

Argentina – Urban Flood Prevention and Drainage
ENVIRONMENTAL IMPACT ASSESSMENT

Executive Summary

Introduction

To assist the Government of the City of Buenos Aires in addressing the problems related to severe urban flooding, the project will develop a cost effective approach to comprehensive urban drainage. The City of Buenos Aires frequently suffers from serious flooding that damages property, the economy, and affects the bulk of its population. Over 25 deaths have been recorded since 1985. Natural phenomena such as intensive rainfall in urban catchment areas, and high tides caused by strong winds in the Rio de Plata (“Sudestada”), are compounded by deficient, old drainage infrastructure.

When completed, the project would have: (i) provided the City of Buenos Aires with protection against floods associated with rainfall events having return periods of up to 10 years, while mitigating the impact of storm events with return periods larger than a decade; and (ii) strengthened the institutional capacity of the City of Buenos Aires to manage the drainage system.

This note summarizes the findings of many technical, social and environmental studies carried out by the City during project preparation:

Feasibility Study: *Plan Director de Ordenamiento Hidráulico*
 Análisis y Evaluación de alternativas
 Proyecto Ejecutivo para la Cuenca del Maldonado

EA Study: *Evaluación de Impacto Ambiental. Proyecto Ejecutivo para la cuenca del Maldonado,*
 Informe Ambiental Complementario
 Anexo al Informe Ambiental Complementario

Terms of reference for the Environmental Assessment study were agreed between the City and the Bank. These reports, carried out by independent consultants, were submitted to the City for detailed review and area available in the offices of the Municipality. Formal Bank review was carried out before appraisal and conform fully to Bank policies regarding environmental and social issues. All of the above reports have been made available at the INFOSHOP.

Feasibility Studies

Financed by the World Bank under the current Flood Protection Project (4117-AR), a four year study of the Buenos Aires drainage system identified structural weaknesses in the surface and underground network, designed an Hydraulic Master Plan, and carried out the project’s feasibility study. Indications suggested that major infrastructure investment was required to address the issue of structural weaknesses in the system. The study had two key objectives: (i) to identify improvements to the city’s drainage system in order to alleviate the problems caused by flooding and (ii) to assess the current infrastructure and make proposals to improve public safety and reduce the impact of flooding on people, buildings, and traffic in the City. The study focused on the development of a master plan for the entire city covering an area of 28,500 ha, including the implementation of an integrated drainage basin study of all streams that cross the city, specially the

Maldonado creek basin, and the formulation of proposals for structural and non-structural solutions, leading to an optimization of the drainage network.

Regulatory Framework for Environmental Assessment

The objective of the proposed works is to improve the environmental quality of the City. This objective will be achieved by the construction of infrastructure– complemented by non-structural measures – for collecting, conducting and discharging the storm water that cannot be absorbed by the urbanized and densely populated urban area. In spite of its positive urban impacts, considering the magnitude and dimension of these proposed works, its precedent setting urban drainage solution, especially in an area of the complexity of the city of Buenos Aires, the construction could cause undesirable impacts that must be mitigated. Considering the type of project and its location area, it was recommended to classify it environmentally as Category “A” following the World Bank’s OP 4.01. The project will not entail any resettlement of population and will not affect any natural habitats. The quantity and quality of the Rio de La Plata will not be affected.

Local legislation regards this type of project as of high potential impact. Furthermore, article 13° of law 123-GCBA (modified by law 452-GCBA) states that the Executive Project for Arroyo Maldonado Catchment area is “susceptible to produce an environmental impact of relevant effect”. Thus, an Environmental Impact Assessment was also required by local authorities. This procedure is supervised by the Government of the City of Buenos Aires, through its Environmental Policy and Assessment Directorate (“*Dirección de Política y Evaluación Ambiental*”), that depends on the Sustainable Development, Production and Tourism Secretariat (“*Secretaría de Producción, Turismo y Desarrollo Sustentable*”).

Environmental Setting

An important element of the feasibility and environmental process followed in this Project was the baseline research that analyzed the hydrological, economic and social characteristics of the project area. The project area is particularly complex given the natural hydrological phenomena (rainfall and “Sudestada”) and its highly urbanized setting. The Maldonado basin covers the most central area of the City, and has a population of over one million inhabitants. Urban floods in this basin have direct impacts with high physical and social consequences and human suffering, as well as important indirect impact on the economic development of the City, by blocking the vital transport network (streets, railway and underground railway) that links the more affluent districts of the North of the City, to the industrial, more popular areas of the South.

