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Seventh Meeting of the Scientific and Technical Advisory Committee (STAC) to the Protocol Concerning Pollution from Land-Based Sources and Activities in the Wider Caribbean.

Virtual, 22 – 25 July 2025

DRAFT RECOMMENDATIONS FOR AMENDMENTS TO THE LBS PROTOCOL AND ANNEXES TO FACILITATE INCREASED REUSE OF DOMESTIC WASTEWATER INCLUDING ADOPTION OF NEW CRITERIA OR STANDARDS FOR DOMESTIC WASTEWATER DISCHARGES.

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Small-Scale Agreement (SSFA) "UNEP and RAC CIMAB Cooperation with respect to GEF CReW+, ACP MEAs III and SIDA Funds (UNEP HQ) projects/programmes in the Wider Caribbean Region"

Final Report (*DRAFT*):

"Draft Recommendations for amendments to the LBS Protocol and Annexes to facilitate increased reuse of domestic wastewater including adoption of new criteria or standards for domestic wastewater discharges with the support of RAC-IMA"

May 2025.

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ACRONYMS AND ABBREVIATIONS

AMEP	Assessment and Management of Environmental Pollution Programme
BOD_5	Biochemical Biological Oxygen Demand
CEP	Caribbean Environment Program
Cimab	Centro de Investigación y Manejo Ambiental del Transporte *(Centre for Research and Environmental Management of Transport)*, Cuba
COD	Chemical Oxygen Demand
GEF	Global Environment Facility
IMA	Institute of Marine Affairs, Trinidad and Tobago
LAC	Latin America and the Caribbean
LBS	Marine Pollution from Land-Based Sources
N	Nitrogen
P	Phosphorus
RAC	Regional Activity Centre
SDG	Sustainable Development Goal
SIDS	Small Island Developing States
SOCAR	State of the Convention Area Report
TSS	Total Suspended Solids
UNDP	United Nations Development Programme
UNEP	Caribbean Environment Programme of the United Nations Environment Programme
WCR	Wider Caribbean Region

1 EXECUTIVE SUMMARY

The Protocol concerning Marine Pollution from Land-Based Sources and Activities (LBS Protocol) is a compendium of procedures/measures developed to respond to the need to protect the marine environment and human health from land-based activities that affect them, which is part of the Cartagena Convention (Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region). It was adopted in 1999 and entered into force in 2010. Although the LBS Protocol entered into force relatively recently, it was nevertheless drafted and adopted more than 25 years ago, so it is imperative to review its content and assess its updating.

The objective of this study is to propose amendments to the LBS Protocol, taking into account the need to update its structure and content. In order to meet the objective, an analysis and evaluation of the structure of the LBS Protocol was carried out, especially of the technical annexes. National and regional legal instruments related to wastewater discharge standards or criteria were assessed and compared with obligations under the Protocol where appropriate. In addition, recent regional studies on the environmental status of the Cartagena Convention area (Wider Caribbean Region) were consulted, the conclusions and/or recommendations of which involved proposals for changes/amendments to the LBS Protocol.

The report is divided into three main chapters. The first is introductory. The second analyses in detail the content of the protocol and its annexes, emphasizing the essential aspects that should or should not be modified. The third chapter summarizes the proposed amendments to the LBS Protocol, understood as changes, elimination and/or incorporation of new articles, discharge limits, annexes, among others.

Two amendments to Annex I are proposed, the first related to the grouping of the priority source categories and activities affecting the Convention area and the second refers to the inclusion of emerging environmental problems that are of concern (the presence of microplastics and other emerging pollutants, sargassum inundation and sea acidification).

In Annex III (domestic wastewater) the proposal is to modify the discharge limit for the Biochemical Oxygen Demand (BOD_5) from 30 to 50 mg L^{-1} for discharges in Class I (more sensitive) waters. The suggestion is also made to include fecal (thermotolerant) coliforms as an indicator of fecal pollution in domestic wastewater for discharges in Class II (less sensitive) receiving bodies with an MPL that could be between 1000 – 5000 MPN 100 mL^{-1} as well as to add the same maximum permissible concentrations of *Enterococcus faecalis* and *Escherichia coli* as indicators of fecal pollution (35 and 126 organisms 100 mL^{-1}) in Most Probable Number (MPN) and in Colony Forming Units (CFU) respectively, for discharges in Class I waters.

In the same Annex III, the proposal is to include nutrients (specifically nitrogen and phosphorus compounds) within the group of parameters with discharge limits for discharges in Class I and II waters, according to the following:

Classification of the receiving body	**Permissible limits (mg $^{L-1}$)**		
	TP	**TN**	**TKN**
Class I	0.1 - 5	1- 10	5 -10
Class II	5 - 10	10 – 50	10 - 40

It is proposed to include a paragraph on the need to update environmental quality indicators and their discharge limits at least every 10 years.

Two amendments to the text in Annex IV are proposed, one related to the desirability of using advanced methods for estimating the pollutant load from non-point agricultural sources of pollution through mathematical models and the other related to an extension of the deadlines for the development and approval of specific legal mechanisms related to prevention, reduction and control of such pollution.

Finally, the inclusion of two new annexes to the LBS Protocol is proposed: one on industrial wastewater and the other on wastewater reuse. In both cases, the objectives, the principles on which they should be based and a proposal on the scope (structure) that they should have, are included.

2 INTRODUCTION

The Wider Caribbean Region (WCR) is considered a habitat of high ecosystem value, among other aspects, due to the large number of small island developing states (SIDS) it hosts, its cultural and environmental richness, the different geopolitical structures and the large number of maritime boundaries it has.

As part of the historic efforts for the protection and conservation of the WCR, in 1981 the governments of the region urged the United Nations Environment Programme (UNEP) to provide assistance to safeguard the coastal and marine resources that form the basis of the future economic and social development of this ecosystem. As a result, the "Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region" was approved in 1983 in Cartagena de Indias, Colombia. The treaty, commonly known as the Cartagena Convention, officially entered into force in 1986 and is the only binding regional agreement with an integrated, cooperative and regional approach to the protection of the region's marine environment.

The Cartagena Convention, in addition to general obligations and institutional arrangements, has three protocols:

1.- PROTOCOL CONCERNING COOPERATION IN COMBATING OIL SPILLS IN THE WIDER CARIBBEAN REGION.

2.- PROTOCOL CONCERNING SPECIALLY PROTECTED AREAS AND WILDLIFE.

3.- PROTOCOL CONCERNING POLLUTION FROM LAND-BASED SOURCES AND ACTIVITIES (LBS).

These three protocols provide a legal framework for regional and national actions, implemented in an integrated manner, that have the supreme objective of protecting the marine environment in the Wider Caribbean region.

In particular, the Protocol on Marine Pollution from Land-Based Sources and Activities (LBS Protocol) is a compendium of procedures/measures developed to respond to the need to protect the marine environment and human health from land-based activities that affect them. Its primary objectives are to reduce the impact of priority pollutants by setting limits on wastewater and emissions and applying best management practices, and to promote the exchange of scientific and technical information on land pollution through regional cooperation in monitoring and research.

The LBS Protocol was adopted in 1999 and entered into force in 2010. At the time of this study, 16 countries have ratified the Protocol, namely: Panama, United States of America, Saint Lucia, Costa Rica, Honduras, Grenada, Belize, Trinidad and Tobago, Guyana, France, Jamaica, Bahamas, Antigua and Barbuda, Barbados, Dominican Republic and Saint Kitts and Nevis.

Although it can be said that the protocol entered into force relatively recently (15 years ago), it was nevertheless drafted and adopted more than 25 years ago, so **it is imperative to review its content and assess its updating**.

2.1 Objectives and Methodological Aspects

The objective of this study is to propose amendments to the LBS Protocol, taking into account the need to update its structure and content. As will be discussed in Section 2.1, any change/modification to the LBS Protocol must be approved by the Contracting Parties, therefore, the scope of this study is limited to recommendations.

In order to achieve the objective of the study, the following tasks were carried out:

1.- Analysis and evaluation of the structure of the LBS Protocol.

2.- Analysis and validity of the content of the technical annexes of the LBS Protocol

Although a general analysis of the structure of the protocol was carried out, the study focuses on proposals for amendments to the **technical annexes** of the protocol.

In order to collect key information related to updating the annexes of the LBS Protocol, a section on the subject was included in a regional survey sent to the National Focal Points of said protocol. However, the level of response was low (only 7 countries: Barbados, Belize, Guyana, Jamaica, Trinidad and Tobago, the United States and Honduras). The information collected was not high quality.

Given the lack of feedback, the desktop study was reinforced, which included analysis and comparison of national and regional legal instruments related to the standards or criteria for wastewater discharges; references to recent regional studies and assessments of the environmental status of the Convention area (Wider Caribbean Region), as well as other information relevant to the objective of the study.

The report is divided into three main chapters. The first is introductory. The second analyses in detail the content of the protocol and its annexes, emphasizing the essential aspects that should or should not be modified. The third chapter summarizes the proposed amendments to the LBS Protocol, understood as changes, elimination and/or incorporation of new articles, discharge limits, annexes, among others.

3 THE LBS PROTOCOL: DESCRIPTION AND UPDATE.

3.1 Overview. Articles.

The LBS Protocol consists of nineteen articles (XIX) and four annexes (IV):

Annex I: Source Categories, Activities and Associated Pollutants of Concern

Annex II: Factors to be used in determining Effluent and Emission Source Controls and Management Practices

Annex III: Domestic Wastewater

Annex IV: Agricultural Non-point Sources of Pollution

The XIX articles (Box 1) describe the scope of the protocol, the general obligations to be fulfilled, as well as the operating mechanisms. The four annexes have a more technical focus and include specific obligations that will be discussed later in this report.

References to amendments to the LBS Protocol and its technical annexes, as well as possible new annexes, are explicitly included in Articles IV (*Annexes*) and XVII (*Adoption and Entry into Force of New Annexes and Amendments to Annexes*).

Article IV, paragraph 3, states that "*The Contracting Parties may also develop such additional annexes as they may deem appropriate, including an annex to address water quality criteria for selected priority pollutants identified in Annex I to this Protocol*."

Article XVII establishes the procedures for the inclusion and approval of new annexes, as well as amendments to existing ones, ***always in accordance with the provisions of the Cartagena Convention and with the approval of the Contracting Parties***.

Therefore, the process of proposing amendments to the LBS Protocol and/or new annexes resulting from this study ***is legally endorsed in the legal body of same***.

Box 1. LBS Protocol Articles

Article I: Definitions
Article II: General Provisions
Article III: General Obligations
Article IV: Annexes
Article V: Cooperation and Assistance
Article VI: Monitoring and Evaluation Programs
Article VII: Environmental Impact Assessment
Article VIII: Development of Information Systems
Article IX: Transboundary pollution
Article X: Participation
Article XI: Education and Awareness
Article XII: Reporting
Article XIII: Institutional Mechanisms
Article XIV: Scientific and Technical Advisory Committee
Article XV: Meetings of the Contracting Parties
Article XVI: Funding
Article XVII: Adoption and Entry into Force of New Annexes and Amendments to Annexes
Article XVIII: Ratification, Acceptance, Approval and Accession
Article XIX: Signature of the Protocol

3.2 Annex I

Annex I of the LBS Protocol is divided into three (3) Parts (A, B and C). Part A sets out the definitions specific to the content of the annex. Part B defines the priority source categories and activities affecting the Convention area (10 in total) and Part C lists the pollutants associated with those sources and activities that are of concern (16 in total).

The sources and activities affecting the WCR (not defined in order of priority, Box 2), as well as the associated pollutants (Box 3), need to be updated. People and the economy, which are the main drivers of environmental change, have changed in recent years: coastal populations and urbanization have increased, and the key economic sectors related to the marine environment have changed (UNEP CEP, 2019).

3.2.1 Part B: Priority Sources and Activities affecting the Convention Area.

At the regional kick-off workshop for the SOCAR Report (*State of the Cartagena Convention Area Report*) (UNEP CEP, 2019) held in 2016, it was recognized that, at that time, agricultural non-point sources, untreated domestic wastewater and the chemical industry are the activities considered to be top priority in the region. Second, according to the report itself, oil refineries, extractive and mining industries, sugar mills and sugar distilleries, and intensive animal rearing operations (especially in small island developing states, SIDS) are high priority, and food, liquor and beverage processing operations and the pulp and paper production industry are low priority.

Of the responses received from countries, in the questionnaire sent for this study (7 in total), all agree that domestic wastewater and agricultural non-point sources are top priority.

