DOCUMENT OF THE INTER-AMERICAN DEVELOPMENT BANK GROUP

TECHNICAL GUIDANCE FOR ALIGNING IDB GROUP'S OPERATIONS TO THE PARIS AGREEMENT

WATER AND SANITATION

March 2023

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ABBREVIATIONS

CC	Climate change
CO_2^e	Carbon Dioxide equivalent
CH4	Methane
DCCRA	IDB Disaster and Climate Change Risk Assessment Methodology
ESPF	IDB Environmental and Social Policy Framework
ESSP	IDB Invest Environmental and Social Sustainability Policy
GHG	Greenhouse Gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GWP	Global Warming Potential
IDB	Inter-American Development Bank
LAC	Latin America and the Caribbean
LTSs	Long-Term Strategies
MBT	Mechanical Biological Treatment
MDBs	Multilateral Development Banks
N_2O	Nitrous oxide
NDCs	Nationally Determined Contributions
PBL	Policy-Based Lending
OECD	Organization for Economic Co-operation and Development
SRF	Solid Recovered Fuel / Specified Recovered Fuel
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlements Programme
W&S	Water and Sanitation Sector, including also Solid Waste Management, Drainage and Flood Control, and Water Resources Management

I. INTRODUCTION

1.1 This document is a preliminary technical complement to the Paris Agreement Alignment Implementation Approach (PAIA). The PAIA has been developed by the IDB Group (IDB, IDB Invest, and IDB Lab), as a methodological tool to pursue the objective of aligning to the Paris Agreement (PA) new operations and projects that have been reformulated. Both the PAIA and this technical guidance are based on the Joint Framework for the assessment of PA alignment in direct investment operations, developed by Multilateral Development Banks (MDB).[1]

1.2 The PAIA outlines IDB Group's strategy to assess the alignment of operations to the PA with the objective of informing decisions on project activities to be financed and ongoing country dialogue. To do so, it establishes a set of principles to guide the consistent and equitable interpretation of the Joint MDB framework when performing the assessment; and it lays out a series of methodical steps to be followed along the preparation cycle of projects.

1.3 The PAIA builds upon IDB's Environmental and Social Policy Framework (ESPF) and IDB Invest's Environmental and Social Sustainability Policy (ESSP). All operations covered by the ESPF and the ESSP must *comply* with these policies during the preparation, execution, and closing of projects. In contrast, PA alignment assessment is meant to *inform* project design before approval, using the information and tools at the disposal of the IDB Group at the time it is made.

1.4 This document contains technical guidance that complements the PAIA for operations related to water and sanitation investments (the W&S sector's portfolio: Water and Sanitation, Solid Waste Management, Drainage and Flood Control, and Water Resources Management). It provides IDB Group personnel with additional criteria to interpret the Joint MDB Framework, with specific considerations that are relevant to operations and tools at the IDB Group. [2]

1.5 The objective of this guidance is to help IDB Group personnel design operations aligned to the mitigation and adaptation goals of the PA; and ensure they present the necessary elements to determine, justify, and disclose all necessary information to assess this alignment at approval.

1.6 This document will be revisited by Management on a yearly basis upon its approval and updated as necessary to reflect the lessons learned by the IDB Group and other institutions as they work towards aligning operations and other financial flows with the goals of the PA. Updates will respond to possible adjustments in the MDB Joint Framework, as well as to the need to incorporate the experience during its implementation, consider technological and knowledge advancements in the region, among others.

1.7 **Scope of this document**. This guidance covers IDB Group's operations regarding investment loans, investment loans, grants[3] and guarantees (i.e., operations involving capital expenditures, referred to as "direct investments" in the MDB frameworks) and policy-based loans and guarantees; it also provides guidance applicable to products with financial intermediaries and corporate finance, which have specific methodological approaches.

1.8 **Relation to other IDB Group documents**. This technical guidance builds on the dialogue agenda between the countries and clients of the IDB Group in Latin America

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1 Technical Note BB1 and BB2: Joint Framework of the MDBs for the Assessment of Alignment with the Paris Agreement of Direct Investment Operations. (November 2021 working document).

2 In case this document presents discrepancies with the Joint MDB Framework, the second prevails except in cases explicitly justified in this guidance.

3 As established in the PAIA, grants with an approved amount greater than US$3 million.

and the Caribbean (LAC). The note seeks to ensure that the systematic analysis of operations for alignment with the Paris Agreement supports the transition to climate-resilient and low-carbon WSA infrastructure systems. In line with this, the Water and Sanitation Sector Framework Document (GN-2781-13) recognizes the challenges that climate change imposes on the WSA Sector and proposes lines of action aimed at disaster and climate change risk management, water security, and efficient and sustainable service delivery. The technical guidance is also related to the Climate Change Sector Framework Document (GN-2835-8) and the IDB Group Climate Change Action Plan 2021-2025 (GN-2848-9). Both documents emphasize the Bank's commitment to promote sustainable management of water resources, circular economy, and solid waste reduction.

II. THE WATER AND SANITATION SECTOR AND CLIMATE CHANGE

2.1 Achieving universal access to quality water and sanitation services is key for reducing inequalities and fostering economic and social development in the LAC region. Despite the region's progress on access to basic water and sanitation services, it still faces challenges in meeting the Sustainable Development Goals (SDGs), relating to: (i) low levels of access to quality water and sanitation services, with substantial inequalities between regions, socioeconomic groups, and ethnicities; (ii) low resource flows, which limit service expansion and improvement, and weak governance; (iii) inefficient management of services; (iv) weaknesses in the framework for environmental sustainability and resilience; and (v) a lack of innovation and digitalization**.** (Development in the Americas (DIA), 2020). Many of the problems in the sector—not just regionally but globally—are rooted in its status as a public good (particularly in the case of sanitation and solid waste services, where exclusion can have high social and/or environmental impacts), as well as its natural monopoly characteristics (asymmetrical information and high economies of scale that make it more efficient, per unit, to build for very long design periods, thus limiting the entry of competitors) and the presence of large externalities (particularly social and environmental). The dispersion and local nature of markets also pose a challenge: in contrast to other network-based services, such as telecommunications or energy, the opportunities for regional service delivery are limited by the high costs of transporting water from the source, within the city/community, and for wastewater removal, given the large infrastructure investments that would be required.

2.2 Addressing climate change in this sector must be seen synergistically with the objective of universal access to quality, sustainable, and resilient water and sanitation services in the LAC region. Both aspects must be the development of a suitable governance and management framework for services, in a manner that accelerates development and innovation in the sector to achieve the goals of the PA.

A. The water and sanitation sector and the mitigation goal of the PA

2.3 The management of water, wastewater, and solid waste, involves in many cases processes with a high energy demand and associated greenhouse gas (GHGs) emissions.

2.4 In 2014, energy-intensive processes associated with extraction, supply, and treatment of water and wastewater accounted for around 4% of global electricity consumption. Of the electricity consumed in the water sector, around 40% was used to extract water, 25% for wastewater treatment and 20% for water distribution (IEA, 2016).

2.5 In the large cities of LAC, the levels of non-revenue water are estimated at 40% of the initial delivery to the distribution network (Peña et al, 2019). It has also been indicated that the minimum value of losses is more than one third of water produced, while the maximum would reach two thirds (Ferro & Lentini, 2015).

