Guaíba+Resilient

Environmental and Social Management Planning Framework (ESMPF)

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1. Introduction: Purpose of ESMPF and description of subprojects

The Environmental and Social Management Planning Framework (ESMPF) serves as a strategic and operational instrument designed to guide the identification, assessment, management, and monitoring of environmental and social risks and impacts associated with the Guaíba+Resiliente Program and its subprojects. Its purpose is to ensure that all planned interventions align with the Environmental and Social Framework (ESF) of the Asian Infrastructure Investment Bank (AIIB), national legislation, and good international practices, while promoting environmental sustainability, social inclusiveness, and climate resilience.

The ESMPF sets out principles, procedures, and institutional arrangements to avoid, minimize, mitigate, or compensate for potential adverse environmental and social effects and to enhance positive outcomes. It establishes the foundation for integrating environmental and social considerations into decision-making throughout all project stages, from planning and design to implementation and monitoring.

This framework is particularly relevant given the diverse and complex nature of the Guaíba+Resiliente subprojects, which include:

Urban Drainage Works

This sub-project focuses on modernizing and expanding Guaíba's macro-drainage system to reduce recurrent flooding and strengthen resilience against extreme rainfall events. It involves creating a bypass or spillway linked to the Celupa Channel, which will act as an overflow route during system overloads, with surrounding squares serving as complementary retention basins. The intervention integrates engineering solutions with green infrastructure, incorporating buffer areas of up to 2% of the drained area. As the only sub-project with a completed executive design, it serves as a pilot for future drainage and hydrological risk control measures in Guaíba, supporting adaptive, nature-based approaches.

Flood Control System

This sub-project proposes a flood control system, potentially including an 8-km dike to protect the Santa Rita neighborhood from river overflows. The design is in an early phase and responds to social and institutional pressures after the 2024 floods. Alternatives to a rigid dike — such as zoning flood areas or using natural containment — are under evaluation, guided by ongoing hydrological studies and climate adaptation principles aligned with the Paris Agreement. The project considers cost-benefit analysis, social trauma, and multi-level coordination, aiming for flexible, context-appropriate solutions that balance structural and non-structural measures.

Construction of Resilient Roads

This sub-project involves studying and designing a new road connection to improve Guaíba's internal and regional mobility, ensuring functional continuity during extreme events and supporting urban expansion to the south. The initiative responds to connectivity weaknesses exposed in the 2024 floods and aims to maintain emergency routes, reduce travel times, and integrate active and public transport. Different route options are under technical and environmental analysis, with emphasis on minimizing impacts on drainage and ecological corridors. By enhancing redundancy and mobility, the road will strengthen overall urban resilience and support future development.

Implementation of the Resilient Logistics and Industrial Hub

This sub-project aims to establish a new logistics and industrial hub in an elevated, flood-safe area, providing a relocation option for businesses affected by the 2024 floods. Strategically linked to BR-116 and the Port of Rio Grande, the hub will promote economic diversification and territorial planning, acting as a barrier against disordered urban sprawl. The site selection prioritizes technical, environmental, and land regularization criteria, with a staged bidding process to support investor participation. The proposal also integrates mobility infrastructure and housing policies, fostering social inclusion and local development while adhering to AIIB guidelines on voluntary acquisition and environmental eligibility.

Integrated Re-qualification of the Guaíba Waterfront

This sub-project targets the environmental and urban transformation of Guaíba's waterfront, combining flood-adapted public infrastructure, nature-based solutions, and ecological restoration. It divides the waterfront into northern and southern sections, each with distinct connectivity and social needs, and proposes multifunctional spaces that can serve both recreational and evacuation purposes. Planned interventions include elevating walkways, strengthening natural banks, and reconnecting neighborhoods historically isolated by industrial uses. The project aligns with the Master Plan and integrates funding mechanisms like Payment for Environmental Services to ensure long-term maintenance and resilience, involving strong community engagement throughout its development.

The ESMPF guides the definition of eligibility criteria, environmental and social screening, and required management measures for each subproject, recognizing their individual and cumulative impacts on the physical, biological, social, and institutional systems of the city. It supports the identification of specific mitigation and adaptation responses for interventions that involve changes in land use, removal of vegetation, hydrological alterations, potential resettlement, or transformation of urban and peri-urban areas.

Furthermore, the ESMPF provides mechanisms for stakeholder engagement, grievance redress, and adaptive management, ensuring transparency and accountability. Through this framework, the city of Guaíba aims to strengthen its institutional capacity, improve territorial governance, and secure a more resilient and inclusive urban development trajectory, while complying with AIIB's Environmental and Social Standards (ESS1, ESS2, and ESS3).

Ultimately, the ESMPF acts as a comprehensive tool to operationalize the vision and objectives of the Guaíba+Resiliente Program, enabling the safe, efficient, and sustainable execution of its subprojects, and contributing to long-term social, economic, and environmental benefits for the city and its residents.

2. Legal Analysis

2.1. Structure of the AIIB Environmental and Social Framework (ESF)

The **Environmental and Social Framework (ESF)** of the Asian Infrastructure Investment Bank (AIIB) aims to ensure that projects financed by the Bank are designed and implemented in an environmentally and socially responsible manner. This framework is guided by internationally recognized principles, policies, and standards, reinforcing AIIB's commitment to sustainable and inclusive development. The ESF is grounded in references such as: the United Nations Sustainable Development Goals (SDGs); the Paris Agreement on climate change; the International Finance Corporation (IFC) Performance Standards; the Equator Principles; the World Bank Environmental and Social Safeguards; and the Core Conventions of the International Labour Organization (ILO). The ESF seeks to integrate these safeguards into the processes of project evaluation, decision-making, and implementation by promoting: stakeholder participation; transparency and accountability; the prevention, mitigation, and compensation of adverse impacts; and the generation of long-term and equitable social and environmental benefits for affected communities. The ESF is composed of four complementary elements:

- Vision Statement: Defines AIIB's principles and commitments for a robust environmental and social approach.
- Environmental and Social Policy (ESP): Establishes the requirements applicable to all financed operations.
- Environmental and Social Standards (ESSs): Specify technical and operational criteria for risk and impact assessment and management.
- Exclusion List (ESEL) and Glossary: Define activities ineligible for financing and key terms within the framework.

The pillars underlying these four components are summarized below, with a focus on their environmental and social safeguard guidelines, in order to contextualize their comparison with the current Brazilian legal framework, as discussed later in this report.

2.1.1. Institutional Vision Statement

AIIB's vision is to become a leading multilateral financial institution supporting sustainable, resilient, and inclusive infrastructure that promotes equitable economic growth and improves quality of life in the regions where it operates. To this end, the Bank addresses sustainable development challenges through five core pillars: i**nsight,** sharing cutting-edge knowledge; i**nnovation,** developing sustainable solutions with diverse partners; i**nvestment,** mobilizing financial resources efficiently and responsibly; i**ntegration,** embedding environmental and social sustainability in all project phases; and i**ntegrity:** operating with transparency and institutional accountability.

AIIB's vision is aligned with the Sustainable Development Goals (SDGs) and the Paris Agreement, promoting investments that are compatible with national climate commitments (NDCs) and targeting at least 50% of its financing portfolio for climate action by 2025. The Bank prioritizes themes such as green infrastructure, regional connectivity, technological solutions, and the mobilization of private capital.

Environmental and social sustainability is addressed transversally, encompassing climate risks, environmental impacts, social inclusion, gender equality, the rights of persons with disabilities, biodiversity protection, and respect for human rights. Inclusion is understood as empowering people to participate in and benefit from development, with a focus on equitable access to basic services, infrastructure, education, healthcare, decent work, and environmental protection.

Additionally, AIIB supports institutional capacity building of countries and clients, promoting the use and strengthening of national and corporate systems. It also values meaningful stakeholder engagement through transparent and participatory consultations and promotes innovative financing mechanisms, such as results-based financing and climate policy financing, the use of financial intermediaries with ESG criteria, and the integration of knowledge and best practices throughout the project cycle.

2.1.2. Environmental and Social Policy (ESP)

The Environmental and Social Policy (ESP) is the central regulatory axis of the AIIB's Environmental and Social Framework (ESF). This policy defines the mandatory requirements for identifying, assessing, and managing environmental and social risks and impacts, as well as the guidelines for mitigation, compensation, monitoring, and effective stakeholder engagement. The main objectives of the ESP are: i) To integrate sustainability principles into the formulation and implementation of financed projects; ii) To protect the rights of populations directly or indirectly affected by the Bank's interventions; iii) To prevent, reduce, and mitigate adverse environmental and social impacts; iv) To promote institutional strengthening of clients and borrowers; and v) To ensure the effectiveness of consultation, participation, and grievance resolution mechanisms.

The ESP applies to all AIIB-financed projects, including co-financed operations with other multilateral development banks (MDBs) or funds administered by the Bank. It is important to note that when the environmental and social requirements of the country in which the project is implemented—or of the client itself—are more stringent than those of AIIB, the Bank may adopt those higher standards, provided they do not conflict with AIIB's institutional principles and rules.

2.1.3. Environmental and Social Standards (ESSs)

The Environmental and Social Standards (ESSs) complement the ESP and guide the planning, assessment, and management of risks and impacts associated with financed operations. AIIB adopts three ESSs, which are applied according to the nature, scale, sensitivity, and complexity of each project:

ESS 1 – Environmental and Social Risk and Impact Assessment and Management

When the Bank determines, in consultation with the Client, that a project is likely to cause adverse environmental and/or social risks or impacts, it requires the Client to carry out an environmental and social assessment proportional in scope to those risks and impacts, indicating appropriate measures to avoid, minimize, mitigate, compensate, or neutralize such effects during project implementation. In this case, the Client—the Municipality of Guaíba—is also responsible for engaging with affected persons by disclosing environmental and social information, conducting meaningful consultations, and implementing accessible grievance mechanisms. It is also necessary to

include relevant environmental and social requirements in the project's procurement notices and contracts, which must be monitored and evaluated by the Municipality in coordination with the Bank.

The themes to be addressed in the environmental and social studies, as well as the recommended instruments resulting from these studies (such as Environmental and Social Management Plans, Environmental and Social Planning Frameworks, Environmental and Social Action Plans, and Environmental and Social Management Systems), are detailed in AIIB's Environmental and Social Framework and are summarized in Table 1.

Table 1. Summary of Environmental and Social Instruments in the Context of AIIB.

Abbreviation	Instrument	Uses	Timing	Application	AIIB requirements
ESMP	Environmental and Social Management Plan	Details measures to prevent, mitigate, compensate and monitor identified environmental and social impacts.	After environmental and social assessment. During project implementation.	Projects classified as Categories A or B.	Required per ESS 1 – Risk and Impact Assessment and Management.
ESMF (ESMPF)	Environmental and Social Management Planning Framework	Defines principles, criteria and procedures for assessing risks and impacts of future subprojects.	Initial phase of projects with multiple subprojects or variable scope.	Programs or projects with subprojects not yet defined (e.g.: credit lines, multi-sector projects).	Required per ESS 1 – must include provision to ensure subsequent compliance with ESS 2 and ESS 3 if applicable.
ESAP (ESP)	Environmental and Social Plan	Lists corrective or additional actions to ensure compliance with the AIIB's environmental and social framework.	After environmental and social *due diligence* or audits. During negotiations and execution.	Proponents of projects with compliance gaps.	Part of the Financial Agreement. Subject to monitoring by the AIIB.
ESMS	Environmental and Social Management System	Ongoing institutional system to manage environmental and social risks and impacts in financed subprojects.	From the beginning of preparation to the end of execution.	Intermediary Financial Institutions (FIs) operating with AIIB resources.	Required per ESS 1, based on Operational Guidelines for Financial Intermediaries.
ESIA	Environmental and Social Impact Assessment	Identifies and evaluates potential environmental and social risks and impacts of a project, informing mitigation measures and decision-making.	Early stage of project preparation, prior to implementation.	Required for projects classified as Category A, and may be required for some Category B projects depending on risk level.	Required per ESS 1 – Risk and Impact Assessment and Management. Must ensure meaningful stakeholder engagement, public disclosure, and integration of findings into project design.

The content, although it may vary depending on the instruments and nature of the projects, should consistently address, among other things, biodiversity, critical and/or protected areas, natural environments and ecosystem services, pollution prevention and energy efficiency, climate change (GHG emissions), dialogue and transparency with communities, gender, vulnerable groups and discrimination, and the implementation of project-level grievance mechanisms that are accessible, transparent, and culturally appropriate. Additionally, it is essential to carry out assessments and, where necessary, recommend and implement mitigation measures related to worker and community health and safety, labor influx, traffic and road safety, as well as civil construction safety. The implementation of a robust labor relations system for project workers must also be ensured.

ESS 2 – Land Acquisition and Involuntary Resettlement

If the project is likely to involve involuntary resettlement, the Bank requires the Client to address this issue in the social section of the impact assessment report, supplemented by a more detailed analysis. This matter should be addressed through a plan or framework, as applicable, which may be referred to as a Land Acquisition and Resettlement Plan, Land Acquisition Plan, or Resettlement Plan (LARP/LAP/RP). In the case of a framework, the documents may be called Land Acquisition and Resettlement Planning Framework, Land Acquisition Planning Framework, or Resettlement Planning Framework (LARPF/LAPF/RPF).

The content of these plans or frameworks must be aligned with the principles established by AIIB's Environmental and Social Standard ESS2, which addresses Land Acquisition and Involuntary Resettlement. This safeguard aims to avoid involuntary displacement whenever possible. When unavoidable, the project must adopt measures to minimize impacts, ensure fair compensation, and promote the restoration—or ideally, the improvement—of the living conditions and livelihoods of affected persons.

ESS2 applies to cases of physical displacement (removal of people from their homes or occupied areas) and economic displacement (loss of access to productive resources, income, or assets), regardless of legal ownership status. It also applies to restrictions on access to traditional or communal use areas, and to cases where land regularization results in social impacts.

Key guiding principles of ESS2 include: meaningful consultation with affected populations; special consideration for vulnerable groups (such as women, the elderly, persons with disabilities, and traditional communities); prior restoration of livelihoods and access to essential services; and the adoption of independent monitoring and evaluation mechanisms. The client is responsible for ensuring that resettlement processes are planned and carried out based on evidence, community participation, and respect for human rights.

The resettlement plan or framework must include information on the characterization of affected populations, locational and technological alternatives, compensation and rehabilitation measures, timeline, budget, grievance mechanisms, and monitoring indicators. In projects with already executed phases, ESS2 requires retrospective analysis to ensure that any previous resettlements comply with the principles of the safeguard.

Whenever feasible, the Bank encourages the negotiation of participatory solutions, focusing on permanence or resettlement near the original site, preserving community ties and support networks. The use of national legislation is acceptable, provided it is compatible with ESS2 standards, which take precedence in the case of gaps or deficiencies in local regulations.

ESS 3 – Indigenous Communities

Environmental and Social Standard 3 (ESS3) sets guidelines to ensure respect for the rights and cultures of Traditional Communities in development projects. Its primary objective is to ensure that these peoples receive culturally appropriate social and economic benefits, are protected from adverse impacts, and can actively participate in decisions that affect them.

The standard applies when Indigenous Peoples are present in or have historical and cultural ties to the areas where projects will be implemented. To be considered traditional, a group must self-identify and be recognized as such by others, maintain a collective relationship with ancestral territories and natural resources, have distinct social and political institutions, and often speak a language or dialect different from the dominant society.

It is important to note that even groups that have been forcibly removed from their traditional territories remain protected under ESS3. The application of the standard takes into account both national legislation and international agreements in force in the country where the project will be implemented, ensuring a comprehensive and culturally sensitive approach to these populations.

If the project involves Indigenous Peoples, the Bank requires the client to address this issue in the social section of the impact assessment report, supplemented by a more in-depth analysis. Several requirements must be considered during the social study, as listed in the ESF. Impacts on Indigenous Peoples must be addressed through an Indigenous Peoples Plan (IPP) or an Indigenous Peoples Planning Framework (IPPF).

The IPP is applied when impacts on Indigenous Peoples are known during the project preparation phase. It is intended to plan specific actions to avoid, mitigate, compensate for, or generate cultural and socioeconomic benefits for the affected Indigenous Peoples. The IPP typically includes identification of affected Indigenous Peoples, impact assessment, free, prior, and informed consultation (FPICon), mitigation/benefit measures, action plan and budget, monitoring, and grievance mechanisms.

The IPPF is required when the project is not yet fully defined or includes future subprojects that may or may not affect Indigenous Peoples, but such information is not yet available. The goal of the IPPF is to establish guidelines, principles, and procedures to ensure that, once subprojects are defined, appropriate IPPs are prepared. The IPPF typically covers: eligibility criteria and risk screening, guidelines for consultation and engagement, procedures for preparing future IPPs, institutional arrangements and responsibilities, and monitoring and reporting requirements.

Although the instruments and their requirements may vary according to the project's scale, risk level, impact, and maturity, the following are cross-cutting principles: participatory and inclusive planning approaches, meaningful consultation, and, where applicable, the free, prior and informed consultation of affected Indigenous Peoples; the establishment of accessible, confidential, and culturally appropriate grievance mechanisms with protection against retaliation; a monitoring plan; and wide dissemination of actions and results throughout the process.

Project Categorization

Projects are categorized by the Bank according to their risk level:

- Category A: Significant, irreversible, and widespread impacts – requires a full Environmental and Social Impact Assessment (ESIA).
- Category B: Localized and mitigable impacts – requires an Environmental and Social Management Plan (ESMP) or simplified analysis.
- Category C: Minimal or no impacts – requires only a basic environmental/social description.
- Category FI: Projects implemented through financial intermediaries – require robust Environmental and Social Management Systems (ESMS).

Table 2. Abridged comparative table of environmental and social instruments by AIIB project category.

Term / Abbreviation	Name	What it is	Moment/Scope	Requirement according to AIIB category
ESIA	Environmental and Social Impact Assessment	Study that evaluates the potential environmental and social impacts of a project	Initial planning stage, and includes the entire project cycle	**Category A** (mandatory) Category B (may be required)
ESMP	Environmental and Social Management Plan	Plan with specific measures to mitigate and monitor the impacts identified in the ESIA	During project implementation	**Category A** (mandatory) Category B (ESMP or ESMPF required at Project level. ESMPs required at subproject level). Category C also may require ESMP
ESMS	Environmental and Social Management System	The organization's ongoing system for integrated management of environmental and social risks	Institutional or organizational level	**Category FI** (mandatory) **Category B** (may be required)
—	Environmental/Social Description	General characterization of physical, biotic, and social environments, without the need for in-depth studies	Initial planning and screening	**Category C** (sufficient)

The **Environmental and Social Exclusion List** (**ESEL**, see section "Environmental and Social Exclusion List, page 77 at https://www.aiib.org/en/policies-strategies/_download/environment-framework/AIIB-Revised-Environmental-and-Social-Framework-ESF-May-2021-final.pdf) outlines the activities that are not eligible for financing by the AIIB. The list is based on specific activities that violate national laws or regulations of the country in which the project is located, but primarily on those listed in international conventions and agreements adhered to by AIIB's Environmental and Social Policy. These include, among others: the Montreal Protocol (ozone-depleting substances); the Rotterdam and Stockholm Conventions (pharmaceuticals, pesticides/herbicides, and other hazardous substances); the **Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)**; the **Bonn, Ramsar, and World Heritage (UNESCO) Conventions**; the **Convention on Biological Diversity (CBD)**; the Basel Convention (prohibiting transboundary movement of waste under international law); and the transport of oil or other hazardous substances in tankers that do

not comply with International Maritime Organization (IMO) requirements, including MARPOL, SOLAS, and the Paris Memorandum of Understanding (Paris MoU).

2.2. Survey of National, State, and Municipal Legislation

2.2.1. Applicable Legal and Regulatory Framework

As previously mentioned, this section presents the main laws, decrees, regulations, and other legal instruments that apply or may apply to the implementation of works under the Guaíba+Resilient Program, focusing on social, environmental, and occupational health and safety aspects.

All relevant regulatory acts are listed in chronological and/or hierarchical order, with respective links to the compiled and updated legal texts whenever available (Tables 3 to 25). The organization follows the level of government responsible — federal, state, or municipal — and is grouped by related themes.

In the context of the Guaíba+Resilient Program, it is important to distinguish between different legal categories of land protection in Brazil—specifically, Permanent Preservation Areas (APPs), Conservation Units (UCs), and Protected Areas—as these influence licensing, land-use planning, and impact mitigation measures.

Permanent Preservation Areas (APPs) are areas automatically protected under the Brazilian Forest Code (Law No. 12.651/2012) due to their environmental characteristics (e.g., riverbanks, steep slopes). They exist regardless of ownership (public or private) and aim to conserve water resources, prevent erosion, and maintain ecological balance. Their use is highly restricted and subject to specific regulations (Law No. 15.434/2020 in Rio Grande do Sul).

Conservation Units (UCs) are a formal type of Protected Area, created through legal acts under the National System of Conservation Units (SNUC – Law No. 9.985/2000). They are classified into Strict Protection and Sustainable Use categories, each with specific rules and objectives. In Rio Grande do Sul, UCs are governed by State Law No. 13.193/2009 (SEUC), and municipalities such as Guaíba may also establish local UCs through compatible legal instruments.

The term Protected Area (Área Protegida) is broader and includes not only UCs and APPs, but also Legal Reserves, Indigenous Lands (Federal Constitution, Art. 231), and Quilombola Territories (Decree No. 4.887/2003), provided they serve conservation functions.

The identification of such areas within the Program's area of influence is essential to ensure compliance with national and subnational legislation and alignment with the AIIB's Environmental and Social Standards, especially in terms of biodiversity and cultural heritage protection.

In addition to national legislation, Brazil, as a member of the United Nations, is a signatory to several international treaties and conventions related to environmental protection and the climate agenda. Notable examples include:

- Paris Agreement
- United Nations Framework Convention on Climate Change (UNFCCC)
- Convention on Biological Diversity (CBD)
- Ramsar Convention on Wetlands of International Importance
- World Heritage Convention (Cultural and Natural)

- Convention on Migratory Species (CMS)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- Vienna Convention for the Protection of the Ozone Layer
- Montreal Protocol
- United Nations Convention on the Law of the Sea (UNCLOS)
- 2030 Agenda and the Sustainable Development Goals (SDGs)

2.2.2. Federal Legislation

Environmental

Table 3. Federative Management & Governance.

Regulatory act	Object/Summary
1988, Art. 225	Establishes the right to an ecologically balanced environment and the duty of public authorities and the community to preserve it.
Law nº 6.938, August 31, 1981	Determines the National Environmental Policy and establishes instruments for its application.
Law nº 7.347, July 24, 1985	Regulates public civil action for liability for damage to the environment.
Law nº 7.797, July 10, 1989	Creates the National Fund for the Environment.
Law nº 7.735, February 22, 1989	Creates the Brazilian Institute of the Environment and Renewable Natural Resources (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis - IBAMA),
Law nº 11.516, August 28, 2007	Creates the Chico Mendes Institute for Biodiversity Conservation (ICMBio).
Supplementary law nº 140, Decembeer 8, 2011	Establishes cooperation standards between the Union, States, Federal District and Municipalities for environmental management.
Decree nº 10.224, February 5, 2020	Regulates the National Fund for the Environment.

Table 4. Protected Areas.

Regulatory act	Object/Summary
Law nº 6.902, April 27, 1981	Addresses the creation of Ecological Stations and Environmental Protection Areas.
Decree nº 89.336, January 31, 1984	Addresses Ecological Reserves and Areas of Relevant Ecological Interest.
Decree nº 99.274, June 6, 1990	Addresses the creation of Ecological Stations and Environmental Protection Areas.
Decree nº 1.922, June 5, 1996	Addresses the recognition of a Private Natural Heritage Reserve (Reserva Particular do Patrimônio Natural - RPPN).
Law nº 9.985, July 18, 2000	Institutes the SNUC and establishes rules for the creation and management of Conservation units
Decree nº 4.340, August 22, 2002	Regulates the National System of Nature Conservation Units (SNUC).
Resolution CONAMA nº 303/2002	Provides parameters and limits for Permanent Preservation Areas (APP).
Decree nº 5.092, May 21, 2004	Defines rules for identifying priority areas for conservation and sustainable use.
Decree nº 5.758, April 13, 2006	Institutes the National Strategic Plan for Protected Areas (Plano Estratégico Nacional de Áreas Protegidas - PNAP).
Decree nº 5.746, April 5, 2006	Regulates aspects of the implementation of the SNUC.
Resolution CONAMA nº 369/2006	Regulates exceptions to intervention in APPs for public utility, social

	interest or low impact.
Law nº 11.284, March 2, 2006	Addresses the management of public forests for sustainable production.
Resolution Conama nº 429/2011	Addresses the methodology for recovering Permanent Preservation Areas.

Table 5. Biodiversity

Regulatory act	Object/Summary
Law nº 5.197, January 3, 1967	Addresses the protection of fauna.
Decree nº 1.298, October 27, 1994	Approves the regulation of National Forests.
Decree nº 2.519, March 16, 1998	Promulgates the Convention on Biological Diversity.
Law nº 9.605, February 12, 1998	Determines criminal and administrative sanctions arising from conduct and activities that are harmful to the environment.
Decree nº 4.339, August 22, 2002	Establishes principles and guidelines for the National Biodiversity Policy.
Law nº 12.651, May 25, 2012	Addresses the protection of native vegetation and protected areas.
Normative Instruction IBAMA nº 21 December 24, 2021	Institutes the National Forest Product Origin Control System (Sistema Brasileiro de Controle de Produto de Origem Florestal - SINAFLOR).

Table 6. Environmental Licensing

Regulatory act	Object/Summary
Resolution CONAMA nº 01/86	Establishes criteria and guidelines for Environmental Impact Assessment.
Resolution CONAMA nº 9/1987	Provides for the holding of public hearings in environmental licensing processes.
Resolution Conama nº 237/97	Regulates aspects of environmental licensing in accordance with the National Environmental Policy.
Resolution CONAMA nº 371/2006	Guidelines on environmental compensation and application of resources.
Normative Instruction IBAMA nº 146, January 10, 2007	Establishes criteria for the management of fauna in licensable enterprises.
Decree nº 6.514, de 22 de julho de 2008	Provides for infractions and administrative sanctions against the environment.
Resolution Conama nº 428/2010	Provides for the environmental licensing of projects that affect conservation units.

Table 7. Climate Change and Environmental Education

Regulatory act	Object/Summary
Law nº 9.795, April 27, 1999	Institutes the National Environmental Education Policy.
Law nº 12.187, December 29, 2009	Institutes the National Policy on Climate Change.
Decree nº 11.550, June 5, 2023	Defines CIM's competences within the scope of national climate policy.
Law nº 14.904, June 27, 2024	Establishes guidelines for the preparation of climate change adaptation plans.

Table 8. Air and Soil Quality

Regulatory act	Object/Summary
Resolution CONAMA nº 05, June 15, 1989	Addresses the PRONAR and measures to control atmospheric pollution.

Resolution CONAMA nº 382, December 26, 2006	Establishes the maximum limits for emission of atmospheric pollutants from stationary sources.
Resolution CONAMA nº 420, December 29, 2009	Defines criteria and guide values for soil quality, and guidelines for contaminated areas.
Resolution CONAMA nº 491, November 19, 2018	Establishes air quality standards and guidelines for assessment.
Resolution CONAMA nº 506, July 5, 2024	Establishes national air quality standards and guidelines for their application.
Law nº 14.850, May 2, 2024	Institutes the National Air Quality Policy.

Table 9. Water Resources and Sanitation

Regulatory act	Object/Summary
Decree nº 24.643, July 10, 1934	Establishes the Water Code, regulating the use of water in Brazil.
Law nº 9.433, January 8, 1997	Institutes the National Water Resources Policy and the National Management System.
Law nº 9.984, July 17, 2000	Creates the National Water and Sanitation Agency (Agência Nacional de Águas - ANA).
Resolution CNRH nº 15, January 11, 2001	Establishes general guidelines for groundwater management.
Resolution CONAMA nº 302, March 20, 2002	Addresses APPs of artificial reservoirs and the regime of use of the surrounding area.
Resolution CNRH nº 32, October 15, 2003	Establishes the National Hydrographic Division.
Resolution CONAMA nº 357, March 17, 2005	Defines classification of water bodies and environmental guidelines, including effluent standards.
Resolution CNRH nº 65, December 7, 2006	Establishes guidelines to coordinate grant procedures with environmental licensing.
Law nº 11.445, January 5, 2007	Establishes national guidelines for sanitation.
Resolution CONAMA nº 396, April 3, 2008	Provides for the classification and environmental guidelines for groundwater.
Resolution CNRH nº 129, June 29, 2011	Establishes guidelines for defining minimum remaining flows.
Resolution CNRH nº 145, December 12, 2012	Establishes guidelines for the preparation of Water Resources Plans for River Basins.
Resolution CNRH nº 232, March 22, 2022	Approves the National Water Resources Plan for the period from 2022 to 2040.
Decree nº 11.960, March 21, 2024	Regulates the National Water Resources Council (Conselho Nacional de Recursos Hídricos - CNRH).

Table 10. Solid Waste

Regulatory act	Object/Summary
Resolution CONAMA nº 307, July 5, 2002	Establishes guidelines, criteria, and procedures for the management of construction waste.
Law nº 12.305, August 2, 2010	Establishes the National Solid Waste Policy.
Decree nº 10.936, January 12, 2022	Regulates Law nº 12.305/2010, which deals with the National Solid Waste Policy.
ABNT NBR 10004:2024, November 27, 2024	Classifies solid waste according to risks to the environment and public health.

Social

Table 11. Community consultation, participation, and Information Access

Regulatory act	Object/Summary
Resolution CONAMA nº 09, December 09, 1987	Regulates the holding of public hearings in environmental licensing processes.
Law nº 9.709, November 18, 1998	Regulates the mechanisms for public consultation provided for in the Federal Constitution.
Law nº 10.650, April 16, 2003	Addresses public access to environmental information in the SISNAMA.
Law nº 12.527, November 18, 2011	Guarantees the right of access to public information, including environmental information.
Law nº 13.709, August 14, 2018	Establishes rules on the processing of personal data and protection of privacy.

Table 12. Expropriation

Regulatory act	Object/Summary
Legislative Decree nº 3.365, June 21, 1941	Addresses expropriations for public utility.
Law nº 4.132, September 10, 1962	Defines cases of expropriation of real estate for social interest.

Table 13. Gender

Regulatory act	Object/Summary
Federal Constitution of 1988, Art. 5º, I and further items	Enshrines equal rights for men and women as a permanent clause.
Law nº 10.778, November 24, 2003	Establishes compulsory reporting of cases of violence against women in health services.
Law nº 10.886, June 17, 2004	Includes the crime of domestic violence in the Penal Code.
Law nº 11.340, August 7, 2006	Creates mechanisms to prevent domestic and family violence against women.
Law nº 12.737, November 30, 2012	Classifies cybercrimes and protects people's privacy, especially women.
Law nº 12.845, August 01, 2013	Guarantees mandatory and comprehensive care for victims of sexual violence.
Law nº 13.104, March 9, 2015	Includes femicide as a qualifier for homicide and classifies it as a heinous crime.
Law nº 13.721, October 02, 2018	Prioritizes forensic examinations of cases of violence against women and vulnerable groups.
Law nº 14.245, November 22, 2021	Prohibits acts that undermine the dignity of the victim and witnesses, and increases the penalty for coercion in the process.
Law nº 14.232, October 28, 2021	Establishes the National Policy on Data and Information on Violence against Women.
Law nº 14.188, July 28, 2021	Creates the Red Lights program (Sinal Vermelho) and the crime of psychological violence against women.
Law nº 14.192, August 04, 2021	Establishes rules to prevent and combat political violence against women.
Law nº 14.611, July 03, 2023	Establishes equal pay criteria between men and women.
Law nº 14.550, April 19, 2023	Guarantees immediate and effective protection for women who report domestic violence.
Law nº 14.942, July 31, 2024	Determines public actions and awards in the month of August (Agosto Lilás) against violence against women.

Table 14. Indigenous Peoples

Regulatory act	Object/Summary
Law nº 6.001, December 19, 1973	Addresses the protection and social integration of Indigenous Peoples, respecting their customs and traditions.
Constitution of the Federative Republic of Brazil of 1988	Recognizes the original rights of Indigenous Peoples over the lands they traditionally occupy.
Decree nº 5.051, April 19, 2004	Enacts the ILO Convention on Indigenous and Tribal Peoples, guaranteeing free, prior and informed consultation.
Adopted by the UN in September 13, 2007	Sets minimum standards for the survival, dignity and well-being of the world's indigenous peoples.
Decree nº 10.088, November 05, 2019	Republishes the text of ILO Convention 169 on Indigenous and Tribal Peoples.

Occupational and Community Health and Safety

In Brazil, the Regulatory Standards (Normas Regulamentadoras – NRs) established by the Ministry of Labor and Employment (MTE) constitute the main body of legislation applicable to Occupational Health and Safety (OHS). Currently, there are 38 NRs in effect, with full texts freely available at: https://www.gov.br/trabalho-e-emprego/pt-br/acesso-a-informacao/participacao-social/conselhos-e-orgaos-colegiados/comissao-tripartite-partitaria-permanente/normas-regulamentadora/normas-regulamentadoras-vigentes. These standards are subject to ongoing review, with the possibility of adding or removing provisions. Therefore, it is important that the companies responsible for implementing the works continuously monitor these updates.

Among the 38 NRs, some have general applicability to any economic activity, while others are specific to certain sectors. Table 15 below presents the 20 NRs most evidently relevant to OHS during the implementation of the works in Guaíba. The most relevant standard is NR-18 (Health and Safety in the Construction Industry), which is specifically aimed at construction activities.

NR-18 also stands out for being developed through a tripartite model, with representatives from workers, employers, and the government. This helps ensure that regulatory requirements are accepted by all stakeholders, thereby facilitating compliance. Given the importance of NR-18, it is recommended that the companies responsible for executing the works in Guaíba carry out periodic audits to assess compliance. This can be done, for example, using NR-18 checklists available in the literature (Medeiros et al., 2016; Costella et al., 2014) and widely used by construction firms in Brazil.

Table 15. NRs with Clear Relevance to Occupational Health and Safety (OHS)

Norms	Scope and relevance for the works in Guaíba
NR-1 (General provisions and management of occupational risks)	A crucial aspect of NR-1, which is expected to come into effect on May 26, 2026, is the requirement that the establishment, such as a construction site, develop a Risk Management Program. This program must include an inventory of risks to the OHS, and their control measures. The most recent revision of this standard requires the inclusion of psychosocial risks in the risk inventory, aiming to contribute to improving the mental health of workers.
NR-4 (Specialized services in safety and occupational medicine)	This standard establishes the parameters and requirements for the establishment and maintenance of Specialized Occupational Health and Safety Services (Serviços Especializados em Segurança e Medicina do Trabalho - SESMT), with the purpose of promoting health and protecting the integrity of workers. The SESMT must be composed of an occupational physician, an occupational safety engineer, an occupational safety technician, an occupational nurse and an occupational nursing assistant/technician, in compliance with Annex II of NR-4.

Norms	Scope and relevance for the works in Guaíba
NR-5 (Internal committee for accident and harassment prevention (prevenção de acidentes e de assédio – CIPA))	This standard establishes the parameters and requirements of the Internal Commission for the Prevention of Accidents and Harassment (CIPA), with the aim of preventing accidents and work-related illnesses. The CIPA includes representatives of the employer and employees. Annex I of this standard defines specific CIPA requirements for the construction industry.
NR-6 (Personal protective equipment (equipamento de proteção individual – EPI))	This standard establishes the requirements for the approval, marketing, supply, and use of Personal Protective Equipment - EPI. The requirements of NR-6 are relevant for the execution of civil construction works, regarding the supply of EPI to workers and its use, as well as guidelines for the acquisition of EPI that meet the specific technical performance standards for them - for example, helmets that meet requirements for resistance to impact from objects.
NR-7 (Occupational health medical control program)	This standard establishes guidelines and requirements for the development of the Occupational Health Medical Control Program (Programa de Controle Médico de Saúde Ocupacional - PCMSO) in organizations, with the objective of protecting and preserving the health of its employees in relation to occupational risks, according to the risk assessment of the organization's Risk Management Program (PGR). The PCMSO is an integral part of the organization's broader set of initiatives in the field of employee health, and must be harmonized with the provisions of other NR.
NR-9 (Assessment and control of occupational exposures to physical, chemical and biological agents)	This standard establishes the requirements for assessing occupational exposure to physical, chemical and biological agents when identified in the Risk Management Program - PGR, provided for in NR-1, and to support it regarding preventive measures for occupational risks. In addition to NR-9, it is important to observe the requirements established by the Occupational Hygiene Standard (Norma de Higiene Ocupacional - NHO) 06, established by FUNDACENTRO, a technical body associated with the Ministry of Labor and Employment. NHO 06 is entitled Assessment of Occupational Exposure to Heat: technical procedure. This standard is available at the electronic address: http://arquivosbiblioteca.fundacentro.gov.br/exlibris/aleph/a23_1/apache_media/7DSKT5D4SHH4FVGY2MHH6UYBV5CX5L.pdf. The works in Guaíba will be carried out mainly outdoors, with workers exposed to the elements most of the time. Therefore, precautions against working in intense heat are essential and must be based on valid measurements, according to procedures defined in NHO 06.
NR-10 (Safety in electrical installations and services)	This standard establishes the minimum requirements and conditions aimed at implementing control measures and preventive systems to ensure the safety and health of workers who, directly or indirectly, interact with electrical installations and services involving electricity. Construction sites use various machines, equipment and lighting powered by electricity, and electric shocks are common accidents in these environments.
NR-11 (Transportation, movement, storage and handling of materials)	This standard establishes safety requirements for the operation of elevators, cranes, industrial conveyors and transport machines. Such equipment, especially cranes, are commonly used in civil construction infrastructure projects, involving dangers such as the equipment itself falling or the loads falling during transportation by the equipment.
NR-12 (Occupational safety in machinery and equipment)	This standard defines technical references, fundamental principles and protective measures to safeguard the health and physical integrity of workers and establishes minimum requirements for the prevention of accidents and occupational diseases in the phases of design and use of machinery and equipment, and also in their manufacture, import, marketing, exhibition and transfer for any reason, in all economic activities, without detriment to compliance with the provisions of other NRs, official technical standards, or applicable international standards and, in the absence or omission of these, optionally, in harmonized European type “C” standards.
NR-15 (Insalubrious activities and operations)	This standard defines the tolerance limits (for example, in terms of noise or heat) for the characterization of unhealthy work and the consequent adoption of risk mitigation measures. According to item 15.1.5, "Tolerance Limit" is understood as the maximum or minimum concentration or intensity, related to the nature and time of exposure to the agent, which will not cause harm to the health of the worker during their working life.
NR-17 (Ergonomics)	This standard establishes the guidelines and requirements to allow adaptation of working conditions to the psychophysiological characteristics of workers, in order to

Norms	Scope and relevance for the works in Guaíba
	provide comfort, safety, health, and efficient performance at work. This adaptation requires a work organization project that takes into account, among other aspects, the time requirements; the pace of work; the content of the tasks; the instruments and technical means available; and the cognitive aspects that may compromise the safety and health of the worker.
NR-18 (Occupational health and safety in the construction industry)	NR-18 requires the development of a Risk Management Plan for each construction site. This plan must meet all the requirements of NR-01 and the following additional requirements, defined in item 18.4.3: a) project of the construction site living area and any work front, in accordance with item 18.5 of this NR, prepared by a legally qualified professional; b) electrical project of temporary installations, prepared by a legally qualified professional; c) projects of collective protection systems prepared by a legally qualified professional; d) projects of Personal Protection Systems Against Falls (Sistemas de Proteção Individual Contra Quedas - SPIQ), when applicable, prepared by a legally qualified professional; e) list of Personal Protective Equipment (EPI) and their respective technical specifications, according to the existing occupational risks.
NR-19 (Explosives)	This standard establishes the requirements and preventive measures to ensure the safety and health of workers at all stages of the manufacture, handling, storage and transportation of explosives. The use of explosives may be necessary in some works involving the movement of large volumes of earth and occasionally rocks, such as dikes and road infrastructure.
NR-23 (Fire safety)	In addition to this NR, municipal and state legislation on prevention and extinguishing of fires in buildings must also be observed. In the State of Rio Grande do Sul, Law No. 14,376 is of special interest, and is available at the electronic address: https://ww3.al.rs.gov.br/filerepository/replegiscomp/Lec%20n%C2%BA%2014.376.pdf
NR-24 (Sanitary and comfort conditions in the workplace)	This standard establishes the minimum hygiene and comfort conditions to be observed by organizations, and the dimensioning of all facilities regulated by this NR must be based on the number of workers using the shift with the largest contingent. On construction sites, this standard is applicable to the design and use of areas such as sanitary facilities, changing rooms, cafeterias, kitchens and accommodation.
NR-25 (Industrial waste)	This standard applies to activities related to the management of industrial waste from industrial processes. Item 25.5.2 defines industrial waste as waste from industrial processes, in solid, liquid, or gaseous form, or a combination thereof, and which, due to their physical, chemical, or microbiological characteristics, do not resemble household waste, such as ash, sludge, oil, alkaline or acidic materials, slag, dust, sludge, leached substances, and waste generated by pollution control equipment and facilities, as well as other liquid effluents and gaseous emissions that contaminate the atmosphere.
NR-26 (Safety signage)	This standard establishes measures regarding safety signage and identification to be adopted in the workplace. This signage includes the identification of chemical products and preventive labeling consisting of a set of elements with written, printed or graphic information relating to a chemical product, which must be affixed, printed or attached to the packaging containing the product.
NR-33 (Health and safety when working in confined spaces)	This standard establishes the requirements for the characterization of confined spaces, the criteria for managing occupational risks in confined spaces and the prevention measures, in order to guarantee the safety and health of workers who interact directly or indirectly with these spaces. Road infrastructure works such as those planned in Guaíba may involve work in confined spaces, such as during the construction of storm drains and manholes.
NR-35 (Work in high places)	Although most of the works in Guaíba are carried out at ground level or

Norms	Scope and relevance for the works in Guaíba
	underground, activities at heights (more than 2.0 m above ground level) must also be carried out. Therefore, NR-35 is important as it determines the necessary training, the need to carry out a risk analysis, as well as rescue procedures in the event of falls, among other requirements.
NR-38 (Occupational health and safety in urban cleaning and solid waste management activities)	This standard establishes the requirements and prevention measures to guarantee the safety and health conditions of workers in urban cleaning and solid waste management activities.

