TC Document

I. Basic Information for TC

▪ Country/Region:	REGIONAL
▪ TC Name:	Support to Water Resources and Environmental Management through remote sensing and digital twins technology
▪ TC Number:	RG-T4702
▪ Team Leader/Members:	Nalesso, Mauro (INE/WSA) Team Leader; Blanco Blanco, Andres Guillermo (INE/WSA) Alternate Team Leader; Garcia Cortessi, Leonardo (GPS/REM); Moreno Moreno, Henry Alberto (INE/WSA); Cruz Moreno, Paula Melisa (INE/TSP); Bonilla Merino, Arturo Francisco (LEG/SGO); Escudero Miranda Tatiana Monica (GPS/EUR); Rodriguez Ramirez, Fabian Andres (INE/WSA); Rubio Fernandez, Eva (TTD/TTR); Moreno Montoya, Nicolas (GPS/GCM); Guichon, Matias (INE/WSA); Cuenca Mora Fernando Manuel (INE/TSP); Romero Burgos Maria Fernanda (INE/WSA); Sanchez Greer Rilla May (INE/WSA) Team Leader; Blanco Blanco, Andres Guillermo (INE/WSA) Alternate Team Leader; Garcia Cortessi, Leonardo (GPS/REM); Moreno Moreno, Henry Alberto (INE/WSA); Cruz Moreno, Paula Melisa (INE/TSP); Bonilla Merino, Arturo Francisco (LEG/SGO); Escudero Miranda Tatiana Monica (GPS/EUR); Rodriguez Ramirez, Fabian Andres (INE/WSA); Rubio Fernandez, Eva (TTD/TTR); Moreno Montoya, Nicolas (GPS/GCM); Guichon, Matias (INE/WSA); Cuenca Mora Fernando Manuel (INE/TSP); Romero Burgos Maria Fernanda (INE/WSA); Sanchez Greer Rilla May (INE/WSA)
▪ Taxonomy:	Client Support
▪ Operation Supported by the TC:	
▪ Date of TC Abstract authorization:	
▪ Beneficiary:	COBINABE (Argentina, Bolivia) & MADES, MOPC (Paraguay)
▪ Executing Agency and contact name:	Inter-American Development Bank
▪ Donors providing funding:	Project Specific Contribution Account(PSC)
▪ IDB Funding Requested[1]:	US$944,690.00
▪ Local counterpart funding, if any:	US$0
▪ Disbursement period (which includes Execution period):	30 months
▪ Required start date:	November 2025
▪ Types of consultants:	Individuals; Firms
▪ Prepared by Unit:	INE/WSA-Water & Sanitation
▪ Unit of Disbursement Responsibility:	INE/WSA-Water & Sanitation
▪ TC included in Country Strategy (y/n):	Si
▪ TC included in CPD (y/n):	No

[1] On March 29 of 2025 The Government of Slovenia committed EUR$1,250,000, equivalent to USD$1,261,419.16 (exchange rate: 0.9414, per FIN Department FX Exchange Report). Of this amount, EUR$620,348.98 (USD$658,999.87) was allocated to operation RG-T4702, with USD$32,949.99 set aside as a 5% administration fee, leaving USD$626,049.88 for the operation's budget. On October 10th of 2026 the Government of Slovenia increased its contribution by EUR$300,000, bringing the total to EUR$1,550,000. For operation RG-T4702, the allocation increased to EUR$905,348.98. Based on the adjusted exchange rate of 1.097, this equals USD$994,410. After deducting the 5% administration fee of USD$49,720, the revised budget for the operation is USD$944,690.

▪ Alignment to the Update to the Institutional Strategy 2024-2030:	Sustainable, resilient, and inclusive infrastructure; Supports sustainable economic growth; Institutional capacity, rule of law, and citizen security; Public sector policy and management

II. Objectives and Justification of the TC

2.1 The objective of this TC is to support water resources and environmental management and planning through the application of innovative services based on remote sensing[2] and digital twins[3] with the purpose of improving institutional capacities for climate adaptation, water resources management, preparedness, and mitigation Argentina, Bolivia, Colombia and Paraguay and to generate information to support IDB operational departments in technical activities that ensure water security and to guarantee that projects and investments meet their operational, financial and economic goals.

