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Global shortfalls in water quality and wastewater policies to protect coral reefs

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Abstract

Water pollution is recognised as one of the triple planetary crises and is causing significant impacts to aquatic ecosystems. Meaningful action on pollution reduction and ecosystem protection requires a robust policy environment to set out what outcomes need to be achieved. Here, we provide the first global assessment of foundational water pollution policies across 105 coral reef jurisdictions to determine whether they are equipped to protect coral reefs. We found that only 53 jurisdictions had wastewater discharge policies, 48 had ambient marine water quality policies, and only 30 had both, while 34 jurisdictions had neither. Only 0.7% of the specific water quality and discharge standards within the policies were set at levels within ecological thresholds for coral reefs. Importantly, the suitability of over 90% of the standards could not be assessed, revealing a significant evidence gap. These findings reveal a substantial and previously unreported governance failure that undermines global biodiversity protection.

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Introduction

Water pollution is one of the defining sustainability challenges of the twenty-first century for oceans [1]. Agricultural runoff, urban development, and inadequate wastewater management have degraded water quality in coastal and marine environments worldwide, threatening both ecosystem integrity and the livelihoods of communities that depend on coastal resources [2]. Reducing pollution is central to international sustainability and biodiversity conservation commitments. Sustainable Development Goal (SDG) 14.1 called for the prevention and reduction of marine pollution from land-based activities by 2025, while Target 7 of the Kunming-Montreal Global Biodiversity Framework (GBF) commits signatory nations to reducing pollution risks to levels not harmful to biodiversity and ecosystem functions by 2030 [3], [4].

The emphasis on reducing pollution to levels that are not harmful to biodiversity represents an important shift from measuring reductions in pollution to evaluating whether those reductions are sufficient to protect ecosystems. Pollution reductions alone cannot demonstrate progress towards biodiversity outcomes unless they are linked to ecologically relevant water quality conditions [3]. Achieving Target 7 therefore requires clear, scientifically defensible targets within national policies that define the water quality needed to protect ecosystems and provide a basis for designing, coordinating, and evaluating pollution-reduction measures [5], [6], [7], [8]. Without such a foundation, water quality targets set in policies may be too lenient to protect sensitive ecosystems or more stringent than can be justified by the available evidence, weakening their legitimacy, feasibility, and durability [7], [9], [10].

Coral reefs provide an important test case for whether existing water quality policies can translate global commitments into ecosystem protection. They are among the most biodiverse ecosystems on Earth, and are particularly vulnerable to water quality degradation [4]. Global live coral cover has declined by more than half since the 1950s, and water quality is a key driver of this decline [11]. Water pollutants, including elevated nutrients, suspended sediments, and chemical contaminants, suppress coral growth, reduce calcification, increase disease prevalence, and lower reef resilience to thermal bleaching [12], [13], [14]. Protecting coral reefs from water pollution therefore requires policies that account for their sensitivity, with pollution reduction and water quality targets stipulated in policies based on ecologically-relevant information.

Two complementary policy instruments are foundational to this protection. Ambient marine water quality targets define the conditions that need to be maintained or achieved within receiving waters to protect ecosystem health [15]. They establish the environmental outcome that pollution management measures must collectively achieve and are especially important for non-point or diffuse sources where individual contributions of polluters are difficult to regulate and enforce [9], [16], [17]. Wastewater discharge standards are focused on limiting the concentrations of pollutants released from identifiable sources of pollution like sewage treatment plants and can be more easily monitored and enforced [18]. However, the effectiveness of these two policy instruments depends on whether the numerical water quality targets and standards (hereafter referred to as numerical values) within the policies reflect the sensitivity of the ecosystems they are trying to protect from pollution.

Despite the importance of these policy instruments for protecting coral reefs from water pollution, their global prevalence and scientific foundations have not been systematically evaluated. It remains unclear how many coral reef countries and territories have ambient marine water quality targets and wastewater discharge standards, how their numerical values were derived, and whether the supporting evidence is relevant to coral reef ecosystems. This information is necessary to determine whether existing national and territorial policy frameworks provide a credible basis for delivering the ecological outcomes outlined under Target 7.

Here, we present the first global systematic assessment of ambient marine water quality targets and wastewater discharge standards across 105 countries and territories (hereafter referred to as jurisdictions) with coral reefs. We ask: (1) how many jurisdictions have each policy instrument in place; (2) are the policies regulated or do they provide non-binding guidance? (3) what types of scientific evidence underpin the numerical values within each policy; (4) whether this evidence is ecologically relevant to coral reef protection; and (5) to what extent does each policy instrument provide the necessary basis for achieving the KM-GBF Target 7 goals for coral reefs? Together, these questions allowed us to assess five gaps within existing policy frameworks: (1) a policy gap where policies do not exist; (2) an enforceability gap, where numerical values are provided as non-binding guidance; (3) an evidence gap, where there is not a traceable or empirical basis for numerical values in policies; (4) an ecological relevance gap, where the supporting evidence for numerical values does not adequately represent reef sensitivity; (5) and an implementation gap, where policies are not designed in ways that can support international policy goals. By identifying the prevalence of these gaps, our study provides a foundation for strengthening national water quality and wastewater policies and translating global pollution commitments into measurable ecosystem protection.

Results

Policy coverage and legislative status

Of the 105 jurisdictions assessed, 53 (50%) had wastewater (WW) discharge policies and 48 (46%) had ambient marine water quality (WQ) policies. Only 30 jurisdictions (29%) had both types of policy in place, while 34 (32%) jurisdictions had neither, with Pacific Island nations showing the lowest coverage overall (Fig. 1). 36 (68%) of the WW policies were legislated, while only 30 (62%) of the WQ policies were legislated. The remainder were non-binding guidelines.

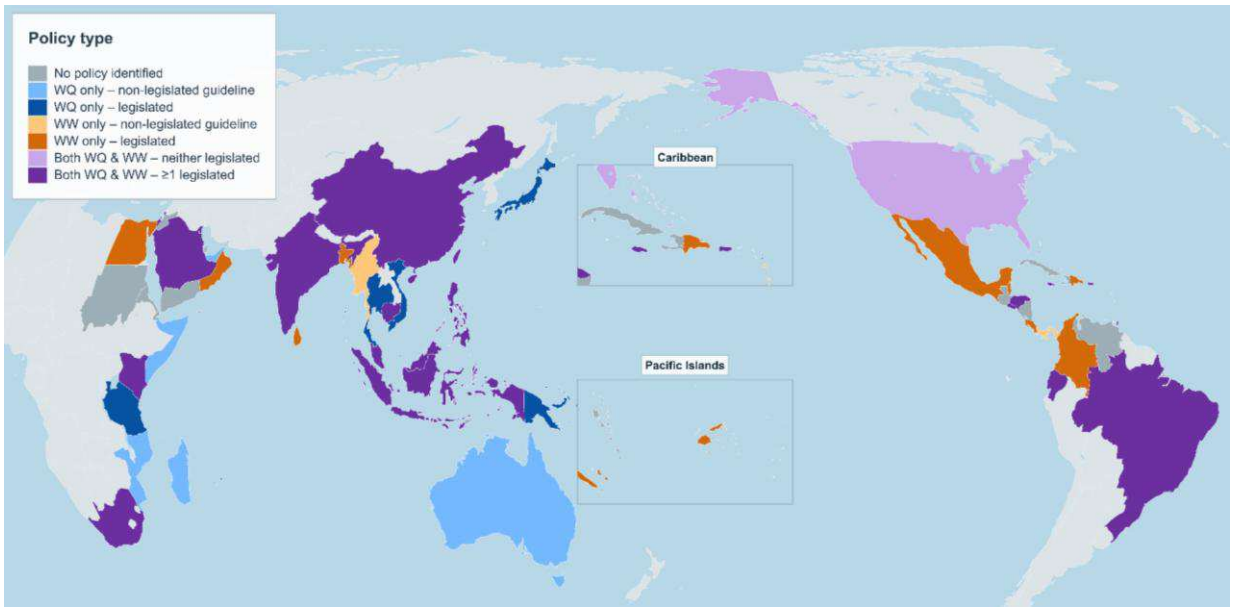


Figure 1: Geographical distribution of the presence of WW and WQ policies, as well as their legislative status.

Evidence basis for policies

We found that even when policies did exist, 38 (72%) of the WW discharge policies and 18 (38%) of the ambient WQ policies did not provide a source or documentation indicating how numerical values were established (S1). Among the 15 jurisdictions with documented WW derivation information, values were most commonly based on other countries' policies (5 jurisdictions, 33%), followed by experimental data and meta-analyses (each 2 jurisdictions, 13%), and expert opinion (1 jurisdiction, 7%) (S2). Among the 30 jurisdictions with documented WQ derivation information, values were most commonly drawn from other countries' policies (27 jurisdictions, 90%), followed by meta-analyses (19 jurisdictions, 63%), expert opinion (9 jurisdictions, 30%), local natural conditions (4 jurisdictions, 13%), and experimental data (1 jurisdictions, 3%). Note that derivation approaches were not mutually exclusive and many jurisdictions used more than one method. Ultimately, only three ambient WQ policies and two WW discharge policies had transparent and retrievable empirical sources.

Ecological relevance of the evidence base

Of the small number of policies with retrievable empirical sources, only the Great Barrier Reef (GBR) Water Quality Guidelines applied ecosystem-level, *in situ* derived endpoints, using regression modelling of coral reef monitoring data against water quality measurements. All other policies with documented evidence relied on acute lethal and sub-lethal endpoints (LC_{50} or EC_{50}). Data on marine species sensitivity to pollution were used in only five policies, and coral reef organisms appeared specifically in only two: the GBR and the Western Indian Ocean Guidelines. Across WW and WQ policies, 2 out of 17 jurisdictions with species data (12%) used freshwater test species to inform their coral reef standards.

Suitability of existing policies to support international policy targets

We assessed the ability of existing policies to support the achievement of international policy targets for reducing pollution to levels that are not harmful to biodiversity in two ways: (1) did policies include recommended parameters and (2) could the existing numerical values within policies protect coral reefs, even if they did not list a source for them? All jurisdictions assessed are signatories to the GBF and CBD, only excluding 4 US territories and Taiwan.

Across the 24 priority parameters examined, WQ policies most frequently addressed physico-chemical variables (dissolved oxygen: 39 jurisdictions) and chemical contaminants (arsenic: 33 jurisdictions), while WW policies were dominated by conventional effluent indicators (chemical oxygen demand: 46 jurisdictions; total suspended solids: 45 jurisdictions; biological oxygen demand: 42 jurisdictions). Nutrient parameters were underrepresented in both policy types but particularly in WQ policies: chlorophyll a appeared in only 5 WQ jurisdictions and 1 WW jurisdiction, and total nitrogen in 13 WQ and 11 WW jurisdictions. Four of the 24 recommended parameters (silica, total organic carbon, light penetration, and turbidity) were absent from WW policies, and silica was also absent from all WQ policies, making it the only parameter with no coverage in either policy type (S3).

