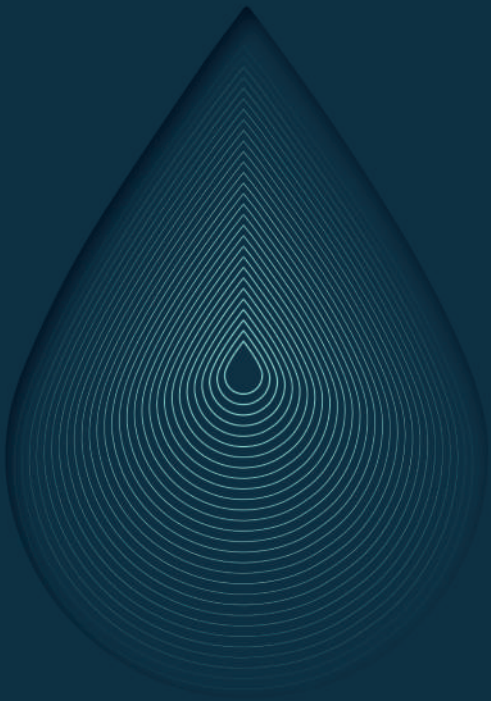


Water Adaptation Plan

2024

BA Infraestructura

Water Adaptation Plan

2024

Head of Government
Jorge Macri

Deputy Head of Government
Clara Muzzio

Minister of Infrastructure
Pablo Bereciartua

Prologue

"We never know the worth of water
till the well is dry"."
English Proverb

Since ancient times, water has been considered the principle of life. That is why the first societies were born on the shores of the sea or waterways. Today, with urban development, we seem to have lost sightof the fact that it is a valuable and limited resource, which we have to take care of and preserve.

Buenos Aires is a global city that was born, grew and flourished on two coasts: that of the Río de la Plata river and that of the Matanza Riachuelo river. That was where our porteña Buenos Aires identity saw the light. But that city that arose looking at the river, for a long time turned its back on it. That is why we want to recover that view and change our relationship with water by building new habits of care and respect for nature. We have a great power of transformation that we can use to be resilient and respond to the challenges brought to us by the consequences of climate change.

That is why, for 16 years, we have been working on a comprehensive environmental policy that invests in public space to address climate implications, mitigate flood risks and rebuild the neighbor's bond with nature. Through the Hydraulic Plan, we already have 83 km of spillways and conduits that drain and channel the waters of intense rains, in less time. We also recovered more than 17 hectares of coastline between Carrasco Park and Costa Salguero, and we continue to make progress in the sanitation of the Riachuelo. Today the flora and fauna are returning, and the neighbors can sail and discover Buenos Aires from another dimension.

With this Water Adaptation Plan we take a further step in our objective of recovering the relationship of each person with water. And we do so convinced that it is part of our commitment to take care of the environment, while being co-responsible in the use, conservation and saving of this vital resource for us and for the future of the entire planet.

Jorge Macri
Head of Government

Prologue II

People have a fascination for water. As we know, the origin of life on our planet took place in water. That life that we try to protect and multiply every day began, millions of years ago, in water. Also that of each one of us. Water is the first medium we inhabit.

Water is also an extraordinary resource. Not only because of its infinite richness, much of it still unexplored, but because of what human beings learned to do with it. It is a source of energy and growth: perhaps the greatest leap that has been made in recent centuries, with the steam engine that drove the Industrial Revolution.

But water also can be an issue. For the porteños, the images of great and dramatic floods became customary for many years. Since 2007, the City has faced the problem in a structural way, moving forward with long-term works that are often not seen and whose effects take time to appear, but which are necessary to ensure the economic development of the City.

Today, those images are part of the past. Our commitment is to provide the conditions in which it is possible to have contact with a friendly natural environment, which does not represent a threat and is easily accessible. Buenos Aires is ideally placed to build a healthy relationship with such a valuable resource. This Water Adaptation Plan is designed so that thousands of Buenos Aires residents, the porteños, can have a lifestyle in the City that they previously sought elsewhere. To once again look at our shores with pride.

Clara Muzzio
Deputy Head of Government

Preface

Adaptation as a priority

Building cities that protect and improve the lives of our neighbors.

The climate of our city has been showing significant changes over the past 60 years regarding the increase in average temperature and precipitation. These changes imply a greater frequency and intensity of extreme weather events, such as heatwaves, southeasterly winds (sudestadas), extreme rainfall, among others. Likewise, climate projections for the remainder of the 21st century indicate that the observed changes will tend to deepen and that these trends cannot be reversed in the short and medium term.

We are facing unprecedented demographic, environmental, economic, social, and spatial challenges, and our City must adapt because beyond mitigation actions, the repercussions of the climate are part of the current reality.

Adaptation is essential. That is why we are working to make the City a place that protects and improves the lives of all its residents, leaving no one behind. In this context, this Water Adaptation Plan arises from the evidence that 90% of natural disasters originate from water; therefore, it is a challenge to address in order to achieve the sustainable and resilient development of our city.

The plan has its origin in the work of co-creation and co-design of an adaptation plan focused on improving the relationship between people and water carried out within the framework of the KBH-BA Strategic Cooperation Agreement: Adaptation to Climate Change (2020-2023) between the City of Buenos Aires and the City of Copenhagen. Based on this background, this plan aims to recover the relationship between neighbors and water; a relationship centered on respect for nature and accessible, equitable and inclusive enjoyment. Today, sustainable life needs health and dignity, and health and dignity need water and development. Water is a limited good, whose quantity on the planet is constant, but whose availability depends only on our ability to manage it and, above all, on the responsibility of all.

The main principles taken into consideration for this Water Adaptation Plan are, on one hand, Integrated Water Resources Management understood as a process that promotes the coordinated management and development of water, land, and related resources, in order to maximize the resulting social and economic well-being equitably without compromising the sustainability of vital ecosystems. In this sense, the Plan has a comprehensive vision focused on respect for nature, the care and protection of coasts, enjoyment, and resilience. On the other hand, planning with a Watershed Unit perspective and the implementation of non-structural measures for the prevention, mitigation of water-related contingencies, and infrastructure adaptation.

Based on these precepts, the Plan proposes hydraulic solutions aimed at achieving three objectives that seek to address the challenges of adapting to climate change, watercourse pollution, and the limited relationship with water. Those objectives are:

- Reduce the risk of flooding to make a safe city.
- Improve water quality to develop a more attractive city in terms of recreation.
- Promote a cultural change associated with the responsible use of water, which allows for a better and stronger relationship with water.

The first objective involves the review of the Hydraulic Plan to adapt it to climate change, which is likely to cause greater intensity and frequency of rains, as well as unexpected rises in the level of the Río de la Plata. The second objective involves addressing the pollution of the watercourses that flow through pipes beneath the City, generating a potential risk to health, hindering recreational activities, and increasing the treatment costs for water purification. Finally, the last purpose of the Plan calls for a shift in culture and behavior that will enable the restoration and recovery of a positive and meaningful connection with water.

In summary, the Adaptation Plan involves improving the efficiency of the water system and the quality of freshwater, adapting existing and new infrastructures to the adverse effects of climate change, diversifying water sources (including reusing and recycling water), and incorporating nature-based solutions that offer natural protection against floods and southeast winds (sudestadas).

Adapting does not mean eliminating all risks. However, this Adaptation Plan, based on a risk and vulnerability analysis with a territorial approach, constitutes a tool to minimize those risks, reducing vulnerability and ensuring that our city is better prepared to face threats.

Water-related adaptation is fundamental for strengthening economies, livelihoods, and natural ecosystems, hence the need to develop and present this Plan as a contribution to the development of our City.

Pablo Bereciartua
Minister of Infrastructure

Index

Vision and Objectives

Our intention is to recover the relationship between people and water in the City, **centered on respect for nature and accessible, equitable and inclusive enjoyment**.

Vision

The City's Water Adaptation Plan is part of a comprehensive vision for water and people. Our vision is to reclaim the relationship between people and water in the City, centered on respect for nature, enjoyment and resilience.

We understand that beliefs and habits should form the basis of a way of relating to nature and climate based on respect and awareness of the transformative power of the human species.

Likewise, as we feel part of nature, we must also develop resilience to be able to respond to the challenge of floods, which are one of the main natural hazards to the city.

Objectives

The Plan describes the hydraulic solutions for adaptation to climate change aimed at achieving three objectives: reducing the risk of flooding; improving water quality; and promoting a cultural change associated with the responsible use of water and the care of water resources.

To this end, the City will integrate these objectives in all areas of government with powers in the planning and development of the City, such as land use planning, mobility, public space and education.

Reduce the risk of flooding to make the city safe.

Improve water quality to develop a more attractive city.

Promote a cultural change that allows for a better and stronger relationship with water.

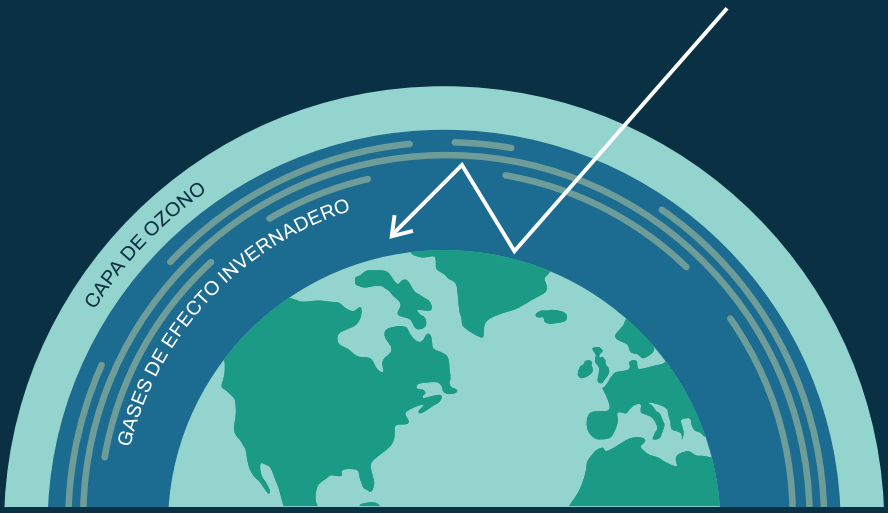
Challenges

To achieve the goals of reducing flood risks, creating a more attractive city, and increasing enjoyment of water, the City must address a number of key challenges:

Need to adapt to climate change

Pollution of water bodies

Limited relationship with water



The need to adapt to climate change

The Buenos Aires Water Plan prescribes a combination of solutions to manage storms for a recurrence period of at least 10 years. Climate change is expected to result in higher rainfall intensity and frequency in Buenos Aires, as well as a rise in the level of the Rio del Plata river, and more severe south storm surges (sudestadas). This means that the Hydraulic Plan must adapt to climate change.

Chapter 3 describes the projections associated with climate change and how to adapt the water plan.

The need to adapt to more intense storms and more severe rainfall events and sudestadas provides an opportunity to raise awareness of water risks in the city. Improving infrastructure to reduce flood risk also contributes to creating a greener and more attractive city by, for example, incorporating nature-based solutions that complement each other to achieve the objectives more effectively.

Chapter 4 discusses these solutions as a whole.