2.6 Water efficiency measures, such as the reduction of physical losses in the network, have a direct effect on energy savings, which can lead not only to the reduction of GHGs, but to overall water systems that are less resource intensive.

2.7 The climate impact of the water sector is not limited to the energy used for water treatment and related CO_2 emissions. Non-treated raw wastewater and solid waste management contribute to emissions of other highly potent GHG, such as methane (CH_4) and nitrous oxide (N_2O).[4] For instance, the management of municipal solid waste (MSW) is estimated to be responsible for 5% of GHG emissions (Kaza, 2018).

2.8 It is estimated that wastewater treatment in centralized facilities alone contributes about 3% of global nitrous oxide emissions, and that methane emissions from wastewater collection and treatment processes contribute about 7% of anthropogenic methane emissions (Jones et al, 2021; Global Methane Initiative, 2013).

2.9 Advanced wastewater treatment and wastewater reuse and circular economy of water-based approaches can help transition to more integrated models that reduce GHG emissions while supplying biogas as a source of renewable energy. Reducing inflows into surface waters of poorly treated wastewater and fecal sludge, i.e., of organic matter and nutrients, can significantly reduce local pollution while contributing to CC mitigation.

2.10 Specific water resources management interventions such as wetland protection and other nature-based solutions can help to sequester carbon in biomass and soils; besides, ecosystem conservation activities avoid emissions caused by their degradation.

2.11 In the solid waste sector, there is a clear potential to mitigate the effects of climate change through the use of low GHG generation technologies for collection and transport; the promotion of waste management practices under a Circular Economy model, including recycling, as well as the promotion of biological treatment and composting of food and organic waste, in addition to green consumption practices.

2.12 In final disposal stages, there are also valuable opportunities for climate change mitigation. Landfill gas, consisting of about 50% CH_4, can be burned to oxidize CH_4 into CO_2, or recovered to generate power (Boulet et al, 2010).

2.13 IDB has supported the construction of landfills designed to meet CC-criteria through the installation and monitoring of landfill gas management systems, including GHG destruction by flaring or energy recovery (IDB, 2010).

2.14 Additionally, treated sludge from wastewater and composted solid organic waste offer opportunities to be used for productive or landscape purposes, and have the potential to displace traditional fertilizers.[5]

2.15 Taking advantage of these mitigation opportunities, in ways that result in more integrated, efficient, and decarbonized W&S systems, will help countries increase the quality of life of the population while meeting their CC goals in the context of the PA.

B. The water and sanitation sector and the adaptation goal of the PA

2.16 Climate change impacts may increase the proportion of the world population exposed to water stress by up to 50 per cent (UN-Habitat, 2021). At the same time, people and

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4 GWP of CH_4 is about 28 times higher than that CO2; GWP of N2O is about 273 higher than that CO2 (IPCC, 2022).

5 The use of sewage sludge as a fertilizer is subject to local regulations and feasibility assessments for each type of sludge generated in a particular location, as the sludge may contain significant concentrations of heavy metals and persistent organic pollutants.

infrastructure are increasingly exposed to extreme hydrometeorological events.

2.17 About 90% of natural disasters are water-related, mostly droughts and floods, and Climate Change is expected to increase the frequency and intensity of these climate extremes (GIZ, 2020).

2.18 A 2019 report by the World Bank estimated that low- and middle-income countries lose $390 billion each year to disruptions of power, transportation, water, and telecommunications services caused by natural hazards (Hallegatte et al, 2019).

2.19 Water availability will become more unreliable with increased climate variability, worsening the situation in water-stressed regions, and generating problems in areas that have not yet been as severely affected (UN-Water, 2020).

2.20 Climate change also has a significant impact on public health, which relies on access to clean water. Heat waves especially affect the elderly and children; floods expose the population to waterborne diseases. Increased local temperature can increase antibiotic resistance in common pathogens (Hutchins, 2019). In this context, it is imperative to seek the achievement of SDG 6 to reduce vulnerability in the population.

2.21 Additionally, climate change-induced **drought and resource conflict** may speed up the pace of rural-urban migration, water scarcity, breakdown of environmental services, flooding, and the subsequent waterborne disease, combined with a rapid rise in health expenditures (UN-Habitat, 2021).

2.22 LAC is the most vulnerable region to natural disasters, presenting the highest economic damages median in the world (0.18 % of GDP per event). In this region, flooding is the most frequent of all natural disasters (Fernández Illescas & Buss, 2016).

2.23 The deforestation of riparian vegetation and silting of water courses are contributing to reduce the water retention capacity of many rivers in LAC. Pollution is also compromising freshwater quality and availability, increasing the pressure on clean water resources that are still available.

2.24 Many water sources in the region are threatened fundamentally due to **inefficient resource management** that implies institutional weaknesses and a lack of reliable and up-to-date information, which can threaten the water security of populations (Bretas et al, 2020).

2.25 In many LAC countries Water, Sanitation and Waste Management infrastructure is managed by public companies, who lack sufficient finances and human resources to improve and expand the existing infrastructure. Additionally, in many countries the legal framework hampers the participation of private companies in the sector.

2.26 The water sector, including water resources management as well as water supply and sanitation, plays a crucial role in fostering the resilience of societies and ecosystems to climate change. Thus, it is necessary to include considerations of uncertainty and potential risks in water systems design, starting with a proper assessment of climate-related risks (World Bank, 2020).

C. Synergies between CC mitigation, adaptation, and water security

2.27 LAC is one of the areas on the planet with the greatest abundance of water resources: it is home to more than 30% of the world's water resources. However, and despite this, the storage capacity of its basins and aquifers is progressively decreasing as a result of climate change (Bretas et al, 2020). Also, the distribution of the resource has large spatial and temporal heterogeneities. The critical reliance on agriculture for economic output, and a growing energy sector with a broader generation matrix, add to the factors that increase pressure on water security in the region.

2.28 Food security, human health, urban and rural settlements, energy production, industrial development, economic growth, and thriving ecosystems are all water-dependent, and the water management systems' performance highly affect these sectors (UN-Water, 2020).

2.29 From a cross-sector and more holistic and **upstream planning perspective** (or from a Water-Energy-Food Nexus approach), the interlink of water resource management with land use management (including forestry), agricultural/irrigation and energy planning, offers a unique and pivotal opportunity to promote both low-carbon and climate-resilient pathways towards the achievement of commitments under the PA.

2.30 In water scarce areas, **wastewater reuse** can be an important source of water and nutrients. In LAC, the use of treated effluents is a pending challenge, and its application has limited diffusion. There are numerous opportunities for the development of these practices in the region, which could contribute to improving water security, with significant **co-benefits in climate change mitigation** (Bretas et al, 2020), such as emission reductions due to fertilizer displacement.

2.31 The optimization in the use of resources is a pillar of increasing resilience. Not only the water efficiency reduces the pressure on water resources, but also generates energy savings (specially in pumping activities), with the consequent impact in GHG levels.

2.32 **Solid waste management** may also play a key role in ensuring water security. Having a solid waste pollution prevention agenda focused on prevention, proper management, treatment and final disposal, and capture and interception in coastal basin areas can contribute significantly to managing LAC's water resources (Bretas et al, 2020).