Box 2. Priority Source Categories and Activities affecting the Convention Area, described in Annex I of the LBS Protocol

- Domestic Wastewater (Sewage)
- Agricultural Non-Point Sources
- Chemical Industries
- Extractive and Mining Industries
- Food Processing Operations
- Manufacture of Liquor and Soft Drinks
- Oil Refineries
- Pulp and Paper Factories
- Sugar Mills and Distilleries
- Intensive Animal Rearing Operations

The SOCAR report itself states that agricultural non-point sources (through surface runoff and through groundwater) represent 60% of nitrogen inputs in the WCR. Surface runoff from agriculture accounts for 56% of phosphorus inputs. In the case of domestic wastewater, through sewage, it represents 9% of total nitrogen inputs and 11% of phosphorus inputs (UNEP CEP, 2019).

In view of the above*, **it is recommended that domestic wastewater and agricultural non-point sources continue to be explicitly included as priority sources affecting the Convention area (Wider Caribbean Region).***

With regard to industrial and hazardous waste activities that affect, due to their pollutant inputs, the WCR, a more detailed analysis is required that is beyond the scope of this study. Although the industrial sources and activities currently included in Annex I are considered to be of medium and low priority according to SOCAR (UNEP CEP, 2019) for most countries, this may vary depending on the level of economic development and the levels of wastewater treatment from such sources in each country.

On the one hand, industries such as the petrochemical industry, including refineries, were recognized by the countries that responded to the survey. With the inclusion and/or exclusion of a specific industrial activity in the list of priority categories, there is a risk that some country or Contracting Party to the LBS Protocol will not see its national interests reflected in it***. Therefore, it is proposed to include industrial activities in general as a priority source affecting the Convention area, without detailing the type of industry as it appears in the current document***. A future detailed study by type of industrial activity, including by subregion, could provide sufficient elements to update the industrial sources that are priorities in the region according to their pollutant inputs.

On the other hand, the SOCAR report itself recognizes that tourism, capture fisheries, as well as agriculture, shipping, manufacturing and oil industries, are among the main contributors to the Gross Domestic Product (GDP) of countries in the WCR and constitute important sources of pressure on the coastal marine environment (UNEP CEP, 2019). ***In this regard, it is proposed to explicitly include tourism, fisheries (including aquaculture and mariculture) and shipping and port industries as priority activities directly or indirectly affecting the Convention area (Wider Caribbean Region).***

The inclusion of sectors such as fisheries and tourism would be doubly desirable, since they themselves depend on a clean, healthy and productive marine environment for their own development.

3.2.2 Part C: Associated Pollutants of Concern

The list of pollutants associated with the sources and activities included in the LBS Protocol that are of concern is quite long and specific (Box 3) and is included as section C.1 (*Primary Pollutants of Concern*). The last point (q) of the associated pollutants that are a cause of concern, allows, as drafted, the inclusion of any other substance that, due to its characteristics (persistence, health risk, toxicity, bioaccumulation, among others) allows it to be classified as a pollutant of concern. ***Therefore, the list can be considered inclusive and not limited***.

Box 3. Associated Pollutants of Concern, described in Annex I of the LBS Protocol.

(a) Organohalogen compounds and substances which could result in the formation of these compounds in the marine environment;
(b) Organophosphorus compounds and substances which could result in the formation of these compounds in the marine environment;
(c) Organotin compounds and substances which could result in the formation of these compounds in the marine environment;
(d) Heavy metals and their compounds;
(e) Crude oil and hydrocarbons;
(f) Used lubricating oils;
(g) Polycyclic aromatic hydrocarbons;
(h) Biocides and their derivatives;
(i) Pathogenic microorganisms;
(j) Cyanides and fluorides;
(k) Detergents and other non-biodegradable surfactants;
(l) Nitrogen and phosphorus compounds;
(m) Persistent synthetic materials and other materials, including garbage, that float, flow, or remain in suspension or settle to the bottom and affect marine life and hamper the uses of the sea;
(n) Compounds with hormone-like effects;
(o) Radioactive substances;
(p) Sediments; and
(q) Any other substance or group of substances with one or more of the characteristics outlined in the following section that includes the factors to be evaluated for a potential pollutant to be considered of concern.

However, the explicit inclusion of other pollutants is suggested, as it implies a regional recognition of their negative impact in the Convention area.

In this sense, it is important to note that SOCAR recognized "emerging pollutants" (EPs), Saharan dust, microplastics and sargassum inundation as "emerging environmental problems" in the WCR (UNEP CEP, 2019).

Within the group of so-called "emerging pollutants" there are a variety of natural or synthetic products ranging from pharmaceutical and hospital waste, personal care products, industrial additives to microplastics themselves. What these products/waste have in common is that their presence (and detection) in the different components of the environment is relatively recent and that they are not sufficiently researched or regulated. They are also often called micropollutants, since in relatively low concentrations they have a major negative impact on living things due to their high toxicity, persistence and level of bioaccumulation (Geissen 2015). Monitoring EPs is challenging as there are still no standardized analytical methods for many of them.

The number of substances that can be considered emerging is undetermined and includes, as mentioned above, drugs for human or veterinary use, antiparasitic drugs, and other biocides; additives from materials used as antioxidants, flame retardants, plasticizers, anticorrosion coatings; household products such as detergents, cosmetics, fragrances, creams; drugs, among others. These are usually compounds that are not subject to specific regulation limiting their presence in the water but could be regulated in the future if they are determined to pose a risk to or through the aquatic environment.

There are other related environmental problems that are considered emerging and that are not necessarily "polluting substances or products", among which are harmful algal blooms (HABs), the increase in the influx of sargassum to the coasts (known as "sargassum inundation") and ocean acidification. In this sense, it is important to clarify that the presence of sargassum in the sea is not an environmental problem, but becomes concerning (i.e., polluting) when it reaches the coasts in large quantities.

Emerging problems and pollutants are being addressed with different approaches and levels of importance in the Wider Caribbean Region. However, the perception of their importance and the resources dedicated to their research is still limited. For this reason, it is considered appropriate and necessary to include both the pollutants themselves and the emerging polluting problems within the framework of the LBS Protocol.

In this regard, the following recommendation is made:

2. Insert, in Part C of Annex I, a new section (C.2) entitled "Emerging environmental problems of concern affecting the Convention area ":

a.- Presence of microplastics and other emerging pollutants

b.- Sargassum Inundation

c.- Sea Acidification

The following section in Part C of Annex I (originally C.2 but becoming section C.3 with the insertion mentioned above) entitled "*Characteristics and Other Factors to be considered when Evaluating Additional Pollutants of Concern*" lists, as the name implies, the characteristics and factors to be assessed by Contracting Parties when evaluating other pollutants of concern. This includes, but is not limited to, toxicity, persistence, health risk and bioaccumulation. ***The factors listed are considered appropriate and sufficient, so changes in this section are not recommended***.

3.3 Annex II

Annex II of the LBS Protocol lists the factors to be used for effluent and emission controls, as well as for management practices.

Part A recommends three (3) subgroups of factors to be considered in management practices: the characteristics and composition of the waste; the characteristics of the polluting sources or activities themselves and other production practices and technologies (from recycling and reuse options to substitution of other products or activities).

The factors listed are recognized as effective for the management of land-based sources of marine pollution and although other management practices are currently used, the factors for the design of such practices are the same.

Part B of Annex II sets out the responsibility of Contracting Parties to apply control and management practices to emission sources and provides for the possibility that such practices (including discharge limits) may be stricter than those recommended in the protocol itself. In this sense, it recommends factors to take into account, related to the characteristics of the discharge sites and the receiving marine environment.

Finally, Part C of this Annex specifies, on the part of the Contracting Parties, the need for the revision of pollutant source control and management practices, and if they are not effective enough, it opens the door to future changes in these practices (including new discharge limits), taking into account technological and scientific advances, as well as other economic and social factors.

It can be concluded that the factors recommended by the protocol for consideration in the control of effluents and in management practices are adaptable to each country and timeless. In addition, it is recognized that this annex does not establish commitments (i.e., obligations), but rather "methodological" recommendations for the control and management of polluting sources that will facilitate compliance with other explicit obligations, especially in Annex III (analysed below). No changes or amendments to Annex II are proposed.

3.4 Annex III

Annex III of the LBS Protocol, on domestic wastewater, is one of the most cited because of its subject matter and the very fact that it includes specific obligations to be fulfilled by the contracting parties that are usually a cause for concern.

Annex III is divided into seven (7) parts (A through G) which will be discussed separately below.

3.4.1 Part A: Definitions.

Part A of Annex III includes definitions of technical terminology related to the subject matter (domestic wastewater). In this section, the most notable are the definitions of Class I and Class II waters in the Cartagena Convention area (Box 4).

Box 4. Water Classification of waters in the Convention Area.

"Class I waters" means waters in the Convention area that, due to inherent or unique environmental characteristics, or biological or ecological fragility or human use, are particularly sensitive to the impact of domestic wastewater. Class I waters include, but are not limited to:

(a) waters containing coral reefs, seagrass beds, or mangroves;

(b) critical breeding, nursery or feeding areas for aquatic and terrestrial life;

(c) areas that provide habitats for species protected under the Protocol concerning Specially Protected Areas and Wildlife to the Convention (SPAW Protocol);

(d) protected areas listed in the SPAW Protocol; and

(e) waters used for recreation.

"Class II waters" means waters in the Convention area, other than Class I waters that, due to oceanographic, hydrologic, climatic or other factors, are less sensitive to the impact of domestic wastewater and where humans or living resources that are likely to be adversely affected by these discharges are not exposed to such discharges.

This classification into two large subgroups: more sensitive (Class I) and less sensitive (Class II) makes compliance with the discharge limits established in Part C of the annex simpler and more effective.

A study carried out in this regard in the countries of the region (Narcis, Gómez, & Pérez, 2025) recognizes that there is significant progress in the classification of marine and coastal areas. At least 13 countries in the region have some legislated system for the classification of coastal marine areas, which is compatible with the classification in the LBS protocol (Colombia, Cuba, Dominican Republic, Honduras, Nicaragua, Panama, Venezuela, Antigua and Barbuda, Belize, Jamaica, Saint Lucia, Trinidad and Tobago and the United States of America). Four of these countries are not contracting parties to the LBS Protocol (Cuba, Colombia, Nicaragua and Venezuela).

The major challenge is that, in very few of these countries do the rules for discharges to marine and coastal areas differentiate the maximum permissible limits of the environmental quality indicators according to the respective classifications of these water bodies receiving wastewater (Annex I) even though they are contracting parties to the LBS Protocol.

Taking into account regional developments in the classification of coastal marine waters and the challenges in this regard, it is recommended to maintain things as set out in Annex III.

3.4.2 Part B: Discharge of Domestic Wastewater

Part B of Annex III includes general obligations to be fulfilled by each Contracting Party related to technologies for the treatment, reuse and disposal of domestic wastewater (Box 5). These

obligations are non-restrictive and can be adjusted according to the capacities of each Contracting Party***, so the proposal is to maintain them as described***.

Box 5. General Obligations regarding the Discharge of Domestic Wastewater included in Annex III

1. Each Contracting Party shall:

(a) In accordance with the provisions of this Annex, regulate domestic wastewater discharged into or adversely affecting the Convention area;

(b) To the extent practicable, locate, design and construct domestic wastewater treatment facilities and outfalls such that any adverse effects on, or discharges into, Class I waters are minimized;

(c) Encourage and promote domestic wastewater reuse that minimizes or eliminates discharges into, or discharges that adversely affect, waters in the Convention area;

(d) Promote the use of clean technologies to minimize discharges or avoid adverse effects within the Convention area; and

(e) Develop plans to meet the obligations contained in this Annex, including, where appropriate, plans to obtain financial assistance.

2. Each Contracting Party shall be entitled to use whatever technology or approach it deems appropriate to meet the obligations set out in Part C of this Annex.

3.4.3 Part C: Effluent Limitations.

Part C of Annex III establishes the domestic wastewater discharge limits. This section can be considered the most complex part, requiring a detailed and in-depth analysis.

The first section of Part C establishes a timetable for the implementation of treatment systems for domestic wastewater (Table 1) so that the effluent complies with the discharge limits established in this section.

Table 1. Timetable for the implementation of new or existing domestic wastewater systems whose effluents meet the effluent limits for domestic wastewater discharges established in Annex III of the LBS Protocol.

Category	Effective Date of Obligation (in years after entry into force of the LBS Protocol)	Sources
1	0	All new domestic wastewater systems.
2	10	Existing domestic wastewater systems other than community wastewater systems.
3	10*	Communities with 10,000 to 50,000 inhabitants.
4	15	Communities with more than 50,000 inhabitants that have a wastewater collection system.
5	20	Communities with more than 50,000 inhabitants that do not have a wastewater system.
6	20	All other communities.
*Contracting Parties that choose to give higher priority to categories 4 and 5 may extend the timeframe for category 3 to twenty (20) years (which is the timeframe for category 6).		