Only five parameters with numerical values within policies were able to be compared to identified ecologically-relevant thresholds. Across most parameters, numerical values frequently exceeded ecologically-relevant targets (Fig. 2). Total suspended solids showed near-universal exceedance, with 90% of policies exceeding the GBR threshold of 2 mg/L and an independent systematic review threshold of 3.2 mg/L [19], [20]. Chlorophyll a and dissolved oxygen showed more variable patterns: only 25% of chlorophyll a policies exceeded the protective threshold, while 16% of dissolved oxygen policies permitted levels below the protective minimum. Importantly, despite nutrient reduction being explicitly called for in international policy, 82% and 94% of existing policies exceeded the total nitrogen and phosphate thresholds, respectively.

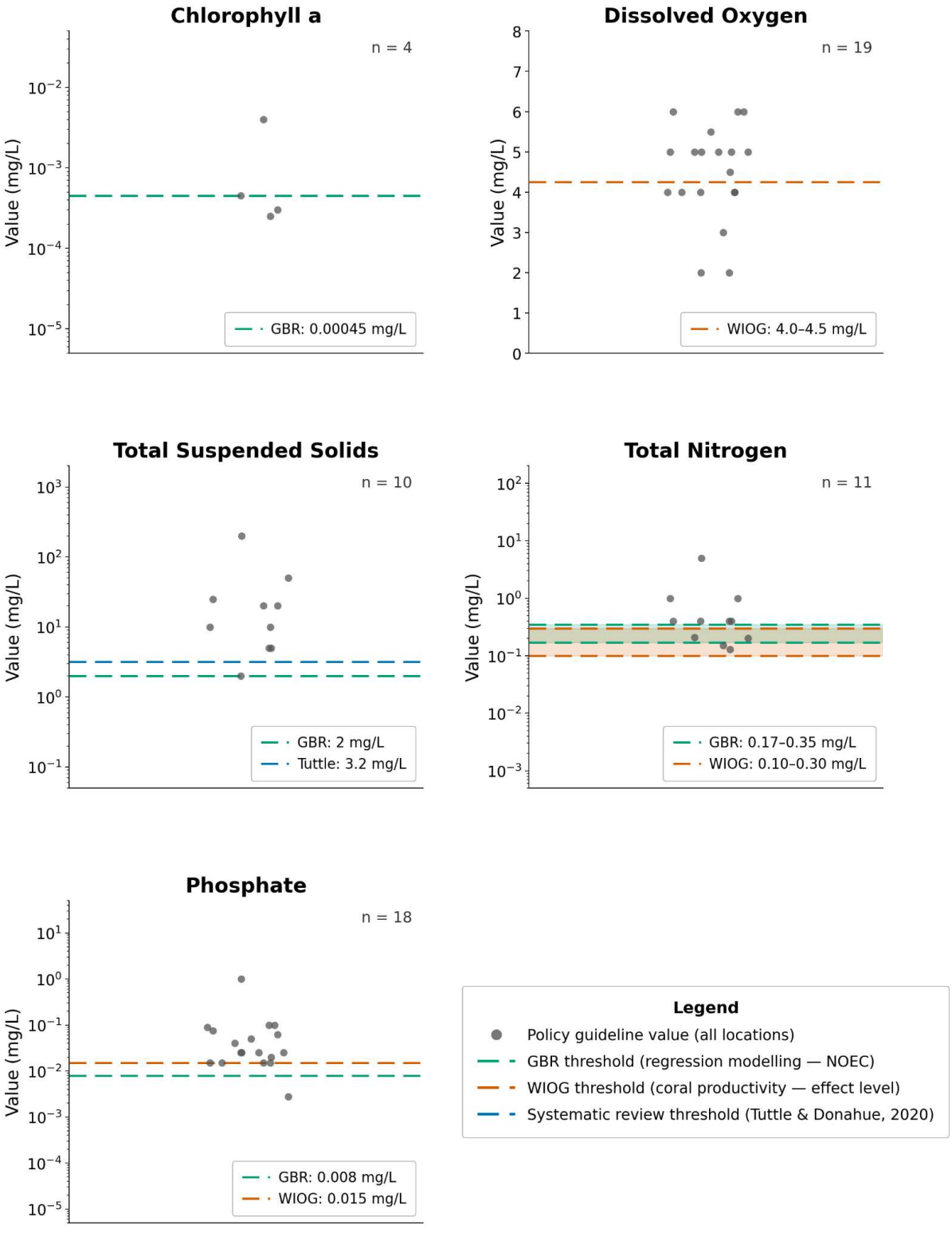


Figure 2: Guideline values for all empirically-derived, coral species relevant policies by indicator; dashed lines show empirically-derived threshold values from policies with documented test types and literature-derived thresholds [20], [21], [22].

Overall, across all 1,704 numerical values within the WQ and WW policies, only 164 (9.6%) were assessable against existing scientifically-established water quality thresholds. The remaining 1,540 (90.3%) of values could not be evaluated, because we could not identify compatible, existing water quality thresholds for these parameters for coral reef

organisms (Fig. 3). Of the 164 that were assessable, 122 (92.7% of the assessable values, 7.2% of all the values) exceeded a known threshold, with the remaining 12 (7.3% of the assessable values, 0.7% of all the values) met or were within ecological thresholds.

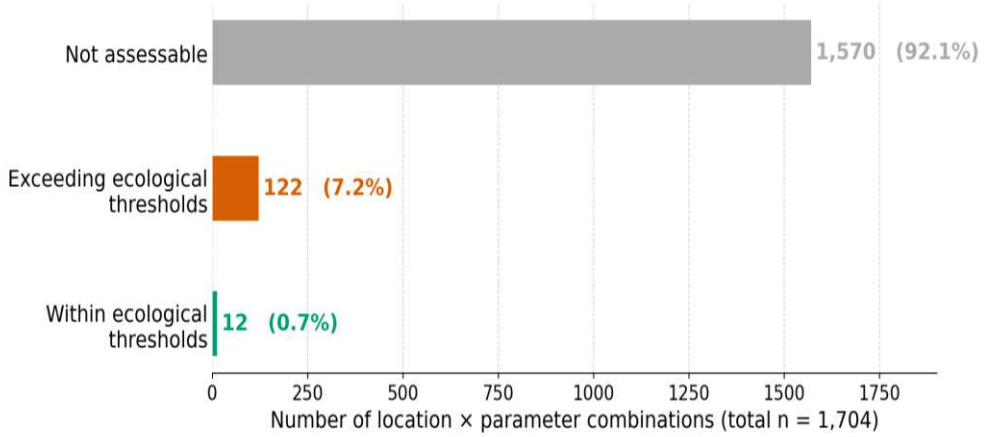


Figure 3: Protective capacity classification for combined wastewater and water quality policies, based on guideline value comparisons as shown in Figure 3. Percentages next to the numbers indicate the percentage across all 1,704 numerical values that fall within each category.

Discussion

Water pollution is one of the major threats to coral reefs, leading to ecosystem degradation, increased vulnerability to climate change impacts, and slower recovery following disturbances [5], [23]. Our global assessment identified multiple, compounding weaknesses within the policy instruments meant to protect coral reefs from land-based sources of pollution. When policies were in place, most did not document the source for their numerical values. Only five policies ultimately had traceable empirical evidence, and coral reef organisms were only represented in the evidence underpinning two policies. In addition, over 90% of the numerical values within policies could not be evaluated against reef-relevant ecological thresholds, due to gaps in the compatible scientific information available on reef organism sensitivity to pollution. Among the numerical values that could be assessed, the vast majority of them exceeded known ecological thresholds. Together, these findings reveal significant, and previously unreported national gaps in policies to protect coral reefs from pollution. If we are to achieve, or even make progress towards Target 7 of the KM-GBF, there needs to be concerted efforts on addressing these policy shortfalls. Otherwise, we risk not only failing on this Target, but undermining many of our other biodiversity targets as well.

Protecting coral reefs from land-based sources of pollution requires both ambient water quality targets and wastewater discharge standards, because they perform complementary functions [24], [25]. Ambient water quality targets are particularly important for managing non-point source or diffuse pollution, where responsibility is distributed across numerous activities, and individual contributions can be difficult to isolate or measure [26], [27], [28]. Wastewater discharge standards instead establish requirements for identifiable point-sources of pollution and can mandate improvements in effluent quality through permitting, infrastructure investments, and compliance mechanisms [6], [29]. Neither policy

instrument is sufficient alone. Discharge standards do not ensure protective conditions within receiving waters where there are multiple sources of pollution, while ambient water quality targets provide limited leverage over individual sources unless they are connected to policy instruments capable of influencing specific sources of pollution and reducing pollutant loads [18], [30]. Jurisdictions that maintain only one (or neither) instrument are therefore poorly positioned to achieve the reductions in land-based pollution necessary to sustain coral reefs under increasing anthropogenic pressure. Our finding that fewer than one in three coral reef jurisdictions have both policy types therefore represents a significant constraint in our ability to protect coral reefs.

The role that the different policy instruments play in managing water pollution support our finding that wastewater discharge standards were more likely to be regulations, while water quality targets were more likely to be non-binding guidelines. Point source pollution is more easily managed through command-and-control type regulations, including discharge standards, than non-point source pollution because the individual polluter is known and enforcement of regulations is therefore more straightforward [10], [26], [31]. Non-point source pollution is harder to manage through command-and-control type regulations because of the complexities around identifying sources and their individual contributions to downstream water quality, the diversity of partners and stakeholders involved, as well as the costs associated with monitoring and enforcement [31], [32].

In practice, a mix of regulations and other policy instruments are needed to foster reductions in pollution, although the way in which they are developed and implemented could drive different outcomes. For instance, in the Great Barrier Reef, although the ambient marine water quality guidelines are non-binding, the regulations that were implemented to mandate the uptake of management practices to meet guideline values created mistrust among farmers and other stakeholders, ultimately hindering uptake of the necessary management practices [33], [34]. On the other hand, in the U.S., the Clean Water Act requires States to set water quality standards, but the development of the total daily maximum pollutant loads that can enter receiving water bodies without exceeding the standards is a voluntary process [35]. In both cases, and indeed in other examples of water pollution management, the role of collaborative decision-making processes has been highlighted as an important component in uptake of pollution management practices, regardless of whether they are regulated or voluntary [26], [32], [33], [35].

While the existence of a water quality and wastewater discharge policies is the first step towards better managing water pollution, the evidence underpinning the policies in coral reef jurisdictions was very limited and in most cases, inappropriate as an evidence base. For instance, two jurisdictions relied on freshwater species' responses to pollution, which differ substantially from tropical reef communities in thermal tolerance, metabolic rate, life history, and toxicokinetic responses to pollutants [36]. Even when marine species were used, 66% of numerical values were based on acute toxicity endpoints such as LC_{50} and EC_{50}. Research on coral reef organisms demonstrates that ecologically relevant impacts, such as behaviour change, reduced growth rates, impaired reproduction, increased disease susceptibility, and altered competitive dynamics, occur at exposures well below acute mortality levels [13], [14], [20], [37], with early life history stages often more vulnerable to pollution. A policy anchored to an LC_{50}-derived value may permit ongoing pollution at levels that cause ecological damage while technically remaining within its own stated limits.

