likely' that this level of impact would occur from this activity due to the amount of boat-based fishing effort in the estuaries in the bioregion.	L	R	I	low
	Spearfishing and hand gathering		minor	likely	The impact on pelagic assemblages as a result of spearfishing was considered 'minor' reflecting the impact of the defined stressors from the activity (e.g. harvest, by-catch) against background variations and life history characteristics of harvested species	L	L	I	low

					which have characteristics of high resilience. It was considered 'likely' that this level of impact would occur from this activity, but at the local scale.				
Recreation and tourism	Boating and boating infrastructure		moderate	likely	The impact on pelagic assemblages as a result of spearfishing was considered 'minor' reflecting the impact of the defined stressors from the activity Copper pollution from antifouling on moored boat leads to significantly elevated concentrations in organisms from areas with high concentrations of moored boats.	A	L: Localised -marinas	I	moderate
Dredging	Navigation & entrance management and modif. and maintenance		moderate	likely	Sediment re-suspension leads to impacts on phytoplankton and potentially impacts on fish.	A	L: Wherever dredging occurs	I	moderate
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings)		moderate	possible	Impacts /ASS leaching reducing abundance of water column biota. Improvements – to flood gates fish passage.	L	L: Hunter	I	moderate
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		minor	likely	Moderate water pollution possible, but none at present.	L	L	M	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		moderate	almost certain	Nutrients can lead to eutrophication, sediments impact primary productivity. Marine debris is unsightly, and can impact biota. Limited current management.	A	R: All estuaries	I,M,L	high
	Clearing riparian and adjacent habitat including wetland drainage		moderate	likely	Local impacts isolated to affected system only. Clearing leads to water pollution such as acid runoff and as blackwater events after floods, when they occur will impact estuarine biota.	A	Hunter, Hawkes, Port Jackson, Botany Bay, Lake Illawarra, Coastal lagoons	L	moderate

	Agricultural diffuse source runoff		moderate	likely	Increased nutrients leads to turbidity, eutrophication and algal blooms. Runoff from agriculture always transports sediment and nutrients.	A	Restricted to estuaries with agricultural catchments. E.g. Hawkes, Hunter, Tuggerah, Macquarie.	I,M,L	moderate
Point Discharges	Industrial discharges		moderate	likely	Impacts water quality through contamination and potential eutrophication and bioaccumulation. Runoff from industrial areas is likely to transport nutrients, contaminants and enriched sediments.	A	Estuaries with industrial discharges and industrial landuse, e.g. Hunter, Lake Macquarie, Hawkes, Port Jackson, Port Kembla.	I,M,L	moderate
	Thermal discharges		moderate	likely	Increases in water temp impacts biota and ecological processes within the affected system. All biota in cooling water is killed. Thermal discharges always impact water quality by changing natural temperature.	A	Lake Mac, Tugg, Lake Illawarra	I,M,L	high
	Sewage effluent and septic runoff		moderate	likely	Increased nutrients increases chance of algal blooms, increased pathogens impacts recreational health and biota. Increased risk of bioaccumulation of contaminants. Sewage discharge and sewer overflow carries nutrients and pathogens.	A	Hunter River, Lake Mac, Tuggerah, Hawkes	I,M,L	moderate
Hydrologic Modifications	Estuary entrance modification		moderate	almost certain	Changes in tidal regime, residence times, and volumes of marine water inflowing impacts water quality. It also results in a significant and on-going change in the types of organisms due to change from estuarine to marine waters. Entrance modification always impacts water quality.	A	Lake Mac, Hawkes, Hunter, Tuggerah, Lake Illawarra, coastal lagoons	L	moderate
Climate change	20 Years								