In addition to the Regulatory Standards (NRs), which emphasize occupational health and safety (OHS), construction works in Guaíba must also comply with Brazil's general labor legislation and adopt practices that prevent informality and forced labor. Regarding informal labor, it is essential to observe Law No. 6019 (https://www.planalto.gov.br/ccivil_03/Leis/L6019.htm), which regulates labor outsourcing. The use of outsourced labor is widespread in the construction sector, which highlights the importance of Law 6019. Its Article 5 is particularly important as it clearly defines the role of the hiring entity and its responsibility to ensure adequate OHS conditions. According to the article, the hiring entity is the private individual or legal entity that enters into a contract with a service-providing company for any of its activities, including its core activity. Article 3, added by Law No. 13.429, further specifies that the hiring entity is responsible for guaranteeing the safety, hygiene, and health conditions of workers when the work is carried out on its premises or a location previously agreed upon in the contract.

Regarding forced labor, in Brazil this is a crime defined under Article 149 of the Penal Code. The law defines forced labor as the imposition of forced labor, exhausting workdays, degrading working conditions, and restriction of movement due to debt. Law No. 10.803/2003 included penalties in the Penal Code for those who exploit forced labor, ranging from 2 to 8 years in prison, in addition to fines.

To facilitate companies' compliance with general labor legislation, the Ministry of Labor and Employment (MTE) offers a tool called the Labor Self-Diagnosis. This tool is free, voluntary, and interactive, and provides information and technical advice to employers, workers, and society at large on the most effective means to promote decent work through responsible business conduct. The goal is to guide companies in identifying the best path toward achieving socially responsible conduct. The tool is available at:
https://www.gov.br/pt-br/servicos/realizar-autodiagnostico-trabalhista

There is no specific legislation regatding community health and safety. However, adherence to the aforementioned NRs—especially NR-18—contributes to the safety and health of the population living near or passing through the vicinity of construction sites. For instance, the planned works in Guaíba involve significant earth movement with excavation and fill, which poses hazards such as slope instability that could damage neighboring structures. When such activities comply with NR-18 requirements, the risks of undesirable impacts on community health and safety tend to decrease. Similarly, works that comply with NR-15—which addresses environmental risk control associated with dust and noise emissions—also tend to reduce associated risks for neighboring communities. Likewise, compliance with NR-25 prevents construction-generated waste (e.g., contaminated mud) from being disposed of in locations that may pose risks to the general population. Requirement 25.3.4 stipulates that solid waste and liquid effluents produced by industrial processes and operations

must be collected, packaged, stored, transported, treated, and disposed of in accordance with applicable laws or specific regulations.

It is also worth noting legislation such as Article 1277 of the Civil Code, Article 42 of the Law on Penal Contraventions, and Article 133 of the Guaíba Municipal Code of Conduct, which establish quiet hours between 10:00 PM and 6:00 AM. Therefore, construction activities must be suspended during these hours to avoid disturbing public peace. The nature of the works also implies intense movement of trucks transporting soil and materials in and out of the construction sites. These activities often result in frequent changes in traffic and pedestrian circulation near the construction areas, making it necessary to comply with traffic regulations, such as proper signage and risk area isolation.

Resettlement and Expropriation

The implementation of urban infrastructure works—especially those with significant territorial impact, such as the Guaíba+Resilient Program—may require the removal of families from their homes or the relocation of economic activities to clear areas for interventions. In such cases, it is essential to apply social safeguards that ensure the protection of the rights of affected individuals, in line with both Brazilian legislation and the international standards adopted by the program's financier (AIIB/ESS2).

Brazilian law provides specific mechanisms for land regularization, expropriation for public use, and resettlement of affected populations. These mechanisms aim to safeguard the right to housing, fair compensation, and informed participation of people impacted by public projects. Table 16 below presents the main federal legal provisions regarding resettlement and expropriation in Brazil.

Table 16. Federal Legislation on Resettlement and Expropriation

Regulatory act	Object/Summary
Legislative Decree nº 3.365/1941 https://www.planalto.gov.br/ccivil_03/Decreto-Lei/Del3365.htm	Addresses expropriations for public utility. Establishes the procedure, the declaration of public utility, and the prior payment of fair compensation in cash.
Law nº 4.132/1962 https://www.planalto.gov.br/ccivil_03/leis/l4132.htm	Addresses expropriation for social interest, for the purposes of urban reform, land and housing regularization.
Law nº 10.257/2001 (Estatuto da Cidade) https://www.planalto.gov.br/ccivil_03/leis/LEIS_2001/L10257.htm	Establishes general rules for urban policy. Provides instruments for land regularization, social use of urban property and the right to housing.
Law nº 13.465/2017 https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/lei/L13465.htm	Addresses urban and rural land regularization. Provides mechanisms for titling possessions and resettlement in public or private areas.
Decree nº 9.310/2018 https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/decreto/D9310.htm	Regulates provisions of the Law nº 13.465/2017, especially on urban land regularization (REURB).
Law nº 11.977/2009 https://www.planalto.gov.br/ccivil_03/_ato2007-2010/2009/lei/l11977.htm	Establishes the Minha Casa, Minha Vida Program, including provisions on involuntary resettlement and housing

Regulatory act	Object/Summary
	assistance for displaced families.
Decree nº 7.499/2011 https://www.planalto.gov.br/ccivil_03/_ato2011-2014/2011/decreto/d7499.htm	Regulates temporary or permanent housing assistance for families in areas at risk or affected by public work.
Law nº 13.465/2017, art. 9º https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2017/lei/L13465.htm	Provides for the possibility of resettlement in a different area through the granting of title or compensation.
Decree nº 5.051/2004 https://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/decreto/D5051.htm	Enacts ILO Convention 169 on Indigenous and Tribal Peoples, guaranteeing prior, free and informed consultation when affected by administrative or legislative measures.

These legal provisions are fundamental for guiding the preparation of Involuntary Resettlement Plans (IRPs), which must detail the conditions, phases, alternatives, and guarantees ensured to families and individuals impacted. This is necessary to align the implementation of the Program with the constitutional principles of dignity, participation, and the social function of property.

2.2.3. State Legislation

Environmental

Table 17. Management and Governance

Regulatory act	Norm
Constitution of the Rio Grande do Sul State, enacted on October 3, 1989	Establishes the environment as a public good and imposes a duty of preservation on public authorities and society.
State Law nº 10.330, December 27, 1994	Provides for the organization of the state environmental protection system.

Table 18. Protected Areas

Regulatory act	Object/Summary
State Decree nº 34.256, April 2, 1992	Creation of the State System of Conservation Units (Sistema Estadual de Unidades de Conservação - SEUC)
State Decree nº 34.573, December 16, 1992	State Parks Regulations
State Decree nº 38.814, August 26, 1998	SEUC regulations
State Decree nº 47.137, 2010	State Program for the Recovery of APPs and RLs
State Decree nº 53.037, May 20, 2016	SEUC update
State Decree nº 57.672, June 13, de 2024	Regulation of Private Natural Heritage Reserves (RPPN)

Table 19. Biodiversity

Regulatory act	Norm

State Law nº 9.519, January 21, 1992	Establishes the Forest Code of the State of Rio Grande do Sul
State Decree nº 35.096, January 25, 1994	Regulates the Forest Product Transportation Control System
State Law nº 15.434, de 9 de janeiro de 2020	Establishes the State Environmental Code of Rio Grande do Sul
State Decree nº 55.132, de 16 de janeiro de 2020	State Nature Conservation Policy
State Decree nº 55.749, de 19 de janeiro de 2021	State Biodiversity Commission (Comissão Estadual da Biodiversidade - COEBio-RS)

Table 20. Environmental Licensing, Environmental Education and Public Consultation

Regulatory act	Object/Summary
Resolution CONSEMA nº 355/2017	Criteria and standards for emission of liquid effluents
Resolution CONSEMA nº 357/2017	Integrated action with IPHAN in licensing
Resolution CONSEMA nº 372/2018	List of projects and activities subject to environmental licensing
Resolution CONSEMA nº 386/2018	Environmental Education Programs and Projects
Resolution CONSEMA nº 380/2018	Identification and classification of urban wetlands
Resolution CONSEMA nº 376/2018	Licensing of vegetation management on highways
State Law nº 15.434, January 9, 2020	Rio Grande do Sul State Environmental Code
Resolution CONSEMA nº 455/2021	Environmental License by Commitment (Licença Ambiental por Compromisso - LAC)
Resolution CONSEMA nº 485/2023	Marginal Strips in consolidated urban APPs
Resolution CONSEMA nº 508/2024	Permanent Monitoring Group of Reverse Logistics
Resolution CONSEMA nº 507/2024	Regulates public consultation in accordance with art. 229 of the State Law nº 15.434/2020

Table 21. Climate Change

Regulatory act	Object/Summary
State Law nº 13.594, January 21, 2011	State Policy on Climate Change
State Decree nº 54.111, March 22, 2018	Regulates the State Policy on Climate Change

Social

Table 22. Gender

Regulatory act	Object/Summary
Ordinary Law nº 9.810, January 06, 1993	Prohibits discrimination against women
Ordinary Law nº 11.303, January 14, 1999	Parity in collegiate bodies
State Decree nº 40.498, December 07, 2000	Policy to Combat Violence Against Women
Ordinary Law nº 11.574, January 04, 2001	Reservation of public resources for women heads of households
State Decree nº 41.196, November 12, 2001	Program for rural women workers
State Decree nº 41.509, March 27, 2002	Women's Reference Centers
Ordinary Law nº 13.947, March 16, 2012	State Council for Women's Rights
Ordinary Law nº 14.484, January 30, 2014	Gender-Inclusive Language in Public Administration

Regulatory act	Object/Summary
State Decree nº 52.932, March 08, 2016	State Forum to Combat Violence Against Rural Women
Ordinary Law nº 15.998, August 7, 2023	Consolidation of legislation on women victims of violence

Table 23. Indigenous Peoples

Regulatory act	Object/Summary
State Law nº 12.004, de 12 de novembro de 2003	Criação do Conselho Estadual dos Povos Indígenas (CEPI)
State Decree nº 54.333, de 6 de setembro de 2018	Institui Fórum Permanente de Educação e Diversidade Étnico-Racial do Estado do Rio Grande do Sul - FPEDER.
Portaria SES n 189/2024	Define o montante e a forma de distribuição do recurso financeiro do Programa Estadual de Incentivos para a Atenção Primária à Saúde (PIAPS)- Qualificação da atenção à saúde aos povos indígenas

2.2.4. Municipal Legislation

All legislation mentioned below can be found on the website of the Guaíba City Council at the following link: https://www.camaraguaiba.rs.gov.br/portal/?sec=npag&id=1636

Environmental

Table 24. Municipal Environmental Legislation

Regulatory act	Object/Summary
Law n.º 194, June 13, 1973	Establishes the Guaíba Building Code
Municipal Law n.º 1.027, December 26, 1990	Establishes the Guaíba Code of Conduct
Municipal Law nº 1.447, March 31, 1999	Creates the Guaíba Municipal Environmental Council (Conselho Municipal de Meio Ambiente de Guaíba - COMMEA) and provides other measures.
Municipal Law n.º 1.730, December 16, 2002	Institutes the Municipal Environmental Code and contains other provisions. This is the legal diploma that establishes the Environmental Policy of the Municipality of Guaíba, covering a variety of topics related to environmental protection, such as basic sanitation, environmental inspection and control, protection of fauna and flora, environmental licensing, among others.
Municipal Law 2.146, October 11, 2006	Institutes the Guaíba Master Plan.
Municipal Decree n.º 13, February 10, 2014	Establishes the participatory Municipal Basic Sanitation Plan for the Municipality of Guaíba.
Municipal Law nº 3.962, May 4, 2021	Establishes the Environmental Protection Policies for the Arroio Passo Fundo Hydrographic Sub-Basin and provides other measures.
Municipal Law nº 4.607, July 11, 2024	Creates the Municipal Policy to Support and Promote the de-silting of rivers, streams, dams, lakes, lagoons, and canals, aiming to prevent and minimize the effects and damage caused by floods and inundations in the Guaíba territory, and provides other measures.
Municipal Law n.º 4.641, October 22, 2024	Establishes the Municipal Policy for drainage and sustainable mechanisms for managing rainwater for the purpose of controlling floods and inundations and provides other measures within the Municipality of Guaíba.

Regulatory act	Object/Summary
Municipal Decree nº 123, April 15, 2025	Addresses the Special Projects Office of the Municipality of Guaíba, assigns the coordination of concessions, the management of international credit operations, participation in urban land use planning, master plan, sanitation, mobility and others, and provides other measures.

Social

Table 25. Municipal Social Legislation

Regulatory act	Object/Summary
Municipal Law nº 4.138, March 4, 2022	Regards the creation, composition, structuring, hierarchies, and functioning of the Municipal Council of Traditional Peoples and Communities of African Origin of the Municipality of Guaíba, and provides other measures.
Municipal Law n.º 4.590, June 20, 2024	Provides principles, rules and instruments for Digital Government to increase efficiency in the Municipality of Guaíba.
Municipal Law nº 4.599, July 9, 2024	Creates a protocol for preventing violence and/or discrimination based on sexual orientation and/or gender identity and for protecting victims of homophobia and transphobia in the municipality of Guaíba, and provides other measures
Municipal Law nº 4.627, September 10, 2024	Establishes the Municipal Day to Combat Violence Against Children and Adolescents in the Municipality of Guaíba.

Municipal Grievance Redress and Reporting System

The municipality of Guaíba has an institutionalized system for recording and addressing public feedback, operated through the Municipal Ombudsman. The official channel is accessible via the digital platform guaiba.atende.net, enabling any citizen to submit complaints, reports, suggestions, compliments, or requests in an accessible and secure manner. Details of the Project's grievance mechanisms, including the Municipal GRM, are provided in a standalone GRM document.

The Ombudsman acts as a link between the population and the municipal administration, ensuring that all communications are formally recorded, tracked, and responded to within established deadlines. The system provides a tracking number for follow-up, safeguards the confidentiality of the complainant, and allows for the submission of documents or evidence. Additionally, submissions can be made anonymously, increasing safety in sensitive contexts.

This mechanism is part of the Citizen Service Policy and is coordinated with the relevant municipal departments and administrative units responsible for addressing each case. Its structure aligns with principles of transparency, administrative efficiency, and social oversight, and can be strengthened as part of the grievance mechanism required by the AIIB, especially in the context of projects with potential social and environmental impacts, such as the Guaíba+Resilient Program.
https://guaiba.atende.net/cidadao/pagina/ouvidoria

Transparency Portal

The municipality of Guaíba provides access to its Transparency Portal through the digital platform guaiba.atende.net/transparencia, in compliance with the Access to Information Law (Federal Law No. 12,527/2011) and other public governance regulations. The portal offers direct access to

data on revenues, expenditures, contracts, tenders, administrative structure, agreements, and municipal regulations.

The tool is designed to ensure the publicity of administrative actions, promote social oversight, and provide the population with means to monitor and inspect the use of public resources. Information is organized by thematic areas, with search filters and downloadable documents, making it easier for citizens to navigate and access.

Within the context of the Guaíba+Resilient Program, the Transparency Portal represents a relevant platform for disseminating information about subprojects, contracts, investments, and execution indicators. Its use can be expanded to meet the AIIB's transparency and information access requirements, thereby strengthening social participation and public sector integrity throughout the project lifecycle.
https://guaiba.atende.net/transparencia/

2.3. Comparative Analysis with AIIB Standards

2.3.1. ESS1 - Environmental and Social Management Assessment

According to the documents and information received from the municipality, environmental licensing will be required for the projects and works covered by this funding. However, the legal authority for licensing will depend on the expected impacts, scale, and polluting potential of each intervention. For certain subprojects — particularly those related to urban drainage — it is understood that municipal authority may apply, as established under CONSEMA Resolution No. 372, which delegates licensing authority to the municipality for projects with local impacts and lower environmental complexity. In contrast, for the subproject proposing the development of a new industrial zone, given the scale and nature of the activity, it is expected that licensing will fall under the authority of the State of Rio Grande do Sul, through FEPAM (State Environmental Protection Foundation). For the remaining subprojects, whose specific interventions are not yet fully defined, licensing jurisdiction will be determined on a case-by-case basis, in accordance with their size and potential environmental and social impacts.

Although the complete project design has not yet been finalized, preliminary data indicate that, for at least some components, licensing procedures will require the preparation of an Environmental Impact Assessment and Report (EIA-RIMA), in line with current legislation. This process will necessarily involve studies addressing both environmental and social aspects. Considering the above, it is important to note that CONAMA Resolution 01/86 is primarily focused on environmental studies, with limited attention to social aspects, and therefore does not fully comply with the requirements of the ESMPF. To address this gap, we recommend that the municipality include, in its Terms of Reference, the requirement to incorporate social studies into the environmental licensing process. Below we present a brief contextualization of the key elements of the environmental licensing legislation applicable, aligned with the AIIB Environmental and Social Framework (ESF) guidelines.

Environmental Impact Assessment

Brazilian environmental legislation, since the 1988 Constitution and Law No. 6,938/1981, establishes that projects that potentially cause significant environmental degradation must undergo a

licensing process that includes the EIAR. This instrument traditionally emphasizes the biophysical aspects of the environment, with less emphasis on social, cultural and economic aspects, especially when related to vulnerable groups.

The AIIB, through its ESF, adopts an integrated approach to environmental and social assessment (ESA), in which impacts are not treated in a segmented manner, but rather considers interrelationships between the environment, communities, human rights, gender equity and climate change. The AIIB also requires that this assessment be proportional to the scale, nature and risks of the project, recognizing that there is no single approach applicable to all cases.

In addition, while the Brazilian EIAR still lacks a systematic approach to cumulative, associated and indirect impacts, the AIIB makes it mandatory to analyze synergistic impacts with other projects and territorial contexts, which significantly increases the complexity and depth of the diagnosis.

Public Participation and Consultation

Social participation in Brazilian licensing is formally consolidated in the requirement of public hearings, as provided for in Art. 225 of the Federal Constitution, in CONAMA (National Environmental Council) Resolution No. 09/1987 and in state and sectoral regulations. However, the Brazilian model is often criticized for adopting an informative and reactive logic, where society is called upon to give its opinion after the technical study is completed, without necessarily guaranteeing effective influence over decisions.

In turn, the AIIB establishes a model of meaningful and continuous consultation, with a focus on the inclusion of vulnerable groups, such as indigenous and traditional communities, women and ethnic minorities. This consultation must occur from the initial stages of the project, with appropriate language, culturally appropriate mechanisms and recording contributions with a documented response. Additionally, the AIIB requires, in applicable cases, Free, Prior and Informed Consultation (FPICon).

Monitoring and Mitigation Measures

Brazilian environmental licensing requires, as a condition for granting licenses, the preparation and implementation of Environmental Monitoring and Control Programs, as well as mitigation, compensation or rehabilitation measures. These programs are established during the licensing process and should be implemented and maintained throughout the project's lifecycle to ensure compliance with the technical guidelines defined in the licensing document. The AIIB requires the preparation, before the start of the work, of an Environmental and Social Management Plan (ESMP), with clear indicators, performance targets and specific mitigation, monitoring and adaptation strategies, the results of which must be continuously monitored, audited and reported to the bank and interested parties. Responsibility for compliance with mitigation measures is clear and falls on both the proponent and the host government entity, under penalty of contractual sanctions.

Grievance Redress Mechanisms

The Brazilian environmental licensing model does not expressly provide for the creation of formal and accessible grievance redress mechanisms (GRM) during project implementation. Although the Public Prosecution's Office, Public Defenders' Offices and the Judiciary System might act, these

channels are slow, formal and distant from the reality of the affected communities, especially traditional and indigenous populations.

The AIIB, on the other hand, requires the establishment of a GRM from the beginning of the project, with characteristics of accessibility, anonymity, transparency and cultural adequacy. This mechanism should allow any affected person or group to file a complaint, with a guarantee of feedback and a reasoned response. The bank also has an independent higher authority (Project-affected People's Mechanism) that can be called upon in cases where the local GRM proves ineffective.

Adaptation to Climate Change

Although Brazil is a signatory to the Paris Agreement and has a National Policy on Climate Change (Law No. 12,187/2009), environmental assessment instruments do not yet systematically incorporate climate risk analysis. The EIAR rarely addresses issues such as climate vulnerability, infrastructure resilience or climate scenario projections.

The AIIB, however, has a specific guideline to consider climate change in all phases of the project. Proponents must identify risks, vulnerabilities and propose adaptation and mitigation measures, in line with international climate commitments. This includes, for example, assessing whether a projected road will be resilient to extreme events predicted for the region decades from now.

Gender

The analysis reveals that Brazilian environmental legislation and its associated instruments still have significant limitations when it comes to incorporating a gender perspective. The current licensing model, centered on the EIAR, lacks normative and operational tools to identify, mitigate and monitor gender-differentiated impacts in large-scale projects.

In contrast, the AIIB offers a more advanced normative framework that considers gender inequality not only as a social justice issue, but also as a critical factor for long-term risk and sustainability. The implementation of sensitive consultations, gender action plans, accessible reporting mechanisms and disaggregated indicators raises the quality standard of projects and contributes to their alignment with international commitments.

2.3.2. ESS2 – Involuntary Resettlement

A comparison between the tenure rules provided for in Brazilian regulations and the safeguards of the AIIB (Asian Infrastructure Investment Bank), especially ESS2 — Land Acquisition and Involuntary Resettlement — reveals different approaches to the recognition of rights and the protection of populations affected by displacements related to infrastructure projects.

In the Brazilian legal system, possession is recognized as a legitimate legal situation, especially when exercised in good faith and in accordance with the social function of property, as provided for in the Federal Constitution and the Civil Code. Laws such as the Statute of Cities and Law No. 13,465/2017 (which deals with urban land regularization) reinforce the possibility of recognizing consolidated occupations, even without formal title, in urban areas. However, in formal expropriation

processes (governed by Legislative Decree No. 3,365/1941), the right to compensation is traditionally linked to formal property ownership. In practice, this can leave informal occupants or leaseholders in a situation of legal uncertainty, unless they are served by regularization or social housing programs. Even so, there are judicial precedents and actions by the Public Prosecutor's Office that recognize the State's duty to compensate squatters affected by public works, especially when they involve vulnerable populations.

In contrast, the AIIB's safeguards policy is more comprehensive and protective. ESS2 establishes that all forms of tenure must be considered in resettlement planning, including formal owners, informal occupants (provided they were residents before the cut-off date), leaseholders, traditional users of common resources, and even informal traders. The fundamental criterion for recognizing the right to compensation is the actual loss suffered—whether of housing, access to land, infrastructure, income, or collective assets—regardless of the legal status of the possession.

The AIIB also requires a clear cut-off date to be defined, communicated in advance to the community. This date establishes a milestone for identifying those eligible for compensation, preventing opportunistic occupations and ensuring predictability. This element, although applicable in Brazil in some cases, is not standardized nationally and often becomes the subject of dispute.

Another aspect in which the AIIB stands out is the requirement that those affected be consulted in a meaningful way throughout the process, with special attention to the needs of vulnerable groups (such as the elderly, female heads of households, people with disabilities, among others). In addition to material compensation, the policy provides social, technical and logistical support, aiming not only to restore, but also to improve living conditions in relation to the situation prior to the project.

In short, while Brazilian legislation offers important instruments, especially in the area of land regularization, it tends to be more restrictive in guaranteeing formal compensatory rights. The AIIB rules, however, adopt a more inclusive approach, focused on equity, human rights and the effectiveness of social protection. For AIIB-funded projects, such as the Guaíba+Resilient Program, the rights matrix and resettlement planning should therefore be guided by the most protective parameters of the ESS2, and may complement national legislation and fill any gaps for the benefit of affected populations. Tables 26 and 27 provide a comparative summary of the types of compensation and protection principles adopted by Brazil and the AIIB.

Table 26. Types of compensation

Situation	Brazil (general)	AIIB (ESS2)
Formal owner	Cash compensation	Compensation equivalent to replacement value
Informal occupant (before construction)	May not have a formal right, but may be compensated for improvements or through social programs.	Entitled to compensation (replacement housing, financial support or resettlement)
Tenant or borrower	No clear provision for compensation	Eligible for compensation or assistance as per resource dependency

Table 27. Protection principles

Social function of the property	Constitutionally recognized	Considered when assessing collective losses
Participation and consultation	Required in cases of removal (e.g. by MPF, Public Defender's Office)	Mandatory, with significant consultation
Vulnerability and equity	Considered on a case-by-case basis, especially by housing programs	Mandatory. Differentiated support for vulnerable groups

Regarding equity in the treatment of people affected by involuntary resettlement, this is a central principle in both Brazilian regulations and the guidelines of the Asian Infrastructure Investment Bank (AIIB), although these approaches present significant differences in terms of scope, operational guarantees, and practical implementation.

In Brazil, equity is grounded in the Federal Constitution, particularly in the principles of human dignity, the social function of property, and the right to housing. However, equitable treatment in the context of expropriations and removals still faces important institutional limitations. Brazilian regulations tend to prioritize compensation for formal property owners, while informal occupants, tenants, or traditional users often depend on specific land regularization programs, housing policies, or judicial decisions to gain access to any form of compensation. Although programs such as *Minha Casa Minha Vida* (My House, My Life) have incorporated vulnerability criteria—such as prioritization of female-headed households or elderly people—these criteria are not always present in resettlement processes linked to public works. Litigation thus becomes one of the main paths through which vulnerable groups seek the recognition of their rights.

In contrast, the AIIB's safeguards policy establishes equity as a mandatory operational principle in all phases of planning and implementing involuntary resettlement. According to ESS2, all affected persons — including formal owners, informal occupants, tenants, traders, and users of common goods — are entitled to compensation, provided their presence in the area predates a defined and publicly communicated cut-off date. The loss of access to housing, land, income, or basic services is the key criterion for applying compensatory measures, regardless of legal tenure status.

Moreover, the AIIB requires that vulnerable groups, such as persons with disabilities, the elderly, traditional communities, or female-headed households, receive differentiated attention. This includes priority in resettlement, personalized social assistance, adaptation of solutions to their specific needs, and continuous post-resettlement monitoring. Meaningful consultation and informed participation are mandatory throughout the process, ensuring that decisions are not made unilaterally and that affected persons can influence the options and formats offered.

Another key distinction in the AIIB's norms is the requirement for accessible grievance mechanisms, protected against retaliation, as well as independent systems for monitoring the implementation of measures. These instruments serve as additional guarantees to ensure that equity is not only a principle but also a verifiable and correctable practice.

In summary, while the Brazilian legal framework recognizes the importance of equity, its implementation in resettlement processes remains partial and often reliant on local interpretation or parallel regularization actions. The AIIB, on the other hand, institutionalizes equity as an essential component of its approach, requiring proportional treatment based on actual losses and social conditions, with special attention to the most vulnerable. For bank-financed projects, such as the

Guaíba+Resilient Program, full adoption of ESS2 parameters helps fill legal gaps and ensures a more just, participatory, and transparent process.

Further details on the resettlement procedures, eligibility criteria, and compensation modalities are presented in a separate Resettlement Policy Framework (RPF) document, which complements this assessment.

Table 28. Protection principles

Aspect	Brazilian regulations	AIIB (ESS2) regulations
Recognition of informal occupations	Partial and variable (depends on regularization)	Recognized for compensation purposes based on actual loss
Treatment of vulnerable people	Indirect (via programs or court decision)	Explicit and mandatory in planning and execution
Equality in access to compensation	Limited by legal status	Based on social and economic criteria
Consultation and participation	Provided for in some programs and guidelines	Mandatory throughout the process
Access to information and complaints mechanisms	Limited and poorly integrated	Accessible and secure mechanisms are required

The rights matrix presented in Table 29 is preliminary in nature and is intended to provide indicative guidance on the types of compensation and resettlement modalities applicable to different profiles of individuals potentially affected by the interventions of the Guaíba+Resilient Program. Its content will be subject to public consultation and may be adjusted according to the specificities of each subproject, based on in-depth field studies and dialogue with the communities involved.

A public workshop is planned, organized by the Guaíba City Council, aiming to present the subprojects, clarify doubts, and gather contributions from civil society regarding resettlement procedures, eligibility criteria, compensation forms, and housing alternatives.

Additionally, the Municipality adopts the principle of prioritizing voluntary resettlement whenever possible. To this end, public calls for voluntary participation will be issued. This strategy aims to ensure greater empowerment of families in the process and enhance the transparency and legitimacy of the adopted solutions.

Table 29. Preliminary rights matrix

Affected Category	Type of Loss	Eligibility Criteria	Rights/Compensation	Delivery Method	Observations
Formal owner of residential property	House and/or land in intervention area	People with legal documentation proving ownership of the affected property	Financial compensation based on full replacement value, no depreciation, or offer of equivalent housing unit	Direct payment into account or via legal process	Includes legally recognized improvements
Informal occupant with possession prior to the cut-off date	Housing in a risk area or construction zone	Individuals occupying the property without formal title, but with continuous residence	Housing replacement in a regularized area or financial compensation proportional to market	Physical relocation with logistical support	There must be proof of residence prior to the cut-off date

Affected Category	Type of Loss	Eligibility Criteria	Rights/Compensation	Delivery Method	Observations
		on site and recognized by the community	value, with technical and social assistance		
Tenants and borrowers	Housing	People who reside in the property under a rental or loan-for-use agreement	Temporary housing assistance and support for accessing a new rental, as well as compensation for moving costs	Direct payment or service provision (depending on the case)	There must be proof of contractual relationship and residence prior to the cut-off date
Informal trader or service provider	Commercial location or reduction of clientele	Formal or informal commercial establishments affected by the removal	Compensation for loss of income, support for business reinstallation and technical assistance for resuming activities	Payment in installments and support for reinstallation	May be subject to enrollment in a micro-credit or training program
Urban or peri-urban farmer (tenant)	Access to land and/or production	Farmers who carry out productive activities in leased or recognized occupied areas, with proof of active production before the cut-off date	Financial compensation proportional to the harvest and technical support	Direct payment and guidance for new production area	Assistance for integration into municipal agricultural programs
Vulnerable population (e.g. elderly people living alone, people with disabilities)	Housing, support network or community infrastructure	Individuals in situations of social or economic vulnerability	Priority support for resettlement and complementary social services	Technical support and dedicated social team	Post-resettlement monitoring by a multidisciplinary team
Community with collective space (church, association, sports court, etc.)	Infrastructure for collective use	Collective spaces for public use that are affected, such as public sports courts, churches, neighborhood associations, etc.	Replacement or reconstruction of the structure in the resettled area or nearby	Implemented by the City Council with community participation	Must be included in the resettlement urban planning

2.3.3. ESS3 – Indigenous Peoples

ESS3 of the AIIB establishes guidelines to ensure that projects respect the identity, rights, and ways of life of Indigenous Peoples. Among its requirements are the conduct of Free, Prior, and Informed Consultation (FPICon), impact mitigation, culturally appropriate benefit-sharing, and the existence of effective grievance mechanisms.

The Brazilian Legal Framework yields significant legal alignment with these principles. The 1988 Federal Constitution recognizes the original rights of Indigenous Peoples to the lands they traditionally occupy and guarantees the preservation of their social organization, customs, languages, beliefs and traditions (Art. 231). Furthermore, Brazil is a signatory to ILO Convention No. 169, which establishes the right of Indigenous People and Tribal Peoples to be consulted through appropriate procedures and representative institutions whenever legislative or administrative measures may directly affect them (article 6), in line with AIIB ESS3 FPICon. In specific situations – such as relocation – ILO Convention No 169 explicitly requires free, prior and informed consultation (FPIC). Brazil has not yet fully regulated the implementation of FPIC, and culturally appropriate grievance mechanisms are still lacking. Additionally, there are persistent weaknesses in integrating environmental licensing

procedures with the effective safeguarding of Indigenous rights. The application of ILO Convention No. 169 is often inconsistent, and no consolidated instruments exist to ensure benefit-sharing or the continuous assessment of sociocultural impacts throughout the project lifecycle.

In the context of the Guaíba+Resilient Project, based on prior consultations with the Municipality, no Indigenous communities were reported within the areas of influence of the planned subprojects. However, there are indications of the presence of traditional communities, such as artisanal fishers. At the broader municipal level, there are records of two Indigenous settlements in Guaíba, both associated with the Guarani Mbya ethnic group, currently listed as "under study" - meaning they are areas traditionally occupied but not yet formally demarcated as Indigeneous Lands by the National Foundation for Indigenous Peoples (FUNAI).

The Arroio do Conde Indigenous Settlement, associated with the Kaingang people, is located near the northern boundary with the municipality of Eldorado do Sul and is attributed to that municipality by FUNAI. According to the Human Rights and Citizenship Commission (2020) families are currently encamped along BR-116 highway in this area.

The Petim and Arasaty Indigenous Settlements are located in the central-eastern region of Guaíba. For both, no public information is available regarding the number of residents or families, nor the size of the claimed territory.

According to official data from FUNAI (as of June 27, 2025), there are no officially recognized Indigenous Lands within the municipality of Guaíba (FUNAI, 2025)). There are also studies indicating the presence of archaeological heritage near Arroio do Conde (Leite, 1975). However, according to the municipality, there are discrepancies between the FUNAI data and the actual presence of Indigenous communities observed in the territory.

It is important to note that although ESS3 specifically addresses “Indigenous Peoples”, defined by criteria such as self-identification, collective attachment to ancestral territories, and distinct sociocultural identity, the standard does not automatically apply to other traditional communities (such as Quilombolas, riverine populations, or extractivist communities) unless they meet similar criteria as outlined by the Bank.

However, in the Brazilian context, it is a recommended practice—including in international audits—to apply ESS3 guidelines by analogy to traditional peoples and communities whenever there is social vulnerability, strong territorial attachment, and a distinct cultural identity. The Brazilian Constitution (Article 231) and Decree No. 6,040/2007, which establishes the National Policy for the Sustainable Development of Traditional Peoples and Communities, ensure territorial and cultural rights for various groups, including Quilombolas, artisanal fishers, riverine people, extractivists, Afro-Brazilian religious communities, and Roma people.

Therefore, it is recommended that the project conduct a more detailed preliminary analysis of the presence and interaction of the planned works with traditional territories and communities, even if they are not formally Indigenous. If direct or indirect impacts are identified, the application of ESS3 principles—adapted to the specificities of these communities—is advised, as discussed in the gap analysis table comparing Brazilian legislation and AIIB’s ESS3.

2.4. Gap Analysis and Proposed Measures

2.4.1. Gap Analysis under ESS1

When relevant social and environmental risks or impacts are identified, the Bank requires that the client conduct an assessment proportional to the severity of those effects, including measures to avoid, minimize, or compensate them. The Municipality of Guaíba, as the client, must also ensure information disclosure, conduct meaningful public consultations, and adopt accessible grievance mechanisms. Environmental and social requirements must be included in project contracts, and their implementation must be monitored. Table 30 presents the identified gaps in relation to ESS1.

Table 30. ESS1 Gap Analysis.

Safeguard	Identified gaps	Suggested Adjustments
Environmental and Social Impact Assessment (E&S)	Lack of a structured approach to broad cumulative and social impacts; need for greater integration between environmental and social variables.	Include in the Terms of Reference for contracting environmental studies related to environmental licensing the need for a structured and integrated social assessment with cumulative and/or synergistic impacts. Establish actions for managing and controlling social risks.
Engagement of concerned parties	Specific and non-continuous public consultations. Need for improvements in clarifications to local communities and documentation/recording of participatory processes.	Include in the Terms of Reference the requirement for duly publicized and documented public consultations, ensuring inclusive stakeholder engagement. Require the development of a communication plan within ToR for contracting works, establishing clear, efficient and responsive channels for information sharing and grievance redress, including rapid mechanisms for complaints.
Labor Compliance and Occupational Health and Safety	Lack of proactive instruments for monitoring occupational health and safety (OHS) conditions, including the absence of formal channels for workers to report OHS incidents, violation, or grievances to employers, regulatory authorities, or oversight bodies. Additionally, there is a lack of structured mechanisms for social monitoring and third-party verification of labor compliance and workplace safety standards.	Include a contractual obligation for the contractor to establish and report on key OHS performance indicators (e.g., regulatory compliance, incident rates); implement an accessible worker GRM for confidential reporting of OHS concerns and grievances; prepare a Worksite Manual with health and safety procedures, reporting channels, and roles; Ensure a community GRM is also in place, in line with AIIB requirements.
Gender Equality and Social Inclusion	Lack of requirement for gender impact analysis and preparation of Equity and Gender Action Plans in projects.	Insert contractual obligations for gender analysis and equal pay, as well as Incentive Plans for the participation of women and vulnerable groups in all phases of projects.
Cultural Historical Heritage	Impact assessment may be superficial and without prior consultation with the community involved. Little integration between IPHAN and the licensing agencies.	Insert a contractual obligation to assess impacts on historical and cultural heritage with community participation and consultation. Insert a contractual obligation to establish a communication plan to disseminate information regarding the project and upcoming consultations.

Safeguard	Identified gaps	Suggested Adjustments
Biodiversity and Critical Ecosystems	High convergence, with the need to reinforce monitoring mechanisms to monitor and meet the premises of the licensing documents.	Insert contractual obligation regarding compensation and conservation plans with effectiveness indicators, consisting of specific targets and continuous monitoring mechanisms. Maintain interface with structured social assessment data.
Climate Change and Resilience	Need for climate risk assessment and integration with national and international targets for reducing GHG emissions and adapting the territory.	Include in the Terms of Reference for contracting environmental studies related to environmental licensing the need for climate risk assessment based on robust data composed of long time series and recognized methodology in the various phases of the projects. Establish monitoring indicators related to the long-term adaptation and resilience of the territory.
Environmental and Social Management and Monitoring (PGAS)	Absence of requirement to establish Environmental and Social Management Plans that integrate the identified relevant social aspects, performance, and governance indicators.	Insert a contractual obligation to standardize projects' Environmental and Social Management Plans with regular monitoring and reporting schedules that focus on AIIB requirements, including indicators of governance, sustainability, and relevant social aspects.

2.4.2. Gap Analysis under ESS2

Table 31 below presents a preliminary gap analysis between the requirements of AIIB's ESS2 safeguard—which addresses land acquisition and involuntary resettlement—and the current normative framework in the Brazilian context. The comparison highlights critical points where the national framework may not provide sufficient or systematic protection to populations affected by infrastructure projects, especially in situations of informality, social vulnerability, or the absence of effective monitoring and participation mechanisms. Based on these gaps, recommendations are made to align the procedures and safeguards of the Guaíba+Resilient Program with AIIB standards, ensuring greater equity, predictability, and transparency in resettlement processes.

Table 31. ESS2 Gap Analysis

Safeguard (ESS2)	Identified gaps	Suggested Adjustments
Recognition of informal occupation	Partial and non-standardized recognition; dependence on specific programs or judicialization.	Adopt an approach oriented towards actual loss, as per ESS2, including informal occupations prior to the cut-off date.
Definition of cut-off date	Lack of national standardization for defining and communicating the cut-off date.	Define and communicate the cut-off date in advance for all sub-projects, with documentation accessible to the community.
Significant participation and consultation	Sporadic, non-continuous public consultations, with low influence power of those affected.	Require engagement plan for interested parties, recording of consultations, continuity, and possibility of incorporating contributions.
Treatment of vulnerable groups	Vulnerability criteria applied in a non-systematic manner; irregular coverage in resettlements linked to	Include mandatory clauses for priority treatment of vulnerable groups, with specific and differentiated support.

Safeguard (ESS2)	Identified gaps	Suggested Adjustments
	construction work.	
Compensation based on actual loss	Compensation linked to the formality of possession, without an approach based on actual loss.	Base compensation on actual loss (of housing, income or access), regardless of the legal status of tenure.
Technical, social and logistical support	Support is not a regulatory requirement and is at the discretion of local policy.	Include as a contractual obligation the provision of technical, social and logistical support to resettled families.
Accessible and secure grievance mechanisms	Complaints channel often non-existent or without guarantees of confidentiality and response.	Establish an accessible, confidential complaints channel with safeguards against retaliation, in accordance with AIIB standards.
Independent monitoring of resettlement	Absence of formal requirement for external and independent monitoring of the process.	Address independent external monitoring of resettlement processes and participatory assessment with those affected.
Prioritization of voluntary resettlement	Uncommon practice; based on local initiative and not on national standards.	Publish notices of participation for voluntary resettlement and provide support for families' informed decision-making.
Replacement of collective infrastructures	Collective infrastructures often disregarded or neglected in relocation.	Include the replacement or reconstruction of equipment and collective spaces as a mandatory part of the resettlement sub-projects.

2.4.3. Gap Analysis under ESS3

AIIB's ESS3 sets forth guidelines to ensure that financed projects respect the rights, cultural identity, dignity, and traditional ways of life of Indigenous Peoples. The standard includes requirements such as meaningful Free, Prior, and Informed Consultation (FPICon), impact assessments, and benefit-sharing. Brazilian legislation shows convergence in constitutional provisions and international commitments but still lacks regulatory and operational instruments to ensure full compliance with ESS3.

Although no Indigenous Land or Settlements have been identified in the areas of influence of the subprojects presented by the Municipality, there is potential interaction with traditional communities. In such cases, it is recommended that the principles of ESS3 be applied, with appropriate adaptations to the specific characteristics of these groups. The following matrix has been prepared from that perspective.

If Indigenous Peoples are later identified within project influence areas that may suffer direct and significant impacts, it will be necessary to prepare an Indigenous Peoples Planning Framework (IPPF), given that the specific impacts are not yet clearly defined.

Table 32. ESS3 Gap Analysis

Safeguard	Identified gaps	Suggested Adjustments
Prior Consultation	Non-systematic practical application and without a national protocol.	Develop a Prior Consultation Protocol specific to the project, based on good practices and validation with communities.

Safeguard	Identified gaps	Suggested Adjustments
Free, Prior and Informed Consultation	Regulating required for full compliance.	Include contractual requirement to obtain CPLI as per ESS3 guidelines if there is any impact identified on Indigenous People.
Socio-cultural Impact Assessment	Lack of systematization and specific and clear requirements during licensing processes.	Include in the Terms of Reference for contracting environmental studies related to environmental licensing the need for social assessment as required in ESS3. Assess the need to implement an IPP in case of any impact identified on Indigenous People.
Grievance Redress Mechanisms (GRM)	Absence of requirement.	Create a Complaints Mechanism that is sensitive to local culture, with the possibility of anonymous complaints and community mediation.
Participatory Monitoring	Lack of a more participatory and intercultural approach in licensing processes.	Include a participatory monitoring clause in the contract with the project executor, with indicators defined with the traditional community.

2.5. Institutional Implementation Considerations

With regard to institutional arrangements, it is important to highlight that the municipality, through the enactment of Municipal Decree No. 123/April 2025, established the Office for Special Projects (Gabinete de Projetos Especiais – GPE), directly linked to the Mayor's Office. Its responsibilities include, among others, the management of international credit operations, with the allocation of experienced and qualified municipal civil servants to carry out their functions.

Despite this measure, it will be necessary for the Municipal Administration to make a concerted effort to strengthen institutional capacity for the implementation of the Guaíba+Resilient Program, in order to ensure its proper execution and sustainability by monitoring and managing the project in compliance with AIIB standards.