2.33 Additionally, recycling and material recovery activities as part of a circular economy also contributes to reducing water demand of production processes, while producing energy savings.

2.34 Conversely, an improper solid waste disposal can negatively impact urban drainage systems in a significant manner. Integrated solutions for waste-sanitation-drainage management in many instances offer opportunities for low-carbon pathways while improving the climate resilience of both infrastructure and population.

2.35 Most projects of the INE/WSA portfolio address various aspects of water security by contributing to the improvement of water resource availability and managing excess water and extreme hydrometeorological events. In line with this, the IDB Group is taking steps to continue investing in nature-based solutions, leading the commitment to increase "nature positive" investments, adopted during COP26 by the Multilateral Development Banks.

III. ASSESSMENT OF OPERATIONS: ALIGNMENT WITH THE PA MITIGATION GOAL (BB1)

3.1 The joint MDB methodology serves as the basis for determining the alignment of operations with the PA. The application of the guide will result in two possible scenarios: "aligned", or "not aligned". In this context, an operation is "aligned" if it does not go against the mitigation (BB1) and adaptation and resilience (BB2) goals of the PA.[6] This section presents and describes the procedure to determine the alignment with the mitigation goal.

3.2 BB1 focuses on whether the operation in question is consistent with a low GHG development trajectory in the country where the operation is located and does not

[6] In operations with activities or use of funds that cannot be defined at the time of approval (e.g., operations with financial intermediaries, corporate loans, etc.), the methodologies specifically defined for this type of operations will be used.

hinder or harm the transition to a decarbonized economy, both at the country and global levels.

A. Activities universally aligned with the PA mitigation goal

3.3 **Activities considered universally aligned**. According to Annex 1 of the Joint MDB Assessment Framework for Paris Alignment for Direct Investment Operations, some activities can be considered to be aligned to the mitigation goal of the PA across countries and under all circumstances. In the W&S sector, Box 1 captures universally aligned activities as long as i) their economic feasibility does not depend on the extraction, processing and/or transportation of fossil fuels; ii) their economic feasibility does not depend on fossil fuel subsidies; and iii) the operation does not depend significantly on the direct use of fossil fuels.

3.4 In addition, the MDB Joint Framework also suggests that the design of operations should reinforce the preservation of high carbon stocks (HCS),[7] an aspect that should be reviewed in conjunction with the IDB's Environmental and Social Policy Framework (ESPF) and IDB Invest's Environmental and Social Sustainability Policy (ESSP), as applicable.

3.5 A large part of the activities financed by the IDB Group in the context of W&S sector are considered universally aligned by MDBs (see Table 1).

Table 1 activities considered universally aligned with the Paris Agreement's Mitigation Goal

Sector	Eligible operation type	Conditions and guidance
Agriculture, forestry, land use and fisheries	Afforestation, reforestation, sustainable forest management, forest conservation, soil health improvement	With the exception of operations that expand or promote expansion into areas of high carbon stocks or high biodiversity areas
	Conservation of natural habitats and ecosystems	With the exception of operations that expand or promote expansion into areas of high carbon stocks or high biodiversity areas
	Flood management and protection, coastal protection, urban drainage	
Waste	Separate waste collection (in preparation for reuse and recycling), composting and anaerobic digestion of biowaste, material recovery, and landfill gas recovery from closed landfills	
Water supply and wastewater	Water supply systems (e.g., expansion, rehabilitation); water quality improvement; water efficiency (e.g., non-revenue water reduction, efficient process in industries); drought management; water management at watershed level	Desalination plants need to go through specific assessment
	Gravity-based or renewable energy-powered irrigation systems	
	Wastewater treatment (domestic or industrial), including treatment and collection of sewage, sludge treatment (e.g., digestion, dewatering, drying, storage), wastewater reuse technology, resource recovery technologies (e.g., biogas into biofuel, phosphorus recovery, sludge as agriculture input, sludge as co-combustion material)	

Source: Annex 1 from Joint MDB Assessment Framework for Paris Alignment for Direct Investment Operations.

3.6 **Universally aligned activities at the IDB Group**. For the four subcategories within the sector and W&S sector's portfolio (Water and Sanitation, Solid Waste Management, Drainage and Flood Control, and Water Resources Management) the

7 Under this approach, it is recognized that secondary forests provide essential carbon storage services and forest products for local communities that are often not considered to be of conservation value and therefore are not protected.

following typical projects by the IDB Group do not require a specific analysis to be declared aligned with the mitigation goals of the Paris Agreement:

3.7 **Water and Sanitation:** These types of works will be considered universally aligned if their electric systems are connected to the country's electricity grid, or when they depend on their own renewable energy generation (e.g., from wind, solar, wave power, etc.) with negligible lifecycle GHG emissions. If that is not the case, they need to go through specific assessment (see Section B).

a. **Water supply systems**: construction, rehabilitation, improvement, and expansion of water supply systems, including drinking water treatment plants, water networks, pumping stations, household connections, macro and micrometering, and complementary facilities, rainwater catchment systems, household water filters.

b. **Wastewater systems:** construction, rehabilitation, improvement, and expansion of wastewater systems, including wastewater treatment plants, outfalls, wastewater networks and collectors, pumping stations, and complementary facilities, individual sanitary solutions such as latrines.

3.8 **Solid Waste Management:** Separate waste collection (in preparation for reusing, recycling, and other forms of recovery), composting and anaerobic digestion of biowaste, material recovery, mechanical biological treatment (MBT), Refuse-derived fuel (RDF) or solid recovered fuel (SRF), and landfill gas recovery from open and closed sanitary landfills.

3.9 **Drainage and Flood Control:** Macro and micro drainage works, separation of rainwater from sewage systems, pipes and collectors, green filter trenches and retention structures, sustainable urban drainage systems – except for any operation that risks expanding or promoting the expansion into areas of high carbon stocks or high biodiversity areas.

3.10 **Water Resources Management.** The interventions considered in this category include:

a. Natural habitat and ecosystems conservation and restoration

b. Riverbank stabilization and erosion control

c. Activities included in the previous categories (a and b) that are conducted at the basin level, provided they do not expand or promote expansion into areas of high carbon stocks or high biodiversity areas.

3.11 As stated in paragraph 3.3, if some activities of the operation are in the universally aligned list but (1) their economic feasibility depends on external fossil fuel exploitation, processing, and transport activities, (2) economic feasibility depends on existing fossil fuel subsidies, (3) they rely significantly on the direct utilization of fossil fuels, then they will not be considered universally aligned. This will also apply to operations with an impact on areas of high carbon stocks.

B. Activities that must validate their alignment with the mitigation goal of the PA

3.12 Based on the projects omitted from the list of universally aligned activities and the active portfolio of the IDB Group, the following types of investments and associated policies will require a specific analysis of alignment with the CC mitigation goal of the PA. Please note that this list is <u>not exhaustive</u> and may be supplemented over time:

a. Sanitary Landfill (construction or expansion)

b. Solid Waste Incineration

c. Open Dump closure

d. Desalination plants

e. Carbon-based pumping

f. In addition, based on the MDB guidance, any of the following operations will require a specific analysis: (i) operations whose economic viability depends on external activities for the extraction, processing and transportation of fossil fuels; (ii) operations whose economic viability depends on existing fossil fuel subsidies (e.g., a fishing fleet that would be unviable without fossil fuel subsidies); and (iii) operations that depend significantly on the direct use of fossil fuels (e.g., a production plant or irrigation system that relies entirely or substantially on fossil fuel pumps).