	Ocean acidification		moderate	likely	Only small pH changes in short time frame, with colicophores, pteropods are vulnerable. Moderate impacts likely.	I	NA	M	moderate
Climate change	50 Years								
Climate change	Altered ocean currents & nutrient inputs		moderate	likely	Changes to primary production associated with increased intensity of the EAC. This could lead to changes in upwelling regimes and either increases or decreases in nutrient concentrations and ratios, with moderate impacts likely.	I	NA	L	moderate
	Climate and sea temperature rise		moderate	possible	Larger temp increases affect biota, with moderate impacts possible.	I	NA	L	low
	Ocean acidification		major	likely	Larger pH changes will occur, with calcifying organisms vulnerable, and major impacts likely.	I	NA	L	high

Threatened and protected species (macrophytes, fish and shark)

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Conf A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		major	possible	The impact on <i>Posidonia</i> and saltmarsh as a result of large commercial vessels was considered 'moderate' reflecting the level of impact of defined stressors from the activity on seagrass (e.g. oil spills, physical disturbance) and the moderate resilience of the habitat to these impacts. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified ports.	L	L: Main ports only, but particularly Botany Bay and Sydney Harbour	L	moderate
	Small commercial vessels (ferries, charter boats)		moderate	possible	The impact on <i>Posidonia</i> and saltmarsh as a result of small commercial vessels was considered 'moderate' reflecting the level of impact of fuel spills and physical disturbance. It was considered 'possible' that this level of impact would occur from this activity due to the amount of vessel activity in the identified estuaries.	A	L: Many large estuaries, particularly Hawkesbury, Hunter, Sydney Harbour	I	low
Commercial fishing	Estuary General		minor	likely	Related to impacts on <i>Posidonia</i> and saltmarsh and associated protected species (e.g. sygnathids), with minor impacts considered to be likely.	L	L: In estuaries where commercial fishing occurs	I	low
	Estuary Prawn Trawl		minor	likely	Related to impacts on protected species (e.g. sygnathids), with minor impacts considered to be likely.	L	L: Hawkesbury estuary	I	low
Charter fishing	Line fishing		minor	likely	Related to impacts on <i>Posidonia</i> and associated protected species (e.g. sygnathids), with minor impacts considered to be likely.	L	L	I	low

Recreational fishing	Shore-based line and trap fishing		minor	likely	Related to impacts on <i>Posidonia</i> and saltmarsh and associated protected species (e.g. sygnathids), with minor impacts considered to be likely.	L	R	I	low
	Boat-based line and trap fishing		minor	likely	Related to impacts on <i>Posidonia</i> and associated protected species (e.g. sygnathids), with minor impacts considered to be likely.	L	R	I	low
Aquaculture	Oyster farming		minor	likely	Related to impacts on <i>Posidonia</i> and saltmarsh, with minor impacts considered to be likely.	L	R	I	low
Recreation and tourism	Boating and boating infrastructure		major	likely	The impact on <i>Posidonia</i> as a result of boating and infrastructure was considered 'major' reflecting the level of defined stressors from the activity (e.g. physical disturbance resulting from propellers, anchoring, moorings, sediment resuspension and shading from boats/jetties resulting in light limitation) and the low resilience of components of the habitat to these impacts. It was considered 'likely' that this level of impact would occur from this activity at the local scale.	A	R: All estuaries, but particularly Lake Macquarie, Hawkesbury River, Sydney Harbour, Port Hacking	I	high
	Four wheel driving		moderate	likely	Related to impacts on saltmarsh, with moderate impacts likely to occur at a local scale.	L	L	I	moderate
Dredging	Navigation & entrance management, modification and maintenance etc.		major	possible	The impact on <i>Posidonia</i> and associated biota as a result of dredging was considered 'major' reflecting the level of impact of the defined stressors from the activity (e.g. physical disturbance, resuspension) and the moderate resilience of the habitat to these impacts. Physical disturbances and removal in generally small areas for discrete projects such as jetties, marinas. It was considered 'possible' that this level of impact would occur from this activity due to the amount of dredging activity in the identified estuaries.	L	L: All estuaries where dredging occurs	I	moderate
Modified freshwater flows	Extraction, artificial barriers to riverine		major	likely	Changed water table and inundation regimes results in very broad overall	L	Hunter Hawks	I	high