While our findings reveal a significant evidence gap for policies, they also highlight clear opportunities for how existing policies can be strengthened. Although there is a clear need to base policies on more ecologically relevant evidence, the finding that over 90% of policy values could not be assessed against ecological thresholds demonstrates a clear science-to-policy gap.This gap should not be interpreted as an absence of relevant science. Multiple systematic reviews have documented the effects of nutrients, sediments, and contaminants on coral reef organisms and communities [14], [20], [37], yet they reveal that findings across studies are difficult to synthesise because of endpoints being measured differently and results expressed in different units, limiting the trend analyses needed to derive or validate numerical thresholds. The result is a science-to-policy translation gap: a growing body of ecologically relevant research that cannot readily be mobilised to assess or strengthen existing guideline values because it is not expressed in consistent parameters, units, or formats that can inform policy. Bridging this gap will require agreed-upon standardised metrics for measuring pollution and its effects on coral reefs, applicable to both laboratory studies and *in situ* monitoring. The GBR has developed best-practice ecotoxicology protocols for laboratory studies, primarily for chemical contaminants [8], [38], providing a model for standardisation. A comparable investment in consistent ecological monitoring would be equally powerful. The Global Coral Reef Monitoring Network's globally standardised approach to coral reef surveys demonstrates how measuring the same parameters in the same way enables detection of trends across scales [39], [40]. Applied to water quality and pollution impacts, such standardisation would not only strengthen the evidence base for policies, but would enable reef managers to monitor reef condition *in situ* against consistent parameters and determine whether reefs are above or below threshold values.

Although most policy values in our dataset exceeded available ecological thresholds, the thresholds themselves present a deeper challenge. Single-parameter numerical standards implicitly assume that protecting against individual-pollutant exposure in isolated test organisms is equivalent to protecting the ecological functions that define a functioning reef, including carbonate accretion, herbivory, larval recruitment, and competitive dynamics between corals and algae [19], [41]. In practice, these functions emerge from species interactions and multi-stressor conditions that no single threshold can fully capture. Several approaches have been developed to grapple with this complexity. Species sensitivity distributions (SSDs) integrate responses across multiple taxa, enabling threshold derivation that reflects community-level sensitivity rather than that of a single test species [42], [43]. Expressing thresholds as a range of safe operating spaces, such as the 20^{th}, 50^{th}, and 80^{th} percentile of an SSD, provides interpretive power that a single value cannot [19]. Creeping non-compliance against the 20^{th} percentile signals that baseline water quality is deteriorating, while increasing exceedances of the 80^{th} percentile indicate that acute pollution events are becoming more frequent. Thresholds that account for exposure duration, rather than instantaneous concentration alone, represent a further step, recognising that ecological harm is better characterised as the product of concentration and duration, such that prolonged exposure to low concentrations can be as damaging as brief exposure to high concentrations [21], [44], [45].

Compounding this, the thermal stress to which reef communities are increasingly exposed under climate change elevates their sensitivity to water quality pollutants [46], meaning that thresholds calibrated to thermally stable, relatively healthy reef conditions may underestimate the concentrations at which pollution causes harm in already-stressed

systems. Ecological relevance is therefore not a fixed property of a threshold value but a relationship between a guideline and the ecological context in which it is applied; one that must be periodically reassessed as reef condition and climate exposure change.

One mechanism available to improve water quality policies without being overly burdensome is through regional cooperation, given that many coral reef countries share similar challenges and species assemblages. The Australian and New Zealand water quality guidelines demonstrate how systematic frameworks can guide standard derivation when local data are limited, providing procedures for modification factors, species sensitivity distributions, and trigger values requiring validation [19], [47]. Regional ecotoxicology laboratories, shared toxicity databases, coordinated monitoring programmes, and training initiatives could reduce costs while improving the evidence base for how to protect coral reefs from pollution [1], [9], [48]. There are multiple jurisdictional bodies that currently have regional guidelines for wastewater (e.g. Caribbean Land-based sources of Protocol) and ambient marine water quality (e.g., Western Indian Ocean initiatives and ASEAN cooperation). While many of the regional policies require strengthening to be ecologically-relevant, they do offer an existing mechanism to address this challenge [30], [38], [49].

Several limitations affect the interpretation of our findings. First, our search protocol may have missed policies published exclusively in certain languages or with limited online availability, though multiple search strategies and international databases provide confidence that major instruments were captured. Reliance on search-engine indexing may also have systematically under-represented policies from countries with lower digital government infrastructure or non-Latin script systems. However, the finding that 93% of policies lack test methodology documentation is unlikely to be substantially altered by additional policies unless those systematically differed in transparency. Second, our analysis cannot establish direct causation between inadequate standards and reef degradation due to multiple confounding factors, most significantly due to a lack of data on actual water quality and the ecological impacts. Third, because so few policies contributed to ecosystem-derived, *in situ* guideline values in our dataset, this risks reproducing a threshold calibrated to only a few reefs' local conditions, and may not represent a universally appropriate protective concentration for reefs with different environmental regimes.

This study shows why policy presence alone is a poor proxy for environmental protection. Across coral reef jurisdictions, gaps in policy coverage are compounded by limited transparency on where numerical values are sourced, sparse representation of reef organisms within existing evidence base, and a shortage of ecological thresholds against which most numerical values can be evaluated. Where compatible comparisons were possible, most values exceeded the available reef-relevant thresholds. Current policy frameworks therefore provide an uncertain and frequently incomplete basis for demonstrating that pollution has been reduced to levels that are not harmful to coral reefs. The immediate priority is not simply to create more standards, but to build coherent policy systems in which numerical values are traceable, periodically reviewed, informed by reef-relevant ecological responses and connected to mechanisms capable of reducing pollutant exposure. This shift is essential if international commitments are to deliver measurable biodiversity outcomes rather than formal policy adoption alone.

Methods

Country and territory selection

We identified 105 countries and territories with documented coral reef presence using the Global Coral Reef Monitoring Network (GCRMN) list of coral reef countries (S4). Overseas territories and dependencies were assessed under the policies of their sovereign state unless a distinct territory-level policy framework was identified.

Policy identification and screening

For each country or territory, we conducted systematic searches for national WQ and WW policies using FAOLEX (FAO Legal Office environmental law database), national environmental protection agency websites, and targeted web searches. The policy review was carried out using key search phrases with each coral reef country or territory name (S5). To ensure more comprehensive coverage of the policies, advanced search techniques were adopted when searching for the standards, which included using: asterixes (*) to find variants of a word; operators "AND" and "OR" to group keywords; and quotation marks to find more relevant results. Pilot testing across ten randomly selected countries confirmed that relevant policies appeared within the first five results in all cases, and no additional policies were identified beyond result ten. Therefore, searches were limited to the first ten results to ensure consistency and feasibility across 105 jurisdictions.

Searches were conducted between January and December 2023 and updated in early 2024. To mitigate language bias, policies in non-English languages were translated using Google Translate. Only policies with numeric guideline values, environmental protection goals, and specific application to coastal and marine environments were retained. When a country had separate policies for different coral reef jurisdictions, we counted each policy as a unique jurisdiction. For example, Australia has a national policy, a Queensland policy (regional), and a Great Barrier Reef-specific policy. All three policies were included in the study, and counted as three different jurisdictions. When countries had adopted regional policies and had developed their own national policies, we deferred to the most recently developed policy (S6). Superseded policies were not included in analyses.

Policy screening

To assess the level of scientific evidence underpinning each policy and its ecological relevance, we investigated how the guideline values listed for the water quality parameters within the policies were derived. Here, derivation refers to the process of developing or identifying the guideline values for water quality parameters listed within policies. Because the policies cumulatively had over 300 water quality parameters listed, we focused on parameters identified as water quality indicators for SDG 14.1 and Target 7 of the Global Biodiversity Framework (GBF), as well as the suggested parameters for wastewater discharge by the World Health Organisation (WHO) (S7).

We undertook a two-phased approach to policy screenings. The first phase was a nested approach to determine whether the numerical values were based on empirical evidence, which consisted of four levels of policy screenings with inclusion and exclusion criteria for each level, summarised in Figure 4 and described in detail below. The second phase examined whether and how the examined policies were based on locally or regionally-derived empirical data on water quality parameters and ecosystem responses. This was done to provide a more informative assessment of policy readiness than policy

presence alone.

Phase 1: Evidence screening

Policy documents were screened using a five-step nested framework (Fig. 4). Step 1 confirmed that the document constituted a formal policy or regulatory instrument. Step 2 confirmed geographic scope (national or territory-level applicability). Step 3 confirmed relevance to marine or coastal receiving environments. Step 4 confirmed that at least one priority parameter was addressed. Step 5 assessed whether a derivation source was documented, whether it was empirical, and whether it was retrievable and transparent. Documents failing any step were excluded from Phase 2.

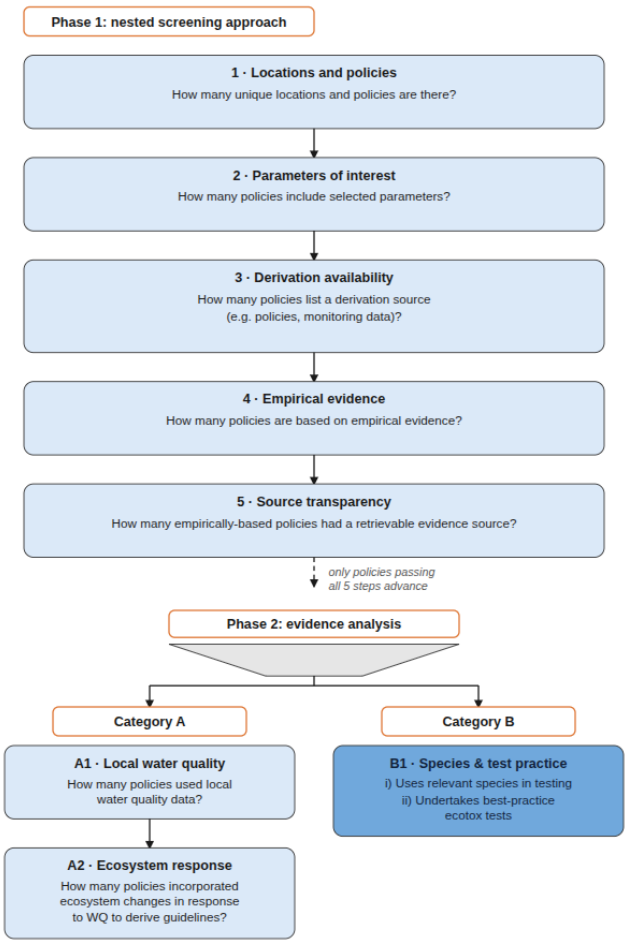


Figure 4: Overview of methods employed for the screenings, divided into nested and evidence analyses.