2.2 This TC will develop two pilot projects focused on water resources management and environmental monitoring in key river basins. The first pilot will be implemented in the Bermejo River, a transboundary system shared by Argentina and Bolivia, with an important impact in the Paraguay River. These projects will be carried out in collaboration with relevant regional institutions. For the Bermejo River, the initiative will be developed in partnership with the Corporación Binacional del Río Bermejo y Tarija Grande (COBINABE) for Bolivia and Argentina, and the Ministerio de Obras Públicas y Comunicaciones (MOPC) and Ministerio del Ambiente y Desarrollo Sostenible (MADES) from Paraguay, and with participation of the Administración Nacional de Navegación y Puertos (ANNP) and the Centro de Armadores Fluviales y Maritimos (CAFyM) from Partaguay to enhance sustainable water resource management and promote data-driven decision-making for ecosystem resilience and fluvial transport and community development. The second pilot will be implemented on a prioritized subbasin of the Magdalena River and will be focused on establishing a system to analyze environmental parameters to study the effects of human activities and climate effects on the natural environment of the most important river for Colombia. This project will be developed with the collaboration of the Corporación Autónoma del Río Grande de la Magdalena (Cormagdalena) and the resulting model will become part of the monitoring system of the Magdalena Cauca Sustainable Management Plan, that already has the IDB Tool, HydroBID as a monitoring tool for hydroclimatic variables.

2.3 The Regional Autonomous Corporation of the Grande de la Magdalena River – CORMAGDALENA was created by Article 331 of the Political Constitution as a special corporate entity of national order with administrative, budgetary, and financial autonomy, endowed with its own legal personality. It will operate as an Industrial and Commercial State Enterprise, subject to the rules governing Joint-Stock Companies, except as provided in this Law. Article 1 of Law 161 of 1994.

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[2] Remote sensing is the science of collect information about objects or areas without direct physical contact. This information is obtained remotely, usually from platforms such as satellites or aircraft.

[3] A digital twin is a virtual representation of a real-world object, system, or process, designed to mimic its behavior and characteristics using real-time data. These virtual models are used to simulate, analyze, and optimize the performance of their physical counterparts, enabling informed decision-making and improving efficiency

2.4 COBINABE was created in 1995 to establish a permanent legal and technical mechanism responsible for the administration of the Upper Bermejo River Basin and the Tarija River Basin. This mechanism will promote the sustainable development of its area of influence, optimize the use of its natural resources, create jobs, attract investment, and enable the rational and equitable management of water resources. COBINABE's objectives include promoting binational action to contribute to the comprehensive development of the basin and the quality of life of its inhabitants; strengthening institutions and enhancing the skills and capabilities of its residents; improving water use and management; preserving water quality; designing, installing, operating, and maintaining a network of hydrometeorological stations; and seeking financing for the execution of works and programs under its jurisdiction.

2.5 Data is a crucial element to assess water availability and demand, understand the sediment dynamics as well as evaluating the impact of extreme events (such as droughts and floods) and other activities that will have an impact on water resources. Unfortunately, local data availability is one of the main issues in the region and for that reason it is important to introduce innovative approaches that allow the access of the data required to create information to analyze and evaluate processes on watersheds. In the last years Satellites are becoming critical for understanding and addressing environmental issues like climate change, deforestation, contamination, sediment transport and other environmental issues. In this matter using satellite data and machine learning Digital twins can be developed with the purpose of monitoring, forecasting and assessing areas with low or non-existing local data, providing invaluable information to support decision making.

2.6 The products of this TC will support the activities of the HydroBID Support Center of the IDB (CeSH) dedicated to improving data collection, management, distribution and use in Latin America and the Caribbean. The HydroBID Support Center was created in 2016 through a PSG from Pepsico Foundation (ATM/CF-15895-RG).

2.7 Since 2016, through several technical cooperations, CeSH has supported the preparation and execution of 38 operations in 14 countries. These investment programs total US$5,097,000,000. CeSH has invested approximately US $5,700,000 in operational support to many IDB sectors, like Energy (ENE), Housing and Urban Development (HUD), Rural Development and Disaster Risk Management (RND). Since its creation, HydroBID tools and services have been implemented and technologically transferred to 23 of the IDB's borrowing countries. In addition, more than 150 agencies and 15 academic and research institutions have joined the HydroBID Community of Practice.