The Municipality's capacity was assessed in relation to several criteria for managing environmental and social risks, including:

Specialized technical team*:* The GPE currently lacks environmental and social specialists on its technical staff, making it necessary to hire directly and to contract a consulting firm to support the acquisition and monitoring of environmental licensing documents and program management. It will also be necessary to establish a technical support team for communication with experts in the area to ensure the management of environmental and social risks, meaningful stakeholder engagement, and the implementation of a structured grievance mechanism in line with AIIB principles, guidelines, and procedures.

Environmental and social management system: The GPE does not have a structured environmental and social management system. Once the team is in place, it should be trained in the AIIB's Environmental and Social Standards (ESS).

In light of the above, the following measures are recommended for the effective management of environmental and social risks:

• Establishment of a qualified team for AS risk management within the GPE, including environmental and social specialists with appropriate work hours. These professionals may be sourced from municipal secretariats or hired directly by the Municipality under this financing agreement;

• Contracting of a specialized consulting firm to support Program management;

• Training of the GPE team in the AIIB's AS policies;

• Implementation of institutional partnerships to enhance response capacity and to meet the various demands of all phases of project development and execution.

2.6. Conclusion and Technical Recommendations Derived from the Legal Analysis

Brazil's socio-environmental legislation is among the most advanced in the world, reflecting a historical commitment to environmental protection and the promotion of social rights. The 1988 Federal Constitution is the foundational legal document, recognizing an ecologically balanced environment as a fundamental right (Art. 225) and establishing duties for the public sector and civil society in its defense. The Constitution also enshrines social rights related to work, health, gender equality, adequate housing, and the protection of vulnerable groups—forming a legal basis compatible with principles of sustainability, social justice, and human rights.

The regulatory framework includes key legislation such as the National Environmental Policy (Law No. 6,938/1981), which introduced environmental impact assessment and control instruments, and the Environmental Crimes Law (Law No. 9,605/1998), which sets civil, criminal, and administrative penalties for environmental damage. The environmental licensing system, established under Article 10 of Law No. 6,938/1981 and regulated by CONAMA Resolution No. 01/1986, remains the main mechanism for the prior control of project impacts.

Brazil is also a signatory to several international agreements that influence and reinforce its national legal framework. Notable examples include the Convention on Biological Diversity (CBD), the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, the UNESCO World Heritage Convention, and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). These international commitments are reflected in national policies such as the National Biodiversity Policy, the National Climate Change Policy (Law No. 12,187/2009), and the National System of Protected Areas (Law No. 9,985/2000), helping align domestic practices with global conservation, climate, and collective rights agendas.

In the social domain, legislation such as the Consolidation of Labor Laws (CLT), the National Occupational Health and Safety Policy (Decree No. 7,602/2011), and the Regulatory Standards of the Ministry of Labor guide preventive actions related to occupational health, safety, and worker well-being. Gender equity and anti-discrimination provisions are present in legislation and specific policies, such as the Maria da Penha Law (Law No. 11,340/2006) and the National Plan for Women's Policies—although implementation still lacks effectiveness, particularly in the context of large infrastructure projects.

In the context of AIIB financing, Brazilian legislation offers a solid foundation for complying with international socio-environmental standards. These standards require additional safeguards for areas such as the protection of Indigenous Peoples and traditional communities, the prevention of

impacts on natural areas and cultural heritage, workers' rights, gender equity, and occupational health and safety. Harmonization between national and international frameworks is operationalized through instruments such as Environmental and Social Management Plans (ESMP), Gender Inclusion and Equity Plans, Stakeholder Engagement Plans (SEP), and Indigenous Peoples Plans (IPP), ensuring legal compatibility and adherence to international best practices.

This normative convergence aims not only to ensure formal compliance with legal and contractual requirements but also to promote a development model that is more equitable, transparent, and environmentally sustainable.

Despite its robustness, the Brazilian Environmental Impact Assessment - EIAR (EIA-RIMA) does not fully meet the requirements of the AIIB's socio-environmental frameworks. While there is high convergence regarding environmental aspects—such as ecological impact assessment, natural resource use, and mitigation measures—there are recurrent gaps in social, institutional, and Indigenous Peoples' dimensions, particularly in the following areas:

· *Stakeholder engagement:* EIAR provides for public hearings, but international banks require continuous, documented, and culturally appropriate consultation processes, especially with Indigenous Peoples, traditional communities, and vulnerable groups.

· *Analysis of alternatives:* EIAR typically presents limited technical and locational alternatives. Banks require more structured and comparative analyses of alternatives based on environmental, social, and economic criteria.

· *Assessment of specific social risks:* The AIIB framework explicitly addresses labor rights, gender equity, occupational health and safety, involuntary resettlement, and impacts on cultural heritage—areas that are often addressed in only a partial or generic manner in EIAR.

· *Detailed management plans:* Banks require specific and detailed management instruments, such as Gender Inclusion Plans, Resettlement Action Plans, and Occupational Health and Safety Plans, which are not typically required or detailed under EIAR.

· Indigenous Peoples: While Brazilian licensing procedures through EIAR contain elements compatible with the AIIB's ESF—especially regarding the identification and evaluation of impacts on Indigenous Communities—significant gaps remain. These include the lack of formalized plans, the requirement for consent, and the creation of culturally appropriate participation and grievance mechanisms.

This partial non-alignment does not prevent national licensing, but it does require the adoption of complementary instruments to ensure full compliance with Bank standards. Therefore, while EIAR serves as a solid and legally recognized impact assessment tool, its use alone is insufficient to fully meet international frameworks. Strengthening complementary approaches is necessary, focusing on participatory governance, social monitoring, respectful and appropriate engagement with Indigenous and traditional communities, and the inclusion of historically marginalized groups, as identified in the normative gap analysis.

3. Environmental and Social Management and Monitoring Considerations

This section presents integrated environmental and social management and monitoring considerations for the sub-projects under the Guaíba+Resiliente Program, aligned with the Asian Infrastructure Investment Bank (AIIB) Environmental and Social Framework (ESF), including its Environmental and Social Policy (ESP) and Environmental and Social Standards (ESSs).

3.1. Guidelines for the Implementation of Sub-projects

Environment and Green Infrastructure

Vegetation preservation and ecological connectivity

- Avoid vegetation suppression in ecologically sensitive areas and, when unavoidable, restore losses with native species.
- Implement ecological corridors and strips of continuous vegetation to maintain connectivity between fragments and mitigate habitat fragmentation.
- Prioritize locational alternatives that reduce vegetation cover suppression and ensure ecological connectivity.
- Adopt hybrid solutions that integrate engineering with natural elements, such as vegetated open channels and margin bioengineering.

Control of soil sealing and promotion of green infrastructure

- Control the expansion of sealing in ecologically sensitive areas, using permeable pavements and sustainable urban drainage solutions.
- Preserve soil permeability in areas not directly occupied, prioritizing the use of green infrastructure.
- Integrate infiltration and retention devices into the urban network, promoting natural infiltration and damping of flow peaks.

Protection of APPs, margins and sensitive habitats

- Avoid direct interventions in Permanent Preservation Areas (Áreas de Preservação Permanente - APPs) and catchment woodlands, respecting the ecological and legal occupation criteria.
- Preserve riverside vegetation and natural landscape elements, integrating them into the urban project.
- Outline and protect ecologically sensitive areas before the start of the works, ensuring their integrity throughout the intervention.
- Avoid destruction or alteration of sensitive habitats by adopting ecological compensations when unavoidable.

Swamps and wetlands management

- Preserve the natural dynamics of floods in floodplain and wetlands areas, avoiding continuous dams or works that compromise their ecological functioning.
- Value the functional role of wetlands as natural infrastructure, generating ecosystem services for water regulation, considering their importance in engineering projects.
- Compensate for the loss of wetlands through the creation or restoration of functionally equivalent zones, ensuring ecological connectivity.

Erosion, Slope and Sediment Management

- Control erosion processes and protect unstable slopes, maintaining vegetation cover and avoiding sharp-angled cuts.
- Employing bioengineering techniques to stabilize banks and slopes, integrating them into the landscape and natural systems.
- Consider the sedimentary balance in the projects and avoid interventions that aggravate changes in the natural regimes of sediment transport and deposition.

Prevention and remediation of contaminated soils

- Conduct prior investigation of construction work areas to identify possible environmental liabilities and contaminated soils.
- Require contaminated area management plan (PGAC) before starting excavations in locations with doubts.
- Establish strict environmental and occupational control protocols in areas at risk of contamination, minimizing the exposure of workers and ecosystems.

Integrated drainage management and soil planning

- Plan and execute urban drainage systems integrated with land use, considering infiltration capacity and natural flow patterns.
- Preserve and restore areas with marginal and submerged native vegetation as part of drainage strategies.
- Incorporate nature-based solutions into urban drainage planning, combining technical efficiency with ecological functions.

Social and Territorial Management

Resettlement and protection of vulnerable populations

- Avoid forced displacement whenever possible and, if unavoidable, ensure dignified, participatory resettlement with reestablishment or compensation of benefits eventually lost by the cessation or allocation of services (ecosystemic and anthropic) and their effects on quality of life.
- Prioritize voluntary resettlement, guaranteeing land rights, prior mapping of occupations, and active listening to the families involved.
- Ensure income restoration measures, psycho-social support and social integration of resettled families, especially in vulnerable contexts.

Land regularization and socio-environmental justice

- Carry out land regularization in an integrated manner with urbanization and access to public services, based on criteria of socio-environmental justice.
- Ensure transparency, conflict mediation and land resolution prior to the works, ensuring legal certainty and minimizing judicialization.
- Incorporate collective trauma and social demands as legitimate dimensions of socio-environmental impacts, adopting processes of listening and social mediation.

Social participation and community communication

- Establish a formal participation mechanism, in force in all sub-project development periods.
- Maintain permanent channels of dialogue with the population, from planning to the post-work phase, through workshops, public consultations and participatory forums.
- Structure a social communication plan with accessible language and multiple channels, ensuring a return to demands and articulation with local leaders.
- Encourage community engagement with educational and informative actions, fostering belonging and social control over projects.

Protection of territorial cohesion and ways of life

- Avoid community fragmentation and ensure the permanence of social groups in their territories, including in the face of real estate appreciation and gentrification processes.
- Ensure instruments to protect the permanence of vulnerable populations, respecting their ways of life and cultural reproduction dynamics.
- Protect the traditional and symbolic uses of the territory, recognizing the social and cultural value of the environments.

Promoting equity and access to urban spaces

- Ensure democratic access to re-qualified public spaces, with continuous maintenance, universal accessibility and inclusive design.
- Ensure territorial connectivity between residential, commercial and service areas, promoting socio-spatial cohesion.
- Apply specific safeguards for vulnerable populations, preventing forced and discriminatory evictions.

Climate Change Assessment

The climate risk analysis is based on an assessment of the risks and impacts on the municipality infrastructure, and its social, economic systems as well as its resilience and adaptability capacity, and the required projects to improve it.

The main climate risk sources are:

Stormwater - Pluvial or urban drainage: This refers to flooding in the urbanized area of the of the town. This type of flood is mainly due to impervious areas, conduits and channels, which increases the mean peak flood by about 600 to 700%; and floods from *River /Lakes (*Guaíba Lake) which are natural floods from a basin system of more than 80,000 km2. The climate variability and change in these floods are accessed through the rainfall intensity – duration in Guaíba and the Lake

floods which are result of the rain in a large basin area of Jacui River and Delta, wind effects on the lakes and likely the Atlantic Ocean Sea Level.

Stormwater: In urban areas, it requires the Urban Drainage Master Plan, which develops the solutions for this type of flood in each urban basin of the town, considering a revised rainfall intensity – duration curve that incorporates climate change effects based on this century's scenarios. This plan will be the basis for flood control measures related to stormwater. The municipality will implement a regulation to control future urbanization, since for new developments will increase runoff from new construction.

River Flood: The main system nearby Guaiba is the lake. There are flood records from a gauge in Porto Alegre, on the other side of the Lake with information dating back to 1899, which is 126 years of data. There is a need to develop an assessment of the impacts due to climate change on floods, considering rainfall-runoff in the basin and the Ocean Atlantic sea level change in flood levels in Guiaba Lake nearby Guaiba. This assessment will define the main protective measures for the town. The Northern part of the town is affected by floods from Jacuí River upstream and its delta, which affect part of the town population in that part of the city.

Table 33 below shows a summary of Guaíba's current exposure and vulnerability to these main causes of climate impact. Table 34 presents the relationship of climate risk to urban aspects of the city.

Table 33. Climate Vulnerability and risk sensitivity.

Risk	**Stormwater**	**RIver/Lake Flood**
Actual	Moderate	Moderate/high
Description of flood conditions	Some areas of the town are affected by the absence of a stormwater system. Near the lake there are floods due to the combination of stormwater and river floods. There is no Urban Drainage Master Plan to ensure integration with the Urban Plan	Part of the town has important impact of the Fluvial Flood such as in 2024; Part of the city has effect on frequent floods (due to Jacui River floods which flows through floodplain in North of the town are).
Future with climate change	Moderate/ High It will increase the intensity and the existing impacts	Moderate/High Moderate for Guaiba Lake floods, but High frequency due to Jacuí River
Description of flood conditions	Increase in the rainfall intensity and flow affected. Increase flood frequency in the stormwater.	Increase flood levels due to climate change in the border of the city. Increase the frequency of floods impacts due to Jacui River.

Table 34. Assessment of Urban aspects and Climate Risk.

Urban Aspects	**Stormwater**	**River Floods**
Governance	There is no dedicated institution for governance of stormwater in the city; There is no Urban Drainage Master	Non-structural measures of flood zoning in the risk area near the lake together with recreational

	Plan, and the regulation should be be based on local information.	areas.
Urban Planning	The urban Plan and Stormwater plan should have a connection and opportunities to develop solutions based on green infrastructure.	Introduce flood zoning in the Urban Master Plan.
Monitoring	Limited information on stormwater in the town.	Improve monitoring along the lake and risk area.
Industrial and Commercial	Development of drainage requirement with safe levels of implementation	Do not allow the development of the industrial and commercial facilities in risk areas
environment	Develop stormwater management with opportunities for green infrastructures in public and private areas	Environmental protection of the Guaiba waterfront

Urban Planning and Mobility

Urban connectivity and functional integration

- Ensure connectivity between residential, commercial and service areas, prioritizing universal accessibility and preferential routes for the population.
- Promote the integration between the implemented infrastructure and the road system, public transport and active mobility, with inclusive and multi-functional urban design.
- Connect the re-qualified urban network to public facilities, commercial areas and cycling networks, articulating the project with housing, education and health plans.
- Promote multimodal solutions and prioritize routes that ensure mobility during extreme events, such as floods and roadblocks.

Accessibility and road safety

- Incorporate road safety and urban design principles with modal segregation, ensuring accessible sidewalks, safe routes and adequate circulation of pedestrians, cyclists, and public transport.
- Plan the work in stages with clear schedules and measures that ensure safe and informed alternative routes, especially for vulnerable groups, emergency vehicles and public transport.
- Ensure minimum circulation during construction work to maintain active mobility, trade operation and access to essential services.

Intersectoral planning and articulation

- Plan interventions with adaptive schedules and articulated with the calendars of the affected urban services, such as education, health, transport and public safety.
- Articulate the mobility project with sectoral plans and contingency strategies, including evacuation routes and humanitarian flow in emergency contexts.
- Integrate road planning into regional logistics systems, considering the capacity of the urban network and its articulation with production centers.

Qualification of re-qualified urban space

- Promote the valorization of cultural, environmental and local identity elements in the urban re-qualification project.
- Incorporate green vegetation and infrastructure into the road layout and public spaces, favoring thermal comfort, coexistence and a qualified landscape.
- Plan the waterfront and public spaces based on participatory planning and zoning instruments, ensuring equitable enjoyment and resilience in the face of floods.

Institutional Governance and Interfederative Coordination

Institutional strengthening and municipal management

- Ensure the continuous training of municipal teams involved in the environmental, social and land management of the program, including construction, environmental, social assistance and planning technicians.
- Strengthen the institutional capacity of municipal agencies to monitor works, inspect conditions and manage conflicts, with adequate allocation of human and financial resources.
- Create stable institutional arrangements to ensure the continuity of socio-environmental actions throughout all phases of the project, including after the completion of the works.

Intersectoral and interfederative coordination

- Establish coordination mechanisms between departments and municipal technical bodies, promoting regular flows of information, joint deliberation and integration of agendas.
- Promote the articulation between municipal, state and federal levels to enable licensing, resettlement, environmental compensation and protection of sensitive areas, respecting competences and synergies.
- Formalize inter-institutional partnerships through technical cooperation agreements, with a clear definition of roles and responsibilities in complying with the measures.

Planning and regulation instruments

- Integrate socio-environmental guidelines into urban planning policies and instruments, such as the Master Plan, Urban Mobility Plan, Sanitation Plan, and Environmental Zoning.
- Ensure consistency between the executive project of construction works and the local regulatory instruments, promoting regulatory compatibility and legal certainty.
- Use the data and recommendations produced as a basis for updating sectoral public plans and policies.

Transparency, social control, and legitimacy

- Ensure active transparency mechanisms on objectives, impacts and measures, with public disclosure of reports, schedules and georeferenced data.
- Promote the institutional legitimacy of the project through citizen participation, active listening and a structured return to the demands raised in the consultation spaces.
- Establish permanent institutional channels for listening and conflict mediation, with a trained team and clear response protocols.

- Observe the legal accountability procedures at the governmental and social levels (accountability).

Risk Management and Operational Safety

Hydrological, geotechnical and environmental risk management

- Assess in advance the hydrological, geotechnical and environmental risks associated with each intervention, especially in areas with a history of flooding, instability of slopes or contaminated soils and water.
- Include extreme climate scenarios and updated hydrological projections in construction works sizing, avoiding solutions that aggravate upstream or downstream vulnerabilities.
- Avoid works that block or redistribute natural flows in an uncontrolled way, promoting solutions that respect hydrological dynamics and reduce systemic risks.
- Provide specific protection measures in areas of unstable soil, such as reinforcement of foundations, containment and shoring techniques, and geotechnical monitoring.
- Avoid procedures related to damage to ecosystems that generate essential ecosystem services or those of importance to social benefits and well-being.

Safety during the execution of construction works

- Ensure the occupational safety of workers through protection protocols, control of contaminated areas and waste, and sediment management during excavations.
- Adopt contingency plans specific to the risks of the work, including emergency plans for floods, collapses, landslides and accidents with heavy machinery.
- Delimit risk areas during execution, with adequate signaling, physical barriers and access control, especially in urban areas with a large movement of people.
- Plan the execution of the works in a staggered manner and with control of service fronts, avoiding the simultaneous exposure of large unstable or contaminated areas.

Technical protocols and licensing requirements

- Require confirmatory investigations of environmental liabilities and preparation of contaminated area management plans (PGAC) prior to the start of works in suspicious locations.
- Fully comply with legal environmental licensing requirements, with special attention to interventions involving native vegetation, wetlands, APPs or vulnerable populations.
- Integrate site safety plans with environmental and social management instruments, ensuring consistency between technical and operational requirements.

Infrastructure & Public Utilities

Reordering and modernization of technical networks

- Make the implementation of the construction works compatible with the reordering of existing technical networks (sanitation, drainage, energy, telecommunications), avoiding interference and overlaps.

- Provide for the replacement and modernization of obsolete or vulnerable networks during the execution of the works, prioritizing solutions that reduce losses and improve urban efficiency.
- Incorporate physical protection measures of technical networks, such as enveloping, demoting or relocation, when there is a risk of structural damage during the intervention.

Ensuring continuity of essential services

- Ensure the maintenance of the operation of essential public services (water, sanitation, energy, transport, health and education) during the execution of the works, through alternative routes, provisional supply and coordinated actions.
- Carry out detailed planning and integrated schedules with service operators to minimize interruptions, ensuring prior communication with affected users.
- Predict early warning and response systems for disruptions or technical failures in critical networks, with teams and materials on standby.

Integration with urban systems and infrastructure improvement

- Promote the integration of the new infrastructure with existing urban systems, ensuring functional coherence and compatibility of technical standards.
- Take advantage of interventions to qualify local urban infrastructure, including expanding networks, improving access and installing sustainable devices.
- Plan solutions that optimize the operation and maintenance of networks in the long term, focusing on durability, technical accessibility and operational efficiency.

Local Economic Development and Land Use

Economic enhancement of the territory and strengthening of local trade

- Promote the urban and landscape valorization of the re-qualified areas as a vector of local economic streamlining, strengthening neighborhood commerce and existing productive circuits.
- Consider the impacts on trade and services during the execution of the works, planning alternative routes, adequate signaling and mitigation actions that reduce economic losses.
- Encourage partnerships with local entrepreneurs and sustainable production chains, taking advantage of the construction and post-work phase to generate employment and income.
- Integrate the program's objectives into municipal economic development strategies, promoting uses compatible with the productive vocation of each territory.

Urban land use and occupation management

- Make infrastructure projects compatible with urban zoning and master plans, avoiding occupations in inappropriate areas and promoting the rational use of urban land.
- Plan the occupation of urban voids and underutilized areas based on sustainability, accessibility and territorial integration criteria.
- Establish urban parameters that guide the occupation of the surroundings of the new infrastructures, ensuring a balance between residential, commercial and institutional uses.

Prevention of gentrification processes and real estate pressure

- Monitor the effects of real estate appreciation in the re-qualified areas and adopt measures to ensure the permanence of vulnerable populations in the benefited territories.
- Provide regulatory instruments and mechanisms to protect popular housing, such as Special Areas of Social Interest (Zonas Especiais de Interesse Social - ZEIS), incentives for social leasing and eviction control.
- Articulate housing and land policies with urban re-qualification projects, promoting social inclusion and diversity of uses in the urban fabric.

Integration and Articulation Guidelines

- Physically consolidate the Perimeter Ring Road, promoting the integration between the Resilient Roads, the Logistics and Industrial Hub, the Celupa Channel and the Re-qualification of the Waterfront.
- Coordinate the construction implementation schedules, avoiding overlapping fronts in contiguous or interdependent areas, especially where there is a functional intersection between drainage, roads and waterfront.
- Institutionally articulate the sub-projects through a multisectoral governance group, ensuring strategic decisions are shared between the departments involved.
- Integrate Resettlement and Land Regularization Plans between sub-projects with potential displacements, adopting unified criteria and articulated territorial coverage.
- Mitigate cumulative impacts on environmentally sensitive areas and ecological corridors, with joint guidelines for vegetation suppression, habitat fragmentation and environmental offsets.
- Adopt Nature-Based Solutions in an integrated manner, mainly in drainage, waterfront and roadway sub-projects, to promote water retention, erosion control and ecological restoration.
- Ensure territorial connectivity and equitable mobility by ensuring that sub-projects reinforce the accessibility of vulnerable neighborhoods to public facilities and economic opportunities.
- Prevent the intensification of socio-spatial vulnerabilities by promoting interventions that favor the reconnection of historically isolated areas, such as the Alegria and Florida neighborhoods.
- Provide for institutional and operational overloads arising from the simultaneous execution of sub-projects, with prior planning of the municipal management, licensing and inspection capacity. (all sub-projects).

3.2 Consolidated Plan of Monitoring and Management Actions

Urban Flood Management Works

The Urban Flood Management Works sub-project integrates the strategy of the Guaíba+Resilient Program to increase the territory's adaptive capacity in the face of extreme hydrometeorological events. Its actions range from planning to the operation of the implemented systems, combining engineering solutions with socio-environmental measures, across the intervention phases.

Monitoring Axes

The continuous monitoring of the works is organized around four main axes:

- **Environmental quality and physical stability:** Monitoring of water bodies, sediments and soil; control of turbidity, heavy metals and coliforms; evaluation of geotechnical stability through settlements, cracks and soil movements.
- **Hydrological and ecological performance:** Evaluation of the efficiency of drainage systems; flow measurement, soil sealing and sediment transport; monitoring of vegetation cover and associated fauna in intervention areas.
- **Urban and social impacts:** Verification of the functionality of routes, services and public spaces; impacts on commerce, accessibility and local routine; active listening to the population and perception of the works.
- **Governance and institutional capacity:** Analysis of integrated action among municipal agencies; functioning of communication and transparency channels; strengthening of technical capacity and participatory governance.

Typology of Management Actions

The management actions adopted throughout the sub-project are grouped into the following categories, according to their focus and moment of application:

- **Prevention (P):** provisional signaling, network bypass, community listening channels, failure assessment and deployment of redundant systems.
- **Correction (Cr):** suspension of works in risk areas, removal of contaminated soils, adjustments in networks and hydraulic structures.
- **Mitigation (M):** implementation of bioengineering, infiltration areas, rain gardens and stabilization of vegetated margins.
- **Compensation (Cp):** creation of natural or artificial retention basins, ecological restoration, urban re-qualification.
- **Optimization (O):** urban education campaigns, technical committees, digitalization of management systems and institutional strengthening.

Institutional Structure

The implementation of actions requires articulation between different levels of government and technical sectors. Below, the organization of the main entities involved:

Municipal Agencies

- **Municipal Secretariat of Environment, Urbanism and Sustainability:** environmental coordination, licensing, risk assessment and articulation with regulatory agencies.
- **Municipal Secretariat of Infrastructure and Public Services:** execution and maintenance of works, management of technical networks and soil stabilization.
- **Municipal Secretariat of Urban Mobility:** guarantee of accessibility and signage during interventions.
- **Municipal Civil Defense Coordination:** disaster prevention and emergency response.
- **Office of Special Projects (Gabinete de Projetos Especiais - GPE):** intersectoral articulation, social mediation and governance of the program.
- **Other departments and boards involved:** Culture, Policies for Women, Human Rights and Citizenship, Administration, Government, People Management and Communication — responsible for social inclusion actions, public communication, active listening and logistical support.
- **Municipal Agency for Economic and Social Development:** support for productive activities, occupation of the territory and mitigation of economic impacts.

External Bodies and Technical Partners

- **Regulators and inspectors:** FEPAM, SEMA-RS, ANA, ANEEL, ANATEL, Ministry of Labor.
- **Instances of control and protection of rights:** Public Prosecutors' Offices (State and Federal), Public Defender's Office and Audit Courts.
- **Universities:** technical-scientific support for environmental monitoring, performance evaluation and nature-based solutions.
- **Guaíba Hydrographic Basin Committee and State Civil Defense:** regional integration of water management strategies and contingency plans.

Flood Control System

The Flood Control System sub-project is part of the set of strategic actions of the Guaíba+Resiliente Program, focusing on reducing hydrological risks and environmental and urban resilience. Its interventions range from land regularization to the integrated operation of drainage structures, articulating legal, social, ecological and territorial planning measures.

Monitoring Axes

The actions planned for the sub-project are distributed throughout all phases of intervention and are organized around the following monitoring axes:

- **Legal regularization and environmental licensing:** Monitoring of the land situation of affected properties, progress of administrative and judicial proceedings, and documentary compliance with the licensing agencies.
- **Ecological and social aspects in the field:** Survey of fauna and flora, identification of vulnerable occupations, monitoring of public perception, community engagement and risks of judicialization.
- **Hydrological and ecological monitoring:** Monitoring of terrestrial, aquatic and floodplain ecosystems through remote sensing, climate data and hydrodynamic modeling; verification of floods and critical overflow areas.
- **Urban mobility and economic impacts:** Evaluation of traffic conditions, operation of public transport, impacts on commercial activities and continuity of public services during the works.
- **Ecological structure:** Analysis of vegetation and ecological corridors, land use and land cover, and ecological connectivity.
- **System operation and climate governance:** Evaluation of the efficiency of drainage systems, soil stability, erosion control, performance of digital management platforms and institutional integration.
- **Cross-cutting monitoring and safeguards:** Continuous evaluation of the performance of social and environmental safeguards, response to extreme events, adherence to inter-municipal forums and effectiveness of interfederative governance.

Typology of Management Actions

The management measures adopted are distributed among different categories, articulated according to the moment and characteristics of the sub-project:

- **Prevention (P):** Land regularization campaigns (if applicable), planning of alternative routes, technical studies and climate scenarios, provisional signaling, crisis office and normative review.
- **Correction (Cr):** Rescue of fauna, adjustments in hydraulic structures, re-qualification of basins, registration of critical areas and integrated land regularization.
- **Mitigation (M):** Technical integration of drainage systems, permeable pavements, bioengineering techniques, biological erosion control and implementation of buffer zones.
- **Compensation (Cp):** Creation of green areas, ecological corridors, re-vegetation, re-settlement with social support, restoration of wetlands, compensation for suppressed ecosystem services and symbolic compensation for affected economic activities.

- **Optimization (O):** Institutional strengthening, integrated management digital platforms, citizen participation, continuous technical advice, active listening and integration with sectoral policies.

Institutional Structure

The implementation of the sub-project mobilizes a wide network of public actors and strategic partners, organized according to their functions and competencies:

Municipal Agencies

- **Environmental, territorial and institutional:** Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Secretariat of Administration and People Management.
- **Public works and services:** Municipal Secretariat of Infrastructure and Public Services, responsible for the technical management of works and hydraulic systems.
- **Mobility and urban economy:** Municipal Secretariat of Urban Mobility, Municipal Secretariat of Social Assistance and Labor, Municipal Agency for Economic and Social Development (Desenvolve Guaíba).
- **Governance and communication:** Directorate of Communication, Municipal Secretariat of Culture, Municipal Secretariat of Education, Municipal Department of Health, and others according to the thematic interfaces.

External Bodies and Technical Partners

- **Regulation and licensing:** SEMA-RS, FEPAM, ANA, CPRM and State Civil Defense.
- **Regional articulation:** Guaíba Hydrographic Basin Committee, Eldorado do Sul City Hall, inter-municipal consortia and local councils.
- **Technical and scientific support:** Universities and technical consultancies, working in monitoring, performance evaluation, training and development of methodologies.
- **Social control and guarantee of rights:** Public Prosecutor's Office (State and Federal), Public Defender's Office, City Council and councils of rights.

Resilient Roads

The Resilient Roads sub-project seeks to promote territorial connectivity on a sustainable and safe basis, integrating road planning, adaptive infrastructure and urban management. Its actions cover all phases of the intervention cycle, with an emphasis on reducing risks related to climate aspects, road safety, environmental protection and social inclusion.

Monitoring Axes

The actions of the sub-project are organized around seven main monitoring axes, applicable from the pre-construction work to the operation phase:

- **Traffic, road safety and urban mobility:** Traffic volume monitoring, accidents and modal conflicts; technical mapping of critical routes and intermodal logistics performance.
- **Land use and occupation and land aspects:** Monitoring of changes in land use, land conflicts, regularization processes and informal occupations.
- **Social impacts and resettlement:** Socioeconomic registration, preparation and execution of resettlement plans, inclusion of vulnerable groups and monitoring of housing conditions.
- **Environmental quality and urban ecosystems:** Verification of vegetation cover, fauna and flora, presence of bioindicators, water quality and integration with water recharge areas.
- **Institutional integration and interfederative articulation:** Coordination between sectoral plans and actions, integration with regional road networks and adherence to technical and political forums.
- **Accessibility and territorial connectivity:** Assessment of accessibility to essential services, use of active modes, displacements and road performance in risk scenarios.
- **Urban governance and land valuation:** Gentrification monitoring, real estate valuation indexes, operation of intersectoral committees and territorial governance indicators.

Typology of Management Actions

Management actions are divided into five categories, according to the type of intervention and the execution phase:

- **Prevention (P):** Resettlement planning, local commissions, legal advice, urban planning instruments, integration with logistics plans and climate scenarios.
- **Correction (Cr):** Technical adjustments in routes, review of critical junctions and road basins based on real data.
- **Mitigation (M):** Implementation of green infrastructure (rain gardens, permeable pavements), adaptive drainage, bike lanes, accessible sidewalks and structural adaptations in vulnerable areas.
- **Compensation (Cp):** Resettlement plans, plant restoration, buffer zones, ecological corridors, community compensations and restoration of wetlands.
- **Optimization (O):** Integrated digital platforms, disaster response protocols, interfederative consortia, multisectoral forums and cooperation agreements.

Institutional Structure

The implementation of the sub-project involves different bodies with complementary attributions, organized by function:

Municipal Agencies

- **Infrastructure and Mobility:** Municipal Secretariat of Infrastructure and Public Services and Municipal Secretariat of Urban Mobility, responsible for planning and technical execution of the roads.
- **Environmental, territorial and legal:** Municipal Secretariat of Environment, Urbanism and Sustainability, responsible for land management and environmental regularization.
- **Articulation and governance:** Office of Special Projects, coordinating territorial articulation and resilience actions.
- **Social and intersectoral support:** Municipal Secretariats of Health, Education and Social Assistance and Labor, acting in the mitigation of social impacts and compatibility with essential services.
- **Development and logistics:** Municipal Agency for Economic and Social Development, articulating the territorial and productive impacts of the works.

External Bodies and Technical Partners

- **Road infrastructure and logistics:** DNIT, ANTT, Ministry of Transport, Ministry of Infrastructure and State Government, responsible for integration with the regional and national road network.
- **Road safety and mobility:** DETRAN-RS, National Road Safety Observatory, State Traffic Council and mobility observatories.
- **Risk management and water resources:** State Civil Defense, CPRM, Ministry of Integration and Regional Development.
- **Environmental and urban:** FEPAM, SEMA-RS, Ministry of the Environment, ICMBio, IBAMA and Ministry of Cities.
- **Governance and social control:** OPAS, community and intersectoral councils, technical entities and universities to support monitoring and evaluation.

Implementation of the Resilient Logistics and Industrial Hub

The Resilient Logistics and Industrial Hub sub-project aims to structure a territory suitable for the installation of productive and logistical projects. The proposal involves physical infrastructure, integrated governance and impact control instruments, with articulated actions from planning to the operation of the pole.

Monitoring Axes

The continuous monitoring of the sub-project covers technical, environmental, social and institutional dimensions, focusing on the following main axes:

- **Physical stability and local environmental impacts:** Evaluation of excavations, slopes and sediments; erosion control; compensation of suppressed areas and monitoring of native vegetation.

- **Social, land and resettlement aspects:** Monitoring of affected communities, socio-land registry, social and psychosocial risks, implementation of resettlement plans and support for permanence in strategic areas.

- **Institutional performance and intersectoral governance:** Analysis of administrative processes, coherence between plans and performance of integrated management throughout all phases.

- **Territorial pressures and land use:** Monitoring of subdivisions, gentrification, pressure on public networks, compatibility with zoning and land valuation.

- **Training and productive insertion:** Monitoring of employability indicators, technical qualification and permanence of the vulnerable population in priority areas.

- **Logistics flows and road infrastructure:** Analysis of cargo traffic, state of the road network, claims and integration with regional road systems.

Typology of Management Actions

The management actions associated with the sub-project are organized into five main categories:

- **Prevention (P):** Territorial planning, cultural safeguarding plans, interfederative agreement, environmental emergency plans, exclusion of sensitive areas, technical support and institutional strengthening.

- **Correction (Cr):** Land regularization, revision of zoning and re-qualification of degraded areas.

- **Mitigation (M):** Containment barriers, low-impact drainage, infiltration ditches, strategic reservoirs, sediment basins, and redirected traffic routes.

- **Compensation (Cp):** Creation of special areas of social interest, vegetated compensatory areas, assisted resettlement, tax incentives, and regulated occupation.

- **Optimization (O):** Integration of information systems, administrative modernization, continuous training, articulation with universities and multilateral organizations, and urban re-qualification.

Institutional Structure

The implementation of the hub involves a wide network of institutions with different roles, organized by area of competence:

Municipal Agencies

- **Infrastructure and Environment:** Municipal Secretariat of Infrastructure and Public Services and Municipal Secretariat of Environment, Urbanism and Sustainability, responsible for technical execution and environmental control.

- **Social and cultural management:** Municipal Secretariat of Social Assistance and Labor, Municipal Secretariat of Culture and Municipal Secretariat of Policies for Women, Human Rights and Citizenship.
- **Development and economy:** Municipal Agency for Economic and Social Development (Desenvolve Guaíba), responsible for qualification, productive insertion, and stimulus to economic activity.
- **Governance and transparency:** Office of Special Projects, Comptroller General of the Municipality, Secretariat of Administration and People Management and Secretariat of Bids and Contracts.

External Bodies and Strategic Partners

- **Licensing and inspection:** Environmental licensing bodies, specialized consultancies, State Court of Auditors (TCE-RS), State Public Prosecutor's Office (MP-RS) and State Attorney General's Office (PGE-RS).
- **Planning and institutional governance:** Secretariat of Planning, Governance and Management (RS), Ministry of Management and Innovation, ENAP, CGU, intermunicipal consortia and multilateral organizations.
- **Infrastructure and logistics:** DNIT, DAER/RS, State Secretariat of Logistics and Transport and Ministry of Transport, in support of the integration of the road network and the control of cargo flows.
- **Science and technology:** Universities, research centers, and multilateral agencies, as partners in the modernization of management and technological innovation.

Recovery and Restructuring of Lake Guaíba Waterfront

The Lake Guaíba Waterfront Restructuring sub-project aims to transform the relationship between city and lake, promoting the environmental, landscape and urban re-qualification of a symbolic and sensitive territory. The interventions integrate technical, ecological, social and institutional actions, focusing on urban resilience, sustainability and collaborative governance.

Monitoring Axes

The actions are continuously monitored throughout all phases, focusing on the following axes:

- **Natural environment and physical stability:** Monitoring of fauna, flora, vegetation cover, sedimentation rates, bathymetry and stability of margins.
- **Utilities and urban infrastructure:** Assessment of pressure on supply and depletion networks, frequency of interruptions, construction waste and operational safety.
- **Governance and institutional regulation:** Integration of sectoral plans, processing time of administrative proceedings, legal compliance, risks of judicialization and recurring failures.

- **Mobility and accessibility:** Impacts on pedestrians, public transport, merchants and users; circulation during the work and accessibility of re-qualified spaces.
- **Social and cultural valuation:** Public perception, symbolic uses of spaces, territorial identity and inclusive urban transformation.
- **Shared management and intersectoral coordination:** Operation of committees and forums, articulation between departments, and adherence to agreed schedules and goals.

Typology of Management Actions

The management measures adopted throughout the sub-project are grouped into the following categories:

- **Prevention (P):** Project adequacy in risk areas, emergency plans, preservation of green areas, signaling and intersectoral training.
- **Correction (Cr):** Adjusted local standards, revision of the master plan, implementation of accessible ramps and provisional routes and constructive adjustments.
- **Mitigation (M):** Nature-based solutions, slope stabilization, buffer zones, re-qualification of interrupted connections and waste control.
- **Compensation (Cp):** Compensatory green areas, urban ecological corridors, merchant support and mobile utility units.
- **Optimization (O):** Technical tables, PSA funds, digitalization of flows, goal integration, participatory management, identity valorization and smart cities.

Institutional Structure

The execution and maintenance of the Waterfront requires multisectoral articulation, involving several agencies with complementary roles:

Municipal Agencies

- **Environmental and urban planning:** Municipal Secretariat of Environment, Urbanism and Sustainability, Directorate of Landscape Architecture, Office of Special Projects.
- **Infrastructure and mobility:** Municipal Secretariat of Infrastructure and Public Services, Municipal Secretariat of Urban Mobility.
- **Governance and institutional articulation:** Attorney General's Office, Secretariat of Administration and People Management.
- **Culture and social inclusion:** Municipal Secretariats of Culture, Education, Health, Social Assistance, Policies for Women, Human Rights and Citizenship.
- **Development and economy:** Municipal Agency for Economic and Social Development.

External Bodies and Strategic Partners

- **Regulators and technicians:** SEMA-RS, FEPAM, ANA, ICMBio, CREA-RS, CPRM, IPHAN, INMET.

- **Technical and academic support:** Universities, Public Policy Observatories, Municipal Heritage Council.
- **Financiers and inspectors:** Ministry of Cities, CAIXA, CGU, TCE-RS, CNM, BNDES, Banco do Brasil, FNP.
- **Planning and mobility:** Metroplan, Ministry of Infrastructure and Ministry of Integration.

3.2. Climate Risk and Vulnerability Assessment (CRVA) Framework and Application

This section provides a consolidated framework and practical application guide for Climate Risk and Vulnerability Assessments (CRVA), supporting the integration of climate resilience into the Guaíba+Resilient Program's subprojects in alignment with AIIB requirements.

Characterization of Current and Projected Climate

The climate characterization of Guaíba and the region integrates historical information on the regional climate with projections of future scenarios, considering the potential effects of climate change on the frequency and intensity of extreme events.

Current Weather: Trends and Historical Extremes

The climate of the Guaíba region is classified as humid subtropical (Cfa in the Köppen classification), with hot summers and relatively cold winters, and well-distributed rainfall throughout the year. Historical data shows:

- Average annual temperatures between 17°C and 20°C, with summer highs exceeding 35°C in extreme events.
- Average annual rainfall between 1,300 mm and 1,700 mm, with peaks in months such as July and September.
- Increasingly frequent extreme weather events, including heat waves, torrential rains in short periods, prolonged droughts, and extra-tropical cyclones.
- The predominant seasonal variability is winter rains from June to September and summer droughts, typical of a temperate or subtropical climate. In recent decades it has been observed in El Niño years rains also in the summer, as happened in 2023.
- Long-term variability has shown long periods with medium or low water levels, interspersed with a few years of flooding. Figure 1 shows the maximum annual levels and two red lines, the largest representing the design quota of the Porto Alegre dike and the second the quota that starts the flooding in Porto Alegre. Guaíba is on the opposite side of Lake Guaíba at a likely lower level for the runoff water line, as it is downstream, but due to the wind it may have very similar constraints. In this figure it is observed that there are few years (six years) in which the city is reached in 125 years.

Among the most striking recent events, we highlight the series of floods in 2023 and 2024, which hit the Guaíba hydrographic region in full, revealing the vulnerability of urban systems in the face of intense precipitation concentrated in a few days. Currently, in 2025 until the end of June, levels of Porto Alegre are close to the overflowing limit of the pier.