	and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates)				impacts on saltmarsh. Major impacts likely to occur.		Coastal lagoons		
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		moderate	likely	Subsidence affects seagrass viability at depth. Difficult to manage, coal mines still mine under seagrass beds, with moderate impacts likely.	L	L	I	moderate
Service infrastructure	Pipelines, cables, trenching and boring		minor	likely	Removal of <i>Posidonia</i> leads to damage, but overall impacts moderate and likely to occur	L	L	I	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	almost certain	Nutrient enrichment, freshwater, sedimentation, physical removal, affects <i>Posidonia</i> and abundance. Major impacts are almost certain at a local scale.	A	All estuaries where <i>Posidonia</i> present	I,M,L	high
	Foreshore development		major	possible	Direct habitat removal and destruction in some areas. Development of foreshore historically meant removing/infilling of saltmarsh. Possible under current management.	L,A	All estuaries (where present)	I,M,L	moderate
	Clearing riparian and adjacent habitat including wetland drainage		major	likely	Damage to habitat during removal and clearing, altering water tables and connectivity, especially with freshwater wetlands. Removal/clearing of adjacent habitats under current management is still likely, especially in rural catchments.	A	All estuaries	I,M,L	high
	Agricultural diffuse source runoff		moderate	almost certain	Nutrient enrichment, turbidity and sedimentation impacts <i>Posidonia</i> health and ability to survive. Agricultural runoff carries nutrients and sediment, ongoing and difficult to manage, with moderate impacts almost certain.	A	Estuaries with <i>Posidonia</i> and agriculture catchment, e.g. Hawkes, Hunter, Tuggerah, Macquarie.	I,M,L	moderate
Point Discharges	Industrial discharges		moderate	possible	Nutrients and contaminants impact seagrass health. Under current management, industrial discharge possibly carries nutrient and	A	Estuaries with seagrass and either current or	I,M,L	low

					contaminants, and impacts moderate and possible.		historical industrial discharges, e.g. Port Jackson, Lake Mac, Bris Water, Botany Bay, Illawarra, coastal lagoons		
	Sewage effluent and septic runoff		moderate	likely	Nutrient enrichment from sewage discharge in <i>Posidonia</i> seagrass beds negatively impacts health through smothering and nitrogen toxicity, with impacts considered to be moderate. Likely, primarily as overflows.	L, I	All estuaries	I,M,L	moderate
Hydrologic Modifications	Estuary entrance modif.		major	likely	Changes estuary water from estuarine/brackish to more marine, results in increased frequency of inundation and mangrove encroachment into saltmarsh areas. Likely in all modified estuaries.	A	All estuaries (where present)	I, M, L	high
Climate change	20 years								
	Sea level rise		major	almost certain	Saltmarsh likely to be inundated and limited chances to expand range. High chance of sea level rise with major impacts on saltmarsh almost certain.	L	NA	M	high
Extreme storm events	Flooding, storm surge, tsunami, inundation		minor	likely	Increased turbidity, and changes to salinities likely to impact <i>Posidonia</i> and saltmarsh. Wave action. Minor impacts likely in time frame.	I	NA	M	low
Climate change	50 years								
	Climate and sea temperature rise		major	likely	Likely impacts to be major on saltmarsh.	I	NA	L	high
	Ocean acidification		major	likely	<i>Posidonia</i> likely to be sensitive to pH changes. Major impacts likely in time frame.	I	NA	L	high
	Altered storm/cyclone activity		moderate	likely	Resilient, tolerant of abiotic stress. Increased nutrient and sediment runoff may be significant, with moderate impacts likely.	I	NA	L	moderate

	Sea level rise		major	almost certain	Saltmarsh likely to be inundated and limited chances to expand range. High chance of sea level rise, with major impacts almost certain.	L	NA	L	high
Extreme events	Flooding, storm surge, inundation		moderate	likely	Increased nutrient and sediment runoff may be significant, with moderate impacts likely.	I	NA	L	moderate