C. Criteria for the specific assessment

3.13 For operations that cannot be considered included in the universally aligned list (section B and others in the W&S sector yet to be identified), there are five specific criteria to be analyzed, as noted in Table 2. In order to consider those types of operations as aligned with the mitigation goal of the PA, the answer to ALL questions from the specific assessment must be "No". Please note that limitations in information availability will not lead to a non-alignment decision, but rather, the assessment will rely on other specific criteria for which information is available.

3.14 This section describes how each one of these general questions by MDBs should be interpreted in the context of water and sanitation projects at IDB Group, first generally (paragraphs 3.15 -3.18) and then with specific considerations per type of investment.

Table 2 Specific criteria of the Joint MDB Framework for PA Alignment for Direct Investments

Specific Criteria (SC)
SC1: Is it inconsistent with the Nationally Determined Contribution of the country where it is carried out? *The NDC of the country should not explicitly or implicitly phase-out this type of operation/economic activity.*
SC2: Is it inconsistent with the Long-Term Strategy of the country where it is carried out? *The LTS (or other similar long-term national economy-wide, sectoral, or regional low-GHG strategies) of the country should not explicitly or implicitly phase-out this type of activity in its lifetime.*
SC3. Is it inconsistent with the global sector-specific decarbonization pathways in line with the PA, considering countries' common but differentiated responsibilities and respective capabilities? *The operation/ economic activity should be checked against widely accepted data and findings in the global literature to inform the assessment, considering the local context and principle of equity.*
SC4: Does it prevent the transition to PA-aligned activities or primarily support or directly depend on non-aligned activities? *The type of operation/ activity should be compared to lower-carbon alternatives and consider the risk of (i) carbon lock-in or (ii) preventing future deployment of Paris-aligned activities*.
SC5: Do transition risks or stranded assets make it economically unviable? *Once climate change considerations are included in the economic and/or financial analysis of the operation, it should meet IDB Group thresholds for viability.*

Note: Insufficient information will not lead to non-alignment. Information to answer SC4 is expected to be available for all operations.

3.15 **SC1 - SC2 Review of the Nationally Determined Contribution (NDC) and the Long-Term Strategy (LTS)**: the project and its activities should not contravene the NDC, LTS and other supporting plans linked to national CC commitments, including subnational and water basin level plans. These criteria involve analyzing these instruments and ensuring the investment is not excluded or phased out in said plans or policies, preferably contributing to them whenever possible.

3.16 **SC3 Review of sectoral low carbon pathways (LCP)**: the project should not be incompatible with sectoral LCPs such as those in **Table *3***, in the context of the operation. This will be assessed jointly with considerations related to the principle of equity and common but differentiated responsibilities, particularly in light of the feasibility analysis under SC4.

Table 3 Low GHG Emissions Development Global Trajectories for Water and Sanitation

Sector or subsector	Global/sectorial low carbon pathways	Source
Water supply and Wastewater	If the urban water sector were to become carbon neutral, it could contribute the equivalent of 20% of the sum of committed reductions by all countries in the Paris Agreement. The Urban Water Cycle uses energy at every stage and emits GHG in the wastewater stages. There are opportunities to reduce carbon emissions at every stage: **Water systems:** energy efficiency improvement would reduce GHG by up to 40%; water efficiency improvement would reduce GHG by up to 50%; **Wastewater systems:** nutrients reuse would reduce GHG by up to 20%; energy recovery would reduce GHG by up to 90%; wastewater treatment would reduce GHG by up to 100%	Ballard, Simone; Porro, Jose; Trommsdorff, Corinne. (2018). The Roadmap to a Low-Carbon Urban Water Utility. An international guide to the WaCCliM approach. Water and Wastewater Companies for Climate Mitigation.
	Through active water leakage control in water-distribution networks, by 2050, reduce water losses by 38-47 percent globally by 2050, with resulting emissions reduction from pumped distribution amounting to 0.66-0.94 gigatons of carbon dioxide and saving 359,489-449,489 million meters of water.	UNFCCC (2021): Climate Action Pathways for Water: Action Table.
	By 2030, water and wastewater utilities have reached complete decarbonization and improved climate resilience through climate risk management.	
	Technology and innovation generators are needed to deliver and scale up water reuse techniques and **zero-carbon desalination**.	
	By 2040, the water sector is a net positive renewable energy and nutrient provider, and 100% of all municipal, industrial, and agricultural wastewater is treated for reuse or discharge into the environment.	
Drainage and Flood Control	By 2030, 100 countries have included NBS for flood and drought risk in their NDCs and national DRR strategies under the Sendai Framework.	
Water Resources Management	Remaining peatlands are conserved and around fifty million hectares rewetted to prevent carbon emissions.	
Solid Waste Management	Signatory cities to the C40 Advancing Towards Zero Waste Declaration have committed to accelerate the transition towards a zero-waste future. These cities have pledged to take ambitious, measurable and inclusive actions to reduce municipal solid waste generation and improve materials management, to reach two goals: (1) Reduce municipal solid waste generation per capita by at least 15% by 2030 compared to 2015, and (2) Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015, and increase the diversion rate away from landfill and incineration to at least 70% by 2030.	UNFCCC (2021): Climate Action Pathways for Human Settlement: Action Table.

3.17 **SC4 No obstruction of the transition ("carbon lock-in")**: does the project involve financing of facilities with significant CO_2e emissions, which will continue to operate even if there are economically feasible, lower-carbon options available to replace it? To meet this criterion, it is necessary to carry out an analysis of alternatives that considers the committed GHG emissions (*carbon lock-in*), which is specific to the type of investment (see paragraphs 3.24- 3.37).

3.18 **SC5 Economic viability given transition risks**. This criterion implies analyzing the risks of the climate transition (that is, those associated with a future scenario that keeps the rise in temperature well below 2°C), and monetizing – to the extent possible – the associated costs and benefits. An operation will be considered "not aligned" if, once the quantitative or qualitative implications of CC have already been incorporated into the analysis, the project does not meet the thresholds of economic and financial viability required by the IDB Group.

3.19 Both the public and private arms of the IDB Group have begun to monitor climate transition risks based on internationally recognized approaches. The main framework of reference is the one established by the Task Force on Climate Related Financial Disclosures, TCFD, [8] which broadly covers three areas of change: a) shifts in policies and regulations associated with the transition; b) technological improvements and innovations; c) potential changes in supply (for example, investor decisions) and/or in consumer behavior; that is, market shifts.