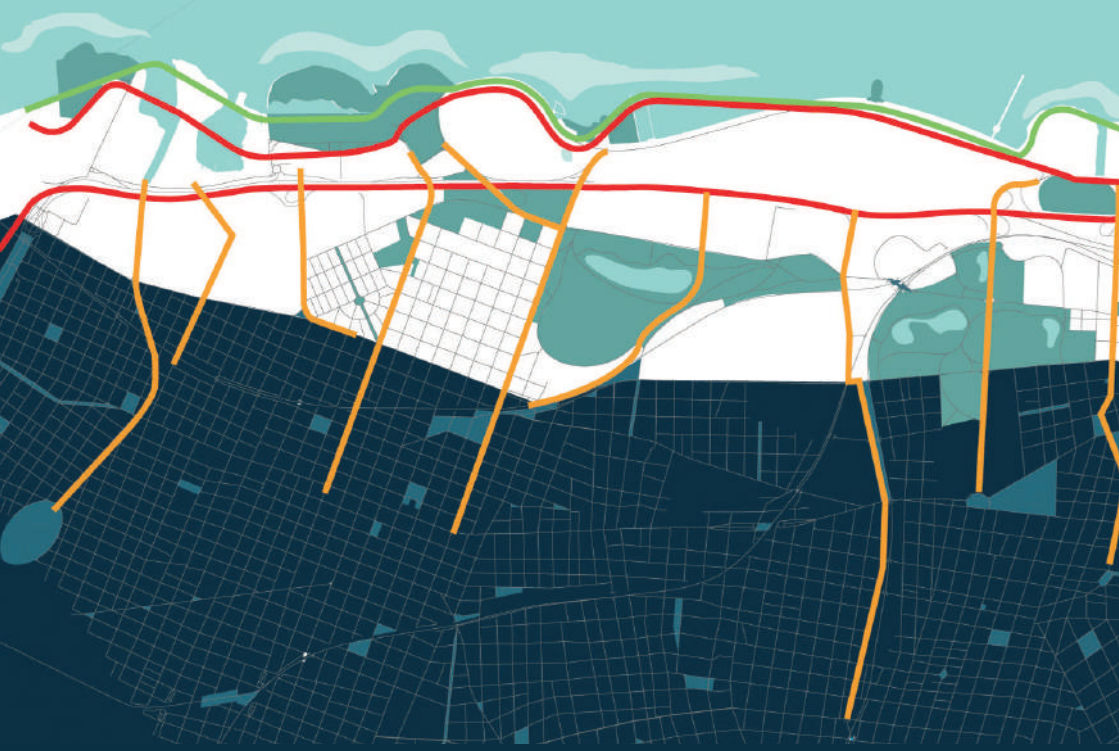
Water quality in the Río de la Plata River

Source: EIA Construction and operation phase of the Aº Vega Basin Hydraulic Works.

Contamination of water bodies

Both the Río de la Plata river and the numerous watercourses that run through pipes under the city are polluted. They pose a potential health risk, impeding bathing and recreation and increasing treatment costs for drinking water purification. Consequently, the City will need to address the contamination of water bodies.

Chapter 6 addresses the challenge of pollution.



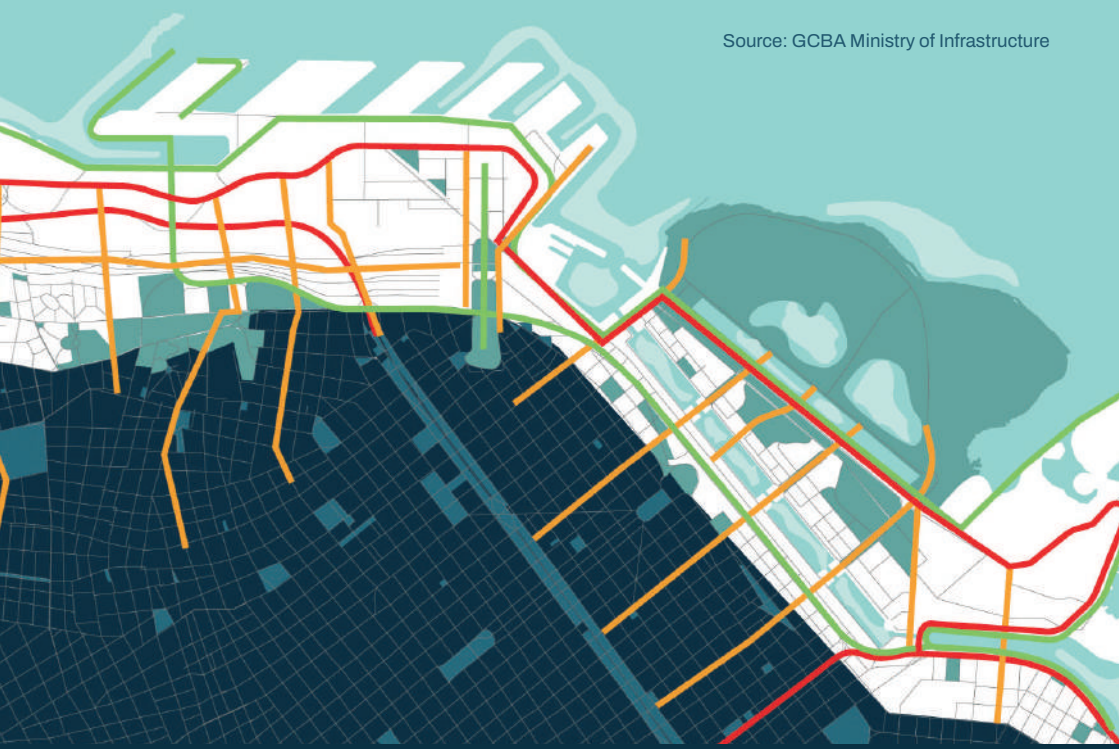
A limited relationship with water

The development of the City of Buenos Aires has led to a limited relationship between citizens and the surrounding waterways. The shores of the Rio de la Plata river and the Riachuelo have very limited recreational use within the City.

All other watercourses run almost entirely in conduits. The result is that citizens have lost what was once a city and a culture based on interaction with water. To re-establish a positive relationship, we must change our attitude and habits towards water as a local government and as citizens. Nature-based solutions and riverbank access can help bring citizens back in touch with waterways. Education about the existence and importance of streams and rivers and our role in protecting and appreciating them addresses the challenge from a cultural perspective.

Chapter 7 deals with the livability of the city concerning water.