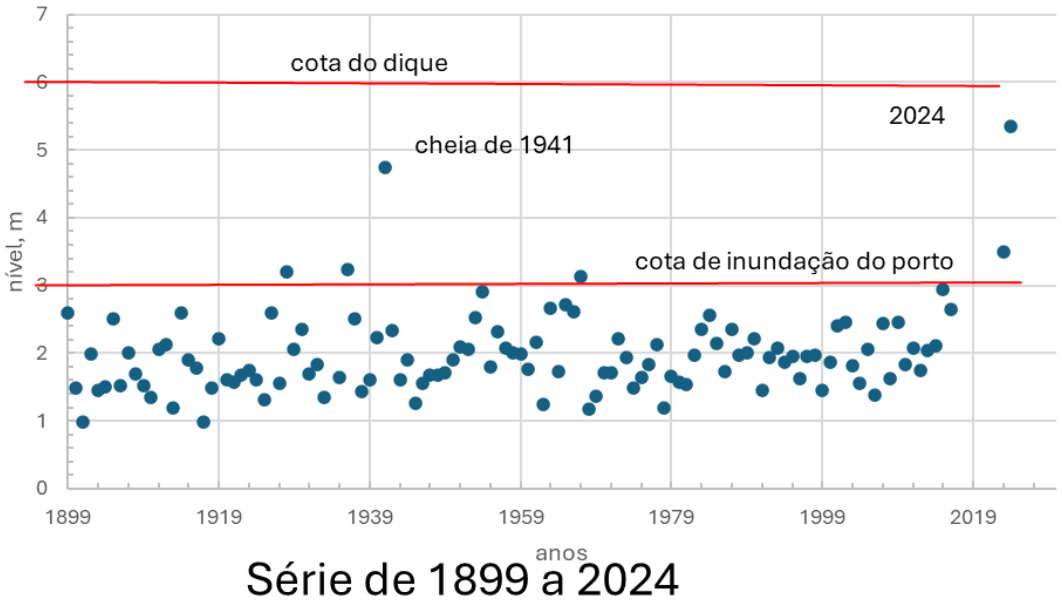


Figure 1. Series of annual maximum levels in Porto Alegre (near Guaíba) from 1889 to 2024

Projected Climate: Future Scenarios and RCPs

To assess the evolution of the climate in the region, climate scenarios elaborated based on the Sixth IPCC Assessment Report (AR6) were considered, using the Shared Socioeconomic Pathways (SSPs) combined with updated Representative Concentration Pathways (RCPs). The SSP framework integrates socioeconomic development trajectories with emission scenarios, offering a more comprehensive analysis of possible futures.

The following pathways were used:

- SSP2-4.5: an intermediate scenario reflecting moderate challenges to mitigation and adaptation, with global warming stabilized around 2.1–3°C by 2100.
- SSP5-8.5: a high emissions scenario, representing continued dependence on fossil fuels and high economic growth without significant mitigation, potentially leading to warming above 4°C by 2100.

Based on regional atmospheric circulation models (RCMs) applied to Southern Brazil, the following projected patterns stand out (Table 35):

Table 35. Regional Climate Projections (RCP 4.5 and RCP 8.5).

Variable	Expected trend (SSP2-4.5 and SSP5-8.5)	Expected impacts
Average temperature	Increase between 2.5°C and 3.5°C	More frequent and intense heat waves;

Variable	Expected trend (SSP2-4.5 and SSP5-8.5)	Expected impacts
	(SSP2-4.5) and 4°C to 5°C (SSP5-8.5) by 2100	heat stress
Annual total rainfall	Stability or slight increase overall, with higher interannual variability	Greater seasonality; extended dry periods and concentrated heavy rainfall events
Heavy rainfall	Significant increase in frequency and magnitude	Increased risk of urban and riverine flooding, landslides, and soil erosion
Extreme events	Intensification and increased unpredictability	Stronger cyclones, severe droughts, and storms

Recent extreme events, such as those in 2024, exemplify the combined effects of multiple climate drivers, including (a) the influence of El Niño, (b) increased Atlantic Ocean temperatures, and (c) a meteorological blocking system to the north of Rio Grande do Sul. A historical comparison illustrates this trend: in May 1941, extreme rainfall occurred over 15 days with lower intensity, whereas in 2024, equivalent or higher volumes fell in only 5 days, indicating a clear shift towards more intense and concentrated precipitation patterns — a behavior aligned with projections under AR6.

Although regional climate projections indicate an increase in the frequency and intensity of heatwaves under high-emission scenarios, this effect is not currently considered critical at the local level in Guaíba. Temperatures above 35 °C are already common in the region and do not represent an exceptional or emerging phenomenon. Therefore, while heatwaves appear as relevant stressors in broader regional models, they have not yet translated into significant local impacts that would warrant prioritized treatment in the current stage of climate vulnerability analysis.

Integrated climate risk analysis

Exposure

Exposure refers to the degree to which environmental, social, and economic systems are subject to potentially damaging extreme weather events such as floods, storms, heat waves, or droughts. In the context of the Guaíba+Resiliente Program, exposure is high, both due to the geographical location of the sub-projects and the environmental and urban characteristics of the region.

The potential impacts related to the flood are: riverine floods on the edge of the city on Lake Guaíba and floods due to the overflow of the Jacuí and reaching the city in its northern part, such as those that occurred in 2024 and; in urban drainage, which are the runoffs within the city, which depends on urbanization and intense rainfall within the municipality.

The scope of the program includes riparian areas of Lake Guaíba, floodplain areas, urban drainage basins and logistics corridors near highways and industrial areas, spaces that have intrinsic geomorphological and hydrological vulnerabilities.

Key exposure elements identified:

- Urban drainage within the city and its compatibility with the exit in Lake Guaíba;
- Zoning of flood areas and the Re-qualification of the Guaíba Waterfront involves flood areas on the lake banks vulnerable to erosion and lake level rise;
- The Resilient Industrial and Logistics Pole and the Resilient Access Roads present a lower risk related to climate issues (they were planned this way), but may suffer indirectly, due to road isolation and infrastructure overload, in scenarios of collapse of drainage or rupture of dykes.

The degree of exposure of sub-projects, in general, is considered high, which reinforces the importance of integrated climate adaptation strategies, preventive territorial management and incorporation of nature-based solutions. Table 36 shows a summary of the degree of exposure of sub-projects to extreme weather events.

Table 36. Degree of exposure of sub-projects.

Coordinator	Degree of Exposure	Determining Factors
Flood Control System	Very High	Implementation area should be conditioning the zoning of flood risk areas based on the flood map with different risks.
Urban drainage works	High	Located in densely urbanized sectors and with flood/inundation records.
Re-qualification of Lake Guaíba Waterfront	High	Interventions planned near the lacustrine edge, inserted in the flood spot; susceptible to instability of the margin and elevations of the water level.
Resilient Access Roads	Medium	Main routes do not cross the 2024 flood areas; only an alternate stretch intersects watercourse, but in area outside the critical zone.
Resilient Industrial and Logistics Hub	Medium to high	Preferred area near the flood spot in the northern sector of the municipality; moderate risk of indirect exposure due to pressure on drainage and soil sealing.

Sensitivity

The sensitivity assessment aims to identify the fragility of physical, ecological, urban, and social systems in the face of exposure to extreme weather events. In the case of the municipality of Guaíba, the impacts observed during the 2024 flood revealed a high sensitivity, with critical failures in multiple urban and environmental subsystems.

From an infrastructural point of view, severe events were recorded, such as the fall of bridges and the reversal of the flow in the Celupa channel, a phenomenon that motivated the design of the Urban Flood Management Works sub-project. These events highlight not only the structural vulnerability of existing infrastructure, but also the limited responsiveness of drainage systems in extreme scenarios.

At the ecological and physical-environmental level, the sensitivity of systems such as wetlands, shores of the Lake Guaíba and stretches of urban streams have undergone processes,

depending on their location, of silting, erosion and loss of riparian vegetation. These impacts compromise essential environmental functions, such as regulating runoff, filtering pollutants, controlling erosion, and supporting biodiversity.

With regard to essential urban services, drastic disruptions in mobility and service provision were observed. The absence of redundant systems, institutional fragmentation and low integration between sectoral bodies made operational continuity difficult at critical times.

From a socioeconomic point of view, the high sensitivity of populations living in areas with precarious infrastructure and less adaptive capacity stands out. The loss of housing, the interruption of community networks and the impacts on groups that depend on traditional practices, such as artisanal fishing, illustrate the social and cultural fragility in the face of extreme events.

Considering the convergence between physical, ecological, institutional and social vulnerabilities, it is concluded that the municipality has high systemic sensitivity. This condition imposes the need for articulated structural and non-structural measures that incorporate criteria of climate resilience, environmental restoration and strengthening of institutional and community capacity to respond to disasters.

The edge of the city suffered floods due to the Lake Guaíba, which occurred due to the overflow of the Jacuí River and of urban drainage, compounded by the urbanization that increases the flow to these urban streams.

To assess the magnitude of these impacts, it is necessary to evaluate the effect of climate change on the Guaíba floods and on the intense rains within the city of Guaíba. These studies are being carried out for the city of Porto Alegre (on the left bank of Lake Guaíba) and for the intense rains of Porto Alegre. Regarding the first, the study can be used for the city of Guaíba. The second is more recommended to be carried out for the rainfall of Guaíba specifically.

Adaptive Capacity

Adaptive capacity represents the institutional, technical, and social aptitude of a territory to respond effectively to the risks associated with climate change, reducing vulnerabilities, preventing damage, and promoting systemic resilience. In the case of the municipality of Guaíba, adaptive capacity presents important advances in the institutional field, but still faces relevant technical and operational gaps, especially with regard to the integrated management of socio-environmental risks.

The creation of the Special Projects Office (GPE), through Municipal Decree No. 123/2025, represents a positive institutional milestone. Linked directly to the Mayor's Office, the GPE was established for the purpose of coordinating strategic projects, including international credit operations. The office has experienced and qualified servers for administrative and financial management, which indicates an advance in governance and intersectoral articulation.

However, the GPE's technical structure does not yet include specialists in the environmental and social areas, which limits its ability to respond to complex climate risks. The absence of a formal environmental and social management system and the lack of internal protocols aligned with AIIB standards are factors that compromise full adherence to the requirements of environmental and social safeguards.

In this context, strengthening adaptive capacity also involves the implementation of structural interventions designed to mitigate flood risks and improve urban resilience. The main interventions recommended include:

- Improvement of the Celupa channel, to avoid floods at its end limit near the Guaíba Lagoon.
- Development of solutions in Guaíba North limits, to avoid floods from the flood plains of Jacuí through Eldorado.
- Development of a Master Stormwater Plan, to cope with stormwater floods in the town.

These engineering measures, combined with nature-based solutions and institutional arrangements, aim to strengthen the systemic response capacity and reduce future vulnerabilities.

The qualified outsourcing strategy appears, in this context, as a viable and recommended alternative, especially in the initial phases of implementation of the Program. The hiring of a specialized consulting firm will allow to fill technical gaps quickly and efficiently, ensuring compliance with AIIB requirements, support the management of licensing instruments and the structuring of monitoring, participation and response mechanisms.

There is also a need for horizontal institutional strengthening, especially at the interface with municipal secretariats such as Environment, Infrastructure, Social Assistance and Urban Planning, as well as with state entities and universities that can offer complementary technical support.

Regarding the community's capacity to adapt, this is uneven between the territories of the municipality. Populations in situations of social vulnerability — especially those affected by the floods of 2024 — demonstrated low autonomous response capacity, requiring specific actions of mobilization, training and involvement in the planning and decision-making processes.

Thus, it is recommended to adopt the following structuring measures:

- Establishment of a technical team specialized in environmental and social safeguards in the GPE, with specific dedication to the management of climatic and socio-environmental risks;
- Hiring qualified external consultancy, as an alternative to fill technical gaps and support the management of the Program during its implementation;
- Continuous training of the GPE team in AIIB standards and procedures, focusing on engagement of interested parties, grievance system and environmental and social monitoring;
- The city does not have an urban rainwater service provider, as provided for in the rainwater sanitation legislation, in addition to not having cost recovery for these urban drainage and riverine flooding activities and collection of adaptation measures in the area.
- Establishment of inter-institutional partnerships with universities, state agencies and community organizations, expanding integrated and multiscale response capacity.

In summary, although the municipality has established promising institutional bases, the effectiveness of climate adaptation will depend on the technical-operational strengthening of the GPE, the adoption of strategic solutions such as specialized outsourcing and the expansion of articulation between the sectors involved, in line with international standards of climate and social risk management.

Synthesis of Integrated Climate Risk

Integrated climate risk is the result of the combination of three central components: the territory's exposure to extreme events, the sensitivity of affected systems, and the adaptive capacity

of society and institutions to respond to such events. In the case of the Guaíba+Resilient Program, the integrated analysis of these factors reveals a scenario of high climate risk for part of the planned sub-projects.

As reported in the previous sections:

- The exposure of the intervention areas is substantial, with several sub-projects located totally or partially in areas affected by the 2024 flood. Notably, floodplain areas, the shores of Lake Guaíba and urban stretches with saturated drainage and a history of flooding/inundation.
- The sensitivity of urban and ecological systems is equally high. The fragility of critical infrastructures (such as drainage channels, bridges, road networks and public facilities), natural containment ecosystems (such as wetlands and riparian forests) and the social vulnerability of affected communities compromise the capacity to absorb impacts.
- The adaptive capacity, although in the process of institutional consolidation with the creation of the Office of Special Projects (GPE), still presents relevant technical and operational gaps, especially with regard to the management of socio-environmental risks according to AIIB standards. The absence of a specialized team and a formalized environmental and social management system limits the effective response to future events, despite the measures foreseen for their strengthening and the possibility of partial supply through qualified outsourcing.

The articulation of these three factors indicates that climate risk is not uniform between sub-projects, but presents gradations. Sub-projects such as the Flood Control System, Urban Flood Management Works and Waterfront Re-qualification are at high composite risk levels, given the overlap of high exposure with high sensitivity and adaptive capacity still in transition. Others, such as the Resilient Roads and the Industrial and Logistics Hub, present moderate to high risk, with less direct exposure, but subject to indirect and synergistic effects if the urban system as a whole collapses.

Based on flood quantification studies, flood control measures are developed, which are structural and non-structural measures. Structural measures are those that change the risk of flooding such as dikes, canals and reservoirs, while non-structural measures are measures that allow the population to live with floods.

In the case of Guaíba and for riverine floods, it is recommended to develop the zoning of flood areas along the edge of Lake Guaiba and include these measures within the city's Urban Master Plan, disciplining the occupation of the population in the risk area. The other non-structural measure is to alert the floods to the levels of the Guaíba waterfront. This alert system may be within the State Government Plan in the Secretariat of Reconstruction. For urban drainage, structural measures are control measures in urban basins with conduits, channels, reservoirs, and infiltration that use nature-based solutions. These measures are developed by urban basin within the city. The non-structural measures within the city involve the regulation of drainage, preventing the increase in the flow of properties from being transferred to the public network.

Application of CRVA in Sub-projects

Based on the characteristics of the five sub-projects that make up the Guaíba+Resilient Program and according to the criteria established by the Environmental and Social Standard ESS1 of the AIIB, the need, recommendation or condition for the preparation of Climate Risk and Vulnerability Assessments (CRVA) is identified, considering the degree of exposure of the territories and systems involved to extreme weather events.

For the Flood Control System sub-project, CRVA is clearly required, since the very nature of the intervention involves the direct mitigation of hydrological risks. The structures to be implemented will depend critically on the dynamics of intense rains, floods, and changes in the urban and lake hydrological cycle, and it is essential that they are sized and planned based on future climate scenarios.

In the case of Urban Drainage Works, the need for CRVA is also evident. These works deal with the restructuring of urban drainage and drainage systems, which are highly sensitive to variability in the rainfall regime. The climate risk analysis will allow us to evaluate the resilience of these systems in the face of the increasing frequency of extreme events and the trend of urban soil sealing.

For the sub-project of resilient access roads, it is also recommended to prepare the ARVC. Although the main focus is on urban mobility and territorial integration, the functionality of these roads in emergency contexts — such as floods, landslides, or road interruptions — makes the analysis of their climate exposure relevant. This is even more critical if these routes are associated with evacuation routes, access to essential services, or connection between vulnerable peripheral areas.

In relation to the Resilient Logistics and Industrial Hub, the need for CRVA is conditional, as it will depend on the specific characteristics of the implantation site. If the area chosen for the hub is subject to flooding, geotechnical instability, water deficit, or other environmental risks aggravated by climate change, the CRVA should be incorporated to guide the planning of the occupation, infrastructure and the relationship with the surrounding urban and natural systems.

Finally, for the Re-structuring of the Lake Guaíba Waterfront sub-project, the realization of the CRVA is mandatory, since it is an intervention in a riverside area directly exposed to variations in the water levels, erosion processes, instability of banks, and flood risk. In addition to physical aspects, the presence of vulnerable populations and the relevance of ecosystem services associated with riparian vegetation reinforce the importance of considering climate scenarios for urban and environmental planning of the waterfront.

In summary, the sub-projects of the Flood Control System, Urban Drainage Works, and the Guaíba Waterfront require the elaboration of CRVA; the sub-project of Resilient Access Roads must recommend its realization as part of a more robust and adaptive planning; and in the case of the Logistics and Industrial Hub, the need for CRVA will depend on a preliminary analysis of the territory's vulnerability, which may or may not confirm the need for the instrument. These distinctions should be reflected in ESMPF planning, ensuring that climate risks are fully considered in the formulation of resilient solutions. Table 37 presents a summary of the preliminary assessment on the need to prepare a Climate Risk and Vulnerability Assessment (CRVA) for each sub-project, indicating the degree of requirement and the associated technical justification, based on the nature of the interventions, exposure to climate risks and the criteria established by the AIIB ESS1.

Table 37. Classification of the CRVA requirement for each sub-project, according to its exposure to climate risks and function in territorial resilience.

Subproject	Requirement for CRVA	Main justification
Flood control system	Yes	Infrastructure directly aimed to hhydrological risk mitigation
Urban drainage works	Yes	Sensitive to rain and water drainage changes
Resilient roads	Recommended	Operation guarantee in disaster scenarios and peripheral vulnerabilities
Logistic and industrial hub	Conditional	Depends on the location and vulnerability of chosen site
Re-struturation of the Guaiba waterfront	Yes	Riverine area with risk of flood, erosion, and vulnerable population

The preliminary identification of the sub-projects that require the preparation of the Climate Risk and Vulnerability Assessment (CRVA), presented here, is indicative and aims to anticipate relevant discussions for the environmental and social planning of the Guaíba+Resilient Program. This is an initial approach, based on the analysis of the expected impacts, the location of the projects, and the nature of the proposed interventions. The detailed definition of the need for CRVA, as well as the technical justification, the suggested preliminary scope, and its insertion in the safeguards planning, will be presented in the specific product referring to the Environmental and Social Safeguards Framework (ESMPF). This product will consolidate the guidelines and instruments applicable to each sub-project, including the complementary climate studies deemed necessary in light of the requirements of the AIIB.

Guidelines and Monitoring and Management Measures for Climate Resilience

Based on the integrated analysis of the DPSIR matrices, the elements directly related to Climate Risk and Vulnerability Assessment (CRVA) were selected, with the objective of aligning the proposed measures with the requirements of environmental and social safeguards, strengthening the capacity to respond to extreme weather events and promoting territorial resilience in the medium and long term. This articulation follows the causal logic previously established between pressures, states, impacts and responses.

The guidelines and measures identified were organized based on the main thematic axes of climate risk and systemic impact, which structure the priority fields of intervention. For each axis, key monitoring indicators and specific management actions were defined, classified according to their prevention, mitigation, correction and adaptation functions.

Table 38 presents this consolidated interface, highlighting the articulation between the critical themes, the monitoring parameters, and the recommended responses. The approach adopted values the use of nature-based solutions (NBS), resilient engineering practices, and climate governance and integrated territorial planning instruments.

Table 38. Interface between the Guidelines and Monitoring and Management Actions from the DPSIR and CRVA matrices.

Thematic Axis	Monitoring Indicators	Associated Management Actions

Thematic Axis	Monitoring Indicators	Associated Management Actions
Extreme Flooding Hydrological Events	Frequency, response time and extent of flooding; groundwater levels and soil infiltration capacity; runoff time and volume in extreme events	(a) Drainage plans by basin within the city: identify flooding sites, develop flooding site solutions using damping and infiltration solutions and channel recovery (b) regulation of urban drainage
Riverine floods	From flooding on the shore of Lake Guaíba: monitoring levels in the city	development of flood zone areas and implement the rules in the City Master Plan
Changes in the Water Regime and Urban Climate	Surface temperature; vegetation cover and shading; thermal comfort; microclimatic changes	Re-vegetation of banks; implantation of native vegetation and strategic shading; green corridors; control of heat islands
Geotechnical Risks and Infrastructure Stability	Cracks, settlements, soil movement, slope instability	Bioengineering of banks; containment structures with vegetation; preventive stabilization of slopes
Urban Services under Climate Pressure	Interruptions in technical networks and accesses; failures and overloads in public water, sewage, mobility systems	Redundancy of networks; integrated operational protocols; preventive maintenance; scheduled expansion of capacity
Climate Governance and Territorial Planning	Integration of sector plans and risk management; process processing time; coherence between planning instruments	Creation of intersectoral technical committees; interfederative agreement; review of zoning and master plans considering climate scenarios

A Model Terms of Reference (ToR) for the preparation of Climate Risk and Vulnerability Assessments (CRVA) is included in Appendix 3. This model provides technical guidance for consultants and implementing entities in the design of CRVA studies aligned with AIIB's ESS1 requirements and tailored to the local climate risk profile of subprojects.

4. Environmental and Social Management Procedures for Subprojects

This section outlines the key environmental and social (E&S) management procedures for subprojects, ensuring alignment with national regulations and the Asian Infrastructure Investment Bank's Environmental and Social Framework (ESF). It covers screening and categorization criteria, required E&S instruments, review and approval processes, and integration of E&S requirements into procurement. Additionally, it details monitoring and supervision arrangements, including indicators and reporting responsibilities, and clarifies institutional roles among the Project Implementation Unit (PIU), consultants, and contractors. Capacity-building needs and cost considerations are also addressed to support effective and sustainable implementation. Together, these procedures promote resilience, social inclusion, and environmental protection throughout the subproject lifecycle.

4.1. Functional Structure of Management Actions by Type and Safeguarding (ESS)

This section presents a consolidated functional structure of the environmental and social management actions identified in the sub-projects of the Guaíba+Resilient Program, organized by type of safeguard. The proposal serves as a strategic reference for the preparation of future socio-environmental impact assessments, by offering a set of minimum guidelines that guide the identification and treatment of risks and impacts throughout the project cycle.

4.1.1. ESS1 Synthesis – Assessment and management of environmental and social risks and impacts

In the context of the Guaíba+Resilient Program, compliance with AIIB ESS1 is ensured through cross-cutting guidelines aimed at the prevention, mitigation, correction and monitoring of environmental and social risks and impacts. Predominant guidelines include the integration of urban planning and environmental management, the adoption of hybrid infrastructure solutions (conventional and nature-based), the reduction of hydrological and geotechnical risks, and the strengthening of intersectoral governance with a focus on transparency, participation and institutional articulation.

Environmental and social monitoring indicators are diversified, covering hydrological (such as flows, water levels and drainage efficiency), environmental (water quality, turbidity, biodiversity), operational (travel time, infrastructure stability) and institutional aspects (operation of monitoring systems, progress of licensing processes, performance of technical committees and social listening channels).

The management actions identified are distributed in different typologies. Mitigation actions include the construction of containment structures, implementation of permeable areas, bioengineering on banks and ecological drainage systems. Offsets involve the creation of green zones, ecological corridors and plant restoration measures. Corrective actions deal with technical and operational adjustments in the face of unforeseen impacts, while operational and preventive actions strengthen institutional capacity, qualified listening and resilient territorial planning.

Additionally, the following strategic engineering and planning actions are highlighted as part of the integrated flood risk management measures:

• Improvement of the Celupa channel, to avoid floods at its end limit near the Guaíba Lagoon;

• Development of solutions in Guaíba North limits, to avoid floods originating from the Jacuí flood plains through Eldorado;

• Development of a Master Stormwater Plan, to cope with stormwater floods within the town.

Institutional responsibilities are mostly assigned to the Municipal Secretariats of Environment, Urbanism and Sustainability, Infrastructure and Public Services, Urban Mobility, the Office of Special Projects, the Civil Defense Coordination and the Landscape Architecture Board. Among the recurring partners are FEPAM, SEMA-RS, CPRM, ANA, IPHAN, universities, basin committees and federal agencies linked to the environment, cities and infrastructure. Table 39 summarizes it.

Table 39. Summary Table – ESS1.

Category	Content
General Guidelines	Integrated urban-environmental planning; prevention of hydrological and erosive risks; green infrastructure; intersectoral management and social participation
Key Indicators	Water flows and levels, soil sealing rate, water and soil quality, index fauna/flora, accessibility, travel time, institutional functioning
Mitigation actions	Margins containment, green urban drainage, bioengineering, permeable areas
Offset Actions (Cp)	Creation of APPs, reforestation with natives, fauna corridors, buffer zones
Correction Actions (Cr)	Readjustments in projects, technical adjustments, stabilization of structures
Operational Actions (O)	Digital management systems, educational campaigns, maintenance plans and public listening
Prevention Actions (P)	Review of master plans, risk zoning, licensing protocols, land regularization
Main responsible bodies	Secretariats of Environment, Infrastructure, Mobility, Office of Special Projects, Civil Defense, Technical Boards
Main partner bodies	FEPAM, SEMA-RS, CPRM, ANA, Universities, IPHAN, Ministry of Cities, Basin Committees, Ombudsman, Public Prosecutor's Office

4.1.2. Synthesis ESS2 – Land Acquisition and Involuntary Resettlement

In the context of the Guaíba+Resilient Program, compliance with the AIIB ESS2 is ensured through guidelines aimed at preventing forced displacement, promoting fair and sustainable resettlement, land regularization and inclusion of affected populations in the benefits of the project. The strategies prioritize respect for territorial rights, adequate compensation, psycho-social support and socioeconomic integration of resettled families.

The main indicators monitored include number of resettled families, resettlement time, level of family satisfaction, document regularization, insertion in the labor market, access to public services and risk of gentrification or indirect displacement.

Management actions include preventive measures such as participatory planning; mitigation and compensation actions such as negotiated re-settlements, housing aid and land regularization; corrective actions such as emergency relocations and review of registrations; and optimization

actions, such as training, psycho-social support and integration with public housing, assistance and work policies.

The institutional responsibilities fall mainly on the Municipal Secretariat of Social Assistance and Labor, Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects and Attorney General of the Municipality. Among the partner agencies are the Public Prosecutor's Office, the Public Defender's Office, Universities, TCE-RS and institutions to support land governance.

Table 40. Summary Table – ESS2.

Category	Content
General Guidelines	Avoiding involuntary displacement; dignified resettlement; fair compensation; social and economic integration
Key Indicators	No. of resettled families, relocation time, satisfaction, productive insertion, land regularization
Mitigation actions	Negotiated re-settlements; housing and economic offsets
Offset Actions (Cp)	Financial aid, land regularization, creation of ZEIS
Correction Actions (Cr)	Review of registrations; emergency relocations; post-resettlement adjustments
Operational Actions (O)	Training; psycho-social support; integration with housing and work policies
Prevention Actions (P)	Participatory planning; inter-institutional agreements; zoning by social interest
Main responsible bodies	SM Social Assistance and Labor; SM Environment and Urbanism; Project Office; PGM
Main partner bodies	MP, Public Defender's Office, TCE-RS, Universities, Observatories, land governance bodies

4.1.3. ESS3 Synthesis – Indigenous Peoples and Traditional Communities

The AIIB's ESS3 aims to ensure that supported projects respect the rights, ways of life, and territorial and cultural ties of Indigenous Peoples and Traditional Communities. This safeguard requires promoting appropriate sociocultural benefits, preventing adverse impacts and ensuring the active participation of these populations in decisions that affect them, based on free, prior and informed consultation (FPIC).

Two indigenous peoples were identified in the municipality of Guaíba, with a consolidated territorial presence or recurrent use of the area of indirect influence of the sub-projects: the Guarani Mbya People (Petim village, in Barra do Ribeiro) and the Kaingang People (with mobility registered in the metropolitan region of Porto Alegre). In addition, traditional communities of artisanal fishermen are established in the region, with historical links with Lake Guaíba and its banks, basing their subsistence practices, sociability and cultural identity on fishing and the collective use of aquatic resources.

Although the areas directly affected by the works do not include formally recognized or demarcated territories, the impact matrices point to indirect and cumulative risks. Such risks arise from land pressure on peripheral areas, induction of disorderly urbanization in territories of collective use and possible rupture of social support networks and traditional practices associated with lake environments, floodplains and rural-urban transition areas.

In particular, the flood control sub-project may require interventions in areas occupied by vulnerable populations or groups that maintain forms of shared land and water use. Interventions on the waterfront and on resilient roads, on the other hand, tend to induce processes of valorization and

indirect displacement, with possible repercussions on groups that exercise traditional fishing practices, environmental management and community sociability.

Given this scenario, it is recommended that the principles of ESS3 be applied whenever there is evidence of the presence of Indigenous Peoples or Traditional Communities directly or indirectly affected. The measures include:

- Specific social screening to identify traditional peoples and communities in areas of influence;
- Culturally appropriate consultations, with guaranteed access to information and freedom of expression;
- Safeguarding territorial, cultural and collective identity rights;
- Implementation of accessible, context-sensitive and retaliation-protected grievance mechanisms.

In addition, it is recommended to articulate with competent institutions, such as the National Foundation of Indigenous Peoples (FUNAI), the Palmares Cultural Foundation, FEPAM and public universities working on territorial rights, ethnodevelopment and artisanal fishing. The precautionary principle should guide risk management, even in the absence of formal regularization of these groups.

Table 41. Summary Table – ESS3.

Category	Content
General Guidelines	Safeguarding cultural and territorial rights; promotion of free, prior and informed consultation; respect for self-determination and traditional ways of life.
Key Indicators	Existence of traditional ethnic or cultural groups in the area of influence; number of consultations carried out; occurrence of direct or indirect displacements; records of socio-territorial conflicts.
Mitigation actions	Adoption of alternative routes to avoid areas of traditional use; consultation with community leaders; agreement on measures of forced non-removal.
Offset Actions (Cp)	Support for traditional practices, such as artisanal fishing; regularization of occupied territories; strengthening of affected socio-cultural networks.
Correction Actions (Cr)	Reparations for non-consulted displacements; restoration of compromised community accesses and uses; agreed compensatory measures.
Operational Actions (O)	Articulation with FUNAI, Palmares Foundation and universities; continuous involvement of community representatives; monitoring of socio-cultural impacts.
Prevention Actions (P)	Prior social screening focusing on traditional peoples and communities; participatory mapping of sensitive areas; application of the precautionary principle.
Main responsible bodies	Municipal Secretariat of Environment, Urbanism and Sustainability; Office of Special Projects
Main partner bodies	FUNAI, Fundação Cultural Palmares, FEPAM, public universities, Public Defender's Office, State and Federal Public Prosecutor's Office.

4.2. Screening and categorization criteria

The screening and categorization of sub-projects were conducted in alignment with the Environmental and Social Framework (ESF) of the Asian Infrastructure Investment Bank (AIIB). The process involved:

- Screening against AIIB's Exclusion List to ensure that none of the proposed activities fall under the Bank's list of ineligible projects;
- Categorization of each sub-project based on both the Municipality's internal classification and AIIB's environmental and social categorization system (Categories A, B, or C), considering the nature, scale, severity, reversibility, and spatial extent of potential impacts.

This process facilitates the early identification of environmental and social risks and opportunities, supporting the definition of appropriate mitigation, compensation, and adaptive management strategies.

Projects identified as posing higher environmental and social risks — such as those involving significant ecosystem disruption, large-scale resettlement, or intervention in sensitive areas — are classified as Category A and require comprehensive assessments, such as Environmental and Social Impact Assessments (ESIA) and Environmental and Social Management Plans (ESMP). Sub-projects with moderate, site-specific, and more readily mitigated impacts are typically categorized as Category B, while those with minimal or no adverse impacts fall under Category C.

This section is directly connected to the summary analysis tables included in the Appendix 5 (A through E), which provide detailed matrix records for each sub-project, used as basis to categorize the sub-projects. See Appendix 1, which presents the tool for screening checklist.

4.3. Instruments required for each category of subproject

The subprojects under the Guaíba+Resilient Program must be categorized according to their potential environmental and social impacts, following AIIB guidelines. The Guaiba Resilient Program was classified as Category A reflecting the highest level of potential risk associated with all subprojects. In the previous stage of the evaluation process, each subproject was classified as Category A reflecting the potential to generate significant adverse, irreversible and/or large-scale environmental and social impacts. It should be noted however that this classification was assigned in the absence of subproject designs and therefore uncertainty surrounding subproject risks and impacts. Each subproject will need to be subsequently screened for its potential impacts and its individual category will be assigned based on the determined level of risk (high, moderate, low), nature of the risks (reversible/irreversible), and scale of the potential impacts (small, medium, large).

Table 42. Summary of expected environmental licensing jurisdiction, required instruments, and additional recommendations for each subproject under the Guaíba+Resilient Program.

Sub-project	Environmental Licensing	Proposed Instruments and Recommendations
Construction of Resilient Access Roads	Expected jurisdiction: State (FEPAM/RS). The type of studies required is determined by the terms of reference (ToRs) issued by the	ESIA + ESMP; FPICon if Indigenous or traditional communities are impacted. Specific studies on biodiversity. Environmental Study (baseline,

Sub-project	Environmental Licensing	Proposed Instruments and Recommendations
	licensing body, with possible additions. Expected licensing stages: preliminary, installation, and operating licensing, ensuring robust safeguarding of E&S aspects.	impact assessment, mitigation), in compliance with AIIB ESF. Stakeholder Engagement and Communication Plan. GRMs. Civil Works Manual.
Urban Drainage Works	Jurisdiction: Municipal. License already issued as this subproject has already started/finished.	The Municipality must observe all instruments and recommendations required for other subprojects. Immediate compliance with AIIB instruments must be prioritized.
Flood Control System	Expected jurisdiction: State (FEPAM/RS). ToRs determine required studies. Expected licensing stages: preliminary, installation, operating licensing. Suggestion: consultation and monitoring by the Municipal Environmental Council.	ESIA + ESMP; FPICon if Indigenous or traditional communities are impacted. Specific studies on biodiversity. Environmental Study (baseline, impact assessment, mitigation), in compliance with AIIB ESF. Stakeholder Engagement and Communication Plan. GRMs. Civil Works Manual.
Resilient Logistic and Industrial Hub	Expected jurisdiction: State (FEPAM/RS). Same ToRs and licensing stages as above. Suggestion: consultation and monitoring by the Municipal Environmental Council.	ESIA + ESMP; FPICon if Indigenous or traditional communities are impacted. Specific studies on biodiversity. Environmental Study (baseline, impact assessment, mitigation), in compliance with AIIB ESF. Stakeholder Engagement and Communication Plan. GRMs. Civil Works Manual.
Integrated Re-qualification of the Guaíba Waterfront	Expected jurisdiction: State (FEPAM/RS). Same ToRs and licensing stages as above. Suggestion: consultation and monitoring by the Municipal Environmental Council.	ESIA + ESMP; FPICon if Indigenous or traditional communities are impacted. Specific studies on biodiversity. Environmental Study (baseline, impact assessment, mitigation), in compliance with AIIB ESF. Stakeholder Engagement and Communication Plan. GRMs. Civil Works Manual.

Regarding the occupational health and safety (OHS) of workers involved in the execution of the five construction projects under the Guaíba + Resilient program, Brazilian legislation requires that the construction company develop a Risk Management Program. The requirements for preparing this program are outlined in Regulatory Standard 01 (NR-1 General Provisions and Management of Occupational Risks) and Regulatory Standard 18 (Occupational Safety and Health in the Construction Industry).

This program must include a list of OHS risks, including psychosocial risks, as well as their control measures. The program must be prepared and submitted to the Ministry of Labor and Employment before the start of the construction work and serves as a guide throughout its execution. Sources of information for developing this program include the designs associated with each construction (e.g., structural design, architectural design) and the construction schedule. There is no legal requirement for OHS instruments for the post-construction phase.

A model Terms of Reference (ToR) for the preparation of subproject-specific Environmental and Social Impact Assessments (ESIAs) and Environmental and Social

Management Plans (ESMPs) is provided in the Appendix 2. This template is intended to guide the structure and minimum content of the studies required for Category A and B subprojects, ensuring alignment with AIIB's ESF requirements and national procedures.

4.4. Review and approval process

The review and approval process for subprojects under the Guaíba+Resilient Program is designed to ensure technical rigor, legal compliance, and adherence to the environmental and social standards established by the Asian Infrastructure Investment Bank (AIIB) and relevant national authorities. This process is composed of a sequence of interdependent steps, each critical to guaranteeing the environmental and social sustainability of the interventions.

The process begins with the elaboration of the Environmental and Social Terms of Reference (ToRs). These ToRs define in detail the scope, objectives, methodologies, and deliverables required for the environmental and social studies of each subproject. They must be comprehensive and incorporate the necessary criteria to address potential environmental and social risks and impacts, including alignment with AIIB's Environmental and Social Framework (ESF) and the specific requirements of local licensing authorities.

Once drafted, the ToRs are submitted to the AIIB for review and approval. The Bank's analysis ensures that the proposed scope is sufficiently robust to address identified risks and that the methodologies proposed are in line with good international practice. Approval of the ToRs by AIIB is a critical milestone, as it serves as the basis for subsequent technical studies and stakeholder engagements.

After the ToRs are approved, the process advances to the procurement of consultant services. Competitive bidding or other procurement methods are used to select specialized and qualified consulting firms or consortia with demonstrated expertise in environmental and social assessments. The selection process must comply with applicable procurement guidelines to ensure transparency, fairness, and technical competence. Bid/tender documents will be reviewed by AIIB to ensure that environmental, social, and health and safety requirements are adequately captured.

With the consultants contracted, they proceed to the elaboration of technical studies in accordance with the approved ToRs, ensuring that all specific requirements and guidelines established by the competent licensing authority (such as FEPAM at the state level or the municipal environmental department) are fully integrated. These studies typically include detailed environmental and social baseline analyses, impact assessments, risk analyses, and the design of mitigation, compensation, and monitoring measures.

Upon completion of the technical studies, an internal review is conducted by the Project Implementation Unit (PIU) and the environmental and social (E&S) specialists. This internal review focuses on verifying technical accuracy, the adequacy of impact predictions and proposed measures, and overall consistency with both the national regulatory framework and AIIB safeguard policies. Adjustments or additional clarifications may be requested at this stage.

Following internal validation, the documentation is submitted for formal analysis by the relevant licensing authorities, such as FEPAM or the Municipality, depending on jurisdiction. The

authorities assess the technical completeness of the studies, verify compliance with legal standards, and may request supplementary information or adjustments before issuing the necessary licenses or authorizations.

Parallel to these steps, it is required that the PIU inform the AIIB of the specific Public Consultation plan at least three months in advance. This early notification allows the Bank to review and advise on consultation strategies to ensure they are inclusive, culturally appropriate, and aligned with Free, Prior, and Informed Consultation (FPICon) principles when relevant.

The next step involves the public consultation and documentation phase. Consultations are carried out with affected communities, civil society organizations, and other stakeholders, providing a platform for presenting project information, discussing potential impacts, and collecting feedback and suggestions. All contributions and concerns raised during these consultations must be properly documented and integrated into final project documents.

After concluding public consultations and integrating the results, the full package of environmental and social studies and consultation records is submitted to the AIIB for technical validation. The Bank conducts a comprehensive review to confirm that all requirements have been adequately addressed and that the subproject is prepared to move forward in compliance with AIIB standards and international best practices.

Once the AIIB completes its analysis and determines that the project meets all criteria, formal approval and clearance for disbursement are issued. This clearance is a prerequisite for the release of funds and signals that the subproject can advance to implementation.

Finally, the process concludes with the bidding process for work implementation, allowing for the selection of qualified contractors to execute the physical works. This final stage ensures that construction activities are initiated only after all environmental and social safeguards are formally approved. Relevant administrative and regulatory clearances and licenses must also be obtained prior to the start of works.and all conditions for responsible implementation are met.

4.5. Procurement considerations - inclusion of E&S requirements in tender documents and contracts

In the Guaíba+Resilient Program, the PIU will require that all responsible parties, implementers, and contractors involved in the execution of works commit to incorporating a set of Mandatory Environmental and Social Clauses, in proportion to the environmental and social risk category of each intervention. These clauses reflect the obligation to comply with applicable municipal, state, and federal environmental and social legislation, as well as the guidelines established in this Environmental and Social Management Framework (ESMF), including the measures outlined in the reference matrices.

This set of Mandatory Environmental and Social Clauses must be included in all Terms of Reference and bidding documents related to activities with the potential to generate environmental and social risks and impacts.

In the context of the Guaíba+Resilient Program, all procurement processes—particularly those involving the contracting of civil works, consultants, and service providers—must be structured to ensure full integration of environmental and social (E&S) safeguards, in alignment with the Environmental and Social Framework (ESF) of the Asian Infrastructure Investment Bank (AIIB).

The inclusion of E&S requirements in procurement documents serves both as a compliance mechanism and a strategic tool to ensure that potential environmental and social risks are adequately addressed during project preparation and implementation. Accordingly, the following procurement considerations shall be observed:

Integration of E&S Clauses in Bidding Documents and Contracts

All tender documents must include:

- Obligations related to the preparation and implementation of Environmental and Social Management Plans (ESMPs), Health and Safety Plans, and emergency response procedures;
- Requirements for establishing and maintaining Grievance Redress Mechanisms (GRMs) for both workers and affected communities;
- Minimum standards for occupational health and safety (OHS), including reporting on incidents and maintaining safe work environments;
- Environmental management obligations, including waste management, pollution prevention, and ecosystem protection measures;
- Commitment to adhere to applicable national legislation and AIIB's Environmental and Social Standards (ESSs).

Eligibility and Evaluation Criteria

E&S capacity will be considered as part of the eligibility and technical evaluation criteria. Bidders must demonstrate prior experience in managing E&S risks, and key personnel must possess relevant qualifications, especially for high-impact subprojects (e.g., flood control systems, road infrastructure, industrial zone development).

Standardized E&S Provisions in Consultancy Contracts

Terms of Reference for consultants shall include:

- Responsibility for preparing ESIAs, ESMPs, RAPs (if needed), and other relevant studies;
- Coordination with environmental authorities and incorporation of licensing requirements;
- Stakeholder engagement strategies and documentation;
- Monitoring and reporting responsibilities in accordance with AIIB ESSs, POM and ESMP.

Disclosure and Transparency

All procurement processes shall ensure transparency regarding environmental and social responsibilities. E&S-related obligations will be clearly disclosed in advance, and consultation processes will be conducted as part of pre-bid meetings when relevant.

Monitoring and Compliance

Contractual arrangements must specify that failure to comply with E&S obligations may result in contractual sanctions, including financial penalties, suspension of payments, or termination of the contract. PIU and supervising entities will be responsible for monitoring contractor compliance, supported by independent audits when necessary.

Capacity Building

To ensure effective implementation of E&S measures by contractors and consultants, training and technical support may be provided during contract execution, particularly in relation to AIIB standards, GRM operation, and community engagement protocols.

For the purpose of occupational health anda safety (OHS), tender documents and contracts must require compliance with the Brazilian Regulatory Standards applicable to the risks of each construction Project. Additionally, it is recommended that there be na explicit mention of the prevention of informality and slave labor.