2.8 This TC aligns closely with the IDB Group Institutional Strategy: Transforming for Scale and Impact (CA-631), particularly in the following objectives: (i) reduce poverty and inequality because it strengthens institutional capacities in LAC to ensure equitable access to water resources, reducing vulnerabilities among marginalized communities and it promotes inclusive decision-making processes by empowering national and local governments with data-driven insights for WRM; (ii) address climate change because it directly contributes to climate adaptation efforts by improving preparedness, mitigation strategies, and resilience and it

supports IDB's commitment to climate finance, integrating climate risk considerations into water resources management planning by enhancing the use of advanced technologies and data analytics to support climate-smart investments and it supports the development and deployment of digital tools, fostering technology adoption and innovation in WRM; and (iii) bolster sustainable regional growth by facilitating regional cooperation by standardizing methodologies for water and environmental management, particularly in transboundary basins and strengthens economic resilience by supporting activities that will guide to efficient water allocation, critical for agriculture, energy, and industrial sectors;. The Program is also aligned with the operational focus area(s) of: (i) biodiversity, natural capital and climate action; (iii) institutional capacity, rule of law, and citizen security; (vi) sustainable, resilient, and inclusive infrastructure; and (vii) regional integration.

2.9 This TC aligns with the country strategy of Argentina (GN-3288-1) on investing in the crosscutting issues of environmental and climate sustainability through actions to generate and transfer knowledge, strengthen capacities, and promote innovation. Alings with the country strategy of Paraguay (GN-3261-3) on supporting priorities like water resources and climate effects by improving the capacity of the productive sector to adapt to the negative impacts of climate change and supporting adaptation measures. The TC is also aligned to the country strategy of Bolivia (GN-L3088) by supporting the crosscutting issues of climate change, environmental sustainability, and institutional capacity investing in a strategic and targeted management of ecosystems, that can be an effective means of enhancing resilience to many natural risks. The TC is also aligned with the country strategy of Colombia (GN-3238-3) by supporting priorities like improving capacities of agencies with innovation, modernization and sophistication and the transversal areas of Protect biodiversity, and climate resilience and adaptation.

III. Description of activities/components and budget

3.1 **Component 1: Application of Digital Twins and Remote Sensing for Hydric Monitoring in Pilot Projects.** This program will finance the implementation of digital twins and remote sensing analysis in strategic river basins, aiming to assess the impact of human, climatic, and environmental factors on hydric dynamics. The focus includes mass movements, sediment transport, and water security, supporting data-driven decision-making for sustainable water management. By integrating advanced technologies, the initiative seeks to enhance monitoring capabilities and improve hydric resource resilience in targeted regions.

3.2 Selected river basins face diverse climatic and environmental challenges, including water deficits, erosion processes, and impacts from human activities and climate change. The pilot will leverage digital twins to improve planning, water resource management, and environmental monitoring, ensuring more resilient hydric systems. The application of remote sensing will further enable real-time data

collection, allowing for proactive measures in ecosystem preservation and hydric sustainability.

3.3 Potential Pilot Basins were selected on a previous process based on relevance of the problem for the region, relevance for the Bank, and relevance for the donor and interest from the recipients' agencies. After this process two first pilot basins were selected on the following order: The Bermejo River Basin (Argentina and Bolivia) and the Magdalena-Cauca River Basin (Colombia).

3.4 The first pilot project will be implemented in the Bermejo River Basin, situated in southern South America and covering an area of 123,000 km². This watershed originates in the Andes Mountains of northwestern Argentina and southern Bolivia, and it holds significant geopolitical and economic importance due to its diverse natural resources and a population of 1.33 million inhabitants. The basin faces climatic variations, including water deficits and a high potential for erosion and sediment transport, issues that are intensified by human activities and climate change. The Bermejo River is strategically divided into two hydrographic zones: the upper basin, which is the transboundary portion, and the lower basin, which includes the confluence with the Paraguay River.

3.5 The project will have 2 main focuses; the first one is to complement the understanding of the hydrodynamics of both hydrographic zones. The upper basin is part of a technical cooperation (RG-T4082) that uses the HydroBID suite of model to develop a planning and decision-making tool for the COBINABE that will be used to prioritize infrastructure investments. This TC will develop a digital twin of the entire watershed to generate data and information not available on local monitoring stations like sediment transport and contamination that will complement the data used on the decision support system (DSS) and allow the extension of the DSS to the entire basin. Data from the Digital Twin will cover the area of the lower basin complementing the data of the Upper Basin, modeled with HydroBID. The second focus will be specifically on determining and forecasting the amount of sediment that from the Bermejo River is getting to the Paraguay River. The sediment of the Bermejo River is a major problem for the navigation in the Paraguay River and cost millions of dollars due to the impossibility of barges and ships to move from Paraguay and Brazil to the sea especially on the dry season. Only this year more the 400 barges and ships were unable to navigate the Paraguay River only in February[4].