Source: GCBA Ministry of Infrastructure



General Guidelines

Accessibility

Strengthen transversal corridors

Linkage between public spaces to the north and south

Mobility

Promote the use of public transportation and discourage the use of automobiles

Water quality

A closer and more quality relationship with water

Stream and coastal towpath recovery

Sustainable Densification

More diverse land uses

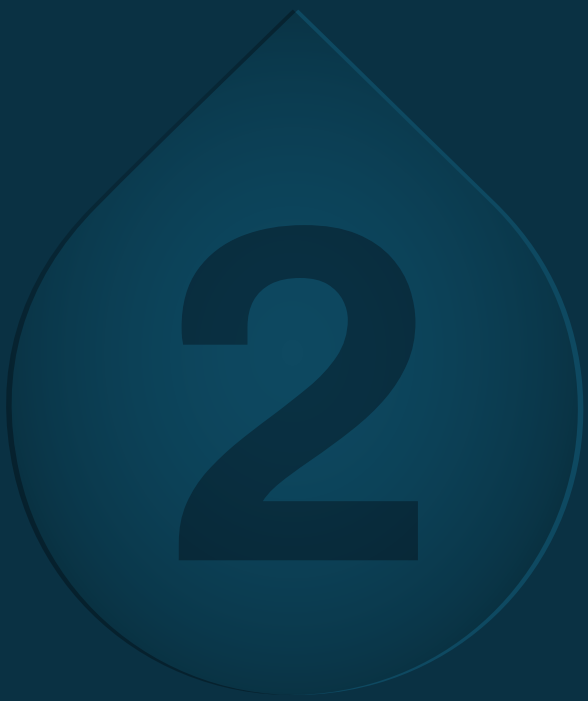
Green spaces

Conservation and creation

Linkage between public spaces to the north and south

Large equipment

Urban integration and positioning as new centralities

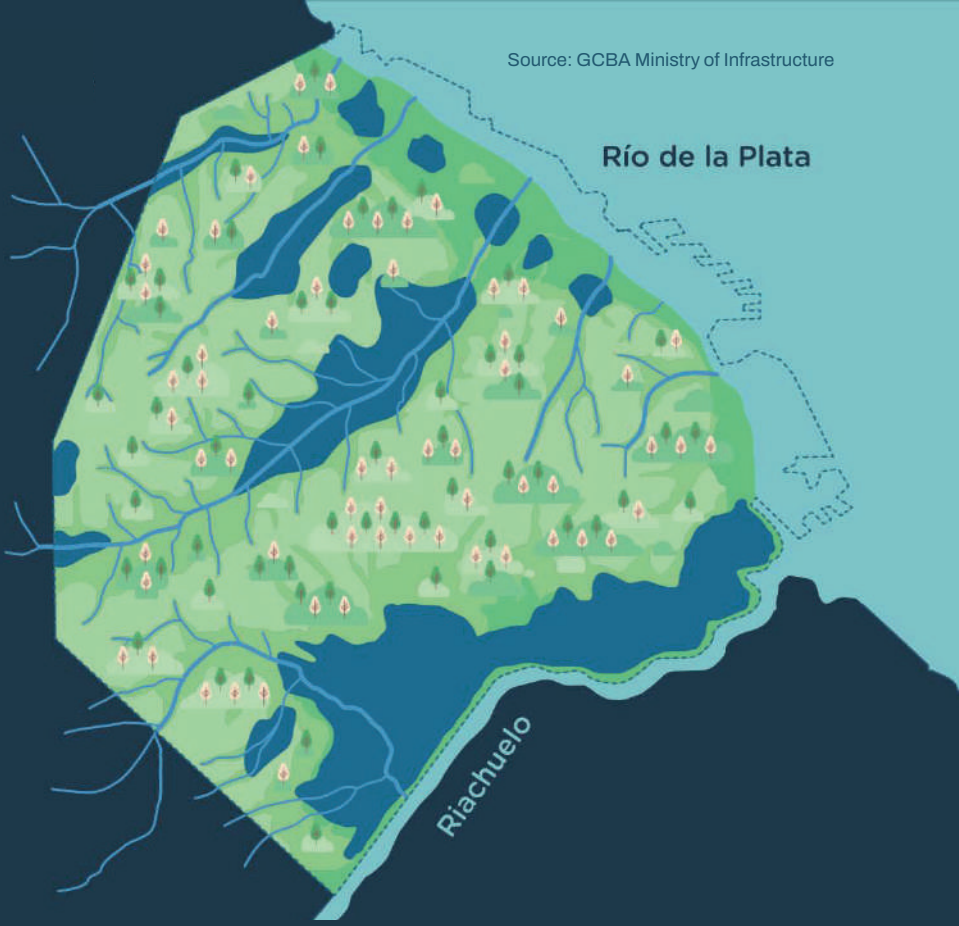


Transversal Intersectoral Planning

History

Hydraulic plans

Integration of adaptation in urban planning



Natural City

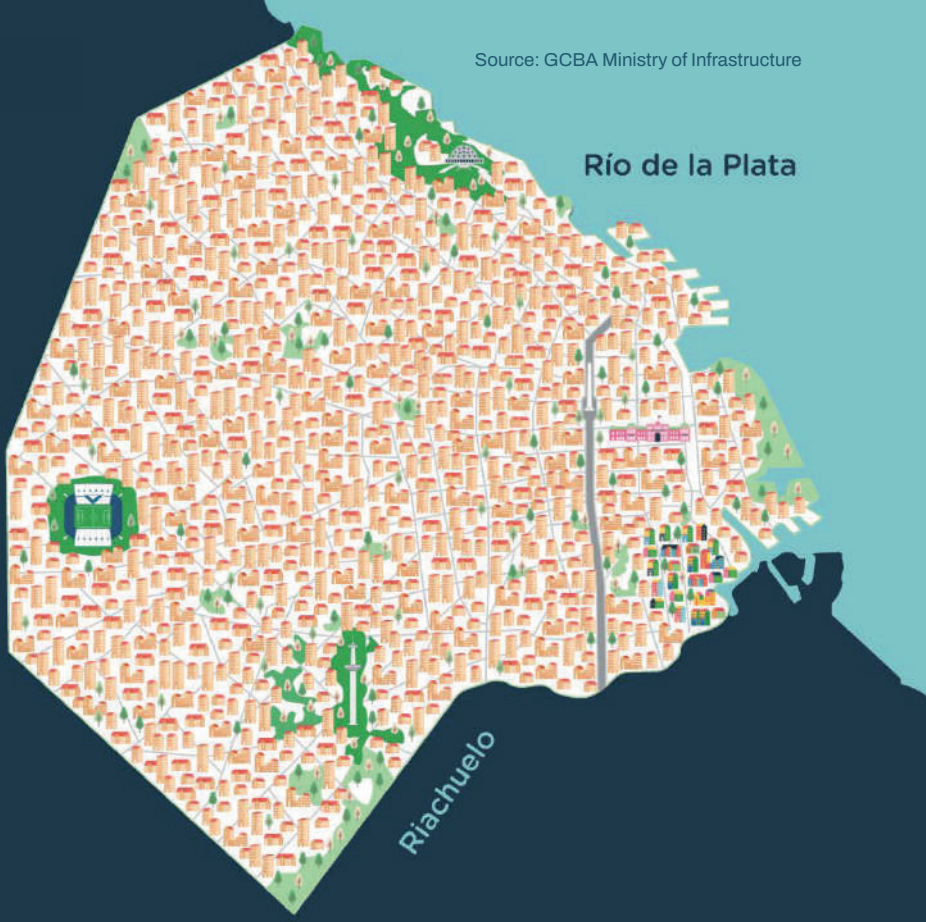
When the city of Buenos Aires was founded in the 16th century, the population settled on the coast of the Río de la Plata, close to several rivers and streams. The city is crossed by 12 minor river basins, the most important of which are the basin of the Arroyo Cildañez stream, a tributary of the Riachuelo in the south of the city, and Arroyo Maldonado, Arroyo Vega and Arroyo Medrano streams, which flow into the Río de la Plata along the Costanera Norte.

+1580

Location of the City between the third and middle South streams.

+1871

Consequently, the urban area's impervious surfaces grew, altering the water balance. The risk and impact of flooding were greatly increased as direct runoff rose and infiltration declined.



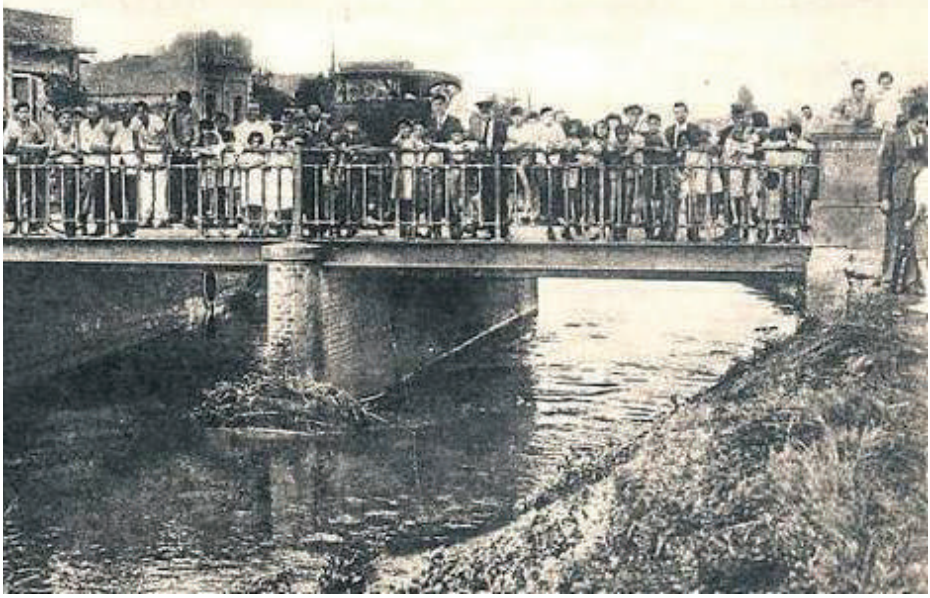
Source: GCBA Ministry of Infrastructure

Our city

The floods of 2013 demonstrated the need for major works. At present, the hydraulic infrastructure, which has already shown its importance during the heavy storms occurred to date, has been greatly improved.
However, the major floods concentrated in the Medrano stream basin showed that there is still much to be done. In addition, climate change has further increased the intensity of rainfall and consequently will increase the need to continue working to mitigate flooding.

Flooding in the Medrano basin.
April 2, 2013

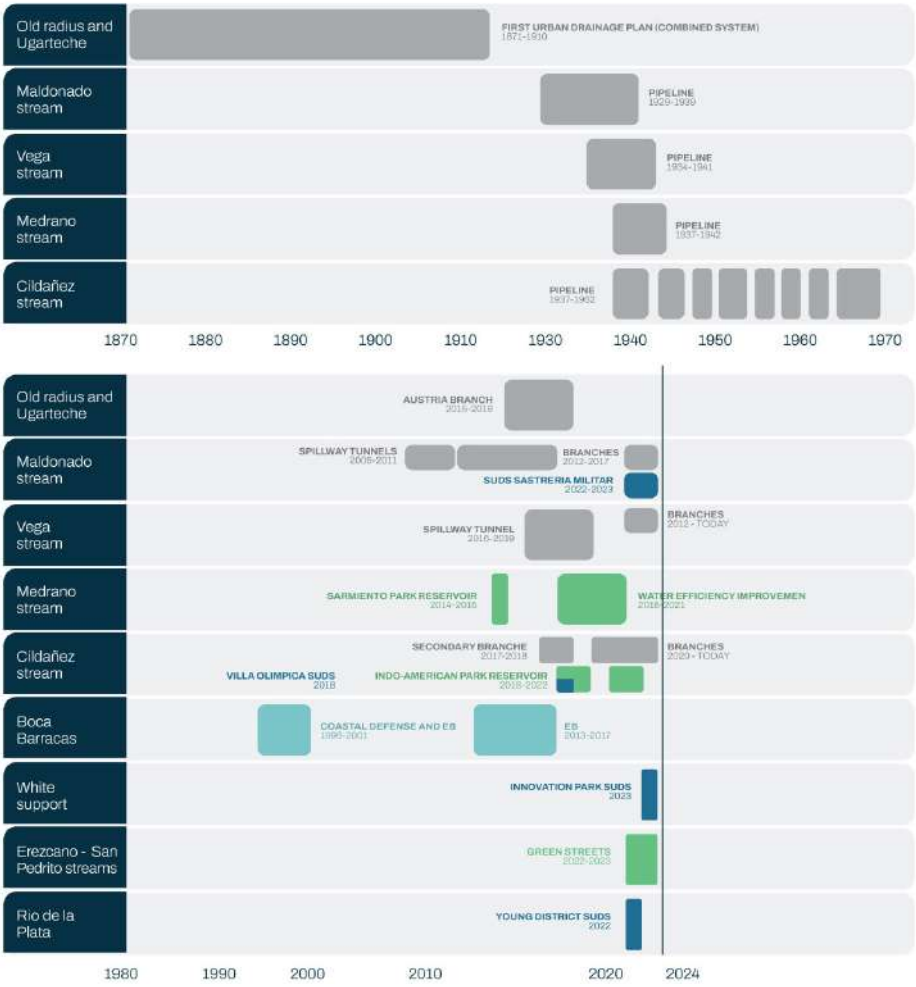
Historic photo of a bridge over the Maldonado stream before tunneling



2.1 Hydraulic Plans

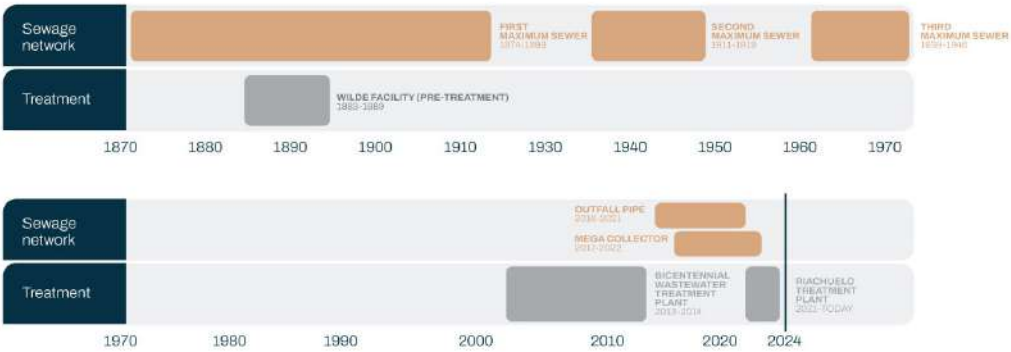
Historically, public policies related to water have focused on sewage systems, pipes, pipelines and wastewater treatment plants. In recent years, nature-based and cultural solutions (such as awareness programs about our relationship with our streams, climate adaptation education, and early warning systems) have been included as relevant dimensions of work. The water adaptation plan integrates and consolidates this approach to comprehensive planning for the city's relationship with water.

Water Risk

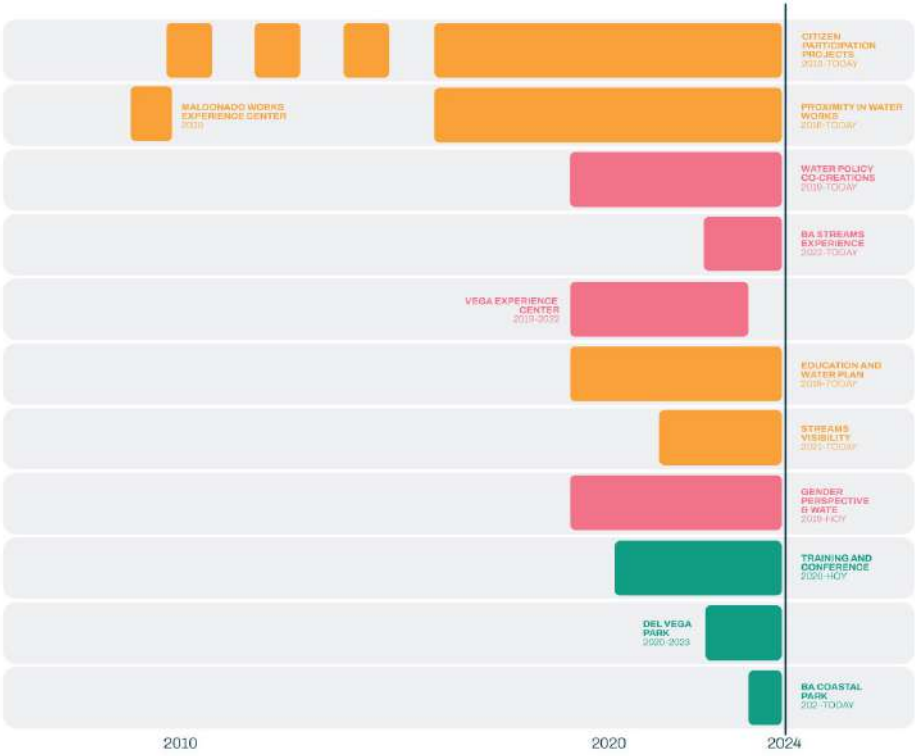


Source: GCBA Ministry of Infrastructure

Water Quality



Cultural Change



Source: GCBA Ministry of Infrastructure

This plan is the continuation of an ambitious effort to reduce flood risks in Buenos Aires through the implementation of the 2000 Water Management Master Plan and the 2006 Water Risk Management Program. One of the main milestones of these plans was the installation of two spillway tunnels for the Maldonado stream, which significantly reduce flood risks in that basin.