3.20 Therefore, to meet this criterion, it is <u>necessary to determine whether there are material transition risks in the subsector of the operation,</u> and if so, incorporate such risks into the financial sensitivity analysis, estimating their impact on the project's feasibility. To do this, the main guiding questions will be the following:

a. The contribution of IDB Group operations to GHG emissions, which has an impact on how the sector may be affected as a result of **changes in regulations**. For instance, given the case of a desalination plant whose operation depends on a thermal power plant, there is a risk of stranded assets due to regulatory changes on the use of fossil fuels.

b. The potential **technological changes** and innovations in the sector, and how they would affect investment decisions in projects. Technological improvements in waste-to-energy plants emerging in other regions may put pressure on waste treatment technologies more widely implemented in LAC.

c. The potential impacts of **market changes** (changes in supply and/or consumer behaviors) in response to the climate transition. What effects could be expected from changes in the market? In the case of sanitary landfills, there may be a risk of future social conflict due to a shift to more circular consumption patterns.

3.21 **In this context, to assess the economic feasibility of a project in the W&S sector under SC5, the team should incorporate GHG emissions as a criterion in the analysis of alternatives**. For this purpose, sectoral GHG emission calculation toolkits may be used, such as ECAM (Energy Performance and Carbon Emissions Assessment and Monitoring).[9]

3.22 Transition risks related to technological and market shifts (3.20 b., 3.20 c.) will be considered qualitatively on a case-by-case basis.

3.23 **Error! Reference source not found.** illustrates the methodological process for determining mitigation alignment.

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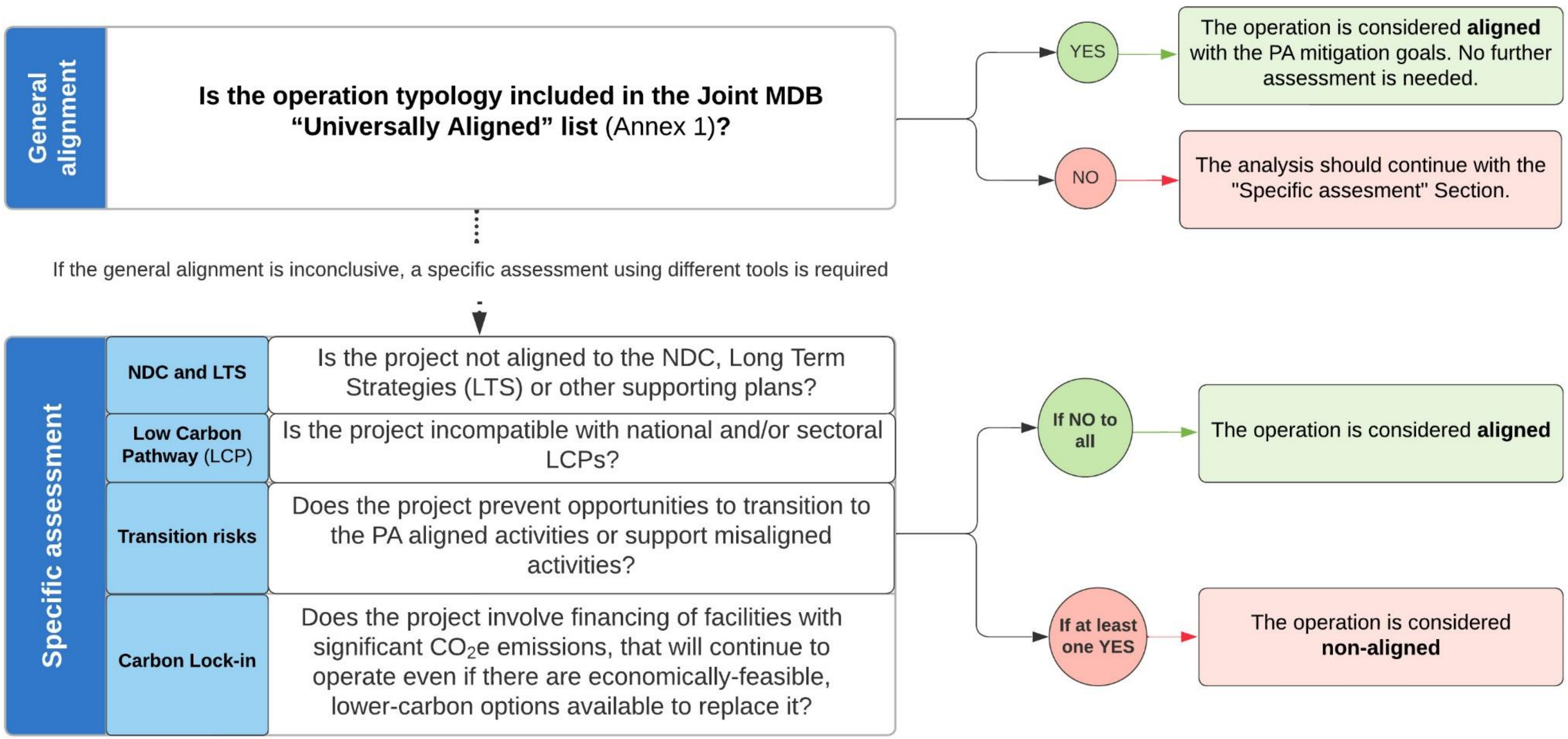
8 See: "Recommendations of the Task Force on Climate-related Financial Disclosures" (2017).

9 ECAM was developed by ICRA for the WaCCliM Project and holds a Creative Commons Attribution-ShareAlike 4.0 International License. WaCCliM is a joint initiative between GIZ and IWA.

Figure 1. Flow chart of the process to determine alignment with the Paris Agreement mitigation goal. Source: Prepared by the authors



3.24 **Sanitary Landfills.** NDC and LTS revision will be carried out as indicated in the beginning of this section.

3.25 Regarding sector Low-Carbon Pathways (LCPs): In most LAC countries, sanitary landfills are widely used, being an accessible and safe way for municipal solid waste final disposal, preventing contamination and contributing to the sanitary conditions of the population, for which the construction of landfills cannot be considered by itself incompatible with the LCPs (criteria on common but differentiated responsibilities).

3.26 However, in order to progressively reduce GHG emissions, it is necessary to gradually state more ambitious solid waste management goals, for which sanitary landfill projects will be considered aligned with LCP as long as they include activities aimed at mitigation (separate waste collection -in preparation for reusing, recycling and other forms of recovering-, composting and anaerobic digestion of biowaste, material recovery, MBT and SRF facilities, and landfill gas recovery from closed landfills).

3.27 The sanitary landfill projects will also be considered aligned with LCPs if:

a. the interventions are conducted in an existing landfill, have a short operational stage (new cells with 5 years of useful life or less), and if the current waste management already includes universally aligned activities, or

b. the interventions benefit small cities (landfills designed for less than 50.000 inhabitants) and are located in high social vulnerability regions (according to national registers and studies) and include activities aimed at mitigation, at least in the next phase of the project or program (in case of multiphase projects or programs).

3.28 Sanitary landfills designed for populations over 300.000 are required to include biogas capture and recovery or burning. Burning will be considered PA mitigation aligned when recovery is not technically or economically feasible, including operational capacity criteria.

3.29 If sanitary landfills are found incompatible with LTSs or NDCs (for example, if there are explicit mitigation goal of reducing the use of sanitary landfills for final disposal), or if the project involves carbon lock-in, then the operation cannot be considered PA mitigation aligned. Operations that expand or promote expansion into areas of high carbon stocks or high biodiversity areas will also not be considered aligned.