Threatened and protected marine mammals, reptiles and birds

Resource use	Activities		Conseq	Likelihood	Consequence/Likelihood statement	Confidence A, L, I	Spatial extent	Timing I, M, L	Risk
Shipping	Large commercial vessels and associated port activities and industries (trade ships, cruise ships)		major	almost certain	The impacts as a result of large commercial vessels was considered 'major' reflecting the impact of the defined stressor from the activity (wildlife disturbance). It was considered 'almost certain' that this level of impact would occur from this activity due to the increasing whale abundance together with increasing shipping significantly increase risk of vessel strike especially on entering and leaving major ports during whale migration season. In particular, naïve calves and species that must remain on the surface following feeding dives are particularly vulnerable. Recovering populations of Southern Right Whale that nurse in shallow bays and estuaries have low resilience to vessel strike, and wildlife disturbance which cause subsequent change behaviour. The impact of noise on marine mammals is well documented in the literature but poorly researched within the bioregion.	A	L: Main ports and coastal shipping routes to 3nm	I	high
	Small commercial vessels (ferries, charter boats)		moderate	almost certain	The impacts as a result of small commercial vessels was considered 'moderate' reflecting the impact of the defined stressor from the activity (wildlife disturbance) and the population status. It was considered 'almost certain' that this level of impact would occur from this activity due to the increasing whale abundance together with	A	L: Many large estuaries, particularly Sydney Harbour, Hawkesbury, Hunter, rivers and coastal lakes	I	moderate

					increasing small vessel activity that significantly increase risk of vessel strike during whale migration season. In particular, naïve calves and species that must remain on the surface following feeding dives are particularly vulnerable. Recovering populations of Southern Right Whale that nurse in shallow bays and estuaries have low resilience to vessel strike, and wildlife disturbance which cause subsequent change behaviour. The impact of noise on marine mammals is well documented in the literature but poorly researched within the bioregion.				
Commercial fishing	Estuary General		moderate	likely	The impacts of the estuary general fishery was considered 'moderate' reflecting the impact of the defined stressor from the activity (wildlife disturbance, marine debris, incidental bycatch). It was considered 'likely' that this level of impact would occur from this activity as NPWS receives reports of entanglements of shorebirds, marine mammals, turtles in estuaries of the bioregion. These data are reported to the Elements database and through Taronga Zoo's case register, though an understanding of the true scale of estuarine entanglements is limited and most likely under-reported. Ingestion of baited hooks etc may be extensive. However, for some species (such as Little penguin) it or 'human objects'/debris represented a major cause of mortality.	L	All estuaries where the fishery occurs	I	moderate
	Estuary Prawn Trawl		moderate	likely	The impacts of the estuary prawn trawl fishery was considered 'moderate' reflecting the impact of the defined stressor from the	I	Hunter, Hawkesbury	I	moderate

					activity (wildlife disturbance, incidental bycatch). It was considered 'likely' that this level of impact would occur from this activity as interactions are known to occur between prawn trawl fishery and seabirds and dolphins in other location, (e.g. South Australia), therefore the risk is inferred to occur in this bioregion. Also, bycatch reporting not a requirement.				
Charter fishing	Line fishing		moderate	likely	The impacts of charter fishing was considered 'moderate' reflecting the impact of the defined stressor from the activity (wildlife disturbance). Seabird entanglements are common in estuaries, with species such as the Australian pelican. Literature suggests a capture rate of 0.36 (95% c.i.: 0.09 to 0.66) birds per 100 fisher hours. Data in the bioregion is insufficient to assess full impact, but this level of impact is likely.	L	Lake Macquarie, Hawkesbury, Pittwater, Port Jackson, Botany, Pt Hacking	I	moderate
Recreational fishing	Shore-based line and trap fishing		major	likely	The impacts of shore-based recreational fishing was considered 'major' reflecting the impact of the defined stressors from the activity (wildlife disturbance, marine debris, incidental bycatch), and the population status of the species. In particular, discarded fishing gear and debris from rec fishers poses a threat to turtles, seals and seabirds through ingestion and entanglement. The NPWS marine incident database holds records of turtle mortality from marine debris ingestion. Marine turtles caught in line entanglements reported to NPWS from coastal lakes, and estuaries. Entangled seals and seals caught in lures reported to NPWS. Interactions with marine mammals and reptiles are likely to occur in this bioregion due to high level of	L	all	I	high