Among several urban drainage basins in the City, the Maldonado is the one with the largest surface and population affected by floods, with the highest flood recurrence, and population density, and where the highest percentage of elderly people is found. The Maldonado river is the major rain drainage collector of the City; it runs from south to north across areas of different economic conditions: from the poor conurbations of the northwest to the upper class quarter of Recoleta. Its basin has been under continuous rapid urbanization pressures since 1936, when the river was channeled underground.

Currently, the Maldonado basin overflows with almost an annual frequency, causing clogging of the drainage system of the City and the consequent flooding of the basin. The technical problems of the underground stream and the hydrological consequences of urbanization – and hence the impermeabilization - of the City are closely related. They, together with the modified patterns of precipitation recorded in the last decades, have had a synergic effect on flooding events. During the last 20 years, the flooding events dramatically increased their frequency: 37 episodes of flooding have been recorded between 1984 and 2004.

Along with the above concerns, there is a need to link institutional strengthening with the proposed infrastructure investment. The improvement of the current infrastructure should be supported by appropriate

management of hydraulic risk in the future. Otherwise, the expected benefits from the investment on physical assets and economic development will be significantly reduced. Furthermore, the lack of institutional capacity would prevent an effective execution of strategic infrastructure programs and the implementation of non-structural measures, whose bulky and multiyear commitments would be subject to disruptive “stop-and-go” implementation. On the other hand, rational management of infrastructure services can yield substantial fiscal and efficiency benefits and help improve the City’s productivity and competitiveness (e.g. via cutting direct and indirect damage costs) along with access to basic public services by poor segments of the population.

The levels of investment in drainage infrastructure have been inconsistent with economic and population growth of the City for the past 70 years. The urban basin already has an important and extensive storm water drainage system. Nevertheless, it is not enough to meet the new requirements of urbanization and intensification of commercial land use generated after its design and construction, dated in 1919 and 1929-1939, respectively. There is a need to rapidly scale up the infrastructure asset base to help the City on track towards a more balanced protection level, while ensuring a platform for sustainable growth in the future.

Analysis of Alternatives

During the planning and design stages, the project identified and analyzed a comprehensive set of alternatives for the management of floods in the Maldonado basin. The main options for flood protection that were considered were: (i) different levels of protection 5, 10, 20 and 50 years of storms recurrence, (ii) different control systems (conduction, storage reservoirs), (iii) different conduction methods (open trenches, tunnels), (iv) different final discharge sites for the storm waters (Rio de la Plata, Riachuelo), and (v) different construction technologies (tunnel boring machine, manual method).

Over 27 technical alternatives were studied to improve the current drainage system within the Maldonado basin. All alternatives were analyzed from technical, economical and environmental perspectives, applying a multi-criteria evaluation analysis. Initial investment costs, operation and maintenance costs, water quality, social impacts, construction impacts were the main comparison criteria.

The hydraulic modeling of the different alternative solutions was accomplished with the help of the software package InfoWorks CS developed by Wallingford Software, United Kingdom. This software allows planners and engineers to predict environmental impact following a rainfall event by modeling of the key elements of storm-sewer and drainage systems. The software transforms rainfall into runoff and incorporates the solution of relevant hydrological equations for modeling free-surface and pressurized flows commonly observed in urban areas during storms. InfoWorks CS incorporates full interactive views of data using geographical plan views, long sections, spreadsheet and time varying graphical data.

The model was applied to all proposed alternatives for the Maldonado flood control project. The goal was to seek a solution that would afford the City of Buenos Aires protection against floods associated with rainfall events having return periods of up to 10 years, while mitigating the impact of storm events with return periods larger than a decade.

Selected Alternative

The analysis of alternatives concluded that the most favorable project consists of a scheme which includes two tunnels without storage incorporated in the tunnels. This meets the technical requirements of the project in terms of flood control while minimizing the environmental impact of the works.

The project includes the construction of two relief tunnels from the main storm drainpipe of the Maldonado basin, with important associated works, as well as reinforcement works of the storm water secondary system of

collectors, to avoid significant inconveniences generated by floods that are produced by storms for a recurrence period (Tr) of 10 years and to mitigate those due to minor frequencies.