Concerning the prevention of informal labor, Law 6019 (https://www.planalto.gov.br/ccivil_03/Leis/L6019.htm), which regulates the outsourcing of labor, must be observed. The outsourcing of labor is widely used in the construction sector, which underscores the importance of Law 6019. Article 5 of this law clearly outlines the role of the contracting party and its responsibility for providing appropriate OHS conditions. According to this article, the contracting party is defined as the individual or legal entity that enters into a contract with a service provider for activities related to any of its operations, including its core business. (...) §. Article 3 adds that it is the responsibility of the contracting party to ensure safety, hygiene, and health conditions for the workers when the work is carried out on its premises or in a location previously agreed upon in the contract. Article 3 was added by Law No. 13.429.

As for slave labor, in Brazil, this is a crime defined under Article 149 of the Penal Code. The law characterizes slave labor as forced labor, exhausting work hours, degrading working conditions, and restriction of movement due to debt. Law No. 10.803/2003 amended the Penal Code to include penalties for those who exploit slave labor, which may range from 2 to 8 years of imprisonment, in addition to fines.

4.6. Monitoring and supervision arrangements

The monitoring and supervision arrangements of the Guaíba+Resilient Program are designed to ensure the continuous and adaptive management of environmental and social risks throughout the lifecycle of each subproject. These arrangements are anchored in a participatory and multi-institutional governance model, guided by the AIIB Environmental and Social Framework (ESF) and Brazilian legal and policy instruments.

The approach integrates preventive, concurrent, and corrective monitoring, ensuring that actions can be adjusted dynamically in response to emerging challenges and new information.

i. Key performance indicators

A set of key performance indicators (KPIs) are proposed below to ensure the effectiveness of the environmental and social mitigation and compensation measures. The list is non-exhaustive and may be modified depending on subproject requirements.

- **Hydrological and flood risk indicators**:
    - Water levels in upstream and downstream sections of flood control structures (dikes, spillways, channels).
    - Frequency, duration, and extent of urban and peri-urban flooding.

    - Changes in infiltration rates, surface runoff, and recharge of aquifers.
    - Functionality of detention basins and green infiltration areas.
    - Performance of natural flood buffers and overflow zones.
- **Soil and geomorphological indicators**:
    - Rates of erosion and sediment transport in channels and lakeshore areas.
    - Stability and integrity of embankments and slopes.
    - Compaction levels and soil permeability in intervention zones.
    - Monitoring of sediment deposition in critical receiving bodies, such as the Guaíba Lake and associated wetlands.
- **Vegetation and biodiversity indicators**:
    - Coverage and continuity of native vegetation, including riparian and wetland areas.
    - Survival and growth rates of compensatory plantings.
    - Connectivity and functionality of ecological corridors.
    - Presence, abundance, and health of indicator species, including aquatic and terrestrial fauna.
    - Status of protected and sensitive habitats (e.g., APPs, floodplains).
- **Water quality indicators**:
    - Turbidity and sediment load in water bodies influenced by construction and operation phases.
    - Nutrient concentration (e.g., nitrogen, phosphorus) and presence of potential contaminants.
    - Biological parameters (e.g., macroinvertebrate indices, chlorophyll levels) as indicators of ecological integrity.
    - Monitoring of groundwater quality in areas of possible contamination or infiltration.
- **Social and territorial indicators**:
    - Number of households relocated or directly affected, and effectiveness of resettlement plans.
    - Restoration of livelihoods and re-establishment of community networks.
    - Indicators of social cohesion and perceived territorial identity.
    - Accessibility to public services and spaces before, during, and after project implementation.
    - Community satisfaction and perception indices collected through regular surveys.
- **Occupational Health and Safety (OHS) indicators**:

- Number of recorded accidents and incidents during construction and operation phases.
- Frequency of near misses and corrective actions taken.
- Workdays lost due to occupational injuries.
- Percentage of workers receiving OHS training and safety briefings.
- Compliance with site-specific health and safety protocols (e.g., use of PPE, signage, supervision).
- Effectiveness of emergency response procedures and drills.

- **Operational and institutional performance indicators**:
  - Compliance rates with licensing conditions and ESMP measures.
  - Timeliness and effectiveness of maintenance for drainage and flood control infrastructure.
  - Responsiveness of municipal emergency services to climate-related incidents.
  - Frequency and effectiveness of interdepartmental coordination meetings.
  - Adherence to reporting schedules and resolution rates for grievances and complaints.

ii. Monitoring and reporting responsibilities and frequencies

The institutional architecture for monitoring and supervision is built on a multi-level system involving municipal, state, and external actors, ensuring technical robustness and transparency.

- **Primary monitoring responsibilities**:
  - **Secretariat of Environment, Urbanism and Sustainability**: Coordinates the technical and operational environmental monitoring (e.g., vegetation, water quality, habitat connectivity), integrates data into municipal environmental information systems, and manages compensatory measures.
  - **Secretariat of Public Works and Services**: Responsible for monitoring civil works compliance, drainage system performance, soil stabilization interventions, and construction-phase environmental safeguards.
  - **Special Projects Office (Gabinete de Projetos Especiais)**: Supervises integrated project management, oversees cross-sectoral risk assessments, and ensures that strategic program goals are met.
- **Support and oversight roles**:
  - **Civil Defense**: Monitors emergency response indicators, supports flood risk monitoring, and oversees early warning systems.
  - **Secretariat of Planning and Urban Development**: Monitors land use dynamics, controls unauthorized occupation, and oversees social and territorial impact indicators.

- **State environmental agencies (FEPAM, SEMA-RS)**: Conduct periodic inspections and audits, validate technical reports, and support corrective actions when necessary.
- **Universities and research institutes**: Provide scientific validation of indicators, lead special studies on biodiversity and hydrology, and support community-based monitoring initiatives.
- **Civil society organizations and local councils**: Participate in social monitoring, validate perception surveys, and contribute to independent oversight.

- **Public participation and transparency mechanisms**:
  - Regular public consultation meetings and community assemblies to present monitoring results and collect feedback.
  - Participatory mapping and community-based environmental monitoring programs, particularly in areas near wetlands, riparian zones, and urban vulnerable neighborhoods.
  - Maintenance of an online platform (e.g., WebGIS) with updated environmental and social data layers accessible to the public.

- **Environmental and social monitoring reporting frequency and deliverables**:

Monitoring reports shall be prepared on a quarterly basis, with responsibilities distributed as follows. An annual consolidated report will be compiled by the PIU, integrating findings and trends from the quarterly submissions.

- Operational and environmental monitoring reports: prepared by the Supervision Consultants and Contractors, including data on water levels, erosion, vegetation status, and infrastructure performance. Immediate special reports must be submitted by Contractors and reviewed by Supervision Consultants following major hydrometeorological events.
- Social monitoring reports: compiled by the Supervision Consultants, based on inputs from Contractors and field teams, summarizing resettlement progress, community engagement outcomes, grievance mechanism activities, and indicators of social cohesion.
- Institutional and governance reports: prepared by the PIU, focusing on cross-sectoral integration, intermunicipal coordination effectiveness, and progress in aligning local policies and procedures with the Environmental and Social Framework (ESF).

The format and frequency of reporting should be finalized in consultation with the PIU, to ensure alignment with internal workflows and avoid duplication.

- **Data management and decision support**:
  - All data must be georeferenced and stored in a central municipal database integrated with the WebGIS platform, ensuring real-time access for decision-makers and stakeholders.
  - Protocols for periodic data audits and validations to verify accuracy and consistency.

- Development of risk dashboards to support rapid decision-making and early warning for critical thresholds (e.g., flood level exceedance, slope movement indicators).

- **Capacity building and continuous improvement**:
  - Regular training sessions for municipal staff and partners on new monitoring technologies, data interpretation, and adaptive management practices.
  - Establishment of technical forums and working groups involving academia, civil society, and government representatives to review monitoring strategies and propose improvements.
  - Periodic updates of monitoring plans to incorporate lessons learned, emerging risks, and technological innovations.

4.7. Institutional arrangements: roles and responsibilities of the PIU, consultants, and contractors; required skillsets and capacity-building needs

Based on the Project's analysis and the identified needs for institutional strengthening under the Guaíba+Resilient Program, it is critical to establish robust and clearly defined institutional arrangements. These arrangements ensure effective environmental and social (E&S) risk management, compliance with AIIB safeguard standards, and operational excellence throughout the Program lifecycle.

Project Implementation Unit (PIU)

The PIU is the central coordination structure responsible for the overall management, supervision, and strategic direction of Program activities. It acts as the main interface with AIIB, national and state authorities, and local stakeholders.

Core responsibilities of the PIU include:

- Overall coordination and integration of Program components and subprojects.
- Strategic procurement management and supervision of contracted consultants and contractors.
- Oversight and quality control of environmental and social safeguard implementation.
- Facilitation of institutional articulation across municipal departments and external partners.
- Consolidation and dissemination of monitoring and evaluation reports.

Required skills for the PIU:

- Proven expertise in environmental and social safeguard standards (especially AIIB's ESS1, ESS2, and ESS3).
- Advanced knowledge of Brazilian environmental licensing procedures and urban governance instruments.
- Experience in procurement processes and contract management that integrate E&S clauses.

- Technical capacity to oversee occupational health and safety (OHS) requirements, including the ability to draft, monitor, and audit compliance.
- Strong skills in stakeholder engagement, communication, and conflict resolution.

Capacity-building needs:

- Targeted training on AIIB safeguard policies, FPICon protocols, and grievance redress mechanisms (GRMs).
- Advanced workshops on integrated risk management and adaptive planning.
- Continuous training on social impact assessment methodologies, community resettlement practices, and participatory monitoring.
- Strengthening capacities for emergency preparedness, with emphasis on hydrometeorological risks and urban climate resilience.

Consultants – Environmental and Social Instruments Preparation

These consultants play a crucial role in supporting technical, environmental, and social assessments and in preparing key instruments such as Environmental and Social Impact Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), resettlement frameworks, and specific sectoral plans (e.g., flood risk management, biodiversity compensation plans).

Core responsibilities:

- Preparation and delivery of environmental and social studies in strict adherence to AIIB standards and national requirements.
- Development of technical designs and impact mitigation strategies aligned with ecological and social sensitivities.
- Support to the PIU in stakeholder engagement processes and public consultations.

Required skills:

- Multidisciplinary expertise encompassing biophysical, social, and territorial planning domains.
- Demonstrated experience in facilitating participatory consultation processes, including culturally appropriate approaches.
- Ability to anticipate and assess the implications of design and construction decisions on environmental performance and OHS.
- Familiarity with ongoing legislative changes in Brazilian environmental and labor frameworks.

Capacity-building needs:

- Regular updates on AIIB ESS and emerging best practices for safeguard integration.
- Strengthening dialogue skills with regulatory bodies, labor unions, and affected communities.
- Training on crisis and emergency response planning during construction and operational phases.

Supervision Consultants – ES Compliance Monitoring

Supervision Consultants are responsible for overseeing the implementation phase, ensuring that Contractors comply with the environmental, social, health, and safety requirements defined in the project's safeguards instruments and contractual obligations.

Key responsibilities include:

- Regular site inspections and compliance monitoring.
- Verification of the implementation of ESMP measures.
- Coordination with the PIU and Contractors to resolve non-compliance issues.
- Preparation of periodic monitoring reports, including data on key ES indicators and grievance resolution.

In some cases, the same consulting firm may undertake both preparation and supervision roles, but responsibilities should be clearly defined and separated in contractual arrangements.

Contractors

Contractors are directly responsible for implementing civil works according to the specifications defined in project documents, including all E&S clauses and mitigation measures outlined in the ESMPs.

Core responsibilities:

- Execution of works in compliance with environmental licenses and approved management plans.
- Application of site-level E&S mitigation and monitoring measures, including waste management, pollution control, and vegetation protection.
- Strict adherence to occupational health and safety standards, with preventive and corrective measures as required.

Required skills:

- Solid knowledge of OHS management and environmental site supervision.
- Capacity to manage multi-disciplinary construction teams and coordinate with oversight entities.
- Skills to engage with community representatives, address grievances, and ensure transparent information flows.

Capacity-building needs:

- Training on the operationalization of grievance redress mechanisms and community liaison protocols.
- Emergency response preparedness, especially for climate-induced events such as floods, storms, or heatwaves.
- Periodic updates on national and local OHS regulations, including practical application on construction sites.

Internal capacities and cross-cutting needs

In addition to actor-specific requirements, certain capacities must be institutionalized within the municipal administration to ensure long-term sustainability and governance continuity:

- Drafting of procurement documents and contracts incorporating comprehensive E&S and OHS requirements, including performance indicators and compliance penalties.
- Auditing and enforcement capacity to monitor contractual adherence during construction, supported by technical audits and field inspections.
- Support systems to assist contractors in resolving compliance challenges proactively, avoiding unnecessary delays or work stoppages.
- Capacity to anticipate, plan for, and respond to emergency scenarios, whether related to natural disasters, labor incidents, or community conflicts.
- Continuous professional development, integrating lessons learned and fostering adaptive management practices across all involved entities.

Infrastructure and equipment strengthening

To support these institutional arrangements, investments in physical infrastructure (e.g., monitoring equipment, data management systems, dedicated operational facilities) are essential. Ensuring real-time data integration and fostering an environment of continuous technical improvement are critical to the resilience and effectiveness of the Program.

4.8. Cost/budget considerations

The effective implementation of the Guaíba+Resilient Program's environmental and social (E&S) safeguards depends directly on adequate and transparent budget allocation. Costs related to E&S management must be explicitly included in the budget of each subproject, ensuring that all mitigation, compensation, and monitoring measures are properly resourced and sustainable throughout the project lifecycle.

Key cost components to be covered in each subproject budget include:

- **Preparation of E&S studies**:
  Costs for the elaboration of Environmental and Social Impact Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), specific technical studies (e.g., biodiversity surveys, hydrological modeling), and resettlement or livelihood restoration frameworks where applicable.
- **Mitigation and compensation measures**:
  Expenses associated with implementing environmental mitigation actions (e.g., reforestation, erosion control, restoration of wetlands), social compensation programs, and resettlement assistance, including transitional support for displaced populations.
- **Public consultations and information disclosure**:
  Costs for organizing and facilitating public consultations, producing communication materials,

maintaining stakeholder engagement channels, and ensuring inclusive and culturally appropriate dissemination of information.

- **Grievance Redress Mechanism (GRM)**:
  Development and maintenance of GRM platforms, staffing for complaint reception and resolution, and supporting materials to inform communities of available channels and procedures.

- **Monitoring, auditing, and reporting**:
  Resources for continuous environmental and social monitoring (including field surveys, laboratory analyses, and remote sensing), commissioning of independent external audits, and periodic reporting to AIIB, licensing authorities, and the public.

- **Capacity-building and training**:
  Investments in training programs for PIU staff, consultants, contractors, and community representatives on safeguard policies, occupational health and safety (OHS), emergency preparedness, and participatory monitoring methodologies.

- **Communication plans and materials**:
  Development of communication strategies, preparation of visual materials and educational content, maintenance of online platforms (e.g., WebGIS), and support for ongoing engagement and awareness-raising campaigns.

A substantial portion of the Program's environmental and social (E&S) budget is dedicated to comprehensive management actions at both the program and subproject levels. This includes the establishment and strengthening of the PIU's E&S team, contracting of external audits and technical consultants, preparation and continuous updating of Environmental and Social Impact Assessments (ESIAs) and Environmental and Social Management Plans (ESMPs), as well as implementation of cross-cutting measures to mitigate or offset identified risks.

Additionally, each subproject budget should incorporate dedicated resources for environmental and social provisions. This ensures that safeguard actions are consistently implemented, supports compliance with AIIB and national standards, and enables the adoption of best practices in occupational health and safety, stakeholder engagement, and long-term environmental stewardship.

Occupational Health and Safety (OHS) budget considerations

The construction budget for each subproject must explicitly account for material and human resources dedicated to OHS, including but not limited to:

- **Personal protective equipment (PPE)**: helmets, safety boots, harnesses, gloves, hearing protection, and other items required based on specific site hazards.

- **Collective protective equipment (CPE)**: temporary barriers to prevent falls, guardrails, signage, and systems to isolate high-risk zones.

- **External specialized services**: training services (e.g., working at heights, confined spaces), environmental monitoring (e.g., noise, dust, chemical exposure assessments), and equipment certification.

- **Specialized OHS professionals**: safety technicians, safety engineers, occupational physicians, and other professionals as required by project scale and complexity.

As established by Regulatory Standard 04 (NR-04) — Specialized Service in Safety Engineering and Occupational Medicine, the number and type of OHS professionals are defined according to the total workforce on each construction site. Compliance with these regulations is mandatory to minimize occupational risks, avoid work stoppages, and ensure the well-being of all workers involved.

Finally, budget lines for E&S and OHS must be detailed in procurement documents and execution contracts to enable effective monitoring, avoid hidden costs, and ensure contractor accountability. Adequate budget planning and allocation represent a fundamental pillar for achieving the Program's environmental and social objectives and building long-term resilience for the municipality of Guaíba.

5. Final considerations

This Environmental and Social Management Planning Framework (ESMPF) for the Guaíba+Resilient Program embodies an integrated and forward-looking approach to urban and territorial resilience. Building upon the foundation established by the Environmental and Social Assessment (ESA), the ESMPF consolidates a comprehensive set of legal, biophysical, social, and institutional analyses into actionable guidelines and instruments.

Throughout the document, emphasis is placed on multi-level integration — combining hydrological, ecological, social, and governance dimensions — to address systemic vulnerabilities and enable adaptive responses to future challenges. Measures such as the creation of green corridors, restoration of wetlands, incorporation of nature-based solutions, and the design of multifunctional infrastructures (like the perimeter ring road) exemplify how environmental performance and urban functionality can be strengthened simultaneously.

The framework also reinforces the importance of social equity and participatory governance, ensuring that affected communities, especially vulnerable groups, are engaged through Stakeholder Engagement Plans (SEPs) and Grievance Redress Mechanisms (GRMs). This participatory emphasis not only reduces social tensions but supports the creation of inclusive, cohesive urban spaces.

Additionally, the ESMPF highlights the critical role of institutional strengthening and continuous capacity building, setting the foundation for robust monitoring systems and iterative policy improvement. By integrating climate adaptation principles across all measures, the Program positions Guaíba as a model for proactive, resilient, and socially inclusive urban development.

In summary, the ESMPF transcends a compliance-based perspective, offering a strategic pathway towards a more equitable, climate-adaptive, and ecologically functional city. Its implementation represents a significant step forward in transforming vulnerabilities into opportunities for sustainable and inclusive growth.

Appendices

1. **Tool for screening – checklist**
2. **Model ToR for preparation of subproject ESIAs and ESMPs**
3. **Model ToR for preparation of Climate and Risk Vulnerability Assessment**
4. **DPSIR Matrices**
5. **Initial Physical Climate Risk Screening Report for Guaíba, Brazil. (Swiss Re Climate Risk Services, 2025)**

Appendix 1

Tool for screening – checklist

This checklist serves as a practical tool to support the initial environmental and social (E&S) screening of subprojects under the Guaíba+Resilient Program. It aims to provide a systematic approach to identifying potential risks and impacts at an early stage, guiding categorization and the definition of required instruments (e.g., ESIA, ESMP, RAP). The checklist aligns with the AIIB Environmental and Social Framework (ESF) and complements national and state licensing requirements.

General information

Subproject name: _____

Location: _____

Description and objectives: _____

Implementing agency: _____

Expected start date: _____

Preliminary estimated budget: _____

Screening questions

1. Physical and environmental risks

- Will the subproject involve large-scale earthworks or land clearing?
- Will it be located in or near environmentally sensitive areas (e.g., wetlands, APPs, riparian zones)?
- Will it affect natural drainage patterns or hydrological connectivity?
- Will it require significant vegetation suppression or removal of native species?
- Are there risks of soil erosion, slope instability, or sediment transport?
- Will it generate significant noise, dust, or air emissions during construction?
- Could it potentially contaminate surface water or groundwater?
- Is there potential for cumulative impacts when combined with other nearby interventions?
- Will the subproject generate solid waste or wastewater requiring treatment or disposal?

2. Biodiversity and ecosystem services

- Will the subproject affect critical habitats or endangered species?
- Will it fragment ecological corridors or reduce habitat connectivity?

- Are nature-based solutions (e.g., bioengineering, vegetated buffers) planned to mitigate impacts?
- Will ecosystem services (e.g., flood regulation, erosion control, microclimate regulation) be compromised?

3. Social and territorial aspects

- Will the subproject require involuntary resettlement or relocation of households or businesses?
- Could it induce informal settlements or unplanned urban expansion?
- Will it affect traditional land uses or community spaces?
- Are there indigenous peoples or traditional communities in the area of influence?
- Are there other vulnerable groups (e.g., low-income households, elderly, people with disabilities) potentially affected by the subproject?
- Will it change access to public services or mobility routes?
- Could it potentially cause or exacerbate social conflicts?

4. Occupational health and safety (OHS)

- Will construction activities involve high-risk operations (e.g., work at heights, excavation, handling hazardous materials)?
- Are appropriate OHS measures and resources (e.g., PPE, CPE, trained staff) planned?
- Will there be sufficient capacity to monitor and enforce OHS standards during implementation?

5. Stakeholder engagement and governance

- Has a Stakeholder Engagement Plan (SEP) been considered or initiated?
- Are grievance redress mechanisms (GRMs) in place or planned?
- Is there an institutional framework to coordinate E&S actions (e.g., dedicated PIU team, municipal committees)?
- Will public consultations be conducted before final design and implementation?

Preliminary risk categorization

☐ Category A – High risk (significant, potentially irreversible, or large-scale impacts)

☐ Category B – Moderate risk (localized, mostly reversible impacts, manageable through mitigation)

☐ Category C – Low or negligible risk (minimal or no adverse impacts)

Recommendations

Instruments required (tick applicable):

☐ Environmental and Social Impact Assessment (ESIA)

☐ Environmental and Social Management Plan (ESMP)

☐ Resettlement Action Plan (RAP) or Livelihood Restoration Plan

☐ Biodiversity Management Plan

☐ OHS Management Plan

☐ Specific technical studies (e.g., hydrological, geotechnical)

Further stakeholder engagement actions needed:

☐ Additional consultations

☐ Specific communication campaigns

☐ Capacity-building activities

Signatures and validation

Screening conducted by: _____

Position: _____

Date: _____

Approved by PIU coordinator: _____

Date: _____

Notes

This checklist should be revisited and updated throughout the project lifecycle, particularly after design adjustments, stakeholder consultations, or major contextual changes. It serves as a dynamic tool for early risk identification and strategic planning, ensuring alignment with AIIB standards and national legal frameworks.

Appendix 2

Model Terms of Reference (ToR) for Subproject Environmental and Social Impact Assessments (ESIAs) and Environmental and Social Management Plans (ESMPs)

Background

The Guaíba+Resilient Program was established in response to the severe flooding events that affected the municipality of Guaíba in May 2024. The program aims to enhance urban drainage, strengthen critical infrastructure, requalify the waterfront, and improve climate risk management. These integrated actions are essential to increase urban resilience, protect livelihoods, and support sustainable economic development. In line with the Asian Infrastructure Investment Bank (AIIB) Environmental and Social Framework (ESF), comprehensive environmental and social studies are required to ensure that all subprojects are designed and implemented responsibly, minimizing risks and maximizing positive impacts.

1. Objective

The objective of this Terms of Reference (ToR) is to guide the preparation of comprehensive Environmental and Social Impact Assessments (ESIAs) and Environmental and Social Management Plans (ESMPs) for subprojects under the Guaíba+Resilient Program. These documents shall identify, evaluate, and assess potential environmental and social risks and impacts, propose mitigation and management measures, and establish monitoring, communication, and engagement strategies to ensure compliance with national legislation and the Asian Infrastructure Investment Bank (AIIB) Environmental and Social Framework (ESF).

2. Scope of Work

2.1 ESIA

The ESIA must cover:

- **Physical environment:** geology, geomorphology, hydrology, drainage dynamics, water and air quality, noise levels.
- **Biological environment:** flora, fauna, habitats (including wetlands and riparian zones), ecosystem services, protected and sensitive areas.
- **Socioeconomic environment:** demographic profile, land use, infrastructure, livelihoods, economic activities, cultural heritage, urban dynamics.
- **Indigenous Peoples and Traditional Communities:** presence, potential impacts, and specific engagement requirements.
- **Climate risk and vulnerability analysis:** integration of future climate scenarios and potential hazards.
- **Assessment of feasible project alternatives**, including location, design, and technology, and the rationale for the final selected option.

2.2 ESMP

The ESMP must include:

- Summary of ESIA findings.
- Detailed mitigation, compensation, and adaptation measures.
- Implementation schedule with defined responsibilities.
- Monitoring framework, including environmental and social indicators.
- Emergency preparedness and contingency plans.
- Occupational Health and Safety (OHS) measures, covering pre-construction, construction, and post-construction phases.
- Grievance Redress Mechanisms (GRMs) for communities and workers.
- Stakeholder engagement and communication plan.
- Budget and resource allocation.
- Occupational Health and Safety (OHS) planning must be integrated across project phases, including risk assessment, safety briefings, proactive/reactive indicators, and prevention of substance abuse and work stoppages.
- The ESMP must establish a clear and accessible Grievance Redress Mechanism (GRM) for affected communities and workers, with confidentiality safeguards and retaliation prevention measures.
- A structured communication plan should define how environmental and social issues will be disclosed and risks communicated, with periodic updates for key stakeholders.
- Institutional capacity-building plan for implementing agencies, addressing ESMP execution, monitoring, and compliance with AIIB ESS.

3. Methodology

- **Legal and institutional framework review:** assessment of relevant Brazilian and municipal laws, as well as AIIB standards (ESS1, ESS2, ESS3).

- **Baseline data collection:** primary surveys and secondary data, integrating ecosystem-based and DPSIR approaches (Drivers–Pressures–State–Impacts–Responses).
- **Impact assessment:** including cumulative, synergistic, direct and indirect impacts.
- **Public consultation:** inclusive, culturally appropriate, documented consultations; Free, Prior and Informed Consultation (FPICon) is mandatory where Indigenous Peoples or Traditional Communities may be affected. The consultation process must include mechanisms to engage vulnerable groups, document all proceedings, and ensure transparency through timely public disclosure in Portuguese and English.
- **Risk analysis and vulnerability screening:** addressing environmental, social, and climate-related vulnerabilities.

4. Deliverables

- **Inception Report**, including detailed work plan and stakeholder mapping.
- **Draft ESIA and ESMP Reports**, for public disclosure and consultation.
- **Final ESIA and ESMP Reports**, incorporating feedback from stakeholders and authorities.
- **Executive Summaries** in Portuguese and English.
- **Annexes:** legal and regulatory analyses, maps, baseline data, consultation records, OHS protocols.

5. Timeline

- Estimated duration: **120–150 days**, depending on subproject complexity.
- Milestones: inception, data collection and baseline, impact assessment, consultation rounds, draft reporting, finalization.

6. Institutional Coordination and Capacity-Building Provisions

- Roles and responsibilities of the PIU (Project Implementation Unit), municipal technical teams (e.g., Secretaria Municipal de Meio Ambiente, Urbanismo e Sustentabilidade; Secretaria de Infraestrutura e Serviços Públicos), and contracted consultants.
- Coordination with AIIB and relevant state/federal agencies.
- Capacity building for municipal staff on ESF compliance and monitoring.

7. Communication Plan

- Public communication strategy detailing timing, channels, and target audiences.
- Risk communication for environmental and social issues.
- Periodic updates to local communities, authorities, and AIIB.

8. Team Qualifications

The consulting team must demonstrate proven experience in preparing environmental and social studies for infrastructure projects, preferably involving international financing institutions. Required expertise includes:

- Environmental science or engineering
- Social sciences (sociology, anthropology, resettlement)
- Occupational health and safety
- Stakeholder engagement and conflict mediation
- Climate risk and vulnerability assessment

Consultants must have relevant academic training (bachelor's or higher degrees) and a minimum of 5 years of professional experience in their respective areas.

Note: All proposed studies and plans must align with AIIB Environmental and Social Framework (ESF), particularly ESS1 (Environmental and Social Assessment and Management), ESS2 (Land Acquisition and Involuntary Resettlement), and ESS3 (Indigenous Peoples), as well as Brazilian national and municipal regulations and the specific context of Guaíba+Resilient Program.

Appendix 3

Climate and Risk Vulnerability Assessment (CRVA)

Terms of Reference

Background

Guaiba municipality is in Rio Grande do Sul, Brazil, with 99,000 inhabitants and an area of 176,166 km^2. It is on the right side of Lake Guaiba in a basin comprising about 84,000 km^2. The town's infrastructure is affected by floods from Lake Guaiba (Fluvial Floods) and stormwater[1] in urban areas and tributaries.

The municipality needs the development of its Climate Risk Vulnerability (CRVA) related to stormwater management and flood plains impacts to improve its resilience towards climate change. Seeking to invest in its climate resilience, Guaiba is applying for an international loan from Asian Infrastructure Investment Bank for the development its resilience investment plan.

Some important climate information show that recent events have impacted climate change:

In 2024, the Guaiba Basin and Patos Lagoon (about 140,000 km^2) suffered a major flood impact with a return period greater than 200 years. The social, economic, and environmental impacts were significant. In 2023 there were two smaller floods and in June 2025 another flood occurred. This is not a common scenario, since in the recorded data period of 1899 - 2025 in Porto Alegre, only 7 years were above the flood limit of the city.

Using the comparison between 1941 and 2024 major floods, it is possible to see the effect of climate change in this last flood (increase intensity in shorter number of days).

2. Objective

The objective of the study is to assess the Guaíba vulnerability to floods from Lake Guaíba and its tributaries and stormwater in urban areas considering climate

[1] Fluvial Floods is from the main river crossing the cities and stormwater are the urban drainage floods. In US it's called stormwater in Europe Pluvial floods.

change. In addition, to develop sustainable solutions to increase resilience of the Guaíba population and environment.

The specific objectives are:

- Identify and characterize the climate hazards relevant to the location and nature of the subproject.
- Analyze how the frequency and intensity of these hazards will evolve over the life of the infrastructure, using scientifically recognized climate projections.
- Assess the vulnerability of the subproject components to these projected climate hazards.
- Conduct a risk analysis to prioritize the most critical scenarios.
- Propose a set of technically and economically feasible adaptation measures to increase the resilience of the infrastructure of specific sub-projects.

3. Methodology

The ARVC methodology should follow international best practices, such as those established by ISO 14090/14091 and the AIIB guidelines on climate resilience. The evaluation should be an iterative process, in close collaboration with the subproject's engineering team. The ***Initial Physical Climate Risk Screening Report*** will serve as a mandatory starting point for identifying hazards and exposure.

3. Scope Of Work

3.1 Identification and Characterization of Climate Hazards

The study should develop the following products:

1. Characterization of the Guaiba Basin and tributaries which affect the municipality, considering climate conditions, physical and environmental characteristics, along with social and economic aspects.
2. Assessment of social, economic and environmental impacts in Guaiba due to past floods using flood maps from Guaiba Lake, stormwater, and tributaries; Identification of the major vulnerability in the urban area of Guaiba due to stormwater and river floods.
3. Assessment of Rainfall duration curve and its statistical non stationarity to climate change and assessment of flood levels in Guaiba Lake and its non stationarity for climate change.

3.2 Analysis of Future Climate Projections

Assessment of climate change effects for 2050, 2080 and 2100 based on CMIP6 scenarios. The analysis should contemplate at least two emissions scenarios (e.g., an intermediate scenario such as SSP2-4.5 and a pessimistic scenario such as SSP5-8.5). The analysis is for:

a. for stormwater rainfall in Guaiba, developing new rainfall Intensity-Duration Curves.
b. flood levels in Lake Guaiba.

This assessment should assess the change of the values for design values of urban drainage and (10 –25 years of return period or for fluvial floods 100 years.

3.3 Exposure and Vulnerability Assessment

Review 2 and 3 in the assessment of social, economic and environmental impacts for 2050, 2080 and 2100 risk scenarios for identification of major vulnerabilities, based in flood maps.

3.4 Climate Risk Analyis

Based on the results from previous aspects, is required the development of a proposed alternative measures to increase resilience to floods in Guaiba and consider climate change adaptation for future events. It should be based on:

Qualitative Analysis: Utilize a risk matrix to classify risks as low, medium, high, or very high.

Quantitative Analysis (where feasible): Where data allow, quantify risks in terms of potential economic losses, repair costs or likelihood of service interruption.

3.5 Proposal for Climate Adaptation Measures

The Consultant must propose a set of concrete, prioritized, and actionable adaptation measures to mitigate the identified risks. The measures should be categorized as:

Structural Measures (Grey Engineering): Changes in the design, such as increasing the sizing of hydraulic structures (channels, culverts), raising implantation levels, using construction materials that are more resistant to heat or humidity, and slope protection.

Nature-Based Solutions (Green Engineering): Measures that use ecosystems to increase resilience, such as the restoration of floodplains, the creation of vegetated detention basins (flood parks), and the use of permeable pavements.

Non-Structural Measures: Improvements in early warning systems, flood zoning, development of emergency operation and maintenance plans, and insurance.

The proposed measures must be accompanied by a cost estimate and a cost-benefit or cost-effectiveness analysis to support decision-making.

4. Procedures

The contents required to deliver the proposed scope of work are the following:

- Climate change scenarios of rainfall should consider climate models, which have the best performance for the climate of the region for existing historic data.
- The scenario is SSP2 (Middle of the Road 4.5), a world where current trends continue, with moderate population growth and economic development for the years 2050 and 2100.
- The assessment of Guaíba flood level should consider climate change from the basin rainfall and sea level potential effect.
- The proposed solutions should consider the effects related to urbanization and climate change of the floods in stormwater and the increased flood conditions for 2050 and 2100.
- The proposed solutions should consider the increased effects of climate change in the floods the Guaiba Lake affecting Guaiba town for the 2050 and 2100.
- The flood measures in the town should be based on non-structural: regulations of stormwater, flood risk areas zoning, flood forecasting; and structural solutions in stormwater and improvement to protect waterfront, among others.

5. Deliverables and Timeline

The outputs and reports are presented in the table below.

Table 1. Deliverables and Timeline.

Report number	Content	Due date[2]
1	Inception Report	15 days
2	Characterization of the Guaíba Basin and tributaries	60 days

[2] Days after start date

Report number	Content	Due date[2]
	Assessment of social, economic and environmental impacts and vulnerabilities	
3	Assessment of climate change effects Review report 2 considering climate change scenarios	120
4 and final	Develop proposed alternative measures to increase resilience to floods in Guaiba town and consider climate change adaptation for future events.	180

6.STAKEHOLDERS ACTIVITIES

The objectives of stakeholder's activities are:

- Identify key stakeholders and their roles in the assessment process.
- Describe the mechanisms for stakeholder consultation and participation.
- Outline procedures for validation and dissemination of findings.

The activities related to stakeholders are the workshops for validation of the project's outputs:

- Workshop n1 – after the delivery of Inception report to present the projects objective e outputs.
- Workshop n2 – After the assessment of the impacts with existing information
- Workshop n3 – in the end of the project with the impacts of climate change and resilience proposal

7. Team Qualifications

The main qualifications for this study are the following:

- Urban flood management considering river and lake floods and stormwater in urban areas. In this subject is important to have experience on sustainable urban drainage project in solutions based on natural systems.
- Urban planning and infrastructure implementation.
- Vulnerability Assessment and resilience plan on climate conditions scenarios.

4. DPSIR Matrices

Notes on the "Responsibility" Column in the DPSIR Matrices

The "Responsibility" column included in the DPSIR matrices refers primarily to the municipal public bodies directly involved in the planning and implementation of the Guaíba+Resilient Program, especially those responsible for contracting and executing environmental and social management actions. As such, the listed entities (e.g., municipal secretariats, project coordination offices) reflect the institutional attribution of mandate at the local government level.

However, for the effective execution of the measures outlined, responsibilities must also be operationally assigned to other key actors involved in the program's implementation, including:

- Project Implementation Unit (PIU): responsible for overall coordination, integration of environmental and social safeguards, supervision of consultants and contractors, and reporting to the AIIB.
- Consultants: responsible for the preparation of studies and instruments (e.g., ESIA, ESMP, RAP), support in stakeholder engagement, technical analysis, and monitoring activities.
- Contractors: responsible for implementing construction-related mitigation measures, complying with OHS requirements, managing worksites in line with environmental and social standards, and maintaining compliance records.

These actors operate under the coordination and oversight of the PIU, and their specific duties are detailed in procurement documents, environmental and social management plans (ESMPs), and supervision protocols. This layered structure ensures that institutional responsibilities (strategic and legal) are complemented by contractual and operational responsibilities, promoting accountability and compliance throughout the project cycle.