Phase 2: Ecological appropriateness

The second phase of our policy screening was to better understand the type, extent, and quality of empirical evidence on which the guideline values were based, i.e., the evidence analysis part, with the aim of assessing the strength, the ecological relevance, and the appropriateness of the evidence used (e.g. including coral reef species). In this case, appropriateness referred to whether the scientific evidence used relied on endpoints appropriate for protecting coral reef ecosystems (e.g. sub-lethal rather than acute toxicity

thresholds). Policies were grouped into two categories reflecting the type of evidence supporting guideline development.

Category A assessed what evidence the policy was based on, and whether such data was derived from *in situ* coral reef studies, drawing on published ecological threshold relationships for nutrients, sediments, and contaminants. Category B assessed whether the derivation method met best-practice ecotoxicological standards: (i) use of sub-lethal chronic endpoints rather than acute lethality; (ii) a minimum of six test species; (iii) species from at least four taxonomic groups; and (iv) inclusion of coral reef taxa. This phase therefore evaluated not only whether evidence existed, but whether it was relevant to the ecological receptors and exposure conditions that the policy was intended to protect (S8).

Policy legislative status

To determine their mandate to regulate water quality and wastewater management, we also examined whether any of the policies that were recorded for jurisdictions were legislated, as opposed to non-binding policies. In each policy, it was determined whether it constituted a regulation or voluntary guideline, and a legislative status was assigned.

Suitability of existing policies to support international policy targets

We assessed the ability of existing policies to support the achievement of international policy targets for reducing pollution to levels that are not harmful to biodiversity in two ways: (1) did policies include recommended parameters in SDG 14.1, KM-GBF Target 7; and the WHO and (2) could the existing numerical values within policies protect coral reefs, even if they did not list a source for them? To determine whether all existing policies were likely to protect coral reef health, numerical values across all policies were compared against ecologically-relevant thresholds within the two policies that met this criteria and recent systematic review on coral thresholds [19], [20], [22]. After assessing the parameters within policies against the available evidence, we were only able to assess the protective ability of five parameters.

For each of the 1,704 policy-parameter combinations in our database, we classified them in the following ways:

- Within ecological thresholds: the numerical value is at or below published ecological thresholds for coral reefs.
- Exceeding ecological thresholds: the numerical value exceeds published ecological thresholds for coral reefs.
- Not assessable: no appropriate guideline value exists to compare against, the derivation pathway could not be established, or insufficient ecological threshold data exist.

References

[1] H. Bouwer, ‘Integrated Water Management for the 21st Century: Problems and Solutions’, *J. Irrig. Drain. Eng.*, vol. 128, no. 4, pp. 193–202, Aug. 2002, doi: 10.1061/(ASCE)0733-9437(2002)128:4(193).

[2] M. S. Dhanya and M. E. Jignesh, ‘Coral Reef Biodiversity—Threats and Management’, in *Biodiversity*, CRC Press, 2022.

[3] T. Hák, S. Janoušková, and B. Moldan, ‘Sustainable Development Goals: A need for relevant indicators’, *Ecol. Indic.*, vol. 60, pp. 565–573, Jan. 2016, doi: 10.1016/j.ecolind.2015.08.003.
[4] A. C. Hughes and R. E. Grumbine, ‘The Kunming-Montreal Global Biodiversity Framework: what it does and does not do, and how to improve it’, *Front. Environ. Sci.*, vol. 11, Nov. 2023, doi: 10.3389/fenvs.2023.1281536.
[5] B. J. Harvey, K. L. Nash, J. L. Blanchard, and D. P. Edwards, ‘Ecosystem-based management of coral reefs under climate change’, *Ecol. Evol.*, vol. 8, no. 12, pp. 6354–6368, May 2018, doi: 10.1002/ece3.4146.
[6] N. Gunningham and D. Sinclair, ‘Policy Instrument Choice and Diffuse Source Pollution’, *J. Environ. Law*, vol. 17, no. 1, pp. 51–81, 2005.
[7] F. J. Kroon, B. Schaffelke, and R. Bartley, ‘Informing policy to protect coastal coral reefs: Insight from a global review of reducing agricultural pollution to coastal ecosystems’, *Mar. Pollut. Bull.*, vol. 85, no. 1, pp. 33–41, Aug. 2014, doi: 10.1016/j.marpolbul.2014.06.003.
[8] J. Brodie *et al.*, *Development of basin-specific ecologically relevant water quality targets for the Great Barrier Reef*. Townsville, Australia: Centre for Tropical Water and Aquatic Ecosystem Research, 2017.
[9] J. Shortle and R. D. Horan, ‘Policy Instruments for Water Quality Protection’, *Annu. Rev. Resour. Econ.*, vol. 5, pp. 111–138, 2013, doi: 10.1146/annurev-resource-091912-151903.
[10] Y. A. Ahmed, K. Kadhim, A. M. H. Mezian, A. O. H. Al-Saedi, A. Sabah, and S. Kazemi, ‘Legal Frameworks Governing Water Quality and Aquatic Ecosystem Preservation’, *Environ. J. Rainwater Catchment Syst.*, vol. 29236, no. 30624, pp. 361–367, Sep. 2025, doi: 10.22034/ewe.2025.526959.2027.
[11] B. Schaffelke *et al.*, ‘The status and trends of coral reefs around the world – connecting science to conservation action’, Copernicus Meetings, OOS2025-938, Mar. 2025. doi: 10.5194/oos2025-938.
[12] Amelia S. Wenger *et al.*, ‘A guide for integrated conservation and sanitation programs and approaches’, *Wildl. Conserv. Soc.*, pp. 1–143, 2023.
[13] A. S. Wenger, J. L. Johansen, and G. P. Jones, ‘Increasing suspended sediment reduces foraging, growth and condition of a planktivorous damselfish’, *J. Exp. Mar. Biol. Ecol.*, vol. 428, pp. 43–48, Oct. 2012, doi: 10.1016/j.jembe.2012.06.004.
[14] A. S. Wenger and M. I. McCormick, ‘Determining trigger values of suspended sediment for behavioral changes in a coral reef fish’, *Mar. Pollut. Bull.*, vol. 70, no. 1, pp. 73–80, May 2013, doi: 10.1016/j.marpolbul.2013.02.014.
[15] A. Coggan, P. Thorburn, S. Fielke, R. Hay, and J. C. R. Smart, ‘Motivators and barriers to adoption of Improved Land Management Practices. A focus on practice change for water quality improvement in Great Barrier Reef catchments’, *Mar. Pollut. Bull.*, vol. 170, p. 112628, Sep. 2021, doi: 10.1016/j.marpolbul.2021.112628.
[16] L. Shabman and K. Stephenson, ‘Achieving Nutrient Water Quality Goals: Bringing Market-Like Principles to Water Quality Management’, *JAWRA J. Am. Water Resour. Assoc.*, vol. 43, no. 4, pp. 1076–1089, 2007, doi: 10.1111/j.1752-1688.2007.00089.x.
[17] B. M. Dowd, D. Press, and M. L. Huertos, ‘Agricultural nonpoint source water pollution policy: The case of California’s Central Coast’, *Agric. Ecosyst. Environ.*, vol. 128, no. 3, pp. 151–161, Nov. 2008, doi: 10.1016/j.agee.2008.05.014.
[18] M. Preisner, E. Neverova-Dziopak, and Z. Kowalewski, ‘An Analytical Review of Different Approaches to Wastewater Discharge Standards with Particular Emphasis on Nutrients’, *Environ. Manage.*, vol. 66, no. 4, pp. 694–708, Oct. 2020, doi: 10.1007/s00267-020-01344-y.
[19] M. St. J. Warne *et al.*, ‘Revisions to the derivation of the Australian and New Zealand guidelines for toxicants in fresh and marine waters’, *Environ. Sci. Pollut. Res.*, vol. 21, no. 1, pp. 51–60, Jan. 2014, doi: 10.1007/s11356-013-1779-6.

[20] L. J. Tuttle and M. J. Donahue, ‘Effects of sediment exposure on corals: a systematic review of experimental studies’, *Environ. Evid.*, vol. 11, pp. 1–33, 2022, doi: 10.1186/s13750-022-00256-0.
[21] K. E. Fabricius, ‘Factors Determining the Resilience of Coral Reefs to Eutrophication: A Review and Conceptual Model’, in *Coral Reefs: An Ecosystem in Transition*, Z. Dubinsky and N. Stambler, Eds, Dordrecht: Springer Netherlands, 2011, pp. 493–505. doi: 10.1007/978-94-007-0114-4_28.
[22] United Nations Environment and Programme, ‘WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas’. 2022.
[23] M. A. MacNeil *et al.*, ‘Water quality mediates resilience on the Great Barrier Reef’, *Nat. Ecol. Evol.*, vol. 3, no. 4, pp. 620–627, Apr. 2019, doi: 10.1038/s41559-019-0832-3.
[24] M. Astaraie-Imani, Z. Kapelan, G. Fu, and D. Butler, ‘Assessing the combined effects of urbanisation and climate change on the river water quality in an integrated urban wastewater system in the UK’, *J. Environ. Manage.*, vol. 112, pp. 1–9, Dec. 2012, doi: https://doi.org/10.1016/j.jenvman.2012.06.039.
[25] S. L. Wear, V. Acuña, R. McDonald, and C. Font, ‘Sewage pollution, declining ecosystem health, and cross-sector collaboration’, *Biol. Conserv.*, vol. 255, p. 109010, Mar. 2021, doi: https://doi.org/10.1016/j.biocon.2021.109010.
[26] C. Taylor, S. Pollard, S. Rocks, and A. Angus, ‘Selecting Policy Instruments for Better Environmental Regulation: a Critique and Future Research Agenda’, *Environ. Policy Gov.*, vol. 22, no. 4, pp. 268–292, 2012, doi: 10.1002/eet.1584.
[27] S. Darghouth, C. Ward, G. Gambarelli, E. Styger, and J. Roux, ‘Watershed Management Approaches, Policies, and Operations: Lessons for Scaling Up’, 2008.
[28] S. Olmstead and J. Zheng, ‘Water Pollution Control in Developing Countries: Policy Instruments and Empirical Evidence’, *Rev. Environ. Econ. Policy*, vol. 15, no. 2, pp. 261–280, Jun. 2021, doi: 10.1086/715645.
[29] W. Kemp *et al.*, ‘Eutrophication of Chesapeake Bay: historical trends and ecological interactions’, *Mar. Ecol. Prog. Ser.*, vol. 303, pp. 1–29, Nov. 2005, doi: 10.3354/meps303001.
[30] I. Lehmann, M. Kok, R. Immerzeel, and A. Marques, ‘Implications of global distributive justice principles for implementation of the Kunming-Montreal Global Biodiversity Framework’, *Conserv. Biol.*, vol. 40, no. 1, p. e70167, 2026, doi: 10.1111/cobi.70167.
[31] A. Xepapadeas, ‘The Economics of Non-Point-Source Pollution’, *Annu. Rev. Resour. Econ.*, vol. 3, no. 1, pp. 355–373, Oct. 2011, doi: 10.1146/annurev-resource-083110-115945.
[32] G. Thompson-Saud and A. S. Wenger, ‘Common characteristics of successful water quality improvement through point source pollution management’, *Mar. Pollut. Bull.*, vol. 185, p. 114281, Dec. 2022, doi: 10.1016/j.marpolbul.2022.114281.
[33] A. Pullin *et al.*, ‘Selecting appropriate methods of knowledge synthesis to inform biodiversity policy’, *Biodivers. Conserv.*, vol. 25, no. 7, pp. 1285–1300, Jun. 2016, doi: 10.1007/s10531-016-1131-9.
[34] U. N. E. Programme, ‘Understanding the State of the Ocean: A Global Manual on Measuring SDG 14.1.1, SDG 14.2.1 and SDG 14.5.1’.
[35] J. Hoornbeek, E. Hansen, E. Ringquist, and R. Carlson, ‘Implementing Water Pollution Policy in the United States: Total Maximum Daily Loads and Collaborative Watershed Management.’, *Soc. Nat. Resour.*, vol. 26, no. 4, pp. 420–436, Apr. 2013, doi: 10.1080/08941920.2012.700761.
[36] A. C. Bejarano, J. R. Clark, and G. M. Coelho, ‘Issues and challenges with oil toxicity data and implications for their use in decision making: A quantitative review’, *Environ. Toxicol. Chem.*, vol. 33, no. 4, pp. 732–742, 2014, doi: 10.1002/etc.2501.