This implementation timetable ***can be considered flexible enough to comply with according to its own content***. Bearing in mind, furthermore, that Part G of Annex III provides for extension periods for categories 2, 3, 4 or 5, if partial compliance with some of them is demonstrated (reduction of at least 5 % of the total discharge of pollutants associated with those categories) and that the need to access financial resources for compliance with the timetable is recognized, ***the adaptability of the implementation timetable for treatment systems is ratified and no modifications are proposed***.

After the implementation timetable for treatment systems, in the same Part C of Annex III, the parameter limits that effluents must meet for discharges in Class I and Class II waters are presented (Table 2).

Table 2. Discharge limits for domestic wastewater established in Annex III of the LBS Protocol.

Parameters	Class I	Class II
Total suspended solids	30 mg L^{-1}	150 mg L^{-1}
Biochemical Oxygen Demand (BOD_5)	30 mg L^{-1}	150 mg L^{-1}
pH	5 - 10	5 - 10
Fats, Oil and Grease	15 mg L^{-1}	50 mg L^{-1}
a) Fecal Coliforms b) *E. coli* (freshwater) c) *Enterococci* (salt water)	a) 200 MPN/100 ml b) 126 organisms/100 ml c) 35 organisms/100ml	-
Floatables	Not visible	Not visible

Below is an analysis of each of the environmental quality indicators included in Annex III and their connection to the discharge rules/regulations of the countries in the WCR, with the aim of assessing possible modifications. References to national discharge standards are presented in Annex I with clarifying comments.

3.4.3.1 Total Suspended Solids

Total suspended solids are the measure of both settleable and non-settleable solids that are present in a wastewater sample. This parameter includes organic and inorganic matter (APHA, 2017). The importance of suspended solids lies in their ability to indicate the environmental quality of the water, since the presence of suspended solids increases the turbidity of the water, which when discharged into a receiving body prevents the penetration of solar radiation and thus slows down the process of photosynthesis in aquatic plants.

Total suspended solids (TSS) are widely recognized as an essential indicator for evaluating wastewater quality. In fact, it is a quality indicator included in the dumping norms or standards of 15 countries in the WCR (Table 3). On the other hand, TSS were included in the "*Other priority parameters*" group to evaluate the environmental quality of coastal water in the framework of the SOCAR report (UNEP CEP, 2019) due to their strong relationship with turbidity (included in the "*Main parameters*" group of that report).

Table 3. Discharge limits for TSS in domestic wastewater in countries in the WCR.

	Country	Maximum Permissible Concentration (mg L^{-1})	Comments
1	Colombia	100	Limits for domestic wastewater from individual home sanitation solutions.
		90	Limits for domestic wastewater from the public sewage system by drain.
		250	Limits for domestic wastewater from the public sewage system by underwater outfall.
2	Costa Rica	50	Mandatory parameter for wastewater discharged into a receiving body.
3	Honduras	100	For wastewater discharge into receiving bodies. It does not specify the type of receiving body, nor the type of wastewater.
4	Panama	35	For the discharge of liquid effluents into receiving bodies of inland and marine waters.
5	Guatemala	275	Date of completion: 2024. By 2023, all municipalities must comply with having complete treatment systems in operation for at least the two (2) main discharges that are reported in the inventory as untreated.
		200	Date of completion: 2028. By 2027, all municipalities must comply with having treatment systems in operation for sixty percent (60%) of the total discharges recorded in the inventory.
		100	Date of completion: 2032. By 2031, all municipalities must comply with having treatment systems in operation for the remaining forty percent (40%) of the total discharges recorded in the inventory.
6	Mexico	20 (M.A.) 24 (D.A.) 28 (I.V.)	For discharges in Mexican marine areas. M.A.: Monthly average. D.A.: Daily average. I.V.: Instantaneous Value.
7	Nicaragua	80	Discharges from domestic wastewater treatment systems
		100	Discharges from sewage treatment systems

8	Venezuela	80	For direct or indirect discharges into the coastal marine environment; provided that the body of water subject to the discharge has not been classified and has specific regulations regarding liquid effluent discharges.
9	Cuba	30	Class A: Marine areas of ecological conservation zones, or protected areas.
		30 - 150	Class C: Marine areas where fishing takes place.
		150	Class D: Marine areas whose waters are for industrial use such as in power generation.
		75	Class E: Marine areas in bays where maritime-port activity takes place.
		150	Class F: Marine areas for navigation and other uses
10	Dominican Republic	90	For municipal wastewater discharge into coastal waters up to 10,000 inhabitants
		75	For municipal wastewater discharge into coastal waters above 10,000 inhabitants
11	Barbados	30	For discharge into Class I waters (200 meters offshore from the outer edge of the reef).
		150	For discharge into Class II waters (Marine waters extending the outer limit of Class I waters, but within the territorial waters of Barbados)
12	Belize	30	For discharges in Class I waters (according to the classification in the LBS Protocol)
		150	For discharges in Class I waters (according to the classification in the LBS Protocol)
13	Jamaica	30	Limits for sewage wastewater discharges from treatment plants
14	Saint Lucia	30	For discharges in Class I waters (according to the classification in the LBS Protocol)
15	Trinidad and Tobago	150	For discharges in coastal marine waters (3 nautical miles)
		200	For discharges in offshore marine areas (beyond waters defined as coastal).

The maximum permissible concentrations of TSS in the national standards or criteria for domestic wastewater discharge in the WCR have a wide range that varies from 20 mg L^{-1} (Mexico, monthly average for discharge in marine areas) to 250 mg L^{-1} (Colombia, for discharge through underwater outfalls).

The strictest national standard, in terms of TSS, Mexico's, which does not distinguish the type of wastewater (therefore, it is assumed that it includes domestic wastewater) and applies to any type of receiving body, except drainage and sewage systems.

On the other hand, Guatemala includes the principle of gradualness in its discharges, with higher maximum limits of TSS for untreated discharges in 2023, with a considerable reduction by 2032.

Not including the extreme values mentioned above, it can be stated that the range of maximum permissible concentrations of TSS in the vast majority of countries is between 30 and 150 mg L^{-1} in keeping with the limits established by the LBS Protocol for discharges in Class I and Class II waters (30 and 150 mg L^{-1}, respectively). It should be clarified that only the rules in Cuba and Barbados differentiate the maximum permissible limits according to the classification of the receiving body (in this case the coastal marine area), which makes such a relationship more equivalent in these two countries, in addition to those that have adopted the discharge criteria in the LBS Protocol (Belize and Saint Lucia for Class I waters).

Although the compatibility between the national discharge standards or criteria in the region and the limits established in the LBS protocol regarding TSS is not absolute, as explained above, ***the recommendation is to keep this environmental quality indicator with the discharge limits included in Annex III for domestic wastewater***. The importance of the indicator, its relationship with the quality of the receiving body and its inclusion in national discharge standards with maximum permissible concentrations in the range of the limit values included in Annex III, support this recommendation.

3.4.3.2 Biochemical Oxygen Demand (BOD_5).

Biochemical Oxygen Demand (BOD) is one of the most important environmental quality indicators in measuring the level of pollution in wastewater. In particular, BOD_5 is an estimate of the amount of oxygen required by a heterogeneous microbial population to oxidize organic matter in a water sample over a maximum period of 5 days (APHA, 2017).

This indicator is representative of the presence of biodegradable organic matter in water. The higher the BOD_5 level, the greater the amount of organic matter present in the water and the greater the oxygen consumption to degrade this organic matter. Therefore, wastewater with high levels of BOD_5 discharged into aquatic receiving bodies leads to a considerable decrease in the level of oxygen dissolved in them, an essential element for the life of the organisms that live in this environment.

Due to the importance and impact of this indicator on the environmental quality of receiving waters, it is universally included in discharge standards and used as a criterion for the design of wastewater treatment plants or systems.

Table 4 shows the maximum permissible limits for BOD_5 in countries in the WCR.

Table 4. Discharge limits for BOD_5 in domestic wastewater in countries in the WCR.

	Country	Maximum permissible limit (mg L^{-1})	Comments
1	Colombia	100	Limits for domestic wastewater from individual home sanitation solutions.
		90	Limits for domestic wastewater from the public sewage system by drain.

		250	Limits for domestic wastewater from the public sewage system by underwater outfall.
2	Costa Rica	50	Mandatory parameter for wastewater discharged into a receiving body.
3	Honduras	50	For wastewater discharge into receiving bodies. It does not specify the type of receiving body, nor the type of wastewater.
4	Panama	50	For the discharge of liquid effluents into receiving bodies of inland and marine waters
5	Guatemala	250	Date of completion: 2024. By 2023, all municipalities must comply with having complete treatment systems in operation for at least the two (2) main discharges that are reported in the inventory as untreated.
		100	Date of completion: 2028. By 2027, all municipalities must comply with having treatment systems in operation for sixty percent (60%) of the total discharges recorded in the inventory.
		100	Date of completion in 2032. By 2031, all municipalities must comply with having the treatment systems in operation for the remaining forty percent (40%) of the total discharges recorded in the inventory.
6	Mexico	-	Does not include this indicator in the national standards for discharges
7	Nicaragua	110	Discharges from domestic wastewater treatment systems
		110	Discharges from sewage treatment systems
8	Venezuela	60	For direct or indirect discharges into the coastal marine environment; provided that the body of water subject to the discharge has not been classified and has specific regulations regarding liquid effluent discharges.
9	Cuba	30	Class A: Marine areas of ecological conservation zones, or protected areas.
		30 - 150	Class C: Marine areas where fishing takes place.
		150	Class D: Marine areas whose waters are for industrial use such as in power generation.
		75	Class E: Marine areas in bays where maritime-port activity takes place.
		150	Class F: Marine areas for navigation and other uses
10	Dominican Republic	100	For municipal wastewater discharge into coastal waters up to 10,000 inhabitants
		70	For municipal wastewater discharge into coastal waters above 10,000 inhabitants

11	Barbados	30	For discharge into Class I waters (200 meters offshore from the outer edge of the reef).
		150	For discharge into Class II waters (Marine waters extending the outer limit of Class I waters, but within the territorial waters of Barbados.
12	Belize	30	For discharges in Class I waters (according to the classification in the LBS Protocol)
		150	For discharges in Class I waters (according to the classification in the LBS Protocol)
13	Jamaica	20	Limits for sewage wastewater discharges from treatment plants
14	Saint Lucia	30	For discharges in Class I waters (according to the classification in the LBS Protocol)
15	Trinidad and Tobago	50	For discharges in coastal marine waters (3 nautical miles)
		100	For discharges in offshore marine areas (beyond waters defined as coastal).

Jamaica is the country with the strictest discharge criteria for this indicator, in this case, 20 mg L^{-1} for wastewater from treatment plants. This limit makes sense, as considerable reduction in BOD_5 is expected through treatment.

The least strict limit is 250 mg L^{-1} and is included in the Colombian standards for discharges through underwater outfalls (a system for disposing of wastewater at sea, generally with minimal pre-treatment) and in the Guatemalan standard with compliance date 2024.

Except for Cuba, Barbados, Jamaica and the countries that have adopted the limits in the LBS Protocol (Belize and Saint Lucia for Class I waters), the rest include maximum permissible concentrations above the criteria established by the protocol for discharges in Class I waters (30 mg L^{-1}). ***The latter could be interpreted as a challenge for those countries in complying with the obligations of the LBS Protocol, in the sense that their national standards are less demanding in terms of this environmental quality indicator***.

Discharge regulations in other countries in the continent have maximum permissible values also above the limit value required by the LBS Protocol for domestic wastewater discharges into Class I (sensitive) waters. El Salvador's Technical Regulations (RTS) stipulate that ordinary wastewater (i.e., domestic), prior to being discharged into the receiving environment (including the sea), must comply with the maximum permissible limit of 60 mg L^{-1} BOD_5 (RTS 13.05.01:2018). Chile, for its part, establishes in its discharge regulations a maximum permitted limit of 60 mg L^{-1} for the discharge of liquid waste (without distinguishing its origin) into marine water bodies within the coastal protection zone (Decree 90, 2000). For its part, Paraguay, in its national regulations, establishes a maximum limit of 50 mg L^{-1} of BOD_5 for effluents of any type that are discharged directly or indirectly into any body of water of the four classifications they have according to their use (Resolution 222:2002). It

should be clarified that in the case of Paraguay this effluent limit refers to discharges into inland water bodies since this country does not have maritime borders.

Considering the information above, ***it is proposed to modify the BOD_5 limit for discharges in Class I waters, from 30 to 50 mg L^{-1}.*** This recommendation should not be interpreted as a greater tolerance for discharges that may affect or compromise the environmental quality of the Convention area (Wider Caribbean Region), but as an incentive to countries that are not yet contracting parties to the LBS Protocol and are afraid to accede to this legal instrument due to the impossibility of complying with such an obligation.