The next step was the 2013 Hydraulic Plan, which included hydraulic works in the Vega and Cildañez stream basins.

More recently, in 2021, a new vision began to be developed to address the impacts of climate change in relation to water, which ends crystallizing in 2024 with the presentation of this plan.

This vision recognizes that heavy rainfall is one of the main natural hazards that climate change imposes, but it also recognizes that water is not only a problem to be solved, but also **an opportunity to improve the livability and resilience of the city.**

The vision takes a holistic approach, encompassing cultural change and surface-level solutions to **foster a more positive relationship with water and create a more attractive urban environment.**

Integration of adaptation in urban planning

Climate change will affect the design and development of the future Buenos Aires, requiring extensive cooperation across the City Government. To ensure a water-ready city, objectives must be integrated across multiple planning areas. However, implementing attractive surface solutions will compete for space in an already dense city. Therefore, it is crucial to find synergies with other users of public space, such as transportation, parks and plazas, to maximize investment and create multifunctional spaces.

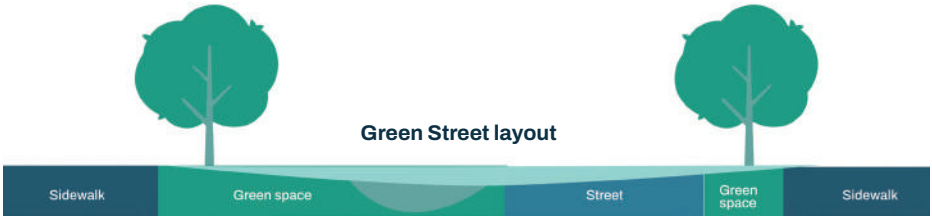
- Strategic Planning
- Traffic Planning
- Surface Water Pollution
- Wastewater Management Planning
- Groundwater
- Sea Level Rise
- Building Permits
- Hydrometeorological Early Warning System
- Emergency Preparedness
- Data Exchange Organization
- Current Data and Future Projects

Strategic Planning

Strategic planning is important for directing long-term development and adapting it to local conditions, including climate adaptation. Land use planning in the city should allow for the development of blue and green solutions for stormwater management, water security for the population, and stream sanitation, based on the water characteristics and needs of the City and its population.

Traffic planning

The criteria for the selection of green streets require compatibility with the road hierarchy (distinction between primary, secondary and tertiary streets) and the desired traffic and local mobility conditions, in order to achieve better adaptation and acceptance by neighbors. The design of green streets must take into account the accessibility conditions of the front owners involved, the convenience or not of parking, and the circulation and operation of emergency vehicles.



Source: GCBA Ministry of Infrastructure

Surface water pollution

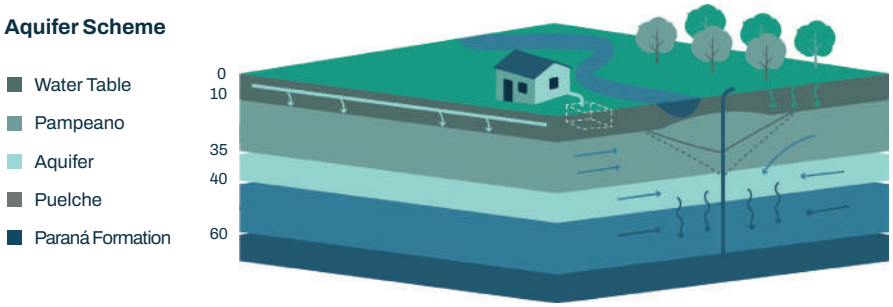
The status of water bodies depends directly on the quality of the water supplied in the form of treated and untreated rainwater, wastewater and groundwater. The treatment of stormwater using blue and green solutions helps to ensure the possibility of purifying surface water and avoiding floods in which untreated water contaminates aquatic areas. Therefore, to achieve an improvement in the condition of watercourses, it is crucial that efforts to adapt the city to the future climate become an integral part of environmental governance to address sources of pollution.

Wastewater management planning

Stormwater management in blue and green surface solutions is part of the overall wastewater management plan. By making surface stormwater management part of the strategy, plans for climate adaptation and wastewater management should be integrated.

Groundwater

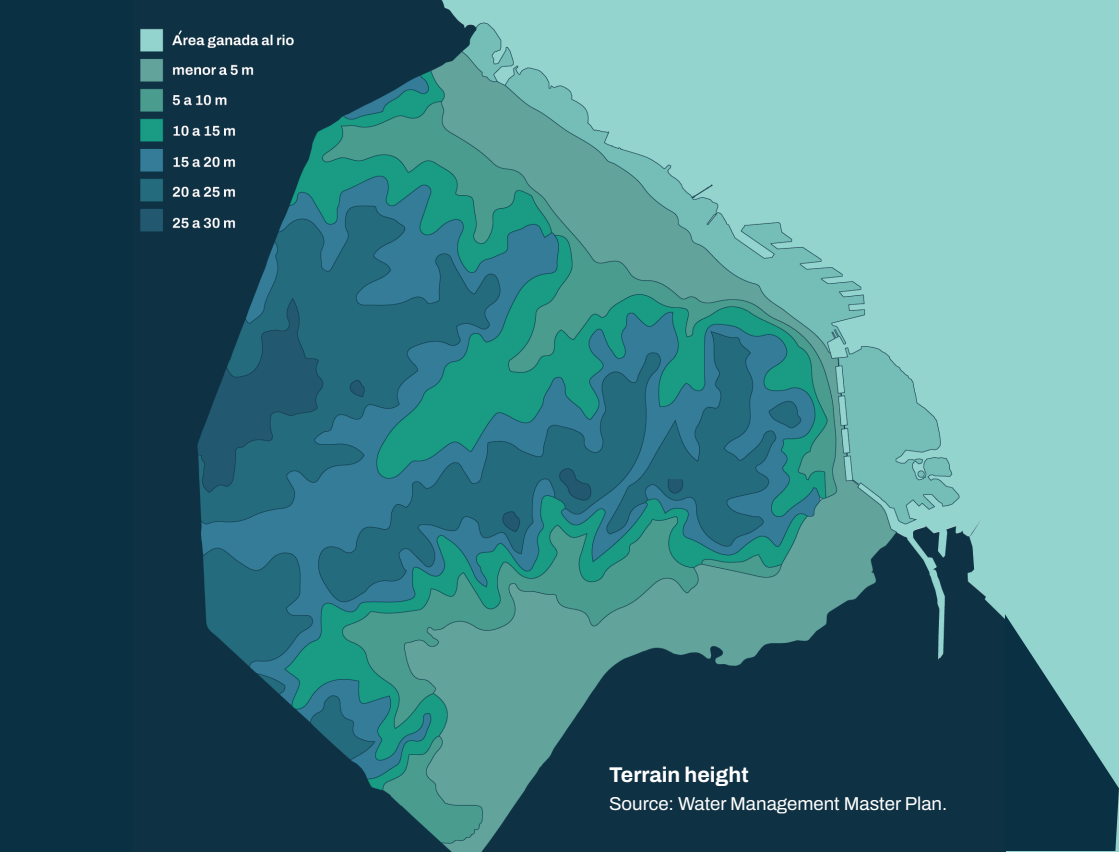
The Buenos Aires area is experiencing a progressive rise in the water table due to several factors, including increased precipitation and the climate factor. Increased precipitation in the future may further affect the groundwater level. Investigating and making plans for managing increased surface precipitation without having detrimental effects on infrastructure and buildings is essential to preventing the harmful effects of a rising water table.



Fuente: Ministerio de Infraestructura GCBA

Results of chemical analysis in ground water

Parameters	Method	Unit	PS	P4	P6	P8	P10	Ref.
Ph	IRAM 1872	UPh	6,7	7	7,1	7	7,2	6,5-8,5
Total Soluble Salts	SM 2540 C	mg/l	1038	516	404	476	484	
Sulfates	IRAM 1872	mg/l	< 10,0	31,3	29,1	36,7	33,7	400
Chlorides	IRAM 1601	mg/l	28,4	41,8	47,2	40,3	34,8	250
Magnesium	IRAM 1872	mg/l	19,8	19,7	17,5	22,3	21	
Aggressiveness to Carbonate	IRAM 1708-1	mg/l	< 10	< 10	< 10	< 10	< 10	
Ammonium	IRAM 1872	mg/l	< 0,05	< 0,05	< 0,05	< 0,05	< 0,05	



Terrain height
Source: Water Management Master Plan.

Sea level rise

Sea level rise will have a long-term impact on flooding in the city and will also increase the salinity of the Río de la Plata river. This is not an immediate challenge because the coastline is, on average, 4 meters above the current river level, but it must be considered when investing in infrastructure with a life expectancy of up to 100 years, as is the case of the coastal development project that is related to the filling of areas with the intention of gaining land for various purposes. On the other hand, the absorption capacity of the soil must be crucially considered, since the impermeabilization of large coastal areas could exacerbate flooding, reducing rainwater infiltration and increasing surface runoff. Therefore, it is essential to implement strategies that promote water absorption and retention in urban planning to mitigate these future risks.

Building permits

Buildings must be constructed in such a way that water and humidity from rain, surface water, air humidity, etc. do not cause damage or inconvenience, such as reduced durability and poor sanitation. In summary, it is important that the design of buildings takes into account the climatic conditions of their location, and takes advantage of the available resources.

Rapid Hydrometeorological Early Warning System

The City must continue adapting its hydrometeorological early warning system to climate change and its challenges. Currently, it has a real-time information network that allows for anticipating the arrival of precipitation, southeast winds (sudestadas), and different climatic phenomena for climate adaptation.

It is composed of 34 sensors, a radar, and a satellite reception antenna. The radar, 20 meters tall, is located in Merlo, Province of Buenos Aires. It has a 360-degree vision that allows predicting weather phenomena affecting the City up to 120 minutes in advance. For its part, the receiving antenna can capture information from a satellite that offers real-time cartography. The 34 weather stations complete the system. They are distributed between the City and the Province of Buenos Aires with sensors and cameras that collect climate data in real time. They measure wind, pressure, humidity, precipitation, temperature, solar radiation, UV rays, and soil temperature. They also allow for measuring the speed, flow, and level of water bodies in the streams that cross the City.

While this equipment is important, its utilization for the benefit of the population is also linked to the continuous improvement of the City's ability to use it positively for water planning, active monitoring, and the development of communication channels for potential alerts.

Emergency preparedness

There should be emergency response and coordination plans based on climatic and hydro-meteorological data - HEWS (Hydrometeorological Early Warning System) whose planning and development should involve citizen participation processes to make them more efficient based on communication and community empowerment.

List of threats

- Flooding Protocol
- Torrential rains and/or strong winds
- Flooding

Operational plans

- Emergencies in neighborhoods
- Precipitation emergencies (Autonomous City of Buenos Aires fire department)

Training

- Mitigation plan for the visually impaired
- Water emergency self-protection sessions
- First responders

Data Exchange Organization

Basins are territorial units of management that must be approached integrally and with common criteria, especially with regard to groups and categories of data for subsequent planning and management of each basin. Each group and category of data must be understood in the context of the basin analysis.