Two tunnels of 6.90 m diameter each were designed. One of them around 4,600 m (“short tunnel”) and the remaining 9,840 m (“long tunnel”), totaling then a conduction of about 14 kilometers length. The tunnels will be built by tunnel boring machines (TBM) of EPB type (Earth Pressure Balance or mix), with pressure compensation during excavation, to counteract the groundwater and soil pressures of the surrounding area. By using this method, significant urban impacts on the surface are avoided. This construction system requires initial working shafts and exit shafts for the TBMs, in the surface, locally disturbing the surroundings.

The existing storm water secondary drainage system will be reinforced, including the replacement and construction of 46 km of conducts that will extend throughout the catchment area of the Maldonado Creek and will be built by open trench method.

The selected alternative, specially tunnel alignments, were subsequently analyzed in more detail. The Bank recommended that a panel of experts, comprising expertise in hydrology and hydraulics, underground structures and tunneling, review feasibility studies and final designs. Their recommendations were included in final designs. Main recommendations included:

- Establish the planned hydrometeorological network as soon as possible that includes flow/level measurements
- The inlet structures that will connect the Maldonado culvert to both tunnels should be studied using physical models to ensure appropriate hydraulic performance. These studies may be conducted during the implementation phase of the project. The design of the structures by the UTE should be tested in a physical model, for example the Laboratorio Nacional de Hidráulica at INA (Ezeiza) is capable of conducting this study. A study of this nature should take approximately 6-8 months.
- There should be measurements of the amount, kind and quality of the total solids entering into the Maldonado drainage system. These measurements could be carried out during the implementation phase of the project.
- This is a complex project where the probability of delays and cost overruns is significant. Thus extreme care should be taken to minimize the uncertainties of the project. For example an overseeing panel of tunnel construction experts could provide valuable advice during the implementation phase of the project.
- Steps should be taken, at the negotiation phase, to ensure that the environmental mitigation stormwater activities proposed by the City are appropriately implemented.
- New construction regulations, either in present form or soon to be adopted both by the CBA and PBA municipalities, will have requirements to decrease the effect of impervious areas. Steps should be taken to enforce these regulations.
- The CBA should continue to have workshops and open forums to inform stakeholders about the benefits and limitations of the flood mitigation project.

Environmental Assessment Process

The environmental assessment process for the project was based on a multi-phase approach: (i) the feasibility studies analyzed alternatives from a technical, economic and environmental merits; and (ii) once a project scheme was selected, a more detailed environmental assessment was carried out which included the preparation of a comprehensive environmental management plan. The process was complemented by intensive consultation process.

Environmental issues were considered at each phase of the design, from the preliminary ideas to the executive project. The following table summarizes relevant actions during the environmental assessment process.

Actions performed during the Planning and Design Phases	
Project and environmental background data gathering and analysis.	√
Field works concerning soils, water quality, climate, transit, urban surveys, surveys and interviews with key stakeholders, etc.	√
Diagnosis of the Environmental Base Line during the Planning Phase.	√
Environmental Analysis of Alternatives.	√
Draft Preliminary Environmental Assessment .	√
Publication of the preliminary project. Seminars were conducted with the participation of specialized professionals of the area, NGOs, local and international experts.	√
Executive Project - Environmental Impact Assessment.	√
Consultation meeting between the City Government and environmental NGOs for project presentation and discussion. Agreement to continue with the meetings during the implementation phase.	√
Bids issued including an Environmental Management Plan that minimizes undesired environmental effects. Special emphasis was focused on the location of site works and work actions that imply transit disturbance.	√
Permits requested to cross avenues and streets with adequate anticipation, as well as to cross railway lines, interferences with other public services networks and occupation of parcels, to the authorities and corresponding companies.	√
Design of adequate information and training of the future staff on expected environmental issues, implementation and control of environmental protection measures, contingency plans and environmental regulations and procedures applicable to activities and construction sites.	√
Assignment of specific responsibilities to future staff in relation with the implementation, operation, monitoring and control of mitigation measures.	√
Requirement to the contractor of contingency plans elaboration for emergency situations (e.g. machine and equipment oil spills, collapses, erosion, flooding during works) with significant environmental consequences.	√
Coordination and agreement concerning mitigation measures with application authorities (Coordinated Action Agreement for works in the Public Street Nr 24/ 97).	√
Communication and Environmental Education Program (PROCEAH) for an efficient and adequate implementation of social communication mechanisms allowing to establish effective contact with all the stakeholders affected by the works.	√
Announcement of temporary diversions of public transport with not less than a week before its occurrence by massive graphic communication media, radio and television.	√
Neither expropriations nor involuntary movement of residents are demanded.	√