				recreational fishing. Recent studies indicate an increased likelihood of entanglement in fishing gear with increased numbers of rec fishers, together with increased human populations in coastal cities.					
	Boat-based line and trap fishing		major	likely	The impacts of boat-based recreational fishing was considered 'major' reflecting the impact of the defined stressors from the activity (wildlife disturbance, marine debris, incidental bycatch), and the population status of the species. In particular, turtles caught in crab pots reported to NPWS – high mortalities of turtles documented from recreational crab pots and fish traps e.g. witches hat traps in NSW also applies in this bioregion where these methods are permitted. Entangled seals and seals caught on lures reported to NPWS. Discarded fishing gear and debris from rec fishers poses a threat to turtles and seabirds through ingestion and entanglement. This is likely given the high level of rec fishing that occurs in this bioregion. The NPWS marine incident database holds records of turtle mortality from marine debris ingestion. Interactions with marine mammals and reptiles are likely to occur in this bioregion due to high level of boat-based recreational fishing.	I	Local – where permitted	I	high
Charter activities	Whale and dolphin watching		moderate	likely	High levels of whale tourism in the bioregion. Adequate research on impacts e.g. noise, disturbance, displacement, stress, reduced fitness, behavioural change.	A	L: Port Jackson	I	moderate
Aquaculture	Oyster farming		moderate	likely	Increased vessel strike for marine turtles, disturbance of shorebirds at roost and feeding sites from boats and human interaction.	I	L: Hawkesbury, Botany Bay, Port Hacking	I	moderate

Recreation and tourism	Boating and boating infrastructure		moderate	likely	Increasing whale and marine turtle abundance together with increasing recreational vessel usage significantly increase risk of vessel strike especially on entering and leaving major ports during whale migration season, and within estuaries and coastal lakes. Naïve calves and species that tend to remain on the surface (marine turtles) are particularly vulnerable. Recovering populations of Southern Right Whale that nurse in shallow bays and estuaries and listed marine turtle species have low resilience to vessel strike, and disturbance from vessels which cause subsequent change behaviour, potentially reducing fitness of the population. The impact of noise and disturbance on marine wildlife is well documented in the literature but poorly researched within the bioregion. Disturbance of shorebirds at major roost and feeding sites may impact on breeding success and reduce migration capacity. Development of infrastructure including marinas will have consequences for marine fauna including noise.	A	L: all	I	moderate
	Four wheel driving		major	almost certain	Damage to nesting and foraging habitat for shorebirds, damage to nesting habitat for turtles. Disturbance of shorebirds at major roost and feeding sites may impact on breeding success and reduce migration capacity.	A	L: Hunter, Coastal lagoons	I	high
Dredging	Navigation & entrance management, modification and maintenance		moderate	possible	Noise impacts on cetaceans from dredging within estuaries and estuary mouth. The impact of noise and disturbance on marine wildlife is well documented in the literature but poorly researched within the	I	L: Ports/Estuaries	I	low