Urban data

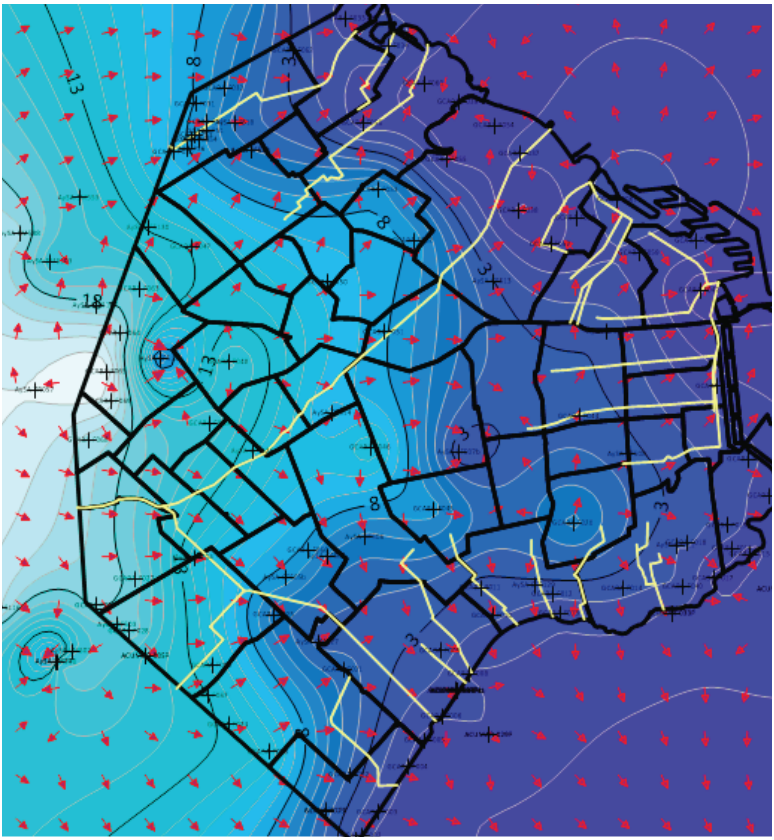
- Land use
- Population density
- Socio-economic status (understand what kind of damage is occurring in terms of flooding).
- Socio-cultural status (do people know how to respond during flooding? may be related to clandestine, connections, etc.).
- Social determinants of health (income, employment, housing, transportation, schooling, etc.).

Environmental data

- Contamination
- Sources of pollutants and quantities
- Biodiversity (flora and fauna)
- Groundwater measurements
- Environmental determinants of health (access to safe water and sanitation, air pollution, zoonotic
- diseases, gastrointestinal and respiratory diseases)

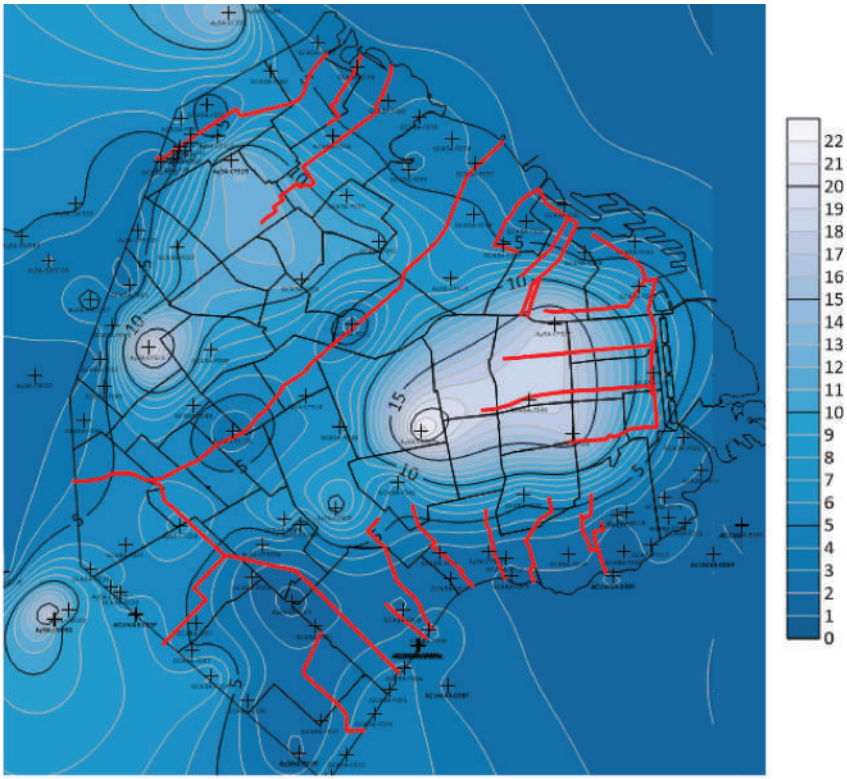
Current data and future projects

The available data are linked to phreatimeters constructed in 2011 and cover up to 2014, with additional data up to 2021. With the available data, it is possible to produce various maps that facilitate the understanding of groundwater flows and changes over the years.



Groundwater flow under the surface of the Capital City year 2011
It shows the location of streams and AYSA [Argentine Water and Sanitation] groundwater extraction sites, highlighting in white the streams that cross the city and the water flows with red arrows.Although the water level is adapted to the surface level, it does not imply that this will be the case for the entire city. Therefore, leaving some areas (in particular, those closest to streams) vulnerable to a rise in water level.

Source: ACUMAR [Matanza Riachuelo River Basin Authority] (2011) - Register of phreatimeters.



Distance in meters between surface water and groundwater for the year 2011
The boundaries of each neighborhood are highlighted in black lines and the streams that cross the city in red. This map is created for each time that data was taken over 3 years (for a total of 6 maps and 15 for the complete record), which allows to create an animation to note how the water level changes. The highest density is in the upper reaches of the Maldonado stream watershed and the upper reaches of the Medrano stream watershed within CABA, both of which align with the proximity of water level to ground level.

Source: ACUMAR (2011) - Register of phreatimeters.

Analysis of scenarios

Sea level rise and southeast storm (sudestada)

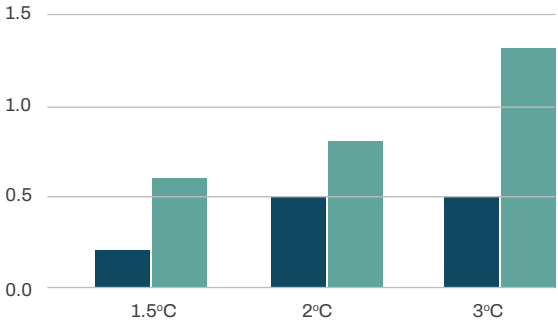
In 2020, the Government of the City of Buenos Aires launched a Climate Action Plan (buenosaires.gob.ar/cambioclimatico/pac-2050) that presents different scenarios to assess the impacts of climate change.

As a basis for assessing the challenges facing the city, data from the IPCC's 5th main report have been used. Using the rcp4.5 and rcp8.5 scenarios from the IPCC's 5th main report, it has been determined that the main challenge for Buenos Aires is the increase in extreme rainfall in the future. Along the same lines, the main conclusions of the 6th IPCC report reinforce these projections, highlighting a significant increase in the frequency and intensity of extreme precipitation events. These events are expected to lead to increased flooding, especially affecting densely populated urban areas. The report emphasizes the need to implement improved drainage systems, green infrastructure and other water management measures to adapt the city by increasing its capacity to respond to urban flood risk. It also underlines the importance of adapting existing infrastructure to withstand these more intense and frequent climatic events.

It is recommended to think the development of the City in relation to the main trends of the chosen scenarios and to adapt the planning according to the evolution of the recommendations emerging from the IPCC.

This can be done by continuously revising the plan according to the latest knowledge in the field and choosing climate adaptation solutions that are flexible in relation to future changes.

Graph
Change in the number of days per year with rainfall above 20 mm in the City of Buenos Aires compared
to 1986-2005 under different global warming thresholds.



Source: GCBA Ministry of Infrastructure

According to the two scenarios developed by the IPCC, the amount and intensity of precipitation will increase by approximately 26% over the next century. Consequently, a climate factor of 1.3 could be used to calculate adaptation solutions in Buenos Aires. This is also in line with the changes in climate predicted in the IPCC 6th Main Report. The climate factor should be used as a sizing factor for solutions to cope with more intense rainfall in the future. In order not to overinvest, sizing should be adapted to the lifetime of a solution. The climate factor of 1.3 should be used for solutions that last a century or more1.

Sea level rise and southeast storm (sudestada)

At present, the City of Buenos Aires does not consider the problem of sea level rise to be a hazard in the foreseeable future, and instead focuses its resources on preventing pollution and flooding from rainfall.

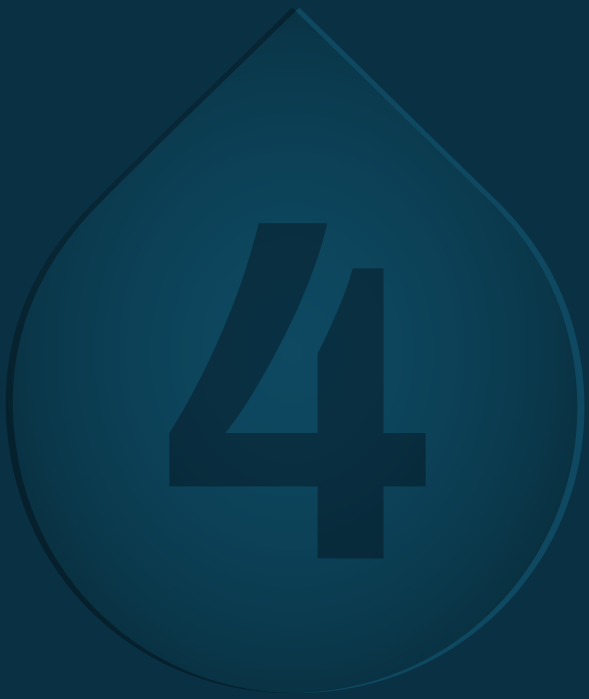
Elevation modeling studies conducted for the City show the coastline elevated to about 4 meters above river level. In addition, most of the shoreline is made up of recently filled land without much population, as most of it is designated for parks and green areas. As a result, there are no flood prevention plans for sea level rise and instead there are projects to fill in more areas to gain land from the river; meanwhile, the situation is constantly monitored for change and more areas are at risk of flooding. In the sixth major report in 2021, the IPCC has expressed concern about the acceleration of sea level rise as a result of climate change. The review of this plan and the evolution of climate-related risks will keep pace with the evolving scientific literature.

1. For solutions lasting, for example, 25 years, the climate factor may be less than 1.3. It should be noted that even if substantial reductions in global greenhouse gas emissions are achieved, the amount of greenhouse gases already emitted will inevitably lead to changes in the Earth's climate.

Source: GCBA Ministry of Infrastructure

Land elevation

The image shows the lower areas in black which represent a higher risk of flooding due to a possible rise in sea level. Elevation is also possible during a meteorological event called “sudestada”, since it follows the direction of the origin of the wind that causes them (from southeast to northwest), which is opposite to the direction of the flow coming from the Río de la Plata. Although the map may look like a huge risk area, in reality, the elevation of the coastline has proven to be an effective barrier against these phenomena, making it a low priority issue compared to flooding caused by rainfall. It is estimated that a combined heavy rainfall event with southeast wind (sudestada) could cause problems, given that many of the areas protected by defenses have pumping stations that would be undersized in the event of climate change. However, there is no data that can be used to model the affected areas, so the map is based on the height of the terrain.