3.4.3.3 pH

pH is a measure of the concentration of hydrogen ions and varies depending on the temperature; if this increases, the pH decreases and acidity increases; It can also vary depending on the salinity, pressure or depth and the activity of the organisms.

It is well-known that pH influences the biological activity of the species and living things that inhabit it. Likewise, pH also conditions numerous marine chemical reactions that solubilize or precipitate dissolved salts, which are ultimately the nutritional elements that maintain aquatic ecosystems. This influence is one of the determining factors of the characteristics of many aquatic environments (marshes, estuaries, lakes, among others), so the continuous impact of this indicator can drastically condition life in them and cause irreversible damage to the ecosystem.

Table 5 presents the pH ranges in the wastewater discharge standards in the WCR.

Table 5. Discharge pH ranges in domestic wastewater in countries in the WCR.

	Country	Permissible ranges for discharges (units)	Comments
1	Colombia	6 - 9	Limits for domestic wastewater from individual home sanitation solutions
		6 - 9	Limits for domestic wastewater from the public sewage system by drain
		6 - 9	Limits for domestic wastewater from the public sewage system by underwater outfall
2	Costa Rica	5 - 9	Mandatory parameter for wastewater discharged into a receiving body.
3	Honduras	6 - 9	For wastewater discharge into receiving bodies. It does not specify the type of receiving body, nor the type of wastewater.
4	Panama	5.5 – 8. 5	For the discharge of liquid effluents into receiving bodies of inland and marine waters.
5	Guatemala	6 - 9	Range to be applied at all stages for all established deadlines (until 2032).

6	Mexico	6 - 9	Permissible limits for discharges in Mexican marine waters.
7	Nicaragua	6 - 9	Discharges from domestic wastewater treatment systems.
		6 - 9	Discharges from sewage treatment systems.
8	Venezuela	6 - 9	For direct or indirect discharges into the coastal-marine environment; provided that the body of water subject to the discharge has not been classified and has specific regulations regarding liquid effluent discharges.
9	Cuba	5.5 - 9	Class A: Marine areas of ecological conservation zones, or protected areas.
		5.5 - 9	Class C: Marine areas where fishing takes place.
		5.5 - 10	Class D: Marine areas whose waters are for industrial use such as in power generation.
		5.5 - 9	Class E: Marine areas in bays where maritime-port activity takes place.
		5.5 - 10	Class F: Marine areas for navigation and other uses
10	Dominican Republic	6 – 8.5	For municipal wastewater in coastal waters with no distinction based on contributing population.
11	Bahamas	6.5 – 8.5	Legislation for discharges is under development. Proposed values.
12	Barbados	6 - 9	For discharge into Class I waters (200 meters offshore from the outer edge of the reef).
		6 - 9	For discharge into Class II waters (Marine waters extending the outer limit of Class I waters, but within the territorial waters of Barbados).
13	Belize	5 - 10	For discharges in Class I waters (according to the classification in the LBS Protocol)
		5 - 10	For discharges in Class I waters (according to the classification in the LBS Protocol)
14	Jamaica	6 - 9	Limits for sewage wastewater discharges from treatment plants
15	Saint Lucia	5 - 10	For discharges in Class I waters (according to the classification in the LBS Protocol)
		5 - 10	For discharges in Class I waters (according to the classification in the LBS Protocol)
16	Trinidad and Tobago	6 - 9	For discharges in coastal marine waters (3 nautical miles)
		6 - 9	For discharges in offshore marine areas (beyond waters defined as coastal).

From the analysis of the discharge pH ranges in the national standards or criteria of countries in the WCR, it can be observed that they all establish stricter ranges (less wide, between 6 and 9) than the LBS Protocol, which in fact includes the same for discharges in Class I and II waters (5 - 10 units). ***Therefore, no modification is recommended for Annex III, since it does not impose an obligation that is difficult to comply with in the countries of the region taking into account their own national obligations***.

3.4.3.4 Fats, Oil and Grease

Fats, oil and grease are organic compounds that are insoluble in water and have low or no biodegradability. This means that they do not mix with water but rather float on its surface or form a layer at the bottom of water bodies (APHA, 2017).

There are two types of fats, oil and grease, those that are naturally generated in the environment known as Organic Matter Extractable by an organic solvent (examples: animal and vegetable oils, animal fat) and the so-called mineral fats and oils. The latter are the most relevant and the ones that are actually the subject of environmental studies, since, although a portion of them may be of natural origin, the large majority are derived from petroleum, in other words, pathogenic and are actually recognized as pollutants of the aquatic environment (ECOQUIMSA, 2017).

In the determining fat, oil and grease content, we don't measure a specific substance, but a group of substances with the same physicochemical characteristics (solubility). Thus, determining the fat, oil and grease content in any matrix includes fatty acids, soaps, fats, waxes, hydrocarbons, oils and any other substance that can be extracted with an organic solvent (CARIPOL, 1980; USEPA, 2011).

Mineral fats and oils in the sea can have different sources, such as domestic wastewater discharges (in these cases the grease comes mainly from waste generated by cleaning) and industrial wastewater discharge, and can even come from oil spills in the sea itself or from dumping fuel or oil on land.

In more specific terms, mineral fats and oils are considered pollutants in domestic wastewater. These compounds are very harmful to the environment and have a major environmental impact on the water of coastal marine areas, as they can induce the formation of a layer of fat, oil or scum in surface waters, which causes an inadequate exchange of oxygen between water and air, reducing the level of dissolved oxygen in the water and therefore decreasing in the passage of light, negatively affecting aquatic life. Its analysis is vital to ensure environmental health and prevent problems related to organic pollution in the aquatic environment (NMX-AA-005-SCFI, 2000).

On the other hand, the analysis and interpretation of fats, oil and grease in wastewater can help to identify the specific sources of pollution emissions, due to the concrete information provided by their study.

Thus, it is important to analyse and determine their content in domestic and industrial wastewater, and it is essential to take measures to reduce the amount of mineral fats and oils that are released into the environment.

Table 6 shows the discharge limits for Fats, Oil and Grease established in the wastewater discharge rules or regulations in countries in the Wider Caribbean Region.

Table 6. Discharge limits for Fats, Oil and Grease in domestic wastewater in countries in the WCR.

	Country	Maximum permissible limits or ranges ($mg\ L^{-1}$)	Comments
1	Colombia	20	Limits for domestic wastewater from individual home sanitation solutions.
		20	Limits for domestic wastewater from the public sewage system by drain.
		50	Limits for domestic wastewater from the public sewage system by underwater outfall
2	Costa Rica	30	Mandatory parameter for wastewater discharged into a receiving body.
3	Honduras	10	FOR WASTEWATER DISCHARGE INTO RECEIVING BODIES
4	Panama	20	For the discharge of liquid effluents into receiving bodies of inland and marine waters
5	Guatemala	50	Date of completion: 2024. By 2023, all municipalities must comply with having complete treatment systems in operation for at least the two (2) main discharges that are reported in the inventory as untreated.
		10	Date of completion: 2028. By 2027, all municipalities must comply with having treatment systems in operation for sixty percent (60%) of the total discharges recorded in the inventory.
		10	Date of completion in 2032. By 2031, all municipalities must comply with having treatment systems in operation for the remaining forty percent (40%) of the total discharges recorded in the inventory.
6	Mexico	15 (M.A.) 18 (D.A.) 21 (I.V.)	For discharges in Mexican marine areas. M.A.: Monthly average. D.A.: Daily average. I.V.: Instantaneous Value.
7	Nicaragua	15	Discharges from domestic wastewater treatment systems
		20	Discharges from sewage systems
8	Venezuela	20	For discharges into the coastal marine environment
9	Cuba	15	Class A: Marine areas of ecological conservation zones, or protected areas.
		15 - 50	Class C: Marine areas where fishing takes place.
		50	Class D: Marine areas whose waters are for industrial use such as in power generation.
		30	Class E: Marine areas in bays where maritime-port activity takes place.
		50	Class F: Marine areas for navigation and other uses
10	Dominican Republic	-	Does not include Fats, Oil and Grease in the discharge standards for domestic wastewater

11	Bahamas	0	Legislation for discharges is under development. Proposed values.
12	Barbados	15	For discharge into Class I waters (200 meters offshore from the outer edge of the reef).
		50	For discharge into Class II waters (Marine waters extending the outer limit of Class I waters, but within the territorial waters of Barbados).
13	Belize	15	For discharges in Class I waters (according to the classification in the LBS Protocol)
		50	For discharges in Class I waters (according to the classification in the LBS Protocol)
14	Jamaica	-	This parameter is not included in the regulations for sewage wastewater discharges from treatment plants.
15	Saint Lucia	15	For discharges in Class I waters (according to the classification in the LBS Protocol)
		50	For discharges in Class I waters (according to the classification in the LBS Protocol)
16	Trinidad and Tobago	15	For discharges in coastal marine waters (3 nautical miles)
		100	For discharges in offshore marine areas (beyond waters defined as coastal).

Many countries in the region include maximum permissible limits (MPL) for fats, oil and grease as a pollutant in their regulations for domestic wastewater discharges. This ratifies the importance of this quality indicator.

The range of permissible values included in the national standards referred to in Table 6 is between 10 and 50 mg L^{-1}, not including the limit considered by Trinidad and Tobago's standards for offshore discharges (100 mg L^{-1}). Honduras and Guatemala (for completion dates 2028 and 2032) have stricter discharge limits (10 mg L^{-1}) compared to what is established by the LBS Protocol for discharges in Class I waters (15 mg L^{-1}).

The importance of Fats, Oil and Grease and the fact that this parameter is widely regulated in national discharge regulations and that the concentration range included in them is within the framework of the limits established by the LBS Protocol (which does not impose an obligation that is difficult to comply with in the countries of the region) are sufficient to ratify the relevance of same in this regional agreement. Therefore, ***the recommendation is to keep this indicator of pollution by organic compounds, with the discharge limits included in Annex III of the LBS Protocol for domestic wastewater.***

3.4.3.5 Bacteriological Indicators

Domestic wastewater is characterized by high concentrations of microorganisms (bacteria, viruses and parasites), which are found in human excrement. The presence of such microorganisms has negative consequences for public health and coastal marine ecosystems due to their direct discharge

into them. All of the above has economic implications associated with the cost of health care, as well as the loss of income from tourism and fishing (UNEP CEP, 2019; Romero & Vargas, 2017).

The most widely used bacteriological indicators for assessing fecal pollution in water bodies and wastewater are the group of fecal (thermotolerant) coliforms formed by several bacterial genera and ***Escherichia coli*** (this genus is also included in the group of fecal or thermotolerant coliforms, although it is treated differentially). Such microorganisms come mainly from the digestive tract of warm-blooded animals, so their presence in water bodies is related to very recent discharges of untreated domestic and livestock wastewater (Ministerial Resolution 125, 2017).

Fecal (thermotolerant) coliform bacteria do not usually cause illness; however, they are used as an indicator of water quality because their presence is related to that of several hard-to-detect pathogens such as ***Salmonella***, ***Shigella***, ***Vibrio***, as well as viruses excreted by carriers of gastrointestinal diseases (Arzu et al., 2016).

However, the WHO (2011, 2014) states that ***Escherichia coli*** is the most appropriate bacteriological indicator for fecal pollution since the other genera that comprise the group of fecal (thermotolerant) coliforms can have a non-fecal origin and exist in uncontaminated natural waters.

Enterococcus spp. (formed by Lancefield Group D Streptococcus and other fecal subgroups) is currently recognized as the most appropriate indicators of fecal pollution, with advantages over fecal or thermotolerant coliforms and over ***Escherichia coli***, due to their ability to survive longer in aquatic environments and their relative resistance to adverse temperature and desiccation conditions in addition to chlorination (Arzu et al., 2016).

Table 7 shows the bacteriological indicators of fecal pollution and their limit concentrations established in the rules or regulations for wastewater discharge in countries in the Wider Caribbean region.

Table 7. Discharge limits for bacteriological indicators in domestic wastewater in countries in the WCR.

	Country	Bacteriological indicator(s) of fecal pollution including	Maximum permissible limits or values per bacteriological indicator of fecal pollution	Comments
1	Colombia	Fecal (thermotolerant) coliforms *Escherichia coli*	-	No limit values are established for bacteriological indicators. The resolution standard states that analysis and reporting of the values will be carried out when the mass load in the wastewater before the treatment system is greater than 26.00 kg day^{-1} BOD_5.
2	Costa Rica	Fecal (thermotolerant) coliforms	1000 MPN* 100 mL^{-1}	For ordinary wastewater from any source that is discharged into a receiving body used for recreational activities of primary contact.