					bioregion data inadequate to make a clear assessment of the threat.				
Modified freshwater flows	Extraction, artificial barriers to riverine and estuarine flow (e.g. dams, weirs, waterway crossings, floodgates)		minor	likely		A	L: Hunter		low
Mining and extractive industries	Oil, gas, minerals, sand, aggregate, underground coal		minor	likely	Noise impacts on cetaceans from offshore developments a high threat. Vessel strike and dredging possible source of threats. No data to make clear assessment of threat.	L	L	I	low
Service infrastructure	Pipelines, cables, trenching and boring		moderate	possible	Noise impacts on cetaceans from offshore developments a high threat. Vessel strike, trenching and boring. No data to make clear assessment of threat. Very limited.	L	L: Large estuaries	I	low
Land-based impacts									
Landuse Intensification	Urban stormwater discharge		major	likely	Evidence of microplastics, marine debris and other contaminants impacting marine fauna. Some data from necropsies by Taronga Zoo in bioregion on ingestion of debris in threatened species.	L	all	I	high
	Foreshore development		major	almost certain	Impacts high on nesting shorebirds and turtles from permanent loss of near shore habitat.	A	all	I	high
	Beach nourishment and grooming		moderate	almost certain	Impacts high on nesting shorebirds. Impacts on foraging shorebirds. Number of beaches this occurs on fairly low. Threat would need to be reassessed if this changes.	L	Port Jackson, Tuggerah, Lake Macquarie	I	moderate
	Clearing riparian and adjacent habitat including wetland drainage		major	likely	Loss of wetlands and habitat for migratory shorebirds likely to lead to local extinctions and additional declines to already threatened species.	A	all	Med-long term	high
	Agricultural diffuse source		moderate	likely	Turbidity affects coastal species.	I	L: Hunter, Hawkesbury	I	moderate

	runoff								
Point Discharges	Industrial discharges		minor	likely	Increased salinity and pollution. Similar impacts as urban discharge but evidence not as clear	I	L	I	low
	Thermal discharges		minor	likely	Turtles seek heated water and often getting caught in inlet canals of power stations. NPWS currently working with power authorities to reduce information gap.	I	Lake Macquarie, probably Illawarra	I	low
	Sewage effluent and septic runoff		moderate	likely	Increase in pollution. Evidence of disease and pharmaceuticals transmission from land based sources e.g. toxoplasmosis in dolphins.	L	Hawkesbury, Hunter, Botany Bay	I	moderate
Hydrologic Modifications	Estuary entrance modifications.		moderate	likely	Turbidity, dredging, noise etc. from developments likely to impact coastal marine species	L	Wave dominated and coastal lagoons	I	moderate
Climate change	20 years								
	Climate and sea temperature rise		minor	likely	Higher sea temp likely to change distribution and abundance of marine turtles further into bioregion (NPWS data showing increasing numbers and nesting). Changes in temp likely to impact turtles nesting success and change the sex composition of population preliminary data being collected by NPWS. Changing climate triggers may impact whale migration and feeding behaviour in NSW waters. Changing dynamics of coastal wetlands likely to impact Ramsar Sites (shorebird protection sites) and internationally listed shorebird species.	L	Drowned valleys and wave dominated estuaries	M	low
	Ocean acidification		minor	likely	Indirect effects from loss of habitat, decreased food availability for marine fauna.	L	R	M	low
	Altered storm/cyclone activity		moderate	likely	Beach deterioration will impact shorebirds and seabird foraging. Increased pollution and marine debris. Increased mortality of marine fauna after extreme weather events.	L	R	M	moderate

	Sea level rise		major	likely	Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Loss of intertidal foraging habitat including seagrass.	A	R	M	high
Climate change	50 years								
Climate change	Altered ocean currents & nutrient inputs		moderate	likely	Changes to EAC likely to impact turtles and foraging whales and dolphins. Swimming against changes current likely to impact fitness of migrating species. Changes to nutrients and subsequent fish abundance likely to impact higher order predators (seabirds, marine mammals, turtles).	I	R	I	moderate
	Climate and sea temperature rise		major	likely	Sea temp likely to change distribution and abundance of marine turtles further into bioregion. Changes in temp likely to impact turtles nesting success and change the sex composition of turtles. Temp may impact migration of whales. Dynamics of coastal wetlands likely to change impacting shorebirds.	I	R	I	high
	Ocean acidification		major	likely	Indirect effects from loss of habitat, decreased food availability for marine fauna.	I	R	I	high
	Altered storm/cyclone activity		moderate	likely	Beach deterioration will impact shorebirds and seabird foraging. Increased pollution and marine debris. Increased mortality of marine fauna after extreme weather events.	I	R	I	moderate
	Sea level rise		almost certain	likely	Loss of habitat and nesting sites for shorebirds and turtles. Loss of shorebirds foraging habitat. Loss of intertidal foraging habitat including seagrass.	I	R	I	high