[37] E. M. Nalley *et al.*, 'Water quality thresholds for coastal contaminant impacts on corals: A systematic review and meta-analysis', *Sci. Total Environ.*, vol. 794, p. 148632, Nov. 2021, doi: 10.1016/j.scitotenv.2021.148632.
[38] A. Coggan, P. Thorburn, S. Fielke, R. Hay, and J. C. R. Smart, 'Motivators and barriers to adoption of Improved Land Management Practices. A focus on practice change for water quality improvement in Great Barrier Reef catchments', *Mar. Pollut. Bull.*, vol. 170, p. 112628, Sep. 2021, doi: 10.1016/j.marpolbul.2021.112628.
[39] D. Souter, S. Planes, J. Wicquart, M. Logan, D. Obura, and F. Staub, 'Status of Coral Reefs of the World: 2020', 2020.
[40] G. Ucciero *et al.*, 'Technologies for marine biodiversity monitoring and mapping: A systematic review', *Mar. Pollut. Bull.*, vol. 227, p. 119432, Jun. 2026, doi: 10.1016/j.marpolbul.2026.119432.
[41] R. Fisher *et al.*, 'KEY ISSUES IN THE DERIVATION OF WATER QUALITY GUIDELINE VALUES: A WORKSHOP REPORT'.
[42] A. C. Bejarano, J. R. Clark, and G. M. Coelho, 'Issues and challenges with oil toxicity data and implications for their use in decision making: A quantitative review', *Environ. Toxicol. Chem.*, vol. 33, no. 4, pp. 732–742, Apr. 2014, doi: 10.1002/etc.2501.
[43] S. M. Cormier and G. W. Suter II, 'A method for deriving water-quality benchmarks using field data', *Environ. Toxicol. Chem.*, vol. 32, no. 2, pp. 255–262, 2013, doi: 10.1002/etc.2057.
[44] S. Wear *et al.*, 'Wastewater Pollution Impacts on Estuarine and Marine Environments', in *Treatise on Estuarine and Coastal Science (Second Edition)*, Elsevier, 2024, pp. 434–466. doi: 10.1016/B978-0-323-90798-9.00084-6.
[45] A. S. Wenger *et al.*, 'Management strategies to minimize the dredging impacts of coastal development on fish and fisheries', *Conserv. Lett.*, vol. 11, no. 5, p. e12572, 2018, doi: 10.1111/conl.12572.
[46] R. R. Carlson, S. A. Foo, and G. P. Asner, 'Land Use Impacts on Coral Reef Health: A Ridge-to-Reef Perspective', *Front. Mar. Sci.*, vol. 6, Sep. 2019, doi: 10.3389/fmars.2019.00562.
[47] Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australiaand New Zealand Council (ARMCANZ), 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'. 2000.
[48] A. Gonzalez *et al.*, 'From data to decisions: Toward a Biodiversity Monitoring Standards Framework', *Proc. Natl. Acad. Sci.*, vol. 123, no. 10, p. e2519347123, Mar. 2026, doi: 10.1073/pnas.2519347123.
[49] D. Dominguez and W. Gujer, 'Evolution of a wastewater treatment plant challenges traditional design concepts', *Water Res.*, vol. 40, no. 7, pp. 1389–1396, Apr. 2006, doi: https://doi.org/10.1016/j.watres.2006.01.034.

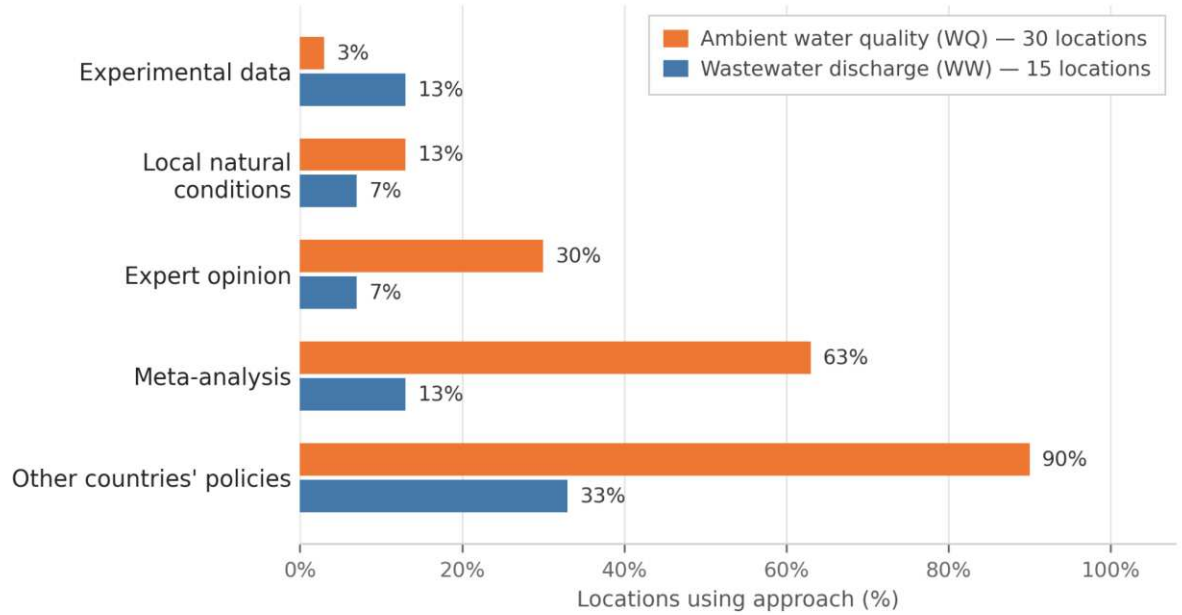
Supplementary materials

S1 *Number of water quality and wastewater discharge policies from 105 jurisdictions across 10 global regions with coral reefs meeting screening criteria (Figure 1) for phases 1 and 2 of the policy review.*

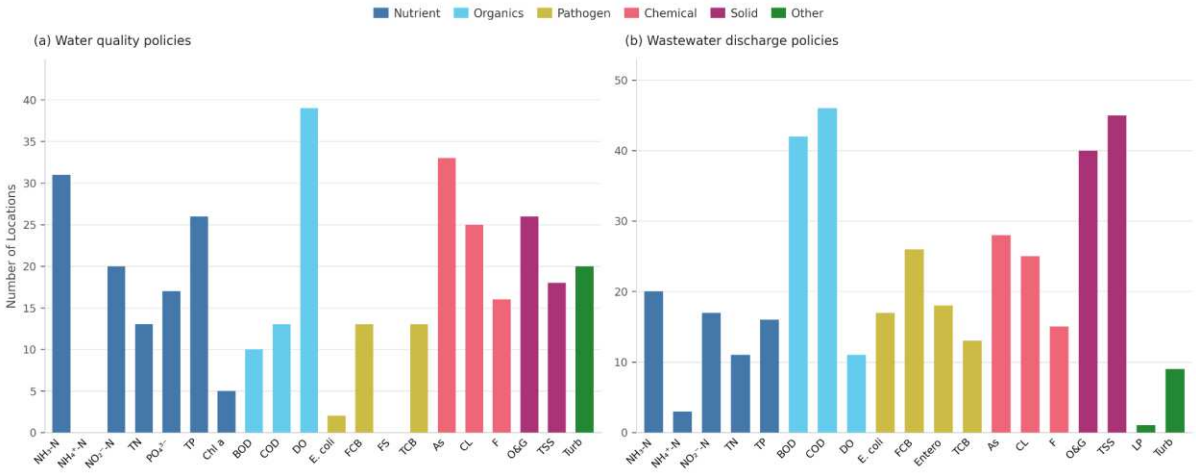
Phase	Category	Steps	Descriptions	Water Quality Number of Jurisdictions	Water Quality Number of Policies	Waste-water Number of Jurisdictions	Waste-water Number of Policies
1		Initial screening step: Jurisdictions and policies	Number of coral reef countries	48	48	53	54
		Second screening	Inclusion of	46	40	51	43

Phase	Category	Steps	Descriptions	Water Quality Number of Jurisdictions	Water Quality Number of Policies	Waste-water Number of Jurisdictions	Waste-water Number of Policies
		step: Parameters of interest	selected parameters (Table S7)				
		Third screening step: Derivation availability	Availability of source for guideline values	30	16	15	15
		Fourth screening step: Empirical evidence	Based on empirical evidence (including regional frameworks and/or that of other countries that are empirical)	17	9	12	12
		Fifth screening step: Source transparency	Retrievability of source for empirical evidence	17	3	2	2
2	A	A1: Local evidence	Using local or regional water quality data	1	1	0	0
		A2: Ecosystem responses	Guideline values were based on ecosystem changes in response to *in situ* water quality	1	1	0	0
	B	B1: Species relevance and ecotoxicology tests	Using relevant species and undertaking best practice ecotoxicology tests, including using NOEC and LOEC as endpoints	1	1	0	0

S2 Derivation types for the parameters used in guideline values in the water quality policies, and wastewater discharge policies. Note that the total number of policies is higher than jurisdictions as they can fall within multiple derivation types at once.



S3 The prevalence of selected water quality parameters in (a) ambient water quality policies, and (b) waste water discharge policies, displayed by category. Abbreviations: NH_3-N = Ammonia Nitrogen; NH_4^+-N = Ammonium Nitrogen; As = Arsenic; BOD = Biochemical Oxygen Demand; COD = Chemical Oxygen Demand; Cl_2 = Chlorine; Cu = Copper; CN = Cyanide; DO = Dissolved Oxygen; Entero = enterococci; E. coli = Escherichia coli; FCB = Faecal Coliform Bacteria; FS = Faecal Streptococcus; F^- = Fluoride; Cr(VI) = Hexavalent Chromium; Pb = Lead; Hg = Mercury; Ni = Nickel; NO_3-N = Nitrate Nitrogen; O&G = Oil & Grease; PO_4^{3-} = Phosphate; TCB = Total Coliform Bacteria; TN = Total Nitrogen; TP = Total Phosphorus; TSS = Total Suspended Solids; Zn = Zinc.