3	Honduras	Fecal (thermotolerant) coliforms	5000 MPN 100 mL^{-1}	For wastewater discharge into receiving bodies. It does not specify the type of receiving body, nor the type of wastewater.
4	Panama	Fecal (thermotolerant) coliforms	500 (MPN 100 mL^{-1} and CFU** 100 mL^{-1})	For liquid effluent discharge into receiving bodies of inland (rivers, lakes, lagoons, natural, artificial, surface or ground) waters and marine waters
		Total Coliforms	1000 (MPN 100 mL^{-1} and CFU 100 mL^{-1})	
		Enterococci	100 (MPN 100 mL^{-1} and CFU 100 mL^{-1})	
		Escherichia coli	250 (MPN 100 mL^{-1} and CFU 100 mL^{-1})	
		Vibrio cholerae	absence	
5	Guatemala	Fecal (thermotolerant) coliforms	107 MPN 100 mL^{-1}	Date of completion: 2024. By 2023, all municipalities must comply with having complete treatment systems in operation for at least the two (2) main discharges that are reported in the inventory as untreated.
			104 MPN 100 mL^{-1}	Date of completion: 2028. By 2027, all municipalities must comply with having treatment systems in operation for sixty percent (60%) of the total discharges recorded in the inventory.
			104 MPN 100 mL^{-1}	Date of completion in 2032. By 2031, all municipalities must comply with having treatment systems in operation for the remaining forty percent (40%) of the total discharges recorded in the inventory.
6	Mexico	*Escherichia coli*	250 (M.A.) MPN 100 mL^{-1} 500 (D.A.) MPN 100 mL^{-1} 600 (I.V.) MPN 100 mL^{-1}	For discharges in Mexican marine areas. M.A.: Monthly average. D.A.: Daily average. I.V.: Instantaneous Value.
		Fecal enterococci	250 (M.A.) MPN 100 mL^{-1} 400 (D.A.) MPN 100 mL^{-1} 500 (I.V.) MPN 100 mL^{-1}	
7	Nicaragua	Fecal (thermotolerant) coliforms	1 x 10^5 MPN 100 mL^{-1}	Discharges from treatment systems into receiving bodies Maximum permissible limit for the period 2017-2022

			1×10^4 MPN 100 mL^{-1}	Maximum permissible limit for the period 2023-2026
			1×10^3 MPN 100 mL^{-1}	Maximum permissible limit for the period 2027-2029
8	Venezuela	Fecal (thermotolerant) coliforms	1000 MPN 100 mL^{-1} CFU 100 mL^{-1}	For direct or indirect discharges into the coastal-marine environment; provided that the body of water subject to the discharge has not been classified and has specific regulations regarding liquid effluent discharges.
9	Cuba	Fecal (thermotolerant) coliforms	200 MPN 100 mL^{-1}	Class A: Marine areas of ecological conservation zones, or protected areas.
			No discharge allowed	Class B: Marine areas dedicated to bathing (direct contact) and where there are coral reefs.
			200 – 400 (MPN 100 mL^{-1})	Class C: Marine areas where fishing takes place.
			1000 (MPN 100 mL^{-1})	Class D: Marine areas whose waters are for industrial use such as in power generation.
			1000 (MPN 100 mL^{-1})	Class E: Marine areas in bays where maritime-port activity takes place.
			No restriction	Class F: Marine areas for navigation and other uses
10	Dominican Republic	Total coliforms	1000 MPN 100 mL^{-1}	For municipal wastewater discharge into coastal waters
11	Bahamas	Fecal enterococci	33 CFU 100 mL^{-1}	Legislation for discharges is under development. Proposed values.
12	Barbados	Fecal strep	35 CFU 100 mL^{-1}	For discharge into Class I waters (200 meters offshore from the outer edge of the reef). Geometric mean of 5 samples per month
		Fecal coliforms	200 CFU 100 mL^{-1}	For discharge into Class I waters (200 meters offshore from the outer edge of the reef). Geometric mean of 5 samples per month
13	Belize	Fecal coliforms	200 MPN 100 mL^{-1}	For discharges in Class I waters (according to the classification in the LBS Protocol)
		E. coli (freshwater)	126 organisms 100 mL^{-1}	
		Enterococci (salt water)	35 organisms 100 mL^{-1}	
14	Jamaica	Fecal coliforms	1000 MPN 100 mL^{-1}	Effluents from existing or future treatment plants
15	Saint Lucia	Fecal coliforms	200 MPN 100 mL^{-1}	For discharges in Class I waters (according to the classification in the LBS Protocol)
		E. coli (freshwater)	126 organisms 100 mL^{-1}	
		Enterococci (salt water)	35 organisms 100 mL^{-1}	
16	Trinidad and Tobago	Fecal coliforms	400 CFU 100 mL^{-1}	For discharge into coastal waters (up to 3 nautical miles) and offshore marine areas (beyond waters defined as coastal).

** MPN: Most Probable number*

*** CFU: Colony Forming Units*

Based on the analysis in Table 7, the following observations can be made:

- The vast majority of countries in the region include maximum permissible limits (MPL) for bacteriological indicators in their regulations for domestic wastewater discharges. Guatemala and Nicaragua apply the Principle of Gradualness of these MPLs in their respective regulations.
- The bacteriological indicator of fecal pollution most included in the standards is thermotolerant (fecal) coliforms in a total of 14 countries. ***Escherichia coli*** and Enterococci (subgroup of the genus Fecal Streptococci) come in second with 5 and 6 countries, respectively. But it is necessary to clarify that, of the latter, 4 of them also include thermotolerant coliforms.
- With regard to the concentration units for the bacteriological indicator included in each standard or criterion for discharges, it is noted that the Most Probable Number (MPN 100 mL^{-1}) is the concentration unit that predominates (12 countries). Colony Forming Units (CFU 100 mL^{-1}) are included in five (5) countries, of which Panama and Venezuela report MPLs in the two units.
- It can be stated that there is compatibility between most of the discharge standards of the countries evaluated and the LBS Protocol (See Table 2) in terms of the bacteriological indicator of fecal pollution included, since as explained above, the vast majority include fecal (thermotolerant) coliforms in their discharge standards, which does not mean that it is the only indicator of fecal contamination mentioned in these regulations.
- Regarding the Maximum Permissible Limit (MPL) for fecal (thermotolerant) coliforms established in the LBS Protocol for discharge into Class I receiving bodies (200 MPN 100 mL^{-1}), ***this value is considered appropriate and restrictive*** for wastewater discharge into sensitive receiving bodies. This value is in fact lower than the MPL required in the vast majority of the discharge regulations of the countries of the region. ***However, the recommendation is that the limit of 200 MPN 100 mL^{-1} for fecal (thermotolerant) coliforms should be kept, due to the direct relationship between this indicator and health***, although it could be a challenge for the countries of the region to comply with this requirement for this bacteriological indicator of fecal pollution within the framework of the LBS Protocol.
- Considering the above-mentioned advantages of the use of ***Enterococcus faecalis*** and ***Escherichia coli*** as indicators of fecal pollution and that both are already included in Annex III of the LBS Protocol, ***it is proposed to include the same maximum permissible concentrations of these indicators (35 and 126 organisms 100 mL^{-1}) in Most Probable***

Number (MPN) and in Colony Forming Units (CFU) respectively, for discharges into Class I waters.

- The LBS Protocol does not establish limits for any fecal pollution indicators for discharge into Class II waters (with a lower degree of sensitivity to the impact of domestic wastewater); however, there is a potential risk that the pollutant load discharged into Class II waters could be displaced to adjacent areas classified as Class I. Oceanographic and geomorphological studies are essential to rule out this possibility. However, it is considered appropriate to include discharge limits for at least one indicator of fecal pollution to ensure that discharges into Class II waters comply with the definition of that class itself: "... *where humans or living resources that are likely to be adversely affected by these discharges are not exposed to such discharges*" (Box 4).

  In this sense, ***the recommendation is to include fecal (thermotolerant) coliforms as an indicator of fecal pollution in domestic wastewater discharges into Class II receiving bodies with an MPL that could be between 1000 – 5000 MPN 100 mL^{-1}*** (range of values also established in some national discharge standards in the region).

3.4.3.6 Floatables

The presence of floating substances or matter are indicators of water quality. There can be several types of floatables in water: plant matter; fats that form water-emulsified lumps or balls of fat; solids of various sizes and textures, among others. These floating materials may contain pathogenic bacteria or viruses associated with individual particles and may concentrate toxic substances such as metals and chlorinated hydrocarbons.

In general, floating matter is considered to be any solid substance retained in a mesh. However, there is no uniformity in terms of mesh diameter in the various regulations or procedures in force in the region for its determination. The LBS Protocol does not set out an exact definition of floating matter. However, the fact that its method of determination has a large qualitative component (its evaluation criterion is its own presence or not) and its discharge into marine water bodies can cause negative impacts, is sufficient for it to be recognized as valid to include it among the indicators to be regulated within the framework of the LBS Protocol.

A large number of countries in the WCR include this parameter in their own discharge regulations, namely: Costa Rica, Honduras, Guatemala, Nicaragua, Cuba, Bahamas, Barbados, Belize, Saint Lucia and Jamaica.

In view of the above analysis***, the recommendation is to keep this indicator as it is included in the LBS Protocol.***

3.4.3.7 Other parameters not included in Annex III of the LBS Protocol.

The quality indicators included in Annex III of the LBS Protocol (pH, TSS, Fats, Oil and Grease, BOD_5, floatables and bacteriological indicators) can be considered sufficiently "universal" as criteria for

domestic wastewater discharge to be included in a binding regional instrument (mandatory compliance once it is recognized). The analyses carried out in the previous sections demonstrate this.

However, it does not mean that they are the only ones. The region's wastewater discharge standards mostly include a basic group of parameters: physicochemical (pH, temperature, solids, conductivity, floatables, fats, oil and grease, among others), nutrients (mainly phosphorus and nitrogen compounds), bacteriological indicators (analysed in detail in section 2.4.5 of this study), organic matter indicators (BOD_5 and COD) and petroleum-based compounds (total hydrocarbons). The above indicators are usually classified as "mandatory" or "basic" in the vast majority of discharge rules or regulations. Heavy metals and certain ions are also usually included in discharge standards among the indicators to be regulated, although almost always related to industrial wastewater.

On the other hand, Annex III of the LBS Protocol calls on Contracting Parties to take into account the impact that nitrogen (N), phosphorus (P) and their derived compounds may have on the degradation of the Convention area and, to the extent possible, to take appropriate measures to control or reduce the total amount of nitrogen and phosphorus that is discharged into the Convention area or that may adversely affect it (Part C, Section 3.c). In other words, Annex III establishes the obligation, in terms of nutrients, in a "qualitative" sense (preparation and establishment of plans, measures, programmes) and not "quantitative" (discharge limits).

However, at the global level, it is recognized that the main anthropogenic sources of nutrients in coastal areas are untreated domestic wastewater, runoff from agricultural fertilizers, livestock production, and atmospheric nitrogen deposition (Seitzinger and Mayorga, 2016; Beusen et al., 2015, 2016). In the case of the Wider Caribbean Region, as referred to in this report, domestic wastewater accounts for 9% of total nitrogen inputs and 11% of phosphorus inputs (UNEP CEP, 2019).

Such is the global concern about nutrient inputs, which is explicitly reflected in Target 14.1 of the Sustainable Development Goals (SDG 14): "*By 2025, prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities, including marine debris and nutrient pollution.*"

In this sense, it is imperative that the LBS Protocol includes, in a more explicit and concrete way, obligations related to nutrient inputs in the Wider Caribbean Region. ***Therefore, it is recommended that nutrients be included in the group of indicators with discharge limits for discharges into Class I and II waters within the framework of Annex III (domestic wastewater).***

The inclusion of nutrients (and specifically nitrogen and phosphorus compounds) among the environmental quality indicators regulated under Annex III (domestic wastewater) will strengthen

the commitment, at the national level, to implement multilateral environmental agreements and other related conventions (including SDG 14, Target 14.1).

It is worth mentioning that the Regional Nutrient Strategy and its Associated Action Plan (RNPRSAP), approved by the Contracting Parties in 2021 (UNEP CEP, 2021) has included a specific activity in its Framework for Action at the regional level that contemplates developing the necessary amendments to the LBS Protocol to explicitly cover nutrients and the links between the state of the Convention area's coastal waters and upstream activities and practices (in the case of tributary watersheds). This activity even proposes to consider a new annex dedicated to nutrients.

In this regard, with the inclusion of discharge limits for nutrients in Annex III (specific to domestic wastewater) and the analysis and references to them in the proposed new annexes to the LBS Protocol (industrial wastewater and wastewater reuse, subsequently analysed in sections 2.6.1 and 2.6.2 respectively), the activity proposed in the RNPRSAP is complied with and a new annex just for nutrients is not necessary.