Environmental Issues

Water Quality and Quantity

Concerns over water quality and quantity issues in the La Plata River stemming from the project were analyzed. Resulting hydrological modeling and water quality analysis demonstrated that the La Plata River will not be affected by the project neither in quantity or quality. The La Plata River is subject to severe pollution from domestic and industrial wastes and storm waters will be of considerable better quality than the receiving bodies. The proposed works will not affect the drainage balance of the basin and therefore water quantity will not be affected.

In conclusion, the project will not generate negative impacts on groundwater as well as on the receiving waters of Rio de la Plata. The tunnels will receive the flows from the existing Maldonado channel by three derivation structures totally isolated from the groundwater table. The waters discharged into Rio de la Plata will have the same quality as those currently discharged by the Maldonado channel. Therefore, significant water quality impacts are not expected on the river.

Although the Guarantor and the Borrower agreed that the works to be carried out will not have impact on the navigability and/or the course (regime) of the Río de la Plata, the Río de la Plata and the Maldonado are international waterways for the purposes of the Bank's policy. Therefore, the Bank, on behalf of Argentina, notified the Government of Uruguay on the Project.

Construction Impacts

The construction of tunnels and channels of such length and diameter will entail potentially significant impacts on urban communities, albeit limited to the construction period. The proper management of excavation materials, the transportation of such materials to disposal sites, and the need to control work activities such as noise, dust, traffic disruption, interference with public services (water, sewerage, telephone, electricity) will necessitate careful planning, close supervision and a continuous community information program. All environmental and social requirements for construction will be part of an Environmental Construction Specifications which will be enforced by an environmental supervision firm.

All critical environmentally and socially sensitive points in the area of influence of the project were identified. The tunnels do not define a linear area of influence because its alignment and construction are deeply underground, with low expected impact on surface and on human activities and welfare. However, surface works such as tunnel construction shafts, connection and derivation chambers could potentially affect surrounding communities during construction. The sensitive areas were identified taking into account the basin main characteristics and the project involved activities. These sensitive points include areas of commercial and industrial activities and parks and green areas.

Cultural Property.

The project will not impact any historical sites. Although no archaeological sites have been reported for the Maldonado basin, the Environmental and Social specifications for Contractors include procedures for chance findings.

Mitigation Measures

During construction, urban aesthetics will be affected by intense soil excavations and construction related activities. Furthermore, they will generate dust and noise emissions, pavement breaking, transit alteration from avenues and streets detours, which have a potential to alter significantly the comfort of the resident population as well normal urban activities. Regulations and technical specifications were aimed to mitigate these negative effects.

Compliance with recommended specifications will be enforced by an Environmental Supervision of the most complex works carried out by an external international firm contracted by UECBA-SUPCE. Moreover, the observance of the Environmental Management Plan will depend on adequate information dissemination to all actors involved. This will be achieved mainly by the preparation of training workshops and lectures, as well as by using graphic information on environmental issues.

Mitigation Measures for the Construction Phase

This stage of the work implies the supervision and control of the strict fulfillment of the mitigation measures. The general environmental requirements to be obeyed during the construction are:

- To avoid contamination of soil, water and air.
- To avoid the destruction of natural vegetation.
- To avoid soil erosion and sedimentation either in the Río de la Plata or within the conducts.
- To avoid the use of fire to eliminate wastes and other remaining materials.
- To dispose solid wastes in environmentally adequate sites.
- To select technologies which meet adequate environmental quality criteria.
- To adequately manipulate archaeological and paleontological materials.
- To obey specific urban regulations in force.

The following Table includes a brief description of the mitigation measures regarding the main environmental components affected by the works during the construction phase.