3.30 **Solid Waste Incineration.** Regarding sector Low-Carbon Pathways (LCPs): Waste incineration provides many advantages for waste management, as it avoids methane emissions, allows the recovery of heat and electricity, prevents dispersion of pollutants, among other benefits. However, it has high capital investment, operation, and maintenance costs, and does not promote recycling or waste reduction.

3.31 The operations including this technology will be considered aligned with LCP if they involve heat recovery and/or electricity generation, and also include activities aimed at mitigation (separate waste collection -in preparation for reusing, recycling, and other forms of recovering). If the incineration plant is carbon-based, the operation cannot be considered PA mitigation aligned, unless a specific assessment proves it constitutes the best technical and economic alternative.

3.32 **Open Dump Closures.** Regarding sector Low-Carbon Pathways (LCPs): Open dumps are a major cause of vector proliferation, causing serious public health problems, as well as being a source of water and soil contamination. The sanitation of these environments is an unavoidable priority for the safety of the population, for which it cannot be considered by themselves incompatible with the LCPs (criteria on common but differentiated responsibilities).

3.33 However, if these interventions are found incompatible with LTSs or NDCs, or if the project involves carbon lock-in according to the questioning framework provided in this section (see paragraph 3.17), then the operation cannot be considered PA mitigation aligned.

3.34 **Desalination Plants.** Regarding sector Low-Carbon Pathways (LCPs): Desalination plants have a very intensive use of electricity while enhancing water security, especially in highly water stressed areas where they are usually built. The project should meet the following criteria:

a. An analysis of technical alternatives considering other water sources (including rainwater harvesting, leakage reduction, and demand control in existing systems) was conducted, resulting desalination as the best technical and economic alternative.

b. Design flows are reasonable (to avoid oversizing).

c. There is operational capacity (or the operation contemplates capacity building) to guarantee the energy efficiency of the system operation.

d. The project includes power generation from renewable sources. If not, the use of non-renewable sources is adequately justified and the project incorporates actions to offset emissions associated with energy consumption (e.g., reforestation, reuse of wastewater).

3.35 However, if these interventions are found incompatible with LTSs or NDCs, or if the project involves carbon lock-in, then the operation cannot be considered PA mitigation aligned.

3.36 **Carbon-based Pumping**[10] Regarding sector Low-Carbon Pathways and carbon lock-in. The project should meet the following criteria:

a. An analysis of technical alternatives (including rainwater harvesting, power lines in isolated systems and renewable energy-based equipment) was conducted, resulting in carbon-based pumping the best technical and economic alternative.

b. Design flows are reasonable (to avoid oversizing).

c. The project benefits vulnerable population (criteria on common but differentiated responsibilities).

d. Follow-up and monitoring activities of the operational phase are included, and they consider (i) a periodic analysis of the pumping system to ensure it is operating at an optimal energy performance level; (ii) a technical and economic analysis to be developed after the useful lifetime of the pumps, which evaluates the possibility of replacing the equipment by other technical alternatives with lower emissions.

3.37 However, if these interventions are found incompatible with LTSs or NDCs, the operation cannot be considered PA mitigation aligned.

3.38 **Reservoir Construction.** Regarding sector Low-Carbon Pathways: the project should include an analysis of technical alternatives, including a strategic and careful site selection, minimizing upstream of nutrient pollution sources[11], and prioritizing deeper and smaller-area designs.

3.39 If the design suggested is not appropriate for technical or economic reasons, a detailed justification must be provided.

3.40 For large reservoirs (a capacity in excess of 10 million m^3 [12]), actions to offset emissions (e.g., reforestation) are required according to IDB Group environmental and social policies and sectorial international technical standards.

3.41 However, if these interventions are found incompatible with LTSs or NDCs, the

[10] This situation is likely to occur especially in water supply projects in isolated rural communities.
[11] Not required for reservoirs included in wastewater treatment systems.
[12] Considered carbon-intensive by European Investment Bank (2019).

operation cannot be considered PA mitigation aligned.

D. Opportunities to support the transition towards low GHG pathways

3.42 This section lays out some of the main approaches identified for the upstream support to the mitigation goals of the Paris Agreement in LAC.

3.43 **Align the sector with national and/or subnational CC targets**. Recognize interconnection between water and other sectors such as energy, waste, agriculture, and urban planning/buildings taking into account a territorial approach. Setting targets for water sector energy needs separate from other use categories can enable the formulation of clearer actions in the sector towards low-GHG pathways.

3.44 Develop a **nexus approach to water** at a community, territorial, national or catchment level. The Nexus approach is based on the need to describe and analyze the interdependencies that the water, energy and food sectors have with each other. The Nexus perspective allows a joint consideration of elements that have traditionally been treated separately (Embid & Martín, 2018) (if a water perspective is adopted, then food and energy systems are users of the resource).

3.45 This can identify opportunities for future low-GHG systems in the sector either at project or upstream planning scales. Nature-based solutions may be most appropriate for reducing the carbon footprint of water treatment, such as through investment in watershed protection as an alternative to traditional water treatment. The water-energy-food nexus can identify opportunities to reuse wastewater outputs as fertilizers, which can reduce energy-intensive fertilizer production and its associated methane emissions, or as a biofuel (in the case of dried sewage sludge).

3.46 **Water demand reduction strategies**: Household water consumption represents 11% - 15% of the total demand for drinking water, while industrial uses reach 15% - 19% of the total (Lentini, 2022). The promotion of water saving and efficiency measures (such as sensibilization actions, or strategies to promote behavior changes) can contribute to reducing water production, with the consequent energy savings.

3.47 Consider **regulatory advances in countries with strong mitigation commitments**: adapt project construction and operation to achieve more demanding objectives, matching requirements demanded by developed countries.

3.48 Integrate and regulate **new and innovative technologies** into system design: for example, encourage water companies to integrate network standards on water pressure and system leakage, as well as water monitoring components such as smart metering devices, to reduce usage and emissions associated with industrial water use and household water supply.

3.49 Tackle embodied carbon footprint in building materials (**scope 3 emissions**): Ensure that materials for W&S sector assets such as sewers and pipelines are considered as part of a mitigation strategy for the sector.

3.50 Promoting **Circular Economy of Water-based approaches and principles** might offer opportunities to mainstream both mitigation adaptation into Water and Nexus (or water-dependent) sectors. Explore means of resource recovery to reduce fossil fuel use and associated greenhouse gas emissions. For example, the recovery of thermal energy from drinking water distribution networks for non-consumptive uses such as industrial cooling, which relies on considerable amounts of electricity; the reuse of wastewater effluent for agriculture; the conversion of biosolids produced or collected during treatment into biogas, heat, and electricity; the energy recovery in solid waste final disposal facilities; the inclusion of prevention and recycling as key factors.

3.51 Assessment and accountability of water proofing from water-energy-agricultural systems, investments and their operation arise as another tool to guide both policy and investment planning to facilitate achievement of combined mitigation and adaption goals.