APPENDIX 4.A. DPSIR Matrix - Urban Flood Management Works

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Urban Drainage Construction Works	Physical-environmental	Change in local water dynamics	Subsystem	1.1 Streams and channels, 12.3 Rainwater drainage network	Possible lowering of the water table and modification of the flow response time	Water regulation, Rainwater flow	intra-municipal	Risk of interference with natural flows and loss of temporary regulatory function	Construction work	Negative	Direct	None of the options	Adopt an integrated approach to risk analysis of urban floods (local drainage) and river floods (Guaíba water level), considering the simultaneity of extreme events, Avoid interventions in flooding periods, Incorporate green infrastructure solutions to maintain regulatory functions during the construction work and at flow peaks, Ensure additional water retention capacity and mitigate interference with natural flow	Real-time flow measurement before, during, and after the works, Continuous hydrological monitoring before and after the work, Mapping the availability and functionality of public spaces for hydrological regulation, Monitoring the variation of the sealing rate and sediments in the channels	Perform integrated hydrological study with 10-year project risk, Deploy detention basins (M), Define preventive activation quotas of redundant systems (bypass, bleeder) based on joint overflow simulations (P), Stabilize banks and beds with vegetation (M), Design and deploy natural or artificial reservoirs equivalent to at least 1% of the drained area, preferably up to 2% (Cp), Evaluate failure scenarios and size hydraulic redundancy systems in the executive project (P).	Construction work and post-work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services; Coordination of Municipal Civil Defense; Municipal Agency for Economic and Social Development	SEMA-RS; ANA; Universities, Guaíba Hydrographic Basin Committee	ESS1
								Temporary suppression of areas of water damping and risks associated with excavations in rainy periods	Construction work	Negative	Direct	None of the options	Minimize interventions in periods of high rainfall and provide temporary alternatives for water damping, Delimit and protect sensitive areas before the start of the work, Integrate project with drainage planning.	Frequent inspections during excavations, Water quality analysis.	Post-work native vegetation replanting (Cr), Sediment containment barriers (M), Provide provisional dam structures and flow retardation in adjacent public areas during the construction phase, associated with the same criteria of 1–2% retention area (M).	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; FEPAM; Universities; ANA	ESS1
								Structuring of new conduits or re-qualification of degraded channels	Construction work	Positive	Direct	Synergistic	Adopt hybrid solutions (engineering + nature), Prioritize the use of open channels with vegetation.	Monitoring of the performance of new channels, Periodic assessment of flow efficiency.	Preventive maintenance plan for channels (Cr), Environmental education in local communities (O).	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; FEPAM; Universities	ESS1
								Reduction of chronic flooding, increase in flow efficiency and reestablishment of urban water regulation	operation	Positive	Indirect	Synergistic	Ensure preventive maintenance of drainage systems, Prioritize solutions that combine kinetic (plumbing) and ecological (green infrastructure) engineering, Consider the strategic function of urban roads in emergency and response contexts, including humanitarian flow	Continuous monitoring of critical flooding points, Flow efficiency indicators (response time, drained volume), Map the critical function of routes such as 20 de Setembro Street and monitor their use in extreme events	Operational adjustments in case of system saturation (Cr), Implementation of rain gardens and urban infiltration areas (M), Integrate in the construction and maintenance plan the expansion of public areas with the function of permanent detention basins, ensuring hydrological regulation capacity compatible with future scenarios of increased flow (Cp), Include road redundancy and additional protection in strategic routes and ensure clearance and special signaling (P).	Construction work and post-work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Urban Mobility; Municipal Civil Defense Coordination	SEMA-RS; FEPAM; Universities; State Civil Defense	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Urban Drainage Construction Works	Physical-environmental	Suppression of remaining riparian and native vegetation	Subsystem	1.2 Wetlands, 2.4 Woodlands and Forests	Removal of vegetation, especially in stretches between the Horto Florestal woods and peri-urban areas	Water regulation, Support for aquatic biodiversity, Water purification, Soil protection and erosion control, Habitat for terrestrial fauna and pollinators, Provision of spaces for leisure	immediately adjacent	Habitat loss and risk of erosion on banks	Construction work	Negative	Direct	Both options	Avoid removals in areas with high ecological sensitivity, Map ecological corridors before vegetation suppression.	Monitoring of the stability of the banks, Monitoring of fauna and vegetation cover throughout the work	Implement bioengineering techniques for erosion control (M), Environmental compensation with local ecological restoration (Cp).	Construction work and post-work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; FEPAM; Universities	ESS1
		Risk of contamination of soils and water bodies	Subsystem	1.1 Streams and channels, 12.5 ETE/EBEB, 12.4 Waste disposal	Potential contamination due to excavations in consolidated urban areas with potentially contaminated soil	Water purification, Reduction of contamination of soils and water bodies, Promotion of environmental health	immediately adjacent	Diffuse contamination by sediment and waste in water bodies, especially during excavations in potentially polluted areas	Construction work	Negative	Indirect	Cumulative	Perform prior mapping of areas potentially contaminated and vulnerable to sediment dispersal, Establish sediment and solid waste control protocol from the beginning of the work, Adopt staggered planning of excavation fronts, minimizing simultaneous exposure of large areas of soil.	Collection and periodic analysis of water and sediments in adjacent water bodies (turbidity, heavy metals, coliforms), Monitoring of disposal areas and containment structures (retention basins, geobags, protective blankets), Continuous photographic record of work fronts and environmental control devices	Installation of physical barriers for sediment retention (M), Application of geotextiles on exposed slopes and immediate revegetation after earth movement (M), Removal and environmentally appropriate disposal of solid waste and contaminated soils (Cr).	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; FEPAM; Universities	ESS1
								Risk of exposure of contaminated soils without adequate remediation, with impact on workers, ecosystems and groundwater	Construction work	Negative	Indirect	Both options	Conduct confirmatory and, if necessary, detailed investigation of environmental liabilities in the work areas, Require contaminated area management plan (plano de gerenciamento de áreas contaminadas - PGAC) before the start of excavations, Establish strict environmental and occupational safety protocols	Monitoring of soil and groundwater quality in affected areas, Verification of the proper use of PPE by workers, Regular inspections on compliance with the PGAC and the construction waste management plan	Safe removal of contaminated soils with transportation to licensed sites (Cr), Temporary encapsulation of critical areas until corrective measures are feasible (Cr), Suspension of activities in areas with critical contamination until adequate remediation (P).	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	FEPAM; SEMA-RS; Universities; Ministry of Labor	ESS1
								Progressive improvement of water quality, provided that the work incorporates adequate drainage and containment systems	operation	Positive	Indirect	None of the options	Design and execute urban drainage systems with diffuse pollution control and solids retention, Integrate sustainable devices into the drainage system, Ensure preventive and corrective maintenance of drainage structures.	Continuous monitoring of water quality at discharge points and receiving bodies (physico-chemical and microbiological parameters), Periodic inspections of drainage and containment structures for efficiency and integrity, Comparison of water quality data before and after system operation	Readjustment of drainage devices in case of unsatisfactory performance (Cr), Implementation of vegetated filters or additional sedimentation tanks (M), Corrections in the urban management of solid waste and prevention of clandestine releases (P).	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; FEPAM; Universities; Guaíba Hydrographic Basin Committee; ANA	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Urban Drainage Construction Works	Physical-environmental	Risk of destabilization of slopes or settlements in urban sections	Subsystem	3.3 Residential, 3.7 Transportation system, 12.1 Drainage protection system	Potential instability settlements where the pipelines will cross neighborhoods with pre-existing infrastructure	Living space, Access to essential goods, Mobility of people and goods	immediately adjacent	Structural damage to buildings and roads, with risk of settlement or localized collapse, especially in areas with unstable or saturated soil	Construction work	Negative	Indirect	None of the options	Perform detailed geotechnical diagnosis before excavations, Incorporate geotechnical risk analysis in the planning and licensing of the work, Establish damping or isolation ranges in areas of structural risk	Real-time monitoring of settlements and soil movements through instrumentation, continuous technical inspection of neighboring buildings and nearby urban infrastructure, recording and rapid response to observed splits, cracks, or settlements	Preventive soil stabilization (P), Reduction of the load on the banks of the excavations and temporary drainage of the water table (P), Temporary relocation of residents and partial suspension of the work in areas with imminent risk (Cr).	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Civil Defense Coordination	SEMA-RS; FEPAM; Universities; State Civil Defense	ESS1
		Risk of destabilization of slopes or settlements in urban sections	Subsystem	3.3 Residential, 3.7 Transportation system, 12.1 Drainage protection system	Potential instability settlements where the pipelines will cross neighborhoods with pre-existing infrastructure	Living space, Access to essential goods, Mobility of people and goods	immediately adjacent	Interruption of mobility and risk to public safety, with road closures and direct threat to the population and workers	Construction work	Negative	Indirect	None of the options	Plan the work in stages, with clear schedules and prior communication to the population, Ensure alternative routes and safety conditions throughout the execution, Ensure inter-sectoral articulation with traffic, transport, health and civil defense	Daily monitoring of closures and traffic conditions in the affected areas, Verification of the effectiveness of signaling and compliance with diversion routes, Registration of incidents and complaints through ombudsman channels and mobility applications	Implementation of clear signs, temporary crosswalks and lighting on the work fronts (P), Provision of traffic agents or community monitors to guide the circulation (P), Suspension of sections of the work at critical times (Cr).	pre-construction work and during construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Infrastructure and Public Services; Municipal Civil Defense Coordination; Municipal Secretariat of Health	State Civil Defense; Universities; Military Brigade	ESS1
								Stabilization of slopes and vulnerable stretches promotes greater structural safety, prevents geotechnical disasters and qualifies existing urban infrastructure	operation	Positive	Indirect	None of the options	Incorporate permanent stabilization practices, Maintain an updated geotechnical register of the treated areas, with a continuous maintenance plan, Integrate stabilization actions with urban planning and green infrastructure	Periodic technical inspections on slopes, containments, and treated areas, geotechnical instrumentation for monitoring settlements, pore pressure and mass movement, stability indicators and reduction of geotechnical emergency occurrences	Structural reinforcement and corrective drainage in areas where residual instabilities are observed (Cr), Compensatory planting of species with soil fixation function in treated areas (Cp), Training of municipal teams for rapid responses to risk signs (O).	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Civil Defense Coordination	SEMA-RS; FEPAM; Universities; State Civil Defense	ESS1
	Socio-spatial	Direct interference in consolidated urban areas	Subsystem	3.3 Residential, 34. Commerce, 3.7 Transportation system	Potential removal of structures (walls, pavements, accesses), especially between the Engenho Allotment and the region of the Ave. Lupicínio Rodrigues	Space for housing and urban stability, access to goods and services, mobility and accessibility	immediately adjacent	Removal of structures, impact on local commerce and urban circulation	Construction work	Negative	Indirect	None of the options	Carry out prior mapping of the impacted structures and activities, Include compensatory measures and functional reorganization of the affected areas in the executive project, Ensure participation of residents and traders in the definition of alternatives	Continuous survey of economic losses and the degree of local accessibility, Monitoring of the effects on trade and mobility during the work, Registration of demands of the population through ombudsmen and direct communication channels.	Implementation of temporary accesses, ramps and provisional signaling (P), Technical and logistical support to the affected trades (Cp), Replacement of pavements, sidewalks and accesses in an improved standard after the completion of the work (O).	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Urban Mobility; Municipal Agency for Economic and Social Development	Universities; SEDAC/RS (in cases of cultural trade and affected heritage); SEDEC/RS; SEINFRA/RS (in articulated state interventions)	ESS1
								Re-qualification of public areas, urban enhancement, better connectivity and accessibility	operation	Positive	Indirect	Both options	Prioritize inclusive urban design, with universal accessibility and multi-functionality of public spaces, Promote integration between the implemented infrastructure and the road system, public transport and active mobility, Value cultural, environmental and local identity elements in the re-qualification project	Indicators of use of public spaces, Assessment of physical accessibility, Monitoring of socioeconomic indicators related to territorial valuation and inclusion	Adjustments in urban furniture or routes implemented based on community demands (Cr), Landscape replacements or corrective techniques in cases of early wear or vandalism (Cr), Urban education campaigns and encouragement of collective appropriation of re-qualified spaces (O).	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Urban Mobility; Municipal Secretariat of Culture	Universities; IPHAN (if cultural legacy is involved); SEDAC/RS; SEMA-RS	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Urban Drainage Construction Works	Socio-spatial	Temporary change to local mobility and accessibility	Subsystem	3.7 Transportation system, 3.2 Hospitals/UBS, 3.4 Commerce3.7 Transportation system, 3.2 Hospitals/UBS, 3.4 Commerce	Potential closure of roads and circulation of heavy machinery (especially in the sections between Centro, Parque 35 and near BR-116)	Mobility of people and goods, Access to urban services, Operation of hospital, school and security systems	immediately adjacent	Road blocking, the presence of heavy machinery and access blocks can compromise the movement of residents, the functioning of local commerce and access to health and education equipment	Construction work	Negative	Indirect	None of the options	Plan and communicate in advance the temporary blockages, prioritizing essential services, Provide alternative accessible and safe routes, especially for pedestrians, emergency vehicles and public transport, Articulate the work schedule with the calendar and routine of the affected services	Real-time monitoring of the operation of accesses, Survey of complaints and indicators of direct impact, Verification of compliance with routes and established signs	Implementation of temporary passages, reinforcement of signaling and traffic control during critical times (P), Establishment of direct dialogue with managers of school and health units for operational adjustments (P), Provision of auxiliary transport in case of significant interruption (Cr).	pre-construction work and during construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Education; Municipal Secretariat of Health; Municipal Civil Defense Coordination	State Civil Defense; Universities; Military Brigade	ESS1
		Temporary change to local mobility and accessibility	Subsystem	3.7 Transportation system, 3.2 Hospitals/UBS, 3.4 Commerce3.7 Transportation system, 3.2 Hospitals/UBS, 3.4 Commerce	Potential closure of roads and circulation of heavy machinery (especially in the sections between Centro, Parque 35 and near BR-116)	Mobility of people and goods, Access to urban services, Operation of hospital, school and security systems	immediately adjacent	The construction work can result in upgraded roads, accessible routes and greater integration between neighborhoods, with direct benefits for everyday mobility and urban logistics	operation	Negative	Indirect	Both options	Prioritize road infrastructure projects with universal design, accessible sidewalks and integration with public transport, Connect the re-qualified urban network with public facilities, commercial areas and bicycle networks, Articulate the mobility project with housing, education and health plans, promoting territorial cohesion	Indicators of use of new routes, Assessment of reduced travel times and increased road safety, Population satisfaction surveys regarding traffic conditions and connectivity	Corrections in road geometry or urban furniture in case of accessibility barriers or failures (Cr), Addition of signs, lighting and safety equipment at critical points (P), Route update and integration with mobility applications (O).	all phases	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	Universities; SEDUR/RS; SEMA-RS	ESS1
		Risk of disarticulation of existing technical networks	Subsystem	12.6 Sewage network, 12.7 ETA, 3.5 Telephone towers, 8. Power supply network	Potential disarticulation of existing sanitation, energy and fiber optic networks, especially in the area between Jardim dos Lagos, Spolier Logística and around Stok Center	Electricity distribution, Sewage collection, Potable water supply, Communication between people and institutions	intra-municipal	Temporary interruptions in essential services, risk of disruptions or overload	Construction work	Negative	Indirect	Synergistic	Pre-map all technical networks in the areas of intervention, Integrate concessionaires and network operators to the planning and scheduling of works, Adopt preventive measures for physical protection and signaling of underground infrastructures.	Real-time monitoring of affected networks during excavations and ground movement, Record of service interruptions, user grievances and operational occurrences, Response time indicators and restoration of services in case of failures	Execution of deviations or temporary shielding of sensitive technical networks (P), Implementation of redundant systems or auxiliary reservoirs (e.g., water tanks, generators) (P), Emergency service with technical teams of the concessionaires for prompt response (Cr).	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Civil Defense Coordination	Utility companies (water, energy, telecommunications, gas); Universities; ANEEL; ANA; ANATEL (depending on the type of network involved); CORSAN, RGE, Equatorial, etc. (local operators according to the service)	ESS1
								Opportunity to reorder and modernize networks, with less future vulnerability and greater efficiency	operation	Positive	Indirect	Synergistic	Take advantage of interventions to rehabilitate and bury technical networks in an organized and secure manner, Integrate the reordering of networks with sectoral plans for sanitation, mobility and telecommunications, Prioritize resilient and adaptable infrastructure solutions, focusing on preventive maintenance and redundancy.	Evaluation of operational efficiency and reduction of failures after the reorganization of the networks, Indicators of improvement of coverage, pressure, quality and continuity of services, Monitoring of access conditions and security for future maintenance	Correction of incompatibilities between networks (Cr), Adjustments in connection points with buildings and public equipment (Cr), Registration update of networks and their integration into municipal urban management systems (O).	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	Concessionaires of public services; Universities; ANA, ANATEL, ANEEL (depending on the nature of the technical network); CORSAN, RGE, Equatorial, local telecommunications operators	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Urban Drainage Construction Works	Institutional and operational	Demand for environmental licensing efforts	Subsystem	3.8 Administrative sector	Need for relatively complex environmental licensing, given the intersection of multiple territorial typologies and the presence of sensitive areas, and including the need for vegetation intervention	Public services management, Support to participation and transparency	intra-municipal	The complexity of environmental licensing, especially when it involves multiple systems and sensitive areas (vegetation, water resources, occupied areas), can cause schedule delays and overload of local technical staff	pre-construction work	Negative	Indirect	Cumulative	Anticipate the licensing phase with the preparation of integrated and multidisciplinary studies, Ensure qualified technical dialogue between bidders, consultants and environmental agencies, Provide realistic deadlines in the general schedule, including analysis periods and complementary requirements	Monitoring of licensing procedures, Registration of bottlenecks and rework in the licensing process, Institutional performance indicators	Elaboration of a Term of Reference shared with the competent bodies, avoiding rework (P), Creation of a task force or specific technical working group to support licensing (O), Structuring of an integrated environmental management plan (plano de gestão ambiental integrado - PGAI) from the beginning of the project (P).	pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Office of Special Projects	FEPAM; SEMA-RS; Universities; Hydrographic Basin Committees	ESS1
	Institutional and operational	Pressure on local management capacity	Subsystem	3.8 Administrative sector, 3.9 Security and defense	Need for articulation between different agencies (works, environment, traffic, sanitation)	Management of public services, Protection of the population and assets	intra-municipal	Technical and institutional overload of municipal bodies (works, environment, social assistance, security), making it difficult to effectively monitor execution, social impacts and legal and participatory obligations	Construction work	Negative	Direct	Cumulative	Provide inter-sectoral governance structure with clarity of roles, information flows and articulation channels, Strengthen institutional capacity through technical training and temporary support (consultancies, agreements), Ensure specific budget for monitoring, inspection and social participation activities	Indicators of responsiveness of municipal agencies, Evaluation of the coverage and effectiveness of inspection, social assistance and communication actions, Monitoring of inter-sectoral meetings and the implementation of conditions	Creation of units or technical committees dedicated to the supervision of the project (O), Hiring of external technical support via institutional cooperation or public calls (O), Establishment of a digital system for integrated management of works and impacts (O).	all phases	Office of Special Projects; Municipal Secretariat of Government; Municipal Secretariat of Administration and People Management; Comptroller General of the Municipality	Universities; Courts of Auditors (TCE/RS); Public Prosecutors (State or Federal Public Prosecutor's Office); SEMA-RS (in interface with inspection and licensing)	ESS1
	Institutional and operational	Public repercussion and need for active communication	Subsystem	3.6 Information network, 3.8 Administrative sector	Work crosses densely populated and visible regions, requiring social communication efforts	Communication between people and institutions, Support for territorial management, environmental monitoring, digital integration of services and support for education, health and risk alerts	intra-municipal	Absence of effective channels of communication and listening can generate disinformation, resistance of the population, judicialization and institutional fragility in the face of socio-spatial conflicts.	Construction work	Negative	Indirect	Synergistic	Structure a social communication plan from the beginning of the work, with accessible and multichannel language, Ensure answers to the demands of the population and articulation with local leaders, Integrate communication to the other fronts of participatory management of the project	Monitoring the number and type of interactions with the community, Evaluation of grievances, response time, and recurrence of conflicts, Indicators of judicializations, protests and community resistance.	Implementation of direct channels and physical listening points (P), Reinforcement of public campaigns on the work, its objectives and impacts (O), Creation of mediation and territorial dialogue centers, with recurring presence (O).	pre-construction work and during construction work	Office of Special Projects; Municipal Secretariat of Government; Directorate of Communication; Municipal Secretariat of Policies for Women, Human Rights and Citizenship	Universities; Public Prosecutors' Offices (State/Federal); Public Defender's Office; Public Ombudsman's Offices; SEDH/RS	ESS1
								If well structured, active communication promotes community engagement, public trust and strengthening of social participation and project legitimacy	operation	Positive	Indirect	Synergistic	Maintain permanent channels of dialogue with the population, even after the execution of the work, Produce and disseminate clear, accessible and updated information about the project, Stimulate community engagement through workshops, public consultations and participatory forums.	Evaluation of the quality and frequency of communication with the target audience, Indicators of trust and public perception, Monitoring of interactions in service channels and listening.	Continuously review and adjust communication formats and channels based on the response of the population, ensuring the inclusion of historically marginalized groups in listening processes (Cr), Strengthening of transparency and accountability mechanisms, incorporating the community response as an active input for feedback and improvement of socio-environmental management strategies (O).	all phases	Directorate of Communication; Office of Special Projects; Municipal Secretariat of Policies for Women, Human Rights and Citizenship	Universities; Public Prosecutors' Offices (State/Federal); Public Defender's Office; Public Ombudsman's Offices; SEDH/RS	ESS1

APPENDIX 4.B. DPSIR Matrix – Flood Control System.

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Physical-ecological	Change in local water dynamics	Subsystem	1.1 Streams and channels, 1.2 Wetlands, 12.2 Protection System (drainage),12.3 Rainwater drainage network	Possible water retention or bypass and change of natural river and channel flood and flow	Water regulation, Water biodiversity support, Water purification, Flood protection, Erosion control, Improvement of water quality	Inter-municipal	Reduction of water connectivity and change in the natural flood cycle	Post-construction work	Negative	Direct	Cumulative	Preserve ecosystem connectivity and natural hydrological regimes whenever possible, Consider water buffering measures and green infrastructure, Technically justify project remodeling based on macro-drainage studies and updated hydrological scenarios, Promotion of nature-based solutions (NBS) as a preferred alternative.	Continuous monitoring of water levels and permanence time of flooding upstream and downstream of the dike.	Deployment of relief structures (gates, controlled overflow channels) (M), Revegetation of compensatory wetlands (Cp), Conducting a technical study of structural and non-structural alternatives with modeling and payback time (P), Net risk and benefit analysis for different types of events (P).	all phases	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services;	SEMA-RS; ANA; Universities, Guaíba Hydrographic Basin Committee	ESS1
								Reduction of floodable areas and loss of ecological functions associated with floodplains	Post-construction work	Negative	Indirect	Synergistic	Compensate for the loss of wetlands with the creation/restoration of equivalent zones and ensure ecological connectivity.	Survey of aquatic and semi-aquatic fauna and flora before and after implementation; remote sensing monitoring of the floodplains.	Ecological compensation with the creation of buffer zones, ecological corridors and artificial floodplain areas (Cp).	Pre- and Post-construction work	Environmental and Social Monitoring Technical TEAM; Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; Universities	ESS1
								Flood mitigation in adjacent urban areas	Post-construction work	Positive	Direct	Cumulative	Reduce population's exposure to hydrological risks and ensure the protection of critical infrastructure.	Monitoring of flooding before and after implementation (historical rainfall series and field data).	Integration between dike system, pump houses and urban drainage (M), periodic preventive maintenance (P).	Pre- and Post-construction work	Civil Defense Coordination; Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; State Civil Defense; CPRM; Universities; ANA	ESS1
								Increased pressure on downstream areas (redistribution of water volumes)	Post-construction work	Negative	Indirect	Cumulative	Consider redistributive impacts and promote inter-municipal cooperative solutions, Evaluate the relevance of local actions in the face of regional hydrological dynamics and articulate with the State and neighboring municipalities.	Continuous hydrodynamic monitoring (sensors and modeling); Field inspection of post-construction overflow areas.	Review of integrated drainage plans (P), Articulation with regional plans and neighboring projects (e.g., Eldorado do Sul) by inter-municipal committees and consortia (P).	Pre- and Post-construction work	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; Guaíba Hydrographic Basin Committee; Eldorado do Sul City Council; Regional Public Consortia, Universities; ANA	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Physical-ecological	Risk of soil sealing	Subsystem	2.3 Grasslands, 2.4 Woods and forests, 12. Sanitation system, 12.3 Drainage - Basin (network) of storm drainage	Risk of soil waterproofing, due to the construction of structures in natural or floodable areas	Erosion control, Provision of spaces for leisure, Climate regulation, Erosion control, Reduction of infiltration capacity and Flood control	Local	Reduced infiltration and increased runoff	Post-construction work	Negative	Direct	Cumulative	Preserve soil permeability in areas not directly occupied and adopt green infrastructure whenever possible.	Monitoring of the soil infiltration rate in paved and unpaved sections; surface water balance.	Implementation of permeable pavements, rain gardens, infiltration ditches and detention reservoirs at strategic points (M), Updating of urban standards to limit the waterproofing coefficient and require compensatory measures in new constructions (P)	All phases	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Universities	ESS1
								Increased risk of flooding in neighboring areas due to loss of retention capacity	Post-construction work	Negative	Indirect	Both options	Contain the hydrological effects of waterproofing with solutions integrated into the urban drainage system and land use planning.	Monitoring of areas of water accumulation in heavy rain events; use of sensors in manholes and critical points of the network.	Mandatory volumetric compensation (Cp), re-qualification of existing detention basins (Cr), preservation of natural infiltration areas (APPs and floodplains) (P), creation or strengthening of a municipal technical unit for urban drainage with planning, operation and maintenance (Cr) attributions, continuous training of the teams responsible for the operation and maintenance of the drainage network (Cp), feasibility study for the implementation of a cost recovery instrument (P)	Construction work and post-constrction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Universities, ANA	ESS1
								Compromise of green areas and ecosystem services	Post-construction work	Negative	Direct	Cumulative	Maintain minimum vegetation cover and recover affected areas with native vegetation after the work.	Survey of vegetation cover (before/after); mapping of functional green areas.	Compensatory planting according to licensing (Cp), implementation of green corridors (Cp), integration with urban afforestation plans (O).	Construction work and post-constrction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Universities	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Physical-ecological	Vegetation suppression	Subsystem	2.4 Woods and forests; 1.2 Wetlands	Suppression of vegetation in marginal areas of the Guaíba or floodplain, with possible habitat fragmentation	Habitat for fauna and pollinators, Climate regulation, Support for aquatic biodiversity	Local	Loss of local biodiversity	Post-construction work	Negative	Direct	Cumulative	Avoid suppression in areas of greater ecological sensitivity; promote equivalent compensatory measures.	Monitoring of indicator species, mapping of affected areas, inventory of flora and fauna before the work.	Rescue of fauna and flora (Cr), environmental compensation with native planting (Cp), creation of adjacent green areas (Cp).	Pre- and construction work	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; Universities	ESS1
								Fragmentation of habitats and ecological corridors	Post-construction work	Negative	Indirect	Synergistic	Maintain ecological connectivity with remaining areas; predict strips of continuous vegetation on the banks.	Mapping of connectivity and circulation of fauna before and after the work.	Implementation of fauna passages and green corridors (Cp), revegetation with native species connecting fragments (Cp).	Construction work and post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; Universities	ESS1
								Reduced capacity for climate regulation and erosion control	Post-construction work	Negative	Direct	Cumulative	Maintain vegetation in APPs; use nature-based solutions in the design of the dike.	Analysis of soil stability and surface temperature; comparison with preserved areas.	Revegetation with deep-rooted species (M), biological erosion control (M), bioengineering techniques (M).	post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Universities; Ministry of Environment (NBS guidelines); ANA	ESS1
								Loss of cultural and landscape ecosystem services	Post-construction work	Negative	Indirect	Cumulative	Value natural and cultural landscapes; integrate vegetation into the dike's landscaping design.	Public perception of the landscape; visitation and recreational use indicators.	Landscape recomposition with native vegetation and local symbolic species (Cp), creation of linear parks (O).	All phases	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; IPHAN (in case there is cultural property involved); Universities	ESS1
		Disturbance of wetlands or ecosystems associated with the natural flood cycle	Subsystem	1.2 Wetlands, 12.1 Protection system, 12.2 EBAP	Effect on biodiversity and ecosystem services such as water regulation and water purification	Water regulation, water purification, flood prevention and urban drainage support	Intra-municipal	Alteration of the hydrological regime of wetlands	Post-construction work	Negative	Direct	Cumulative	Preserve the natural dynamics of floods in floodplain areas and wetlands; avoid continuous dams.	Monitoring the frequency and duration of flooding in wetlands; variation of groundwater levels.	Maintenance of controlled overflow areas (P), creation of buffer zones (M), water relief areas (M).	Operation	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Guaíba Hydrographic Basin Committee; Universities; ANA	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Physical-ecological	Disturbance of wetlands or ecosystems associated with the natural flood cycle	Subsystem	1.2 Wetlands, 12.1 Protection system, 12.2 EBAP	Effect on biodiversity and ecosystem services such as water regulation and water purification	Water regulation, water purification, flood prevention and urban drainage support	Intra-municipal	Reduced biodiversity associated with wet environments	Post-construction work	Negative	Indirect	Synergistic	Avoid the destruction or alteration of sensitive wetland habitats and make ecological trade-offs where unavoidable.	Monitoring of aquatic and semi-aquatic fauna and flora, with a focus on indicator and endemic species.	Creation of artificial wetlands (Cp), rehabilitation of degraded areas (Cr), connectivity corridors (Cp).	Construction work and operation	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Guaíba Hydrographic Basin Committee; Universities	ESS1
								Compromise of ecosystem service delivery (water purification, flood damping)	Post-construction work	Negative	Direct	Cumulative	Value the functional role of wetlands as natural infrastructure; consider their role in engineering projects.	Assessment of water quality, retention time and reduction of pollutant load in affected wetlands.	Integration of wetlands in the urban drainage system (M), maintenance of riparian vegetation (M), buffer zones (M).	Operation	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	SEMA-RS; Guaíba Hydrographic Basin Committee; Universities	ESS1
								Conflicts of use and loss of sociocultural value of wetlands	Post-construction work	Negative	Indirect	Cumulative	Recognize the traditional uses and symbolic and cultural value of wetlands and integrate them into territorial planning.	Participatory monitoring, traditional use records, public perception, and cultural mapping.	Requalification of the banks with community participation (Cr), creation of multiple-use spaces compatible with conservation (O).	Operation	Social Participation Coordination; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	IPHAN (in case there is cultural property involved); SEDAC/RS; Universities	ESS1
	Social and urban	Land use modification	Subsystem	3.3 Residential, 3.4 Commerce, 3.7 Transportation system, 2.1 Agricultural areas, 2.3 Grasslands	Modification of land use in areas currently non-built or of irregular occupation, with the potential to induce disorderly future urbanization and in areas of risk	Support for social cohesion, Maintenance of the local economy, Territorial integration, Reduction of production and leisure areas	Intra-municipal	Conversion of natural areas into impermeable soil	Construction work and post-construction work	Negative	Direct	Cumulative	Control the expansion of waterproofing over environmentally sensitive areas.	Systematic land use and cover mapping.	Revision of master plans (P), requirement of green offsets (Cp).	Construction work and post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability	Universities	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Social and urban	Land use modification	Subsystem	3.3 Residential, 3.4 Commerce, 3.7 Transportation system, 2.1 Agricultural areas, 2.3 Grasslands	Modification of land use in areas currently non-built or of irregular occupation, with the potential to induce disorderly future urbanization and in areas of risk	Support for social cohesion, Maintenance of the local economy, Territorial integration, Reduction of production and leisure areas	Intra-municipal	Land conflicts and irregular use of occupied areas	All phases	Negative	Direct	Cumulative	Carry out land regularization with socio-environmental justice and prevent occupations in risk or protection zones, Incorporate collective trauma and social demands as relevant socio-environmental impacts with listening and mediation, Provide for active communication actions and psychosocial support, legitimizing the institutional response based on social listening.	Socio-land registry; monitoring of occupations in fragile areas or areas of environmental interest.	Integrated land regularization (Cr), removals with dignified resettlement (Cp), preventive inspection (P), Inclusion of studies of the social and psychological impact of floods in the feasibility assessment (P), Development of participatory strategies for listening and feedback to the population on decisions related to the project (O).	pre-construction work and during construction work	Attorney General's Office of the Municipality; Municipal Secretariat of Social Assistance and Labor; Municipal Secretariat of Environment, Urbanism and Sustainability	State Public Prosecutor's Office; Public Defender's Office; Ministry of Cities; Universities	ESS1 and 2
								Indirect induction of the occupation of vulnerable areas, increasing future hydrological risks and hindering preventive territorial management	Construction work and post-construction work	Negative	Indirect	Both options	Incorporate risk criteria into urban planning; Avoid risky occupation with compatible use; Integrate zoning and risk management; Promote multi-functionality of floodable areas; Align zoning with structural works	Remote and field monitoring of risk areas; Updating risk and land use maps; Monitoring of vulnerability indicators; Audits of permits in restricted areas	Zoning of flood areas with restrictions in the Master Plan (P); Occupation with leisure infrastructure in risk zones (O); Risk-based land use normative review (P); Georeferenced Registry of Critical Areas (Cr); Articulation between urban planning and civil defense (Cr); Educational campaigns on risk (Cp)	All phases	Special Projects Office; Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; Municipal Civil Defense; Universities; Municipal Chamber	ESS1
								Changes in the landscape and loss of territorial identity	Construction work and post-construction work	Negative	Indirect	Cumulative	Value the local landscape and cultural elements in new urban occupations and infrastructure.	Visual and participatory monitoring of urban landscape transformation and community perception.	Incorporation of identity elements in urban furniture and landscaping (O), protection of cultural landmarks (Cp).	Post-construction work	Municipal Secretariat of Culture; Municipal Secretariat of Environment, Urbanism and Sustainability	IPHAN (in case there is cultural property involved); SEDAC/RS; Universities	ESS1
		Potential land conflicts or involuntary resettlement	Subsystem	3.3 Residential, 3.9 Defense and Security; 12 Sanitation system	Potential conflicts, especially in bordering areas with formal or informal occupations	Urban Stability and Right to Housing, Community Resilience Support, Indirect Impacts on Basic Urban Infrastructure in Resettled Areas	Local	Physical displacement of families living in affected areas	Pre-construction work	Negative	Direct	Cumulative	Avoid forced displacement wherever possible and, where unavoidable, ensure dignified and participatory resettlement.	Socioeconomic registration of affected families; monitoring of housing conditions before and after resettlement.	Resettlement plan with locational alternatives (Cp), minimum infrastructure (Cp), participation of the affected community (O).	Pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Social Assistance and Labor	Public Prosecutor's Office, Public Defender's Office	ESS1 and 2

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Social and urban	Potential land conflicts or involuntary resettlement	Subsystem	3.3 Residential, 3.9 Defense and Security; 12 Sanitation system	Potential conflicts, especially in bordering areas with formal or informal occupations	Urban Stability and Right to Housing, Community Resilience Support, Indirect Impacts on Basic Urban Infrastructure in Resettled Areas	Local	Loss of livelihoods and/or community support networks	Construction work and post-construction work	Negative	Indirect	Synergistic	Ensure income restoration measures and psychosocial support for resettled families.	Monitoring income, occupancy, and access to post-resettlement services; qualified listening to those affected.	Compensation and productive training programs; maintaining territorial ties whenever possible.	Construction work and post-construction work	Municipal Secretariat of Social Assistance and Labor; Municipal Agency for Economic and Social Development – Desenvolve Guaíba	Public Defender's Office	ESS1 and 2
								Social and judicial conflicts related to possession and ownership	Pre-construction work	Negative	Direct	Cumulative	Ensure transparency, conflict mediation and land regularization prior to the work.	Legal mapping of the affected properties; monitoring of judicial and administrative proceedings.	Extrajudicial agreements, free legal advice, participatory land regularization campaigns.	Pre-construction work	Municipal Attorney General's Office, Municipal Secretariat of Administration and Management of People, Secretariat of Social Assistance	State Public Defender's Office, State Public Prosecutor's Office, Real Estate Registry	ESS1 and 2
								Increased vulnerability of traditional or at-risk groups	All phases	Negative	Indirect	Both options	Apply specific safeguards for vulnerable populations, respecting their ways of life and territorial rights.	Participatory monitoring with leaders; risk mapping and access to legal guarantees.	Specific plans for vulnerable groups; prior, free and informed consultation; cultural and territorial guarantees.	all phases	Municipal Secretariat of Social Assistance, Municipal Secretariat of Education, Municipal Secretariat of Culture	State Public Prosecutor's Office, Public Defender's Office, Guardianship Council, human rights organizations and local community associations	ESS1, 2 and 3
		Temporary mobility interruption	System	3.7 Transportation system, 6. Road network	Effects on mobility during the construction phase, with impacts on local accesses and circulation routes between Guaíba and Eldorado do Sul	Mobility of people and goods, Access to urban services, Urban integration and Urban logistics	Inter-municipal	Difficulty in accessing essential services (health, education, security)	Construction work	Negative	Direct	Cumulative	Ensure safe alternative routes during the works; maintain communication with users and institutions.	Survey of affected routes; flow and travel time monitoring in critical areas.	Implementation of signalized detours (P), alternative work schedules (P), advance communication with the population (O).	Construction work	Secretariat of Urban Mobility; Municipal Secretariat of Infrastructure and Public Services; Communications Directorate	Public Transport Operators, Civil Defense, Military Brigade (in cases of traffic control), residents' associations	ESS1
								Damage to local economic and commercial activities	Construction work	Negative	Indirect	Cumulative	Minimize the discontinuity of access to establishments and inform critical periods in advance.	Monitoring the flow of customers and billing of affected businesses; active listening with trade associations.	Planning of phases of the work by section (P), creation of temporary loading/unloading areas (P), symbolic compensations (Cp).	Construction work	Municipal Agency for Economic and Social Development – Desenvolve Guaíba; Municipal Secretariat of Infrastructure and Public Services, Communications Directorate	Local Trade Associations, CDL, SEBRAE	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Social and urban	Temporary mobility interruption	System	3.7 Transportation system, 6. Road network	Effects on mobility during the construction phase, with impacts on local accesses and circulation routes between Guaíba and Eldorado do Sul	Mobility of people and goods, Access to urban services, Urban integration and Urban logistics	Inter-municipal	Delay in public transport and greater vulnerability of dependent groups	Construction work	Negative	Direct	Synergistic	Ensure the continuity of the service with alternative routes and attention to vulnerable groups (the elderly, children, PWDs).	Monitoring of waiting times and frequency of public transport; complaints and occurrences registered.	Alternative routes planned with transport companies (P), installation of temporary points (P), information campaigns (O).	Construction work	Secretariat of Urban Mobility; Social Assistance Secretariat; Communications Directorate	Public Transport Operators, Councils for the Rights of Persons with Disabilities and the Elderly	ESS1
								Temporary reduction in urban quality of life	Construction work	Negative	Indirect	Cumulative	Reduce as much as possible the construction time and its impacts on urban daily life with transparent communication and efficient planning.	Public perception, number of complaints registered, indicators of urban well-being.	Schedule management with goals of time reduction (P), active communication (O), opening of community listening channels (O).	Pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Communications Secretariat; General Ombudsman of the Municipality	Mayor's Office, Community Councils, City Council	ESS1
	Institutional and Operational	Increased demand on municipal technical and management capacity	Subsystem	3.8 Administrative sector, 3.6 Information network	Municipal management efforts to maintain the dike system and integrated operation with pump houses and macro-drainage	Responsiveness and governance, Environmental monitoring and digitalization of management	Intra-municipal	Overload of municipal teams for technical monitoring and inspection of works	Construction work	Negative	Direct	Cumulative	Strengthen technical teams with training, resources and inter-institutional arrangements.	Assessment of workload, response time and number of servers involved in the actions.	Temporary hiring (P), partnerships with universities and technical bodies (O), support from specialized consultancies (O).	Construction work	Municipal Secretariat of Administration and Human Resources Management; Mayor's Office	Universities, technical entities, technical consultancies	ESS1
								Difficulty in coordination between secretariats and agencies involved	All phases	Negative	Indirect	Synergistic	Implement integrated governance mechanisms and intersectoral monitoring committees.	Evaluation of intersectoral meetings, effectiveness of information flows and integration of actions.	Creation of a crisis/coordination office (P), regular meetings between secretariats (P), shared information systems (O).	All phases	Mayor's Office; Municipal Secretariat of Administration and Human Resources Management	Civil Defense, consortia or inter-municipal committees	ESS1
								Risk of delays and failures in complying with environmental and social safeguards	All phases	Negative	Direct	Cumulative	Ensure a dedicated team for monitoring safeguards with external technical support if necessary.	Implementation of ESMPF measures Indicators ; compliance with deadlines and protocols.	Technical advice for safeguards (O), ongoing training (O), review of approval and execution flows (Cr).	All phases	Special Projects Office; Municipal Secretariat of the Environment; Municipal Municipal Secretariat of Administration and Human Resources	Technical consultancies	ESS1
								Reduction in the quality of ordinary public services due to overlapping tasks	Construction work	Negative	Indirect	Cumulative	Preserve the continuity of essential public services during the period of execution of the works.	Performance indicators of public services during the construction phase (health, cleaning, transportation, etc.).	Reinforcement of teams or rotation of functions (P), integrated planning with overload prediction (P).	construction work	Municipal Secretariat of Administration and Human Resources Management; Health Secretariat, Municipal Secretariat of Infrastructure and Public Services	Management units of the public services impacted	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	[illegible] Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Institutional and operational	Need for integration with climate and hydrological monitoring systems	Subsystem	3.6 Information network, 12.1 Drainage - Protection system, 12.3 Drainage - Basin (network) of storm drainage	Demand for integration of monitoring systems to ensure the effectiveness of the structure in the face of future extreme events	Support for territorial management and risk alerts, Integration with flood forecasting and response systems	Inter-municipal	Inability to predict extreme events and respond appropriately to floods or droughts	Post-construction work	Negative	Direct	Cumulative	Ensure integration with early warning systems and regional hydrometeorological monitoring networks.	Continuous monitoring of rainfall, flow rates, river levels and weather forecasts with real-time data.	Installation of sensors and automatic stations (P), integration with Civil Defense (P), training for data use (O).	Post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Security; Civil Defense Coordination	Regional Hydrometeorological Consortium, SEMA-RS, State Civil Defense	ESS1
								Outdated data that support decisions regarding the operation of the dike and macro-drainage system	Post-construction work	Negative	Direct	Cumulative	Maintain updated and accessible georeferenced data systems for technical decision-making.	Periodic audits of information systems; consistency analysis of data used in operational scenarios.	Integration with municipal WebGIS and interoperable platforms (P), update protocols and automatic backup (P).	Post-construction work	Municipal Secretariat of Innovation and Technology, Municipal Secretariat of Environment, Urbanism and Sustainability	State Civil Defense, Regional Hydrometeorological Consortium, SEMA-RS	ESS1
								Risk of ineffective decisions due to lack of coordination between technical and institutional actors	Post-construction work	Negative	Indirect	Synergistic	Promote cooperative governance and joint operating protocols based on shared data.	Assessment of fluidity in information exchange; number of technical meetings and joint resolutions.	Creation of multi-sectoral technical councils (O), integrated risk and climate management platforms (P).	Post-construction work	Municipal Secretariat of Innovation and Technology, Municipal Secretariat of Environment, Urbanism and Sustainability	State Civil Defense, SEMA-RS, Guaíba River Basin Committee, Regional Hydrometeorological Consortium	ESS1
								Missed opportunities for resource optimization and disaster prevention	All phases	Negative	Indirect	Cumulative	Transforming data into a strategic tool for prevention and territorial management.	Indicators of efficiency in responding to extreme events; cost-benefit analysis of preventive measures.	Climate scenario-driven planning (P), integration between historical data and climate projections (P).	All phases	Municipal Secretariat of Innovation and Technology, Municipal Secretariat of Environment, Urbanism and Sustainability	State Civil Defense, SEMA-RS, Regional Hydrometeorological Consortium, Universities	ESS1
		Pressures on environmental licensing and inter-municipal coordination	Subsystem	3.8 Administrative sector	Environmental licensing demands and inter-municipal coordination, due to the sensitivity and scale of the intervention in a neighboring area and with potential regional repercussions.	Coordination in emergencies and inter-institutional regulation	Intra-municipal	Delays in environmental licensing due to technical complexity and legal requirements	Pre-construction work	Negative	Direct	Cumulative	Anticipate environmental studies and ensure technical dialogue with licensing agencies from the outset.	Monitoring deadlines and procedures in the licensing process; analyzing requirements and pending issues.	Preparation of simplified EIA when applicable (P), prior technical meetings (P), construction of joint terms of reference (P).	Pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability	FEPAM, SEMA-RS, environmental consultancies	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment of the environmental service offer)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Flood Control System	Institutional and operational	Pressures on environmental licensing and inter-municipal coordination	Subsystem	3.8 Administrative sector	Environmental licensing demands and inter-municipal coordination, due to the sensitivity and scale of the intervention in a neighboring area and with potential regional repercussions.	Coordination in emergencies and inter-institutional regulation	Intra-municipal	Risks of judicialization and legal uncertainty during the project's progress	Pre-construction work and during construction work	Negative	Indirect	Cumulative	Ensure legal compliance and transparency in licensing and public consultation processes.	Legal monitoring of processes; recording of demonstrations and judicializations.	Quality public hearings (P), well-founded technical opinions (Cr), wide publicity of documents (O).	Pre-construction work and during construction work	Municipal Attorney General's Office, Secretariat of Environment, Urbanism and Sustainability	Public Prosecutor's Office, Municipal Chamber, FEPAM	ESS1
								Conflicts of jurisdiction and difficulties in inter-municipal coordination	All phases	Negative	Indirect	Synergistic	Establish cooperation protocols between municipalities and promote regional governance on environmental issues.	Mapping of responsibility interfaces; indicators of participation in inter-municipal forums and collegiate bodies.	Creation of public consortia (O), joint committees (O), integrated licensing and mitigation plans (P).	All phases	Secretariat of Environment, Urbanism and Sustainability	Guaíba River Basin Committee, FEPAM, neighboring municipalities (e.g., Eldorado do Sul), Inter-municipal Public Consortiums	ESS1

APPENDIX 4.C. DPSIR Matrix – Construction of Resilient Roads.