S4 List of coral reef countries, as defined by and adapted from the Global Coral Reef Monitoring Network.

Region	**Country**
Eastern Tropical Pacific	Mexico

Eastern Tropical Pacific	France (Clipperton Atoll)
Eastern Tropical Pacific	Costa Rica
Eastern Tropical Pacific	Nicaragua
Eastern Tropical Pacific	El Salvador
Eastern Tropical Pacific	Guatemala
Eastern Tropical Pacific	Panama
Eastern Tropical Pacific	Colombia
Eastern Tropical Pacific	Ecuador
Eastern Tropical Pacific	Chile
Brazil	Brazil
Caribbean	Antigua and Barbuda
Caribbean	Aruba
Caribbean	Bahamas
Caribbean	Barbados
Caribbean	Belize
Caribbean	British Virgin Islands
Caribbean	Colombia
Caribbean	Costa Rica
Caribbean	Cuba

Caribbean	Curaçao
Caribbean	Dominica
Caribbean	Dominican Republic
Caribbean	Grenada
Caribbean	Guadeloupe
Caribbean	Guatemala
Caribbean	Haiti
Caribbean	Honduras
Caribbean	Jamaica
Caribbean	Martinique
Caribbean	Mexico
Caribbean	Montserrat
Caribbean	Nicaragua
Caribbean	Panama
Caribbean	Puerto Rico
Caribbean	Saint Kitts and Nevis
Caribbean	Saint Lucia
Caribbean	Saint Vincent and the Grenadines
Caribbean	Trinidad and Tobago
Caribbean	US Virgin Islands
Caribbean	Venezuela
Red Sea & Gulf of Aden	Djibouti
Red Sea & Gulf of Aden	Egypt
Red Sea & Gulf of Aden	Eritrea
Red Sea & Gulf of Aden	Israel

Red Sea & Gulf of Aden	Jordan
Red Sea & Gulf of Aden	Saudi Arabia
Red Sea & Gulf of Aden	Somalia
Red Sea & Gulf of Aden	Sudan
Red Sea & Gulf of Aden	Yemen
Western Indian Ocean	Somalia
Western Indian Ocean	Kenya
Western Indian Ocean	Tanzania
Western Indian Ocean	Mozambique
Western Indian Ocean	South Africa
Western Indian Ocean	Mauritius
Western Indian Ocean	Madagascar
Western Indian Ocean	Comoros
Western Indian Ocean	Seychelles
Western Indian Ocean	La Réunion (France)
Regional Organization for the Protection of the Marine Environment (ROPME)	Bahrain

Regional Organization for the Protection of the Marine Environment (ROPME)	Iran
Regional Organization for the Protection of the Marine Environment (ROPME)	Iraq
Regional Organization for the Protection of the Marine Environment (ROPME)	Kuwait
Regional Organization for the Protection of the Marine Environment (ROPME)	Oman
Regional Organization for the Protection of the Marine Environment (ROPME)	Qatar
Regional Organization for the Protection of the Marine Environment (ROPME)	Saudi Arabia

Regional Organization for the Protection of the Marine Environment (ROPME)	The United Arab Emirates
South Asia	Bangladesh
South Asia	India
South Asia	Maldives
South Asia	Myanmar
South Asia	Pakistan
South Asia	Sri Lanka
South Asia	The Chagos Archipelago
Australia	Australia
Pacific	American Samoa (USA)
Pacific	Commonwealth of the Northern Marianas (USA)
Pacific	Cook Islands
Pacific	Fiji
Pacific	Federated States of Micronesia
Pacific	French Polynesia (France)
Pacific	Main and Northwestern Hawaiian Islands (USA)
Pacific	Kingdom of Tonga
Pacific	Republic of Kiribati

Pacific	Republic of the Marshall Islands
Pacific	Nauru
Pacific	New Caledonia (France)
Pacific	Niue
Pacific	Republic of Palau
Pacific	Pitcairn (UK)
Pacific	Pacific Remote Island Area (USA)
Pacific	Papua New Guinea
Pacific	Samoa
Pacific	Solomon Islands
Pacific	Tokelau (NZ)
Pacific	Tuvalu
Pacific	Vanuatu
Pacific	Wallis & Futuna (France)
East Asia	China
East Asia	Hong Kong
East Asia	Taiwan
East Asia	Japan
East Asia	South Korea
East Asia	Brunei Darussalam
East Asia	Cambodia
East Asia	Indonesia
East Asia	Malaysia
East Asia	Myanmar

East Asia	Philippines
East Asia	Singapore
East Asia	Thailand
East Asia	Vietnam

607

608 *S5: Search terms used to gather documents for water quality and wastewater discharge*
609 *policies and guidelines*

Policy Type	**Search Term**
Water Quality	[Country] AND water AND quality AND (guide* OR threshold* OR criteria OR standard*)
	[Country] AND "water quality" AND (guide* OR threshold* OR criteria OR standard*)
	[Country] AND marine AND water AND quality AND (guide* OR threshold* OR criteria OR standard*)
Wastewater	[Country] AND (wastewater OR sewage OR effluent) AND guide*
	[Country] AND (wastewater OR sewage OR effluent) AND threshold*
	[Country] AND (wastewater OR sewage OR effluent) AND criteria*
	[Country] AND (wastewater OR sewage OR effluent) AND standard*

610

611

612 *S6: Overview of policies retained and analysed in this study. Policies that were adopted but*
613 *later superseded by other policies were not retained. WQ - water quality policy; WW -*
614 *wastewater policy. The Land-Based Sources (LBS) Protocol is a regional environmental*
615 *agreement adopted in 1999 (in force 2010) under the Cartagena Convention to protect the*
616 *Wider Caribbean Region's marine environment*

Policy Type	**ID**	**Jurisdiction**	**Policy Name**	**Legislated (1=yes, 0=no)**	**Notes**
Both	WQ_140101-2	El Salvador	Special Regulation of Technical Norms of Environmental Quality	1	*Current policy (selected)*
Both	WQ_070101	Honduras	National Technical Standard for Water	1	*Current policy (selected)*

Both	WQ_380101-2	Saudi Arabia	General Environmental Regulations and Rules for Implementation	1	*Superseded by "Executive Regulation for the Environmental Law for the Protection of Aqueous Media from Pollution" — shown for transparency*
Wastewater Discharge	WW_460201	American Samoa	AMERICAN SAMOA WATER QUALITY STANDARDS	1	*Current policy (selected)*
Wastewater Discharge	WW_010101	Antigua and Barbuda	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_440101	Bahamas	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_030101	Bangladesh	The Environment Conservation Rules	1	*Current policy (selected)*
Wastewater Discharge	WW_040101	Barbados	The LBS Protocol	0	*Superseded by "Barbados Water Authority Standards of Service 2023 - 2025" — shown for transparency*
Wastewater Discharge	WW_040102	Barbados	Barbados Water Authority Standards of Service 2023 - 2025	1	*Current policy (selected)*
Wastewater Discharge	WW_050101	Belize	Environmental Protection (Effluent Limitations)(Amendment) Regulations, 2009	1	*Current policy (selected)*
Wastewater Discharge	WW_050102	Belize	The LBS Protocol	0	*Superseded by "Environmental Protection (Effluent Limitations)(Amendment) Regulations, 2009" — shown for transparency*
Wastewater Discharge	WW_060101	Brazil	CONAMA Resolution 430/11	1	*Current policy (selected)*
Wastewater Discharge	WW_460301	California	Water Quality Control Plan for Ocean Waters of California	0	*Current policy (selected)*
Wastewater Discharge	WW_460302	California	Water Quality Standards	1	*Superseded by "Water Quality Control Plan for Ocean Waters of California" — shown for transparency*
Wastewater Discharge	WW_070101	Cambodia	Sub Decree on Water Pollution Control	1	*Current policy (selected)*
Wastewater Discharge	WW_080101	Cape Verde	Official Bulletin n° 44	1	*Current policy (selected)*
Wastewater Discharge	WW_090101	China	Integrated wastewater discharge standard	1	*Current policy (selected)*
Wastewater Discharge	WW_100101	Colombia	Decree 1594 of 1984	1	*Current policy (selected)*

Wastewater Discharge	WW_110101	Costa rica	The LBS Protocol	0	*Superseded by "Regulation on the discharge and reuse of wastewater." — shown for transparency*
Wastewater Discharge	WW_110102	Costa rica	Regulation on the discharge and reuse of wastewater.	1	*Current policy (selected)*
Wastewater Discharge	WW_000FS1	Curaçao	ANNEX to the Ministerial Decree of 11 August 2020, establishing the Environmental Permitting Policy	0	*Current policy (selected)*
Wastewater Discharge	WW_120101	Dominican Republic	The LBS Protocol	0	*Superseded by "Water quality standards and discharge control" — shown for transparency*
Wastewater Discharge	WW_120102	Dominican Republic	Water quality standards and discharge control	1	*Current policy (selected)*
Wastewater Discharge	WW_480101	Ecuador	Official Gazette -- Special Edition No. 387	1	*Current policy (selected)*
Wastewater Discharge	WW_130101	Egypt	River Nile Protection and Development Project	1	*Current policy (selected)*
Wastewater Discharge	WW_500101	Fiji	National liquid waste standards	1	*Current policy (selected)*
Wastewater Discharge	WW_150101	France	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_150102	France	91/271/EEC on urban wastewater treatment	1	*Superseded by "The LBS Protocol" — shown for transparency*
Wastewater Discharge	WW_150103	France	98/15/EC on urban wastewater treatment	1	*Superseded by "The LBS Protocol" — shown for transparency*
Wastewater Discharge	WW_160101	Grenada	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_150201	Guadeloupe	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_460401	Guam	Guam Water Quality Standards Regulations	1	*Current policy (selected)*
Wastewater Discharge	WW_170101	Guyana	The LBS Protocol	0	*Current policy (selected)*