IV. Assessment of operations: alignment with the PA adaptation goal (BB2)

4.1 The evaluation of alignment with PA adaptation goal focuses on establishing whether the operation manages its climate vulnerability and risk[13] and is consistent with a climate-resilient development of the country. Specifically, it focuses on determining whether the long-term achievement of the operation's development objectives is vulnerable to the effects of climate change, and whether the activities are consistent with climate resilience trajectories defined at the national or subnational level. For this purpose, it focuses on three criteria:

a. **Criterion 1 – Climate risk and vulnerability context.** Determine if the operation is vulnerable to CC, identifying and evaluating its exposure to physical climate impacts. Depending on the type of operation, these may be impacts on assets, on the services it plans to provide, on human and natural systems, and/or on its beneficiaries. If the operation is considered to be at risk, it continues with Criterion 2. Operations with low or immaterial climate risk can skip Criterion 2 and go directly to Criterion 3.

b. **Criterion 2 – Definition of climate resilience measures**. Have climate adaptation and resilience measures been identified and incorporated into the operation to manage physical climate risks and/or to contribute to climate resilience?

c. **Criterion 3 – Does not contravene plans for climate resilience.** Depending on relevance and availability, consider policies, strategies, and plans at the territorial, local, national, or regional level, as well as community or private sector priorities. The operation should not be inconsistent with them.

4.2 In the case of the IDB and IDB Lab, the first two of the three criteria must follow what is established in the Bank's policies, in particular in IDB's Environmental and Social Policy Framework (ESPF), which, under the Environmental and Social Performance Standard 4 reinforces the resilience of projects to anticipate and avoid adverse impacts on the project itself in the face of natural disaster hazards and climate change during the project cycle. In these cases, the "Disaster and Climate Change Risk Assessment Methodology for IDB Projects" (DCCRA) will determine those instances where greater consideration of the physical impacts of climate change is necessary to ensure alignment of transportation projects. All projects complying with the DCCRA methodology will be considered aligned under the first two alignment criteria with the adaptation goal established by the MDBs. The third criterion will be applied in the formulation of the project in accordance with the provisions of the PAIA, identifying whether the operation is related to the national or subnational priorities of the country in terms of adaptation, and if so, how the planning efforts have been considered.

4.3 In the case of IDB Invest, the alignment in terms of the first two criteria will be done in accordance with the provisions of IDB Invest Environmental and Social Sustainability Policy (ESSP) and IDB Invest Climate Risk Assessment methodology (CRA).

4.4 Most of the works contemplated in the W&S sector improve human settlement resilience by design, since they are intended to improve the provision of basic services (reducing the vulnerability of the population to the effects of climate change), the environmental sanitation, and flooding risks mitigation. Nevertheless, their compatibility with national NDCs should be verified.

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13 The Disaster and Climate Change Risk Assessment Methodology for IDB projects (DCCRA) includes specific measures according to the type of infrastructure after evaluating the criticality.

A. Considerations for the assessment of alignment with the adaptation goal of the PA in the water and sanitation sector

4.5 **To ensure long-term alignment with adaptation goal of the PA, the Joint MDB framework advises on the importance of avoiding maladaptation.**[14] When factors of climate variability and change are incorrectly considered in project design, the results of investments are reduced or rendered ineffective due to external impacts that can be estimated and mitigated. The climate risk of an infrastructure system depends on the characteristics of its components and the severity of exposure to hazards. A summary of potential impacts of climate change on water supply and sanitation infrastructure is shown in Table 4.

Table 4 Potential impacts of climate change on water resources, water supply and sanitation infrastructure

Hazard	Potential Impacts on Water and Sanitation Infrastructure
Sea level rise	• Increased saline intrusion into coastal aquifers. • Increased salinity of brackish surface water sources. • Assets on the coasts or in floodplains may be at increased risk from flooding, storm damages, and coastal erosion. • Increased risk of operational impairment of outfalls, including reduced ability to discharge wastewater into coastal waters.
Warmer temperatures	• Increased glacial melting, decreased seasonal snowpack formation, and earlier spring snowmelt may alter summer flows in surface waters and summer levels in reservoirs. • Changes in watershed vegetation may alter the recharge of groundwater aquifers and change the quantity and quality of runoff into surface waters. • Increased evaporation in surface sources of water. • Increasing biological and chemical degradation of water quality. • Increased wildfire and pest risks in watershed areas. • Changes in watershed agricultural practices and in the resulting pollution loads from agriculture. • Increased frequency and/or intensity of droughts. • Increased operating challenges to biological and chemical processes of treatment facilities. • Increased temperatures and increased evaporation in receiving water bodies, changing chemical balances and increased eutrophication. • Reduced capacity to meet wastewater treatment requirements and standards.
More frequent or intense extreme weather events or both	• Increased turbidity and sedimentation of surface water, requiring more demanding treatment and time. • Changes in nature of rainfall pattern leading to inadequate infiltration and groundwater recharge resulting in reduced flow or yield of water, or both. • More frequent or intense flash floods, or both, damaging infrastructure and disrupting services. • Increased risk of direct flood damage to treatment plants, pumping and conveyance. Floodwaters can wash out open tanks and filter beds, damage mechanical equipment and electrical power and controls, contaminate the treatment process and water storage, and strew debris on the site. • Potential loss of reservoir storage as a result of increased erosion in watershed. • Increased loading of pathogenic bacteria and parasites in reservoirs. • Operational challenges to aquifer storage and recovery and water reclamation facilities. • More frequent overflow events of combined sewer systems. • Increased risk of untreated sewage overflows contaminating water supply sources. • Changes in quantity and quality of watershed runoff and in the resulting non-point source pollution loads to receiving waters. • Increased risk of landslide which may damage infrastructure.

14 Maladaptation refers to climate adaptation actions that increase current or future climate vulnerabilities within the boundaries of an operation, shift vulnerabilities from within the boundaries of an operation to an external/surrounding system (causing adverse effects on social, environmental, economic, or physical aspects of the system), or undermine sustainable development. Maladaptation occurs when an adaptation action undermines the coping capacities of existing systems, diminishes the capabilities of future generations to respond to climate vulnerabilities, or places a disproportionate burden for climate action on present-day or future external actors.

Hazard	Potential Impacts on Water and Sanitation Infrastructure
	• Strong winds and airborne debris can puncture elevated storage tanks, wellheads, break mechanical equipment, destroy buildings. • Flooding may threaten the containment of waste in landfills and dumpsites, and high winds can blow litter from landfills into surrounding communities and waterways, as well as damaging infrastructure and equipment. • Extreme rainfall events may overflow storm drains.
Changes in precipitation	• Reduced replenishment rates of groundwater resulting in declining water tables where net recharge rate is exceeded. • Reduced recharge rates of surface waters that can condition intake levels. • Drought can expose submerged parts to air. • Increased variability in hydraulic behaviors can cause deviation from design conditions in water and wastewater infrastructure. Drought creates low flows and influents with higher concentrations of pollutants; complicates treatment. Corrosive influents can damage equipment. A higher concentration of influents can result in less-effective disinfection. Lower flows in the receiving water bodies may worsen the situation.

Source: Adapted from UN-Habitat (2021).

4.6 The main vulnerabilities for each of the four typical categories of works financed by W&S are featured below.

4.7 **Water and Sanitation.** Because of their function within a water system, many components need to be near rivers, lakes, or coastlines. This means that components lie in floodplains and are thus vulnerable to floods. Examples are intakes for water treatment plants and entire wastewater treatment plants. Damage may be caused by inundation of the component, the force of fast-flowing water, or loss of service from other components, which results in supply interruptions due to water shortages.