COMPONENT	MITIGATION MEASURE
Water	<p>Installation of chemical bathrooms in temporary worksites. Wastewaters will be rightly conducted to avoid their dumping to the storm water or to the Rio de la Plata.</p> <p>Disposal sites for construction material and for extracted soil storage must have an adequate drainage system as well as sediment traps, in order to conditioning them prior to their discharge in sewers or river.</p> <p>All necessary safety measures will be implemented in order to avoid spills, especially fuels or other hazardous wastes.</p>
Air	<p>Equipment, machines and trucks will be periodically maintained, according to specific regulations related to gas and noise emissions.</p> <p>Time dedication to the different involved tasks will obey specifications related those activities implying sound levels greater than 80 db. It will be restricted to the normal sleeping time (10 pm to 06 am).</p> <p>All measures needed to avoid or minimize the dispersion of dust and particles will be implemented within the material storage area.</p> <p>Fire will not be used to waste or remaining material reduction or elimination. The use of contaminant, toxic substances, which can alter the air quality, will be minimized.</p> <p>All applicable regulations related to gas and noise emissions will be obeyed.</p>
Vegetation	<p>Adequate measures to avoid destruction of the existing natural vegetation and urban trees will be adopted. Whether necessary, authorization will be requested to the Supervision. All the extracted species will be reintroduced <i>in situ</i> or in other adequate sites.</p> <p>Natural vegetation and urban trees eventually affected by the works will be protected adequately by fences, covers, etc.</p>
Soil	<p>The disposal sites will be reduced as much as possible according to construction requirements and the criteria established in the bid specifications. The identified sites to carry out the discharge have been selected based upon their adequacy. The soil will be disposed in those places approved by competent authorities, according to regulations. Samples of extracted soil will allow to determine its quality. Whether hazardous materials are detected, the soils will be stored and treated. Otherwise, the soils will be transported to their final disposal areas. The disposal sites will be managed under restoration practices. Transit and transport disturbance due to soil transportation will be of low significant magnitude, given that the "Average Annual Daily Rate" is of 4,000 trucks/day in direction to the disposal sites, while the increase due to the works will be 240 truck/day (6 %). Moreover, in the opposite direction the "Average Annual Daily Rate" is of 32,000 truck/days being the 240 trucks returning to the working area wholly empty.</p>
Urban area	<p>The facilities must be built and maintained in such a way to ensure safety conditions for both the staff and the surrounding population.</p> <p>The work areas will be reduced as much as possible, keeping them with appropriate health and safety conditions.</p> <p>The working timetable will be minimized, complying the estimated schedules.</p>
Population/ Safety	<p>The affected population will be recorded with adequate anticipation in order to prevent the inconveniences they would eventually undergo.</p> <p>The facilities, work accesses, derivations, hazards and risks will be communicated by visible signals.</p> <p>Safety measures will be adopted to avoid accidents (fences, footbridges, etc).</p> <p>In all the areas affected by the works, the accesses to the houses, workplaces and parking will be facilitated as much as possible.</p> <p>The work schedule time will be minimized as much as possible, avoiding whether possible the development of activities during the night.</p>
Use of land and urban equipment	<p>Written authorization will be required for land occupation needed for the works.</p> <p>All the needed authorizations for public services supply and street occupation will be managed in due time and manner.</p> <p>Those areas or sites temporarily occupied by the facilities and works will be recovered as much as possible to their original condition, excepting those new components aimed to improve the community quality of life. In such a case a written authorization should be requested, either from official organisms or private owners.</p>

COMPONENT	MITIGATION MEASURE
Economic activity	Economic directly affected facilities will be reported, as well as the objectives and estimated duration and expected impacts of the works. The facilities, work accesses, hazards and risks will be clearly marked. In all the affected areas by the works, provision should be made to facilitate the access of staff and suppliers to the workplaces. The work duration will be shortened as much as possible.
Traffic	The areas affected by the works, such as streets and avenues will be reduced as much as possible. Facilities, work accesses, derivations, hazards and risks will be clearly indicated, in order to allow the circulation of heavy transport. All needed detours to be made during the works will be visibly and adequately signaled, indicating alternative ways. Changes of passenger transportation itinerary will be immediately reported. All applicable legislation related to transport and transit must be strictly obeyed.
Cultural heritage	The finding of archaeological or historic areas of interest will be treated according to the current legislation. In case of findings, works will be transitory interrupted with the intervention of the competent authority. The contractor must cooperate through protection of the site, assessment and transport to a proper deposit.
Interference transport with road accesses	New circuit for bus transport lines affected by the works will be established as soon as possible. Transport firms will be informed in due time and manner when they are affected circuit changes. Derivations and alternative routes will be reported in time and manner by massive communication means.
Interference with service infrastructure	The Supervision will consider and approve the location of the places where energy and water necessary for the construction and provision of work places will be extracted Water extraction for construction should not diminish the availability of sources for water supply for people housed by the area of influence of the work. All the necessary procedures for the provision of essential services will be implemented with adequate anticipation to the involved companies (e.g., EDENOR and EDESUR for electrical supply, Aguas Argentinas for the water, etc.).
Labor	Regulations related to health and safety at work will be strictly obeyed. All the staff will be trained in relation to health and safety measures, education, keeping good manners, and environmental awareness.