Wastewater Discharge	WW_460501	Hawaii	Hawaii administrative rules - wastewater systems	1	*Current policy (selected)*
Wastewater Discharge	WW_180102	Honduras	The LBS Protocol	0	*Superseded by "National regulation on the discharge and reuse of wastewater." — shown for transparency*
Wastewater Discharge	WW_180103	Honduras	National regulation on the discharge and reuse of wastewater.	1	*Current policy (selected)*
Wastewater Discharge	WW_190101	India	The Environment (Protection) Rules	1	*Current policy (selected)*
Wastewater Discharge	WW_200101	Indonesia	Urban Wastewater Management In Indonesia	0	*Current policy (selected)*
Wastewater Discharge	WW_490101	Israel	Prevention of Water Pollution - Metals and Other Pollutants, Regulations, 2000 (5761-2000).	1	*Current policy (selected)*
Wastewater Discharge	WW_210101	Jamaica	The NRCA National Sewage Effluent Standards	1	*Superseded by "Natural Resources Conservation (Wastewater and Sludge) Regulations 2013" — shown for transparency*
Wastewater Discharge	WW_210102	Jamaica	The LBS Protocol	0	*Superseded by "Natural Resources Conservation (Wastewater and Sludge) Regulations 2013" — shown for transparency*
Wastewater Discharge	WW_210103	Jamaica	Natural Resources Conservation (Wastewater and Sludge) Regulations 2013	1	*Current policy (selected)*
Wastewater Discharge	WW_220101	Kenya	ENVIRONMENTAL MANAGEMENT AND CO-ORDINATION (WATER QUALITY) REGULATIONS, 2006	1	*Current policy (selected)*
Wastewater Discharge	WW_230101	Kuwait	Kuwait Environmental Quality Guidelines	1	*Current policy (selected)*
Wastewater Discharge	WW_460601	Maine	Water Quality Standards	1	*Current policy (selected)*
Wastewater Discharge	WW_240101	Malaysia	Environmental Quality (Sewage) Regulations 2009	1	*Current policy (selected)*
Wastewater Discharge	WW_250101	Maldives	National Waste Water Quality Guidelines 2007	0	*Current policy (selected)*
Wastewater Discharge	WW_250102	Maldives	The sewage disposal regulations	1	*Superseded by "National Waste Water Quality Guidelines 2007" — shown for transparency*

Wastewater Discharge	WW_150301	Martinique	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_270101	Mauritius	Environment Protection (Standards for effluent discharge) Regulations 2003	1	*Current policy (selected)*
Wastewater Discharge	WW_280101	Mexico	Official Mexican Standard NOM-001-Semarnat-1996	1	*Superseded by "Official Mexican Standard NOM-001-SEMARNAT-2021" — shown for transparency*
Wastewater Discharge	WW_280102	Mexico	Official Mexican Standard NOM-001-SEMARNAT-2021	1	*Current policy (selected)*
Wastewater Discharge	WW_290101	Myanmar	National Environmental Quality (Emission) Guidelines	0	*Current policy (selected)*
Wastewater Discharge	WW_300101	New Caledonia	Code of Ordinances	1	*Current policy (selected)*
Wastewater Discharge	WW_320101	Oman	Regulations for wastewater re-use and discharge	1	*Current policy (selected)*
Wastewater Discharge	WW_330101	Palau	Marine and Fresh Water Quality Regulations	1	*Current policy (selected)*
Wastewater Discharge	WW_340101	Panama	Water Discharge of Liquid Effluents Directly to Bodies and Surface water Masses and Underground	0	*Current policy (selected)*
Wastewater Discharge	WW_340102	Panama	The LBS Protocol	0	*Superseded by "Water Discharge of Liquid Effluents Directly to Bodies and Surface water Masses and Underground" — shown for transparency*
Wastewater Discharge	WW_360101	Philippines	Water quality guidelines and general effluent standards	1	*Current policy (selected)*
Wastewater Discharge	WW_460701	Puerto Rico	Fact Sheet - Draft National Pollutant Discharge Elimination System Comerio WWTP	0	*Superseded by "Fact Sheet - National Pollutant Discharge Elimination System Puerto Nuevo Regional WWTP" — shown for transparency*
Wastewater Discharge	WW_460702	Puerto Rico	Water Quality Standards	1	*Superseded by "Fact Sheet - National Pollutant Discharge Elimination System Puerto Nuevo Regional WWTP" — shown for transparency*
Wastewater Discharge	WW_460703	Puerto Rico	Fact Sheet - National Pollutant Discharge Elimination System Guayama Regional WWTP	0	*Superseded by "Fact Sheet - National Pollutant Discharge Elimination System Puerto Nuevo Regional WWTP" — shown for transparency*
Wastewater Discharge	WW_460704	Puerto Rico	Fact Sheet - National Pollutant Discharge Elimination System Puerto Nuevo Regional WWTP	0	*Current policy (selected)*
Wastewater Discharge	WW_370101	Saint Lucia	The LBS Protocol	0	*Current policy (selected)*

Wastewater Discharge	WW_380102	Saudi Arabia	Executive Regulations for Treated waste water system	1	*Superseded by "Executive Regulation for the Environmental Law for the Protection of Aqueous Media from Pollution." — shown for transparency*
Wastewater Discharge	WW_380103	Saudi Arabia	Executive Regulation for the Environmental Law for the Protection of Aqueous Media from Pollution.	1	*Current policy (selected)*
Wastewater Discharge	WW_390101	Seychelles	Environment Protection (Standards) Regulations	1	*Current policy (selected)*
Wastewater Discharge	WW_400101	South Africa	Wastewater and Industrial Effluent By-law, 2013	1	*Current policy (selected)*
Wastewater Discharge	WW_410101	Sri Lanka	National Environmental (Protection and Quality) Regulations	1	*Current policy (selected)*
Wastewater Discharge	WW_420101	Taiwan	Effluent Standards	1	*Current policy (selected)*
Wastewater Discharge	WW_450102	Trinidad and Tobago	The LBS Protocol	0	*Current policy (selected)*
Wastewater Discharge	WW_460102	United States of America	The LBS Protocol	0	*Current policy (selected)*
Water Quality	WQ_010101	American Samoa	American Samoa Water Quality Standards	1	*Current policy (selected)*
Water Quality	WQ_020102	Antigua and Barbuda	Antigua and Barbuda Environmental Protection and Management Act	1	*Current policy (selected)*
Water Quality	WQ_030101	Australia	Australian and New Zealand Guidelines for Fresh and Marine Water Quality	0	*Superseded by "Toxicant Default Guideline Values for protecting aquatic ecosystems" — shown for transparency*
Water Quality	WQ_030102	Australia	Toxicant Default Guideline Values for protecting aquatic ecosystems	0	*Current policy (selected)*
Water Quality	WQ_310101	Bahamas	The Pollution Control And Waste Management Regulations of 2000	0	*Current policy (selected)*
Water Quality	WQ_430101	Barbados	Marine Pollution Control Act 2000TABLE OF PROHIBITED CONCENTRATIONS 2023	1	*Current policy (selected)*
Water Quality	WQ_040101	Brazil	Brazilian Environmental Legislation CONAMA Resolution 357/05	1	*Current policy (selected)*
Water Quality	WQ_290101	Brunei	ASEAN Marine Water Quality Criteria	0	*Current policy (selected)*

Water Quality	WQ_07 0101-2	Cambodia	Council of Ministers (2009) .Sub Decree on Water Pollution Control. No.27 ANRK.BKCambodia.	1	*Current policy (selected)*
Water Quality	WQ_06 0101	China	Sea Water Quality National Standard	1	*Current policy (selected)*
Water Quality	WQ_39 0101	Comoros	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_32 0101	Curaçao	Environmental Permitting Policy	1	*Current policy (selected)*
Water Quality	WQ_33 0101	Ecuador	Environmental Quality Standard and Effluent Discharge: Water Resource	1	*Current policy (selected)*
Water Quality	WQ_03 0201	Great Barrier Reef	Australian Water Quality Guidelines for Fresh and Marine, Waters National Water Quality Management Strategy	0	*Superseded by "Water Quality Guidelines for the Great Barrier Reef Marine Park" — shown for transparency*
Water Quality	WQ_03 0202	Great Barrier Reef	Water Quality Guidelines for the Great Barrier Reef Marine Park	0	*Current policy (selected)*
Water Quality	WQ_34 0101	Guam	Water Quality Standards Regulations - Chapter 5 of Title 22 of the Guam Administrative Rules and Regulations.	1	*Current policy (selected)*
Water Quality	WQ_27 0101	Hawaii	Clean Water Act Amendment and Compilation of Chapter 11-54 Hawaii Administrative Rules	1	*Current policy (selected)*
Water Quality	WQ_08 0101	India	Water Quality Standards For Coastal Waters Marine Ooutfalls	1	*Current policy (selected)*
Water Quality	WQ_09 0101	Indonesia	Government Regulation of the Republic of Indonesia	1	*Current policy (selected)*
Water Quality	WQ_09 0102	Indonesia	ASEAN Marine Water Quality Criteria	0	*Superseded by "Government Regulation of the Republic of Indonesia " — shown for transparency*
Water Quality	WQ_10 0101	Israel	Environmental Quality Standards For The Mediterranean Sea In Israel	0	*Current policy (selected)*
Water Quality	WQ_11 0101	Jamaica	Jamaica National Ambient Water Quality Standard Marine Water, 2009	0	*Current policy (selected)*
Water Quality	WQ_12 0101	Japan	Environmental Quality Standard for Water Pollution	1	*Current policy (selected)*

Water Quality	WQ_350101	Kenya	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_230101-2	Kuwait	Environmental Quality Guidelines	1	*Current policy (selected)*
Water Quality	WQ_400101	Madagascar	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_130101	Malaysia	Malaysia Marine Water Quality Criteria and Standard	0	*Current policy (selected)*
Water Quality	WQ_130102	Malaysia	ASEAN Marine Water Quality Criteria	0	*Superseded by "Malaysia Marine Water Quality Criteria and Standard" — shown for transparency*
Water Quality	WQ_140101	Marshall Islands	Marine Water Quality Regulations	1	*Current policy (selected)*
Water Quality	WQ_200101	Mauritius	Guidelines for Coastal Water Quality	1	*Current policy (selected)*
Water Quality	WQ_200102	Mauritius	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Superseded by "Guidelines for Coastal Water Quality" — shown for transparency*
Water Quality	WQ_360101	Mozambique	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_150101	Northern Mariana Islands	Division of the Environmental Quality Chapter 65-130 Water Quality Standard	1	*Current policy (selected)*
Water Quality	WQ_160101	Palau	Chapter 2401-11 Marine and Fresh Water Quality Regulations	1	*Current policy (selected)*
Water Quality	WQ_170101	Papua New Guinea	Environment (Water Quality Criteria) Regulation 2002	1	*Current policy (selected)*
Water Quality	WQ_350101-2	Papua New Guinea	Environment (Water Quality Criteria) Regulation	1	*Superseded by "Environment (Water Quality Criteria) Regulation 2002" — shown for transparency*
Water Quality	WQ_180101	Philippines	Water Quality Guidelines and General Effluent Standards of 2016	1	*Current policy (selected)*
Water Quality	WQ_180102	Philippines	ASEAN Marine Water Quality Criteria	0	*Superseded by "Water Quality Guidelines and General Effluent Standards of 2016" — shown for transparency*
Water Quality	WQ_190101	Puerto Rico	Puerto Rico Water Quality Standards Regulation	1	*Current policy (selected)*