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Construction of resilient roads	Functional-infrastructural	Expansion of the road network and its load and urban logistics systems	system	3.7 Transportation system; 6. Road; 4. Port	Increased vehicle flow and pressure on roads, public transport and local logistics.	Urban mobility, logistics, modal integration, production flow	Inter-municipal	Traffic overload on urban roads connected to BR-116	Construction work	Negative	Direct	Cumulative	Plan road capacity compatible with increased traffic and articulate with regional logistics systems	Monitor the volume and composition of traffic on connection routes and accesses to BR-116	Implementation of road improvements (M), re-qualification of accesses (Cr), additional lanes (M) and adequate signaling (M)	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Urban Mobility	DNIT; State Government; ANTT	ESS1
								Increased risk of accidents and conflicts between modes	Construction work	Negative	Direct	Synergistic	Incorporate road safety and urban design principles with modal segregation	Monitor statistics of accidents and critical points of road conflict	Creation of exclusive routes (M) or preferred lanes for different modes (M) and improvement of safe crossing (M)	pre-construction work and during construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Health; Municipal Secretariat of Education	DETRAN-RS; National Road Safety Observatory	ESS1
								Increased urban resilience and functional continuity in climate emergency contexts	post-construction work	Positive	Indirect	Synergistic	Prioritize routes and solutions that guarantee safe access during extreme events (floods, blockages); Integrate the road system with evacuation routes, logistics centers, health units and emergency support points; Compatibility of projects with Contingency Plans and Urban Mobility Plans.	Geo-referenced survey of stretches with recurrent flooding and their accessibility during critical events; Monitoring of route functionality during weather events (e.g., traffic interruption time); Record of track use in Civil Defense operations and emergency response.	Technical mapping of critical routes and definition of desired service levels in risk scenarios (P), Adequacy of infrastructure (raised pavement, reinforced drainage) in critical sections (M), Inclusion of the route in disaster response protocols and Civil Defense training (O), Review of the layout based on hydrological simulations and road interruption histories (Cr), Implementation of specific signaling for emergency routes and safe escape routes (Cp)	during construction work and post-construction work	Office of Special Projects; Municipal Civil Defense Coordination; Municipal Secretariat of Infrastructure and Public Services	State Civil Defense; Ministry of Integration and Regional Development	ESS1
								Improved urban mobility, integration between urban areas and access to essential services	post-construction work	Positive	Direct	Cumulative	Ensure connectivity between residential, commercial and service areas, prioritizing universal accessibility, Make new routes compatible with the current patterns of displacement and preferred routes of the population, Promote multi-modal solutions (pedestrians, bicycle paths, public transport)	Source-destination research and displacement flows between urban areas connected by the routes, Indicators of average travel time and accessibility to schools, health centers and shopping centers, Periodic assessment of the level of use of the road by active modes (bicycle, pedestrians).	Participatory planning of the route and its connection points with urban equipment (P), Implementation of accessible sidewalks (M), bike lanes (M) and safe crossings along the road (M), If there is a need for removals or segregation, ensure alternative routes (Cp) and community compensation measures (Cp), Continuous monitoring of the quality of mobility and possible operational bottlenecks (O), Adjustments in the project to improve junctions or points of conflict after tests of actual operation (Cr)	all phases	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Education; Municipal Secretariat of Health	State Government; Ministry of Cities	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Construction of resilient roads	Functional-infrastructural	Expansion of the road network and its load and urban logistics systems	system	3.7 Transportation system; 6. Road; 4. Port	Increased vehicle flow and pressure on roads, public transport and local logistics.	Urban mobility, logistics, modal integration, production flow	Inter-municipal	Improved regional connectivity and logistics integration	post-construction work	Positive	Indirect	Synergistic	Harness the potential of logistical integration to streamline the territory in an orderly manner	Evaluate travel time and regional logistical performance after deployment	Integration of the route to regional logistics plans (P) and creation of efficient connection points between modes (M)	all phases	Municipal Agency for Economic and Social Development; Office of Special Projects; Municipal Secretariat of Infrastructure and Public Services	Ministry of Transport; FEPAM; State Government	ESS1
	Territorial and socioeconomic	Modification of land use and occupation in areas of road influence	subsystem	2.1 Agricultural areas; 2.3 grasslands; 2.4 Woods and forests; 3.3 Residential; 3.4 Commerce; 11. Industrial district	Stimulation of urbanization and transformation of natural or rural areas into urban areas.	Territorial transformation, pressure on rural areas, urban densification	intra-municipal	Conversion of natural or rural areas into urban land	post-construction work	Negative	Direct	Cumulative	Apply environmental and sustainability criteria in urban expansion	Track changes in land use and vegetation suppression	Establishment of buffer zones (Cp), ecological corridors (Cp) and expansion limits (P)	pre-construction work	Municipal Secretariat of Urban Mobility	DETRAN-RS	ESS1
								Increase in real estate speculation and uneven valuation of the territory	post-construction work	Negative	Indirect	Synergistic	Controlling overvaluation with land policy instruments	Monitor market values, gentrification rates and land pressure	Implementation of progressive IPTU (P), onerous grant (P) and installment plan regulation (P)	post-construction work	Municipal Secretariat of Urban Mobility	Ministry of Infrastructure	ESS1
								Stimulation of disorderly occupation in peripheral areas	post-construction work	Negative	Indirect	Cumulative	Strengthen urban planning and land use control	Map irregular occupations and identify critical areas of informal expansion	Update of master plans (P) and application of preventive urban management instruments (P)	post-construction work	Municipal Secretariat of Infrastructure and Public Services	FEPAM; Ministry of the Environment	ESS1
	Socio-institutional	Potential need for resettlement or land regularization	subsystem	3.3 Residential; 3.4 Commerce; 3.8 Administrative sector	Demand for removals or regularization of occupations to enable the proposed routes.	Risk of population displacement, pressure for land regularization and services	intra-municipal	Involuntary displacement of residents in the intervention areas	pre-construction work	Negative	Direct	Cumulative	Adopt international involuntary resettlement guidelines with a focus on restoring quality of life	Update and monitor the socioeconomic register of affected families	Preparation (P) and implementation of Resettlement Plan with assisted resettlement (Cp) and fair indemnities (Cp)	pre-construction work	Office of Special Projects	State Civil Defense; CPRM	ESSs 1 and 2
								Land conflicts and legal uncertainty in informally occupied areas	pre-construction work	Negative	Indirect	Synergistic	Ensure transparency, participation and mediation of conflicts in the regularization processes	Monitor the progress of land regularization and recorded conflicts	Establishment of local land regularization commissions (P) and free legal advice (P)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability	FEPAM; Ministry of the Environment; ICMBio	ESSs 1 and 2
								Possibility of improving housing conditions through land regularization	post-construction work	Positive	Indirect	Synergistic	Promote land regularization integrated with urbanization and access to basic services	Evaluate the improvement in housing conditions and access to rights after regularization	Integration of housing (P), sanitation (P) and titling actions with a focus on social inclusion (P)	post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability	IBAMA; SEMA-RS	ESSs 1 and 2
	Environmental and physical-biotic	Interference in environmentally sensitive areas susceptible to flooding	subsystem	1.1 Streams and channels; 1.2 Wetlands; 12.1-12.3 Urban drainage; 2.4 Woods and forests	Impairment of ecological functions and increased risks of flooding and loss of biodiversity.	Water regulation, flood protection, erosion control, biodiversity	intra-municipal	Suppression of riparian vegetation, fragmentation and impairment of ecological functions	Construction work	Negative	Direct	Cumulative	Avoid direct interventions in APPs and watercourse margins; adopt ecological occupation criteria	Mapping of riparian vegetation and monitoring of local fauna and flora	Plant re-composition with native species (Cp) and creation of buffer zones (Cp)	pre-construction work and during construction work	Municipal Secretariat of Urban Mobility	Ministry of Cities	ESS1
								Increased vulnerability to flooding and changes in surface runoff	Construction work	Negative	Direct	Synergistic	Maintain soil permeability and integrate nature-based solutions	Monitoring of flooding points and measurement of surface runoff	Implementation of rain gardens (M), permeable pavements (M) and retention basins (M)	work and during construction work	Municipal Secretariat of Urban Mobility	Mobility Observatories ; State Traffic Council	ESS1
								Reduction of natural water retention and filtration capacity	Construction work	Negative	Indirect	Cumulative	Preserve wetlands and natural infiltration systems as green infrastructure	Monitoring of water quality, soil moisture and presence of bioindicator species	Restoration of wetlands (Cp) and maintenance of water recharge areas (Cp)	Construction work	Office of Special Projects	CPRM; State Civil Defense	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Construction of resilient roads	Institutional and governance	Reinforcement of the demand for inter-federative and inter-sectoral articulation	subsystem	3.6 Information network; 3.8 Administrative sector; 12.4-12.8 Sanitation and supply	Demand for coordination between entities and sectors to ensure efficiency and avoid overlaps.	Public management, policy coordination, integration between sectors and levels of government	Inter-municipal	Low effectiveness of actions due to lack of alignment between entities and sectors	Construction work	Negative	Indirect	Cumulative	Establish joint planning routines between departments and spheres of government	Evaluate the degree of integration between plans and actions of the different sectors and entities	Creation of permanent forums for technical (O) and political (O) articulation	Construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Infrastructure and Public Services	ANTT; Ministry of Transport	ESS1
								Rework and overlap of public investments	Construction work	Negative	Indirect	Synergistic	Integrate information systems, licensing and budget execution	Monitor the integrated physical-financial schedule of works and services	Implementation of unified digital project management platforms (O)	Construction work	Municipal Secretariat of Urban Mobility	DETRAN-RS; CPRM	ESS1
								Strengthening institutional governance and coordinating public policies	post-construction work	Positive	Indirect	Synergistic	Promote cooperation between federated entities based on common objectives and shared territories	Monitor the functioning of inter-sectoral committees and governance indicators	Formalization of cooperation agreements (O), consortia (O) and decision-making collegiate bodies (O)	post-construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Health	Ministry of Health; OPAS	ESS1

APPENDIX 4.D. DPSIR Matrix – Implementation of the Resilient Logistic and Industrial Hub.

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Implementation of the Resilient Logistics and Industrial Hub	Physical-ecological	Vegetation suppression and soil sealing	Subsystem	2.3 grasslands, 2.4 Woods and forests	Vegetation removal and soil sealing increases temperature, increases runoff, reduces water infiltration, increases soil erosion, and compromises habitats.	Climate regulation, soil protection and erosion control, surface and groundwater, habitat for terrestrial fauna and pollinators	localized	Loss of climate and hydrological regulation, increased runoff, reduced infiltration and reduction of groundwater, soil erosion and reduction of terrestrial fauna.	Construction work	Negative	Direct	Both options	Avoid suppression in sensitive areas; prioritize locational alternatives; drainage damping, recover infiltration and ensure ecological connectivity.	Monitoring of vegetation cover; verification of suppressed versus authorized areas; evaluation of regeneration; indicators such as suppressed hectares and indicator fauna.	Implement compensatory areas (Cp); Re-vegetate with natives (Cr); Maintain strips of natural vegetation (P); Delimit exclusion areas (P)	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability	Environmental consultancy; Licensing body	ESS1
		Alteration of the surface runoff regime and risk of overloading the drainage system	Subsystem	12.1 Drainage - Protection system	Increased sealing and alteration of surface runoff can overwhelm drainage systems and reduce water infiltration into the soil.	Flood protection, infrastructure and housing security, risk reduction	intra-municipal	Increased risk of flooding and overloading of the urban drainage system	Construction work	Negative	Direct	Synergistic	Design project compatible with basin capacity; integrate sustainable drainage criteria; consider future climate scenarios; prioritize nature-based solutions.	Hydrological monitoring of surface flow; critical flooding points; indicators such as flow time, frequency of flooding and flow in intense rains.	Low impact drainage infrastructure (M); Temporary infiltration ditches (M); Rain gardens and reservoirs (M); Emergency plans for floods in the construction phase (P)	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	Project engineering team; Hydraulics/hydrology consultancy; Licensing body	ESS1
		Compaction and soil movement with risk of erosion and silting	Subsystem	2.3 grasslands	Soil compaction can reduce infiltration capacity and increase erosion.	Soil protection and erosion control, offering spaces for leisure	intra-municipal	Reduced water infiltration and increased surface erosion	Construction work	Negative	Direct	Cumulative	Assess the geotechnical risk of the areas of interest; maintain soil stability; avoid prolonged exposure; avoid works in sloping areas; contain sediments; follow technical standards for soil environmental management.	Slope and excavation inspections; turbidity monitoring in nearby water bodies; indicators such as erosion rate, carried sediments, containment failures.	Containment barriers (M); Sediment retention basins (M); Tarpaulins and erosion control blankets (M); Provisional re-vegetation (Cr); Planning of sequence of works (P)	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability	Contractor responsible for the works; Technical consultants; Licensing body	ESS1
		Potential future environmental contamination by industrial effluents or improperly managed waste	system	1. Non-built aquatic; 2. Non-built terrestrial	Improper release of industrial effluents or solid waste can contaminate water bodies and soil.	Sewage treatment, Pollution reduction and Public health protection	intra-municipal	Contamination of surface water bodies	post-construction work	Negative	Direct	Cumulative	Integrated waste management; Monitoring of water quality	Continuous monitoring of water quality in receiving bodies	Implementation of treatment systems (M); Contingency plans (P)	post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Agency for Economic and Social Development	Industrial operators; Licensing Body	ESS1
								Public health risk in vulnerable areas	post-construction work	Negative	Indirect	Synergistic	Environmental health surveillance; Identification of vulnerable groups	Epidemiological monitoring in risk areas	Educational campaigns (O); Public health protocols (P)	post-construction work	Municipal Secretariat of Health; Municipal Secretariat of Social Assistance and Labor; Municipal Secretariat of Environment, Urbanism and Sustainability	Licensing agency	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Implementation of the Resilient Logistics and Industrial Hub	Social and territorial	Modification of land use and disruption of existing functions (rural, housing, informal or traditional)	system	2. Non-built terrestrial; 3. Urban	The replacement of traditional land uses by logistical functions can generate territorial fragmentation, disruption of social networks and devaluation of cultural practices.	Housing provision, Support for social cohesion and urban stability	intra-municipal	Loss of social and cultural functions of the territory	Construction work	Negative	Indirect	Cumulative	Protection of traditional ways of life, avoiding agricultural production areas; Participatory planning	Interviews and follow-up of affected communities	Cultural safeguarding plans (P); Integration of local demands in the project (O)	pre-construction work and during construction work	Municipal Secretariat of Culture; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Policies for Women, Human Rights and Citizenship	NA	ESS1 & ESS3s (where applicable)
								Potential land conflicts and insecurity of tenure	pre-construction work and during construction work	Negative	Direct	Synergistic	Prioritization of voluntary resettlement; Guarantee of land rights; Prior mapping of occupations	Continuous social and land registration	Negotiation with communities (M); Land regularization (Cr)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Attorney General's Office of the Municipality; Municipal Secretariat of Social Assistance and Labor	NA	ESSs 1 and 2
								Potential for innovation and urban re-qualification	post-construction work	Positive	Indirect	Synergistic	Promotion of innovative urban planning instruments; Encouragement of sustainable occupation	Monitoring of land use and occupancy density	Urban re-qualification plan (O); Technical support for urban innovation (O)	all phases	Municipal Agency for Economic and Social Development; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	NA	ESS1
								Potential valorization of the territory and streamlining of underutilized areas	post-construction work	Positive	Direct	Cumulative	Strategic urban land management; Public-private partnerships for use of underutilized areas	Periodic analysis of land and real estate value; Occupancy rate	Tax incentives (O); Public calls for occupation of priority areas (O)	all phases	Municipal Agency for Economic and Social Development; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services	NA	ESS1
		Landowners pressure and increased real estate speculation in the surrounding region	Subsystem	3.3 Residential	Overvaluation of land can drive out vulnerable populations, put pressure on public services, and cause an increase in the housing deficit.	Housing provision, Support for social cohesion and urban stability	intra-municipal	Indirect expulsion of vulnerable populations	post-construction work	Negative	Indirect	Cumulative	Ensuring permanence and control of gentrification processes; protection of vulnerable groups	Monitoring of rent variation, records of involuntary displacement	Creation of special areas of social interest (P); Incentives for permanence of vulnerable families (O)	pre-construction work and during construction work	Municipal Secretariat of Social Assistance and Labor; Municipal Secretariat of Policies for Women, Human Rights and Citizenship; Municipal Secretariat of Environment, Urbanism and Sustainability	NA	ESSs 1 and 2
								Disorderly transformation of the urban fabric	post-construction work	Negative	Indirect	Synergistic	Integrated and preventive territorial management; application of instruments of the City Statute	Monitoring of land subdivisions and changes in use and occupation	Adoption of zoning oriented to the rational use of the territory (P); Active inspection (M)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Urban Mobility	NA	ESS1

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Implementation of the Resilient Logistics and Industrial Hub	Social and territorial	Risk of conflicts with irregular uses or communities established in the target area	Subsystem	3.3 Residential	The occupation of areas by industrial enterprises without participatory planning can generate social conflicts, legal insecurity and disruption of local ties.	Housing provision, Support for social cohesion and urban stability	intra-municipal	Worsening social vulnerabilities and housing insecurity	pre-construction work and during construction work	Negative	Direct	Cumulative	Participatory mapping; Respect for tenure and housing; Prevention of forced evictions	Continuous social and land survey; Social risk indicators	Negotiated resettlement plan (M); Land regularization (Cr); Legal and social support (O)	pre-construction work and during construction work	Municipal Secretariat of Social Assistance and Labor; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Policies for Women, Human Rights and Citizenship	NA	ESSs 1 and 2
								Disruption of solidarity networks and consolidated ways of life	Construction work	Negative	Indirect	Synergistic	Ensuring community cohesion; Active participation in planning	Qualitative interviews; Post-resettlement monitoring	Community engagement plan (P); Psychosocial and cultural support (O)	pre-construction work and during construction work	Municipal Secretariat of Social Assistance and Labor; Municipal Secretariat of Policies for Women, Human Rights and Citizenship; Municipal Secretariat of Culture	NA	ESSs 1 and 2
		Implementation of new large infrastructure	Subsystem	3. Urban; 5. Power generation; 6. Road; 9. Fuel Distribution; 11. Industrial district; 12. Sanitation system	The territorial and functional reorganization of space resulting from the installation of large infrastructure changes patterns of land use, mobility, economic dynamics and services, as well as energy demand and investments	Urban commercial and productive activities, Social and identity cohesion; Socioeconomic integration, Access to public services; Territorial integration and mobility; Support for urban and productive growth; Facilitation of urban logistics; Continuity of services in emergencies, logistics supply; Generation of employment and stimulation of the local and regional economy; Reduction of contamination of soils and water bodies	intra-municipal	Regional economic streamlining	post-construction work	Positive	Direct	Synergistic	Promoting local production chains and stimulating sustainable investments	Indicators of tax collection, investment volume and municipal GDP	Articulation with regional development policies (O); Structuring tax incentives (O)	post-construction work	Municipal Agency for Economic and Social Development; Municipal Secretariat of Finance	State Secretariat of Economic Development	ESS1
								Formal jobs creation	during construction work and post-construction work	Positive	Direct	Cumulative	Valuing the local workforce; professional qualification linked to the project	Indicators of formal employment, insertion in the labor market and qualification	Technical training programs (O); Articulation with the S and SINE System (O)	pre-construction work and during construction work	Municipal Agency for Economic and Social Development; Municipal Secretariat of Social Assistance and Labor	NA	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Implementation of the Resilient Logistics and Industrial Hub	Urban and infrastructure	Increased use of existing road network (heavy traffic, logistics connections)	Subsystem	3.7 Transportation system	Increased heavy vehicle traffic can overload existing roads, increasing congestion, emissions and road safety risks.	Mobility of people and goods, support for logistics and emergencies	Inter-municipal	Accelerated degradation of road infrastructure	post-construction work	Negative	Direct	Cumulative	Integrated road planning; preventive maintenance	Periodic technical inspections of the road network; records of emergency interventions	Structural reinforcement of tracks (M); Continuous maintenance plan (P)	post-construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Urban Mobility	DNIT; DAER/RS; State Secretariat of Logistics and Transport (RS); Ministry of Transport	ESS1
								Increase in road accidents and risks	post-construction work	Negative	Indirect	Synergistic	Road safety; proper signage; heavy traffic control	Accidents claims indicators; monitoring the circulation of heavy vehicles	Redirection of cargo routes (M); Educational campaigns and inspection (Q)	post-construction work	Municipal Secretariat of Urban Mobility; Municipal Secretariat of Infrastructure and Public Services	DAER/RS; DNIT	ESS1
								Improvement in production flow logistics	post-construction work	Positive	Indirect	Both options	Prioritize the articulation of the industrial hub with strategic road infrastructure and regional logistics	Monitoring the volume and destination of cargo traffic linked to the industrial hub	Planning and implementation of optimized access to the main road system (e.g., BR-116), with adequate signaling and compatibility with road capacity (M)	all phases	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Urban Mobility	DNIT; DAER/RS; State Secretariat of Logistics and Transport (RS); Ministry of Transport	ESS1
	Urban and infrastructure	Demand for expansion or adaptation of urban infrastructure (water, energy, sewage, mobility)	Subsystem	3.8 Administrative sector	Pressure for services such as water, energy, sewage, drainage and transportation, including workers' accessibility to the hub, can overwhelm urban systems	Management of public services, guarantee of rights, articulation in emergencies	intra-municipal	Overload of existing urban systems, such as increased flooding in drainage.	post-construction work	Negative	Direct	Cumulative	Integrated infrastructure planning; assessment of installed capacity	Monitoring of pressure on public networks and systems; indicators of failures or interruptions	Scheduled expansion of systems capacity (P); Investments in modernization (O)	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Urban Mobility	NA	ESS1
								Opportunity for modernization and efficiency of urban networks	during construction work and post-construction work	Positive	Indirect	Synergistic	Adoption of technological and sustainable solutions; inter-sectoral integration	Efficiency indicators (losses, consumption, coverage)	Implementation of smart technologies (smart grids, telemetry, compact stations) (O)	during construction work and post-construction work	Municipal Secretariat of Infrastructure and Public Services; Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Agency for Economic and Social Development	NA	ESS1
	Institutional and operational	Demand for greater institutional capacity for environmental, territorial and industrial management	Subsystem	3.8 Administrative sector	The implementation of complex projects requires specialized technical capacity to plan, monitor and mitigate risks.	Management of public services, guarantee of rights, articulation in emergencies	intra-municipal	Risk of inefficiency in the implementation of public policies and monitoring	post-construction work	Negative	Indirect	Cumulative	Institutional strengthening and technical capacity building; improvement of inter-sectoral governance	Institutional performance indicators; governance audits	Continuous training (O); Creation of specialized technical units (P); Inter-federative agreement (P)	pre-construction work and during construction work	General Comptroller of the Municipality; Municipal Secretariat of Government; Municipal Secretariat of Environment, Urbanism and Sustainability	Secretariat of Planning, Governance and Management (RS); Ministry of Management and Innovation in Public Services; Secretariat of Planning of RS; ENAP; CGU; TCE-RS; universities	ESS1

Driver (sub-project)	Pressure	State					Impact					Response						
		Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management actions (see classification in the respective tab)	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
							Opportunity for innovation in governance and qualification of public policies	during construction work and post-construction work	Positive	Indirect	Synergistic	Promotion of collaborative networks; use of public management technologies	Performance evaluation and institutional transparency	Implementation of integrated information systems (O); Federative technical support (P)	during construction work and post-construction work	Office of Special Projects; Comptroller General of the Municipality; Municipal Agency for Economic and Social Development	Secretariat of Planning, Governance and Management (RS); support from universities and multilateral agencies	ESS1
	Need for inter-sectoral articulation (urbanism, environment, economic development)	Subsystem	3.8 Administrative sector	The absence of articulation between sectors can lead to overlapping actions, coverage gaps and institutional conflicts.	Management of public services, guarantee of rights, articulation in emergencies	intra-municipal	Fragmentation of public policies and overlapping actions	post-construction work	Negative	Indirect	Cumulative	Integration of sector plans; shared governance	Analysis of coherence and convergence between plans and projects	Creation of inter-sectoral committees (P); Agreement of integrated goals (P)	pre-construction work and during construction work	Municipal Secretariat of Government; Comptroller General of the Municipality; Office of Special Projects	Secretariat of Planning, Governance and Management (RS); multilateral organizations	ESS1
							Improving the effectiveness and synergy of territorial policies	during construction work and post-construction work	Positive	Indirect	Synergistic	Integrated territorial management; urban-environmental planning	Cross-sectoral performance indicators; integrated management reports	Training in integrated planning (O); Incentives to network (O)	during construction work and post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Office of Special Projects; Comptroller General of the Municipality	Secretariat of Urban and Metropolitan Development; Secretariat of Planning, Governance and Management; intercity consortium	ESS1
Implementation of the Resilient Logistics and Industrial Hub	Institutional and operational	Pressure on the environmental licensing and land regularization system	Subsystem	3.8 Administrative sector	The entry of large enterprises can strain licensing and regularization systems.	Waste removal, Contamination prevention, Vector control and Environmental health promotion	intra-municipal	Risk of delays and legal uncertainty in authorizing processes	pre-construction work	Negative	Direct	Cumulative	Improvement of administrative procedures; expansion of technical teams	Indicators of average processing time and number of pending issues	Training of technicians (O); Digitization of processes (O); Inter-federative agreement (P)	pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability; Municipal Secretariat of Bids and Contracts; Attorney General's Office of the Municipality	Licensing body; State Attorney General's Office (PGE-RS); State Public Prosecutor's Office (MP/RS); State Court of Accounts (TCE-RS)	ESS1
							Potential institutional strengthening and modernization of management systems	during construction work and post-construction work	Positive	Indirect	Synergistic	Institutional modernization; interoperability of systems	Evaluation of the effectiveness of administrative flows; performance of digital platforms	Investments in IT and document management (O); Partnerships with universities and MP (P)	during construction work and post-construction work	General Comptroller of the Municipality; Municipal Secretariat of Administration and People Management; Office of Special Projects	Secretariat of Planning, Governance and Management; MP; Universities	ESS1

APPENDIX 4.E. DPSIR Matrix – Integrated Re-qualification of the Guaíba Waterfront.

Driver (sub-project)	Pressure		State					Impact					Response						
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Integrated Re-qualification of the Guaíba Waterfront	Physical-ecological	Suppression of riparian vegetation and soil cover	Subsystem	2.4 Forests and woodlands	Vegetation suppression can lead to loss of local habitats and biodiversity	Climate regulation, erosion control, habitat for fauna, leisure spaces	localized	Reduction of local biodiversity and habitat loss	Construction work	Negative	Direct	Cumulative	Avoid vegetation suppression in sensitive areas and restore losses after interventions, Implement economic instruments to encourage the maintenance of vegetation cover and ecological connectivity	Monitoring of fauna and flora in impacted areas	Re-vegetation with native species (Cp), creation of compensatory areas (Cp), creation of municipal PSA fund (Cr), agreements with large landowners (P), use of mandatory compensations to finance ecological corridors (O)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Directorate of Landscape Architecture, Municipal Agency for Economic and Social Development	SEMA-RS, ICMBio, Universities	ESS1
								Increased erosion and silting of water bodies	Construction work	Negative	Direct	Synergistic	Control erosion processes and maintain native vegetation cover on banks	Monitoring of erosion processes and water quality	Construction of containment structures and bank stabilization (M)	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Directorate of Landscape Architecture	SEMA-RS, CPRM, Universities	ESS1
								Loss of ecosystem services from climate regulation and slope protection	Construction work	Negative	Indirect	Cumulative	Conserve areas with ecosystem services essential to the local microclimate	Verification of vegetation cover and micro-climatic changes	Implementation of green areas and maintenance of native vegetation (M)	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability, Directorate of Landscape Architecture, Municipal Secretariat of Infrastructure and Public Services	SEMA-RS, INMET, Universities	ESS1
								Reduction of the landscape value and environmental quality of riverside urban areas	Construction work	Negative	Indirect	Synergistic	Preserve landscape elements and integrate them into urban design	Periodic assessment of community perception and visual integrity of the waterfront	Integrated landscape treatment and preservation of existing green areas (P)	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability, Directorate of Landscape Architecture, Municipal Secretariat of Culture, Office of Special Projects	IPHAN, Universities , Municipal Heritage Council	ESS1
								Potential impairment of fauna associated with lake edge vegetation and APPs	Construction work	Negative	Direct	Cumulative	Implement ecological corridors and avoid habitat fragmentation	Monitoring of indicator species and fauna movement	Creation of fauna passages and recovery of APPs (Cp)	all phases	Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Directorate of Landscape Architecture	SEMA-RS, ICMBio, Universities	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Integrated Re-qualification of the Guaíba Waterfront	Physical-ecological	Change in hydrological regime and increased sealing	Subsystem	1.1 Streams and channels; 12.1-12.3 Drainage	Hydrological changes can aggravate runoff and vulnerability to flooding	Water regulation, flood prevention, erosion control, infrastructure protection	intra-municipal	Increased erosion on banks and slope instability	Construction work	Negative	Direct	Synergistic	Preserve margin vegetation and plan bioengineering techniques for stabilization, Integrate ecological corridors and riparian vegetation as a way to mitigate erosion, promote ecological connectivity and absorb wave energy in extreme events	Monitor stability of margins and occurrence of landslides	Apply nature-based solutions (e.g., replanting of riparian vegetation, bioengineering) (M), implantation of native vegetation in buffer strips (Cp), ecological zoning and connectivity between vegetation fragments (P)	during construction work and post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Directorate of Landscape Architecture	SEMA-RS, State Civil Defense, Universities	ESS1
								Reduction of natural water retention and filtration capacity by marginal and submerged vegetation	during construction work and post-construction work	Negative	Indirect	Cumulative	Maintain and restore areas with marginal and submerged native vegetation	Monitor submerged vegetation cover and water quality	Implement buffer zones with riparian vegetation and restrict works in sensitive submerged areas (P)	during construction work and post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Directorate of Landscape Architecture	SEMA-RS, ANA, Universities	ESS1
								Increased soil sealing and reduced vegetation cover	during construction work and post-construction work	Negative	Direct	Cumulative	Avoid sealing in sensitive areas and adopt permeable pavements	Periodic mapping of impermeable areas and green cover	Use drainage materials and re-qualify urban green areas (M)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Directorate of Landscape Architecture, Office of Special Projects	SEMA-RS, ICMBio, ANA	ESS1
								Change in sediment deposition and transport patterns in the adjacent lake system	during construction work and post-construction work	Negative	Indirect	Cumulative	Consider the sedimentary balance in the projects and avoid interferences that aggravate their alteration	Monitoring of bathymetric profiles and sedimentation rates	Re-adapt the design for compatibility with natural sediment flows (P)	pre-construction work and during construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Municipal Secretariat of Infrastructure and Public Services	SEMA-RS, CPRM, ANA	ESS1
		Risk of soil instability	subsystem	2.3 grasslands; 12.3 Rainwater drainage basin	Potential increase in soil instability due to works in wetlands and subject to erosion on the shores of Lake Guaíba	Erosion control, slope stability, water quality	immediately adjacent	Slides and landslides in urban areas adjacent to Guaíba	construction work	Negative	Direct	Cumulative	Avoid cuts on unstable slopes and maintain protective vegetation	Monitoring of ground movements and signs of instability	Implementation of stabilized slopes and drainage systems (M)	construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects	SEMA-RS, State Civil Defense, CPRM	ESS1
								Compromising of infrastructure foundations and buildings near the banks	construction work	Negative	Direct	Synergistic	Carry out geotechnical studies beforehand for foundation planning	Technical inspections of foundations and marginal structures	Structural reinforcement in risk areas and use of deep foundations (M)	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Secretariat of Environment, Urbanism and Sustainability	CREA-RS, CPRM, Universities	ESS1
								Increased water turbidity by sediment carryover	construction work	Negative	Indirect	Cumulative	Minimize soil movement and protect margins with vegetation cover	Periodic turbidity measurements and sediment analysis	Creation of vegetated barriers and control of surface runoff (M)	construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects	SEMA-RS, ANA, Universities	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
								Risk to the safety of workers and the population during the execution of the works	construction work	Negative	Direct	Cumulative	Adopt occupational safety and risk management protocols on construction sites	Incident logging, safety audits and use of PPE	Training of teams, risk signaling and emergency response plan (P)	construction work	Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Civil Defense, Municipal Secretariat of Administration and People Management	SEMAS-RS, Ministry of Labor, State Civil Defense	ESS1
Integrated Re-qualification of the Guaíba Waterfront	Social and Urban	Physical-spatial transformation of consolidated and non-consolidated areas of the urban waterfront	subsystem	3.3 Residential; 3.4 Commerce; 3.8 Administrative sector	Urban re-qualification with risk of indirect displacement of vulnerable populations	Provision of housing, social cohesion, guarantee of rights, maintenance of the local economy	intra-municipal	Real estate appreciation and local economic streamlining	post-construction work	Positive	Indirect	Synergistic	Promote policies to encourage local commerce and the creative economy	Monitor the evolution of real estate prices and commercial occupation profile	Encourage local micro and small businesses; offer lines of credit (O)	post-construction work	Municipal Agency for Economic and Social Development – Desenvolve Guaíba, Municipal Secretariat of Culture, Municipal Secretariat of Finance, Office of Special Projects	SEBRAE, Banco do Brasil, BNDES	ESS1
								Re-qualification of public spaces and increase in the quality of urban life	pre-construction work	Positive	Direct	Synergistic	Ensure democratic access to public spaces and their ongoing maintenance	Assess the user population's satisfaction with the new public spaces	Create participatory management plans for re-qualified public spaces (O)	post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Culture, Office of Special Projects, Municipal Secretariat of Policies for Women, Human Rights and Citizenship	Universities, Municipal Councils, Public Policy Observatories	ESS1
								Potential indirect displacement of low-income populations	post-construction work	Negative	Indirect	Cumulative	Ensure instruments to protect the permanence of vulnerable populations	Map changes in housing patterns and eventual indirect removals	Adopt instruments such as ZEIS, social rent or inclusive land regulation (P)	post-construction work	Municipal Secretariat of Social Assistance and Labor, Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects, Municipal Secretariat of Policies for Women, Human Rights and Citizenship	Ministry of Cities, Universities, CAIXA	ESSs 1 and 2
								Transformations in social bonds and cultural uses of the territory	post-construction work	Negative	Indirect	Cumulative	Respect and incorporate the cultural uses and memories of the re-qualified territory	Conduct community listening on the appropriation and symbolic uses of space	Value identity elements in landscape and communication projects (O)	post-construction work	Municipal Secretariat of Culture, Municipal Secretariat of Policies for Women, Human Rights and Citizenship, Directorate of Landscape Architecture, Office of Special Projects	IPHAN, Municipal Council of Culture	ESSs 1 and 3 (if applicable)

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
								Incentive for orderly occupation and territorial integration of the waterfront	post-construction work	Positive	Direct	Synergistic	Plan the waterfront based on participatory planning and zoning instruments, Promote integration between the north and south sections of the waterfront through resilient infrastructure, ensuring urban connectivity, universal accessibility and equitable enjoyment of the landscape, Incorporate adaptive urban occupation strategies in areas of moderate flood risk, such as adaptive ground floors, elevated housing and seasonal transition zones, Predict and deploy resilient mobility solutions that ensure safe circulation during flooding, integrating the waterfront with the rest of the urban fabric even in critical scenarios	Monitor the occupation of the territory in relation with the master plan and urban zoning	Regulate land use and occupation with an inclusive and sustainable approach (P), feasibility studies for reopening interrupted connections (P), implementation of greenways and safe passages (M), articulation with waterway mobility (O), revision of the master plan to allow constructive adaptations (Cr), incentives for resilient architectural solutions (P), planning of rails, elevated or removable roads (P), integration with waterway and intermodal terminals (Cr)	post-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Infrastructure and Public Services, Municipal Secretariat of Urban Mobility, Office of Special Projects, Directorate of Landscape Architecture	SEMA-RS, Metroplan, State Governmen t, Ministry of Cities	ESS1
Integrated Re-qualification of the Guaíba Waterfront	Social and Urban	Temporary disruption of mobility and local accessibility	subsystem	3.7 Transportation system; 6. Road system	Temporary disruption of mobility and local accessibility, during the phases of works and interventions in existing public spaces	Mobility, territorial integration, access to public services	Inter-municipal	Difficulty in accessing essential services (health, education, trade)	construction work	Negative	Direct	Cumulative	Ensure safe and alternative routes informed in advance	Map complaints and demands related to access to services	Deploy accessible signage and guidance on deviations (P)	Construction work	Municipal Secretariat of Urban Mobility, Municipal Civil Defense, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects	State Civil Defense, National Secretariat of Protection and Civil Defense	ESS1
								Interruption of collective and individual transport routes (including aquatic)	construction work	Negative	Direct	Synergistic	Coordinate interventions with urban transport operators	Monitor operation of affected transmission lines and routes	Organize temporary mobility plan with adapted lines (P)	Construction work	Municipal Secretariat of Urban Mobility, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Civil Defense	FEPAM, Metroplan, Ministry of Infrastructu re	ESS1
								Increased commuting time and population stress	construction work	Negative	Indirect	Cumulative	Plan works with adaptive schedules and transparent communication	Evaluate travel times and flow of vehicles/pedestri ans	Offer channels for social listening and reprogramming of work fronts (M)	Construction work	Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Directorate of Communication, Municipal Secretariat of Urban Mobility, Municipal Secretariat of Policies for Women, Human Rights and Citizenship	State Civil Defense, Universities , Ministry of Cities	ESS1
								Temporary reduction in the circulation of pedestrians and cyclists	construction work	Negative	Direct	Cumulative	Ensure minimum circulation for active mobility during the works	Conduct surveys in areas with high pedestrian and cyclist circulation	Create temporary tracks and ramps accessible for active circulation (Cr)	Construction work	Municipal Secretariat of Urban Mobility, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Secretariat of Policies for Women, Human Rights and Citizenship	Ministry of Cities, Ministry of Infrastructu re	ESS1

Driver (sub-project)	Pressure	State					Impact					Response						
		Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
							Loss to local economic activities due to reduced customer flow	construction work	Negative	Indirect	Synergistic	Maintain accessibility to commercial fronts with signage and temporary passages	Listen to local traders and track economic performance during construction	Establish direct dialogue with merchants and logistics compensation (Cp)	Construction work	Municipal Secretariat of Urban Mobility, Municipal Secretariat of Infrastructure and Public Services, Municipal Agency for Economic and Social Development, Office of Special Projects	State Civil Defense, Ministry of Cities, Metroplan	ESS1
	Overloading demand for essential urban services	subsystem	3.1 Power substations; 12.4-12.8 Sanitation and waste	Pressure on the urban service system (energy, sewage, waste, drainage), with increased demand in re-qualified areas	Continuity of essential services, sanitation, water supply, public health	intra-municipal	Temporary overload of water and sewage networks during the work	construction work	Negative	Direct	Cumulative	Plan interventions with expected impact on sanitation networks	Monitor pressures in supply and sewage networks	Reinforce critical sections of networks and predict deviations or provisional reservoirs (M)	pre-construction work and during construction work	Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Secretariat of Environment, Urbanism and Sustainability	SEMA-RS; FEPAM; Universities	ESS1
							Increased demand for proper waste collection and disposal	construction work	Negative	Direct	Synergistic	Reinforce the logistics of waste collection and disposal in work areas	Control generated volumes and frequency of waste collection	Implement eco-points and increase temporary collection routes (Cr)	construction work	Municipal Secretariat of Infrastructure and Public Services, Municipal Secretariat of Environment, Urbanism and Sustainability, Office of Special Projects	FEPAM, ANA, Universities	ESS1
							Interruptions or overload in the supply of electricity and internet	construction work	Negative	Indirect	Cumulative	Coordinate with carriers preventive actions of overload in services	Monitor indicators of stability and quality of essential services	Negotiate schedules and adjustments with carriers to avoid disruptions (P)	pre-construction work and during construction work	Office of Special Projects, Municipal Secretariat of Infrastructure and Public Services, Municipal Secretariat of Administration and People Management, Municipal Secretariat of Environment, Urbanism and Sustainability	FEPAM, ANA, CREA-RS	ESS1
Integrated Re-qualification of the Guaíba Waterfront	Social and Urban	Overloading demand for essential urban services	subsystem	3.1 Power substations; 12.4-12.8 Sanitation and waste	Pressure on the urban service system (energy, sewage, waste, drainage), with increased demand in re-qualified areas	Continuity of essential services, sanitation, water supply, public health	intra-municipal	Need to expand public services	post-construction work	Negative	Indirect	Cumulative	Anticipate demand for public services with cross-sector planning	Evaluate health, education and safety care indicators	Expand mobile or temporary public service units (M)	post-construction work	Municipal Secretariat of Health, Municipal Secretariat of Education, Municipal Secretariat of Social Assistance and Labor, Municipal Secretariat of Policies for Women, Human Rights and Citizenship, Office of Special Projects	SEMA-RS, CREA-RS, Universities	ESS1
							Stimulus to the modernization of existing urban infrastructure	post-construction work	Positive	Indirect	Synergistic	Incorporate technological and sustainable solutions in urban re-qualification	Monitor construction schedules and levels of service to the population	Utilize smart city technologies and upgrade obsolete systems (O)	post-construction work	Directorate for the Promotion of Science, Technology and Innovation, Municipal Secretariat of Infrastructure and Public Services, Office of Special Projects, Municipal Secretariat of Administration and People Management	FEPAM, CREA-RS, Ministry of the Environment	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
	Institutional and operational	Demand for multi-sectoral articulation	subsystem	3.8 Administrative sector	Need for multi-sectoral articulation (environment, culture, tourism, mobility) to ensure the integration of restructuring actions with other public policies	Public management, articulation in emergencies, participation and transparency	intra-municipal	Strengthening institutional capacity for integrated planning and execution	post-construction work	Positive	Indirect	Cumulative	Invest in technical and institutional training with a focus on integrated planning	Evaluate the performance and articulation between secretariats and responsible bodies	Empower cross-sector teams and create permanent technical forums (P)	all phases	Municipal Secretariat of Administration and People Management, Office of Special Projects, Directorate of Monitoring of Strategic Planning and Results Monitoring, Municipal Secretariat of Government	FEPAM, CREA-RS, ANA	ESS1
								Greater alignment between sectoral public policies (urbanism, environment, mobility, housing)	all phases	Positive	Indirect	Synergistic	Establish coordination mechanisms between sectors and levels of government	Monitor integration between sector plans and policies	Promote alignment workshops and common planning agendas (P)	pre-construction work	Office of Special Projects, Directorate of Strategic Planning Monitoring and Results Monitoring, Municipal Secretariat of Government, Municipal Secretariat of Administration and People Management	CPRM, CREA-RS, Universities	ESS1
								Optimizing the use of public resources and reducing project overlaps	during construction work and post-construction work	Positive	Indirect	Synergistic	Develop integrated action plans and shared timelines	Monitor budget execution and multi-institutional schedules	Establish committees of shared management and coordinated use of resources (O)	Construction work	Office of Special Projects, Directorate of Strategic Planning Monitoring and Results Monitoring, Municipal Secretariat of Administration and People Management, Municipal Secretariat of Government	State Civil Defense, CPRM, CREA-RS	ESS1
								Fragmentation of actions and conflicts of competence between sectors	construction work	Negative	Indirect	Cumulative	Create cross-sectoral governance structures with well-defined roles	Check for overlaps or gaps between sectoral actions	Review institutional flows and formalize cooperation agreements (Cr)	Construction work	Office of Special Projects, Municipal Secretariat of Government, Directorate of Strategic Planning Monitoring and Results Monitoring, Municipal Secretariat of Administration and People Management	Ministry of Integration, State Civil Defense	ESS1
								Reduced effectiveness of urban and environmental interventions	post-construction work	Negative	Indirect	Cumulative	Implement integrated monitoring and performance evaluation systems	Measure cross-results and synergy indicators between policies	Redesign instruments and targets based on cross-sector assessments (O)	post-construction work	Directorate for Monitoring Strategic Planning and Results Monitoring, Office of Special Projects, Municipal Secretariat of Government, Municipal Secretariat of Administration and People Management	SEBRAE, BNDES, BRDE	ESS1

Driver (sub-project)	Pressure		State					Impact					Response							
			Hierarchy of affected system	Affected system(s) and/or subsystem(s)	Process	Affected Services	Affected beneficiaries	Impact (commitment to the offer of environmental service)	Project Phase	Positive or negative	Direct or indirect	Synergistic and/or cumulative	Guidelines	Monitoring actions	Management Actions	Project Phase	Responsibility	Other related bodies	Environmental and Social Management Framework (ESF) and applicable AIIB Environmental and Social Standards (ESSs)
Integrated Re-qualification of the Guaíba Waterfront	Institutional and operational	Environmental licensing capacity overload	subsystem	3.8 Administrative sector	Reinforcement of environmental licensing capacity, especially due to the location in APP and wetland areas and the scale of the project	Guarantee of rights, institutional control, socio-environmental governance	intra-municipal	Delays in issuing environmental permits and authorizations	pre-construction work	Negative	Direct	Cumulative	Improve planning and forecasting of licensing demand	Monitor average processing deadlines and volume of processes	Hire temporary technical support consultancies or partnerships with universities (P)	pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Bids and Contracts, Office of Special Projects, Directorate of Strategic Planning Monitoring and Results Monitoring	Public Policy Observatories, Universities	ESS1
								Risks of approval of projects without proper analysis	pre-construction work	Negative	Indirect	Synergistic	Ensure technical quality of analysis with specialized support	Conduct periodic technical audits of licensing processes	Implement technical checklists and cross-review of opinions (P)	pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Bids and Contracts, Office of Special Projects, Directorate of Strategic Planning Monitoring and Results Monitoring	Ministry of Cities, CAIXA, CNM	ESS1
								Disconnection between legal requirements and local institutional reality	pre-construction work	Negative	Indirect	Cumulative	Adapt procedures to local contexts without compromising the technical requirement	Assess adherence of legal requirements to local operational capability	Develop local complementary standards adjusted to institutional realities (Cr)	pre-construction work	Municipal Secretariat of Environment, Urbanism and Sustainability, Municipal Secretariat of Bids and Contracts, Office of Special Projects, Attorney General of the Municipality	CGU, State Audit Court, Ministry of Cities	ESS1
								Erosion of the relationship between licensing bodies and entrepreneurs	pre-construction work	Negative	Indirect	Synergistic	Foster transparent channels of dialogue between agencies, entrepreneurs and society	Monitor the rate of judicialization and rework due to failures in the process	Create permanent technical dialogue tables and guideline guides (O)	pre-construction work	Office of Special Projects, Municipal Secretariat of Environment, Urbanism and Sustainability, Attorney General's Office of the Municipality, Directorate of Communication, Municipal Secretariat of Government	CGU, Ministry of Cities, Intergovernmental Observatories	ESS1
								Encouraging institutional strengthening and modernization of the licensing system	post-construction work	Positive	Indirect	Cumulative	Invest in technological modernization and continuous training of teams	Measure efficiency gains and institutional satisfaction after implemented improvements	Digitize flows, integrate systems and conduct periodic training (O)	post-construction work	Municipal Secretariat for Administration and People Management, Directorate for the Promotion of Science, Technology and Innovation, Office of Special Projects, Directorate for Monitoring Strategic Planning and Results Monitoring	CNM, National Front of Mayors, Ministry of Cities	ESS1

ASIAN INFRASTRUCTURE INVESTMENT BANK

Initial Physical Climate Risk Screening Report

Guaíba, Rio Grande de Sul, Brazil

04.06.2025

Bespoke Report created by Swiss Re Climate Risk Services
using the RDS Sustainability Compass

Table of Contents

Summary

This report summarizes the results of an initial physical climate risk screening for the project, as a basis for physical climate risk assessment, management and relevant climate risk reporting. Key insights for the most important aspects of physical climate risks and adaptation measures are provided below.