3.6 The second pilot project will be implemented in a prioritized subbasin of the Magdalena River to assess the effects of human activities, climate change, and environmental factors on mass movement, sediment transport, and the potential

[4] https://www.mundomaritimo.cl/noticias/mas-de-400-barcazas-y-naves-de-diverso-tipo-se-ven-impedidas- de-navegar-en-el-rio-paraguay

impacts on wetlands that hold significant environmental and local economic value. The Magdalena River is one of Colombia's primary rivers, flowing through 11 departments: Magdalena, Atlántico, Bolívar, Cesar, Antioquía, Santander, Boyacá, Cundinamarca, Caldas, Tolima, and Huila, covering 24% of the national territory. As the main river artery of Colombia, the Magdalena encompasses a rich diversity of ecosystems, supports 80% of the country's population, and contributes 85% of the national Gross Domestic Product.

3.7 The Regional Autonomous Corporation of the Magdalena River (CORMAGDALENA) aims to "recover navigation and port activities, adapt and conserve land, generate and distribute energy, and ensure the sustainable use and preservation of the environment, fish resources, and other renewable resources." According to the 2018- 2022 National Development Plan, “Pact for Colombia, Pact for Equity,” CORMAGDALENA is tasked with the formulation, adoption, and implementation of a general plan to achieve its objectives, with a focus on the navigable channel.

3.8 To promote the development of intermodal transport along the river and ensure the sustainable development of the communities within the basin, the Ministry of Transport has requested support for CORMAGDALENA in activities related to hydrological planning and comprehensive management. This support will help generate information and knowledge about the conditions affecting the quantity and quality of the navigable waters of the river, ultimately benefiting the overall state of the basin. The model will enhance understanding of the impacts of human activities and climate change on Magdalena's wetlands, promoting science-based decision-making in support of the Sustainable Management Plan for the Watershed, which CORMAGDALENA is responsible for monitoring.

3.9 **Component 2: Knowledge and Dissemination**. component will finance all activities and consultants related to knowledge and dissemination efforts, including technology transfer to related agencies, workshops, training, and the dissemination of events and products. Socialization events are planned among the various agencies involved in the process to foster better communication and facilitate the interaction and exchange of information and experiences. Publication and dissemination of materials on the results of the implementation of the pilots will also be developed.

Indicative Budget

Activity /Component	Description	Total Funding (IDB)
Component 1	Application of Digital Twins and Remote Sensing for Hydric Monitoring	$855,000.00

Component 2	Knowledge and Dissemination	$89,690.00
	Total	**$944,690.00**

3.10 The Government of Slovenia expects to commit EUR 905,348.98, equivalent to USD 994,410. Out of this amount, USD 49,720 will be set aside as a 5% administration fee. The remaining contribution of USD 944,690 corresponds to the project amount, based on the exchange rate of 1.097. Final resources in US dollars will depend on the exchange rate on the date when the resources are received by the Bank and converted into US dollars. If a significant adverse fluctuation in the exchange rate reduces the amount of US dollars in this budget and such amount cannot be covered by the contingency line, the project activities will be decreased appropriately, and the budget will be adjusted accordingly by the project team.

3.11 Resources of this project to be received from The Government of the Republic of Slovenia through a Project Specific Grant (PSG). A PSG is administered by the Bank according to the “Report on COFABS, Ad-Hocs and CLFGS and a Proposal to Unify Them as Project Specific Grants (PSGs)” (Document SC-114). As contemplated in these procedures, the commitment by The Government of the Republic of Slovenia will be established through a separate Administration Agreement.

IV. Executing agency and execution structure

4.1 This This implementation of TC will be carried out by the Bank, in accordance with Appendix II of the Operational Guidelines for Processing Technical Cooperation (OP-619-4), as requested by the beneficiary entities, as they lack the necessary operational capacity to duly and timely execute the activities provided in the respective project and because compliance with internal requirements would delay the execution of the TC jeopardizing achievement of its objectives. The Water and Sanitation Division (INE/WSA) will be responsible for the execution of this TC.