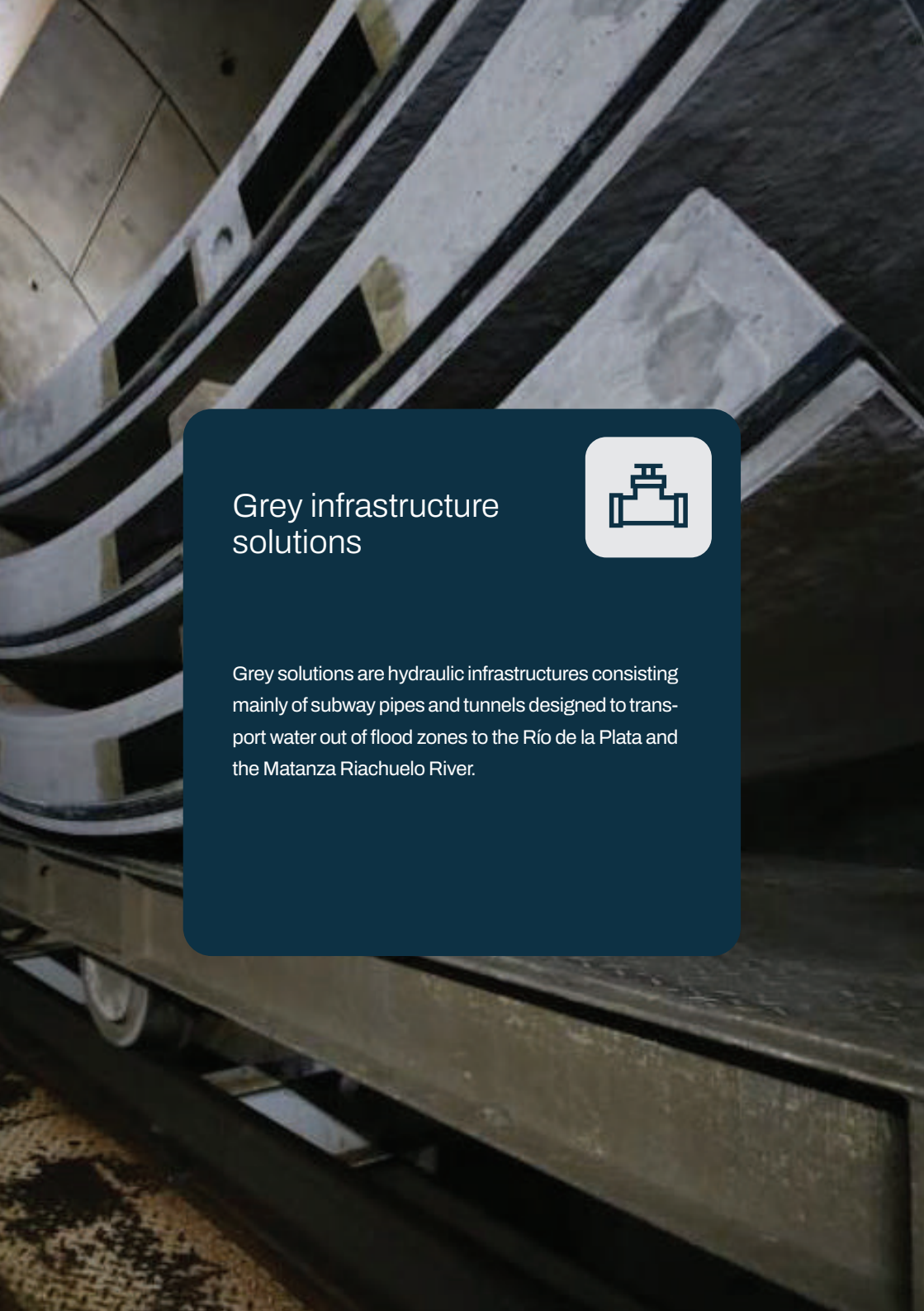
Types of solutions

Grey infrastructure solutions

Nature-based urban solutions

Cultural change solutions

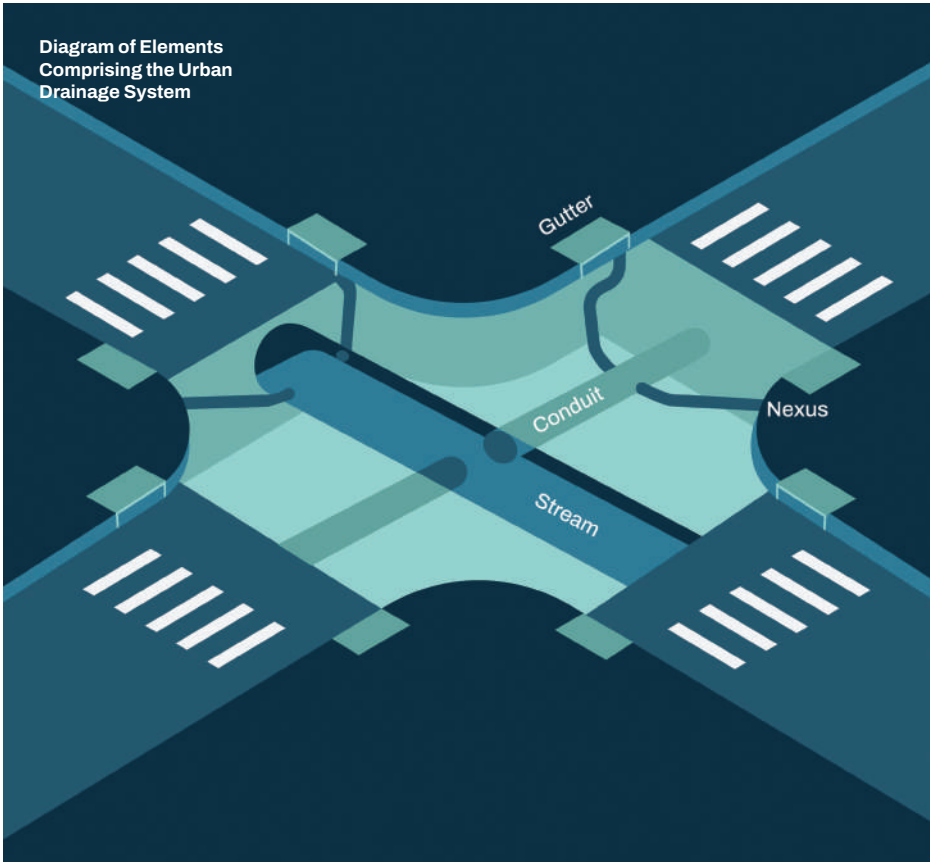
Second Vega Stream Outfall Tunnel



Grey infrastructure solutions

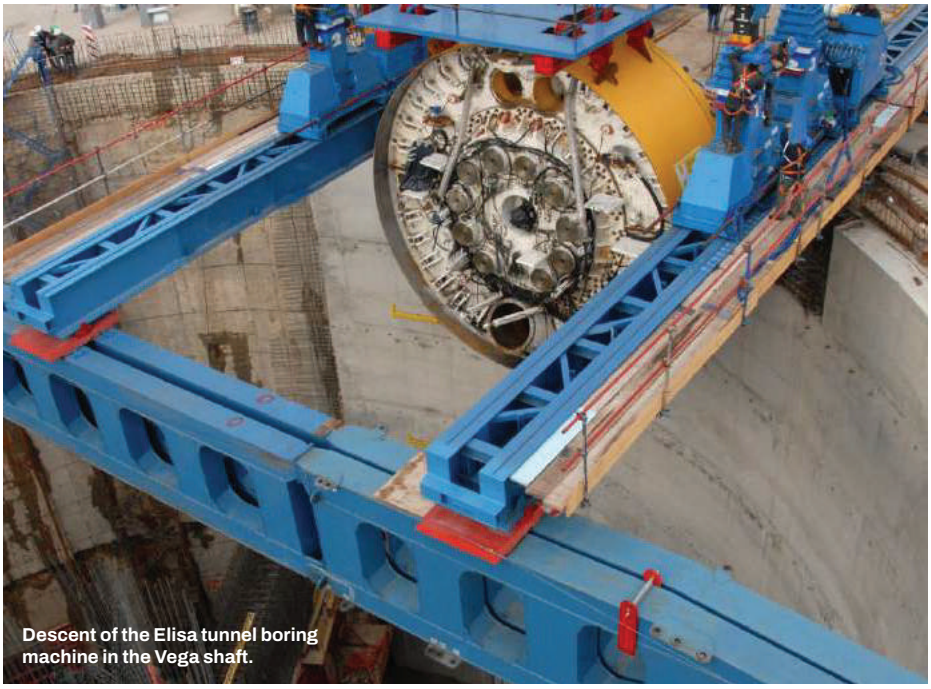
Grey solutions are hydraulic infrastructures consisting mainly of subway pipes and tunnels designed to transport water out of flood zones to the Río de la Plata and the Matanza Riachuelo River.

Grey solutions are hydraulic infrastructures consisting mainly of subway pipes and tunnels designed to transport water out of flood zones to the Río de la Plata and the Matanza Riachuelo River. As the City has developed, natural water flows have given way to pavement and structures. To prevent flooding, miles of grey water infrastructure have been built throughout the city. In addition to subway pipes and tunnels, the streets function as surface channels with drains connecting them to the pipes below. Therefore, in order to prevent the streets and pipes from overflowing and flooding the surrounding buildings and infrastructure, it is necessary for the design of the streets to provide for drainage and connection to the pipes.



Source: GCBA Ministry of Infrastructure

Filling of the single well – Maldonado stream



Descent of the Elisa tunnel boring machine in the Vega shaft.

Eco Park of the City

Green Infrastructure Solutions

These solutions are planned and designed based on nature, seeking to improve resilience to heavy rainfall, the heat island effect, protect biodiversity and improve habitability. The Water Adaptation Plan is dynamic. In its initial phase, priority is given to the implementation of this type of nature-based solutions.

Coastal development model

Water solutions

Water solutions on the shores of the Rio de la Plata and Riachuelo integrate the enjoyment of water, water quality, protection against sea level rise and sustainable development of cities. These are measures to better prepare the city for the potential rise in river and sea level.[2.]

2. The specific increase in river level in the Río de la Plata under a climate change scenario with a factor of 1.3 could mean a 30% increase in river level, and the effects of sea level rise, changes in precipitation, and the incidence of extreme phenomena should also be considered. It is part of the planned climate adaptation to update the climate and hydrological models associated with these factors.

Construction of a green street.

Green Streets

These are streets that replace paved surfaces with green areas for rainwater management, where the initial retention occurs both through infiltration and accumulation in depressions in the ground and in foliage. Green streets use the natural soil retention process to reduce runoff, improve water quality, reduce road accidents, reduce the carbon footprint, and improve the quality of life for neighbors.

Regeneration of the Medrano stream in Saavedra Park.