		Pluvial Flooding		Fluvial Flooding		Heatwave	
Current Exposure	2024	**Moderate**		**Very Low***		**Low**	
Future Exposure Change SSP2-4.5 | SSP5-8.5	2050	↑ 6	↑ 5	→ 0	→ 0	↗ 2	↑ 7
	2080	↗ 4	↑ 7	→ 0	→ 0	↑ 5	↑ 9
Future Exposure SSP2-4.5 | SSP5-8.5	2050	High	Moderate	Very Low	Very Low	Low	Moderate
	2080	Moderate	High	Very Low	Very Low	Low	High
Sensitivity		**High**		**High**		**Low-Medium**	
Future Risk Future Exposure x Sensitivity SSP2-4.5 | SSP5-8.5	2050	**Very High**	**High**	**Low****	**Low****	**Low**	**Medium**
	2080	**High**	**Very High**	**Low****	**Low****	**Low**	**Medium**
Adaptation Measures		• Avoid flood sensitive infrastructure (e.g. industrial areas) in topographic depressions. • Understand water flow paths, water entry points, anticipated flood depth and duration, and impact of flooding to facility. • Install physical flood protection. • Develop and implement a flood emergency response plan.		• Avoid flood sensitive infrastructure (e.g. industrial areas) in at the waterfront area. • Understand flood water entry points, anticipated flood depth and duration, and impact of flooding to facility. • Install physical flood protection. • Develop and implement a flood emergency response plan.		• Heat extremes can lead to higher energy consumption in data centers due to increased cooling demands or potentially reduce their operational efficiency. Consider heat extremes in planning phase.	

* Except for the areas at the waterfront have high to very high flood exposure.

**Note that the assessment does not consider changes in rainfall over the complete river catchment and in cases where the catchment is large, exposure changes with climate change might not be adequately captured in the fluvial flood climate risk score.

Note that future risks can be obtained for three climate change scenarios and six different future time steps (2030, 2040, 2050, 2060, 2070, and 2080) in this report. In cases where there is a current natural hazard exposure but no data on future exposure change, the future risk is reported equal to the current risk.

1 Introduction

1.1 Scope

The purpose of this report is to summarize the findings of the initial physical climate risk screening for the projects located in Guaíba, Rio Grande de Sul, Brazil. The initial screening serves as a basis for more detailed climate risk assessment and adaptation planning. Using information on the project from AIIB project team, this report was created by Swiss Re climate risk experts and risk engineers. The findings are based on the outputs of Swiss Re's proprietary natural catastrophe models and Risk Data and Service tools as well as IPCC climate change projections for three climate change scenarios, namely SSP1-2.6, SSP2-4.5, and SSP5-8.5.

The main objective of the initial physical climate risk screening is to flag any potential material physical climate risks that the project may be prone to. The first part of this report describes the methodology (Figure 1), models and data used for the screening and the location and project to be assessed. In the second part, the initial natural hazard and physical climate hazard exposure screening is performed to flag any such potential exposure that the project may be prone to including its sensitivity to such hazards. The third part contains an assessment on how the relevant climate-related hazards will change due to climate change – expressed by the **Future Exposure Change (FEC).** The FEC reflects the changes in the future exposure compared to baseline climate conditions (1981-2010), under the three different climate change scenarios. Combining the current exposure levels with the FEC yields future hazard exposure estimates. Combining future hazard exposure with the project sensitivity for such hazards results in a physical climate risk level. For the primary hazard, defined as the most relevant hazard with respect to sensitivity and financial impact, a more targeted discussion on adaptation measures is provided. Additionally, the report also includes an analysis of nature risks, expressed as the dependency of the project on Biodiversity and Ecosystem Services (BES).

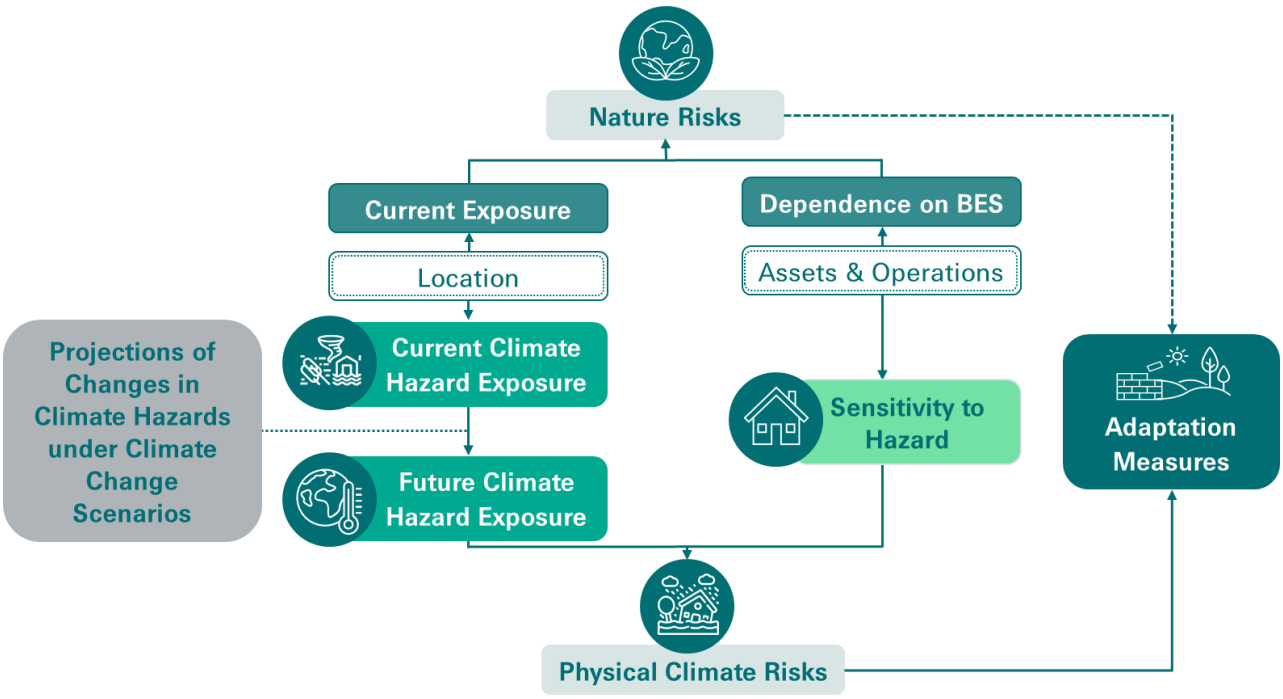
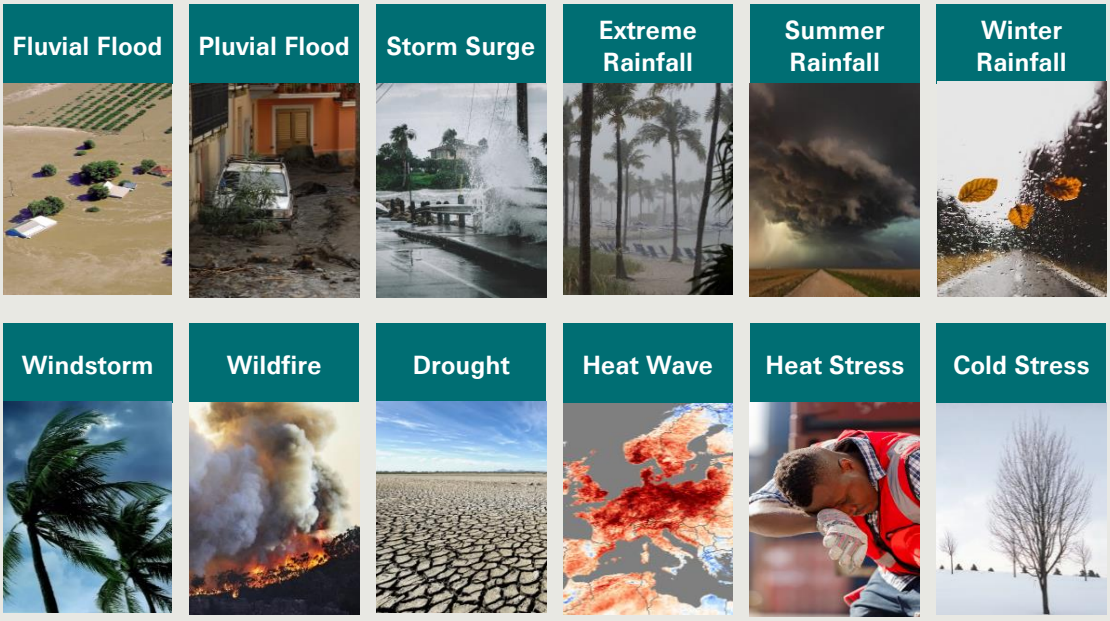


Figure 1 Overview of Climate Risk Screening Methodology

1 12 Climate-related Hazards
(present and future scenarios)



2 Other Natural Hazards
(present-day only)

- Hailstorm
- Tornado
- Lightning
- Landslide

Not impacted by climate change but included:

- Earthquake
- Volcanic Ash Thickness

3 10 Nature Risks
(present-day only)

- Water Security
- Water Quality
- Habitat Intactness
- Pollination
- Air Quality & Local Climate
- Soil Fertility
- Erosion Control
- Coastal Protection
- Food Provision
- Timber Provision

Figure 2 Overview on climate hazards and nature risks covered

1.2 Site Description

Notice: All data inputs this report is based on are listed in the appendix. Swiss Re only received limited information about the site and the project.

Topography and Environment

The project is located in the Municipality of Guaíba, in the state of Rio Grande do Sul, Brazil. The city is situated on the western shore of the Guaíba Lake, which receives inflows from four rivers (Jacuí river, Sinos river, Gravataí river and Caí river) before discharging into the Atlantic Ocean via the Lagoa dos Patos [1]. The municipality's terrain is predominantly flat and lies at low elevation near the lake, though it is interspersed with several hills [1]. The region experiences a humid subtropical climate with distinct seasonal variation with hot summers and relatively mild winters. Annual precipitation averages around 1,400 mm [1]. The water level of Guaíba Lake are at its lowest levels in summer [1]. In 2024, the region was severely affected by floods which caused widespread inundation and infrastructure failure [2].

Technical Characteristics

The project in Guaíba, Rio Grande de Sul, Brazil includes greenfield investments for the construction of green logistics and industrial areas. There is also restoration of flood protection, transport and urban infrastructure which were affected by the flood in 2024. Estimated life span of the planned assets is 30-50 years.

As there is limited information on the specific project locations, the assessment analyzes the natural catastrophe and climate risk exposure using a bounding polygon defined by the following geographic coordinates: (latitude: 30.1028° S, longitude: 51.3113° W), (latitude: 30.1123° S, longitude: 51.3826° W), (latitude: 30.1195° S, longitude: 51.3770° W), and latitude: 30.1100° S, longitude: 51.3130° W).

[1] https://en.wikipedia.org/wiki/Gua%C3%ADba
[2] https://en.wikipedia.org/wiki/2024_Rio_Grande_do_Sul_floods

2 Sensitivity Assessment

The project in Guaíba, Rio Grande do Sul, Brazil involves greenfield investments for the development of green logistics and industrial zones. It also includes the restoration of flood protection systems, transportation networks, and urban infrastructure that were damaged during the 2024 flood. As there was not detailed information provided on the exact nature of the new infrastructure, the sensitivity assessment was done for general urban infrastructure and general industrial areas (no specialized industries).

Urban infrastructure and industrial areas are sensitive to flooding, landslides, windstorm, wildfires and earthquakes as large events can cause serious damage to infrastructure, buildings and industrial machinery. Repair of infrastructure, clean up and long replacement times of damaged machinery after an event can lead to prolonged business interruption. Sensitivity to heat extremes is in general low to medium but note that heat extremes can increase energy consumption of data centers due to their cooling requirements or reduce their efficiency. Sensitivity to hailstorm is in general also low-medium but note that in case solar panels are installed, they have a high vulnerability due to the large potential of damage from hail. Note, we have received limited information about the project characteristics.

Table 1 summarizes the asset-specific sensitivity level for each hazard, based on insights from subject matter experts at Swiss RE. Appendix 1 provides further details on the definition of sensitivity levels.

Table 1 Estimated level of asset-specific sensitivity for each hazard assuming the assets are built in line with relevant building codes.

Hazard	Sensitivity of urban infrastructure / industrial areas
Flooding (incl. extreme precipitation)	High
Wind extremes	High
Wildfire + drought	High
Heat stress + heat wave	Low-Medium
Cold stress + snowload	not applicable at location
Earthquake	High
Landslide	High
Hailstorm	Low-Medium
Lightning	Low-Medium

3 Current Exposure

Key Insights

- **Fluvial flood** exposure is assessed as **very low** as the majority of the analyzed area is not shown to be in a river flood zone. However, the areas at the waterfront have high to very high flood exposure (return period of 50 or 100-years). There is also some exposure to storm surge directly at the waterfront, however only a small part of the analyzed area is exposed.
- **Pluvial flood** exposure is assessed as **moderate** as some larger parts of the analyzed area are modelled to be inundated on average every 200-years. Smaller areas also exhibit pluvial flood return periods of 50 and 100-years. There is no part of the analyzed polygon area which is particularly exposed but the pluvial flood zones are distributed in several patches over the polygon area. This highlights that care should be taken not to develop sensitive infrastructure (e.g. data centers, industrial buildings) in a topographic depression.
- **Lightening** exposure is rated to be **high** due to frequent thunderstorms.
- Additionally, **hailstorm** exposure is **moderate**.

Table 2 provides an overview of hazard-specific exposure levels under baseline conditions, while Table 3 defines the different exposure levels in relation to hazard intensity values.

Table 2 Overview of hazards and associated exposure levels under baseline conditions.

Peril	Parameter	Value	Intensity value	Exposure Levels
Fluvial Flood - Global Swiss Re Zones	Return Period	-	1.0	Very Low
Pluvial Flood - Global Swiss Re Zones	Return Period	200 years	5.1	Moderate
Storm Surge	Return Period	-	1.0	Very Low
Earthquake	EQ PGA (g)	0.014	1.0	Very Low
Windstorm	50y Peak Gust	22m/s	1.0	Low
Tornado	Tornados per year	0.15	2.5	Low
Hailstorm	Hail days per year	0.2 - 0.4	4.7	Moderate
Lightning	Lightning annual flash rate/km2	18.5	7.7	High
Wildfire	Intensity value	1.01	1.0	Very Low
Volcanic Ash Thickness	Ash Thickness (cm), return period 475y	-	-	No Data
Landslide	Intensity value	1	1.0	Very Low

Table 3 Hazard intensity values and levels of hazard exposure.

Fluvial Flood	**Pluvial Flood**	**Storm Surge**	**Earthquake**	
Return period (years)	Return period (years)	Return period (years)	475y Peak Ground Acceleration (g)	Hazard exposure levels
>500	>500	>500	<0.045	Very low
500	500	500	0.046-0.084	Low
200	200	200	0.085-0.160	Moderate
100	100	100	0.161-0.400	High
<=50	<=50	<=50	>0.401	Very High

Windstorm	**Tornado**	**Hailstorm**	**Lightning**	
50y Peak Gust (m/s)	F2-F5 Tornadoes per 2500 km^2 and year	Hail Days (>2 cm) per 2500 km^2 and year	Annual flash rate per km^2	Hazard exposure levels
<20	<0.1	<0.1	<1	Very low
20-30	0.1-0.2	0.1-0.2	1-3	Low
30-40	0.2-0.35	0.2-0.4	4-6	Moderate
40-60	0.35-0.75	0.4-0.8	7-25	High
>60	>0.75	>0.8	>26	Very High

Wildfire	**Volcano Ash**	**Landslide**	**Subsidence**	
Intensity value	Ash thickness (cm), return period 475 years	Intensity value	Subsidence classification	Hazard exposure levels
1-3	<0.1	1-2.15	1	Very low
3-4	0.1-2	2.16-5.10	2	Low
4-5	2-10	5.20-7.34	3	Moderate
5-7	10-40	7.35-9.01	4-5	High
7-10	>40	9.02-10	6	Very High

Note, wildfires, landslides and subsidence only provide intensity classifications, but no physical units.

Wildfire intensity value is calculated based on historic fire frequency, changes in the climate leading to weather with higher fire susceptibility in the last two decades, and the wildland-urban interface indicating sources for fire ignition.
Landslide intensity value is calculated based on 4 variables, including slope, geological classification and a triggering factor, which considers both the rainfall and earthquake risk at a given location and thus increases the risk of susceptibility.
Subsidence classification is calculated based on lithology, land-surface slope, land cover, and Köppen-Geiger climate classification.

4 Future Exposure

Methodology

The **Future Exposure Changes** reflect **changes** in the exposure of the project site to relevant climate hazard in the future compared to the average climate of the years 1981 to 2010. The values are on a scale of 0 to 10, with a "0" indicating no change or even a reduction in the exposure and a "10" indicating a substantial increase in the exposure (See table 3).

The **Future Exposure** combines the current exposure with the future exposure changes. The Future Exposure is divided into six categories, namely very low, low, moderate, high, very high and extreme, while "none" means that the location is highly unlikely to be affected by this hazard.

Table 4 and Table 5 present the future exposure changes and level of future exposure, respectively. Further details on future exposure change associated with each hazard, and the three climate change scenarios considered in the screening are provided in Appendix I; while the underlying hazard data under the scenarios for future time periods are provided in Appendix II.

Current Exposure + Future Exposure Changes = Future Exposure

Key Insights

- **Fluvial flood** exposure is currently very low (except for the area at the waterfront) and is modelled to **remain at the same level** under all assessed climate change scenarios (SSP1-2.6, SSP2-4.5, SSP5-8.5). Note, the assessment does not account for rainfall changes across the entire river catchment. In large catchments, this means potential changes in flood risk due to climate change may not be fully captured and this introduces uncertainty in the future flood exposure projections at the waterfront
- **Pluvial flood** exposure is currently moderate, but models show a moderate to significant **increase** under all assessed climate change scenarios (SSP1-2.6, SSP2-4.5, SSP5-8.5). Concurrently, **extreme precipitation** is also modelled to **increase**. This increase in extreme precipitation can cause pluvial flooding in areas previously not located in a flood zone, especially when the area urbanizes without investments into an appropriately sized drainage system.
- Climate models project a **significant** to **extreme increase in heatwaves** which shifts heatwave exposure from at present low levels to moderate levels by 2050 and high levels by 2070 under SSP5-8.5.
- Additionally, climate models simulate a moderate increase in drought, wildfire, and heat stress exposure towards the end of the century under SSP5-8.5. However, present wildfire and drought exposure is modelled as very low and present heat stress exposure is modeled as moderate.

Table 4 Future Exposure Changes for three climate scenarios and six future time steps

		2030	2040	2050	2060	2070	2080
Fluvial Flood	SSP1-2.6	0	0	0	0	0	0
	SSP2-4.5	0	0	0	0	0	0
	SSP5-8.5	0	0	0	0	0	0
Pluvial Flood	SSP1-2.6	4	6	6.1	5.4	4.5	4.5
	SSP2-4.5	4.3	6	6.4	5.3	4.8	4.1
	SSP5-8.5	4.3	3.8	5.1	6.7	7	7.1
Storm Surge (Sea Level Rise)	SSP1-2.6	0	0	0	0	0	0
	SSP2-4.5	0	0	0	0	0	0
	SSP5-8.5	0	0	0	0	0	0
Extreme Precipitation	SSP1-2.6	5.4	8.1	8.3	7.3	6.1	6.1
	SSP2-4.5	5.8	8.1	8.7	7.2	6.5	5.5
	SSP5-8.5	5.8	5.1	7	9.1	9.5	9.6
Winter Precipitation (Nov. - Mar.)	SSP1-2.6	0.1	0.1	0.1	0.1	0.1	0.1
	SSP2-4.5	0.1	0.1	0.1	0.1	0.1	0.1
	SSP5-8.5	0.1	0.1	0.1	0.1	0.1	0.1
Summer Precipitation (Apr. - Oct.)	SSP1-2.6	2.6	3.3	3.6	2.3	2	2.1
	SSP2-4.5	0.9	1.3	1.7	1.1	0.5	0.9
	SSP5-8.5	0.7	0.7	2.1	3.3	4.8	5.2
Wind Score	SSP1-2.6	0.1	0.1	0.1	0.1	0.1	0.1
	SSP2-4.5	0.1	0.1	0.1	0.1	0.1	0.1
	SSP5-8.5	0.1	0.1	0.1	0.1	0.1	0.1
Wildfire	SSP1-2.6	0.2	0.3	0.3	0.3	0.3	0.4
	SSP2-4.5	0.3	0.6	1	1.5	2.1	2.5
	SSP5-8.5	0.6	1.7	2.8	3.6	4.5	5.4
Drought	SSP1-2.6	1.6	1.4	1.3	1.6	1.7	1.8
	SSP2-4.5	0.1	0.5	1.5	2.3	3.2	4
	SSP5-8.5	1.9	2.5	3.8	4.5	4.3	3.2
Heat Wave	SSP1-2.6	0.2	0.3	0.5	0.5	0.7	0.7
	SSP2-4.5	0.2	0.9	1.7	3.2	4.5	5.3
	SSP5-8.5	1.1	3.3	6.8	8	8.6	8.9
Heat Stress	SSP1-2.6	0.2	0.3	0.3	0.3	0.3	0.4
	SSP2-4.5	0.3	0.6	1	1.5	2.1	2.5
	SSP5-8.5	0.6	1.7	2.8	3.6	4.5	5.4
Cold Stress	SSP1-2.6	0.1	0.1	0.1	0.1	0.1	0.1
	SSP2-4.5	0.1	0.1	0.1	0.1	0.1	0.1
	SSP5-8.5	0.1	0.1	0.1	0.1	0.1	0.1

Future Exposure Changes

Extreme (8 - 10) | Significant (6 - 8) | Moderate (4 - 6) | Minor (2 - 4) | Negligible (0 - 2)

Table 5 Future Exposure for three climate scenarios and six future time steps

		Historical	2030	2040	2050	2060	2070	2080
Fluvial Flood	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Pluvial Flood	SSP1-2.6	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate
	SSP2-4.5	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate
	SSP5-8.5	Moderate	Moderate	Moderate	Moderate	High	High	High
Storm Surge (Sea Level Rise)	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Extreme Precipitation	SSP1-2.6	Very High	Very High	Extreme	Extreme	Extreme	Extreme	Extreme
	SSP2-4.5	Very High	Very High	Extreme	Extreme	Extreme	Extreme	Very High
	SSP5-8.5	Very High	Very High	Very High	Extreme	Extreme	Extreme	Extreme
Winter Precipitation (Nov. - Mar.)	SSP1-2.6	Very High	Very High	Very High	Very High	Very High	Very High	Very High
	SSP2-4.5	Very High	Very High	Very High	Very High	Very High	Very High	Very High
	SSP5-8.5	Very High	Very High	Very High	Very High	Very High	Very High	Very High
Summer Precipitation (Apr. - Oct.)	SSP1-2.6	Very High	Very High	Very High	Very High	Very High	Very High	Very High
	SSP2-4.5	Very High	Very High	Very High	Very High	Very High	Very High	Very High
	SSP5-8.5	Very High	Very High	Very High	Very High	Very High	Very High	Very High
Wind Score	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Wildfire	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Drought	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Heat Wave	SSP1-2.6	Low	Low	Low	Low	Low	Low	Low
	SSP2-4.5	Low	Low	Low	Low	Low	Low	Low
	SSP5-8.5	Low	Low	Low	Moderate	Moderate	High	High
Heat Stress	SSP1-2.6	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	SSP2-4.5	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	SSP5-8.5	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Cold Stress	SSP1-2.6	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP2-4.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
	SSP5-8.5	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low

5 Material Physical Climate Risk(s) and Potential Adaptation Measures

5.1 Climate Risk and Natural Hazard Risk

Methodology

The **Future Risk** is the combination of **Future Hazard Exposure** and **Sensitivity** of the site infrastructure and/or operation to the analyzed hazard. The Risk is divided into six categories, namely very low, low, medium, high, very high and extreme. In cases where there is a current natural hazard exposure but no data on future exposure change or the hazard is not influenced by climate change (e.g., earthquakes), the future risk is reported equal to the current risk.

Future Hazard Exposure + Sensitivity = Future Risk

Key Insights

- Fluvial flood exposure is currently very low except for the waterfront area and expected to remain at those levels under the analyzed climate change scenarios. Note, that the assessment does not account for rainfall changes across the full river catchment and may underrepresent climate driven changes in fluvial flood exposure. Pluvial flood exposure is currently moderate, and pluvial flood zones are dispersed in patches across the assessed area. Pluvial flood exposure is modelled to increase under all analyzed climate scenarios reaching high levels in some years. Sensitivity to flooding is high as flooding can lead to property damage and business interruption. This results in a **present high and future high to very high pluvial flood risk**. Flood sensitive infrastructure (e.g. data centers, industrial buildings) should be avoided in topographic depressions and at the waterfront.
- Climate models project a significant to extreme rise in heatwave exposure from currently low levels to moderate by 2050 and high by 2070 under the SSP5-8.5 scenario. The vulnerability to heat extremes is low-medium for general infrastructure leading to a **low present and a medium future heatwave risk**. However, it is important to note that heat extremes can lead to higher energy consumption in **data centers** due to increased cooling demands or potentially reduce their operational efficiency making them **more vulnerable** to heat extremes compared to general urban infrastructure. Hence, increasing heat extremes should be considered in their planning phase.
- Hailstorm exposure is assessed as moderate and combined with a low-medium sensitivity to the hazard results in a **medium hailstorm risk**. However, hailstorm can **cause severe damage to solar panels** and appropriate damage reduction measures should be implemented if projects contain solar panels.
- Lightning exposure is assessed as high and combined with a low-medium sensitivity to the hazard results in a **medium lightning risk**.

5.2 Potential Adaptation Measures

Adaptation is the process of reducing or preventing the material physical climate risks. There are wide ranging measures that can be used to address risk such as structural changes to the design, insurance, and early warning systems paired with emergency preparedness planning.

The proposed project involves greenfield investments for the development of green logistics and industrial zones. It also includes the restoration of flood protection systems, transportation networks, and urban infrastructure that were damaged during the 2024 flood.

The key climate hazards for the site are notably pluvial flood distributed in several patches over the polygon area and fluvial flood at the waterfront.

Potential adaptation measures for addressing material physical climate risks include:

Fluvial and Pluvial flood:

- Avoid flood sensitive infrastructure (e.g. data centers, industrial buildings) in topographic depressions and at the waterfront or install appropriate flood protection measures.
- Understand flood water flow paths and entry points (e.g. doorways, underground areas), anticipated flood depth and duration, and impact of flooding to facility (e.g. is critical equipment located in basements or on the ground floor).
- Establish a flood warning system based on governmental sites and weather forecasts.
- Develop and implement a flood emergency response plan and business continuity plan to quickly recover business operation after event.
- Move critical and high-value equipment outside of flood prone areas.
- Install physical flood protection and/or sandbagging where needed.

6 Nature Risk

Swiss Re is the thought leader in quantifying Nature Risk. For this purpose, we use our patented **Biodiversity & Ecosystem Service (BES)** index. The index further allows to identify potential dependencies between the state of nature and the commercial activities operating in the same environment.

Key Insights

- As the development projects are spanning over urban and agricultural areas, the BES state of the location is modelled as **very low to moderate for the majority of the assessed BES indicators** except for water security which is assessed as very high. However, there is no dependency or low dependency based on the specified NACE code (Construction of utility projects for fluids) on such BES and the **operational relevance is therefore rated as low** with the except for erosion control.
- There is moderate dependency on erosion control and a very low (highly degraded) state. Combining this further with the increase in pluvial flood risk and increase in extreme precipitation with climate change as shown in previous sections, **erosion control provided by ecosystems can play a high operational relevance**. Hence, strategically investing in vegetation to restore erosion control or not to further degrade it could be considered.

Table 6 Nature Physical Risk: Breakdown in sublayers

	BES State	+	Dependency on BES	=	Operational Relevance
Habitat Intactness	Moderate		No Dependency		Negligible
Pollination	Not Defined		No Dependency		Not Defined
Air Quality And Local Climate	Moderate		Low Dependency		Low
Water Security	Very High		No Dependency		Negligible
Water Quality	Not Defined		No Dependency		Not Defined
Soil Fertility	Moderate		Very Low Dependency		Low
Erosion Control	Very Low		Moderate Dependency		High
Coastal Protection	Not Defined		Not Defined		Not Defined
Food Provision	Very Low		Not Defined		Not Defined
Timber Provision	Low		No Dependency		Negligible

BES State

Very Low	Low	Moderate	High	Very High

Dependency and Operational Relevance levels

Very High	High	Moderate	Low	Very Low

Appendices

Appendix I: Definitions

1. Sensitivity

Sensitivity levels	Description
Low	Impact of the peril on operation and/or infrastructure is minimal or non existent with respect to the standardized scale created from all occupancies.
Low-Medium	Impact of the peril on operation and/or infrastructure is low with respect to the standardized scale created from all occupancies.
Medium	Impact of the peril on operation and/or infrastructure is moderate with respect to the standardized scale created from all occupancies.
Medium-High	Impact of the peril on operation and/or infrastructure is considerable with respect to the standardized scale created from all occupancies.
High	Impact of the peril on operation and/or infrastructure is very high with respect to the standardized scale created from all occupancies.

* Please note that these qualitative grades are generated by subject matter experts at Swiss Re.

2. Future Exposure Change

Hazard	Description	Potential Impact
Fluvial Flooding (River)	Change in mean and extreme precipitation coupled with Swiss Re's pluvial flood zones.	Risk of flooding from fluvial floods (river floods) leading to property losses or business interruption.
Pluvial Flooding	Change in extreme in the 90th percentile of daily precipitation coupled with Swiss Re's pluvial flood zones.	Risk of flooding from pluvial floods (heavy rain) leading to property losses or business interruption.
Storm Surge (Sea Level Rise)	Median change in sea level height coupled with Swiss Re's storm surge zones.	Risk of flooding from storm surge for coastal locations.
Extreme Precipitation	Change in extreme in the 90th percentile of daily precipitation.	Risk of heavy downpour may lead to property losses or business interruption outside of flood zones.
Winter Precipitation	Absolute change in November to March precipitation.	Risk of flooding in the months November to March, or an indication of a bipolar development in precipitation patterns.
Summer Precipitation	Absolute change in April to October precipitation.	Risk of flooding in the months April to October, or an indication of a bipolar development in precipitation patterns.
Daily Wind Extreme	Based on the probability of exceeding a daily mean value of 12 m/s (43.2 km/h). The Score does not include extratropical cyclones or tropical cyclones as these events are poorly resolved in climate models.	Risk of storm damage leading to property loss or business interruption.
Wildfire	Change in atmospheric water capacity coupled with change in extreme temperature and increases in the number of dry days couples with Swiss Re's wildfire hazard layers.	Risk of wildfire leading to property losses or business interruption.
Heat Wave	Based on a combination of the absolute change in heat wave duration (80% weight) and absolute change in heat wave frequency (20% weight).	Risk of heat waves leading to increased cooling cost, reduced productivity, or business interruption.
Heat Stress	Based on a combination of the change in atmospheric water capacity, change in extreme temperature (99th percentile), and the increase in number of dry days (days with <1mm precipitation). All components are weighted equally i.e. 33%.	Risk of long-term lack of water and depletion of water sources with impact on the business operations or employees.
Drought	Based on the Standardized Precipitation Index (SPI) weighted in combination with the number of Heat wave days during abnormally dry seasons (SPI <= -1.3). The Drought Score describes meteorological drought i.e. precipitation well below average.	Risk of lack of water for business operations or destruction of agricultural yield.
Cold Stress	Based on the absolute change in number of freezing days (temperature < 0).	Absolute change in number of freezing days (temperature <0).

3. Climate Change Scenarios Assessed by the IPCC

Shared Socioeconomic Pathway (SSP) and Representative Concentration Pathway (RCP)	Abbreviations	Description	Estimated global warming by 2080-2100
SSP 1-2.6: Sustainability	Reduced Emissions	Gradual development towards a socially and economically sustainable path driven by an increasing commitment to achieving development goals. The global consumption is oriented towards low material growth as well as lower resource and energy intensity.	1 - 2°C
SSP 2-4.5: Middle of the Road	Middle	Globally, slow progress is made towards achieving the sustainable development goals. Social, economic, and technological trends do not shift notably from historical patterns. Environmental systems experience degradation, despite progress being made in some parts of the world. An overall reduction in the intensity of resource and energy use is taking place.	2 – 3.5°C
SSP 5-8.5: Fossil-fuelled Development	No Emission Reduction	CO2 emissions triple by 2075 leading to economic growth and a social divide. Investments are rather made towards technological adaptation to climate change and border control. This scenario is seen as an extreme case.	3 - 6°C

4. Nature Risks

BES Index	Index reflecting the state of BES at the asset location(s)
Habitat Intactness	Average abundance of originally present species remaining in the ecosystems.
Pollination	Adequate pollination of crops dependent on wild pollinators.
Air Quality and Local Climate	Vegetation's contribution to reducing air pollutants and to carbon sequestration.
Water Security	(Fresh) water availability.
Water Quality	Proportion of nitrogen retained by ecosystems.
Soil Fertility	Soil organic carbon stocks.
Erosion Control	Ecosystem contribution in reducing erosion risk.
Coastal Protection	Contribution of coastal habitats to mitigating flooding and erosion.
Food Provision	Outputs of cultivated land measured by crop cover.
Timber Provision	Outputs of forested land measured by forest cover.

Appendix II: Climate Hazard Data

The below tables provide the absolute or relative [%] change for the underlying data used to calculate the future exposure changes. The change is given relative to the period (1981-2010) and the historical values (hist) are given in absolute numbers.

1. Climate Hazard Information – SSP1-2.6

Climate Hazard	Climate Indices	Unit	Hist.	2030	2040	2050	2060	2070	2080
Temperature	Mean annual temperature	°C	20 °C	20.1°C	20.2°C	20.3°C	20.3°C	20.4°C	20.4°C
	Extreme 24h mean temperature	°C	25 °C	25.3°C	25.4°C	25.4°C	25.4°C	25.5°C	25.5°C
	Cooling degree days (Above 18°C)	days	227	241.0	245.0	247.0	248.0	248.0	248.0
	Heating degree days (Below 18°C)	days	138	124.0	120.0	118.0	117.0	117.0	117.0
Heat Wave	Number of heat waves per year	heat waves	1	2.0	2.0	2.0	2.0	2.0	2.0
	Heat wave days per year	heat wave days	2	8.0	9.0	10.0	10.0	11.0	11.0
Cold Stress (Frost)	Days below 0°C	days	0	0.0	0.0	0.0	0.0	0.0	0.0
Drought	Annual Standard Precipitation Index (SPI)	SPI	0	0.1	0.2	0.3	0.3	0.2	0.2
Extreme Wind	Daily extreme wind speed change (90th perc)	%	5 m/s	0.6%	0.9%	1.6%	1.4%	1.5%	1.8%
Sea Level Rise	Sea level rise	m	0 m	0.1	0.1	0.2	0.2	0.2	0.3
Precipitation	Extreme 1-day precipitation change	%	14 mm	3.9%	6.2%	6.3%	5.6%	4.9%	4.3%
	Extreme 3-day precipitation change	%	36 mm	5.7%	8.7%	8.0%	7.3%	6.7%	6.3%
	Mean change in wettest month	%	173 mm	4.1%	6.8%	7.7%	8.1%	10.3%	11.9%
	Total precipitation change Jun. to Aug.	%	397 mm	5.4%	5.9%	7.3%	3.7%	4.8%	4.3%
	Total precipitation change Dec. to Feb.	%	387 mm	-2.9%	-1.7%	-0.6%	-2.5%	-3.0%	-2.7%

2. Climate Hazard Information – SSP2-4.5

Climate Hazard	Climate Indices	Unit	Hist.	2030	2040	2050	2060	2070	2080
Temperature	Mean annual temperature	℃	20 ℃	20.2℃	20.4℃	20.7℃	20.9℃	21.0℃	21.1℃
	Extreme 24h mean temperature	℃	25 ℃	25.2℃	25.5℃	25.6℃	25.8℃	26.0℃	26.0℃
	Cooling degree days (Above 18℃)	days	227	240.0	245.0	252.0	258.0	263.0	264.0
	Heating degree days (Below 18℃)	days	138	125.0	120.0	113.0	107.0	102.0	101.0
Heat Wave	Number of heat waves per year	heat waves	1	2.0	3.0	3.0	4.0	5.0	6.0
	Heat wave days per year	heat wave days	2	8.0	13.0	18.0	24.0	30.0	33.0
Cold Stress (Frost)	Days below 0℃	days	0	0.0	0.0	0.0	0.0	0.0	0.0
Drought	Annual Standard Precipitation Index (SPI)	SPI	0	0.1	0.1	0.1	0.0	0.0	0.1
Extreme Wind	Daily extreme wind speed change (90th perc)	%	5 m/s	1.6%	1.6%	2.2%	2.3%	2.7%	2.7%
Sea Level Rise	Sea level rise	m	0 m	0.1	0.2	0.2	0.3	0.3	0.4
Precipitation	Extreme 1-day precipitation change	%	14 mm	4.7%	7.0%	7.7%	5.0%	4.8%	5.2%
	Extreme 3-day precipitation change	%	36 mm	2.9%	4.7%	4.5%	2.0%	1.7%	3.2%
	Mean change in wettest month	%	173 mm	1.0%	2.4%	0.5%	5.4%	3.0%	3.7%
	Total precipitation change Jun. to Aug.	%	397 mm	1.4%	1.2%	3.4%	2.4%	1.0%	1.6%
	Total precipitation change Dec. to Feb.	%	387 mm	-1.5%	-1.9%	-1.4%	-2.6%	-2.6%	-4.1%

3. Climate Hazard Information – SSP5-8.5

Climate Hazard	Climate Indices	Unit	Hist.	2030	2040	2050	2060	2070	2080
Temperature	Mean annual temperature	℃	20 ℃	20.4℃	20.7℃	21.0℃	21.4℃	21.9℃	22.3℃
	Extreme 24h mean temperature	℃	25 ℃	25.4℃	25.7℃	26.1℃	26.5℃	26.9℃	27.2℃
	Cooling degree days (Above 18℃)	days	227	244.0	254.0	263.0	274.0	286.0	300.0
	Heating degree days (Below 18℃)	days	138	121.0	112.0	102.0	91.0	79.0	65.0
Heat Wave	Number of heat waves per year	heat waves	1	3.0	4.0	5.0	6.0	6.0	5.0
	Heat wave days per year	heat wave days	2	15.0	25.0	41.0	55.0	68.0	75.0
Cold Stress (Frost)	Days below 0℃	days	0	0.0	0.0	0.0	0.0	0.0	0.0
Drought	Annual Standard Precipitation Index (SPI)	SPI	0	0.2	0.2	0.2	0.4	0.6	0.7
Extreme Wind	Daily extreme wind speed change (90th perc)	%	5 m/s	4.2%	5.0%	5.1%	4.6%	4.5%	4.5%
Sea Level Rise	Sea level rise	m	0 m	0.1	0.2	0.3	0.3	0.4	0.5
Precipitation	Extreme 1-day precipitation change	%	14 mm	5.1%	4.1%	5.4%	8.3%	10.6%	12.6%
	Extreme 3-day precipitation change	%	36 mm	4.2%	4.1%	6.1%	9.0%	11.2%	12.5%
	Mean change in wettest month	%	173 mm	1.2%	2.5%	5.4%	8.4%	7.9%	7.8%
	Total precipitation change Jun. to Aug.	%	397 mm	1.6%	1.3%	4.3%	5.5%	9.2%	9.9%
	Total precipitation change Dec. to Feb.	%	387 mm	-3.6%	-1.5%	-3.4%	-2.7%	-2.7%	-1.0%

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