4.8 The systems are also vulnerable to droughts that generally cause a reduction in water availability, leading to a reduction in the amount of water that a utility can deliver to users. This may be aggravated by competition for water across sectors, such as agriculture, the biggest consumer of water worldwide, but also energy generation, as well as the environment (for example, the need to maintain ecological flows) (Muñoz-Castillo et al, 2019).

4.9 Warmer temperatures are likely to increase water demand, and also produce higher evaporation rates from reservoirs, leading to water deficiencies.

4.10 Overexploitation of available water sources and transporting water over long distances to compensate for the problem is often a solution, but it is not sustainable in the long term and can lead to maladaptation situations. In the first case, the water supply may be compromised, leading to salinization of aquifers or loss of ecological flows in surface waters. In the second, the injection of water from a different basin can cause problems of high-water tables and increase the risk of flooding.

4.11 Droughts also cause localized impacts on individual components as well. For example, intakes may cease to be submerged if the water level drops below a given minimum elevation, affecting the performance of the raw water pumps, and possibly causing mechanical problems. Drought may lower groundwater levels so that well pumps operate inefficiently and suffer mechanical damage. The distribution network may also lose efficiency as the increased variability in hydraulic behavior deviates from design conditions. Pipes may suffer damage due to low water pressure (World Bank, 2020).

4.12 Droughts also harm wastewater treatment systems. For example, when water-conservation measures are imposed, flows to the wastewater treatment plant drop and influent contaminant concentrations increase. This can damage equipment, adversely affect the treatment process, raise treatment costs, and lower effluent quality (World Bank, 2020).

4.13 Hurricanes and strong winds also threat water and sanitation systems operation. The vulnerability of a water infrastructure component to these hazards depends on its exposure to high-velocity winds. An elevated water storage tank may collapse during high wind, whereas an underground tank may be unaffected. High winds can destroy buildings that house critical functions in treatment plants. Buried water lines, hydrants, and sewers will break if nearby buildings are destroyed. Chemicals and other supplies may be dispersed by wind. Wind-borne debris can damage various components.

4.14 **Drainage and Flood Control.** Flooding is the most common natural disaster in the world and comes in a variety of forms: coastal flooding, riverine flooding, flash floods, localized flooding caused by heavy rains, and river blockages caused by ice jams, which are expected to worsen in frequency and severity due to climate change, making drainage and flood control works essential measures to improve the resilience of human environments to these events.

4.15 However, given the high climate variability associated with climate change, these infrastructures might be at risk due to under-sizing. Designs based on historical records, in most cases, might no longer be adequate.

4.16 Besides, traditional gray infrastructure solutions are cost intensive and often harm the relationship of vulnerable communities with their city and with nature or transfer the risk to peri-urban or rural hinterland residents, leading to maladaptation situations.

4.17 Sea walls, river barrages, and other traditional grey infrastructure solutions may be required in some cities, and can even enhance urban life through multifunctional design, but this should be achieved through a careful assessment of climate risks exacerbation for neighboring communities.

4.18 **Solid Waste Management.** An increased incidence of flooding, landslides or inundation may threaten the containment of waste in recovery and disposal facilities, and high winds can, for instance, blow litter from landfills into surrounding communities and waterways, as well as damaging infrastructure and equipment.

4.19 Extreme weather events can also generate waste themselves through the destruction of property and infrastructure, generating larger volumes for final disposal, which may shorten the useful life of the management and treatment facilities.

4.20 Additionally, the dispersion of waste caused by extreme weather events pose risks to the terrestrial and aquatic environment and are likely to have negative impacts on neighboring communities or the lives and livelihoods of socially excluded groups working in landfills and dumpsites. It can also lead to the clogging of drainage systems and increase the frequency and intensity of flood events.

4.21 It is necessary to ensure that sensitive or critical facilities are not built-in areas of high climate hazards, where the negative impacts or externalities of a shock intersect with vulnerable communities. This is achieved in the waste sector by restricting the construction of management facilities in locations susceptible to hazards, which may cause groundwater contamination for local communities and impact surrounding ecosystems.

4.22 In summary, the main adaptation options related to solid waste include protecting critical infrastructure, reducing the needs of disposal facilities through recycling, as well as taking particular care in the proper siting of these facilities to minimize their vulnerability, and requiring waste treatment facilities to prepare adaptation plans.

4.23 **Water Resources Management**. When not accurately assessed, water resources management interventions can lead to flood risk, impacts on water security driven either by both water quality and water quantity impacts, increasing in some case competition for scarce resources if not well planned. Wetland construction or other aquifer recharge structures intended to protect water resources (for example, to prevent saline intrusion) have the potential to increase flood risks due to rising water tables.

4.24 The promotion of planning according to IWRM principles, including holistic Water Security Plans at several scales (national, basin, municipal) which includes specific drought and flood management systems, investments in NBSs to protect water sources, integrated approaches for cross-sector coordinated planning as the WEF Nexus or the inclusion of Circular Economy of Water principles into planning; provide an opportunity for resilient and adaptive water management and to avoid maladaptation on Bank's Water and Sanitation portfolio.

B. Opportunities to help transition towards climate-resilient trajectories

4.25 The main approaches identified for this purpose are the following:

4.26 Ensuring long-term flexibility in terms of adaptable water, wastewater, and solid waste infrastructure, management solutions, governance structures and policy instruments. Specifically, Climate Resilient Water Security Plans can help ensure water for human consumption.

4.27 Account for system redundancies in system design to increase resilience. Ensure that infrastructure can be delivered by alternate means if climate hazards disrupt the primary source.

4.28 Modifying operating regimes according to context-specific climate conditions and environmental factors (as defined at the planning stage and informed by a feasibility study) will enhance resilience of the local environment and contribute to longer term investment returns.

4.29 Identifying and inducing multiple (co-)benefits, including GHG mitigation effects, as well as benefits in terms of biodiversity and sustainable socio-economic development. Approaches as Ecosystem-based Adaptation (EbA) and other Nature-based Solutions are proven to be useful. Nature-based solutions can safeguard infrastructure function against threats from increasing climate hazards and reduce the frequency and cost of required maintenance.

4.30 Water demand reduction strategies: The promotion of water saving and efficiency measures (such as sensibilization actions, or strategies to promote behavior changes) can reduce the pressure on water resources, thus increasing water supply systems resilience.

4.31 Reuse of treated wastewater to increase resilience against water scarcity. Reuse for agricultural irrigation has been practiced for decades. Treated wastewater of adequate quality can also be used to recharge groundwater or surface water resources or for industrial purposes.

4.32 Involving adaptive governance approaches that include mechanisms for regular review and learning in order to adapt selected solutions to potentially changing conditions.

4.33 Ensuring alignment with national, subnational and/or sectoral climate priorities, strategies, plans and overall development objectives.

4.34 Considering potentially negative effects on other sectors, societal groups, neighboring communities, or states, and taking a basin-wide perspective, as appropriate.

4.35 Considering gender aspects and the needs of vulnerable communities and ecosystems.

4.36 Provide forums for participatory stakeholder consultation: Local adaptive capacity can be enhanced by creating responsive and inclusive, gender-responsive venues for stakeholder participation. Residents have experience coping with climate hazards in the local context.

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