Stream Regeneration

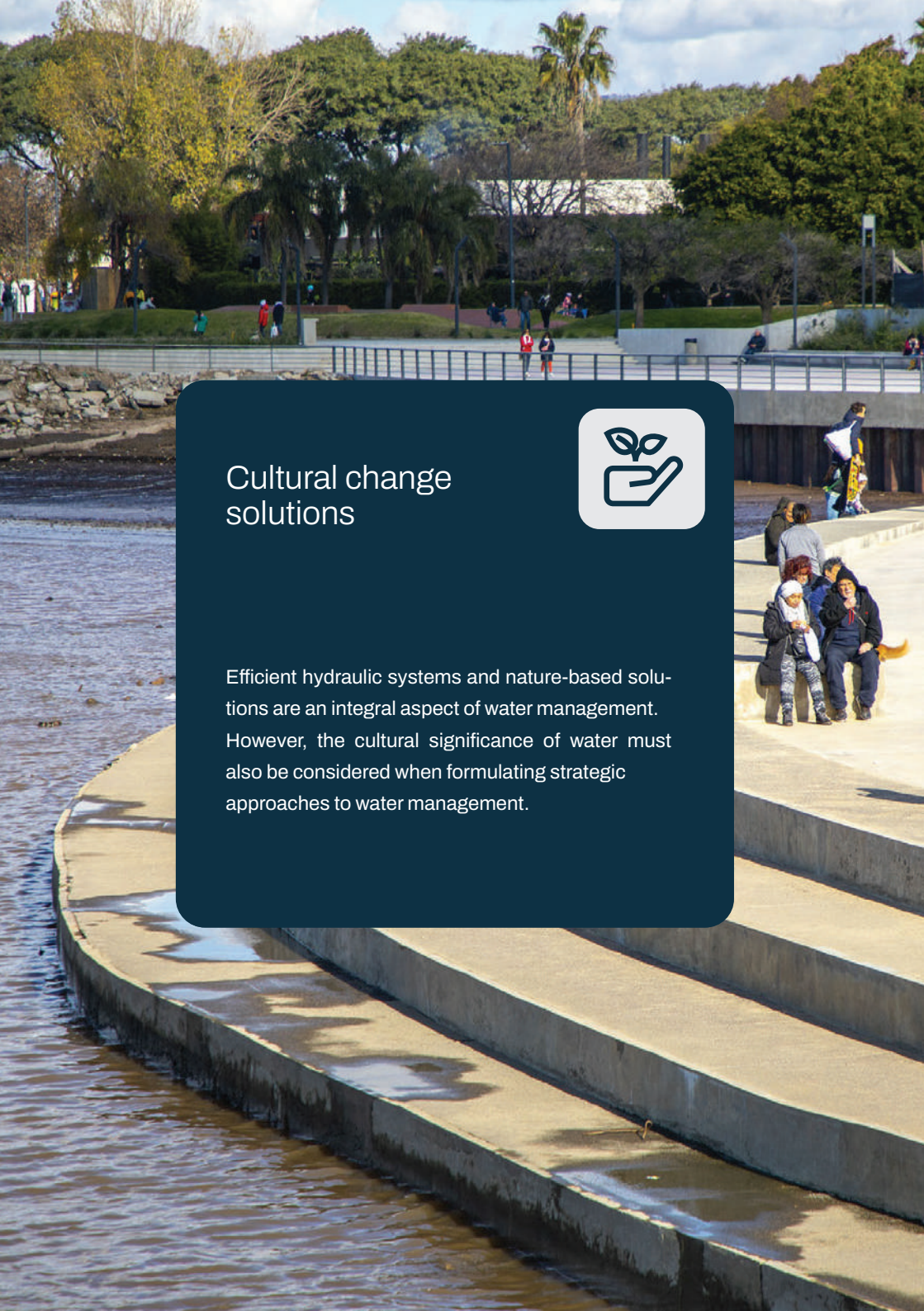
This is the process of recovering the hydro morphological characteristics of a river or stream to improve its ecological integrity. Its objective is to restore the natural state and functioning of the fluvial system to promote biodiversity, promote flood prevention and reinforce environmental awareness.

Soldati Lake Natural Reservoir in the Indo-American Park.

Natural Reservoirs

These are spaces within large cities that protect typical environments of the region, often with their native plants and animals. They create temporary retention areas for water surpluses that, during rainfall events that exceed the transport capacity of the conduits, fulfil the function of storage; similar to what happens in nature with the floodplains, which today are occupied by the population. In such a case, the volume of water is diverted from the conduits to the reservoirs, storing the excess volume to prevent flooding in populated areas (homes and businesses). In addition, in many cases, they allow the development of ecosystems and spaces for the enjoyment and knowledge of nature.

In Sarmiento Park, an area for sports use is planned, where soccer fields are located. By excavating them to a suitable level, they will act as temporary retention areas for excess water during storms that exceed the capacity of the Arroyo Medrano stream system and its tributaries. Meanwhile, a natural reserve has been developed in the Indo-American Park for the temporary retention of excess water, where animals and plants thrive.



Cultural change solutions

Efficient hydraulic systems and nature-based solutions are an integral aspect of water management. However, the cultural significance of water must also be considered when formulating strategic approaches to water management.

Our attitudes towards rivers and our interaction with them are both part of the problem and part of the solution. To effect a profound cultural change in the relationship with water, a multidimensional and interdisciplinary approach is needed. This approach must include various aspects of education, awareness and cultural transformation to create a deeper understanding and connection to water resources. In the City of Buenos Aires, the goal is to recover the lost connection to water, so that citizens and visitors can enjoy clean water resources and appreciate the recreational opportunities they offer, while understanding the risks associated with polluted water and overflowing drainage systems.

To this end, this Water Adaptation Plan seeks a lasting impact on both humans and ecosystems, through holistic and comprehensive plans for education, awareness, cultural transformation and citizen participation where digital platforms, schools and public spaces, especially those linked to bodies of water, are excellent spaces to promote the desired changes.

Cultural solutions focus on changes in citizens' beliefs and behavior to raise awareness of flood hazards and how to reduce them.

It is possible to use the challenge of having to adapt to a changing climate as an opportunity to develop a new relationship with both rainwater and our streams and rivers, incorporating the enjoyment of water.

Projection of the history of water with an anthropological vision in the Ecopark.

Water education

The school is a central agent of cultural change to achieve the global objectives of sustainable development and is directly linked to the challenge of promoting the relationship with water in the city through education. To this end, didactic sequences were designed and implemented for primary and secondary levels, teacher training courses and “gamification”, which includes the production of videos and digital content. The educational contents are also linked to practical work in the territory, which promotes visits and analysis in natural reservoirs to mitigate floods, the surface of piped streams, the coast and the mouths of streams in the Río de la Plata.

Likewise, the interventions through signage and visual communication on the places where the streams run is an action aimed at generating awareness, interest and responsibility about the streams of our city.

Guided visits with students to the Hydraulic Plan Experience Center.

Learning from history

Learning from past experience to improve the present. In the case of the Arroyos de Buenos Aires streams experience, research was conducted on the relationship of different generations of inhabitants of the city with water, seeking to understand the cultural paradigms that conditioned the way they perceived and used the streams and rivers that crossed the city. It is an interactive experience in which the figures of other generations of Buenos Aires inhabitants “appear” and tell about their experiences with water. It was chosen to be installed in a restored building in the City’s Eco Park and seeks to raise awareness among visitors so that they reflect on the historical uses and current care of the streams.

Streams Visibility

Streams that flow beneath the streets and avenues of Buenos Aires cross the city without the locals being aware of them. The project intends to install vertical and horizontal signage on public roads, in public spaces with high traffic, like parks, squares, and avenues, following the original route of the Maldonado, Medrano, Ugarteche, White, Vega, and Cildáñez streams. This is because one cannot value or take care of what one does not know.

Co-creative workshops with neighbors of the Cildáñez Basin at CIFA.

Participation in water policy and social activities

Climate change adaptation is strengthened by citizen participation and consensus building through different actions such as meetings with citizens and stakeholders to co-create, co-design and plan climate change adaptation solutions. In the City of Buenos Aires, for water-related climate adaptation, ethnographic interviews, participant observation, co-creation workshops with agile methodologies, gender perspective workshops and engagement meetings with citizens were conducted

The participatory development of contingency plans in response to water-related challenges, such as flood risk and river pollution, is especially important. It is crucial that vulnerable populations have contingency plans that have involved key stakeholders and neighbors.

Co-creative workshops with neighbors of the Cildáñez Basin at CIFA.

Water policies with a gender perspective

The differential impact of floods on gender has been analyzed in different populations around the world. In the City of Buenos Aires this differential impact has also been corroborated and, in order to work on it, several meetings have been held with affected citizens to identify public policies and solutions to balance the differential impact by gender before, during and after the event. It is also important to ensure gender balance in the technical teams that provide flood-related services. Furthermore, it is an important aspect in the case of nature-based solutions and spaces for water enjoyment, where the gender perspective is included in the design of the solution.

5

Watershed approach

General approach

Map: Streams and watersheds

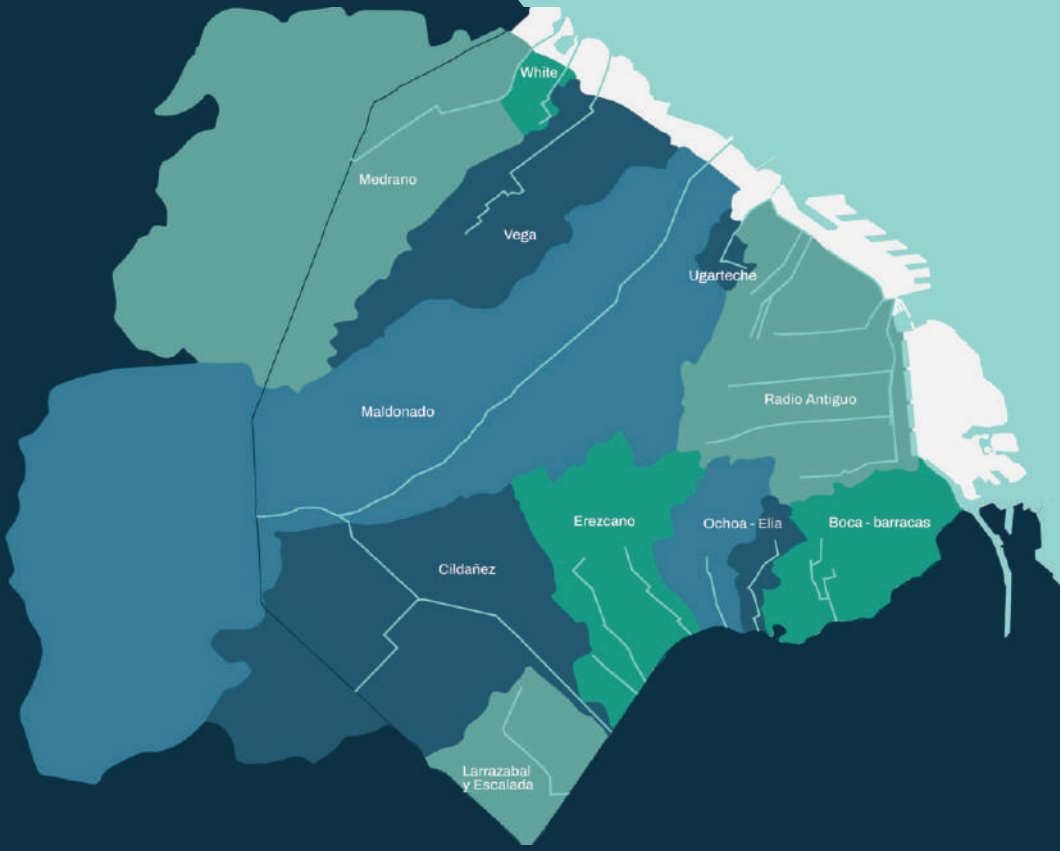
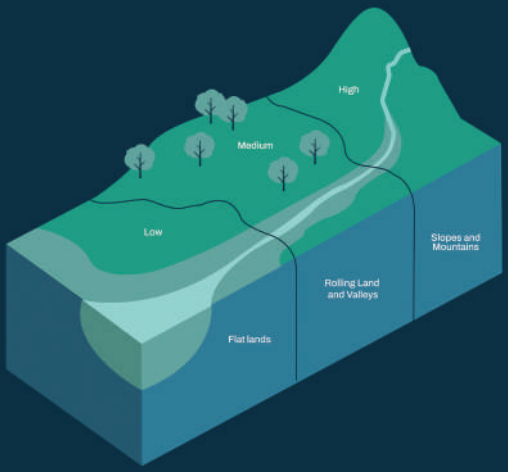


Diagram: Sectors of a basin:



Source: GCBA Ministry of Infrastructure

General Approach and Concept

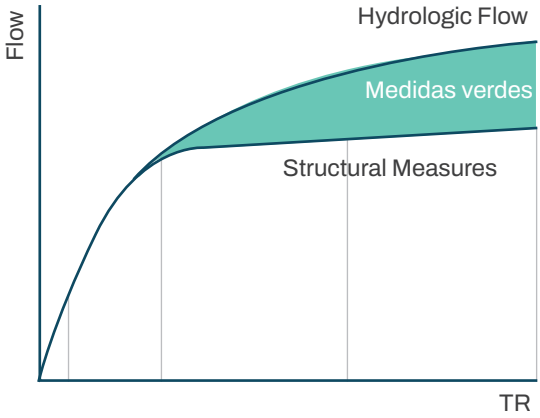
This Plan is based on the watershed approach where water is the integrating axis of the territory that links and interconnects natural, social and economic elements. In this framework, taking water as part of our climate solutions, the ultimate goal is to achieve low-cost, efficient and transformative actions in urban areas, reactivating the benefits of ecosystems and biodiversity.