Water Quality	WQ_41 0101	Reunion	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_21 0101	Saudi Arabia	Royal Comission Environmental Regulations Volume I Regulations and Standards	1	*Superseded by "Executive Regulation for the Environmental Law for the Protection of Aqueous Media from Pollution" — shown for transparency*
Water Quality	WQ_21 0102	Saudi Arabia	Executive Regulation for the Environmental Law for the Protection of Aqueous Media from Pollution	1	*Current policy (selected)*
Water Quality	WQ_42 0101	Seychelles	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_30 0101	Singapore	ASEAN Marine Water Quality Criteria	0	*Current policy (selected)*
Water Quality	WQ_37 0101	Somalia	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Current policy (selected)*
Water Quality	WQ_22 0101	South Africa	South African Water Quality Guidelines for Coastal Marine Water - Volume 1: Natural Environment and Mariculture Use	0	*Current policy (selected)*
Water Quality	WQ_22 0102	South Africa	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Superseded by "South African Water Quality Guidelines for Coastal Marine Water - Volume 1: Natural Environment and Mariculture Use" — shown for transparency*
Water Quality	WQ_23 0101	Taiwan	Surface Water Classification and Water Quality Standards	1	*Current policy (selected)*
Water Quality	WQ_38 0101	Tanzania	WESTERN INDIAN OCEAN Guidelines for Setting Water and Sediment Quality Targets for Coastal and Marine areas	0	*Superseded by "The Environmental Management (Water Quality Standards) Regulations, 2007" — shown for transparency*
Water Quality	WQ_43 0101-2	Tanzania	The Environmental Management (Water Quality Standards) Regulations, 2007	1	*Current policy (selected)*
Water Quality	WQ_24 0101	Thailand	Enhancement and Conservation of National Environmental Quality Act, Thai Coastal Water Quality Standards	1	*Current policy (selected)*
Water Quality	WQ_24 0102	Thailand	ASEAN Marine Water Quality Criteria	0	*Superseded by "Enhancement and Conservation of National Environmental Quality Act, Thai Coastal Water Quality Standards" — shown for transparency*
Water Quality	WQ_25 0101	Trinidad and Tobago	Environmental Management Act Chapter 35:05	1	*Superseded by "The Water Pollution Rules" — shown for transparency*
Water Quality	WQ_25 0102	Trinidad and Tobago	The Water Pollution Rules	1	*Current policy (selected)*

Water Quality	WQ_450101	Trinidad and Tobago	The water Pollution rules, 2019	1	*Superseded by "The Water Pollution Rules" — shown for transparency*
Water Quality	WQ_050101	US Virgin Islands	Amended Virgin Islands Water Quality Management Program Water Quality Standards	1	*Current policy (selected)*
Water Quality	WQ_260101	United Arab Emirates	Guiding Standards for Marine Water Properties in the United Arab Emirates	0	*Current policy (selected)*
Water Quality	WQ_460101	United States of America	Aquatic Life Criteria Table	0	*Current policy (selected)*
Water Quality	WQ_280101	Vietnam	TCVN 5943-95 Coastal sea water standards	1	*Current policy (selected)*
Water Quality	WQ_280102	Vietnam	ASEAN Marine Water Quality Criteria	0	*Superseded by "TCVN 5943-95 Coastal sea water standards" — shown for transparency*

S7: Sustainable Development Goals and World Health Organisation parameters used throughout the screening process

Category	Parameter	Presence in policies
Nutrient	Ammonia Nitrogen	y
	Ammonium Nitrogen	y
	Nitrate Nitrogen	y
	Total Nitrogen	y
	Phosphate	y
	Total Phosphorus	y
	Chlorophyll a	y
Organics	Biochemical Oxygen Demand	y
	Chemical Oxygen Demand	y
	Silica	n
	Dissolved Oxygen	y
	Total Organic Carbon	y
Pathogen	*E.coli*	*y*

	Enterococcus	*y*
	Fecal Coliform Bacteria	y
	Faecal Streptococcus	y
	Total Coliform Bacteria	y
Chemical	Arsenic	y
	Chlorine	y
	Fluoride	y
Solid	Oil & Grease	y
	Total Suspended Solids	y
Other	Light penetration	y
	Turbidity	y

S8: Tests and test organisms specified per parameter and jurisdiction, for each policy whose empirically-derived derivation source was retrievable.

Policy Type (WW/WQ)	**Location**	**Parameter**	**Derivation of source (yes/no)**	**Test Type**	**Test organism**	**Marine species?**	**Coral reef species?**	**Notes**
WW + WQ	American Samoa	Ammonia	Yes	Acute and chronic toxicity tests	Not documented	Yes	Not documented	
		Total Suspended Solids	Yes	Acute and chronic toxicity tests	Not documented	Yes	Not documented	
		Total Nitrogen	Yes	Acute and chronic toxicity tests	Not documented	Yes	Not documented	
		Turbidity	No	N/A	N/A	N/A	N/A	
		Total Phosphorous	No	N/A	N/A	N/A	N/A	
		Chlorophyll a	No	N/A	N/A	N/A	N/A	
		Dissolved Oxygen	No	N/A	N/A	N/A	N/A	
		pH	No	N/A	N/A	N/A	N/A	

		Enterococci	No	N/A	N/A	N/A	N/A	
WW + WQ	Guam	Nitrate-N	No	N/A	N/A	Yes	No	
		Ammonia	Yes	Acute and chronic tests	Not documented	Yes	No	
		Biological Oxygen Demand	No	N/A	N/A	N/A	N/A	
		Faecal Coliforms	No	N/A	N/A	Yes	N/A	
		Enterococci	No	N/A	N/A	N/A	N/A	
		Arsenic	Yes	Acute and chronic tests	Not documented	Yes	No	
		Total Suspended Solids	No	N/A	N/A	Yes	No	
		Turbidity	No	N/A	N/A	Yes	No	
		Dissolved Oxygen	Yes	N/A	N/A	Yes	No	
WQ	Great Barrier Reef	Chlorophyll a	Yes	Statistical ecosystem-response analysis (regression modeling of *in situ* monitoring data)	Community-level metrics, not species: cover of macroalgae, taxonomic richness of hard corals, phototrophic and heterotrophic octocorals	Yes	Yes	
		Total Suspended Solids	Yes	Statistical ecosystem-response analysis (regression modeling of *in situ* monitoring data)	Community-level metrics, not species: cover of macroalgae, taxonomic richness of hard corals,	Yes	Yes	

					phototrophic and heterotrophic octocorals			
		Particulate Nitrogen	Yes	Statistical ecosystem-response analysis (regression modeling of *in situ monit*oring data)	Community-level metrics, not species: cover of macroalgae, taxonomic richness of hard corals, phototrophic and heterotrophic octocorals	Yes	Yes	
		Particulate Phosphorous	Yes	Statistical ecosystem-response analysis (regression modeling of *in situ* monitoring data)	Community-level metrics, not species: cover of macroalgae, taxonomic richness of hard corals, phototrophic and heterotrophic octocorals	Yes	Yes	
WQ	Comoros, Kenya, Madagascar, Mauritius, Mozambique, Reunion, Seychelles, Somalia, Tanzania	Ammonia	Yes	Acute LC50	*Ampelisca abdita (amphipod); Palaemonetes pugio (grass shrimp); Penaeus monodon, P. japonicus (penaeid shrimp); Scylla serrata (mud crab); Homarus american*	Yes	No	Based on meta-analysis for the Western Indian Ocean Guidelines (WIOG)

					us (lobster); Palinurus sp. (spiny lobster); abalone (Haliotis); unnamed molluscs/fish			
		Nitrate-N	Yes	Coral productivity threshold; shrimp safe levels; LC50 for non-corals	*Coral productivity (Lapointe et al. 1992); Penaeus monodon, P. chinensis, P. indicus; Palinurus sp.*	Yes	Yes	
		Phosphate	Yes	*Ulva lactuca* growth; coral productivity	*Ulva lactuca* growth; coral productivity	Yes	Yes	
		Dissolved Oxygen	Yes	LC50 for non-corals	Coral productivity; *Penaeus monodon, P. chinensis; abalone; Palinurus sp.*	Yes	Yes	
		Enterococci	Yes	N/A	N/A	Yes	No	
		Faecal Coliforms	Yes	N/A	N/A	Yes	No	
		Arsenic	Yes	Growth inhibition, Lowest effect concentration (LEC), LC50, acute toxicity for non-corals	*Skeletonema costatum; Tetraselmis chui, Hymenomonas carterae, Thalassiosira aestivalis, Champia parvula, Plumaria elegant,*	Yes	No	

					Chelonia labrosus, Macomo balthica, Nassarius absoleus, Argospecten irradians, Corophium insidiosum, Elasmopus bampo, Scylla serrata, Mysidopsis bahia, Crangon crangon			
		Chlorine	Yes	LC50	*Skeletonema costatum; Chlamydomonas spp.; Donax serra (SA white mussel); Palaemonetes pugio; Homarus americanus*	Yes	No	
		Fluoride	Yes	LC50, NEC, LEC, EC50	*Penaeus indicus and japonicus and monodon (WIO penaeid); Tylodiplax blepharis kios, Mytiluzz (crab); Mytilus edulis; abalone*	Yes	No	
		Total Suspended Solids	No	N/A	N/A	N/A	N/A	
WQ	Brunei, Indonesia, Malaysia, Philippine	Ammonia	Yes	Acute LC50, NOEC/LOEC where	*Penaeus monodon, P. semisulcatus,*	Yes	No	The Association of Southeast Asian

	s, Singapore, Thailand, Vietnam			available	*Metapenaeus macleayi, Macrobrachium rosenbergii, Sparus aurata, Lates calcarifer, Paralichthys orbignyanus*			Nations (ASEAN)
		Nitrate-N	No	N/A	N/A	N/A	N/A	
		Phosphate	No	N/A	N/A	N/A	N/A	
		Dissolved Oxygen	Yes	Lab studies on LC50/EC50	*Mulinia lateralis, Arctica (Cyprinia) islendica, Scrobicularia plana, Mya arenaria, Macoma balthica, Streblospio benedicti, Scoloplos armiger, Penaeus semisulcatus, P. japonicus, P. monodon, P. vannamei, Palaemon elegans*	Yes	No	
		Enterococci	Yes	Epidemiology + indicator enumeration (MPN/100 mL); no ecotoxicity tests	None (bacteria are the indicators); shellfish used in accumulation studies: *Crassostrea virginica/gigas, Mercenaria*	Yes	No	

					mercenaria, Mya arenaria, Perna viridis, Anadara granosa			
		Faecal Coliforms	Yes	Epidemiology + indicator enumeration (MPN/100 mL); no ecotoxicity tests	None (indicators); bivalve accumulation studies as for *E. coli*	N/A	No	
		Faecal Streptococcus	Yes	Epidemiology; no ecotoxicity tests	None	N/A	N/A	
		Arsenic	Yes	Acute LC50/EC50, chronic NOEC/LOEC	*Mysidopsis bahia (mysid), Crassostrea gigas (Pacific oyster), Champia parvula (red alga), Skeletonema costatum, Thalassiosira aestivalis (diatoms), Plumaria elegans (red alga), Lates calcarifer (seabass), Tridacna gigas (giant clam)*	Yes	*Tridacna gigas* is a coral-reef giant clam, but it appears only in the effects review and is not used in the criterion calculation	
		Oil & Grease	No	N/A	N/A	N/A	N/A	
		Total Suspended Solids	No	N/A	N/A	N/A	N/A	

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