Another specific activity in the RNPRSAP Framework for Action, in this case under the heading "*Regional monitoring, assessment and reporting*", is to develop regional criteria, standards and limits for nutrients in domestic and industrial wastewater effluents. For the execution of this activity, a regional study was carried out by the LBS RACs entitled "*Establish Regional Criteria and Standards for N and P in Domestic and Industrial Wastewater Discharges*" (Narcis, et al., 2025) which aimed, as its name indicates, to propose regional criteria for nitrogen (N) and phosphorus (P) compounds in both domestic and industrial wastewater discharges. To achieve the objective, the national wastewater discharge regulations in the countries in the WCR were reviewed and evaluated, including the maximum permitted limits for the different nitrogen and phosphorus compounds, as well as other criteria from other countries and regions.

The study showed that, although there is progress in terms of discharge regulations in a large number of countries, there are still gaps throughout the region. There is a disparity in terms of the N and P compounds evaluated (mostly total phosphorus, TP and total nitrogen, TN). On the other hand, there is also a marked dispersion in terms of the range of values of the maximum permissible limits for the different N and P compounds throughout the region, even for receiving water bodies with similar classifications (Narcis, et al*., 2025*).

Despite the inherent challenges, it is implicit that, at least coastal and marine areas categorized as Class I under the LBS Protocol, must be protected by setting standards for nitrogen and phosphorus, as these compounds cause nutrient pollution, eutrophication and, consequently, deoxygenation, and are among the main causes of coral reef degradation, the loss of marine biodiversity and the loss of habitat in marine and coastal ecosystems.

As a result of the analysis of the reference study, three nutrients with regional discharge criteria or limits are proposed, namely: total nitrogen (TN), total phosphorus (TP) and total Kjeldahl nitrogen

(TKN), the latter included because of its major significance in wastewater treatment systems and its universally recognized method of determination.

The study initially proposes a range of limit values for each indicator, aligned with discharges in Class I and Class II waters according to the LBS Protocol as shown in Table 8.

Table 8. Proposed range of maximum permissible limits for nutrients in domestic wastewater (*Narcis, et al., 2025*).

Classification of the receiving body	Permissible limits (mg L^{-1})		
	TP	TN	TKN
Class I	0.1 - 5	1- 10	5 -10
Class II	5 - 10	10 – 50	10 - 40

The premise of these proposed limits is to facilitate the protection and management of the Convention area from the impact of nutrients from domestic wastewater, by regional environmental authorities. Consequently, conservative ranges are proposed for discharges in Class I waters and less strict ranges for discharges in Class II waters. It is further noted that the proposed limits should be achievable, but subject to long-term change where these thresholds may be stricter if necessary. It is also clarified that the vast majority of national discharge regulations use a system of maximum permissible limits for nitrogen and phosphorus compounds in the form of concentration and not in the form of a pollutant load (concentration per discharge flow), so it was considered more prudent to initially recommend discharge limits in the form of concentration, which is also how it is included for the rest of the environmental quality indicators in Annex III (Narcis, et al., 2025).

In conclusion, the approach taken in the reference study is considered appropriate ***and therefore the explicit inclusion of nutrients within the framework of Annex III of the Protocol is recommended, specifically, through the three indicators (TP, TN and TKN) with their ranges of permissible limits shown in Table 8.***

In line with the above-mentioned study's indication that the proposed ranges of nutrient limits may be subject to long-term change, and that in the framework of this assessment it has been proposed to modify the limits of two of the five indicators included in Annex III, ***it is recommended that a paragraph on the need for a revision process and updating of environmental quality indicators and their discharge limits at least every 10 years be explicitly included in the text of the Annex itself***. This period, which is just half the maximum time set in the implementation timetable for new or existing wastewater systems to meet these limits (20 years), would allow Contracting Parties to make a mid-term assessment of the progress made and reassess their plans and strategies for the systems, should it be necessary due to changes in discharge limits.

It is recommended that the text proposed above be included in Point 3 (All Discharges) of Part C of Annex III itself. In the same section, and taking into account the proposal to explicitly add nutrients (nitrogen and phosphorus compounds) to the parameters with specific discharge limits, ***the recommendation is to delete paragraph (a) referring to the commitment of Contracting Parties to take appropriate measures to control or reduce the amount of total nitrogen and phosphorus that is discharged into, or may adversely affect, the Convention area.*** This paragraph would no longer make sense having included nutrients in the tables in points 1 (Discharges into Class II Waters) and 2 (Discharges into Class I Waters).

3.4.4 Part D: Industrial Pretreatment

The very name of this section infers that it will address the issue of industrial wastewater, however, it is focused on ensuring the development and execution by the contracting parties of management and treatment programs for same when they are discharged into domestic wastewater treatment systems, which is the objective of Annex III (Box 6).

This section makes sense with the understanding that, in some coastal cities/settlements, the systems for collecting, treating and disposing of industrial and domestic wastewater, including rainwater, tend to mix with each other, becoming one for all types of wastewater.

Box 6. Industrial Pretreatment

Each Contracting Party shall endeavour, in keeping with its economic capabilities, to develop and implement industrial pretreatment programmes to ensure that industrial discharges into new and existing domestic wastewater treatment systems:

(a) do not interfere with, damage or otherwise prevent domestic wastewater collection plants and treatment systems from meeting the effluent limitations specified in this Annex;

(b) do not endanger operations of, or populations in proximity to, collection and treatment systems through exposure to toxic and hazardous substances;

(c) do not contaminate sludge or other reusable products resulting from wastewater treatment; and

(d) do not contain toxic pollutants in amounts harmful to human health and/or aquatic life.

Each Contracting Party shall endeavour to ensure that industrial pretreatment programmes include spill containment and contingency plans.

Each Contracting Party shall, within the scope of its capabilities, promote appropriate industrial wastewater management, such as the use of recirculation and closed loop systems, to eliminate or minimize wastewater discharges to domestic wastewater systems.

In view of the above, the responsibilities explicitly included in this section with respect to the pretreatment of industrial wastewater can be assessed as fair and appropriate provided that it is discharged into domestic wastewater treatment systems and, therefore, it should not be modified.

However, in section 2.6.1 of this study, an analysis is made of the benefit of including a separate annex within the framework of the LBS Protocol, for industrial wastewater. Once this inclusion is approved, then section D (industrial pre-treatment) should be removed from Annex III and its

content (with corresponding changes) included in the new exclusive annex for industrial wastewater.

3.4.5 Part E: Household Systems

This section establishes Contracting Parties' commitment to manage the construction, operation and maintenance of household wastewater collection systems where they do not exist, in order to avoid the pollution of surface or ground waters that are likely to adversely affect the Convention area.

The inclusion of this section in the framework of Annex III is an acknowledgement of the limitations existing in the WCR in terms of domestic wastewater collection and treatment systems at the time it was drafted. However, the current situation does not differ significantly.

Although it is recognized that there is a marked absence of information available in Latin America and the Caribbean (LAC) on access to basic sanitation, connection to treatment systems, and wastewater treatment (Saravia et al., 2022), the limited information reported by countries shows a significant and clear delay in this area.

In 2020, only 67% of the LAC population was connected to a sewage system, 19% in rural areas and 78% in urban areas, and only 34% had a connection to a sewage system that safely managed wastewater treatment (JMP, 2021).

Therefore, the recommendation is to keep the option of using household systems for the collection of domestic wastewater in areas where there is no other system, within the framework of Annex III, as it guarantees a valid option for commitment by the contracting parties in the face of the current connection and treatment constraints, especially in rural areas.

3.4.6 Part F: Management, Operations and Maintenance

As its title indicates, this section of Annex III focuses on the Contracting Parties' commitment to establish maintenance programmes for new and existing domestic wastewater collection and treatment systems, as well as ensure the formulation and implementation of training for those in charge of such systems.

This section also relates the evaluation processes of wastewater collection systems to compliance with national regulations, which gives it additional value by linking national legal instruments with regional ones (the LBS Protocol).

No amendments are proposed to this section.

3.4.7 Part G: Extension period.

In this section of Annex III, reference is made to variants of extension periods for the implementation of the timetable presented in Part C of the annex.

In section 2.4.3, the appropriateness of the extension periods established in this section was analysed, specifically their facilitation of each Contracting Party's own adaptability to the implementation timetable of new or existing treatment systems that comply with the discharge limits established in Part C itself. ***Therefore, no modifications are proposed to the extension periods.***

3.5 Annex IV

Annex IV of the LBS Protocol (Agricultural Non-Point Sources of Pollution) is last but not least.

As explained in section 1.3.1 of this report, agricultural non-point sources of pollution represent the largest nutrient input in the WCR (UNEP CEP, 2019) and are considered a high priority for countries in the region. However, their quantification and control remain a major challenge for the region. Hence their importance and the interest in their continued inclusion as an independent technical annex within the LBS Protocol.

Annex IV consists of three parts (A, B and C). Part A sets out the annex's own definitions and Part C establishes the obligation for national reporting on plans related to the prevention, reduction and control of pollution of the Convention area from agricultural non-point sources, in accordance with Article XII of the LBS Protocol, which is detailed in Part B (analysis below). ***No amendments or changes to Parts A and C of Annex IV are recommended.***

Part B of Annex IV stipulates contracting parties' obligation to formulate plans, policies and legal mechanisms for the prevention, reduction and control of pollution of the Convention area from non-point sources of pollution, that may adversely affect the Convention area.

This section presents the elements that such plans and policies should contain, which includes everything from the assessment of agricultural non-point sources of pollution (estimation, impact identification, administrative framework assessment, best practices and monitoring programmes) to education, training and awareness programmes.

In this regard, ***the recommendation is to include in Part B, section 1(a), the benefit of using advanced methods for estimating the pollutant load from non-point sources of pollution through mathematical models*** with which environmental impacts and health risks can be quantified and predicted very accurately (section 1(b)).

Part B also establishes a period of five (5) years for the Contracting Parties to formulate the plans, policies and legal mechanisms mentioned above. Taking into account the importance and complexity of non-point sources of pollution, especially of agricultural origin, in the WCR (described in this document), the period or date of compliance with such an obligation could be somewhat restrictive. On the other hand, the formulation and adoption of specific national legal mechanisms (norms, decrees, laws, resolutions, regulations, among others) is usually a slow and cumbersome process in most countries. ***In this regard, the recommendation is to include an extension period of another five (5) years for the development and approval of specific legal mechanisms once significant***

progress is demonstrated in the formulation and implementation of national plans and policies related to the prevention, reduction and control of pollution from non-point sources of pollution.

3.6 Proposals for other annexes.

3.6.1 Industrial Wastewater

As analysed in section 2.2.1 of this study, both the LBS Protocol in its current version, as well as recent studies and surveys (UNEP CEP, 2019), distinguish industrial wastewater as a source of pollution that affects the Convention area, always recognizing that the priority level varies between the countries in the WCR.

It is precisely taking into account this variability according to the levels of economic development and according to the various types of industrial activities within the region that it is proposed to include these sources as a priority, but in a general way and not by type of industries as it appears in the current version (see section 2.2.1).

The obligations/responsibilities for the control and management of the other sources recognized as priorities in Annex I of the protocol (i.e. domestic wastewater and agricultural non-point sources of pollution) are explicitly set out in Annexes III and IV respectively. ***It is therefore recognized that the LBS Protocol needs to include a new differentiated annex just for industrial sources of pollution.***

The main objective of that Annex shall be to promote the control of industrial wastewater discharges based on the circular economy principle, and the protection of human health, ecosystems and the environment in general.

The new annex must encourage in its articles, the creation of waste minimization programmes, the installation of treatment systems and the use of the best available practices for the disposal of wastewater, always with the ultimate objective of reducing the production and concentration of pollutants discharged into the marine environment.

However, it is recognized that the scope and content of a specific annex for the control and management of industrial wastewater ***at the regional level is a major challenge considering that its quality and volume vary depending on the type of industry that produces it.***

On the other hand, the review of national legislation in countries in the WCR (standards, regulations) related to industrial wastewater discharges, denotes less progress compared to legislation for domestic wastewater discharges. Only three (3) English-speaking countries (Belize, Jamaica, Trinidad and Tobago) and four Spanish-speaking countries (Colombia, Costa Rica, Dominican Republic, Nicaragua) have differentiated regulations for industrial wastewater (Narcis, et al., 2025). It should be noted that in the rest of the countries in the WCR, the rules/regulations do not specify the origin or source of wastewater and, therefore, apply to all discharges, i.e. domestic and industrial.