The purpose is to climate-proof the City of Buenos Aires and develop new green infrastructure to complement existing drainage systems and storm tunnels.

The plan is to develop the City's overall infrastructure with integrated stormwater solutions. The existing structural measures of the 2001 Water Management Master Plan are the backbone that will be integrated with the green surface measures to ensure that the most extreme events of the future can be managed within the City's stormwater infrastructure.

Graph
The graph shows two curves: one for "Hydrologic flow" and the other for "Structural measures", both as a function of "Recurrence time". The "Hydrologic flow" curve represents the volume of water without grey structural interventions. The area between both curves represents the impact of the "Green Measures", which contribute to decrease the flow and mitigate flood risks.

Source: GCBA Ministry of Infrastructure



Surface Water Pollution

Sampling sites

Contamination challenges for the city

Watershed approach

Rainwater utilization

Surface water pollution

Addressing water pollution is key to making the cultural change of re-establishing the city's connection to water, including the possibility of bathing in the Río de la Plata. In addition, better water quality impacts not only ecosystems but also the health of the population, improving their quality of life.

The water quality of urban streams and the Río de la Plata deteriorates due to the continuous discharge of domestic and industrial wastewater. Climate change must be included in attempts to lower the level of pollution in streams and rivers since the above-mentioned changes in the City's precipitation regime and the rise in groundwater levels (Chapter 3) would make matters worse. As part of the decontamination policy, the APrA (Environmental Protection Agency) seasonally monitors the water quality of the streams that run under the City at the intake and the mouth of the Río de la Plata.

Sampling sites

Samples taken in the Rio de la Plata show Escherichia coli levels between 1,000 and 45,000 CFU/100 ml and Enterococci between 740 and 9,500 CFU/100 ml. This far exceeds bathing water safety criteria, which in the European Union are set at 573 CFU/100 ml for E. coli and 150 CFU/100 ml for Enterococci. The highest levels of Escherichia coli and Enterococci are recorded at the sampling point "Club de Pescadores" (Fishermen's Club), just downstream of the mouth of Arroyo Medrano stream, while the highest discharge of organic matter is measured just downstream of the mouth of Arroyo Medrano. The concentration of these parameters are critical factors for the safe recreational use of watercourses, including bathing. In addition, organic matter and the nutrients nitrogen and phosphorus, along with the content of toxic compounds, are critical factors for surface water biodiversity and for the quality of untreated water used as drinking water.

Source: Map of sampling points of the Permanent Program of Surface Water Quality, Environmental Protection Agency of the City of Buenos Aires.

Sampling site

Piped stream

- Medrano mouth
- Medrano Inlet
- Maldonado Mouth
- Maldonado/Cildanez Inlet
- Cildanez mout

Rio de la Plata

- Children's Park
- North waterfront
- AYSA water intake
- Fishermen's Club
- Ecological Reserve

Lakes

- Regatas
- Rosedal
- Planetario
- Victoria Ocampo
- Centenario Park
- Roca Park

Riachuelo

- Prefecture Base
- Uriburu Bridge
- La Noria Bridge

Contamination challenges for the city

Main sources of water pollution in the basins of Buenos Aires rivers

- Overflow from the sewage system into streams due to insufficient capacity of the sewage system, because of: City expansion, stormwater that is connected to the sewer system, groundwater infiltration, industrial pollution, and surface trash.
- In some places, sewage is connected to the stormwater system, which discharges directly into streams and the Rio de la Plata.
- Direct discharge of wastewater to surface waters.

The following table summarizes the sources of pollution, suggestions for remediation methods, and current initiatives. Since climate change will lead to an increase in rainfall intensity, the above causes, which are impacted by stormwater, will be exacerbated.

Source of Pollution	Correction Method	Current Initiatives	Impact by Rains
Entry of contaminants from provincial municipalities	Increase the rate of connections	AySA's Participatory Management Model	Partial, entry of contaminants in dry seasons
Informal connections in the City	Increase the rate of connections		Maybe
Illegal connections: a) rainwater to sewage b) sewage to rainwater	Detect and correct connections		Illegal Connections a. Yes b. No
Direct sewage discharges into the Riachuelo	Collector	Lower Costanera Collector	No
Sewage overflow	Increase hydraulic capacity	Lower Costanera Collector	Yes

When it is not raining, the sewer pipes continue to have a base flow that is mostly made up of water from the phreatic surface and pollutant loads, which circulate through the pipes and end up in the Rio de la Plata or the Riachuelo. While it is true that when flooding occurs all the rainwater dilutes the pollutants present in this base flow, the sewage system frequently overflows, generating the risk of potential contact between people and pollutants, which would lead to an increased risk of disease transmission, even without bathing in the watercourses.

The situation described above needs to be addressed in order to implement reservoirs and other retention solutions in open areas. In addition, floods could cause damage to infrastructure, property and goods, while affecting the livability of citizens and their attitude towards water. Finally, water pollution needs to be addressed in order to use rainwater as a resource for irrigation in parks, street washing or bus washing.

Watershed approach

The destination of the watercourses of the metropolitan area is the Río de la Plata river. However, there are different sources of contamination in each basin related to their industrial activities, sewage coverage, presence of informal settlements, etc. Therefore, it is necessary to work in an intersectoral manner in each basin to achieve the quality of water suitable for bathing and the increase of biodiversity. Pollution reduction efforts should be carried out in parallel with water planning for stormwater and wastewater management in each watershed, in coordination with plans to expand the sewage network. This work should include all stakeholders, such as neighbors associations, industries and municipalities in a framework of collective responsibility.

Although the polluting sources vary in each basin, sewage overflows and clandestine connections to the drainage network are common to almost all of them.

Therefore, the overall watershed approach must address this situation by ensuring that pollutant discharges are collected and subsequently diverted back into the sewage network for treatment before final discharge to the Río de la Plata. With this objective in mind, the first step is to study the existing network and evaluate each of the discharges to the stream.

There are 3 main types of discharges to be detected, each with its own recommended corrective measures:

Sewer overflows

These are the result of the lack of capacity of the sewer system to handle peak hour flows and, to correct them, additional sewer lines need to be constructed. Taking into account the objective of decontamination, these pipes can be built parallel to the main drainage pipes, collecting the overflows and thus preventing them from being discharged into the rainwater network, and then discharging them at a point downstream where the capacity of the system allows it.

Clandestine connections (Sewage / Residential)

Small-scale discharges, carried out at the user level due to deficient connections to the network, lack of knowledge of existing networks, or non-existent sewerage networks in the area, as is the case in most of the informal settlements in the area. This situation should be addressed by creating more networks at the user distribution level and reinforcing connections between users.

Industrial waste discharges

Medium- and large-scale discharges by industries present in the area, which exceed current legal limits. They can be detected by measuring pollutant levels and identifying pollutants that are not characteristic of sewage networks. To do this, measurements and other documentation proving the illegal discharge of industrial wastewater must be collected, and the local authorities must be contacted to force the industries to regularize their situation.

Rainwater utilization

Drinking water is obtained from the Rio de la Plata. Although it is an abundant resource, it takes a lot of energy and chemical treatments to supply clean, safe drinking water to the City.

This drinking water is used for purposes such as toilet flushing and irrigation, which do not require drinking water quality so it could be replaced by rainwater. This is especially relevant for new constructions. Rainwater can also be used for small recreational water bodies and to supply water for street washing, irrigation of green areas and in construction.

7

Livability

History of Buenos Aires and its waterways

Livability Benefits

History of Buenos Aires and its waterways

In the past, people could swim and enjoy the river on the City of Buenos Aires' waterfront. The residents no longer had access to the rivers, and the water lost its allure. The city turned its back on the Río de la Plata and the Riachuelo rivers and hid its streams due to pollution and infrastructural expansion.

Even so, the rivers have great potential to contribute to the livability of the City. Around the year 2000, significant momentum was given to hydraulic planning to address the increasing risks of flooding. Now, as a complement to hydraulic planning, this adaptation plan addresses climate challenges and our limited positive contact with the watercourses that surround us.

Given the need to invest in infrastructure to secure the City against more intense precipitation and rising sea levels, these investments can be used in a way that simultaneously increases the city's habitability. The nature-based and cultural solutions described in Chapter 4 can help create a more attractive and livable city.

Bathing in the Buenos Aires waterfront in the 1920s.:

BA Coast Project. Integral plan for the recovery of the coast of the Río de la Plata:

Livability Benefits

Hydraulic and nature-based solutions must be planned and built to provide all of the aforementioned advantages in order to fulfill the potential for habitability. This is accomplished by using an intersectoral approach, as outlined in Chapter 3, in which hydraulic specialists collaborate with, for instance, biologists and mobility specialists to build the solutions. There are numerous advantages to using hydraulic technologies to increase livability:

Recreational use

Access to water and a greener city make the city more pleasant and offer more recreational uses, whether it's a bench under a tree on a green street or a volleyball court by the river.

Improvement of mobility

There are more pedestrians and cyclists in a more appealing city with greater room for non-automotive modes of transportation.

Health

The population is healthier when there are more outdoor leisure activities and more people walking or cycling, with all the associated advantages. Additionally, having access to water and green areas boosts creativity and lowers stress.

Urban cooling

As described in the Climate Action Plan, the city creates a warming effect that can be mitigated with green spaces, leading to a more pleasant climate and a reduced need for artificial cooling in the summer.

Awareness

Ecological solutions and access to water increase awareness of our natural environment, which in turn can lead to greater care for the natural environment and respect for flood risks.

Livability Benefits

Investment/Financing

At present, responsibility for investment in water infrastructure is distributed as follows:

- Water and sewage supply: National Government through Agua y Saneamientos Argentinos (AySA)
- Rainwater pipes: Government of the City of Buenos Aires
- Urban streams in tunnels: Government of the City of Buenos Aires.

The solutions described above, i.e. a combination of green and grey infrastructure, require two aspects to be taken into account:

- The legality of the planned investments to be made by each entity.
- Making total investments based on a feasibility study, in which the investments are related to the potential flood losses and the benefits derived from the creation of blue-green solutions and recreational waters.

It should be clarified whether current environmental, floodwater, and wastewater legislation allows for optimal environmental and financial management.

It is not feasible to protect the City against extreme rainfall events that cover the entire gravity scale. No matter how conservative the design criteria for the drainage system may be, there will always be the uncertainty that a heavy rainfall event will produce even greater amounts of water. However, it is necessary to define an acceptable street water depth during flooding resulting from an extreme rainfall event. The duration, frequency and intensity of rainfall determine the required hydraulic capacity of the flood prevention system.

Investments against the background of risk analysis based on economic losses as a result of floods can to some extent serve as a basis for decision making. Public policy decisions necessarily involve the investment variable.

In addition, a broader assessment is needed in socially distressed residential areas, where economic conditions are relatively limited, but where flooding will have very large consequences for the existence of the individual citizen.

The challenge is to select the optimal combination of green-blue surface solutions, the opening of channelized waterways, and traditional grey solutions. This requires the development of alternative capture solutions to compare costs and benefits, balancing investment-financing functions and opportunities.

Water management could be a problem transformed into an opportunity in many respects and for many stakeholders, with strategies aimed at improving the City in a sustainable and constant manner.

Positive externalities

Investments

If the city is prepared for climate change, it will be more attractive for investment, as the investment will be better protected. A simultaneous greening of the city and the establishment of areas for recreational water use can form the basis for significant urban development and economic progress for the city.

Employment

The works related to stormwater management will generate jobs and tax revenues during the construction phase.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