Mitigation Measures for the Operation and Maintenance Phase

According to the Environmental Impact Study, the negative effects estimated for the operation phase will not be significant, and will be largely compensated by the benefits of the project. It is expected it will improve the population quality of life, and the assets protection. Mitigation measures must be focused to ensure the accomplishment of environmental, health and safety regulations. They are referred as follows:

- Periodical tunnels maintenance (estimated annually) in order to avoid sediment accumulation, exotic bivalves fouling of conducts (“bio fouling”).
- Population access restriction to discharge pumping chamber areas.
- Conservation and maintenance of discharge chamber area, to avoid landscape alteration.
- Drainpipe maintenance, inlets, manholes, function boxes, urban debris or other materials elimination, to ensure their proper performance.

Environmental Management Plan (EMP)

The EMP will include subprograms, projects and activities aimed to implement the different mitigation measures as well as institutional strengthening measures. Its financing has been planned in the project components or in the City programs.

The EMP is summarized in the following Table.

PROGRAM	OBJECTIVE	Estimated Cost USD	Institution in charge
Institutional Coordination	To coordinate with authorities and related institutions dealing with roads, infrastructure use and service networks issues; for the construction and coordination with related authorities in current environmental policies, including the EMP for archaeological resources.	NA	Implementation Unit
<i>Construction Phase</i>			
Health and safety at work	To implement and control health and safety regulations regarding the protection of all the staff.	45,925	Contractor
Water and Soil:	To limit the potential impact of polluting components, and discharge the hazardous solid waste	87,000 Transport & treatment USD30/cm	Contractor
Traffic management	To limit the impacts through a traffic management plan	36,600	
Environmental monitoring and supervision	To control and supervise quality indicators selected according to legal requirements, in surface, groundwater, air and land To measure the noise	13,696	Contractor Inspection experts
<i>Operation Phase</i>			
Community information	To inform and contain themselves the affected community and other stakeholders.	NA	Environmental Sub Secretary
Staff training	To train different company levels staff about environmental conservation, protection and conservation during project construction and operation.		Contractor
Environmental monitoring and supervision	To control and supervise quality indicators selected according to legal requirements, in surface, groundwater, air and land. Measures to be carried out in the tunnels and in the secondary network Quality control of the first flush	14,647/year	Hydraulic Authority
Environmental Training	To stimulate population awareness about the need of water care and wise use; to prevent its contamination and depletion, and to maintain clean the storm water inlets and to promote solid waste adequate treatment.		Environmental Sub Secretary
EMP Audits	To ensure transparency of EMP and mitigation measures accomplishment.	50,000/year	Implementation Unit

Public Consultation and Participation

Buenos Aires has created a formal organization (*Mesa de Dialogo ambiental*) where public institutions and environmental NGOs meet on a regular basis. The City Government presented a comprehensive version of the project. Twenty one local NGOs assisted and had the opportunity to react and give their comments. They all agreed on the long term positive impacts of the project and expressed their agreement with the EMP for the construction period. The participants also agreed on pursuing the dialogue with the City during the next phases of preparation and implementation.

During the preparation of the EA, consultation meetings were held with NGOs, community organizations, and private sector associations. A final consultation workshop discussed the draft EA. The draft EA report is available in the offices of UECBA (Unidad Ejecutora de la Ciudad de Buenos Aires) and on its web site. The final EA report includes an Annex that summarizes the consultation process including participants, a record of concerns, and agreements reached during these meetings.