As explained in section 2.4.4 of this study, Part D in Annex III refers to the fact that the efforts required to develop and implement pretreatment programmes for industrial discharges (in this case in new and existing domestic wastewater treatment systems) will depend on the economic capacity of each contracting party (see Box 6). The recognition of the economic factor in the treatment and disposal of industrial wastewater is essential to achieve better acceptance of any regulatory framework initiative in the region, such as the one proposed for a specific annex within the framework of the LBS Protocol.

In view of the above, it is proposed that the new annex on industrial wastewater should have a general, holistic and not highly restrictive approach. In this regard, it is proposed that it does not include, at least in a first phase, maximum permissible concentration limits for industrial effluents.

In general terms, it is proposed that the annex on industrial wastewater should include the following:

1. ***Definitions and scope of application.***
2. ***Proposals for criteria to facilitate the control of industrial discharges that take into account, among others, the following factors:***
   - ***Levels of treatments according to the load released***
   - ***Characteristics of the different industrial sectors***
   - ***Classification of the final discharge receiving body according to its use.***
3. ***Promoting the drafting of national plans and programmes for the prevention, reduction and control of pollution from industrial sources that recognize the financial challenge of each contracting party in their implementation and include, inter alia, the following:***
   a. ***Education and training activities for the industrial sector***
   b. ***Active participation of the private sector***
   c. ***Economic incentive programmes to expand the use of better, novel and appropriate practices for the management and treatment of industrial wastewater.***
4. ***The importance of strengthening national legislative frameworks in the contracting parties (policies, standards, regulations) for actions to control industrial sources of pollution.***
5. ***Recognition of the need for robust national institutional frameworks for the implementation of monitoring and evaluation of industrial sources affecting the Convention area.***
6. ***National reporting mechanisms for compliance with the commitments/obligations stipulated in the annex itself.***

3.6.2 Wastewater Reuse.

The importance of water reuse globally is reflected in its explicit inclusion in the framework of the Sustainable Development Goals (SDGs). Specifically, SDG 6 (Clean water and sanitation) establishes, in target 6.3, the approach to wastewater recycling and reuse in a concrete way: "*By 2030, improve*

water quality by reducing pollution, eliminating dumping and minimizing the release of hazardous chemicals and materials, halving the percentage of untreated wastewater and substantially increasing recycling and safe reuse globally."

The productive use of wastewater, especially domestic wastewater, is an alternative for agricultural irrigation due to its nutrient and organic matter content, which would favor the increase of harvests and the improvement of soils. But the importance of wastewater reuse should not be seen only as a benefit from the point of view of soil fertilization or from the point of view of market utility (savings in water acquisition costs). Water reuse is important to preserve and sustainably manage a resource that is finite and increasingly in demand.

In order to address the current and future challenges related to the management of wastewater (including domestic, industrial and agricultural wastewater) that the LBS Protocol recognizes as sources of pollution affecting the Cartagena Convention area, ***it is recommended to include a new technical annex whose main objective should be to promote/enhance and standardize wastewater reuse in the Wider Caribbean Region***.

The purpose of this study is not to present the explicit content of the new annex but to propose general guidelines that it should contain for future drafting.

In this regard, the first ***consideration is that an annex on wastewater reuse must have as its fundamental principle the protection of human health and ecosystems in the Convention area.***

Precisely because of the importance of wastewater reuse for human health, several international organizations have spoken out on the subject, including the World Health Organization, which published a four-volume document (WHO, 2006) with guidelines for the safe use of wastewater, excreta and greywater, namely:

1.- Policies and regulatory aspects (Volume I)

2.- The use of wastewater in agriculture (Volume II)

3.- The use of wastewater and excreta in aquaculture (Volume III)

4.- The use of excreta and grey water in agriculture (Volume IV)

The above guidelines can serve as a basis for establishing the guidelines of the new annex, respecting the principle of the protection of human health as mentioned above.

Another principle that should govern the new annex is the application of the concept of the circular water economy as one of the potential strategies to address current and future water-related challenges, and thus ensure a more sustainable future.

In general terms, the annex should include the following:

1. ***Scope of application and definitions (recirculation, reuse, monitoring, among others).***

2. ***Classifications of types of wastewater reuse, e.g. landscaping, agricultural irrigation, cleaning, construction, among other safe and sustainable uses of wastewater.***
3. ***Minimum indicators or parameters (mandatory and optional) that must be evaluated in the water for its reuse according to each proposed type.***
4. ***Maximum permissible concentrations of the proposed indicators.***
5. ***Control and monitoring actions that must include, among other aspects, the minimum sampling frequencies for wastewater destined for reuse.***

4 SUMMARY OF RECOMMENDATIONS FOR AMENDMENTS TO THE PROTOCOL.

The objective of this chapter is to present, in a summarized way, the recommendations for the proposed amendments to the LBS Protocol according to the analyses carried out in the previous chapter.

In this regard, the proposed amendments, understood as changes, and additions to the text of the protocol in each of the current technical annexes, as well as other proposed annexes, are presented.

Annex I

1.- It is recommended that the "Priority Source Categories and Activities affecting the Convention Area" be described as:

- Domestic Wastewater
- Agricultural Non-Point Sources
- Industrial Activities (mainly the chemical and petroleum industries)
- Tourism
- Fisheries (including aquaculture and mariculture)

2. Insert, in Part C of Annex I, a new section (C.2) entitled "Emerging Environmental Problems of Concern affecting the Convention Area ":

- Presence of microplastics and other emerging pollutants
- Sargassum inundation
- Sea acidification

Annex III

1.- The following modifications to the discharge limits are proposed for domestic wastewater discharge into Class I and II waters:

- Change the BOD_5 limit for discharges in Class I waters, from 30 to 50 mg L^{-1}
- Include the same maximum permissible concentrations of *Enterococcus faecalis* and *Escherichia coli* as indicators of fecal pollution (35 and 126 organisms 100 mL^{-1}) in Most

Probable Number (MPN) and in Colony Forming Units (CFU) respectively, for discharges in Class I waters.

- Include fecal (thermotolerant) coliforms as an indicator of fecal pollution in domestic wastewater discharge into Class II receiving bodies with an MPL that could be between 1000 – 5000 MPN 100 mL^{-1}.
- Include nutrients (specifically nitrogen and phosphorus compounds) in the group of parameters with discharge limits for discharges in Class I and II waters, according to the proposal made within the framework of the regional study "*Establish Regional Criteria and Standards for N and P in Domestic and Industrial Wastewater Discharges*".

Classification of the receiving body	**Permissible limits (mg L^{-1})**		
	TP	**TN**	**TKN**
Class I	0.1 - 5	1- 10	5 -10
Class II	5 - 10	10 – 50	10 - 40

2.- Explicitly include in the text in Part C.3 (All Discharges), a paragraph regarding the need to review and update environmental quality indicators and their discharge limits at least every 10 years.

3.- It is recommended that paragraph (a) in Part C.3 (All Discharges) be deleted from Part C, which refers to the Contracting Parties' commitment to take appropriate measures to control or reduce the amount of total nitrogen and phosphorus that is discharged into, or may adversely affect, the Convention area. This paragraph would no longer be needed having included nutrients in the tables in C.1 (Discharges into Class II Waters) and C.2 (Discharges into Class I Waters).

Annex IV

1.- Include in Part B, section 1(a), the benefit of using advanced methods for estimating the pollutant load from agricultural non-point sources of pollution through mathematical models.

2.- Add in the first paragraph of Part B, which establishes the five-year period for the formulation and implementation of national plans and policies related to the prevention, reduction and control of pollution from non-point sources, an extension period of another five (5) years for the preparation and approval of specific legal mechanisms once significant progress is demonstrated in the process described above.

The inclusion of two new annexes to the LBS Protocol is proposed:

1.- INDUSTRIAL WASTEWATER

The main objective of a specific annex for industrial wastewater is to promote the control of industrial wastewater discharges based on the circular economy principle, and the protection of human health, ecosystems and the environment in general. It is recognized that this is a major

challenge considering that industrial wastewater varies in quality and volume depending on the type of industry that produces it.

It is proposed that the annex on industrial wastewater should include the following:

1. Definitions and scope of application.
2. Proposals for criteria to facilitate the control of industrial discharges that take into account, among others, the following factors:
   - Levels of treatments according to the load released
   - Characteristics of the different industrial sectors
   - Classification of the final discharge receiving body according to its use.
3. Promoting the drafting of national plans and programmes for the prevention, reduction and control of pollution from industrial sources that recognize the financial challenge of each contracting party in their implementation and include, inter alia, the following:
   a. Education and training activities for the industrial sector
   b. Active participation of the private sector
   c. Economic incentive programmes to expand the use of better, novel and appropriate practices for the management and treatment of industrial wastewater.
4. The importance of strengthening national legislative frameworks in the contracting parties (policies, standards, regulations) for actions to control industrial sources of pollution.
5. Recognition of the need for robust national institutional frameworks for the implementation of monitoring and evaluation of industrial sources affecting the Convention area.
6. National reporting mechanisms for compliance with the commitments/obligations stipulated in the annex itself.

2.- WASTEWATER REUSE

This annex must have, as its fundamental principle, the protection of human health and ecosystems in the Convention area and, as its main objective, the promotion/enhancement and standardization of wastewater reuse in the Wider Caribbean Region.

The following structure is proposed for the annex:

1. Scope of application and definitions (recirculation, reuse, monitoring, among others).
2. Classifications of types of wastewater reuse, e.g., landscaping, agricultural irrigation, cleaning, construction, among other safe and sustainable uses of wastewater.
3. Minimum indicators or parameters (mandatory and optional) that must be evaluated in the water for its reuse according to each proposed type.
4. Maximum permissible concentrations of those of the proposed indicators.
5. Control and monitoring actions that must include, among other aspects, the minimum sampling frequencies for wastewater destined for reuse.

5 BIBLIOGRAPHIC REFERENCES

- Agreement 058 (1997). Technical standards for wastewater discharges into receiving bodies and sewage systems. Honduras. 12 pp.
- Government Agreement 254 (2019). Amendments to Government Agreement 236-2006: Regulation of wastewater discharges and reuse and sludge disposal. Guatemala. 4 pp.
- APHA-WPCF-AWWA (2017). Standard Methods for the examination of Water and Wastewater. American Public Health Association. 23rd Edition New York. 1280 pp.
- Arzu, O. R. et al. (2016). Relationship between indicators of fecal pollution in groundwater. Available at: http://repositorio.unne.edu.ar/handle/123456789/51060.
- Beusen, A.H.W., A. F. Bouwman, L.P.H. Van Beek, J.M. Mogollón, and J.J. Middelburg (2016). Global riverine N and P transport to ocean increased during the 20th century despite increased retention along the aquatic continuum. Biogeosciences 13: 2441-2451
- Beusen, A.H.W., L.P.H. Van Beek, A.F. Bouwman, J. M. Mogollón, and J.J. Middelburg (2015). Coupling global models for hydrology and nutrient loading to simulate nitrogen and phosphorus retention in surface water – description of IMAGE-GNM and analysis of performance. Geoscientific Model Development 8: 4045-4067
- CARIPOL (1980). Manual of Petroleum Pollution Monitoring. LAB (4301). Rickenbaker, Causing Miami, Fla. 33149, 14 pp.
- Cisneros E, Olga. Saucedo R, Heber E. Rivas L, Helena. (2013). REFERENCE GUIDE FOR WASTEWATER REUSE IN AGRICULTURAL IRRIGATION. Mexican Institute of Water Technology. 29 pp.
- Clean Water Act, Title 33 Navigation and Navigable Waters. The Government of the United States of America.
- Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment (OJ L 135, 30.5.1991), pp. 40–52
- Decree 21 (2017). Regulation establishing the provisions for wastewater discharge. Nicaragua. 48 pp.
- Decree 883 (2005). Standards for the classification and quality control of water bodies and liquid discharges or effluents. Venezuela 23 pp.
- Decree 90 (2000) Emission standard for the regulation of pollutants associated with the discharge of liquid waste into marine and inland surface waters. Office of the Minister and Secretary General of the Presidency. Chile. 16 pp.
- Executive Decree 33601-MINAE-S: 2007. Wastewater Discharge and Reuse Regulations. Costa Rica. 56 pp.
- ECOQUIMSA (2017). Wastewater. Physicochemical analysis of fats and oils. Occupational Health and Safety Environmental Analysis and Monitoring Laboratory. Guatemala City, 25 pp.
- Environment Protection Act (2011). The Government of Belize.
- Environmental Management Act (2000). The Government of Trinidad and Tobago.
- Environmental Planning and Protection Act (2019). Government of The Bahamas.
- Environmental Protection (Effluent Limitations) (Amendment), Regulations (2009), The Government of Belize, 11 pp.
- Environmental Protection (Water Quality) Regulations (2000). The Government of Guyana, 12 pp.