4.2 We are currently coordinating the letters of interest from the beneficiaries' governments, so far receiving the one from Argentina. We are also in the process of obtaining letters from Bolivia, Paraguay, and Colombia, anticipating their receipt by the first quarter of 2026.

4.3 This TC is based on the activities of the CeSH, an IDB regional initiative, that has been providing innovative solutions, technical support and technology transfer to the borrowing countries and bank operations since 2016 through internal support (specialist and consultants), technical partners and members of the HydroBID community of practice. For this reason, and as requested by the participant agencies, this TC will be executed by the IDB through the Water and Sanitation Division (INE/WSA) since the IDB has the necessary technical expertise in applying and providing technical support in collaboration with the country sector specialists and its offices. The overhead costs include travel expenses for IDB staff. All program documents and records, particularly those that support financial management, will be kept by INE/WSA. These documents and records will be sufficient to: (i) support activities, decisions and transactions related to the program, including all expenses incurred; and (ii) substantiate the correlation

between expenses incurred and expenses charged to the program resources. It should all be noted that letters from the countries that will benefit from this TC will be obtained in due course.

4.4 This TC is based on the activities of the CeSH, an IDB regional initiative, that has been providing innovative solutions, technical support and technology transfer to the borrowing countries and bank operations since 2016 through internal support (specialist and consultants), technical partners and members of the HydroBID community of practice. For this reason, and as requested by the participant agencies, this TC will be executed by the IDB through the Water and Sanitation Division (INE/WSA) since the IDB has the necessary technical expertise in applying and providing technical support in collaboration with the country sector specialists and its offices. The overhead costs include travel expenses for IDB staff. All program documents and records, particularly those that support financial management, will be kept by INE/WSA. These documents and records will be sufficient to: (i) support activities, decisions and transactions related to the program, including all expenses incurred; and (ii) substantiate the correlation between expenses incurred and expenses charged to the program resources. All It should be noted that letters from the countries that will benefit from this TC will be obtained in due course.

4.5 The technical activities related to the service offerings and applications of the pilots will be developed by the Slovenian Centre of Excellence for Space Sciences and Technologies Space-SI, through a single source selection. Space-SI, established in 2010 by a consortium of academic institutions, high-tech SMEs and large industrial and insurance companies to benefit from the advantages of small satellite technologies and applications in Earth observation, meteorology and astrophysics. The RTD activities of SPACE-SI focused on high resolution interactive remote sensing and formation flying missions are an innovative service for which they have unique experience and technical capabilities necessary to fulfill the proposed activities, and consequently their support to the beneficiaries' agencies.

4.6 The knowledge products generated from Bank-executed activities within this technical cooperation will be the property of the Bank and may be made available to the public under a creative commons license. However, at the request of the beneficiaries, in accordance with the provisions of AM-331, the intellectual property of said products may also be licensed through specific contractual commitments that shall be prepared with the advice of the Legal Department.

4.7 The execution and disbursement period will be 30 months.

4.8 The project team will be responsible for the preparation and submission to the donor of the project reporting, in compliance with the stipulations of the Administration Agreement.

V. Major issues

5.1 One risk associated with the implementation of this TC could be the lack of capacities in local agencies to use innovative technology.

5.2 To mitigate this risk, the IDB will work with the related agencies and the CeSH to guarantee that local agencies and institutions receive the training to ensure that sufficient technical resources are available to meet the technological requirements.

5.3 Another risk is related to the sustainability of the main products. To mitigate this risk the project Is relying on the technical teams of COBINABE and CORMAGDALENA that are not affected by any political change that may occur during the development of the project.

5.4 The Bank will own the intellectual property rights of the products and deliverables financed by this TC.

VI. Exceptions to Bank policy

6.1 This TC does not involve any exceptions to the Bank's Policies.

VII. Environmental and Social Aspects

7.1 This Technical Cooperation is not intended to finance pre-feasibility or feasibility studies of specific investment projects or environmental and social studies associated with them; therefore, this TC does not have applicable requirements of the Bank's Environmental and Social Policy Framework (ESPF).

Required Annexes:

Request from the Client_54040.pdf

Results Matrix_5694.pdf

Terms of Reference_64419.pdf

Procurement Plan_25425.pdf