- Environmental Protection and Management Act (2019) The Government of Antigua and Barbuda, No. 10 of 2019.
- Florida, US State: Title 62, Chapter 62-302, Florida. December 26, 1996. Section 62-302.300 Findings, Intent and Antidegradation Policy for Surface Water Quality (Integrated).
- Geissen, V., Hans Mol, Erwin Klump, Günter Umlauf, Marti Nadal, Martine van der Ploeg, Sjoerd E.A.T.M. van de Zee and Coen J. Ritsema. (2015). Emerging pollutants in the environment: A challenge for water resource management. International Soil and Water Conservation Research, 3(1): 57-65.
- Mexican Institute of Water Technology and the Ministry of Environment and Water of Bolivia (2018). TECHNICAL GUIDE FOR WASTEWATER REUSE IN AGRICULTURE. Mexico, Bolivia and Germany Triangular Cooperation Project. ISBN: 4-1-550-18 P.O. SECOND EDITION.
- JMP (Joint Monitoring Programme for Water Supply and Sanitation) (2021). Rural and urban service levels, 2015 and 2020, [online], https://washdata.org/data/household#!/.
- NA-CDAS (2012). Environmental Standard on Discharge Control for Surface Waters, Sewage Systems and Coastal Waters. Ministry of Environment and Natural Resources. Dominican Republic, 27 pp.
- Narcis M., Pérez M., Valdez M., Sende V., Gómez Y., Beltrán J.M. (2025). ESTABLISH REGIONAL CRITERIA AND STANDARDS FOR N AND P LOADS IN DOMESTIC AND INDUSTRIAL WASTEWATER DISCHARGES (Draft). Technical Report prepared by RAC IMA (*Institute of Marine Affairs*, Trinidad and Tobago) and RAC Cimab (*Centro de Investigación y Manejo Ambiental del Transporte*, Cuba) for the Caribbean Environment Program (CEP), 65 pp.
- Narcis, M., Gómez Y., Pérez, M. (2025). GUIDELINES FOR CLASSIFICATION OF WATERS ACCORDING TO THE LBS PROTOCOL (Draft). Technical Report prepared by RAC IMA (*Institute of Marine Affairs*, Trinidad and Tobago) and RAC Cimab (*Centro de Investigación y Manejo Ambiental del Transporte*, Cuba) for the Caribbean Environment Program (CEP), 55 pp.
- National Resources Conservation Authority Act (1991). The Government of Jamaica.
- NC 521 (2007). Wastewater Discharge into the coastal area and marine waters. Specs. Cuban Standard National Bureau of Standards, Cuba.14 pp.
- NMX-AA-005-SCFI (2000). Water Analysis - Determination of Recoverable Fats and Oils in Natural Water, Wastewater, and Treated Wastewater. Secretariat of Commerce and Industrial Development, Mexico, 16 pp.
- NOM-001-SEMARNAT (2021). Maximum permissible limits for pollutants in wastewater discharges into receiving bodies. Mexico 19 pp.
- WHO (1989). Technical Report Series. Sanitary guidelines on the use of wastewater in agriculture and aquaculture. WHO. Geneva. 90 Pages.
- WHO (2011). Guidelines for the quality of water for human consumption (fourth edition) Geneva. World Health Organization.
- WHO (2014). Guidelines for the quality of water for human consumption (fourth edition incorporating the first addendum) Geneva. World Health Organization.
- UN (2004). Department of economic and social affairs. Division for sustainable development indicators of sustainable development. Available at: http://www.un.org/esa/susdev/natlinfo/indicators/isd.htm.

- Public Health (Water Quality Control) Regulations (1978). The Government of Saint Lucia, 41 pp.
- DGNTI-COPANIT Regulation 35 (2019). Environment and health protection. Safety. Water quality. Liquid effluent discharge into inland and marine water bodies. Panama. 46 pp
- Resolution 0883 (2018). Establish the parameters and maximum permissible limit values in point discharges into marine water bodies, and other provisions.
- Resolution 222 (2002). By which the Water Quality Registry in the National Territory is established. Paraguay. 6 pp.
- Ministerial Resolution 125 (2017). Sanitary guidelines for the safe use of recreational waters. Module II Sanitary guidelines for enteropathogens and opportunistic microorganisms in ambient water. Available at: https:⁄ www.argentina.gob.ar.
- Romero, T. & Vargas, D. (2017). Use of efficient microorganisms to treat polluted water. Hydraulic and Environmental Engineering. Riha Vol. 38. No. 3. ISSN 1680 0338
- RTS 13.05.01 (2018). Salvadoran Technical Regulations. Water. Wastewater. Wastewater quality parameters for discharge and management of sewage sludge. 45 pp.
- Saravia Matus, S. et al. (2022). Circular economy opportunities in wastewater treatment in Latin America and the Caribbean, Natural Resources and Development series, No. 213 (LC/TS.2022/193), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC).
- Seitzinger, S., and E. Mayorga (2016). Large Marine Ecosystems: Status and Trends. Chapter 7.3: Nutrient inputs from river systems to coastal waters. United Nations Environment Programme, Nairobi.
- SLNS 83 (2016). St. Lucia Bureau of Standards, Guidelines for Recreational Water Quality. 7 pp.
- SLNS 83 (2016). St. Lucia Bureau of Standards, Guidelines for Recreational Water Quality. 7 pp.
- The Marine Pollution Control Act (1998). The Government of Barbados.
- UNEP CEP (2019). Technical Report No 96: State of the convention Area Report. An assessment of marine Pollution from Land- based sources activities in the Wider Caribbean Region (SOCAR). Authors: S. Heileman, L. McManus, C. Corbin, L. Christian, S. Adrian, E. Mayorca, D. Banjoo. Caribbean Environment Program (CEP), 182 pp.
- UNEP CEP (2021). Regional Nutrient Pollution Reduction Strategy and Action Plan for the Wider Caribbean Region (RNPRSAP). Authors: L. McManus, S. Heileman, C. Corbin, D. Banjoo. Caribbean Environment Program (CEP), 251 pp.
- USEPA (1976). Quality Criteria for Water. Washington, DC.
- USEPA (1999). National Recommended Water Quality Criteria -- Correction. Office of Water, Washington, DC. EPA 822-Z-99-001. April.
- USEPA (2011). Method 1664, Revision A: N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry, February 1999. United States Environmental Protection Agency, Office of Water, Washington, D.C. 4 pp.

- Valencia G, Eduardo; Romero C, Jonathan; Aragón C, Renso A. (2010). METHODOLOGY FOR TREATED DOMESTIC WASTEWATER REUSE IN IRRIGATION. Natural Resources and Environmental Engineering Journal, no. 9, January-December, pp. 55-59. ISSN: 1692-9918 revistaeidenar@univalle.edu.co. University of Valle. Cali. Colombia.
- Veliz Lorenzo, E; Llanes O, José G; Asela F, Lidia; Bataller V, Mayra (2019). Domestic wastewater reuse for agricultural irrigation. Critical assessment. CENIC Journal. Biological Sciences, vol. 40, no. 1, January-April. National Centre for Scientific Research. City of Havana, Cuba. pp. 35-44
- Wastewater and Sludge Regulations (2013). The Government of Jamaica, National Resources Conservation. 41 pp.
- Water Pollution Rules (2019). The Government of Trinidad and Tobago 732 pp
- WHO (2006). Guidelines for the safe use of wastewater, excreta and greywater. Vol 2. Wastewater use in agriculture. Geneva. WHO/UNEP/FAO 196 pp.
- World Health Organization (2006). Guidelines for the safe use of wastewater, excreta and greywater. Vol 2. Wastewater use in agriculture. Geneva. WHO. 2006. UNEP, FAO, 196 p.
- WPR T&T (2019). The Government of Trinidad and Tobago, Rules Water Pollution.

6 ANNEXES

6.1 Annex 1. Discharge Standards of the Countries in the Wider Caribbean Region.

	Country	Rules or Regulations for wastewater discharge into coastal areas and/or inland water bodies	Comments
1	Colombia	Resolution 0883:2018. "By which the parameters and maximum permissible limit values are established in point discharges into marine water bodies."	Resolution 501: 2022, amending some articles of Resolution 0883: 2018. It differentiates the discharge limits for domestic wastewater and for industrial, commercial and service activities.
2	Costa Rica	Executive Decree 33601-MINAE-S: 2007 Wastewater Discharge and Reuse Regulations	It establishes differentiated maximum permissible limits for discharges into receiving bodies and sewage systems. It differentiates the origin of wastewater into two types: ordinary (of domestic origin) and special (different from ordinary)
3	Honduras	Agreement 058: 1997 "Technical Standards for Wastewater Discharges into Receiving Bodies and Sewage Systems".	Applies to all types of wastewater and does not specify the receiving body
4	Panama	DGNTI Technical Regulation -COPANIT 35: 2019. "Environment and health protection. Safety. Water Quality. Liquid effluent discharge into inland and marine water bodies".	For all liquid effluents from domestic, commercial, industrial, and institutional activities.
5	Guatemala	Agreement 236:2006: "Regulation of wastewater discharge and reuse and sludge disposal". Revised and updated by Government Agreement 254:2019	It does not specify the receiving body. It includes the principle of gradualness and establishes maximum permissible limits in three stages, years 2024, 2028 and 2032.
6	Mexico	Official Mexican Standard NOM-001-SEMARNAT: 2021, which establishes the permissible limits for pollutants in wastewater discharges in the nation's receiving bodies. It entered into force progressively as of April 3, 2023.	It does not specify the origin of the wastewater (typology) It differentiates the MPLs for discharges in rivers, reservoirs, marine areas and soil.
7	Nicaragua	Decree 21:2017. "Regulation establishing the provisions for wastewater discharge".	It differentiates the MPLs for Discharges from sewage treatment systems and domestic wastewater. It also includes limits for discharges from hospitals and certain industrial activities.

8	Venezuela	Decree 883: 2005 Standards for the Classification and Control of the Quality of Water Bodies and Liquid Discharges or Effluents.	For all wastewater discharges, it does not specify their typology. It differentiates the receiving water bodies (rivers, estuaries, lakes and reservoirs) and the coastal marine environment.
9	Cuba	Cuban Standard 521:2007 "Wastewater discharge into the coastal and marine area. Specifications".	It does not specify the typology (origin) of the wastewater. It differentiates the MPLs for 6 types of coastal marine waters according to their use, with more restrictive limits from A (marine protected areas) to F, less restrictive (marine waters used in navigation).
10	Dominican Republic	NA-CDAS-2012 "Environmental Standard on Control of Discharges into Surface Waters, Sewage Systems and Coastal Waters" (2012)	Differentiates MPLs for discharges in surface waters and in coastal waters. In the case of municipal (domestic) waters, it differentiates the limits according to the tributary population.
11	Antigua and Barbuda	The Environmental Protection and Management Act (2019)	It establishes limits for receiving waters, but not for discharges.
12	Bahamas	Pollution Control and Waste Management Regulations (Draft)	In the process of approval. The indicators included in the draft (pH, fats and oils and bacteriological indicators) and their limits were derived from the analysis of existing quality criteria developed by the USEPA, by the states of Hawaii and Florida and by the territory of Puerto Rico (USA).
13	Barbados	Table of Prohibited Concentrations (2023)	The document was prepared by the University of the West Indies for the Department of Environmental Protection of the Ministry of Environment and National Planning, which presents "*end of pipe"* standards for wastewater. However, it does not appear as part of official legislation or any legal document.
14	Belize	Environmental Protection (Effluent Limitation) Amendment Regulations, 2009	The LBS Protocol's effluent indicators and limits were adopted by national legislation once the country acceded to it.
15	Grenade	-	It has no national legislation for domestic wastewater discharges.
16	Guyana	Environment Protection (Water Quality) Regulations (2000)	It identifies some parameters for wastewater discharges, but does not include discharge limits.
17	Jamaica	Wastewater and Sludge Regulation. Natural Resources Conservation (2013).	It establishes discharge limits for sewage and industrial wastewater from treatment systems.
18	Saint Lucia	Guidelines for Recreational Water Quality (SLNS 83:2016)	It establishes permissible effluent limits for estuarine and coastal waters taking

			into account the discharge criteria of the LBS Protocol for Class I waters.
19	Trinidad and Tobago	Water Pollution Rules (WPR), 2019	It establishes "permissible limits" or "end of pipe standards" for industrial discharges in coastal waters (up to 3 nautical miles) and in offshore marine areas (beyond waters defined as coastal)
20	United States (Florida)	Clean Water Act (CWA) (2022) Water Quality Standards (WQS) *For Florida:* Florida Surface Water Quality Standards (2018)	It includes water quality standards, but does not include discharge limits for wastewater